Foundation for

Pavement Preservation

2001

Pavement Preventive Maintenance Guidelines

Strategies for initiating new or improving existing pavement preventive maintenance programs

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FP²

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BACKGROUND

Pavement preventive maintenance (PPM) programs have been successful in many agencies. However, other agencies are presently struggling to find ways to initiate such programs. This study is designed to identify the goals, needs and barriers relating to PPM programs throughout the USA, develop strategies for success, and assemble the information into a simple guide to be used by agencies wanting to initiate new or improve upon existing PPM programs.

This study is sponsored by the Foundation for Pavement Preservation (FP2). FP2, established in 1992, provides resources to advance knowledge for managing and preserving pavements. FP2 supports research to educate government and industry professionals in the economical, safety, and performance advantages of pavement preservation.

One of the most important elements of the study was collecting information from the agencies regarding their goals in the PPM arena and barriers in the way to their success. To accomplish this, a survey (see Annex A) was sent to the members of the AASHTO Subcommittee on Maintenance. A summary of the information received from the 34 responding agencies is found in Annex B. The agencies were also asked to address the state of their PPM programs, budget levels, funding sources and distribution of resources. This information is summarized in Annex C.

The guidelines that follow were developed from generally accepted knowledge of PPM principles and processes along with information received from the agencies. The guidelines are meant to provide basic information to those agencies embarking on PPM as a new or improved way of doing business, and to provide them with some strategies that have proven successful elsewhere. The guidelines will answer the following questions:

- What is pavement preventive maintenance?
- Why become involved with pavement preventive maintenance?
- What are the benefits of pavement preventive maintenance?
- What are the barriers and/or potential pitfalls to the development of a pavement preventive maintenance program?
- What are the steps necessary to implement a pavement preventive maintenance program?

PAVEMENT PREVENTIVE MAINTENANCE GUIDELINES

What is Pavement Preventive Maintenance?

Preventive maintenance is a relatively new concept for most highway agencies. Therefore, not surprisingly, there has been widespread misunderstanding and confusion throughout the transportation community over what preventive maintenance is and what it isn't. This has led, in some cases, to lack of agency and public support for Preventive Maintenance. As practitioners become more familiar with the concepts and tools of preventive maintenance, the definition offered by the AASHTO Standing Committee of Highways is gaining acceptance.

AASHTO defines preventive maintenance as: …*the planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without substantially increasing structural capacity).*

Pavement preventive maintenance narrows that focus to the application of one or more treatments, generally to the surface of a structurally sound roadway.

AASTHO's Lead State Team on Pavement Preservation summed things up quite nicely by defining pavement preventive maintenance as,

Applying the right treatment to
the right pavement at the right time.

Why Become Involved with Pavement Preventive Maintenance?

Traditionally, highway agencies have allowed the ride quality and structural condition of a pavement to deteriorate to fair to poor condition before taking steps to rehabilitate the pavement. The aim of rehabilitation is to repair structural damage and restore measurable pavement conditions such as ride, rutting and cracking. This is costly and time consuming activity with associated traffic disruptions and inconvenience to adjacent businesses and residences. This "worst-first" scenario came about for many reasons, including the requirements for Federal-aid funding, the maximization of capitol growth, and a long-standing philosophy of, "If it ain't broke, don't fix it."

Highway agencies have found that applying a series of low-cost preventive treatments can extend the service lives of their pavements. This translates into a better investment, better ride quality, and increased customer satisfaction and support.

The experience with pavement preventive maintenance in a number of agencies demonstrates this success – each dollar spent now has been estimated to save up to six dollars in the future.

What Are the Benefits of Pavement Preventive Maintenance?

The benefits associated with pavement preventive maintenance, both perceived and documented, vary from agency to agency depending not only upon a particular agency's strategic objectives, but also on what stakeholder is promoting the concept. For example, the traveling public will be most attracted to improved ride, while the pavement management engineer will find value in the fact that overall condition of the network will improve over time, and the executive management of an agency will be drawn to the reported cost savings.

The benefits most often associated with successful pavement preventive management programs are listed below. Although not all these benefits are currently being measured, they are the ones that appear repeatedly in the literature and practitioner discussions:

Higher Customer Satisfaction – Nationwide, surveys commissioned by the National Quality Initiative and the Rebuild America Coalition as well as studies undertaken in Arizona, California, and Washington have reported that a focus on customer satisfaction should be a part of every preventive maintenance program. The surveys indicated that, for the most part, motorists recognize that a well-maintained highway system is important in terms of enhanced safety, mobility and pavement conditions. Furthermore, the general public is willing to pay more in taxes to achieve this goal.

Clearly, the end results of an effective pavement preventive management program are smoother pavements, fewer delays for reactive maintenance activities such as pothole patching, and less disruptions for major rehabilitation projects. These positive changes will be noticed and supported by the traveling public.

Better Informed Decisions – Agencies with successful pavement preventive maintenance programs have a proven track record of applying the, "right treatment to the right pavement at the right time." This does not simply happen, of course, since PPM programs are based on a combination of past performance history, current conditions of the existing pavements, and expected performance of the different treatment options available. The availability of and accessibility to information are critical elements to the success of any PPM program.

While better-informed decisions are important benefits of a PPM program, getting the necessary information collected and assembled into a usable format presents a formidable challenge to most agencies. Please see further discussion in the *Barriers* section, below.

Improved Strategies and Techniques – As an agency ventures into the PPM arena, it quickly becomes clear that preventive maintenance treatments must provide the highest level of performance possible. Improved methods or materials, or a combination of the two, can accomplish increased performance. As a result of these increased needs and demands, many of today's materials have been designed to provide improved performance. Industry has also stepped to the plate in this regard, by developing new application methods and equipment that add to the overall performance of the treatments.

While the initial costs of the new and improved treatments may be higher in some cases, the expected life of the treatments is going to be much greater than conventional applications. The net effect is an overall reduction in maintenance costs.

Improved Pavement Condition – Successful pavement preventive maintenance programs have been shown time and again to extend the performance cycle of individual pavements and entire networks. This benefit is also one of the better measured and documented. Some of the agencies with excellent supporting data in this regard include New York, Michigan, Wisconsin, California and Ohio.

Cost Savings – From an agency standpoint, one of the most significant benefits of pavement preventive maintenance programs is financial. Historically, true cost savings are one of the most elusive benefits to document. There have been comparisons made of treatment strategy costs over theoretical pavement networks, in which the effects on the overall condition of the pavement network for the given treatments are compared. These comparisons have documented a theoretical cost savings for PPM. Unfortunately, for existing roads what is available is a comparison between the historic costs of reactive maintenance and the anticipated costs of a preventive maintenance strategy.

Cost savings are easier to document if an agency has made a commitment to providing a certain level of service, such as maintaining a ride quality or a threshold pavement condition index. In these cases, it can be shown that the agency can consistently provide a higher level of service with a PPM program than without.

Nonetheless, some agencies that have active pavement preventive programs feel they can see substantial financial advantages. Michigan ($700 million since 1992) and California (a 4:1 to 6:1 benefit with preventive maintenance treatments) are reporting the benefits of their PPM programs. These savings are generally realized in the form of better overall pavement condition, or the same condition for a reduced cost, rather than a decrease in revenue required.

Increased Safety – From the customer's viewpoint, improving safety is priority number one. Safety is also high on the national level; the Federal Highway Administration has a Strategic Plan Goal to reduce fatal and injury crash rates 20 percent over 10 years.

By their very nature, pavement preventive maintenance programs provide measurable safety benefits. Today's improved treatments can be relied upon to provide better surfaces, from better aggregate retention to fewer safety related defects such as ruts, raveling and potholes. This resultant improved surface texture has a direct positive influence on surface friction (both wet and dry), surface water spray and road noise. In addition, pavements in better overall condition require fewer and less disruptive repairs. This translates into less exposure of the traveling public and contractor personnel to the hazards of construction activities.

The agencies were asked to identify the benefits they considered important in a pavement preventive maintenance program, along with whether or not there were measurements in place to document these benefits. As can be seen in Annex B (question 4), the identified benefits of pavement preventive maintenance are considered important by nearly every agency responding

to the survey. Also, with the exception of Improved Pavement Condition which can by readily measured by an agency's Pavement Management System (PMS), agencies are struggling to subjectively measure the benefits gained from their PPM programs. However, intuitively and anecdotally, the benefits are real.

What are the Barriers and/or Potential Pitfalls to the Development of a Pavement Preventive Maintenance Program?

In some agencies, the development of a pavement preventive maintenance program is a major shift in philosophy, impacting not only agency staffs but external stakeholders as well. As with any change, progress is oftentimes slow and met with barriers, both real and perceived. Some of the most common barriers agencies face when developing a pavement preventive maintenance program are outlined below:

Public Perception – Motorists are accustomed to seeing roads deteriorate to a certain level before repairs are made. And, usually the roads in the worst shape have received the most attention both from the motorists in the form of complaints and from the agencies in terms of a worst-first rehabilitation strategy. Pavement preventive maintenance programs steer work toward pavements that are in relatively good condition and away from pavements that are failing.

A common concern among agency personnel who wish to move away from this worst-first philosophy is that the public will never accept this change. However, recent surveys have shown that the public is interested in sound fiscal practice, improved pavement performance, and shorter and fewer delays. With proper information and education, this interest could be channeled into support of an agency's pavement preventive maintenance program.

Management Perceptions – The status of maintenance activities has historically been low with the management of most public agencies. There has always been more management interest (and Federal funding for that matter) in building new roads than maintaining existing ones.

While the engineering climate is right to support the shift to pavement preventive maintenance, management support needs to be fostered and strengthened. This will be an ongoing effort since the management level in many agencies is the one that changes the most.

Research Needs – Actual data to support and promote the advantages of pavement preventive maintenance programs are difficult to locate, or oftentimes do not exist. This lack of "hard proof" makes it difficult for agencies to convince decision makers that the move from the old worst-first way of doing business to a preventive maintenance approach makes good business sense, especially in light of stakeholder concerns and complaints.

Training – owner agencies and contractors have successfully constructed various maintenance treatments for years. However, in the emerging field of pavement

preventive maintenance it is not enough to simply be familiar with mechanics of applying high quality surface treatments. There is a need to be able to select candidate projects and identify the appropriate treatments and timing of those treatments.

Just-in-time training is needed to get necessary information to those who need to know, when they need to know it.

Data Management – Performance monitoring of pavement preventive maintenance treatments is necessary to enable agencies to identify what works and what doesn't. Unfortunately, for the most part, only minimal performance monitoring has been performed on maintenance treatments, usually as a part of research projects.

The objective of maintenance is to recognize a problem, fix it, and move on to the next problem. This is no time and little interest in monitoring the performance of past work. However, if the status of pavement preventive maintenance is to be raised from its current level, performance monitoring must become the standard practice within agencies.

Dedicated Funding Challenges – Because applying pavement preventive maintenance treatments at the proper time is critical, funding for PPM work must be dedicated and predictable. A fact of life within most agencies is that priorities can shift with changes in political climate, agency management or funding structure. A program that is strategic to an agency today may be cut back or eliminated tomorrow by reducing or diverting to other programs, staffing, funding or both.

Pavement preventive maintenance programs are particularly susceptible to funding variability. Since PPM programs require treatments applied on a regularly scheduled cyclical basis, any gaps in funding will decrease the overall conditions of the agency's network. This, in turn, tends to push the agency back into a worst-first programming mode.

Crew Acceptance – Buy-in at all levels within an organization is critical to the success of pavement preventive maintenance initiatives. One of the levels too often ignored when changes are made is the crew level where the work actually gets done.

Crews often feel threatened with changes to the way they have historically done business. They perceive these changes as an indication that their prior work methods and strategies were unsatisfactory and/or not valued. These feelings of discontent, if not addressed, will get PPM programs off to a tenuous start and may most likely doom them to failure.

Agencies with existing or developing pavement preventive maintenance programs were asked to identify and prioritize barriers encountered during the development of their programs. This information is recapped in Annex B (Questions 5a and 5b).

What are the Steps necessary to implement a pavement preventive maintenance program?

The successful implementation or modification of any agency's pavement preventive maintenance program involves identifying the specific needs for the development of a successful program. Furthermore, the agencies must develop strategies to meet these needs. While each agency will approach this process in a manner that is best suited to its individual situation, it is useful to know what other agencies in similar circumstances have done.

As part of the *Pavement Preventive Maintenance Survey* (Survey) Annex A, the agencies were asked to list what they consider their top needs in the development of a successful PPM program. The top identified needs are listed below with the number of agencies indicating that particular need in parentheses:

Adequate/Dedicated Funding (16)
Top Management Support/Commitment (13)
Data Collection and Management (12)
Crew Acceptance (5)
Training (6)
Improved Models/Project Selection (6)
Legislative Support (5)
Publicity (2)

Using responses from the Survey, information presented in NHI Course No. 13154, *Pavement Preventive Maintenance*, and conventional wisdom, some strategies and lessons learned relating to these critical needs are presented below.

Clearly, each of the needs does not necessarily stand on its own. They are interrelated. For example, success of fund requests and management commitment are contingent upon current, accurate, and objective data showing that PPM is effective. For this reason, some of the recommended strategies can be applied to more than one need.

A brief summary of the identified needs follows:

Adequate/Dedicated Funds – Agencies that have succeeded in implementing pavement preventive maintenance programs recognize the importance of obtaining an adequate, secure, and ongoing source of funds. The establishment of dedicated funds helps to ensure that a stable flow of funding is provided to enable the agency to apply the necessary techniques in a timely manner. Annex C contains information regarding PPM funding levels, sources of funds, and distribution of these funds among treatment types, for the past 5 years.

Top Management Support Commitment – Establishment of an effective pavement preventive maintenance program requires top management commitment and support. There are many demands on agency resources and those programs supported at the highest levels have the best chance of succeeding.

Data Collection and Management – Objective, accurate, repeatable measurements are critical to the success of pavement preventive maintenance programs. Most agencies rely on their Pavement Management Systems to provide the needed information. In most

cases, modifications to the PMS are required to capture the information necessary to fully support the PPM program.

Crew Acceptance – In order for a pavement preventive maintenance program to be successful, those responsible for performing and monitoring the work must buy-in to the philosophies and concepts of PPM. If those people doing the work do not support it, the chances of success are unlikely.

Training – The concepts and philosophies of pavement preventive maintenance are new to most agencies. In fact, PPM is a major shift in direction, requiring not only knowledge of the technical and mechanical aspects of the work, but also an understanding and appreciation of the overall purpose of PPM as well.

Improved Models/Project Selection – There are numerous pavement preventive maintenance treatment options available for both asphalt concrete and Portland cement concrete pavements. Some of the options are appropriate, others are not. In order to choose "the right treatment at the right time," agencies need to develop a treatment selection process based on performance and life cycle costs. In most cases, this is much easier said than done.

Legislative Support – Most agency budgets and major fund requests are touched in some way by the Legislative process. Therefore, Legislative support is a critical element in the success of an agency's pavement preventive maintenance program. If a program isn't funded to an adequate and consistent level, it won't happen.

Publicity – Pavement preventive maintenance does not make news; there are no ribbon cuttings or groundbreaking ceremonies. In fact, many people question the wisdom/rational of a program that devotes resources to well-performing pavements, while pavements clearly in need of repair are ignored. The public is interested in sound fiscal practices. With proper information and education, this interest can be channeled into support of a PPM program.

Recommended strategies to meet these needs are listed below. In general, these strategies have been reported by states with successful pavement preventive maintenance programs. For the most part, the strategies are self-explanatory and are listed as simple bullets:

1. Develop a plan that demonstrates the benefits of preventive maintenance to obtain money to fund the plan.
2. Promote the plan externally to obtain funds and internally to achieve acceptance of the concept.

3. Steps need to be taken to shift funding toward preventive maintenance activities.
4. An agency must have patience and realize that benefits of the program won't be evident immediately.
5. Being able to minimize the amount of time in which contracts can be turned over is important so that pavement conditions do not deteriorate further.
6. In a centralized organization, special efforts must be made to involve field personnel in the decision process.
7. Keep pavement preventive maintenance projects simple.
8. Initially, don't flood the industry with work. Start small, and increase the program as the industry builds up and matures.
9. Work with industry to jointly develop specifications for preventive maintenance treatments.
10. Don't oversell the concepts of pavement preventive maintenance.
11. Programs need to be adaptable to changes in treatment costs, types and performance.
12. Monitor the program and if some elements don't work, fix them.
13. Work collegially with industry to solve problems.
14. Establish Goals – It is difficult to introduce a new program or maintain an existing one if it does not have a stated purpose. Goals need to be simple and measurable and meet customer and agency needs. Examples of measurable goals are:
    a. Pavement condition
    b. Average structural rating
    c. Percent of pavements in a condition category
    d. Cost savings
15. Document and Promote the Benefits – Once a pavement preventive maintenance program is implemented, the effort must continue. If those establishing policy cannot see the benefits, funding will most likely be discontinued.
16. Obtain Dedicated Funding – An adequate, consistent and ongoing flow of funds into any program is a significant accomplishment. The agencies successful in getting funds dedicated to pavement preservation maintenance programs have used one of the three following sources:
    a. New money (revenue enhancement)
    b. Available funds from other programs
    c. Increased flexibility with Federal funds
17. Funding levels should match preventive maintenance needs.
18. Develop and Improve Treatments and Timing
    a. Don't become complacent
    b. Monitor feedback
    c. Modify guidelines
    d. Develop Manuals of Practice
19. Provide public community speakers to educate the public on the benefits of a PPM program.
20. Develop video for maintenance use.
21. Conduct focus groups on perception of how well an agency performs maintenance with some emphasis on pavements.
22. Meetings with system preservation theme in 2000 and 2001 for key managers.
23. Advocated research with NCHRP, TRB, etc.
24. We have sponsored NHI courses, held workshops, etc., to emphasize the importance of PPM.

25. “Best Practices” Manual (or users guide) to be developed.
26. Rely upon the “expertise of experience” to determine appropriate PPM treatment timing.
27. Hold annual reviews of older PPM treatments to determine performance.

Table 1, *Strategies for Meeting the Implementation Needs of a Pavement Preventive Maintenance Program,* incorporates the information presented above in a matrix format. Several of the strategies presented are applicable to more than one need, as indicated in the table.

Table 1 - *Strategies for Meeting the Implementation Needs of a Pavement Preventive Maintenance Program*

Strategies	Needs							
	Adequate/ Dedicated Funding	Top Management Support/ Commitment	Data Collection and Management	Crew Acceptance	Training	Improved Models/ Project Selection	Legislative Support	Publicity
1. Develop a plan	✓	✓		✓			✓	
2. Promote the plan externally	✓	✓		✓			✓	✓
3. Shift funding to PM activities	✓							
4. Patience is necessary	✓	✓	✓	✓	✓	✓	✓	✓
5. Minimize contract prep time		✓		✓			✓	
6. Involve field personnel		✓	✓	✓	✓			
7. Keep PPM projects simple		✓		✓				✓
8. Phase new treatments in		✓		✓				✓
9. Develop specs with industry		✓		✓	✓			✓
10. Don't oversell PPM concepts	✓	✓		✓		✓		
11. Programs must react to change	✓	✓		✓	✓	✓		
12. Monitor and revise as necessary	✓	✓	✓	✓		✓	✓	✓
13. Work collegially with industry	✓	✓		✓	✓		✓	✓
14. Establish goals	✓	✓	✓			✓		
15. Document and promote benefits	✓	✓		✓	✓	✓	✓	✓
16. Obtain dedicated funding	✓							
17. Funding levels should match needs		✓		✓				
18. Develop and improve treatments	✓		✓	✓	✓	✓		
19. Public community speakers					✓		✓	✓
20. Video for maintenance use				✓	✓			✓
21. Focus groups	✓	✓					✓	✓
22. Informational meetings	✓	✓		✓	✓			✓
23. Research w/ NCHRP, TRB, etc.			✓		✓	✓		
24. Sponsor NHI and other training		✓		✓	✓			
25. "Best Practices" Manual		✓		✓	✓			
26. Rely upon the staff experience			✓		✓	✓		
27. Annual reviews of PPM treatments	✓	✓	✓	✓		✓		

Note: The numbering of the Strategies listed in this table is consistent with the numbering of the Strategies outlined on pages 9 and 10.

CONCLUSION

For most agencies, the philosophy of pavement preventive maintenance – applying the right treatment at the right time – represents a dramatic change in philosophy, strategy and direction. Previously, the most common approach to project selection within a network was the worst-first strategy. In this case, the pavements that are selected for treatment are those that are closest to failure. Accordingly, the treatments that are applied are more expensive, more time-consuming to construct, and are generally short-lived.

Pavement preventive maintenance programs begin, either formally or informally, with the concept that cost-effective treatments can be applied earlier in a pavement's life. These treatments are thinner, are very cost-effective, are constructed relatively rapidly with minimal disruption to the motoring public, and reach or exceed their design lives because they are applied to pavements that are in generally good condition.

Most public agencies face financial constraints and must make choices about how to spend their limited transportation dollars. Even with dedicated pavement preventive maintenance funding, a choice must be made how to maintain pavements. Where constraints are present, preventive maintenance and worst-first strategies are incompatible. A program in which the worst pavements are treated first, with remaining funds (if any) going to preventive treatments, is destined for failure. The failing treatments will require the lion's share of the funding, and the treatments applied to them will not perform well, discrediting the overall program. With insufficient funds remaining to apply the right treatment to the right pavement at the right time, program failure is all but assured.

Without a doubt, the barriers preventing agencies from making a shift to the pavement preventive maintenance approach are many and varied. Nonetheless, these barriers are being challenged and brought down. Studies have shown that the public is ready to embrace the pavement preventive maintenance approach. Any changes that result in better riding pavements, improved safety, and fewer delays due to continuous maintenance and rehabilitation are welcomed. At the same time, research is proving the benefits of both a number of individual treatments as well as the overall contribution of preventive maintenance programs to the health of the pavement network. These results have been used to secure and augment dedicated funding to continue the programs.

The likelihood of success of pavement preventive maintenance programs can be improved by following a well-planned out implementation process. While every agency will approach the process in a manner that is best suited to its particular situation, the most successful approaches have included the following steps:

- Develop a measurable goal for the program.
- Implement a means of assessing and documenting the benefits of a program to the agency, legislature, and public.
- Seek and obtain dedicated funding.

In addition, several agencies have introduced innovative practices such as simplified contracting procedures and warranties as a means of further ensuring the success of their programs.

During the development of the materials for NHI Course No. 13154, *Pavement Preventive Maintenance*, five state highway agencies that have successfully implemented pavement preventive maintenance programs were identified and visited. Each of these agencies is unique in its organizational and administrative structure, geography, and its approach to the implementation and perpetuation of pavement preventive maintenance programs. The experience of each of these agencies can be very valuable to those agencies embarking on similar programs. To facilitate an exchange of information, the names of the contacts from four of the states are provided below.

Agency	Contact	Phone
California	Larry Orcutt, Program Manager – Maintenance	(916) 654-5849
Michigan	Larry Galehouse, Pavement and Roadside Engineer	(517) 322-3315
New York	Edward Denehy, Transportation Maintenance Div.	(518) 457-6914
Texas	Joe Graff, Deputy Director - Maintenance Division	(512) 416-3195

ANNEX A

PAVEMENT PREVENTATIVE MAINTENANCE SURVEY

(CIRCULATED NOVEMBER 2000)

AGENCY :		DATE:
NAME:	TITLE / AREA OF RESPONSIBILITY:	
PHONE NUMBER:		E-MAIL:

Definitions used in the Survey

Preventative Maintenance is a tool for pavement preservation and as defined by AASHTO, a planned strategy of cost-effective treatments to an existing roadway and its appurtenance that preserves the system, retards deterioration, and maintains or improves functional condition without substantially increasing structural capacity. **P**avement **P**reventative **M**aintenance (PPM) narrows that focus to the application of one or more treatments to the surface of a structurally sound roadway. Or in other words, Pavement Preventative Maintenance is *applying the right treatment, to the right pavement, at the right time.*

1. Does your state currently have a Pavement Preventative Maintenance program? Yes ❒ No ❒

   Comments:_____

1a. If Yes, does it meet your needs? Yes ❒ No ❒

   Comments:_____

1b. If No, are you interested in pursuing a PPM program? Yes ❒ No ❒

   Comments:_____

2. Does your state have a dedicated budget for its Pavement Preventative Maintenance program? Yes ❒ No ❒

   Comments:_____

2a. If Yes, What level of annual funding is dedicated?

   ❒ < $10 M ❒$10 to $25 M

   ❒ $25 to $50 M ❒$50 to $75 M

   ❒>$75 M

   Comments:_____

3. If your state has a dedicated budget for PPM, are there funds appropriated for specific treatments (i.e. thin overlays, chip seals, microsurfacing, etc.)? Yes ❒ No ❒

   Comments:_____

3a. If Yes, please list the treatment types with the approximate percent of budget allocated to each type.

Treatment Type	% of PPM Budget
_____	_____ %
_____	_____ %
_____	_____ %
_____	_____ %
_____	_____ %

4. Listed below are benefits/goals frequently associated with successful PPM programs. Please check the appropriate boxes.

Benefits/Goals	Consider Important	Measures in Place
Higher Customer Satisfaction	❒ Y ❒ N	❒ Y ❒ N
Better Informed Decisions	❒ Y ❒ N	❒ Y ❒ N
Improved Strategies & Techniques	❒ Y ❒ N	❒ Y ❒ N
Improved Pavement Conditions	❒ Y ❒ N	❒ Y ❒ N
Cost Savings	❒ Y ❒ N	❒ Y ❒ N
Increased Safety	❒ Y ❒ N	❒ Y ❒ N
Other (Please Identify)	❒ Y ❒ N	❒ Y ❒ N
Other (Please Identify)	❒ Y ❒ N	❒ Y ❒ N

Comments:_____

_____

_____

5. There are a number of barriers that agencies face when developing PPM programs. The most common barriers are listed below.
   A. **Public Perceptions** - Motorists will not accept the move from a worst-first strategy.
   B. **Management Perceptions** - The status of maintenance activities has historically been low with the management of most public agencies.
   C. **Research Needs** - Actual data to support and promote the advantages of PPM programs are difficult to locate, or simply do not exist.
   D. **Training** - Confusion surrounding many of the issues central to PPM is widespread. Training is needed to get necessary information to those who need to know.
   E. **Data Management** - Performance monitoring of PPM treatments is necessary to enable agencies to identify what works and what doesn't.
   F. **Dedicated Funding Challenges** - Because applying preventative maintenance treatments at the proper time is critical, funding for PPM must be dedicated and predictable.
   G. Other (Please Identify)_____

      _____
   H. Other (Please Identify)_____

_____

5a. If your State currently has a PPM program, please prioritize the five most significant barriers you encountered while developing your program, with the most significant being number one**.** Please include a brief description of the actions you undertook to overcome these barriers along any written policies/documentation you might have in that regard.

Barrier 1_____

Action(s) Taken:_____

_____

Barrier 2_____

Action(s) Taken:_____

_____

Barrier 3_____

Action(s) Taken:_____

_____

Barrier 4_____

Action(s) Taken:_____

_____

Barrier 5_____

Action(s) Taken:_____

_____

5b. If you are currently developing or revising your PPM program, please prioritize the five most significant barriers you are facing. If available, please include a brief description of the strategies you are using to overcome these barriers, along with any supporting documentation you might have.

Barrier 1_____

Strategy:_____

_____

_____

Barrier 2_____

Strategy:_____

_____

_____

Barrier 3_____

Strategy:_____

_____

_____

Barrier 4_____

Strategy:_____

_____

_____

Barrier 5_____

Strategy:_____

_____

_____

6. Please list what you consider to be your top three needs to the development of a successful PPM program.

   1._____

   2._____

   3._____

7. Regarding the administration of your state's PPM program. How would you characterize the distribution of PPM funds?

   Centralized ❒ De-Centralized ❒ Combination ❒

   Comments:_____

   _____

   _____

7a. How would you characterize the selection of PPM treatments?

   Centralized ❒ De-Centralized ❒ Combination ❒

   Comments:_____

   _____

   _____

7b. Are PPM activities tied to your state's Pavement Management System? Yes ❒ No ❒

   If yes, how?:_____

   _____

   _____

8. The Foundation for Pavement Preservation is interested in working with states, individually, to develop strategies to meet their specific needs for initiating or improving their PPM programs. Are you interested in this service?
   Yes ❒ No ❒

   Comments:_____

   _____

   _____

9. Please indicate the person or persons most familiar with your agency's PPM program and who would be available to answer questions, if they should arise.

   Name:_____

   _____

   Title/ Responsibility:_____

   _____

   _____

   Phone Number:_____

   _____

We appreciate you taking the time to complete this survey. An electronic version is an available by contacting Dennis Jackson at djackson@kbacm.com. **Please complete and return this survey on or before November 17, 2000 in the enclosed envelope or by fax (425) 455-9732. The mailing address is:**

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Bellevue, WA 98004

ANNEX B

Pavement Preventive Maintenance Survey - Recap

Questions 1, 2 and 3: The agencies were asked to address the state of their PPM programs. The number of agencies responding to each question is noted in (parentheses).

Question			Comments
1. Does your agency currently have a PPM program?	Yes (23)	No (10)	(a) thru (j)
1a. If yes, does it meet your needs?	Yes (18)	No (5)	(k) thru (p)
1b. If no, are you interested in pursuing a PPM program?	Yes (10)	No (5)	(q) thru (s)
2. Does your agency have a dedicated budget for its PPM program?	Yes (18)	No (11)	(t) thru (x)
2a. If yes, what level of annual funding is dedicated?	<$10M (4) $10-$25M (6) $25-$50M (5)	$50-$75M (3) $75-$100M (0) >$100M (2)	(y) thru (z)
3. If a PPM budget is dedicated, are there funds appropriated for specific treatments?	Yes (12)	No (9)	(aa) thru (cc)
3a. If yes, please list treatment types with approximate percent of budget allocated to each type.	Thin overlays Chip seals Crack sealing PCCP Joint Sealing Flush seals Microsurfacing Surface renewal Diamond Grinding	0% to 95% 25% to 70% 5% to 50% 0% to 12% 0% to 10% 0% to 59% 0% to 7% 0% to 5%	

Comments

(a) Now in second year (NV)
(b) Under development (AB) and (MO)
(c) Since 1992 (NY) and (MI)
(d) As part of our contract maintenance money (KS), (OK)
(e) Although PPM treatments are done throughout the state, there is not a program with dedicated funds (ID
(f) The program is managed under maintenance contracts (LA)
(g) History is not readily available on various PP techniques (NC)
(h) Evolved from general best practices to more structured process (BC)
(i) Inadequate funds (NS), (IL)
(j) PM projects are not programmed systematically (TN)
(k) Realize cost savings, extending pavement life (NV)
(l) We are making progress after years of inactivity (RI)
(m) Within the limits of the budget (LA)
(n) We struggle to fund the program each year. We aren't sure if we are using the right cycle times (UT)
(o) We are applying PP but still concentrating more on worst-first (NC)
(p) The program is continually improved and expanded (MI) and (KS)
(q) Funding is set aside in 5th year of capital program (AZ)
(r) We are in the development stage (NC), (TN)
(s) Need a statewide effort at PPM (KS)
(t) Programmed in 3R program from Materials Division. Coincides with Maintenance Betterment Program (NV)
(u) Only for project level activities (e.g. seal coat program) (AB)
(v) Pavement and bridge PM funds are included as a budget line item (NY)
(w) We have a high level of commitment to PM, but funding is not dedicated (UT)
(x) As part of Maintenance funding. Legislature appropriates funds specifically for contract resurfacing (NC)
(y) Needs annual approval. Not pre-programmed (NV)
(z) We consistently spend between $30 and $ 50M for PM, but it is not dedicated money (UT)
(aa) Treatments are selected with an asset management system, based on optimum return of investment (SK)
(bb) Region staffs are free to select specific treatments, but overall budget is based on a mix of treatments (UT)
(cc) Funding is dedicated for contract resurfacing, which is generally HMA overlays (NC)

Question 4: The agencies were asked to identify the benefits they considered important in a pavement preventive maintenance program, along with whether or not there were measurements in place to document these benefits. The number of agencies responding to each question is noted below.

Benefits	Consider Important		Measurements in Place	
	Yes	No	Yes	No
Higher customer satisfaction	25	2	8	19
Better informed decisions	25	4	10	16
Improved strategies and techniques	25	2	12	14
Improved pavement condition	27	1	20	7
Cost savings	26	2	13	14
Increased safety	24	4	11	16
Increased understanding by those in DOT outside PPM program	1	-	-	1

Comments

(a) Need public feedback mechanism (NV)
(b) Asset management systems monitor condition combined with internal processes for feedback (BC)
(c) Working to improve decision making skills (IN)

Questions 5a and 5b: The agencies were asked to prioritize the most significant barriers they encountered or are encountering in developing their PPM programs and to include any actions taken to overcome these barriers.

Barriers are in boldface followed by the agencies listing the particular barriers and the priority of that barrier for that agency. Actions taken are indented below the barrier.

Public Perceptions – NV-#1, SK-1, RI-#2, MT-#1, NC-#5, CA-#4, GA-#5, MI-#5, NS-#1, ME-#1, AK-#2

No specific action taken (NV)
Public community speakers, video for maintenance use (SK)
This is not yet fully dealt with (RI)
Answer questions as they are asked (MT)
Conducting focus groups on perception of how well we perform maintenance with some emphasis on pavements (NC)
Districts publicizing the benefits of PM and pavement life vs. $$$ (CA)
Public was willing to have the best maintained highways as long as not taxed burdened (GA)
Educate the public on the benefits of a PPM program (MI)

Management Perceptions – AB-#4, WY-#3, SK-#4, RI-#4, MT-#2, NC-#1, CA-#1, KS-#3, GA-#2, TN-#3, IL-#1, ME-#3, AK-#3

Management fully supports the concept of the proposed PPM (AB)
Evolution over a period of time (WY)
Informal communications, performance measures (SK)
Established a dedicated budget and review of Pavement Management System (MT)
Hold meetings with system preservation theme in 2000 and 2001 for key managers (NC)
Illustrated the low cost/lane mile, used PMS to show the reduction in distressed miles (CA)
Not a problem since most have good maintenance background (KS)
Upper Management recognized the need for committed funding and how to utilize all available funds such as Federal funds to maintain pavement (GA)
Earmarked funds for contract maintenance selected by maintenance engineers (IL)

Research Needs – AB-#1, NY-#5, WA-#2, RI-#1, UT-#3, MO-#2, BC-#2, KS-#4, GA-#4, NS-#5

A plan to collect Surface Condition Data has been implemented to support SDI, IRI and rating (AB)
Advocated continued research with NCHRP, TRB, etc. (NY)
Lack of research to specifically correlate maintenance treatments to extension of pavement cycle life (WA)
Many of the techniques are new to us (RI)
We still don't have good answers about how often PM treatments should be applied (UT)
Need to be able to articulate definite cost savings and benefit to state to obtain funds (MO)
Monitor other states (BC)
Have not done much. Our decisions are based on engineering judgment only (KS)
Research was going on for the best pavement methods as a primary preventative maintenance program. Other areas needed to be considered such as crack sealing, shoulder maintenance, drainage, etc (GA)

Training – NV-#3, AB-#5, NY-#4, WY-#2, RI-#3, UT-#4, NC-#4, CA-#3, MO-#4, KS-#5, MI-#4, NS-#4, AK-#5

Inform all. Some presentations to management and troops (NV)
Training of data collectors is fully QC/QA and users have been involved in all stages of development and implementation (AB)
Instituted training programs for maintenance personnel (NY)
Offer training on techniques and benefits (WY)
We are still learning (RI)
We have sponsored NHI courses, held workshops, etc., to emphasize the importance of PM (UT)
Overcoming the philosophy to do worst first through NHI training on PPM (NC)
Meetings statewide with District managers to demonstrate the benefits of PM (CA)
"Best Practices" manual (or user's guide) to be developed (MO)
At all levels. Presented at all meetings (KS)
Educate the agency and contractors about PPM treatments. Training must be continued for all agency staff on a regular basis (MI)

Data Management – NV-#2, AB-#2, WY-#1, SK-#2, RI-#5, UT-#2, NC-#3, CA-#5, MO-#3, GA-#3, MI-#2, NS-#2, TN-#1, ME-#4, AK-#4

Must synchronize among all Divisions (NV)
The analytical tools include site specific modeling along with feedback analysis (AB)
Still not where it needs to be. Too limiting (WY)
Additional staff (database managers), staff training (SK)
Just now collecting data (RI)
We still rely on the "expertise of experience" to determine appropriate PM treatment timing (UT)
Implementation of new maintenance management system and integration with PMS (NC)
Developing a project tracking system for PMS to study project performance (CA)
Management was willing to take a risk based on limited knowledge that the theory should work (GA)
Have annual review of older PPM treatments to determine performance (MI)
Revising data collection practices to strengthen capabilities (NS)

Dedicated Funding Challenges – AB-#3, NY-#3, SK-#5, CT-#1, UT-#1, MT-#4, NC-#2, CA-#2, MO-#1, BC-#1, KS-#1, GA-#1, MI-#3, NS -#3, TN-#2, ME-#2, IN-#3

The rehabilitation and maintenance budgets will be combined and treatment selections will be based on funding levels provided (AB)
Dedicated funding enacted in 1992 (NY)
Training and seminars for financial staff (SK)
Receiving Federal approval and use of Federal funds (CT)
We have made PM a funding priority with our Transportation Commission (UT)
Maintenance used PPM first. Based on this success, the construction program implemented PPM as well (MT)
Need additional funding and presentations have been made to General Assembly (NC)
Built on management discussions to develop financial support for dedicated funds (CA)
Working with senior management through the budgeting and programming process to obtain funding (MO)
Make business case for multi-year (3) funding (BC)
Moved some funds from contract maintenance (KS)
Convinced State Legislators that pavement preservation is essential in maintaining a growing highway system. Can build more roads if funds do not have to be committed to high roadway maintenance problems (GA)
Push, lobby, and document the need for PPM "lock-box" budget (MI)
Developing management systems to provide objective analysis of funding needs (NS)

High Priority Political and Mobility/ Improvement Projects Siphon off Available Funds – NY-#1, WA-#1, UT-#5

Not much you can do about this (NY)
Whine significantly (WA)
Capacity demands always threaten our funding (UT)

Perception of Legislature and Budget Control Agency – NY-#2

Prepared *Preventive Maintenance Primer* for distribution to Legislature (NY)

Crew Acceptance/Agency Culture– SK-#3, MT-#3, MO-#5, KS-#2, MI-#1

Strong management support (SK)
Held training courses and meetings to discuss PPM (MT)
Took time to see the benefit (KS)
Changing to a proactive strategy by moving from the worst-first construction approach (MI)

Selecting the Right Treatment at the Right Time – MT-#5

Use our pavement management system (MT)

Selection of Segments for Treatment and Timing – IN-#1

Establishing pavement management program and District review teams (IN)

Determining Best Treatment – IN-#2

Performance review studies by research division and District review teams (IN)

Question 6: The agencies were asked to list what they consider to be their top three needs to the development of a successful PPM program. The needs are listed below with the number of agencies identifying that particular need in (parentheses).

Adequate/Dedicated Funding (16)
Top Management Support/Commitment – (14)
Data Collection and Management (tie to PMS) – (13)
Crew Acceptance – (5)
Training – (7)
Improved Models/Project Selection (6)
Legislative Support (3)
Publicity (2)
FHWA Involvement/Funding (1)
Industry Support (1)
Ability to Modify Decisions (1)

Question 7: The agencies were asked to identify their funding and programming hierarchy. The number of agencies responding to each question is noted in (parentheses).

Question				Comments
7. How are your agency's PPM funds distributed?	Centralized (12)	De-centralized (2)	Combination (12)	(a) thru (j)
7a. How are the PPM treatments selected?	Centralized (6)	De-centralized (9)	Combination (11)	(k) thru (r)
7b. Are your agency's treatments tied to your Pavement Management System?	Yes (19)		No (7)	(s) thru (ii)

Comments

(a) Capital, rehabilitating, maintenance programs
(b) Contract maintenance funds and regular maintenance funds allocated to Districts who then identify needs (WY)
(c) Funding distributed to regions (SK)
(d) Hawaii has 4 maintenance districts on separate islands. One maintenance district includes 3 islands (HI)
(e) Funding decisions made centrally/legislatively. Projects selected by divisions (NC)
(f) HQ Maintenance develops statewide/district allocations based upon annual PMS data (CA)
(g) Regions select and administer projects. Direction is set by Central Office (MI)
(h) Need for dedicated funds (MO)
(i) Dollars in HQ, but work in Districts without restrictions (KS)
(j) Candidates selected in geographic districts, final selection in head office (NS)
(k) Rehabilitation (Central), maintenance (De-centralized) (AB)
(l) Work hand-in-hand or the program isn't successful (WY)
(m) Process not established (AZ)
(n) Division engineers and staff select projects and treatments (NC)
(o) Districts develop candidate projects to help retire their workload (CA)
(p) Central office develops budget and guidelines, regions follow guidelines (MI)
(q) Though combined, the District does a lot to get it started (KS)
(r) Treatment selection done at regional project level based on technical requirements (BC)
(s) PMS assesses condition (NV)
(t) System will handle both 1 to 3 and 3 to 10 year planning as well as 1 year maintenance activities (AB)
(u) Recommendations from PMS are highly considered when treatments are being developed and planned (WY)
(v) Rehabilitation is just one treatment in the PPM program (SK)
(w) The first cut at selection is from PMS (RI)
(x) Project selection can be derived from system (CT)
(y) The PMS incorporates timely preventive maintenance treatments into its model and also makes recommendation for rehab treatments (UT)
(z) PMS ranking criteria for each mile section assigns repair strategy (HI)
(aa) We have 18 years of data that needs to be integrated into PMS (NC)
(bb) Our PMS identifies preventive maintenance needs and targets (CA)
(cc) All PPM activities are tied to the PMS (MI)
(dd) Condition thresholds indicate treatment type recommended. Needs work. (MO)
(ee) This is part of the problem, separate systems (KS)
(ff) Funding needs, allocation, and project selection are tied to PMS (BC)
(gg) Design of our PMJ incorporates PPM (NS)
(hh) Will in future (TN)
(ii) Info on this lift projects provided to PMS. They rate all roads every two years (ME)

Question 8**:** Several agencies expressed an interest in working directly with FP2 as they initiate or improve their PPM programs. The agencies with contact person are listed below:

Agency	Contact	Phone
Alaska	Frank Richards, State Maintenance Engineer	(907) 465-3900
British Columbia	Rodney Chapman, Director Const. & Maint.	(250) 387-7626
California	Rob Marsh, Chief Roadway Maintenance	(916) 654-5640
Indiana	William Flora, Pavement Management Engineer	(317) 232-1060
Kansas	Dean Testa, Chief Construction & Maintenance	(785) 296-3576
Louisiana	Bill Drake, Contract Maintenance Engineer	(225) 379-1778
Montana	Jim Stevenson, Maintenance Review Supervisor	(406) 444-7201
Nevada	Frank Taylor, Maintenance Engineer	(775) 888-7050
North Carolina	Steve Varnedoe, State Maint & Equipment Engr.	(919) 715-5662
Nova Scotia	Douglas Stewart, Director of Operations	(902) 424-2348

ANNEX C

Funding Levels for Pavement Preventive Maintenance - Recap

Questions 1 through 6: The states were asked to address the state of their PPM programs, budget levels, funding sources and distribution of resources. The number of agencies responding to each question is noted in (parentheses).

Question			Comments
1. Does your agency currently have a PPM program?	Yes (11)	No (10)	(a) thru (l)
2. If yes, what level of annual funding is dedicated for 2001?	<$10M (4) $10-$25M (3) $25-$50M (2)	$50-$75M (1) $>$75M (3)	(m) thru (n)
3. If yes, what percentage were State funds and what percentage were Federal funds?	State funds Federal funds	10% to 100% 0% to 90%	
4. If yes, what percentage of PPM funds went to flexible pavements, rigid pavements, and composite pavements (rigid pavement with existing flexible overlay)?	Flexible Rigid Composite	10% to 100% 0% to 15% 0% to 87%	
5. For flexible pavements, please list the treatment types (microsurfacing, slurry seals, crack seals, fog seals, chip seals, thin (<1-12") cold mix overlays, thin (<1-12") hot mix overlays, etc.), with the approximate percent of budget allocated to each type.	Thin overlays Chip seals Crack sealing Mill and fill Spot repairs Microsurfacing Fog seals Flush seals	0% to 95% 0% to 52% 0% to 50% 0% to 50% 0% to 42% 0% to 8% 0% to 1% 0% to 1%	(o) thru (p)
6. For rigid pavements, please list the treatment types (crack and joint seal, grinding, fault repairs, thin (<1-1/2") hot mix overlays, dowel bar retrofit, etc.), with the approximate percent of budget allocated to each type.	Joint & crack seal Spall repair Full depth repair Thin overlays Dowel bar retrofit Grinding	0% to 100% 0% to 62% 0% to 16% 0% to 10% 0% to 2% 0% to 1%	

Comments

(dd) States answering "Yes": AK, AZ, AR, CA, CT, KS, ME, MI, NY, TN, and TX

(ee) States answering "No": FL, IA, ID, MS, MO, NJ, OH, VT, WV, and WI

(ff) Funding for PPM comes from FHWA's state apportionment (AK)

(gg) We do PM from our pavement maintenance budget (WI)

(hh) Since 1992 (NY)

(ii) Formal program created in 1986 (TX)

(jj) Prior to FY2000, the Iowa DOT dedicated a portion of its contract maintenance budget to preventive maintenance. However, a change in upper level management philosophy has severely limited our preventive maintenance efforts.

(kk) Idaho does fund some preventive maintenance activities, however, there is not a formal program with dedicated funds (ID)

(ll) It is part of the pavement budget and the first to be committed (VT)

(mm) Mississippi is working on a PPM program. The types of PM treatments used will be thin overlays and chip seals. Federal matching funds will be used and the program will start in FY2002 (MS)

(nn) Under development (MO)

(oo) No formal program. PPM work is done as part of PP program (OH)

(pp) Augmented by non-dedicated funding (NY)

(qq) $325M per year in 2001-2003 (TX)

(rr) Fog seal and crack sealing performed with routine maintenance funds (TX)

(ss) Treatments performed as funding allows, most treatments deferred (NJ)

Questions 7 through 10: The states were asked to indicate previous budget levels and funding sources for their PPM programs, if available. The number of agencies responding to each question is noted in (parentheses).

Question			Comments
7. If available, what level of annual funding was dedicated to your PPM program in 2000?	<$10M (7) $10-$25M (2) $25-$50M (2)	$50-$75M (1) $>$75M (3)	(q) thru (r)
7a. If yes, what percentage were State funds and what percentage were Federal funds?	State funds Federal funds	10% to 100% 90% to 0%	
8. If available, what level of annual funding was dedicated to your PPM program in 1999?	<$10M (7) $10-$25M (1) $25-$50M (2)	$50-$75M (0) $>$75M (3)	(q) thru (r)
8a. If yes, what percentage were State funds and what percentage were Federal funds?	State funds Federal funds	10% to 100% 90% to 0%	
9. If available, what level of annual funding was dedicated to your PPM program in 1998?	<$10M (7) $10-$25M (1) $25-$50M (2)	$50-$75M (0) $>$75M (3)	(q) thru (r)
9a. If yes, what percentage were State funds and what percentage were Federal funds?	State funds Federal funds	10% to 100% 90% to 0%	
10. If available, what level of annual funding was dedicated to your PPM program in 1997?	<$10M (7) $10-$25M (1) $25-$50M (2)	$50-$75M (0) $>$75M (3)	(q)
10a. If yes, what percentage were State funds and what percentage were Federal funds?	State funds Federal funds	10% to 100% 90% to 0%	

Comments

(tt) Augmented by non-dedicated funding (NY)
(uu) Same as 2001 (CT)