Table 9-1. Checklist of Factors for Overall Pavement Condition Assessment and Problem Definition

Facet	Factors	Description
Structural Adequacy	Existing Distress	1. Little or no load/fatigue-related distress 2. Moderate load/fatigue-related distress (possible deficiency in load-carrying capacity) 3. Major load/fatigue-related distress (obvious deficiency in current load-carrying capacity) 4. Load-carrying capacity deficiency: Yes or No
	Nondestructive testing (FWD deflection testing)	1. High deflections or weak layers: Yes or No 2. Are backcalculated layer moduli reasonable? 3. Are joint load transfer efficiencies reasonable?
	Nondestructive testing (GPR, PSPA testing and SASW)	1. Determine layer thickness 2. Are voids located beneath PCC pavements?
	Nondestructive testing (profile testing)	Determine joint/crack faulting
	Destructive testing	1. Adequate core strength and condition? 2. Adequate layer thicknesses?
	Previous maintenance performed	Minor | Normal | Major
	Has lack of maintenance (level or timing) contributed to structural deterioration?	Yes_____ No_____ Describe: ____________________ ____
Functional Adequacy	Smoothness: Cause of smoothness deficiency:	Measurement ______________________________ Very Good | Good | Fair | Poor | Very Poor Foundation movement Localized distress or deterioration Other
	Noise	Measurement ______________________________ Satisfactory | Questionable | Unsatisfactory
	Friction resistance	Measurement ______________________________ Satisfactory | Questionable | Unsatisfactory
Subsurface Drainage	Climate (moisture and temperature region)	Moisture throughout the year: • Seasonal moisture or high water table • Very little moisture • Deep frost penetration • Freeze-thaw cycles • No frost problems
	Is there presence of moisture-accelerated distress?	Yes | Possible | No
	Subsurface drainage facilities	Satisfactory | Marginal | Unsatisfactory
	Surface drainage facilities	Satisfactory | Marginal | Unsatisfactory
	Has lack of maintenance contributed to deterioration of drainage facilities?	Yes | No Describe: ______________________________

Continued on next page.

Table 9-1. Checklist of Factors for Overall Pavement Condition Assessment and Problem Definition, *continued*

<table>
<tr><th>Facet</th><th>Factors</th><th colspan="6">Description</th></tr>
<tr><td rowspan="3">Materials Durability</td><td>Presence of durability-related distress (surface layer)</td><td colspan="6">1. Little to no durability-related distress
2. Moderate durability-related distress
3. Major durability-related distress</td></tr>
<tr><td>Base erosion or stripping</td><td colspan="6">1. Little to no base erosion or stripping
2. Moderate base erosion or stripping
3. Major base erosion or stripping</td></tr>
<tr><td>Nondestructive testing (GPR testing)</td><td colspan="6">Determine areas with material deterioration/moisture damage (stripping)</td></tr>
<tr><td rowspan="2">Shoulder Adequacy</td><td>Surface condition</td><td colspan="6">1. Little to no load-associated/joint distress
2. Moderate load-associated/joint distress
3. Major load-associated/joint distress
4. Structural load-carrying capacity deficiency: Yes or No</td></tr>
<tr><td>Localized deteriorated areas</td><td colspan="2">Yes</td><td colspan="2">No</td><td colspan="2">Location:</td></tr>
<tr><td rowspan="4">Condition-Performance Variability</td><td rowspan="2">Does the project section include significant deterioration of the following:
• Bridge approaches
• Intersections
• Lane to lane
• Cuts and fills</td><td colspan="3">Yes</td><td colspan="3">No</td></tr>
<tr><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Is there a systematic variation in pavement condition along the project (localized variation)?</td><td colspan="3">Yes</td><td colspan="3">No</td></tr>
<tr><td>Is there systematic lane-to-lane variation in pavement condition?</td><td colspan="3">Yes</td><td colspan="3">No</td></tr>
</table>

Continued on next page.

Table 9-1. Checklist of Factors for Overall Pavement Condition Assessment and Problem Definition, *continued*

Facet	Factors	Description	
Miscellaneous	PCC joint damage:	Yes	No
	• Is there adequate load transfer (transverse joints)? • Is there adequate load transfer (centerline joint)? • Is there excessive centerline joint width? • Is there adequate load transfer (lane-shoulder)? • Is there joint seal damage? • Is there excessive joint spalling (transverse)? • Is there excessive joint spalling (longitudinal)? • Has there been any blowups?		
Constraints	Are detours available for rehabilitation construction?	Yes	No
	Should construction be accomplished under traffic?	Yes	No
	Can construction be done during off-peak hours?	Yes	No
	Are there bridge clearance problems?	Yes	No
	Are there lateral obstruction problems?	Yes	No
	Are there utility problems/issues?	Yes	No
	Any other constraint problems?	Yes	No

9.2 Data Collection to Define Condition Assessment

This subsection summarizes the steps and activities used to assess the condition of the existing pavement and select a proper rehabilitation strategy, as shown in Figure 9-1. Note that it is not always necessary to complete all the steps for assessing the pavement and individual layers. Table 9-2 lists the input levels associated with setting up and conducting a pavement evaluation plan in support of the MEPDG.

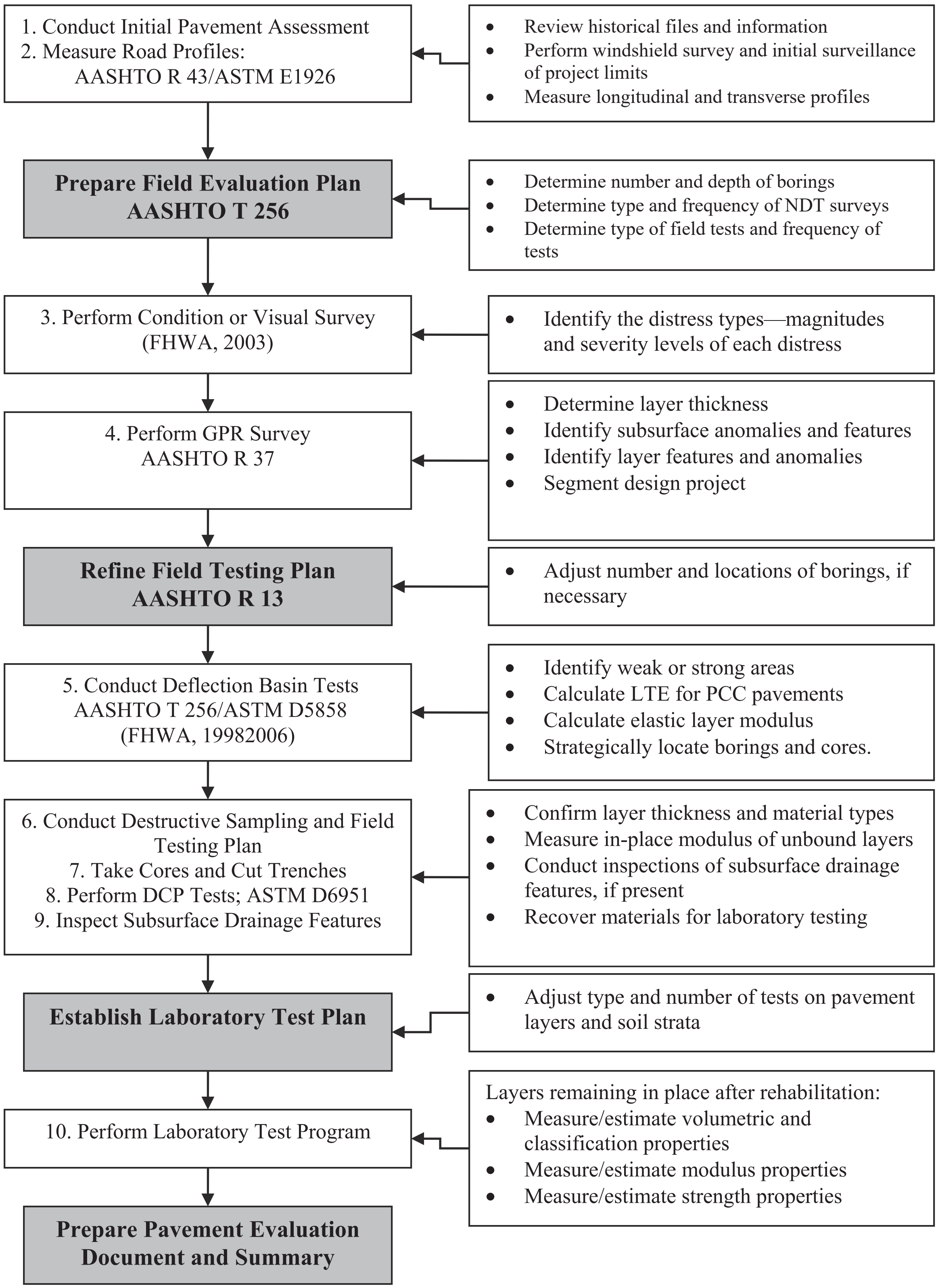

Figure 9-1. Steps and Activities for Assessing Condition of Existing Pavements for Rehabilitation Design (Refer to Table 9-2)

Table 9-2. Hierarchical Input Levels for a Pavement Evaluation Program to Determine Inputs for Existing Pavement Layers for Rehabilitation Design

Assessment Activity	Input Level for Pavement Rehabiliton Design			Purpose of Activity
	1	2	3	
1. **Initial Assessment** Review files and historical information, conduct windshield survey	Yes	Yes	Yes	Estimate the overall structural adequacy and materials durability of existing pavement, then segment project into similar condition of: • Existing layers • Shoulders, if present • Drainage features (surface and subsurface) Then identify potential rehabilitation strategies.
2. **Surface Feature Surveys** Measure profile, noise, and friction of existing surface.	Yes, Only Profile	Yes, Only Profile	No	Determine functional adequacy of surface. Profile, friction, and noise surveys are only used to determine if rehabilitation is needed because the surface will usually be replaced or modified. Profile surveys are used to select a proper rehabilitation strategy—milling depth or diamond grinding, leveling course thickness, or none. Estimate the initial IRI value after AC overlay and CPR appropriateness.
3. **Detailed Condition Survey** Determine type, amount, and severity of existing distresses	Yes	Yes	No	Estimate structural adequacy or remaining life and materials durability of existing pavement layers and select a rehabilitation strategy. • Distortion (faulting of PCC and rutting in AC) • Cracking (non-load related cracks versus fatigue cracks) • Material disintegration distresses (raveling, D-cracking, etc.) Define/segment areas with different distresses.
4. **GPR Survey** Estimate layer thickness, locate subsurface anomalies and features	Yes	No	No	Determine structural adequacy, subsurface features and anomalies, and materials durability of existing pavement layers: • Estimate layer thickness • Identify potential subsurface anomalies • Locate voids beneath pavement surface • Locate AC layers with stripping • SASW

Continued on next page.

Table 9-2. Hierarchical Input Levels for a Pavement Evaluation Program to Determine Inputs for Existing Pavement Layers for Rehabilitation Design, *continued*

Assessment Activity	Input Level for Pavement Rehabiliton Design			Purpose of Activity
	1	2	3	
5. **Deflection Basin Tests** Measure load-response of pavement structure and foundation	Yes	Yes	No	Determine structural adequacy and in-place modulus of existing pavement layers and foundation. • Calculate LTE of cracks and joints in PCC pavements • Calculate layer modulus of all lifts • Locate borings and cores for destructive tests Level 2—Uniform spacing of deflection basin tests in areas with different distresses Level 1—Clustered spacing of deflection basin tests in areas with different distresses along entire project
6. **Destructive Sampling** Cores extracted and soil borings taken to recover materials for visual observation and lab testing	Yes	Yes	Yes	Determine structural adequacy and materials durability. • Visual classification of materials and soils • Confirm layer thickness and material types • Identify/confirm subsurface anomalies (AC stripping, voids, etc.) • Determine depth to rigid layer or bedrock • Determine water table depth • Identify seams with lateral water flow Level 3—Limited borings in areas identified from the initial pavement assessment activity. Levels 1 and 2—Boring and cores drilled in each segment identified from the condition survey, deflection basin tests, SASW, and GPR survey.
7. **Field Inspections** Cores and trenches in distressed areas	Yes	No	No	Structural adequacy and rehabilitation strategy selection: • Determine the rutting in each paving layer from the excavated trenches • Determine where cracking initiated and the direction of crack propagation

Continued on next page.

Table 9-2. Hierarchical Input Levels for a Pavement Evaluation Program to Determine Inputs for Existing Pavement Layers for Rehabilitation Design, *continued*

Assessment Activity	Input Level for Pavement Rehabiliton Design			Purpose of Activity
	1	2	3	
8. **Field Tests** DCP tests of unbound layers	Yes	No	No	Determine structural adequacy—estimate the in-place modulus from DCP tests performed on the unbound layer through the core locations.
9. **Field Inspections** Subsurface drainage features	Yes	No	No	Subsurface drainage adequacy—inspecting drainage features with mini-cameras to check condition of edge drains andure positive drainage.
10. **Laboratory Tests** Unbound materials and soils, AC mixtures, and PCC mixtures	Yes	Yes	No	Layers that will remain in place after rehabilitation: • Classification tests (gradation and Atterberg limits tests) • Unit weight and moisture content tests • Coefficient of thermal expansion—PCC • Strength tests—PCC and AC layers • Modulus tests—PCC layers only Level 3—All inputs based on defaults and visual classification of materials and soils; no laboratory tests are performed on layers that will remain in place. Level 2—Modulus estimated from DCP and deflection basin tests for unbound layers and volumetric properties for bound layers. Level 1—Laboratory tests listed above

9.2.1 *Initial Pavement Assessment*

Regardless of the input level adopted for the pavement evaluation, the condition assessment needs to begin with an assembly of historic data. This information is obtained from a windshield pavement condition field survey of the entire project followed by a detailed survey of selected areas of the project. The following activities should be performed to assist in preparing the field evaluation plan.

- Review historical records for the roadway segment planned for rehabilitation. The information needed includes the original pavement construction month and year (a required input to the AASHTOWare PMED) and any preventive maintenance, pavement preservation, or repair activities that have been applied to the roadway segment. The preventive maintenance, pavement preservation, and repair activities are only needed to assist the designer in establishing the condition of the existing pavement and help explain performance anomalies.

- Review construction files and results from previous borings and laboratory results, if available. The Soil Conservation Service Series maps may also be used to ensure that the different subsurface soils along the project are sampled and tested, if needed. These maps were identified and discussed in Chapter 8 on characterizing the foundation soils for new alignments.
- Review previous distress and profile surveys and pavement management records to establish performance trends and deterioration rates, if available.
- Review previous deflection basin data surveys, if available.
- Perform a cursory pavement condition survey or complete a windshield inspection of the roadway's surface, cross-sectional and drainage features, and other related items. This initial survey consists of photo logs, low-aerial photographs, and automated distress surveys.
- Group together segments of the roadway that have similar layer thickness, surface distresses, subsurface features, and foundation soils.

As part of the initial condition assessment or the more detailed condition survey (see Subsection 9.2.3), longitudinal and transverse profiles may be measured and used to decide on the types of pre-overlay treatments that might be needed.

9.2.2 *Prepare Field Evaluation Plan*

It is recommended that an engineer prepare an evaluation plan that outlines all activities needed for investigating and determining the causes of the pavement defects. The plan should include damage observed during the initial surveillance and how to select and design an appropriate repair strategy for those defects. The field evaluation plan could consist of a detailed pavement condition survey, nondestructive testing, destructive sampling and testing, and traffic control, at a minimum. Table 9-3 may be used as an example in setting up the field evaluation plan. It is always good practice to locate any underground utility locations before conducting coring and subsurface drilling operations within the roadway right-of-way so that they are avoided and not damaged.

9.2.3 *Conduct Condition or Visual Survey*

The result from a detailed pavement condition index survey serves as a key factor in determining the condition or strength of the existing pavement layers. Pavement visual surveys are performed to identify the types, locations, and severities of distress. The survey should be performed on the pavement, shoulders, and any drainage features at intervals along the project site. Automated distress surveys are used for rehabilitation design purposes.

Table 9-3 provides a summary of the visual survey data needed for determining the inputs to the AASHTOWare PMED software, related to the condition of the existing pavement. In accordance with the MEPDG, distress identification for flexible, rigid, and composite pavements is based on the *Distress Identification Manual* for the LTPP program (*11*). The approach in the LTPP manual was used to identify and measure the distresses for all pavement segments that were included in the global calibration process of the AASHTOWare PMED software. Table 9-4 summarizes methods for collecting non-materials performance data from field sections at the three input levels.

Table 9-3. Field Data Collection and Evaluation Plan

Step	Title	Description
1	Historic data collection	This step involves collecting information like the location of the project, year constructed, year and type of major maintenance, pavement design features, materials and soils properties, traffic climate, conditions, and any available performance data.
2	First field survey	This step involves conducting a windshield and detailed distress survey of sampled areas within the project to assess the pavement condition. Data required includes distress information, drainage conditions, subjective smoothness, traffic control options, and safety considerations.
3	First data evaluation and the determination of additional data requirements	This step requires determining critical levels of distress and smoothness and the causes of their loss using information collected during the first field survey. This list will aid in assessing preliminarily existing pavement condition and potential problems. Additional data needs will also be addressed during this step.
4	Second field survey	This step involves conducting detailed measuring and testing, such as coring and sampling, profile (smoothness) measurement, skid resistance measurement, deflection testing, drainage tests, and measuring vertical clearances.
5	Laboratory testing of samples	This step involves conducting tests of materials strength, resilient modulus permeability, moisture content, composition, density, and gradations, using samples obtained from the second field survey.
6	Second data evaluation	This step involves determining existing pavement condition and an overall problem definition. The condition and the overall problem will be defined by assessing the structural, functional, and subsurface drainage adequacy of the existing pavement. Condition assessment and overall problem definition also involve determining material durability, shoulder condition, variability in pavement condition along the project, and potential constraints. Additional data requirements for designing rehabilitation alternatives will also be determined during this step.
7	Final field and office data compilation	This step involves preparing a final evaluation report.

Table 9-4. Guidelines for Obtaining Non-Materials Input Data for Pavement Rehabilitation

Existing Pavement Layer	Design Input	Measurements and Tests Required for Design Inputs
Flexible pavement	Total length of transverse cracks	Levels 1 and 2: Conduct visual survey along the design lane of the project and measure the total length of transverse cracks for all severity levels. Compute the total length of transverse cracks in ft/mi for the predominant severity level.
	Load transfer efficiency (LTE) across transverse cracks	Input Level 1: Conduct FWD testing across the transverse crack to determine the LTE or use crack severity level to determine the default LTE to be used in design.
		Input Level 2: The LTE value is defined by the severity level of the transverse cracks.
	Alligator cracks (bottom-up) plus previous repair of this distress	Levels 1 and 2: Conduct visual survey along the design lane of the project and measure the area of alligator fatigue cracking of all severities, plus any previous repair of this cracking. Compute percent area affected (cracked and repair).
	Rutting of each layer in the existing pavement	Level 1: Measure from transverse trench data across the traffic lane. Levels 2 and 3: Proportion the total surface rutting to each layer of the pavement and the subgrade. Utilize cores from the wheel path and non-wheel path to help estimate layer rutting.
	Pavement Rating	Level 3: Pavement Rating described as Poor, Fair, Good, Very Good, or Excellent from the windshield survey of the initial assessment (no specific definitions are available).
Semi-rigid pavement	Total length of transverse cracks	Levels 1 and 2: Conduct visual survey along the design lane of the project and measure the total length of transverse cracks for all severity levels. Compute the total length of transverse cracks in ft/mi for the predominant severity level.
	Load transfer efficiency (LTE) across transverse cracks	Input Level 1: Conduct FWD testing across the transverse crack to determine the LTE, or use crack severity level to determine the default LTE to be used in design.
		Input Level 2: The LTE value is defined by the severity level of the transverse cracks.
	Alligator cracks (bottom-up), plus previous repair of this distress	Levels 1 and 2: Conduct a visual survey along the design lane of the project and measure the area of alligator fatigue cracking of all severities, plus any previous repair of this cracking. Compute percent area affected (cracked and repair).
	Rutting of each layer in the existing pavement	Level 1: Measure from transverse trench data across the traffic lane. Levels 2 and 3: Proportion the total surface rutting to each layer of the pavement and the subgrade. Utilize cores from the wheel path and non-wheel path to help estimate layer rutting.
	Pavement Rating	Level 3: Pavement Rating described as Poor, Fair, Good, Very Good, or Excellent from the windshield survey of the initial assessment (no specific definitions are available).

Continued on next page.