U.S. Department of Transportation

Federal Highway Administration

Highway Performance Monitoring System Field Manual

For the Continuing Analytical and Statistical Data Base

December 1987 As Amended

Office of Highway Information Management

FHWA Order M 5600.1A

U.S. Department of Transportation
Federal Highway Administration

Order

Subject

HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS) FIELD MANUAL

Classification Code: M 5600.1A

Date: December 1, 1987

Par. 1. Purpose
2. Cancellation
3. Authority
4. Responsibility
5. Comments

1. PURPOSE. To transmit the new HPMS Field Manual (OMB No. 2125-0028) for use beginning with the collection of calendar year (CY) 1988 data to be reported on June 15, 1989.

2. CANCELLATION. FHWA Order M 5600.1, Highway Performance Monitoring System (HPMS) Field Manual, dated January 1984, updated February 1987, is cancelled, effective June 30, 1988, (see paragraph 5a).

3. AUTHORITY. The reports and procedures outlined in the HPMS Field Manual are authorized under 23 U.S.C. 307 which authorizes the Secretary to engage in research on all phases of highway construction modernization, development, design, maintenance, safety, financing, and traffic conditions. In addition, 23 CFR 1.5 provides the Federal Highway Administrator with authority to request such information that is deemed necessary to administer the Federal-aid highway program. Estimates of the future highway needs of the Nation are mandated by the Congress on a biennial basis (23 U.S.C. 307 (e)). Additionally, HPMS data serve as the information source for the "Highway Safety Performance" report prepared by the FHWA pursuant to Section 207 of the Surface Transportation Assistance Act of 1982 (P. L. 97-424).

4. RESPONSIBILITY. While cities, counties, municipalities, and metropolitan planning organizations are participating in the HPMS in some instances, the State highway agencies are responsible for the overall collection and reporting of quality, timely HPMS data. The FHWA regional and division personnel will continue to be responsible for HPMS coordination and data quality reviews.

DISTRIBUTION: Special: Headquarters, Regions, Divisions

OPI: HPM-20

5. COMMENTS

a. Although this Manual will supersede the current January 1984 manual, as updated, the current manual must be kept and used for the preparation of the June 15, 1988, submittal of CY 1987 data.

b. The new HPMS Field Manual reflects the elimination of a few data items, coding revisions to a few data elements, the addition of several new pavement-related data items, and a revised data submittal tape format. These revisions go into effect beginning with the reporting of CY 1988 data on June 15, 1989, except as noted in paragraph 5c.

c. With the reporting of CY 1989 data beginning on June 15,1990, pavement roughness data shall be reported for all rural arterial and urban Interstate and other freeways and expressways sample sections.

d. Chapter V1, "Highway Performance Monitoring System Software Package," and related appendices (M--Edit Specifications for HPMS Data; N--Battery of Summary Tables from the HPMS Submittal Software; O--Card Formats to Add New HPMS Sections; P--Update Data Item Numbers for HPMS Submittal Software; and Q--HPMS Submittal Software Subprogram Operation) will be transmitted when the revised software is completed (4th quarter of fiscal year 1988).

e. Attention is directed to Appendix K of the HPMS Field Manual and the need for the States to undertake statistically based travel monitoring procedures as outlined in the "Travel Monitoring Guide."

David R. McElhaney
Director, Office of Highway
Information Management

Attachment

HIGHWAY PERFORMANCE MONITORING SYSTEM

FIELD MANUAL

FOR THE CONTINUING ANALYTICAL AND STATISTICAL DATABASE

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

DECEMBER 1987

OMB NO. 2125-0028
(EXPIRES SEPTEMBER 30, 1990)

U.S. Department
of Transportation
Federal Highway Administration

Order

Subject
HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS) FIELD MANUAL UPDATES

Classification Code
M 5600.1A, Chg. 1

Date
July 15, 1988

PURPOSE. To transmit new and revised portions of the HPMS Field Manual (OMB No. 2125-0028) dated December 1, 1987, for use beginning with 1988 data to be reported in June 1989.

a. State highway agencies are responsible for collecting and reporting quality and timely HPMS data. The FHWA regional and division personnel will continue to be responsible for HPMS coordination and data quality reviews.

b. Revised pages are being issued to make provisions for the addition of Chapter VI and several Appendices, and to correct minor errors in the text. Also, revised codes and definitions are being issued for data item 18, Designated Truck Route/Parkway.

c. Chapter VI and Appendices M, N, O, P, Q and R are new additions to the December 1, 1987 HPMS Field Manual that document the HPMS Submittal Software Package.

d. Appendix S contains the definitions of the Climate Zone codes.

e. Appendix K has been revised and now contains expanded traffic monitoring documentation and program implementation directions. Immediate attention should be focused on this material.

David R. McElhaney
Director, Office of Highway
Information Management

Attachment

DISTRIBUTION:
Special: Headquarters
Regions
Divisions

OPI:
HPM-20

FILING INSTRUCTIONS

Page Changes

Remove	Pages	Insert	Pages
Preface	iii-v	Preface	iii-vi
		Chapter III	7
Chapter IV	3-6	Chapter IV	3-6
Chapter IV	15-16	Chapter IV	15, 15A & 16
Chapter IV	21-22	Chapter IV	21-22
Chapter IV	25-26	Chapter IV	25-26
Chapter IV	37-40	Chapter IV	37-40
Chapter IV	43-44	Chapter IV	43-44
Chapter IV	47-48	Chapter IV	47-48
Chapter V	3-6	Chapter V	3-6
Chapter V	11-12	Chapter V	11-12
Chapter V	17-18	Chapter V	17-18
		Chapter VI	1-42
Appendix I	1-4	Appendix I	1-4
Appendix J	7-8	Appendix J	7-8
Appendix J	11-12	Appendix J	11-12
Appendix K	1-4	Appendix K	1-6
		Appendix M	1-16
		Appendix N	1
		Appendix O	1-8
		Appendix P	1-3
		Appendix Q	1-6
		Appendix R	1-3
		Appendix S	1-3

HPMS

BULLETIN

Highway Performance Monitoring System (HPMS)
Field Manual Updates

December 1, 1987 version including the July 15, 1988 update
Pen & Ink Changes

October 5, 1988

We have discovered some errors in the HPMS Field Manual that will require hand updating. These corrections are contained on the attached sheet. It is imperative that the appropriate State highway department personnel actually doing the HPMS data item updates obtain these corrections. Please ensure (hand carry, if necessary) that the attached corrections are delivered to the proper State personnel for incorporation into their HPMS Field Manuals.

We are providing critical corrections, informally, to quickly communicate the information to the field. We intend to formally provide full updated pages to the HPMS Field Manual (perhaps in Spring, 1989) when sufficient changes warrant using the FHWA Order process.

We are forwarding one copy of this bulletin with attachment to each region and three copies to each division. Two copies should be forwarded to the appropriate staff at the State.

Please advise us if you have not received the following items that were sent out in early August:

1. HPMS Submittal Software for the 1988 data to be submitted in June, 1989.

2. July 15, 1988 update to the December 1, 1987 version of the HPMS Field Manual.

HPM-20

Attachment

Highway Performance Monitoring System (HPMS)
Field Manual Updates
December 1, 1987 version including the July 15, 1988 update
Pen & Ink Changes, October 5, 1988

1. Page II-2, item 9, Population:

Remove the words "based on" and replace them with "including annual updates to" such that the paragraph now reads:

9. Population -- Current population including annual updates to the latest official Census estimates adjusted to current Federal-aid urban area boundaries.

2. Page IV-5, item 74:

Change the position "419" to "418" such that the item description now reads:

74 418-423 6 | X | X | X | X | X || X | X | X | X | X | # At-Grade Intersections

3. Page V-6, after item 45:

Add the following four items to the bottom of the page:

46. Median Type	I.C.
47. Median Width	I.C.
48. ROW Width	I.C.
49. Widening Feasibility	C.A.N.

4. Appendix P-1, item 1:

Change item "1" to "01" to indicate that the leading zero must be included when updating. The corrected entries are as follows (note the addition of a footnote):

		State Control Field
01-01 *	10	First 10 positions of the State Control Field
01-02 *	10	Next 10 positions of the State Control Field
01-03 *	10	" " " " " " " "
01-04 *	10	" " " " " " " "
01-05 *	10	" " " " " " " "
01-06 *	10	" " " " " " " "
01-07 *	10	" " " " " " " "
01-08 *	10	" " " " " " " "
01-09 *	10	" " " " " " " "
01-10 *	10	Last 10 positions of the State Control Field

* - The leading zero must be coded when updating this item.

HPMS

BULLETIN # 2

Highway Performance Monitoring System (HPMS)
Field Manual Updates and New Submittal Software Package

December 1, 1987 version including the July 15, 1988 update
and the Oct. 5, 1988 Bulletin Changes

December 6, 1988

We have discovered some problems concerning the coding of certain items when a sample section is on a raised roadway (causeway) or on a bridge, and software problems concerning updating and calculations. We have also recognized that the Measured Pavement Roughness data item is not required for the 1988 data, and have provided an option to turn off the edit when roughness data are not supplied. The corrections and more information are contained on the attached sheet. The software tape is being transmitted to the division offices under separate cover. It is imperative that the appropriate State Highway Agency personnel actually doing the HPMS data item updates obtain this bulletin and the computer tape. Please ensure (hand carry, if necessary) that the attached corrections and the revised HPMS Submittal Software computer tape are delivered to the proper State personnel.

We are providing critical HPMS Field Manual corrections, informally, to quickly communicate the information to the field. We intend to formally provide full updated pages to the Manual (perhaps in Spring, 1989) when sufficient changes warrant using the FHWA Order process.

We are forwarding one copy of this bulletin with attachment to each region and three copies to each division. Two copies of the bulletin and the computer tape should be forwarded to the appropriate staff at the State. Please advise us if you have not received the following items that were previously sent out:

1. July 15, 1988 update to the December 1, 1987 version of the HPMS Field Manual.
2. "HPMS BULLETIN" dated October 5, 1988.

HPM-20

ttachment

Highway Performance Monitoring System (HPMS)
Field Manual & Software Updates
December 1, 1987 version including the July 15, 1988 update
and the Oct. 5, 1988 Bulletin Changes

1. Page IV-25, item 33, Type of Base:

   Change the fourth sentence in the middle of the description paragraph to read:

   Code "0" where this item is not applicable due to functional system requirements. Add a code "5" to the list of codes:

   5 Not applicable due to raised roadway (causeway, bridge deck, etc.)

2. Page IV-25, item 34, Type of Subgrade:

   Change the last sentence of the description paragraph to read:

   Code "0" where this item is not applicable due to functional system requirements. Add a code "5" to the list of codes:

   5 Not applicable due to raised roadway (causeway, bridge deck, etc.)

3. Page IV-26, item 35, Subsurface Drainage:

   Change the second sentence of the description paragraph to read:

   Code "0" where this item is not applicable due to functional system requirements. Add a code "5" to the list of codes:

   5 Not applicable due to raised roadway (causeway, bridge deck, etc.)

4. Appendix M-7, edit specifications for items 33, 34 & 35, Type of Base, Type of Subgrade & Subsurface Drainage:

   Add code "5" as a legitimate code to each of the descriptions reflecting the coding changes described above.

4. Appendix M-11, edit specifications for item 55, Speed Limit:

   Add: If urbanized area section (Item 5 = 3), speed limit must be less than or equal to 55.

5. Pages VI-10 to VI-12, SELEDIT option of the HPMS Submittal Software:

   A new suboption has been added concerning the Measured Pavement Roughness data item -- insert the following on page VI-12 following the "NOGRADE" suboption:

   NOROUGH -- The roughness data will not be edited -- it is not provided or the user does not wish for the data to be edited. Default is to edit the roughness data.

   Example of use:

   SELEDIT=R,FINAL,NOROUGH Each rural section is to have all edits except roughness checks performed.

6. Software change: the Weighted Design Speed (item 56) was not being calculated for urban sections due to a terrain type check that should not have been taking place. No changes to the manual are required.

7. Software change: when a single railroad crossing ID or structure ID was deleted, the Record Continuation Code (item 23) was not properly updated. No changes to the manual are required.

. Note that it is necessary to replace the entire load module libraries with the new Submittal Software tape. Partial replacement of only certain modules will not be acceptable.

HPMS

BULLETIN # 3

PEN AND INK REVISIONS TO CHAPTER IV AND APPENDIX J

Please make the following pen and ink updates to your HPMS Field Manual:

Page IV-17, Item 22--Number of Through Lanes

Please add the following to the end of first paragraph: "Other additional short-length lanes needed for toll booth operations, special emergency turnaround lanes, and deceleration lanes serving service stations and restaurants accessible under special circumstances in the roadway median, etc." should also be excluded.

Appendix J, Page J-4. Please delete all references to specific equipment by name or manufacturer's Trade Mark name. This revision is needed because several new pieces of equipment have been marketed since 1987 that can perform at the class II level. The original Appendix J predated recent announcements of new equipment availability. Also new instrumentation and/or equipment modifications may, at an owner's option, make their present equipment perform as a class II device.

We advise any State considering purchase of new or equipment enhancement packages for their present equipment to require the marketing agent/manufacturer to demonstrate that the equipment in question can perform at the precision of the stated class level prior to purchasing any new instrumentation to collect data.

The maximum error and measurement interval criteria by class, presently contained on page J-4, will remain the same as originally contained in the December 1, 1987, FHWA ORDER.

****

US Department
of Transportation
Federal Highway Administration

Order

Subject

HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS) FIELD MANUAL

Classification Code
M 5600.1A, Chg. 2

Date
April 14, 1989

1. PURPOSE. To transmit Chapter VIII of the HPMS Field Manual dated April 14, 1989, for immediate use by the State highway agencies in performing the joint AASHTO/FHWA sponsored update of the Principal Arterial System (PAS) functional classification. Also transmitted is a revised copy of the guidelines publication titled "Highway Functional Classification: Concepts, Criteria and Procedures" (dated April 14, 1989) which the States shall use in performing the PAS classification update.

   a. State highway agencies are responsible for performing the PAS classification update and reporting the data specified for the Route List.

   b. State highway agencies are responsible for the preparation of the color-coded functional system maps as specified in this Chapter.

   c. Field Implementation Workshops are presently being arranged by the AASHTO Task Force on a System of National Significance. The workshops will be jointly conducted by AASHTO Task Force and FHWA Headquarters personnel.

   d. The FHWA encourages participation in the workshops by those MPOs and local officials that may be affected by any changes in the principal arterial system. The division office should meet with the State and help identify those organizations or agencies within their State that should attend the workshops.

2. DISCUSSION. It is recognized that this activity is being initiated under a very tight schedule, with only limited advance notice for arranging necessary resources. That being the case, and recognizing that desirable policy coordination (including the necessary level of cooperation with appropriate local officials) may not be accomplished within the established timeframe, the required updated functional classification may be considered as "preliminary."

DISTRIBUTION

Special: Headquarters
Regions
Divisions

OPI

HPN-12
HPM-20

This does not preclude formal reclassification in full accordance with Federal-Aid Highway Program Manual (FHPM) Chapter 4-6-7 where a State so desires, has the time, and all necessary concurrences are achieved. That option is available at any time.

Kevin E. Heanue
Director, Office of
Planning

David R. McElhaney
Director, Office of Highway
Information Management

FILING INSTRUCTIONS

Page Changes

Remove	Pages	Insert	Pages
Table of Contents dated 7/15/88	v-vi	Table of Contents	v-vii
		Chapter 8	1-12

U.S. Department of Transportation
Federal Highway Administration

Order

Subject

HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS) FIELD MANUAL

Classification Code	Date
M 5600.1A, Chg. 3	April 20, 1990

1. PURPOSE. To keep the Highway Performance Monitoring System (HPMS) Field Manual current. In addition to the updates normally expected to clean up the Manual, this change contains wording in appropriate places that discourages use of collective urbanized area sample panels in view of increased emphasis on urbanized areas. The updates also provide for the optional reporting of latitude and longitude for all arterial highway system records (sample and universe) in Item 1, State Control Field, or by an external file.

2. CANCELLATION. To delete the following: (a) The HPMS BULLETIN dated October 5, 1988, (b) HPMS BULLETIN #2 dated December 6, 1988, and (c) HPMS BULLETIN #3 dated May 25, 1989 by providing revised pages to the Manual. Also, Chapter VIII of the HPMS Field Manual issued as Change 2 and dated April 15, 1989, and the related update issued via HPMS BULLETIN #4 dated May 31, 1989 are to be deleted.

3. SPECIAL NOTE. It is requested that the revised copy of the functional classification guidelines publication titled "Highway Functional Classification: Concepts, Criteria and Procedures" (Revised March 1989) that was issued as part of Change 2 be retained by the States and FHWA field offices for future use.

David R. McElhaney
Director, Office of Highway
Information Management

DISTRIBUTION:
Special: Headquarters
Regions
Divisions

OPI: HPM-20

FILING INSTRUCTIONS

Page Changes

Remove	Pages	Insert	Pages
Table of Contents	v-vii	Table of Contents	v-vi
Chapter II	1-2	Chapter II	1-2
Chapter II	7-8	Chapter II	7-8
Chapter III	3-4	Chapter III	3-4
Chapter IV	1-2	Chapter IV	1-2
Chapter IV	5-8	Chapter IV	5-8
Chapter IV	11-12	Chapter IV	11-12
Chapter IV	17-18	Chapter IV	17-18
Chapter IV	21-26	Chapter IV	21-26
Chapter IV	29-36	Chapter IV	29-36
Chapter IV	41-48	Chapter IV	41-48
Chapter V	5-8	Chapter V	5-8
Chapter V	13-14	Chapter V	13-14
Chapter VI	11-12	Chapter VI	11-12
Chapter VI	23-24	Chapter VI	23-24
Chapter VII	3-4	Chapter VII	3-4
Chapter VIII	1-14	-	-
Appendix C	1	Appendix C	1
Appendix H	1-2	Appendix H	1-2
Appendix H	7-8	Appendix H	7-8
Appendix J	1-14	Appendix J	1-15
Appendix L	1-5	Appendix L	1-5
Appendix M	1-4	Appendix M	1-4
Appendix M	7-8	Appendix M	7-8
Appendix M	11-12	Appendix M	11-12
Appendix P	1-2	Appendix P	1-2

HPMS

BULLETIN # 4

POST WORKSHOP CHANGES TO CHAPTER VIII -- FUNCTIONAL SYSTEMS CLASSIFICATION UPDATE -- MAY 31, 1989

Revisions to Chapter VIII of the HPMS Field Manual are being issued in response to the requests/suggestions made by several State highway agencies during the recent Field Workshops conducted for the principal arterial systems classification update for the analysis of a Highway System of National Significance (HSNS). The four (4) revisions are as follows:

1) Data Item No. 10 -- This data item has been lengthened to accommodate segment length entries of miles and tenths on page VIII-10 (XXXX.X with an assumed decimal point -- new positions numbered 34-38.) Please note that this change causes the location of all data items that follow to change as well.

2) Data Item No. 15 -- This data item has been lengthened to accommodate SHA use of FIPS 5-digit Place Codes for Small Urban Areas as an option to SHA's assigning and using codes beginning with "701". To accommodate this revision, the SHA's should note the following coding instruction changes for Data Item 15, on page VIII-11:

   A) Urbanized area codes must be right justified, with positions 57 and 58 containing "00".

   B) SHA's using State-assigned codes for Small Urban Areas, beginning with "701", must right justify these codes and enter "00" in positions 57 and 58.

   C) Enter "00000" for rural segments.

3) Please **delete** Item 1) text on page VIII-2 and replace it with the following. "By july 1, 1989, State completes and transmits to the FHWA division office 3 copies of the draft of the statewide Principal Arterial system functional

classification update maps (rural and urban). The division office shall retain one copy for its use, and forward a copy to each, the regional office, and Headquarters. In addition, the State is to send a fourth copy, via express mail, to Mr. Marcus L. Yancey (who has agreed to prepare a nationwide composite map for AASHTO), Texas State Department of Highways and Public Transportation, Dewitt C. Greer Building, 11th and Brazos Streets, Austin, Texas 78701."

4) Please **delete** the last sentence of the first paragraph contained on page VIII-5; replace this sentence with the following sentence. **"Two copies of all small urban area and urbanized area maps (or map insets) are to be furnished to FHWA Headquarters by September 15, 1989".**

Please replace page VIII-12 with the attached pages VIII-12 and VIII-12A; retain page VIII-11.

ROUTE LIST 1/

Item No.	Position	Length	Data Item
1	1-2	2	State Code
2	4	1	Rural/Urban Designation Code
3	6-7	2	Functional System Code
4	9	1	Access Control
5	11-12	2	Number of Through Lanes
6	14	1	Route Signing
7	16-20	5	Signed Route Number
8	22-24	3	Route Segment Number
9A	26	1	To Be Defined
9B	28	1	To Be Defined
9C	30	1	To Be Defined
9D	32	1	To Be Defined
10	34-38	5	Length In Miles
11	40-45	6	1988 weighted AADT
12	47-51	5	1988 weighted Heavy Truck AADT
13	53	1	Mileage (segment) Status Code
14	55	1	Connecting Link Code
15	57-61	5	Urbanized Area, Urban Place, or Small Urban Area Code

16 2/	63	1	Future -- New or Existing Location
17 2/	65	1	Future -- Access Control
18 2/	67-68	2	Future -- Number of Through Lanes
19 2/	70-75	6	Future -- AADT

1/ If data are to be submitted in ASCII format, a carriage return (**Enter**) should be placed at the end of each line.

2/ Definitions and instructions for coding these Items will be provided in the future when definitions and coding instructions are provided for Items 9 A-D.

HIGHWAY PERFORMANCE MONITORING SYSTEM

FIELD MANUAL

FOR THE CONTINUING ANALYTICAL AND STATISTICAL DATABASE

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

DECEMBER 1987

OMB NO. 2125-0028
(EXPIRES SEPTEMBER 30, 1990)

Disclosure of Estimated Burden

The public reporting burden for this collection/assembly of data is estimated to average 1,591 hours per State response (including the District of Columbia and the Commonwealth of Puerto Rico). A significant variation in individual reporting burden likely exists among the States, including the DC and PR, because of the amount of data normally collected and retained in State files to carry out State planning, Strategic highway planning, design, pavement management, long-term pavement performance analyses, fiscal analyses, and other functions. In addition, the number of HPMS sample sections vary among the States based on the size and complexity of the State, internal State use of HPMS data, the number of urbanized areas within the State and the urbanized area sampling option selected and implemented by the State. In addition, frequent employee turnover in some States adds to the their seemingly high overall reporting burden, since the learning of instructions and guidelines, familiarization with the data base and its current status, retraining on-the-job, and repeating certain tasks resulting from inexperience all add to the total time (burden) to prepare the annual data submittal. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to:

Federal Highway Administration
Office of Highway Information Management, HPM-20
400 Seventh Street, S.W.
Washington, D.C. 20590

And to:

Office of Information and Regulatory Affairs
Office of Management and Budget
Washington, D.C. 20503

Note: *Pages tt and ttt will be furnished to HPMS Field Manual users when OMB approval is received.* The title page of the Field Manual will also be updated at that time, reflecting the new expiration date.

Estimated Reporting Burden

Form 1/	Average Response Time
Mileage and Daily Travel Summary Part 1--Statewide Totals, Rural and Urban Part 2--Individual Urbanized Areas	12 hours
Motor Vehicle Accident Summary	36 hours
Summary of Local Functional System Mileage	12 hours
Travel Activity by Vehicle Type and Functional System--Parts 1 and 2	16 hours

1/ Please note that the States have the option of reporting these data either via paper form or via floppy diskette. Last year 33 States exercised the floppy diskette reporting option--the number of States using this option is growing each year. It is also noted that increased use of this option by the States has reduced the average estimated reporting burden, since most of the States are creating the files that replace the forms by, in many cases, downloading the data from mainframe computers or extracting the data from microcomputer files. Hence, most if not all of manual effort required in the past to complete the forms has been eliminated.

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 annual 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. It will also serve as an information base to evaluate the effectiveness, over time, of various pavement rehabilitation strategies.

Estimates indicate that approximately 60 percent of today's, as well as the future's, highway investment dollars in the U.S. will be consumed by constructing, reconstructing, and preserving pavements. Our Nation's economic well being is highly dependent upon the availability of safe, efficient, and economical highway transportation. The condition of pavements, without any doubt, is a key variable in terms of the economy of transportation services that are provided. Poor pavements increase vehicle operating costs which result in increased cost of goods and services to the entire population. Since pavements play such an important role, we must continue to increase our knowledge of its condition and performance.

In the early 1980's, the overall mission of highway agencies began to change from that of constructing new highways to that of preserving existing highways, with particular emphasis being placed on pavement performance and the investigation and promotion of sound, economical, efficient means of preserving and extending the economic life of pavements. To do so, comprehensive information is needed regarding the condition, performance and the loadings placed on pavements. Many State highway agencies have developed and implemented Pavement Management Systems (PMS) to serve this need. Much of the pavement related data collected via HPMS should be available from State PMS's.

FHWA ORDER M 5600.1A
December 1, 1987

This Manual reflects the FHWA efforts to reduce total data reporting, to eliminate duplication, and to coordinate all fhwa data reporting requirements. The objectives of the 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, extent and usage of the various systems;

3. To improve our knowledge of the condition and performance of pavements;

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

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

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

The HPMS data system will provide indispensable 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.

TABLE OF CONTENTS

Highway Performance Monitoring System (HPMS)

Appendices

List of Tables

List of Figures

List of Figures

CHAPTER I

INTRODUCTION

BACKGROUND

In a cooperative effort to develop the HPMS integrated data base, various organizations within the FHWA Headquarters have merged independent data collection efforts into a single data reporting system. Under this system, data for each calendar year is to be reported by June 15 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 and sample inventory data and areawide data. The term "universe" is used throughout this Manual when referring to limited data reported 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 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 annual average traffic (AADT) volume groups (strata) for each functional highway system in the rural, small urban, and urbanized areas of a State. Control totals for mileage, travel, accidents, and local functional system data are provided via areawide forms. The areawide mileage and travel data are to be consistent with the mileage and travel data developed from the universe and sample records.

PURPOSE AND SCOPE

The purpose of this Manual is to provide guidelines for reporting HPMS data and to establish updating 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, the States may provide section-by-section data if they so desire.

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.

   Capital improvement data are also part of the sample section data requirements. This consists of all improvements completed on the sample panels of 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 universe and sample data, and therefore, it is important that it be kept current. Areawide data consists of totals for mileage, travel, accidents (rural and urban only), local system data, land area, population, and travel activity by vehicle type.

Data on capital expenditures by State and geographic area will be obtained through a financial reporting system. These are reported on the PR-534 form, "Capital Outlay and Maintenance Expenditures." The instructions for preparing this form are included in "A Guide for Reporting Highway Statistics."

This Manual outlines procedures for the preparation of the various types of HPMS data, including forms, contains instructions for building and editing the data set, and includes a timetable for coordinating and updating the various aspects/components of the HPMS.

It is important to note 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 (SHA) in cooperation with local governmental units, metropolitan planning organizations (MPO), and other organizations.

All 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 annual submittal of the data set 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 to the guidelines provided in this Manual and that the data are submitted to the SHA 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

Four summary forms are provided for reporting of: (1) Mileage and Daily Travel, (2) Motor Vehicle Accidents, (3) Local Functional System Mileage Data, and (4) Travel Activity by Vehicle Type and Functional System. Each form is to be submitted annually to the FHWA division office in triplicate (or ~~on optional~~ floppy disk as noted below). State submissions along with supporting documentation covering all problems (including any revisions to previous estimates) should be forwarded to the Federal Highway Administration, Office of Highway Information Management, Highway Systems Performance Division, HPM-20, Washington, D.C. 20590 ~~on or before~~ June 15 following the year for which data are being reported. For example, ~~1988~~ 1993 data are due by June 15, ~~1989~~. 1994

The areawide data may be furnished to the FHWA in one of two ways: (1) coding forms may be filled out and submitted, or (2) Lotus 1-2-3 spreadsheets on IBM compatible low or high density diskettes ~~(5 1/4")~~ may be prepared and submitted. Those electing to supply IBM compatible Lotus 1-2-3 spreadsheets should obtain templates from the above address.

It should be noted that option 2 is truly an option; if a State has these data in a microcomputer format and can easily place the data into the spreadsheet templates, the State should consider electing spreadsheet use, accordingly. Otherwise, it is expected that option 1 will be used.

Coding forms may be generated by copying the forms from the following pages.

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 to ensure that the sums of the parts add to the totals. The Lotus 1-2-3 spreadsheet templates contain formulae for these checks.

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

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 and vehicle classification data, only)

   For the HPMS, small urban and urbanized areas are defined as Federal-aid urban areas or portions thereof within the State boundary. In either case, a Federal-aid urban area must be a census place with a population of 5,000 to 49,999 (small urban area) or a designated urbanized area with a population of 50,000 or more. Federal-aid urban boundaries are established by responsible State and local officials and 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 urbanized areas are furnished in Appendix B.

8. Land Area (Net) -- The U. S. 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.) The net land area should reflect the Federal-aid urban area boundaries.

9. Population -- Current population including annual updates to 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", Federal-aid Highway System, (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. Priority for Assigning Accidents to Systems:

    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 System DVMT -- This is reported on the Motor Vehicle Accident Summary (Figure II-2, Columns 8-10). Enter the percent of the travel for a particular functional system that is carried by a specified Federal-aid system. Report percents in whole numbers, right-justified with leading zero(es) in the three digit field. For example, the percentage would be coded 050 if the Federal-aid Urban system carried 5,000 of the 10,000 DVMT reported for urban collectors. The spreadsheet option for reporting areawide data allows for reporting this percentage to the nearest one-hundredth of a percent.

MILEAGE AND DAILY TRAVEL SUMMARY

Mileage, DVMT, population, net land area, number of small urban areas, and ~~public Federal-aid ferryboat mileage~~ are reported on the summary form shown as Figure II-1--Parts I and II. Part 1 of the form provides for statewide summaries of data by functional system for rural and small urban areas and also statewide totals of these data for all areas. Summaries for individual urbanized areas are to be reported on Part 2 of the form. States with many individual urbanized areas will need additional Part 2 forms. Data must be reported for individual urbanized areas regardless of the option chosen by the State for sampling urbanized areas. Note that a total line is provided for summing all urbanized area values.

Figure II-1

MILEAGE AND DAILY TRAVEL SUMMARY

PART 1 - 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 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	
	0 0										

RURAL DATA

PUBLIC ROAD MILEAGE/ DAILY VEHICLE-MILES OF TRAVEL	YEAR	STATE	R-U	FUCTIONAL SYSTEM							POPULATION (000)	LAND AREA (SQ. MI.)
				PRINCIPAL ARTERIAL		MINOR ARTERIAL	COLLECTOR		LOCAL	TOTAL		
				INTERSTATE	OTHER		MAJOR	MINOR				
	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			1							1 0		
DVMT (000)			1							2 0		

SMALL URBAN DATA

PUBLIC ROAD MILEAGE/ DAILY VEHICLE-MILES OF TRAVEL	YEAR	STATE	R-U	FUCTIONAL SYSTEM						POPULATION (000)	LAND AREA (SQ. MI.)
				PRINCIPAL ARTERIAL			MINOR ARTERIAL	COLLECTOR	LOCAL	TOTAL		
				INTERSTATE	OTHER FREE-WAYS & EXPWYS	OTHER						
	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			2							1 0		
DVMT (000)			2							2 0		

*R-U CODE: 1=RURAL, 2=SMALL URBAN, 3=URBANIZED

OMB No. 2125-0028

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 (1–2)	STATE (3–4)	R-U* (5)	(6–7)	URBANIZED AREA (8–10)	(11–12)	FUNCTIONAL SYSTEM: PRINCIPAL ARTERIAL: INTERSTATE (13–20)	PRINCIPAL ARTERIAL: OTHER FREEWAYS & EXPRESSWAYS (21–28)	PRINCIPAL ARTERIAL: OTHER (29–36)	MINOR ARTERIAL (37–44)	COLLECTOR (45–52)	LOCAL (53–60)	TOTAL (61–68)	POPULATION (000) (69–73)	LAND AREA (SQ. MI.) (74–80)
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									
STATEWIDE TOTAL URBANIZED — MILEAGE			0			1 0									
STATEWIDE TOTAL URBANIZED — DVMT (000)			0			2 0									

*R-U CODE: 1=RURAL, 2=SMALL URBAN, 3=URBANIZED

USE SUPPLEMENTARY SHEETS FOR ADDITIONAL URBANIZED AREAS

OMB No. 2125-0028

Mileage Data

Road mileage data reported on the form(s) must agree with existing "open-to-traffic" public road mileage submitted on the tape file, and that reported as the certified public road mileage. 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.

Travel Estimates

Estimates of 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 projections. Selected Federal legislative programs include DVMT as references or as apportionment factors. In addition, 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.

Development of HPMS estimates of highway travel by functional system are to be derived using count-based traffic data that are in concert with the "Traffic Monitoring Guide" (TMG). The explicit goal of HPMS is to derive areawide DVMT estimates based on count-based traffic volume data furnished for the arterial and collector sample sections. The HPMS panels of sections have been statistically designed for a high level of measurable accuracy, especially for the determination of travel. Recommended procedures for the annual updating of sample and Interstate universe section AADT's and for obtaining DVMT are described in Appendix K, with further references to the TMG. Briefly, the procedures entail traffic counting on one-third of the sample sections and one-sixth of the non-sample Interstate universe sections each year, and the application of correction factors, such as axle, weekday/weekend and seasonal, to pneumatic tube counts. Growth factors are applied to those sample and Interstate sections that are not counted in the current year. Note: all Interstate sample and universe sections must be updated each year either by direct count adjusted to AADT, or by factoring based on other known information. The Interstate data are used for the annual apportionment of I-4R funds. The entire HPMS sample is referred to in the TMG as the core sample; the vehicle classification sample is a statistical subset of that core sample -- the truck weight sample is a subset of the vehicle classification subset (see the TMG for procedures and good practice recommendations).

DVMT estimates will be developed separately for rural, small urban and individual urbanized areas for each functional system. Emphasis must be placed on the development of local functional system DVMT to assure that it is reasonable and consistent. The sum of the individual urbanized area travel estimates for a State choosing to group urbanized areas, must be consistent with the overall travel estimate produced from the expanded sample for the areas grouped into a collective urbanized area. (See Appendix K for more details concerning traffic counting and travel estimating procedures.)

Population and Land Area

Periodic review and updating of the population and net land area data are 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. States should submit annually revised estimates when they find significant changes have occurred in either population or land area for any rural or urban area of a State, for any given reason.

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 will be derived to establish the performance of the functional systems. These data will also be the basis of the annual report to the Congress required by Section 207 of the Surface Transportation Assistance Act of 1982. The form used for reporting accident data is displayed 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 for accidents on public roadways under Federal jurisdiction within the State should be obtained from the appropriate agencies. Detailed accident related definitions are contained in the "Manual on Classification of Motor Vehicle Traffic Accidents," American National Standards Institute (ANSI) D16.1-1983, ~~as amended~~. In general, a traffic accident is an accident which occurs within the right-of-way of a public road or highway. All motor vehicle accidents involving injuries, both fatal and non-fatal, that occur within the rights-of-way of these public roadways are to be reported.

Fatal accident statistics reported to FHWA shall conform to the 30-day rule, i.e., a fatality resulting from an accident and occurring within 30 days of the accident 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 to the data.

Accidents are assigned to systems based on the "Manual on Classification of Motor Vehicle Traffic Accidents", ANSI D16.1-1983, as amended, using the hierarchy of the Federal-aid systems within the functional 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 must 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.

Percent Functional System DVMT -- This figure (columns 8-10) is to be reported for all appropriate lines. This percentage is calculated as the ratio of the travel carried by Federal-aid mileage within the functional system to the total functional system travel.

The total percentage for each functional system category (including travel on Federal-aid and non-Federal-aid systems) should be 100 percent. This is true even though only the percent for Federal-aid systems is reported. For example, under the category Rural Principal Arterial, Other, only the percentage for Federal-aid Primary is to be reported. However, the percentage for that cell plus the percentage for non-Federal-aid should total 100 percent.

The percentage is entered as a whole percent on the form. The spreadsheet option for reporting areawide data will accommodate percent figures of less than a whole, but must include the decimal (i.e., 50.6 may be entered).

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.

Example
fatal acc with fatal & injured persons
acc should be counted once as fatal
sum for number of persons fatal & non fatal injury
Sum of the fatal & non fatal accidents may exceed the actual total since some accidents will involve both fatalities & injuries.

Figure II-2

MOTOR VEHICLE ACCIDENT SUMMARY

STATE: _____ PREPARED: _____ (DATE)

FUNCTIONAL/FEDERAL-AID SYSTEM		YEAR	STATE	R-U*	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	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	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

*R-U CODE: 1=RURAL, 4=URBAN (SMALL URBAN AND URBANIZED AREAS COMBINED)

OMB No. 2125-0028

LOCAL FUNCTIONAL SYSTEM MILEAGE SUMMARY

The Local Functional System Mileage Summary form (see Figure II-3) requires the reporting of public local functional system mileage stratified by surface type and annual average daily traffic (AADT) group for the rural, small urban, and total urbanized areas of the State. These data will be used to describe in general terms the AADT and pavement type characteristics of the local functional system and will be published annually in "Highway Statistics." Comparison of the annual submittals will be made to establish trends in AADT growth and paving. It is assumed that a very small portion of the mileage on the local functional system will experience significant traffic growth, thereby, reducing the effort required to update this information.

The mileages reported on the Local Functional System Mileage Summary form must be consistent with those reported in the Mileage and Daily Travel Summary form as well as that contained on the data submittal tape. Road mileages in Figure II-3 are to be stratified by three surface/pavement types (paved, gravel/soil, and unimproved) as well as by the appropriate AADT group.

Paved -- bituminous, concrete, brick, block, and other special surfaces (codes 51 and above).

Gravel/Soil -- graded roads with a soil, gravel, or stone surface (code 40).

Unimproved -- unimproved or natural earth roads (codes 20 & 30).

Since this summary is stratified by several general characteristics of the local functional system, the State should complete the summary using its best judgement. A "best" estimate is satisfactory but should be made in such a fashion that it can be repeated consistently on an annual basis.

Rural Local Roads

Procedures for stratifying rural mileage will depend on the degree of detail available in existing maps and local road inventories. In some cases, stratification by AADT and surface type may be available directly from road inventory data. County series general highway maps or United States Geological Survey (USGS) maps may also be examined to determine location and extent of development in an area to assist in estimating current AADT's where local roads are not included in the State or county traffic counting program.

GIS

TIGER FILES

electronic

Small Urban and Urbanized Areas' Local Roads and Streets

For small urban areas, it is recommended that the proportion of mileage in each stratification be determined from an analysis of a sample of the urban areas. An initial analysis of three areas is recommended. The area of consideration may then be enlarged if a reasonable degree of consistency is not apparent in the proportion of mileage in the various AADT and pavement type strata.

It is recommended that the required mileage stratification in the small urban areas be determined by dividing the areas into subareas with different types of development. Local land use planning maps, zoning maps, or any other readily available information can be used in accomplishing the stratifications. The local functional system mileage distribution for each surface and AADT strata can be determined for each subarea. The distribution for the subareas can then be averaged and applied to the total local functional system mileage to determine the required values for each strata.

A similar procedure is recommended for urbanized areas. Once estimates representative of all small urban and all urbanized areas are developed, they can be added to determine the total urban estimate.

Figure II-3

SUMMARY OF LOCAL FUNCTIONAL SYSTEM MILEAGE

BY SURFACE TYPE AND VOLUME GROUP

STATE: ____________________ PREPARED: ____________________ (DATE)

	MILEAGE BY SURFACE TYPE	YEAR (1–2)	STATE (3–4)	R-U* (5)	(6–10)	(11–12)	RURAL AVERAGE DAILY TRAFFIC VOLUME: UNDER 50 (13–20)	50–199 (21–28)	200–499 (29–36)	500 & OVER (37–44)	TOTAL (45–52)
RURAL	PAVED			1		5 1					
	GRAVEL/SOIL			1		5 2					
	UNIMPROVED			1		5 3					
	TOTAL			1		5 4					

		(1–2)	(3–4)	(5)	(6–10)	(11–12)	URBAN AVERAGE DAILY TRAFFIC VOLUME: UNDER 200 (13–20)	200–499 (21–28)	500–1999 (29–36)	2000 & OVER (37–44)	TOTAL (45–52)
SMALL URBAN	PAVED			2		5 1					
	GRAVEL/SOIL			2		5 2					
	UNIMPROVED			2		5 3					
	TOTAL			2		5 4					
URBANIZED	PAVED			3		5 1					
	GRAVEL/SOIL			3		5 2					
	UNIMPROVED			3		5 3					
	TOTAL			3		5 4					

*R-U CODE: 1=RURAL, 2=SMALL URBAN, 3=URBANIZED

OMB No. 2125-0028

Percent of Travel by Vehicle Type and Functional System

The percent of travel made by various vehicle types over the various functional systems of highway are to be reported as areawide data on the "Travel Activity by Vehicle Type and Functional System" form provided as Figure II-4, Part 1. The vehicle types to be reported are listed and defined in Table II-1. Travel is reported for each vehicle type relative to the total DVMT for a functional system for each area type such that the values for each functional system sum to 100 percent. Note that a level of accuracy to the nearest one-tenth of a percent of the travel is used. If a vehicle type has reported travel less than one tenth of a percent, report this on a separate sheet, with appropriate vehicle type identification and attach it to the form. The spreadsheet option for reporting areawide data provides for reporting values to hundredths or thousandths of a percent (the decimal must be included).

Reporting of motorcycle travel is optional. States that can report such travel data should do so.

FHWA believes that automation is the only method that will allow the number and duration of vehicle classification sessions needed to provide statistically reliable information. Various States have begun automated collection of data for the 13 vehicle types that are defined in Table II-1 and in the "Traffic Monitoring Guide" (TMG), and have found the information to be reliable for their own and Federal reporting purposes. Other States using equipment that they believe cannot differentiate autos from other 2-axle 4-tire vehicles may report these two vehicle types as an aggregate figure. Of course, if a State that uses automated equipment normally augments its data with automobile-specific information, that data should be provided. It is particularly important that States making manual classification counts continue to provide automobile information distinct from other two-axle, four-tire vehicles. In coding combined data for a functional system, the values should be entered in the passenger car column and the "other two-axle, four-tire" column should be kept blank. An entry of a zero in either column is interpreted to mean that such vehicle types were monitored but not found in the traffic stream.

The vehicle activity information is to be reported for rural areas, and total urban areas. The TMG includes procedures for the development of a vehicle classification sample which is a subset of the HPMS sample sections. The procedures are flexible, allow incorporation of existing automated sites, and are deemed sufficient to meet the areawide and sample section reporting needs of the HPMS.

If the TMG has been fully implemented, estimates of percent travel for all vehicle type/functional system cells on the form are computed as the average of all the classification sample locations within that cell. For example, the percentage of buses on the rural Interstate System is simply the average of the percents of buses of all vehicle classification measurements in the sample taken on the rural Interstate System. If the sample consisted of 10 sections and the percent buses measured at each section were 0.9, 0.5, 1.1, 0.8, 0.3, 0.4, 0.2, 1.3, 0.5, and 0.3 (total = 6.3), then the average of 0.6 would be the estimated percentage of buses in the rural Interstate cell of the areawide form. If the TMG has not been fully implemented, the cell values will be based on the the State's internal procedures.

In addition, States are encouraged to submit to HPM-30 the site specific information upon which the areawide form is based, as it becomes available. The format for reporting such site specific classification data can be found in Chapter 6 of Section 5 of the TMG. The TMG section describes the reporting of station description and vehicle classification information. While submittal of the information as machine readable media is preferred, printed reports may also be furnished.

It should be noted that the TMG vehicle classification procedures also enable direct coding of the sample section data for Item 57, Percent Commercial Vehicles. Since the classification counts are made on a subset of the HPMS samples, however, other estimation methods will be needed on those samples that are not in close proximity to the classification counts.

Upon review of the classification data that has been submitted in the past, it became apparent that the treatment of trucks with trailers, and the time of day/day of week for which vehicle classification data is reported varies from State to State. These inconsistencies could cause inaccurate use of the data as well as results based on the data. In view of the rising importance of truck traffic estimates, it is imperative that the classification data be more precise, particularly concerning the information noted above. For these reasons, an additional form, provided as Figure II-4, Part 2, must be submitted as part of the Travel Activity by Vehicle Type and Functional System form. Each State is to indicate how various truck trailer counts are reported, and provide the time of day/day of week that the State normally collects the information. If classification is accomplished differently on different systems or in different areas (such as rural, urban), a copy of this form should be provided for each system/area, appropriately annotated.

Note: In reporting information on trucks, the following criteria should be used:

a. Truck tractor units traveling without a trailer will be considered single-unit trucks.

b. Truck tractor units pulling other such units in a "piggyback" (or "saddle-mount") configuration will be considered as one single-unit truck and will be defined only by the axles on the pulling unit.

c. Vehicles shall be defined by the number of axles in contact with the roadway. Therefore, "floating" axles are counted only when in the down position.

d. The term "trailer" includes both semi- and full-trailers.

Table II-1, Vehicle Types

Type Code	Type Name and Description
1	Motorcycles (Optional) -- All two- or three-wheeled motorized vehicles. Typical vehicles in this category have saddle type seats and are steered by handle bars rather than a wheel. This category includes motorcycles, motor scooters, mopeds, motor-powered bicycles, and three-wheel motorcycles. This vehicle type may be reported at the option of the State.
2	Passenger Cars -- All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.
3	Other Two-Axle, Four-Tire, Single-Unit Vehicles -- All two-axle, four-tire vehicles, other than passenger cars. Included in this classification are pickups, panels, vans and other vehicles such as campers, motor homes, hearses, El Caminos, Rancheros, ambulances, carryalls, and four-wheel drive vehicles. Other two-axle, four-tire, single-unit vehicles pulling recreational or other light trailers are included in the classification.
4	Buses -- All vehicles manufactured as traditional passenger-carrying buses with two-axles, six-tires and three or more axles. This category includes only traditional buses functioning as passenger-carrying vehicles. All two-axle, four-tire minibuses should be classified as other two-axle, four-tire, single-unit vehicles. Modified buses should be considered as trucks and be appropriately classified.

Table II-1, Vehicle Types (Cont.)

Type Code	Type Name and Description
5	Two-Axle, Six-Tire, Single-Unit Trucks -- All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having two axles and dual rear wheels.
6	Three-Axle, Single-Unit Trucks -- All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having three axles.
7	Four or More Axle, Single-Unit Trucks -- All trucks on a single frame with four or more axles.
8	Four or Less Axle, Single-Trailer Trucks -- All vehicles with four or less axles consisting of two units, one of which is a tractor or straight truck power-unit.
9	Five-Axle, Single-Trailer Trucks -- All five-axle vehicles consisting of two units, one of which is a tractor or straight truck power-unit.
10	Six-or More Axle, Single-Trailer Trucks -- All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power-unit.
11	Five-or Less Axle, Multi-Trailer Trucks -- All vehicles with five or less axles consisting of three or more units, one of which is a tractor or straight truck power-unit.
12	Six-Axle, Multi-Trailer Trucks -- All six-axle vehicles consisting of three or more units, one of which is a tractor or straight truck power-unit.
13	Seven-or More Axle, Multi-Trailer Trucks -- All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power-unit.

Figure II-4

TRAVEL ACTIVITY BY VEHICLE TYPE AND FUNCTIONAL SYSTEM

PART. 1

STATE: _____ PREPARED: _____ (DATE)

	FUNCTIONAL SYSTEM	YEAR		STATE		R-U*	FUNCTIONAL SYSTEM	PERCENT OF TRAVEL - XX.X (ASSUMED DECIMAL)**																																			
								MOTORCYCLES (OPTIONAL)			PASSENGER CARS			OTHER 2-AXLE, 4-TIRE, SINGLE-UNIT VEHICLES			BUSES			2-AXLE, 6-TIRE, SINGLE-UNIT TRUCKS			3-AXLE, SINGLE-UNIT TRUCKS			FOUR OR MORE AXLE, SINGLE-UNIT TRUCKS			FOUR OR FEWER AXLE, SINGLE-TRAILER TRUCKS			5-AXLE, SINGLE-TRAILER TRUCKS			SIX OR MORE AXLE, SINGLE-TRAILER TRUCKS			FIVE OR FEWER AXLE, MULTI-TRAILER TRUCKS			6-AXLE, MULTI-TRAILER TRUCKS			SEVEN OR MORE AXLE, MULTI-TRAILER TRUCKS		
		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
RURAL	INTERSTATE					1	0 1																																				
	OPA					1	0 2																																				
	MA					1	0 6																																				
	MAJOR COLL					1	0 7																																				
	MINOR COLL					1	0 8																																				
	LOCAL					1	0 9																																				
URBAN	INTERSTATE					4	1 1																																				
	OFE					4	1 2																																				
	OPA					4	1 4																																				
	MA					4	1 6																																				
	COLL					4	1 7																																				
	LOCAL					4	1 9																																				

*R-U CODE: 1=RURAL, 4=URBAN (SMALL URBAN AND URBANIZED AREAS COMBINED)

OMB No. 2125-0028

** IF PERCENT OF TRAVEL IS LESS THAN ONE-TENTH OF A PERCENT FOR A VEHICLE TYPE, ATTACH A SEPARATE SHEET SHOWING THE VALUE TO THE FIRST SIGNIFICANT DIGIT. IF REPORTING ON MACHINE READABLE MEDIUM, PLEASE CODE THE VALUE DIRECTLY.

may use own computerized form actual values,

FIGURE II-4

TRAVEL ACTIVITY BY VEHICLE TYPE AND FUNCTIONAL SYSTEM

PART 2

STATE: _____ DATA YEAR: _____

IS VEHICLE CLASSIFICATION DATA REPORTED ON PART 1 REPRESENTATIVE OF ALL HOURS OF THE DAY, DAYS OF THE WEEK, AND SEASONS OF THE YEAR?

☐ YES ☐ NO

IF NO, PLEASE ANSWER THE FOLLOWING:

1. VEHICLE CLASSIFICATION DATA ON PART 1 ARE REPRESENTATIVE OF DATA NORMALLY COLLECTED DURING THE HOURS OF:

____AM/PM TO ____AM/PM

2. VEHICLE CLASSIFICATION DATA ON PART 1 ARE REPRESENTATIVE OF DATA NORMALLY COLLECTED ON THE FOLLOWING DAYS DURING THE FOLLOWING MONTHS (CHECK THOSE THAT ARE APPROPRIATE):

___ SUNDAY	___ THURSDAY	___ JANUARY	___ MAY	___ SEPTEMBER
___ MONDAY	___ FRIDAY	___ FEBRUARY	___ JUNE	___ OCTOBER
___ TUESDAY	___ SATURDAY	___ MARCH	___ JULY	___ NOVEMBER
___ WEDNESDAY		___ APRIL	___ AUGUST	___ DECEMBER

VEHICLE TYPE	REPORTED UNDER WHICH VEHICLE CATEGORY ON PART 1
2-AXLE, 4-TIRE TRUCKS WITHOUT A TRAILER	
2-AXLE, 4-TIRE TRUCKS WITH A TRAILER	
2-AXLE, 6-TIRE PICKUP TRUCKS WITHOUT A TRAILER	
2-AXLE, 6-TIRE PICKUP TRUCKS WITH A TRAILER	
OTHER SINGLE-UNIT TRUCKS WITH SEMI-TRAILERS	
OTHER SINGLE-UNIT TRUCKS WITH FULL-TRAILERS	

COMMENTS

OMB No. 2125-0028

CHAPTER III

UNIVERSE AND SAMPLE DATA REQUIREMENTS

The HPMS requires the annual reporting of universe data (comprehensive statewide public road mileage, and Federal-aid system mileage not yet built or open to traffic) classified by specific categories, and selected roadway physical operational and usage characteristics for sample sections. The annual data submittal must include all required items, including those that remain unchanged. Sample sections are to be updated according to the established schedule for each data element (see Chapter V). The type of capital improvement is also to be reported for arterial and collector sample sections in the year of completion. This Chapter outlines the requirements for universe and sample data.

Preliminary to discussing the makeup of the data tape records, the following definitions apply throughout this Manual:

Public Road -- "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)).

"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)

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, standard 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 restrictive gates. (FHPM, 4, 5, 3)

Primitive roads (surface type A) do not meet the criteria for "public roads" since they are defined as routes "on which there is no public maintenance" and are "usable by 4-wheel drive vehicles and publicly traveled by small numbers of vehicles."

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)

Universe Data -- Data representing all public road mileage and Federal-aid system mileage not yet built or open to traffic. The universe data defines the extent of roadway mileage by system and jurisdiction. These can be reported in either of the following ways:

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

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. Interstate System and sampled mileage data cannot be reported in grouped data form.

Sample sections -- Randomly selected sections from the universe of arterial and collector sections for which additional physical and operational data elements in addition to the universe data are reported. The sections are homogeneous as to geometrics, cross section, AADT and condition, and the termini are fixed as to location over time. The arterial and collector samples (in section form consisting of both universe and sample data) provide basic physical inventory and operational data for specific sections of highway from 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 Appendix H.

UNIVERSE DATA

Records will be submitted on computer tape for all public road mileage for all systems plus Federal-aid system mileage not yet built or open to traffic. 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 sections (includes basic Interstate System mileage (Section 103, title 23 U.S.C), Interstate System additions, section 139(a), 139(b), and 139(c), and Toll mileage), States may group remaining highway sections, such as collector and local functional system mileage. 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 analytical use of the data set by the SHA's. 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 general categories of 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.

Optionally, the latitude and longitude coordinates for the beginning and ending points of universe and sample sections are provided.

System -- Provides for coding of functional system and Federal-aid system.

Jurisdiction -- Provides for coding of State or local highway system and special funding category.

Operation -- Includes type of facility, truck prohibition, and toll.

Other -- Contains length of highway section and fields for the coding of AADT and the number of through lanes.

SAMPLE SECTION DATA

In addition to the universe data items reported for all records, arterial and collector sample section records will contain additional condition, usage, inventory and operational data.

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 the rural, small urban, and 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 urbanized areas -- Interstate, other freeways and expressways, other principal arterial, minor arterial, and collector.

When the HPMS was initially implemented, individual urbanized areas were required to be sampled. This requirement then became optional, along with the collective method. However, in view of possible future events concerning increased emphasis on urban areas, the States are now highly encouraged to sample urbanized areas, individually. At a minimum, the State shall sample the aggregate of the urbanized areas. However, at the State's option, it may continue to sample individual urbanized areas or it may sample some individual urbanized areas and group the remaining urbanized areas. For those States electing to group all or a portion of the urbanized areas, a procedure for drawing a new sample from the existing sample is contained in Appendix H.

Sample section data reported in addition to the universe data are described below by category. The data items within each category are discussed in detail in Chapter IV.

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.

Improvements -- Describes the improvement type for the year of the improvement completion.

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 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 -- Provides linkage to existing structure and railroad crossing information systems.

Interstate System Sample Requirements

The Interstate System consists of four (4) separate sample mileage types, each with its own unique category mileage base to which it is expandable. The categories are as follows:

1. Interstate (other than categories 2-4 noted below)
2. Interstate Toll
3. Interstate with Secretarial Agreement
4. Interstate Section 139(a) additions

If only category "1" Interstate mileage exists within a State, then the Interstate System will continue to be sampled as a single unit (this will be the case in over half the States). However, an additional Interstate System sample unit is necessary for each of categories 2-4 if mileage exists for the respective category(s) -- the procedures outlined in Appendix H must be followed when this occurs.

Because of the importance of the Interstate System, its homogeneity and other factors, several States have sampled and reported via HPMS, 100 percent of the Interstate System mileage. If any other State has the desire and/or need to sample its entire Interstate and report it via HPMS, this is acceptable and we need only to be informed.

Capital Improvement Data

Improvement type data are essential to the evaluation of the relative effectiveness of existing highway programs. The following must be reported for each sample section having an improvement completed during the data year, and is carried unchanged, until another improvement is completed on the section in another year. The improvement types are shown in hierarchial order which should be followed in assigning the improvement type.

Type of Improvement -- Improvement types are as follows:

Code	Description	Code	Description
10	New Route	40	Major Widening
20	Relocation	50	Minor Widening
31	Reconstruction to Freeway	60	Restoration and Rehabilitation
32	Reconstruction with More Lanes	71	Resurfacing with Shoulder Improvements & Concrete Pavement
33	Reconstruction to Wider Lanes	72	Resurfacing with Shoulder Improvements & Bituminous Pavement
34	Pavement Reconstruction with Alignment Improvements	77	Resurfacing with Concrete Pavement
35	Pavement Reconstruction	78	Resurfacing with Bituminous Pavement

The type of improvement is determined by the nature of the construction rather than the source of funding. For example, bituminous resurfacing financed with Interstate-4R funds is to be coded as resurfacing (code 78) and the reconstruction of a 2-lane, urban collector facility with wider lanes financed with State and local funds should be coded "33". Only one type of improvement can be reported for a particular section in a given year. The year of improvement completion is also coded and retained in the record.

The "New Route" (code 10) improvement type can only be used when a new sample is randomly selected (because of volume group sample deficiency) on a newly constructed and completed roadway that was opened to traffic during the reporting year. The "Relocation" improvement type (code 20) can only be used if the existing section is replaced by a section on new alignment and the originial section is abandoned. It should be noted that in cases where a relocation improvement has been made and the existing section remains in service as a collector or higher functional system, the original sample section should continue to be monitored. If the existing facility is reclassified as local, the sample is eliminated entirely. As an indirect consequence of this relocation improvement (if it meets the above conditions), a number of the data items on the original section will change. Since codes 10 & 20 will rarely be used, the majority of capital improvements will receive codes 31 through 78.

Section Data Changes Resulting from Capital Improvements -- 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 sample subdivisions and 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.)

Note that the type of improvement, as well as the year of improvement, have become a part of the permanent (fixed portion) record for a sample section, and remain as part of the record until another surface improvement is completed on the section.

Interstate-4R Apportionment

The current I4R apportionment formula under Sec. 104(b)(5)(B), Title 23, U.S.C., for resurfacing, restoring, rehabilitating, and reconstructing the Interstate System utilizes lane miles and vehicle miles travelled on Interstate routes that are completed and open to traffic. HPMS serves as the source for these data; several of the universe data items must be scrutinized to ascertain eligibility status. The pertinent eligibility items are as follows:

Item #	Description	Codes	Meaning
9	Functional System	01,11	Interstate
11	Federal-aid System	1	Interstate
12	Federal-aid System Status	1	Open to Traffic
16	Special Systems	41	Interstate 139(c) (Alaska & Puerto Rico)
19	Toll	1	Non-toll
	Toll	3	Interstate Toll under Secretarial Agreement
	Toll	4	Interstate non-toll under Secretarial Agreement
20	Length		If a section meets the I4R requirements based on the above data items, the items listed to the left are used for calculating the apportionment factors
21	AADT		
22	Number of Through Lanes		

It is important to note that only the Interstate through lanes and only the vehicular traffic on these Interstate through lanes are to be reported in HPMS for use in I4R aqpportionment. Specifically excluded from I4R apportionment are the lane miles and travel on toll facilities without Secretarial Agreements, ramps, frontage roads and collector/distributor segments that are part of interchanges.

Data for the following roadways are input to the I4R apportionment formula:

Open to traffic Interstate on:
- Interstate (free)
- Interstate 139(c) Section 139(c) of Title 23, U.S.C.
- Interstate Toll/non-toll facilities under Secretarial Agreement

Data for the following roadways are excluded from the I4R apportionment formula:

- Non-Interstate
- Interstate 139(a)
- Interstate 139(b)
- Interstate Toll facilities not under Secretarial Agreement
- Not open-to-traffic Interstate

CHAPTER IV

RECORD FORMAT AND CODING INSTRUCTIONS

This Chapter contains the record format and detailed coding instructions for the universe and sample section data. There are four types of records that can be reported:

1. Universe Interstate Sections -- These will contain Items 1-23. The record length is 163 positions. Where an Interstate section is also a sample section, refer to (4), below for coding instructions.

2. Universe Sections excluding Interstate -- These will contain Items 1-23, where applicable, with non-applicable items zero-filled. The record length is 163 positions. When a section is also a sample, refer to (4) below for appropriate instructions.

3. Universe Grouped Records -- These will contain Items 1-23, where applicable, with non-applicable items zero-filled. The record length is 163 positions. Interstate and sample sections cannot be grouped.

4. Arterial and Collector Sample Sections -- These will contain Items 1-78. Items 1-76, where non-applicable, will be zero-filled and Items 77-78 will be coded if applicable. The record length for Items 1-76 is 427 positions. Items 77-78 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, grade, etc. 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 common alignment but where staged construction resulted in substantial differences in roadway dimensions or operational conditions.

All numeric data items are to be zero-filled where codes are not applicable or are not required. Leading zeroes must be provided for numeric data items where the entered value or code does not already fill the allocated field length. Alphanumeric fields may include blanks and do not have to be zero-filled. There is one exception to this rule -- the route numbers (Item 14) for Interstate must be right-justified, zero-filled, and contain no alpha characters. (However, see Item 14 for additional route coding information.) Route numbers for other systems may follow the alphanumeric coding scheme. Appendix R provides a concise summary of the numeric and alphanumeric data items.

AK, HI & PR

RECORD FORMAT SUMMARY

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

Int	Report these items for all Interstate sections (including Interstate sample sections).
Sam	Report these items for all arterial and collector sample sections (including Interstate sample sections).
All	Report these items for all other sections/records.
Pos	This column indicates the position of the item in the tape record as reported to FHWA.
Len	This column indicates the length of the field used for the data item.

Under the columns headed "Required Sample Items", an "X" indicates that the item is required for the Functional System being reported. The following abbreviations are used:

Int	Interstate	Rural and Urban
OFE	Other Freeways and Expressways	Urban
OPA	Other Principal Arterial	Rural and Urban
MA	Minor Arterial	Rural and Urban
MaC	Major Collector	Rural
MiC	Minor Collector	Rural
Col	Collector	Urban

A few data items require additional discussion regarding the type of section for which the data item is applicable. For instance, Percent Passing Sight Distance (Item 54) is required for rural paved, 2-lane facilities. The summary table can only indicate that this item is required for rural. Each data item description must be consulted for complete details.

Universe Data

Item No.	Pos	Len	Required Universe Items: Int	Sam	All	Data Item
						Identification
1	1-100	100				State Control Field
2	101-102	2	X	X	X	Year
3	103-104	2	X	X	X	State code
4	105-107	3	X	X	X	County code
5	108	1	X	X	X	Rural/Urban Designation
6	109-113	5	X	X	X	Urbanized Area Code
7	114	1	X	X	X	Type of Section/Grouped Data
8	115-126	12	X	X	X	Section/Grouped Data Identification
						System
9	127-128	2	X	X	X	Functional System
10	129	1	X	X	X	Generated Functional System Code
11	130	1	X	X	X	Federal-aid System
12	131	1	X	X	X	Federal-aid System Status
13	132	1	X			Route Signing
14	133-137	5	X			Route Number
						Jurisdiction
15	138-139	2	X	X	X	Governmental Level of Control
16	140-141	2	X	X	X	Special Systems
						Operation
17	142	1	X	X	X	Type of Facility
18	143	1	X	X	X	Designated Truck Route/Parkway
19	144	1	X	X	X	Toll
						Other
20	145-150	6	X	X	X	Section/Group Length
21	151-156	6	X	X		AADT
22	157-158	2	X	X		Number of Through Lanes
23	159-163	5	X	X	X	Record Continuation Code

Sample Data

Item No.	Pos	Len	Required Sample Items: Rural Int	Rural OPA	Rural MA	Rural MaC	Rural MiC	Urban Int	Urban OFE	Urban OPA	Urban MA	Urban Col	Data Item
													Identification
24	164-175	12	X	X	X	X	X	X	X	X	X	X	Sample Number
25	176	1	X	X	X	X	X	X	X	X	X	X	Sample Subdivision
													Computational
26	177-178	2	X	X	X	X	X	X	X	X	X	X	AADT Volume Group Identifier
27	179-184	6	X	X	X	X	X	X	X	X	X	X	Expansion Factor
													Pavement
28	185-186	2	X	X	X	X	X	X	X	X	X	X	Surface/Pavement Type
29	187-188	2	X	X				X	X	X			Concrete Joint Spacing
30	189	1	X	X				X	X	X			Load Transfer Devices
31	190	1	X	X	X	X	X	X	X	X	X	X	Pavement Section
32	191-192	2	X	X				X	X	X			SN or D
33	193	1	X	X				X	X	X			Type of Base
34	194	1	X	X				X	X	X			Type of Subgrade
35	195	1	X	X				X	X	X			Subsurface Drainage
36	196-198	3	X	X	X			X	X				Measured Roughness
37	199-210	12											Reserved - Federal
38	211-212	2	X	X	X	X	X	X	X	X	X	X	PSR
39	213-215	3	X	X	X	X	X	X	X	X	X	X	Overlay or Pavement Thickness
													Improvements
40	216-219	4	X	X	X	X	X	X	X	X	X	X	Year of Surface Improvement
41	220-221	2	X	X	X	X	X	X	X	X	X	X	Type of Improvement
													Geometrics
42	222	1	X	X	X	X	X	X	X	X	X	X	Access Control
43	223-224	2	X	X	X	X	X	X	X	X	X	X	Lane Width
44	225	1	X	X	X	X	X	X	X	X	X	X	Shoulder Type
45	226-229	4	X	X	X	X	X	X	X	X	X	X	Shoulder Width
46	230	1	X	X	X	X	X	X	X	X	X	X	Median Type
47	231-232	2	X	X	X	X	X	X	X	X	X	X	Median Width
48	233-235	3	X	X	X	X	X	X	X	X	X	X	ROW Width
49	236	1	X	X	X	X	X	X	X	X	X	X	Widening Feasibility

Sample Data (Cont.)

Item No.	Pos	Len	Required Sample Items: Rural Int	Rural OPA	Rural MA	Rural MaC	Rural MiC	Urban Int	Urban OFE	Urban OPA	Urban MA	Urban Col	Data Item
													Geometrics, Cont.
50	237	1				X	X						Horz. Align. Adeq.
51	238-328	91	X	X	X			X	X	X			Curves by Class
52	329	1				X	X						Vert. Align. Adeq.
53	330-371	42	X	X	X			X	X	X			Grades by Class
54	372-374	3	X	X	X	X	X						% Passing Sight Distance
													Traffic/Capacity
55	375-376	2	X	X	X	X	X	X	X	X	X	X	Speed Limit
56	377-378	2				X	X						Wtd. Des. Speed (calculated)
57	379-382	4	X	X	X	X	X	X	X	X	X	X	Percent Commercial Vehicles
58	383-384	2	X	X	X	X	X	X	X	X	X	X	K-Factor
59	385-387	3	X	X	X	X	X	X	X	X	X	X	Dir. Factor
60	388-392	5						X	X	X	X	X	Peak Capacity
61	393-395	3	X	X	X	X	X	X	X	X	X	X	V/SF Ratio (calculated)
62	396-397	2						X	X	X	X	X	Turning Lanes
63	398	1						X	X	X	X	X	Signalization
64	399-400	2						X	X	X	X	X	% Green Time
65	401	1						X	X	X	X	X	Peak Parking
66	402-407	6	X	X	X	X	X	X	X	X	X	X	Future AADT
67	408-409	2	X	X	X	X	X	X	X	X	X	X	Future AADT Year
													Environment
68	410-411	2	X	X	X	X	X	X	X	X	X	X	Climate Zone *
69	412	1	X	X	X	X	X	X	X	X	X	X	Drainage Adeq.
70	413	1	X	X	X	X	X						Type of Terrain
71	414	1	X	X	X	X	X						Type of Development
72	415	1						X	X	X	X	X	Urban Location
73	416-417	2	X	X	X	X	X	X	X	X	X	X	# Grade Sep. Interchanges
74	418-423	6	X	X	X	X	X	X	X	X	X	X	# At-Grade Intersections
75	424-425	2	X	X	X	X	X	X	X	X	X	X	# Structures
76	426-427	2	X	X	X	X	X	X	X	X	X	X	# At-Grade RR Crossings
													Supplemental Data
77	--varies--		X	X	X	X	X	X	X	X	X	X	Structure ID's
78	--varies--		X	X	X	X	X	X	X	X	X	X	At-Grade RR Crossing ID's

* Initial entry of Item 68, Climate Zone will be accomplished by software.

UNIVERSE MILEAGE CODING INSTRUCTIONS

Identification

Item 1 -- State Control Field (Length = 100)

This portion of the record is for the use of the State. However, in view of the increased utility and emphasis on graphic capabilities and Geographic Information Systems (GIS), at both the State and Federal levels, the States are requested, on an optional basis, to supply the beginning and ending latitude and longitude coordinates for each universe and sample section. The primary interest is in the arterial systems at the Federal level, however, the States may provide coordinates for other systems, if they are available. Since there is no room in the current record to accommodate these data, we are requesting that the optional data be placed in the State Control Field until the HPMS record format is changed for other reasons. At that time, space will be provided elsewhere in the data record. The following field positions are to be used:

Beginning Point Latitude;	positions 70-76;	length = 7
Beginning Point Longitude;	positions 77-83;	length = 7
Ending Point Latitude;	positions 84-90;	length = 7
Ending Point Longitude;	positions 91-97;	length = 7

The data fields are to be right-justified, zero-filled and contain positive degrees, with an implied decimal point, four places in from the rightmost position. For example, a point at Latitude 35 deg., 33 min., 22 sec. = 35.556111 deg., and would be coded as "0355561". Similarly, a point at Longitude 121 deg., 5 min., 52 sec. = 121.097777 deg., and would be coded as "1210978".

If the State groups data (Item 7 = 3), zero fill these fields for the grouped section records, as well as for those records that are not reported (this need be done only if the State is reporting for some systems and not for others).

Should a State have coordinates, but cannot use this reporting method, other means for providing these data will be accepted at this time. This may include a separate file of coordinates tied to the HPMS route milepoint, or some other means of identification, such as a copy of the front of the HPMS records (county, ID, etc.). Thorough documentation of these files including record and field format will also be required. Please contact FHWA Headquarters (HPM-20) for more information exchange, if the State will provide these data in an external file.

Coordinate reporting for some systems will likely be standardized for HPMS in the future.

Item 2 -- Year (Length = 2)

Enter the last two digits of the calendar year for which the data apply. For example, the 1989 data reported in 1990 would be coded "89".

Item 3 -- 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 4 -- County Code (Length = 3)

Use the 3-digit FIPS county code (see Federal Information Processing Standards Publication 6, "Counties of the States of the United States"). If a State elects to use some other coding scheme, supply a copy of the code relationship to the county FIPS codes to FHWA Headquarters (HPM-20).

Item 5 -- 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 (population 5,000 to 49,999)
3	Urbanized (population > 49,999)

Item 6 -- Urbanized Area Code (Length = 5)

This item must be coded when Item 5, Rural/Urban designation is coded "3" for urbanized. Otherwise, this field is not required.

The State may sample urbanized areas individually (which is highly encouraged) or it may group two-or-more urbanized areas into one-or-more collective groups (which is now discouraged). In order to identify how the State is sampling urbanized areas, this item must be coded in the format XXYYY where:

XX = 00 -- If urbanized area is being individually sampled.

XX = Sequential # from 11 -- If two-or-more areas are being grouped, one code should be used for each group. For example, if a State has consolidated all urbanized areas into one group, only "11" should be coded. If areas have been consolidated into two groups plus some individual areas, the first group of areas must be coded "11", the second group must be coded "12", and the individual areas must be coded "00".

YYY = The actual 3-digit urbanized area code, depending on which urbanized area the section mileage falls within. (See Appendix B.) The urbanized area code for the specific urbanized area is always coded regardless of the sampling option selected.

Both XX and YYY must be coded for all urbanized area universe and sample records.

Item 7 -- 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	Unique Number -- a countywide unique number

See examples in Item 8.

Item 8 -- 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 its needs independent of the unique identification maintained for HPMS sample sections (see Item 24, Sample Number). This item may change to suit the needs of the State. The Sample Number must never change. The appropriate ID is as follows:

1. For all Interstate, use route-milepoint identification compatible with that used for the Interstate Cost Estimates (ICE). Inventory milepoints for the "as built" Interstate should be used for this item and the ICE.

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

3. For non-Interstate, non-sample grouped data, use a countywide, unique, identification number.

4. For other sections, use an identification unique within each county.

Examples for each method follow:

1. Route, Milepoint (Item 7 = 1)

   Inventory route number is coded in positions 115-120, 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 121-126, right justified, (xxx.xxx -- implied decimal point). 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 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.:	114	115	116	117	118	119	120	121	122	123	124	125	126
Code:		1	0	0	0	0	5	0	0	7	9	2	0	0

Item 8 (Cont.)

2. A-Node, B-Node -- Segment (Item 7 = 2)

A-Node is coded in Positions 115-119, right justified
B-Node is coded in Positions 120-124, right justified
Segment is coded in Positions 125-126, 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.	114	115	116	117	118	119	120	121	122	123	124	125	126
Code	2	0	0	5	7	2	0	0	6	9	1	0	4

3. Grouped Data (Item 7 = 3)

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

Grouped data is an aggregation of roadway mileage, where at least the following data items are homogeneous across all mileage being combined: Items 1-12, and 15-19.

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

Example: 98365

Pos.	114	115	116	117	118	119	120	121	122	123	124	125	126
Code	3	0	0	0	0	0	0	0	9	8	3	6	5

Item 8 (Cont.)

4. Unique Number (Item 7 = 4)

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

Example: 4321

Pos.	114	115	116	117	118	119	120	121	122	123	124	125	126
Code	4	0	0	0	0	0	0	0	0	4	3	2	1

NOTE: Items 1-8 contain the identification portion of the section records.

System

Item 9 -- Functional System (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 and 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 Freeways and Expressways and Other Principal Arterial functional systems. 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.

Definitions of the highway functional systems can be found in "Highway Functional Classification, Concepts, Criteria and Procedures," FHWA, ~~July~~ March 1989

Item 10 -- Generated Functional System Code (Length = 1)

This field consists of a code that is generated based on Item 9, Functional System, that is used as a software aid. It is encoded by the HPMS Submittal Software, SELCALC option, described in Chapter VI. If Item 9 is changed by non-HPMS software, the SELCALC option must be run to obtain the proper code in this field. This code is automatically updated when using the SELMODU option of the HPMS Submittal Software to update Item 9. The codes are as follows:

Code	Description	
	Rural	Urban
1	Interstate	Interstate
2	Other Principal Arterial	Other Freeways & Expressways
3	Minor Arterial	Other Principal Arterial
4	Major Collector	Minor Arterial
5	Minor Collector	Collector
6	Local	Local

Item 11 -- 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 12 -- 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 open-to-traffic

A section is considered "open to traffic" when the geometric standards of the section are reasonably adequate for vehicle use and the roadway is open to present daily traffic.

ALL NON-FEDERAL-AID MILEAGE REPORTED SHOULD BE OPEN TO TRAFFIC.

Item 13 -- 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 reporting this data item, this field should be coded "0". If roadway is unsigned, code this field "7".

Code	Description
0	Not reported
1	Interstate
2	U.S.
3	State
4	County
5	Township
6	Municipal
7	None of the above or not signed

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. Signed Interstate business routes, unless they are built to Interstate standards and are part of the Interstate system, should be reported as non-Interstate routes.

Item 14 -- 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 class in the hierarchy (see Item 13) are signed along a roadway section, the lowest route number should be entered in this field. If Item 13 is coded "0", zero-fill this field.

Only the officially approved AASHTO Interstate route number should be coded, right-justified. Extra alphanumeric characters should not be entered -- zero-fill the remaining digits. Short Interstate route spurs should be identified with their own approved route number and not that of the main route.

Alaska, Hawaii and Puerto Rico may use alpha characters in the Interstate route number field as part of the official AASHTO route number. Other exceptions to the Interstate numeric rule include a major route that has a parallel or diverging branch with fully paired directional roadways and has an official route number containing a letter for relative direction (i.e., E for east). For example, route 35 in Minnesota splits with 35E going through St. Paul and 35W through Minneapolis.

Jurisdiction

Item 15 -- 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. Where more than one code could be used for a section, the lowest numerical code shall be reported (i.e., if county and town boundaries are the same and only one governing body exists, use code "02").

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 16 -- Special Systems (Length = 2)

This field is used to code the special funding categories in which some existing and open-to-traffic highway segments fall (but not-open-to-traffic Federal-aid Systems should be included). These special systems are separate and distinct from those outlined in previously defined fields. 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. Where conflicts exist, the 40/41/42 codes have priority -- otherwise use the lower numbered code (i.e., use "15" where "15" and "20" are both applicable, but use "42" where both "20" and "42" are applicable).

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/
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) 3/
40	Addition to the Interstate System (23 U.S.C. 139 (a)) 4/
41	Addition to the Interstate System (23 U.S.C. 139 (c))
42	Future addition to the Interstate System (23 U.S.C. 139 (b)) 5/
43	139(a) approved after [illegible]

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).

3/ Mileage constructed via Defense Access Road funds.

4/ Highway mileage designated as part of the Interstate System under the provisions of 23 U.S.C. 139(a) should be coded "40" for this data element and should be functionally classified as Interstate (Item 9 should be coded "01" or "11"). Item 11 should be coded "1".

5/ Highway mileage designated as a future part of the Interstate System under the provisions of 23 U.S.C. 139(b) should be coded "42" for this data element. This mileage is part of the Federal-aid Primary System (Item 11 should be coded "2") and should not be functionally classified as Interstate until the highway has been officially designated as part of the Interstate System.

Operation

Item 17 -- Type of Facility (Length = 1)

Code	Description
1	One-Way
2	Two-Way

Definitions:

One-Way -- A one-way is a roadway with traffic moving in one direction only. When part of a one-way couplet, each roadway should be inventoried independently to obtain universe data.

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

Item 18 -- Designated Truck Route/Parkway (Length = 1)

Designated truck routes (codes "1", "2") are those sections/routes that are available to truck tractor and 48-foot (or longer if grandfathered) semitrailer combinations, and to truck tractor and 28-foot twin trailer combinations that may be 102 inches wide with no overall length limitations.

The designated truck routes are (1) routes included in the National Truck Network designated under 23 Code of Federal Regulations (CFR) 658, Appendix A, and authorized by Sections 411 (length) and 416 (width) of the Surface Transportation Assistance Act of 1982, and (2) other roadways both on and off of the Federal-aid Systems, designated under State authority.

The following are not to be included as designated truck routes for the purposes of this data item (use code "4"):

a. Routes (or portions thereof) that simply provide "access" for these large vehicles to terminals and for food, fuel, repair or rest services.

b. Those routes designated only under State authority that restrict some of the trucks described above because of length or width limitations or because of time of day restrictions.

For purposes of this data element, a parkway (code "3") is a highway that has full or partial access control, is usually located within a park or a ribbon of park-like developments, and prohibits commercial vehicles. In this instance, buses are not considered commercial vehicles.

Code	Description
1	Designated truck route under Federal authority in 23 CFR 658. This code would include all Interstate and those sections/routes designated only under Federal authority or under both Federal and State authority. It would not include the routes in those 15 States that have designated all, or almost all, of the non-Interstate Federal-aid Primary; use code "2" under this situation, if there are no limitations/restrictions 1/
2	Designated truck route only under State authority and fully available to both combinations of trucks described above 1/
3	Parkway -- not on a designated truck route
4	Not a Parkway -- not on a designated truck route

1/ Those States designating all, or almost all, of its non-Interstate Federal-aid Primary are: AR, CO, IN, KS, LA, MS, MT, NE, NV, OH, OK, SD, TX, WA AND WY. Code "2" shall be used for this mileage if it is fully available to the trucks described above.

Item 19 -- Toll (Length = 1)

Code	Description
1	Non-Toll
2	Toll
3	Interstate Toll segment under Secretarial Agreement (Section 105 of 1978 Federal-aid Highway Act)
4	Interstate Toll segment under Secretarial Agreement now free of tolls

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 even 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. The coding for this item should agree with any other data furnished to FHWA.

If a roadway was built with and is still maintained by toll funds, the roadway is considered toll.

Other Data

Item 20 -- Section/Group Length (xxx.xxx -- implied decimal) (Length = 6)

Mileage should be reported as measured along the centerline of the roadway. On independently aligned, divided highways, the reported mileage should be the average of the lengths of the directional roadways, measured along their centerlines. When a route terminates at an interchange, the length is measured as the average of the two directional, connecting roadway lengths to the first points of intersection or crossover/under with the other mainline route. Where a route length is reported from or to the intersection with another route, the point of measurement should be taken as the theoretical center of the intersection if the two routes were unseparated highways meeting at grade. Except in the case of the terminating route described above, ramps are considered part of the mainline routes and are not considered for HPMS length purposes.

For non-Interstate, non-sample 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 -- the section identifications must be unique.

While provision has been made for coding to a maximum precision of 0.001 miles, records should reflect the precision normally utilized by the State, but at least to the nearest tenth. This not only provides maximum precision, but alleviates rounding, programming, and checking problems. The field should be coded with trailing and leading zeros, depending on the precision obtained, e.g., 56.2 miles would be coded "056200".

Item 21 -- Annual Average Daily Traffic (AADT) (Required for all Interstate and sample sections; optional for remaining sections. 1/) (Length = 6)

Enter the section's AADT (total, both directions for two-way facilities and directional if part of a one-way couplet or just one-way) 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, and to provide "actual counts" adjusted to represent AADT rather than "estimates".

The reported AADT values are to be annually updated. Current traffic data taken from sites near/adjacent to continuous automatic traffic recorders (ATR's) are the preferred source in lieu of coverage counts. AADT values that are derived from pneumatic tube counts should include the application of seasonal, weekday/weekend, and growth factors (if not current year counts), as well as corrections for vehicles with more than 2-axles. Specific guidance for frequency and size of traffic data collection programs is contained in Appendix K with further references to the "Traffic Monitoring Guide."

Leading zeros must be coded. For example, an AADT of 25,300 vehicles per day is coded "025300". The field is zero filled when not used.

1/ If AADT information is accurate and available for all sections (except local functional system), the State may wish to enter all AADT data in order to use a software option that will calculate the volume group expansion factors for sample sections, automatically (no universe mileage cards are required). The software is described in Chapter VI under the SELEXPF option.

Item 22 -- Number of Through Lanes (Required for all Interstate and sample sections) (Length = 2)

Enter the prevailing number of through lanes in both directions (excluding collector-distributor lanes, weaving lanes, frontage road lanes, parking and turning lanes, etc.) carrying through traffic in the off-peak period. Exclude truck climbing lanes unless the length and importance is sufficient to warrant inclusion. Other additional short-length lanes needed for toll booth operations, special emergency turnaround lanes, and deceleration lanes serving service stations and restaurants accessible under special circumstances in the roadway median, etc., should also be excluded.

Enter "00" for all non-applicable sections.

Item 23 -- Record Continuation Code (Length = 5)

This field must be present in all records. It indicates what type of section record is being coded, consists of three elements, and is normally encoded by software. It consists of the following:

Record Positions	Description	Code
159-163	Indicates Universe Record, only	00000
159	Indicates Sample Record	1
160-161	Number of Structure ID's provided	xx
162-163	Number of Railroad Crossing ID's provided	yy

where "xx" and "yy" are counts of the ID's provided with leading zeroes coded. Enter "00" if none are reported.

Examples:

A sample section that has no ID's coded for either structures or railroad crossings	"10000"
A sample record with 4 railroad crossing ID's and no structure ID's	"10004"
A universe record	"00000"

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

SAMPLE SECTION CODING INSTRUCTIONS

Samples are obtained only from open-to-traffic, public road mileage under the jurisdiction of and maintained by a public authority.

Identification

Item 24 -- 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, once coded, will be considered as a unique number that cannot change in the future. It will be assigned to all subdivided portions of the sample sections, as necessary.

Item 25 -- Sample 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 24, Sample Number, always remains the same.

Sample sections should be sudivided only when significant changes have occurred. Routine maintenance, short lengths of surfacing or sealing, or repair of several joints would not normally constitute a significant change. If more than nine subdivisions are proposed, it is suggested that the section be reviewed for recombination of contiguous subdivisions with similar characteristics. Recombining contiguous subdivisions that have become homogeneous should be done annually.

Computational Elements

Item 26 -- 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 F-1 to F-3.

Item 27 -- Expansion Factor (Length = 6 -- xxx.xxx -- implied decimal)

Enter the factor to the nearest one-thousandth.

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

Expansion Factor = Total miles in the Volume Group / Sampled miles in the 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 thousandth. For urbanized areas, code the expansion factor for the volume group within the functional system and individual urbanized area or grouped urbanized areas to which the section belongs.

If, for any reason, the expansion factor for a given group exceeds 100.000, additional sections in the volume group must be selected for sampling until the expansion factor is reduced to a maximum of 100.000.

Item 27 (Cont.)

It should be stressed that the same expansion factor is used for all sample sections in the same volume group of a functional system (except for Interstate subcategories which are considered separately -- see Appendix H), and that it is normally calculated and encoded by software. A tabular summary of expansion factors by volume group within each functional system and geographic area will be prepared by the State and submitted along with the required data. HPMS Submittal Software (SELEXPF option) will create the required table; this action is preferred by FHWA. However, if a State chooses to develop its own expansion factor table, the computer generated tables must still be executed to ensure that multiple expansion factors do not exist and that reported values are correct. 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.			
Urban, etc.			

Pavement Attributes

Item 28 -- Surface/Pavement Type (Length = 2)

Enter the code that represents the type of surface on the section. These codes are consistent with the Financial Management Information System (FMIS).

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 road. The road may have been bladed and minor improvements may have been made locally. (Unpaved)
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. It is 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. (Unpaved)
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 also be stabilized. (Unpaved)
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. (Low Type)
52	Mixed Bituminous -- A road, the surface course of which is 1 inch or greater and less than 7 inches in compacted thickness composed of gravel, stone, sand or similar material, and mixed with bituminous material under partial control as to grading and proportions. (Intermediate Type)
53	Bituminous Penetration -- A road, the surface course of which is 1 inch or greater and less than 7 inches in compacted thickness composed of gravel, stone, sand or similar material, bound with bituminous penetration material. (Intermediate Type)
61	High Flexible -- Mixed bituminous or bituminous penetration road on a flexible base with a combined (surface and base) thickness of 7 inches or more. Includes any bituminous concrete, sheet asphalt or rock asphalt having a high load-bearing capacity. (High Type Flexible)

Item 28 (Cont.)

62 Composite; Flexible over Rigid -- Mixed bituminous or bituminous penetration road on a rigid pavement with a combined (surface and base) thickness of 7 inches or more. Includes any bituminous concrete, sheet asphalt or rock asphalt overlay that is greater than 1 inch of compacted bituminous material. Otherwise, use rigid pavement codes. (High Type Flexible)

NOTE: If applicable, codes 74, 75 and 76 have priority over other rigid surface type codes.

71 High Rigid; Plain Jointed -- Portland cement concrete pavement that is jointed but is without reinforcing. (High Type Rigid)

72 High Rigid; Reinforced Jointed -- Reinforced (with mesh or equivalent) portland cement concrete pavement that has been jointed. (High Type Rigid)

73 High Rigid; Continuously Reinforced -- Continuously reinforced portland cement concrete pavement. (High Type Rigid)

74 Rigid over Rigid; Bonded or Partially Bonded -- Portland Cement concrete pavement over a portland cement concrete pavement where the two separate layers have been bonded. (High Type Rigid)

75 Rigid over Rigid; Unbonded (i.e., bond breaker used) -- Portland cement concrete pavement over a portland cement concrete pavement where the two separate layers are unbonded. (High Type Rigid)

76 Rigid over Flexible -- Portland cement concrete pavements that have been placed over a bituminous (mixed or penetration) pavement. (High Type Rigid)

80 Brick, Block or Other 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. (High Type Flexible)

Item 29 -- Concrete Joint Spacing (Length = 2)

This item is required for Interstate, Other Freeways and Expressways and Other Principal Arterials. Enter the joint spacing to the nearest foot. Code the leading zero where necessary. If there is no jointing or the surface type is not portland cement concrete, code "00". A weighted average is to be coded where the joint spacing is variable. Only the surface layer is to be considered. Construction joints (used primarily for continuously reinforced concrete pavements) are not to be considered. The intent of this item is to obtain a measure for all intentionally formed joints.

Item 30 -- Load Transfer Devices (including dowel bars) (Length = 1)

Enter the code to indicate whether or not load transfer devices (including dowel bars) have been used in jointed portland cement concrete pavements. This item is required for Interstate, Other Freeways and Expressways and Other Principal Arterials. Only the surface layer is to be considered. Code "0" where this item is not applicable due to functional system or to surface type. Continuously reinforced Portland cement concrete surfaces would normally be jointless (except for contruction joints) -- code "0" to indicate non-applicability.

Code	Description
1	No load transfer devices have been used.
2	Load transfer devices have been used.

Item 31 -- 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 enter the code for the type of pavement section (heavy, medium, light) where SN or D are not reported. The SN or D, as appropriate, are required for Interstate, Other Freeways and Expressways and Other Principal Arterials. Where available, code SN or D for all functional systems. A roadway with at least 1 inch of compacted flexible overlay (disregarding short patches) is considered a flexible pavement for purposes of this code.

To assist in determining the type of pavement section for those sections where SN or D, as appropriate, are not required or are not available, Table IV-2 has been prepared showing typical pavement sections. This guide includes typical thicknesses of surface, base and subbase. Unpaved facilities are those designated as unimproved, graded and drained earth, gravel or stone (codes 20/30/40 in Item 28).

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

Item 31 (Cont.)

Table IV-2

Pavement Section Coding

Code	Type of Section	Flexible Pavement "SN" Range	Surface Type & Min. Thick.	Base Type & Min. Thick.	Subbase Type & Min. Thick.	Rigid Pavement Range in Pavement Thickness "D"
3	Heavy	4.6-6.0	6" Asphaltic Concrete - - - - - - - - or - - - - - - - 4" Asphaltic Concrete	12" Aggregate 8" Asphaltic Concrete	13" Aggregate 8" Aggregate	> 9.0" (8" if continuously reinforced)
4	Medium	3.1-4.5	4" Asphaltic Concrete - - - - - - - - or - - - - - - - 3" Asphaltic Concrete	8" Aggregate 6" Asphaltic Concrete	8" Aggregate	7.1 - 9.0" (6" if continuously reinforced)
5	Light	1.0-3.0	Surface Treatment - - - - - - - - or - - - - - - - 2" Asphaltic Concrete	4" Aggregate 6" Aggregate	4" Aggregate	6.0 - 7.0"

Item 32 -- Structural Number (SN) or Slab Thickness (D) (Length = 2)

This item is required for Interstate, Other Freeways and Expressways and Other Principal Arterials. Where available, code SN or D for all functional systems. Enter the SN value to the nearest tenth (x.x -- implied decimal) for those sections coded "1" in Item 31. Enter D (in inches) for those sections coded "2" in Item 31. Otherwise code "00".

Item 33 -- Type of Base (Length = 1)

This item is required for Interstate, Other Freeways and Expressways and Other Principal Arterials. Enter the code that describes the type of base. Use the highest numerical code where a mixture of materials have been used. Code "0" where this item is not applicable due to functional system requirements. The codes used for this item are consistent with the Financial Management Information System (FMIS) coding scheme. HPMS code "3" includes all stabilized FMIS codes of "3" to "7".

Code	Description
1	Roadbed Soil.
2	Granular Material.
3	Stabilized earth or granular material with admixture (cement, lime, fly ash, asphalt, etc.)
5	Not applicable due to raised roadway (causeway, bridge deck, etc.)
8	Hot mix asphalt.
9	Lean concrete.

Item 34 -- Type of Subgrade (Length = 1)

Enter the code that describes the type of material used for the subgrade on the section. This item is required for Interstate, Other Freeways and Expressways and Other Principal Arterials. Code "0" where this item is not applicable due to functional system requirements.

Code	Description
1	Coarse graded material (gravel, sand, etc.)
2	Fine graded material (original earth, clay, etc).
5	Not applicable due to raised roadway (causeway, bridge deck, etc.)

Item 35 -- Subsurface Drainage (Length = 1)

Enter the code that describes the subsurface drainage provided on the section for all Interstate, Other Freeways and Expressways and Other Principal Arterial sections. Code "0" where this item is not applicable due to functional system requirements. These codes are consistent with the Financial Information Management System (FMIS). The intent of this item is to obtain information about base drainage and edge drains, specifically. Ignore other types of drainage systems for HPMS purposes.

Code	Description
1	Dense (undrainable) base without edge drains (i.e., no subsurface drainage).
2	Dense (undrainable) base with edge drains.
3	Drainable base without edge drains.
4	Drainable base with edge drains.
5	Not applicable due to raised roadway (causeway, bridge deck, etc.)

In the situation where edge drains no longer function, use "without edge drains" codes.

Item 36 -- Measured Pavement Roughness (Length = 3)

Zero-fill for unpaved roadways.

This item is required for all paved rural arterials and urban Interstate and other freeways and expressways. It is suggested for all other paved sample sections (see Table IV-3). Enter the actual calibrated roughness measurement to the nearest inch per mile. Provide leading zeroes for measurements less than "100". Enter "000" when not reported.

Appendix J contains requirements and references pertaining to equipment, calibration/correlation and data collection procedures. Note that calibration and data collection activities are to be conducted during stable pavement and weather conditions (no frost heave, freeze/thaw, wet conditions, etc.).

Table IV-3

Roughness Reporting Requirements

Functional System	Roughness
Rural:	
Interstate	Required
Other Principal Arterial	Required
Minor Arterial	Required
Major Collector	Suggested
Minor Collector	Suggested
Urban:	
Interstate	Required
Other Fwys and Exprswys	Required
Other Principal Arterial	Suggested
Minor Arterial	Suggested
Collector	Suggested

Item 37 -- Reserved for Federal Use (Length = 12)

This field shall be zero-filled when not using the HPMS Submittal Software to update and maintain the data. The HPMS software will zero-fill, otherwise.

Item 38 -- Pavement Condition (Length = 2 -- x.x -- implied decimal)

Enter the pavement condition, actual Present Serviceability Rating (PSR) or equivalent, to the nearest tenth, for all paved sections. For unpaved sections (defined in Item 31), 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. Where different lanes have different pavement condition ratings, code the worst condition.

Item 38 (Cont.)

Table IV-4

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 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 affect the speed of free-flow traffic. Flexible pavement may have large potholes and deep cracks. Distress includes ravelling, cracking, rutting, and occurs over 50 percent or more of the surface. Rigid pavement distress includes joint spalling, faulting, patching, cracking, scaling, and may include pumping and faulting.
1.0	
Very Poor	Pavements that are in an extremely deteriorated condition. The facility is passable only at reduced speeds, and with considerable ride discomfort. Large potholes and deep cracks exist. Distress occurs over 75 percent or more of the surface.
0.0	

Item 39 -- Overlay or Pavement Thickness (Length = 3 -- xx.x -- implied decimal)

Enter the overlay pavement thickness or the pavement thickness (for new pavements) to the nearest tenth (in inches) when an improvement has been completed on the section. This item is intended to be coded when resurfacing is accomplished as part of any improvement or when the pavement is completely reconstructed. It shall remain fixed (retained in the HPMS data record) until another resurfacing/reconstruction improvement is completed on the section. Code "000" initially.

All Type of Improvement codes (Item 41), with the possible exception of "40", "50" and "60" (Major or Minor Widening and Restoration and Rehabilitation), would cause a change to this item (or the initial coding of this item). When this item is changed (or initially coded), Item 40, Year of Surface Improvement, should also be changed.

The thickness reported here should include all newly laid pavement including replacement pavement material where milling has occurred.

Improvements

Item 40 -- Year of Surface Improvement (Length = 4)

Enter the year when a surface improvement (e.g., resurfacing or reconstruction, including new samples selected on newly constructed or improved roadway facilities) has been completed on the section; e.g., 1988 would be coded "1988". Do not remove this entry in subsequent data years (it shall be retained in the HPMS data record until another improvement affecting the surface is completed on the section). Initially, (for existing non-improved sections) this field should be coded "0000".

All Type of Improvement codes (Item 41), with the possible exception of "40", "50" and "60" (Major or Minor Widening and Restoration and Rehabilitation), would cause a change to this item (or the initial coding of this item). If this field is changed (or initially coded), check to see if Item 39, Overlay or Pavement Thickness, should also be changed.

Item 41 -- Type of Improvement (Length = 2)

This item is coded as defined below for all improvements completed during the reporting year. If completed improvements overlap, use the improvement type code with the highest priority (lowest numerical code). If no improvements were completed during the reporting year, the section shall retain the last improvement type coded. Do not include routine maintenance. Code "00", initially. The codes are consistent with the Financial Management Information System (FMIS), but contain an extra digit in some instances, and are somewhat more elaborate in other cases.

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 at the point(s) of change. Use one of the following codes:

Item 41 (Cont.)

Code — Improvement Type Definitions

10 NEW ROUTE -- The only time this code could possibly be used is when a new sample has been randomly chosen on a newly constructed roadway that was completed and opened to traffic in the data year being reported.

20 RELOCATION -- Construction of a facility on new location that replaces an existing route to the extent that the old route is abandoned. If the existing facility remains in use as a collector or higher functional system, do not code the improvement and retain the old facility as the sample with no improvement (unless the old facility was also improved). If the existing facility is abandoned, the sample should be placed (selected) on the new facility and coded with this improvement type; if the existing location becomes a local functional system facility, delete the sample.

RECONSTRUCTION -- Construction on approximate alignment of an existing route where the pavement structure is substantially removed and replaced. Such reconstruction may include widening to provide additional through lanes, adding grade separations, and replacing other highway elements. Adjustment to existing horizontal and vertical alignment can be made. Code one of the following types of reconstruction (Codes 31 to 35). The last digit of each code corresponds to the FMIS codes.

31 RECONSTRUCTION TO FREEWAY -- Complete reconstruction to freeway design standards on substantially existing alignment. This improvement type always includes the addition of full control of access. It may include the addition of through lanes, dualizing, addition of interchanges or grade separations, or widening of through lanes, depending on what was required to bring the facility to freeway standards.

32 RECONSTRUCTION WITH MORE LANES -- Complete reconstruction on substantially the same alignment with the addition of through lanes to the existing section. Alignment, shoulder, and drainage deficiencies are corrected.

33 RECONSTRUCTION TO WIDER LANES -- Complete reconstruction on substantially the same alignment with through lanes at least one foot wider than the existing section. Alignment, shoulder, and drainage deficiencies are corrected.

34 PAVEMENT RECONSTRUCTION WITH ALIGNMENT IMPROVEMENTS -- Reconstruction of the highway section to correct a pavement deficiency. Specific horizontal or vertical alignment deficiencies are also corrected.

35 PAVEMENT RECONSTRUCTION -- Complete reconstruction on substantially the same alignment without widening the pavement structure. Drainage deficiencies and minor alignment deficiencies are corrected.

Item 41 (Cont.)

Code	Improvement Type Definitions
40	MAJOR WIDENING -- The addition of through 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.
50	MINOR WIDENING -- The addition of more width per through lane to the roadway of an existing facility without adding through lanes. The existing pavement is salvaged. In many cases, the improvement will include resurfacing the existing pavement and other incidental improvements such as shoulder and drainage improvements.
60	RESTORATION AND REHABILITATION -- Work required to return an existing pavement (including shoulders) to a condition of adequate structural support or to a condition adequate for placement of an additional stage of construction. 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 stabilization prior to resurfacing; grinding/grooving of rigid pavements; replacing deteriorated materials; reworking or strengthening bases or subbases, and adding underdrains. If this type of improvement is done in preparation for resurfacing, it should be reported separately only if the resurfacing is not completed in the year for which the data is reported. This HPMS code would include FMIS Type of Rehabilitation codes of "01" and "02" (subsealing, joint repair, diamond grinding, milling, inlays, etc.)
71	RESURFACING WITH SHOULDER IMPROVEMENTS AND PORTLAND CEMENT CONCRETE PAVEMENT RESTORATION -- Placement of additional portland cement concrete material over the existing roadway to improve serviceability or to provide additional strength. Shoulders are widened or reconstructed to provide additional strength. There may be some upgrading of unsafe features and other incidental work. This code should also be used when concrete restoration includes techniques such as sub-sealing, joint repair, diamond grinding, etc. 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 ---relocation, reconstruction, minor widening, etc.
72	RESURFACING WITH SHOULDER IMPROVEMENTS AND BITUMINOUS PAVEMENT RESTORATION -- Placement of at least 1 inch of compacted bituminous material over the existing roadway to improve serviceability or to provide additional strength. Shoulders are widened or reconstructed to provide additional strength. There may be some upgrading of unsafe features and other incidental work. 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 --- relocation, reconstruction, minor widening, etc.

Item 41 (Cont.)

Code	Improvement Type Definitions
77	RESURFACING WITH PORTLAND CEMENT CONCRETE PAVEMENT RESTORATION -- Placement of additional portland cement concrete material over the existing roadway to improve serviceability or to provide additional strength. There may be some upgrading of unsafe features and other incidental work in conjunction with resurfacing. This code should also be used when concrete restoration includes techniques such as sub-sealing, joint repair, diamond grinding, etc. 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 -- relocation, reconstruction, minor widening, etc.
78	RESURFACING WITH BITUMINOUS PAVEMENT RESTORATION -- Placement of at least 1 inch of compacted bituminous material over the existing roadway to improve serviceability or to provide additional strength. There may be some 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 --- relocation, reconstruction, minor widening, etc.

Geometrics/Configuration

Item 42 -- 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 and by prohibiting direct driveway connections.
2	Partial Access Control -- Preference has been given to through traffic movement. In addition to possible interchanges, there may be some crossings at-grade with public roads, but direct private driveway connections have been minimized through the use of frontage roads or other local access restrictions.
3	No Access Control. For HPMS purposes, this code includes all sections that do not meet the criteria for the above codes.

GENERAL GUIDELINES for coding Number of Through Lanes (Item 22), Lane Width (Item 43), Shoulder Type (Item 44), Shoulder Width (Item 45) and Peak Parking (Item 65)

All of these data items need to be considered together in order to properly code them for HPMS. The normal descriptions are given under the respective data item. This section simply provides some additional guidelines where the coding of one item depends on one of the other items.

The number of through lanes and the lane width should be coded according to the striping, if present, or according to the usage if no striping or only centerline striping is present. The roadway beyond the ends of the sample section being inventoried may be considered when the number of lanes and the lane width, in particular, are being coded. For example, if the sample section is short and atypically wider than the rest of the contiguous roadway, code the typical roadway usage according to the rest of the roadway for these two data items.

Shoulder width (or lane width) cannot include parking lanes, bicycle lanes or bikeways. There is no shoulder (or shoulder width) under these circumstances. If there is parking on one side of a roadway and a shoulder or a curb on the other side, code both parking and shoulder type (and shoulder width), accordingly.

A shoulder cannot exist between a traffic lane and a parking lane that is completely within the roadway boundaries. Code no shoulder and zero (00) shoulder width under this circumstance. Code the lane width as it is actually being used.

As with all HPMS data items, code the lesser or worse condition where the two sides of the roadway differ.

It is recognized that the total roadway width may not be fully represented under a few of the coding schemes that would develop under these guidelines. Under these situations, the "lost" roadway area is considered to be for acceleration/deceleration, parking movement, driveway turning, weaving, etc., for which there are no data items in HPMS.

total roadway width

Item 43 -- Lane Width (Length = 2)

Enter the prevailing traffic lane width (through lanes) to the nearest foot. Provide the leading zero for lane widths less than 10 feet. There are situations where the traffic lane and the shoulder have the same surface with no delineation to distinguish the lane from the shoulder. In such cases, use a reasonable width for each based on the actual width used by traffic. For example, a 32-foot total paved surface width with centerline striping only and no additional shoulder width, could be coded as 12-foot lanes with 4-foot shoulders. See the "GENERAL GUIDELINES", above, for further coding applications.

In some situations, striping is placed inside the edge of the pavement in order to keep traffic (particularly trucks) from raveling the edge. Ignore the striping and code the actual lane width under this situation. For example, a 2-lane roadway that contains a solid stripe one foot inside the edge of the roadway (to the left of the right shoulder), having a width from centerline to edge-striping of 11 feet, should be coded as 12 feet.

Item 44 -- Shoulder Type (Length = 1)

Enter the code for the predominant type of shoulder on the section. If left and right shoulder types differ on a multilane facility, the right shoulder type should 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 shoulder. See the "GENERAL GUIDELINES" above Item 43, Lane Width, for further coding applications. These codes are consistent with the Financial Management Information System (FMIS).

Code	Description
1	None -- No shoulders or curbs exist.
2	Surfaced with Bituminous Material -- A bituminous course over a granular or stabilized base.
3	Surfaced with Portland Cement Concrete (not tied) -- A portland cement concrete course over a granular or stabilized base.
4	Surfaced with Tied Portland Cement Concrete -- A portland cement concrete course over a granular or stabilized base that is part of the mainline pavement.
5	Stabilized -- A gravel or other granular material, with or without admixture, capable of supporting most loads even under wet conditions.
6	Combination -- A part of the shoulder width is surfaced and/or a part is stabilized, and/or a part is turf, etc. -- some combination of codes 2-5, 7.
7	Earth -- Natural earth with or without turf.
8	Curbed -- No shoulders exist; section is curbed.

Item 45 -- Shoulder Width (Length = 4)

45a -- Right Shoulder -- Enter the width to the nearest foot. Enter "00" if no right shoulder exists. (Length =2)

45b -- Left Shoulder -- On divided highways, enter the width of the left (median) shoulder to the nearest foot. Enter "00" where no left shoulder exists. (Length = 2)

Do not include parking or bicycle lanes. Use the predominant width where it is not constant. Particular attention should be paid to "combination" shoulders to ensure that the total width is being reported. See the "GENERAL GUIDELINES" above Item 43, Lane Width, for further coding applications.

Item 46 -- Median Type (Length = 1)

Enter one of the following codes:

Code	Description
1	Curbed
2	Positive Barrier
3	Unprotected
4	None

A positive barrier would normally consist of guard-rail or concrete, but could consist of a line of closely-spaced (large) trees or of thick, impenetrable shrubbery on most of the section. Turning lanes or bays are not considered medians unless a median exists on the major portion of the roadway, and the turning lanes/bays are cut into the median at intersections, entrances to commercial enterprises, etc.

Item 47 -- 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 foot. Enter "00" for undivided roadways. Enter "99" where the median width is 100 feet or greater. Ignore turning bays cut into the median.

Item 48 -- Existing Right-of-Way Width (Length = 3)

Enter the prevailing right-of-way width in feet for the section. Where data are unavailable, estimates are sufficient. In heavily built up areas such as the CBD where the only space between the curbs and buildings is the sidewalk area, enter the curb-to-curb width. Code "999" where the right-of-way is 1000 feet or greater. Provide leading zeroes, where necessary.

Item 49 -- 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 numerous large buildings, severe terrain, cemeteries and park land; do not consider restrictions because of current right-of-way width, State practices concerning widening, politics or projected traffic. Single-family residences, barns, private garages, etc. are considered expendable for purposes of this item. Office buildings, shopping centers and other large enterprises would not be considered expendable. The code is to represent the lanes that could be added in both directions, e.g. if a lane could be added for each direction of the roadway, then use code "4"; if only some widening could occur (a few feet, perhaps), use code "2".

Restriping to narrower lanes, such that an additional lane results in a multilane facility, does not constitute widening feasibility. When coding this item, medians and other areas already within (as well as outside) the right-of-way are considered to be available for widening.

Code	Description
1	No widening is feasible
2	Yes, partial lane
3	Yes, one lane
4	Yes, two lanes
5	Yes, three lanes or more

Items 50-53 -- Coding Guide for Horizontal and Vertical Alignment

Table IV-5

Highway Category	Item 50- Horizontal Alignment Adequacy	Item 51- Curves by Class	Item 52- Vertical Alignment Adequacy	Item 53- 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 50 -- Horizontal Alignment Adequacy (Rural only) (Length = 1)

This item is required for paved rural collectors unless Item 51, Curves by Class, is present. (See Table IV-5, above.) Code "0" when Item 51 is reported (the HPMS calculation software will insert an appropriate value) or when this item is not required. If Item 51 is not reported for the required systems (rural arterials and urban principal arterials) this item should be appropriately coded. The following codes will be used:

Code	Description
1	All curves meet appropriate design standards for the type of roadway. 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 the section is severely restricted due to the design speed of curves.

Item 51 -- Curves by Class (Length = 91)

This item is required for paved rural arterials (Interstate, other principal arterial and minor arterial) and urban principal arterials (Interstate, other freeways and expressways and other principal arterial), but may be reported for other functional systems if the data are available. (See Table IV-5, above.) Zero-fill this item when it is not reported. When this item is not reported for the required systems, Item 50, Horizontal Alignment Adequacy should be coded. The following data will be reported:

	Curve Classes by Degree of Curvature	No. of Curves (right-justified)	Record Positions	Length of Curves in Class (implied decimal) (xx.xxx miles)	Record Positions
a.	0.0-0.4	--	238-239	-----	240-244
b.	0.5-1.4	--	245-246	-----	247-251
c.	1.5-2.4	--	252-253	-----	254-258
d.	2.5-3.4	--	259-260	-----	261-265
e.	3.5-4.4	--	266-267	-----	268-272
f.	4.5-5.4	--	273-274	-----	275-279
g.	5.5-6.9	--	280-281	-----	282-286
h.	7.0-8.4	--	287-288	-----	289-293
i.	8.5-10.9	--	294-295	-----	296-300
j.	11.0-13.9	--	301-302	-----	303-307
k.	14.0-19.4	--	308-309	-----	310-314
l.	19.5-27.9	--	315-316	-----	317-321
m.	28+	--	322-323	-----	324-328

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

Item 52 -- Vertical Alignment Adequacy (Rural only) (Length = 1)

This item is required for paved rural collectors unless Item 53, Grades by Class, is present. (See Table IV-5, above.) Code "0" when Item 53 is reported (the HPMS calculation software will insert an appropriate value) or when this item is not required. If Item 53 is not reported for the required systems (rural arterials and urban principal arterials) this item should be appropriately coded. 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 (when truck climbing lanes are not provided).
4	Frequent grades and vertical curves that impair sight distance and/or severely affect the speed of trucks; truck climbing lanes are not provided.

Item 53 -- Grades by Class (Length = 42)

This item is required for paved rural arterials (Interstate, other principal arterial and minor arterial) and urban principal arterials (Interstate, other freeways and expressways and other principal arterial), but may be reported for other functional systems if the data are available. (See Table IV-5, above.) Zero-fill this item when it is not reported. When this item is not reported for the required systems, Item 52, Vertical Alignment Adequacy should be coded. The following data will be reported:

	Grade Classes by Gradient (percent)	No. of Grades (Right-Justified)	Record Positions	Length of Grades in Class (implied decimal) (xx.xxx miles)	Record Positions
a.	0.0-0.4	--	330-331	-----	332-336
b.	0.5-2.4	--	337-338	-----	339-343
c.	2.5-4.4	--	344-345	-----	346-350
d.	4.5-6.4	--	351-352	-----	353-357
e.	6.5-8.4	--	358-359	-----	360-364
f.	8.5 +	--	365-366	-----	367-371

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

Item 54 -- Percent of Length with Sight Distance of 1500 Feet (Rural, paved 2-lane facilities only) (Length = 3)

For all rural, paved 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. Striping should be used for this measurement where it delineates unsafe passing zones. Contiguous roadway on both ends of the section are to be considered in estimating this item, particularly where the section is very short (i.e., 1500 feet = .28 mile). Where there is a discernable directional difference, enter the more restrictive sight distance percentage. See Appendix C for optional estimating procedures. Code "000" for nonapplicable sections including dense rural.

Traffic/Capacity

Item 55 -- Speed Limit (Length = 2)

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

Item 56 -- Weighted Design Speed (Rural only) (Length = 2)

This item is required for all paved rural collectors with type of development -- rural (Item 71 = 1). Code "00" for all sections for which the weighted design speed is not supplied. Enter the weighted design speed, to the nearest 5 m.p.h., as determined by weighting the design speed of the individual horizontal curves and tangents in the section by the length of each. This item is calculated by the HPMS Submittal Software when Curves by Class (Item 51) are present. When Curves by Class are not provided for the required systems (rural arterials and urban principal arterials), this item must be appropriately coded. A recommended procedure for calculating weighted design speed is contained in Appendix D.

Item 57 -- Percent Commercial Vehicles (Peak and Off-Peak) (Length = 4)

Enter the percentage of commercial vehicles to the nearest whole percent. Commercial vehicles include classes 4 through 13 (buses through seven-or more axle, multi-trailer trucks) as identified in Chapter II and in the Traffic Monitoring Guide (TMG). These vehicle classes are discussed in Chapter 3 of the TMG, and exclude pickups, panels, etc.

Certain routes may exibit significant differences in commercial vehicle percentages between peak and non-peak hour operation (i.e., recreational routes), and such differences can have a significant bearing on the calculation of capacity. In those cases where the State determines that such peak operations have a significant bearing on capacity calculations, separate peak usage values are to be reported even if they must be estimated. In those situations where such differences are known not to exist, the same percentage should be reported for both peak and non-peak.

The vehicle classification data reported for each sample section should be representative of the commercial vehicle activity over all days of the week and seasons of the year.

57a -- Peak Percent Commercial Vehicles (Length = 2)

57b -- Off-Peak Percent Commercial Vehicles (Length = 2)

Item 58 -- 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 percent.

Item 59 -- 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. Provide leading zeroes, where necessary.

Item 60 -- Peak Capacity (Length = 5)

Urban Areas

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 1985 "Highway Capacity Manual" (HCM) should be used for these calculations. For purposes of this data element, a service flow consistent with Level of Service "E" as defined in the 1985 HCM should be calculated.

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.

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 flow at Level of Service "E", as described in the 1985 HCM. The procedures described in the HCM should be used for this calculation; however, the rural capacity is normally calculated by the HPMS Submittal Software (see Chapter VI under the SELCALC option).

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 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. It is requested that a capacity for dense rural sections be coded as it is very difficult to calculate a reasonable value based on the data reported.

This field should be zero filled when not reported.

The procedures used by the HPMS Submittal Software to calculate rural capacity are given in Appendix L.

Item 61 -- Volume/Service Flow Ratio (V/SF) (Length = 3 -- x.xx -- implied decimal)

This field is generated by the HPMS Submittal Software from data within the HPMS record. Appendix M contains the formulas.

Item 62 -- Turning Lanes (Urban Data Item) (Length = 2)

Enter the code (one each for left and right) that best describes the peak-period turning lane situation for a typical intersection on the section. Where peak capacity (Item 60) has been entered for a particular (critical) intersection, code the turning lanes at that intersection; otherwise code for a typical intersection. Ignore turning lanes/bays that are not located at intersections (at commercial entrances, for instance). Code "0" for rural sections or when no intersections exist on the section.

LEFT Turning Lanes/Bays (Length = 1)

Code	Description
1	Multiple left turning lanes/bays exist (includes a continuous left turning lane that becomes multiple left turn bays just prior to the intersection). Through movements are prohibited in these lanes.
2	A continuous left turning lane exists from intersection to intersection. Through movements are prohibited in this lane.
3	A single left turning bay exists.
4	No left turning lanes/bays exist (intersections do exist).
5	No left turns are permitted during the peak period.

RIGHT Turning Lanes/Bays (Length = 1)

Code	Description
1	Multiple right turning lanes/bays exist (includes a continuous right turning lane that becomes multiple right turn bays just prior to the intersection). Through movements are prohibited in these lanes.
2	A continuous right turning lane exists from intersection to intersection. Through movements are prohibited in this lane.
3	A single right turning bay exists.
4	No right turning lanes/bays exist (intersections do exist).
5	No right turns are permitted during the peak period.

Examples:
(1) A critical intersection with signals on a section contains 2 left turn lanes and a right turn bay; code "13".
(2) No signal controlled intersections exist on a section with 3 intersections. One of the intersections has a turn bay for right turns; however, the capacity entered in Item 60 did not take the right turn bay into consideration. The code would be "44" for the section.

Item 63 -- Prevailing Type of Signalization (Urban Data Item)
(Length = 1)

Enter the appropriate code that best describes the predominant signal system on the section. Code "0" for rural sections.

Code	Description
1	Uncoordinated Fixed Time (includes pre-programmed changes for rush hour or other time periods)
2	Traffic Actuated
3	Progressive (coordinated signals)
4	No Signal System

Item 64 -- Typical Peak Percent Green Time (Urban Data Item)
(Length = 2)

Enter the typical percent green time in effect during peak hours at the signalized intersections for the route which is being inventoried. Enter "00" if no signalized intersections exist. Where signals are traffic actuated, code an estimated average green time during peak hours. Ignore green-arrow time for turning movements -- this item is intended to obtain through movement green time. Code "00" for rural sections.

Item 65 -- Peak Parking (Urban Data Item) (Length = 1)

Enter the appropriate code reflecting the type of peak-hour parking, if any, that exists on the section. If parking prohibitions are routinely ignored, use the "permitted" code(s) to reflect the actual situation rather than the regulations. The facility does not have to be formally signed or striped for parking to use the "permitted" code(s) (i.e., parking is simply available). If parking is actually beyond the shoulder (or beyond the pavement edge where no shoulder exists), use code "3" for no parking. Code "0" for rural sections. See the "GENERAL GUIDELINES above Item 43, Lane Width, for further coding applications.

Code	Description
1	Parking permitted one side
2	Parking permitted both sides
3	No parking allowed or none available

Item 66 -- Future AADT (Length = 6)

Enter the forecasted annual average daily traffic (AADT) (total both directions) for the appropriate year entered in Item 67, Year of Future AADT. This cannot be for less than 17 years nor for more than 22 years. The intent is to obtain a 20-year forecast, but it may be for some other period of time that is within the noted timespan. For example, the future AADT may be for any of the years 2006 to 2011 for the 1989 data year to be reported in 1990. This item may be updated anytime, but must be updated when the forecast falls below the 17-year limit.

Item 67 -- Year of Future AADT (Length = 2)

Enter the last two digits of the year for which Item 66, Future AADT has been forecasted. This cannot be less than 17 years nor more than 22 years from the data year. For example, a 20-year forecast reported for the 1989 data year would be coded "09" (for the year, 2009).

Environment

Item 68 -- General Climate Zone (Length = 2)

This code is entered by the HPMS Submittal Software via the SELCALC option with the CZONE suboption from county/climate zone equivalency tables. It should be checked by the State and may be changed if found not to be representative of the area in question. Once corrected, there should be no further need for change except under extraordinary situations. Note that if the county code is changed using the SELMODU option, the climate zone will be updated, if necessary, by the HPMS Submittal Software. If county codes are updated via a State procedure, the climate zone should be updated via the SELCALC option. The definitions for the 9 possible climate zones are contained in Appendix S.

Item 69 -- 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 for the type of roadway 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 70 -- Type of Terrain (Rural Data Item) (Length = 1)

Enter the code for the predominant terrain type through which the section passes. Code "0" for urban sections.

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 71 -- Type of Development (Rural Data Item) (Length = 1)

Enter the code for the predominant type of development. Code "0" for urban sections.

Code	Description
1	Rural -- All areas outside of Federal-aid urban boundaries (places 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 72 -- Urban Location (Urban Data Item) (Length = 1)

Enter the appropriate code that best reflects present land use in the area adjacent to the section. If an area appears to fit two of these categories, the code for the higher density of development should be used (lower numerical code). Code "0" for rural sections.

Code	Description
1	Central Business District (CBD) -- That portion of a municipality in which the dominant land use is for intense business activity. The CBD is characterized by large numbers of pedestrians, commercial vehicle loadings of goods and people, a heavy demand for parking space, and high parking turnover.
2	Fringe -- That portion of a municipality immediately outside the CBD in which there is a wide range in type of business activity, generally including small businesses, light industry, warehousing, automobile service activities, and intermediate strip development, as well as some concentrated residential areas. Most of the traffic in this area involves trips that do not have an origin or destination within the area. This area is characterized by moderate pedestrian traffic and a lower parking turnover than is found in the CBD, but may include large parking areas serving that district.
3	Outlying Business District -- That portion of a municipality or an area within the influence of a municipality, normally separated by some distance from the CBD and its fringe area, and in which the principal land use is for business activity. This district has its own local traffic circulation superimposed on through movements to and from the CBD, a relatively high parking demand and turnover, and moderate pedestrian traffic. Compact off-street shopping developments entirely on one side of the street are not included in the scope of this definition.
4	Residential -- That portion of a municipality, or an area within the influence of a municipality, in which the dominant land use is residential development, but where small businesses may be included. This area is characterized by few pedestrians and a low parking turnover.
5	Rural in character.

Item 73 -- Number of Grade-Separated Interchanges (Length = 2)

For all freeway and expressway facilities enter the number of grade-separated interchanges. If a section begins and ends with an interchange, only one of the interchanges is counted. The direction of inventory should always be consistent, statewide, (i.e., increasing milepoint or east to west or south to north, etc.) for all sections. Enter "00" if none exist or if the facility being sampled is not a freeway or an expressway.

An expressway is defined as a divided highway for through traffic with full or partial access control and including grade separations at all or most major intersections. A freeway is defined as an expressway with full control of access.

Item 74 -- 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 of the intersections is counted. The direction of inventory should always be consistent, statewide, (i.e., increasing milepoint or east to west or south to north, etc.) for all sections. Controls at shopping centers, industrial parks and other large traffic generating enterprises, should be included.

74a -- Signals -- Enter the number of intersections with a signal controlling the route being inventoried. 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)

74b -- Stop Signs -- Enter the number of intersections with a stop sign controlling the route being inventoried. A continuously-operating, flashing red signal shall be counted as a stop sign control. If none, code "00". (Length = 2)

74c -- Other or No Controls -- Enter the number of intersections where the route being inventoried is not controlled by either a signal or a stop sign -- or is controlled by other types of signing or has no controls. A continuously-operating, flashing yellow signal shall be considered as "other or no control". If none, code "00". (Length = 2)

Item 75 -- Number of Structures (Length = 2)

Enter the number of structures located within the section. Supply a leading zero where necessary. Include structures built over or under an obstruction such as water, highway, railway, pedestrian-way, depression, etc., and having a passageway for carrying traffic or other moving loads, and having a length measured along the centerline of the crossing of 20-or-more feet. Include structures that pass over the facility as well as those on the facility (except as noted below). Twin (side by side) structures are to be reported as two separate structures.

All highway grade-separated structures are to be reported only once, as part of the facility of highest functional system. If the higher type facility is not the sample, then the structure is not reported. If two sample 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. Ramps or collector/distributor roadways are not considered part of a mainline sample for this item, and structures on these facilities are not reported unless the ramp or collector/distributor actually passes over or under the sample.

For any structure included in this field, the corresponding structure identification number will be recorded in Item 77. 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 must be subdivided.

Item 76 -- Number of At-Grade Railroad Crossings (Length = 2)

Enter the number of at-grade railroad crossings on the section. Supply a leading zero where necessary. Multiple tracks should be reported as a single crossing. Exclude crossings on abandoned railroads. For any grade crossing in this field, the corresponding grade crossing identification number will be recorded in Item 78. 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 must 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 77 -- Structure Identification Numbers (Variable -- Length = 15 x Item 75)

For each structure reported in Item 75, the appropriate 15-digit unique structure identification number is coded from the "Bridge Inventory and Appraisal of the Nation's Bridges" (also referred to as the National Bridge Inventory or NBI). For example, if Item 75 = 03, 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.

The 15-digit structure ID's must be exactly the same as those in the NBI including embedded, leading or trailing blanks or zeroes.

Item 78 -- At-Grade Railroad Crossing Identification Numbers (Variable -- Length = 7 x Item 76)

For each at-grade railroad crossing reported in Item 76, the appropriate 7-digit railroad grade crossing ID is coded from the "National Railroad Highway Crossing Inventory." For example, if Item 76 = 02, this item will contain two railroad crossing ID fields, each 7-digits long, for a total of 14-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.

CHAPTER V

UPDATE PROCEDURES FOR UNIVERSE AND SAMPLE DATA

The two previous chapters discussed the basic requirements for the HPMS data and contained 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, pavement specialists and administrators. Using this information to develop performance-investment relationships, planners can assess the effectiveness of various highway programs, improvement strategies and future investments.

The HPMS has been designed to permit updating to be accomplished with a minimum of effort. For the sample sections, special care is recommended to establish internal State highway agency mechanisms to report changes that have taken place as they occur (normally to a State data base from which HPMS is extracted). States are encouraged to set up these ongoing mechanisms 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 are inefficient and disruptive.

It is essential that internal State coordination be established and maintained between the HPMS staff and that of the Pavement Management System (PMS). Such coordination should assure the efficient, dual use of the pavement data collected via the PMS. This is also true for other data collection efforts that are not contained within the same state office (traffic data, vehicle classification, improvements, etc.).

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 obtain national standardized data that will serve a variety of purposes. With little additional effort, it can be used to assess the effectiveness of pavement rehabilitation strategies and as input to other future studies that may become necessary.

All data are submitted annually in the record format outlined in Chapter IV. Data items are updated annually as changes occur or on a 2-year or 4-year cycle as indicated below. Note that Interstate and sample section AADT is to be updated annually (see Appendix K). Where a 2- or 4-year update cycle period is indicated, updated data will be reported in the odd years for the even years, e.g., pavement condition data representative of 1988 should be reported in 1989. The following presents the types of updates 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. (e.g., 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. (e.g., functional system)

I.C. "Improvement Change" refers to those items that can only change as a result of a capital improvement. (e.g., shoulder width)

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.

Data Item	Update Cycle
Identification	
1. State Use	C.A.N.
2. Year	Code the calendar year for which data applies i.e., 1988 data submitted in 1989 is coded "88".
3. State Code	N.C.P.
4. County Code	N.C.P.
5. 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 or special Censuses. New or revised urban area boundaries may necessitate rural/urban (R/U) code revisions for some sections. Several other items will require updating as a result of a change to this item.

Data Item	Update Cycle
Identification (Cont.)	
6. Urbanized 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.) Care must be taken to indicate whether an urbanized area is part of a collective urbanized area. (See Chapter IV.)
7. Type of Section/Grouped Data ID	C.A.N.
8. Section/Grouped Data ID	C.A.N.
System	
9. Functional System	C.A.N.
10. Generated Functional System Code	C.A.N.
11. Federal-aid System	C.A.N.
12. Federal-aid System Status	C.A.N.
13. Route Signing	C.A.N.
14. Route Number	C.A.N.
Jurisdiction	
15. Governmental Level of Control	C.A.N.
16. Special Systems	C.A.N.
Operation	
17. Type of Facility	C.A.N.
18. Designated Truck Route/Parkway	C.A.N.
19. Toll	C.A.N.

Data Item	Update Cycle
Other	
20. Section/Group Length	C.A.N. - Changes in length may occur because of construction, section subdivision or due to events such as jurisdictional changes.
21. AADT	AADT's on all Interstate sections and on all sample sections must be updated annually. Appendix K contains a discussion concerning traffic counting recommendations and the annual updating of AADT estimates.
22. No. of Through Lanes	I.C.
23. Record Continuation Code	C.A.N.

Sample Section Data

The sections sampled and inventoried must be maintained. As part of the updating process, data elements reported for the sample sections must be accurate and current. Data elements that are traffic related or that indicate changes in physical condition must be verified on a periodic basis. AADT, pavement roughness and PSR are the most critical data elements in this regard. Other data, such as type and year of improvement, 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 contained 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	
24. Sample Number	N.C.P. - This number is used for all subdivisions of the section, and never changes.
25. 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 (same) 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	
26. AADT Volume Group Identifier	C.A.N. - As AADT for a section changes, it may fall outside of the limits of its present assigned volume group.
27. Expansion Factor	C.A.N. - As sample or total mileage within volume groups changes, the expansion factor must be recalculated. This is normally redone prior to every submittal.

Data Item	Update Cycle
Pavement Attributes	
28. Surface/Pavement Type	I.C.
29. Concrete Joint Spacing	I.C.
30. Load Transfer Devices	I.C.
31. Pavement Section	I.C.
32. SN or Slab Thickness	I.C.
33. Type of Base	I.C.
34. Type of Subgrade	I.C.
35. Subsurface Drainage	4 Year or I.C.
36. Roughness	I.C. or 2 Year
37. Reserved for Federal Use	-----
38. Pavement Condition (PSR)	I.C. or 2 Year
39. Overlay or Pavement Thickness	I.C.
Improvements	
40. Year of Surface Improvement	I.C.
41. Type of Improvement	I.C.
Geometrics/Configuration	
42. Access Control	I.C.
43. Lane Width	I.C.
44. Shoulder Type	I.C.
45. Shoulder Width	I.C.
46. Median Type	I.C.
47. Median Width	I.C.
48. ROW Width	I.C.
49. Widening Feasibility	C.A.N.

Data Item	Update Cycle
Geometrics/Configuration, Cont.	
50. Horizontal Alignment Adequacy (Rural Only)	I.C.
51. Curves by Class	I.C.
52. Vertical Alignment Adequacy (Rural Only)	I.C.
53. Grades by Class	I.C.
54. Percent Passing Sight Distance (Rural Only)	I.C.
Traffic/Capacity	
55. Speed Limit	C.A.N.
56. Weighted Design Speed (Rural Only)	I.C.
57. Percent Commercial Vehicles (Peak and Off-peak)	2 Year
58. K-Factor	2 Year
59. Directional Factor	2 Year
60. Peak Capacity	C.A.N.
61. Volume/Service Flow (V/SF) Ratio	C.A.N.
62. Turning Lanes	I.C.
63. Prevailing Type Signalization (Urban Only)	C.A.N.
64. Typical Percent Green Time (Urban Only)	C.A.N.
65. Peak Parking (Urban Only)	C.A.N.
66. Future AADT	Revise target year such that the future AADT is in the range of not less than 17 years nor more than 22 years when compared to the current AADT.
67. Year of Future AADT	C.A.N.

Data Item	Update Cycle
Environment	
68. Climate Zone	N.C.P.
69. Drainage Adequacy	I.C. or 4 Year
70. Type of Terrain	N.C.P.
71. Type of Development	C.A.N.
72. Urban Location	C.A.N.
73. No. of Grade Separated Interchanges	I.C.
74. No. of At-Grade Intersections	I.C.
75. No. of Structures	I.C.
76. No. of At-Grade RR Crossings	I.C.
Supplemental Data	
77. Structure Identification Numbers	I.C.
78. At-Grade Railroad Crossing ID Numbers	I.C.

SAMPLE PANEL UPDATES

Each State must have panels of sample sections representing rural areas as a unit, small urban areas as a unit and urbanized areas in one of three possible ways:

1. Individually sampled as required in the initial HPMS implementation;

2. Grouped into one or more collective statewide panels similar to the rural and small urban panels (note that this method is no longer recommended); or

3. A combination of some individual urbanized areas and collective panel(s) for other areas. (Not recommended - see 2).

The option to group urbanized areas into one or more collective panels is discussed in Appendix H. States grouping urbanized areas for the first time should refer to Appendix H to establish the collective panel sample. Although the procedure is applicable to every State, only those States having a large number of urbanized areas will benefit significantly from it. It is recommended that the present individual area approach be maintained by any State where collective sampling will not significantly reduce the sample size.

The remainder of this chapter discusses the updating of rural, small urban, and previously established individual or collective urbanized area panels. Although the panels of sampled sections are to remain as fixed as possible, there are various 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.

Types of Sample Updates

Census Designations

The decennial censuses of population are likely to cause 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), and 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 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. In addition, the loss of samples that move from rural to small urban or from rural or small urban to urbanized may cause a deficiency in the rural or small urban panels. However, since universe mileage also must be moved to accommodate these changes, the stability of the sample panel may remain in tact, but checks for this will still have to be made. The suggested procedures for adjusting to area sample assimilations, newly designated small urban and individual urbanized areas, and functional system revisions follow:

1. All universe 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 the new mileage will have to be reclassified or if all mileage within the area will need to be reclassified.

2. Functional system universe mileage within the new or expanded urban areas will be stratified into traffic volume groups consistent with those groups established for the latest HPMS sample.

3. Transfer rural sample sections taken over by small urban or urbanized areas into the appropriate functional systems and volume groups.

4. Transfer small urban sample sections taken over by urbanized areas into the appropriate functional systems and volume groups.

5. Establish the required sample sizes for the revised rural, small urban, and urbanized area panels, and draw additional samples where necessary. Procedures to draw additional samples are discussed below.

6. Although changes in census designation of small urban to rural and urbanized to small urban or to rural could possibly occur, such changes will be uncommon, and will not usually require sample base verification. Universe and sample sections affected by such changes should be assigned to the correct functional system and volume group in the new panel.

Functional Reclassification of Sections

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

1. Reclassification of mileage within panels as a result of functional system changes;

2. Areal reassignment of existing road sections to adjust for expanding urban boundaries between decennial censuses; and/or

3. 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; if the current universe mileage for a given functional system has increased from the base period mileage by 10 percent or more, additional randomly selected sections will probably 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 3 years) there should be only minor changes in sample section and universe mileage 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 misassignments (inaccurate AADT) are inevitable and may be corrected when current and accurate AADT is assigned to the section.

If, for reasons other than census period readjustments, a specific volume group loses 5 to 10 percent of its sample sections to other volume groups, the volume group should be checked for sample adequacy using the formula and procedure outlined in Appendix G. Since universe sections/mileage will also have changed volume groups, the sample adequacy may remain stable, but it is prudent to make this check, anyway. The minimum requirement of 3 sample sections per volume group must be maintained, (or the State must sample/report all that exist where fewer than 3 are available). If volume group losses cause the sample adequacy to fall 5-10 percent below that required, new randomly selected sections are to be added to the affected volume groups to maintain the required precision level.

Where a volume group loses samples due to volume group reassignments to the extent that it is no longer represented (no samples), or a new volume group turns up because of AADT change, new samples must be selected in those groups. Temporarily (for the current submittal), the universe mileage for the unsampled volume group(s) may be combined with an adjoining group in order to ensure that the expansion for the complete functional system mileage will be accurate. Note that DVMT expansion will be less accurate under this situation. It is imperative that the next HPMS submittal contain samples in these currently unsampled volume groups.

Sample Size Review

The required sample size is a function of the variability of data (primarily AADT) within a volume group, the functional system/volume group precision level and the number of sections available for sampling in the volume group (the universe). The term "precision level" in this Manual is defined as the degree of confidence that the sampling error of a produced estimate will fall within a desired fixed range. Thus, for a precision level of 80-percent confidence with 10-percent allowable error (80-10), there is the probability that 80 times out of 100, 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 functio system and geographic area are indicated in Appendix F, Tables F-

A procedure (Appendix G) is provided for determining the requ size. Note that there are three specific precision levels f small urban, and grouped urbanized areas and two precision le individual urbanized areas. For individual urbanized areas, precision levels for individual volume strata are 80-10 or 70 upon the number of individual urbanized areas in a given Sta States with less than three individual urbanized areas will level of 80-10 for all functional systems, while those wit will use the lower precision level of 70-15 for minor ar collectors and 80-10 for principal arterials.

If the total number of sections available for sam the State groups some/all of its nonsampled uni of this total may be obtained by dividing the an estimate of the average section length i the average length of the samples already be used.

wn (i.e., estimate mileage by tively, up may

ed sample the rural, els for the the design -15, depending e. Those use a precision three or more ls and

1 to F-3.

The AADT coefficient of variation is an important part of the procedure (formula) to obtain the required number of samples for each stratum. Estimates of the AADT coefficients of variation for a particular State can be derived from its existing HPMS data using standard statistical computer packages. Alternatively, FHWA headquarters can supply the coefficients from any State tape submittal upon request. Further, a booklet entitled "Estimates of Sample Adequacy" can be generated from any State's HPMS tape submittal by FHWA Headquarters. The booklet contains the coefficients (generated both from the sample section AADT's and from the universe section AADT's, if they exist), the number of existing, unique sample sections, the required number of samples based on the generated coefficients, an estimate of the universe in the volume group, and other estimates and information useful for doing a sample size review. Advise FHWA Headquarters (HPM-20) if such a computer analysis (the booklet) is desired.

Another procedure to be used in the updating process is contained in Appendix I, Sample Size Requirements for Estimating Proportions. Figure I-1, "Functional System Sample Size Needed to Detect a 10 Percent Change in Proportions," provides a curve that can be used by a State to determine if its sample size meets the criteria set forth in the Appendix. Just as statewide precision level requirements are to be maintained for functional volume group estimates of data element averages and aggregates, also a minimum sample size level needed to satisfy the statistical rements for estimating changes in the proportions of data item e., percentage of rough pavement) at the statewide functional It is required that the design sample size at the statewide tem level for all three geographic areas be such that the table change in proportions is no greater than 10 percent, less, at the 80-percent confidence level. Normally, the sum roup sample sizes for average and aggregates as determined n Appendix G exceeds the minimum functional system sample s for the measurement of proportions, especially for rural reas. However, it is possible that the sample urbanized areas aggregated to statewide functional system isfy the minimum criterion for proportions. This may area (rural, small urban or urbanized) where the AADT riation tend to be small.

there is a design requi attributes (i. system level. functional sys smallest detec and preferably of the volume g by the formula size requirement

ix I, Figure 1 is used to ensure minimum sample eas. Sample size deficiencies, as determined from this onal system, are to be prorated among the volume groups system according to the initial sample sizes obtained ormula. Further discussion of proportions is I.

le Adequacy" booklet also contains a sample size Appendix I criteria.

Where a volume group loses samples due to volume group reassignments to the extent that it is no longer represented (no samples), or a new volume group turns up because of AADT change, new samples must be selected in those groups. Temporarily (for the current submittal), the universe mileage for the unsampled volume group(s) may be combined with an adjoining group in order to ensure that the expansion for the complete functional system mileage will be accurate. Note that DVMT expansion will be less accurate under this situation. It is imperative that the next HPMS submittal contain samples in these currently unsampled volume groups.

Sample Size Review

The required sample size is a function of the variability of data (primarily AADT) within a volume group, the functional system/volume group precision level and the number of sections available for sampling in the volume group (the universe). The term "precision level" in this Manual is defined as the degree of confidence that the sampling error of a produced estimate will fall within a desired fixed range. Thus, for a precision level of 80-percent confidence with 10-percent allowable error (80-10), there is the probability that 80 times out of 100, 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 F-1 to F-3.

A procedure (Appendix G) is provided for determining the required sample size. Note that there are three specific precision levels for the rural, small urban, and grouped urbanized 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.

If the total number of sections available for sampling is not known (i.e., the State groups some/all of its nonsampled universe mileage), an estimate of this total may be obtained by dividing the total volume group mileage by an estimate of the average section length in that stratum. Alternatively, the average length of the samples already existing in the volume group may be used.

The AADT coefficient of variation is an important part of the procedure (formula) to obtain the required number of samples for each stratum. Estimates of the AADT coefficients of variation for a particular State can be derived from its existing HPMS data using standard statistical computer packages. Alternatively, FHWA headquarters can supply the coefficients from any State tape submittal upon request. Further, a booklet entitled "Estimates of Sample Adequacy" can be generated from any State's HPMS tape submittal by FHWA Headquarters. The booklet contains the coefficients (generated both from the sample section AADT's and from the universe section AADT's, if they exist), the number of existing, unique sample sections, the required number of samples based on the generated coefficients, an estimate of the universe in the volume group, and other estimates and information useful for doing a sample size review. Advise FHWA Headquarters (HPM-20) if such a computer analysis (the booklet) is desired.

Another procedure to be used in the updating process is contained in Appendix I, Sample Size Requirements for Estimating Proportions. Figure I-1, "Functional System Sample Size Needed to Detect a 10 Percent Change in Proportions," provides a curve that can be used by a State to determine if its sample size meets the criteria set forth in the Appendix. Just as statewide precision level requirements are to be maintained for functional system 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 rough pavement) at the statewide functional system 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 sum of the volume group sample sizes for average and aggregates as determined by the formula in Appendix G exceeds the minimum functional system sample size requirements for the measurement of proportions, especially for rural and small urban areas. However, it is possible that the sample requirements for urbanized areas aggregated to statewide functional system levels may not satisfy the minimum criterion for proportions. This may also occur in any area (rural, small urban or urbanized) where the AADT coefficients of variation tend to be small.

The curve in Appendix I, Figure 1 is used to ensure minimum sample compliance in all areas. Sample size deficiencies, as determined from this curve for any functional system, are to be prorated among the volume groups within the functional system according to the initial sample sizes obtained from the Appendix G formula. Further discussion of proportions is contained in Appendix I.

The "Estimates of Sample Adequacy" booklet also contains a sample size estimation based on the Appendix I criteria.

Sample Selection for Updates

The selection of additional sample sections for a given volume group is straightforward for most updates. Basically, the number of existing sample sections is compared to the required number as determined on previous pages and additional sample sections are randomly drawn from the non-sampled universe sections to cover any shortfalls.

The only variation for this sample procedure occurs when new urbanized areas are designated. The State has the option of sampling these new urbanized areas as individual areas or grouping them with other new and/or current urbanized areas into a collective urbanized area panel. (Note, however, that the collective method is no longer recommended.) If a State chooses to sample new areas as individual areas or to group them as a collective new urbanized area, the selection process is as described above. Procedures for drawing a complete sample are discussed in Appendix H. In the case where new urbanized areas have been or are to be grouped with current urbanized areas, it is likely that the new urbanized area mileage will not be adequately represented by the rural and small urban samples that already exist in the new area or areas. For the new area mileage to be adequately represented, the number of samples in the new urbanized area in a given volume group should be proportional to the new area universe mileage in the given volume group. To achieve the required balance between current areas and new area mileage, any sample need required by the formula in Appendix G that exceeds the number of existing samples, must be randomly selected from the new area mileage (if new area mileage exists in the volume group), until the new area mileage is proportionally represented. Once proportionality is achieved, new samples will be drawn from the complete universe of the volume group for all areas in the collective group.

A simplified example will best illustrate the procedure. Let's assume that a collective urbanized area composed of seven urbanized areas exists in a State. Three new urbanized areas are defined as a result of the census, and a decision is made to incorporate them into the collective group. The procedure requires that every volume group stratum in every functional system be examined. However, for this hypothetical example only volume group two of the Interstate will be analyzed. The following table presents a summary of the Interstate part of the collective urbanized area for volume groups 1 through 6.

Example Interstate Sample Summary

	NUMBER OF SECTIONS OR MILEAGE IN VOLUME GROUPS					
	1	2	3	4	5	6
1 Existing Samples - Current 7 Areas	0	17	16	13	7	5
2 Existing Mileage	0	20	30	50	20	10
3 Existing Universe (Sections)	0	25	40	80	30	10
4 Additional Universe (Sections)	0	10	10	25	10	15
5 Additional Mileage	0	7	9	15	8	10
6 Required Sample (Sections)	0	23	17	14	8	7
7 Required minus Existing (Sections)	0	6	1	1	1	2
8 Existing Samples - New Areas	0	2	2	1	0	0
9 Samples to be Selected	0	4	0	0	1	2
10 Total Mileage	0	27	39	65	28	20

The first row lists the existing sample size in the existing collective urbanized area (7 individual areas), the second row lists the mileage, and the third the number of sections in the existing universe. The fourth and fifth rows list the additional number of sections and mileage from the three new urbanized areas. The sixth row lists the required overall sample size estimated from the formula in Appendix G for all 10 areas. The seventh row contains the number of additional samples needed to accommodate the formula results. The eighth row lists the rural and small urban samples already existing in the new areas, and the ninth row lists the number of sections which must be added to the sample. The last row lists the total mileage in the new collective urbanized area group consisting of all 10 areas.

To determine the number of samples to be selected from the added universe (the three new urbanized areas), compute the ratio of new mileage to total mileage (7/27 = 26 percent for volume group 2). It is determined that 26 percent of the mileage and 26 percent of the volume group 2 sample should be located in the "new" part of the collective urbanized area volume group mileage. Since only 9 percent (2/23) of the required number of samples exist in the new urbanized areas, all 4 of the additionally required samples should be selected from the three new urbanized areas. If any rural and small urban samples exist in the three new areas, they should be deducted from the samples to be selected as has been done in row nine. Two sections exist in the second volume group for the Interstate in the three new urbanized areas; therefore, only four new sample sections need to be selected. Since the selection of four new samples in the new areas will bring the sample into proper balance (6/23 = 26 percent), any samples required in the future should be randomly selected from all available volume group 2 sections from all 10 areas. If balance had not been achieved, preference should be given to the new areas (in subsequent new sampling) until balance is proper. See Appendix H, "Preparation for Sample Selection" for guidelines for establishing new sample sections.

Expansion Factor

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

1. Census Redesignations
2. Expansions of Federal-aid Boundaries and/or Census Boundaries
3. Functional System Redesignations
4. Sample section additions or losses in a volume group
5. Universe section additions or losses in a volume group
6. New Mileage

Normally, expansion factors are recalculated before every HPMS submittal tape to ensure that all volume group changes (both universe and sample), new sample sections, etc. have been accommodated. The calculation of expansion factors is discussed in Chapter IV and in Appendix H.

Summary of Causes for Updates and Corrective Procedures

The following overview of the causes for sample panel updates is in two parts: (1) point in time causes resulting directly or indirectly from Census releases; and, (2) causes generally occurring gradually over time during intercensus periods.

Cause	Corrective Procedure
Census Period	
1. 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 and universe bases and select additional samples as necessary.
2. New urbanized areas (small urban and/or rural to urbanized)	Adjust all rural and small urban sample section records within the new area to urbanized area requirements. Determine whether new areas are to be sampled individually or as a part of an existing or new collective area panel. Procedures for drawing new samples for individual or new collective area panels are discussed in Appendix H. Procedures for adding a new area or areas to an existing collective area panel are discussed above. Verify all sample and universe bases and select additional samples as necessary.

3. Expansion of the Federal-aid boundaries of small urban or 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 and universe bases and select additional samples as necessary.
4. Functional system reclassification--any area	Reassign reclassified sections (universe and sample) to appropriate volume groups. Sample new sections as necessary to maintain required volume group precision levels.
5. Losses in urban population	No action until area designation changes.

Cause	Corrective Procedure
Intercensus Period	
1. New mileage by functional system	Verify sample and universe base if change in functional system mileage is 10 percent or more, and sample new sections, if necessary.
2. Functional system reclassification--any area	Possible volume group reallocation of universe and/or sample sections, precision upgrading, and additional samples.
3. Volume group reassignment of sample sections	Reassign sample sections but no further action is needed if changes are minor (see the section on volume group reassignments, above); if changes are major, verify volume group sample and universe bases for all affected volume groups and add samples, if necessary.
4. Expansion Factor	Adjust expansion factor values for sample section records in the affected group.

Permanence of Sample Selections

Once a roadway 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, and the sample should then be placed on the new roadway. In cases where a roadway is truly abandoned with no relocation, i.e., not open to traffic, the section is dropped. Since only arterial and collector mileage is being sampled, sections reclassified as a part of the local functional system must also be dropped, even if it was reclassified as local because of the relocation.

Sample Panel 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 3 years for conformity with sample size requirements (see the previously discussed subsection on functional reclassification, the "rule of thumb" criterion). However, it is necessary to maintain a minimum of 3 samples per volume group (where more than that number of sections actually exist), and to sample unsampled volume groups that appear because of AADT (volume group) change, on as close to a yearly basis as possible. Where time does not permit this to be accomplished before a June 15 submittal, additional samples should be drawn and readied for the next annual submittal (or prior to another submittal) in order to preserve the integrity of the sample panel. More information and other alternatives are contained in Appendix H. Such changes that occur would be included with other changes in the annual submittals.

Sample Panel Reduction

The previous discussions have all commented upon the need for additional samples. The intent is to ensure that the sample panel is kept in conformance with the precision levels and sample size that enables an adequate representation of the States' arterial and collector systems, and meets target reliabilities. Since the HPMS has been in existence for some time, these additions of samples and the movement of universe and sample sections from one volume group to another, etc., have caused oversampling in some volume groups in some States. A volume group is considered to be oversampled when the number of existing unique samples exceeds the number of required samples by more than 10 percent. For example, if 40 sample sections are required in a particular volume group based upon accurate AADT data, the volume group could be considered to be oversampled if it contains more than 44 samples. However, individual volume group reductions of less than 3 sample sections should not be considered.

To the extent that all sampling criteria would still be met, a sample reduction could take place in the oversampled volume groups, if the sample panel size has become a burden for a State. There are several steps that must be taken BEFORE any sample deletion/elimination actually takes place. These would include a comprehensive report of intended actions that would be submitted to FHWA Headquarters for evaluation, which would contain a plan and other information related to the required steps in the list below:

1. Random deletion of the samples within each volume group that is oversampled is a must in order to maintain a statistically sound sample panel. Some "special situation" deletions of particular sample sections can be discussed on a case by case basis.

2. The minimum of 3 samples per volume group must be maintained (where there are more than 3 sections available).

3. A few samples (around 10 percent normally) above the number required by the procedure contained in Appendix G should be retained (where they already exist) to allow for movement, over time, from one volume group to another, from one area type to another, etc. For instance, if 32 samples are required, 35 should be retained if more than that already exist.

4. Trends of sample/universe section movement from one volume group to another should be examined, so that volume groups that are continually losing or gaining samples may be treated appropriately (i.e., the sample retention discussed in step 3 could be increased or decreased depending on the trends).

5. A maximum expansion factor of 99.999 must be maintained. Again, to allow for movement of samples from one group or area to another, over time, the expansion factor should be kept to levels that will ensure that the maximum expansion factor will not be easily reached over a reasonable time period.

6. The sample size requirements for estimating proportions discussed under the "Sample Size Review" heading, above, must be maintained for each functional system (see Appendix I, also).

7. The AADT on the samples should be as up to date and accurate as possible, such that coefficients of variation derived from them are reliable. AADT coefficients of variation should be derived from the universe if all or most of the arterial/collector systems contain reasonably accurate AADT data. In addition, the universe section count by volume group must be as accurate as possible so that the results from the Appendix G formula (giving the required number of samples) are reasonably accurate.

8. Only one of a series of sample subdivisions is to be counted as an existing sample. However, if a sample has been subdivided because of AADT (volume group) change, functional system change or an area type change, one of the subdivided portions is to be counted in each of the respective categories.

There are other considerations that a State should think through before making a decision to reduce its sample panel size:

(1) If a State is using the HPMS analytical package, or is using the HPMS file for other purposes, it may want to keep an oversampled panel in tact, or even consider using higher precision levels. The latter case would tend to increase the sample panel, of course.

(2) If a State has a computerized inventory system already established for all or most of the roadways in the State, the number of samples now being maintained probably does not create any particular burden and could be easily retained, even if the panel is oversampled.

(3) The sample reduction examination and actual deletion may require more work than the resulting benefit of maintaining fewer samples. This will almost certainly be the case where only a few volume groups are oversampled, or where only a few samples could be eliminated per volume group.

(4) After a reduction in a volume group takes place, and when/if that volume group requires more samples for any number of reasons, new samples will again have to be drawn.

The State will have to assess its own needs and priorities and act accordingly. If a State decides to reduce its sample panel, its submitted report/plan will be evaluated at FHWA Headquarters. Appropriate remarks will be returned via the field offices. A summary of the eliminated sample sections that includes the county, functional system, sample number (ID) and volume group (items 4, 9, 24 and 26, respectively) will accompany the State's data tape submittal where the elimination action actually takes place. Sample elimination should not take place until FHWA Headquarters has reviewed and commented upon the State's submitted plan.

The "Estimates of Sample Adequacy" booklet (discussed under the "Sample Size Review" heading, above) contains information that would be beneficial for any review of the sample panel, including a reduction study. As stated under that discussion, the booklet is available from FHWA Headquarters (HPM-20), upon request.

CHAPTER VI

HIGHWAY PERFORMANCE MONITORING SYSTEM SUBMITTAL SOFTWARE PACKAGE

INPUT DATASET REQUIRED BY THE HPMS SUBMITTAL SOFTWARE DEVELOPED BY THE FHWA

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 and formats of the different types of records required as input by the FHWA-developed software documented in this Chapter.

Dataset Record Layout

Complete Section Record	Minimum - 163 digits Maximum -1282 digits

---

Part 1: Fixed

Universe portion of all records (including samples)	158 digits
Continuation Code (see below)	5 digits
Total fixed portion	163 digits

Part 2: Variable

Sample Section:		
Consists of 163 fixed digits plus 264 digits =		427 digits
Plus, if applicable, the following additional variable data:		
Structure ID's;	an additional	15-750 digits
At-grade Railroad Crossing ID's;	an additional	7-105 digits

The Continuation Code (item 23), provides information indicating what type of record is being reported (universe or sample), and if it is a sample, whether structure and/or railroad ID's are present (and how many) (see Chapter IV).

For example, a record for a sample section that contains three structures and has no railroad crossings would contain the following:

Universe Portion	158 digits
Continuation Code (10300)	5 digits
Sample Portion	264 digits
Structure ID's (3 x 15 digits)	45 digits

For a record length of 472 digits.

Required Format

The required dataset will contain a mixture of universe and sample section records varying in length from the minimum of 163 digits to the maximum of 1282 digits, although it is unlikely that the latter figure will ever occur. The following are the attributes of the file:

LRECL (Logical Record Length);	1286 (1282 + 4) bytes
BLKSIZE (Physical Record Length);	6233 bytes
RECFM (Record Format);	VB (Variable-Blocked)

The dataset must be written in Extended Binary Coded Decimal Interchangeability Code (EBCDIC) character representation.

The HPMS record format is contained in Appendix R.

NOTE: The HPMS Submittal Software will accept a variable-blocked HPMS dataset as input with any blocksize. However, all HPMS datasets output from the submittal software are blocked at 6233. The HPMS dataset submitted to FHWA Headquarters must be blocked at 6233.

THE SUBMITTAL SOFTWARE PACKAGE

INTRODUCTION

This module of programs has been developed by the FHWA for State highway agency use in preparing the annual HPMS data submittal tape, maintaining the dataset, editing the data, and developing summary tables. This software will process a dataset with a variable length record format consisting of rural and urban universe records and sample records. The module consists of a main (driver/calling) program, FHWAHPMS, and seven dynamically called subprograms STHPMODU, STHPEDIT, STHPEXPF, STHPCALC, STHPSUMT, STHPBTAB, and STHPINTS . Each of the subprograms and the main program are written in COBOL. The subprograms STHPMODU, STHPCALC, and STHPBTAB each have dynamically called secondary subprograms written in COBOL and FORTRAN. The module of programs was designed and developed on an Amdahl 580 (compatible with IBM 370/3033) with full operating system (OS).

The execution of the module options are controlled by the user parameter cards through the main program, FHWAHPMS. The subprogram functions are as follows:

- o STHPMODU provides the following functions to keep the file current and to correct coding errors.
  - o Update individual data items
  - o Add new records to the file
  - o Delete records from the file
  - o Add or delete structure ID's and/or at-grade railroad crossing ID's
- o STHPEXPF can calculate the expansion factor for each sample section. It also produces two summary tables; one contains the number of sections, sampled mileage, expansion factor, and expanded sample mileage by volume group, functional system, and area type; the other contains the number of sections and accumulated universe mileage by volume group, functional system and area type for all sections open to traffic.
- o STHPEDIT reads the HPMS dataset, checks each record for coding errors, or lists each section without editing. The edits are performed in three groups determined by the user's selection on the parameter card -- each data item is checked for a valid code, various data items are crossed checked, or various data items are checked to see if they are within a range of reasonable values.

- STHPCALC calculates for the first time or recalculates all of the following data items and places (or replaces) them on the sample section record:

  - Generated one-digit functional system code (all records)
  - Rural peak capacity for paved sections
  - Weighted design speed (WDS) using the reported curve data for applicable sections
  - Volume-to-service flow (capacity) ratio (V/SF)
  - Horizontal alignment adequacy code for rural sections with reported curve data
  - Vertical alignment adequacy code for rural sections with reported grade data

  The procedures used in the capacity calculations are based on service flow for level of service E (see Appendix L). The procedure for the WDS calculation is the same as outlined in Appendix D. The V/SF calculation is described in the edit specifications (see Appendix M).

  STHPCALC also assigns the climate zone, based on the county FIPS code, for the first time or replaces all of the climate zones any time the option is chosen.

- STHPSUMT is primarily used to verify functional system mileage and DVMT. It permits comparisons between the expanded sample, universe, and areawide values by providing sample and universe summaries in the same format as the areawide tables. A summary of Federal-aid system mileage by functional system is also produced to verify urban and rural Federal-aid mileage within a State.

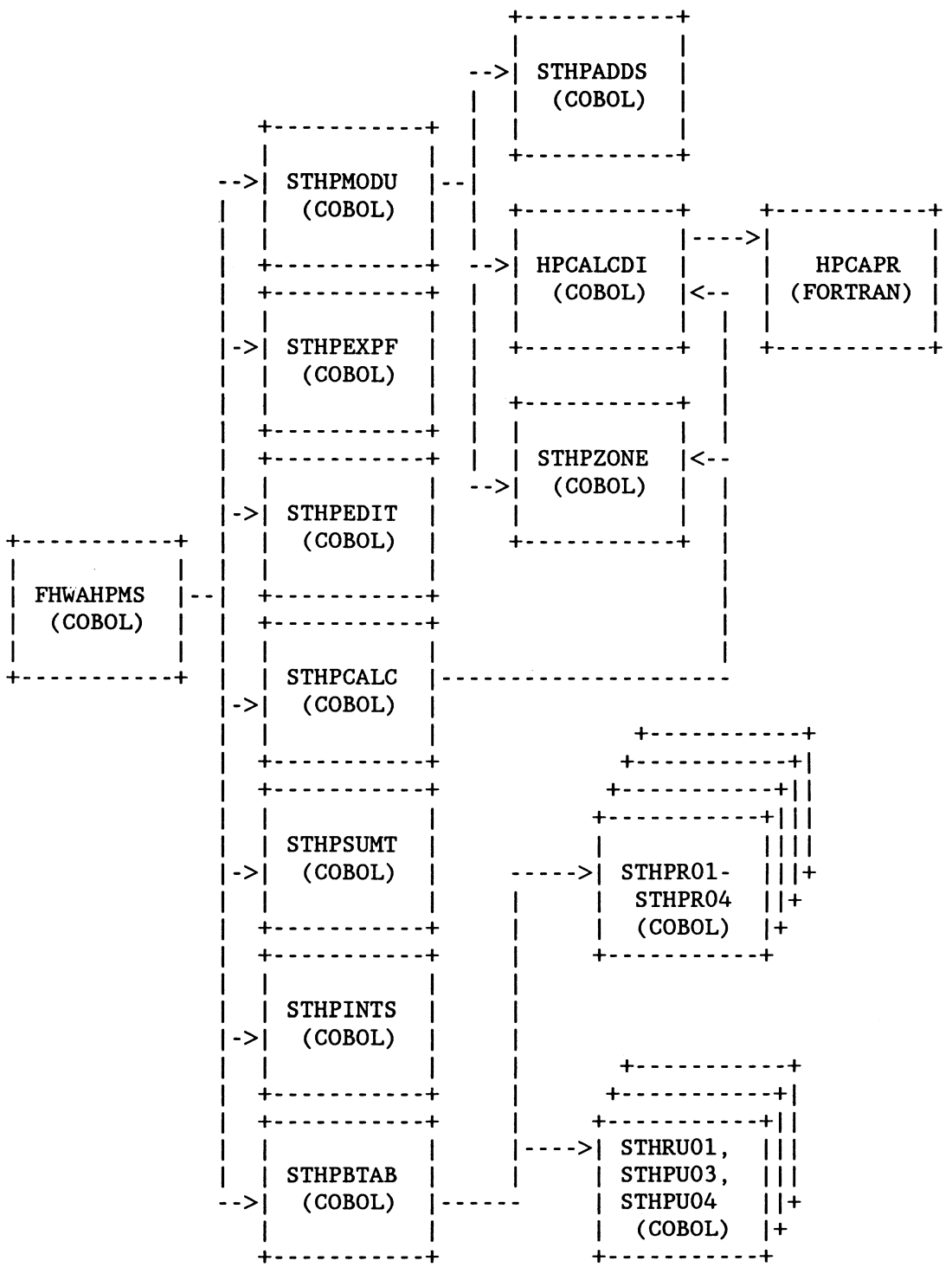
- STHPINTS develops and produces two Interstate system mileage data tables by route number from the universe data. Each table contains the number of records, miles, lane/miles, and DVMT for each route. One table contains mileage data for Interstate sections opened to traffic under Title 23 U.S.C. Sections 103(e)(1), 103(e)(2), 139(c), and 139(a), which are functionally classified as Interstate, on an Interstate Federal-aid system, and route signed as Interstate. A second table contains data for sections that meet some, but not all, of the Interstate characteristics mentioned above, plus Section 139(b) mileage.

- STHPBTAB develops and produces a battery of performance summary tables based on the expanded sample inventory data. The battery consists of 9 rural tables and 6 urban tables from which the user may select the table(s) desired.

The module has been designed to enable a State to edit and update the universe sections only or sample sections only as long as the record is in the HPMS variable length record format and in sort by section ID within county. However, the <u>final</u> edit and summaries submitted to FHWA <u>must</u> be from only one dataset consisting of a State's <u>complete</u> data <u>in sort</u> by section ID within county. The dataset must also contain the variable length records with current (updated if the data was being updated by software other than provided by FHWA) calculated data items.

FIGURE VI-1

Highway Performance Monitoring System Submittal Software Package



FHWAHPMS

A. IDENTIFICATION

Program Name: FHWAHPMS
Language: COBOL
Compiler: OS/VS COBOL with dynamic option
Written By: Beverly J. Harrison
Highway Performance Analysis Branch, HPN-21
Planning Analysis Division
Federal Highway Administration
Washington, D. C. 20590
Phone: 202-366-4048

Date: February, 1988

B. PURPOSE

FHWAHPMS edits the HPMS dataset, maintains the dataset, calculates various data items, develops and produces summary tables from the expanded sample data and universe data, and provides a battery of performance summary tables based on the sample data.

C. COMPONENTS

Written By: Beverly J. Harrison
Language: COBOL and FORTRAN
Compiler: OS/VS COBOL with dynamic option
VS Fortran

Date: February - March, 1988

FHWAHPMS is a dynamic calling program. The program dynamically calls STHPMODU, STHPEXPF, STHPEDIT, STHPCALC, STHPSUMT, STHPBTAB, and STHPINTS. Each subprogram is linked with FHWAHPMS, if and only if, it is called during execution.

STHPMODU dynamically calls STHPADDS, STHPZONE and HPCALCDI which dynamically calls HPCAPR.

STHPCALC dynamically calls STHPZONE and HPCALCDI which dynamically calls HPCAPR.

STHPBTAB dynamically calls STHPR01 through STHPR04 and STHPU01, STHPU03 and STHPU04.

D. PARAMETER CARDS

There are several types of parameter cards the user may use to execute FHWAHPMS. The program options selected determine the number and type of parameter cards required for execution. The parameter cards may be placed in the execution deck in any order.

1. State Name Card (STATECN)

The State name card is required for all executions. The keyword STATECN is coded in columns 1-7 followed by an equal sign (=) in column 8. Starting in column 9, 1-20 characters and blanks may be used to code the State name. The State name must be followed with the two-digit State code found in Appendix A. The State code must be coded as /xx/, where xx is the two-digit code, including a leading zero, where necessary.

e.g., STATECN=__TEST_STATE/89/
STATECN=TEST_STATE_HPMS/99/

2. Inventory Year Card (INVYEAR)

This card is required for all executions. Starting in column 1, code the keyword INVYEAR followed by an equal sign (=) in column 8. In columns 9-12, code the inventory year in which the section data was collected.

The year (item 2) in the data record will be set to the year on the INVYEAR parm card when the program option, SELMODU, is selected and valid transaction cards are included.

e.g., INVYEAR=1988

3. Program Option Card (SELMODU, SELEXPF, SELEDIT, SELCALC, SELSUMT, SELBTAB, SELINTS)

The user must select at least one program option card for each execution. SELMODU, SELEXPF, SELEDIT, SELINTS, and SELSUMT may be included in the same execution under certain conditions. The option cards SELCALC and SELBTAB must be used alone. More information is provided under the heading "Restrictions for Program Option Combinations" at the end of this section (D).

a. SELMODU

This card enables the user to select the subprogram which maintains the HPMS dataset. It is selected when the user desires to modify (update) items for a section, add a new section, delete a section, or add/change structure or railroad crossing ID's. Code the program option name SELMODU in columns 1-7 followed by an equal sign (=) in column 8. Starting in column 9, the keyword for the subprogram option selected is coded. The possible keywords are as follows:

Only one of the following three keywords may be coded in an execution:

ADDONLY - Only new sections are to be added to the existing dataset.

ADDMOD - New sections are to be added and existing sections are to be modified or deleted.

MODONLY - Sections are to be modified or deleted and no new sections are being added.

Optional keywords that may be used in addition to the above:

NOLIST - The listing of the user supplied transaction cards is not produced.

NOMOD - The listing which summarizes the type(s) of update for the section by section identification and county is not produced.

The year (item 2) in the data record will be set to the year on the INVYEAR parm card when this program option (SELMODU) is selected and valid transaction cards are included.

e.g., SELMODU=ADDMOD - New sections are being added and existing sections modified.

SELMODU=ADDONLY,NOLIST - New sections are being added and the transaction card listing will not be printed.

The transaction cards required for updating are discussed in Section E, Control Cards, Item 1.

b. SELEXPF

The printed output of this option is to be submitted to FHWA Headquarters along with the submittal tape (see Chapter IV, Item 27).

This card enables the user to select the subprogram which calculates the expansion factors for sample sections, replaces the existing expansion factor on each sample record with the new one, and generates the expansion factor summary table. The subprogram will calculate the expansion factor for specified volume groups either using cards provided by the user containing the group's universe mileage (see Section E, Control Cards, Item 2) or from universe mileage accumulated from the input file, and produces a table listing all of the expansion factors in the dataset by volume group, functional system, and area type. The table produced can be used to check the accuracy of existing expansion factors and to ensure they are the same throughout each volume group, and that the expanded sample mileage for a volume group equals the universe mileage. SELEXPF is coded in columns 1-7 followed by an equal sign (=) in column 8. Each keyword selected is then coded and separated by a comma. The keywords may be in any order and are as follows:

One keyword from the following set must be coded.

R - Rural sections only are to have expansion factors calculated and/or summary tables produced.

U - Urban sections only are to have expansion factors calculated and/or summary tables produced.

RU - Rural and Urban sections are to have expansion factors calculated and/or summary tables produced.

One keyword from the following set must be selected.

FACTCALC - New expansion factors are to be calculated and placed on appropriate sample section records. The summary table for all rural and/or urban volume groups on the dataset is produced automatically by the subprogram when new expansion factors are calculated.

FACTTAB - Only the expansion factor summary table is to be produced. No new expansion factors will be calculated.

One keyword from the following set must be selected with the FACTCALC option.

MILEDATA - New expansion factors are to be calculated using universe mileage accumulated from the input master file. To use this option, AADT's must be coded and be greater than zero for all records (including universe). Only open to traffic arterial and collector system records are used. If arterial/collector records with zero AADT's are found, they will be listed, and expansion factors will not be calculated.

MILECARD - New expansion factors are calculated using input cards containing the volume group's universe mileage (see Section E, Control Cards, Item 2).

Optional keyword.

UNIVTAB - Produces a universe mileage table by AADT volume group for all arterial and collector sections open to traffic. To select this table, AADT's must be coded and be greater than zero for all non-local functional system records that are open to traffic.

e.g., SELEXPF=U,FACTTAB - Urban expansion factor summary table will be produced.

SELEXPF=FACTCALC,RU,MILECARD - An expansion factor will be calculated for each rural and urban volume group for which a universe mileage card is coded.

SELEXPF=R,UNIVTAB - Rural universe mileage summary table will be produced.

c. SELEDIT

The printed output of this option (SELEDIT=RU,FINAL) is to be submitted to FHWA Headquarters along with the submittal tape with appropriate explanations for all remaining messages.

This program option card enables the user to select the subprogram which edits each section in the HPMS dataset or lists each section without editing. The user also has the option of having the county name printed on the edit listing for each county code by providing control cards containing the county codes and names (see Section E, Control Cards, Item 4). Code the program option card name SELEDIT in columns 1-7 with an equal sign (=) in column 8. Starting in column 9, code the keywords for the subprogram option(s) selected, each separated by a comma. The order of the keywords is not significant.

One of the following keywords is required for editing or listing:

R - Only rural sections are to be edited or listed.

U - Only urban sections are to be edited or listed.

RU - Rural/Urban sections are to be edited or listed.

If the data records are to be listed, one of the following type of listing keywords must be coded:

LISTSECT - All universe and sample section data are to be listed.

LISTUNIV - Only universe section data are to be listed.

LISTSAMPLE - Only sample section data are to be listed.

If the data records are to be edited, one of the following type of editing keywords must be coded:

VALIDCODES - Each data item will be checked for a valid code. Valid codes should be present before other edits are run.

CROSSCKS - Various data items will be cross-edited.

RANGECKS - Various data items will be checked to see if the coded value is within a reasonable range.

FINAL - All types of edits will be performed in one execution -- valid codes, cross edits and range edits.

More than one type of edit keyword may be coded in one execution. However, before cross-edits, range-edits or the final edit are performed, each data item must contain a valid code. It is recommended that the VALIDCODES edit be performed before the other edits.

(See Appendix M for edit specifications.)

Optional keywords that may be used in addition to, and only with the editing keywords noted above:

SAMPNUMNO - The sample number (Item 24) will not be checked for uniqueness within county. Default is that the sample number will be checked. May only be coded with the keyword VALIDCODES.

VGRPNO - The volume group number and AADT will not be cross-checked. Default is that the volume group and AADT will be checked. The volume group numbers and AADT ranges have been set up according to the FHWA sample design. (See Appendix F for the AADT ranges used for this edit.) Use only with keyword CROSSCKS.

ERRMESS - Must be coded if the user desires a suppressed listing with section ID, item number in error, and messages only. Otherwise, the listing includes the value coded for every data item for sections containing an error(s), along with the item number in error and the message.

NOCURVE - The curve data will not be edited -- it is not provided or the user does not wish to edit the data. Default is to edit curve data.

NOGRADE - The grade data will not be edited -- it is not provided or the user does not wish to edit the data. Default is to edit grade data.

NOROUGH - The roughness data will not be edited -- it is not provided or the user does not wish to edit the data. Default is to edit roughness data.

e.g.,

SELEDIT=R,VALIDCODES,SAMPNUMNO - Each data item for a rural section is to be checked for a valid code. The sample number for sample sections will not be checked for uniqueness.

SELEDIT=RANGECKS,RU,ERRMESS - Selected data items on rural and urban sections will be checked for a value within a reasonable range with only error messages printed.

SELEDIT=R,LISTUNIV - List all rural universe sections with no editing.

SELEDIT=RU,FINAL,NOROUGH - Each section is to have all edits except roughness checks performed.

* CNTYINC

This optional parm card enables the user to select sections to be listed or edited by specific county(ies). CNTYINC may be included only when the user has selected the program option SELEDIT. Code the parm card name CNTYINC in columns 1-7 with an equal sign (=) in column 8. Starting in column 9, code the three digit county FIPS code for the counties to be included in the listing or edit, each separated by a comma. The leading zero(es) must be coded for those county FIPS codes that are less than 100. Up to 15 counties may be selected; the county FIPS codes must be coded in ascending order. If more than 15 counties are required to be listed/edited, this option must be reselected in another computer run of FHWAHPMS.

* NOTE: This option must be coded on a card separate from the SELEDIT options, as shown in the following examples:

e.g., SELEDIT=R,LISTSAMPLE - List all rural samples in the three
CNTYINC=011,033,151 counties with FIPS codes of 11, 33 and 151.

SELEDIT=R,FINAL - Each rural section in counties 51 and 73
CNTYINC=051,073 are to have all types of edits performed on the data.

d. SELSUMT

This program option card enables the user to select the subprogram which produces the summary tables to verify system mileage and DVMT by functional system. SELSUMT is coded in columns 1-7 followed by an equal sign (=) in column 8. Starting in column 9, code the keyword(s) for the summary table(s) desired. If more than one keyword is selected, each must be separated by a comma.

At least one keyword from the following set must be selected:

SAMPLEMT - The summary table containing sample mileage and travel by functional system is to be produced.

UNIVMT - The summary table containing universe mileage by functional system and Interstate travel is to be produced.

UNIVDVMT - The summary table containing universe travel by functional system for all open to traffic arterials and collectors is to be produced. This option should be selected only if AADT's are coded for all arterial and collector universe sections. Note that the table will still be produced whether or not AADT's exist on the universe sections -- it is left to the user to be particularly cognizant of this.

CNTYMILE - The summary table containing universe mileage by jurisdiction and functional system within county is to be produced.

FEDAID - The summary table containing universe mileage by Federal-aid system and jurisdiction is to be produced.

FUTDVMT - The summary table containing current year DVMT, future year DVMT, and the percent change by functional system is to be produced.

e.g., SELSUMT=FEDAID,UNIVDVMT
SELSUMT=UNIVMT,CNTYMILE
SELSUMT=FUTDVMT,SAMPLEMT,UNIVMT

e. SELINTS

SELINTS enables the user to select the subprogram which produces the Interstate system mileage, lane-mileage and travel summary tables by route number. In columns 1-7, code the program option card name, SELINTS. The remainder of the card is blank.

f. SELCALC

This program option card enables the user to select the subprogram which determines the generated functional system code (item 10), calculates certain data items for the first time or recalculates the same data items and places/replaces them on the record, and assigns the climate zone by county. In columns 1-7, code the program option card name, SELCALC followed by an equal sign (=) in column 8. Starting in column 9, code the keyword(s) for the desired option. If both keywords are selected, they must be separated by a comma. This program option cannot be selected with any of the other program options. The items generated/calculated and the procedures used in the calculations are outlined on page VI-4.

At least one of the following keywords must be selected:

DCALC - All of the generated/calculated data items are to be calculated/recalculated and placed on the data record.

CZONE - The climate zone for each county is to be placed on the data record.

e.g., SELCALC=CZONE,DCALC - Climate zones are to be assigned and all data items calculated or recalculated and placed on the data record.

SELCALC=DCALC - All data items are to be calculated or recalculated and placed on the data records.

This program option should be selected to calculate/generate the necessary data items before the program option, SELEDIT, is selected with the keywords FINAL, CROSSCKS or RANGECKS.

g. SELBTAB

SELBTAB enables the user to select the subprogram which produces the battery of rural/urban performance summary tables from the sample section data. The user may select from 1 to 9 rural tables and 1 to 6 urban tables. In columns 1-7, code SELBTAB followed by an equal sign (=) column 8. Starting in column 9, code the number and area type of each table and/or range of tables desired, each followed by a comma. This program option card cannot be included with any other program option. (See Appendix N for the titles and numbers of the tables.)

Optional keywords. (Use for urban table(s) only.)

UZASMU - The urban table(s) requested will be by the statewide total of urbanized areas, small urban areas, and total urban. Default is to show total urban only.

INDUZA - The urban table(s) requested will be by individual urbanized area (or by collective groups) , small urban, and total urban. Default is to show total urban only.

e.g.,
SELBTAB=R1,R9,U6,INDUZA - Rural tables 1 and 9 and urban table 6 showing individual urbanized areas are to be produced.

SELBTAB=U1-U6,R9 - Urban tables 1,2,3,4,5 and 6 showing total urban areas only, and rural table 9 are to be produced.

4. Maximum Number Edit Errors (MAXERRS)

This card is optional and is coded if the user wants the subprogram which edits the data to stop execution when a maximum number of sections with coding errors is reached. The MAXERRS card may be included only with the program option card SELEDIT. MAXERRS is coded in columns 1-7 followed by an equal sign (=) in column 8. Starting in column 9, code the numeric value for the maximum number of sections allowed to be in error. A number with 1-5 digits may be coded. The default value is for all sections to be edited.

e.g., MAXERRS=200 - Execution for the edit subprogram will terminate when 200 sections with at least one data item in error have been detected.

Restrictions for Program Option Combinations

SELMODU and/or SELEDIT and/or SELEXPF and/or SELSUMT may always be included in the same execution.

SELINTS may be included with SELEDIT and/or SELSUMT for any execution.

SELINTS may be included with SELEXPF with the keyword, FACTTAB. SELINTS cannot be included with SELEXPF with the keyword, FACTCALC.

SELCALC cannot be included with any other program options. Before the program option SELCALC is selected, the HPMS dataset should be free of coding errors, i.e., all data items have valid codes. SELCALC will replace all calculated data items with recalculated values. If the dataset has been updated externally using non-HPMS software, this option should be executed in order to ensure that all calculated/generated data items are correct and current and that the climate zone is included. If the dataset is being updated using the program option SELMODU and a data item used in a calculation is updated, SELMODU will automatically call the subprogram to recalculate the data items. If SELMODU is being used to update the county code and the user is not updating the climate zone at the same time, SELMODU will call the subprogram to determine the correct climate zone.

SELBTAB cannot be included with any other program option. SELBTAB must have an input master dataset with current (updated) calculated data items as these data items are used in some of the summary tables produced by the subprogram.

If allowable multiple program options are selected, the subprograms are executed in the following order:

STHPMODU -- SELMODU
STHPEXPF -- SELEXPF
STHPEDIT -- SELEDIT
STHPSUMT -- SELSUMT
STHPINTS -- SELINTS

E. CONTROL CARDS

Several of the program options require control cards for execution. If the program option SELMODU has been selected by the user, control cards are required to indicate which transactions are to be performed by the subprogram STHPMODU. The program option SELEXPF=FACTCALC,MILECARD requires control cards containing the universe mileage for the volume groups for which expansion factors are to be calculated. Urbanized area control cards are optional for the program option SELSUMT or SELBTAB which contain the urbanized area codes and names. County name control cards are optional for the program options SELEDIT or SELSUMT which contain the county codes and names.

1. Transaction Sets

Required for the program option SELMODU with one of the keywords ADDONLY, MODONLY, or ADDMOD. There are five types of transaction set control cards used by the subprogram as follows.

N - Add a new section.

U - Update an existing section.

S - Add and/or delete structure ID's for an existing section.

R - Add and/or delete at-grade railroad crossing ID's.

D - Delete an existing section.

Each transaction card must contain the county code (item 4) and section ID (item 8) coded for the section which is to be altered. The delete card (D) and new section card (N) cannot be used with any other transaction card for the same section. The other three types of transactions may be included for the same section. If more than one transaction set is included for the same section, all the cards in one transaction set must be placed together.

These control cards are placed in the input dataset, UMODCARD (see Section F). The card format for each transaction set will be discussed separately.

a. Add a New Section Transaction Card (N)

This transaction card enables the user to add a new universe or sample section record to the master dataset. The number of cards in the transaction set depends on the type of section being added. Three cards are required to add a universe section; a sample section requires at least five cards. Adding a sample section will require from 1-23 cards depending on the individual section. This transaction set cannot be used with any other transaction set for the same section and all N1, N2, N3.. . . cards for one section must be together. See Appendix O for all card layouts to add a new section.

b. Update a Section Transaction Card (U)

This transaction card enables the user to correct coding errors and update the value coded for a data item. The update transaction set may be used in combination with the add/delete structure ID card and/or add/delete at-grade crossing ID card. Each card in the update transaction set for a section must have the following format:

Transaction Card Code--"U"	Column 1
Sequence Number--"1-9"	Column 2
County Code	Columns 3-5
Section ID	Columns 6-17
Data item number to be updated and data value in the following format:	Columns 18-80

/N1,D1/N2,D2/N3,D3/. . ./Ni,Di/

where N1...Ni = data item number to be updated*

D1...Di = new data value

*The data item numbers are listed in Appendix P.

Several updates may be coded on one card provided that the last column coded contains a "/" thereby requiring the last set of "N" and "D" values for a given update to be on the same card. The value coded for the data item must contain the same number of characters as the length of the data item, i.e., to update item 21, AADT, one must code 6 digits. Leading zeroes must be coded for all numeric data items.

If a section in the dataset is currently coded as a rural section and has become an urban section, all data items for the section which need to be updated must be updated at the same time, i.e., all urban data items must be updated at the same time the rural/urban code (item 5) is changed to urban (code = 2 or 3). This is because the update procedure includes calculation/generation of the calculated data items, and all values used in these calculations must be present. Similarly, if a section in the dataset is currently coded as an urban section and has become a rural section, all data items for the section which need to be updated must be updated at the same time, i.e., all rural data items must be updated at the same time the rural/urban code (item 5) is changed to rural (code = 1).

The data items which have a part a, b, c, etc. (e.g., items 45, 51, 57, etc.) must have the letter coded as part of the item number as indicated in Appendix P, i.e., to correct the right shoulder width to "10" one would code /45-A,10/. The data items with more than one set of values (e.g., State Control Field, railroad crossing ID's or structure ID's) must have the position of the one to be corrected as part of the item number as indicated in Appendix P, i.e., to correct the third railroad crossing ID, one would code /78-03,007631A/. The position for the item number must be coded as two digits with leading zero.

The card sequence number must always start with 1, and indicates the location of the update card when there is more than one per section. The county code must have a three-digit numeric value and the section ID must be coded exactly the same as the ID for the section in the dataset, including leading/trailing zeroes or blanks. If all data item corrections required for a section cannot be coded on nine update cards, another execution will have to be made to correct the remaining data items. There cannot be more than nine update cards with the same county and section ID code.

e.g.,

U1017___000011289/20,001110/74-B,03/ Item 20, Section Length, is to be corrected to the value 001110; Item 74-B, Number of At-grade Intersections with stop signs is to be corrected to a value of "03".

U6020_____286/51-E,0201023/78-12,701936A/70,2/

Item 51-E, Curves, is changed to 0201023; Item 78, the 12th crossing ID is to be corrected to 701936A; Item 70, Type of Terrain is changed to "2".

c. Add or Delete Structure ID Transaction Card (S)

This transaction card enables the user to add structure ID's to an existing sample section with no ID's coded, add more structure ID's to a sample section which already has ID's coded (must be < 50), or delete one or more ID's from the existing set of ID's for a section. This card may be used in combination with the update card and/or the add/delete at-grade crossing ID card. The structure ID transaction card format is as follows:

Transaction Card Code--"S"	Column 1
Sequence Number--"1-9"	Column 2
County Code	Columns 3-5
Section ID	Columns 6-17
Function to be performed on Structure ID--"A" add ID's coded. --"D" delete ID's coded.	Column 18
Structure ID's to be added or deleted coded 15 characters each, 1 to 4 per card	Columns 19-78
Blank	Columns 79-80

The card sequence number must begin with 1 and be numeric. A three-digit numeric value must be coded for the county code and the section ID must be coded exactly the same as the existing section in the dataset including leading/trailing zeroes or blanks. Only one function ("D" or "A") may be coded per card and all ID's coded on that card will be added or deleted; however, existing structure ID's may be deleted for a section and new ID's added by coding one or more cards with a "D" and one or more with an "A". Each structure ID must be 15 characters (blanks included) in length.

e.g., S1171____RT07628D2243CTYRT10RT25
S2171____RT07628A_FED76982761072FED769871469352

Two structure transaction cards for one section. First, a structure ID is to be deleted and then two new ID's are to be added to the section.

If more than 36 structure ID's are to be deleted and/or added for a section, the subprogram STHPMODU will need to be executed more than once since the maximum number of ID's that can be coded in one execution is 36 (4 per card, 9 cards maximum).

NOTE: The structure ID transaction card does not adjust the number of structures coded in item 75. The user must update this data item, separately.

d. Add or Delete At-grade Railroad Crossing ID Transaction Card (R)

The use of this transaction card enables the user to add crossing ID's to an existing sample section with no ID's coded, add more crossing ID's to a section which already has ID's coded (must be < 15), or delete one or more ID's from the existing set of ID's for a section. The crossing transaction card may be used in combination with the update card and/or the add/delete structure ID card. The card format is as follows.

Transaction Card Code--"R"	Column 1
Sequence Number--"1-9"	Column 2
County Code	Columns 3-5
Section ID	Columns 6-17
Function to be performed on Crossing ID--"A" add ID's coded. --"D" delete ID's coded.	Column 18
Crossing ID's to be added or deleted coded as 7 characters each, 1 to 8 per card	Columns 19-74
Blank	Columns 75-80

The card sequence number must be a numeric value and must start with 1. The county code must be a three-digit numeric value. The section ID coded must match the ID in the dataset exactly including leading/trailing zeroes or blanks. Crossing ID's may be deleted and added for the same section by using one or more crossing ID transaction cards with a function of "D" plus one or more with a function of "A", respectively. Each crossing ID coded must be seven characters in length--six numeric digits and one alphabetic.

e.g., R1273_____12854D724329B816629F
R2273_____12854A872131J923517D396424A157739H

Two crossing transaction cards for the same section. The first function deletes two crossing ID'S, while the second function adds four crossing ID's to the section.

NOTE: The crossing ID transaction card does not adjust the number of at-grade crossings coded in item 76. The user must update this data item, separately.

e. Delete a Section Transaction Card (D)

This transaction card enables the user to remove a section record from the dataset and cannot be used with any other transaction card. The card format is as follows.

Transaction Card Code--"D"	Column 1
Sequence Number--Always "1"	Column 2
County Code	Columns 3-5
Section Identification	Columns 6-17
Occurrence of section to be deleted	Column 18
Blank	Columns 19-80

The county code must be a three-digit numeric value. The section identification must be coded exactly as the one to be deleted (including embedded or leading/trailing zeroes or blanks). The occurrence of the section to be deleted must be numeric and tells which section is to be deleted if there is more than one in the dataset with the same section ID (item 8). In most cases, the occurrence will be coded "1".

e.g., D1124__RT11__10212 - Delete the second section with matching ID.

2. Universe Mileage Cards

Required control card(s) for the program option SELEXPF with keywords FACTCALC and MILECARD containing the universe mileage for each volume group for which expansion factors are to be calculated. The subprogram will total the sample mileage in the volume group, divide it into the universe mileage to get the new expansion factor, and then replace the old expansion factors on the sample records for that volume group with the new expansion factors. These control cards are used with the input dataset, UNIVERSE (see Section F).

Since the Interstate system requires the sampling of four mileage categories, the universe mileage card must contain a code indicating for which category (type) of Interstate mileage the expansion factors are being calculated, as well as the volume group. Interstate (functional system code 01 or 11) is the only functional system which must have a category of mileage coded on the universe mileage card. The codes for the Interstate category are listed under the card format, below. The universe mileage coded on the control card must be the total mileage for the volume group and category of Interstate mileage, i.e., for volume group 02 on Interstate toll (category code "2") the universe mileage would consist only of the Interstate which is toll in that AADT group. If an Interstate section falls in more than one category, apply the universe mileage to the category with the lower code, i.e., Section 139(a)/toll would be applied to category code "2". If this causes expanded mileage errors (i.e., one or both of the subcategory mileages do not expand to the universe mileage actually in each of the subcategories, individually), 100 % sampling of the conflicting mileage will be required.

This card format is:

Type of Area --Rural: Code "RUR". --Small Urban: Code "SMU". --Individually Sampled Urbanized Areas: Code the three-digit urbanized area code. --Grouped Urbanized Area for Sampling: Code the letter "G" followed by the two-digit prefix (between 11 - 20) used for the group of urbanized areas, as coded in Item 6.	Columns 1-3
Functional System --Code the two-digit functional system code (Item 9).	Columns 4-5
Volume Group Number --Code the two-digit volume group number including leading zero, where necessary, for which the universe mileage is being entered.	Columns 6-7
Universe Mileage --Code the universe mileage for the volume group any place in these columns. The mileage for the volume group may be coded to the nearest thousandth of a mile. When coding to the nearest tenth, hundredth or thousandth of a mile the decimal point must be coded. Leading zeroes are optional.	Columns 8-16

Interstate Mileage Category Code	Column 17
--Interstate (non-toll, not 139(a), & not Secretarial Agreement)	code "1"
--Interstate toll (Item 19, code "2")	code "2"
--Interstate with Secretarial Agreement (Item 19, codes "3" & "4")	code "3"
--Interstate 139(a) addition (Item 16, code "40")	code "4"

All Other Functional Systems -- Column 17 Blank

Blank — Columns 18-80

There must be a card for each volume group within a functional system for which a new expansion factor is to be calculated when using the MILECARD option.

e.g., G201102125 1
G20110200125.0001
G201102125.0 1

These three cards would all have the same effect. Expansion factors are to be calculated for urban Interstate, volume group 02 for grouped urbanized areas using the prefix "20", with universe mileage of 125.

RUR0604316.827 - Expansion factors are to be calculated for rural minor arterials volume group 04 with universe mileage equal to 316.827 miles.

3. Urbanized Area Name Cards

Optional for the program selection SELSUMT. Optional for SELBTAB when urban summary tables which show individual urbanized areas have been selected (INDUZA). These cards enable the subprogram to print the urbanized area name on the summary tables. One card is required for each urbanized area in a State. Up to 35 cards may be included. The card format is as follows:

Urbanized Area Code	Columns 1-3
--Individually sampled urbanized areas; code the three-digit urbanized area code.	
--Grouped urbanized areas for sampling; code the letter "G", followed by the two-digit prefix (between 11 and 20) used for the group of urbanized areas.	
Urbanized Area Name	Columns 4-33
Blank	Columns 34-80

The three-digit urbanized area code must be coded with leading zeroes. 1-30 characters, including blanks, may be used for the name of the urbanized area. If the user does not desire the urbanized area name on the summary table(s), these cards may be omitted, or coded with columns 4-33 blank. If omitted, the urbanized area code (or the group code for collective urbanized areas) will be listed. These control cards are used with the input dataset, URBCARD (see Section F).

e.g., 247__NEW_TOWN_CHICAGO
G13_PEORIA-ROCKFORD-ALTON

4. County Name Cards

Optional for the program selection SELSUMT with keyword, CNTYMILE. Optional for the program selection SELEDIT. These cards enable the subprogram(s) to print the county name on the summary table CNTYMILE in SELSUMT and/or on the SELEDIT edit listings and messages for each county in a State. Up to 250 cards may be included. The card format is as follows:

County Code --The three-digit county code.	Columns 1-3
County Name	Columns 4-33
Blank	Columns 34-80

The three-digit county code must be coded with leading zeroes, where necessary. From 1-30 characters, including blanks, may be used for the name of the county. If the user does not desire the county name on the table(s), these cards may be omitted, or coded with columns 4-33 blank. If omitted, the county FIPS code will be listed. These control cards are used with the input dataset, CTYCARD (see Section F).

e.g., 012_ROCKFORD

F. INPUT/OUTPUT DATASETS

Several datasets are used during execution depending on the program options(s) selected.

1. SYSUDUMP Standard "system output" dataset used if the program abnormally terminates during execution. Routed to the printer. Required for all executions if a dump is desired for abnormal termination.

2. SYSOUT Standard "systems output" dataset for printing system messages. Required for all executions.

3. USERPARM Input dataset containing the parameter cards. Consists of 80-character records. Required for all executions.

4. LISTPARM Output dataset routed to the printer for listing of parameter cards, error messages and information messages for the user. Required for all executions.

5. CURMAST Input dataset which contains the current HPMS dataset. The type record format, variable blocked, and the record length, 163 to 1282 characters, are defined by the subprogram(s). The block size can vary and may be defined by the user or determined from the dataset labels. Required input dataset for SELMODU, SELBTAB and SELCALC for all executions. Input dataset for SELEXPF, SELEDIT, SELSUMT and SELINTS, depending on program option combinations requested.

6. NEWMAST Input/output dataset which contains the updated HPMS dataset. The DCB parameters are defined by the subprogram(s). Required output dataset for SELMODU. Required input dataset for SELEXPF if selected with SELMODU; for SELEDIT if selected with SELMODU; for SELSUMT if selected with SELMODU.

7. CALMAST Required output dataset for SELCALC which contains the updated (current) calculated/recalculated data items and/or the updated (current) climate zones. The DCB parameters are defined by the subprogram.

8. CURUPMOD Temporary input/output dataset required for the program option SELMODU, which contains the updated HPMS dataset before the data is sorted or copied to the new master dataset. Required temporary input/output dataset for the program option SELEXPF with keyword, FACTCALC. The DCB parameters are defined by the subprogram.

9. EXPFMAST Input/output dataset which contains the HPMS dataset with new expansion factors. Required output dataset for SELEXPF with keyword FACTCALC. Required input dataset for SELEDIT if selected with SELEXPF; for SELSUMT if selected with SELEXPF. The DCB parameters are defined by the subprogram(s).

10. TEMPFILE Temporary input/output dataset required for the program option SELEXPF with keyword UNIVTAB. Contains the sorted HPMS dataset later used to produce the summary universe mileage table. The DCB parameters are defined by the subprogram.

11. PRINTER Output dataset routed to the printer. Required output dataset for the program option SELEXPF and/or SELSUMT. Required output dataset for SELCALC or SELBTAB. Contains program messages, error messages and summary tables.

12. ERRPRINT Output dataset routed to the printer. Required output dataset for SELMODU and/or SELEDIT. Contains transaction cards found to be in error, and/or error messages and data sections with at least one data item in error along with error messages.

13. UMODCARD Input dataset which contains the 80-character transaction cards to add, modify and/or delete section records on the HPMS dataset. Required dataset for program option SELMODU with keyword ADDONLY or ADDMOD or MODONLY.

14. UMODFILE Temporary input/output dataset required for the program option SELMODU with keyword ADDONLY or MODONLY or ADDMOD. Contains the sorted valid transaction card sets to modify and/or delete HPMS sections. The DCB parameters are defined by the subprogram.

15. MODPRINT Output dataset routed to the printer. Required output dataset for the program option SELMODU. Contains summary tables and error messages.

16. UNIVERSE Input dataset which contains the 80-character universe mileage cards. Required for program option SELEXPF <u>with</u> keywords FACTCALC and MILECARD.

17. URBCARD Input dataset which contains the 80-character urbanized area name cards. Required dataset for program option SELBTAB when urban summary tables showing individual urbanized areas have been selected if the user desires the urbanized area name on the summary tables. Required dataset for SELSUMT. If urbanized area names are not desired on the tables from the program options SELSUMT or SELBTAB, this dataset must still be included as URBCARD DD DUMMY.

18. CTYCARD — Input data set which contains the 80-character county name cards. Required dataset for program option SELSUMT with keyword CNTYMILE if user desires the county name on the output table. Required dataset for SELEDIT. If county names are not desired on the output, this dataset must still be included as CTYCARD DD DUMMY.

19. RURALIN — Temporary input/output dataset required for the program option SELBTAB if rural summary tables(s) have been selected. The dataset contains the sample rural HPMS section records reduced in length. The DCB parameters are defined by the subprogram(s).

20. URBANIN — Temporary input/output dataset required for the program option SELBTAB if urban summary table(s) have been selected. The dataset contains the sample urban HPMS section records reduced in length. The DCB parameters are defined by the subprogram(s).

21. SORTWK01, SORTWK02, SORTWK03, SORTWK04 — Intermediate storage datasets for sorting applications. The sort program requires at least three work datasets. A SORTLIB DD card may be needed on some systems.

    Required for program options SELMODU, SELINTS, SELEXPF, SELSUMT and SELBTAB. Required for program option SELEDIT with keyword VALIDCODES and without keyword SAMPNUMNO (i.e., sample number is to be checked for uniqueness).

Required INPUT/OUTPUT datasets by program option.

All executions of FHWAHPMS require the following datasets:

SYSUDUMP (if a dump is desired for abnormal end)
SYSOUT
USERPARM
LISTPARM

Program option SELMODU

CURMAST
CURUPMOD
NEWMAST
ERRPRINT
UMODCARD
UMODFILE
MODPRINT
SORTWK01
SORTWK02
SORTWK03

Program option SELEDIT

CURMAST
ERRPRINT
1/ CTYCARD
SORTWK01 . . . |
SORTWK02 . . . | If sample number is being checked for
SORTWK03 . . . | uniqueness.

1/ If county names are not desired on the listings, this card must be included as CTYCARD DD DUMMY.

Program option SELCALC

CURMAST
CALMAST
PRINTER

Program option SELEXPF

SELEXPF with keyword UNIVTAB
CURMAST
PRINTER
TEMPFILE
SORTWK01
SORTWK02
SORTWK03

SELEXPF with keyword FACTTAB
CURMAST
PRINTER
SORTWK01
SORTWK02
SORTWK03

SELEXPF with keyword FACTCALC
CURMAST
EXPFMAST
CURUPMOD
PRINTER
2/ UNIVERSE with keyword MILECARD
SORTWK01
SORTWK02
SORTWK03

2/ If universe mileage is accumulated from the master file, this dataset may be omitted.

Program option SELBTAB

	CURMAST	
	PRINTER	
3/	URBCARD	If urban tables are selected
	RURALIN	If rural tables are selected
	URBANIN	If urban tables are selected
	SORTWK01	
	SORTWK02	
	SORTWK03	

3/ If urbanized area names are not desired on the tables, this card must be included as URBCARD DD DUMMY.

Program option SELSUMT

	CURMAST	
	PRINTER	
4/	URBCARD	
4/	CTYCARD	If county mileage table is selected
	SORTWK01	
	SORTWK02	
	SORTWK03	

4/ If urbanized area names are not desired on the tables, the URBCARD DD card must be included as URBCARD DD DUMMY. If county names are not desired on the county mileage table, the CTYCARD DD card must be included as CTYCARD DD DUMMY.

Program option SELINTS

CURMAST
PRINTER
SORTWK01
SORTWK02
SORTWK03

G. PROGRAM OPERATION

The user parameter cards are read and each is checked for card name to determine which program option(s) has been selected and which keyword(s) was selected for the program option(s). Each parameter card read is edited for general type errors--valid parameter card name with valid keyword(s), invalid inventory year, invalid card format, and numeric value where required. If a general error is found, the remainder of the parameter cards are read and listed without being checked for card name and keyword(s) coded along with the appropriate general error message. If the end of the parameter cards is reached before any general errors are found, a more detailed edit is performed on the set of cards with specific error messages(s) listed for any error(s) detected. Some of the types of more detailed edits are:

1. INVYEAR card must be included in parameter card set.

2. SELCALC program option card cannot be included with any other program option card.

3. SELEXPF program option card must contain one of the keywords FACTCALC or FACTTAB.

Execution of FHWAHPMS will terminate if an error is found in the set of parameter cards (general or the more detailed editing). If execution terminates, all parameter cards will be listed for the user along with appropriate error message(s).

Once the end of the parameter cards is reached with no errors, each subprogram required to perform the program option(s) selected by the user will be dynamically called by FHWAHPMS. If mutliple program options have been selected, the subprograms will be called in the following order:

STHPMODU (SELMODU)
STHPEXPF (SELEXPF)
STHPEDIT (SELEDIT)
STHPSUMT (SELSUMT)
STHPINTS (SELINTS)

After all selected subprograms have been called and execution has been returned to FHWAHPMS for the last time, a message is printed reminding the user which dataset should be kept as the latest HPMS master dataset.

Each subprogram operation is discussed briefly in Appendix Q.

H. OUTPUT

1. Datasets on Tape or Disk

   a. The program option SELMODU creates an updated HPMS dataset, NEWMAST.

   b. The program option SELEXPF creates an HPMS dataset, EXPFMAST, with new expansion factors for sample sections.

   c. The program option SELCALC creates an HPMS dataset, CALMAST, with each section record containing the recalculated values for each calculated data item in the record.

2. Printed

   a. List of user parameter cards.

   b. List of program control cards.

   c. Error messages if invalid parameter card(s) are included.

   d. Error messages if invalid control cards are coded.

   e. Listing of section record(s) in error and error messages from editing of data.

   f. Listing of section records in dataset.

   g. Summary tables.

   h. Information messages for the user.

I. ERROR MESSAGES/USER MESSAGES

The messages are listed below for FHWAHPMS and each subprogram that lists errors for the user. The error messages for the editing of the data items will not be included here -- see the edit specifications contained in Appendix M.

FHWAHPMS

1. "INVALID KEYWORD ON PARAMETER CARD" - Indicates the user has misspelled a keyword. Execution terminates.

2. "INVALID CARD NAME ON PARAMETER CARD" - Indicates the user has misspelled the name on one of the parameter cards. Execution terminates.

3. "YEAR IS NOT NUMERIC ON INVYEAR PARAMETER CARD" - Indicates the year coded is not a 4-digit number. Execution terminates.

4. "MAXIMUM NUMBER ERROR CODED IS NOT NUMERIC OR IS MORE THAN 5 DIGITS" - Self-explanatory. Execution terminates.

5. "MAXERRS CARD IS INCLUDED WITHOUT PROGRAM OPTION CARD SELEDIT" - Indicates the user has forgotten to include the program option card for the edit or should not have included the MAXERRS card as no editing of data is to be done. Execution terminates.

6. "REQUIRED STATE NAME CARD AND/OR INVENTORY YEAR CARD MISSING" - These two parameter cards are required for all executions. Execution terminates.

7. "INVALID FORMAT FOR TABLE SELECTION ON SELBTAB CARD OR INVALID TABLE NUMBER SELECTED" - Indicates the user has not coded the area type with the table number (U or R) or the number coded is 0 or greater than 9.

8. "RANGES ON SELBTAB CARD ARE INVALID" - Indicates the user has coded the end range table number smaller than the beginning range table number. Execution terminates.

9. "PARAMETER CARD SET DOES NOT CONTAIN AT LEAST ONE PROGRAM OPTION CARD" - Each execution of FHWAHPMS must contain one of the cards SELMODU, SELEDIT, SELEXPF, SELSUMT, SELCALC, or SELBTAB. Execution terminates.

10. "BEGIN RANGE TABLE AREA TYPE AND END RANGE TABLE AREA TYPE ARE NOT THE SAME ON THE SELBTAB CARD" - The area types (R -rural, U - urban) coded on the range selection for tables must be the same. Execution terminates.

11. "ONE OF THE KEYWORDS - LISTSECT, LISTUNIV, LISTSAMPLE - IS CODED WITH A TYPE EDIT KEYWORD ON THE SELEDIT CARD" - The listing of sections and editing of the data items are mutually exclusive. Only one type of keyword may be coded in an execution. Execution terminates.

12. "SELEXPF CARD HAS BOTH KEYWORDS CODED--FACTCALC and FACTTAB; ONLY ONE MAY BE CODED" - Self-explanatory. Execution terminates.

13. "SELEXPF CARD HAS FACTCALC KEYWORD CODED. ONE OF KEYWORDS--MILEDATA OR MILECARD--MUST BE CODED" - Self-explanatory. Execution terminates.

14. "SELEXPF CARD HAS ONE OF KEYWORDS--MILEDATA OR MILECARD--CODED. KEYWORD FACTCALC MUST BE CODED" - Self-explanatory. Execution terminates.

15. "THE PROGRAM OPTION CARD SELBTAB MAY NOT BE INCLUDED WITH ANY OTHER PROGRAM OPTION CARD" - SELBTAB cannot be selected with any other program option since the dataset must be as free of errors and as complete as possible for the battery of summary tables to be useful. Execution terminates.

16. "INVALID CARD FORMAT ON PARAMETER CARD" - A comma has been omitted, the slashes for the State code, or the equal sign has been omitted. Execution terminates.

17. "STATE CODE IS NOT NUMERIC ON STATECN CARD" - Self-explanatory. Execution terminates.

18. "THE PROGRAM OPTION CARD SELCALC MAY NOT BE INCLUDED WITH ANY OTHER PROGRAM OPTION CARD" - SELCALC cannot be included with any other program option card. The dataset needs to contain valid codes before the calculated data items are calculated for the first time. Execution terminates.

19. "ONLY ONE KEYWORD MAY BE CODED ON THE SELMODU CARD" - All SELMODU keywords are mutually exclusive. Execution terminates.

20. "CNTYINC CANNOT BE INCLUDED WITHOUT THE PROGRAM OPTION CARD, SELEDIT" - self-explanatory. Execution terminates.

21. "PROGRAM OPTION SELSUMT WAS SELECTED WITH KEYWORD SAMPLEMT. IT WAS NOT EXECUTED. ZERO AADT'S WERE FOUND WHILE DETERMINING THE UNIVERSE MILEAGE FROM THE DATASET. NO NEW EXPANSION FACTORS WERE CALCULATED" - self-explanatory.

22. "PARAMETER CARDS CONTAIN AT LEAST ONE ERROR. CHECK ALL CARDS. EXECUTION TERMINATED" - self-explanatory. Execution terminates.

23. "***** INVALID COUNTY CODES IN DATA. SECTION WAS NOT INCLUDED IN SELECTION. MAY BE MISSING SECTIONS DESIRED" - self-explanatory.

24. "NO ERRORS WERE DETECTED IN THE PARAMETER CARDS. EXECUTION OF PROGRAM OPTIONS SELECTED BY USER STARTED" - self-explanatory.

25. "***** PROGRAM OPTION SELEDIT WAS SELECTED WITH SPECIFIC COUNTIES DESIRED (CNTYINC)" - Reminds the user all counties in the dataset have not been edited.

STHPMODU (SELMODU)

1. "UPDATE CARD IMPROPER FORM" - Indicates the user has not coded the transaction card correctly. This card is not used.

2. "SEQ NUM MUST BE NUMERIC > 0" - Indicates the sequence number on the transaction card has been miscoded. The transaction is not used for building the valid transaction dataset.

3. "CK: SEQ NUM, ID or TRAN CODE" - The ordering of the transaction set should be verified, section ID and county code checked. In some situations, the transaction code may be invalid. The set with matching ID's is not used.

4. "DELETE CARDS > 1 WITH SAME ID" - More than one delete card has been included for the same section. The deletion is not performed for either card. Verify ID's on cards.

5. "INVALID TRANSACTION CODE" - The first column on the card does not contain an N, U, D, R or S. The transaction set with matching ID is not used.

6. "TRAN CODE NOT =; SEQ # > 1, ID =" - Different transaction codes coded for same ID with a sequence number not equal 01. Verify ID, transaction code, and sequence number. The set is not used.

7. "TOO MANY BRID/XING ID FOR SECT" - Indicates that the addition of bridge or crossing ID's exceeded the maximum number - bridge (structure), 50; crossing, 15. Only the ID's beyond the maximum number were not added. Card with these ID's is listed.

8. "INVALID ITEM NUMBER" - Indicates that particular update could not be performed. All valid updates on card are performed.

9. "ID TRANS NOT = ID FOR SECTION" - Indicates the county code and section ID on the transaction card does not match any in the dataset. No transaction performed.

10. "OCCURRENCE OF DELETION INVALID" - Indicates ID for deletion matched, but there was only one section with that ID. Deletion is not performed.

11. "INVALID FORMAT FOR UPDATE CARD" - Verify the coding of card. This particular card is not used, but all valid cards in set are used and updates are performed.

12. "INVALID FORMAT FOR UPDATE" - Indicates that particular update has a coding error--not of form /xx,xxxx/ or /xx-x,xx/. All valid coded updates on card are used.

13. "INVALID FORMAT FOR STRUCID CARD" - Indicates that particular structure transaction card is miscoded and is not used. Any valid cards in set are used with actions performed on the record.

14. "INVALID FORMAT FOR XINGID CARD" - Indicates that particular crossing transaction card is miscoded and is not used. Any valid cards in set are used with actions performed on section.

15. "INVALID FORMAT FOR DELETE CARD" - Indicates the card is miscoded. The deletion is not performed.

16. "INVALID FORMAT ITEM & SUB-ITEM" - Indicates the coding for a data item with a sub-item is invalid -- not of the form /xx-x,xxx/ or /xx-xx,xx/. All validly coded updates on the card are used.

17. "CALCULATED DATA ITEM" - A calculated data item, other than capacity (item 60), has been coded as a data item to be updated. The item is not updated, but all validly coded updates on the card are used.

18. "INVALID SUB-ITEM LETTER OR NUM" - Indicates the sub-item letter or number coded for item number 1, 45, 51, 53, 57 62 or 74 is miscoded or the structure ID referenced is > 50 or the crossing ID referenced is > 15. The update is not performed. Any other valid updates on card are performed.

19. "CODE NOT 'A' or 'D' FOR ID'S" - Indicates the action to be performed on structure or crossing ID is miscoded. This card is not used. Any other valid card in set is used.

20. "DEL BRID/XING ID DOESN'T MATCH" - Indicates the ID coded to be deleted from section structure (bridge) ID's or crossing ID's is not on data record. Verify. Any other valid ID to delete on card is deleted for section.

21. "INVALID ITEM NUM WITH SUB-ITEM" - Indicates a letter or number has been coded for an item number which has no subitems. See Appendix P to verify which data items have subitems. This particular update is not performed, but any valid update on card is performed.

22. "DEL CARD & OTHER TRAN CARD = ID" - Indicates a delete for a section has been coded with another transaction set. Verify transaction codes. Cards are not used.

23. "ITEM NUM MUST HAVE SUB-ITEM" - Indicates the coded item number must have a letter or number subitem. This particular update is not made. Any other valid updates on card are performed.

24. "T-CODE N; 2 TYPE 1 CARDS = ID'S" - Check the transaction code N card type number. Cannot have two card type 1 for same section. Section record is not added to dataset.

25. "NEWSECT CARD & OTHER TRAN = ID'S" - Check the county code and section ID. Transaction code N cannot be coded with any other transaction for same section. Transaction sets are not used.

26. "NEWSECT CARD TYPE MUST BE 1-9" - Card type has been miscoded for a new section to be added. Check all card type numbers. Section is not added to the dataset.

27. "NEWSECT TYPE1 CARD MISSING" - To add a section - universe, or sample - there must be a transaction card N with card type 1.

28. "NEWSECT 2 TYPE2 CARDS INCLUDED " - Each section to be added must have one card type 1 and one card type 2. Section is not added.

29. "NEWSECT TYPE1/2 CARD MISSING" - See #28.

30. "NEWSECT 2 TYPE3 CARDS INCLUDED" - To add a new section, there must be one each of card type 1, card type 2, and card type 3. Section is not added.

31. "NEWSECT TYPE1/2/3 CARD MISSING" - The first N transaction card for a new section starts with a number > 3. See #30.

32. "TOO MANY CARDS FOR NEWSECTION" - The maximum number of cards to add a new sample section of maximum length is 23. Section is not added.

33. "ID FOR NEWSECT = ID ON DATASET" - Check the county code and section ID coded for the transaction set N. Section is not added since it already exists.

34. "TOO MANY ID'S CODED--NEWSECT" - More than 13 structure ID cards (card type 8) or more than 2 crossing ID cards (card type 9) have been included for the new section. Section is not added.

35. "CURVE CARD2 MISSING--NEWSECT"
"CURVE CARD1 MISSING--NEWSECT" - A new sample section must have curve data provided if it is a rural arterial or urban principal arterial. There must be two type 6 cards for these sections. Section is not added.

36. "STRUC CARD MISSING - CK CARD #'S" - A new section is to be added with structure ID's (card type 8). The sequence numbers for card type 8 are not in order or a card has been omitted. Section is not added.

37. "XING CARD MISSING - CK CARD #'S" - A new section is to be added with crossing ID's (card type 9). The sequence numbers for card type 9 are not in order or a card has been omitted. Section is not added.

38. "UNIV SECT INVALID ITEM NUMBER" - The update item number is greater than 22 for a universe section. The udpate for the data item is not made. All other valid updates on card are made for the section.

39. "ITEM 23 CANNOT BE MODIFIED" - The user cannot change item 23, the continuation code. The subprogram makes any necessary changes when modifications are made to the section.

40. "STRUC ID'S NOT CODED FOR SECT" - An update has been coded for a structure ID on a section which does not have any. The transaction card, S, should be used. Other valid updates for the section are made.

41. "ID # TO BE UPDATED> #ID'S" - An update has been coded for a structure ID or crossing ID beyond the number of ID's for the section. Update is not made. Any other valid updates for the section are made.

42. "XING ID'S NOT CODED FOR SECT" - An update has been coded for a crossing ID on a section which does not have any. The transaction card, R, should be used. Any other valid updates for the section are made.

43. "NEWSECT 2 TYPE 4 CARDS INCLUDED" - To add a sample section, there must be one each of card type 1, card type 2, card type 3, card type 4 and card type 5. Section is not added.

44. "NEWSECT 2 TYPE 5 CARDS INCLUDED" - See # 43, above.

45. "INVALID SECTION TYPE FOR NEWSECT" - The transaction set N must contain a 1 or 2 in card type 1, column 80, to indicate type of section being added. Section is not added.

46. "CTYPE4/5 CODED SECTION TYPE UNIV" - The type of section being added coded in card type 1 disagrees with number of cards coded for a new section. Only a sample section (section type 2) has card type 4 and card type 5 provided. Check number of cards coded and section type. Section is not added.

47. "CTYPE 6-9 CODED SECT TYPE 1" - Too many cards coded for new section with type of section coded. Card types 6-9 indicate sample section. Check section type coded. Section is not added.

48. "CTYPE4/5 MISSING SECT TYPE IS 2" - The section type of 2 indicates a sample section is to be added which must have one card each of card type 1, 2, 3, 4 and 5. Check section type number. Section is not added.

49. "CUR CARD NUM = 0 or GREATER 2" - To provide curves for a new section on a required functional system there must be a card type 6 number 1 and card type 6 number 2. Section is not added.

50. "CTYPE8/9 CARD NUM NOT NUMERIC" - Card type 8 - structure ID's and card type 9 - crossing ID's - for a new section must have a card number to indicate the sequence of these mutliple card types. Section is not added.

51. "INVALID DATA ITEM FOR SECTION" - Crossing ID's (transaction R), or structure ID's (transaction S) have been coded for a universe section. Check county code and section ID. Transaction is not performed.

52. "******CLIMATE ZONE WAS NOT DETERMINED FOR ALL SAMPLE SECTIONS. NON-NUMERIC COUNTY CODES OR INVALID COUNTY CODES WERE FOUND. VERIFY ALL COUNTY CODES." - Zero is placed on data record for the climate zone. County code must be valid to determine the climate zone.

STHPEXPF (SELEXPF)

1. "NO UNIVERSE MILEAGE CARDS SUBMITTED. NO EXPANSION FACTORS WILL BE CALCULATED" - The program option SELEXPF=FACTCALC,MILECARD was selected, but no universe mileage cards were submitted.

2. "NO SAMPLE MILEAGE FOUND" - A universe mileage card was submitted for a volume group for which no sample sections could be found.

3. "UNIVERSE MILEAGE LESS THAN SAMPLE MILEAGE" - Universe mileage given on card is less than the sample mileage for this volume group.

4. "****EXPANSION FACTOR CALCULATED" - Expansion factor has been successfully calculated for this volume group.

5. "UNMATCHED URBAN CODE" - No sample sections could be found that matched the urban code on the universe mileage card.

6. "INVALID FUNC CLASS" - Functional system in columns 4-5 of the universe mileage card is not among the valid codes.

7. "INVALID VOLUME GROUP" - Check columns 6-7 of the universe mileage card.

8. "MILEAGE NOT NUMERIC" - Check columns 8-16 of the universe mileage card.

9. "ERROR--MULTIPLE EXPANSION FACTORS" - More than one expansion factor for this volume group was found on the master file. All the sample sections within a volume group should have the same expansion factor.

10. "NO ZERO AADTS WERE DETECTED--THE UNIVERSE MILEAGE HAS BEEN ACCUMULATED AND EXPANSION FACTORS CALCULATED" - The program option SELEXPF=FACTCALC,MILEDATA was selected and expansion factors have been successfully calculated.

11. "THE FOLLOWING RECORDS SHOW AN AADT = 0 FOR ROADS OPEN TO TRAFFIC. THE UNIVERSE MILEAGE COULD NOT BE DETERMINED; CHECK YOUR RECORDS AND TRY AGAIN" - The program option SELEXPF=FACTCALC,MILEDATA was selected, however the input file contains records with zero AADTs.

12. "*******NO EXPANSION FACTORS CALCULATED" - Expansion factors were not calculated due to error(s).

STHPCALC (SELCALC)

1. "******CLIMATE ZONE WAS NOT DETERMINED FOR ALL SAMPLE SECTIONS. NON-NUMERIC COUNTY CODES OR INVALID COUNTY CODES WERE FOUND. VERIFY ALL COUNTY CODES." - Zero is placed on data record for the climate zone. County code must be valid to determine the climate zone.

STHPBTAB (SELBTAB), STHPEDIT (SELEDIT), STHPSUMT (SELSUMT)

1. "TOO MANY URBAN AREA CARDS SUBMITTED; REMAINING CARDS IGNORED" - Program can only accommodate 35 urbanized area codes. At present no State has more than 30 urbanized areas.

2. "TOO MANY COUNTY NAME CARDS SUBMITTED: REMAINING CARDS IGNORED" - Program can only accommodate 250 county name codes.

3. "THE FOLLOWING CARDS SHOW COUNTY CODES WHICH ARE NOT NUMERIC. CORRECT CARDS AND TRY AGAIN. ****PROCESS TERMINATED"- Check columns 1-3 of the county name card. Leading zeroes must be coded.

J. CORE

The amount of core required depends on the program option selected or the combination of program options selected. The amount of core for execution varies from approximately 90K bytes to 280K bytes. The approximate amount of core by program option is as follows:

1/ SELMODU(STHPMODU) 128K bytes to 176K bytes
SELEXPF(STHPEXPF) 156K bytes
2/ SELEDIT(STHPEDIT) 128 bytes to 170K bytes
SELCALC(STHPCALC) 90K bytes
SELSUMT(STHPSUMT) 152K bytes
SELBTAB(STHPBTAB) 98K bytes
SELINTS(STHPINTS) 280K bytes

1/ STHPMODU requires approximately 158K bytes for the keyword MODONLY; approximately 160K bytes for the keywords ADDONLY or ADDMOD. If the county code or section ID is modified, approximately 176K bytes are required as the new master dataset is sorted by section ID within county code.

2/ STHPEDIT requires the larger amount of core for execution if the sample ID number is to be checked for uniqueness within county, as the dataset must be sorted.

K. SAMPLE JCL SETUPS

Sample Run
Produce Battery of Summary Tables
for Individual Urbanized Areas

```
//TABLES  EXEC  PGM=FHWAHPMS,REGION=110K
//STEPLIB   DD  UNIT=DISK,VOL=SER=LP0001,DISP=SHR,
//  DSN=LP.LP02XXBH.SUBMIT89.LOADLIB
//USERPARM  DD  *
STATECN=TEST STATE/30/
INVYEAR=1988
SELBTAB=R1-R9,U1-U6,INDUZA
/*
//LISTPARM  DD  SYSOUT=A,DCB=BLKSIZE=133
//CURMAST   DD  UNIT=DISK,VOL=SER=LP0001,DISP=SHR,
//  DSNAME=ERROR.FREE.FILE
//URBCARD   DD  *
 .
 .
 .
 Place urbanized area cards here.
 .
 .
 .
/*
//PRINTER   DD  SYSOUT=A,DCB=BLKSIZE=133
//SYSOUT    DD  SYSOUT=A
//SYSUDUMP  DD  SYSOUT=A
//RURALIN   DD  DSN=&TEMPRUR,UNIT=DISK,SPACE=(TRK,(30)),DISP=NEW
//URBANIN   DD  DSN=&TEMPURB,UNIT=DISK,SPACE=(TRK,(30)),DISP=NEW
//SORTWK01  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK02  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK03  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK04  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK05  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK06  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//
```

Sample Run
Modify Dataset, Produce Expansion Factor Table,
Produce Summary Tables, and Edit Dataset

```
//TESTRUN  EXEC  PGM=FHWAHPMS,REGION=176K
//STEPLIB   DD  UNIT=DISK,VOL=SER=LP0001,DISP=SHR
//     DSN=LP.LP02XXBH.SUBMIT89.LOADLIB
//USERPARM  DD  *
STATECN= TEST STATE/30/
INVYEAR=1988
SELEDIT=RU,CROSSCKS
SELMODU=ADDMOD
SELEXPF=RU,FACTTAB
SELSUMT=SAMPLEMT,UNIVMT
/*
//LISTPARM  DD  SYSOUT=A,DCB=BLKSIZE=133
//CURMAST   DD  UNIT=DISK,VOL=SER=LP0001,DISP=SHR,
//     DSNAME=OLD.FILE
//UMODCARD  DD  *
 .
 .
 Place transaction cards to modify dataset here.
 .
 .
/*
//URBCARD   DD  *
063FIRST TEST CITY
204SECOND TEST URBANIZED AREA
/*
//CTYCARD   DD  *
049CLAY
115DADE
200GREEN
/*
//CURUPMOD  DD  UNIT=DISK,DISP=NEW,DSNAME=&TEMPMAST,SPACE=(CYL,(5))
//UMODFILE  DD  DSN=&TEMP,UNIT=DISK,SPACE=(TRK,(20)),DISP=NEW
//NEWMAST   DD  UNIT=DISK,VOL=SER=LP0001,DISP=(NEW,KEEP),
//  DSNAME=UPDATED.FILE,SPACE=(TRK,(75,10),RLSE)
//MODPRINT  DD  SYSOUT=A,DCB=BLKSIZE=133
//ERRPRINT  DD  SYSOUT=A,DCB=BLKSIZE=133
//PRINTER   DD  SYSOUT=A,DCB=BLKSIZE=133
//SYSOUT    DD  SYSOUT=A
//SORTWK01  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK02  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK03  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK04  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK05  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SORTWK06  DD  UNIT=DISK,SPACE=(CYL,(1,1))
//SYSUDUMP  DD  SYSOUT=A
//
```

Because the subprograms in these runs are called dynamically, a second STEPLIB card may be required on some operating systems.

CHAPTER VII

ANNUAL DATA SUBMITTAL

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

THE DATA TAPE

It should be emphasized that a clean data tape that has been created, edited and summarized with the latest HPMS Submittal Software, is of the utmost importance. Data records in the format discussed in Chapter IV must be submitted on magnetic tape by June 15 of each year reflecting the status of the State's roadway inventory as of December 31 of the preceding (data) year. Note that these records must contain the generated/calculated data items that are inserted into the records by the FHWA-developed software documented in Chapter VI (see keyword SELCALC). 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 and for historical/backup purposes.

The tape should be written in 1600 or 6250 bpi density, nine-channel (9-track), and should contain standard internal tape labels compatible with the IBM operating system. The data set name (DSNAME) should be HPxxzz, where xx is the last two digits of the data year and zz is the State FIPS 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 cannot be met, the transmittal correspondence and 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 Highway Information Management, HPM-20, FHWA." The same or another external label should contain State identification -- the tape will be returned via the FHWA division office.

STATISTICAL INFORMATION

Expansion Factor Table

An expansion factor table stratified by area type (rural, small urban, and individual and/or grouped urbanized) by functional system volume group should be established for the sample sections by the State as outlined under Item 27, 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. Note that the expansion factors and the subject summary table must be developed automatically by the FHWA-developed software documented in Chapter VI (SELEXPF option).

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 system and the required precision level should be submitted by the State. The format for this table should be similar to that shown in Appendix F, or in the example contained in Chapter IV under Item 27. A copy of the table will be submitted along with the other required annual data.

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

AREAWIDE DATA

Areawide 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), II-3 (Local Functional System Mileage Summary), and II-4, Parts 1 and 2, (Travel Activity by Vehicle Type and Functional System). The forms may be copied from the appropriate pages in Chapter II. The forms are to be submitted in triplicate to the appropriate FHWA division office for forwarding to the address shown ahead to arrive in the FHWA Washington, D. C. Headquarters by June 15 of the year following the data year. Alternatively, a Lotus 1-2-3 spreadsheet may be submitted in lieu of the forms as described in Chapter II. Diskettes may be sent directly to FHWA Headquarters (HPM-20), but two printed copies should be forwarded to the division office.

SUMMARY

The following items are to be submitted annually by June 15 of the year following the calendar data year:

1. Data tape, as discussed in Chapters IV and VI.

2. Statistical information:

   a) Printout of final edit (option SELEDIT=RU,FINAL) including explanations for all remaining messages.

   b) Expansion Factor Table as discussed in Chapters IV (Item 27) and VI (SELEXPF option).

   c) Number and Ranges of Volume Groups by Functional System and Required Precision Level (see Appendix F). This is to be submitted only 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 and 2).

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

   c) Local Functional System Mileage Summary (Figure II-3).

   d) Travel Activity by Vehicle Type and Functional System (Figure II-4, Parts 1 and 2).

4. Letter of transmittal containing the information discussed below.

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

Chief, Highway Systems Performance Division
Office of Highway Information Management, HPM-20
400 7th Street, S.W., Room 3306
Federal Highway Administration
Washington, D. C. 20590

The letter of transmittal should contain documentation describing the contents of the submittal, as follows: a summary of unusual changes in the contents from previous years, a discussion of any large variation in mileage or number of sections, comments in response to previous year HPMS data reviews, a summary of recurring unusual conditions (see heading, below), and any other information pertinent to the submittal.

The Areawide Data Forms should be submitted in triplicate to the appropriate FHWA division office.

Recurring Unusual Conditions

FHWA Headquarters reviews each State's annual data submittal in depth and returns comments about the review to the State via the FHWA field offices. It is not possible for headquarter's personnel to remember unusual conditions pertinent to specific States, nor is it reasonable or likely that all correspondence beyond the current and, perhaps, one previous data submittal year will be examined. To at least reduce or possibly eliminate the likelihood of repeat comments concerning unusual conditions that will exist in the data year after year, it is suggested that each State remind FHWA of these conditions by providing a concise summary of them with each data submittal.

Since microcomputer text editors seem to be widely available, we would suggest that a file of these comments be preserved, updated, printed and attached to each State submittal of HPMS data. The summary need not be formal; it should be concise, and may refer to correspondence where more detailed information may be found. It should be updated as things change, of course. Some examples of what this summary could include are as follows:

A State's Recurring Unusual Condition Summary

- Interstate 95 in Bigtown does have 2 lane, 2 way roadways for 2.62 miles. The facility ends in the middle of downtown. This condition will remain that way as far as we know.

- We have four sample sections with 18 foot shoulders. These will disappear when additional lanes are completed in 1993 -1995. See correspondence dated June 21, 1988 for more details.

- We would like three State copies of the DRP booklet rather than the usual two.

- Except for roadways that are improved where the PSR is updated upon completion of the construction, all PSR values reflect the same year. These data are collected in odd years, only. This method fits the two year update cycle called for in Chapter V of the HPMS Field Manual, and was approved by the FHWA Division office in 1984.

- Etc.

MAINTAINING THE DATA TAPE

It is recommended that each State maintain a current HPMS submittal data file and make updates periodically, rather than rebuilding the entire file at the end of each year. 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. Once coded, all other data items and records will remain as is unless changed due to update cycles, improvements, or the correction of errors.

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		

APPENDIX B

Urbanized Area Codes

State	Urbanized Area	Code
Alabama	Anniston	254
	Auburn-Opelika	294
	Birmingham	035
	Columbus (GA)	109
	Decatur	295
	Dothan	296
	Florence	255
	Gadsden	192
	Huntsville	184
	Mobile	067
	Montgomery	115
	Tuscaloosa	183
Alaska	Anchorage	256
Arizona	Phoenix	033
	Tucson	073
	Yuma (CA)	287
Arkansas	Fayetteville-Springdale	297
	Fort Smith (OK)	202
	Little Rock-North Little Rock	092
	Memphis (TN, MS)	034
	Pine Bluff	219
	Texarkana (TX)	211
California	Antioch-Pittsburg	257
	Bakersfield	117
	Chico	298
	Fairfield	299
	Fresno	080
	Hemet	300
	Lancaster	301
	Los Angeles-Long Beach-Pomona-Ontario	002
	Merced	380
	Modesto	234
	Napa	302
	Oxnard-Ventura-Thousand Oaks	224
	Palm Springs	303
	Redding	304
	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 Maria	305

Urbanized Area Codes

State	Urbanized Area	Code
California (Cont.)	Santa Rosa	235
	Seaside-Monterey	236
	Simi Valley	237
	Stockton	119
	Visalia	306
	Yuba City	307
	Yuma (AZ)	287
Colorado	Boulder	238
	Colorado Springs	153
	Denver	024
	Fort Collins	308
	Grand Junction	309
	Greeley	310
	Pueblo	149
Connecticut	Bridgeport	051
	Bristol	239
	Danbury (NY)	240
	Hartford	047
	Meriden	212
	New Britain	154
	New Haven	064
	New London-Norwich	259
	Norwalk	176
	Springfield-Chicopee-Holyoke (MA)	043
	Stamford	103
	Waterbury	118
Delaware	Wilmington (NJ, MD)	063
Dist. of Columbia	Washington (MD, VA)	008
Florida	Daytona Beach	260
	Fort Lauderdale-Hollywood	058
	Fort Myers	261
	Fort Pierce	311
	Fort Walton Beach	312
	Gainesville	241
	Jacksonville	050
	Lakeland	262
	Melbourne-Cocoa	263
	Miami	021
	Naples	313
	Ocala	314
	Orlando	087

Urbanized Area Codes

State	Urbanized Area	Code
Florida (Cont.)	Panama City	315
	Pensacola	125
	St. Petersburg	057
	Sarasota-Bradenton	264
	Tallahassee	220
	Tampa	059
	West Palm Beach	097
	Winter Haven	316
Georgia	Albany	209
	Athens	317
	Atlanta	025
	Augusta (SC)	131
	Chattanooga (TN)	086
	Columbus (AL)	109
	Macon	143
	Rome	318
	Savannah	100
	Warner Robins	319
Hawaii	Honolulu	052
	Kailua-Kaneohe	320
Idaho	Boise City	217
	Pocatello	321
Illinois	Alton	265
	Aurora	292
	Beloit (WI)	291
	Bloomington-Normal	227
	Champaign-Urbana	181
	Chicago-Northwestern IN (IN)	003
	Danville	322
	Davenport-Rock Island-Moline (IA)	074
	Decatur	169
	Dubuque (IA)	206
	Elgin	293
	Joliet	138
	Kankakee	323
	Peoria	093
	Rockford	099
	Round Lake Beach	379
	St. Louis (MO)	011
	Springfield	146

Urbanized Area Codes

State	Urbanized Area	Code
Indiana	Anderson	223
	Bloomington	324
	Chicago-Northwestern IN (IL)	003
	Elkhart-Goshen	325
	Evansville	114
	Fort Wayne	094
	Indianapolis	029
	Kokomo	326
	Lafayette-West Lafayette	222
	Louisville (KY)	031
	Muncie	182
	South Bend (MI)	077
	Terre Haute	178
Iowa	Cedar Rapids	148
	Davenport-Rock Island-Moline (IL)	074
	Des Moines	071
	Dubuque (IL)	206
	Iowa City	327
	Omaha (NB)	046
	Sioux City (NB, SD)	156
	Waterloo	150
Kansas	Kansas City (MO)	019
	Lawrence	328
	St. Joseph (MO)	179
	Topeka	134
	Wichita	062
Kentucky	Cincinnati (OH)	017
	Clarksville (TN)	280
	Evansville (IN)	114
	Huntington-Ashland (WV, OH)	105
	Lexington-Fayette	144
	Louisville (IN)	031
	Owensboro	242
Louisiana	Alexandria	266
	Baton Rouge	088
	Houma	329
	Lafayette	218
	Lake Charles	171
	Monroe	180
	New Orleans	022
	Shreveport	085

Urbanized Area Codes

State	Urbanized Area	Code
Maine	Bangor	330
	Lewiston-Auburn	196
	Portland	145
	Portsmouth-Dover-Rochester (NH)	283
Maryland	Annapolis	331
	Baltimore	012
	Cumberland (WV)	285
	Hagerstown (PA)	284
	Washington (DC, VA)	008
	Wilmington (NJ, DE)	063
Massachusetts	Boston	007
	Brockton	147
	Fall River (RI)	130
	Fitchburg-Leominster	189
	Lawrence-Haverhill (NH)	104
	Lowell (NH)	136
	New Bedford	127
	Pittsfield	199
	Providence-Pawtucket-Warwick (RI)	026
	Springfield-Chicopee-Holyoke (CT)	043
	Taunton	332
	Worcester	076
Michigan	Ann Arbor	142
	Battle Creek	267
	Bay City	186
	Benton Harbor	333
	Detroit	005
	Flint	065
	Grand Rapids	061
	Jackson	190
	Kalamazoo	141
	Lansing	102
	Muskegon-Muskegon Heights	162
	Port Huron	334
	Saginaw	123
	South Bend (IN)	077
	Toledo (OH)	044
Minnesota	Duluth-Superior (WI)	113
	Fargo-Moorhead (ND)	188
	Grand Forks (ND)	289
	La Crosse (WI)	243
	Minneapolis-St. Paul	013
	Rochester	244
	St. Cloud	268

Urbanized Area Codes

State	Urbanized Area	Code
Mississippi	Biloxi-Gulfport	231
	Hattiesburg	335
	Jackson	112
	Memphis (TN, AR)	034
	Pascagoula-Moss Point	336
Missouri	Columbia	245
	Joplin	337
	Kansas City (KS)	019
	St. Joseph (KS)	179
	St. Louis (IL)	011
	Springfield	157
Montana	Billings	204
	Great Falls	210
	Missoula	338
Nebraska	Lincoln	121
	Omaha (IA)	046
	Sioux City (IA, SD)	156
Nevada	Las Vegas	170
	Reno	191
New Hampshire	Lawrence-Haverhill (MA)	104
	Lowell (MA)	136
	Manchester	165
	Nashua	246
	Portsmouth-Dover-Rochester (ME)	283
New Jersey	Allentown-Bethlehem-Easton (PA)	068
	Atlantic City	128
	New York-Northeastern NJ (NY)	001
	Philadelphia (PA)	004
	Trenton (PA)	069
	Vineland-Millville	233
	Wilmington (DE, MD)	063
New Mexico	Albuquerque	070
	Las Cruces	339
	Santa Fe	340
New York	Albany-Schenectady-Troy	041
	Binghamton	110
	Buffalo	016
	Danbury (CT)	240
	Elmira	269
	Glen Falls	341
	Newburgh	342

Urbanized Area Codes

State	Urbanized Area	Code
New York (Cont.)	New York-Northeastern NJ (NJ)	001
	Poughkeepsie	270
	Rochester	039
	Syracuse	056
	Utica-Rome	089
North Carolina	Asheville	193
	Burlington	271
	Charlotte	082
	Concord	343
	Durham	173
	Fayetteville	221
	Gastonia	272
	Goldsboro	344
	Greensboro	132
	Hickory	345
	High Point	195
	Jacksonville	346
	Raleigh	163
	Wilmington	226
	Winston-Salem	124
North Dakota	Bismarck-Mandan	347
	Fargo-Moorhead (MN)	188
	Grand Forks (MN)	289
Ohio	Akron	040
	Canton	079
	Cincinnati (KY)	017
	Cleveland	010
	Columbus	030
	Dayton	038
	Hamilton	168
	Huntington-Ashland (WV, KY)	105
	Lima	198
	Lorain-Elyria	116
	Mansfield	228
	Middletown	348
	Newark	349
	Parkersburg (WV)	273
	Sharon (PA)	290
	Springfield	167
	Steubenville-Weirton (WV, PA)	177
	Toledo (MI)	044
	Wheeling (WV)	155
	Youngstown-Warren	049

Urbanized Area Codes

State	Urbanized Area	Code
Oklahoma	Enid	350
	Fort Smith (AR)	202
	Lawton	200
	Oklahoma City	045
	Tulsa	060
Oregon	Eugene	161
	Longview (WA)	286
	Medford	351
	Portland (WA)	027
	Salem	225
Pennsylvania	Allentown-Bethlehem-Easton (NJ)	068
	Altoona	175
	Erie	095
	Hagerstown (MD)	284
	Harrisburg	083
	Johnstown	159
	Lancaster	164
	Monessen	352
	Philadelphia (NJ)	004
	Pittsburgh	009
	Reading	107
	Scranton(081)--Wilkes-Barre(072)	281
	Sharon (Ohio)	290
	State College	353
	Steubenville-Weirton (OH, WV)	177
	Trenton (NJ)	069
	Williamsport	274
	York	152
Puerto Rico	Aguadilla	376
	Arecibo	377
	Caguas	247
	Mayaguez	216
	Ponce	215
	San Juan	214
	Vega Baja-Manati	378
Rhode Island	Fall River (MA)	130
	Newport	354
	Providence-Pawtucket-Warwick (MA)	026

Urbanized Area Codes

State	Urbanized Area	Code
South Carolina	Anderson	355
	Augusta (GA)	131
	Charleston	108
	Columbia	106
	Florence	356
	Greenville	126
	Rock Hill	357
	Spartanburg	275
South Dakota	Rapid City	358
	Sioux City (IA, NB)	156
	Sioux Falls	194
Tennessee	Bristol (VA)	288
	Chattanooga (GA)	086
	Clarksville (KY)	280
	Jackson	359
	Johnson City	360
	Kingsport (VA)	276
	Knoxville	098
	Memphis (MS, AR)	034
	Nashville-Davidson	054
Texas	Abilene	166
	Amarillo	120
	Austin	090
	Beaumont	135
	Brownsville	248
	Bryan-College Station	249
	Corpus Christi	096
	Dallas-Fort Worth	282
	El Paso	066
	Galveston	137
	Harlingen-San Benito	201
	Houston	015
	Killeen	277
	Laredo	205
	Longview	361
	Lubbock	122
	McAllen-Pharr-Edinburg	230
	Midland	197
	Odessa	174
	Port Arthur	139
	San Angelo	208
	San Antonio	028
	Sherman-Denison	232

Urbanized Area Codes

State	Urbanized Area	Code
Texas (Cont.)	Temple	362
	Texarkana (AR)	211
	Texas City-La Marque	250
	Tyler	213
	Victoria	363
	Waco	140
	Wichita Falls	151
Utah	Odgen	133
	Provo-Orem	203
	Salt Lake City	053
Vermont	Burlington	364
Virginia	Bristol (TN)	288
	Charlottesville	365
	Danville	366
	Kingsport (TN)	276
	Lynchburg	207
	Newport News-Hampton	084
	Norfolk-Portsmouth	036
	Petersburg-Colonial Heights	251
	Richmond	055
	Roanoke	129
	Washington (DC, MD)	008
Washington	Bellingham	367
	Bremerton	368
	Longview (OR)	286
	Olympia	369
	Portland (OR)	027
	Richland-Kennewick	278
	Seattle-Everett	020
	Spokane	075
	Tacoma	078
	Yakima	279
West Virginia	Charleston	101
	Cumberland (MD)	285
	Huntington-Ashland (KY, OH)	105
	Parkersburg (OH)	273
	Steubenville-Weirton (OH, PA)	177
	Wheeling (OH)	155

Urbanized Area Codes

State	Urbanized Area	Code
Wisconsin	Appleton	252
	Beloit (IL)	291
	Duluth-Superior (MN)	113
	Eau Claire	370
	Green Bay	158
	Janesville	371
	Kenosha	185
	La Cross (MN)	243
	Madison	111
	Milwaukee	014
	Oshkosh	253
	Racine	160
	Sheboygan	372
	Wausau	373
Wyoming	Casper	374
	Cheyenne	375

APPENDIX C

Determination of Available Sight Distance

In order to provide data for determining speed, it is necessary to estimate 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 for paved, 2-lane roadways. Any available data, such as construction plans, etc., can be used for this determination. The procedure described below is suggested as a method of determining available sight distance when these data are 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.

Lastly, 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.

Note that roadway beyond the end points of the section should be taken into consideration when obtaining this information, particularly on short sections. The 1,500 foot sight distance could prevail even on a section that is less than 1,500 feet (.28 mile). Striping may be used for making this estimate where it delineates unsafe passing zones.

Where there is a discernable directional difference, the more restrictive direction should be measured and reported.

APPENDIX D

Procedures for Determining Weighted Design Speed

Weighted design speed is defined as the weighted average of the design speeds within the section, when each curve and tangent segment within the section is considered to have an individual design speed.

This Appendix contains a recommended procedure for computing weighted design speed where it is not already available. It utilizes the theory that approximately 800 feet (0.15 mile) is the effective length of each curve. Tangent segments 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 weighted design speed calculation is provided in Figure D-1. The steps to be taken 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 the travel time in minutes corresponding to that number of curves from Table D-1 . 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 the "Total travel time" column. Divide the length of the highway section by the total travel time and then multiply by 60 min./hr. to obtain the weighted design speed (WDS) in miles per hour.

7. Round to the nearest of the following values: 70 ,60, 50, 45, 40, or 35.

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 a weighted design speed of 59 m.p.h. This is then rounded to 60 m.p.h.

Figure D-1

Worksheet for Calculating Weighted Design Speed (WDS)

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.

Weighted Design Speed = (Section Length 4.20 mi. divided by Total Travel Time 4.26 min.) x 60:

= 59 mph

Rounded WDS = 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 (mph)	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 (mph)	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 F

Prescribed Volume Groups and Precision Levels

Table F-1

RURAL AREA Volume Groups and Precision Levels

Vol. Grp.	Interstate (90-5)	Other Principal Arterial (90-5)	Minor Arterial (90-10)
01	0- 9,999	0- 4,999	0- 2,499
02	10,000- 19,999	5,000- 9,999	2,500- 4,999
03	20,000- 29,999	10,000- 14,999	5,000- 9,999
04	30,000- 39,999	15,000- 19,999	10,000-19,999
05	40,000- 49,999	20,000- 29,999	20,000-29,999
06	50,000- 59,999	30,000- 39,999	30,000-39,999
07	60,000- 69,999	40,000- 49,999	40,000-49,999
08	70,000- 79,999	50,000- 59,999	50,000-59,999
09	80,000- 89,999	60,000- 69,999	60,000-69,999
10	90,000-104,999	70,000- 84,999	70,000-79,999
11	105,000-119,999	85,000- 99,999	80,000-89,999
12	120,000-134,999	100,000-114,999	90,000-99,999
13	> or = 135,000	> or = 115,000	> or = 100,000

Vol. Grp.	Major Collector (80-10)	Minor Collector (80-10)
01	0- 2,499	0- 999
02	2,500- 4,999	1,000- 1,999
03	5,000- 9,999	2,000- 2,999
04	10,000-19,999	3,000- 4,999
05	20,000-29,999	5,000- 9,999
06	30,000-39,999	10,000-19,999
07	40,000-49,999	20,000-29,999
08	50,000-59,999	30,000-39,999
09	60,000-69,999	40,000-49,999
10	70,000-79,999	50,000-59,999
11	80,000-89,999	60,000-69,999
12	90,000-99,999	70,000-79,999
13	> or = 100,000	> or = 80,000

Prescribed Volume Groups and Precision Levels

Table F-2

SMALL URBAN AREA Volume Groups and Precision Levels

Vol. Grp.	Interstate (90-5)	Other Freeways and Expressways (90-5)	Other Principal Arterial (90-5)
01	0- 9,999	0- 9,999	0- 4,999
02	10,000- 19,999	10,000- 19,999	5,000- 9,999
03	20,000- 29,999	20,000- 29,999	10,000-14,999
04	30,000- 39,999	30,000- 39,999	15,000-19,999
05	40,000- 49,999	40,000- 49,999	20,000-24,999
06	50,000- 59,999	50,000- 59,999	25,000-29,999
07	60,000- 69,999	60,000- 69,999	30,000-34,999
08	70,000- 79,999	70,000- 79,999	35,000-39,999
09	80,000- 89,999	80,000- 89,999	40,000-44,999
10	90,000-104,999	90,000-104,999	45,000-54,999
11	105,000-119,999	105,000-119,999	55,000-64,999
12	120,000-134,999	120,000-134,999	65,000-74,999
13	> or = 135,000	> or = 135,000	> or = 75,000

Vol. Grp.	Minor Arterial (90-10)	Collector (80-10)
01	0- 2,499	0- 999
02	2,500- 4,999	1,000- 1,999
03	5,000- 9,999	2,000- 4,999
04	10,000-14,999	5,000- 9,999
05	15,000-19,999	10,000-14,999
06	20,000-24,999	15,000-19,999
07	25,000-29,999	20,000-24,999
08	30,000-34,999	25,000-29,999
09	35,000-39,999	30,000-34,999
10	40,000-49,999	35,000-44,999
11	50,000-59,999	45,000-54,999
12	60,000-69,999	55,000-64,999
13	> or = 70,000	> or = 65,000

Prescribed Volume Groups and Precision Levels

Table F-3

URBANIZED AREA Volume Groups and Precision Levels

Vol. Grp.	Interstate (80-10) 1/ (90-5) 2/	Other Freeways and Expressways (80-10) 1/ (90-5) 2/	Other Principal Arterial (80-10) 1/ (90-5) 2/
01	0- 24,999	0- 24,999	0- 2,499
02	25,000- 49,999	25,000- 49,999	2,500- 4,999
03	50,000- 74,999	50,000- 74,999	5,000- 9,999
04	75,000- 99,999	75,000- 99,999	10,000-14,999
05	100,000-124,999	100,000-124,999	15,000-19,999
06	125,000-149,999	125,000-149,999	20,000-24,999
07	150,000-174,999	150,000-174,999	25,000-34,999
08	175,000-199,999	175,000-199,999	35,000-44,999
09	200,000-224,999	200,000-224,999	45,000-54,999
10	225,000-249,999	225,000-249,999	55,000-69,999
11	250,000-274,999	250,000-274,999	70,000-84,999
12	275,000-299,999	275,000-299,999	85,000-99,999
13	> or = 300,000	> or = 300,000	> or = 100,000

Vol. Grp.	Minor Arterial 3/ (90-10) 2/	Collector 3/ (80-10) 2/
01	0- 2,499	0- 999
02	2,500- 4,999	1,000- 1,999
03	5,000- 9,999	2,000- 4,999
04	10,000-14,999	5,000- 9,999
05	15,000-19,999	10,000-14,999
06	20,000-24,999	15,000-24,999
07	25,000-34,999	25,000-34,999
08	35,000-44,999	35,000-44,999
09	45,000-54,999	45,000-54,999
10	55,000-69,999	55,000-69,999
11	70,000-84,999	70,000-84,999
12	85,000-99,999	85,000-99,999
13	> or = 100,000	> or = 100,000

1/ Precision levels for individual urbanized areas.
2/ Precision levels for collective urbanized areas.
3/ For individual urbanized areas, 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.

NOTE NOTE NOTE NOTE NOTE NOTE NOTE NOTE NOTE

Due to the method used for producing the "preliminary" copies of the HPMS Field Manual, formulas with superscripts (i.e., something, squared) do not print properly.

The formula in the preliminary Appendix G contains 3 variables that should be squared (Z, C and d). Note that the three superscripted items have turned up as Z2, C2 and d2, respectively. The <u>final</u> printed copy will contain the appropriate superscripts.

APPENDIX G

Sample Size Estimation Procedures

The sample size estimates for each stratum are derived from the following formula:

$$n = \frac{Z2\ C2\ /\ d2}{1 + (1/N)\ ((Z2\ C2\ /\ d2) - 1)}$$

where n = required sample size,

Z = value of the standard normal statistic for an alpha confidence level (two-sided),

Confidence Level	Value of Z
90 %	1.645
80 %	1.282
70 %	1.040

C = AADT coefficient of variation from a State's AADT data,

d = desired precision rate (from Appendix F for HPMS), and

N = universe or population stratum size (# universe sections available for sampling in a volume group).

For example, the sample size for the first rural Interstate stratum with a desired precision rate of + or - 5-percent with a 90-percent confidence level, an AADT coefficient of variation of 0.40 and 300 available universe sections for sampling is estimated by:

$$n = \frac{(1.645)2\ (.40)2\ /\ (.05)2}{1 + (1/300)\ ((1.645)2\ \ (.40)2\ /\ (.05)2) - 1)}$$

$$= \frac{173.18}{1 + (172.18/300)}$$

= 110 required samples

The critical point in this process is the value designation of C, the AADT coefficient of variation. The original HPMS design was based on empirical estimates using data from a small number of States. The procedures presented here require the estimation of AADT coefficients of variation based on the latest State data. The results are then always up-to-date, based on the latest information, and are tailored to the specific State.

The AADT coefficients of variation may be generated from a State's universe data using standard statistical computer packages, if reasonably accurate AADT data are present on all, or most of the collector/arterial records. Otherwise, the existing sample data should be used for the coefficient generation. If a State is not able to generate its own coefficients, the FHWA headquarters can provide the "Estimates of Sample Adequacy" booklet which contains the coefficients from both the sample and from the universe (or from any portion of the universe that contains AADT data), among other information.

The booklets were distributed with the 1985 data reviews (in 1986), and will again be generated for the 1988 data (to be reported in 1989), and every three years, thereafter. However, if a State wishes the booklet to be generated from its data at any time, for any submittal, it only needs to be requested.

APPENDIX H

SELECTING THE SAMPLE OF HIGHWAY SECTIONS

BACKGROUND

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

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

With the availability of HPMS sample data the empirical procedure has been verified. The information gained from the existing sample or universe data in each State is used to optimize and refresh the sample. Procedures for determining necessary sample size based on the analysis of existing data are described in this Appendix.

In order to obtain cost-effective, valid comparisons of system performance over time, and to reduce administrative effort, the sample was designed as a fixed sample. Hence, the same sections that are inventoried now will be updated in future years on a cyclical basis. This means of obtaining data is efficient because: (1) the need for the periodic drawing of a complete new sample is eliminated, (2) the need to update or reinventory all data elements every cycle is eliminated, and (3) only those data elements that change over time need be updated on a cyclical basis. The length of the cycle is determined by the known statistical characteristics of individual elements, the intended use and accuracy needed, and the time and cost required to collect and report such data. However, the use of fixed panel sections is not without disadvantages. These include: the possible loss of the sample's representativeness as the highway networks and traffic patterns change, and the inability to assess the correctness of the estimates by comparing them with those of a different sample. Procedures have been developed to ensure the representativeness of the sample and therefore, the administrative practicability of the fixed panel approach outweighs the disadvantages.

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

SCOPE

Data needs will vary for the rural, small urban, and urbanized areas. This variation is reflected in the sample design. The design is capable of producing valid estimates of the condition of the highway plant and its operating and performance characteristics on a State-by-State basis. Rural and small urban functional systems will be sampled on a statewide basis. The original HPMS design required that urbanized areas be sampled individually. In order to reduce the data collection burden and to increase flexibility, that requirement has been modified. Urbanized areas can be sampled individually, collectively on a statewide basis, or in any combination at the State's option. (Note, however, that the collective method is no longer recommended.) Before making a decision to consolidate urbanized areas, it is recommended that States fully evaluate the ramifications of such a decision. However, once a State has decided on using one of the urbanized area sampling options, the State should remain committed to applying the option chosen.

STRATIFICATION AND PRECISION LEVELS

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

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

The HPMS sample size requirements are more stringent for the arterials, where a higher level of precision is needed because of higher Federal interest. In rural, small urban, and collective urbanized areas, the sample sizes are based on a 90-5 precision level for the volume groups of the principal arterial system, 90-10 for the minor arterial system, and 80-10 for the collector system(s). For individual urbanized areas, the design precision levels for individual volume strata are 80-10 or 70-15, depending upon the number of urbanized areas designated as individual at the States' option. Those States with less than three designated individual urbanized areas will use a precision level of 80-10 for all functional systems, while those with three or more may use the lower precision level of 70-15 for minor arterials and collectors and 80-10 for principal arterials thereby requiring a smaller number of samples. The statewide summation of individual urbanized functional system data element estimates will result in an overall precision level of at least 80-10 at the State level. The higher precision levels at the State level are necessary for two important reasons: (1) to obtain comparable urban and rural precision levels and (2) to obtain precision levels that can adequately accommodate desired levels of accuracy for estimates of proportionate values.

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

PREPARATION FOR SAMPLE SELECTION

Before a sample can be drawn, the universe from which it will be selected must be defined. This is of the utmost importance because expansion factors relate directly to the universe definition. The first step is to delimit the boundaries between rural, small urban, and urbanized areas using Federal-aid boundaries. Next, the functional system of all arterial and collector routes within each of these areas must be identified. These steps, presumably, have already been accomplished. Then, all road sections in each functional system must be assigned to predetermined AADT groups. (See Appendix F.) Either uniform or nonuniform section lengths can be used. The sections should be relatively homogeneous as to geometrics, traffic volume, cross section and condition, and should be long enough to constitute a logical section for various analyses such as needs appraisal. In general, rural section lengths should range from 0.30 to 10.00 miles, while urban access controlled facility section lengths should usually not exceed 5.00 miles. All other urban section lengths should range from 0.10 to 3.00 miles. A trade-off exists between the length of sections and future section subdivision. Longer sections reduce the universe size and result in a smaller number of initial samples. However, longer sections are likely to require subdivision in later years in order to maintain homogeneity, which will increase the universe size and result in an increase to the sample size.

The total number of road sections and total mileage in each volume group are also needed to determine the proper sample size necessary for each functional system. These data define the universe and will be needed for any future readjustments to the sample after adjustment to new AADT conditions. It is imperative that each State retain this information, and update it at least once per year. The information is also used to (re-) calculate expansion factors. If volume groups other than the predetermined volume groups used in the FHWA-developed approach (discussed below) are selected, the AADT limits of these volume groups shall be reported on a volume group form, modeled after the Appendix F tables.

SECTION DOCUMENTATION

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

CALCULATION OF EXPANSION FACTORS

The purpose of the HPMS panel of sections is to provide an expandable base for the rural, the small urban, and the defined urbanized area systems in each State, all stratified by functional system and traffic volume. An expansion factor must be calculated for each volume stratum within each functional system. This is accomplished by dividing the total mileage in the stratum by the mileage included in that stratum's sample. As noted above, the total universe mileage in each stratum must be known, retained and updated each year in order to calculate the expansion factors. Stratum universe mileage should be the best available whenever expansion factors are to be calculated. This expansion factor will be placed on each sample record, will be reported via the computer printout resulting from the SELEXPF option of the HPMS Submittal Software (see Chapter IV, Item 27 and Chapter VI), and will allow the samples to be expanded to represent the entire functional subsystems for rural, small urban, and urbanized areas.

Example Factor Calculation 1/
Rural Interstate

Volume Group	Number of Sample Sections	(A) Total Mileage of Sample Sections	(B) Total Mileage in Volume Group	(C) Expansion Factor (Col. B Divided By Col. A)
1	9	38.4	1132.6	29.49
2	8	41.6	924.0	22.21
3	6	23.7	362.1	15.28
4	3	10.6	133.9	12.63
5	2	7.4	36.0	4.86
6	2	6.9	18.1	2.62

1/ Chapter VI contains the computerized procedure for calculating expansion factors (SELEXPF option).

FHWA-DEVELOPED SAMPLING APPROACH

Rural and Small Urban Areas

Both rural and small urban area data will be sampled on a statewide basis, stratified only by functional system and volume group. The volume group for each universe section must be identified using the tables in Appendix F before sample selection can begin. Then the number of sections to be included in the sample is determined using the procedure in Appendix G. The number of sample sections per volume group, in general, is determined based on: (1) number of sections available for sampling (the universe), (2) the specified precision levels, and (3) the variances of the AADT's as stratified.

A minimum sample of three sections is required for each volume group. Obviously, if less than three universe sections exist in a volume group, they must all be sampled, or alternatively, the volume group may temporarily be combined with the next adjoining group, or split between the upper and lower adjoining groups based on the AADT's. The sections must be returned to their proper volume group(s) before the next submittal following the one being modified, and/or before a sample review takes place.

Sections are to be selected from the universe of each functional system and volume group using a random number table or random number generation computer software, until the required sample size is reached.

Individual Urbanized Areas

Each State has the option to determine which urbanized areas, if any, will be sampled individually (see collective urbanized areas, ahead). Each area defined for sampling purposes, (at the State's option, as an individual urbanized area or several areas collectively) will have its sample stratified by functional system and volume group. (The AADT volume groups to be used are shown in Appendix F). In situations where AADT's higher than those contained in this table are encountered, it is suggested that higher volume groups be added that contain a range similar to that for the highest volume group shown in the table for the appropriate functional system. All portions of bi-State and tri-State urbanized areas must be sampled -- if sampled as individual areas, the sample in each State should not be less than its pro rata share for the entire urbanized area by functional system volume group nor in any case less than one section per applicable volume group (this is the only allowable exception to the three sections per volume group rule). In such areas, expansion factors must be calculated separately for each State's portion.

To ensure a consistent sampling approach, States concerned with bi- or tri-State urbanized areas are urged to coordinate with the appropriate neighboring State(s) so that all portions of an urbanized area are sampled in the same manner. It should be noted that an individual sampling approach must be applied to all parts of urbanized areas if estimates are desired for the complete urbanized area. For example, to develop estimates for the Kansas City urbanized area (Ks., Mo.), the two States must sample their respective portions of the area individually, as was done before the introduction of the optional collective procedure. If either Kansas or Missouri includes its portion of the Kansas City area in the collective category, then no estimates of the complete Kansas City urbanized area will be possible.

The required number of samples for the volume groups in each functional system is determined by the procedure in Appendix G. As with rural and small urban areas, the required number of sections must be randomly selected from the universe of each volume group, and a minimum of three sections per stratum is required.

Collective Urbanized Areas

Note that in view of possible future events concerning increased emphasis on urban areas, this method of sampling is no longer recommended.

A State may elect to redefine its urbanized area sampling panels to group individual urbanized areas into a collective panel (more than one collective panel can be developed if the State elects to do so). This option will reduce the reporting burden (sample size) in urbanized areas for many States by eliminating the requirement for individual urbanized area reporting. However, since the precision levels increase for collective urbanized area sampling (see Appendix F), the reporting burden will not decrease for all States, particularly those with a small number of urbanized areas. The biggest advantage is the significant reduction in sample size for highly urbanized States or States with large numbers of urbanized areas. When this Manual was printed, 13 States had exercised this option. Disadvantages include the elimination of individual urbanized area estimates which may reduce the usefulness of the HPMS to a State, the distortion of the original sample design, and the lack of continuity from the existing data. It is recommended that a State throughly assess the consequences of grouping urbanized areas in terms of actual reduction in sample size, effort involved in revising existing sample data, and usefulness of a collective vs. individual urbanized area sample prior to making a decision to group its urbanized areas. Once a decision is made concerning the sampling philosophy in a given State, the sampling approach should not change.

Modification of Existing Sample Panels -- Only the sample panels representing individual urbanized areas that are to be grouped into collective panel(s) are subject to modification. The volume groups and precision levels associated with the collective panels are provided in Table F-3, Appendix F. Note that the precision levels for collective panels are the same as the rural and small urban precision levels and are higher than those associated with individual urbanized areas.

Functional system and volume group stratifications remain the same for the collective area panel as for individual urbanized areas. Sample sizes for the new collective area panel(s) are determined by the procedure in Appendix G. The total number of sections available for sampling (universe) in the given volume groups are taken from all of the urbanized areas in the collective group. Each urbanized area should be represented in the sample panel for the collective group.

Assuming that the required number of sample sections for a given volume group is less than the existing number of sample sections (the reason for going to a collective group, normally), the required number can be randomly selected from the existing sample sections. If the required sample size is larger than the current number of samples, the additional samples will be randomly drawn from the total available sections excluding those sections which are already samples. Each volume group must have a minimum of three sample sections or all that are available, if less than 3 universe sections exist in the volume group. Excess existing sample sections may be eliminated, but consideration should be given to retaining 5-10 percent above the number of sections required to allow for the movement of sections from one volume group to another over time. Also, careful consideration must be given to the impact that new urbanized areas being added as a result of future Censuses will have on future sample size requirements. Sample ID's that are eliminated under this situation should be listed with appropriate remarks and sent to FHWA Headquarters with the HPMS tape submittal that contains the deletions.

Once the collective area panel has been established, the sample section expansion factors must be recomputed to be representative of the collective area panel, i.e., for a given functional system/volume group in the panel, the ratio of universe mileage to sample mileage.

Collective Area Panels for New Urbanized Areas -- Sample panels for this situation are established using procedures similar to those for rural or small urban areas. The number of sections available for sampling in the functional system and volume group strata (see Appendix F) for the new collective urbanized area must be established. Then the required number of samples for the volume groups in each functional system is determined from the procedure in Appendix G. Finally, the required number of sections are randomly selected from the universe of each volume group and a minimum of three sample sections per stratum is required. (See Chapter V for adding sample sections from new urbanized areas to an existing collective group.)

Interstate System Sampling Procedures

The Interstate system must be sampled in such a way as to allow specific estimation of each mileage category contained within the system: (1) Interstate (other than (2) through (4) that follow), (2) Interstate toll, (3) Interstate with Secretarial Agreement and, (4) Interstate Section 139(a) additions. The procedures contained in this section of the Appendix will facilitate specific estimation, modeling, and assessment of the aforementioned categories. Such specific categorical estimations are a necessity for the complete assessment of the Interstate system components and the impact that future legislative actions and resultant policies could have on the overall Federal-aid Interstate System program.

The procedures that follow are applicable only if a State has Interstate system mileage in categories 2, 3, and/or 4 noted above; otherwise, no change is required in the current sample. In effect, each subcategory is to be treated as another "functional system" complete with its own universe mileage and expansion factors. The net result, however, is that the number of Interstate samples will increase. This procedure is applicable to either the optional collective or individual urbanized area sample panels as well as to the statewide rural and statewide small urban area sample panels. The procedure, applicable to each sample area, is as follows:

1. Determine the mileage and the number of universe sections in each of the four Interstate categories by area type (rural, small urban, urbanized) and volume group. The universe mileages in each category by area and volume group stratum for the four categories (less if appropriate) of Interstate, Interstate toll, Interstate with Secretarial Agreement, and Interstate Section 139(a) additions will be used later in the expansion factor computation. The number of universe sections for each category in each area and volume group stratum will be used in the sample selection process.

2. Subdivide the (existing) HPMS sample by the same categorial stratification as in step 1.

3. Using the universe data, compute coefficients of variation of AADT for each stratum. Apply the procedure in Appendix G to estimate the required sample size in each stratum. The precision requirements as contained in Appendix F remain the same for all Interstate strata. As with all HPMS sampling procedures, a minimum of three sample sections per stratum are required. Any universe stratum with less than 3 sections may be <u>temporarily</u> combined with the next adjoining volume group, or may be left in its own volume group, if all available universe sections are sampled. Sections that are moved to another volume group must be reinstated to their proper groups for subsequent sample reviews (i.e., each year when preparing for HPMS submittals).

4. By comparing the existing number of samples in each stratum (step 2) and the sample size estimates (step 3), determine the number of additional samples required. Additional samples in each stratum should be selected from the non-sampled universe sections using a simple random process (table of random numbers) or the established HPMS procedure.

5. Recompute the expansion factors for the complete sample using the HPMS expansion factor procedures, i.e., the ratio of universe to sample mileage in each individual stratum.

Conflicting Mileage -- Under situations where Interstate mileage falls into more than one subcategory (i.e., toll and 139(a)), 100 percent sampling of the conflicting mileage will have to be realized. Otherwise, the calculated expansion factors will enable proper expansion to one of the subcategories, but erroneous expansion will likely result in the other subcategory.

Completion of the process will allow the existing HPMS expansion procedures to produce estimates for the categories of interest.

THEORETICAL APPROACH

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

Stratification

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

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

where,

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

N = the total number of road sections available for sampling (universe) in the same given functional system.

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

In the FHWA approach, the above formula was used to a limited extent and the predetermined number of strata restricted to no more than thirteen for national coverage. However, other procedures for volume group stratification may also be applicable. In the original design, data from earlier studies were used to estimate the variability for the FHWA-developed stratification. For other stratification schemes, an empirical procedure was used to develop these estimates. Empirical procedures are applicable in cases where no prior data from other sources, or pilot studies are available. Since the HPMS has been implemented for some time, sufficient data is available to make the use of empirical procedures unwarranted. The AADT coefficients of variation may be generated for any State by standard statistical computer packages based on the State's own, current data.

Appendix G presents a procedure to estimate sample size. To apply the procedure for any volume group stratification, all that is needed is an estimate of the AADT coefficient of variation and the application of the formula as presented in Appendix G. As noted above, the State should generate its own AADT coefficients. If this is not possible, FHWA Headquarters can develop coefficient of variation estimates, on request, for any tape submittal made by a State. The resulting report can be used for sample size review, and contains, among other information, the coefficients of variation that reflect the State's reported AADT data. (See the booklet, "Estimates of Sample Adequacy", that was developed from the 1985 data submittal, and sent to each State with the data review information for that year.)

Sample Design Approval

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

1. A brief narrative description of the sample design.

2. The numbers and ranges of the volume group strata by functional system within each of the areas--rural, small urban, and urbanized panel(s)--see Appendix F.

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

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

5. The design precision level of accuracy at the volume group level for each functional system within each area. The minimum functional system volume group levels 1/ discussed earlier in this Appendix must be met.

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

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

Standard Method for Computing Sample Size

The AADT volume group strata are assigned areawide (rural, small urban, and urbanized) to each of the five functional systems in each area. The formula for calculating the sample size, n, for each volume stratum for a given precision level of accuracy by simple random sampling is presented in Appendix G. The procedure for estimating non-standard volume groups was described in the previous section.

ALTERNATIVE RANDOM SAMPLE SELECTION METHOD

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

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

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

Sample Location Approach No. 1

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

Volume Group Mileage (Nearest Mile)

Route	Miles	Cumulative Miles
x	xx	xxx
y	yy	yyy, etc.

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

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

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

Sample Location Approach No. 2

The second approach is much like the first except that only one random number is drawn and all other sample locations are chosen at fixed mileage intervals from the random start milepoint. The required fixed interval is calculated by dividing the total volume group mileage by the required number of samples for the volume group. For example, using information from step 2 above and assuming five samples are needed, the fixed interval will be 35/5 = 7 miles. Therefore, with a random number of 12, as before, the locations sampled from the cumulative mileage column would be 12, 19, 26, 33, and 5 which translate to the following route locations:

Route 50, milepoint 5
Route 100, milepoints 2 and 9
Route 212, milepoints 1 and 8

Given the locations to be sampled, the States must establish homogeneous sections containing these locations that conform to section length requirements defined on page H-4 of this Appendix.

Sample Adequacy Review

This Appendix contains procedures for developing the HPMS arterial and collector sample panel. Since HPMS has been in existence for some time, the procedures should now be used for reviewing the adequacy of the existing sample panels, and to update them, where needed. It is recommended that a review be made at least every 3 years in order to preserve the integrity of the sample. Chapter V contains more details about, and methods for, performing these reviews.

NOTE NOTE NOTE NOTE NOTE NOTE NOTE NOTE NOTE

Due to the method used for producing the "preliminary" copies of the HPMS Field Manual, formulas with superscripts (i.e., something, squared) do not print properly.

The formulas in the preliminary Appendix I contain 2 variables that should be squared (Z and (p2-p1)). Note that the two superscripted items have turned up as "Z2" and "(p2 - p1)2", respectively. The final printed copy will contain the appropriate superscripts.

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 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 of less than 2.0). Therefore, steps must be taken to ensure that the sample size requirements for averages and aggregates also allow for a 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 sampling size and sampling error, the true values of estimating proportions being unknown. The relationship between the smallest detectable true percent change in proportions and sample size is shown in the following formulas.

Given the formula:

$$(p2 - p1)^2 = Z^2 \ (pbar \times qbar \ (1/n1 + 1/n2))$$

where,

p1 = the estimated proportion for a given data element attribute for a functional system at time period # 1.

p2 = The same as above for time period # 2.

(p2 - p1) = the smallest detectable true change, not concealed by sampling error.

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

pbar = (p1 + p2) / 2

qbar = 1 - pbar

n1 = the total number of road sections in the sample panel for time period # 1.

n2 = the same as above for time period # 2.

Assuming the "worst case" situation where pbar = qbar = 0.50, and n1 = n2 in the fixed sample, then let $2/n0 = 1/n1 + 1/n2$.

Substituting, the formula reduces to:

$$(p2 - p1)^2 = 0.5Z^2 / n0 \quad \text{or} \quad n0 = 0.5Z^2 / (p2 - p1)^2$$

and,

$$n = n0 / (1 + n0/N)$$

giving the number of samples required in a functional system to detect a given change in proportions;

where,

n0 = 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 sample sections (n) to detect a 10 percent change (p2 - p1) with 80 percent confidence (Z) is:

$$n0 = 0.5(1.282)^2 / (0.10)^2 = 0.822 / 0.01 = 82$$

$$n = 82 / (1 + 82/200) = 58$$

The graph contained in Appendix Figure I-1 is plotted for sample size (n), and universe size (N) (for a complete functional system), based on 80 percent confidence in the detection of a 10 percent change.

The minimum detectable true change in proportions (p2 - p1) for any given number of sample sections at stratum of functional system level is obtainable from the formula given below. Thus, for a functional system sample of 103 sections out of a total of 3,338 in the universe, the minimum detectable percent change at 80 percent confidence is:

$$(p2 - p1)^2 = ((N - n) / N) (Z^2 (pbar \times qbar) (2 / n))$$

where,

$N - n / N$ = the finite correction factor

and, substituting values:

$$(p2 - p1)^2 = ((3338 - 103) / 3338) (1.282)^2 (0.50 \times 0.50) (2/103)$$

$$(p2 - p1)^2 = 0.007732$$

$$(p2 - p1) = 0.0879 = 8.8 \text{ percent}$$

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 the 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.

The formula in Appendix G that generates the required sample size for each stratum (volume group), relies heavily on the AADT coefficient of variation. In the past the coefficients used by most States were derived empirically from a few State's data and other estimating procedures and published in Appendix G. In almost all cases, the resulting sample size for each functional system was more than adequate for meeting this HPMS minimum requirement for estimating proportions. With the advent of methods for each State to generate its own coefficients, more careful consideration must be placed on this proportionality criteria, especially where a State's coefficients are very small when compared to the originally-used values (e.g., smaller coefficients will result in fewer samples per volume group and fewer samples in the functional system).

Each State should check its data against the graph in Figure I-1 (or by application of the above formula). Where it is found that additional samples are required for a functional system, the sample should be distributed among the volume groups based on the number that were required by application of the Appendix G formula. For example, if the number of required samples from the formula in Appendix G for some functional system was:

volume group 01 -- 35
volume group 02 -- 15

total 50

the total number of universe sections in this functional system = 200
the number of required samples from the graph (Figure I-1) = 60
the sample shortfall due to the proportionality criteria (60-50) = 10

the actual sample distribution should be:

volume group 01 = 35 + ((35 / 50) x 10) = 42 required samples
volume group 02 = 15 + ((15 / 50) x 10) = 18 required samples

new total 60

Both criteria (Appendix G and proportionality) are now satisfied.

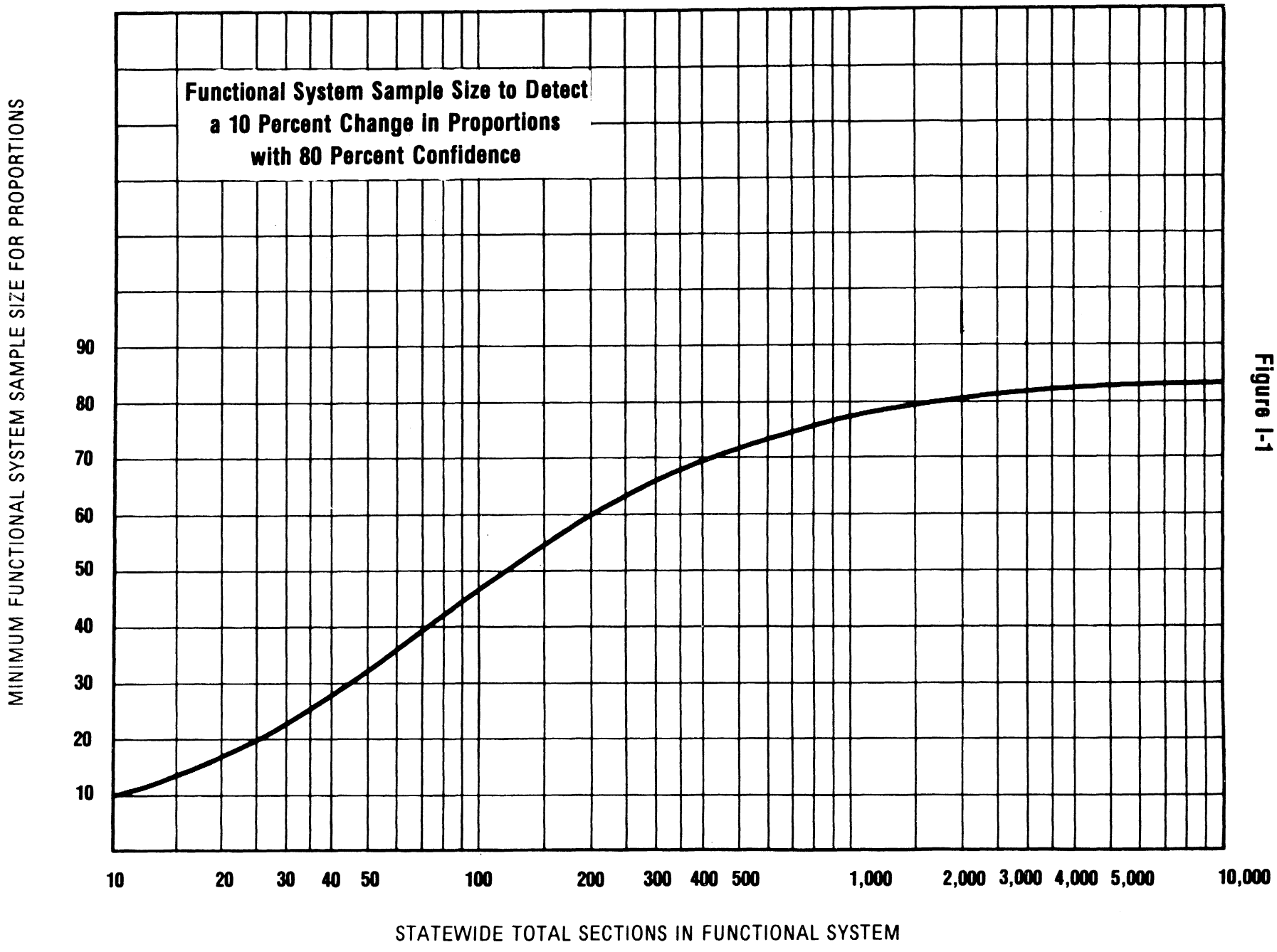

Functional System Sample Size to Detect
a 10 Percent Change in Proportions
with 80 Percent Confidence
MINIMUM FUNCTIONAL SYSTEM SAMPLE SIZE FOR PROPORTIONS
90
80
70
60
50
40
30
20
10
10
20
30
40
50
100
200
300
400
500
1,000
2,000
3,000
4,000
5,000
10,000
STATEWIDE TOTAL SECTIONS IN FUNCTIONAL SYSTEM

Figure I-1

APPENDIX J

Roughness Equipment, Calibration and Data Collection

Abbreviations and Acronyms used in this Appendix

AASHTO-- American Association of State Highway and Transportation Officials
AMRL -- AASHTO Materials Reference Lab
ARS -- Average Rectified Slope
ASTM -- American Society for Testing and Materials
HPMS -- Highway Performance Monitoring System
IRI -- International Roughness Index
LTPP -- Long Term Pavement Performance
NBS -- National Bureau of Standards
NCHRP -- National Cooperative Highway Research Program
PMCG -- Pavement Management Coordinating Group
PMS -- Pavement Management System
RQCS -- Reference Quarter Car Simulation
RRI -- Reference Roughness Index
RTRRM -- Response Type Road Roughness Meter
SHA -- State Highway Agency
SHRP -- Strategic Highway Research Program

Definitions

o HPMS Roughness Reporting Units -- IRI in inches per mile.

o RTRRM -- A system contained in a vehicle or in a trailer that utilizes a road meter to measure and accumulate suspension deflections (axle to body displacement or acceleration values) over a section of roadway, which are used to indicate the roughness of the pavement.

o Calibration Section -- A section of roadway that is used to calibrate an RTRRM via correlation to the known profile.

o Known Profile -- Refers to a roadway (usually a calibration section) whose profile has been accurately measured with a Class I or II device/procedure. (Classes are defined on page J-3.)

o Calibration Checks -- Refers to the periodic RTRRM units remeasurements made on a calibration site to see if the RTRRM is still in calibration with the original measurements.

o Validation Checks -- Refers to the initial and periodic Class II device units measurements made on a calibration site (known profile) to see if the device is obtaining the proper measurements.

o Regression Analysis -- A statistical procedure to explain relationships between variables.

o Profile Device -- A device used to measure the longitudinal profile of a roadway.

Introduction

In order to provide a measure of pavement condition that has nationwide consistency and is as realistic and practical as possible, a uniform, calibrated roughness measurement for paved roadways has been introduced to the HPMS. This came about as the result of the Pavement Management Coordinating Group's (PMCG) recommendation that additional pavement related data be added to HPMS. This was based on extensive work done by the Pavement Initiative 2 Task Force, a subgroup of the PMCG. The details and reporting requirements were established by an HPMS Pavement/Roughness Working Group made up of State Highway Agency and FHWA field and headquarters personnel and other interested parties, such as a World Bank representative.

Roughness is defined (in accordance with ASTM E 867-82A) as "The deviations of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads and drainage." After a detailed study of various methodologies and road profiling statistics by the FHWA/State Pavement/Roughness Working Group, the International Roughness Index (IRI) was chosen as the HPMS standard reference roughness index. It was concluded that the roughness reference statistic will be defined from the absolute longitudinal profile of the road surface, and that methods (equipment) which provide indirect measures of the profile (RTRRM's) must be calibrated against the "known profile" reference statistic. The IRI was chosen because it facilitates correlation to a variety of roadmeter vehicles over a range of surface types.

The summary numeric (HPMS data reporting unit) is the IRI in inches per mile. IRI is computed from elevation data ("known profile") in a wheelpath for use as a profile numeric for profile measuring methods and as a calibration standard for RTRRM's. The primary advantages of the IRI are:

1. It is a time-stable, reproducible mathematical processing of the known profile.

2. It is broadly representative of the effects of roughness on vehicle response and user's perception over the range of wavelengths of interest, and is thus, relevant to the definition of roughness.

3. It is a zero-origin scale consistent with the roughness definition.

4. It is identical to the Reference Quarter Car Simulation (RQCS) inches per mile statistic derived in the National Cooperative Highway Research Program (NCHRP) 228 Report.

5. It is compatible with all profile measuring equipment currently available, and projected, in the U.S. market. Through correlation, it is directly applicable as an Average Rectified Slope (ARS) statistic for the calibration of response-type roadmeters.

6. It is independent of section length and amenable to simple averaging.

7. It is directly consistent with recently established international standards, and able to be related, through published correlations (Paterson, Reference 13) to other U.S. and foreign roughness measures.

Equipment

The State must determine which class of equipment it will use to collect the roughness data for HPMS reporting; the following will provide the State with sufficient information to make this determination. The different methods of collecting profile and roughness data may be grouped into four classes (see Table J-1 for examples of each):

Class I -- Includes all manual profiling techniques such as rod and level.

Class II * - Includes direct profile measuring equipment. This group also includes noncontact devices such as laser, light beam and acoustic techniques which must be kept in calibration in accordance with manufacturer's specifications.

Class III -- Includes the Response Type Road Roughness Meters (RTRRM) and is the most common equipment presently being used for extensive data collection. The RTRRM systems measure the dynamic response of a mechanical device as it travels over the roadway surface at a constant speed. These devices use a variety of displacement technologies including the use of axle/body displacement transducers and accelerometers mounted on axles and/or bodies. Such devices must be calibrated to known profiles. Traditional RTRRM's measure ARS values which make correlation to IRI very convenient.

Class IV -- Subjective estimations of roughness made by an observer using a descriptive scale that approximates the IRI for different road conditions and ride sensations. This method is not suitable for HPMS purposes.

* The accuracy of Class II profiling equipment must be initially and periodically validated through field comparisons to known profiles (i.e., to measurements made from a Class I equipment/procedure), or to stringent manufacturer's specifications. Reference 15 contains more information.

The following table summarizes equipment specifications for HPMS in each of the above classes. The maximum error for each class was determined through recent research by the World Bank (Reference 2). Units are shown in terms of the IRI in metric and English units.

TABLE J-1

List of Equipment Types and Maximum Error by Class

Class	Equipment	Maximum Error	Measurement Interval
I	Manual Profiling Techniques	1.5 % bias; .3 m/km = 19 inches/mile	< or = 1.0 ft.
	Example: Rod and Level		
II	Direct Profiling Equipment	5 % bias; .7 m/km = 44 inches/mile	< or = 2.0 ft.
	Example: South Dakota Profilometer		
III	RTRRM's *	10 % bias; .5-1.0 m/km = 32-63 inches/mile	
	Example: Mays Ride Meter		
IV	Not suitable for use in collecting roughness data for HPMS.		

We advise any State considering purchase of new equipment or enhancing older equipment to require the marketing agent/manufacturer to demonstrate that the new equipment will perform at the precision of the stated class level prior to purchasing any new instrumentation to collect roughness data.

The following concerns are noted with regard to the selection and use of equipment:

1. Class I or II devices/procedures must be used for profile measurement for calibration purposes. Equipment should be carefully evaluated to assure that proper equipment class designation is being applied in accordance with the maximum IRI error noted in the above table. Profiling devices should be validated to assure that proper profile measurements of a section with a known profile are being obtained.

2. Class III vehicle-mounted response-type devices are not as desirable as trailer-mounted equipment. Vehicle-mounted equipment, if used, must be calibrated and checked more often.

3. Extreme care must be exercised during the operation of all equipment to ensure that its use is within the manufacturer's specifications and that all guidelines are followed.

Reference 12 contains additional information on roughness and profile measurement equipment.

HPMS Roughness Measurement Procedure

Roughness must be reported for HPMS in IRI units converted to inches per mile (1.0 m/km = 63.36 in/mi). When Class I or II equipment is being used for roughness measurements (see Table J-1), the procedure is reduced to a matter of reporting the units required by HPMS (inches per mile). When Class III equipment is being used (commonly referred to as Response Type Road Roughness Meters or RTRRM's), the procedure requires calibration of the RTRRM to the IRI via correlation to accommodate the HPMS IRI reporting requirement. Most States will (or already) use RTRRM's for collecting roughness data and will follow the Class III procedures. The State must determine the class of its roughness measurement equipment based on the equipment descriptions and maximum IRI error given under the Equipment heading in Table J-1, and then proceed with one of the following two procedures.

Procedure 1 -- Class I or II Profiling Equipment

The profile information gathered with these types of devices is simply reported in IRI (inches per mile), and applied to the HPMS sample records. The profile information is also used for the calibration of Class III RTRRM's.

The procedures for the development of IRI are described in the World Bank Technical Paper # 46 (Reference 2), Chapter 3. Micro-computer software for converting rod and level profile data into the necessary HPMS units is described in Reference 8.

Procedure 2 -- Class III Roughness Measurement Equipment

The roughness measurement information gathered with RTRRM's must be converted to IRI in inches per mile using the calibration through correlation method described under the "RTRRM Calibration Procedure" heading, below. The resulting IRI is then applied to the appropriate sample section records. Additional information on calibration procedures is outlined in Chapter 4 of the World Bank Technical Report # 46 (Reference 2).

For consistency of data to be reported via HPMS, periodic verification of the equipment to ensure that the RTRRM is still in calibration must also be accomplished. This is described, below, under the heading "Conducting Periodic Calibration Tests." Supplemental information is contained in the World Bank Technical Paper # 46 (Reference 2), Chapter 4, Section 4.3.4, and in Reference 15.

Calibration of Equipment

Calibration is the key to good, sound data collection practices. It is essential to calibrate the equipment on a routine basis using calibration sections which have "known profiles" that have been established by a Class I or Class II device/procedure.

Each State must document and retain records of its calibration procedures (i.e., selection of calibration sites, description of sites, how and when profiles were obtained, frequency at which calibration will be conducted, speed(s) to be used, minimum number of passes, etc.), as well as the actual calibrations undertaken (i.e., dates the equipment are calibrated, the results of each calibration, etc.) It is the responsibility of the FHWA field offices to monitor the SHA's calibration procedures and to review the State's documentation of the process.

All roughness measurements reported in HPMS must be reported as IRI in inches per mile. If the procedure that the State is using does not provide an IRI in inches per mile (via Class I or II equipment), then the calibration through correlation procedure outlined below for RTRRM devices must be used to correlate the device output to IRI.

RTRRM Calibration Procedure

Roughness measurements obtained by RTRRM's are converted to IRI values by a calibration through correlation procedure. It is essential that each RTRRM be calibrated to a "known profile" determined by application of a Class I or II device/method. The need for calibration cannot be overemphasized in terms of collecting high-quality, consistent and comparable roughness measurements.

The calibration procedure is best described by a series of steps that must be taken in order to allow for conversion and correlation of the RTRRM roughness measurement to the IRI. The following is a simplified step-by-step calibration via correlation procedure. These steps are intended to be HPMS guidelines and should be considered minimum requirements; manufacturer and/or State procedures may be more stringent. The good weather conditions outlined under the "Guidelines for the Collection of Roughness Data", ahead, should also be followed here.

1. Choose a minimum of nine calibration sections, each at least 0.2 miles long, such that there are at least three sections in each of the roughness ranges described in Table J-2. The sites should be representative of the surface types found in the State and be located, where possible, on low-volume roads where roughness properties will not rapidly change, and where traffic is less likely to interfere with the measurements. If, after initial data collection, there exists a significant variance of readings between pavement types, separate calculations can be performed for each type. Some States will choose more than nine sections because of equipment location, equipment manufacturer stipulations, ease of getting to a calibration site, size of the State, etc. In order to reduce costs and to conserve time, the calibration sites should be chosen as close together, and as near to the RTRRM storage facility as possible.

Table J-2

Roughness Calibration Ranges

Group	IRI Roughness Range (inches per mile)
a. Smooth	0 - 190
b. Medium	191 - 320
c. Rough	> 320

Additional guidance is as follows:

- o Minimum calibration section lengths are 0.2 miles.
- o Minimum approach distance for each site is 150 feet (or enough to bring the RTRRM to proper speed and to stabilize equipment).
- o Where possible, choose sites on low-travel roadways whose roughness properties will not change rapidly over time.
- o Sites should be chosen on tangent sections of roadways that have little or no grade.
- o Where possible, coordinate (use) calibration locations with SHRP/LTPP sites, SHA pavement management and other common use locations.

NOTE: It is recognized that roadway calibration sections in all three of the roughness ranges contained in Table J-2 may not be applicable or available in some States, particularly for roadways that have pavement roughness extending into the "rough" range (> 320 inches per mile, IRI). In such instances it is not necessary to have RTRRM calibration sections in the rough range. It should be noted, however, that calibration sections must include roadways that have a measured roughness that meets or goes beyond the range of actual values that will be collected, because extrapolation of the regression line/equation beyond the roughness ranges in which the calibrations are completed is considered poor practice, and is not suitable for HPMS use. States should choose calbration sections such that all RTRRM measurements taken will be encompassed by the regression line end points, as defined by the calibration sections.

2. Clearly mark the termini and the wheelpath (measurement) area of each calibration section in the field (chalk, flags, etc.), and measure the profile using a Class I or II device/procedure. For each calibration site, measure the longitudinal profile by determining elevation to the nearest 0.04 inches (or 1.0 mm) every 12 inches, using the procedures outlined in the World Bank Technical Paper Number 46 (Reference 2) . This determines the "known profile."

3. For each calibration site, compute the International Roughness Index (IRI) in inches per mile based on the Class I or II device. Chapter 3 of World Bank Technical Paper Number 46 (Reference 2), contains more information about these calculations as do other references listed at the end of the Appendix. This is the Y value for each point plotted in the example correlation graph contained in step 6, below.

4. Measure the roughness on each of the calibration sections with each RTRRM device that the State intends to use. This should be done for each speed that will be used to collect roadway data, and should follow the manufacturer's specifications. The speed is to be held constant for the entire calibration site. A minimum of five passes for each device, at each speed on each calibration section is required in order to obtain an average reference roughness index (RRI) for the road profile. RRI's that are obviously far outside of the other readings (> 10 percent) should be eliminated if at least five readings still remain, or another pass should be made on the site to replace the questionable reading.

5. Calculate the average RRI for each calibration section, for each RTRRM device at each speed. The resulting average RRI's then become the X values of each point that is plotted (see example correlation graph in step 6, below). Note that each graph represents one given speed for a given RTRRM.

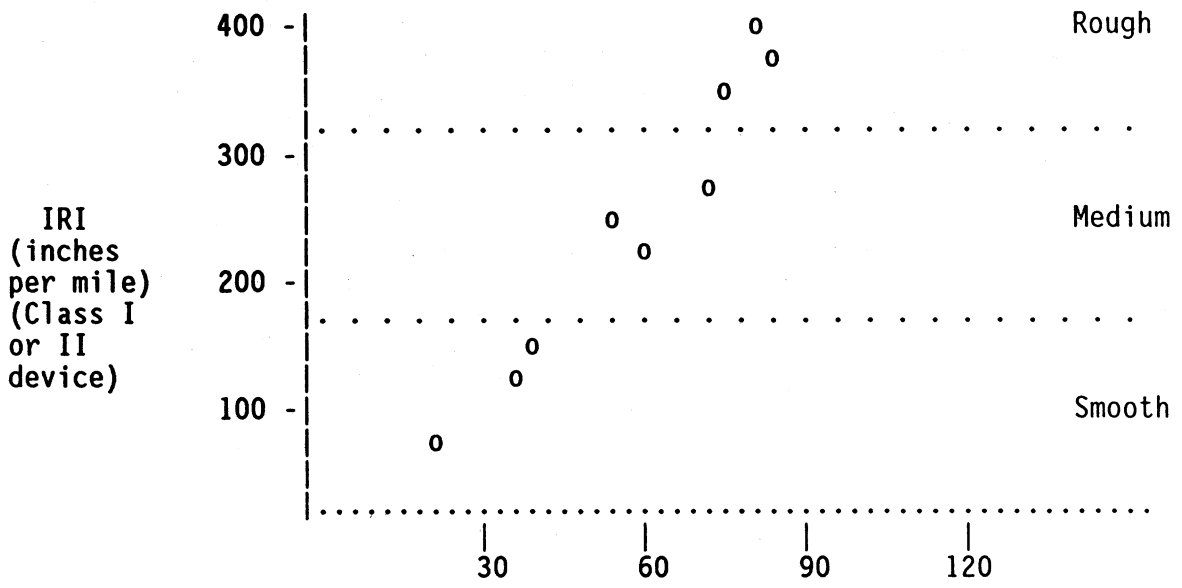
6. Plot the IRI (inches per mile) obtained from step 3 vs. the average RRI from step 5 for a given device, and a given calibration speed for each of the calibration sections. There should be a minimum of nine points on each graph as in the following example:

J-9

Example RTRRM Correlation Graph

HPMS Calibration Sections for a State

50 M.P.H. -- Mays Meter # 2 (Oscar)



A line is drawn through the points in a "best fit" fashion using a linear or nonlinear regression calculation (the regression analysis is performed for the data plotted on each graph). The calibration equation is in the form "$Y = bX + a$" (or "$Y = cX^2 + bX + a$" or "$Y = dX^3 + cX^2 + bX + a$", etc.), where "Y" = IRI in inches per mile, and "X" = the RRI reading in units per mile ("a", "b", "c", etc. are constants that result from the regression calculation). This line/equation becomes the HPMS correlation line/equation (where IRI will be reported in inches per mile) for all RTRRM measurements made on HPMS sample sections at the speed and with the device indicated.

For HPMS purposes, the simplest equation shown ($Y = bX + a$) will suffice. However, other more advanced linear or polynomial methods of curve-fitting may be used at the discretion of each State in order to improve the fit or to follow its normal procedures. Adequate documentation of any procedure used should be maintained to allow for technical evaluation reviews.

Conducting Periodic Calibration Verification Tests

The good weather conditions outlined under the "Guidelines for the Collection of Roughness Data", ahead, should also be followed here.

Verification of the "Known Profile"

Calibration sites will require periodic remeasurement with a Class I or II device (to ensure that the profile has remained stable), but this depends on the local conditions at the site and the length of time it will serve as a calibration site. Heavily travelled roadways and those subjected to severe weather conditions will require remeasurement to reestablish the "known profile" more often. To ensure that an accurate "known profile" is being used for calibration verification activities, it is expected that remeasurement would be performed once per year at a minimum, just prior to data collection activities (in the Spring, for instance). Year-round data collection activities may require more frequent remeasurements of the calibration sites. If the known profile IRI changes, complete recalibration will be necessary as described under the "RTRRM Calibration Procedure", above. Any time maintenance or resurfacing is performed on a calibration site, of course, the "known profile" must be reestablished or the site should be abandoned in favor of another site in its original roughness range.

RTRRM Calibration Check

To determine if the RTRRM has changed since the last calibration or calibration verification, and to check for RTRRM repeatability and its sensitivity to environmental conditions, calibration verification tests are required. This includes documentation of the same nature that is obtained for the RTRRM calibration (dates, results, site description, etc.). These tests should be run at least at the minimums noted below (see item 4). However, under the risk of discarding already collected data because an RTRRM is found to be out of calibration, a State may wish to increase the frequency of its verification tests. The following RTRRM calibration verification is based on the premise that the "known profile" is accurate:

1. Conduct periodic verification of equipment calibration using at least one calibration site per roughness group.

2. Five runs are required on each of the selected calibration sites for each test speed used. Variability of readings should be within 10 percent of each other.

3. The average Reference Roughness Index (RRI) must fall within + or - 5 percent of the previously established RRI (the average value obtained for the RTRRM at the given, constant speed when initially determining the point value for the calibration via correlation procedure) for each calibration site. If this comparison does not fall within these limits for each site, the equipment is out of calibration. When the equipment is out of calibration, it must be repaired and/or recalibrated using the calibration procedures outlined above. If repair is needed, recalibration will be necessary after the repair is completed.

4. Calibration verification must be conducted prior to conducting roughness surveys, and in the interim, at least once each month or every 2,000 travelled miles, whichever comes first. If the risk of gathering inaccurate data is potentially high, calibration verification should be conducted on a more frequent basis (perhaps weekly) to avoid collection of inaccurate data.

Guidelines for the Collection of Roughness Data

To the maximum practical extent, HPMS roughness data should be obtained from ongoing State Pavement Management Systems (PMS), Long Term Pavement Performance (LTPP) and Strategic Highway Research Program (SHRP) activities. HPMS activities are not intended to change any existing PMS data collection procedures as long as the resultant data meet the minimum requirements of the HPMS. The goal of HPMS is to ensure nationwide consistency and repeatability of roughness measurements over time and the complete avoidance of duplicate State data collection efforts.

The following are some field survey guidelines for State use:

Where roughness data are collected in both directions, the State will select one direction for each HPMS sample section to be reported and will use this same direction for that sample section in all future applications. It would be useful to choose one direction, statewide, and use that for all sample sections (i.e., east to west, south to north).

For multilane facilities, it is recommended that roughness data for the outside (right) lane be reported. However, if this is not practical, whichever lane is measured must be used for all future HPMS reporting.

If a one-wheel device is used to collect roughness data, it is recommended that the right wheel path be measured. However, if this is not practical, whichever wheel path is measured must be used for all future HPMS reporting.

All roughness data collection must be performed when the pavement is in stable condition. Data should not be collected during winter (frost/freeze or freeze/thaw) or wet base conditions. Data collection should be performed during good weather conditions. Good practice rules are as follows:

Temperature: Between 40 and 100 degrees F.

Wind: Data collection should not be performed when wind conditions affect the stability of the equipment/vehicle.

Rain: Data collection should not be performed when there is any accumulation of water upon the roadway surface.

Data should only be collected at the speeds which correspond to the manufacturer's recommended speed range and at the calibration speed(s); speeds should also be consistent with the posted speed limit. Constant speeds are to be maintained for all measurements. If the speed does not remain constant for the entire measurement site, the data should be rejected. Data collection should not begin until the vehicle accelerates to the calibration speed and the vehicle/equipment has stabilized.

The impacts of bridges and railroad crossings (or other obstacles which cause localized discontinuities) should be reflected in the roughness measurement.

Roughness measurements should be taken over a whole HPMS sample section and converted to units per mile. However, in order to achieve equipment and speed stability, a minimum of 150 feet (but consistent with the manufacturer's specification) is required prior to the measurement area. If this minimum cannot be met prior to the start of the sample section, some shorter portion of the HPMS section may be measured, but that same portion should always be measured in future roughness data collection activities. As noted in Chapter V, roughness data on HPMS sample sections are to be collected biennially, at a minimum.

Reporting Requirements

It is required that roughness data in IRI (in inches per mile) be reported for HPMS sample sections on all rural arterials and urban freeways and expressways. Roughness data reporting is suggested for all other sample section facilities where it is already collected or could be readily obtained by the State. (See Table IV-3, Page IV-27.) The lower functional systems (rural and urban collectors and urban other principal arterials and minor arterials) have been placed in the "suggested" category since it is recognized that there will be situations when it may not be possible to obtain roughness measurements with presently available RTRRM's. The major obstacles are identified as:

- o Speed restrictions (minimum or intermittant)
- o Section lengths
- o Traffic signals
- o Congestion

It should be noted that the road users' perception of roughness may not be reflected by response type device readings at low speeds, and therefore, erroneous results are likely. Furthermore, safety and related concerns must prevail under congested conditions, and therefore, use of RTRRM's under such circumstances is not always prudent.

Wavelength Filtering Levels for HPMS IRI

It should be noted that the longitudinal road profile includes a broad spectrum of wavelengths, from surface texture (short wavelengths) to hills and valleys (long wavelengths). The upper and lower limits depend on the particular profiling equipment. In order to obtain an IRI for the "ride" qualities of interest to HPMS, the IRI analysis described in the World Bank Technical Paper Number 46 should be used. This algorithm effectively eliminates (filters) the profile data outside of the 1.3 - 30 meter (approximately 4 - 100 foot) wavelength band (Reference 2, Chapter 3, page 21). Additional discussion of wavelength filtering, including illustrations, may be found in the "Description and Evaluation of the South Dakota Road Profiler", Reference 16.

Those States that use roughness measuring equipment that does not yield roughness profiles can obtain the IRI statistic through the regression procedure described previously (i.e., calibration through correlation to a profile derived IRI).

Coordination Among Various Pavement Activities

A considerable number of activities are currently taking place within the highway community which deal with pavement data. Coordination among these activities is essential in order to optimize the return on the efforts expended in data collection, analysis, reporting and use.

The HPMS effort almost certainly needs to be coordinated with the following activities:

a. Strategic Highway Research Program (SHRP)/Long Term Pavement Performance (LTPP)
b. National Bureau of Standards (NBS)/AASHTO Materials Reference Lab (AMRL)
c. State Pavement Management Systems (PMS)

The LTPP activities as part of the SHRP will monitor pavement performance and usage in detail for approximately 1,500 pavement sections, nationwide, over a 20-year period. Attempts should be made to ensure that as many LTPP sections as possible are also HPMS sample sections or at least representative (i.e., in close proximity) of HPMS samples. The pavement and traffic monitoring data collected on these LTPP sections should be used for the HPMS sample sections, where possible.

It is expected that all LTPP sections will be profiled at least every 2 years. Efforts should be made to utilize the LTPP established sections/profiles as multiple use HPMS/SHA calibration sections in each State.

Many State transportation agencies have operational or are developing a PMS to guide program development, improve life-cycle costs, and select the most effective pavement improvement strategy. The HPMS pavement data reporting must be consistent with State PMS as much as possible. For this reason, the roughness and/or condition statistic developed by the State PMS should include the IRI statistic to be reported for HPMS. This would minimize the effort and/or expense of reporting HPMS pavement condition data from the State PMS database. One of the goals of HPMS is to advocate the complete avoidance of duplicate State data collection efforts, and the States are encouraged to coordinate roughness measuring activities, where possible, such that the same equipment and calibration sites are used for HPMS, PMS, LTPP, etc.

References

1. Gillespie, T.D., Sayers, M.W., and Segal, L. (1980), Calibration of Response-Type Road Roughness Measurement Systems. NCHRP Report 228, Transportation Research Board, 81 p.

2. Sayers, M.W., Gillespie, T.D. and Paterson, W.D.O. (1986), Guidelines for Conducting and Calibrating Road Roughness Measurements. Technical Paper 46, World Bank, Washington, D.C., 87 p.

3. Sayers, M.W., Gillespie, T.D. and Queiroz, C.A.V. (1986), The International Road Roughness Experiment: Establishing Correlation and a Calibration Standard for Measurements. Technical Paper 45, World Bank, Washington, D.C., 453 p.

4. Janoff, M.S., Nick, J.B., Davit, P.S. and Hayhoe, G.F. (1985), Pavement Roughness and Rideability. NCHRP Report 275, Transportation Research Board, Washigton, D.C., 66 p.

5. Jordan, P.G. (1984), Measurment and Assessment of Uneveness on Major Roads. Laboratory Report 1125, Transport and Road Research Laboratory, Crowthorne, UK, 23 p.

6. Hudson, W.R., Halbach, D., Zaniewski, J.P. and Moser, L. (1985), Root-Mean-Square Vertical Acceleration as a Summary Roughness Statistic. ASTM STP 884, American Society for Testing and Materials, Philadelphia, Pennsylvania, pp. 3-24.

7. Pavement Rating Procedures, FHWA, September 1985; ARE, Inc.

8. Pavement Condition Rating Guide, FHWA, September 1985; ARE, Inc.

9. Highway Pavement Distress Identification Manual for Highway Condition and Quality of Highway Construction Survey, FHWA, March 1979; Department of Civil Engineering, University of Illinois.

10. Darter, M.I., Becker, J.M., Snyder, M.B., and Smith, R.E. (1985), Portland Cement Concrete Pavement Evaluation System (COPES). NCHRP Report 277, Transportation Research Board, Washington D.C., 175 p.

References

11. Manual for Condition Rating of Flexible Pavements, Ministry of Transportation and Communications, Ontario, Canada, August 1975.

12. Automated Pavement Data Collection Equipment, FHWA Demonstration Project No. 72, FHWA-DP-2-1, September 1986.

13. Paterson, W.D.O. (1986), International Roughness Index: Relationship to Other Measures of Roughness and Riding Quality. Transportation Research Record 1084, Transportation Research Board, Washington, D.C., pp 76-85.

14. Calibration Procedures for Roadmeters, FHWA Research, Development and Technology, FHWA-TS-86-201, April 1986.

15. Calibration of Road Roughness Equipment, Volume I, Experimental Investigation, 84p; Volume II, Calibration Procedures, 29p, FHWA Research, Development and Technology, FHWA-RD-89-077 and -078, respectively, March 1989.

16. Description and Evaluation of the South Dakota Road Profiler, 150p, FHWA Demonstration Project No. 72 (addition), FHWA-DP-89-072-002, November 1989.

APPENDIX K

Traffic Counting Procedures for the HPMS

The recommended procedures for the development of reliable estimates of annual average daily traffic (AADT) on the HPMS sample sections, and systemwide travel (daily vehicle-miles of travel) by expansion of the sample section AADT are contained in the Traffic Monitoring Guide (TMG). 1/

The development of section AADT estimates must be comprehensive and include the use of appropriate adjustment factors to compensate for known unique characteristics, and to adjust short counts to AADT. HPMS sample sections not counted during the current year must be updated to current AADT estimates by the use of appropriate growth factors prior to the annual HPMS data submittal. Estimates of DVMT can be developed by direct expansion of the HPMS sample. The procedure is to multiply the sample section AADT by the section length and that product by the expansion factor; and then sum the sections up to the HPMS stratification level desired. Current HPMS Submittal Software described in Chapter VI (SELSUMT option) will perform these calculations by functional system. Since the HPMS sample expansion procedures are based on the ratio of universe to sample mileage, mileage totals at any stratification level should be exact. These results combined with a direct volume measurement and a well-distributed HPMS sample should result in highly reliable DVMT estimates. DVMT estimates derived from the HPMS sample can be used as the source of areawide form data or to verify independent areawide estimates.

The integration of different aspects of traffic monitoring (traffic volume, vehicle classification, and truck weight), results in the direct linkage of estimates obtained by the three programs. This unified, supportive structure has a common estimation base. The traffic volume aspect consists of three elements: Continuous ATR's, the HPMS Sample, and Special Needs.

Continuous ATR's

The continuous ATR's provide seasonal, day-of-week, or growth factors which may be needed to adjust the short coverage counts to AADT. Analytical procedures to determine the appropriate level of effort and to develop the needed estimates are described in the TMG.

HPMS Sample 2/

The HPMS sample provides an appropriate statistical base for the development of location-specific (AADT) estimates at each HPMS sample section and systemwide DVMT by expansion of the HPMS sample. By the incorporation of vehicle classification and truck weight, the structure provides a smooth-functioning estimation hierarchy.

1/ Federal Highway Administration, Notice N5600.7, "Traffic Monitoring Guide", U. S. DOT, June 1985.

2/ The TMG references the HPMS sample as the "core sample."

The TMG recommends use of 48-hour counts covering the HPMS sample over a 3-year cycle. The counts should be randomly scheduled spatially (geographically) and temporally (over the calendar year) to insure adequate representation and to minimize bias. Axle correction factors to adjust raw counts obtained via axle counting equipment are derived from the vehicle classification sample.

The annual traffic volume sample to be counted on each functional system consists of a randomly selected one-third of the HPMS sample sections (see Section 3 of the TMG) by randomly dividing each stratum sample (volume group) into three parts. Minor adjustments are necessary for strata with numbers of sections not divisible by 3 or having less than 3 samples (for a full discussion refer to Section 3 of the TMG). One-third of the sample would be monitored each year, where growth factors would be applied to the other two-thirds. The full HPMS sample would be completely covered after 3 years. To allow for a stable sampling process the HPMS sample should be reexamined and updated every three years prior to the start of the monitoring process, and left unmodified during the 3 years of the cycle. Unsampled volume groups or those volume groups with fewer than 3 samples, however, must be remedied annually (see Chapter V). The reexamination process involves updating the universe framework to include all road system modifications which affect the HPMS strata, and to reevaluate the sample according to the procedures in Appendices G and H.

Special Needs

The special needs element integrates the system aspects discussed above with the location-specific needs of each State. This unstructured, flexible approach allows complete definition according to State desires. Three aspects of the HPMS program that are served by the special needs element are the counting on HPMS Interstate universe sections, the preparation of strata (volume groups) for the universe mileage to provide adequate sample expansion factors, and the counting on roadways functionally classified as local for the areawide reporting.

Interstate Universe Procedures

The importance of the Interstate system coupled with the use of Interstate VMT figures as apportionment factors for the I-4R program, require an additional level of effort. Even though the existing Interstate HPMS sample would be expected to provide highly reliable DVMT estimates, supplemental data are collected to enhance the level of precision; namely, monitoring each nonsampled Interstate universe section between interchanges at a minimum of once every six years. This requirement can be met by counting one-sixth of the nonsampled Interstate road sections each year. As with the the HPMS sample sections, the counts should be randomly scheduled spatially and temporally to insure adequate Statewide representation. These counts would be used to provide AADT estimates for each HPMS Interstate universe section, where growth factors would be applied on those sections not counted in the current year. In those situations where there are a number of nonsampled Interstate universe sections (and no HPMS sample sections) on the link between contiguous interchanges, only one count during each 6-year cycle need be taken and the resultant count would be applied to all universe sections within the link.

For example, the Interstate road link between contiguous interchanges may consist of 3 nonsampled HPMS universe sections, all of which would be assigned the annual AADT value derived from a single count made between the interchanges each six years. In cases where a sample section count is taken between interchanges, the derived AADT may be used for all universe sections between the interchanges, as well.

These traffic counting procedures will result in a full HPMS sample counted every 3 years and a full Interstate System counted at a minimum of every six years. The Interstate universe and sample section counts would be converted to current AADT using the standard TMG procedures (see Section 3 of the TMG), including the use of appropriate adjustment factors. Sample and Interstate universe section AADT would then be reported annually as required.

Use of Alternative Counting Procedures

The procedures discussed in this Appendix are based on the use of procedures recommended in the TMG and supplemented with the Interstate System universe counting process described above. States may decide to apply other procedures of their preference to develop the desired reporting. States using the procedures described in the TMG and this Appendix need only state that fact at the time of data submission. However, to insure the reliability of the data reported and subsequently used in the critical apportionment process, States deciding to use alternative procedures must insure that such procedures produce estimates with reliabilities that equal or exceed those in the TMG. Thorough documentation of these procedures shall be furnished to the FHWA. The following guidelines denote the type of information to be furnished:

1. A complete description of the procedures including the number of counts, the period of monitoring, the cycle of monitoring, the spatial and temporal distribution of count sites, the AADT estimation process, the adjustment factor development and application processes, the assignment of counts to HPMS sample and/or universe sections, etc.

2. A comprehensive analysis describing the statistical reliability of the data collected and of the procedures used, and how the procedures meet the reliability levels prescribed in the TMG.

Alternative procedures are to be reviewed and approved by the FHWA.

APPENDIX L

HIGHWAY CAPACITY IN HPMS SUBMITTAL SOFTWARE

RURAL CAPACITY

The procedures used in the HPMS submittal software for calculating highway capacity generally conform to the 1985 Highway Capacity Manual (HCM). The capacity calculations are based on service flow rates for level of service E. The procedures for general terrain are used. All references to chapters, tables, etc., are to the HCM. These tables are not reproduced in this Appendix. Assumptions for situations not explicitly covered in the HCM are given below.

For 3-lane highways, it is assumed that one direction is used as a single lane without passing, and the opposite direction has 2 lanes, allowing passing. The direction with one lane is analyzed as one direction of a 2-lane highway with no passing opportunities. The direction with 2 lanes is analyzed as one direction of a 2-lane with 100 percent passing sight distance.

For highways with odd numbers of lanes greater than 3, the odd lane is dropped and the capacity calculation is entered with the even number of lanes.

For one-way 1-lane sections, 2-lane capacity is used with a directional factor of 1.0. For one-way multilane sections, the capacity is calculated as one direction of a multilane highway. Obstructions on both sides are used for determining the lateral clearance factor.

Sections with dense rural development (when data item #71 is coded "2") are treated like other rural sections for capacity calculations (see note page L-5). For multilane highways, a factor for suburban development is used. The State should code the capacity for all sections with dense rural development where rural procedures would not give the correct capacity. The timing of such entries should be after calculations are made (SELCALC option), since these capacity values would be replaced any time a calculation computer run is made.

Shoulder width is used as the lateral clearance for entering the tables of adjustments for restricted lane width and lateral clearance. For 2-lane highways, right shoulder width is used. For multilane undivided highways, right shoulder width is used as the clearance to an obstruction on one side of the roadway. For divided multilane highways, including freeways, the average width of both left and right shoulders is used as the clearance to

obstructions on both sides of the roadway. This is done when the median is curbed (median type code 1) or when the median is unprotected (median type code 3). If there is a barrier median (median type code 2), right shoulder width only is used as the clearance to an obstruction on one side of the roadway.

TWO-LANE HIGHWAYS

For rural 2-lane highways, the following procedure from Chapter 8 is used:

SF = 2800 * v/c * fD * fW * fHV

Where:
- SF = service flow (actual capacity)
- v/c = (service flow)/(ideal capacity), Table 8-1, for level of service (LOS) E
- fD = adjustment for directional distribution, Table 8-4
- fW = adjustment factor for lane width and lateral clearance, Table 8-5, LOS E; right shoulder width is used for lateral clearance
- fHV = adjustment factor for trucks from the equation below

fHV = 1/[1+Pt(Et-1) + Pr(Er-1)]

Where:
- Pt = percent trucks (decimal)
- Et = passenger car equivalent for trucks, Table 8-6, using LOS E
- Pr = percent recreational vehicles:
  - For arterials, Pr = 0.04
  - For collectors, Pr = 0.0
- Er = passenger car equivalent for recreational vehicles, Table 8-6, using LOS E

The term for busses is omitted, assuming zero percent busses.

THREE-LANE HIGHWAYS

For rural 3-lane highways, the following procedure is adapted from the 2-lane procedures in Chapter 8. The 4800 base service flow is used assuming that one direction of travel has a base service flow of 2800 (100 percent passing opportunity) and the opposing direction of travel has a base service flow of 2000 (no passing opportunities).

SF = 4800 * v/c * fD * fW * fHV

Where: v/c = average of the two v/c values from Table 8-1. (LOS E) using (1) no passing sight distance and (2) 100 percent passing sight distance

All other terms in the equations are the same as for 2-lane highways.

MULTILANE (Divided and undivided)

For rural multilane highways, the following procedure from Chapter 7 is used.

SF = MSF * N * fW * fHV * fE * fP

Where:
- SF = service flow (actual capacity)
- MSF = maximum service flow rate per lane, Table 7-1. For 55 mph or greater average highway speed, MSF = 2000; For less than 55 mph, MSF = 1900
- N = number of lanes in one direction
- fW = adjustment factor for lane width and lateral clearance, Table 7-2
- fHV = adjustment factor for trucks from equation below
- fE = adjustment factor for type of development and type of highway uses Table 7-10; for rural dense development, the suburban factor is used.
- fP = adjustment factor for type of driver population, Table 7-11; the value 0.90 is used.

fHV = 1/[1+Pt(Et-1) + Pr(Er-1)]

Where:
- Pt = percent trucks (decimal)
- Et = passenger car equivalent for trucks, Table 7-3, using LOS E
- Pr = percent recreational vehicles
  - For arterials, Pr = 0.04
  - For collectors, Pr = 0.0
- Er = passenger car equivalent for recreational vehicles, Table 7-3, using LOS E

The term for busses is omitted, assuming zero percent busses.

FREEWAYS

For freeways, the following procedure from Chapter 3 is used. Freeways are divided highways with full control of access.

SF = MSF * N * fW * fHV * fP

Where:
- SF = service flow (actual capacity)
- MSF = maximum service flow rate per lane, Table 3-1. For 55 mph or greater average highway speed, MSF = 2000; For less than 55 mph, MSF = 1900
- N = number of lanes in one direction
- fW = adjustment factor for lane width and lateral clearance, Table 3-2
- fHV = adjustment factor for trucks, from equation below
- fP = adjustment factor for the character of the traffic stream, Table 3-10; the value 0.90 is used.

fHV = 1/[1+Pt(Et-1) + Pr(Er-1)]

Where:
- Pt = percent trucks (decimal)
- Et = passenger car equivalent for trucks, Table 8-6, LOS E
- Pr = percent recreational vehicles
  - For arterials, Pr = 0.04
  - For collectors, Pr = 0.0
- Er = passenger car equivalent for recreational vehicles, Table 3-3, using LOS E

The term for busses is omitted, assuming zero percent busses.

ONE-WAY HIGHWAYS

One-lane highways:

For 1-lane one-way highways the following procedure is adapted from Chapter 8. The equation for 2-lane highways is used with a directional factor always equal to 1.0.

SF = 2800 * v/c * fD * fW * fHV

Where:
- SF = service flow (actual capacity)
- v/c = (service flow)/(ideal capacity), Table 8-1, for LOS E
- fD = adjustment for directional distribution, Table 8-4

fW = adjustment factor for lane width and lateral clearance, Table 8-5, LOS E; right shoulder width is used for lateral clearance
fHV = adjustment factor for trucks from the equation below

fHV = 1/[1+Pt(Et-1) + Pr(Er-1)]

Where:
Pt = percent trucks (decimal)
Et = passenger car equivalent for trucks, Table 8-6, using LOS E
Pr = percent recreational vehicles
For arterials, Pr = 0.04
For collectors, Pr = 0.0
Er = passenger car equivalent for recreational vehicles, Table 8-6, using LOS E

The term for busses is omitted, assuming zero percent busses.

Two or more lanes:

For one-way highways with 2 or more lanes, multilane procedures from Chapter 7 are used.

SF = MSF * N * fW * fHV * fE * fP

Where: All terms in the equation are the same as for multilane highways. Shoulder width is used for lateral clearance. The average of right and left shoulder widths is used as the clearance to obstructions on both sides for entering Table 7-2.

URBAN CAPACITY

Urban capacity procedures are not included in the HPMS submittal software. Urban capacities are to be coded by the State.

APPENDIX M

EDIT SPECIFICATIONS FOR HPMS DATA

DATA ITEM	EDIT PERFORMED 1/
1 - State Control Field	No edit.
2 - Year	Must equal the last two digits of the inventory data year coded on the user parameter card.
3 - State Code	Must match the State code on the user parameter card.
4 - County Code	Must contain a nonzero numeric value.
5 - Rural/Urban Designation	Must be a "1", "2", or "3".
6 - Urbanized Area Code	Must be numeric. a. If a rural or small urban section (Item 5 = 1 or 2), item reserved for State use, no edit. b. If an urbanized section (Item 5 = 3), positions 109 and 110 must be 00 or 11 - 20; positions 111 - 113 must be 001 to 400.
7 - Type of Section ID	Must contain a value from 1 to 4. a. If functional class is Interstate (Item 9 = 01 or 11), type of section ID must equal "1" (route-milepoint). b. If non-Interstate sample section, type of section ID must equal "1" or "2" (route-milepoint or A-node, B-node, segment).
8 - Section Identification	Must be nonzero alphanumeric and be unique countywide. If type of section is route-milepoint (Item 7 = 1), the milepoint field must be numeric.

1/ When data items do not apply, zero fill.

DATA ITEM	EDIT PERFORMED
9 - Functional System	Must contain one of the following: Rural (Item 5 = 1): "01", "02", "06", "07", "08", or "09". Urban (Item 5 = 2 or 3): 11 thru 17 or "19". If sample section, must not be "09" or "19".
10 - Generated Functional System Code (No Edit)	Generated by the calculation software. The two-positional functional system code (Item 9) is converted to a one-positional code for matrix use in the FHWA software and placed on the data record. The conversions are as follows: Item 9 — Item 10 01, 11 — 1 (Interstate) 02, 12, 13 — 2 (Principal Arterial; Other Freeways or Expressways) 06, 14, 15 — 3 (Minor Arterial; Other Principal Arterial) 07, 16 — 4 (Major Collector; Minor Arterial) 08, 17 — 5 (Minor Collector; Collector) 09, 19 — 6 (Local)

DATA ITEM	EDIT PERFORMED
11 - Federal-Aid System	Rural: Must contain a "1", "2", "4", or "8". a. If F.C. (Item 9) equals "01", then this item must equal "1". b. If F.C. equals "02", then this item must equal "2" or "8". c. If F.C. equals "06", then this item must equal "2" or "8". d. If F.C. equals "07", then this item must equal "4" or "8". e. If F.C. equals "08" or "09", then this item must equal "8". Urban: Must contain a "1", "2", "3", or "8". a. If F.C. (Item 9) equals "11", then this item must equal "1". b. If F.C. equals 12 thru 16, then this item must equal "2", "3", or "8". c. If F.C. equals "17", then this item must equal "3" or "8". d. If F.C. equals "19", then this item must equal "8". If non-Federal-aid open to traffic (Item 12 = 8), this item must equal "8".
12 - Federal-Aid System Status	Must contain a "1", "2", or "8". If non-Federal-aid (Item 11 = 8), this item must equal "8". If sample section, Item 23 contains a "1" in position 159, this item must be coded "1" or "8".
13 - Route Signing	Must contain a value from 0 to 7. If Interstate (Item 9 = 01 or 11), this item must equal "1". If this item equals "1" then functional system (Item 9) must be coded 01 or 11 and Federal-aid system (Item 11) must be coded 1.
14 - Route Number	If Interstate (Item 9 = 01 or 11), this item must be nonzero alphanumeric.

DATA ITEM	EDIT PERFORMED
15 - Governmental Level of Control	Must contain a "01", "02", "03", "04", "11", "12", "21", "25", "26", "31", "32", "60", "62", "64", "66", "68", or "70". If this item equals "26", Items 11 and 12 must equal "8".
16 - Special Systems	Must contain a "01" thru "06", "10", "15", "20", "25", "30", "40", "41", or "42". a. If 139(a) mileage (Item 16 = 40) then the functional system must be Interstate (Item 9 = 01 or 11) and Federal-aid system must be Interstate (Item 11 = 1). b. If 139(b) mileage (Item 16 = 42), then must be Federal-aid primary (Item 11 = 2). c. If 139(b) mileage (Item 16 = 42), then functional system (Item 9) must be coded "02" or "06" if rural; or coded "12", "14" or "16", if urban.
17 - Type of Facility	Must contain a "1" or "2".
18 - Designated Truck Route/ Parkway	Must contain a "1", "2", "3" or "4".
19 - Toll	Must contain a "1", "2", "3" or "4". Toll segment under Secretarial Agreement (Item 19 = 3, 4) must be coded Interstate (Item 9 = 01 or 11).
20 - Section/Group Length	Must contain a nonzero numeric entry.
21 - AADT	Must be numeric. a. If an Interstate section (Item 9 = 01 or 11) and open to traffic (Item 12 = 1), this item must be nonzero. b. If a non-Interstate sample section, this item must be nonzero.

DATA ITEM	EDIT PERFORMED
22 - Number of Through Lanes	Must be numeric. If Interstate open to traffic (item 12 = 1) or non-Interstate sample section: a. This item must be nonzero. Rural: Should contain a value from 01 to 10. Urban: Should contain a value from 01 to 14. b. If type of facility is two-way (item 17 = 2), and paved section (item 28 > 50) must be two or more lanes.
23 - Record Continuation Code	Must be numeric. a. If the continuation code contains "00000", this must be a universe section with items 1-22 coded. c. If the continuation code contains a "1" in the first position (position 159) of this field, this must be a sample section with items 1 thru 76 coded where applicable. Record length is 427 plus the sum of the following: (1) If positions 160-161 are nonzero, add value times 15. (2) If positions 162-163 are nonzero, add value times 7. Maximum record length is 1,282 digits.
24 - Sample Number	Must be a nonzero alphanumeric entry, unique countywide.
25 - Sample Subdivision	Must be numeric.
26 - AADT Volume Group Identifier	Must be nonzero numeric for sample sections. For FHWA Standard Sample Design, AADT's must correspond to ranges specified in Appendix F and this item must contain a value from 01 thru 13.
27 - Expansion Factor	Must be nonzero numeric and contain a value of 001000 thru 100000.

DATA ITEM	EDIT PERFORMED
28 - Surface/Pavement Type	Must contain one of the following: "20", "30", "40", "51", "52", "53", "61", "62", "71", "72", "73", "74", "75", "76" or "80". If Interstate (item 9 = 01 or 11), this item should contain a value of "61", "62", "71", "72", "73", "74", "75" or "76".
29 - Concrete Joint Spacing	Must be numeric. If this item is > 00, the surface type (item 28) must be portland cement concrete, coded 71-76.
30 - Load Transfer Devices	Must be 0, 1 or 2. If Interstate, Other Freeways/Expressways or Other Principal Arterial and surface type (item 28) is coded "71" or "72", then this item must be "1" or "2". If surface type (item 28) is coded "51", "52", "53", "61" or "62", then this item must be coded "0".
31 - Pavement Section	If a paved section (item 28 > 50), this item must contain a value from 1 to 5. If surface/pavement type is "rigid" (item 28 = 71, 72, 73, 74, 75 or 76), this item must be a 2 thru 5. If surface/pavement type is "flexible" (item 28 = 51, 52, 53, 61, 62 or 80), this item must be a "1", "3", "4", or "5". If Interstate, Other Freeways/Expressways or Other Principal Arterial, this item must be "1" or "2". If an unpaved section (item 28 < 50) it must contain "0".

DATA ITEM	EDIT PERFORMED
32 - Structural Number or Slab Thickness	Must be numeric. a. If structural number is known (Item 31 = 1), this item should contain a value from 10 to 70. b. If thickness is known (Item 31 = 2), this item should contain a value from 06 to 14. c. If Item 31 does not contain "1" or "2", this item must contain "00". d. If Interstate, Other Freeways/Expressways or Other Principal Arterial, this item must <u>not</u> be coded "00".
33 - Type of Base	Must be 0, 1, 2, 3, 5, 8 or 9. If Interstate, Other Freeways/Expressways or Other Principal Arterial, then this item must <u>not</u> be coded "0".
34 - Type of Subgrade	Must be 0, 1, 2 or 5. If Interstate, Other Freeways/Expressways or Other Principal Arterial, then this item must be coded "1", "2" or "5".
35 - Subsurface Drainage	Must be 0, 1, 2, 3, 4 or 5. If Interstate, Other Freeways/Expressways or Other Principal Arterial, then this item must be coded "1", "2", "3", "4" or "5".
36 - Measured Roughness	Must be numeric. a. If surface type is unpaved (Item 28 < 50), this item must be coded "000". b. This item must be greater than zero for all paved (Item 28 > 50) rural arterials. c. This item must be greater than zero for urban Interstate and Other Freeways/Expressways.
37 - Reserved for Federal Use	Must contain zeroes.

DATA ITEM	EDIT PERFORMED
38 - Pavement Condition	If a paved section (Item 28 > 50), this item must contain a value from 01 to 50. Otherwise, it must contain "00".
39 - Overlay or Pavement Thickness	Must be numeric. If this item is greater than zero, then year of surface improvement (Item 40) and type of improvement (Item 41) must not be coded zero.
40 - Year of Surface Improvement	Must be numeric. If this item is not coded zero, then overlay or pavement thickness (Item 39) and type of improvement (Item 41) must not be coded zero.
41 - Type of Improvement	Must be 00, 10, 20, 31, 32, 33, 34, 35, 40, 50, 60, 71, 72, 77 or 78. If this item is not = 40, 50 or 60, then year of surface improvement (Item 40) and overlay or pavement thickness (Item 39) must not be coded zero.
42 - Access Control	Must contain a value of "1", "2", or "3". If Interstate (Item 9 = 01 or 11), full control of access should exist (this item = 1).
43 - Lane Width	Must be numeric and should contain a value from 06 to 18.
44 - Shoulder Type	Must contain a value from 1 to 8.

DATA ITEM	EDIT PERFORMED
45 - Shoulder Width	Must be numeric and should contain a value from 00 to 12.
a. Right Shoulder:	a. If shoulder exists (item 44 = 2 through 7), this item must be greater than "00". b. If curbed or no shoulder exists (item 44 = 1 or 8), this item must contain "00".
b. Left Shoulder:	If no median exists, this item must contain "00". Otherwise, left shoulder should contain a value from 00 to 12.
46 - Median Type	Must contain a value from 1 to 4.
47 - Median Width	Must contain a numeric value from 00 to 99. a. If a median exists (item 46 = 1, 2, or 3), median width must be greater than zero and must be greater than or equal to twice the left shoulder width (item 45b). b. If no median exists (item 46 = 4), this item must be equal to "00".
48 - Existing Right-of-Way Width	Must be nonzero numeric. a. If median width (item 47) > 00, then this item must contain a value greater then or equal to the number of lanes times lane width, plus right shoulder widths, plus median width. b. Otherwise, this item must contain a value greater than or equal to the number of lanes times lane width, plus shoulder widths, left and right.
49 - Is Widening Feasible?	Must contain a value from 1 to 5.
50 - Horizontal Alignment Adequacy (Rural Data Item) (Calculated based on curve data for <u>all</u> paved rural sections.)	Must contain a value from 0 to 4. If a paved rural section, this item must contain a value from 1 to 4. If curves are not reported for a paved rural section and the coded value is "0", a "2" will have been inserted in this field.

DATA ITEM	EDIT PERFORMED
51 - Curves By Class	Must contain a nonzero numeric entry for at least one curve class for all paved (item 28 > 50) rural arterials (item 9 = 01, 02 or 06) and all paved urban principal arterials (item 9 = 11 to 15). Otherwise, may be zero filled. The number of curve fields and curve length fields must contain a numeric value for each curvature class. a. If the number of curves is greater than zero, the corresponding curve length field must contain a nonzero numeric value. b. If the number of curves equals "00", the corresponding curve length field must contain "00000". c. The sum of the curve length fields must equal the section length.
52 - Vertical Alignment Adequacy (Rural Data Item) (Calculated based on grade data for <u>all</u> paved rural sections.)	Must contain a value from 0 to 4. If a paved rural section, must contain a value from 1 to 4. If grades are not reported for a paved rural section and the coded value is "0", a "2" will have been inserted in this field.
53 - Grades By Class	Must contain a nonzero numeric entry for at least one grade class for all paved (item 28 > 50) rural arterials (item 9 = 01, 02, or 06) and all paved urban principal arterials (item 9 = 11 to 15). Otherwise, may be zero filled. The number of grade fields and grade length fields must contain a numeric value for each grade class. a. If the number of grades is greater than zero, the corresponding grade length field must contain a nonzero numeric value. b. If the number of grades equals "00", the corresponding grade length field must contain "00000". c. The sum of the grade length fields must equal the section length.

DATA ITEM	EDIT PERFORMED
54 - Percent of Length with Sight Distance equal to or greater than 1500 Feet (Rural Data Item)	Must be numeric. If coded, must be equal to or less than 100.
55 - Speed Limit	Must be a nonzero numeric value from 10 to 65. If within urbanized area, should be 55, or less.
56 - Weighted Design Speed	Must be numeric. If a paved (Item 28 > 50) rural collector (Item 9 = 07 or 08) with type of development rural (Item 71 = 1) and <u>if curves are not reported</u>, this item must contain a value from 35 to 70.
(Calculated from curve data.)	Rural: For all paved arterials and for paved rural collectors with type of development rural (Item 64 = 1), this item must contain a value from 35 to 70. Otherwise, it should be "00".
	Urban: If an urban Interstate or a freeway or expressway by design type, this item must contain a value from 35 to 70. Otherwise, it must contain a "00".

Calculation procedure is the same as outlined in Appendix D.

If curve data are not reported and a value of "00" has been coded, default values will be inserted as follows:

<u>Rural</u> by functional system (Item 9) and type of terrain (Item 70);

	Item 70 Coded:		
<u>Item 9</u>	<u>1</u>	<u>2</u>	<u>3</u>
01	70	70	70
02	70	70	65
06	70	65	60
07	60	55	45
08	55	50	45

<u>Urban</u> Interstate, "70"; Freeways and Expressways by design type, "65".

DATA ITEM	EDIT PERFORMED
57 - Percent Commercial Vehicles: a. Peak	Must be numeric and should contain a value less than or equal to "40".
b. Off-Peak	Must be numeric and should contain a value less than or equal to "45".
58 - K-Factor	Must be numeric and should contain a value from 01 to 24.
59 - Directional Factor	Must be nonzero numeric. If one-way (Item 17 = 1), this item must contain "100". Otherwise, it should contain a value from 050 to 075.
60 - Peak Capacity	Urban: Must contain a nonzero numeric entry. a. Maximum Capacity (service flow): One-Way (Item 17 = 1): Should contain a value less than or equal to the number of lanes (Item 22) times 1,600. For example, the maximum capacity for a two-lane, one-way street would be 3,200 vehicles per hour. It is highly unlikely that this figure would be exceeded. Two-Way (Item 17 = 2): The capacity applies to one direction but the edit check utilizes all lanes of the two-way roadway. The capacity should contain a value less than or equal to the number of lanes (Item 22) times 1,000. For example, the maximum capacity for a four-lane city street should not exceed 4,000 vehicles per hour in one direction. It is highly unlikely that this figure would be exceeded.

DATA ITEM	EDIT PERFORMED
60 - Peak Capacity (Cont.)	b. Minimum Capacity (service flow): For two-way (item 17 = 2), multilane (item 22 > 3) sections with full or partial access control (item 42 = 1 or 2) and no at-grade intersections (sum of items 74a, 74b, and 74c = 0), should contain a value > or = the number of lanes (item 22) times 450. For all others, should contain a value > or = the number of lanes (item 22) times 150.
(The calculation procedure for rural sections is outlined in Appendix L.)	Rural: If capacity not reported, must contain "000000" and capacity will be calculated from inventory data (for paved facilities only). If capacity is reported, it must be nonzero numeric and meet the following conditions: a. Maximum Capacity (service flow): One-Way: Should contain a value less than or equal to the number of lanes (item 22) times 2,000. Two-Way: (1) If the number of lanes (item 22) equals "2", it should contain a value < or = 2,800. (2) If the number of lanes (item 22) equals "3", it should contain a value < or = 4,800. (3) Multilane -- it should contain a value < or = the number of lanes (item 22) times 1,000. For example, the maximum capacity in one direction for a four-lane facility (item 26 = 4) is 4 times 1,000 or 4,000 vehicles per hour (2,000 per lane in one direction). b. Minimum Capacity (service flow): Should contain a value > or = the number of lanes (item 22) times 450 for flat terrain (item 70 = 1) or times 300 for rolling terrain (item 70 = 2) or times 175 for mountainous terrain (item 70 = 3).

DATA ITEM	EDIT PERFORMED
61 - Volume-to-Service Flow (V/SF) Ratio: Equations for V/SF ratio: Rural 2 or 3 lanes: V/SF = [AADT (item 21) x K-Factor (item 58)] / Peak-Hour Capacity (item 60) Rural Multilane and all Urban Sections: V/SF = [AADT (item 21) x K-Factor (item 58) x Direction Factor (item 59)] / Peak-Hour Capacity (item 60)	Should be a value less than 1.50.
62 - Turning Lanes (Urban Data Item)	Left: Must be numeric value 0 to 5. If the number of intersections (item 74) is all zeroes, this item must be zero. If number of intersections (item 74) > 0, this item must be coded 1-5. Right: Must be numeric value 0 to 5. If the number of intersections (item 74) is all zeroes, this item must be zero. If number of intersections (item 74) > 0, this item must be coded 1-5.
63 - Prevailing Type of Signalization (Urban Data Item)	Must contain a value from 1 to 4. If signals are reported on this section (item 74a > 00), this item must contain a value from 1 to 3. Otherwise, it must contain a "4".
64 - Typical Peak Percent Green Time (Urban Data Item)	Must contain a numeric value and should be less than "86". If signalized intersections are reported for this section (item 74a > 00), this item must be greater than "00".
65 - Peak Parking (Urban Data Item)	Must contain a value from 1 to 3.

DATA ITEM	EDIT PERFORMED
66 - Future AADT	Must contain a nonzero numeric value. The future AADT is compared with the current AADT (Item 21). It is flagged to be checked if: a. The growth is 4 times or more when compared to the current AADT. b. The growth is less than or equal to .4 when compared to the current AADT.
67 - Year of Future AADT	Must contain a numeric value (last two digits of the forecast year) that is at least 17 years beyond the inventory year and less than or equal to 22 years from the inventory year.
68 - General Climate Zone	Must be a numeric value from 01 to 09.
69 - Drainage Adequacy	Must contain a value from 1 to 3.
70 - Type of Terrain (Rural Data Item)	Must contain a value from 1 to 3.
71 - Type of Development (Rural Data Item)	Must contain a "1" or "2".
72 - Urban Location (Urban Data Item)	Must contain a value from 1 to 5.
73 - Number of Grade-Separated Interchanges	Must contain a numeric value.
74 - Number of At-Grade Intersections	
a. Signals	Must be numeric. If full access control (item 42 = 1), this item must equal "00".
b. Stop Signs	Must be numeric. If full access control (item 42 = 1), this item must equal "00".
c. Other or No Controls	Must be numeric. If full access control (item 42 = 1), this item must equal "00".

DATA ITEM	EDIT PERFORMED
75 - Number of Structures	Must be numeric less than "51".
76 - Number of At-Grade Railroad Crossings	Must be numeric less than "16". If full access control (item 42 = 1), this item must equal "00".
77 - Structure Identification Numbers	Must be alphanumeric. The number of ID's provided must equal the number of structures reported in item 75.
78 - At-Grade Railroad Crossing Identification Numbers	The first six positions of each crossing ID must be a numeric value. The seventh character must be alphabetic. The number of ID's provided must equal the number of railroad crossings reported in item 76.

APPENDIX N

BATTERY OF SUMMARY TABLES FROM THE HPMS SUBMITTAL SOFTWARE

Table Number *	Title	Data Set
1	System Mileage and Travel (In Thousands) by Type Facility and Functional System	Rural, Urban
2	Lane Miles by Type Facility and Functional System	Rural, Urban
3	Paved Mileage and Travel (In Thousands) by Terrain Type and Weighted Design Speed	Rural
4,3	System Paved Miles and Peak Hour Travel (In Thousands) by Volume Service Flow Ratio and Development	Rural, Urban
5,4	Paved Mileage and Travel (In Thousands) by Shoulder Width and Shoulder Type	Rural, Urban
6,5	Paved Mileage and Travel (In Thousands) by Pavement Condition and Pavement Type	Rural, Urban
7,6	Mileage and Travel (In Thousands) by Lane Width	Rural, Urban
8	Paved Mileage and Travel (In Thousands) by Functional System and Horizontal Alignment Adequacy	Rural
9	Paved Mileage and Travel (In Thousands) by Functional System and Vertical Alignment Adequacy	Rural

* Where two table numbers are shown, the number to the left refers to the rural table while the one to the right refers to the urban table.

APPENDIX O

CARD FORMATS TO ADD NEW HPMS SECTIONS

Transaction Code "N" (New)

The number of cards required to add a section depends on the type of section being added.

Leading zeroes must be coded. All nonapplicable data items on a card type must be zero-filled.

Universe Section

All universe sections added must have card type 1, and card type 2, and card type 3 (card layouts follow).

Sample Section

All sample sections must have card types 1-5. All nonapplicable data items for a section should be zero-filled. Card types 6-9 are:

Curve Data (Card Type 6)
Grade Data (Card Type 7)
Structure ID's (Card Type 8)
At-grade Crossing ID's (Card Type 9)

Only the appropriate card types 6-9 should be coded for the section.

1/ UNIVERSE SECTION (Type Section "1")

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "1"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
State Control Field (Item 1), First 50 Characters	50	18-67
Blank (these columns must be blank)	12	68-79
Type of section being added (Universe always code "1")	1	80

Transaction Code: Code "N"	1	1
Card Type: Code "2"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
State Control Field (Item 1), Second 50 Characters	50	18-67
Blank (these columns must be blank)	13	68-80

NOTE: Card type "1" and card type "2" must be included for all universe sections. Whether none, part or all 100 characters are being used, include the cards, but leave unused portions blank.

Transaction Code: Code "N"	1	1
Card Type: Code "3"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
Year (Item 2)	2	18-19
State Code (Item 3)	2	20-21
Rural/Urban Designation (Item 5)	1	22
Urbanized Area Code (Item 6)	5	23-27
Type of Section/Grouped Data ID (Item 7)	1	28
Functional System (Item 9)	2	29-30
Federal-Aid System (Item 11)	1	31
Federal-Aid System Status (Item 12)	1	32
Route Signing (Item 13)	1	33
Route Number (Item 14)	5	34-38
Governmental Level of Control (Item 15)	2	39-40
Special Systems (Item 16)	2	41-42
Type of Facility (Item 17)	1	43
Designated Truck Route/Parkway (Item 18)	1	44
Toll (Item 19)	1	45
Section/Group Length (Item 20)	6	46-51
AADT (Item 21)	6	52-57
Number of Through Lanes (Item 22)	2	58-59
Blank (These columns must be blank)	21	60-80

1/ All non-applicable data items for a section should be zero-filled.

1/ SAMPLE SECTION (Type Section "2")

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "1"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
State Control Field (Item 1), First 50 Characters	50	18-67
Blank (these columns must be blank)	12	68-79
Type of section being added (Sample always code "2")	1	80

Transaction Code: Code "N"	1	1
Card Type: Code "2"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
State Control Field (Item 1), Second 50 Characters	50	18-67
Blank (these columns must be blank)	13	68-80

NOTE: Card type "1" and card type "2" must be included for all sample sections. Whether none, part or all 100 characters are being used, include the cards, but leave unused portions blank.

Transaction Code: Code "N"	1	1
Card Type: Code "3"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
Year (Item 2)	2	18-19
State Code (Item 3)	2	20-21
Rural/Urban Designation (Item 5)	1	22
Urbanized Area Code (Item 6)	5	23-27
Type of Section/Grouped Data ID (Item 7)	1	28
Functional System (Item 9)	2	29-30
Federal-Aid System (Item 11)	1	31
Federal-Aid System Status (Item 12)	1	32
Route Signing (Item 13)	1	33
Route Number (Item 14)	5	34-38
Governmental Level of Control (Item 15)	2	39-40
Special Systems (Item 16)	2	41-42
Type of Facility (Item 17)	1	43
Designated Truck Route/Parkway (Item 18)	1	44
Toll (Item 19)	1	45
Section/Group Length (Item 20)	6	46-51
AADT (Item 21)	6	52-57
Number of Through Lanes (Item 22)	2	58-59
Blank (These columns must be blank)	21	60-80

1/ All non-applicable data items for a section should be zero-filled.

1/ SAMPLE SECTION (Cont.)

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "4"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
Sample Number (Item 24)	12	18-29
Sample Subdivision (Item 25)	1	30
AADT Volume Group Identifier (Item 26)	2	31-32
Expansion Factor (Item 27)	6	33-38
Surface/Pavement Type (Item 28)	2	39-40
Concrete Joint Spacing (Item 29)	2	41-42
Load Transfer Devices (Item 30)	1	43
Pavement Section (Item 31)	1	44
SN (Structural Number) or D (Slab Thickness)	2	45-46
Type of Base (Item 33)	1	47
Type of Subgrade (Item 34)	1	48
Subsurface Drainage (Item 35)	1	49
Measured Pavement Roughness (Item 36)	3	50-52
Pavement Condition (PSR) (Item 38)	2	53-54
Overlay or Pavement Thickness (Item 39)	3	55-57
Year of Surface Improvement (Item 40)	4	58-61
Type of Improvement (Item 41)	2	62-63
Access Control (Item 42)	1	64
Lane Width (Item 43)	2	65-66
Shoulder Type (Item 44)	1	67
Shoulder Width; Right (Item 45-A)	2	68-69
Left (Item 45-B)	2	70-71
Median Type (Item 46)	1	72
Median Width (Item 47)	2	73-74
ROW Width (Item 48)	3	75-77
Widening Feasibility (Item 49)	1	78
Blank (These columns must be blank)	2	79-80

1/ All non-applicable data items for a section should be zero-filled.

1/ SAMPLE SECTION (Cont.)

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "5"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
Horizontal Alignment Adequacy (R) (Item 50)	1	18
Vertical Alignment Adequacy (R) (Item 52)	1	19
% Passing Sight Distance (R) (Item 54)	3	20-22
Speed Limit (Item 55)	2	23-24
Weighted Design Speed (R) (Item 56)	2	25-26
Percent Commercial Vehicles: Peak (Item 57-A)	2	27-28
Off-Peak (Item 57-B)	2	29-30
K-Factor (Item 58)	2	31-32
Directional Factor (Item 59)	3	33-35
Peak Capacity (Item 60)	5	36-40
Turning Lanes: Left (U) (Item 62-A)	1	41
Right (U) (Item 62-B)	1	42
Prevailing Signalization (U) (Item 63)	1	43
Typical Percent Green Time (U) (Item 64)	2	44-45
Peak Parking (U) (Item 65)	1	46
Future AADT (Item 66)	6	47-52
Year of Future AADT (Item 67)	2	53-54
Drainage Adequacy (Item 69)	1	55
Type of Terrain (R) (Item 70)	1	56
Type of Development (R) (Item 71)	1	57
Urban Location (U) (Item 72)	1	58
Number of Grade-Separated Interchanges (Item 73)	2	59-60
Number of At-Grade Intersections: Signals (Item 74-A)	2	61-62
Stop Signs (Item 74-B)	2	63-64
Other or No Controls (Item 74-C)	2	65-66
Number of Structures (Item 75)	2	67-68
Number of At-Grade Railroad Crossings (Item 76)	2	69-70
Blank (These columns must be blank)	10	71-80

NOTE: R: Rural Data Item
U: Urban Data Item

1/ All non-applicable data items for a section should be zero-filled.

SAMPLE SECTION (Cont.)

		Length	Column
Transaction Code: Code "N"		1	1
Card Type: Code "6"		1	2
County Code (Item 4)		3	3-5
Section ID (Item 8)		12	6-17
Curves by Class (Item 51):			
Curve Card Number: Code "1"		1	18
Curve Classes:			
Degree of Curvature	No. of Curves & Total Length		
a. 0.0 - 0.4		7	19-25
b. 0.5- 1.4		7	26-32
c. 1.5 - 2.4		7	33-39
d. 2.5 - 3.4		7	40-46
e. 3.5 - 4.4		7	47-53
f. 4.5 - 5.4		7	54-60
g. 5.5 - 6.9		7	61-67
Blank (These columns must be blank.)		13	68-80

Transaction Code: Code "N"		1	1
Card Type: Code "6"		1	2
County Code (Item 4)		3	3-5
Section ID (Item 8)		12	6-17
Curve Card Number: Code "2"		1	18
Curve Classes:			
Degree of Curature	No. of Curves & Total Length		
h. 7.0 - 8.4		7	19-25
i. 8.5 - 10.9		7	26-32
j. 11.0 - 13.9		7	33-39
k. 14.0 - 19.4		7	40-46
l. 19.5 - 27.9		7	47-53
m. 28+		7	54-60
Blank (These columns must be blank.)		20	61-80

NOTE: Number of curves must be right-justified in first 2 positions and length of curves right-justified in last 5 positions (xx.xxx assumed decimal).

Leading zeroes must be coded.

A curve class must be zero-filled if curves do not exist for that class.

These cards are required for the functional systems for which curve data is a required item, but may be coded for other facilities. All other sections will have the curve data fields zero-filled by the program. Must use both cards when coding curve data.

SAMPLE SECTION (Cont.)

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "7"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
Grades by Class (Item 53):		
Gradient (%) No. of Grades & Total Length		
a. 0.0 - 0.4	7	18-24
b. 0.5 - 2.4	7	25-31
c. 2.5 - 4.4	7	32-38
d. 4.5 - 6.4	7	39-45
e. 6.5 - 8.4	7	46-52
f. 8.5+	7	53-59
Blank (These columns must be blank.)	21	60-80

NOTE: No. of grades must be right-justified in first 2 positions. Total length of grades should be right-justified in last 5 positions (xx.xxx assumed decimal). A grade class must be zero-filled if grades do not exist for that class. This card is required for functional systems for which grades are a required data item, but may be coded for other facilities. All other sections will have the grade data field zero-filled by the program.

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "8"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
Structure ID's (Item 77)		
Structure ID Card Number	2	18-19
Structure ID's:		
ID #1	15	20-34
ID #2	15	35-49
ID #3	15	50-64
ID #4	15	65-79
Blank (This column must be blank.)	1	80

NOTE: Up to 13 structure ID cards may be coded to contain the maximum 50 structure ID's per section. All cards must be coded 8 in column 2. In columns 18-19, number the type 8 cards beginning with 01, 02,. . . 13.

Card(s) 8 is included only if the section has structures (item 75 is greater than zero).

SAMPLE SECTION (Cont.)

	Length	Column
Transaction Code: Code "N"	1	1
Card Type: Code "9"	1	2
County Code (Item 4)	3	3-5
Section ID (Item 8)	12	6-17
At-grade Railroad Crossing ID's (Item 78):		
At-grade Railroad Crossing ID Card Number	1	18
At-grade Railroad Crossing ID's:		
ID #1	7	19-25
ID #2	7	26-32
ID #3	7	33-39
ID #4	7	40-46
ID #5	7	47-53
ID #6	7	54-60
ID #7	7	61-67
ID #8	7	68-74
Blank (These columns must be blank.)	6	75-80

NOTE: Up to 2 at-grade crossing ID cards (card type 9) may be used to code the maximum of 15 at-grade crossing ID's per section. In column 18, number the type 9 cards--1 on the first one and 2 on the second one, if used.

Card(s) 9 is included only if the section has at-grade railroad crossings (item 76 is greater than zero).

APPENDIX P

UPDATE DATA ITEM NUMBERS FOR HPMS SUBMITTAL SOFTWARE

Item No.	Field Length	Data Item Name
		State Control Field
01-01 *	10	First 10 positions of the State Control Field
01-02 *	10	Next 10 positions of the State Control Field
01-03 *	10	" " " " " " " "
01-04 *	10	" " " " " " " "
01-05 *	10	" " " " " " " "
01-06 *	10	" " " " " " " "
01-07 *	10	" " " " " " " "
01-08 *	10	" " " " " " " "
01-09 *	10	" " " " " " " "
01-10 *	10	Last 10 positions of the State Control Field
2	2	Year
3	2	State Code
4	3	County Code
5	1	Rural/Urban Designation
6	5	Urbanized Area Code
7	1	Type of Section/Grouped Data ID
8	12	Section/Grouped Data Identification
9	2	Functional System
10	1	Generated Functional System Code (The software will make the necessary changes. Cannot be changed by the user.)
11	1	Federal-Aid System
12	1	Federal-Aid System Status
13	1	Route Signing
14	5	Route Number
15	2	Governmental Level of Control
16	2	Special Systems
17	1	Type of Facility
18	1	Designated Truck Route/Parkway
19	1	Toll
20	6	Section/Group Length
21	6	AADT
22	2	Number of Through Lanes
23	5	Record Continuation Code (The software will make the necessary changes. Cannot be changed by the user.)
		END OF UNIVERSE RECORD
24	12	Sample Number
25	1	Sample Subdivision
26	2	AADT Volume Group Identifier
27	6	Expansion Factor
28	2	Surface/Pavement Type
29	2	Concrete Joint Spacing
30	1	Load Transfer Devices

* - Leading zero is required to update Item 1.

Item No.	Field Length	Data Item Name
31	1	Pavement Section
32	2	SN (Structural Number) or D (Slab Thickness)
33	1	Type of Base
34	1	Type of Subgrade
35	1	Subsurface Drainage
36	3	Measured Pavement Roughness
37	12	Reserved for Federal Use
38	2	Pavement Condition
39	3	Overlay or Pavement Thickness
40	4	Year of Surface Improvement
41	2	Type of Improvement
42	1	Access Control
43	2	Lane Width
44	1	Shoulder Type
45-A	2	Shoulder Width: Right
45-B	2	" " Left
46	1	Median Type
47	2	Median Width
48	3	ROW Width
49	1	Widening Feasibility
50	1	Horizontal Alignment Adequacy
		Curves by Class
51-A	7	# & Length of Curves fr. 0.0 degrees to 0.4 degrees
51-B	7	" 0.5 " " 1.4 "
51-C	7	" 1.5 " " 2.4 "
51-D	7	" 2.5 " " 3.4 "
51-E	7	" 3.5 " " 4.4 "
51-F	7	" 4.5 " " 5.4 "
51-G	7	" 5.5 " " 6.9 "
51-H	7	" 7.0 " " 8.4 "
51-I	7	" 8.5 " " 10.9 "
51-J	7	" 11.0 " " 13.9 "
51-K	7	" 14.0 " " 19.4 "
51-L	7	" 19.5 " " 27.9 "
51-M	7	" 28 degrees +
52	1	Vertical Alignment Adequacy
		Grades by Class
53-A	7	Number and Length of Grades 0.0% to 0.4%
53-B	7	" 0.5% to 2.4%
53-C	7	" 2.5% to 4.4%
53-D	7	" 4.5% to 6.4%
53-E	7	" 6.5% to 8.4%
53-F	7	" 8.5%+
54	3	% Passing Sight Distance
55	2	Speed Limit
56	2	Weighted Design Speed

Item No.	Field Length	Data Item Name
57-A	2	Percent Commercial Vehicles: Peak
57-B	2	" " " Off-Peak
58	2	K-Factor
59	3	Directional Factor
60	5	Peak Capacity
61	3	Volume/Service Flow (V/SF) Ratio (Calculated -- the software will make the necessary changes. Cannot be changed by the user.)
62-A	1	Turning Lanes: Left
62-B	1	Right
63	1	Prevailing Signalizaton
64	2	Typical Percent Green Time
65	1	Peak Parking
66	6	Future AADT
67	2	Year of Future AADT
68	2	General Climate Zone
69	1	Drainage Adequacy
70	1	Type of Terrain
71	1	Type of Development
72	1	Urban Location
73	2	No. of Grade-Separated Interchanges
74-A	2	No. of At-Grade Intersections: Signals
74-B	2	" " " " Stop Signs
74-C	2	" " " " Other/ No Controls
75	2	No. of Structures
76	2	No. of At-grade Railroad Crossings
		Structure I.D. Nos.
77-01	15	The exact ID for the 1st Structure ID on the File
77-02	15	" 2nd "
.	"	" . "
.	"	" . "
.	"	" "
77-50	15	" 50th "
		At-Grade R.R. Crossing I.D. Nos.
78-01	7	The exact ID Code for the 1st RR X'ing on the File
78-02	7	" 2nd "
.	"	" . "
.	"	" . "
.	"	" . "
78-15	7	" 15th "

APPENDIX Q

HPMS Submittal Software Subprogram Operation

STHPMODU (SELMODU)

The options selected for the subprogram are listed for user information.

For all keywords coded on SELMODU, the transaction card sets are read and checked for general format errors, sequence errors, and valid transaction codes. Each valid transaction set is placed in a temporary dataset with one record consisting of all cards in a transaction set. Invalid transaction sets are listed for the user along with an error message. When the end of the transaction set is reached, if the temporary dataset contains valid transactions, it is sorted by section ID within county to match the sort of the input master dataset. Next, the process of matching the section ID on the master dataset with the section ID coded on the transaction set begins. If the section ID on the dataset (including the county code) is less than the ID on the transaction set, the section record is written on the new master dataset without any change. If the section ID on the dataset is greater than the transaction set ID and the transaction code is N, the subprogram STHPADDS is called to check and process the cards for the new section to be placed on the new master dataset. When the section ID on the dataset equals the transaction set ID, the following applies:

(1) The section is not written on the new master dataset for a delete transaction.

(2) The section is written on the new master dataset with modifications for an update transaction, structure ID's added or deleted, or crossing ID's added or deleted.

If the data item used in a calculation is updated, the subprogram HPCALCDI is called to recalculate the "calculated data items"; if the county FIPS code is updated, subprogram STHPZONE is called to assign the climate zone before the modified section is written on the new master. If a new section is being added, HPCALCDI is called to calculate the "calculated data items", and STHPZONE is called to assign the climate zone based on the county FIPS code, before the added section is written on the master.

This matching process continues until the end of the transaction card sets are reached or the end of the existing master is reached. A summary is printed indicating the transactions by section ID, county code, and functional system. A listing is also given showing all transaction sets found in error during the matching process along with error messages. If a county code or section ID was updated, the new master dataset is sorted by section ID within county. Execution then returns to FHWAHPMS.

STHPEDIT (SELEDIT)

Each subprogram option in effect is listed for the user's information. A check is made to determine if a listing of sections is to be produced or editing is to be performed. If one of the keywords LISTSECT, LISTUNIV, or LISTSAMPLE is coded, each section record is read with all sections being listed or all universe sections being listed or all sample sections being listed. A summary report is also listed with execution then returning to FHWAHPMS. If editing is selected, a check is made to determine the type(s) of edits to be performed. Each section record is read with the type(s) of edit(s) performed in the following order:

(1) If valid code edits were selected, each data item is checked for a valid code.

(2) If cross-edit checks were selected, various data items are cross-edited to see if the coding between the two or more data items agree.

(3) If cross-edit checks were selected and volume groups are to be checked with AADT, this editing is performed.

(4) If range edits were selected, various data items will be checked to see if the coded value is within a reasonable range.

(5) If all edits were selected (SELEDIT=FINAL), all of the above edits will be performed.

If no errors are detected, the next section record is read and the editing for that section is performed. If at least one data item is found to be in error, a check is made to see which print option was selected--section ID's with error messages or section ID's, all coded values for data items and error messages. The appropriate listing is then printed along with counts made for the summary report. After the section with errors is printed, a check is made to see if the number of sections in error exceeds the maximum number of errors allowed, if not, a new section is read and the editing is performed for that section. When the maximum number of errors allowed is reached or the end of the dataset is reached, the edit summary report is printed. Upon reaching the end of all other editing, if the valid code edits were selected and the sample number is to be checked for uniqueness, the master dataset is sorted by sample number within county. Each section is then read with the sample number compared to the sample number of the previous section for uniqueness. Any section with duplicate sample numbers is listed with county code and section ID. A summary report is printed and execution returns to FHWAHPMS.

STHPCALC (SELCALC)

The options in effect for STHPCALC are listed for the user's information. Each section record on the input master dataset is read. A work functional system code of one position is determined from the coded two-position code and placed on the data record. If the record is for a universe section, the record is written on the new dataset and the next record is read. If the record is a sample section, the State code and county code are passed to STHPZONE to determine the climate zone and/or the data record is passed to the subprogram HPCALCDI which calculates the rural peak capacity, volume-to-service flow (capacity) ratio, weighted design speed, horizontal alignment adequacy and vertical alignment adequacy for each applicable section. The record with the calculated data items is passed back to STHPCALC which writes the record on the new dataset, and the next section record is read. Upon reaching the end of the input dataset, a summary report is printed. Execution then returns to FHWAHPMS.

STHPZONE (called by STHPMODU or STHPCALC)

The State and county FIPS codes passed by the calling program are used to search a matrix and determine the climate zone, which is passed back to the calling program.

If an invalid county code -- nonnumeric value or not valid for the State -- is detected, the climate zone is set to zero, and is returned to the calling program.

HPCALCDI (called by STHPMODU or STHPCALC)

Each passed sample section is checked to determine which data items are to be calculated for that particular section and calculated if needed in the following order:

(1) Weighted design speed is calculated for all urban Interstate and freeways/expressways by design type; all paved rural arterial sections for which curve data are provided, and all paved rural collectors with type of development coded rural, and for which curve data are provided.

(2) Rural peak capacity is calculated for all paved sections (if the rural peak capacity was coded, this is not calculated) by the FORTRAN subprogram HPCAPR.

(3) Volume-to-service flow ratio is calculated for all sections with nonzero peak capacity.

(4) Horizontal alignment adequacy is calculated for all paved rural sections for which curve data are provided.

(5) Vertical alignment adequacy is calculated for all paved rural sections for which grade data are provided.

Any data item that cannot be calculated because a data item used in the calculation is not numeric, is set to zero. Weighted design speed is set to default values by functional system and terrain type for rural, or by design type for urban, if curves are not provided and the weighted design speed is coded zero. Horizontal alignment is set to 2 if curves are not provided and the coded value is zero. Vertical alignment is set to 2 if grades are not provided and the coded value is zero.

After all calculations have been made, the section record with the new calculated values is passed back to the calling program STHPMODU or STHPCALC.

STHPADDS (called by subprogram STHPMODU when a new section is to be added to the master dataset)

The transaction set N is passed along with the HPMS record. Each card in the set is checked to determine the card type (1-9). The data on card type 1 is moved to the appropriate place in the HPMS record and a switch is set indicating the type of section being added--universe, or sample. The coding on card type 2 is moved to the appropriate place in the HPMS record. The coding on card type 3 is moved to the appropriate place in the HPMS record. Switches are checked to determine if card types 1-3 have been coded. If not, an error switch is set and control is returned to STHPMODU and the section is not added. For each of the other card types (4-9), a check is made to see if the type section switch is set for a universe section. If so, an error switch is set, passed back to STHPMODU and the section is not added. If the type section switch is set for a sample, each card type 5-9 which is coded has the data moved to the appropriate storage location. The following editing is performed on card types 6, 8, and 9:

(1) Card type 6
--Curve card number 1 is coded.
--Curve card number 2 is coded.

(2) Card type 8
--Structure ID card number is numeric.
--Number structure cards equals number coded on card.
--Number structure ID's coded is not greater than 50.

(3) Card type 9
--Crossing ID card number is numeric
--Number crossing cards equals number coded on card.
--Number crossing ID's coded is not greater than 15.

An error switch is set if an error is detected, passed back to STHPMODU, and the new section is not added. When all cards in the transaction set have been checked and edited for general errors, and the coded data has been moved, if a universe section is being added and an error was found, control returns to STHPMODU; if a sample section is being added, more editing is performed before control is returned to STHPMODU. Since the section being added is a sample, if card types 4 and 5 were not coded, the section is not complete and is not to be added. If only one of the curve data cards (type 6) was coded, curve data is missing and the section will not be added. All data in storage and error switches are now passed back to STHPMODU.

STHPEXPF (SELEXPF)

This subprogram calculates the expansion factor (if that option is requested) and produces the expansion factor table.

If expansion factors are to be calculated, the input file is sorted and the sample mileage is accumulated in a table by volume group within functional system and urban area. If the MILECARD option is chosen, the universe mileage cards are then read and new expansion factors are calculated for the volume group for which cards have been provided; if the MILEDATA option is chosen the universe mileage is accumulated from the input file and new expansion factors are calculated for the volume group provided there are no zero AADTs. Finally, the input file is read again and the new expansion factors are substituted on the output file.

Regardless of whether any new expansion factors have been calculated, a table showing the factors on the file is generated. The file is sorted by urban area code, functional system, and volume group. Then break logic is used to produce the table.

STHPSUMT (SELSUMT)

This subprogram produces five summary tables: the Federal-aid table, the sample mileage table, the universe mileage table, the county mileage table, and the future DVMT table. The program reads the cards which contain the names associated with the urbanized area codes. These names are sorted in a matrix and are used in printing some of the tables. Only the tables requested are produced. If the county mileage table is requested, the program reads the cards which give the names associated with the county codes. These names are sorted in a matrix and used in the printing of the table. The input file is read twice (once to extract rural data and once to extract urban data) to produce the Federal-aid table. The file is sorted to produce each of the other three tables.

STHPINTS (SELINTS)

This subprogram produces two Interstate system mileage summary tables by route number. The input file is read and only those records which meet certain conditions are selected and sorted. The sorted file is then read and the two tables are produced showing the number of records, mileage, lane-miles, and DVMT by route number for each category of Interstate (free, toll, 139, etc.).

STHPBTAB (SELBTAB)

This subprogram of FHWAHPMS governs the creation of the battery of 15 summary tables from the sample data. If the program option INDUZA is selected the program reads the cards which contain the names associated with the urbanized area codes. These names are stored in a matrix and used in printing the tables showing individual urbanized areas. Depending on which tables are requested, STHPBTAB creates urban and/or rural workfiles consisting of sample records. These files are sorted and the subprograms required to produce the requested tables are called. STHPBTAB has 7 subprograms--STHPR01 through STHPR04 and STHPU01, STHPU03 and STHPU04.

STHPR01
This subprogram of STHPBTAB produces rural tables 1 and 2. The rural workfile is read once for each table requested.

STHPR02
This subprogram of STHPBTAB produces rural table 3. The rural workfile is read once for each table requested.

STHPR03
This subprogram of STHPBTAB generates rural tables 4, 5, 6 and 7. The rural workfile is read once for each table requested.

STHPR04
This subprogram of STHPBTAB produces rural tables 8 and 9. The rural workfile is read once for each table requested.

STHPU01
This subprogram of STHPBTAB generates urban tables 1 and 2. The urban workfile is read once for each table requested.

STHPU03
This subprogram of STHPBTAB creates urban tables 3, 4 and 5. The urban workfile is read once for each table requested.

STHPU04
Urban table 6 is generated by this subprogram of STHPBTAB. The urban workfile is read once for each table requested. Notice there is no urban table 7, 8 or 9.

APPENDIX R

HPMS RECORD FORMAT

FORMAT: Variable Length, Blocked
LOGICAL RECORD LENGTH: Min: 167 Max: 1286
PHYSICAL RECORD LENGTH: 6233

N = Numeric AN = Alphanumeric

PART I: ALL SECTIONS

Item No.	Data Item	Position	Length	Type
1	State control field	1-100	100	AN
2	Year	101-102	2	N
3	State code	103-104	2	N
4	County code	105-107	3	N
5	Rural/Urban Designation	108	1	N
6	Urbanized Area Code	109-113	5	N
7	Type of Section/Grouped Data	114	1	N
8	Section/Grouped Data Identification	115-126	12	AN
9	Functional System	127-128	2	N
10 1/	Generated Functional System Code	129	1	N
11	Federal-aid System	130	1	N
12	Federal-aid System Status	131	1	N
13	Route Signing	132	1	N
14	Route Number	133-137	5	AN
15	Governmental Level of Control	138-139	2	N
16	Special Systems	140-141	2	N
17	Type of Facility	142	1	N
18	Designated Truck Route/Parkway	143	1	N
19	Toll	144	1	N
20	Section/Group Length (xxx.xxx)	145-150	6	N
21	AADT	151-156	6	N
22	Number of through lanes	157-158	2	N
23	Record Continuation Code Indicates Universe Record (00000)	159-163	5	N

1/ Generated Functional System Code:

The two-positional code for item 9, Functional System, is converted to a one-positional code by the FHWA software to be used in the software as a subscript for storage matrices. The conversions are as follows:

Item 9	Item 10	Description
01, 11	= 1	(Interstate)
02, 12, 13	= 2	(Principal Arterial; Other Freeways or Expressways
06, 14, 15	= 3	(Minor Arterial; Other Principal Arterial)
07, 16	= 4	(Major Collector; Minor Arterial)
08, 17	= 5	(Minor Collector; Collector)
09, 19	= 6	(Local)

PART II: SAMPLE DATA SECTIONS

R = Rural Data Item; U = Urban Data Item

Item No.	Data Item	Position	Length	Type
23	Indicates Sample Section (code 1)	159	1	N
	Indicates Number of Structure ID's Provided (00 = none; > 00 = # ID's)	160-161	2	N
	Indicates Number of Railroad Crossing ID's Provided (00 = none; > 00 = # ID's)	162-163	2	N
24	Sample Number	164-175	12	AN
25	Sample Subdivision	176	1	N
26	AADT Volume Group Identifier	177-178	2	N
27	Expansion Factor (xxx.xxx)	179-184	6	N
28	Surface/Pavement Type	185-186	2	N
29	Concrete Joint Spacing	187-188	2	N
30	Load Transfer Devices	189	1	N
31	Pavement Section	190	1	N
32	SN (Structural Number) or D (Slab Thicknes)	191-192	2	N
33	Type of Base	193	1	N
34	Type of Subgrade	194	1	N
35	Subsurface Drainage	195	1	N
36	Measured Pavement Roughness	196-198	3	N
37	Reserved For Federal Use	199-210	12	-
38	Pavement Condition (PSR) (x.x)	211-212	2	N
39	Overlay or Pavement Thickness	213-215	3	N
40	Year of Surface Improvement	216-219	4	N
41	Type of Improvement	220-221	2	N
42	Access Control	222	1	N
43	Lane Width	223-224	2	N
44	Shoulder Type	225	1	N
45-A	Shoulder Width: Right	226-227	2	N
45-B	Left	228-229	2	N
46	Median Type	230	1	N
47	Median Width	231-232	2	N
48	ROW Width	233-235	3	N
49	Widening Feasibility	236	1	N
50 2/	Horizontal Alignment Adequacy (R)	237	1	N
51	Curves by Class	238-328	91	N
52 2/	Vertical Alignment Adequacy (R)	329	1	N
53	Grades by Class	330-371	42	N
54	% Passing Sight Distance, 1500 Feet (R)	372-374	3	N
55	Speed Limit	375-376	2	N

2/ For a rural section, these data items must be coded for paved collectors if curve/grade data is not provided. If curve/grade data is provided, these data items will be calculated by FHWA software for paved arterials and paved collectors.

PART II: SAMPLE DATA SECTIONS (Cont.)

R = Rural Data Item; U = Urban Data Item

Item No.	Data Item	Position	Length	Type
56 3/	Weighted Design Speed (WDS)	377-378	2	N
57-A	Percent Commercial Vehicles: Peak	379-380	2	N
57-B	Off-Peak	381-382	2	N
58	K-Factor	383-384	2	N
59	Directional Factor	385-387	3	N
60	Peak Capacity (Calculated - R; Coded - U)	388-392	5	N
61	Volume / Service Flow (V/SF) Ratio (Calculated)	393-395	3	N
62-A	Turning Lanes: Left (U)	396	1	N
62-B	Right (U)	397	1	N
63	Prevailing Signalization (U)	398	1	N
64	Typical Percent Green Time (U)	399-400	2	N
65	Peak Parking (U)	401	1	N
66	Future AADT	402-407	6	N
67	Year of Future AADT	408-409	2	N
68	General Climate Zone	410-411	2	N
69	Drainage Adequacy	412	1	N
70	Type of Terrain (R)	413	1	N
71	Type of Development (R)	414	1	N
72	Urban Location (U)	415	1	N
73	# Grade-Separated Interchanges	416-417	2	N
	# At-Grade Intersections:			
74-A	Signals	418-419	2	N
74-B	Stop Signs	420-421	2	N
74-C	Other or No Controls	422-423	2	N
75	# Structures	424-425	2	N
76	# At-Grade Railroad Crossings	426-427	2	N

3/ For an urban section, weighted design speed is calculated for all Interstate and applicable freeways and expressways by design type. For a rural section if curve data is provided, WDS is calculated for paved collectors in rural development; otherwise, it must be coded by the State. For rural arterials, WDS is calculated by FHWA software for all paved sections.

PART III: VARIABLE (SAMPLE DATA SECTIONS, ONLY)

The remaining part of the record is variable and applies only to sample sections when applicable. The number of characters varies from 7 to 855, depending on the number and combination of structure I.D.'s and at-grade railroad crossing I.D.'s provided. The applicable data will be coded in the following order:

77	Structure ID's	15-750 Characters	AN
78	At-Grade Railroad Crossing ID's	7-105 Characters	AN

APPENDIX S

CLIMATE ZONE DEFINITIONS

The HPMS climate zones and the following definitions for the zones have been taken from the report, "A Pavement Moisture Accelerated Distress (MAD) Identification System", Vol. 2, September 1981, report number FHWA/RD-81/080. The report is the result of research done by the University of Illinois for the FHWA Office of Research.

Should an HPMS sample section appear to belong to a different climate zone than has been assigned on a countywide basis via the HPMS Submittal Software, the State may change the climate zone (item 68) based on the definitions contained in this Appendix. Note that the definitions have repetitive portions -- there are three different interpretations of winter conditions and three different interpretations of wet/dry conditions. Using all possible combinations, they account for the nine possible climate zones.

Since the HPMS Submittal Software contains and assigns the climate zones internally, the timing for changing the climate zones will have to be after all modifications (SELMODU) and calculations/generations (SELCALC) with the software are complete. Note, however, that the climate zone is changed by the software only if the county FIPS code is updated under the SELMODU option, and/or only if the CZONE sub-option is chosen under the SELCALC option.

CLIMATE ZONE 01; Wet; Freeze

This zone experiences long winters with the temperature below freezing for extended periods. The potential for a slowly advancing freezing front into the subgrade is extremely high. Frost damage is to be expected accompanied with other low temperature problems.

Due to the climatic influences, the subgrade will remain wet for the majority of the year and very little moisture variation will occur. Performance relationships indicate that the zone will maintain a moisture level that will produce low load related performance.

CLIMATE ZONE 02; Wet; Freeze-Thaw

This zone experiences winters with more fluctuation of the temperatures about the freezing point. Freeze-thaw cycling into the base course is to be expected. Some thermal fatigue problems could be expected, with hot summers being a problem in the West due to radiation.

Due to the climatic influences, the subgrade will remain wet for the majority of the year and very little moisture variation will occur. Performance relationships indicate that the zone will maintain a moisture level that will produce low load related performance.

CLIMATE ZONE 03; Wet; No Freeze

This zone is characterized by relatively mild winters (compared to 01, 02, 04, 05, 07 or 08) and damage may range from minimal thermal fatigue in the North, to high temperature stability problems in the South.

Due to the climatic influences, the subgrade will remain wet for the majority of the year and very little moisture variation will occur. Performance relationships indicate that the zone will maintain a moisture level that will produce low load related performance.

CLIMATE ZONE 04; Intermediate; Freeze

This zone experiences long winters with the temperature below freezing for extended periods. The potential for a slowly advancing freezing front into the subgrade is extremely high. Frost damage is to be expected accompanied with other low temperature problems.

The state of moisture in the subgrade will vary during the year, but the average moisture condition is very much drier than zones 01, 02, and 03. This zone produces a moisture state that produces load related performance in a transitional portion between good and poor. Seasonal concentration of moisture will be important in determining which level of performance would be present.

CLIMATE ZONE 05; Intermediate; Freeze-Thaw

This zone experiences winters with more fluctuation of the temperatures about the freezing point. Freeze-thaw cycling into the base course is to be expected. Some thermal fatigue problems could be expected, with hot summers being a problem in the West due to radiation.

The state of moisture in the subgrade will vary during the year, but the average moisture condition is very much drier than zones 01, 02, and 03. This zone produces a moisture state that produces load related performance in a transitional portion between good and poor. Seasonal concentration of moisture will be important in determining which level of performance would be present.

CLIMATE ZONE 06; Intermediate; No Freeze

This zone is characterized by relatively mild winters (compared to 01, 02, 04, 05, 07 or 08) and damage may range from minimal thermal fatigue in the North, to high temperature stability problems in the South.

The state of moisture in the subgrade will vary during the year, but the average moisture condition is very much drier than zones 01, 02, and 03. This zone produces a moisture state that produces load related performance in a transitional portion between good and poor. Seasonal concentration of moisture will be important in determining which level of performance would be present.

CLIMATE ZONE 07; Dry; Freeze

This zone experiences long winters with the temperature below freezing for extended periods. The potential for a slowly advancing freezing front into the subgrade is extremely high. Frost damage is to be expected accompanied with other low temperature problems.

In this zone, the annual moisture state is dry. The load related performance is good for all materials. Seasonal concentrations of moisture will be responsible for producing slightly lower performance in one area than another where the moisture is not concentrated in one time period.

CLIMATE ZONE 08; Dry; Freeze-Thaw

This zone experiences winters with more fluctuation of the temperatures about the freezing point. Freeze-thaw cycling into the base course is to be expected. Some thermal fatigue problems could be expected, with hot summers being a problem in the West due to radiation.

In this zone the annual moisture state is dry. The load related performance is good for all materials. Seasonal concentrations of moisture will be responsible for producing slightly lower performance in one area than another where the moisture is not concentrated in one time period.

CLIMATE ZONE 09; Dry; No Freeze

This zone is characterized by relatively mild winters (compared to 01, 02, 04, 05, 07 or 08) and damage may range from minimal thermal fatigue in the North, to high temperature stablility problems in the South.

In this zone the annual moisture state is dry. The load related performance is good for all materials. Seasonal concentrations of moisture will be responsible for producing slightly lower performance in one area than another where the moisture is not concentrated in one time period.

U.S. GOVERNMENT PRINTING OFFICE: 1988 - 521-881/00287