HIGHWAY FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Highway Attachment 6 – TxDOT's Pavement Management Information System

Laredo, TX

HWY16MH011

(19 pages)

PAVEMENT MANAGEMENT INFORMATION SYSTEM

January 21, 2009

Texas pavements are under heavy demands from increasing loads, higher traffic volumes, and greater expectations from the traveling public, while facing restricted funds. At the same time, the Texas Transportation Commission has established a statewide goal of having 90 percent of pavement lane miles in "good" or better condition by Fiscal Year 2012.

TxDOT's Pavement Management Information System (PMIS) can help address the increasing demands being placed on Texas pavements, and help pavement managers meet the new statewide pavement condition goal.

What is PMIS?

PMIS is "an automated system for storing, retrieving, analyzing and reporting information to help with pavement-related decision-making processes." PMIS supports network-level pavement decisions at the Division, District, Area Office, and Maintenance Section level. The PMIS decision support for pavement managers is based on analyses conducted from pavement condition data collection surveys done at the beginning of each fiscal year.

The PMIS database serves as a statewide memory bank for TxDOT, containing information dating back to fiscal year 1985 (FY 1985, September 1984) for all TxDOT-maintained mileage. PMIS also serves as a safety net for new pavement managers or administrators who can quickly find information and make reliable decisions about pavement sections that they might never have seen.

PMIS helps TxDOT monitor statewide trends in pavement condition, and is a part of the allocation formulas of the annual Unified Transportation Program (UTP). District personnel can also use PMIS to monitor, select, and set priorities for preventive maintenance and rehabilitation programs, and to estimate future pavement needs.

PMIS is the automated portion of TxDOT's statewide pavement management system and supports pavement management at all levels of the organization. Pavement management is not a new idea. TxDOT has been managing pavements since its inception in 1917, making decisions based on engineering judgement and experience. However, with experienced personnel leaving and pavement funding becoming more restricted, it is more difficult, but more important, to get the most effectiveness out of every pavement-related decision. PMIS can help with those decisions.

This brochure provides an overview of the major elements of PMIS:

- Pavement Ratings, Measurements, and Scores
- Data Collection Sections, Raw Data Points, and Management Sections
- Summary and Detail Reports
- Network Analysis Procedures (Needs Estimate, Optimization, and Impact Analysis).

Pavement Ratings, Measurements, and Scores

PMIS has information on visual pavement distress ratings, ride quality and rutting measurements, deflection measurements, and skid resistance (surface friction) measurements. PMIS then combines the ratings and measurements into a series of six Scores to help pavement managers compare the quality of pavement sections.

These ratings, measurements, and Scores are described in more detail below.

Visual Distress Ratings and Distress Score

Specially-trained and certified pavement raters perform a visual distress survey each year from September to December on pavements in each of the three major Texas pavement types:

- Flexible Pavement (also known as Asphalt Concrete Pavement, or ACP)
- Continuously Reinforced Concrete Pavement (CRCP)
- Jointed Concrete Pavement (JCP)

Since FY 2001, all TxDOT-maintained mileage is rated each year for visual distress.

The distress types rated for ACP are: Patching, Failures, Block Cracking, Alligator Cracking, Longitudinal Cracking, Transverse Cracking, Raveling, and Flushing. Flexible pavement rutting (Shallow Rutting and Deep Rutting) is measured by the TxDOT Profiler/Rutbar vehicle (see “Ride Quality Measurements, Ride Score, and Rutting Measurements” on the next page).

The distress types rated for CRCP are: Spalled Cracks, Punchouts, Asphalt Patches, Concrete Patches, and Average Crack Spacing.

The distress types rated for JCP are: Failed Joints and Cracks, Failures, Shattered Slabs, Slabs with Longitudinal Cracks, Concrete Patches, and Apparent Joint Spacing.

The “PMIS Rater’s Manual” has more information on all of these visual distress types. It also describes the PMIS pavement evaluation process.

These distress ratings combine to make the **Distress Score**, which ranges from 1 (most distress) to 100 (least distress), with a score below 80 indicating problems. A low Distress Score may result from multiple distresses (such as Shallow Rutting and Alligator Cracking) or from a single severe distress (such as Deep Rutting). Table 1 describes the Distress Score classes used in PMIS.

Table 1 - Distress Score Classes.

Distress Score	Class	Description
90 – 100	“A”	Very Good
80 – 89	“B”	Good
70 – 79	“C”	Fair
60 – 69	“D”	Poor
1 - 59	“F”	Very Poor

Ride Quality Measurements, Ride Score, and Rutting Measurements

Ride Quality and Rutting data are measured each year (from September to December), and at the same time, by a single vehicle: the TxDOT Profiler/Rutbar. The Profiler/Rutbar device (as shown in Figure 1) uses two lasers, two accelerometers, and a distance signal to measure the inertial profile of each wheelpath. The measurements are passed to an on-board data storage computer which computes Serviceability Index (SI) and International Roughness Index (IRI) summary statistics every 0.1-mile for each wheelpath.

The Profiler/Rutbar vehicle also measures rutting on flexible pavements. To measure rutting, five ultrasonic sensors mounted on an eight-foot wide bar, measure the distance between the bar and pavement surface. These distances are then used to calculate average rut depth and rut percentages for each wheelpath. Sensors are located in each wheelpath, at the center of the vehicle, and eighteen inches outside each wheelpath. Rut depth and percentage measurements are passed to the data storage computer which computes average rut depth and PMIS rutting percentages every 0.1-mile for each wheelpath.

To ensure data consistency, TxDOT calibrates each Profiler/Rutbar vehicle during the summer, and verifies the calibration periodically throughout the data collection season (which is between the month September and January) to ensure quality measurements.

Since FY 2001, all TxDOT-maintained mileage is measured each year for ride quality and rutting (flexible pavements only).

TxDOT operates 16 Profiler/Rutbar vehicles located in various districts to measure Ride Quality and Rutting.

PMIS reports ride quality as **Ride Score**, which ranges from 0.1 (very rough) to 5 (very smooth). A Ride Score below 3.0 suggests a rough road to the average person. Table 2 shows the classes of Ride Score used in PMIS.

Table 2 - Ride Score Classes.

Ride Score	Class	Description
4.0 - 5.0	"A"	Very Smooth
3.0 - 3.9	"B"	Smooth
2.0 - 2.9	"C"	Medium Rough
1.0 - 1.9	"D"	Rough
0.1 - 0.9	"F"	Very Rough

Figure 1 - Profiler/Rutbar Vehicle.

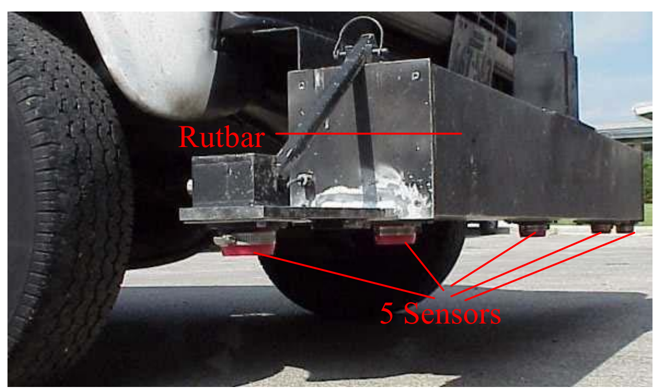


Figure 2 - Profiler/Rutbar Vehicle (detail view).

International Roughness Index (IRI)

As part of its ride quality measurement, the Profiler/Rutbar also measures **International Roughness Index (IRI)** for PMIS. IRI describes the amount of roughness within a given length of pavement (in inches per mile) - higher values mean more roughness. IRI is a standard measure of roughness used by transportation agencies around the world, and it is used in FHWA's Highway Performance Monitoring System (HPMS) to describe the condition of the nation's transportation system to the U.S Congress. IRI is also used as a performance measure in TxDOT's new ride quality ("smoothness") specification. IRI values in PMIS range from 1 (smoothest) to 950 (roughest). Table 3 lists the five classes of IRI used in PMIS.

Table 3 - IRI Classes.

IRI (inches per mile)	Class	Description
1 – 59	"A"	Very Smooth
60 – 119	"B"	Smooth
120 – 170	"C"	Medium Rough
171 – 220	"D"	Rough
221 – 950	"F"	Very Rough

Condition Score

PMIS uses the data from the ride and distress surveys in the calculation of the **Condition Score**. The Condition Score combines Distress Score and Ride Score into a single value that corresponds to the average person's perception of pavement quality. Factors such as climate, traffic, and functional class are not factored into the calculation. Condition Score ranges from 1 (very poor) to 100 (very good), as described in Table 4.

Table 4 - Condition Score Classes.

Condition Score	Class	Description
90 – 100	"A"	Very Good
70 – 89	"B"	Good
50 – 69	"C"	Fair
35 – 49	"D"	Poor
1 - 34	"F"	Very Poor

For the statewide pavement condition goal, "good" or better condition is defined as PMIS Condition Score of 70 or above.

Visual distress, ride quality, and rutting are the fundamental pavement evaluation surveys used in PMIS. These surveys provide basic information for managing pavements. However, PMIS has two other surveys – pavement deflection and skid resistance – which provide additional information for managing pavements.

Deflection Measurements and SSI Score

The deflection survey is optional for PMIS but is needed for project-level pavement design. It helps the pavement manager determine the structural integrity of the pavement. Deflection data can be measured throughout the Fiscal Year and stored in PMIS. The Falling Weight Deflectometer (FWD) measures this data. The FWD uses seven geophones and a load plate. The geophones are spaced at 1-foot intervals, from directly underneath the load plate to six feet away from the load plate. The FWD (as shown in Figure 3) drops a weight on the pavement and measures the resulting deflection at each of the seven geophones.

TxDOT operates 15 FWD's located in various districts for the measurements of deflection data.

A parameter called **SSI Score** (Structural Strength Index) reports deflection data. The SSI score varies form 1 (very weak) to 100 (very strong). An SSI score below 80 shows that the pavement structure is inferior and may require extensive monitoring and frequent maintenance for suitable driving conditions. Table 4 shows the classes of SSI Score.

Table 5 - SSI Score Classes.

SSI Score	Class	Description
90 – 100	"A"	Very Strong
80 – 89	"B"	Strong
70 – 79	"C"	Fair
60 – 69	"D"	Weak
1 - 59	"F"	Very Weak

Figure 3 - Falling Weight Deflectometer (FWD).

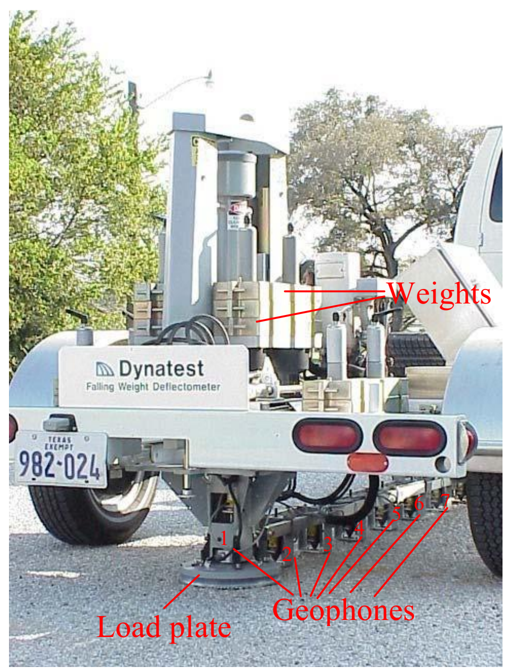


Figure 4 - FWD (detail view).

Skid Resistance Measurements and Skid Score

The other PMIS survey type is skid resistance. Skid resistance is measured and stored in PMIS on approximately 25 percent of the state's highway network per year. This data can be measured throughout the year, but is generally measured between April and August and stored in PMIS. A locked-wheel skid trailer and a tow vehicle (as shown in Figure 5) measures this data. The data is measured at 50 miles per hour and with a smooth tire. The trailer's left wheel locks at periodic intervals while a metered amount of water is sprayed on the pavement surface. Engineers use this data to evaluate the surface friction properties of aggregate types, asphalt mix design, and pavement construction methods

TxDOT operates 7 skid units located in various districts to measure skid resistance.

The score that classifies skid resistance data is the **Skid Score**. Skid Scores range from 1 (very poor) to 99 (very good), however scores above 70 are rare. The Skid Score does not indicate the stopping characteristic of a vehicle, driver, or climate condition, nor does it describe the overall safety of a pavement section.

Figure 5 - Skid Truck.

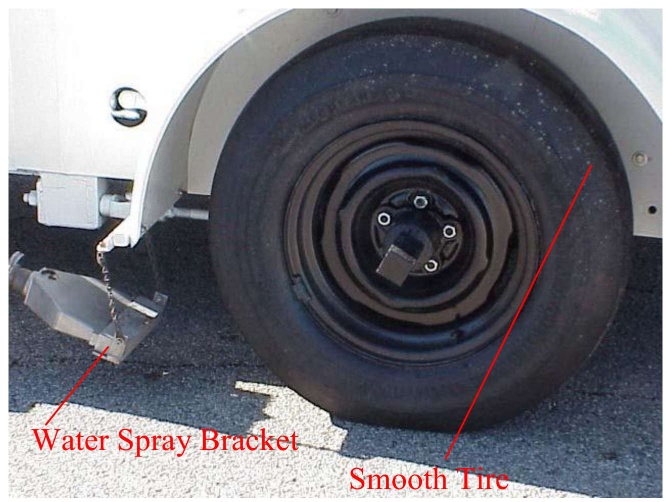


Figure 6 - Skid Truck (detail view).

TxDOT operates two other types of pavement measuring equipment – the Seismic Pavement Analyzer (SPA) and the and Ground-Penetrating Radar (GPR) – which are not used in PMIS but are valuable for non-destructive project-level and forensic evaluation of pavement structural condition.

Seismic Pavement Analyzer (SPA)

The Seismic Pavement Analyzer (SPA) is another trailer-mounted device that measures pavement structural strength. The SPA uses eight sensors: three geophones and five accelerometers to measure the velocity of waves that pass through the pavement. As shown in the figure below, the geophones and the accelerometers are lowered to touch the pavement when testing. By separating out waves of different frequencies, the wave velocity at different pavement depths is determined. Because wave velocity and pavement stiffness are directly related, a stiffness profile can then be constructed. Layers that are cracked, stripped, or have an unusually low stiffness can be found with the SPA.

SPA data analysis is fairly involved, so researchers from the University of Texas at El Paso (UTEP) continue to help TxDOT personnel with data interpretation, in exchange for data and the feedback which helps them to improve the SPA and other seismic devices. The SPA also has an impact-echo feature that can estimate layer thicknesses similar to the way that the Profiler/Rutbar measures the distance between an ultrasonic sensor and the pavement surface. SPA measurements takes about the same amount of time as FWD measurements.

TxDOT owns only one SPA, and its use is determined on a case-by-case basis.

SPA measurements are not stored in PMIS but are used extensively in project-level and forensic studies.

Figure 7- Seismic Pavement Analyzer (SPA).

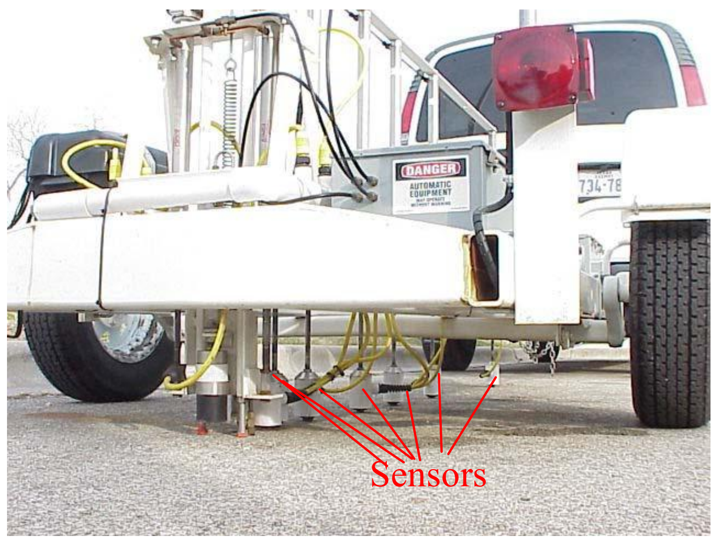


Figure 8- Seismic Pavement Analyzer (detail view).

Ground-Penetrating Radar (GPR)

Ground-Penetrating Radar (GPR) is a non-destructive testing tool for evaluating anomalies beneath the surface of pavements. The GPR System uses an air-launched antenna that is attached to the front of the data collection vehicle. The antenna is mounted between 10 and 14 inches above the pavement surface. The depth of penetration for the 1-gigahertz (GHz) antenna is approximately 18 to 24 inches. It operates by transmitting short pulses of electromagnetic energy into the pavement. These pulses are reflected back to the antenna with an amplitude and arrival time that is related to the electrical properties (dielectric) and thickness of the pavement layers. Attenuation or absorption of the GPR energy is sensitive to material thickness, and changes in the dielectric constant, a property related to a material's density and moisture content. At highway speeds the GPR can take a trace every 5-10 feet.

GPR can be used to develop a continuous sub-surface profile to locate potential problem areas within the pavement layers before any coring is performed (i.e. asphalt layer thickness, moisture related problems, void detection, asphalt stripping, and base course evaluation). It may be used to establish a layer thickness database and identify homogeneous sections. It can also be used as part of a comprehensive investigation along with the FWD and SPA by providing estimated layer thickness and where and how often FWD and SPA measurements should be taken.

The 1GHz air-launched antenna is not a good testing tool for reinforced concrete pavement because the reinforcing steel causes signal attenuation.

TxDOT has three GPR systems. TTI also has an air-launched unit to support TxDOT's data collection efforts. TTI also operates a ground-coupled radar system for special purposes, such as locating rebar within a reinforced concrete slab and "seeing" deeper into the pavement structure.

GPR measurements are not stored in PMIS but are used extensively in project-level and forensic studies.

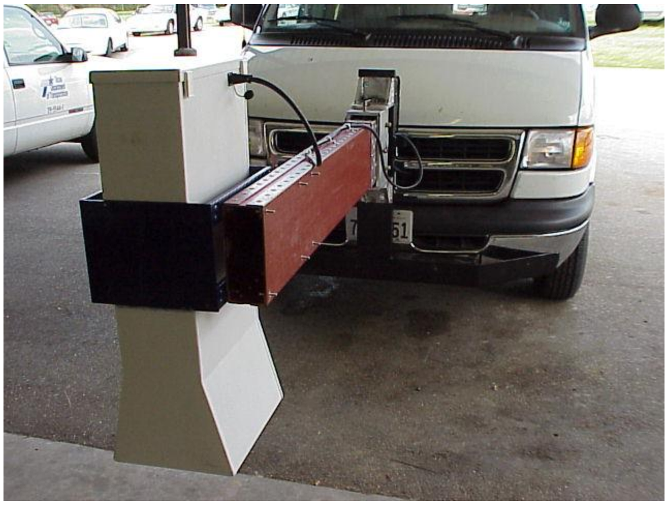


Figure 9 - Ground Penetrating Radar (GPR).

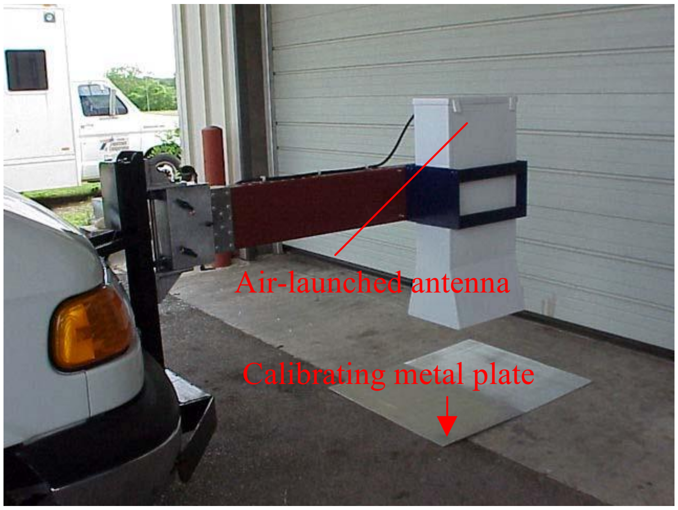


Figure 10 - GPR (detail view, during calibration).

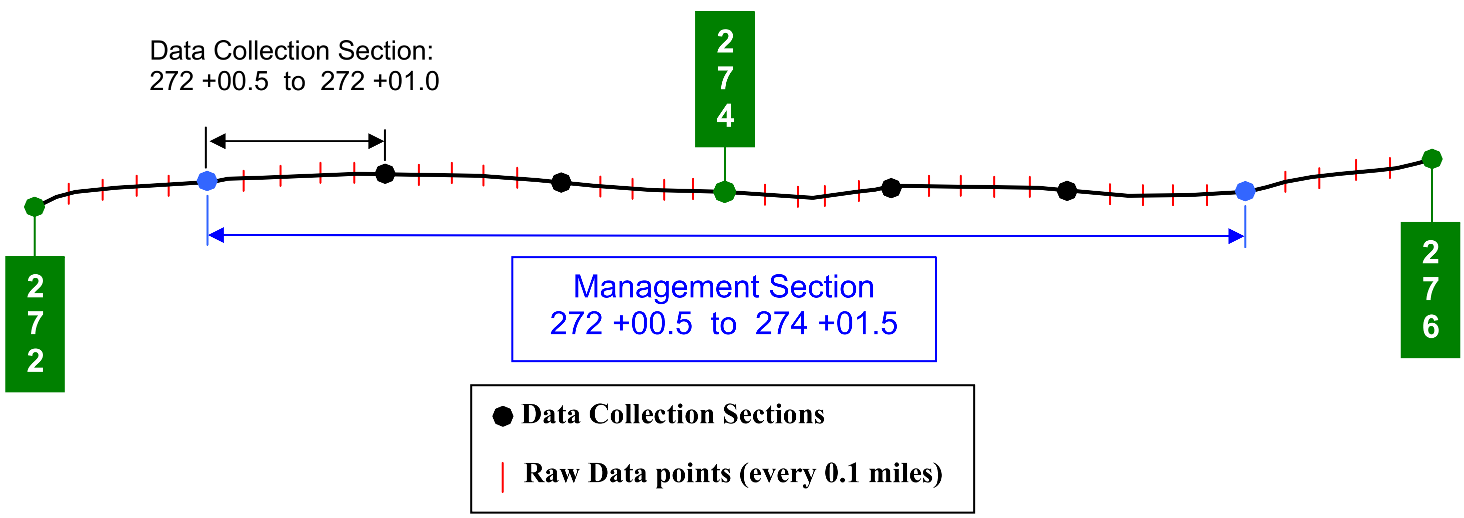
Data Collection Sections, Raw Data Points, and Management Sections

PMIS includes all highways maintained by TxDOT, but in most cases the entire length of the highway is much too long to be used for reporting. Thus PMIS divides each highway into smaller sections and those are used for reports. Pavement evaluation ratings and measurements are then collected at detailed, closely-spaced, intervals and summarized into sections for reporting. PMIS reports use Data Collection Sections, Raw Data points, and Management Sections, depending on the level of detail needed.

Data Collection Sections (DCS) are used most often in PMIS. A DCS is an arbitrarily-defined section of pavement, usually 0.5-mile in length, which PMIS uses to report and analyze data. PMIS inventory data, pavement evaluation data, and Scores, are stored by DCS. DCS do not match existing Control-Section or Control-Section-Job limits, though, and they can change from year to year. In the map below, for example, the pavement section from 272 +00.5 to 272 +01.0 is a Data Collection Section.

Each DCS is made up of one or more **Raw Data points** stored at 0.1-mile or shorter intervals. PMIS has a series of Raw Data reports that list the actual raw data values that have been summarized into each DCS. In map below, the DCS from 272 +00.5 to 272 +01.0 has five Raw Data points which are spaced at a 0.1-mile intervals.

After Raw Data points have been summarized into DCS, they can then be combined into a **Management Section**. A Management Section is a section of pavement, of similar structure, that will be treated in a uniform manner – it is the PMIS equivalent of a candidate project. When working with a Management Section, PMIS combines the DCS within the limits of the Management Section and computes new ratings and Scores for that section. Management Sections are very useful for network analysis (Needs Estimate, Optimization, and Impact Analysis) because they can simulate a list of candidate projects to be treated with limited funds. In the map below, the pavement section from 272 +00.5 to 274 +01.5 is a Management Section (which contains six Data Collection Sections and 30 Raw Data points).



Summary and Detail Reports

PMIS contains many reports to help list, summarize, and analyze data. The reports are organized in five categories, as shown on the PMIS Main Menu:

Category 1. Standard Reports
Category 2. Data Transactions (On-line) Reports
Category 3. Management Sections Reports
Category 4. Network Analysis Reports
Category 5. Administration Reports.

The Administration reports are for routine tasks performed in maintaining and administering PMIS, and are not described in this brochure.

Category 1 – Standard Reports

PMIS contains three types of standard reports. These standard reports list data and provide some basic summaries, with little additional analysis. They are good for getting a first-look at what's in PMIS. These report types are:

- Class 1 Reports — Section Lists and Data
- Class 2 Reports — Administrative Summaries
- Other PMIS Standard Reports.

Class 1 Reports – Section Lists and Data

The "Class 1" reports list PMIS sections and whatever data has been stored for them. The lists of sections can include inventory data along with the PMIS pavement evaluation data. These reports can list pavement evaluation data for each Data Collection Section, or they can also list "raw" data for more-detailed needs.

"Class 1" also includes the frequently-used Ratings and Scores reports, which list all available PMIS data (ratings and scores) for each Data Collection Section, for one year or multiple years. Ratings and Scores reports also allow "critical values" searches on the PMIS database (for example, list all sections with Ride Score less than 3.0).

Class 1 Reports – Section Lists and Data	
Data Collection Reports	
Pavement Sections to be Rated	Lists PMIS beginning and ending limits for each PMIS section, and indicates what type of data (if any) is required
Status of Data Collection Survey	Lists PMIS sections and indicates which types of data (if any) have been stored
Unrated Pavement Sections	Lists PMIS sections where particular types of data have not yet been stored
Summary Status of Data Collection Survey	Summarizes lane miles (total and percentage) which do and do not have data stored, by PMIS data type
Modified Section Length and Pavement Type	Lists PMIS sections where Section Length or Pavement Type have been changed
Raw Data Reports	
Distress Data	Lists distress ratings and calculated Distress Score (if possible)
IRI / Ride Data	Lists 0.1-mile IRI data (by wheelpath), SI values, and summary statistics (high, low, average, and standard deviation)
Deflection Data	Lists deflections for each geophone (normalized to 9000 pounds or not) for each deflection test
Skid Resistance (SN) Data	Lists skid numbers (SN) and calculated Skid Scores for each skid test
Automated Rutting Data	Lists 0.1-mile rut percentages and average depths (by wheelpath)
Ratings and Scores Reports	
Single-Year Ratings and Scores (Ride Version)	Lists distress ratings and scores for all PMIS sections (shows Ride Score instead of IRI)
Single-Year Ratings and Scores (IRI Version)	Lists distress ratings and scores for all PMIS sections (shows IRI instead of Ride Score)
Single-Year Ratings and Scores, by Increasing Condition Score (Ride Version)	Lists worst PMIS sections first, based on Condition Score (shows Ride Score instead of IRI)
Single-Year Ratings and Scores, by Increasing Condition Score (IRI Version)	Lists worst PMIS sections first, based on Condition Score (shows IRI instead of Ride Score)
Critical Values Ratings and Scores (Ride Version)	Lists PMIS sections meeting specific criteria (for example, Ride Score less than 3.0)
Critical Values Ratings and Scores (IRI Version)	Lists PMIS sections meeting specific criteria (for example, IRI greater than 120 inches/mile)
Multi-Year Ratings and Scores (Ride Version)	Lists ratings and scores over time (shows Ride Score instead of IRI)
Multi-Year Ratings and Scores (IRI Version)	Lists ratings and scores over time (shows IRI instead of Ride Score)
Construction and Work History Reports	
Construction and Work History Report	Lists PMIS sections under construction, or with specific dates or types of surfacing

Class 2 Reports – Administrative Summaries

Administrative reports provide summary data to evaluate the highway network condition over time. These reports show what effect past budgets, weather, and maintenance treatments have had on the pavements. These reports also provide executive-level ("network-level") descriptions of pavement condition. Results from the reports are excellent for displaying in tables, charts, graphs, or maps.

There are seven Administrative Summaries reports:

Class 2 Reports — Administrative Summaries	
Average PMIS Scores Reports	Computes averages of PMIS Scores (Distress, Ride, Condition, IRI Left Wheelpath, and IRI Right Wheelpath)
Maintenance Level of Service Reports	Shows percentage of miles (flexible pavement only) in each of the five pre-defined maintenance level of service categories for Rutting, Failures, Alligator Cracking, Ride Quality, and Combined
Score Classes Reports	Shows percentage of miles in each of the five pre-defined class categories (A, B, C, D, and F) for the PMIS Scores (Distress, Ride, Condition, IRI Left Wheelpath, IRI Right Wheelpath, and Skid), as used in the *Condition of Texas Pavements* PMIS Annual Report
PMIS Scores by Control Sections	Calculates PMIS Scores (Distress, Ride, Condition, Skid, and SSI) by Control-Section
PMIS Mileage Summary Reports	Shows the total centerline, roadbed, and lane miles in PMIS
PMIS Overall Scores Reports	Shows 'overall' (as opposed to 'average') Distress, Ride, and Condition Scores
Pavement Distress Rating Classes Reports	Shows percentage of miles in each of five pre-defined class categories (A, B, C, D, and F) for any pavement distress type

Other PMIS Standard Reports

There are four other PMIS standard reports that do not fit easily into the categories already described. These reports primarily support data collection.

Other PMIS Standard Reports	
Create Section List File	Creates a small file of PMIS Data Collection Sections limits that can be downloaded and used in data measurement equipment
Create Automated Rating Form	Creates paper forms with PMIS Data Collection Sections limits already filled-in, which can be used for distress rating in the field Please Note: forms will show any ratings that have already been stored
Visual Data Action Report	Lists sections and distress data stored by a particular person (based on mainframe sign-on key) at a particular time
Deleted Raw Data Action Report	Lists sections where raw data has been deleted

Category 2 – Data Transactions (On-line) Reports

Although this feature is mainly used to store, browse, and delete PMIS data in an interactive, on-line environment, it does have three reports.

Data Transactions (On-line)	
Visual Data – Store, Browse, and Delete	
Visual Data (On-line) Action Report	Lists sections and distress data stored by a particular person at a particular time
Other Raw Data – Browse and Delete	
Deleted Raw Data Action Report (duplicate)	Lists sections where raw data has been deleted
Construction and Work History Data	
Construction and Work History Report (duplicate)	Lists sections under construction, or with specific dates or types of surfacing

Category 3 – Management Sections Reports

PMIS Management Sections let the pavement manager combine PMIS Data Collection Section into "candidate projects." This feature is especially helpful when running the Network Analysis reports to develop proposed lists of sections ("projects") to be treated within existing funds.

There are four Management Section reports:

Management Sections	
Print Management Sections	Shows the beginning and ending limits of each Management Section in PMIS
Check Validity of Management Sections	Lists Management Sections which will fail analysis because of invalid limits (which must be altered before the section can be analyzed)
Alter Management Sections (PMIS Coordinators only)	Lets the district PMIS Coordinator create, modify, or delete Management Sections
Reset District Management Sections (PMIS Coordinators only)	Lets the district PMIS Coordinator undo **all** changes and go back to the PMIS default Management Section limits

Category 4 – Network Analysis Reports

Network Analysis is where PMIS estimates pavement needs and tries to help pavement managers respond to the realities of limited funding. Network Analysis reports can be run using Data Collection Sections or Management Sections.

There are 14 Network Analysis reports, as shown below:

Network Analysis	
Needs Estimate (select up to three of the following reports)	
Executive Summary	Summarizes lane mile and funding needs (PM/LRhb, MRhb/HRhb, and Total) for entire district, by county, and by maintenance section Summaries are based on functional classification, not highway system
Highway System Summary	Summarizes lane mile and funding needs for each treatment type (and total), by PMIS Highway System (IH, US, SH, FM, BR, and PR)
Broad Pavement Type Summary	Summarizes lane mile and funding needs for each treatment type (and total), by Broad Pavement Type (ACP, CRCP, and JCP)
Detail Pavement Type Summary	Summarizes lane mile and funding needs for each treatment type (and total), by Detail Pavement Type (1-10)
List All Sections	Lists all PMIS sections, along with estimated treatment type and cost (if any)
List Sections by Treatment	Lists all PMIS sections that can be analyzed, for any particular type of treatment (for example, PM sections only, or MRhb and HRhb sections)
Projected Pavement Condition	
Projected Pavement Condition Report	Estimates future pavement condition (distress ratings, ride quality, treatment, and cost) for 1-10 years based on current PMIS data and prediction models
Optimization and Impact Analysis (select up to three of the following reports)	
Optimization List Sections Which Can be Treated	Lists all PMIS sections and shows which sections can receive which treatments within a user-specified funding amount (budget)
District Optimization, by Highway System	Summarizes optimization results (lane miles and funding) for a district, by PMIS Highway System
District Impact, by Highway System	Summarizes impacts of limited funding for a district, by PMIS Highway System
Statewide Optimization, by District	Summarizes optimization results (lane miles and funding) for the entire state, by district
Statewide Optimization, by Highway System	Summarizes optimization results (lane miles and funding) for the entire state, by PMIS Highway System
Statewide Impact, by District	Summarizes impacts of limited funding for the entire state, by district
Statewide Impact, by Highway System	Summarizes impacts of limited funding for the entire state, by PMIS Highway System

There are four other Network Analysis reports that do not fit easily into the categories already described. These reports are:

Network Analysis (continued)	
Analysis File Maintenance	
Current Analysis File Status Report	Summarizes the amount of data in the SAS Analysis Work File, and when it was last created
Other Network Analysis Reports	
PMIS Usage Reports – Year to Date	Shows how many people have used PMIS in the current fiscal year, and which reports have been run
Modify Treatment Costs	Lets a PMIS user change the default costs (dollars per lane mile) for one or more of the PMIS treatment types (PM, LRhb, MRhb, and HRhb)
List Sections Which Cannot be Analyzed	Lists sections which cannot be analyzed, and identifies the data problem(s) that need to be corrected

Network Analysis Procedures

Needs Estimate

The Needs Estimate determines the funding needed to repair all pavements in a single year. The estimate is reported in terms of lane miles and funding.

The Needs Estimate classifies pavement needs into the following broad treatment categories:

- Needs Nothing (NN)
- Preventive Maintenance (PM)
- Light Rehabilitation (LRhb)
- Medium Rehabilitation (MRhb)
- Heavy Rehabilitation or Reconstruction (HRhb).

Optimization

PMIS has an Optimization feature that deals with the reality of limited funding. Optimization gives the pavement manager a tool to take available funding and get the most benefit from it. The pavement manager can enter the available budget in one of the following ways:

1. For one year (either current Fiscal Year or a future Fiscal Year).
2. For one year with an inflation factor.
3. For multiple years (one to ten years).

The program also allows the user to change the percent of truck traffic per year.

The program uses Management Sections or Data Collection Sections and evaluates the treatment as determined by the Needs Estimate.

If funding is sufficient, the section receives the Needs Estimate ("needed") treatment. If funding is not sufficient, the program gives the section a Stopgap treatment. A Stopgap treatment is repair maintenance needed to preserve a pavement section until the next Fiscal Year or when sufficient funding becomes available. The number of lane miles that require stopgap treatment is an indicator of over- or under-funding.

The Optimization program then ranks all of the funded sections according to benefit. Multi-year Optimization ages the treated and untreated lane mileage one year. PMIS then applies the next Fiscal Year's budget to the aged sections.

The Needs Estimate can run using Data Collection Sections or Management Sections. Management Sections used in the Optimization program care changeable. The pavement manager can change these Management Sections to match pavement condition, candidate projects, or any other limits.

Even with the ability to alter Management Sections, PMIS cannot consider all factors. Thus, PMIS allows Districts to "force" treatments by:

- Choosing a section whose treatment did not receive a high enough benefit to be selected with the available budget.
- Canceling a section recommended for treatment.
- Changing a treatment.

One example would be a US highway due for widening in three years. The Optimization program proposes a Light Rehabilitation. The District could force the treatment on this road to a Heavy Rehabilitation and even specify when to apply the treatment.

Impact Analysis

Impact Analysis shows the effects of four different factors on current and future pavement condition. These factors are:

1. Budget
2. Management Section Limits
3. Management Section Treatments
4. Truck Traffic.

Impact Analysis determines if the current funding will allow pavement conditions to improve, deteriorate, or remain the same, in terms of:

- Average Distress Score
- Average Ride Score
- Average Condition Score
- Pavement Maintenance Level of Service.

The Following three points are examined in the Impact Analysis:

1. Current Condition (before treatments).
2. After Needs Estimate treatments.
3. After Optimization treatments.

As an example, suppose the Needs Estimate shows that a district needs a budget of $50 million for a pavement rehabilitation, and that the current average condition Score is 87.5. The Impact Analysis might suggest that:

- If the budget was reduced to $30 million, the average Condition Score would be 83.7.
- If the budget was reduced to $40 million, the average Condition Score would be 86.1.
- If the budget remained at $50 million, the average Conditon Score would be 90.3.

Thus a request for increased funding could accompany the Impact Analysis report, with the Impact Analysis report used as justification.

Summary

PMIS is a set of tools to help monitor current pavement condition and plan ahead for future conditions. It can be used to estimate pavement needs, select preventive maintenance and rehabilitation projects, monitor the effectiveness of existing treatments, and improve future pavement designs. PMIS can help pavement managers improve the overall condition of Texas pavements within given funding by using longer-lasting treatments applied at the right place and at the right time.

For More Information About PMIS Or Pavement Management...

The Construction Division, Materials and Pavements Section, is ready to help answer your pavement management questions. If you should have questions about PMIS or pavement management, please call Mr. Bryan E. Stampley, P.E., at (512) [redacted]. For information about PMIS data collection or equipment, please call Mr. Todd Copenhaver at (512) [redacted]. You can also fax questions and suggestions to us at (512)[redacted].