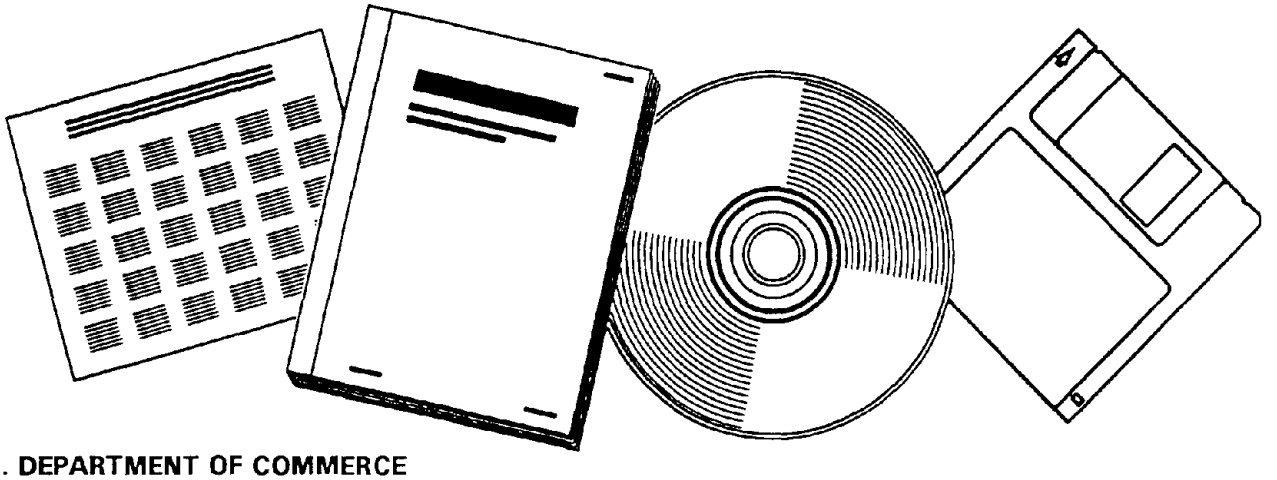
PB97-164073

LONG-TERM PAVEMENT PERFORMANCE INFORMATION MANAGEMENT SYSTEM DATA USERS REFERENCE MANUAL

EBA ENGINEERING, INC., BALTIMORE, MD

MAY 97



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

Long-Term Pavement Performance Information Management System Data Users Reference Manual

PUBLICATION NO. FHWA-RD-97-001

MAY 1997

U.S. Department of Transportation
Federal Highway Administration

Research and Development
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

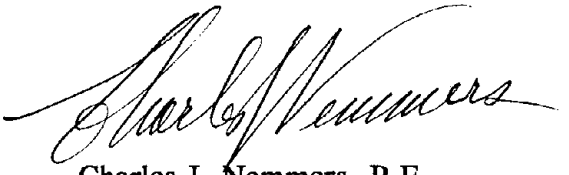
FOREWORD

This document provides information to pavement researchers on the data collected in the Long-Term Pavement Performance Information Management System (LTPP IMS). It describes the type and format of the data collected, includes guidelines for requesting data, and provides examples of the reports generated from the data.

The *Data Users Reference Manual* is for pavement engineers and researchers involved in the study of comprehensive data to improve design, maintenance, and rehabilitation of pavements.

This document supersedes the *Long-Term Pavement Performance Information Management System: Data Users Guide* published in July 1993. It accompanies the seventh release of IMS data and will be superseded at the time of the eighth release.

The Federal Highway Administration (FHWA) has distributed this document primarily in electronic form. Copies are being sent to FHWA regional and division offices, Strategic Highway Research Program Coordinators, and all data users. A copy can be found through the LTPP web page at http://www.tfhrc.gov/pavement/ltpp/ltpphome.htm by selecting the LTPP Data Base button.



Charles J. Nemmers, P.E.
Director, Office of Engineering
Research and Development

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	PB97-164073
FHWA-RD-97-001		

4. Title and Subtitle	5. Report Date
Long -Term Pavement Performance Information Management System Data Users Reference Manual	May 1997
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Barbara. K. Ostrom, Debbie Walker, Sandy Harris, Shahed Rowshan	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
EBA Engineering, Inc. 5800 Metro Drive Baltimore, Maryland 21215	3C6B
	11. Contract or Grant No.
	DTFH61-95-Z-00086
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	Data Users Reference Manual June 1996- September 1997
Office of Engineering R&D Federal Highway Administration 6300 Georgetown Pike McLean, Virginia 22101-2296	14. Sponsoring Agency Code HNR-30

15. Supplementary Notes

Contracting Officer's Technical Representative (COTR) - Shahed Rowshan, HNR-30

16. Abstract

The Long-Term Pavement Performance Information Management System (LTPP IMS) Data Users Reference Manual contains an overview of the LTPP program and the data available to researchers.

LTPP is a 20-year study of pavements to improve design, rehabilitation, and maintenance practices. This document is intended to assist researchers in understanding the data that are currently available for General Pavement Studies Experiments and how to obtain it. The General Pavement Studies are a group of asphalt concrete (AC) and portland cement concrete (PCC) experiments using in-service pavements. In addition to materials test results for the pavement sections, data on pavement history, maintenance, and rehabilitation are stored in the IMS. Information on distress, transverse profile, cross profile, pavement deflection, and traffic is collected on a routine basis and added to the data base regularly.

The manual includes information on the quality control process. One chapter discusses a related, but separate, traffic data base.

Data for all valid sections are available in various formats. A copy of a data request form is included, along with instructions on filling out the form and any applicable fees.

17. Key Words	18. Distribution Statement
LTPP, IMS, Pavement Data, Data Request, GPS, General Pavement Studies.	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161 and by electronic download through http://www.tfhrc.gov/pavement/ltpp/ltpphome.htm

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	64	

PREFACE

PURPOSE OF MANUAL

The purpose of this document is to provide sufficient information for a data user to understand the basic ideas of the Long-Term Pavement Performance Information Management System (LTPP IMS). The contents of this document fall into two broad categories. The first is background information on LTPP and its development. The second category is detailed information about the LTPP data base.

OVERVIEW OF THE LTPP PROGRAM

- Background and objectives of the LTPP program.
- Type of data collected.
- Procedure used to check data integrity.

LTPP DATA BASE STRUCTURE AND CONTENTS

- How to request LTPP data.
- Format of the data received.
- Examples of reports generated with LTPP data.
- Off-line traffic data.

Complete information about data collection procedures, quality assurance testing, and data storage in the LTPP IMS is included in other documents. The *Data Collection Guide for Long-Term Pavement Performance Studies* includes the data collection procedures for most of the information collected. Other data collection procedures are contained in the Specific Pavement Studies construction manuals, *Distress Identification Manual for the Long-Term Pavement Performance Project* and *Manual for Profile Measurement: Operational Field Guideline. Laboratory Material Handling and Testing* contains the protocols for testing materials. Information on the data base structure and field definitions is routinely provided with requests. *LTPP IMS Data Quality Checks* describes the quality control checks implemented within the data base itself. An electronic copy will be provided upon request.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
	AREA			
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
	VOLUME			
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
	ILLUMINATION			
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
	FORCE and PRESSURE or STRESS			
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
	VOLUME			
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
	TEMPERATURE (exact)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
	ILLUMINATION			
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
	FORCE and PRESSURE or STRESS			
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

(Revised September 1993)

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

CHAPTER 1. OVERVIEW

BACKGROUND

The Strategic Highway Research Program (SHRP) was a 5-year, $150 million research program. It was funded through a set-aside of State-apportioned Federal-aid highway funds. Congress authorized SHRP under the 1987 Highway Act. The program addressed recommendations made by State highway officials, industry representatives, and researchers participating in the Strategic Transportation Research Study. The study was done in response to several trends affecting the highway industry. SHRP was a strategic program because it concentrated on a short list of high-payoff activities where even modest progress yielded savings that exceeded the research costs. The activities included: asphalt, pavement performance, concrete and structures, and highway operations.

The Long-Term Pavement Performance (LTPP) program was designed as a 20-year program. After the first 5 years were completed under SHRP, the LTPP program became a Federal Highway Administration (FHWA) managed effort in July 1992. At that time, the Pavement Performance Division of the Office of Research and Development assumed the responsibility for the remaining 15 years. The Pavement Performance Division is located at the Turner-Fairbank Highway Research Center (TFHRC) in McLean, Virginia.

Data collected are available from a data base known as the LTPP Information Management System (LTPP IMS or IMS). The LTPP program will collect data on pavement sections in the study during the 20-year period. Data are collected on forms found in the *Data Collection Guide for Long-Term Pavement Performance* and other documents, or in machine-readable form from monitoring equipment. Technical contractors enter the data in the IMS and implement the quality control procedures. The data base is evolving during the LTPP program to fit changes in data collection and new needs of researchers.

OBJECTIVE OF THE LTPP PROGRAM

The objective of the Long-Term Pavement Performance program was set forth in *America's Highways: Accelerating the Search for Innovation*:[1]

> "Increase pavement life by the investigation of the long-term performance of various designs of pavement structures and rehabilitated pavement structures, using different materials and under different loads, environments, subgrade soils, and maintenance practices."

From this broad objective, six specific objectives were established for the LTPP Program:

- Evaluate existing design methods.

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[1] *America's Highways: Accelerating the Search for Innovation.* Special Report 202. Washington, DC: Transportation Research Board, 1984.

- Develop improved design methodologies and strategies for the rehabilitation of existing pavements.

- Develop improved design equations for new and reconstructed pavements.

- Determine the effects of loading, environment, material properties and variability, construction quality, and maintenance level on pavement distress and performance.

- Determine the effects of specific design features on pavement performance.

- Establish a national long-term pavement data base to support SHRP objectives and future needs.

LTPP EXPERIMENTS

The LTPP program has two complementary experiments to meet the objectives. The General Pavement Studies (GPS) use existing pavements as originally constructed or after the first overlay. The second set of LTPP experiments is the Specific Pavement Studies (SPS). These studies are designed to meet LTPP objectives that the GPS experiments cannot completely meet. The SPS experiments frequently require constructing new pavements. The LTPP IMS has been designed to support both experiments and provide a uniform way to collect and distribute LTPP data. Test sections are in the United States and Canada. A variety of data is collected for each pavement section, including construction and maintenance activities, material properties, structural and surface characteristics, pavement loading, and climatic information.

General Pavement Studies

General Pavement Studies (GPS) use existing pavement sections nominated by State and Province department of transportation officials to meet experimental criteria. SHRP and the FHWA's Pavement Performance Division selected the actual sections included. The sections are pavements whose materials and structural designs reflect standard engineering practices in the United States and Canada. A statistical sampling design describes the criteria for each experiment. The sampling design consists of a combination of pavement structures, traffic, and factors affecting pavement performance. Table 1 shows the descriptions of the different studies.

At the start of the GPS experiment, test sections were assigned to specific cells in the sampling design based on structure, materials, traffic, subgrade, and environmental zone. Data collection activities in the LTPP study were used to confirm the assignments. The GPS plan called for approximately 1,100 pavement test sections across North America. The number of GPS pavement test sections by State/Province as of July 1996 is presented in table 10 in appendix A.

Table 1. General Pavement Studies definitions.

Experiment	Definition
GPS-1	Asphalt Concrete (AC) on Granular Base
GPS-2	AC on Bound Base
GPS-3	Jointed Plain Concrete
GPS-4	Jointed Reinforced Concrete
GPS-5	Continuously Reinforced Concrete
GPS-6A	Existing AC Overlay on AC Pavements
GPS-6B	New AC Overlay on AC Pavements
GPS-7A	Existing AC Overlay on Portland Cement Concrete (PCC) Pavements
GPS-7B	New AC Overlay on PCC Pavements
GPS-9	Unbonded PCC Overlays on PCC Pavements

Specific Pavement Studies

Specific Pavement Studies are intended to collect reliable data over a fixed period in the life of the pavement section to improve pavement performance prediction and develop new design equations. SPS projects provide the comparisons needed to investigate and quantify the factors that are important in predicting pavement distress and performance. An SPS project consists of a series of sections at a single location. The sections vary in structure or maintenance treatment or rehabilitation strategy, with all other factors being similar. Some important factors, such as drainage methods, cannot be properly studied using GPS sections because the desired range of methods cannot be found among existing pavements. Studies of preventive maintenance and rehabilitation require varied treatments duplicated on several sections to compare alternatives.

Table 2. Specific Pavement Studies definitions.

Experiment	Definition
SPS-1	Strategic Study of Structural Factors for Flexible Pavements
SPS-2	Strategic Study of Structural Factors for Rigid Pavements
SPS-3	Preventive Maintenance Effectiveness of Flexible Pavements
SPS-4	Preventive Maintenance Effectiveness of Rigid Pavements
SPS-5	Rehabilitation of Asphalt Concrete Pavements
SPS-6	Rehabilitation of Jointed Portland Cement Concrete Pavements
SPS-7	Bonded Portland Cement Concrete Overlays on Concrete Pavements
SPS-8	Study of Environmental Effects in the Absence of Heavy Loads
SPS-9	Validation of SHRP Asphalt Specification and Mix Design (Superpave)

Table 2 lists the nine Specific Pavement Studies. The original experimental design called for approximately 1,600 sections built at 200 locations. Counts and locations of SPS sections are in table 11 in appendix A. The list is current as of July 1996. Not all of the necessary sections have been identified or built.

One advantage of the SPS program is the ability to monitor performance and traffic from the initial date of construction or opening to traffic. This establishes a project-specific and comprehensive baseline data set. The data can be used to explain the performance of each pavement test section. The State and provincial highway agencies nominate the sites for the SPS program. FHWA approves them when they meet a study's statistical sampling design. Each SPS project requires considerable cooperation between State and provincial highway agencies and LTPP to ensure that construction and maintenance meet study requirements.

While they have been described separately to simplify explaining the experiments, the results from the GPS and SPS experiments are complementary. Some pavement test sections are used for both experiments. The data collection approach has been to identify the data items for both the GPS and SPS experiments that are a high priority for achieving the goals of the LTPP studies.

Seasonal Monitoring Program

The primary objective of the Seasonal Monitoring Program (SMP) is to provide information on variations in temperature and moisture content within a pavement structure. Limited resources make it impossible to obtain detailed climatic impacts on all of the sections. To obtain the maximum benefits from available resources, 64 sites were selected as the core group. GPS and SPS sites are included. The sites are divided into two groups. Each group is intensively monitored in alternate years. Climatic data are collected continuously throughout that year. Monitoring of pavement strength is conducted monthly during the year. Measurements of surface characteristics are obtained at least seasonally during the year. A minimum of three monitoring cycles across 6 years is expected.

LTPP DATA BASE DEVELOPMENT

Many factors were considered while developing the data base and selecting the data to be stored in the LTPP IMS. Types of data included were based on available technology, expected usefulness of the data, anticipated effect on pavement performance, and associated cost of the data collection versus anticipated benefits. For the data collected and recorded in the LTPP IMS, data quality and "truth in data" are extremely important. Clear procedures and standards were established and are observed for the collection and recording of data. These procedures help guarantee the consistency and the quality of the data collected. Extensive data quality checks are performed during the entire process. Information is also available showing the data reliability for a set of data. Throughout the selection, gathering, and recording processes, the basic philosophy of the LTPP program has been to provide high-quality data collected in a statistically correct and consistent manner.

STRUCTURE OF THE LTPP IMS

The LTPP IMS is organized into two tiers composed of four regional offices and a technical assistance contractor (TAC) supervising the central IMS. The regional offices were established to coordinate and communicate LTPP-related activities in the United States and Canada. Each region is responsible for a specific group of States and Provinces. The States in each of the four LTPP regions are listed in table 3.

The regional offices focus on:

- Data Collection performed directly by the regional personnel or provided to them from State Highway Agencies (SHA's) or other contractors.
- Data Entry into the IMS of data provided either on paper forms or electronically.
- Data Quality Control.

The TAC is responsible for:

- Data Collection, Entry, and Quality Control of climatic data.
- Quality Assurance of all LTPP data.
- Providing data to the public.

Table 3. Regions with included States/Provinces.

North Atlantic (NA)	CT, DC, DE, MA, MD, ME, NC, NH, NJ, NY, PA, RI, VA, VT, WV, NB, NF, NS, ON, PE, PQ
North Central (NC)	IA, IL, IN, KS, KY, MI, MN, MO, ND, NE, OH, SD, WI, MB, SK
Southern (S)	AL, AR, FL, GA, LA, MS, NM, OK, PR, SC, TN, TX
Western (W)	AK, AZ, CA, CO, HI, ID, MT, NV, OR, UT, WA, WY, AB, BC

INTERNATIONAL PARTICIPATION

Thirty-three countries participate in the LTPP study. Australia, Austria, Finland (for the Nordic Countries), Japan, the Netherlands, and the United Kingdom have adopted the LTPP IMS for data entry and are processing data for their own LTPP studies. Each country using the LTPP IMS has customized their data base for the software, data types, and testing methods unique to that country.

CHAPTER 2. LTPP DATA AVAILABLE

This chapter describes the data collected on LTPP sections.

BACKGROUND

The LTPP IMS currently has seven data modules with information collected on the LTPP test sections. Each module has multiple tables, representing a collection of related information. Tables contain individual records that store information for a specific pavement section, a layer, etc. Records include individual fields that represent the smallest elements in the data base. Tables also exist that link information between modules.

The tables for each module are identified in appendix B. A one-sentence summary describes the type of data stored in the table. The three-character file extension commonly used to identify the data precedes the table name as shown in the example.

For Example:

		MATERIALS TESTING
T32	TST_L05B	Table containing layer descriptions for all constructions.

Some collected data are not available directly from the IMS data base. It is either extraneous information, information not considered of general interest, or data sets that are too large for on-line storage. The three sets representing the largest volume of off-line data are:

- Falling-Weight Deflectometer (FWD) time history data.
- Raw traffic data in the form of hourly counts and vehicle weight records.
- Climatic data on a daily basis and for additional weather stations.

The regional offices retain FWD time history data in the original files. The LTPP Central Traffic Database organizes and stores raw traffic data. The technical assistance contractor stores climatic data.

TYPE OF DATA COLLECTED

LTPP test section data are classified into seven modules:

- Inventory.
- Materials Testing.
- Climatic.
- Maintenance.
- Rehabilitation.
- Traffic.
- Monitoring:
  - automated distress
  - manual distress

- friction
- longitudinal profile
- cross profile
- deflection (FWD).

Most of the data are provided by the States or collected by the regional offices. Climatic data come from the National Oceanic and Atmospheric Administration or the Canadian Climatic Center. The modules are described in more detail on the following pages.

Three elements help to assemble information on a section within and/or across modules. They are State code, SHRP ID, and construction number. State code is the two-digit Federal Information Processing Standards (FIPS) code identifying the State/Province where the section is located. The SHRP ID uniquely identifies the section with the State. Construction number is essential for most time-dependent pavement tables. This element indicates if the pavement structure being evaluated is the one at the start of the study. If the structure changed, this value will be greater than 1. Some maintenance and all rehabilitation activities will increase the value of the construction number.

Inventory

Description
The inventory module has tables that contain historical information on the section location and material characteristics of the pavement. The data are generally based on State department of transportation records. Inventory data include location of the section, pavement type, layer thicknesses and types, material properties, composition, construction improvements, and other background information. The pavement type, layer thicknesses, and material properties help to verify the GPS study assignment.

Inventory data are historical in nature and exist for all GPS sections. SPS projects selected for maintenance experiments also will have project data in the Inventory module. Construction data for SPS projects are stored in SPS Construction modules that are not currently available.

Source of Data
Inventory data collection sheets are filled out by participating State highway agencies. States forward the sheets to the LTPP regional office for data entry. Regional offices have collected new latitude and longitude information using a global positioning system.

Data Collection Frequency
These data are collected once at the beginning of the section's nomination into the LTPP program.

Module Characteristics
This module has 26 tables.

Table names in this module begin with INV_.

GPS data requests from this module should generally include the INV_Layer table and the TST_L05A and TST_L05B tables to provide information on pavement structure.

Materials Testing

Description
Extensive field drilling and sampling and laboratory materials testing are performed on each test section to:

- Verify and document the existing pavement structure when a test section is included in an LTPP study.
- Evaluate the individual layer or material components of the pavement.

Field and laboratory tests are conducted to establish material properties and characteristics. Characterization of material properties and the variations in these properties between and within the test sections is required to evaluate causes of performance differences between test sections. It also provides a basis for improving the models used in pavement design. The materials characterization includes parameters used in current pavement design and mechanical analysis models. The engineering properties are generally required to assess the characteristics and behavior of materials.

The sampling and testing program is conducted on many different types of materials, such as portland cement concrete, asphalt concrete, asphalt-treated base, cement-treated base, permeable asphalt-treated bases, and unbound granular subbase materials. The laboratory testing process involves more than 40 test procedures, including thickness determinations, compressive strength, graduation, Atterberg Limits, and resilient modulus.

Source of Data
The SHRP testing laboratories perform the materials testing. They provide results on paper forms or electronically. Tests are conducted using the protocols found in *Laboratory Material Handling and Testing*. Sample locations are determined using the *Drilling and Sampling Guide*. The regions maintain the maps identifying sample locations.

Data Collection Frequency
These data are collected at least once at the beginning of the section's nomination into the LTPP program. Additional testing may be performed depending on the study requirements and to investigate unexpectedly poor performance.

Module Characteristics
This module has 76 tables.

Table names for this module begin with TST_.

Tables TST_L05A and TST_L05B should always be included when requesting GPS data from this module. Knowledge of pavement structure is necessary to appropriately link test results and pavement layers.

Climatic

Description
The available climatic data include actual measurements from at least one nearby weather station for each GPS test section. In addition, a site-specific statistical estimate based on as many as five nearby weather stations is available. The estimates are called virtual weather stations and have names beginning with VV.

Climatic data for SPS sites are not yet included in the IMS. Climatic data for the seasonal monitoring sites will be maintained in a separate module when it becomes available.

A substantial amount of data is kept in an off-line climatic data base. Raw climatic data collected from the National Oceanic and Atmospheric Administration (NOAA) and the Canadian Climatic Center (CCC) (for Canadian test sections) are included. These data consist of daily measurements for the LTPP selected parameters. The most recent data are for 1990. To summarize the daily measurements, monthly statistics (mean, standard deviation, skewness, kurtosis, minimums, maximums, counts, and totals) have been calculated.

Responsible for Collecting Data
Climatic data available in the LTPP IMS are derived from weather data originally collected by NOAA and the CCC. The technical assistance contractor developed the statistics.

Data Collection Frequency
Data are updated at irregular intervals.

Module Characteristics
Table names in this module begin with ENV_.

This module has five tables.

The minimum request for climatic data is the ENV_Annual, the ENV_Monthly_Derived, and the ENV_Weather_GPS_Link tables. The first two provide most commonly used summary statistics. The last links GPS sites with their respective weather stations.

Maintenance

Description

The maintenance module has data recorded on 17 data sheets. One data sheet is used for historical maintenance activities. This module primarily records maintenance activities performed on the test section after inclusion in the LTPP program. Data include maintenance-related information such as placement of seal coats, patches, joint resealing, milling, and grooving.

Source of Data

Each State is expected to notify the LTPP regional office prior to performing maintenance. This allows the regional office to do any necessary collection of monitoring data to identify the condition of the pavement prior to maintenance. Maintenance activities considered to have an impact on experimental results include patching, crack sealing, and seal coats.

Data Collection Frequency

Data are collected on pavement condition prior to maintenance being performed. States supply information on the actual maintenance activities. The States provide details about maintenance on paper forms.

Module Characteristics

This module has nine tables.

Table names in this module begin with MNT_.

A request for maintenance information on GPS sections should include the INV_Major_Imp table and the TST_L05A and TST_L05B tables. Some maintenance activities may have been incorrectly entered as improvements. The TST_* tables may provide an indication of surface conditions for various monitoring and testing activities.

Rehabilitation

Description

Major improvements to a test section after inclusion in the LTPP program are documented in the rehabilitation module. The tables in this module store information on major rehabilitation activities, such as overlay properties and construction, shoulder replacements, and joint repairs. Rehabilitation activities include resurfacing, reconstruction, and addition of lanes. Rehabilitation sometimes alters the pavement structure. In these cases, layer data are recorded.

Source of Data

Each State is expected to notify the LTPP regional office prior to doing rehabilitation on a highway segment containing an LTPP section. This allows the regional office to collect any necessary monitoring data to identify the condition of the pavement prior to rehabilitation. Some types of rehabilitation do not fit the GPS or SPS experiments. Sections receiving those treatments are not studied after rehabilitation.

Data Collection Frequency

Data are collected on pavement condition before and after rehabilitation. States provide information on paper forms describing the actual rehabilitation done. Material test data are provided prior to rehabilitation.

Module Characteristics

This module has 49 tables.

Table names in this module begin with RHB_.

GPS rehabilitation data requests should include the RHB_Imp and RHB_Layer tables and the TST_L05A and TST_L05B tables. The TST_* tables may provide an indication of surface conditions for various monitoring and testing activities.

Traffic

Description

Traffic data provide estimates of annual vehicle counts by vehicle classification and distribution of axle weight by axle type. This module stores annual traffic summary statistics. Data are provided for each year since the road was opened to traffic. With few exceptions (Annual Average Daily Traffic-based values), the information applies only to the lane being studied. Equivalent single-axle values for loading may be estimated or based on American Association of State Highway and Transportation Officials procedures. Traffic statistics for approximately two-thirds of the GPS study sites and half of the SPS project locations are based on monitored data.

Source of Data

Traffic data are collected using a combination of permanent and portable equipment by the individual States/Provinces. Data from monitoring equipment are provided electronically. States may also provide estimates using paper forms.

Data Collection Frequency

Data are collected according to the individual State's data collection plan throughout the year and summarized annually in the regions.

Module Characteristics

This module has six tables.

Table names for this module begin with TRF_.

Traffic data requests should include the TRF_Basic_Info and TRF_ANL_EST_TOT_GPS_LN (estimates) tables and the TRF_Monitor_Basic_Info (monitored) table. Both historical and monitored data are needed for a complete history of pavement loading.

Monitoring

The six types of monitoring data included in the LTPP IMS are automated distress, manual distress, friction, longitudinal profile, cross profile, and deflection.

Automated and Manual Distress

Description
Distress data provide a measure of pavement condition, primarily on the surface. The data evaluate the frequency and severity of cracking, patching and potholes, existence of surface deformation, and presence of surface defects.

Source of Data
The primary means used to obtain the surface distress data stored in the LTPP IMS is through visual interpretation of high-resolution 35-mm photographic images of the pavement surface. Visual distress surveys are performed by special contractors. They provide the results electronically to the LTPP regional offices.

Manual distress surveys are also conducted. The regional offices are responsible for manual distress surveys.

The guidelines for distress data collection are contained in the *Distress Identification Manual for the Long-Term Pavement Performance Project.*

Data Collection Frequency
The surface distress is collected every 1 to 2 years.

Module Characteristics
There are eight tables for distress data.

Distress tables have names beginning with MON_DIS_. Tables with PADIAS in the name have automated distress data. All others have manual distress results.

Both types of distress tables should generally be requested for any time-dependent section analyses. The method used on a section may vary from survey to survey.

Friction

Description
The friction number, time of day, surface type, vehicle speed, and test method are some principal elements stored.

Source of Data
Each State is responsible for taking friction measurements and submitting paper forms with the results.

Data Collection Frequency
States take friction measurements at least every 2 years according to their data collection plans.

Module Characteristics
There is one table for friction data.

Longitudinal Profile

Description
Occasionally, longitudinal profile is simply called profile data. It shows the relative elevation of the pavement along the wheel path. The International Roughness Index (IRI), Mays Index, Root Mean Square Vertical Acceleration (RMSVA), and an approximation of slope variance are also computed from the data. The raw data include the X-Y profile data for at least five repeat runs for each wheel path. It is stored separately from the statistics.

Source of Data
LTPP regional offices are responsible for collecting longitudinal profile data. The data are collected using profilometers or dipsticks. The *Manual for Profile Measurement: Operational Field Guidelines* contains details on the process.

Data Collection Frequency
The longitudinal profile of each LTPP test section is measured approximately once per year. Sections for the detailed study of seasonal effects are tested quarterly every other year.

Module Characteristics
There are two tables with longitudinal profile data.

Tables for longitudinal profile data are named MON_Profile_.

The table MON_Profile_Master contains all of the summary statistics.

Cross Profile

Description
Cross profile is commonly called rut data. It describes how the cross section of the pavement varies from constant elevation.

Source of Data
Each LTPP regional office is responsible for collecting cross-profile data for their region. Photographic cross-profile measurements are taken every 15.25 m along a test section, with measurements taken at 30 points across the pavement width [approximately 152.5-mm intervals]. Alternatively, a dipstick is used to obtain manual cross-profile measurements with a transverse interval of 0.305 m. A second alternative is to use a straight edge to measure rut depth.

Data Collection Frequency
The cross-profile data are collected every 1 to 2 years.

Module Characteristics
There are four tables with cross-profile data.

Table names for cross-profile data begin with MON_Rut_.

The MON_Rut_Depths table contains the summary statistics for straight-edge measurements on asphalt surfaces. Measurements using the PASCO device or a dipstick do not have rut values calculated. All MON_Rut_* tables should be requested if rutting information is desired since the method of measurement for a section may vary from survey to survey.

Falling-Weight Deflectometer

Description
A Falling-Weight Deflectometer (FWD) measures the structural strength of the pavement. Tables for deflection data contain peak load and deflection measurements, and site-specific air and pavement temperature data collected with the deflection testing. Load and deflection time history data for selected drops at each test point are maintained in off-line storage.

Source of Data
Each LTPP regional office is responsible for collecting FWD data in their region. Most of the data are collected and transmitted electronically. Temperature data are submitted using paper forms.

Data Collection Frequency
An initial round of deflection testing is performed on all test sections using LTPP-owned FWD's at the beginning of a study. Most sections are expected to be tested approximately once every 5 years. Sections selected for the detailed study of seasonal effects are tested 12 to 14 times every other year.

Module Characteristics
There are eight tables containing information from FWD testing.

Table names for FWD data begin with either MON_Defl_, MON_Temperature_, or MON_Dynatest_.

All eight tables are needed to use FWD data. There are no summary statistics such as back-calculated moduli in the IMS.

CHAPTER 3. QUALITY CONTROL

This chapter describes the quality checks in the data base. The checks are done to ensure that the data collected for the LTPP program are reliable.

BACKGROUND

Before data are released to the public, a series of quality control (QC) checks are performed to ensure the integrity of the data. New and updated data have been released seven times as of September 1996. Further releases are expected to occur on an annual basis.

WHAT IS QUALITY CONTROL (QC)?

QC represents the procedures done by LTPP data collectors to ensure that the data in the IMS are as accurate, complete, and consistent as possible. The Pavement TAC is responsible for the QC of climatic data. The LTPP regional offices are responsible for the QC of the remaining LTPP data.

QC is an ongoing process during data collection and entry. Data collection procedures are designed to make sure that data are collected using matching formats, similar amounts, and comparable conditions for all sites in a study. Comparable conditions include calibration and other factors influencing measurements. Data entry procedures include review of inputs before and after entry. This is a check for errors related to keystroke input, field operations, procedures, equipment operations, etc. Some checks are incorporated in pre-processing software that reviews and summarizes electronically collected data items. As data are loaded into the data base, the software does four types of checks: mandatory, logic, range, and verification. Mandatory checks review fields that must have data for the data base software to function. Logic checks are used to ensure data compatibility across tables, for example, asphalt testing being done on asphalt layers. Range checks are used to compare data against allowable minimums, maximums, or specific values. Verification is used to ensure that the sections exist for which data have been collected. Quality control checks on the data base are shown in *LTPP IMS Data Quality Checks*.

The quality checks performed are categorized as A through E. They are described below:

Group A: Random checks of data are done to ensure correct data transfer from the regions to the central location.

Group B: Initial experiment assignments are verified based on inventory data. For the remaining data, a set of dependency checks are done to ensure that essential section information has been stored in the LTPP IMS.

Group C: A minimum data search is done for critical elements. For example, testing data on layer types must include a description of the material, its location in the structure, and a non-zero thickness.

Group D: Expanded range checks are applied to certain fields to identify data element values that fall outside an expected range, such as a layer thickness that should be non-zero and not exceed some generally accepted maximum.

Group E: Intra-modular checks are designed to verify the consistency of data within a record or between records. For example, in testing the description of the asphalt, test results should match the description of the corresponding layer in the table on pavement structure.

Each data record has a letter (A through E) showing the last QC check that was successfully done. Records must go through all quality control checks before they are released. Only a fraction of the data fields are checked. Any record for which correct section information is stored in the data base is available after the QC is completed. An account of the QC processing is included with the data record. Since the checks are run in sequence from A to E, the last successful check is identified on the record as the record status variable. A value of B does not necessarily indicate that all QC checks were unsuccessful. Some records have no QC checks done in the IMS and therefore will not have any other identifier. Similarly, a record with a C does not imply that the group D and group E checks were unsuccessful, merely that a necessary data element was not available when the QC check was done.

A data request is accompanied by a statement about the QC process and conditions for data release:

> *Data provided for release pertain only to sections that meet the experiment definitions. All data provided have gone through the quality control process. Every effort has been made to provide clean, error-free, and complete data.*
>
> *If a report, paper, or technical document is generated using results from this release, then a statement must be included indicating that LTPP data were used and the date that the data were obtained.*

CHAPTER 4. REQUESTING DATA

This chapter explains the various ways of requesting LTPP data.

BACKGROUND

Three ways exist to get information from the LTPP IMS. They include contacting the Data Customer Service Center, the Internet, and State department of transportation access to the regional offices. The Data Customer Service Center provides data sets meeting specific user needs and support for questions that may occur while using the data. There is no direct access to the data base itself and no action is anticipated to change this. Commonly requested data sets are available through the LTPP web site at:
http://www.tfhrc.gov/pavement/ltpp/ltpphome.htm under the LTPP Data Base button.

The LTPP Data Sampler version 7.0 running under Windows contains limited extracts of commonly used data base information, but is not a data base itself. The sampler's principal function is to help a user in developing a customized request for GPS data.

CUSTOM REQUESTS

Most users have a specific reason for requesting data and need only a limited portion of the LTPP data. To obtain that information, a completed LTPP IMS Data Request Form should be submitted to the Data Customer Service Center at FHWA's Turner-Fairbank Highway Research Center. The form is the last page of this manual. The following sections describe how to complete the form.

Selecting Sections

Section data may be selected according to many schemes, the most common being experiment, geographical location, and individual section. Data are collected on a section basis, but may be provided on either a section or project basis. A GPS section is a single location and is the smallest unit for GPS data. An SPS project contains multiple-SPS sections at a single location and is the smallest unit for SPS data. There are three functional groupings of experiments — GPS, SPS, and SMP. GPS section data are readily available for all experiments. SPS data have not completed QC checks as of the September 1996 release. Users requesting SPS data at this time will be placed on a waiting list. No SMP data are available in the September 1996 release. Users requesting SMP data will also be placed on a waiting list.

Data may also be requested by States/Provinces either individually or as a group. The LTPP geographic regions are the only standard groups in the IMS. The regions were identified in chapter 1. Other groupings, such as climatic regions, may be specified by the user.

Requesting sections individually is also possible. To identify a section completely, the State and section number are needed. The State may be designated by name, initials, or FIPS

code. The section number is the four-digit SHRP ID assigned to the GPS section or SPS project.

Selecting Tables

Data are stored in the IMS in tables of related fields. The tables contained in each module are listed in appendix B. Tables may be requested by full name or extension.

Some or all of the tables for a module may be requested. Where a specific group of tables is needed to provide complete analysis information, the response should automatically include them. Deflection data are one such instance, climatic data are another, and axle load distributions for traffic are a third. The user should consider what information is really needed to answer the research question when requesting tables. Some tables are very large and may limit options for format and media. The very large tables identified at this time are ENV_Monthly_Parameter, MON_Profile_Data, and MON_Dynatest_Drop_Data.

Traffic information from the Central Traffic Database (CTDB) may also be requested. Users wanting more detail than in the annual summaries in the IMS may ask for daily summaries and/or raw classification and weight records. Daily traffic summaries have counts and axle distributions by vehicle classification. Raw classification and weight records are stored in Traffic Monitoring Guide (TMG) formats. Files of weight records are rarely less than 1 Mb and a complete year's worth of data may be as much as 80 Mb. A detailed discussion of the CTDB is in chapter 6, Traffic Data.

Formats - IMS

LTPP IMS data are now available in three basic formats: ASCII text files, Excel® 5.0 spreadsheets, and SAS® data sets. These options are discussed below.

ASCII Files

The fastest way to obtain data is to request ASCII text files. ASCII text files contain information from only one table and have no limit on the number of records. A user will need to consider file length and size in creating data sets for analysis. The data tables may be grouped by a characteristic identified by the user in the request. The actual file format can be either fixed-column or comma-separated value. In a fixed-column format, each record is represented by a continuous line of data. The breakpoints in the line to define the fields are obtained from the schema. The user applies the software tool of their choice to split a record into fields. In a comma-separated value format, each field is marked off by commas. Text and date fields are identified by quotation marks. This is a very easy format to put into other types of software, unless tables contain fields with comments. Comments may include commas. These may be recognized as breakpoints rather than part of a comment. The user needs to know how their software handles this type of ASCII file.

Excel

Spreadsheet files can be created for individual users. The software currently available to Customer Relations is Excel 5.0. Tables are grouped in files in some logical fashion depending on the focus of the request. Workbooks may be based on experiments, States, modules, or tables. Worksheets within the workbook frequently depend on tables. There is generally a 1.5-Mb limit on individual workbooks for ease in handling. A few tables will not be provided in spreadsheet format for requests exceeding approximately 15 sections. This is due to the large file size. They include: ENV_Monthly_Parameter, MON_Profile_Data, MON_Dynatest_Drop_Data, and MON_Rut_X_Y. The contents of these files are defined in appendix B.

SAS

SAS is a data-processing package with statistical and graphical capabilities that handles very large data sets on a record-by-record basis. All tables can be provided as SAS data sets except MON_DEFL_Comments. This table has a very large variable-length component that cannot be handled by SAS. The principal limitation of SAS is the restriction of field names to 8 characters rather than the 32 allowed in the IMS. This results in a set of lists matching SAS field names and IMS field names by table for each request. The SAS field names attempt to reflect the actual IMS field name, but identical names for different fields in different tables and/or modules may occur since there are more than 5,000 field names in the IMS. The user should review all included lists and resolve any field name conflicts.

Formats - CTDB

LTPP CTDB data are available in up to three formats depending on the type of data requested. Daily traffic summaries may be provided in a report, calendar, or ASCII fixed-column format. A daily traffic summary report includes the number of vehicles counted and/or weighed, and the axle load distribution by axle group and vehicle type for that day. The reports are ASCII text files. A daily traffic summary calendar is an ASCII text file that shows the days on which the different types of data were collected. Files of raw classification counts and weight records are supplied as ASCII fixed-column records only.

Media

LTPP data are provided on IBM PC-compatible media accessible under DOS or Windows. The primary media are:

- 3-1/2" [88.9-mm] high-density diskettes.
- QIC-80 tape (125 Mb or 170 Mb uncompressed).
- TR-1 tape (400 Mb uncompressed).
- Hard copy.

Data provided on electronic media will generally be zipped. Any necessary extraction software and extraction instructions will be provided. ASCII files generally zip at rates between 6:1 and 10:1. Tapes are not compressed in order to avoid potential compatibility problems.

In special circumstances, by prior arrangement, it may be possible to have data furnished on 5-1/4" [133.4-mm] diskettes, 4-mm tape, nine-track magnetic tape, or 1-Gb optical cartridge.

The requested data and associated materials will be sent by U.S. mail unless other arrangements are made.

Fees

There is no cost to employees of State, Federal, and international agencies and industry groups currently participating in LTPP. A basic charge is assessed to all other users for handling and media with a premium for large non-ASCII format requests. The complete fee schedule is:

Media:	
- 3.5" [88.9-mm] diskettes	$ 1 each
- QIC-80 tape	$15 each (125-Mb tapes will be used unless 170-Mb tapes are explicitly requested)
- TR-1 tape	$35 each
- hard copy	$0.05 per page after the first 30 pages
- other media	determined at time of request

Handling:		
- Basic fee	$75	
- Excel spreadsheets for requests exceeding 75 tables		+ $75
- SAS files for requests exceeding 75 tables		+ $50

Most focused requests require four diskettes or fewer. Tapes should be considered for requests including many sections and ENV_Monthly_Parameter, MON_Dynatest_Drop_Data, or MON_Profile_Data. Multiple sites of raw traffic data are best handled with tapes.

The National Highway Institute bills requestors.

STANDARD DATA SETS

Individuals without a specific research interest to be addressed by IMS data may prefer to request complete or nearly complete copies of all or part of the IMS data base. The data sets provided are supported no differently than those of a custom request. All supporting documents, reference materials, and tools are included. All data provided apply to valid sections and have completed the QC process. Data are grouped by experiment only. File format is ASCII fixed column. The media is determined by group size. Fees depend on group size and media. Currently, only standard GPS data sets exist.

Content

There are three types of standard data sets: complete copies, general interest copies, and download copies. Complete copies are identified with an R and include all tables with all releaseable data.

Tables with no data are included to verify that the information is not available. R_1 includes the asphalt-related studies in GPS-1, -2, -6A, -6B, -7A, and -7B. R_2 includes the portland cement-related studies in GPS-3, -4, -5, -7A, -7B, and -9. R_3 has all GPS studies. General interest copies omit some tables and information considered to be of limited interest. The only omitted table is MON_Profile_Data. Empty tables are included to verify that no data are available. The omitted information is climatic data prior to 1980 and FWD drops for loads other than 40kN (9,000 lbs). W_1 includes the asphalt-related studies in GPS-1, -2, -6A, and -6B. W_2 includes the portland cement-related studies in GPS-3, -4, -5, -7A, -7B and -9. W_3 has all GPS studies. Download copies have had their contents further reduced to create zipped files of 2 Mb or less for ease in electronic transfer. As a result, even less information is provided than for the W series files. The omitted tables are MON_Profile_Data, ENV_Monthly_Parameter, and any table without data. Climatic data are restricted to information for virtual weather stations only since 1980. Deflection tables are limited to a single site visit (the first generally) with data from stations 0 and below and 5 and above only for a drop of 40 kN (9,000 lbs). In all tables, only data that were successful in meeting all QC conditions are included. F_1 through F_9 match the corresponding GPS study numbers with 6A and 6B in F_6 and 7A and 7B in F_7.

Format, Media, and Fees

All data sets are provided only in ASCII fixed-column format. R and W series data sets are available on tape only. The F series data sets are available for downloading through http://www.tfhrc.gov/pavement/ltpp/ltpphome.htm and the LTPP Data Base button. The F series data sets are also available by mail on tape or diskette.

Fees are charged only for data sets provided on tape or diskette. The fees below are all-inclusive; the $75 basic fee is waived.

	QIC-80*/TR-1
R_1 - Complete copy of all GPS asphalt concrete (AC) sections (GPS-1, -2, -6A, -6B, -7A, -7B)	$60/$35
R_2 - Complete copy of all GPS portland cement concrete (PCC) sections (GPS-3, -4, -5, -7A, -7B, -9)	$45/$35
R_3 - All GPS sections	$90/$35
W_1 - subset of R_1	$45/$35
W_2 - subset of R_2	$30/$35
W_3 - subset of R_3	$60/$35

Files designed for electronic download

Asphalt concrete sections	QIC 80*/Diskette
F_1 - GPS-1 sections	$15/$5
F_2 - GPS-2 sections	$15/$3
F_6 - GPS-6A/B sections	$15/$5
F_7 - GPS-7A/B sections	$15/$5

Portland cement concrete sections	QIC 80*/Diskette
F_3 - GPS-3 sections	$15/$4
F_4 - GPS-4 sections	$15/$4
F_5 - GPS-5 sections	$15/$4
F_7 - GPS-7A/B sections	$15/$5
F_9 - GPS-9 sections	$15/$4

* QIC-80 based on 125-Mb tape with selected files zipped and no other type of file compression.

LTPP DATA SAMPLER

The LTPP Data Sampler and Data Request software program provides an overview of the quantity and type of data collected from the GPS sites. The program includes the schema and data dictionary. The easy-to-use, menu-driven program offers several features:

- A convenient means of viewing summary LTPP data.
- A method for navigating the LTPP IMS.
- A means for assessing the quantity of available data.
- A form for creating a customized request.

The most recent version as of January 1997 is release 7.0 dated January 1997. The sampler is available free of charge upon request or by download from the Web at http://www.tfhrc.gov/pavement/ltpp/ltpphome.htm under the LTPP Data Base button.

SUPPORTING INFORMATION

The supporting information provided with every request consists of two types — reference materials to understand the data received and software tools.

Seven items of reference material are included with every request. They include a table to link sections to experiments, a table of comments of general section interest, a schema, a data dictionary, a codes listing, the QC document, and an addendum. Since the data are stored in a relational data base, items of information such as experiment number are saved in only one place. The section number (State_Code and SHRP_ID), experiment number, experiment type, and construction dates are included in the Experiment_Section table. The Comments table can help to explain values that look like outliers. The schema is a listing of tables with all of their associated fields and formats. The data dictionary contains definitions of the fields, their units, and any codes list. The codes listing has the name of each group of codes, the values of the codes, and the source in which it is originally found. The QC document lets the user see what checks were applied in the IMS and the specified values for ranges. The addendum contains the disclaimers; information needed by the user, but not readily accessible in LTPP documentation; and any systematic problems discovered in the data since the release was made. These items are discussed with examples in the next chapter.

The software tools are being developed for easier use of IMS-derived ASCII fixed-column files. Since spreadsheets are one of the most frequently used analysis packages, a set of parsing files and a title file in Excel 5.0 can be provided. Excel has been named solely because it was the most frequently mentioned spreadsheet in a 1995 survey of IMS data users. The other most frequently mentioned analysis package in the survey was SAS.

The parsing files may be adapted to any spreadsheet or application that can split fixed-column ASCII text files. A template for parsing exists for the most commonly requested tables that do not have a variable formatted as LONG in ORACLE. Currently, the only table with this restriction is MON_DEFL_Comments. The title file contains all of the field names in field order by table. Each worksheet within the workbook represents a single IMS module, including individual worksheets for each SPS study (and the SMP study). A title file may be created in any spreadsheet using the schema or text files created using SAS code. The ASCII text file of title information is also available. Instructions on the parsing process are included with the parsing files.

A set of SAS programs to convert the IMS tables or CTDB raw traffic files to SAS data sets can be supplied. SAS programs are developed as tables are requested in that format or must be split into shorter lengths for inclusion in Excel spreadsheets. The programs were developed for use under SAS versions 6.08/6.11. They are modified as the schema changes. Current versions do not merge related groups of tables. Every program has a companion text file that documents the SAS file. The text file documents the naming of SAS data sets, and how to match the IMS field names and the SAS field names. It may include any algorithms used for deriving SAS field names and additional variables. When identical field names are known to exist within a module, they are identified in this file. The duplicate field name listings are not all-inclusive. It should be noted that at least six tables in the IMS have field widths that exceed the maximum allowed by SAS (240 characters). Here, two SAS variables are used to contain all the data. The readers are written to take advantage of SAS macro features. The variables in the macro are described in the file header.

ADDITIONAL INFORMATION

For information on the LTPP IMS, such as available data, details of QC checks, and specific technical questions; information or help related to data requests; and the LTPP Data Sampler and Data Request Software, contact:

Data Customer Service Center
Pavement Performance Division (HNR-30)
Federal Highway Administration
6300 Georgetown Pike
McLean, VA 22101-2296
TEL: (703) 285-2514
FAX: (703) 285-2767
E-mail: ltppinfo@fhwa.dot.gov

CHAPTER 5. REFERENCE MATERIAL

The purpose of this chapter is to discuss the documents used to describe the LTPP IMS data base structure, format, and content.

BACKGROUND

The LTPP IMS is a relational data base. To use LTPP data, it is necessary to understand where individual pieces of information are stored and how to link related items. The principal elements for this are the LTPP schema, LTPP data dictionary, and Codes Listing report. Current versions of these items are provided with each request and are described below.

The quality control checks are provided so that a user can look at the data review process.

Two tables within the IMS are necessary to use the data base fully. They are Experiment_Section and Comments. These items are automatically provided with each request in a file format compatible with the other data.

Besides the structural information on the IMS, reports can be generated to describe individual States or sections and the availability of data for both GPS and SPS experiments.

LTPP SCHEMA

The schema shows all data elements grouped by the table to which they belong in the LTPP IMS. It has field names, their location in an individual record, and formatting. Formatting included is for the IMS data base and for coding the data in FORTRAN, C, or SAS programs. The key fields used in the relational data base to uniquely identify the record are aligned with the left margin. All other fields are indented.

The tables in the schema are arranged in alphabetical order by table name. Since table names are prefaced with a three-letter module identifier, all tables for a module appear together. Each table may also be identified by a three-character extension. The first character indicates the module. Most are obvious, but the following exceptions exist: F-traffic, N-maintenance, C-testing for some SPS test data tables, and A-Experiment_Section and Comments. The remaining characters are two-digit numbers that were assigned when the tables were developed. The number assigned to a table may change when the data base is revised. The current copy of the schema when the data are extracted from the IMS is included with any request.

Table 4. Extract from the schema.

TST_L05B: Table containing layer descriptions for all constructions. File Ext - T32.

COLUMN NAME	FORMAT	COLUMNS	FORTRAN	C	SAS
SHRP_ID	VARCHAR2(4)	1- 4	A4	%4.4s	$4.
STATE_CODE	NUMBER(2,0)	5- 7	I3	%3d	3.
CONSTRUCTION_NO	NUMBER(2,0)	8- 10	I3	%3d	3.
LAYER_NO	NUMBER(2,0)	11- 13	I3	%3d	3.
PROJECT_LAYER_CODE	VARCHAR2(1)	14- 14	A1	%1.1s	$1.
DESCRIPTION	NUMBER(2,0)	15- 17	I3	%3d	3.
LAYER_TYPE	VARCHAR2(2)	18- 19	A2	%2.2s	$2.
REPR_THICKNESS	NUMBER(4,1)	20- 25	F6.1	%6.1lf	6.1
MATL_CODE	NUMBER(3,0)	26- 29	I4	%4d	4.
LAYER_COMMENT1	VARCHAR2(1)	30- 30	A1	%1.1s	$1.
LAYER_COMMENT2	VARCHAR2(1)	31- 31	A1	%1.1s	$1.
LAYER_COMMENT3	VARCHAR2(1)	32- 32	A1	%1.1s	$1.
COMMENT_NOTE	VARCHAR2(50)	33- 82	A50	%50.50s	$50.
INV_LAYER_NO	NUMBER(2,0)	83- 85	I3	%3d	3.
INV_LAYER_NO_2	NUMBER(2,0)	86- 88	I3	%3d	3.
RECORD_STATUS	VARCHAR2(1)	89- 89	A1	%1.1s	$1.

An extract from the schema is shown in table 4. The table illustrated is a principal table in reviewing materials testing data. The example has key fields: SHRP_ID, State_Code, Construction_No, and Layer_No. Using these fields, information on tests done on a given layer can be linked to it. SHRP_ID is unique in a State. The State_Code is the two-digit FIPS code. The Construction_No shows whether the information applies to the section from the start of the experiment or after a maintenance or rehabilitation event that added or changed layers in the section. The Layer_No is exactly that. Layer numbering in LTPP begins with one at the subgrade and increases to the surface. Milled layers may result in discontinuities in numbering. The remaining fields contain information about the layer identified by the Layer_No, but are not required to identify the record and its information uniquely. Note that the last field — Record_Status — shows the level of QC that the record has passed. For most tables, Record_Status will be the last field.

LTPP DATA DICTIONARY

The LTPP data dictionary describes each field. It contains field names, the name of the table where the field can be found, definitions, units, and range check information used in the quality control process. Sometimes codes are included. In other cases, the code name in the Codes List is identified in the validation entry.

The information is organized in alphabetical order by field name. The Data Dictionary is updated whenever a table or field is changed. Although much of the data in the dictionary are accurate, there may be both missing and outdated items. This report provides key information and should be referenced before analyzing the data. The most current copy is provided with a request.

Table 5. Sample elements of the data dictionary.

```
COMMENT_NOTE                                                Table: TST_L05B

  Additional comments about layer.

   Data Type: CHAR(50)             Protocol:
       Units:                     Validation:
 QC Required: No                   QC Range:
      Source: TESTING Form L05B Item number: 7

DESCRIPTION                                                 Table: TST_L05A; TST_L05B

  A code describing the type of layer (i.e.  overlay, original surface).

   Data Type: NUMBER(2,0)          Protocol:
       Units:                     Validation:  DESCRIPTION
 QC Required: Conditional          QC Range:
      Source: TESTING Sheets L05A/B Item number:

INV_LAYER_NO                                                Table: TST_L05B

  The first corresponding layer in INV_LAYER.

   Data Type: NUMBER(2,0)          Protocol:
       Units:                     Validation:
 QC Required: No                   QC Range:
      Source: TESTING Form L05B Item number: 8

LAYER_COMMENT(1-3)                                          Table: TST_L05B

  Codes to describe any additional info concerning layer.

   Data Type: CHAR(1)              Protocol:
       Units:                     Validation:  L05B_COMMENT_CODES
 QC Required: No                   QC Range:
      Source: TESTING Form L05B Item number: 6

MATL_CODE                                                   Table: TST_L05B

  Material code for the layer.

   Data Type: NUMBER(3,0)          Protocol:
       Units:                     Validation:  MATERIAL
 QC Required: Conditional          QC Range:  01-20, 71-73 (AC/PC); 301-399
(TB,TS,GB,GS); 180-1863 (ST); 100-299 (SS); 999
      Source: TESTING Form L05B Item number:
```

Extracts from the data dictionary are shown in table 5. The entries selected are fields from TST_L05B, the table used in the schema example. There are 11 items in a data dictionary entry: field name, table, definition, data type, protocol, units, validation, QC required, QC range, source, and item number. The first two are self-explanatory.

- Field definition describes the field content, including simple codes where applicable.

- Data type describes whether the field is numeric, alphanumeric, or date. If a data element is numeric, the location of the decimal point is shown along with the possible size of the number. The number to the left of the comma is the number of places allowed to the left of the decimal point, excluding the sign. The number to the right

of the comma is the number of places to the right of the decimal point. If the data element is alphanumeric (character), its maximum length is shown. Date values, when extracted, generally appear in the format DD-MMM-YY.

- Protocol is used for materials testing tables to indicate the materials testing protocol used to obtain the given value.

- Units entry shows whether a measured value is a percentage, date, time, or in U.S. customary or SI (Le Système International d'Unités) units. It gives the actual unit used or the abbreviation for the unit used as a data element in the data base. An example is precipitation in climatic data measured in the United States in hundredths of an inch. The field in the data base that indicates the measurement unit is shown in the units entry as HI.

- Validation item in the LTPP data dictionary report has a name in uppercase when a code table is used for data validation or to enter a value in the field. All code tables included as validation items are contained in a separate codes list. If the list of codes is very short, the codes and the definitions may be shown here.

- QC required shows whether a value must exist in the field. "No" indicates that the field can be empty. "Yes" indicates that the field must have a value. "Conditional" means that under a specific set of conditions, the field must be filled.

- QC range is the list of possible values for a QC range check. Sometimes this entry doubles as the codes list for a variable, particularly when the codes list is very short.

- Source shows the paper form or manual where the data originated.

- Item is tied to the source entry as the location on a specified form where the data was originally entered.

CODES LISTING

The codes listing report shows all the code tables used in the LTPP IMS. All codes relating to a specific data element in a table make up a code table. For each code table, a listing is shown of the code values and their meanings. Not all coded fields have code tables. A common example is a field with a Yes/No entry using Y/N as a response.

Standardized codes were established for much of the non-numeric data entered in the IMS. The use of codes reduces data entry and storage, and provides more quality control. For example, numeric comment codes were established for use in recording laboratory results. Each of those numeric codes corresponds to an individual comment relating to conditions that may affect the results.

Table 6. Example of a codes listing entry.

SHRP LTPP IMS
CODES TABLE LISTING

CODE NAME: DESCRIPTION
DESCRIPTION: Layer description codes
SOURCE: DCG: Inventory sheet 3

Code	Description
1	Overlay
2	Seal Coat
3	Original Surface Layer
4	AC Layer Below Surface (Binder Course)
5	Base Layer
6	Subbase Layer
7	Subgrade
8	Interlayer
9	Friction Course
10	Surface Treatment
11	Embankment Layer

Table 6 is an extract from the codes listing. The example shown is for the field "Description" in TST_L05B. Where possible, the name of the code table and the field name are the same. The description entry briefly describes the general classification of the codes. Source indicates where further documentation on the codes may be found. In the example, DCG is the abbreviation for *Data Collection Guide.*

LTPP IMS DATA QUALITY CHECKS

This document has a brief history of the development of the QC process for the IMS. The bulk of the document is a listing of the actual checks arranged by module. Within each module, the checks are presented in group order (A, B...) and within a group by table.

EXPERIMENT_SECTION

The Experiment_Section table identifies some key fields by which tables may be linked, including State, SHRP_ID, and Construction_No. Its principal use is to identify the experiment(s) to which a section or site belongs and any changes that have occurred in its status.

COMMENTS

The Comments table includes general comments made during the QC process and associated with the requested sections. The comments supplied have been provided by the regions to clarify and/or validate existing data and/or explain the reason for missing data. Since data collection is continuing, some earlier comments may no longer apply. Occasionally, new, corrected, or verified data may have been entered in the IMS after the inclusion of the original comment.

LTPP DATA REPORTS

The standard reports available from the LTPP IMS are designed to provide general summary information presented in an easy-to-read format. These reports are meant to provide specific information. The reports currently available were defined by the LTPP regional offices, FHWA, and other contractors. While not developed specifically for pavement researchers, these reports may be beneficial for these users. A description and sample of each report are provided. The sample reports shown were current as of November 1996.

Section Totals Per State

This report is shown in table 10 in appendix A, LTPP Section Counts and Locations. It is a chart showing the number of pavement sections in the LTPP experiment by State/Province and study. The comparable table for SPS pavement sections is shown in table 11 in appendix A.

Section Reference

Table 7. Sample section reference report.

```
19-JUN-96                          SHRP LTPP IMS                          36
                                 REFERENCE REPORT


STATE: Colorado                    SHRP SECTION ID: 81029      STATE ID: 110

       DISTRICT: 3                    FUNCT. CLASS: Rural Principal Arterial
         COUNTY: MOFFAT                  LTPP CODE: GPS-1
        HIGHWAY: U. S.     40       PAVEMENT TYPE: AC with Granular Base
    MILE MARKER: 69.75                HPMS-SAMPLE:
          LANES:  1                   HPMS-SUBDIV:
  DIR OF TRAVEL: West Bound              LATITUDE: 40 31:30
                                       LONGITUDE: 107 55:0
                                       ELEVATION: 5920

LOCATION INFO: 2.05 miles east from Lay Grocery Store. Approx. 10 mi. west
               of ST-318 intersection with US-40.


STATE: Colorado                    SHRP SECTION ID: 81047      STATE ID: 36

       DISTRICT: 3                    FUNCT. CLASS: Rural Major Collector
         COUNTY: RIO BLANCO              LTPP CODE: GPS-1
        HIGHWAY: State     64       PAVEMENT TYPE: AC with Granular Base
    MILE MARKER: 16.6                 HPMS-SAMPLE:
          LANES:  1                   HPMS-SUBDIV:
  DIR OF TRAVEL: West Bound              LATITUDE: 40 5:55
                                       LONGITUDE: 108 49:55
                                       ELEVATION: 5260

LOCATION INFO: 1.3 miles west of White River.  1.64 miles west of Minimart.
                Approx. 2 mi. east of ST-139 intersection with ST-64.
```

Available for a single section, single State, or all sections, the section reference report lists general information about the pavement section. It provides more detail than the sections-by-

State report. A sample is provided in table 7. It is derived from a table called INV_ID and Experiment_Section.

Sections by State

Table 8. Sample sections by State.

19-JUN-96 SHRP LTPP IMS 7
GENERAL PAVEMENT STUDIES
CURRENT SECTIONS BY STATE

8 - Colorado

Experiment: GPS-1: AC OVER GRANULAR BASE

Section	Route	# Lanes	Direction	Milepoint	County
081029	US 40	1	West	69.75	MOFFAT
081047	ST 64	1	West	16.60	RIO BLANCO
081053	US 50	1	North	75.30	DELTA
081057	ST 141B	2	South	160.65	MESA
087780	US 24	2	West	291.26	EL PASO

Experiment: GPS-3: JOINTED PLAIN CONCRETE

Section	Route	# Lanes	Direction	Milepoint	County
083032	I- 70	2	East	95.75	GARFIELD
087776	I- 70	2	East	290.30	ADAMS

Experiment: GPS-6A: EXISTING AC OVERLAY OF AC

Section	Route	# Lanes	Direction	Milepoint	County
086002	I- 25	2	North	106.35	PUEBLO
086013	US 14	2	West	235.40	LOGAN
087783	I- 70	2	East	67.66	GARFIELD

Experiment: GPS-6B: PLANNED AC OVERLAY OF AC

Section	Route	# Lanes	Direction	Milepoint	County
087781	US 50	2	West	402.18	BENT

Experiment: GPS-7A: EXISTING AC OVERLAY OF JCP

Section	Route	# Lanes	Direction	Milepoint	County
087035	I- 70	2	East	286.25	ADAMS
087036	I- 70	2	East	308.55	ARAPAHOE

Experiment: GPS-9: UNBONDED PCC OVERLAY OF PCC

Section	Route	# Lanes	Direction	Milepoint	County
089019	I- 25	2	North	246.50	WELD
089020	I- 25	2	South	256.40	LARIMER

Available for a single State or all States, the sample sections by State report shows all pavement sections for a State grouped by experiment type. Section number, route, number of lanes, direction, milepoint, and county are shown. The sample provided in table 8 for Colorado illustrates the diversity of sections that can be found within a State. Note that the number of lanes is the number in the LTPP direction. Milepoints are determined according to the individual State's system.

Pavement Summary

Table 9. Examples of pavement layer summaries.

26-AUG-96 SHRP LTPP IMS 19
PAVEMENT SUMMARY

State: Colorado SHRP Section ID: 81057
Construction Event: 1 Cn Assign Date 30-APR-85

Layer No	TST L05B Code/Description	Layer Type	Repr Thick
1	7 Subgrade	SS	
2	8 Interlayer	GS	0.1
3	6 Subbase Layer	GS	13.7
4	8 Interlayer	GB	0.1
5	5 Base Layer	GB	3.8
6	3 Original Surface	AC	3.9

Layer	INVENTORY Code/Description	Type	Min Thick	Avg Thick	Max Thick	Std Dev
1	7 Subgrade	G		0.0		
2	6 Subbase Layer	B		9.0		
3	5 Base Layer	B		4.0		
4	3 Original Surface	A		4.0		

State: Colorado SHRP Section ID: 81057
Construction Event: 2 Cn Assign Date 13-AUG-93

Layer No	TST L05B Code/Description	Layer Type	Repr Thick
1	7 Subgrade	SS	
2	8 Interlayer	GS	0.1
3	6 Subbase Layer	GS	13.7
4	8 Interlayer	GB	0.1
5	5 Base Layer	GB	3.8
6	3 Original Surface	AC	3.9
7	2 Seal Coat	AC	0.5

Layer	INVENTORY Code/Description	Type	Min Thick	Avg Thick	Max Thick	Std Dev
1	7 Subgrade	G		0.0		
2	6 Subbase Layer	B		9.0		
3	5 Base Layer	B		4.0		
4	3 Original Surface	A		4.0		

Generated for a single section, single State, or all sections, the pavement layer summary shows the structure and development of a pavement section. The data are provided from the inventory data (INV_Layer) and/or the results of material testing (TST_L05B). An example for a GPS section is shown in table 9. A construction event is 1 when a section is assigned to an LTPP experiment. A rehabilitation or major maintenance event will increment the value of the construction number. The date of the event, either assignment or additional construction, is the Cn Assign Date. Other data include layer number, layer type code with its description, a materials code, and the average thickness from core measurements. This section received a seal coat and has a pavement layer summary associated with each construction number.

CHAPTER 6. TRAFFIC DATA

This chapter discusses the Central Traffic Database (CTDB), a repository of raw traffic data and summary files.

BACKGROUND

Traffic data are expected to be collected at every GPS section and SPS project. The CTDB contains that information. It provides more detailed loading information than the annual summaries in the IMS. It has both the raw count and weight data, and various types of summary information. Data can be requested in raw form, daily summaries, or annual estimates using the same procedures as for the IMS.

DATA COLLECTION

The LTPP traffic data collection plan was developed to balance the needs of the research program and the constraints of existing technology and finite State resources. The plan recognized several major principles:

- Traffic loading estimates should be the result of on-site measurements wherever possible.
- Data from all LTPP locations should be treated consistently in collection, submission, review, and aggregation, without modification to reflect "expected" values.
- All data included in the data base should follow the principle of "truth-in-data." Truth-in-data was defined to include the following:
  - Practices and conditions under which the data were collected must be reported.
  - Editing of traffic data must be documented and a record of the original (unedited) data must be retained.
  - Estimates of the variability in the data must be made and reported.

Traffic data collection for LTPP sections is a State/Provincial responsibility. Data collection plans in each State have integrated LTPP requirements and individual State practices. This results in varying amounts and types of data being collected for LTPP.

TRAFFIC DATA CATEGORIES

Definitions of traffic sets may be made based on types, source, or level of aggregation. Professional judgment and measured values are two sources of traffic information for both volume and loading information in the CTDB. The levels of aggregation may be none, straight aggregation, or expanded summaries.

Historical

Often sections were selected for LTPP experiments without any prior site measured data for traffic volume or loading information. States/Provinces supplied volume and loading estimates for the period before the start of the LTPP experiment. These estimates were based on limited counts near the site or on information from similar routes. These estimates and their basis are identified as estimates in the CTDB (and the IMS) when they exist.

Historical, or before the 1990 start of traffic monitoring for LTPP sections, is not the only period for which traffic estimates exist. Estimates identified as "monitored" values are provided when monitoring equipment has failed or not yet been installed. They are identified as estimates in the CTDB and the IMS when they exist.

Monitored

Monitored data may come from either portable or permanently installed equipment. The data may be collected using automatic traffic recorders (ATR's), automatic vehicle classification (AVC) devices, and/or weigh-in-motion (WIM) equipment. ATR's provide volume information only. AVC provides counts of vehicles by type. Several schemes for classifying vehicles are used, but all data in the CTDB are stored in Scheme F, a 15-class scheme. Scheme F is defined in the *Traffic Monitoring Guide* (TMG). WIM equipment weighs vehicles at highway speeds and produces a record for each observed vehicle. The record includes class, individual wheel or axle weights, and axle spacings.

The original design for LTPP assumed that low-cost, reliable WIM would be readily available for data collection. As a result, the expected data collection level was year-round WIM from permanent installations. Low-cost equipment does not yet exist and two other data collection levels were proposed. One was year-round AVC with 1 week of WIM in every season (or quarterly) and the other was year-round AVC with seasonal 48-hour weekday and weekend counts. Less than two-thirds of the LTPP sites have at least a year's worth of data using one of these plans.

Portable equipment requires calibration when put into operation; permanent equipment requires calibration on a periodic basis. Details on calibration are kept at the regional offices. Calibration may result in the adjustment of data.

Annual Estimates

There are two types of annual estimates in the CTDB — one by vehicle class and the other for all vehicles. The estimates are for the LTPP lane only. Both types include vehicle counts and axle weight distributions by axle types. Vehicle counts are solely trucks. Axle types are singles, tandems, tridems, and quads+. The actual numbers of vehicles and axles counted and weighed are included along with the yearly estimate.

Where traffic data include automobile and traffic counts in both directions, annual average daily traffic estimates are provided.

Daily Summaries

Up to three basic count types — volume, classification, and weight — are summed at the daily level. None of the data are adjusted or imputed on a daily basis. Each count type is summed for the LTPP lane and for the LTPP and non-LTPP directions when applicable data are present. Weight data are summarized as axle distributions. Load per vehicle class for each truck type present is calculated. Information is also provided on the equipment and classification schemes used to obtain the data, the location of the equipment relative to the LTPP site, and the total amount of data collected.

Raw Data

The three basic count types for daily summaries are the ones presented as raw data. Volume data records are generally created on a by-lane, by-direction basis for each day. The format used is the 3-card record from the TMG. Since volume counts contain no information about trucks, they are the least-frequently provided. Classification data are also reported by direction by lane, but each record contains only an hour's data. The formats used are the 4-card and the C-card described in the second and third editions of the TMG. Weight records are generated for each truck individually. There are three possible formats for weight records: 7-card, W-card, and HELP. The 7-card is the second edition TMG format. The W-card is the third edition TMG format for metric records. The HELP format is from the Heavy Vehicle Electronic License Plate study. Copies of the record formats are provided with a request for raw traffic data.

Raw data records contain information on the traffic QC process. Two fields at the end of each record provide information on the successful passing of QC or on the type of failure and its severity. Some of the traffic QC parallels the Vehicle Travel Information Systems (VTRIS) checks. Other traffic QC reviews reasonableness of vehicle distributions and gross weights. The coding for QC failures is provided with a raw data request.

Raw data are provided with copies of the transmittal sheets that show equipment type, classification schemes, and any unusual operating conditions, including equipment malfunction or calibration factors.

TRAFFIC DATA REQUESTS

Traffic data from the CTDB are requested using the same form as data from the IMS. The process, including fees, was discussed in chapter 4. Since most annual estimate information is in the IMS, it is unlikely that a user will request it from the CTDB. It is the only category of CTDB information that does not appear on the request form. Users who wish CTDB estimates should write in the type of estimates wanted — either annual and/or by vehicle.

Output formats for CTDB data requests vary by the level of detail requested. The estimates and summaries can be provided as ASCII text on either diskette or hard copy, or in ASCII comma-separated value format for entry into a program. A hard-copy output runs 2 pages for the annual all-vehicle estimate and 11 pages for the by-vehicle estimate. Similarly, the daily

summaries run 11 pages of text per day. In addition, a report format called calendar is available that indicates on which days data were collected by count type.

Raw data are provided as a copy of the ASCII fixed-column text file. The transmittal sheets describing collection conditions are provided as ASCII comma-separated value files.

Like the IMS, the CTDB has a schema and a data dictionary. Copies of the items necessary to interpret the requested data are automatically provided.

APPENDIX A. LTPP SECTION COUNTS AND LOCATIONS

Listings of the number of GPS and SPS sections by State/Province can be obtained from the IMS on request. Sections from GPS-1 and -2 that have moved into GPS-6B are only counted once as GPS-6B sections. This is also applicable for sections in GPS-3, -4, or -5 that have moved into GPS-7B or -9.

Table 10. GPS sections by State/Province.

State/Province	1	2	3	4	5	6A	6B	7A	7B	9	TOTALS
Alabama	2	5	1	2	1	1	3				15
Alaska	2					2	2				6
Arizona	16	2	2		1	4					25
Arkansas		3	1	7	2					2	15
California	4	14	11		1	1	2			3	36
Colorado	5		2			3	1	2		2	15
Connecticut	1			1	1				1		4
Delaware		1		2	2						5
District of Columbia							1				1
Florida	13	4	7				4				28
Georgia	4	6	8		1		1	1		1	22
Hawaii	4										4
Idaho	9		2		1	1					13
Illinois	2			2	7	1		2	3		17
Indiana		2	3	2	1		1		5	1	15
Iowa	1	1	5		2	1			2		12
Kansas	3		3	5		1					12
Kentucky	1		1			1					3
Louisiana		1		1							2
Maine	3		2				1	1			7
Maryland		3			1						4
Massachusetts	3										3
Michigan	5		1	1	1	1		1		2	12
Minnesota	14	1	7	7				1	1	2	33
Mississippi		10	2	1	4		4		1	2	24
Missouri	4			7	1	1	2	1	3		19
Montana	2					2	3				7
Nebraska	1		5	1	1		1	1	1	1	12
Nevada	2	2	3				1				8
New Hampshire	1										1
New Jersey	3	3		1		1					8
New Mexico	4	1	1			4					10
New York	1	2		2			1				6
North Carolina	10	4	5		3		1				23
North Dakota		1	2		1						4
Ohio			1	1	1			1	2	3	9
Oklahoma		7	4		3	1	3	1		1	20
Oregon		1			6	1		3			11
Pennsylvania	3		2	2	2	1	1	2	4	2	19
Rhode Island								1			1
South Carolina	2		1		3		1	1			8
South Dakota	1		7		3		2	1			14
Tennessee	2	4				2	7				15
Texas	32	13	3	5	19	4	4	1		4	85
Utah	3		7			4					14
Vermont	2	2	1								5
Virginia	3	2			4		3				12

Table 10. GPS sections by State/Province (continued).

State/Province	1	2	3	4	5	6A	6B	7A	7B	9	TOTALS
Washington	5		6			4	2				17
West Virginia				2				1			3
Wisconsin			13		2						15
Wyoming	2	7	1			3					13
Puerto Rico		2	2								4
Alberta	2	2					1				5
British Columbia	1	1				2					4
Manitoba	1	1	1				2		1		6
New Brunswick	1	1	1			1					4
Newfoundland	3										3
Nova Scotia						1					1
Ontario	2	3									5
Prince Edward Island	1	2									3
Quebec	3	1	4							1	9
Saskatchewan	2					2	2				6
TOTALS (ALL GPS)	191	115	128	52	75	51	57	22	24	27	742

The counts are for SPS sections, not projects. The number of sections per project varies, but only those required for LTPP studies are included in the count.

Table 11. SPS sections by State/Province.

State/Province	1	2	3	4	5	6	7	8	9	TOTALS
Alabama	16		18		12					46
Alaska										0
Arizona	18	22	22	25	12	28			17	144
Arkansas	13	13	5	12		9				52
California			14	27	23	15				79
Colorado		14	11		14			3		42
Connecticut										0
Delaware	14	14								28
District of Columbia										0
Florida	14		23		16				5	58
Georgia					18					18
Hawaii										0
Idaho			15							15
Illinois			12			15				27
Indiana				3		22			5	30
Iowa	14	14	4	6		10	12			60
Kansas	19	14	12	8					4	57
Kentucky			11	3						14
Louisiana	13						10			23
Maine					11					11
Maryland			8		15				7	30
Massachusetts										0
Michigan	10	14	28			10				62
Minnesota			23		13		11		6	53
Mississippi			5	3	11			3	4	26
Missouri			14	8		15	12			49
Montana			6		13			3		22

Table 11. SPS sections by State/Province (continued).

State/Province	1	2	3	4	5	6	7	8	9	TOTALS
Nebraska	14		9	9					4	36
Nevada	13	14	20	20					3	70
New Hampshire										0
New Jersey					12			5		17
New Mexico	13				10			3	5	31
New York			19					4		23
North Carolina		15								15
North Dakota		19								19
Ohio	14	20		10				5	4	53
Oklahoma	13		17	4	10	9				53
Oregon										0
Pennsylvania			13	8		13				34
Rhode Island										0
South Carolina										0
South Dakota				9		12		4		25
Tennessee			13			11				24
Texas	19		87	20	9			3	4	142
Utah			32	68						100
Vermont										0
Virginia	14		7							21
Washington		14	18					3		35
West Virginia										0
Wisconsin									21	21
Wyoming			13							13
Puerto Rico										0
Alberta					10					10
British Columbia										0
Manitoba			8		10					18
New Brunswick										0
Newfoundland										0
Nova Scotia										0
Ontario			11							11
Prince Edward Island										0
Quebec			6							6
Saskatchewan			15							15
TOTALS (ALL SPS)	231	187	519	243	219	169	45	36	89	1738

APPENDIX B. LTPP TABLE DESCRIPTIONS

Below is a list of tables containing LTPP data with a brief description of their contents and the file extension that is frequently used to identify it. The tables are presented in alphabetical order within modules.

Users interested in SPS or Seasonal Monitoring Program Data should request a copy of the complete schema from either the Data Customer Service Center or by download from http://www.tfhrc.gov/pavement/ltpp/ltpphome.htm through the LTPP Data Base button.

EXTENSION and NAME	DESCRIPTION
	GENERAL TABLES
A00 COMMENTS	Overall section comments.
A01 EXPERIMENT_SECTION	Stores current experiment information that is driven by Maintenance and Rehabilitation activities.
	INVENTORY
I10 INV_ADMIX	Admixture amounts and types (Data Sheets: Inventory 8, 20).
I04 INV_AGE	Age of pavement data (Data Sheet: Inventory 4).
I11 INV_AGGR_COMP	Aggregate composition for coarse, fine, and combined aggregates. (Data Sheets: Inventory 9, 12).
I12 INV_AGGR_DUR	Aggregate durability data (Data Sheets: Inventory 10, 12).
I24 INV_DEICE_SITE_DATA	Snow removal/deice section information (Sheet 23).
I25 INV_DEICE_TYPES	Deicer types used on a particular section (Sheet 23).
I01 INV_GENERAL	Geometric, drainage, and general information. (Sheets 1, 2, 3).
I13 INV_GRADATION	Gradation of coarse, fine, and combined aggregates (Data Sheets: Inventory 9, 13, 19).
I00 INV_ID	Project and section identification (Data Sheet: Inventory 1).
I03 INV_LAYER	Layer descriptions (Data Sheet: Inventory 3).
I05 INV_MAJOR_IMP	Major improvement data (Data Sheet: Inventory 4).
I16 INV_MODIFIER	Modifier data (Data Sheet: Inventory 14).
I06 INV_PCC_JOINT	Portland cement concrete layers joint data (Data Sheets: Inventory 5, 6).
I08 INV_PCC_MIXTURE	Portland cement concrete layers mixing data (Data Sheets: Inventory 8-10).
I07 INV_PCC_STEEL	Portland cement concrete layers reinforcing steel (Data Sheet: Inventory 7).
I09 INV_PCC_STRENGTH	Portland cement concrete layers strength data (Data Sheet: Inventory 11).
I14 INV_PMA	Plant-mixed asphalt bound layers aggregate properties (Data Sheets: Inventory 12, 13).
I15 INV_PMA_ASPHALT	Plant-mixed asphalt bound layers asphalt cement properties (Data Sheets: Inventory 14, 15).
I20 INV_PMA_COMPACTION	Plant-mixed asphalt bound layers construction compaction data (Data Sheet: Inventory 18).
I18 INV_PMA_CONSTRUCTION	Plant-mixed asphalt bound layers construction data (Data Sheet: Inventory 18).
I17 INV_PMA_ORIG_MIX	Plant-mixed asphalt bound layers original mixture properties (Data Sheets: Inventory 16, 17).
I19 INV_PMA_ROLLER	Plant-mixed asphalt bound layers roller information. (Sheet 18).
I02 INV_SHOULDER	Inside and outside shoulder information (Data Sheet: Inventory 2).

		INVENTORY (cont.)
I22	INV_STABIL	Stabilizing agent data (Data Sheet: Inventory 20).
I23	INV_SUBGRADE	Subgrade data (Data Sheets: Inventory 21, 22).
I21	INV_UNBOUND	Unbound or stabilized base or subbase material (Data Sheets: Inventory 19, 20).
		CLIMATIC
E01	ENV_ANNUAL	Yearly climatic freeze index/freeze-thaw and yearly coverage data for a particular weather station.
E02	ENV_MONTHLY_DERIVED	Monthly climatic data for a particular weather station.
E03	ENV_MONTHLY_PARAMETER	Monthly climatic data for a particular weather station and parameter.
E05	ENV_WEATHER_GPS_LINK	Establishes the link between a GPS site and each of its weather stations.
E04	ENV_WEATHER_STATIONS	Weather station-specific data. (Name, location, year started, etc).
		MATERIALS TESTING
T02	TST_AC01	AC core examination and thickness. Contains AC layer thicknesses.
T01	TST_AC01_LAYER	Core exam and thickness information. Contains field layer and real layer number.
T03	TST_AC02	Bulk Specific Gravity test results for asphalt bound layers.
T04	TST_AC03	Maximum specific gravity test results for asphalt bound layers.
T05	TST_AC04	Quantitative extraction test results for asphalt bound layers.
T36	TST_AC05	Moisture Susceptibility of Asphaltic Concrete.
T27	TST_AC07_A**	Asphalt Concrete Layer Resilient modulus test.
T30	TST_AC07_A_SUM**	Summary for TST_AC07_A.
T29	TST_AC07_A_WK**	Worksheet for TST_AC07_A. Resilient modulus.
T28	TST_AC07_B**	Asphalt Concrete Layer Resilient modulus test.
T37	TST_AC_MOIST_DAMAGE	Visual determination of AC moisture-related damage.
T38	TST_AE01	Recovery of asphalt from solution by abson method.
T39	TST_AE01S	Properties of asphalt cements extracted from cores: Abson recovery. (SPS 3 Only).
T40	TST_AE02	Concentration of extracted asphalt cement at 77 and 115 degrees F.
T41	TST_AE02S	Properties of asphalt cements extracted from cores: Penetration of bituminous materials. (SPS 3 Only).
T42	TST_AE03	Specific gravity of extracted asphalt cement.
T43	TST_AE04	Viscosity of asphalt cement at 77 degrees F (25 degrees C).
T44	TST_AE05	Kinematic and absolute viscosity.
T45	TST_AE06S	Properties of asphalt cements extracted from cores: Viscosity of bituminous materials. (SPS 3 Only).
T46	TST_AG01	Specific gravity and aborption of extracted coarse aggregate.
T47	TST_AG02	Specific gravity and aborption of extracted fine aggregate.
T06	TST_AG04	Gradation of combined aggregates determined during lab testing.
T21	TST_AG05	NAA test for fine aggregate particle shape.
T48	TST_ASPHALT_CEMENT	Sampling asphalt cement at the mix plant.
T49	TST_CS01	Properties of joint sealants, Hot-Poured.
T50	TST_CS02	Properties of joint sealants, Silicones.
T51	TST_FRESH_PCC	Sampling fresh Portland cement concrete mixtures.

** Data not available for release.

		MATERIALS TESTING (cont.)
T18	TST_HOLE_LOG	Information about the location and size for holes, pits, and probes.
T20	TST_ISD_MOIST	In situ density and moisture test information taken from test pits.
T33	TST_L05	Table containing laboratory material testing data (project level).
T31	TST_L05A	Table containing layer descriptions for all constructions.
T32	TST_L05B	Table containing layer descriptions for all constructions.
T52	TST_L06	Laboratory sample disposal and storage record for AC.
T53	TST_L07	Laboratory sample disposal and storage record for PCC.
T09	TST_PC01	Compressive strength of in-place concrete test results for PCC layers.
T11	TST_PC02	Splitting tensile strength test results for PCC layers.
T12	TST_PC04	Static modulus of in-place concrete test results for PCC layers.
T54	TST_PC05	Density of Portland cement concrete.
T22	TST_PC06	Core examination and thickness.
T55	TST_PC07	Determination of the shear strength at the interface of bonded layers of concrete.
T56	TST_PC08	Air content of hardened concrete.
T57	TST_PC09	Flexural strength.
T19	TST_SAMPLE_LOG	Information about the samples taken from holes, pits, and probes.
T58	TST_SAMPLE_LOG_SPS_3_4	Log of chip seal, slurry seal, and crack sealant material samples retrieved from SPS-3 and SPS-4 projects.
T59	TST_SC01	Properties of emulsified asphalt: Tests on emulsion.
T60	TST_SC02	Properties of aggregates: Plastic fines in graded aggregates by use of the sand equivalency test.
T61	TST_SC03	Properties of aggregates: Testing crushed stone for single bituminous surface treatments.
T62	TST_SC04	Properties of aggregates: Determination of flakiness index of aggregates.
T63	TST_SC05	Properties of slurry seals: Testing of slurry seal.
T64	TST_SC06	Properties of slurry seals: Measurement of excess asphalt in bituminous mixtures by use of a loaded wheel and sand cohesion.
T65	TST_SC07	Properties of slurry seals: Wet stripping test for cured slurry seal mixes.
T66	TST_SC08	Properties of slurry seals: Determination of slurry system compatibility.
T67	TST_SC09	Properties of slurry seals: Mixing, setting and water resistence test to identify quick-set emulsified asphalts.
T68	TST_SC10A	Properties of chip seals: Aggregate gradation.
T69	TST_SC10B	Properties of slurry seals: Aggregate gradation.
T70	TST_SC11	Properties of chip seals: Chip seal mix design.
T71	TST_SC12	Properties of slurry seals: Determination of asphalt content from slurry seal sample.
T72	TST_SC13	Properties of chip seal aggregates: Polish value.
T07	TST_SS01_UG01_UG02	Gradation of coarse, fine, and combined agg.
T08	TST_SS02_UG03	Hydrometric analysis of combined aggregates determined during lab testing.
T13	TST_SS04_UG08	Type and class of unbound granular base /subbase and subgrade materials.
T34	TST_SS06	Determination of the modulus of subgrade reaction by non-repetitive static plate load test.
T73	TST_SS08	Density of Subgrade Soil.
T74	TST_SS10	Unconfined Compressive Strength of Subgrade Soil.
T75	TST_SS11	Permeability.

		MATERIALS TESTING (cont.)
T14	TST_TB01	Type and class of material and type of treatment results for treated base/subbase and subgrade layers.
T10	TST_TB02	Unconfined compressive strength results for treated base/subbase or subgrade layers.
T15	TST_UG04_SS03	Atterberg limit test results for unbound base/subbase layers or subgrade.
T16	TST_UG05_SS05	Moisture density relationship test results for unbound base/subbase or subgrade.
T23	TST_UG07_SS07_A	Unbound granular base/subbase layer - Subgrade soils
T24	TST_UG07_SS07_B	Unbound granular base/subbase layer - Subgrade soils.
T25	TST_UG07_SS07_WKSHT_CYCLES	Worksheet for TST_UG07_SS07 - Resilient modulus.
T26	TST_UG07_SS07_WKSHT_SUM	Summary information for TST_UG07_SS07 - Resilient modulus.
T76	TST_UG09	Permeability of unbound granular base/subbase layers.
T17	TST_UG10_SS09	Natural moisture content results for unbound base/subbase layers or subgrade.
C01	SPS_GPS_LINK	Linkage of GPS sections to SPS projects.
		MAINTENANCE
N01	MNT_ASPHALT_CRACK_SEAL	Crack sealing data for pavement with AC surfaces (Data Sheet 5).
N02	MNT_ASPHALT_PATCH	Patching data for pavements with AC surfaces (Data Sheet 6).
N03	MNT_ASPHALT_SEAL	Seal coat application data for pavements with AC surfaces (Data Sheets 3,4).
N04	MNT_COST	Cost data (Data Sheet 17).
N05	MNT_GMG	Diamond grinding, milling, or grooving data for pavement surfaces (Data Sheet 12).
N06	MNT_HIST	Historical maintenance information (Data Sheet 1).
N07	MNT_PCC_FULL_DEPTH	Full-depth repair data for PCC surfaces. (Sheets 13,14,15,16).
N08	MNT_PCC_JOINT_RESEAL	Joint resealing data for PCC surfaces (Data Sheets 10, 11).
N09	MNT_PCC_PART_DEPTH	Partial-depth patching data for PCC surfaces. (Sheets 7-9).
		REHABILITATION
R02	RHB_ACO_AGGR_PROP	AC Overlay - Aggregate properties. (Data Sheets: Rehab 3,4).
R04	RHB_ACO_LAB_AGED_AC	AC Overlay - Laboratory-aged asphalt cement properties.
R05	RHB_ACO_LAB_MIX	AC Overlay - Laboratory mixture design. (Sheet 7).
R06	RHB_ACO_MIX_PROP	AC Overlay - Mixture properties as placed. (Data Sheets: Rehab 8,9).
R03	RHB_ACO_PROP	AC Overlay - Asphalt cement properties (Data Sheet: Rehab 5).
R18	RHB_CMRAP_COMBINED_AGG	Cold mix recycled asphalt pavement - Combined aggregate properties. (Sheet 26).
R21	RHB_CMRAP_COMBINE_AC	Cold mix recycled asphalt cement - Combined AC properties (Data Sheet: Rehab 29).
R16	RHB_CMRAP_GEN_INFO	CMRAP - General information and reclaimed aggregate properties. (Sheet 23).
R22	RHB_CMRAP_LAB_AGED_AC	Cold mix recycled asphalt pavement - Laboratory-aged combined AC properties. (Sheet 30).
R23	RHB_CMRAP_LAB_MIX	Cold mix recycled asphalt pavement - Laboratory mixture design. (Sheet 31).
R24	RHB_CMRAP_MIX_PROP	Cold mix recycled asphalt pavement - Mixture properties as placed (Data Sheets: Rehab 32,33).
R20	RHB_CMRAP_NEW_AC_PROP	Cold mix recycled asphalt pavement - New AC properties (Data Sheet: Rehab 28).

		REHABILITATION (cont.)
R19	RHB_CMRAP_RECLAIM_AC	Cold mix recycled asphalt pavement - Reclaimed AC properties (Data Sheet: Rehab 27).
R17	RHB_CMRAP_UNTREAT_AGGR	Cold mix recycled asphalt pavement - Untreated aggregate properties. (Sheets 24,25).
R45	RHB_CRACK_SEAT_PCC	Crack and seat PCC pavement (Data Sheet: Rehab 60).
R25	RHB_HEATER_SCARIF	Heater scarification surface recycled asphalt pavement (Data Sheets: Rehab 35).
R09	RHB_HMRAP_COMBINED_AGG	Hot mix recycled asphalt pavement - Combined aggregate properties. (Sheet 14).
R12	RHB_HMRAP_COMBINE_AC	Hot mix recycled asphalt cement - Combined AC properties (Data Sheet: Rehab 17).
R07	RHB_HMRAP_GEN_INFO	HMRAP - General information and reclaimed aggregate properties. (Sheet 11).
R13	RHB_HMRAP_LAB_AGED_AC	Hot mix recycled asphalt pavement - Laboratory-aged combined AC properties. (Sheet 18).
R14	RHB_HMRAP_LAB_MIX	Hot mix recycled asphalt pavement - Laboratory mixture design. (Sheet 19).
R15	RHB_HMRAP_MIX_PROP	Hot mix recycled asphalt pavement - Mixture properties as placed (Data Sheets: Rehab 20,21).
R11	RHB_HMRAP_NEW_AC_PROP	Hot mix recycled asphalt pavement - New AC properties (Data Sheet: Rehab 16).
R10	RHB_HMRAP_RECLAIM_AC	Hot mix recycled asphalt pavement - Reclaimed AC properties (Data Sheet: Rehab 15).
R08	RHB_HMRAP_UNTREAT_AGGR	Hot mix recycled asphalt pavement - Untreated aggregate properties. (Sheets 12,13).
R00	RHB_IMP	Improvement data (Sheet 1).
R01	RHB_LAYER	Layer descriptions (Data Sheet: Rehab 2).
R44	RHB_LOAD_TRANSFER	Load transfer restoration data (Data Sheets: Rehab 58,59).
R48	RHB_MILL_AND_GRIND	Milling and Grinding data for pavement surfaces (Data Sheet: Rehab 64).
R29	RHB_PCCO_AGGR	PCC Overlay - Aggregate data. (Data Sheets: Rehab 40,41).
R30	RHB_PCCO_CONSTRUCTION	PCC Overlay - Construction data. (Data Sheets: Rehab 41,42).
R26	RHB_PCCO_JOINT_DATA	PCC Overlay - Joint data (Data Sheets: Rehab 36,37).
R28	RHB_PCCO_MIXTURE	PCC Overlay - Mixing data (Data Sheets: Rehab 39).
R27	RHB_PCCO_STEEL	PCC Overlay - Reinforcing steel. (Sheet 38).
R31	RHB_PCCO_STRENGTH	PCC Overlay - Strength data (Data Sheet: Rehab 43).
R40	RHB_PMA_COMPACTION	AC Overlay - Compaction data (Data Sheet: Rehab 10).
R38	RHB_PMA_CONSTRUCTION	AC Overlay - Construction data (Data Sheet: Rehab 10).
R39	RHB_PMA_ROLLER	AC Overlay - Roller data (Data Sheet: Rehab 10).
R41	RHB_PRESSURE_RELIEF	Pressure relief joints in PCC pavements (Data Sheet: Rehab 53).
R49	RHB_RCYPCC_COMBINED_AGGR	Recycled PCC - Combined aggregate data. (Data Sheet: Rehab 49).
R36	RHB_RCYPCC_CONSTRUCTION	Recycled PCC - Construction data. (Data Sheet: Rehab 50,51).
R32	RHB_RCYPCC_JOINT	Recycled PCC - Joint data (Data Sheets: Rehab 44,45).
R34	RHB_RCYPCC_MIXTURE	Recycled PCC - Mixing data (Data Sheets: Rehab 47)
R35	RHB_RCYPCC_NEW_AGG	Recycled PCC - New aggregate data. (Data Sheets: Rehab 48,49).
R33	RHB_RCYPCC_STEEL	Recycled PCC - Reinforcing steel (Data Sheet: REHAB 46).
R37	RHB_RCYPCC_STRENGTH	Recycled PCC - Strength data (Data Sheet: Rehab 52).
R46	RHB_RESTORE_AC_SHOULDER	Restoration of AC shoulders. (Sheet 61).
R47	RHB_RESTORE_PCC_SHOULDER	Restoration of PCC shoulders (Data Sheet: Rehab 62,63).
R43	RHB_SUBDRAINAGE	Subdrainage (retrofit) data (Data Sheet: Rehab 57).
R42	RHB_SUBSEALING_PCC	Subsealing PCC pavement (Data Sheets: Rehab 55,56).

		TRAFFIC
F01	TRF_BASIC_INFO	Traffic data - Basic traffic information from sheet 1.
F02	TRF_EST_ANL_TOT_GPS_LN	Traffic data - Estimate of annual totals in study lane.
F04	TRF_MONITOR_AXLE_DISTRIB	Number of axles in each weight range for each axle group for monitoring data.
F06	TRF_MONITOR_AXLE_SUMMARY	Annual number of axles in each axle group for monitoring data.
F00	TRF_MONITOR_BASIC_INFO	Summary information concerning data collection and site characteristics on a yearly basis.
F05	TRF_MONITOR_VEHICLE_DISTRIB	Annual vehicle type distribution information.
		MONITORING
M25	MON_DEFL_COMMENTS	Comments for Dynatest FWD data.
M02	MON_DEFL_DEV_CONFIG	Dynatest FWD device configuration data.
M03	MON_DEFL_DEV_SENSORS	Information on the location and gain for each deflection sensor.
M04	MON_DEFL_LOC_INFO	Point-specific test condition data for Dynatest FWD.
M01	MON_DEFL_MASTER	Master table for FWD data.
M10	MON_DIS_AC_REV	Revised Distress survey information for pavements with AC surfaces.
M11	MON_DIS_CRCP_REV	Distress identification for reinforced PCC pavement surfaces.
M09	MON_DIS_JPCC_FAULT	Joint faulting for JPCC pavement surfaces.
M08	MON_DIS_JPCC_REV	Distress identification for jointed PCC surfaces.
M15	MON_DIS_PADIAS_AC	Distress survey information for pavements with AC surfaces.
M16	MON_DIS_PADIAS_CRC	Distress identification for reinforced PCC pavement surfaces.
M17	MON_DIS_PADIAS_JC	Distress identification for JPCC surfaces.
M18	MON_DIS_PADIAS_MAP	Distress map for section.
M19	MON_DROP_SEP	Lane-to-shoulder dropoff and separation for AC and JPCC surfaces.
M06	MON_DYNATEST_DROP_DATA	Peak and other drop-specific data values for Dynatest FWD.
M20	MON_FRICTION	Friction-resistance measurements.
M14	MON_RUT_DEV_CONFIG	Configuration information for PASCO device.
M13	MON_PROFILE_DATA	Profilometer elevation data.
M12	MON_PROFILE_MASTER	Profilometer master record.
M26	MON_RUT_X_Y	Transverse profile data from all surveys conducted using PASCO and DIPSTICK.
M24	MON_RUT_DEPTHS	Rutting info for AC surfaces from straightedge measurements.
M23	MON_RUT_MASTER	Rut and cross profile summary data.
M21	MON_TEMPERATURE_DEPTHS	Hole depths data taken from in-pavement measuring devices.
M22	MON_TEMPERATURE_TEMPS	Temperature data taken from in-pavement measuring devices.

GLOSSARY

ASCII - American Standard Code for Information Interchange
CTDB - Central Traffic Database
FHWA - Federal Highway Administration
FWD - Falling-Weight Deflectometer
GPS - General Pavement Studies
IMS - Information Management System
LTPP - Long-Term Pavement Performance Program
QC - quality control
SHA - State Highway Administration
SHRP - Strategic Highway Research Program
SMP - Seasonal Monitoring Program
SPS - Specific Pavement Studies
TMG - Traffic Monitoring Guide

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3. *Data Structure Reference Manual*, Draft prepared by SHRP Contract P-016, SHRP, Washington, DC, April 1992. (Superceded by current versions of Schema, Data Dictionary, and Codes List provided with requests or on demand in electronic format; 4.5 Mb of ASCII text files.)

4. *LTPP IMS Data Quality Checks*, Draft, LTPP, Washington, DC, January 1996. (Revised at least semi-annually and available on request; 400+ pages in WordPerfect® 6.1 for Windows®).

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7. *Traffic Monitoring Guide*, USDOT, FHWA, Washington, DC, 2nd edition, 1992.

8. *Traffic Monitoring Guide*, USDOT, FHWA, Washington, DC, 3rd edition, February 1995.

9. *Researcher's Guide to the Long-Term Pavement Performance Traffic Data*, Draft, June 1996.

INDEX

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LTPP DATA REQUEST FORM

DATE: _____

NAME: _____
TITLE: _____
ORGANIZATION: _____
ADDRESS: _____
_____
_____

PHONE: _____ FAX: _____
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TYPE OF ORGANIZATION:
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RESEARCH CONSULTANT / INTERNATIONAL USER / OTHER _____

— ATTACH ADDITIONAL SHEETS AS NECESSARY TO COMPLETE YOUR REQUEST —
FOR DETAILED INFORMATION, SEE THE DATA USERS REFERENCE MANUAL

SECTIONS: (COMPLETE ALL THAT APPLY.)

1) EXPERIMENT(S)
GPS: 1 2 3 4 5 6A 6B 7A 7B 9
SPS: 1 2 3 4 5 6 7 8 9 9A
SMP: LOOP 1 LOOP 2

2) LTPP REGION(S)/STATE(S)-PROVINCE(S): _____
_____
_____

3) SPECIFIC SECTION(S): _____
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TABLES: (PLEASE IDENTIFY THE TABLES BY NAME. ADD EXTRA SHEETS AS NECESSARY)

4) ENVIRONMENTAL (ENV) _____ OR ALL
5) INVENTORY (INV) _____ OR ALL
6) MAINTENANCE (MNT) _____ OR ALL
7) MATERIALS TESTING (TST) _____ OR ALL

TABLES (CONT):

8) MONITORING (MON) _____

AUTOMATED DISTRESS | FRICTION | CROSS PROFILE
MANUAL DISTRESS | LONGITUDINAL PROFILE | DEFLECTION | OR ALL

9) REHABILITATION (RHB) _____ OR ALL

10) SEASONAL MONITORING PROGRAM (SMP) _____ OR ALL

11) SPS CONSTRUCTION (SPS) _____ OR ALL

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