

LONG TERM PAVEMENT PERFORMANCE

LTPP PRODUCT PLAN



U.S. Department of Transportation
Federal Highway Administration

LTPP PRODUCT PLAN

I. BACKGROUND

The Long Term Pavement Performance (LTPP) program received its foundational mission from a 1984 study entitled, “America’s Highways: Accelerating the Search for Innovation,” which was published as Special Report 202 by the Transportation Research Board (TRB). The program’s mission was to “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, subgrades, soils, and maintenance practices.”

The program was further defined through the *Strategic Highway Research Program Research Plans, Final Report*, in May 1998. The plan proposed a 20-year study on in-service pavements across the Nation. It also recognized the need for “major payoffs” from the proposed program in the short term (5 years) and in the intermediate term (10 years). The plan outlined six key objectives:

- Evaluate existing design methods.
- 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 levels on pavement distress and performance.
- Determine the effects of specific design features on pavement performance.
- Establish a national long-term pavement performance database to support the Strategic Highway Research Program (SHRP) objectives and future needs.

LTPP received its first and second funding authorizations in 1989 and 1993, respectively. In 1998, Congress passed the Transportation Equity Act for the 21st Century (TEA-21). This act continues support of the LTPP program for the next 6 years, but with the following stipulation:

“Under the program, the Secretary shall make grants and enter into cooperative agreements and contracts to”
(A) Monitor, material-test, and evaluate highway test sections in existence as of the date of the grant, agreement, or contract; (B) Analyze the data obtained in carrying out subparagraph (A); and (C) Prepare products to fulfill program objectives and meet future pavement technology needs.”

I. INTRODUCTION

As the program enters the midway point, nearly 2,400 sites have been built and included in the program. Under subparagraph A, methodologies for monitoring the pavements, testing materials, sorting environmental and traffic data, and organizing data are now in place. Under subparagraph B, more than 40 research reports have been written or are underway. These reports capture important pavement performance values and present new and improved ways of collecting and managing pavement performance data.

It is specifically in response to subparagraph C that this plan has been developed. In order to receive the fullest value from the experiment, Congress has summarily asked for a Product Development Plan for LTPP. This plan fulfills that obligation—with one caveat—“prepared” products need to be delivered to the appropriate customers in a rational, organized manner.

To accomplish this goal, the Federal Highway Administration (FHWA) asked the Transportation Research Board—Long Term Pavement Performance (TRB-LTPP) Committee, in their role as advisor to LTPP, to evaluate five potential changes to the current program:

- Establishment of an LTPP Product Subcommittee.
- Consideration of National Pavement Needs.
- Expansion of Expert Task Group (ETG) responsibilities to address product development.
- Establishment of a new FHWA Product Development and Delivery Program.
- Development of an LTPP Product Plan.

The TRB-LTPP Committee supported FHWA's recommendation for the Product Subcommittee and asked the subcommittee to assist in the creation of an LTPP Product Plan.

III. KEY DEFINITIONS

By its nature, LTPP produces scientific, rather complex analysis reports. Research knowledge and findings contained in analysis reports are not ready-to-use and are only building blocks for future products. The goal of the product program, however, is to develop and deliver products that meet the following definition:

LTPP Products are ready-to-use guidelines, procedures, protocols, best practices, software, equipment, etc. that are packaged for and delivered primarily to a State department of transportation's (DOT's) management and technical staff.

Many potential product ideas will be recommended for development and delivery. Under the plan, each product should pass a "means test" that will help determine its acceptance into the tracking, resource allocation, and delivery functions of LTPP.

The ***Product Means Test*** includes six key criteria for the product:

- Has a sound technical basis and is supported by formal research results, findings, peer review, and other information and experiences.
- Based substantially on the LTPP results, with reasonable support, validation, or reference to other research, experiences, or practices.
- Provides tools, information, answers, etc. that address a national need and add value to the current technology base.
- Is a complete product that is readily useable by the State DOT highway management and technical staff.
- Can be adopted, at least provisionally, by the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).
- Has been formally evaluated by an independent Technical Working Group (TWG).

LTPP has frequently polled potential customers from the State DOTs, industry, and academia to determine the needs of the customers. National Pavement Needs were identified by chief engineers during site visits.

National Pavement Needs include the following:

- New or Reconstructed Pavements.
- Maintenance and Rehabilitation.
- Pavement Management Systems.
- Traffic Loading and Environmental Effects.
- National Pavement Performance Data Services.

A **Research Report** is the initial documented output produced by or resulting from the LTPP experiment. A research report is directly traceable to the analysis of the collected data. In its basic form, a research report explains the background, data, testing, statistical correlations, conclusions, and recommendations from the analysis. For the purposes of the Product Plan, it is not considered to be an LTPP product as defined above.

Research Findings are significant or key findings as determined by the principal investigator for that particular analysis. The findings might take the form of conclusions, recommendations, models, formulae, or general theories. FHWA has asked the ETGs to take a more formal position by elevating these results to official “Research Findings” and has recommended that these findings become the foundational information for further development and/or delivery of products.

The **Implementation Process** is the umbrella term for all the activities involved in moving a product from concept through delivery.

The **Development Phase** is the portion of the implementation process that organizes and structures LTPP findings, other research results, adds practical user requirements, and produces a product that is ready for evaluation and delivery.

The **Delivery Phase** is the direct marketing and service functions of the implementation process where the user is introduced to the product and asked to evaluate and possibly adopt the product for use.

IV. PRODUCT DEVELOPMENT ORGANIZATIONAL ELEMENTS

The overall purpose of the Product Plan is to structure LTPP as a product-focused research program. To do so, new and revised organizational structures have been initiated. Significantly, these structures include the formation of the Product Subcommittee under the direction of the TRB-LTPP Executive Committee and they increase the ETG’s responsibilities.

Product Subcommittee Roles and Responsibilities

A chief engineer, who also serves on the executive committee, chairs the Product Subcommittee. One representative from each of the ETGs and an industry liaison member serves on the subcommittee. The subcommittee’s roles and responsibilities are to:

- Promote the establishment of a product-focused LTPP research program.
- Promote the development and maintenance of an FHWA LTPP Product Plan, which includes procedures for product identification, development, and delivery.
- Ensure that the products focus on National Pavement Needs.
- Ensure that the ETGs address these needs throughout the research and development process.
- Recommend problem statements for National Cooperative Highway Research Program (NCHRP) product development projects.

- Promote proper linkage and coordination with organizations and committees responsible for moving LTPP products to the end-user.
- Advise and comment on the LTPP product development and delivery process.
- Identify critical issues related to LTPP products and present them to the TRB-LTPP Committee.
- Ensure that product information is shared with the States and industry in a timely and efficient manner.
- Measure the success of the product development process.
- Measure the effectiveness of the products in meeting National Pavement Needs.

ETG Roles and Responsibilities Related to the Product Development Process

Another important element of the product development process is the involvement and responsibilities of the four ETGs—Traffic, Distress, Analysis, and Materials. As LTPP begins analysis and product development in earnest, the ETGs are strategically positioned to support product identification, development, and delivery. The ETGs all bring excellent historical background and technical skills to LTPP.

The following additions to the ETG's roles and responsibilities are to:

- Initiate and accept potential product identification.
- Ensure the proper application of LTPP data in the development of products.
- Assist in the development of research analysis and product development statements that relate to National Pavement Needs, potential products, and eventual users.
- Act as a liaison to NCHRP for analyses and product development projects, ensuring that the panel is cognizant of the background behind the project statement and the long-term plans for the output.
- Recommend final disposition of NCHRP analyses and product development projects as they are used to produce LTPP products, focusing on determining official research findings.
- Provide advice to FHWA on product readiness.
- Provide advice to FHWA on product marketing plans.
- Provide FHWA with technical support services during the delivery phase.

FHWA Product Development and Delivery Process

FHWA's Office of Pavement Technology (HIPT) will coordinate LTPP product development activities and work cooperatively with their Resource Centers, the Office of Asset Management, the LTPP Research Team, the National Highway Institute, the International Programs Office, and others, as appropriate.

HIPT's key roles and responsibilities are to:

- Develop and implement an LTPP Product Development and Delivery Program.
- Provide product delivery expertise throughout the product process, including analysis and development activities.
- Designate FHWA project managers (in-house or contracted) for specific development and delivery activities.
- Organize and manage product-specific Technical Working Groups with the coordination and cooperation of the appropriate Expert Task Group.
- Determine that the products are ready for evaluation, promotion, or adoption.

- Prepare national product delivery packages, which may include the use of non-LTPP studies, sufficient to give the State highway management and technical staff a fuller perspective on the product's value.
- Catalog and track products under development, evaluation, and delivery.
- Establish and maintain a product delivery communication and outreach program.
- Identify and seek financial resources for product delivery activities.
- Coordinate activities with the LTPP Product Subcommittee.
- Provide advocacy for the FHWA product development and delivery program.

V. FURTHER DEFINING THE NATIONAL PAVEMENT NEEDS

TEA-21 uses the phrase “National Pavement Needs.” It is reasonable that LTPP should only address those needs where they can make a substantial and credible contribution. As described in Key Definitions above, LTPP will focus on developing products that meet National Pavement Needs in the five categories below. Each National Pavement Needs area shows the overall goal(s) that is directly related to customer surveys. In addition, the Product Plan is also linked to the various objectives in the LTPP Data Analysis Program Strategic Plan, thereby showing a fully integrated program.

New or Reconstructed Pavements

Goal: Identify improved designs and design features with more accurate service predictions, tendencies, or trends.

- Objective 5: Development of pavement response and performance models applicable to pavement design and performance prediction.
- Objective 7: Quantification of the performance impact of specific design features (presence or absence of positive drainage, differing levels of pre-rehabilitated surface preparation, etc.).

Maintenance and Rehabilitation

Goal: Identify cost-effective methodologies and strategies for the rehabilitation and maintenance of existing pavements.

- Objective 5: Development of pavement response and performance models applicable to pavement design and performance prediction.
- Objective 6: Maintenance and rehabilitation strategy selection and performance prediction.

Pavement Management Systems

Goal: Identify improved measurement and prediction tools.

- Objective 2: Materials characterization.
- Objective 4: Evaluation and use of pavement condition data in pavement management.

Traffic Loading and Environmental Effects

Goal: Identify improved weigh-in-motion (WIM) technology and data interpretation that will more accurately determine specific traffic volumes.

Goal: Determine the environmental effects on pavement performance.

- Objective 1: Traffic characterization and prediction.
- Objective 3: Determination of environmental effects in pavement design and performance prediction.

National Pavement Performance Data Services

Goal: Establish and maintain an accurate, accessible, and high-quality database.

The Product Subcommittee, the ETGs, and HIPT will use these National Pavement Needs groups in several ways. The first way is to place a potential product into one of the categories and definitions to improve structuring of delivery packages. The second is to assign an ETG the responsibility of developing and tracking the individual products. The third is to ensure a reasonable balance in product development resource allocation within the categories. Table 1 (on page 9) shows how current and planned LTPP products address the national pavement needs.

VI. THE DEVELOPMENT AND DELIVERY PROCESSES

LTPP Process Flow (Internal)

It was clear from the onset that LTPP needed a process to ensure that products were identified early; that the implementation process was started at the earliest possible time; and that specific roles, responsibilities, and checkpoints were established at critical junctures. A process should include the following steps:

1. Identify potential products that meet the National Pavement Needs.
2. Assign the potential product to an Expert Task Group for evaluation and assessment of technical feasibility.
3. Prioritize potential products, considering the potential promise, the demand, and the resources available.
4. Assign the potential product to an FHWA project manager for tracking and assessing the potential for delivery.
5. Establish Technical Working Groups to evaluate the product prior to delivery.
6. Develop the products through contract or staff activities.
7. Re-evaluate the product throughout the development process.
8. Develop an initial marketing strategy.
9. Determine product adequacy and readiness for full delivery (three to five States).
10. Supplement the product delivery package with sufficient background information to give the user the tools needed to understand and apply the product.
11. Complete the final marketing plan and initiate delivery.
12. Make necessary adjustments to the product as customers report back on its usefulness and value.
13. “Institutionalize” the product by promoting standards and guidelines that will be managed by AASHTO, ASTM, and others.

LTPP Product Flow (External)

One of the strengths of LTPP is the active involvement of the States and industry, along with FHWA. Since its inception, LTPP has always had a goal of involving as many partners as possible in the program. The following AASHTO organizational elements will constantly be kept involved and abreast of the product development process through periodic status reports, product feedback reports, etc.:

Research Advisory Committee (RAC)—Members of RAC have a key role in identifying products, evaluating and balloting on LTPP research and development statements, and testing and applying the LTPP products within their States.

Standing Committee on Research (SCOR)—This committee consists of chief engineers and research directors that prioritize research for inclusion in NCHRP. They will have a key role in determining both the extent of the financial support given to LTPP and the specific research and development projects that will be undertaken in the next several years. SCOR will be periodically kept abreast of product development activities.

Standing Committee on Highways (SCOH)—This committee ultimately gives programmatic support to LTPP after evaluating recommendations from SCOR.

Subcommittee on Materials (SOM)—This subcommittee sets the standards for AASHTO. They address all LTPP-developed pavement materials and pavement management test procedures and standards developed by LTPP. The Materials Subcommittee plays a key role in ruggedness, precision/bias, and final testing protocols. Members of this committee will be actively included in the Materials ETG and the Product Subcommittee.

Joint Task Force on Pavements—This task force guides AASHTO in many elements of pavement technology, including the *2002 Guide for Design of New and Rehabilitated Pavement Structures*. LTPP will coordinate with the Joint Task Force on Pavements on all product development and product delivery packages to ensure commonality of goals and to improve coordination.

AASHTO Technology Implementation Group—AASHTO has recently formed the Technology Implementation Group (TIG). The role of the TIG is to identify technologies to meet user needs, champion implementation of selected technologies, and create and maintain a delivery system.

FHWA will also involve the key industry groups associated with LTPP -- the American Concrete Pavement Association, the National Asphalt Pavement Association, the Asphalt Institute, and the National Stone Association.

VII. PRODUCT MONITORING

FHWA is developing a system that will consider three key parameters:

- The flow of products from conception through delivery will be closely monitored. Product milestones will be set.
- Product budget estimates will be established that will allow managers to determine what resources are needed by fiscal year and link available funds to the product development and delivery functions.
- During the delivery phase, all products will be measured by the “SEA” system:

See the Product—This index is a relatively direct measure of the number of activities undertaken to expose potential users to the products, i.e., number of conferences, website hits, brochures delivered, presentations to groups, technical calls.

Evaluate the Product—This index tracks the key evaluators of the product to determine its benefits and the feasibility of final application or adoption, i.e., projects designed or constructed, sensitivity studies, comparative analyses of local practices, tests run, provisional standards.

Apply, Adopt, and Accrue the Benefits—This index tracks key States or other entities that have adopted the product for standard use, i.e., measurement of potential value—pavement performance life extension, higher load-carrying capability, reduced testing costs or variability, reduced maintenance.

The LTPP Product Delivery Phase will normally terminate somewhere during the “A” step (Apply, Adopt, and Accrue the Benefits). Criteria used are: (1) Is there adequate momentum for the product to move forward without specialized promotion? and/or (2) Is there adequate information available for the user to make a determination as to the product’s value?

Some implementation programs include deployment as the last element in the technology-transfer cycle. However, deployment takes many years to be quantified, especially in the pavement arena. LTPP will not normally track this element of the cycle.

VIII. COMMUNICATION PLAN

The LTPP Communication Plan outlines various objectives to reach the broad highway community, including:

- Common language and framework.
- Awareness of the value of LTPP and its products.
- Communication between LTPP and its key constituents.

FHWA will link the LTPP product development and delivery process to their overall communication program.

IX. CONCLUSION

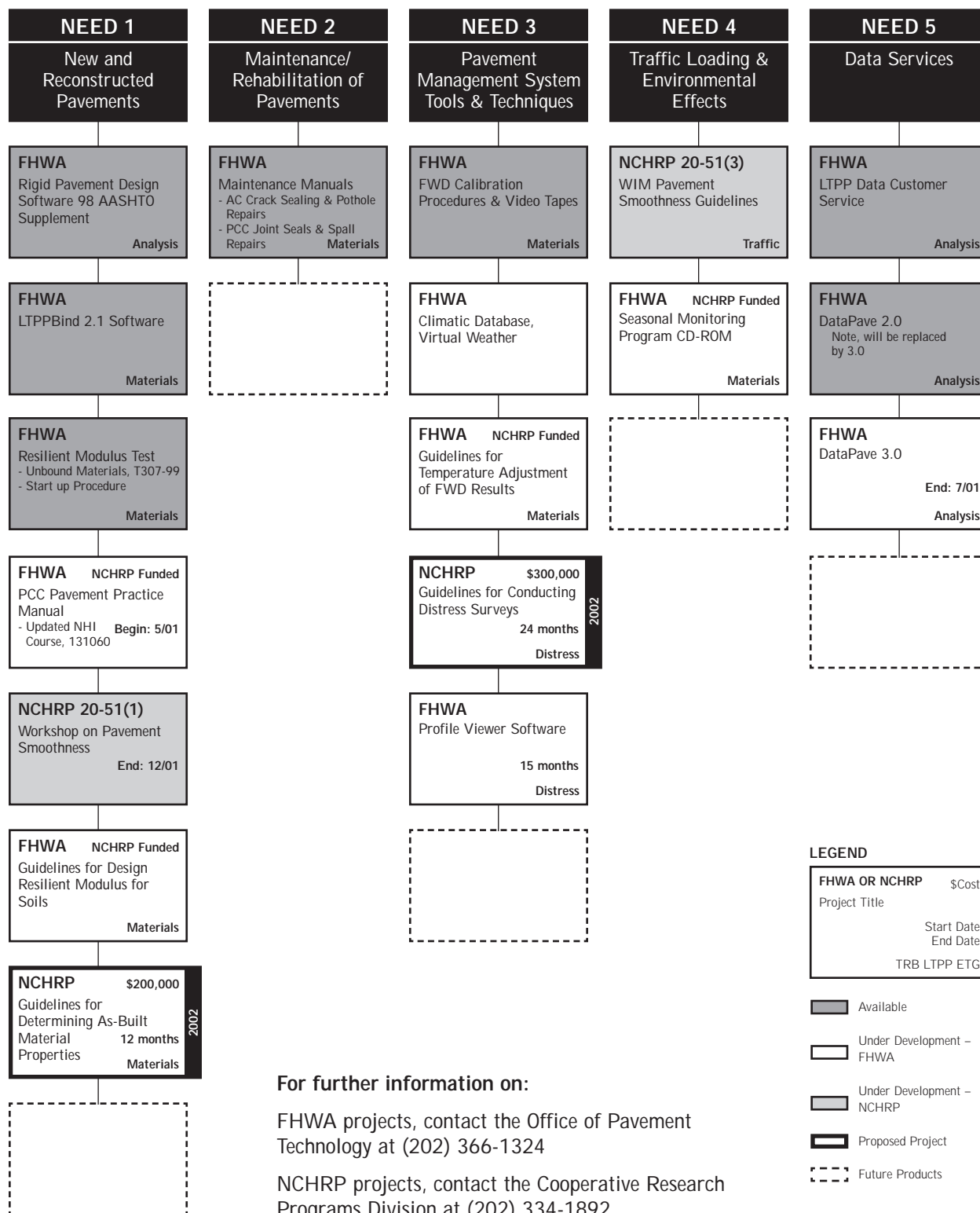
LTPP has seized the opportunity to establish itself as a product-based research program. Over the last 10 years, much has been accomplished—organizing the experiments, locating and building the sections, collecting and analyzing data, and reporting early results to the highway community.

The primary purpose of a research program is experimentation aimed at the discovery and interpretation of facts, the revision of accepted theories in light of these new facts, and the practical application of new or revised theories. Inherent in the conduct of LTPP is the eventual impact it will have on improving pavement performance. Will it indeed shed light on previously unknown facts? Will it lead management and the technical staff to make changes that will lead to improved pavement performance? The answer to the first question is a strong “yes”; the answer to the second question is also “yes”, but only if LTPP makes a concerted effort to develop and deliver products that are true to the experiment, but are also easy to understand and use.

Few practitioners have the time or skills to sift through thousands of pages of research reports or lines of data in a database. LTPP recognizes this fact and will strive to present easy-to-understand and easy-to-apply products. The plan presented in this publication captures a sincere effort to do just that.

TABLE 1: LTPP PRODUCTS

Identification and development of LTPP products is driven by national pavement needs. The LTPP Product table shows how current and future LTPP products address the national pavement needs.





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ERRATA

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Because of an oversight, recipients of the above referenced publication are asked to make the following pen-and-ink changes:

<u>Location</u>	<u>Change</u>
Page 1, second paragraph, date of the <i>Strategic Highway Research Program Research Plans, Final Report</i>	From 1998 to 1986
Page 1, third paragraph, funding authorization dates	From 1989 and 1993 to 1987 and 1992

We apologize for any inconveniences this may have caused you.

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