January 2007

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Pavement Preservation Studies Technical Advisory Guide: Summary

Author: D. Jones

Partnered Pavement Research Program (PPRC) Contract Strategic Plan Element 3.2.9: Development of Guidelines for Effective Maintenance Treatment Evaluation Test Sections

PREPARED FOR:

California Department of Transportation
Division of Research and Innovation
Office of Roadway Research

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Abstract:

This document provides guidelines for the establishment, monitoring and reporting of pavement preservation experiments in California. Information is provided in chapters covering:

- Management and responsibilities
- Project fundamentals
- Experiment work plan
- Site selection
- Experiment construction
- Experiment monitoring
- Forensic investigations
- Laboratory testing
- Data analysis, reports and implementation
- Data management and documentation
- Example experiment work plans, checklists and forms

The document aims to assist with achieving successful completion of experiments and implementation of the findings.

Keywords:

Pavement preservation, experiment evaluation

Proposals for implementation:

Follow protocol in all future pavement preservation and innovative product experiments. Update as required.

Related documents:

Pavement Preservation Studies Technical Advisory Guide (UCPRC-GL-2005-01)

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DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

DOCUMENT REVIEW AND IMPLEMENTATION STATUS

This document has been reviewed within the University of California Pavement Research Center, by the Caltrans Division of Research and Innovation, and by the Caltrans Division of Maintenance, Office of Pavement Preservation and its appointed reviewers.

The document can be used as a guide for the design, construction and assessment of pavement preservation experiments. The document is released as a draft for implementation for a period of 12 months, ending December 2007. Any comments or recommendations to improve the document, based on use during implementation, should be forwarded to the Chief of the Office of Pavement Preservation. A revised document, incorporating comments received, will be released in January 2008.

PROJECT OBJECTIVES

The objective of this project is to improve the quality of data and analyses obtained from Pavement Preservation and Innovative Product Experiments in California, and promote statewide implementation of the findings of successful studies.

This objective will be met after completion of three tasks:

1. Prepare and discuss a draft table of contents for a detailed guideline on undertaking pavement preservation and innovative product experiments.
2. Prepare a detailed guideline.
3. Prepare a summarized “glove-box” version of the detailed guideline.

This document addresses Task No. 3.

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PURPOSE OF THIS GUIDELINE

This guideline has been written to assist Caltrans staff with establishing and monitoring pavement preservation experiments. Experience has shown that, although numerous such experiments have been built in the past, very little useful information that can be used to make informed decisions about implementing the treatment, technology, procedure, or product state-wide results. There are a number of reasons for this including movement and turnover of staff, inappropriate experimental designs, insufficient data collection and/or loss of interest over time (i.e., experiment is never completed). Considerable time and expense are incurred during the establishment of experiments. Failure to complete an experiment invariably means that it will be repeated by someone else, somewhere else at a later date. The same applies to experiments that although completed, are not coordinated at state level.

This summary guideline, which should be read in conjunction with the detailed guideline, provides direction on the following:

- Establishing a study team and assigning responsibilities
- Justification for doing an experiment
- Developing an experiment work plan
- Locating, marking out and establishing the site
- Construction of the experiment
- Monitoring the experiment
- Data analysis
- Reporting and implementation
- Data management

By applying the principles discussed in the guideline, the following can be achieved:

- Statistically valid, scientifically correct and defendable answers obtained within a determined time period
- Results from every experiment established, regardless of the movement of individuals within and out of the organization
- Findings that are applicable state-wide and useable by individuals outside the study
- Justification for expenses incurred
- Justification for statewide implementation
- Justification for changes to specifications and practices
- Accountability of individuals involved
- Prevention of duplication of effort

1. INTRODUCTION

1.1. Background

Pavement preservation represents a proactive approach in maintaining highways. It enables State Departments of Transportation (DoTs) to reduce costly, time-consuming rehabilitation and reconstruction projects and the associated traffic disruptions. With timely preservation the traveling public can be provided with improved safety and mobility, reduced congestion, and smoother, longer lasting pavements.

A Pavement Preservation program consists primarily of three components (Figure 1.1):

- Preventive maintenance
- Minor rehabilitation (non-structural)
- Routine maintenance activities

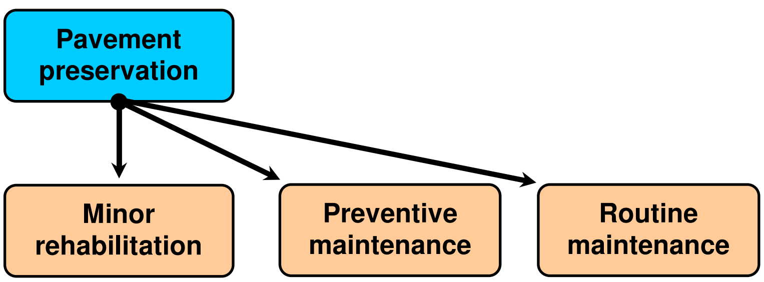
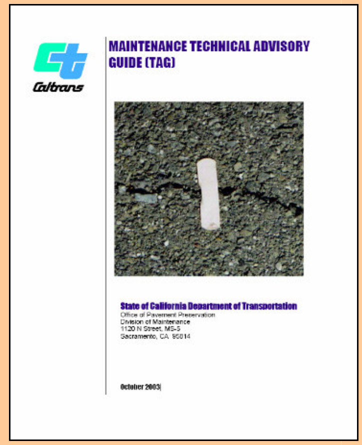


Figure 1.1: Components of pavement preservation

Caltrans invests millions of dollars each year in pavement preservation activities. Documented performance of the pavement preservation practices during these activities is important so that Caltrans can determine which alternatives are most appropriate under particular circumstances. Many factors contribute to this decision. To establish the most appropriate pavement preservation practice or to assess the performance and effectiveness of new materials or equipment, experiments are usually constructed and monitored. Provided that an appropriate experimental design is followed, the experiment is monitored regularly and objectively and the data is suitably interpreted, these experiments can contribute significantly to the understanding of pavement preservation and the state-wide implementation/ adoption of the most appropriate and cost-effective practices.

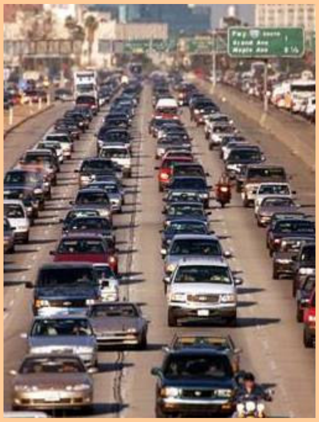


MTAG

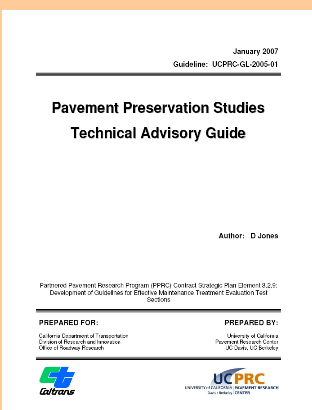
Crack seal

Shoulder fog seal

Diamond grinding



The purpose of this document is to provide Caltrans personnel with guidelines for the consistent design, construction, and monitoring of experimental sections, capturing and storing data, and interpreting and documenting the results.



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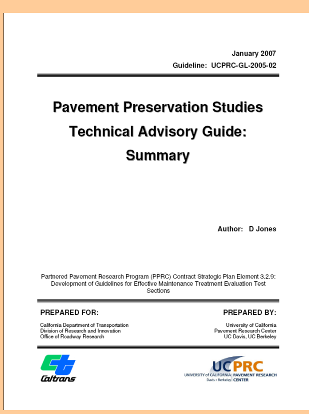

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However, in many instances, the purpose of the experiment is not clearly defined, accepted monitoring standards are not adhered to, data are not effectively captured, and the experiment is not completed with a result on which a decision can be made with regard to state-wide implementation. Alternatively, the originator of the experiment moves and his/her successor may not be aware or may not be willing to sustain the exercise. Consequently, inconclusive results are often obtained and the new procedure or practice is not adopted. Invariably, the experiment is repeated elsewhere by another individual, often with the same inconclusive result.

The purpose of this document is to provide Caltrans personnel with guidelines for the consistent design, construction and monitoring of experimental sections, capturing and storing data and interpreting and documenting the results. This guideline supplements the "Maintenance Technical Advisory Guide (MTAG)" and the "Guide to the Investigation and Remediation of Distress in Flexible Pavements" and uses information from those documents as well as past test section project evaluations located throughout the State of California.

The document is presented in two parts:

- A comprehensive document providing detailed information on establishing and monitoring pavement preservation test sections.
- A summary guide in the form of brief descriptions and checklists on key components of establishing and monitoring pavement preservation test sections (this document).

1.2. Pavement Preservation Definitions

The distinctive characteristics of pavement preservation activities compared to construction, rehabilitation and emergency maintenance are that they restore the function of the existing roadway system and extend its service life, but do not increase capacity or strength (Table 1.1). Different pavement preservation terminology is often used by local and State DoTs. This can cause inconsistency relating to how preservation programs are applied and their effectiveness measured. To overcome these inconsistencies, the Federal Highway Administration (FHWA) has proposed a number of definitions (*FHWA Memorandum on Pavement Preservation Definitions, 09/12/05*).

Table 1.1: Pavement preservation purpose

Category	Activity	Purpose			
		Increase capacity	**Increase strength**	**Reduce aging**	**Restore serviceability**
Construction	New construction	✓	✓	✓	✓
	Reconstruction	✓	✓	✓	✓
Rehabilitation	Major rehabilitation		✓	✓	✓
	Structural overlay		✓	✓	✓
Pavement Preservation	Minor rehabilitation			✓	✓
	Preventive maintenance			✓	✓
	Routine maintenance				✓
Maintenance	Reactive maintenance				✓
	Catastrophic maintenance				✓

1.3. Key Activities

The design, construction, monitoring and reporting of experimental sections can be divided into a number of key activities, all of which are equally important in ensuring that relevant data are captured and interpreted in such away that an informed decision can be taken on the implementation of the findings of an experiment. These activities include:

- Delegating responsibility
- Preparing an experimental design
- Selecting and establishing a suitable site
- Construction
- Monitoring
- Forensic studies
- Laboratory testing
- Data management
- Reporting and implementation

A flow chart of the process is provided in Figure 1.2. Each activity is discussed in the following chapters.

1.4. Typical Pavement Preservation Activities

Various pavement preservation activities are performed on highways. Certain activities are preventive in that they are performed before any significant distress has occurred. Others are remedial and are carried out to repair distresses in the pavement.

Reconstruction

Rehabilitation

Preventive maintenance

Routine maintenance

Reactive maintenance

Catastrophic maintenance

Dowel bar retrofit

Chip sealing

Microsurfacings

Slurry sealing

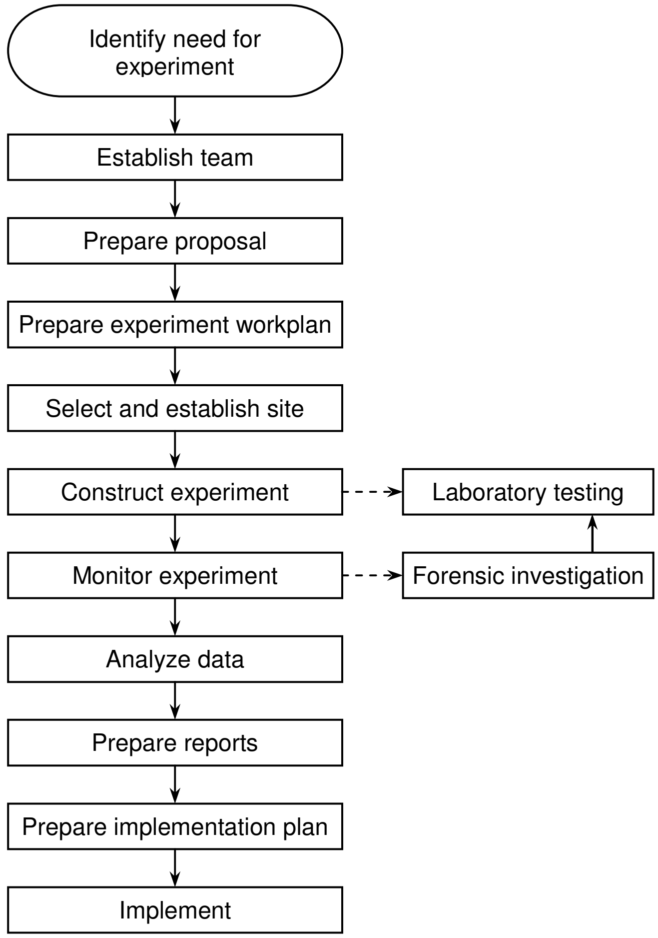


Figure 1.2: Flowchart of key activities

Many routine activities are unlikely to be assessed in research experiments and will not be covered in any detail in this document. Typical activities that may well be researched are listed in Table 1.2. The list is not exhaustive and only provides an example of activities commonly investigated in pavement preservation experiments. The list does include issues such as drainage, pavement markings, barriers, water crossings and vegetation control, although investigations can be undertaken on these with a view to improving techniques or assessing new products. Throughout this document, where appropriate, activities will be referred to as ‘total’ and ‘selective’ treatments as detailed in the table.

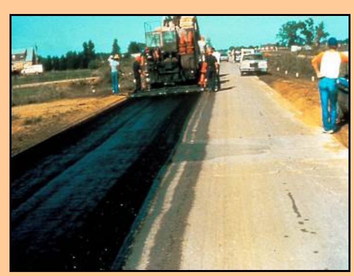
Table 1.2: Typical pavement preservation activities

Activity*	Area treated	Preventive	Remedial
Thin overlays	Total	✓	✓
Ultra-thin overlays		✓	✓
Bonded wearing course		✓	✓
Microsurfacings		✓	✓
Chip seals		✓	✓
Slurry seals		✓	✓
Fog seals		✓	-
Crack seal	Selective	-	✓
Crack fill		-	✓
Joint seal		-	✓
Patching		-	✓
Partial-depth concrete repair		-	✓
Full-depth concrete repair		-	✓
Edge repair		-	✓
Diamond grinding		-	✓
Dowel bar retrofit		✓	-
* Activities may include the use of mechanical improvements such as geotextiles or geogrids			

1.5. Quality Management

The Caltrans Project Delivery Quality Management Plan (QM) was established to implement and document a fully integrated project delivery "Quality System" for all transportation projects regardless of funding source, sponsorship, or who performs the work. This plan focuses on the delivery of Quality Transportation Projects, emphasizing accountability and utilizing continuous improvements, to assist the Department in achieving its mission to "Improve mobility across California". In terms of pavement preservation experiments, quality management will aim to ensure consistently designed and tested experiments that provide good quality data that can be used with confidence to develop and implement procedures to improve delivery of infrastructure in California.

1.6. Using this Summary Guideline

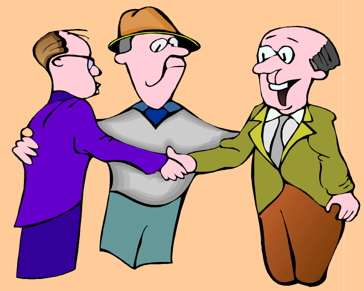


As the name implies, this document is a summary of a significantly more comprehensive guide on the design, construction, monitoring, and analysis of pavement preservation experiments. This summary guide provides an introduction to each chapter discussed in the more comprehensive guide, and highlights key points. More detail is provided on the site selection, construction and monitoring phases, where it is anticipated that the summary guide will be most used. The evaluator is, however, encouraged to regularly refer to the comprehensive guide for more detailed information and discussion during each phase of an experiment, specifically with regard to quality management.

This summary guide includes the example checklists and forms contained in the comprehensive guide.

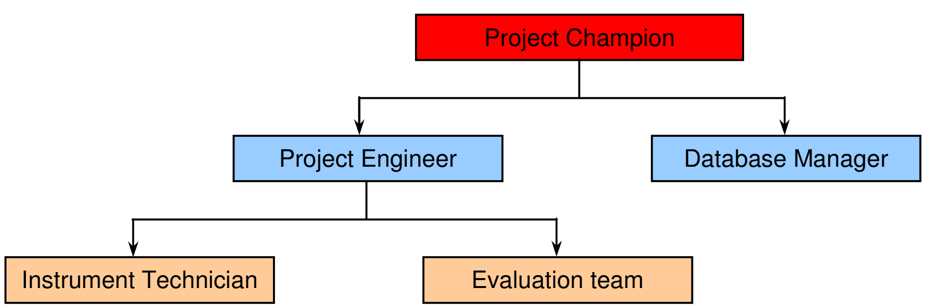
2. MANAGEMENT AND RESPONSIBILITIES

A team of suitably qualified and experienced personnel is required to manage, establish and evaluate pavement preservation experiments in close liaison with other units who have responsibility for the road. This team will be accountable for optimizing the establishment and evaluation of pavement preservation experiments and presentation of the highest quality data possible in a format that is useable by other Divisions within Caltrans. The establishment and evaluation of experiments is expensive. Outcomes may result in state-wide changes to current practice and specifications and implementation might be scrutinized by many individuals within the state, as well as nationally and internationally. Roles and responsibilities thus need to be clearly defined and monitored by means of appropriate job descriptions, key-result areas, and performance evaluation.



Typical **staffing requirements** associated with pavement preservation experiments include the following. Roles and responsibilities for each are explained in the detailed guideline.

- Project Champion
- Project Engineer/Project Manager
- Database Manager
- Instrumentation Technician
- Evaluation Team



Typical staff organization chart for pavement preservation experiments

3. PROJECT FUNDAMENTALS

Project fundamentals revolve around the need to do the experiment and the implications of implementing the findings. Pavement preservation experiments are built for a variety of reasons, primarily to understand the behavior, performance, and potential benefits of doing something new or differently. However, experience has shown that in many instances, the objectives for constructing an experiment are often not fully thought out, insufficient background study is carried out, inappropriate data is collected, monitoring programs and protocols are not adhered to, the results are not written up, and the findings are not implemented. Therefore, it is imperative that the reason for initiating the experiment is fully understood and that a comprehensive experimental design is prepared in order to ensure that the objectives are met and, if successful, the procedure being evaluated can be adopted as standard practice, where appropriate, with confidence.

In the detailed guideline, this chapter explains:

- Study proposals (Checklists 1 and 2, Appendix A)
- Background studies
- Introduction to experimental designs (Checklist 3, Appendix A)

A flow chart depicting the processes covered in this chapter is provided in Figure 3.1.

Study proposals for experiments are considered in two phases by Caltrans — pre-proposal and full proposal. A summary of the process proposed by Caltrans Division of Maintenance, Office of Pavement Preservation is provided in the detailed guide. Further information can be obtained from the Chief of the Office of Pavement Preservation.

Background studies check what work has already been done on the topic and help to decide whether the experiment is required. Information can be sought on similar experiments and the key parameters that need to be assessed. A brief state-of-the-art report should be prepared on completion of the background study summarizing:

- Overview of why the study is being undertaken and the potential benefits to Caltrans

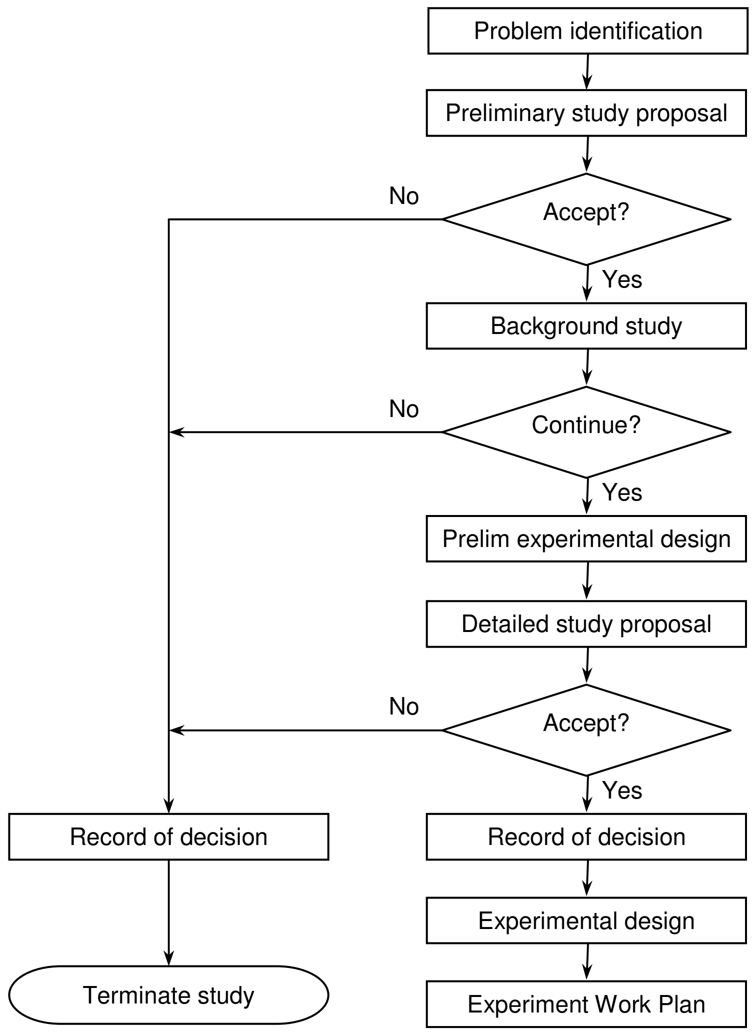


Figure 3.1: Flowchart for project approval

- Findings of the literature review
- Results from the preliminary laboratory study if undertaken
- Applicability of the findings to California
- Justification to continue or discontinue the study
- Proposed experimental design

A **full proposal** should be prepared after completion of the background study. This proposal should include the content from the pre-proposal and background information documents, as well as:

- Potential partners (those who have a vested interest in the results and who could make technical, financial or "in-kind" contributions)

- Project logistics
- Proposed work plan (see Chapter 4) and timetable
- Estimated study budget
- Definition of success, including the performance and cost criteria that will define success compared to current Caltrans practice.
- Details on how the findings would be implemented including expected deliverables, who would lead the implementation process and probable timetable and cost
- Signed commitment by the project team to complete the study

****

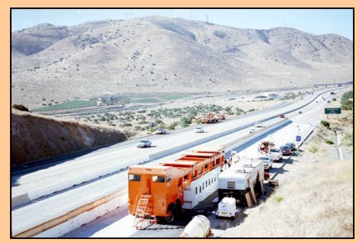
Pavement preservation experiments can take many forms, including but not limited to one or a combination of the following:

- Assessing a new strategy/treatment/technology (i.e., does this technology "work"?)
- Comparing one strategy/treatment/technology with another (i.e., which is the "best" treatment?)
- Refining a strategy/treatment/technology (i.e., what is the "best way" to do this treatment?)
- Understanding a treatment/technology (i.e., "how" does this technology work?)

Replicate studies are important in many types of experiment, especially where variables (construction, material variability, weather) can influence performance of the treatment being assessed. The inclusion of replicates will improve the reliability of the findings. Two types of replicate need to be considered:

- Replications within the same test section, typically used to deal with construction, material, and/or pavement variability within the test section.
- Replications between other regions, materials, pavement types, climates and/or traffic, etc. in the state to identify boundaries to implementation, if these are not already being considered as factors in the experimental design.

Key **evaluation criteria**, on which the success of the treatment will be decided, need to be established for each experiment. These should be linked to the experiment objective. For example, if two modified binders are being compared in a chip seal experiment, the key evaluation criteria will probably be



Heavy Vehicle Simulator experiment - "how does this technology work"

Rut evaluation

raveling/stone loss over time. Evaluation criteria are discussed in more detail in Chapter 7.

Failure criteria - bleeding

In any experiment, it is important to establish and understand what the **failure criteria** for any experiment are and what action needs to be taken when failure occurs. Examples of failure criteria include rut depth, stone loss, and length or area of cracking.

The criteria for deciding when an **experiment is completed** should also be determined in the experimental design. This will be the point at which sufficient data has been collected such that an informed decision can be made on whether to adopt/proceed with implementation or reject the strategy/treatment/technology. It could be time (e.g., level of performance after a period of elapsed time) or performance based (e.g., no improvement over control in terms of performance indicators).

4. EXPERIMENT WORK PLAN

The Experiment Work Plan is a comprehensive document detailing the objectives of the experiment, the experimental design, the control, evaluation procedures and responsible persons. It should be considered a "live" document in that changes during the course of the experiment are often necessitated. An Experiment Work Plan must be prepared for every experiment once the decision to proceed with an experiment is made by the Project Champion and Pavement Preservation Task Group Chair after completion and review of the background study and detailed proposals.

The procedure for preparing an experiment work plan, the work plan content and format and revisions to the work plan are discussed step-by-step in the detailed guide. Checklists 4 to 6 in Appendix A are relevant to procedures in this chapter. A flow chart summarizing the process is provided below (Figure 4.1).

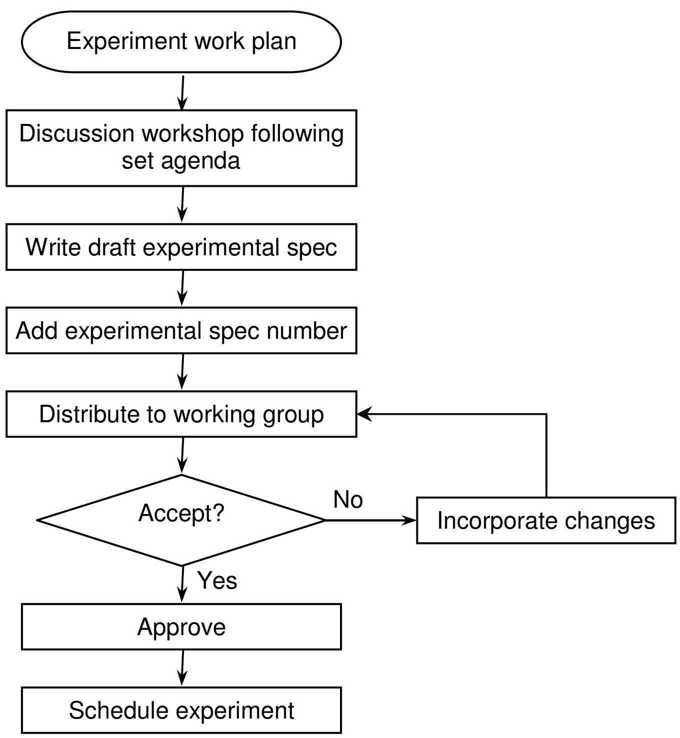


Figure 4.1: Flowchart for development of an experiment work plan

5. SITE SELECTION

Site selection is critical. The site needs to be representative of roads, traffic and environment where the pavement preservation strategy might be used if proved successful in the proposed experiment. If feasible, experiments can be combined to optimize monitoring schedules and comparisons between ongoing performances of the different studies. All experiments should include a control section and replicates. Control sections are typically the standard pavement preservation strategy that would have been used. For example, if a new chip seal design is being assessed, the experiment should include a section constructed using the existing chip seal design so that a direct comparison of performance can be made. Replicates are typically included to assess variability at each site and the influence of, for example, climate and traffic between sites.

In the detailed guide, this chapter discusses the following components of site selection. A flow chart depicting the processes covered is provided in Figure 5.1.

- Site selection procedure (Checklists 7 and 8 in Appendix A)
- Experiment numbering
- Layout and marking (Checklist 9 in Appendix A)
- Instrument installation

The identification and selection of experiment sections will depend on the specific criteria and objectives of the study. The following general issues should, however, be considered when selecting sections:

- Sections should be representative of the issue being investigated and results obtained from these sections should be representative of other roads with similar conditions.
- Where possible experiments should be conveniently located for monitoring and or demonstration purposes.
- Individual sections within the experiment, including the control, should be similar in terms of alignment, structure, traffic, and condition. Side-by-side sections should not be used for direct comparison.
- The establishment of the section should not pose a safety hazard to road users, or be positioned so that the safety of the persons monitoring the section is jeopardized.

Road is curved, sight distance is limited, and structure is inconsistent.

Road is straight, safe, and consistent.

FWD

Consistent cracking

Consistent bleeding/stone loss

Inconsistent rutting and cracking

Inconsistent concrete surface

Environmentally sensitive

- The road on which the section is being located should not be maintained, rehabilitated or resealed within the planned monitoring period, unless assessment of that intervention is part of the monitoring program and prior warning is given to the Project Engineer.
- Sections should be located as close as possible to traffic counting/weigh-in-motion stations, unless a station is incorporated into the section.
- Sections should be selected such that testing to "failure" of certain sections can be completed and then repaired without significant impacts to the road user.

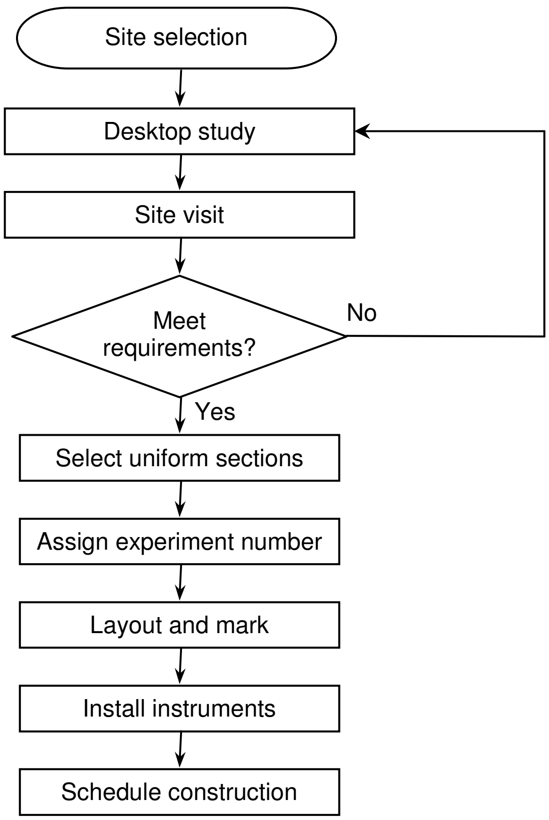


Figure 5.1: Flowchart for site selection

The **site selection procedure** involves three main stages:

- Desktop study
- Site visit
  - Experimental design considerations
  - Safety considerations
  - Environmental considerations
- Site report and approval

Each experiment, and section within the experiment if applicable, should be assigned a **unique experiment number** for management purposes. A number should be obtained from the Chief of the Office of Pavement Preservation. This number will be linked to the proposal and experiment specification registers described in the previous chapter.

Once selected the test sections should be **labeled, marked and instrumented** according to the requirements of the Experiment Work Plan. Suitable signs should be erected at either end of the experiment with experiment details and a contact number or website where Caltrans staff can obtain additional information and notify the Project Engineer of any observations or interventions that may be necessary. The length of the experiment will be detailed in the Experiment Work Plan and will vary depending on the treatment being assessed. Typical sections lengths are:

- Total surface — 200 m (600ft)
- Selective surface — sufficient length to have at least 12 replicates with the same treatment (i.e., 12 cracks, 12 potholes, 12 joints)

PPTS/3/05/1/1

Example experiment section number

Experiment number sign

6. EXPERIMENT CONSTRUCTION

The performance of any road is directly related to the quality of construction. It is therefore imperative that the construction process is closely observed so later performance can be related back to it. Since pavement preservation strategies are being evaluated, it is also very important that the road is comprehensively evaluated before any work is undertaken in order to determine the level of success of the strategy.

When undertaking any assessments, observations or measurements, it should always be kept in mind that the data will ultimately be used in an analysis to determine the effectiveness of the technique and/or product being assessed. Careful consideration should thus be given to the manner in which the assessments are recorded such that quality analysis can be undertaken and valid conclusions drawn.

In the detailed guide, this chapter discusses the following components of experiment construction. A flow chart depicting the processes covered is provided in Figure 6.1.

- Pre-construction assessment (Checklist 10 in Appendix A)
- Construction assessment (Checklist 11 in Appendix A)
- Material sampling
- Instrument installation

Typical issues to consider in the **pre-construction assessment** are listed on Checklist 10 in Appendix A.

Every aspect of the **construction process**, from preparation of the surface through cleaning up excess materials (e.g., brooming after chip seal application) can influence later performance of the treatment. The entire process thus needs to be observed and systematically documented so later performance can be linked to the construction process where applicable. Examples of critical areas requiring observation include, but are not limited to:

- Calibration of the spray and stone application rate on fog seals and chip seals
- Brooming of excess stone after chip seal application
- Repair of distress prior to overlay treatments

Structural assessment prior to action

Poor drainage may influence experiment performance

Microsurfacing application

- Checking binder temperature and compaction techniques
- Cleaning process and effectiveness in crack, joint and pothole repairs
- Reviewing quality control and quality assurance procedures

Chip spreader calibration

Brooming excess chip seal stone

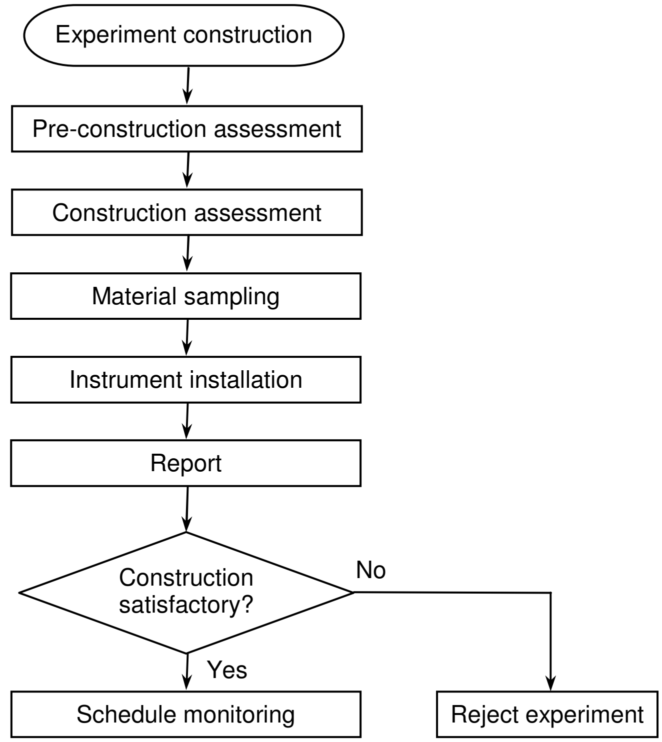


Figure 6.1: Flowchart for experiment construction

If a **proprietary treatment** is being assessed, then the manufacturer or supplier should appoint a technical representative to provide advice on the project. They should also provide a step-by-step procedure together with checklists that need to be followed in order to ensure that the experiment is constructed correctly. The procedure must clearly state situations to avoid and the consequences if they are not.

The Caltrans Project Engineer must supervise and systematically document the entire **construction process** from site preparation through to opening the road to traffic. If applicable, any deviations from procedures for proprietary products should be noted. On completion, the Project Engineer must be fully satisfied that the test section is representative of the Experiment Work Plan and that sufficient data have been collected from the construction process to adequately relate later performance to the road prior to treatment, and to construction.

Typical issues to consider when observing construction include, but are not limited to (see Checklist 11 in Appendix A):

- Systematic documentation of the process and deviations from the procedure provided
- Treatment (e.g., binder, aggregate, sealant) source and characteristics
- Equipment type and condition
- Calibration procedures
- Surface, crack or pothole preparation
- Compaction
- Establishment, application and demobilization time
- Quality control and quality assurance processes followed
- Uniformity
- Wastage
- Problems encountered and how they were dealt with
- Recommendations to improve the process

All observations should be documented on a Construction Assessment Form. The contents of the form will depend on the type of treatment. An example of a form is provided in Appendix B (Form 1). A checklist, relevant to the pavement preservation treatment, should be completed to ensure that all aspects of the construction process have been documented and recorded.

A **quantitative measure** is always more useful than a subjective observation when analyzing data collected from an experiment. Where feasible, any component of the process being assessed that can be measured should be measured with appropriate calibrated equipment and the data recorded. Typical parameters that can be measured during construction include, but are not limited to:

- Haul distances and times
- Time taken for each component including opening and closing times
- Characteristics of the surface before and after treatment:
- Air and surface temperatures and other site weather conditions
- For overlays:
    - Asphalt concrete temperature
    - Thickness
    - Quantity applied per unit surface area
    - Compaction procedures

Poor quality construction


Thickness control


Contamination


Segregation


Drainage impairment


Measurement of early rutting

Aggregate samples

Density after compaction

Slab sample

Core sample

- For seals:
  - Binder temperature
  - Spray rate
  - Aggregate size, shape and quantity applied per unit area
- For patches:
  - Thickness
  - Quantity applied per unit surface area
- For cracks
  - Sealant temperature
  - Sealant applied per linear meter
- Density after compaction

Copies of the Resident Engineer's and Inspector's notebooks should be obtained where possible.

Representative samples of all the materials used in the pavement preservation treatment should be collected at appropriate times throughout the construction procedure. Quantities and replicates will depend on the tests detailed in the Experiment Work Plan. A sample log should be kept and records of all samples should be noted on the Construction Assessment Form. All samples should be appropriately labeled. Two types of sample may be collected, namely for:

- Laboratory testing
- Reference purposes

A **construction report** should be prepared summarizing the construction process and detailing any specific issues that may influence performance and how these should be assessed during later monitoring evaluations. Deviations from the Experiment Work Plan should be listed. The report should also clearly state whether procedures were such that a satisfactory experiment has been constructed and that monitoring should continue. The as-built records should be included in the report and will serve as a basis for later monitoring. Report approval signifies that monitoring of the experiment can continue.

7. EXPERIMENT MONITORING

Experiment monitoring is the phase during which most of the data that will be used in the analysis is collected. Experience has shown that it is also the phase when studies lose momentum and are even abandoned as new interests are followed and/or staff move on to other activities, positions or employment. It is thus important to maintain interest in experiments and ensure that the monitoring program is adhered to. Movement of staff should not affect successful completion of a study.

Visual assessment of rutting

In the detailed guide, this chapter discusses (Figure 7.1):

- Background information on experiment monitoring
- Operational issues (Checklist 12 in Appendix A)
- Monitoring timetables
- Protocols and criteria
- Visual assessment procedures (Checklist 13 in Appendix A)
- Measurements and sampling

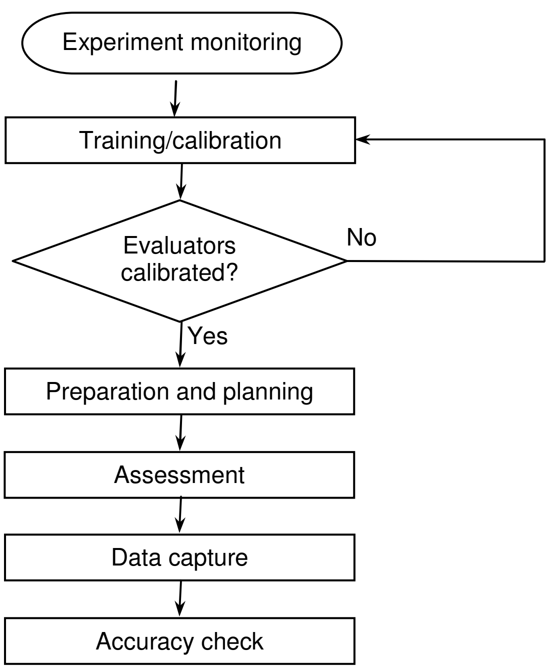


Figure 7.1: Flowchart for experiment monitoring


Longitudinal crack


Fatigue crack, base failure


Shear crack, base failure


Raveling on chip seal


Pumping through crack


Pumping through patch joint

The appearance of distress is varied and often extremely complex. The task of describing this is achieved by recording its main characteristics - the so-called attributes of distress. The attributes typically used in assessment are type, degree and extent. Detailed explanations relevant to each type of distress are described in the Pavement Condition Survey Manual and similar appropriate visual assessment guides.

<u>Type of Distress</u> - The type of distress evaluated will depend on the purpose of carrying out the assessment. For example, types assessed on chip seal overlays will differ from those on joint seal experiments. A number of assessment parameters are considered essential for any type of evaluation, while detailed descriptions of particular distress types will be required for specific pavement preservation treatments. Typical parameters assessed include, but are not limited to:

- Cracking (fatigue, block, edge, longitudinal, reflection, transverse, corner, durability)
- Potholes and/or existing patching and patch deterioration
- Surface deformation (rutting, shoving)
- Surface defects (bleeding, polished aggregate, raveling, map cracking, scaling, popouts)
- Miscellaneous distresses (lane-to-shoulder drop-off, lane-to-shoulder separation, water bleeding and pumping, blowouts)
- Joint deficiencies (joint seal damage, spalling, faulting)
- Functional performance (ride quality, skid resistance, spray, noise, etc)

Distresses can be assessed individually or in terms of their interactive effect on the functional performance of the road together with deflection, material properties, road profile (transverse and longitudinal), drainage, etc. An example of this is the development of potholes, which result in deterioration of overall functionality, particularly riding quality.

<u>Degree</u> - The degree of a particular type of distress is a measure of its severity. Because the degree of distress can vary over the pavement section, the degree to be recorded should, in connection with the extent of occurrence, give the predominant severity of a particular type of distress. The degree is described by a number where:

- Degree 1 indicates the first evidence of a particular type of distress (“slight”).

- Degree 3 indicates a warning condition. This would normally indicate that intervention might be required in order to avoid the distress deteriorating to a severe condition.
- Degree 5 indicates the worst degree ("severe"). Urgent attention is required.

Degree descriptions relate to the possible consequences of each type of distress and therefore also to the urgency of maintenance or rehabilitation. A flow diagram illustrating the use of the five-point classification system is shown in Figure 7.2.

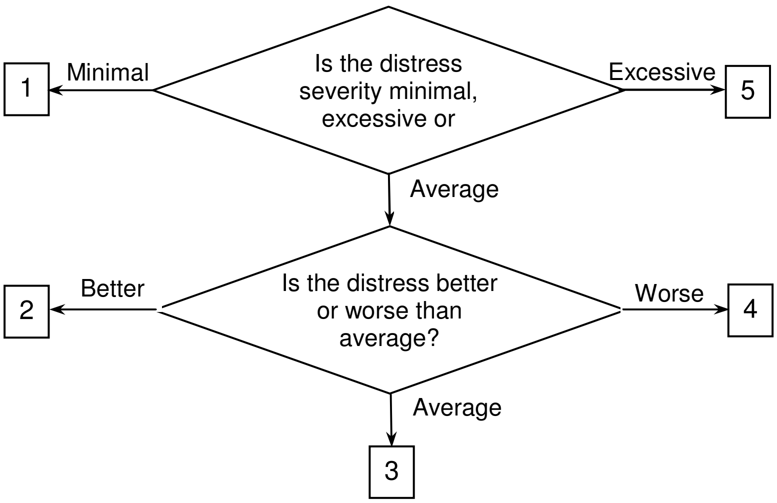


Figure 7.2: Flow diagram – five-point classification system

<u>Extent</u> - The extent of distress is a measure of how widespread the distress is over the length of the experimental section or panel. The extent is also indicated on a five-point scale in which the length of road affected by the distress is estimated as a percentage. The general description of the extent classifications is given in Table 7.1 and illustrated diagrammatically in Figure 7.3.

Table 7.1: General description of extent classifications

Extent	Description	Estimate (%)
1	Isolated occurrence, not representative of the section or panel being evaluated.	< 5
2	Between 1 and 3	5 - 20
3	Intermittent occurrence, over most of the section or panel or extensive occurrence over a limited portion of the section.	20 - 60
4	Between 3 and 5	60 - 80
5	Extensive occurrence.	80 - 100

Degree 1 distress

Degree 3 distress

Degree 5 distress

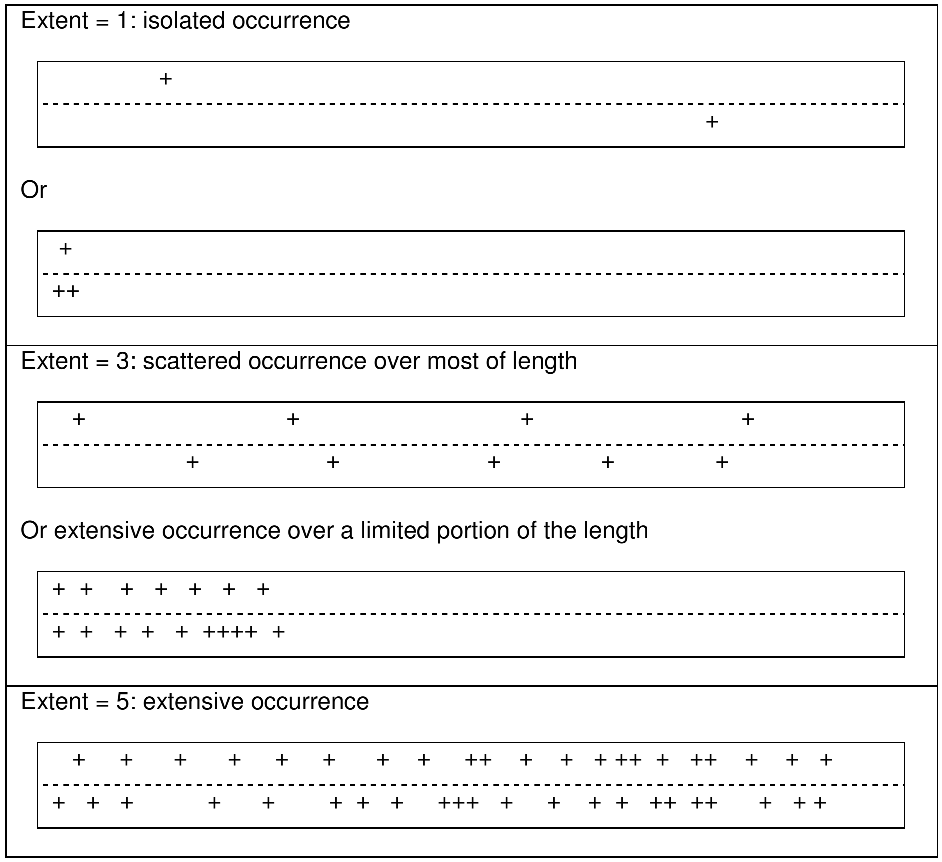
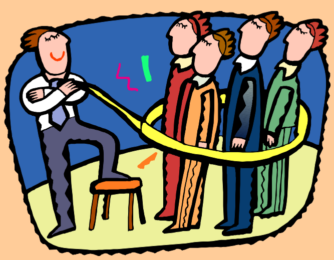


Figure 7.3: Diagrammatical illustration of extent



Depending on the study, the maximum severity possible is often of equal or greater interest than the predominant severity. In terms of pavement preservation test sections, specific interest will be on those defects that the treatment was intended to address.

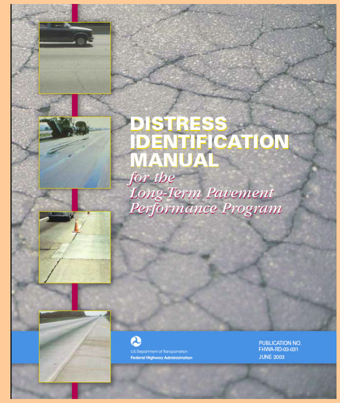
To minimize the element of subjectivity and to ensure good knowledge of the assessment procedures, it is essential to **train and calibrate** all evaluators at regular intervals.

Safety considerations

There are numerous **operational issues** that need to be taken care of prior to undertaking a monitoring evaluation, including notifications, traffic closures and equipment preparation. These will differ between Districts and between experiments and are not covered in detail in this guideline. An example checklist (Checklist 12) is provided in Appendix A.

The **monitoring timetable** will be detailed in the Experiment Work Plan. When preparing this timetable, it is important to have a balance between collecting sufficient data and collecting too much. It is also important to identify an expected end point for the experiment, either linked to:

- Time (e.g., exceeds expected design life in years),
- Traffic (e.g., cumulative vehicles passed or exceeds expected design life in axles), or
- Failure criteria (e.g., rut depth).



FHWA LTPP distress identification manual

The **protocols and criteria** that need to be used as a basis for monitoring will be detailed in the Experiment Work Plan. Visual assessments will typically be carried out using the Caltrans Visual Condition Survey Manual. If more detail is required for analysis purposes, the LTPP Distress Identification Manual can be used. Caltrans or ASTM methods should be followed for measuring functional parameters such as ride quality, skid resistance, splash and spray, and noise.

Failed chip seal

(>20% stone loss)

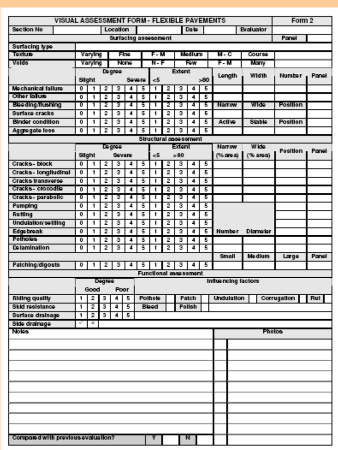
It is important to establish and understand what the **failure criteria** for any experiment are and what action needs to be taken when failure occurs. Examples of failure criteria, based on California requirements, that can be used in assessing pavement preservation experiments include, but are not limited to:

- Chip seals and overlays
  - Crack severity and extent [e.g., >2.5 m (6.5 ft) total length or 2.5 m/m^2 (6.5 ft^2) total crack density]
  - Rut depth [e.g., > 12.5 mm (0.5 in.)]
  - Stone loss (e.g., > 20% of area)
- Reinforcement materials
  - Reflective cracking [e.g., >2.5 m/m^2 (6.5 ft) total crack density, >3 mm (0.1 in.) width]
  - Rut depth [e.g., >25 mm (1.0 in.)]
- Crack and joint sealants
  - Spalling [e.g., >100 mm (4 in.) wide]
  - Separation and/or shrinkage [>3 mm (0.1 in.)]
  - Whip off [>25 mm (1.0 in.)]
- Pothole repair materials
  - Deformation [e.g., >25 mm (1.0 in.)]
  - Cracking (e.g., > 10% of area)
  - Separation and/or shrinkage [e.g., >3 mm (0.1 in.)]
  - Punch outs (any)

Patch joint failure

Skid resistance and permeability measurements

Visual assessments



VISUAL ASSESSMENT FORM - FLEXIBLE PAVEMENTS															Form 2
Section No			Location				Date				Evaluator				
Surfacing assessment														Panel	
Surfacing type															
Texture	Varying		Fine		F - M		Medium		M - C		Course				
Voids	Varying		None		N - F		Few		F - M		Many				
	Degree						Extent					Length	Width	Number	Panel
	Slight					Severe	<5				>80				
Mechanical failure	0	1	2	3	4	5	1	2	3	4	5				
Other failure	0	1	2	3	4	5	1	2	3	4	5				
Bleeding/flushing	0	1	2	3	4	5	1	2	3	4	5	Narrow	Wide	Position	
Surface cracks	0	1	2	3	4	5	1	2	3	4	5				
Binder condition	0	1	2	3	4	5	1	2	3	4	5	Active	Stable	Position	
Aggregate loss	0	1	2	3	4	5	1	2	3	4	5				
Structural assessment															
	Degree						Extent					Narrow (% area)	Wide (% area)	Position	Panel
	Slight			Severe			<5	>80							
Cracks - block	0	1	2	3	4	5	1	2	3	4	5				
Cracks - longitudinal	0	1	2	3	4	5	1	2	3	4	5				
Cracks transverse	0	1	2	3	4	5	1	2	3	4	5				
Cracks - crocodile	0	1	2	3	4	5	1	2	3	4	5				
Cracks - parabolic	0	1	2	3	4	5	1	2	3	4	5				
Pumping	0	1	2	3	4	5	1	2	3	4	5				
Rutting	0	1	2	3	4	5	1	2	3	4	5				
Undulation/settling	0	1	2	3	4	5	1	2	3	4	5				
Edge break	0	1	2	3	4	5	1	2	3	4	5	Number	Diameter		
Potholes	0	1	2	3	4	5	1	2	3	4	5				
Delamination	0	1	2	3	4	5	1	2	3	4	5				
												Small	Medium	Large	Panel
Patching/digouts	0	1	2	3	4	5	1	2	3	4	5				
Functional assessment															

	Degree					Influencing factors									
	Good			Poor											
Riding quality	1	2	3	4	5	Pothole		Patch		Undulation		Corrugation		Rut	
Skid resistance	1	2	3	4	5	Bleed		Polish							
Surface drainage	1	2	3	4	5										
Side drainage	✓	✗													

Notes					Photos
Compared with previous evaluation?	Y		N		

Visual assessment form

Depending on the type of experiment, failure could also be determined by functional properties such as riding quality, skid resistance, spray and noise (e.g., exceeding specified limits). Once failure has occurred, the experiment can either be terminated or a maintenance intervention can be carried out and the monitoring continued if treatment life-cycles are being assessed.

Visual assessments should be carried out on each section or panel according to the criteria detailed in the Experiment Work Plan and using the protocols described above. Prior to each evaluation, the previous evaluation forms should be reviewed in order that the evaluator can familiarize him/herself, be able to identify new deterioration, and distinguish between deterioration that occurred prior to and after the previous monitoring visit. A systematic process should be followed such that the entire panel or section is covered and all parts of the evaluation form are completed. The road surface should be viewed from all angles (i.e., both ends and both sides) to ensure that the angle of sunlight and shadows does not influence the rating. The evaluation form should be completed in full. If a particular distress is not observed, a zero should be logged to show that it was not overlooked. Digital photographs should also be taken during each visit and recorded on the evaluation form.

Observations and measurements should be recorded on the standard forms provided with the Pavement Condition Survey Manual, or a customized form prepared for the experiment (see example Forms 2 and 3 in Appendix B). If customized forms are prepared, the same form must be used for all monitoring to ensure consistency and to facilitate analysis.

The evaluator should also carry out a **first-level check** by comparing the previous evaluation with the current one. This is achieved by comparing forms and identifying any discrepancies such as decreasing rut depth or the presence of a specific distress in a previous evaluation and its absence in later evaluations. All discrepancies should be corrected or justified before completing the evaluation. If necessary, part of the evaluation may need to be repeated. A checklist (Checklist 13 in Appendix A) should be used by the evaluator as a reminder to ensure that all requirements are met.

Quantitative measures are always more useful than subjective observations when analyzing data collected from an experiment. Where feasible, any component of the process being assessed that can be physically measured should be measured with appropriate calibrated equipment and the data recorded, either on an appropriate form, or electronically depending on the parameter and the equipment used. Parameters that need to be measured during the visual assessment will differ depending on the type and objectives of the experiment. Some examples of physical measurements on different pavement preservation experiments are listed in Table 7.2.

Table 7.2: Examples of physical measurements

Measurement	Total surface treatment	Selective treatment	Method
Cracking			
• Fatigue	✓	-	Tape, wheel, digitized photo
• Block	✓	-	Tape, wheel
• Longitudinal	✓	-	Tape wheel
• Reflection	✓	-	Tape, wheel, digitized photo
• Transverse	✓	-	Tape, wheel
• Corner	✓	-	Tape
• Durability	✓	-	Tape, wheel
Crack seal			
• Shrinkage	-	✓	Tape, steel ruler
Surface Deformation			
• Rutting	✓	-	Straight edge & wedge
• Shoving	✓	-	Straight edge & wedge
• Potholes	✓	✓	Straight edge & tape
• Patch deterioration	-	✓	Straight edge & tape
• Patch shrinkage	-	✓	Tape measure, steel ruler
• Patch deformation	-	✓	Straight edge & wedge
Surface Defects			
• Bleeding	✓	✓	Tape, wheel
• Raveling/stone loss	✓	✓	Tape, wheel
• Scaling	✓	-	Tape, wheel
• Popouts	✓	✓	Straight edge & tape
Miscellaneous			
• Blowouts	✓	✓	Straight edge & tape
Joint Deficiencies			
• Seal shrinkage	-	✓	Tape, steel ruler
• Faulting	✓	✓	Tape, steel ruler
Functional			
• Longitudinal profile	✓	✓	Laser profilometer
• Riding quality	✓	✓	Laser profilometer
• Skid resistance	✓	✓	Skid or Pendulum tester
• Noise	✓	✓	Noise tester
• Spray	✓	-	Spray tester of photographs
Structural			
• Deflection	✓	-	FWD
• In situ strength	✓	-	DCP
• Modulus	✓	✓	FWD, Seismic
• Layer thickness	✓	-	GPR


FWD measurement


Profiler


Measurements on experiment


Rut measurements


DCP measurements

Forensic investigation

If a **failure** has occurred on a section, the cause should be identified and documented. A forensic investigation should be considered if the cause cannot be determined with confidence, for example, excessive stone loss on a chip seal, or rutting after the application of a fog seal.

The need to collect **samples** from a section will depend on the type and objectives of the experiment and will be detailed in the Experiment Work Plan. Samples should be correctly labeled and a sample log should be kept for any samples taken. All sample details should be recorded on the Assessment Form.

8. FORENSIC INVESTIGATIONS

Forensic investigations should be undertaken to confirm the mode of and reason for failure on any experiment. They should also be considered as a final opportunity to rigorously study the section, the findings of which could contribute significantly to understanding how the various treatments performed. Most forensic evaluations on pavement preservation treatments will simply involve a close-out evaluation. If the reason for failure cannot be determined with certainty, a more detailed forensic investigation by means of cores and/or test pits may be required.

This chapter in the detailed guide covers (Figure 8.1):

- Level of detail
- Test pit location
- Coring
- Test pit excavation
- Sample logistics
- Test pit logging
- In-pit testing
- Test pit repair

A guide for the need for forensic evaluations in pavement preservation experiments is provided in Table 8.1.

Table 8.1: Guide for forensic investigations

Activity*	Detailed forensic required?	Test pit + cores	Cores only
Thin overlays	Yes, if rutting & cracking present	✓	-
Ultra-thin overlays	Yes, if rutting & cracking present	✓	-
Bonded wearing course	Dependent on failure mechanism	✓	✓
Microsurfacings	No, unless deformation after application	-	✓
Chip seals	No, unless deformation after application	-	✓
Slurry seals	No, unless deformation after application	-	✓
Fog seals	No, unless deformation after application	-	✓
Crack seal	No	-	✓
Crack fill	No	-	✓
Joint seal	No	-	✓
Patching	Dependent on type of failure	✓	✓
Partial-depth PCC repair	No	-	✓
Full-depth concrete repair	Dependent on type of failure	✓	✓
Edge repair	No	-	✓
Diamond grinding	No	-	✓
Dowel bar retrofit	No	-	✓


Test pit and cores

Test pit


Test pit - note variable layer thickness

Core log

Saw cutting test pit

In pit density measurements

In pit DCP measurements

Test pit profile, note rutting in lower AC layer

Test pit profile

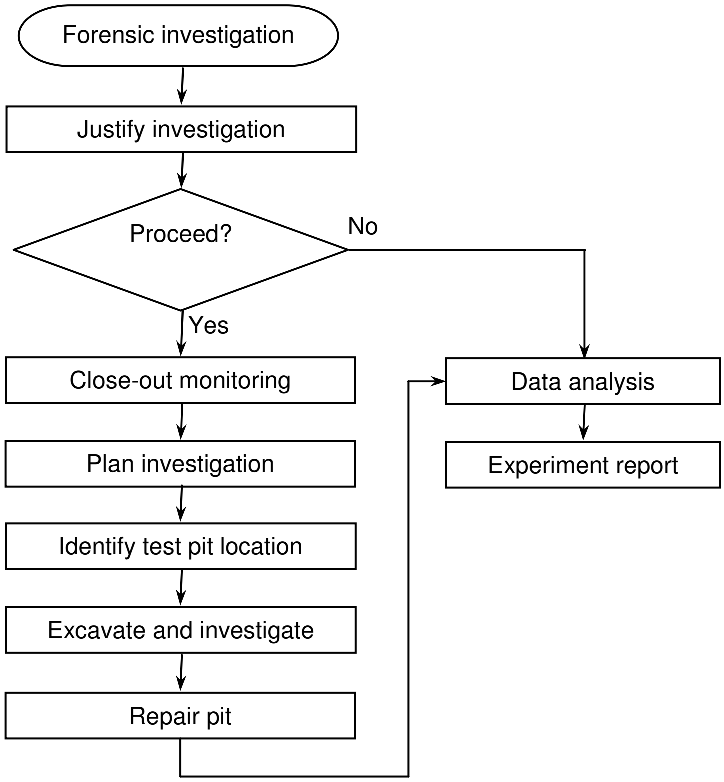


Figure 8.1: Flowchart for forensic investigations

9. LABORATORY TESTING

Laboratory testing is carried out in order to obtain an understanding of the material characteristics of the existing road surface or treatment being applied. In most instances these properties need to be known in order to understand why the road performed the way it did and to determine a set of criteria that can be used as a basis for determining where treatments or techniques that are being assessed can be applied elsewhere on the network.

Indirect tensile (ITS) strength test

Laboratory testing should only be carried out when the results will enhance knowledge of how the pavement performed and the reliability of the findings of the study in terms of addressing the study objectives. Testing should not be carried out simply for the sake of testing. The need for testing and the type of testing will be identified in the Experimental Work Plan.

Testing that might be carried out typically includes characterization of the properties, durability, and performance of the various materials used in the experiment, and samples removed during the course of the experiment or after completion of the experiment

A discussion on laboratory testing falls outside the scope of these guidelines. However, the following should be considered before testing:

- Care should be taken to fully understand a test, its purpose and its limitations before selecting it. Most tests are developed for a specific purpose. When used to test something outside the original scope, the mechanism and results may not be entirely relevant. Results need to be interpreted with care and the test may need to be modified to suit the need.
- An appropriate method may need to be sought to test a particular parameter. This may not be commonly used within Caltrans and laboratory staff may need to be trained in its use. Alternatively, a new test may need to be adopted or developed to address a particular need.
- Test methods should be strictly adhered to, unless modified to suit the needs of the experiment. If modified, the changes need to be clearly documented with a justification for doing so. Test methods should not be changed simply to obtain a satisfactory answer.

Laboratory testing procedures are fully documented in the California Test Methods document. Where appropriate, ASTM, AASHTO, and/or other organizations' test methods may be followed. The reasons for using an alternative test method should be justified.

10. DATA ANALYSIS, REPORTS, AND IMPLEMENTATION

Appropriate data analysis and reporting is a fundamental part of any experiment. In this phase of the research, the data collected from the visual assessments and measurements is analyzed to determine whether the strategy, treatment, technology, procedure and/or product performed and behaved in a manner, such that adoption of it would have benefits over existing practice.

This chapter in the detailed guide covers:

- Data analysis
- Construction, progress, and first- and second-level analysis reports
- Implementation

The focus of **data analysis** will be the systematic comparison of the behavior and performance of the strategy, treatment, technology, procedure or product against that of the control. The criteria that are used for this comparison will depend on the Experiment Work Plan.

Reports are the means by which experiments, findings and recommendations are documented. Format and content will depend on the type of experiment. Five types of report are typically prepared during the course of an experiment:

- Site selection reports
- Construction report
- Progress/interim reports
- Research reports
    - First-level analysis report
    - Second-level analysis report
- Implementation report

Implementation reports provide a summary of the experiment and the findings, together with recommendations on how the findings should be implemented. The report should be presented to the relevant office chiefs and disseminated to the district maintenance and materials engineers, and depending on the outcome, an implementation/adoption timetable should be agreed to.

Implementation of the findings is perhaps the most important, but often most overlooked, phase of any experiment. By following all the procedures discussed in these guidelines, valid and quantified justifications for implementing new or improved technologies and procedures can be developed. Once defined, these technologies and procedures need to be systematically implemented. The following implementation process is proposed:

- The project champion should notify relevant head office staff and district office maintenance and materials engineers about the experiment(s) in the early stages of the study. This notification can also be seen as an opportunity to identify potential replicate sections, and to find out about similar experiments that may have been conducted in the past, but not documented.
- The project engineer should send brief progress reports and updates via email to head office staff and district office maintenance and materials engineers throughout the duration of the study. If early significant findings are noted, engineers from other districts should be encouraged to visit the experiment as part of future monitoring exercises.
- On completion of the study, the summary/implementation report should be presented to the office chiefs at a Pavement Standards Team meeting. This exercise should be used to initiate the implementation plan proposed in the implementation report.
- Depending on the recommendations in the implementation report, proceed with implementation. This may include:
    - Revision of the Maintenance Technical Advisory Guide (MTAG)
    - Revision of standards, guideline documents, specifications and procedures
    - Notifying relevant staff of the revised procedures
    - Workshops and demonstration projects to disseminate the findings.

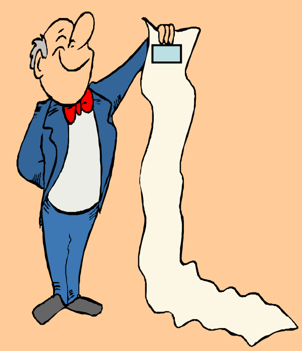
11. DATA MANAGEMENT AND DOCUMENTATION

A comprehensive record of data documenting the behavior of the test section and comparison to a control is critical to the success of any experiment. This requires a systematic data capture, storage, and retrieval procedure to ensure accuracy, uniformity and continuity in measurements.

This chapter in the detailed guideline discusses:

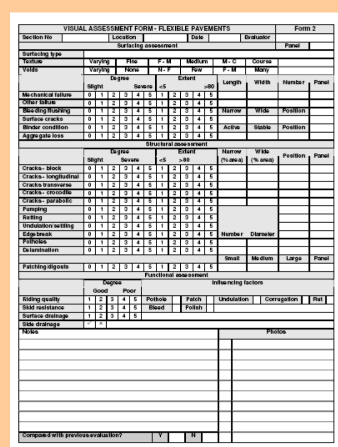
- The Project File
- Checklists
- Data collection forms
- Proposal register
- Experiment register
- Progress reports

A **project file** should be opened for each experiment when a proposal is prepared. All documentation relevant to the project should be kept in the file. The Project File "belongs" to an experiment and not to an individual and the contents should be accessible to any interested person.



Checklists are an effective way of ensuring that all relevant tasks for a particular part of a study are completed. They also provide a record to prove that the tasks were carried out and can also be used to guide the process.

Data collection forms will be the primary source of information in most experiments. They should be filled in with care and as comprehensively as possible, remembering that data analysis may be carried out by someone other than the individual who did the assessment, and may be carried out a number of years later when recollection of the assessment may be difficult. All data from the forms should be captured into a spreadsheet or database as soon as possible after they have been collected. By capturing data on separate sheets with the same format, first-level data checks can be carried out using comparative graphs.



VISUAL ASSESSMENT FORM - FLEXIBLE PAVEMENTS							Form 2
Section No		Location		Date		Evaluator	
Surfacing assessment							Panel
Surfacing type							
Texture	Varying	Fine	F - M	Medium	M - C	Course	
Voids	Varying	None	N - F	Few	F - M	Many	

	Degree (Slight … Severe)	Extent (<5 … >80)				
			Length	Width	Number	Panel
Mechanical failure	0 1 2 3 4 5	1 2 3 4 5				
Other failure	0 1 2 3 4 5	1 2 3 4 5				
Bleeding/flushing	0 1 2 3 4 5	1 2 3 4 5	Narrow	Wide	Position	
Surface cracks	0 1 2 3 4 5	1 2 3 4 5				
Binder condition	0 1 2 3 4 5	1 2 3 4 5	Active	Stable	Position	
Aggregate loss	0 1 2 3 4 5	1 2 3 4 5				
Structural assessment						
	Degree (Slight … Severe)	Extent (<5 … >80)	Narrow (% area)	Wide (% area)	Position	Panel
Cracks - block	0 1 2 3 4 5	1 2 3 4 5				
Cracks - longitudinal	0 1 2 3 4 5	1 2 3 4 5				
Cracks transverse	0 1 2 3 4 5	1 2 3 4 5				
Cracks - crocodile	0 1 2 3 4 5	1 2 3 4 5				
Cracks - parabolic	0 1 2 3 4 5	1 2 3 4 5				
Pumping	0 1 2 3 4 5	1 2 3 4 5				
Rutting	0 1 2 3 4 5	1 2 3 4 5				
Undulation/settling	0 1 2 3 4 5	1 2 3 4 5				
Edge break	0 1 2 3 4 5	1 2 3 4 5	Number	Diameter		
Potholes	0 1 2 3 4 5	1 2 3 4 5				
Delamination	0 1 2 3 4 5	1 2 3 4 5				
			Small	Medium	Large	Panel
Patching/digouts	0 1 2 3 4 5	1 2 3 4 5				

Functional assessment	Degree (Good … Poor)	Influencing factors
Riding quality	1 2 3 4 5	Pothole, Patch, Undulation, Corrugation, Rut
Skid resistance	1 2 3 4 5	Bleed, Polish
Surface drainage	1 2 3 4 5	
Side drainage	✓ ✗	

Notes	Photos
Compared with previous evaluation? Y N	

Photographs and videos will be invaluable in later analysis. Cross references and details of when and where the photograph and videos were taken and what they illustrate must be captured on the evaluation form.

Data board

EP-PPTS/3/05/1/ver1
Proposal number

PPTS/3/05/1/1
Section number

ES-PPTS/05/1/ver1
Work plan number

CR-PPTS/05/1/ver1
Construction report

IR-PPTS/05/1/ver1
Interim/progress report

ER-PPTS/05/1/ver1
Experiment report

Photographs should be stored electronically in a series of subdirectories linked to the monitoring dates. Care must be taken to ensure that the numbers on the photographs match those on the evaluation forms and that there will be no confusion when analyzing the data. The date, and if appropriate the time, that the photograph was take should be included in the file name. Key information can also be recorded on a data board in the photograph.

Centralized numbering systems provide a simplified means of tracking experiments statewide, and the documentation prepared from them. Numbers can be obtained from the Chief of the Office of Pavement Preservation. The following numbering systems are used:

- Experiment Proposal Register
- Experiment Register
- Report Number Register

The data collected from each evaluation should undergo a **first-level data check** by both the Project Engineer and the Database Manager. This will include, but not be limited to:

- A check that data does not fall outside predetermined minimum and maximum boundaries (e.g., a severity cannot exceed 5, percentage areas cannot exceed 100)
- A comparison with data collected from the previous monitoring exercise to check inconsistencies (e.g., rut depth less than previous)

All projects need to be closed. For a pavement preservation experiment, project closure will usually occur once the final report has been submitted and an implementation plan has been initiated by the Chief of the Office of Pavement Preservation.

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APPENDIX A: CHECKLISTS

Examples of the following checklists typically used in pavement preservation experiments are provided in this Appendix:

- Checklist 1: Justification for Study
- Checklist 2: Proposal for a Pavement Preservation Experiment
- Checklist 3: Project Planning
- Checklist 4: Experiment Work Plan Content
- Checklist 5: Experiment Work Plan Document
- Checklist 6: Experiment Initiation
- Checklist 7: Desktop Study
- Checklist 8: Site Selection
- Checklist 9: Site Layout and Marking
- Checklist 10: Preconstruction Assessment
- Checklist 11: Construction Assessment
- Checklist 12: Monitoring Preparation
- Checklist 13: Monitoring
- Checklist 14: Project Closure

CHECKLIST - JUSTIFICATION FOR STUDY					Checklist 1
Issue		Yes	No	Comments	
1	Has similar research been done by any other individual/organization?				
2	Are the findings of previous studies applicable to Caltrans?				
3	Are the findings statistically valid?				
4	Will doing a similar study provide additional useful information to advance knowledge or enhance implementation by Caltrans?				
5	If the study is undertaken, will it be practical for Caltrans to adopt/implement the findings in practice?				
6					
7					
8					
9					
10					
11					
12					

Recommendation		
Should the study proceed? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - PROPOSAL FOR A PAVEMENT PRESERVATION EXPERIMENT				Checklist 2
Issue		**Yes**	**No**	**Comments**
1	Is the purpose of the experiment clear?			
2	Was the background study sufficiently comprehensive to justify that the experiment is required?			
3	Are the reasons for undertaking the experiment justifiable in terms of potential benefits to Caltrans?			
4	Are details on how the findings would be implemented by Caltrans adequate?			
5	Is the work plan sufficiently comprehensive such that statistically valid data will be obtained?			
6	Is the study timetable appropriate?			
7	Is the budget sufficiently comprehensive and realistic? Have the cost of traffic closures been included?			
8	If a proprietary additive/procedure is being tested, is the background documentation provided adequate?			
9	Have potential partners been identified?			
10	Has an individual/position accepted responsibility for completing the study in the proposed time frame?			
11	Has an individual/position accepted responsibility for implementing the findings into Caltrans practice?			
12	Has the proposal been registered with the Chief of Office of Pavement Preservation?			
13	Has a proposal number been issued?			

Recommendation

Is the proposal adequate?	Yes	No
If no, state why and what needs to be done to continue		

Name		Signature		Date	

CHECKLIST - PROJECT PLANNING MEETING				Checklist 3
Issue		**Yes**	**No**	**Comments**
1	Is the objective of the experiment clear?			
2	Have the implications of the findings from the background study been adequately established?			
3	Does the experimental design meet the test objective?			
4	Has a suitable control experiment for comparative purposes been agreed upon?			
5	Has the location of the experiment been decided?			
6	Have all the construction requirements been identified?			
7	Has the instrumentation and equipment required to provide data for envisaged outcome been identified?			
8	Has a monitoring program been drawn up?			
9	Has a monitoring procedure been agreed to?			
10	Have failure and experiment completion criteria been set?			
11	Has an associated laboratory test program been formulated?			
12	Have data collection, validation and storage protocols been agreed upon?			
13	Have report formats and frequency been defined?			
14	Have criteria been set for the treatment/technology/procedure/product to be adopted as standard practice?			
15	Has a plan for implementing the treatment if successful been formulated?			
16	Has consideration been given to repairing the road after testing?			
17	Has responsibility for each of the above been delegated and accepted?			

Recommendation		
Has sufficient information been gathered to prepare an experiment work plan? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - EXPERIMENT WORK PLAN CONTENT				Checklist 4
	Content	**Yes**	**No**	**Comments**
1	Objective of the test			
2	Staffing and contact details			
3	Responsibility and reporting matrix • Report preparation • Report approval • Health and safety • Environment • Data collection • Data validation • Data submission			
4	Experimental design, including details on replicates and controls			
5	Section detail • Section number • Section details including district, county, route number, lane number and GPS coordinates • Test panel position • Pavement description • Construction, rehabilitation or maintenance interventions required before testing can begin • Checklists			
6	Instrumentation • Inventory of instruments • Location and/or depth • Calibration • Measurement specifications • Data collection requirements including number and location of points and conditions under which measurements will be recorded • Checklists			
7	Evaluation program • Evaluation detail • Protocols/methods/criteria to be followed • Failure criteria definition • Associated laboratory testing • Checklists			
8	Data collection, validation, and storage • Start date • Frequency of data collection • Data validation (visual, comparison with previous measurement, within predefined parameters) • Data transfer to Database Manager (timing, medium) • Criteria to be met for experiment completion • Checklists			
9	Reports			
10	General notes			

Recommendation		
Has sufficient information been included in the experiment work plan? If no, state why and what needs to be done to continue	Yes	No

Name		Signature		Date	

CHECKLIST - EXPERIMENT WORK PLAN REPORT				Checklist 5
	Content	**Yes**	**No**	**Comments**
1	Title page?			
2	Approval signature page?			
3	Revision notes page?			
4	Table of contents?			
5	Chapter 1: Objective of the test			
6	Chapter 2: Staffing and contact details			
7	Chapter 3: Responsibility and reporting matrix			
8	Chapter 4: Experimental design			
9	Chapter 4: Section detail			
10	Chapter 5: Instrumentation			
11	Chapter 6: Monitoring program			
12	Chapter 7: Data collection, validation, and storage			
13	Chapter 8: Reports			
14	Chapter 9: General notes			
15	Appendices: Checklists and forms			
16	Reports			
17	General notes			
	Issue	**Yes**	**No**	**Comments**
1	Does the work plan have a number?			
2	Has the work plan been submitted and approved by the Chief of the Office of Pavement Preservation?			
3	Have copies been distributed?			
4	Have instructions for revisions been distributed?			

Recommendation

Has the experiment work plan phase of the experiment been satisfactorily completed?	Yes	No

If no, state why and what needs to be done to continue.

Notes

Name		Signature		Date	

CHECKLIST - EXPERIMENT INITIATION				Checklist 6
General issues		**Yes**	**No**	**Comments**
1	Has the Project Champion given written approval to proceed with the experiment?			
2	Has a copy of the approval been added to the Project File?			
3	Has an experiment number been issued by the Chief of the Office of Pavement Preservation?			
4	Has a project team been assembled?			
5	Has the project team accepted responsibilities as assigned in the experiment work plan?			
6	Have all necessary arrangements been made to proceed with the experiment?			
7				
8				
9				
10				
11				
12				

Recommendation		
Can the experiment proceed? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - SITE SELECTION DESKTOP STUDY				Checklist 7
General issues		Yes	No	Comments
1	Do the identified roads and sections meet the requirements of the experiment work plan?			
2	Can the experiment be incorporated into a planned pavement preservation activity on the proposed road?			
3	If a planned activity, can the planned treatments be accommodated in the operation?			
4	If a planned activity, can the planned pavement preservation treatment on the selected section be used as a control?			
5	Is the planned operation long enough to accommodate the experiments?			
6	Is the alignment uniform?			
7	Is the planned operation long enough to accommodate replicate sections?			
8	Are there any potential problems envisaged with later monitoring activities (e.g., road closures)?			
9	Are there constraints outside the Experiment Work Plan that could influence the use of the site (e.g., safety)?			
10	Is appropriate construction equipment available?			
11	Are there appropriately trained personnel to do the treatments?			
12	Can the contractual arrangements be modified to accommodate the experiment?			

Recommendation		
Does the proposed site meet the requirements of the experiment work plan? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - SITE SELECTION				Checklist 8
General issues		**Yes**	**No**	**Comments**
1	Is the proposed section representative of the issue being investigated?			
2	Is the proposed section conveniently located for monitoring and demonstration purposes?			
3	Will any results obtained from this proposed section be representative of other roads with similar conditions?			
4	Are individual sections within the proposed experiment similar in terms of alignment, structure and condition?			
5	Will the establishment of the proposed section pose a safety hazard to road users?			
6	Will the establishment of the proposed section pose a safety hazard to persons undertaking monitoring evaluations?			
7	Will the road on which the proposed section is planned be maintained or rehabilitated within the monitoring period?			
8	Can planned maintenance be included as part of the evaluation?			
9	If planned maintenance is not part of the evaluation, can steps be taken to ensure that the experiment is not maintained?			
10	Is the proposed section located as close as possible to a traffic counting/weigh-in-motion station?			
11	Can the proposed section be tested to 'failure' and then repaired without significant impacts to the road user?			
12				

Recommendation		
Does the proposed site meet the requirements of the experiment work plan?	Yes	No
If no, state why and what needs to be done to continue.		

Name		Signature		Date	

CHECKLIST - SITE LAYOUT AND MARKING				Checklist 9
General issues		Yes	No	Comments
1	Were product suppliers present?			
2	Were appropriate criteria used to identify representative sections?			
3	Are the selected sites sufficiently uniform?			
4	Are there any attributes that may adversely influence the performance of the treatment?			
5	Can all necessary safety procedures be implemented/followed?			
6	Can all necessary environmental procedures be implemented/followed?			
7	Are the product suppliers satisfied that their products will be fairly evaluated?			
8	Has the section been marked according to the experiment work plan?			
9	Were GPS coordinates taken?			
10	Have instruments been installed and calibrated according to the manufacturer's specifications?			
11	Have arrangements been made for the collection of weather data?			
12	Has an experiment map been drawn?			
13	Has an experiment number been allocated?			
14	Have signs been erected?			
15	Has experiment register been updated?			
16	Has construction been scheduled?			

Recommendation		
Does the proposed site meet the requirements of the experiment work plan? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - PRE-CONSTRUCTION ASSESSMENT				Checklist 10
General issues		**Yes**	**No**	**Comments**
1	Were correct safety precautions taken?			
2	Was the traffic closure acceptable?			
3	Are the selected sites sufficiently uniform?			
4	Were product suppliers present?			
5	Was a comprehensive visual assessment undertaken?			
6	Was the prescribed form used to capture data?			
7	Was any destructive testing carried out, and if yes, was the damage appropriately repaired?			
8	Are the experiment signs intact?			
9	Is the instrumentation installed during experiment establishment functioning correctly?			
10	Are there any factors that could negatively influence the performance of the experiment?			
11	Has the road been adequately prepared?			
12	Are product suppliers satisfied that construction can proceed?			
13				
14				
15				

Recommendation		
Should construction of the experiment proceed? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - CONSTRUCTION ASSESSMENT					Checklist 11
General issues		Yes	No	Comments	
1	Was the entire process systematically documented?				
2	Were all deviations from the planned process justified and/or explained?				
3	Have the potential influence of the deviations on the experiment performance been quantified?				
4	Were the binder, aggregate and/or premix characteristics documented?				
5	Was the equipment inspected and condition documented?				
6	Was the equipment correctly calibrated?				
7	Was the area of distress adequately prepared?				
8	Was the surfacing/patch/crack seal adequately compacted?				
9	Were establishment, application and demobilization times recorded?				
10	Were appropriate quality control procedures followed?				
11	Was the treatment uniform throughout the experiment?				
12	Was wastage documented?				
13	Were any unanticipated problems encountered and how were they dealt with?				
14	What procedures can be implemented to improve the process?				
15	Were the required measurements taken at the specified intervals?				
16	Were the required samples taken at the specified intervals?				
17	Were instruments installed as specified?				
18	Were the product suppliers satisfied with the experiment?				

Recommendation					
Was the experiment satisfactorily constructed? If no, state why and what needs to be done to continue.				Yes	No
Name		Signature		Date	

CHECKLIST - MONITORING PREPARATION				Checklist 12
	General issues	**Yes**	**No**	**Comments**
1	Have all notifications been made?			
2	Have road closures and traffic control arrangements been made?			
3	Has assessor training and calibration been completed?			
4	Are section maps, previous monitoring forms, blank forms, visual assessment guide, and experiment work plan packed?			
5	Is equipment packed? (Camera, geo pick, straight edge, wedge, tape measure, GPS, DCP, moisture cans, pick, spade, etc.)			
6	Is safety equipment packed? (Protective clothing, vests, first-aid, water, etc.)			
7	Is the equipment correctly calibrated? (Nuclear gage, DCP weight and cones, etc.)			
8	Have other equipment been arranged? (e.g., FWD and profiler, etc.)			
9				
10				
11				
12				

Recommendation		
Can monitoring proceed? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - MONITORING				Checklist 13
General issues		Yes	No	Comments
1	Was the experiment monitored according to the requirements of the experiment work plan?			
2	Was the standard prescribed form used? If not, has all relevant information been captured?			
3	Were all cells on the form completed?			
4	Was the assessment compared to the previous assessment?			
5	Were any significant changes since the previous monitoring accounted for?			
6	Were the required photographs taken?			
7	Were the required physical measurements taken?			
8	Were the required samples taken?			
9	Were the samples logged?			
10	Were the samples delivered and instructions for testing submitted?			
11	Have the data and photographs been captured in a spreadsheet or database?			
12	Have all forms been added to the project file?			
13				
14				
15				

Recommendation		
Was the monitoring exercise successfully completed? If no, state why and what needs to be done to continue.	Yes	No

Name		Signature		Date	

CHECKLIST - PROJECT CLOSURE				Checklist 14
General issues		**Yes**	**No**	**Comments**
1	Has the monitoring been completed in terms of the requirements of the experiment work plan?			
2	Have the objectives of the experiment been met?			
3	Is termination of the project justified?			
4	Have all reports as required in the experiment work plan been written?			
5	Have all the objectives of the experiment as detailed in the work plan been addressed?			
6	Have all reports had an independent technical review?			
7	Have all reports been logged with the Chief of the Office of Pavement Preservation and numbered in the central register?			
8	Have the required steps been taken to have the findings implemented?			
9	Have the findings been presented to relevant Caltrans departments and if applicable, published?			
10	Has all data been captured in the database and backed up?			
11	Has the project file been closed and archived?			
12	Have materials samples been disposed of?			
13	Have signs, markings and instrumentation been removed from the site?			
14	Have all registers been updated by the Chief of the Office of Pavement Preservation?			
15	Have all team members and other interested and affected parties been notified?			

Recommendation		
Was the project successfully completed? If no, state why and what needs to be done to complete it.	Yes	No

Name		Signature		Date	

APPENDIX B: DATA COLLECTION FORMS

Examples of the following forms typically used for the monitoring of pavement preservation experiments are provided in this Appendix:

- Form 1: Visual Assessment Form used for Chip Seal Evaluation (alternative to Pavement Condition Survey standard form)
- Form 2: Profile Assessment
- Form 3: Construction Assessment form for Chip Seal Application
- Form 4: Materials Inventory
- Form 5: Project Site Report
- Form 6: Section Sketch
- Form 7: Core Log
- Form 8: Test Pit Sketch
- Form 9: Log for Surfacing Layers
- Form 10: Log for Granular and Stabilized Base
- Form 11: Photographs
- Form 12: Density and Moisture Content
- Form 13: DCP

PAVEMENT PRESERVATION EXPERIMENT CONSTRUCTION ASSESSMENT FORM							Form 1
Section No		Location		Date		Evaluator	

Experiment description				
Weather conditions				
Dates/Times	Establishment		Road closure	
	Road Opening		Demobilization	
Surface preparation				

Equipment inspections and calibration	Distributor	
	Chip spreader	
	Haul trucks	
	Rollers	
	Broom	

Binder	Source/type			Notes
	Application rate			
	Total applied			
	Temperature			
	Samples			
Aggregate	Source/type			Notes
	Application rate			
	Total applied			
	Temperature			
	Samples			
Compaction	Roller			Notes
	Passes			
Brooming				Notes

Notes	Photos/video			

PAVEMENT PRESERVATION EXPERIMENT VISUAL ASSESSMENT FORM							Form2(a)
Section No		Location		Date		Evaluator	

Surfacing assessment

Surfacing type							
Texture	Varying	Fine	F - M	Medium	M - C	Course	
Voids	Varying	None	N - F	Few	F - M	Many	

	Degree Slight					Severe	Extent <5				>80	Length	Width	Panels
Mechanical failure	0	1	2	3	4	5	1	2	3	4	5			
Other failure	0	1	2	3	4	5	1	2	3	4	5			
Bleeding/flushing	0	1	2	3	4	5	1	2	3	4	5	Narrow	Wide	Position
Surface cracks	0	1	2	3	4	5	1	2	3	4	5			
Binder condition	0	1	2	3	4	5	1	2	3	4	5	Active	Stable	Position
Aggregate loss	0	1	2	3	4	5	1	2	3	4	5			

Structural assessment

	Degree Slight					Severe	Extent <5				>80	Narrow (% area)	Wide (% area)	Position	Panels
Cracks - block	0	1	2	3	4	5	1	2	3	4	5				
Cracks - longitudinal	0	1	2	3	4	5	1	2	3	4	5				
Cracks transverse	0	1	2	3	4	5	1	2	3	4	5				
Cracks - crocodile	0	1	2	3	4	5	1	2	3	4	5				
Cracks - parabolic	0	1	2	3	4	5	1	2	3	4	5				
Pumping	0	1	2	3	4	5	1	2	3	4	5				
Rutting	0	1	2	3	4	5	1	2	3	4	5				
Undulation/settlement	0	1	2	3	4	5	1	2	3	4	5				
Edgebreak	0	1	2	3	4	5	1	2	3	4	5	Number	Diameter		
Potholes	0	1	2	3	4	5	1	2	3	4	5				
Delamination	0	1	2	3	4	5	1	2	3	4	5				
												Small	Medium	Large	Panels
Patching	0	1	2	3	4	5	1	2	3	4	5				

Functional assessment

	Degree Good				Poor	Influencing factors									
Riding quality	1	2	3	4	5	Potholes		Patching		Undulation		Corrugation		Ruts	
Skid resistance	1	2	3	4	5	Bleeding		Polishing							
Surface drainage	1	2	3	4	5										
Side drainage	✓		✗												

Notes

PAVEMENT PRESERVATION EXPERIMENT VISUAL ASSESSMENT FORM		Form2(b)
Sample details	**Photos**	

PAVEMENT PRESERVATION EXPERIMENT PROFILE ASSESSMENT FORM

Form 3(a)

Section No		Panel	1 - 5	Date		Evaluator	

Transverse

Panel A	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
Max rut																					
Width																					
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
Panel 1	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
Max Rut																					
Width																					
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
Panel 2	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
Max Rut																					
Width																					
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
Panel 3	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
Max Rut																					
Width																					
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
Panel 4	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
Max Rut																					
Width																					
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
Panel 5	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
Max Rut																					
Width																					
		2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL

Section No			Panel	6 - 10																	Form 3(b)	
Transverse	Panel B	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
	Max Rut																					
	Width																					
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
	Panel 6	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
	Max Rut																					
	Width																					
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
	Panel 7	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
	Max Rut																					
	Width																					
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
	Panel 8	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
	Max Rut																					
	Width																					
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
	Panel 9	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
	Max Rut																					
	Width																					
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
	Panel 10	Lane Center	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	RE
	Max Rut																					
	Width																					
			2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	CL
Long	Position		1		2		3		4		5		6		7		8		9		10	
	Outer																					
	Inner																					
	Lane center																					

PAVEMENT PRESERVATION EXPERIMENT - MATERIALS INVENTORY						Form 4
Section No		**Operator**			**Date**	
Sample Number	Sample location	Sample size	Sample type	Material type and code	Sample condition	Program of work

Comments	

Responsible person		**Sign**	

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - PROJECT SITE REPORT			Form 5
Section No		**Date**	
Start time		**Completion time**	
Responsibility		**Crew chief**	
Head driller		**Crew size**	
Traffic control		**Repair**	
Weather			
Equipment			
Description of work and comments			

	Description	Shipped to	Shipped by	Date
Samples				

	Equipment	Traffic	Other
Site problems			

Forms							
Sketch		Materials inventory		Core log		Pit assessment	
DCP		Density/moisture		List of photographs			

Pit reinstated		**Site cleaned**	
Responsible person sign		**Date**	

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - SKETCH					Form 6
Section No		**Date**		**Evaluator**	

Experimental section plan and location of test pit(s), core points and testing locations

Centerline

Start

Shoulder

Reference	Activity	Description and reason

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - CORE LOG			Form 7
Section No		**Date**	
Evaluator		**Operator**	
Core hole No		**Sketch**	
Equipment			
Core size			
Coolant			
Offset			
Reason for core			

Depth	Core drilled (mm)	Core recovered	Sample No	Layer thickness and description	Material code

	Comments

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - TEST PIT SKETCH						Form 8
Section No:		Profiled by:			Date:	
	Zone 5 (IWT to centerline)	Zone 4 (IWT)	Zone 3 (Between tracks)	Zone 2 (OWT)	Zone 1 (Shoulder to OWT)	

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - WEARING COURSE LAYERS				Form 9
Section No:	Profiled by:		Date:	

Depth (mm)	Descriptor	Zone 1 (Shoulder to OWT)	Zone 2 (OWT)	Zone 3 (Between tracks)	Zone 4 (IWT)	Zone 5 (IWT to centerline)	Sample No
to							
to							
to							
to							
to							
to							

Interlayer bond									
Checklist	Cracks		Description						
	Rutting		Heaving		Bleeding		Raveling		
	Interface bond		Moisture at interface		Layer definition		Pumping		
Other									

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - LOG FOR GRAVEL AND STABILIZED LAYERS									Form 10
Section No		**Profiled by:**					**Date:**		
Depth (mm)	**Descriptor**	**Moisture**	**Color**	**Consistency**	**Structure**	**Size**	**Other**		**Sample**
to									
to									
to									
to									
to									
to									
Surface/layer bond									

Checklist	Cracks		Description							
	Rutting		Pumping		Interface bond		Moisture at interface		Layer definition	
	Carbonation									
Other										

PAVEMENT PRESERVATION EXPERIMENT INVESTIGATION - PHOTOGRAPHS				Form 11
Section No		Date		
Evaluator				

Photo number	Location	Description	Storage disc

PAVEMENT PRESERVATION EXPERIMENT DENSITY & MOISTURE CONTENT								Form 12
Section No			**Date**			**Evaluator**		
Calibration	Prv	Std	Std	Std		**Calibrated by**		
Std MC						**Calibration date**		
Std wet density								

	Probe	Input	Actual	Wet	Dry	MC	Notes
Panel A	24	200	600				
	22	200	550				
	20	200	500				
	18	200	450				
	16	200	400				
	14	200	350				
	12	200	300				
	10	200	250				
	8	200	200				
	6	150	150				
	4	100	100				
	2	50	50				
Panel B	24	200	600				
	22	200	550				
	20	200	500				
	18	200	450				
	16	200	400				
	14	200	350				
	12	200	300				
	10	200	250				
	8	200	200				
	6	150	150				
	4	100	100				
	2	50	50				
Panel C	24	200	600				
	22	200	550				
	20	200	500				
	18	200	450				
	16	200	400				
	14	200	350				
	12	200	300				
	10	200	250				
	8	200	200				
	6	150	150				
	4	100	100				
	2	50	50				

Gravimetric moisture content

	Sample depth	Tin No	Moisture content	Actual dry density	Notes
Test A					
Test B					
Test C					

Validated by		**Signature**	

PAVEMENT PRESERVATION EXPERIMENT DCP RECORDING SHEET							Form 13	
Section No			Panel		Date		Operator	
Position A			Position B			Position C		
0			0			0		
5	205	405	5	205	405	5	205	405
10	210	410	10	210	410	10	210	410
15	215	415	15	215	415	15	215	415
20	220	420	20	220	420	20	220	420
25	225	425	25	225	425	25	225	425
30	230	430	30	230	430	30	230	430
35	235	435	35	235	435	35	235	435
40	240	440	40	240	440	40	240	440
45	245	445	45	245	445	45	245	445
50	250	450	50	250	450	50	250	450
55	255	455	55	255	455	55	255	455
60	260	460	60	260	460	60	260	460
65	265	465	65	265	465	65	265	465
70	270	470	70	270	470	70	270	470
75	275	475	75	275	475	75	275	475
80	280	480	80	280	480	80	280	480
85	285	485	85	285	485	85	285	485
90	290	490	90	290	490	90	290	490
95	295	495	95	295	495	95	295	495
100	300	500	100	300	500	100	300	500
105	305	505	105	305	505	105	305	505
110	310	510	110	310	510	110	310	510
115	315	515	115	315	515	115	315	515
120	320	520	120	320	520	120	320	520
125	325	525	125	325	525	125	325	525
130	330	530	130	330	530	130	330	530
135	335	535	135	335	535	135	335	535
140	340	540	140	340	540	140	340	540
145	345	545	145	345	545	145	345	545
150	350	550	150	350	550	150	350	550
155	355	555	155	355	555	155	355	555
160	360	560	160	360	560	160	360	560
165	365	565	165	365	565	165	365	565
170	370	570	170	370	570	170	370	570
175	375	575	175	375	575	175	375	575
180	380	580	180	380	580	180	380	580
185	385	585	185	385	585	185	385	585
190	390	590	190	390	590	190	390	590
195	395	595	195	395	595	195	395	595
200	400	600	200	400	600	200	400	600
Validated by					Signature			