Performance Evaluation of Various Rehabilitation and Preservation Treatments

Final – January 6, 2010

U.S. Department of Transportation
Federal Highway Administration

Office of Asset Management
HIAM-1
Washington DC 20590-0001
FHWA-HIF-10-020

FOREWORD

The pavement preservation philosophy has seen increased adoption in State Departments of Transportation (DOTs) across the United States as a result of the successful educational and outreach programs instituted by FHWA and other pavement preservation organizations over the past decade. The fact remains that the effectiveness of pavement preservation activities has not been well documented or publicized throughout the United States. Intuitively for pavement professionals the philosophy makes perfect sense, however, hard facts supporting this stance are still elusive except for anecdotal examples.

The objective of this study was to conduct a synthesis to highlight the degree to which pavement preservation treatments (including minor rehabilitation treatments) extend the service life of pavements with or without adding strength. This study was carried out by conducting a study of six target states that were known to perform, collectively, the totality of all treatments under consideration.

The results of this study are summarized in a series of tables documenting the data provided by the states. A summary of each treatment's performance is also contained in this report. A series of observations, conclusions, and recommendations are also included. The findings of this activity will be used to provide support for FHWA policy guidance related to pavement maintenance and minor rehabilitation, commonly referred to as pavement preservation.

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16. Abstract

The pavement preservation philosophy has seen increased adoption in State Departments of Transportation (DOTs) across the United States as a result of the successful educational and outreach programs instituted by FHWA and other pavement preservation organizations over the past decade. The fact remains that the effectiveness of pavement preservation activities has not been well documented or publicized throughout the United States. Intuitively for pavement professionals the philosophy makes perfect sense, however, hard facts supporting this stance are still elusive except for anecdotal examples.

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The results of this study are summarized in a series of tables documenting the data provided by the states. A summary of each treatment's performance is also contained in this report. A series of observations, conclusions, and recommendations are also included. The findings of this activity will be used to provide support for FHWA policy guidance related to pavement maintenance and minor rehabilitation, commonly referred to as pavement preservation.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AADT	Annual average daily traffic
AASHTO	American Association of State and Highway Transportation Officials
DF	Dry-Freeze
DNF	Dry-No Freeze
DOT	Department of Transportation
ESAL	Equivalent Single Axle Load
FHWA	Federal Highway Administration
HMA	Hot-Mix Asphalt
HPMS	Highway Performance Monitoring System
MMS	Maintenance Management System
PCC	Portland Cement Concrete
PCR	Pavement Condition Rating
PM	Preventive Maintenance
PMS	Pavement Management System
RIP	Research in Progress
TRIS	Transportation Research Information Service
WF	Wet-Freeze
WNF	Wet-No Freeze

EXECUTIVE SUMMARY

Pavement preservation has been defined by FHWA as, "a program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety and meet motorist expectations." One of the critical features of a pavement preservation program is determination of the extended service life provided by each of the treatments employed by a State Department of Transportation (DOT). Determining this function for each treatment allows a comparison of treatment effectiveness and ultimately provides input into the final treatment selection process. The objective of this study was to conduct a synthesis to highlight the degree to which pavement preservation treatments (including minor rehabilitation treatments) extend the service life of pavements with or without adding strength. The work was carried out through an examination of current state practices and performance results in six "target" states. This study examined treatments for hot-mix asphalt and portland cement concrete pavements.

The process used by the team to capture data from the states included the following:

- A literature review to identify potential target states,
- Development of a standardized data collection input spreadsheet with definitions for each input parameter,
- Completion of the data collection template by the states[1], and
- Synthesis of the results and determination of representative values.

A total of 256 projects from six target States collectively covering the specific 20 treatment types were collected and these projects formed the basis for the performance evaluations in this study. Of the 256 projects submitted, seventy-one projects (28%) were subsequently not considered for further inclusion in the study due to a variety of factors, the most notable being the absence of extended service life information.

For the remaining projects, the data was summarized to yield the most common values for the following data items:

a. Timing of application - the stage of life (in years) the preventive and/or rehabilitative action was taken.

b. Annual average daily traffic and percentage of trucks on the pavement section associated with each treatment.

c. Distress types and values used to trigger each treatment.

d. Extended pavement service life or structural life associated with each treatment.

e. Cost/lane-mile associated with each treatment.

In summary, the extended service life ranges for each treatment are shown in the following.

[1] It should be noted that this process was very intensive for the target states and their participation and response is highly appreciated

Treatment	Reported Extended Service Life Range, Years
HMA Thin Overlay	3-23
HMA Chip Seal	3-8
HMA Microsurfacing	3-8
HMA – Crack Sealing	0-4
HMA Mill and Resurfacing	4-20
HMA Hot In-place Recycling	3-8[2]
HMA Slurry Seal	4-7
HMA Fog Seal	4-5
HMA Cold In-place Recycling	4-17
HMA Full Depth Reclamation	10-20
HMA Structural Overlay (Mill and Fill)	6-17
HMA Whitetopping	3-17
PCC Diamond Grinding	4-17
PCC Dowel Bar Retrofit	2-16
PCC Full Depth Repair	3-14
PCC Joint Sealing	4
PCC Partial Depth Repair	1-7
PCC HMA Overlay without Slab Fracturing	1-20
PCC Crack and Seat or Rubblize and Overlay	10-15
PCC Unbonded Overlay	15-31

Through conduct of this study, the following conclusions were reached:

- Most of the target states use a number of preservation treatments and strategies. This was to be expected as the target states were pre-screened to yield as much data as possible on life extension of as many of the treatments as possible.
- It seems that it was very difficult for the states to extract the data needed for this study. For some States all of the data exists, but cannot be linked effectively and/or efficiently. In others States the data simply does not exist, or data has not been collected for a long enough period of time. Improvements to systems to collect and link traffic, condition, construction, and maintenance history are needed.

[2] The upper value (8) is based upon extended service life to-date.

- Pavement condition data (distress, ride, and rutting) are collected and summarized using different strategies across the States making it difficult to compare data between States.
- Within a particular State, the process for collecting and analyzing pavement performance data changes over time. These changes make it difficult to perform long-term studies of treatment performance and effectiveness.
- Many of the treatments, especially recycling treatments, are relatively new to many states (cold in-place recycling, full-depth reclamation, and hot in-place recycling) and the States (1) do not have much experience with these treatments, or (2) existing recycled sections have not been down long enough to assess the life extension.
- Because of the above stated limitations, it is very difficult to perform a comparison of the effectiveness of treatments across State DOTs.

Based on these conclusions, the study provides the following recommendations:

- The States should continue to be encouraged to use and quantify the performance and benefits of pavement preservation treatments.
- The States should continue to develop and implement integrated infrastructure management systems. A primary goal of these systems should be to make quantitative decisions on the use of cost effective treatments throughout the systems life cycle. In order to accomplish this, the systems should be able to link the treatment type, treatment date, treatment location, cost, previous construction history, and performance information over a long period of time. These systems should also attempt to identify why a particular treatment was used and the decision criteria used to touch a section of roadway.
- It should be realized that each State develops its pavement management system (PMS) to meet the business needs of the individual State. A State PMS is also dependent on the technology deployed by that State to collect their information. Individual State PMSs are not necessarily designed to foster comparison of one State's data with another, although that functionally would be useful from the Federal Highway Administration's (FHWA's) perspective. It is recommended that development and adoption of performance standards that can be used to compare pavement performance State-to-State be continued. The current re-development of the Highway Performance Monitoring System (HPMS) process is a good start in this regard. The AASHTO distress protocols are another good start. Use of uniform standards can provide information that can be used by all states to compare their pavement investment decision with neighboring States in order to make informed pavement treatment investment decisions. Minimum guidelines should be used so that each State can collect a set of uniform data (State-to-State) but still have the flexibility to manipulate the data to the condition score or analysis matrix to meet their individual State's needs.
- Research into methods and technology transfer in order to maintain temporal continuity for pavement performance data should be encouraged. By necessity, State DOTs change their performance data collection protocols, technology, and methods over time. When this occurs, a break occurs in the performance history of every pavement section. Performance over time cannot be easily determined. Therefore, treatment effectiveness determination can be compromised. Strategies to overcome this reality should be developed and implemented.

- Long-term monitoring of pavements in a consistent manner should be encouraged. Many States do not have adequate long term monitoring data with which to perform this study. In addition, some of the treatments are relatively new and time must pass before their long-term effectiveness can be determined.
- The various national and regional pavement preservation groups should continue to work with and educate the States in development of systems to collect data that will support determination of the cost effectiveness of preservation and rehabilitation treatments. Anecdotal data alone is not sufficient to convince agencies to use preservation treatments.
- System preservation has become a priority for many, if not all, State DOTs. As a result, the capability of tracking, storing and presenting various types of treatment performance data is critical to make effective conversions both within and outside of the organization, which essentially leads to a more accountable usage of limited budget and the best possible conditions for the funding levels available. In this regard, some of the keys for the State should include: maintain consistency in pavement management personnel and data quality; develop a strong, cooperative relationship with the software vendor; regularly promote pavement preservation concepts/benefits; build consensus for the pavement preservation; continue to improve PMS system with time.

The results of this study have provided insight into the extended service life of various treatments throughout six target states. Valuable lessons were learned in conducting a study of this type and these lessons should be carried forward to other studies that compare treatment performance between various State DOTs.

CHAPTER 1. INTRODUCTION

BACKGROUND

According to the Federal Highway Administration (FHWA), pavement preservation is "a program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety and meet motorist expectations." (Geiger, September 2005) The pavement preservation philosophy has seen increased adoption in State Departments of Transportation (DOTs) across the United States as a result of the successful educational and outreach programs instituted by FHWA and other pavement preservation organizations over the past decade. In some cases, the preservation mentality is still facing harsh political realities as politicians have a difficult time explaining to their constituents why a good road is having work performed on it while the bad roads remain untouched. Even within a State DOT, the preservation philosophy has met some resistance as it is difficult to change old habits of worst-first. The fact remains that the effectiveness of pavement preservation activities has not been well documented or publicized throughout the United States. Intuitively for pavement professionals the philosophy makes perfect sense, however, hard facts supporting this stance are still elusive except for anecdotal examples.

It is becoming increasingly important to transportation agencies to gain public support for low cost pavement preservation treatments applied to roads while they are still in good condition versus heavy rehabilitation or full roadway reconstruction which are applied to roads in poor condition. Recognizing that there is an imperative need to demonstrate the value of cost effective pavement preservation and rehabilitation treatments, the FHWA undertook this study to provide supporting documentation for preparing future guidance. This should allow agencies to demonstrate the cost effectiveness of pavement preservation strategies and perhaps begin to provide hard facts of the benefits of preservation to those who are trying to implement a pavement preservation philosophy, or those trying to promote the philosophy to politicians and senior agency officials.

OBJECTIVES AND SCOPE

The objective of this study was to conduct a synthesis to highlight the degree to which pavement preservation treatments (including minor rehabilitation treatments) extend the service life of pavements with or without adding strength. The work was carried out through an examination of current State practices and performance results in six "target" States. The study emphasizes treatments that are commonly used and known to be cost effective while extending pavement service life (preventive maintenance (PM) and minor rehabilitation) or extending both pavement service life and improving its load carrying capacity through structural enhancement (major rehabilitation). This study examined treatments for hot-mix asphalt (HMA) and portland cement concrete (PCC) pavements. Table 1 summarizes the treatments included in this study and the information solicited for each target State.

Table 1. List of PM and rehabilitation strategies and data collection items.

PM and Rehabilitation Treatments	Inventory and Performance Related Data
<u>Hot-Mix Asphalt (HMA)</u> **PM Treatments and Minor Rehabilitation** 1. HMA overlays 2. Chip seals 3. Microsurfacing 4. Crack sealing 5. Mill and resurfacing 6. Hot in-place recycling 7. Slurry seals 8. Fog seals 9. Cold in-place recycling **Major Rehabilitation** 10. Full depth reclamation 11. Structural overlay (Mill& Fill) 12. Whitetopping **<u>Portland Cement Concrete (PCC)</u>** **PM Treatments and Minor Rehabilitation** 13. Diamond grinding 14. Dowel bar retrofit 15. Full depth repair 16. Joint sealing 17. Partial depth repair **Major Rehabilitation** 18. HMA overlay without slab fracturing (rubblization or crack-and-seat) 19. Crack-and-seat or rubblize and overlay (with HMA) 20. Unbonded overlay	(a) State, route number, treatment type, project length, and LTPP climatic zone. (b) Year of treatment and year of last rehabilitation. (c) Annual average daily traffic and percent trucks. (d) Distress types and trigger values used to trigger the selected treatments. (e) Pavement Condition Rating before and after treatment has been applied. (f) Extended pavement service life or structural life associated with the selected treatments. (g) Method used to determine pavement life extension. (h) Cost data associated with the selected treatment. (i) Source of information for (a) thru (h), i.e. PMS, maintenance database, flat files, etc. (j) Experience of the contractor and DOT field personnel with this treatment.

REPORT ORGANIZATION

The report is divided into a series of chapters and appendices. Chapter 2 describes the process used to perform the data collection exercise. Chapter 3 provides a summary of the most common values for each of the treatments examined as well as a list of observations. Chapter 4 provides conclusions and recommendations related to conduct of the study and the data provided by the States.

A series of appendices are included. The conduct of the study would not have been possible without assistance from the States. Appendix A acknowledges this participation. Appendix B provides a short description of how each State that responded to this project calculates its particular pavement condition rating. Appendix C presents a series of tables that contain the data collected from the study, organized by treatment type. Appendix D contains the same information organized by climatic zone.

CHAPTER 2. INVENTORY AND PERFORMANCE DATA COLLECTION

SELECTION OF TARGET STATES

To conduct this study, the team first identified target States from which to solicit data. The target States had to meet two critical criteria. The first criteria, and perhaps most important, is the State had to have a well developed pavement management system (PMS), or other information gathering system (e.g. Maintenance Management System) that has a majority of the necessary data in order to support this study. The second key criteria was to determine which of those States that have a robust information base also use a majority of the treatments presented in Table 1. Based on fixed project parameters, a maximum of six States were to be used for this study. These six States should have collectively used all of the treatments. Three projects for each type of treatment were desired from each of three States (total of 9 projects per treatment type). With twenty treatments, this equates to 180 projects. As much as possible, the projects were to be distributed across the four Long Term Pavement Performance (LTPP) climatic zones.

As a first step in narrowing down the target States, the project team conducted an extensive review of various reports and publications pertaining to the 20 treatment types. This literature review was conducted through searching online resources including, but not limited to, the Transportation Research Information Service (TRIS), Research in Progress (RIP) Database, American Society of Engineers (ASCE) library, Google, FHWA, American Association of State Highway and Transportation Officials (AASHTO) and State DOT web sites.

During this phase of the project, some of the key items the project team investigated were:

- Type of treatments used by a given State.
- The type and robustness of construction and pavement performance data available.
- Ability to determine life extension of the treatments as a function of pavement condition.
- Follow-up contacts.

It was observed that while there are many useful pieces of information in the literature regarding performance of these treatment types, they often did not contain enough specific information to be substantially useful for this study. Some of the challenges resulting from the literature review are contained in Table 2.

As a result, a shortlist of twelve target States was selected along with four backup States. The project team coordinated this effort with FHWA and narrowed this list to six target States and three backup States. Data collection from greater than nine States would have required a lengthy approval process. Of these nine States, six were able to provide information prior to the data collection deadline.

Figure 1 displays the geographic locations of the six target States (California, Kansas, Michigan, Minnesota, Texas, and Washington) from which data was received for this study.

Table 2. Identified issues with literature-based data collection

Data Collection Items	Issues Identified
Timing of application	• Treatment year is not available in the literature
Annual average daily traffic (AADT) and percent trucks on the pavement section	• Some projects have only qualitative description, e.g. high traffic, low traffic • Some projects have only weigh-in-motion data (number of ESALs) • Some projects have only AADT but no percentage of trucks • Traffic data is from a different year with unknown traffic growth rate
Distress types and values used to trigger treatments	• Some treatment selections are based on research/business needs and project/funding availability. For example, funding is available for a pavement section that needs rehabilitation and the agency simply wants to investigate the feasibility of some specific treatment • In most cases qualitative description rather than specific values of distresses were provided
Pavement condition rating before and after treatment has been applied	• Pavement condition rating in terms of performance index value(s) is sometimes available, but in most cases the condition rating is through the qualitative description of severity and extent of individual distresses
Extended pavement service life or structural life	• The qualitative description of performance improvement is available but extension of service life in terms of years of service is not available
Method used to determine the pavement life extension	• In most cases no specific method is mentioned. Visual observation and engineering judgment is used extensively.
Cost/lane mile that includes only pavement related activities	• Some cost data are in quantities, miles, or area based but information regarding the number of lanes, lane width, etc. are not available for conversion to $/lane-mile • Most cost data includes both pavement-related and non-pavement related costs and it is difficult to differentiate between them
Source of information for “a” thru “g” (i.e. PMS, Maintenance database, flat files, etc.)	• Information came from a mix of sources, e.g. part of the information is from a database and part from flat files
Experience of the contractor and DOT field personnel with this treatment	• In most cases prior experience of the contractor and/or DOT field personnel with a particular treatment is not stated in the literature

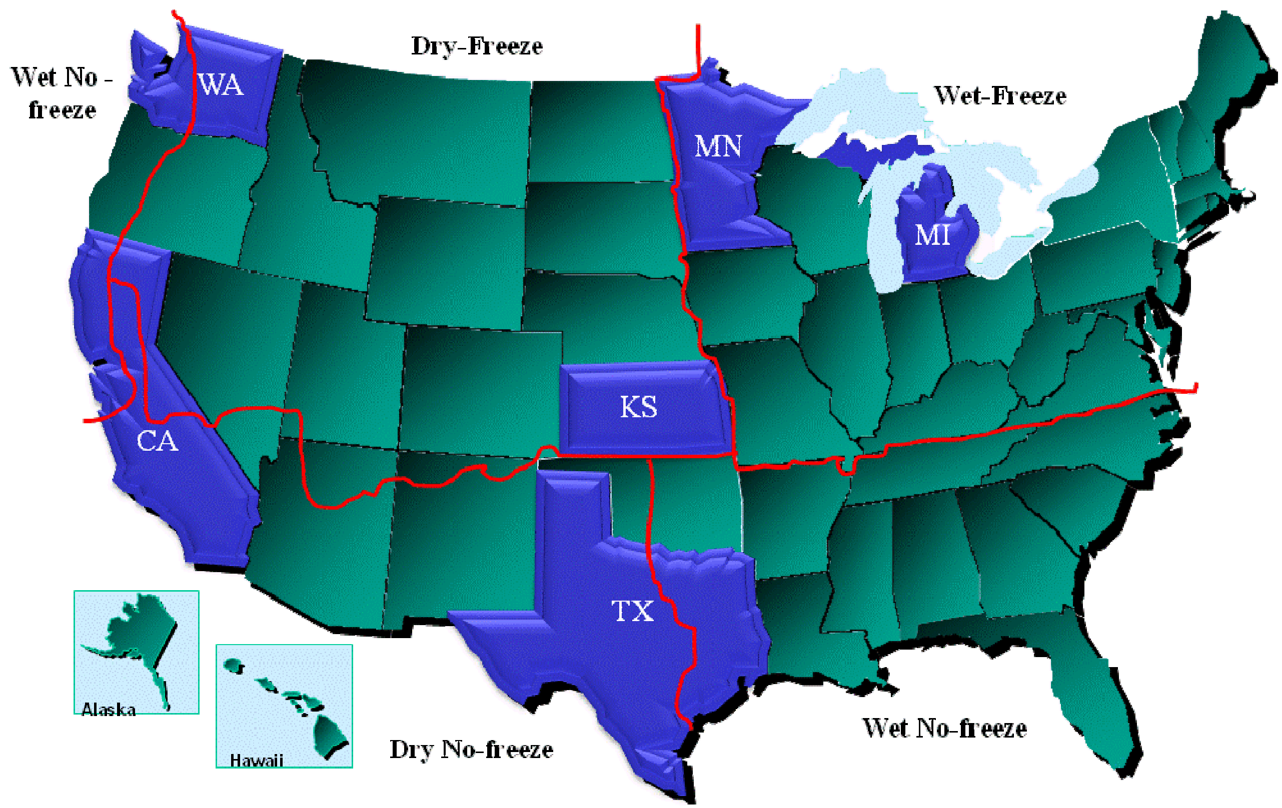

Figure 1. Drawing. Diagram of target states and LTPP climatic zone.

DATA COLLECTION METHOD

Based on the literature review and subsequent narrowing of the target State population, a data collection form and spreadsheet were developed to document the data needed from each State DOT. In order to effectively and efficiently collect required data from the targeted State DOTs, individuals that had knowledge about pavement preservation practices and procedures within each State were contacted to determine the State's interest in participating in this study (see table 3). Each State was receptive and offered to provide data for this project. The effort to pull this performance data from various data sources is not trivial and the study team extends its appreciation to those who contributed data. Appendix A provides an acknowledgement of the work of the individual States that participated in the study.

Table 3. State contact title for treatment performance data collection.

State DOT	Contact Title
CA	Chief, Office of Pavement Preservation
KS	Pavement Management Engineer
MI	Pavement Management Engineer Capital Preventive Maintenance Engineer
MN	Preventive Maintenance Engineer
TX	Pavement and Materials Engineer
WA	Pavement Management Engineer

To limit effort on the target States by asking an open-ended question such as, "Please provide us information on projects for these 20 treatments," pre-identification of projects with specific treatments in each State (to the extent possible) was conducted. Further, in order to obtain consistent responses from State DOTs the agencies were asked to complete a pre-formatted Maintenance and Rehabilitation Treatments Worksheet that contained a list of definitions and expected entries for the spreadsheet columns. The fields used for the worksheet are shown in Table 4.

A total of 256 projects from six target States collectively covering the specific 20 treatment types were collected which formed the basis for the performance evaluations in this study. Of the 256 projects submitted, seventy-one projects (28%) were subsequently not considered for further inclusion in the study due to a variety of factors, the most notable being the absence of extended service life information. Unfortunately, this resulted in the elimination of all California data. This resulted in a net of 185 projects. Each of these projects is identified by State, route number, and project length. The treatment year, pavement condition before and after treatment, etc. were reported, if available. The data collected from the States is contained in Appendix C. Figure 2 contains a summary of the number of States responding and the number of individual projects submitted by the States by treatment type.

Table 4. Data input worksheet column definitions.

Column Name	Definition	Typical Entry Example
Pavement Treatment Type	Treatments highlighted are known to have been actively used in your State and hence are requested. For other treatments, if relevant information is readily available, input those as well.	N/A
Route Number	List according to the definition in your State	SR 140, IS 95, etc.
Project Length Miles	If begin and end milepost are available, list as MPXXX~XXX; Otherwise directly list the length.	MP10.0 to MP 13.0
Climatic Zone	Follow the definitions from the FHWA LTPP program, namely, Dry Freeze (DF), Wet Freeze (WF), Dry No-freeze (DNF), and Wet No-freeze (WNF).	DNF
Treatment Year	List the year, month would be preferred if available	10-1995
Last Rehab Year	The year when it was last rehabilitated, prior to this treatment being performed	1986
AADT/% Trucks	Preferably the traffic data at the treatment year. If traffic data is from other years, list the corresponding year (for example, 3260 (1996)). If AADT not available, use qualitative description (e.g. high traffic, low traffic) if applicable.	11,000/8%
Distress Types and Values Used to Trigger Treatments	Textual description of reason for treatment. If specific values of distresses are not available, use qualitative description if applicable. Sometimes the treatment selections are based on research/business needs and project/funding availability, in this case, please specify.	Section experiencing severe rutting (> 2 inch).
PCR Prior	Pavement Condition Rating before treatment has been applied. Use performance index value(s) if available, otherwise use qualitative description.	60
Date of Survey	List the year for PCR prior, month would be preferred if available	09-1994
PCR After	Pavement Condition Rating after treatment has been applied. Use performance index value(s) if available, otherwise use qualitative description.	85
Date of Survey	List the year for PCR after, month would be preferred if available	10-1996
Extended Service Life	Extension of service life in terms of years of service associated with the treatment (service prior to next treatment – either maintenance or rehabilitation). If not available, use descriptive text regarding the performance improvement or estimate based on similarities observed on other projects.	12 years
Method Used to Determine Pavement Life Extension	If no specific method is available, please specify whether it is visual observation/engineering judgment based, or no such pavement life extension definition exists in your State.	Performance Curve
Cost/Lane-mile, $	Data is preferred on a lane-mile basis. For cost data that are in quantities, miles, or area based, if unable to be converted to $/lane-mile, list the original cost data as it is.	$100,000 / lane mile

Table 4. Data input worksheet column definitions.

Column Name	Definition	Typical Entry Example
Data Sources	Based on source of majority of information. Use five primary types of sources: PMS (Pavement Management System), MMS (Maintenance Management System), RP (Research Project), Flat File, or other (please explain if other).	PMS
Experience with Treatment	Experience of the contractor and DOT field personnel with this treatment (high, medium, or low). A high experience level is used for treatments that are consistently and routinely used in your State. A medium level of experience is used for treatments that are sometimes used in your State or treatments that have been used for five years or less, and low experience would be reserved for treatments not regularly used in your State or treatments in a pilot study mode. If available, list the approximate application history, i.e. how long the treatment has been used in your State.	High

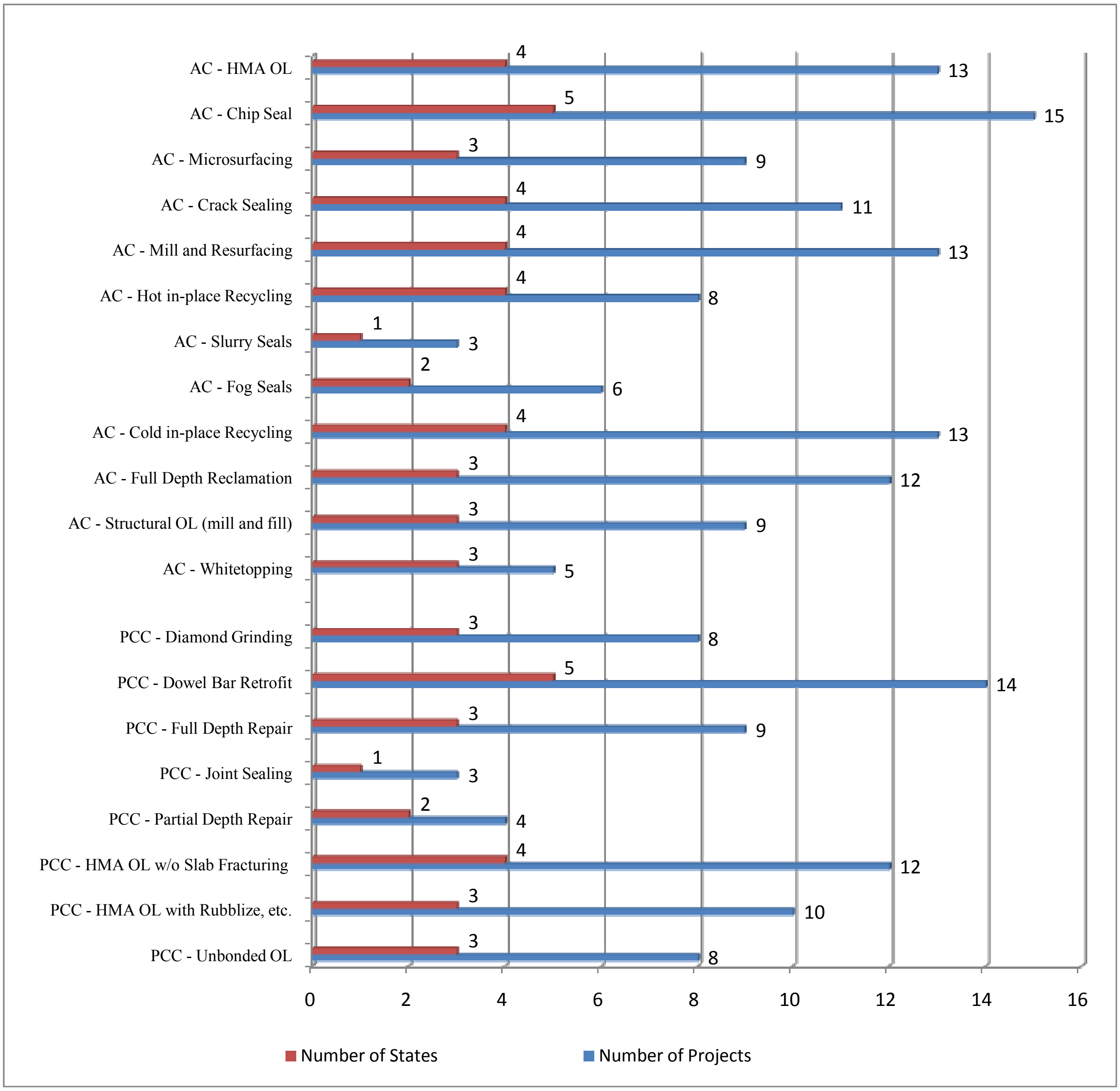

Figure 2. Chart. Number of States responding and number of projects identified.

It should be pointed out that, due to the limitation on the number of target States and the elimination of some submitted projects, other factors, several types of treatments did not have adequate data to meet the minimum three States with at least three projects per State criteria. This goal was met for 12 of the 20 treatments. Table 5 displays the resultant target State versus treatment data used in this study.

Table 5. Target States and submitted treatment performance data.

Target State	Preventive Maintenance Treatments, Minor Rehabilitation and Major Rehabilitation for HMA and Concrete																			
	H-P 1	**H-P 2**	**H-P 3**	**H-P 4**	**H-P 5**	**H-P 6**	**H-P 7**	**H-P 8**	**H-P 9**	**H-R 1**	**H-R 2**	**H-R 3**	**C-P 1**	**C-P 2**	**C-P 3**	**C-P 4**	**C-P 5**	**C-R 1**	**C-R 2**	**C-R 3**
Kansas	3	3		2		3	3		3			3	3	3	3		3	3		
Michigan	3	3	3	3	3	2			3	3	3	1		3	3	3		3	4	4
Minnesota	3	2	3	3	3				3	3	3	1	3	3	3		1	3	3	3
Texas		3	3	3	3	1		3		6				1					3	
Washington	4	4			4	2		3	4		3		2	4				3		1

Code	Definition	Code	Definition	Code	Definition
H-P 1	HMA Overlays	H-P 8	Fog Seal	C-P 2	Dowel Bar Retrofit
H-P 2	Chip Seals	H-P 9	Cold in-place Recycling	C-P 3	Full Depth Repair
H-P 3	Microsurfacing	H-R 1	Full Depth Reclamation	C-P 4	Joint Sealing
H-P 4	Crack Sealing	H-R 2	Structural Overlay (Mill and Fill)	C-P 5	Partial Depth Repair
H-P 5	Mill and Resurfacing	H-R 3	Whitetopping	C-R 1	HMA Overlay with Slab Fracturing
H-P 6	Hot in-place Recycling			C-R 2	Crack and Seat or Rubblize with Overlay
H-P 7	Slurry Seal	C-P 1	Diamond Grinding	C-R 3	Unbonded Overlay

Note 1: The gray shading in this chart denotes the treatment data used in this report. The number inside the shaded box denotes the number of projects utilized for a particular treatment/State combination.

CHAPTER 3. TREATMENT PERFORMANCE

OVERVIEW

The primary objective of this study was to conduct a synthesis to highlight the degree to which preventative maintenance treatments and rehabilitation practices extend the service life of pavements. The findings of this project will be used to provide support for the FHWA policy guidance related to pavement rehabilitation and preventive maintenance.

Based on the data received from the States, the following summary is provided:

1. Appendix B. Provides a brief description of how each selected State determines its Pavement Condition Rating (PCR) as used in this project.
2. Appendix C. Tables organized by treatment type (20 tables) displaying the collected data.
3. Appendix D. Tables organized by climatic zone displaying each treatment that was evaluated within that climatic zone.

Based on the information contained in the above, the project team summarized the findings and has identified, if appropriate, the most common values for the following data items:

f. Timing of application - the stage of life (in years) the preventive and/or rehabilitative action was taken.

g. Annual average daily traffic and % truck on the pavement section associated with each treatment.

h. Distress types and values used to trigger each treatment.

i. Extended pavement service life or structural life associated with each treatment.

j. Cost/lane mile associated with each treatment.

This summary is contained in Table 6 thru Table 25 of this section. A listing of the tables contained herein is as follows:

Table 6. HMA – thin overlay summary

Table 7. HMA - chip seal summary

Table 8. HMA – microsurfacing summary

Table 9. HMA - crack sealing summary

Table 10. HMA - mill and resurfacing

Table 11. HMA - hot in-place recycling

Table 12. HMA - slurry seal summary

Table 13. HMA - fog seal summary

Table 14. HMA - cold in-place recycling summary

Table 15. HMA - full depth reclamation summary

Table 16. HMA - structural overlay (mill and fill) summary

OBSERVATIONS

During conduct of this study, several observations were made. A discussion of each follows:

- Traffic volumes (AADT) and percent trucks are usually very easy for the States to obtain.
- All of the States that participated in the study had a network level condition rating system. It should be noted that none of the States use the same condition rating system. Comparing one State to the other (in terms of pavement performance) is thus not practical without substantial effort.
- Dissemination of data for this type of study is very difficult for the states. For example, none of the States uses a formal method to determine the extended service life for their treatments (it is theorized that this statement may be true that even if the scope was expanded to all 50 States). One State, while providing most of the requested project information, could not provide extended service life information.
- Although periodic condition surveys are conducted, many of the target States still have no formal methods in place, especially at the project level, to measure or evaluate life extension of the treatments as a function of pavement condition other than through visual observation, experience and/or engineering judgment.
- For construction history and cost data, State DOTs generally either (1) do not have the requisite data or (2) the data is stored in other systems which they cannot access, do not understand, or do not have the time to manipulate the data. For example, the last treatment year (construction history) is missing for many projects thus making it difficult to determine the time of life when the pavement treatment was applied. As another example, while it is possible to separate pavement and non-pavement related cost, the target States generally hesitate to do so mainly because of the large amount of time and effort this would consume.
- Pavements are rehabilitated for a number of reasons other than condition. Political, budgetary (stimulus for example), aesthetics, condition, etc. all come into play when deciding to rehabilitate a roadway. Therefore, determination of life extension is not solely based upon the condition, or engineering based needs, of a pavement.
- For some of the original 256 projects provided by the States, it was clear that pavements were receiving preservation treatments on sections exhibiting structural distress or in very

poor condition. Conversely some pavements were receiving preservation treatments when no distress was evident.

- For some projects included in the appendices, the trigger values and condition indicator reported do not align. An example can be seen in the chip seal project list wherein cracking is the trigger and IRI is the reported condition indicator. In these cases, the extended service life is still considered to be useful information, thus the project is included in this study. In these cases, the values for before and after the treatment should be used with caution as, in the example above, the IRI increases after treatment while there is no information on how cracking responded. This is a significant limitation of this study and is a function of State condition reporting.

Table 6. HMA – HMA thin overlay summary.

Description				
A HMA overlay with one lift of surface course generally with a thickness of 38 mm (1.5 in) or less (FP^2, 2001).				
Target States	KS	MI	MN	WA
Number of Projects Identified	3	3	3	4
Performance Related Items	**Typical Ranges/Common Values**			
Timing of Application	Based on 8 projects, timing of application ranges from 4 to 24 years.			
Traffic Information	Based on 13 projects, AADT ranges from 166 to 31,300; truck percent ranges from 1% to 30%; number of daily trucks ranges from 9 to 1987.			
Distress Types and/or Values	Based on 13 projects, the main triggering distresses are cracking (transverse, longitudinal, alligator and block); rutting; ride; and raveling.			
Extended Pavement Service Life	Based on 13 projects, extended pavement service life ranges from 3 to 23 years.			
Cost/lane Mile (2009 dollars)	Based on 13 projects, cost/lane mile ranges from $29,409 to $249,699.			

Table 7. HMA - chip seal summary.

Description					
A surface treatment in which the pavement is sprayed with asphalt (generally emulsified) and then immediately covered with aggregate and rolled. Chip seals are used primarily to seal the surface of a pavement with non load-associated cracks and to improve surface friction, although they also are commonly used as a wearing course on low volume roads (FP[2], 2001).					
Target States	KS	MI	MN	TX	WA
Number of Projects Identified	3	3	2	3	4
Performance Related Items	**Typical Ranges/Common Values**				
Timing of Application	Based on 11 projects, timing of application ranges from 2 to 13 years.				
Traffic Information	Based on 15 projects, AADT ranges from 347 to 15,400; truck percent ranges from 4.5% to 45%; number of daily trucks ranges from 36 to 780.				
Distress Types and/or Values	Based on 14 projects, the main triggering distresses are cracking (transverse, longitudinal, alligator and block) and raveling.				
Extended Pavement Service Life	Based on 13 projects, extended pavement service life ranges from 3 to 8 years.				
Cost/lane Mile (2009 dollars)	Based on 15 projects, cost/lane mile ranges from $6,732 to $145,976.				

Table 8. HMA - microsurfacing summary.

Description			
A mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed, and spread on a paved surface. Microsurfacing differs from slurry seal in that it can be used on high volume roadways to correct wheel path rutting and provide a skid resistant pavement surface (FP^2, 2001).			
Target States	MI	MN	TX
Number of Projects Identified	3	3	3
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 7 projects, timing of application ranges from 1 to 11 years.		
Traffic Information	Based on 9 projects, AADT ranges from 513 to 28,290; truck percent ranges from 4.0% to 30%; number of daily trucks ranges from 48 to 3,112.		
Distress Types and/or Values	Based on 9 projects, main triggering distresses are cracking (transverse, longitudinal, alligator and block); and shallow rutting.		
Extended Pavement Service Life	Based on 9 projects, extended pavement service life ranges from 3 to 8 years.		
Cost/lane Mile (2009 dollars)	Based on 9 projects, cost/lane mile ranges from $19,436 to $32,698.		

Table 9. HMA - crack sealing summary.

Description				
A maintenance procedure that involves placement of specialized materials into working cracks (Crack in a pavement that undergo significant deflection and thermal opening and closing movements greater than 2 mm (1/16 in), typically oriented transverse to the pavement centerline) using unique configurations to reduce the intrusion of incompressibles into the crack and to prevent infiltration of water into the underlying pavement layers (FP^2, 2001).				
Target States	KS	MI	MN	TX
Number of Projects Identified	2	3	3	3
Performance Related Items	**Typical Ranges/Common Values**			
Timing of Application	Based on 10 projects, timing of application ranges from 1 to 38 years.			
Traffic Information	Based on 11 projects, AADT ranges from 65 to 100,000; truck percent ranges from 3.4% to 22.0%; number of daily trucks ranges from 3 to 5,200.			
Distress Types and/or Values	Based on 11 projects, main triggering distresses are cracking (transverse, longitudinal, alligator and block).			
Extended Pavement Service Life	Based on 11 projects, extended pavement service life ranges from 0 to 4 years.			
Cost/lane Mile (2009 dollars)	Based on 11 projects, cost/lane mile ranges from \$883 to \$9,792.			

Table 10. HMA - mill and resurfacing summary.

Description				
The old oxidized surface of HMA is removed and replaced with new material. Generally, the old surface has become brittle and cracked and the replacement surface provides improved protection to the underlying layers (Von Quintus, Simpson, & Eltahan, July 2006).				
Target States	MI	MN	TX	WA
Number of Projects Identified	3	3	3	4
Performance Related Items	**Typical Ranges/Common Values**			
Timing of Application	Based on 12 projects, timing of application ranges from 2 to 19 years.			
Traffic Information	Based on 13 projects, AADT ranges from 3,400 to 119,500; truck percent ranges from 3.4% to 25%; number of daily trucks ranges from 408 to 10,429.			
Distress Types and/or Values	Based on 13 projects, main triggering distresses are cracking (transverse and longitudinal), ride quality and rutting.			
Extended Pavement Service Life	Based on 13 projects, extended pavement service life ranges from 4 to 20 years.			
Cost/lane Mile (2009 dollars)	Based on 13 projects, cost/lane mile ranges from $63,612 to $679,684.			

Table 11. HMA - hot in-place recycling summary.

Description				
A process which consists of softening the existing asphalt surface with heat, mechanically removing the surface material, mixing the material with a recycling agent, adding virgin asphalt and aggregate to the material (if required), and then replacing the material on the pavement (FP^2, 2001).				
Target States	KS	MI	TX	WA
Number of Projects Identified	3	2	1	2
Performance Related Items	**Typical Ranges/Common Values**			
Timing of Application	Based on 6 projects, timing of application ranges from 6 to 32 years.			
Traffic Information	Based on 8 projects, AADT ranges from 348 to 12,985; truck percent ranges from 4% to 39%; number of daily trucks ranges from 38 to 2,340.			
Distress Types and/or Values	Based on 8 projects, main triggering distresses are cracking (transverse, longitudinal and alligator); rutting.			
Extended Pavement Service Life	Based on 3 projects, extended pavement service life ranges from 3 to 8 (performance to-date) years.			
Cost/lane Mile (2009 dollars)	Based on 8 projects, cost/lane mile ranges from $31,136 to $130,383.			

Table 12. HMA - slurry seal summary.

Description A mixture of slow setting emulsified asphalt, well graded fine aggregate, mineral filler, and water. It is used to fill cracks and seal areas of old pavements, to restore a uniform surface texture, to seal the surface to prevent moisture and air intrusion into the pavement, and to improve skid resistance (FP^2, 2001).	
Target States	KS
Number of Projects Identified	3
Performance Related Items	**Typical Ranges/Common Values**
Timing of Application	Based on 3 projects, timing of application ranges from 7 to 13 years.
Traffic Information	Based on 3 projects, AADT ranges from 1,498 to 17,072; truck percent ranges from 14% to 23%; number of daily trucks ranges from 277 to 2,390.
Distress Types and/or Values	Based on 3 projects, main triggering distresses are ride quality and cracking.
Extended Pavement Service Life	Based on 3 projects, extended pavement service life ranges from 4 to 7 years.
Cost/lane Mile (2009 dollars)	Based on 3 projects, cost/lane mile ranges from $26,505 to $32,542.

Table 13. HMA - fog seal summary.

Description		
A light application of slow setting asphalt emulsion diluted with water and without the addition of any aggregate applied to the surface of a bituminous pavement. Fog seals are used to renew aged asphalt surfaces, seal small cracks and surface voids, or adjust the quality of binder in newly applied chip seals (FP[2], 2001).		
Target States	TX	WA
Number of Projects Identified	3	3
Performance Related Items	**Typical Ranges/Common Values**	
Timing of Application	Based on 4 projects, timing of application ranges from 1 to 10 years.	
Traffic Information	Based on 6 projects, AADT ranges from 1,709 to 34,000; truck percent ranges from 15% to 35%; number of daily trucks ranges from 306 to 11,900.	
Distress Types and/or Values	Based on 4 projects, main triggering distresses are cracking (longitudinal and block) and patching.	
Extended Pavement Service Life	Based on 6 projects, extended pavement service life ranges from 4 to 5 years.	
Cost/lane Mile (2009 dollars)	Based on 6 projects, cost/lane mile ranges from $1,029 to $211,579.	

Table 14. HMA - cold in-place recycling summary.

Description				
A process in which a portion of an existing bituminous pavement is pulverized or milled, and then the reclaimed material is mixed with new binder and, when needed, virgin aggregates. The binder used most often is emulsified asphalt with or without a softening agent. The resultant blend is placed as a base for a subsequent overlay or surface treatment (FP^2, 2001).				
Target States	KS	MI	MN	WA
Number of Projects Identified	3	3	3	4
Performance Related Items	**Typical Ranges/Common Values**			
Timing of Application	Based on 11 projects, timing of application ranges from 4 to 27 years.			
Traffic Information	Based on 13 projects, AADT ranges from 368 to 19,051; truck percent ranges from 4% to 46.9%; number of daily trucks ranges from 36 to 1276.			
Distress Types and/or Values	Based on 9 projects, main triggering distresses are cracking (transverse, longitudinal and block) and ride quality.			
Extended Pavement Service Life	Based on 10 projects, extended pavement service life ranges from 4 to 17 years.			
Cost/lane Mile (2009 dollars)	Based on 13 projects, cost/lane mile ranges from $44,176 to $337,525.			

Table 15. HMA - full depth reclamation summary.

Description			
It involves pulverizing the existing asphalt surface and mixing the pulverized material with the underlying base and sometimes subgrade soils along with a stabilizing agent such as lime. The mixed material is then used as the base for the pavement system (Smith, Lewis, Turner, & Jared, January 2008).			
Target States	MI	MN	TX
Number of Projects Identified	3	3	6
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 4 projects, timing of application ranges from 12 to 24 years.		
Traffic Information	Based on 12 projects, AADT ranges from 418 to 42,000; truck percent ranges from 5% to 35%; number of daily trucks ranges from 35 to 12,600.		
Distress Types and/or Values	Based on 9 projects, main triggering distresses are cracking (transverse, longitudinal, multiple), severe rutting, ride quality.		
Extended Pavement Service Life	Based on 12 projects, extended pavement service life ranges from 10 to 20 years.		
Cost/lane Mile (2009 dollars)	Based on 12 projects, cost/lane mile ranges from $55,109 to $352,641.		

Table 16. HMA - structural overlay (mill & fill) summary.

Description An increase in the pavement load carrying capacity by adding additional pavement layers (FP[2], 2001).			
Target State	MI	MN	WA
Number of Projects Identified	3	3	3
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 8 projects, timing of application ranges from 9 to 22 years.		
Traffic Information	Based on 9 projects, AADT ranges from 1,927 to 15,254; truck percent ranges from 4% to 19.9%; number of daily trucks ranges from 143 to 1,053.		
Distress Types and/or Values	Based on 6 projects, main triggering distresses are cracking (transverse, longitudinal, alligator), and ride quality.		
Extended Pavement Service Life	Based on 9 projects, extended pavement service life ranges from 6 to 17 years.		
Cost/lane Mile (2009 dollars)	Based on 9 projects, cost/lane mile ranges from $107,000 to $242,497.		

Table 17. HMA - whitetopping summary.

Description The construction of a portland cement concrete layer on top of an existing asphalt concrete pavement (Trevino & McCullough, January 2005).			
Target States	KS	MI	MN
Number of Projects Identified	3	1	1
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 5 projects, timing of application ranges from 20 to 31 years.		
Traffic Information	Based on 5 projects, AADT ranges from 584 to 3,475; truck percent ranges from 5% to 18%; number of daily trucks ranges from 105 to 320.		
Distress Types and/or Values	Based on 4 projects, main triggering distresses are cracking (transverse), and ride quality.		
Extended Pavement Service Life	Based on 4 projects, extended pavement service life ranges from 3 to 17 years.		
Cost/lane Mile (2009 dollars)	Based on 5 projects, cost/lane mile ranges from $105,814 to $663,344.		

Table 18. PCC - Diamond grinding summary.

Description			
A process that uses a series of diamond-tipped saw blades mounted on a shaft or arbor to shave the upper surface of a pavement to remove bumps, restore pavement rideability, and improve surface friction (FP^2, 2001).			
Target States	KS	MN	WA
Number of Projects Identified	3	3	2
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 6 projects, timing of application ranges from 13 to 42 years.		
Traffic Information	Based on 8 projects, AADT ranges from 723 to 196,295; truck percent ranges from 5.4% to 25%; number of daily trucks ranges from 87 to 17,235.		
Distress Types and/or Values	Based on 8 projects, main triggering distresses are joint faulting and ride quality.		
Extended Pavement Service Life	Based on 8 projects, extended pavement service life ranges from 4 to 17 years.		
Cost/lane Mile (2009 dollars)	Based on 8 projects, cost/lane mile ranges from $20,682 to $218,210.		

Table 19. PCC - Dowel bar retrofit summary.

Description A rehabilitation technique that is used to increase the load transfer capability of existing jointed PCC pavements by placement of dowel bars across joints and/or cracks that exhibit poor load transfer (FP^2, 2001).					
Target States	KS	MI	MN	TX	WA
Number of Projects Identified	3	3	3	1	4
Performance Related Items	**Typical Ranges/Common Values**				
Timing of Application	Based on 14 projects, timing of application ranges from 1 to 41 years.				
Traffic Information	Based on 14 projects, AADT ranges from 1,483 to 140,638; truck percent ranges from 2% to 24.2%; number of daily trucks ranges from 163 to 13,164.				
Distress Types and/or Values	Based on 14 projects, main triggering distresses are cracked panels with some faulting and transverse joint spall, and ride quality.				
Extended Pavement Service Life	Based on 13 projects, extended pavement service life ranges from 2 to 16 years.				
Cost/lane Mile (2009 dollars)	Based on 11 projects, cost/lane mile ranges from $19,945 to $488,757.				

Table 20. PCC - Full depth repair summary.

Description			
Removal and replacement of a segment of pavement to the level of the subgrade in order to restore areas of deterioration (Schutzbach & Lyons, September 1993).			
Target States	KS	MI	MN
Number of Projects Identified	3	3	3
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 9 projects, timing of application ranges from 4 to 25 years.		
Traffic Information	Based on 9 projects, AADT ranges from 4,011 to 27,600; truck percent ranges from 7.1% to 38%; number of daily trucks ranges from 622 to 5,497.		
Distress Types and/or Values	Based on 9 projects, main triggering distresses are cracked panels and ride quality.		
Extended Pavement Service Life	Based on 9 projects, extended pavement service life ranges from 3 to 14 years.		
Cost/lane Mile (2009 dollars)	Based on 6 projects, cost/lane mile ranges from $19,238 to $102,162.		

Table 21. PCC - Joint sealing summary.

Description	
Used on jointed concrete pavements to prevent moisture from entering the underlying layers below the concrete slabs and to prevent incompressible materials from entering the joint which would increase stresses within the concrete slab as the slab expands during the heat of the day (Smith, Freeman, & Pendleton, 1993).	
Target States	MI
Number of Projects Identified	3
Performance Related Items	**Typical Ranges/Common Values**
Timing of Application	Based on 3 projects, timing of application ranges from 6 to 12 years.
Traffic Information	Based on 3 projects, AADT ranges from 5,492 to 65,500; truck percent ranges from 7% to 27%; number of daily trucks ranges from 1,483 to 4,585.
Distress Types and/or Values	Based on 3 projects, main triggering distresses are open joints and ride quality.
Extended Pavement Service Life	Based on 3 projects, extended pavement service life is 4 years.
Cost/lane Mile (2009 dollars)	Based on 3 projects, cost/lane mile ranges from $2,856 to $15,402.

Table 22. PCC - Partial depth repair summary.

Description Repairs of localized areas of surface deterioration of concrete pavements, usually for compression spalling problems, severe scaling, or other surface problems that are within the upper one-third of the slab depth (Wilson, Smith, & Romine, October 1999).		
Target States	KS	MN
Number of Projects Identified	3	1
Performance Related Items	**Typical Ranges/Common Values**	
Timing of Application	Based on 4 projects, timing of application ranges from 5 to 9 years.	
Traffic Information	Based on 4 projects, AADT ranges from 215 to 14,300; truck percent ranges from 16% to 18%; number of daily trucks ranges from 39 to 2,574.	
Distress Types and/or Values	Based on 4 projects, main triggering distresses are cracked panels and joint spalling.	
Extended Pavement Service Life	Based on 4 projects, extended pavement service life ranges from 1 to 7 years.	
Cost/lane Mile (2009 dollars)	Based on 4 projects, cost/lane mile ranges from $773 to $95,853.	

Table 23. PCC - HMA overlay without slab fracturing summary.

Description				
It involves the placement of an asphalt concrete overlay on an existing concrete pavement to improve ride quality, surface texture, and / or noise (Khurshid, Irfan, Labi, & Sinha, January 2008).				
Target States	KS	MI	MN	WA
Number of Projects Identified	3	3	3	3
Performance Related Items	**Typical Ranges/Common Values**			
Timing of Application	Based on 12 projects, timing of application ranges from 10 to 36 years.			
Traffic Information	Based on 12 projects, AADT ranges from 2,196 to 77,596; truck percent ranges from 5% to 31%; number of daily trucks ranges from 154 to 13,114.			
Distress Types and/or Values	Based on 6 projects, main triggering distresses are faulting, cracked panels and ride quality.			
Extended Pavement Service Life	Based on 12 projects, extended pavement service life ranges from 1 to 20 years.			
Cost/lane Mile (2009 dollars)	Based on 7 projects, cost/lane mile ranges from $48,725 to $1,655,590.			

Table 24. PCC - Crack-and-seat or rubblize and overlay (with HMA) summary.

Description			
An operation on concrete pavement that involves fracturing the concrete. With a crack-and-seat operation, the particle sizes are generally two to three feet blocks. A rubblized pavement is fractured to particle sizes less than one foot. The fractured material is overlaid with asphalt concrete (Ksaibati, Miley, & Armaghani, August 1998; Choubane & Nazef, April 2005).			
Target States	MI	MN	TX
Number of Projects Identified	4	3	3
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 7 projects, timing of application ranges from 2 to 41 years.		
Traffic Information	Based on 10 projects, AADT ranges from 610 to 25,450; truck percent ranges from 5% to 45%; number of daily trucks ranges from 31 to 5,854.		
Distress Types and/or Values	Based on 6 projects, main triggering distresses are cracked and broken panels, spalled joints, and ride.		
Extended Pavement Service Life	Based on 7 projects, extended pavement service life ranges from 10 to 15 years.		
Cost/lane Mile (2009 dollars)	Based on 10 projects, cost/lane mile ranges from $146,667 to $714,323.		

Table 25. PCC - Unbonded overlay summary.

Description Increase in the pavement structure of an existing concrete or composite pavement by addition of jointed plain, jointed reinforced, or continuously reinforced concrete pavement placed on a separator layer (usually an asphalt layer) designed to prevent bonding to the existing pavement (FP[2], 2001).			
Target States	MI	MN	WA
Number of Projects Identified	4	3	1
Performance Related Items	**Typical Ranges/Common Values**		
Timing of Application	Based on 7 projects, timing of application ranges from 8 to 38 years.		
Traffic Information	Based on 8 projects, AADT ranges from 3,700 to 25,826; truck percent ranges from 7.3% to 29%; number of daily trucks ranges from 741 to 6,380.		
Distress Types and/or Values	Based on 4 projects, main triggering distresses are cracked and broken panels, transverse joints, and ride.		
Extended Pavement Service Life	Based on 8 projects, extended pavement service life ranges from 15 to 31 years.		
Cost/lane Mile (2009 dollars)	Based on 7 projects, cost/lane mile ranges from $356,774 to $797,438.		

CHAPTER 4. CONCLUSIONS AND RECOMMENDATIONS

Based on the data collected and the observations presented previously, the following conclusions and recommendations appear to be warranted.

CONCLUSIONS

- Most of the target States use a number of preservation treatments and strategies. This was to be expected as the target States were pre-screened to yield as much data as possible on life extension of as many of the treatments as possible.
- The following types of data were needed for this study:
    - Treatment location information
    - Traffic data
    - Treatment information (type, date of placement)
    - Construction history information (date of last treatment)
    - Condition information prior to and after the treatment
    - Treatment cost information (pavement costs only)
    - Extended service life information

  It seems that is was very difficult for the States to extract the data needed for this study. For some States all of the data exists, but cannot be linked effectively. In others States the data simply does not exist, or data has not been collected for a long enough period of time. Improvements to systems to collect and link traffic, condition, construction, and maintenance history are needed.
- Pavement condition data (distress, ride, and rutting) are collected and summarized using different strategies across the States making it difficult to compare data between States.
- Within a particular State, the process for collecting and analyzing pavement performance data changes over time. This makes it difficult to perform long term studies of treatment performance and effectiveness.
- Many of the treatments, especially recycling treatments, are relatively new to many States (cold in-place recycling, full-depth reclamation, and hot in-place recycling) and the States (1) do not have much experience with these treatments, or (2) existing recycled sections have not been down long enough to assess the life extension.
- Because of the above stated limitations, it is very difficult to perform a comparison of the effectiveness of treatments across State DOTs.

RECOMMENDATIONS

The following are the recommendations resulting from this study:

- The States should continue to be encouraged to use and quantify the performance and benefits of pavement preservation treatments.
- The States should continue to develop and implement integrated infrastructure management systems. A primary goal of these systems should be to make quantitative decisions on the use of cost effective treatments throughout the systems life cycle. In order to accomplish this, the systems should be able to link the treatment type, treatment date, treatment location, cost, previous construction history, and performance information over a long period of time. These systems should also attempt to identify why a particular treatment was used and the decision criteria used to touch a section of roadway.
- It should be realized that each State develops its pavement management system to meet the business needs of the individual State. State PMSs are also dependent on the technology deployed by each State to collect their information. Individual State PMSs are not necessarily designed to foster comparison of one State's data with another, although that functionally would be useful from FHWA's perspective. It is recommended that development and adoption of performance standards that can be used to compare pavement performance data between States be continued. The current re-development of the Highway Performance Monitoring System (HPMS) process is a good start in this regard. The AASHTO distress protocols are another good start. Use of uniform standards can provide information that can be used by all States to compare their pavement investment decision with neighboring States in order to make better informed pavement treatment investment decisions. Minimum guidelines should be used so that each State can collect a set of uniform data (State-to-State) but still have the flexibility to manipulate the data to the condition score or analysis matrix to meet their individual needs.
- Research into methods and technology transfer in order to maintain temporal continuity for pavement performance data should be encouraged. By necessity, State DOTs change their performance data collection protocols, technology, and methods over time. When this occurs, a break occurs in the performance history of every pavement section. Performance over time cannot be easily determined. Therefore, treatment effectiveness determination can be compromised. Strategies to overcome this reality should be developed and implemented.
- Long term monitoring of pavements in a consistent manner should be encouraged. Many States do not have adequate long-term monitoring data with which to perform this study. In addition, some of the treatments are relatively new and time must pass before their long-term effectiveness can be determined.
- The various national and regional pavement preservation groups should continue to work with and educate the States in development of systems to collect data that will support determination of the cost effectiveness of preservation and rehabilitation treatments. Anecdotal data alone is not sufficient to convince agencies to use preservation treatments.
- System preservation has become a priority for many, if not all, State DOTs. As a result, the capability of tracking, storing and presenting various types of treatment performance data is

critical to make effective conversions both within and outside of the organization, which essentially leads to a more accountable usage of limited budget and the best possible conditions for the funding levels available. In this regard, some of the keys for the State should include: maintain consistency in pavement management personnel and data quality; develop a strong, cooperative relationship with the software vendor; regularly promote pavement preservation concepts/benefits; build consensus for the pavement preservation; continue to improve PMS system with time.

APPENDIX A - ACKNOWLEDGMENTS

Extensive support for the collection of the treatment performance data was provided by six state highway agencies. The primary contacts at these agencies were:

State DOT	State Contact	Title
California	Shakir Shatnawi	Chief, Division of Pavement Management
	Larry Rouen	Acting Office Chief, Office of Pavement Preservation
	Bob Moore	Division of Pavement Management
Kansas	Rick Miller	Pavement Management Engineer
Michigan	Pat Schafer	Pavement Management Engineer
	Kevin Kennedy	Capital Preventive Maintenance Engineer
	Benjamin Krom	Pavement Performance and Selection Engineer
Minnesota	Erland Lukanen	Preventive Maintenance Engineer, Office of Materials
Texas	Jeff Seiders	Pavement & Materials Engineer
	Bryan E. Stampley	Senior Pavement Engineer
Washington	David Luhr	Pavement Management Engineer
	Jeff Uhlmeyer	State Pavement Design Engineer
	Jim Weston	Pavement Implementation Engineer

APPENDIX B - PAVEMENT CONDITION RATING BY TARGET STATES

KANSAS DOT

For the purposes of this report, Kansas reported their pavement condition rating in terms of the International Roughness Index.

References

Miller, R. (2009, July 17). Pavement Management Engineer, KSDOT. *Email Correspondence*.

Pavement Management Information System (PMIS) Glossary. (2009, February 25). Retrieved July 29, 2009, from Kansas Department of Transportation: http://www.ksdot.org/matreslab/pmis/glossary.asp

MICHIGAN DOT

MDOT collects pavement performance data (surface distresses, ride quality, and friction) on one-half of the network every year for every 0.1 mile along the pavement network under its jurisdiction. The pavement surface distress survey is conducted by videotaping and the pavement distresses collected by MDOT include transverse, longitudinal, and alligator cracking; block cracking; patches; and raveling. MDOT uses a pavement condition rating called Distress Index (DI). DI of a pavement section is a weighted score of the Distress Points (DPs) assigned to the distresses recorded by viewing video images of the pavement and identifying the type, extent and severity of each distress. For any pavement section, the DI can be calculated as the sum of the DPs along a section normalized to the section length as:

$$DI = \frac{\sum DP}{L}$$

Where ΣDP is the sum of the DPs along the pavement section and L is the number of 0.1-mile pavement sections. The DI scale starts at zero for a distress free pavement condition and increases (without bound) as pavement condition worsens. MDOT assigns DIs in three categories with threshold values based on historical pavement performance: low ($DI \leq 20$), medium ($20 < DI < 40$), and high ($DI \geq 40$). A DI of 50 or higher corresponds to a distress level beyond which rehabilitation or reconstruction should be seriously considered. A DI of 50 also corresponds to a remaining service life (RSL) of zero.

References

Schafer, P. (2009, May 29). Pavement Management Engineer, Michigan DOT. *Email Correspondence* .

Bausano, J. P., Chatti, K., & Williams, R. C. (2004). Determining Life Expectancy of Preventive Maintenance Fixes for Asphalt-Surfaced Pavements. *Transportation Research Record: Journal of the Transportation Research Board, No. 1866, TRB, National Research Council, Washington, D.C.* , 1-8.

MINNESOTA DOT

Pavement condition information is collected using a Pathway Services Digital Inspection Vehicle. The equipment is used to collect roughness, rutting, cracking, and faulting as well as digital images of the pavement surface. MNDOT's pavement condition data is used to calculate three condition indexes: the PSR, SR, and PQI. These indices are used to rank pavement sections and for predicting future condition and needs. Each index is reported to the tenths place and is briefly described below.

Present Serviceability Rating (PSR)

The PSR is MNDOT's ride or smoothness index. It uses a 0.0 – 5.0 rating scale, the higher the value, the smoother the road. Most new construction projects have an initial PSR slightly over 4.0. Pavements are normally designed for a terminal PSR value of 2.5. This does not mean the road is not drivable at this level but rather that it has deteriorated to a point where most people feel it is uncomfortable to drive. MNDOT measures IRI and converts it to PSR by the following formula:

$$PSR = 5.6972 - 2.104\sqrt{IRI}$$

Surface Rating (SR)

The SR is MNDOT's crack and surface distress index. It uses a 0.0 – 4.0 rating scale, the higher the number the less cracking is present. A brand new road has a SR of 4.0. As the type, amount and severity of the various defects increase, the SR drops. The pavement distresses that make up the SR are determined by two trained raters from MNDOT's Pavement Management Unit. Once the distress is categorized and measured, the SR can be calculated using the following procedure:

> Step 1. Convert the amount of distress to a percentage (the amount of each distress type and severity level must be converted to percent).
>
> Step 2. Calculate the Individual Weighted Distress (multiply the percent of each distress by the appropriate weighting factors).

Table 1. Bituminous Pavement SR Weighting Factors

Distress Type	Severity	Weighting Factor
Transverse Cracking	Low	0.01
	Medium	0.10
	High	0.20
Longitudinal Cracking	Low	0.02
	Medium	0.03
	High	0.04
Longitudinal Joint Deterioration	Low	0.02
	Medium	0.03
	High	0.04
Multiple (block) cracking	-	0.15
Alligator Cracking	-	0.35
Rutting	-	0.15
Raveling & Weathering	-	0.02
Patching	-	0.04

Table 2. Concrete Pavement SR Weighting Factors

Distress Type	Severity	Weighting Factor
Transverse Joint Spalling	Low	0.10
	High	0.20
Longitudinal Joint Spalling	Low	0.10
	High	0.20
Cracked Panels	-	0.07
Broken Panels	-	0.07
Faulted Joints	-	0.10
Faulted Panels	-	0.07
100% Overlaid Panels		0.00
Patched Panels		0.14
D-Cracking		0.10

Table 3. Continuously Reinforced Concrete Pavement (CRCP) SR Weighting Factors

Distress Type	Severity	Weighting Factor
Patch Deterioration	-	0.30
Localized Distress	-	0.40
D-Cracking	-	0.05
Transverse Cracking	-	0.25

Step 3. Calculate the Total Weighted Distress (TWD) (sum all of the Individual Weighting Distress to get the Total Weighted Distress).

Step 4. Convert the TWD to SR (Use the TWD and Table 4 to find the SR).

Table 4. Calculating SR from Total Weighted Distress

Total Weighted Percent	SR
0	4.0
1	3.8
2	3.6
3	3.4
4	3.2
5	3.0
6	2.9
7	2.8
8	2.7
9	2.6
10	2.5
11	2.4
12	2.3
13	2.2
14	2.1
15	2.0
16 – 17	1.9
18	1.8
19 – 20	1.7
21	1.6
22 – 23	1.5
24	1.4
25 – 26	1.3
27	1.2
28 – 29	1.1
30 – 33	1.0
34 – 40	0.9
41 – 47	0.8
48 – 54	0.7
55 – 61	0.6
62 – 68	0.5
69 – 75	0.4
76 - 82	0.3
83 – 89	0.2
90 – 96	0.1
97 – 100	0.0

Pavement Quality Index (PQI)

The PQI is MN/DOT’s overall pavement condition index. It combines the PSR and SR to give an overall performance indicator. It is equal to the square root of the PSR multiplied by the SR and ranges from 0.0 (failed) to about 4.5 (no defects).

References

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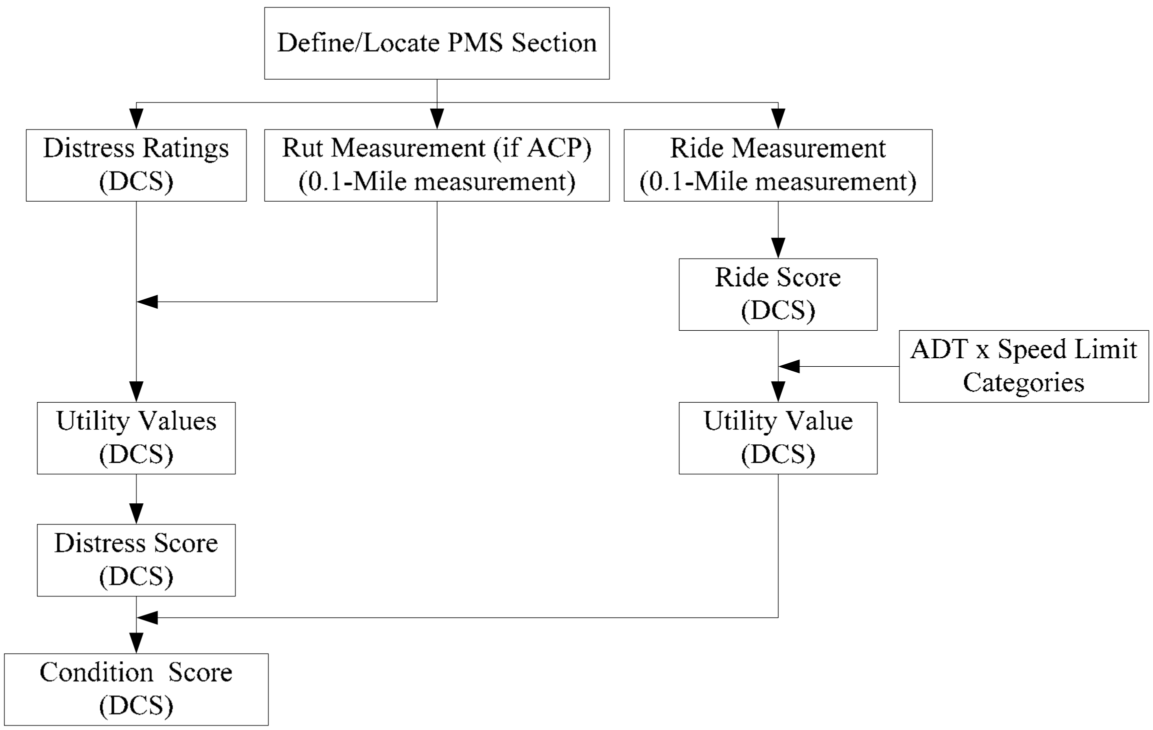
Kuemmel, D., Robinson, R., Sonntag, R., Griffin, R., & Giese, J. K. (2001). Policies and Thresholds for Pavement Improvement on Rural Two-Lane Highways. *Transportation Research Record: Journal of the Transportation Research Board, No. 1769, TRB, National Research Council, Washington, D.C.* , 11-19.

TEXAS DOT

TXDOT measures rut (wherever available), ride quality and rates pavement distress on the State maintained highway network each year. Visual distress ratings, rutting and ride quality are summarized by every Data Collection Section (DCS) which is arbitrarily-defined in the Pavement Management Information System (PMIS) and usually 0.5-mile in length. A Condition Score (CS) index combines distress ratings, ride quality measurements (measured IRI converted to Serviceability Index), average daily traffic, and speed limit into a single value from 1 (worst) to 100 (best), as shown in Figure 1.



TX DOT Process Used to Calculate PMIS Condition Score

A multiplicative utility analysis approach is used to calculate the pavement distress score for every DCS section. Each distress value, with the exception of raveling, flushing, average crack spacing, and apparent joint spacing, is converted into a utility value between 0 and 1 using a sigmoidal (S-shaped) utility curve. This curve may be represented by the following equation:

$$U_i = 1 - \alpha e^{-\left(\frac{\rho}{L_i}\right)^{\beta}}$$

Where:

U = utility value;
L = level of distress (for distress type) or ride quality lost (for ride quality);
i = distress type (e.g., deep rutting or punchouts);
e = base of the natural logarithms (e = 2.71828…);
α = a horizontal factor controlling the maximum amount of utility that can be lost;
ρ = a prolongation factor controlling "how long" the curve "last" above a certain value;
β = a slope factor controlling how steeply utility is lost in the middle of the curve.

The pavement distress score is calculated from the pavement utility curves. The equations listed in Table 1, one for each pavement type, are used to calculate the Distress Score.

TX DOT Pavement Types, Distress Types and Rating Methods

Pavement type	Distress Score Equation
Asphalt Concrete Pavement (ACP)	$DS = 100 \times [U_{SRut} * U_{DRut} * U_{Patch} * U_{Fail} * U_{Blk} * U_{Alg} * U_{Lng} * U_{Trn}]$ DS = Distress Score, U = Utility Value, SRut = Shallow Rutting, DRut = Deep Rutting, Patch = patching, Fail = Failures, Blk = Block Cracking, Alg = Alligator Cracking, Lng = Longitudinal Cracking, and, Trn = Transverse Cracking.
Continuously Reinforced Concrete Pavement (CRCP)	$DS = 100 \times [U_{spall} * U_{punch} * U_{ACPat} * U_{PCPat}]$ DS = Distress Score, U = Utility Value, Spall = Spalled Cracks, Punch = Punchouts, ACPat = Asphalt patches, and PCPat = Concrete Patches.
Jointed Concrete Pavement (JCP)	$DS = 100 \times [U_{Flj} * U_{Fail} * U_{SS} * U_{Lng} * U_{PCPat}]$ DS = Distress Score, U = Utility Value, Flj = Failed Joints and Cracks, Fail = Failures, SS = Shattered (Failed) Slabs, Lng = Slabs with Longitudinal Cracking, and PCPat = Concrete Patches.

The Serviceability Index (SI) is measured automatically and reported on a scale of 0 (rough) to 5 (smooth), which is the user perception correlated to the roughness of the highway. Within the PMIS, ADT × Speed Limit is used to classify sections into Low (ADT ≤ 500 at 55 miles per hour), Medium (ADT 501 to 3,000 at 55 miles per hour), and High (ADT > 3,000 at 55 miles per hour) categories for ride quality and subsequently determine the percent of ride quality lost, L, given in equation 1. The SI is converted into a Ride Utility score from 0 to 1 using the same equation as previously introduced. To arrive at a final PMIS Condition Score for each segment of highway, the Distress Utility and Ride Utility scores are combined as shown follows.

$$CS = 100 \times U_{DS} \times U_{RS}$$

where:

CS = Condition Score,
DS = Distress Score, and
U_{Ride} = a Ride Utility score from 0 to 1.

References

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WASHINGTON STATE DOT

The Washington DOT uses the Pavement Structural Condition (PSC) value to rate their pavement conditions. The PSC is a measure of pavement distress such as cracking and other distress measures and ranges from zero (extensive distress or very poor condition) to 100 (no distress or very good condition). PSC is a single index value used to quantify all forms and severity levels of pavement cracking including alligator (fatigue) cracking, longitudinal cracking, transverse cracking and patching for flexible pavements; and slab cracking, joint and crack spalling, pumping, faulting, scaling (e.g., from reactive aggregate distress) and patching for rigid pavements. PSC is calculated separately for flexible and rigid pavements and described by four broad pavement condition categories:

Excellent ($75 < PSC \leq 100$)
Good ($50 < PSC \leq 75$)
Fair ($25 < PSC \leq 50$), and
Poor ($0 \leq PSC \leq 25$).

Each type of distress severity is converted to an "equivalent cracking (EC)" number based on its extent and severity. The PSC is then determined using the following equations. In practice, a threshold value of PSC =50 triggers maintenance/rehabilitation for pavements.

$$\text{Flexible pavements: } PSC = 100 - 15.8(EC)^{0.50}$$

$$\text{Rigid pavements: } PSC = 100 - 18.6(EC)^{0.43}$$

Most often pavement distress such as cracking triggers pavements maintenance/rehabilitation; however, excessive roughness, rutting, or low surface friction can as well.

The following presents an example of how the condition index, PSC, is calculated for asphalt pavements. Note that the relevant calculations for concrete pavements are not available when this report was prepared; instead the abovementioned PSC for rigid pavements was used.

Calculation of PSC for Asphalt Pavements

The first step is to calculate the sum of the following (Type Coefficient * ((coefficient * distress) ^ power)):

Distress	Type Coefficient	Coefficient	Power
% Length Patching High*	0.75	1	1
% Length Patching Med*	0.75	0.445	1.15
% Length Patching Low*	0.75	0.13	1.35
% Both Wheel Paths of Alligator Cracking High	1	1	1
% Both Wheel Paths of Alligator Cracking Med	1	0.445	1.15
% Both Wheel Paths of Alligator Cracking Low	1	0.13	1.35
% Length Transverse Cracking High	0.8	1	1
% Length Transverse Cracking Med	0.8	0.445	1.15
% Length Transverse Cracking Low	0.8	0.13	1.35

% Length Longitudinal Cracking High	0.1	1	1
% Length Longitudinal Cracking Med	0.1	0.445	1.15
% Length Longitudinal Cracking Low	0.1	0.13	1.35

*The maximum allowed percentages of patching are 28.5%, 16.5%, and 8.1% for high, medium, and low, respectively. This limits the effect of patching on the overall PSC score. If the distress is higher than this, the maximum value is used.

The sum of deducts (SD) is then applied in the following equation:

PSC = 100 – 15.8 * (SD ^ 0.5).

In other words, a 1 mile section of road with 1000 ft. of low longitudinal cracking, 400 ft. of medium alligator cracking, 250 ft. of low patching, and 50 high severity transverse cracks would have a PSC score of:

> Low Longitudinal Deduct = 0.1 * [0.13 * (100 * (1000/5280))]^1.35 = 5.302
> Med Alligator Deduct = 1 * [0.445 * (100 * (400/(5280 * 2)))]^1.15 = 1.823
> Low Patch Deduct = 0.75 * [0.13 * (100 * (250/5280))]^1.35 = 0.40
> High Trans Deduct = 0.8 * [1 * (100 * (50/5280))]^1 = 0.758
> Total Deduct = 8.283
> PSC = 100 – 15.8 * (8.23 ^ 0.5) = 54.67

References

WSDOT. (May 1999). *Washington State Highway Pavements: Trends, Conditions and Strategic Plan.* Olympia, WA: WSDOT Field Operations Support Service Center, Materials Laboratory.

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APPENDIX C - TREATMENT DATA

The performance data collection was performed through an examination of current State practices and performance results in six "target" States. While every attempt has been made to evaluate each treatment in at least three projects per State and at least three States out of six target States, the data was supplemented with information from the literature or through data obtained from the SHRP Maintenance Effectiveness Studies whenever limited data was available from the target States.

The tables in this Appendix detail data related to the 20 types of treatments. They include the following types of information:

a. Project location information
b. Climatic zone for each project under review
c. Timing of application
d. Annual average daily traffic and % truck on the pavement section associated with the selected treatment
e. Distress types and values used to trigger the selected treatments
f. Pavement Condition Rating before and after treatment has been applied
g. Extended pavement service life or structural life associated which the selected treatments
h. Method used to determine the pavement life extension
i. Cost/lane mile associated with the selected treatment (normalized to 2009 dollars using a 4% discount rate)
j. Source of information for task 3a thru task 3g
k. Experience of the contractor and DOT field personnel with this treatment
l. Year of project (this will help put the project cost into perspective)

In order to obtain consistent responses from State DOTs that vary significantly in pavement preservation and renewal practices, the agencies were asked to complete the pre-formatted Maintenance and Rehabilitation Treatments Worksheet with data items provided with specific definitions to facilitate data entry, as shown in the following.

Data Items and Definitions

Column Name	Definition
Pavement Treatment Type	Treatments highlighted are known to have been actively used in your State and hence are requested. For other treatments, if relevant information is readily available, input those as well.
Route Number	List according to the definition in your State
Project Length Miles	If begin and end milepost are available, list as MPXXX~XXX; Otherwise directly list the length
Climatic Zone	Follow the definitions from the FHWA LTPP program, namely, Dry-Freeze (DF), Wet-Freeze (WF), Dry-No freeze (DNF), and Wet-No freeze (WNF).
Treatment Year	List the year, month would be preferred, if available
Last Rehab Year	The year when it was last rehabilitated, prior to this treatment being performed
AADT/% Trucks	Preferably the traffic data at the treatment year. If traffic data is from other years, list the corresponding year (for example, 3260(1996)). If AADT not available, use qualitative description (e.g. high traffic, low traffic), if applicable.
Distress Types and Values Used to Trigger Treatments	Textual description of reason for treatment. If specific values of distresses are not available, use qualitative description if applicable. Sometimes the treatment selections are based on research/business needs and project/funding availability, in this case, please specify.
PCR Prior	Pavement Condition Rating before treatment has been applied. Use performance index value(s) if available, otherwise use qualitative description.
Date of Survey	List the year for PCR prior to treatment, month would be preferred if available
PCR After	Pavement Condition Rating after treatment has been applied. Use performance index value(s) if available, otherwise use qualitative description.
Date of Survey	List the year for PCR after treatment, month would be preferred, if available
Extended Service Life	Extension of service life in terms of years of service associated with the treatment (service prior to next treatment - either maintenance or rehabilitation). If not available, use descriptive text regarding the performance improvement or estimate based on similarities observed on other projects
Method Used to Determine Pavement Life Extension	If no specific method is available, please specify whether it is visual observation/engineering judgment based, or no such pavement life extension definition exists in your State.

Column Name	Definition
Cost/Lane mile, $	Data is preferred on a lane-mile basis for pavement related costs only. For cost data that are in quantities, miles, or area based, if unable to be converted to $/lane-mile, list the original cost data as it is.
Data Sources	Based on the source of the majority information. Use five primary types of sources: PMS (Pavement Management System), MMS (Maintenance Management System), RP (Research Project), Flat File, or other (please explain if other).
Experience with Treatment	Experience of the contractor and DOT field personnel with this treatment (high, medium, or low). A high experience level is used for treatments that are consistently and routinely used in your State. A medium level of experience is used for treatments that are sometimes used in your State or treatments that have been used for five years or less, and low experience would be reserved for treatments not regularly used in your State or treatments in a pilot study mode. If available, list the approximate application history, i.e. how long the treatment has been used in your State.

The following tables are contained in this appendix.

Table C.1. HMA - Overlay

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
1. HMA OL (< 2 inches)	KS	US 75	DF	5.0	1994	1983	11	1,002	9.0%	Ride values	IRI = 113	1994	IRI = 109	1995	15 to-date	PMS performance tracking	$37,498	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	KS	I 70	DF	10.0	2002	Unavailable	Unavailable	5,967	30.0%	Ride values	IRI = 97	2002	IRI = 36	2003	3	PMS performance tracking	$50,722	PMIS	High	Cost/Lane Mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	KS	K 148	DF	15.0	2001	Unavailable	Unavailable	166	14.0%	Ride values, transverse cracking	IRI = 95	2001	IRI = 71	2002	5	PMS performance tracking	$29,409	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	MI	M-32	WF	10.3	2000	1992	8	4,200	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <40, Ride Quality Index <70 and Rut <12mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <25, Ride Quality Index <70 and Rut <12mm."	DI = 0.1	1998	DI = 0.0	2000	Flexible - 5 to 10 Composite - 4 to 9	Engineering judgment/experience	$46,152	PMS/Flat File	High	ESL based on state experience with treatment.
1. HMA OL (< 2 inches)	MI	M-183	WF	1.5	1998	1994	4	878	1.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <40, Ride Quality Index <70 and Rut <12mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <25, Ride Quality Index <70 and Rut <12mm."	DI = 1.2	1998	DI = 0.6	2000	Flexible - 5 to 10 Composite - 4 to 9	Engineering judgment/experience	$35,185	PMS/Flat File	High	ESL based on state experience with treatment.
1. HMA OL (< 2 inches)	MI	US-2	WF	0.4	1998	1988	10	6,094	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <40, Ride Quality Index <70 and Rut <12mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <25, Ride Quality Index <70 and Rut <12mm."	DI = 65.2	1997	DI = 1.6	1999	Flexible - 5 to 10 Composite - 4 to 9	Engineering judgment/experience	$47,588	PMS/Flat File	High	ESL based on state experience with treatment.
1. HMA OL (< 2 inches)	MN	I-35	WF	13.8	1987	Unavailable	Unavailable	31,300	5.2%	Transverse cracking	PQI = 2.7	1984	PQI = 4.1	1988	20	PMS performance tracking	$31,209	HPMA	High	None
1. HMA OL (< 2 inches)	MN	TH 16	WF	12.4	1989	Unavailable	Unavailable	1,200	9.5%	Transverse, longitudinal, and multiple cracking	PQI = 2.4	1987	PQI = 3.9	1990	15	PMS performance tracking	$31,209	HPMA	High	None
1. HMA OL (< 2 inches)	MN	TH 92	WF	3.2	1992	Unavailable	Unavailable	2,300	8.7%	Transverse and longitudinal cracking	PQI=3.0	1991	PQI=3.9	1994	17 to-date (a projection of 23)	PMS performance tracking PMS performance prediction	$31,209	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
1. HMA OL (< 2 inches)	WA	SR 12	WNF	11.2	2004	1991	13	13,719	14.5%	PSC - Pavement Structural Condition	PSC = 63	2003	PSC = 99	2005	5 to-date (expected 16)	PMS performance tracking Engineering judgment/experience	$132,815	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 2	WNF	9.9	2004	1995	9	4,345	11.9%	PSC - Pavement Structural Condition	PSC = 69	2003	PSC = 99	2005	5 to-date (expected 16)	PMS performance tracking Engineering judgment/experience	$129,610	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 20	WNF	17.7	1996	1972	24	808	11.5%	PSC - Pavement Structural Condition	PSC = 60	1995	PSC = 99	1997	13 to-date (expected 16)	PMS performance tracking Engineering judgment/experience	$178,758	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 20	DF	15.8	1999	1987	12	1,286	22.1%	PSC - Pavement Structural Condition	PSC = 61	1998	PSC = 99	2000	10 to-date (expected 11)	PMS performance tracking Engineering judgment/experience	$249,699	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

1 Please refer to the observations section of the report for a discussion of limitations of data presented in these tables.
2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.2. HMA - Chip Seal

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
2. HMA - Chip Seal	KS	US 75	DF	5.0	2004	2002	2	1,002	9.0%	Cracking	IRI=64	2004	IRI=70	2005	4	PMS performance tracking	$8,696	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	KS	US 24	DF	10.0	2005	2002	3	347	14.0%	None stated	IRI=63	2005	IRI=80	2006	4 to-date (expected 8)	PMS performance tracking Engineering judgment/experience	$10,673	PMIS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	KS	US 24	DF	15.3	1999	Unavailable	Unavailable	713	5.0%	Ride, transverse cracking	IRI=87	1999	IRI=86	2000	4	PMS performance tracking	$7,548	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	MI	US-31	WF	6.7	2004	1991	13	7,800	8.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-6 years, Distress Index < 25-30, Ride Quality Index <54 and Rut <3mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut <3mm."	DI=19.3	2003	DI=1.1	2005	Flexible: Single Seal 3-6; Double Seal 4 to 7; Composite: Double Seal 3 to 6.	Engineering judgment/experience	$29,388	PMS/Flat File	High	ESL based on state experience with treatment.
2. HMA - Chip Seal	MI	M-72	WF	14.5	2004	1998	6	6,000	13.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-6 years, Distress Index < 25-30, Ride Quality Index <54 and Rut <3mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut <3mm."	DI=2.6	2004	DI=4.4	2006	Flexible: Single Seal 3-6; Double Seal 4 to 7; Composite: Double Seal 3 to 6.	Engineering judgment/experience	$18,653	PMS/Flat File	High	ESL based on state experience with treatment.
2. HMA - Chip Seal	MI	Old US-131	WF	2.3	2006	1997	9	3,400	12.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-6 years, Distress Index < 25-30, Ride Quality Index <54 and Rut <3mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut <3mm."	DI=7.3	2005	DI=0.7	2007	Flexible: Single Seal 3-6; Double Seal 4 to 7; Composite: Double Seal 3 to 6.	Engineering judgment/experience	$21,186	PMS/Flat File	High	ESL based on state experience with treatment.
2. HMA - Chip Seal	MN	12	WF	4.6	1998	1993	5	5,700	9.5%	Transverse cracks - but not triggered by distress	PQI=3.9	1997	PQI=3.7	1999	Not Measurable	PMS performance tracking	$6,732	HPMA	High	MN DOT has not seen signficant life extension from chip seal treatments.
2. HMA - Chip Seal	MN	169	WF	5.0	2000	1987	13	15,400	4.5%	Transverse cracking and some longitudinal cracking	PQI=3.6	2000	PQI=3.1	2002	Not Measurable	PMS performance tracking	$6,732	HPMA	High	MN DOT has not seen signficant life extension from chip seal treatments.
2. HMA - Chip Seal	TX	LP 1604 - Bexar County	DNF	4.8	2005	before 2004	Unavailable	7,700 (2007)	5.0% (2008)	Block, alligator & longitudinal cracks	CS=90.5	2004	CS=92.75	2005	5	Observation Engineering judgment/experience	$40,259	Site manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	TX	SH36 - Comanche County	DNF	7.2	2004	before 2004	Unavailable	3,000 (1999)	25.0% (2008)	Poor skid, longitudinal cracks	CS=60	2004	CS=97.95	2005	5	Observation Engineering judgment/experience	$145,976	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	TX	US90 - Val Verde County	DNF	16.6	2005	before 2004	Unavailable	1,150 (2007)	45.0% (2008)	Alligator and longitudinal cracks	CS=99.94	2005	CS=99.97	2006	5	Observation Engineering judgment/experience	$115,419	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 17	DF	20.5	2004	1998	6	1,964	22.2%	PSC - Pavement Structural Condition	PSC=73	2003	PSC=88	2005	5 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$71,015	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 20	DF	20.6	2006	1999	7	1,510	14.0%	PSC - Pavement Structural Condition	PSC=75	2005	PSC=98	2007	3 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$91,339	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 105	WNF	25.2	2005	1995	10	1,339	10.3%	PSC - Pavement Structural Condition	PSC=64	2004	PSC=96	2006	4 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$40,399	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 410	WNF	19.2	2004	1999	5	742	8.2%	Unavailable	PSC=94	2003	PSC=98	2005	5 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$59,561	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
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5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.3. HMA - microsurfacing

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
3. HMA - microsurfacing	MI	US-31 NB	WF	3.6	1996	1989	7	2,276	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-10 years, Distress Index < 15-30, Ride Quality Index <54 and Rut < 25mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut < 25mm."	DI=1.0	1995	DI=0.5	1997	Flexible: Single Course 3-5; Multiple Course 4-6; Composite: NA	Engineering judgment/experience	$27,246	PMS/Flat File	High	ESL based on state experience with treatment.
3. HMA - microsurfacing	MI	US-31	WF	6.8	1998	1991	7	5,279	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-10 years, Distress Index < 15-30, Ride Quality Index <54 and Rut < 25mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut < 25mm."	DI=7.5	1997	DI=1.7	1999	Flexible: Single Course 3-5; Multiple Course 4-6; Composite: NA	Engineering judgment/experience	$26,270	PMS/Flat File	High	ESL based on state experience with treatment.
3. HMA - microsurfacing	MI	M-89	WF	1.1	2005	1998	7	9,200	4.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-10 years, Distress Index < 15-30, Ride Quality Index <54 and Rut < 25mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut < 25mm."	DI=5.6	2004	DI=2.1	2006	Flexible: Single Course 3-5; Multiple Course 4-6; Composite: NA	Engineering judgment/experience	$32,698	PMS/Flat File	High	ESL based on state experience with treatment.
3. HMA - microsurfacing	MN	I-94	WF	10.1	2001	1990	11	28,290	11.0%	Transverse cracks and a little Rutting	PQI=3.4	1999	PQI=3.8	2001	5	PMS performance tracking	$27,279	HPMA	High	None
3. HMA - microsurfacing	MN	3	WF	8.0	2003	1996	7	5,500	4.7%	Transverse cracks, longitudinal cracks, and longitudinal joint deterioration	PQI=3.6	2002	PQI=3.6	2003	3	PMS performance tracking	$27,279	HPMA	High	None
3. HMA - microsurfacing	MN	9	WF	18.5	1999	1994	5	513	9.4%	Transverse cracks	PQI=3.8	1997	PQI=3.8	2001	5	PMS performance tracking	$27,279	HPMA	High	None
3. HMA - microsurfacing	TX	SH121 - Collin County	WNF	14.0	2005	2004	1	14,000	15.0% (2008)	Flushing from previous seals, shallow rutting	CS=77.9	2005	CS=77.6	2006	4 to-date (expected 8)	Observation Engineering judgment/experience	$24,197	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
3. HMA - microsurfacing	TX	US277 - Jones County	DNF	14.3	2005	before 2004	Unavailable	3,300	20.0% (2008)	Flushing, patches	CS=95.4	2004	CS=99.4	2006	4 to-date (expected 8)	Observation Engineering judgment/experience	$28,202	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
3. HMA - microsurfacing	TX	US 180 - Shackelford County	DNF	6.9	2004	before 2004	Unavailable	2,100	30.0% (2008)	Flushing, longitudinal cracks, some shallow rutting	CS=84.6	2004	CS=94.8	2005	5 to-date (expected 8)	Observation Engineering judgment/experience	$19,436	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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Table C.4. HMA - crack sealing

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
4. HMA - crack sealing	KS	US 50	DF	5.0	2002	Unavailable	Unavailable	953	22.0%	Cracking	IRI=88	2002	IRI=95	2003	4	PMS performance tracking	$2,964	PMIS	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	KS	K 4	DF	10.0	2001	1991	10	472	12.0%	None stated	IRI=52	2001	IRI=56	2002	4	PMS performance tracking	$884	PMIS	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	MI	US-2	WF	0.2	2000	1998	2	8,200	4.0%	For flexible pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index < 15, Ride Quality Index <54 and Rut < 3 mm;" For composite pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index <5, Ride Quality Index <54 and Rut < 3mm."	DI=2.4	1999	DI=0.8	2001	Flexible -Up to 3; Composite - Up to 3;	Engineering judgment/experience	$1,877	PMS/Flat File	High	ESL based on state experience with treatment.
4. HMA - crack sealing	MI	M-89	WF	1.1	2000	1998	2	7,700	7.0%	For flexible pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index < 15, Ride Quality Index <54 and Rut < 3 mm;" For composite pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index <5, Ride Quality Index <54 and Rut < 3mm."	DI=4.5	2000	DI=3.7	2002	Flexible -Up to 3; Composite - Up to 3;	Engineering judgment/experience	$2,859	PMS/Flat File	High	ESL based on state experience with treatment.
4. HMA - crack sealing	MI	M-24	WF	15.0	1998	1988	10	30,392	5.0%	For flexible pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index < 15, Ride Quality Index <54 and Rut < 3 mm;" For composite pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index <5, Ride Quality Index <54 and Rut < 3mm."	DI=10.5	1996	DI=4.8	1998	Flexible -Up to 3; Composite - Up to 3;	Engineering judgment/experience	$9,792	PMS/Flat File	High	ESL based on state experience with treatment.
4. HMA - crack sealing	MN	I-35	WF	8.5	1999	1995	4	32,500	16.0%	Transverse cracks	PQI=3.9	1998	PQI=3.8	2000	0	PMS performance tracking	$1,098	HPMA	High	State regularly applies crack sealing, but has some reservation regarding its benefit, especially the fact that it does not have any effect on improving the poor ride quality caused by adjacent transverse cracks in HMA.
4. HMA - crack sealing	MN	65	WF	14.0	2001	2000	1	65	4.6%	Transverse cracks	PQI=3.8	2001	PQI=3.8	2002	0	PMS performance tracking	$1,098	HPMA	High	State regularly applies crack sealing, but has some reservation regarding its benefit, especially the fact that it does not have any effect on improving the poor ride quality caused by adjacent transverse cracks in HMA.
4. HMA - crack sealing	MN	27	WF	7.2	1995	1989	6	2,295	5.8%	Transverse cracks	PQI=3.6	1995	PQI=3.5	1997	0	PMS performance tracking	$1,098	HPMA	High	State regularly applies crack sealing, but has some reservation regarding its benefit, especially the fact that it does not have any effect on improving the poor ride quality caused by adjacent transverse cracks in HMA.
4. HMA - crack sealing	TX	SS 371	DNF	1.8	2005	1967	38	10,300	10.2%	Longitudinal and transverse cracks larger than seal coat can cover	CS=62	2008	CS=89	2009	1-2	Observation Engineering judgment/experience	$883	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	TX	SL 1604	DNF	10.3	2005	1981	24	4,500	7.2%	Longitudinal and transverse cracks larger than seal coat can cover	CS=93	2008	CS=92	2009	1-2	Observation Engineering judgment/experience	$883	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	TX	SL 1604	DNF	3.1	2005	1989	16	100,000	3.4%	Longitudinal and transverse cracks larger than seal coat can cover	CS=92	2008	CS=89	2009	1-2	Observation Engineering judgment/experience	$883	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

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Table C.5. HMA - mill and resurfacing

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
5. HMA - mill and resurfacing	MI	US-2	WF	1.0	2001	1984	17	6,100	14.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index < 40, Ride Quality Index <80 and Rut < 25 mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <30, Ride Quality Index <80 and Rut < 25mm."	DI=16.3	1999	DI=0	2001	Flexible 5 to 10 yrs Composite 4 to 9 yrs	Engineering judgment/experience	$63,612	PMS/Flat File	High	Fix has been part of the capital preventive maintenance (CPM) program since the program started up in 1992. Originally the one course was limited to 1.5" but in recent years in some cases we use 2". The project listed was cold milled 1.5", then resurfaced with 1.5" HMA (full depth flexible section). ESL based on state experience with treatment.
5. HMA - mill and resurfacing	MI	M-54	WF	1.2	2005	1986	19	12,000	8.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index < 40, Ride Quality Index <80 and Rut < 25 mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <30, Ride Quality Index <80 and Rut < 25mm."	DI=63.6	2004	DI=1	2006	Flexible 5 to 10 yrs Composite 4 to 9 yrs	Engineering judgment/experience	$66,966	PMS/Flat File	High	Fix has been part of the capital preventive maintenance (CPM) program since the program started up in 1992. Originally the one course was limited to 1.5" but in recent years in some cases we use 2". The project listed was cold milled 1.5", then resurfaced with 1.5" HMA (full depth flexible section). ESL based on state experience with treatment.
5. HMA - mill and resurfacing	MI	I-196 BL	WF	0.8	2005	1989	16	16,800	4.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index < 40, Ride Quality Index <80 and Rut < 25 mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <30, Ride Quality Index <80 and Rut < 25mm."	DI=53.3	2004	DI=0.7	2006	Flexible 5 to 10 yrs Composite 4 to 9 yrs	Engineering judgment/experience	$69,561	PMS/Flat File	High	Fix has been part of the capital preventive maintenance (CPM) program since the program started up in 1992. Originally the one course was limited to 1.5" but in recent years in some cases we use 2". The project listed was cold milled 1.5", then resurfaced with 1.5" HMA (full depth flexible section). ESL based on state experience with treatment.
5. HMA - mill and resurfacing	MN	I-394	WF	6.2	2004	1991	13	119,500	3.4%	Ride	PQI=3.2	2004	PQI=3.6	2005	5 to-date (a projection of 12)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
5. HMA - mill and resurfacing	MN	TH 169	WF	8.6	1996	1986	10	12,200	5.9%	Transverse cracks and some rutting	PQI=3.6	1994	PQI=4.0	1998	13 to-date (a projection of 16)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
5. HMA - mill and resurfacing	MN	TH 2	WF	2.7	2006	1993	13	3,400	12.0%	Longitudinal joint deterioration and transverse cracking	PQI=2.5	2004	PQI=3.5	2007	3 to-date (a projection of 10)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
5. HMA - mill and resurfacing	TX	FM 1382 - Dallas County	WNF	2.9	2008	2006	2	25,000	5.0% (2008)	Shallow rutting, cracking, minor flushing	CS=80.3	2008	Unavailable	2009	20 (expected)	Engineering judgment/experience	$156,275	Site manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	TX	SH73 - Orange County	WNF	2.3	2006	before 2004	Unavailable	28,100	5.0% (2008)	Numerous cracks, rough IRI	CS=68.6	2006	CS=96.6	2007	20 (expected)	Engineering judgment/experience	$679,684	Site manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	TX	BU 83-D - Taylor County	DNF	1.3	2006	2004	2	15,300	15.0% (2008)	Large number of longitudinal cracks	CS=41.8	2006	CS=97.4	2007	20 (expected)	Engineering judgment/ experience	$446,192	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	I-5	WNF	7.3	1998	1984	14	53,815	19.4%	Rutting	PSC=96	1997	PSC=99	1999	11 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$199,419	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	I-5	WNF	10.0	1999	1991	8	54,416	19.0%	PSC - Pavement Structural Condition	PSC=89	1998	PSC=99	2000	10 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$127,883	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	I-90	DF	16.9	1993	1982	11	15,503	25.0%	PSC - Pavement Structural Condition	PSC=69	1992	PSC=99	1995	10	PMS performance tracking	$178,845	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	SR 195	DF	9.4	1999	1988	11	5,275	17.9%	PSC - Pavement Structural Condition	PSC=61	1998	PSC=99	2000	10	PMS performance tracking	$213,684	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

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Table C.6. HMA - hot in-place recycling

Treatment (note 1)	State	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
6. HMA - hot in-place recycling	KS	2001	Unavailable	Unavailable	348	11.0%	Ride, cracking	IRI=94	2001	IRI=44	2002	3	PMS performance tracking	$31,136	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	KS	2001	1990	11	1,295	14.0%	Cracking	IRI=73	2001	IRI=53	2002	8 to-date	PMS performance tracking	$41,889	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	KS	1999	1993	6	376	13.0%	None stated	IRI=67	1999	IRI=55	2000	4	PMS performance tracking	$60,130	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	MI	1995	1963	32	6,000	39.0%	Unavailable	DI=75.7	1995	DI=4.9	1997	Unavailable	Unavailable	$130,383	PMS/Flat File	Low	This fix was tried a few times in the past but was unsuccessful at the time primarily from a construction stand point. 1.5" of HMA was added as part of this project.
6. HMA - hot in-place recycling	MI	1997	1984	13	2,949	4.0%	Unavailable	DI=74.7	1996	DI=25.9	2000	Unavailable	Unavailable	$37,820	PMS/Flat File	Low	This fix was tried a few times in the past but was unsuccessful at the time primarily from a construction stand point.
6. HMA - hot in-place recycling	TX	2005	before 2004	Unavailable	10,200 (2007)	15.0% (2008)	Severe alligator cracking	CS=58.8	2004	CS=37.5	2006	Unavailable	Unavailable	$101,058	Site Manager, PMIS, DCIS, Plans Online, TRM database	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	WA	1995	1985	10	12,985	9.5%	Transverse and longitudinal cracking	PSC=57	1984	PSC=98	1986	Unknown (little experience)	Unavailable	$34,131	WSPMS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	WA	2009	1993	16	8,017	10.2%	Rutting	PSC=82	2008	Unavailable	Unavailable	Unknown (little experience)	Unavailable	$120,407	WSPMS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.7. HMA - slurry seal

Treatment (note 1)	State	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
7. HMA - slurry seal	KS	2004	1997	7	17,072	14.0%	Ride	IRI=111	2004	IRI=81	2005	5 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$32,542	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
7. HMA - slurry seal	KS	2005	1994	11	1,980	14.0%	None stated	IRI=75	2005	IRI=81	2006	4	PMS performance tracking	$29,086	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
7. HMA - slurry seal	KS	2004	1991	13	1,498	23.0%	Ride, cracking	IRI=116	2004	IRI=73	2005	4	PMS performance tracking	$26,505	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.8. HMA - fog seal

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
8. HMA - fog seal	TX	IH20 - Harrison County	WNF	16.9	2006	2005	1	34,000 (2003)	35.0% (2008)	Cracking	CS=91.1	2006	CS=94.2	2007	3 to-date (expected 5)	Observation Engineering judgment/experience	$7,127	Site manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	TX	US67 - Runnels County	DNF	12.9	2005	before 2004	Unavailable	2,100 (2003)	25.0% (2008)	Patches, longitudinal cracks	CS=12.4	2004	CS=39.6	2005	4 to-date (expected 5)	Observation Engineering judgment/experience	$1,029	Sitemanager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	TX	US180 - Palo Pinto County	WNF	12.3	2005	before 2004	Unavailable	2,500 (2007)	15.0% (2008)	Block cracking, longitudinal cracks, numerous patches	CS=70.9	2005	CS=88.0	2006	4 to-date (expected 5)	Observation Engineering judgment/experience	$12,452	Sitemanager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	WA	I-90	DF	10.6	2005	1995	10	15,788	25.0%	Rutting	PSC=96	2004	PSC=99	2006	4	PMS performance tracking	$108,600	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	WA	I-90	DF	9.2	2004	1994	10	9,151	23.1%	Unavailable	PSC=98	2004	PSC=99	2006	4	PMS performance tracking	$125,205	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	WA	SR 211	DF	14.9	2006	1999	7	1,709	17.9%	Unavailable	PSC=99	2005	PSC=99	2006	4	PMS performance tracking	$211,579	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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Table C.9. HMA - cold in-place recycling

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
9. HMA - cold in-place recycling	KS	US 281	DF	5.0	1998	1990	8	368	16.0%	Ride, cracking	IRI=128	1998	IRI=49	1999	4	PMS performance tracking	$44,176	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	KS	US 183	DF	10.0	2004	1996	8	1,157	10.0%	Ride, cracking	IRI=118	2004	IRI=61	2005	5 to-date (expected 10)	PMS performance tracking Engineering judgment experience	$69,288	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	KS	US 24	DF	15.3	2003	Unavailable	Unavailable	713	5.0%	Ride, cracking	IRI=111	2003	IRI=78	2004	6 to-date (expected 9)	PMS performance tracking Engineering judgment experience	$67,193	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	MN	23	WF	10.5	1999	1978	21	3,438	16.0%	Transverse cracking, ride	PQI=2.8	1998	PQI=4.0	1999	10 to-date (a projection of 15)	PMS performance tracking PMS Performance prediction	$122,213	HPMA	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. State had concerns about performance and have not performed any CIRs in recent years, but is revisiting CIR on a research basis with foamed asphalt and chemical set emulsions. The performance issue was premature stripping of the CIR layer, resulting in what looks like alligator cracking of the wear course but the cracking was in the HMA above the CIR.
9. HMA - cold in-place recycling	MN	23	WF	4.5	2002	1985	17	2,650	15.0%	Centerline joint deterioration, transverse cracking, ride	PQI=2.4	2002	PQI=4.0	2003	7 to-date (a projection of 17)	PMS performance tracking PMS Performance prediction	$122,213	HPMA	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. State had concerns about performance and have not performed any CIRs in recent years, but is revisiting CIR on a research basis with foamed asphalt and chemical set emulsions. The performance issue was premature stripping of the CIR layer, resulting in what looks like alligator cracking of the wear course but the cracking was in the HMA above the CIR.
9. HMA - cold in-place recycling	MN	25	WF	6.4	1992	Unavailable	Unavailable	19,051	6.7%	Transverse and multiple cracking before CIR, multiple cracking and centerline joint deterioration at end of CIR life	PQI=2.4	1991	PQI=4.0	1992	9	PMS performance tracking	$122,213	HPMA	Low	State had concerns about performance and have not performed any CIRs in recent years, but is revisiting CIR on a research basis with foamed asphalt and chemical set emulsions. The performance issue was premature stripping of the CIR layer, resulting in what looks like alligator cracking of the wear course but the cracking was in the HMA above the CIR.
9. HMA - cold in-place recycling	MI	M-29	WF	2.0	2001	1978	23	10,600	4.0%	Unavailable	DI=46.7	2000	DI=0	2002	See comments	Unavailable	$322,680	PMS/Flat File	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has tried this fix on 5 projects. They are being monitored but to date State has not reached any conclusions on the performance as compared to a traditional resurfacing or mill and fill project.
9. HMA - cold in-place recycling	MI	M-65	WF	6.1	2002	1984	18	6,800	5.0%	Unavailable	DI=29	2000	DI=0.3	2002	See comments	Unavailable	$251,413	PMS/Flat File	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has tried this fix on 5 projects. They are being monitored but to date State has not reached any conclusions on the performance as compared to a traditional resurfacing or mill and fill project.
9. HMA - cold in-place recycling	MI	M-34	WF	3.7	2006	1979	27	4,300	7.0%	Unavailable	DI=117.3	2004	DI=3	2006	See comments	Unavailable	$337,525	PMS/Flat File	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has tried this fix on 5 projects. They are being monitored but to date State has not reached any conclusions on the performance as compared to a traditional resurfacing or mill and fill project.
9. HMA - cold in-place recycling	WA	SR 24	DF	7.4	2004	2000	4	1,478	29.8%	Unavailable	PSC=99	2003	PSC=100	2005	5 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$147,410	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	WA	SR 127	DF	3.4	2002	1987	15	745	32.9%	PSC - Pavement Structural Condition	PSC=42	2001	PSC=99	2003	7 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$163,702	WSPMS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	WA	SR 221	DF	3.0	1998	1987	11	2,212	46.9%	PSC - Pavement Structural Condition	PSC=32	1997	PSC=99	1999	11 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$315,891	WSPMS	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	WA	SR 28	DF	13.0	2004	1999	5	1,223	20.3%	PSC - Pavement Structural Condition	PSC=68	2003	PSC=99	2005	5 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$126,425	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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Table C.10. HMA - full depth reclamation

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
10. HMA - full depth reclamation	MI	I-75	WF	4.0	1997	1985	12	8,198	13.0%	Unavailable	DI=59	1997	DI=0.6	1999	10	Engineering judgment/experience	$112,065	PMS/Flat File	High	MDOT has not estimated extended service life for the individual projects. For rehabilitation projects, the life expectation estimates are based on a combination of engineering judgment and data. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	MI	I-75	WF	7.7	1998	1978	20	14,010	10.0%	Unavailable	DI=79.3	1997	DI=1.7	1999	10	Engineering judgment/experience	$118,539	PMS/Flat File	High	MDOT has not estimated extended service life for the individual projects. For rehabilitation projects, the life expectation estimates are based on a combination of engineering judgment and data. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	MI	US-127	WF	9.2	1998	1974	24	7,166	13.0%	Unavailable	DI=78.7	1997	DI=0	1999	10	Engineering judgment/experience	$352,641	PMS/Flat File	High	MDOT has not estimated extended service life for the individual projects. For rehabilitation projects, the life expectation estimates are based on a combination of engineering judgment and data. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	MN	TH 73	WF	13.5	2000	Unavailable	Unavailable	680	5.1%	Transverse and longitudinal cracks, rutting, and patching	PQI=2.1	1998	PQI=4.1	2001	9 to-date (a projection of 15)	PMS performance tracking PMS performance prediction	$163,495	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
10. HMA - full depth reclamation	MN	TH 200	WF	4.8	2003	Unavailable	Unavailable	1,107	15.0%	Cracking	PQI=2.1	2002	PQI=4.0	2004	6 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$163,495	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
10. HMA - full depth reclamation	MN	TH 6	WF	6.4	2004	1983	21	418	15.0%	Transverse, longitudinal cracking, C/L joint deterioration, ride	PQI=2.4	2003	PQI=4.1	2005	5 to-date (a projection of 15)	PMS performance tracking PMS performance prediction	$163,495	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
10. HMA - full depth reclamation	TX	FM 1409 - Liberty County	WNF	9.6	2005	before 2004	Unavailable	4,700 (2004)	5.0% (2007)	Very rough ride, severe rutting, numerous patches, raveling, cracking	CS=48.1	2005	CS=95.8	2006	4 to-date (expected 20)	Observation Engineering judgment/experience	$55,109	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	SH 205 - Kaufman County	WNF	6.1	2005	before 2004	Unavailable	7,000 (2007)	15.0% (2008)	Severe, deep and shallow ruts. alligator, longitudinal & transverse cracks. Very rough ride	CS=50.3	2004	CS=100	2005	4 to-date (expected 20)	Observation Engineering judgment/experience	$252,333	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	US 190 - Jasper County	WNF	10.5	2005	before 2004	Unavailable	5,000	15.0% (2008)	Numerous alligator and longitudinal cracks, indicative of shrink/swell subsurface material	CS=47.0	2004	CS=100	2007	4 to-date (expected 20)	Observation Engineering judgment/experience	$179,491	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	US 259 - Rusk County	WNF	5.9	2005	before 2004	Unavailable	10,900	35.0% (2008)	Shallow rutting	CS=86.3	2004	CS=94.1	2005	4 to-date (expected 20)	Observation Engineering judgment/experience	$64,713	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	IH 45 - Ellis County	WNF	10.1	2006	before 2004	Unavailable	42,000 (2007)	30.0% (2008)	Deep ruts, severe longitudinal cracking	CS=49.9	2004	CS=69.8	2005	3 to-date (expected 20)	Observation Engineering judgment/experience	$163,818	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	IH 35 - Travis County	DNF	2.8	2004	before 2004	Unavailable	14,000	15.0% (2008)	Subgrade rutting and alligator cracking	CS=99.2	2006	CS=79.3	2004	5 to-date (expected 20)	Observation Engineering judgment/experience	$193,502	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

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Table C.11. HMA - structural overlay

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
11. HMA - structural overlay	MI	US-12	WF	0.4	1994	1984	10	6,300	8.0%	Unavailable	DI=107.7	1993	DI=0.3	1995	Flexible 8-10 years; Composite 6-8 years	Engineering judgment/experience	$135,468	PMS/Flat File	High	This is a standard fix that is used on a regular basis. It has been very successful with performance varying depending on the existing pavement condition and whether it is being placed on a composite pavement or flexible pavement. The project listed was cold milled 1.5" then resurfaced with two courses (3" total) of HMA. The ESL is a prediction based upon agency experience.
11. HMA - structural overlay	MI	M-37	WF	0.9	1999	1984	15	5,200	4.0%	Unavailable	DI=75.5	1998	DI=1.9	2000	Flexible 10-12 years; Composite 8-10 years	Engineering judgment/experience	$144,605	PMS/Flat File	High	This is a standard fix that is used on a regular basis. It has been very successful with performance varying depending on the existing pavement condition and whether it is being placed on a composite pavement or flexible pavement. The project listed was cold milled 1.5" then resurfaced with two courses (3" total) of HMA. The ESL is a prediction based upon agency experience.
11. HMA - structural overlay	MI	US-31 NB	WF	7.5	1999	1989	10	4,200	5.0%	Unavailable	DI=20.9	1999	DI=5.4	2003	Flexible 10-12 years; Composite 8-10 years	Engineering judgment/experience	$115,292	PMS/Flat File	High	This is a standard fix that is used on a regular basis. It has been very successful with performance varying depending on the existing pavement condition and whether it is being placed on a composite pavement or flexible pavement. The project listed was cold milled 1.5" then resurfaced with two courses (3" total) of HMA. The ESL is a prediction based upon agency experience.
11. HMA - structural overlay	MN	I-35	WF	9.3	1998	1989	9	15,254	6.9%	Cracking	PQI=3.0	1998	PQI=4.1	2000	11 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$107,000	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
11. HMA - structural overlay	MN	1	WF	12.0	2005	1983	22	3,100	4.6%	Transverse and longitudinal cracking and ride	PQI=2.5	2004	PQI=3.9	2005	4 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$107,000	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
11. HMA - structural overlay	MN	10	WF	11.7	1995	1980	15	8,000	11.0%	Transverse cracks and multiple cracking and ride	PQI=2.3	1994	PQI=3.9	1996	14 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$107,000	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
11. HMA - structural overlay	WA	SR 395	DF	6.8	1999	1986	13	1,927	14.8%	PSC - Pavement Structural Condition	PSC=57	1998	PSC=100	1999	10 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$242,497	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
11. HMA - structural overlay	WA	SR 12	DF	2.9	1998	Unavailable	Unavailable	6,168	16.2%	PSC - Pavement Structural Condition	PSC=51	1997	PSC=99	1999	12	PMS performance tracking	$183,586	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
11. HMA - structural overlay	WA	SR 12	DF	6.5	2007	1997	10	2,548	19.9%	PSC - Pavement Structural Condition	PSC=80	2006	PSC=99	2008	2 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$163,032	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

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4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.12. HMA - whitetopping

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
12. HMA - whitetopping	KS	US 54	DF	0.8	2000	1969	31	2,465	13.0%	Rough ride, transverse cracking	IRI=106	2000	IRI=58	2001	3	PMS performance tracking	$105,814	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
12. HMA - whitetopping	KS	US 54	DF	1.4	2000	1969	31	2,010	8.0%	Transverse cracking	IRI=98	2000	IRI=66	2001	3	PMS performance tracking	$105,814	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
12. HMA - whitetopping	KS	US 54	DF	2.9	2000	1969	31	3,475	5.0%	Rough ride, transverse cracking	IRI=128	2000	IRI=72	2001	3	PMS performance tracking	$105,814	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
12. HMA - whitetopping	MI	M-46	WF	4.0	1999	1970	29	2,000	6.0%	Unavailable	DI=43.7	1998	DI=0.6	2000	Unavailable	Engineering judgment/experience	$409,883	PMS/Flat File	Low	Still considered experimental
12. HMA - whitetopping	MN	TH-30	WF	8.5	1993	1973	20	584	18.0%	Transverse and longitudinal cracks and patching	PQI=1.4	1991	PQI=4.0	1994	16 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$663,344	HPMA	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. This is the only highway whitetopping project constructed by MNDOT. The others are either research sections at MNROAD, or a local solution to an HMA rutting problem.

Notes:

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3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.13. PCC - diamond grinding

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
13. PCC - diamond grinding	KS	US 54	DF	6.0	1998	1976	22	2,580	25.0%	Ride and faulting	IRI=146	1998	IRI=68	1999	9	PMS performance tracking	$65,069	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	KS	US 59	DF	8.4	2001	1960	41	1,814	7.0%	None stated	IRI=77	2001	IRI=76	2002	6	PMS performance tracking	$113,893	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	KS	US 166	DF	9.0	1998	1980	18	723	12.0%	Ride and faulting	IRI=168	1998	IRI=73	1999	11 to-date (expected 17)	PMS performance tracking Engineering judgment/experience	$42,489	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	MN	TH 10	WF	5.4	1982	Unavailable	Unavailable	11,500	10.0%	Joint faulting, ride	PQI=2.5	1982	PQI=3.2	1983	4	PMS performance tracking	$20,682	HPMA	High	The last rehab year was 2000, but the rehab after 1982 was a major CPR in 1986. The original construction was in 1947. This pavement is on a sand subgrade and that is likely that reason it is still in service as a concrete pavement.
13. PCC - diamond grinding	MN	I-94	WF	2.9	2004	1991	13	52,300	16.0%	Joint faulting, ride	PQI=2.6	2004	PQI=3.5	2006	5 to-date (a projection of 6)	PMS performance tracking PMS performance prediction	$20,682	HPMA	High	Orig construction was 1973. The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
13. PCC - diamond grinding	MN	15	WF	1.0	2004	Unavailable	Unavailable	20,900	5.4%	Transverse joints, cracked panels, ride	PQI=2.8	2003	PQI=3.5	2005	5 to-date (a projection of 13)	PMS performance tracking PMS performance prediction	$20,682	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
13. PCC - diamond grinding	WA	I-5	DF	4.1	1999	1969	30	196,295	8.8%	PPC - Pavement Profile Condition	PSC=80	1998	PSC=86	2000	15 (expected)	Engineering judgment/experience	$218,210	WSPMS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	WA	I-5	DF	19.8	2009	1964-1967	42	184,057	6.8%	PPC - Pavement Profile Condition	PSC=76	2008	Unavailable	Unavailable	15 (expected)	Engineering judgment/experience	$113,428	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.14. PCC - Dowel Bar Retrofit

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
14. PCC - DBR	KS	US 400	DF	5.0	2001	1987	14	2,206	16.0%	Ride and joint distress	IRI=128	2001	IRI=132	2002	8 to-date (expected 13)	PMS performance tracking Engineering judgment/experience	$127,764	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	KS	US 400	DF	7.0	2001	1988	13	1,818	19.0%	Ride, joint distress, and faulting	IRI=165	2001	IRI=148	2002	8 to-date (expected 13)	PMS performance tracking Engineering judgment/experience	$127,764	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	KS	US 36	DF	13.0	2004	1989	15	1,483	11.0%	Ride	IRI=101	2004	IRI=86	2005	5 to-date (expected 14)	PMS performance tracking Engineering judgment/experience	$135,000	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	MI	I-696 EB	WF	6.4	1998	1978	20	82,386	5.0%	Trigger values are "a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54."	DI=8	1997	DI=5.5	1999	2-3	Engineering judgment/experience	$29,929	PMS/Flat File	Low	9 projects over the last 12 years
14. PCC - DBR	MI	M-10 NB	WF	7.3	2000	1987	13	68,000	2.0%	Trigger values are "a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54."	DI=1.8	1999	DI=6.9	2001	2-3	Engineering judgment/experience	$54,809	PMS/Flat File	Low	9 projects over the last 12 years
14. PCC - DBR	MI	I-69 NB	WF	8.6	1999	1991	8	30,400	18.0%	Trigger values are "a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54."	DI=7.6	1997	DI=5	1999	2-3	Engineering judgment/experience	$19,945	PMS/Flat File	Low	9 projects over the last 12 years
14. PCC - DBR	MN	I-94	WF	7.4	2004	1984	20	84,200	9.0%	Cracked panels with some faulting and transverse joint spall and ride	PQI=2.6	2004	PQI=3.5	2005	5 to-date (a projection of 16)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. This CPR included dowel retrofits into mid-panel cracks that were faulting. There now are a few slots that have disintegrating grout. Diamond grinding was done after dowels and CPR was complete.
14. PCC - DBR	MN	I-94	WF	3.0	2007	1986	21	13,950	16.0%	Cracked panels and ride	PQI=2.6	2007	PQI=3.1	2008	2 to-date (a projection of 2)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. This dowel bar retrofit also had diamond grinding. State suspected that the dowels were for mid panel cracks.
14. PCC - DBR	MN	TH 77	WF	2.2	2007	1982	25	70,000	2.9%	Cracked panels	PQI=3.0	2006	PQI=3.1	2008	2 to-date (a projection of 7)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
14. PCC - DBR	TX	US 69	WNF	4.5	2007	Yearly concrete repairs	1	58,000	9.4%	Inserted load transverse devices to prevent further faulting in pavement slabs	CS=49	2006	CS=90	2008	Unavailable	Unavailable	$260,325	As-built	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	I-5	WNF	3.1	2000	1959	41	56,385	11.3%	PPC - Pavement Profile Condition	PSC=55	1999	PSC=60	2001	9 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$65,741	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	I-5	WNF	6.4	2000	1959	41	140,638	9.4%	PPC - Pavement Profile Condition	PSC=35	1999	PSC=90	2001	9 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$418,835	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	I-82	DF	20.6	1997	1971	26	15,132	24.2%	PPC - Pavement Profile Condition	PSC=90	1996	PSC=94	1998	12 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$383,532	WSPMS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	SR 195	DF	5.3	1997	1959	38	4,125	21.6%	PPC - Pavement Profile Condition	PSC=58	1996	PSC=99	1999	12 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$488,757	WSPMS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.15. PCC - full depth repair

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
15. PCC - full depth repair	KS	I 135	DF	5.0	1994	1971	23	17,072	14.0%	Ride, joint distress	IRI=122	1994	IRI=129	1995	9	PMS performance tracking	Unavailable	PMIS	Unavailable	None
15. PCC - full depth repair	KS	US 77	DF	8.0	1997	1972	25	5,656	11.0%	Ride	IRI=100	1997	IRI=99	1998	5	PMS performance tracking	Unavailable	PMIS	Unavailable	None
15. PCC - full depth repair	KS	I 70	DF	12.0	1992	1969	23	4,011	38.0%	Ride	IRI=110	1992	IRI=102	1993	9	PMS performance tracking	Unavailable	PMIS	Unavailable	None
15. PCC - full depth repair	MI	I-94 WB	WF	3.1	1996	1986	10	13,014	36.0%	Trigger values are "a minimum remaining service life of 7 years, Distress Index < 20 and Ride Quality Index <54."	DI=12.6	1995	DI=8.9	1997	3-10	Engineering judgment/experience	$45,596	PMS/Flat File	High	MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
15. PCC - full depth repair	MI	US-31 NB	WF	12.2	2005	1987	18	7,400	15.0%	Trigger values are "a minimum remaining service life of 7 years, Distress Index < 20 and Ride Quality Index <54."	DI=10.3	2005	DI=6.6	2007	3-10	Engineering judgment/experience	$19,238	PMS/Flat File	High	MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
15. PCC - full depth repair	MI	I-94 EB	WF	5.2	2006	1990	16	23,900	23.0%	Trigger values are "a minimum remaining service life of 7 years, Distress Index < 20 and Ride Quality Index <54."	DI=6.7	2005	DI=3.6	2007	3-10	Engineering judgment/experience	$31,557	PMS/Flat File	High	MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
15. PCC - full depth repair	MN	I-35	WF	8.6	1999	1995	4	17,600	7.1%	Transverse joints and cracked panels	PQI=3.0	1998	PQI=3.6	2000	9	PMS performance tracking	$102,162	HPMA	High	None
15. PCC - full depth repair	MN	TH 52	WF	2.8	1994	1983	11	18,000	11.0%	Cracked panels	PQI=3.2	1991	PQI=3.4	1994	14	PMS performance tracking	$102,162	HPMA	High	It is hard to identify how long the pavement would have lasted without major CPR.
15. PCC - full depth repair	MN	TH 10	WF	2.2	1997	1987	10	27,600	13.0%	A few cracked panels	PQI=3.7	1997	PQI=3.8	1998	11	PMS performance tracking	$102,162	HPMA	High	None

Notes:

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Table C.16. PCC - joint sealing

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
16. PCC - joint sealing	MI	I-696 EB	WF	6.2	1995	1989	6	65,500	7.0%	Trigger values are “a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54.”	DI=0.2	1995	DI=0.2	1997	4	PMS performance tracking	$6,867	PMS/Flat File	High	MDOT has used several different materials to seal and reseal joints such as silicone, neoprene, and hot-poured rubber. MDOT's current standard is to use low-modulus hot-poured rubber.
16. PCC - joint sealing	MI	I-69 EB	WF	5.6	1996	1984	12	5,492	27.0%	Trigger values are “a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54.”	DI=0.5	1995	DI=1.1	1997	4	PMS performance tracking	$2,856	PMS/Flat File	High	MDOT has used several different materials to seal and reseal joints such as silicone, neoprene, and hot-poured rubber. MDOT's current standard is to use low-modulus hot-poured rubber.
16. PCC - joint sealing	MI	I-75 NB	WF	6.5	1998	1990	8	22,800	17.0%	Trigger values are “a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54.”	DI=0.8	1997	DI=0.6	1999	4	PMS performance tracking	$15,402	PMS/Flat File	High	MDOT has used several different materials to seal and reseal joints such as silicone, neoprene, and hot-poured rubber. MDOT's current standard is to use low-modulus hot-poured rubber.

Notes:

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2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.17. PCC - partial depth repair

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
17. PCC - partial depth repair	KS	K 23	DF	4.1	2004	1996	8	215	18.0%	None stated	IRI=70	2004	IRI=58	2005	4	PMS performance tracking	$773	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
17. PCC - partial depth repair	KS	US 50	DF	6.0	2001	1996	5	2,364	16.0%	Joint distress	IRI=59	2001	IRI=67	2002	1	PMS performance tracking	$4,437	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
17. PCC - partial depth repair	KS	K 23	DF	9.0	2004	1996	8	217	18.0%	Joint distress	IRI=77	2004	IRI=60	2005	4	PMS performance tracking	$773	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
17. PCC - partial depth repair	MN	TH 169	WF	1.7	2005	1996	9	14,300	18.0%	A few cracked panels	PQI=3.3	2004	PQI=3.5	2005	4 to-date (a projection of 7)	PMS performance tracking PMS performance prediction	$95,853	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.

Notes:

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2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
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Table C.18. PCC - HMA OL w/o slab frac

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
18. PCC - HMA OL w/o slab frac	KS	US 75	DF	5.0	2001	1991	10	3,311	5.0%	Joint distress	IRI=99	2001	IRI=79	2002	3	PMS performance tracking	$58,370	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	KS	US 77	DF	9.5	2001	1985	16	2,196	7.0%	Ride	IRI=104	2001	IRI=59	2002	1	PMS performance tracking	$80,272	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	KS	US 169	DF	11.6	2003	1980	23	2,924	11.0%	Ride, joint distress	IRI=99	2003	IRI=52	2004	6 to-date (expected 8)	PMS performance tracking Engineering judgment/experience	$48,725	PMIS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	MI	I-96	WF	8.1	1998	1962	36	48,172	11.0%	Unavailable	DI=52.2	1997	DI=0.1	1999	6-8	Engineering judgment/experience	$730,259	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	MI	I-94 EB	WF	7.4	1998	1985	13	19,819	31.0%	Unavailable	DI=53	1997	DI=0	1999	6-8	Engineering judgment/experience	$307,606	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	MI	I-94 WB	WF	7.3	2001	1985	16	20,700	30.0%	Unavailable	DI=11.5	1999	DI=0	2001	6-8	Engineering judgment/experience	$351,812	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	MN	I-35	WF	6.6	1997	1980	17	27,400	18.0%	Faulting and cracked panels and ride	PQI=2.6	1997	PQI=4.0	1998	12 to-date (a projection of 17)	PMS performance tracking PMS Performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
18. PCC - HMA OL w/o slab frac	MN	52	WF	6.4	1998	1986	12	19,560	11.0%	Ride, transverse joints, cracked panels	PQI=2.3	1998	PQI=3.9	1999	11 to-date (a projection of 17)	PMS performance tracking PMS Performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
18. PCC - HMA OL w/o slab frac	MN	44	WF	8.9	1992	1978	14	2,970	7.5%	Transverse joints, faulting, cracked and broken panels and ride	PQI=2.1	1990	PQI=4.1	1993	11	PMS performance tracking	Unavailable	HPMA	High	None
18. PCC - HMA OL w/o slab frac	WA	I-5	DF	3.3	1993	1966	27	38,773	9.0%	PSC - Pavement Structural Condition	PSC=44	1992	PSC=99	1994	16 to-date (expected 20)	PMS performance tracking Engineering judgment/experience	$1,655,590	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	WA	I-5	DF	5.1	1970	1952	18	77,596	16.9%	Unavailable	PSC=75	1969	PSC=77	1971	20	PMS performance tracking	Unavailable	WSPMS	Low	PCCP Const. in 1955. Two overlays since original in 1970
18. PCC - HMA OL w/o slab frac	WA	I-5	DF	1.3	1974	1955	19	56,598	19.0%	Unavailable	PSC=75	1973	PSC=100	1975	20	PMS performance tracking	Unavailable	WSPMS	Medium	None

Notes:

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5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table C.19. PCC - crack and seat/rubblize with HMA Overlay

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
19. PCC - crack and seat/rubblize with HMA OL	MI	US-10	WF	1.4	1999	1958	41	6,700	9.0%	Unavailable	DI=33.8	1997	DI=0	1999	10 to-date (expected 12)	Observation Engineering judgment/experience	$397,160	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MI	US-23	WF	2.0	1995	1974	21	1,700	14.0%	Unavailable	DI=85	1995	DI=1.3	1997	14 to-date (expected 17)	Observation Engineering judgment/experience	$547,740	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MI	M-18	WF	6.7	1999	1976	23	4,900	7.0%	Unavailable	DI=108	1996	DI=0.1	2000	10 to-date (expected 15)	Observation Engineering judgment/experience	$366,451	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MI	I-69	WF	5.7	1998	1986	12	25,450	23.0%	Unavailable	DI=38	1997	DI=0.1	1999	11 to-date (expected 12)	Observation Engineering judgment experience	$714,323	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MN	2	WF	10.8	2006	1984	22	3,080	10.0%	Ride and spalled transverse joints	PQI=2.9	2006	PQI=3.9	2007-8	3 to-date (a projection of 10)	PMS performance tracking PMS performance prediction	$174,594 - $236,530	HPMA	Medium for C&S and Low for Rubblize	Original PCC construction was 1974. The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
19. PCC - crack and seat/rubblize with HMA OL	MN	75	WF	7.3	1994	Unavailable	Unavailable	2,100	11.0%	Cracked and broken panels and ride	PQI=2.9	1992	PQI=3.7	1996	14	PMS performance tracking	$174,594 - $236,530	HPMA	Medium for C&S and Low for Rubblize	None
19. PCC - crack and seat/rubblize with HMA OL	MN	22	WF	6.8	1999	Unavailable	Unavailable	5,300	5.4%	Spalled transverse joints and ride	PQI=2.9	1998	PQI=4.0	2000	10 to-date (a projection of 15)	PMS performance tracking PMS performance prediction	$174,594 - $236,530	HPMA	Medium for C&S and Low for Rubblize	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
19. PCC - crack and seat/rubblize with HMA OL	TX	FM 2887 - Runnels County	DNF	7.8	2008	2005	3	610 (2007)	5.0% (2008)	Extremely high number of longitudinal cracks	CS=73	2006	CS=80	2007	Unavailable	Unavailable	$146,667	Site manager, PMIS, DCIS, Plans Online, TRM database	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
19. PCC - crack and seat/rubblize with HMA OL	TX	US 83 - Cottle County	DNF	6.7	2007	before 2004	Unavailable	700	45.0% (2008)	Large number of longitudinal cracks	CS=90	2006	CS=100	2008	Unavailable	Unavailable	$282,930	Site Manager, PMIS, DCIS, Plans Online, TRM database	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
19. PCC - crack and seat/rubblize with HMA OL	TX	US 83 - Wheeler County	DNF	6.1	2007	2005	2	1,700	25.0% (2008)	Numerous patches, longitudinal cracks, rough ride	CS=80.3	2006	CS=99.8	2008	Unavailable	Unavailable	$253,625	Site Manager, PMIS, DCIS, Plans Online, TRM database	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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3 Percent Trucks - year of treatment unless otherwise indicated.
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Table C.20. PCC - unbonded overlay

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
20. PCC - unbonded overlay	MI	I-75 NB	WF	3.9	2003	1973	30	8,300	9.0%	Unavailable	DI=71.8	2001	DI=0	2005	6 to-date (expected 15)	Observation Engineering judgment/experience	$356,774	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MI	I-94	WF	9.0	1995	1960	35	3,700	28.0%	Unavailable	DI=32.7	1995	DI=3	1997	14 to-date (expected 18)	Observation Engineering judgment/experience	$797,438	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MI	I-69	WF	7.5	1999	1972	27	22,000	29.0%	Unavailable	DI=32.1	1999	DI=0.4	2001	10 to-date (expected 15)	Observation Engineering judgment/experience	$622,032	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MI	US-131	WF	3.2	1998	1960	38	23,284	18.0%	Unavailable	DI=75.3	1997	DI=0	1999	11 to-date (expected 15)	Observation Engineering judgment/experience	$639,701	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MN	10	WF	5.7	2003	1987	16	10,150	7.3%	Transverse joints, faulting, cracked panels, ride	PQI=2.8	2002	PQI=3.9	2004	At least 6 (expected 25)	HPMA performance (projection)	$396,367	HPMA	High	None
20. PCC - unbonded overlay	MN	I-35	WF	6.6	1998	1983	15	22,300	14.0%	Faulting, cracked panels, ride	PQI=2.8	1997	PQI=4.1	1999	At least 11 (expected 31)	HPMA performance (projection)	$396,367	HPMA	High	This is one of our best performing unbondeds. Our unbonded all perform well.
20. PCC - unbonded overlay	MN	212	WF	5.7	1986	Unavailable	Unavailable	9,700	12.0%	Transverse joints	PQI=2.8	1984	PQI=4.0	1986	At least 23 (expected 30)	HPMA performance (projection)	$396,367	HPMA	High	This is our oldest unbonded in the system and the main problems it has is some tipped dowel baskets during construction.
20. PCC - unbonded overlay	WA	I-90	DF	5.3	1973	1965	8	25,826	22.8%	PSC - Pavement Structural Condition	PSC=30	1971	PSC=60	1975	15	Experience	Unavailable	WSPMS	Medium	None

Notes:

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5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

APPENDIX D - LIST OF TREATMENTS BY CLIMATIC ZONE

The following tables are contained in this Appendix.

Table D.1. Wet no-freeze zone

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
3. HMA - microsurfacing	TX	SH121 - Collin County	WNF	14.0	2005	2004	1	14,000	15.0% (2008)	Flushing from previous seals, shallow rutting	CS=77.9	2005	CS=77.6	2006	4 to-date (expected 8)	Observation Engineering judgment/experience	$24,197	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	TX	FM 1382 - Dallas County	WNF	2.9	2008	2006	2	25,000	5.0% (2008)	Shallow rutting, cracking, minor flushing	CS=80.3	2008	Unavailable	2009	20 (expected)	Engineering judgment/experience	$156,275	Site manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	TX	SH73 - Orange County	WNF	2.3	2006	before 2004	Unavailable	28,100	5.0% (2008)	Numerous cracks, rough IRI	CS=68.6	2006	CS=96.6	2007	20 (expected)	Engineering judgment/experience	$679,684	Site manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	TX	SH 35 - Brazoria County	WNF	1.9	2005	before 2004	Unavailable	10,200 (2007)	15.0% (2008)	Severe alligator cracking	CS=58.8	2004	CS=37.5	2006	Unavailable	Unavailable	$101,058	Site Manager, PMIS, DCIS, Plans Online, TRM database	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	TX	IH20 - Harrison County	WNF	16.9	2006	2005	1	34,000 (2003)	35.0% (2008)	Cracking	CS=91.1	2006	CS=94.2	2007	3 to-date (expected 5)	Observation Engineering judgment/experience	$7,127	Site manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	TX	US180 - Palo Pinto County	WNF	12.3	2005	before 2004	Unavailable	2,500 (2007)	15.0% (2008)	Block cracking, longitudinal cracks, numerous patches	CS=70.9	2005	CS=88.0	2006	4 to-date (expected 5)	Observation Engineering judgment/experience	$12,452	Sitemanager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	FM 1409 - Liberty County	WNF	9.6	2005	before 2004	Unavailable	4,700 (2004)	5.0% (2007)	Very rough ride, severe rutting, numerous patches, raveling, cracking	CS=48.1	2005	CS=95.8	2006	4 to-date (expected 20)	Observation Engineering judgment/experience	$55,109	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	SH 205 - Kaufman County	WNF	6.1	2005	before 2004	Unavailable	7,000 (2007)	15.0% (2008)	Severe, deep and shallow ruts. alligator, longitudinal & transverse cracks. Very rough ride	CS=50.3	2004	CS=100	2005	4 to-date (expected 20)	Observation Engineering judgment/experience	$252,333	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	US 190 - Jasper County	WNF	10.5	2005	before 2004	Unavailable	5,000	15.0% (2008)	Numerous alligator and longitudinal cracks, indicative of shrink/swell subsurface material	CS=47.0	2004	CS=100	2007	4 to-date (expected 20)	Observation Engineering judgment/experience	$179,491	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	US 259 - Rusk County	WNF	5.9	2005	before 2004	Unavailable	10,900	35.0% (2008)	Shallow rutting	CS=86.3	2004	CS=94.1	2005	4 to-date (expected 20)	Observation Engineering judgment/experience	$64,713	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	IH 45 - Ellis County	WNF	10.1	2006	before 2004	Unavailable	42,000 (2007)	30.0% (2008)	Deep ruts, severe longitudinal cracking	CS=49.9	2004	CS=69.8	2005	3 to-date (expected 20)	Observation Engineering judgment/experience	$163,818	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	TX	US 69	WNF	4.5	2007	Yearly concrete repairs	1	58,000	9.4%	Inserted load transverse devices to prevent further faulting in pavement slabs	CS=49	2006	CS=90	2008	Unavailable	Unavailable	$260,325	As-built	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 12	WNF	11.2	2004	1991	13	13,719	14.5%	PSC - Pavement Structural Condition	PSC = 63	2003	PSC = 99	2005	5 to-date (expected 16)	PMS performance tracking Engineering judgment/experience	$132,815	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 2	WNF	9.9	2004	1995	9	4,345	11.9%	PSC - Pavement Structural Condition	PSC = 69	2003	PSC = 99	2005	5 to-date (expected 16)	PMS performance tracking Engineering judgment/experience	$129,610	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 20	WNF	17.7	1996	1972	24	808	11.5%	PSC - Pavement Structural Condition	PSC = 60	1995	PSC = 99	1997	13 to-date (expected 16)	PMS performance tracking Engineering judgment/experience	$178,758	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 105	WNF	25.2	2005	1995	10	1,339	10.3%	PSC - Pavement Structural Condition	PSC=64	2004	PSC=96	2006	4 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$40,399	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Table D.1. Wet no-freeze zone

2. HMA - Chip Seal	WA	SR 410	WNF	19.2	2004	1999	5	742	8.2%	Unavailable	PSC=94	2003	PSC=98	2005	5 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$59,561	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	I-5	WNF	7.3	1998	1984	14	53,815	19.4%	Rutting	PSC=96	1997	PSC=99	1999	11 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$199,419	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	I-5	WNF	10.0	1999	1991	8	54,416	19.0%	PSC - Pavement Structural Condition	PSC=89	1998	PSC=99	2000	10 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$127,883	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	I-5	WNF	3.1	2000	1959	41	56,385	11.3%	PPC - Pavement Profile Condition	PSC=55	1999	PSC=60	2001	9 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$65,741	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	I-5	WNF	6.4	2000	1959	41	140,638	9.4%	PPC - Pavement Profile Condition	PSC=35	1999	PSC=90	2001	9 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$418,835	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

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3 Percent Trucks - year of treatment unless otherwise indicated.
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Table D.2. Wet freeze zone

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
1. HMA OL (< 2 inches)	MI	M-32	WF	10.3	2000	1992	8	4,200	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <40, Ride Quality Index <70 and Rut <12mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <25, Ride Quality Index <70 and Rut <12mm."	DI = 0.1	1998	DI = 0.0	2000	Flexible - 5 to 10 Composite - 4 to 9	Engineering judgment/experience	$46,152	PMS/Flat File	High	ESL based on state experience with treatment.
1. HMA OL (< 2 inches)	MI	M-183	WF	1.5	1998	1994	4	878	1.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <40, Ride Quality Index <70 and Rut <12mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <25, Ride Quality Index <70 and Rut <12mm."	DI = 1.2	1998	DI = 0.6	2000	Flexible - 5 to 10 Composite - 4 to 9	Engineering judgment/experience	$35,185	PMS/Flat File	High	ESL based on state experience with treatment.
1. HMA OL (< 2 inches)	MI	US-2	WF	0.4	1998	1988	10	6,094	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <40, Ride Quality Index <70 and Rut <12mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <25, Ride Quality Index <70 and Rut <12mm."	DI = 65.2	1997	DI = 1.6	1999	Flexible - 5 to 10 Composite - 4 to 9	Engineering judgment/experience	$47,588	PMS/Flat File	High	ESL based on state experience with treatment.
2. HMA - Chip Seal	MI	US-31	WF	6.7	2004	1991	13	7,800	8.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-6 years, Distress Index < 25-30, Ride Quality Index <54 and Rut <3mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut <3mm."	DI=19.3	2003	DI=1.1	2005	Flexible: Single Seal 3-6; Double Seal 4 to 7; Composite: Double Seal 3 to 6.	Engineering judgment/experience	$29,388	PMS/Flat File	High	ESL based on state experience with treatment.
2. HMA - Chip Seal	MI	M-72	WF	14.5	2004	1998	6	6,000	13.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-6 years, Distress Index < 25-30, Ride Quality Index <54 and Rut <3mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut <3mm."	DI=2.6	2004	DI=4.4	2006	Flexible: Single Seal 3-6; Double Seal 4 to 7; Composite: Double Seal 3 to 6.	Engineering judgment/experience	$18,653	PMS/Flat File	High	ESL based on state experience with treatment.
2. HMA - Chip Seal	MI	Old US-131	WF	2.3	2006	1997	9	3,400	12.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-6 years, Distress Index < 25-30, Ride Quality Index <54 and Rut <3mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut <3mm."	DI=7.3	2005	DI=0.7	2007	Flexible: Single Seal 3-6; Double Seal 4 to 7; Composite: Double Seal 3 to 6.	Engineering judgment/experience	$21,186	PMS/Flat File	High	ESL based on state experience with treatment.
3. HMA - microsurfacing	MI	US-31 NB	WF	3.6	1996	1989	7	2,276	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-10 years, Distress Index < 15-30, Ride Quality Index <54 and Rut < 25mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut < 25mm."	DI=1.0	1995	DI=0.5	1997	Flexible: Single Course 3-5; Multiple Course 4-6; Composite: NA	Engineering judgment/experience	$27,246	PMS/Flat File	High	ESL based on state experience with treatment.
3. HMA - microsurfacing	MI	US-31	WF	6.8	1998	1991	7	5,279	9.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-10 years, Distress Index < 15-30, Ride Quality Index <54 and Rut < 25mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut < 25mm."	DI=7.5	1997	DI=1.7	1999	Flexible: Single Course 3-5; Multiple Course 4-6; Composite: NA	Engineering judgment/experience	$26,270	PMS/Flat File	High	ESL based on state experience with treatment.
3. HMA - microsurfacing	MI	M-89	WF	1.1	2005	1998	7	9,200	4.0%	For flexible pavements, trigger values are "a minimum remaining service life of 5-10 years, Distress Index < 15-30, Ride Quality Index <54 and Rut < 25mm;" For composite pavements, trigger values are "a minimum remaining service life of 5 years, Distress Index <15, Ride Quality Index <54 and Rut < 25mm."	DI=5.6	2004	DI=2.1	2006	Flexible: Single Course 3-5; Multiple Course 4-6; Composite: NA	Engineering judgment/experience	$32,698	PMS/Flat File	High	ESL based on state experience with treatment.
4. HMA - crack sealing	MI	US-2	WF	0.2	2000	1998	2	8,200	4.0%	For flexible pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index < 15, Ride Quality Index <54 and Rut < 3 mm;" For composite pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index <5, Ride Quality Index <54 and Rut < 3mm."	DI=2.4	1999	DI=0.8	2001	Flexible -Up to 3; Composite - Up to 3;	Engineering judgment/experience	$1,877	PMS/Flat File	High	ESL based on state experience with treatment.
4. HMA - crack sealing	MI	M-89	WF	1.1	2000	1998	2	7,700	7.0%	For flexible pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index < 15, Ride Quality Index <54 and Rut < 3 mm;" For composite pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index <5, Ride Quality Index <54 and Rut < 3mm."	DI=4.5	2000	DI=3.7	2002	Flexible -Up to 3; Composite - Up to 3;	Engineering judgment/experience	$2,859	PMS/Flat File	High	ESL based on state experience with treatment.
4. HMA - crack sealing	MI	M-24	WF	15.0	1998	1988	10	30,392	5.0%	For flexible pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index < 15, Ride Quality Index <54 and Rut < 3 mm;" For composite pavements, trigger values are "a minimum remaining service life of 10 years, Distress Index <5, Ride Quality Index <54 and Rut < 3mm."	DI=10.5	1996	DI=4.8	1998	Flexible -Up to 3; Composite - Up to 3;	Engineering judgment/experience	$9,792	PMS/Flat File	High	ESL based on state experience with treatment.
5. HMA - mill and resurfacing	MI	US-2	WF	1.0	2001	1984	17	6,100	14.0%	For flexible pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index < 40, Ride Quality Index <80 and Rut < 25 mm;" For composite pavements, trigger values are "a minimum remaining service life of 3 years, Distress Index <30, Ride Quality Index <80 and Rut < 25mm."	DI=16.3	1999	DI=0	2001	Flexible 5 to 10 yrs Composite 4 to 9 yrs	Engineering judgment/experience	$63,612	PMS/Flat File	High	Fix has been part of the capital preventive maintenance (CPM) program since the program started up in 1992. Originally the one course was limited to 1.5" but in recent years in some cases we use 2". The project listed was cold milled 1.5", then resurfaced with 1.5" HMA (full depth flexible section). ESL based on state experience with treatment.

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5. HMA - mill and resurfacing	MI	M-54	WF	1.2	2005	1986	19	12,000	8.0%	For flexible pavements, trigger values are “a minimum remaining service life of 3 years, Distress Index < 40, Ride Quality Index <80 and Rut < 25 mm;” For composite pavements, trigger values are “a minimum remaining service life of 3 years, Distress Index <30, Ride Quality Index <80 and Rut < 25mm.”	DI=63.6	2004	DI=1	2006	Flexible 5 to 10 yrs Composite 4 to 9 yrs	Engineering judgment/experience	$66,966	PMS/Flat File	High	Fix has been part of the capital preventive maintenance (CPM) program since the program started up in 1992. Originally the one course was limited to 1.5" but in recent years in some cases we use 2". The project listed was cold milled 1.5", then resurfaced with 1.5" HMA (full depth flexible section). ESL based on state experience with treatment.
5. HMA - mill and resurfacing	MI	I-196 BL	WF	0.8	2005	1989	16	16,800	4.0%	For flexible pavements, trigger values are “a minimum remaining service life of 3 years, Distress Index < 40, Ride Quality Index <80 and Rut < 25 mm;” For composite pavements, trigger values are “a minimum remaining service life of 3 years, Distress Index <30, Ride Quality Index <80 and Rut < 25mm.”	DI=53.3	2004	DI=0.7	2006	Flexible 5 to 10 yrs Composite 4 to 9 yrs	Engineering judgment/experience	$69,561	PMS/Flat File	High	Fix has been part of the capital preventive maintenance (CPM) program since the program started up in 1992. Originally the one course was limited to 1.5" but in recent years in some cases we use 2". The project listed was cold milled 1.5", then resurfaced with 1.5" HMA (full depth flexible section). ESL based on state experience with treatment.
6. HMA - hot in-place recycling	MI	I-196 EB	WF	4.7	1995	1963	32	6,000	39.0%	Unavailable	DI=75.7	1995	DI=4.9	1997	Unavailable	Unavailable	$130,383	PMS/Flat File	Low	This fix was tried a few times in the past but was unsuccessful at the time primarily from a construction stand point. 1.5" of HMA was added as part of this project.
6. HMA - hot in-place recycling	MI	M-142	WF	16.6	1997	1984	13	2,949	4.0%	Unavailable	DI=74.7	1996	DI=25.9	2000	Unavailable	Unavailable	$37,820	PMS/Flat File	Low	This fix was tried a few times in the past but was unsuccessful at the time primarily from a construction stand point.
9. HMA - cold in-place recycling	MI	M-29	WF	2.0	2001	1978	23	10,600	4.0%	Unavailable	DI=46.7	2000	DI=0	2002	See comments	Unavailable	$322,680	PMS/Flat File	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has tried this fix on 5 projects. They are being monitored but to date State has not reached any conclusions on the performance as compared to a traditional resurfacing or mill and fill project.
9. HMA - cold in-place recycling	MI	M-65	WF	6.1	2002	1984	18	6,800	5.0%	Unavailable	DI=29	2000	DI=0.3	2002	See comments	Unavailable	$251,413	PMS/Flat File	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has tried this fix on 5 projects. They are being monitored but to date State has not reached any conclusions on the performance as compared to a traditional resurfacing or mill and fill project.
9. HMA - cold in-place recycling	MI	M-34	WF	3.7	2006	1979	27	4,300	7.0%	Unavailable	DI=117.3	2004	DI=3	2006	See comments	Unavailable	$337,525	PMS/Flat File	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has tried this fix on 5 projects. They are being monitored but to date State has not reached any conclusions on the performance as compared to a traditional resurfacing or mill and fill project.
10. HMA - full depth reclamation	MI	I-75	WF	4.0	1997	1985	12	8,198	13.0%	Unavailable	DI=59	1997	DI=0.6	1999	10	Engineering judgment/experience	$112,065	PMS/Flat File	High	MDOT has not estimated extended service life for the individual projects. For rehabilitation projects, the life expectation estimates are based on a combination of engineering judgment and data. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	MI	I-75	WF	7.7	1998	1978	20	14,010	10.0%	Unavailable	DI=79.3	1997	DI=1.7	1999	10	Engineering judgment/experience	$118,539	PMS/Flat File	High	MDOT has not estimated extended service life for the individual projects. For rehabilitation projects, the life expectation estimates are based on a combination of engineering judgment and data. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	MI	US-127	WF	9.2	1998	1974	24	7,166	13.0%	Unavailable	DI=78.7	1997	DI=0	1999	10	Engineering judgment/experience	$352,641	PMS/Flat File	High	MDOT has not estimated extended service life for the individual projects. For rehabilitation projects, the life expectation estimates are based on a combination of engineering judgment and data. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
11. HMA - structural overlay	MI	US-12	WF	0.4	1994	1984	10	6,300	8.0%	Unavailable	DI=107.7	1993	DI=0.3	1995	Flexible 8-10 years; Composite 6-8 years	Engineering judgment/experience	$135,468	PMS/Flat File	High	This is a standard fix that is used on a regular basis. It has been very successful with performance varying depending on the existing pavement condition and whether it is being placed on a composite pavement or flexible pavement. The project listed was cold milled 1.5" then resurfaced with two courses (3" total) of HMA. The ESL is a prediction based upon agency experience.
11. HMA - structural overlay	MI	M-37	WF	0.9	1999	1984	15	5,200	4.0%	Unavailable	DI=75.5	1998	DI=1.9	2000	Flexible 10-12 years; Composite 8-10 years	Engineering judgment/experience	$144,605	PMS/Flat File	High	This is a standard fix that is used on a regular basis. It has been very successful with performance varying depending on the existing pavement condition and whether it is being placed on a composite pavement or flexible pavement. The project listed was cold milled 1.5" then resurfaced with two courses (3" total) of HMA. The ESL is a prediction based upon agency experience.
11. HMA - structural overlay	MI	US-31 NB	WF	7.5	1999	1989	10	4,200	5.0%	Unavailable	DI=20.9	1999	DI=5.4	2003	Flexible 10-12 years; Composite 8-10 years	Engineering judgment/experience	$115,292	PMS/Flat File	High	This is a standard fix that is used on a regular basis. It has been very successful with performance varying depending on the existing pavement condition and whether it is being placed on a composite pavement or flexible pavement. The project listed was cold milled 1.5" then resurfaced with two courses (3" total) of HMA. The ESL is a prediction based upon agency experience.
12. HMA - whitetopping	MI	M-46	WF	4.0	1999	1970	29	2,000	6.0%	Unavailable	DI=43.7	1998	DI=0.6	2000	Unavailable	Engineering judgment/experience	$409,883	PMS/Flat File	Low	Still considered experimental
14. PCC - DBR	MI	I-696 EB	WF	6.4	1998	1978	20	82,386	5.0%	Trigger values are “a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54.”	DI=8	1997	DI=5.5	1999	2-3	Engineering judgment/experience	$29,929	PMS/Flat File	Low	9 projects over the last 12 years
14. PCC - DBR	MI	M-10 NB	WF	7.3	2000	1987	13	68,000	2.0%	Trigger values are “a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54.”	DI=1.8	1999	DI=6.9	2001	2-3	Engineering judgment/experience	$54,809	PMS/Flat File	Low	9 projects over the last 12 years
14. PCC - DBR	MI	I-69 NB	WF	8.6	1999	1991	8	30,400	18.0%	Trigger values are “a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54.”	DI=7.6	1997	DI=5	1999	2-3	Engineering judgment/experience	$19,945	PMS/Flat File	Low	9 projects over the last 12 years

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15. PCC - full depth repair	MI	I-94 WB	WF	3.1	1996	1986	10	13,014	36.0%	Trigger values are "a minimum remaining service life of 7 years, Distress Index < 20 and Ride Quality Index <54."	DI=12.6	1995	DI=8.9	1997	3-10	Engineering judgment/experience	$45,596	PMS/Flat File	High	MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
15. PCC - full depth repair	MI	US-31 NB	WF	12.2	2005	1987	18	7,400	15.0%	Trigger values are "a minimum remaining service life of 7 years, Distress Index < 20 and Ride Quality Index <54."	DI=10.3	2005	DI=6.6	2007	3-10	Engineering judgment/experience	$19,238	PMS/Flat File	High	MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
15. PCC - full depth repair	MI	I-94 EB	WF	5.2	2006	1990	16	23,900	23.0%	Trigger values are "a minimum remaining service life of 7 years, Distress Index < 20 and Ride Quality Index <54."	DI=6.7	2005	DI=3.6	2007	3-10	Engineering judgment/experience	$31,557	PMS/Flat File	High	MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
16. PCC - joint sealing	MI	I-696 EB	WF	6.2	1995	1989	6	65,500	7.0%	Trigger values are "a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54."	DI=0.2	1995	DI=0.2	1997	4	PMS performance tracking	$6,867	PMS/Flat File	High	MDOT has used several different materials to seal and reseal joints such as silicone, neoprene, and hot-poured rubber. MDOT's current standard is to use low-modulus hot-poured rubber.
16. PCC - joint sealing	MI	I-69 EB	WF	5.6	1996	1984	12	5,492	27.0%	Trigger values are "a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54."	DI=0.5	1995	DI=1.1	1997	4	PMS performance tracking	$2,856	PMS/Flat File	High	MDOT has used several different materials to seal and reseal joints such as silicone, neoprene, and hot-poured rubber. MDOT's current standard is to use low-modulus hot-poured rubber.
16. PCC - joint sealing	MI	I-75 NB	WF	6.5	1998	1990	8	22,800	17.0%	Trigger values are "a minimum remaining service life of 10 years, Distress Index < 15 and Ride Quality Index <54."	DI=0.8	1997	DI=0.6	1999	4	PMS performance tracking	$15,402	PMS/Flat File	High	MDOT has used several different materials to seal and reseal joints such as silicone, neoprene, and hot-poured rubber. MDOT's current standard is to use low-modulus hot-poured rubber.
18. PCC - HMA OL w/o slab frac	MI	I-96	WF	8.1	1998	1962	36	48,172	11.0%	Unavailable	DI=52.2	1997	DI=0.1	1999	6-8	Engineering judgment/experience	$730,259	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	MI	I-94 EB	WF	7.4	1998	1985	13	19,819	31.0%	Unavailable	DI=53	1997	DI=0	1999	6-8	Engineering judgment/experience	$307,606	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	MI	I-94 WB	WF	7.3	2001	1985	16	20,700	30.0%	Unavailable	DI=11.5	1999	DI=0	2001	6-8	Engineering judgment/experience	$351,812	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
19. PCC - crack and seat/rubblize with HMA OL	MI	US-10	WF	1.4	1999	1958	41	6,700	9.0%	Unavailable	DI=33.8	1997	DI=0	1999	10 to-date (expected 12)	Observation Engineering judgment/experience	$397,160	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. MDOT has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MI	US-23	WF	2.0	1995	1974	21	1,700	14.0%	Unavailable	DI=85	1995	DI=1.3	1997	14 to-date (expected 17)	Observation Engineering judgment/experience	$547,740	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MI	M-18	WF	6.7	1999	1976	23	4,900	7.0%	Unavailable	DI=108	1996	DI=0.1	2000	10 to-date (expected 15)	Observation Engineering judgment/experience	$366,451	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
19. PCC - crack and seat/rubblize with HMA OL	MI	I-69	WF	5.7	1998	1986	12	25,450	23.0%	Unavailable	DI=38	1997	DI=0.1	1999	11 to-date (expected 12)	Observation Engineering judgment experience	$714,323	PMS/Flat File	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly. State has used the current technique for full depth repairs for 21 years. Contractors are capable of a high production rate with modern equipment.
20. PCC - unbonded overlay	MI	I-75 NB	WF	3.9	2003	1973	30	8,300	9.0%	Unavailable	DI=71.8	2001	DI=0	2005	6 to-date (expected 15)	Observation Engineering judgment/experience	$356,774	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MI	I-94	WF	9.0	1995	1960	35	3,700	28.0%	Unavailable	DI=32.7	1995	DI=3	1997	14 to-date (expected 18)	Observation Engineering judgment/experience	$797,438	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MI	I-69	WF	7.5	1999	1972	27	22,000	29.0%	Unavailable	DI=32.1	1999	DI=0.4	2001	10 to-date (expected 15)	Observation Engineering judgment/experience	$622,032	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
20. PCC - unbonded overlay	MI	US-131	WF	3.2	1998	1960	38	23,284	18.0%	Unavailable	DI=75.3	1997	DI=0	1999	11 to-date (expected 15)	Observation Engineering judgment/experience	$639,701	PMS/Flat File	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	MN	I-35	WF	13.8	1987	Unavailable	Unavailable	31,300	5.2%	Transverse cracking	PQI = 2.7	1984	PQI = 4.1	1988	20	PMS performance tracking	$31,209	HPMA	High	None
1. HMA OL (< 2 inches)	MN	TH 16	WF	12.4	1989	Unavailable	Unavailable	1,200	9.5%	Transverse, longitudinal, and multiple cracking	PQI = 2.4	1987	PQI = 3.9	1990	15	PMS performance tracking	$31,209	HPMA	High	None

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1. HMA OL (< 2 inches)	MN	TH 92	WF	3.2	1992	Unavailable	Unavailable	2,300	8.7%	Transverse and longitudinal cracking	PQI=3.0	1991	PQI=3.9	1994	17 to-date (a projection of 23)	PMS performance tracking PMS performance prediction	$31,209	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
2. HMA - Chip Seal	MN	12	WF	4.6	1998	1993	5	5,700	9.5%	Transverse cracks - but not triggered by distress	PQI=3.9	1997	PQI=3.7	1999	Not Measurable	PMS performance tracking	$6,732	HPMA	High	MN DOT has not seen signficant life extension from chip seal treatments.
2. HMA - Chip Seal	MN	169	WF	5.0	2000	1987	13	15,400	4.5%	Transverse cracking and some longitudinal cracking	PQI=3.6	2000	PQI=3.1	2002	Not Measurable	PMS performance tracking	$6,732	HPMA	High	MN DOT has not seen signficant life extension from chip seal treatments.
3. HMA - microsurfacing	MN	I-94	WF	10.1	2001	1990	11	28,290	11.0%	Transverse cracks and a little Rutting	PQI=3.4	1999	PQI=3.8	2001	5	PMS performance tracking	$27,279	HPMA	High	None
3. HMA - microsurfacing	MN	3	WF	8.0	2003	1996	7	5,500	4.7%	Transverse cracks, longitudinal cracks, and longitudinal joint deterioration	PQI=3.6	2002	PQI=3.6	2003	3	PMS performance tracking	$27,279	HPMA	High	None
3. HMA - microsurfacing	MN	9	WF	18.5	1999	1994	5	513	9.4%	Transverse cracks	PQI=3.8	1997	PQI=3.8	2001	5	PMS performance tracking	$27,279	HPMA	High	None
4. HMA - crack sealing	MN	I-35	WF	8.5	1999	1995	4	32,500	16.0%	Transverse cracks	PQI=3.9	1998	PQI=3.8	2000	0	PMS performance tracking	$1,098	HPMA	High	State regularly applies crack sealing, but has some reservation regarding its benefit, especially the fact that it does not have any effect on improving the poor ride quality caused by adjacent transverse cracks in HMA.
4. HMA - crack sealing	MN	65	WF	14.0	2001	2000	1	65	4.6%	Transverse cracks	PQI=3.8	2001	PQI=3.8	2002	0	PMS performance tracking	$1,098	HPMA	High	State regularly applies crack sealing, but has some reservation regarding its benefit, especially the fact that it does not have any effect on improving the poor ride quality caused by adjacent transverse cracks in HMA.
4. HMA - crack sealing	MN	27	WF	7.2	1995	1989	6	2,295	5.8%	Transverse cracks	PQI=3.6	1995	PQI=3.5	1997	0	PMS performance tracking	$1,098	HPMA	High	State regularly applies crack sealing, but has some reservation regarding its benefit, especially the fact that it does not have any effect on improving the poor ride quality caused by adjacent transverse cracks in HMA.
5. HMA - mill and resurfacing	MN	I-394	WF	6.2	2004	1991	13	119,500	3.4%	Ride	PQI=3.2	2004	PQI=3.6	2005	5 to-date (a projection of 12)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
5. HMA - mill and resurfacing	MN	TH 169	WF	8.6	1996	1986	10	12,200	5.9%	Transverse cracks and some rutting	PQI=3.6	1994	PQI=4.0	1998	13 to-date (a projection of 16)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
5. HMA - mill and resurfacing	MN	TH 2	WF	2.7	2006	1993	13	3,400	12.0%	Longitudinal joint deterioration and transverse cracking	PQI=2.5	2004	PQI=3.5	2007	3 to-date (a projection of 10)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
9. HMA - cold in-place recycling	MN	23	WF	10.5	1999	1978	21	3,438	16.0%	Transverse cracking, ride	PQI=2.8	1998	PQI=4.0	1999	10 to-date (a projection of 15)	PMS performance tracking PMS Performance prediction	$122,213	HPMA	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. State had concerns about performance and have not performed any CIRs in recent years, but is revisiting CIR on a research basis with foamed asphalt and chemical set emulsions. The performance issue was premature stripping of the CIR layer, resulting in what looks like alligator cracking of the wear course but the cracking was in the HMA above the CIR.
9. HMA - cold in-place recycling	MN	23	WF	4.5	2002	1985	17	2,650	15.0%	Centerline joint deterioration, transverse cracking, ride	PQI=2.4	2002	PQI=4.0	2003	7 to-date (a projection of 17)	PMS performance tracking PMS Performance prediction	$122,213	HPMA	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. State had concerns about performance and have not performed any CIRs in recent years, but is revisiting CIR on a research basis with foamed asphalt and chemical set emulsions. The performance issue was premature stripping of the CIR layer, resulting in what looks like alligator cracking of the wear course but the cracking was in the HMA above the CIR.
9. HMA - cold in-place recycling	MN	25	WF	6.4	1992	Unavailable	Unavailable	19,051	6.7%	Transverse and multiple cracking before CIR, multiple cracking and centerline joint deterioration at end of CIR life	PQI=2.4	1991	PQI=4.0	1992	9	PMS performance tracking	$122,213	HPMA	Low	State had concerns about performance and have not performed any CIRs in recent years, but is revisiting CIR on a research basis with foamed asphalt and chemical set emulsions. The performance issue was premature stripping of the CIR layer, resulting in what looks like alligator cracking of the wear course but the cracking was in the HMA above the CIR.
10. HMA - full depth reclamation	MN	TH 73	WF	13.5	2000	Unavailable	Unavailable	680	5.1%	Transverse and longitudinal cracks, rutting, and patching	PQI=2.1	1998	PQI=4.1	2001	9 to-date (a projection of 15)	PMS performance tracking PMS performance prediction	$163,495	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
10. HMA - full depth reclamation	MN	TH 200	WF	4.8	2003	Unavailable	Unavailable	1,107	15.0%	Cracking	PQI=2.1	2002	PQI=4.0	2004	6 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$163,495	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
10. HMA - full depth reclamation	MN	TH 6	WF	6.4	2004	1983	21	418	15.0%	Transverse, longitudinal cracking, C/L joint deterioration, ride	PQI=2.4	2003	PQI=4.1	2005	5 to-date (a projection of 15)	PMS performance tracking PMS performance prediction	$163,495	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
11. HMA - structural overlay	MN	I-35	WF	9.3	1998	1989	9	15,254	6.9%	Cracking	PQI=3.0	1998	PQI=4.1	2000	11 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$107,000	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.

Table D.2. Wet freeze zone

11. HMA - structural overlay	MN	1	WF	12.0	2005	1983	22	3,100	4.6%	Transverse and longitudinal cracking and ride	PQI=2.5	2004	PQI=3.9	2005	4 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$107,000	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
11. HMA - structural overlay	MN	10	WF	11.7	1995	1980	15	8,000	11.0%	Transverse cracks and multiple cracking and ride	PQI=2.3	1994	PQI=3.9	1996	14 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$107,000	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
12. HMA - whitetopping	MN	TH-30	WF	8.5	1993	1973	20	584	18.0%	Transverse and longitudinal cracks and patching	PQI=1.4	1991	PQI=4.0	1994	16 to-date (a projection of 17)	PMS performance tracking PMS performance prediction	$663,344	HPMA	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. This is the only highway whitetopping project constructed by MNDOT. The others are either research sections at MNROAD, or a local solution to an HMA rutting problem.
13. PCC - diamond grinding	MN	TH 10	WF	5.4	1982	Unavailable	Unavailable	11,500	10.0%	Joint faulting, ride	PQI=2.5	1982	PQI=3.2	1983	4	PMS performance tracking	$20,682	HPMA	High	The last rehab year was 2000, but the rehab after 1982 was a major CPR in 1986. The original construction was in 1947. This pavement is on a sand subgrade and that is likely that reason it is still in service as a concrete pavement.
13. PCC - diamond grinding	MN	I-94	WF	2.9	2004	1991	13	52,300	16.0%	Joint faulting, ride	PQI=2.6	2004	PQI=3.5	2006	5 to-date (a projection of 6)	PMS performance tracking PMS performance prediction	$20,682	HPMA	High	Orig construction was 1973. The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
13. PCC - diamond grinding	MN	15	WF	1.0	2004	Unavailable	Unavailable	20,900	5.4%	Transverse joints, cracked panels, ride	PQI=2.8	2003	PQI=3.5	2005	5 to-date (a projection of 13)	PMS performance tracking PMS performance prediction	$20,682	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
14. PCC - DBR	MN	I-94	WF	7.4	2004	1984	20	84,200	9.0%	Cracked panels with some faulting and transverse joint spall and ride	PQI=2.6	2004	PQI=3.5	2005	5 to-date (a projection of 16)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. This CPR included dowel retrofits into mid-panel cracks that were faulting. There now are a few slots that have disintegrating grout. Diamond grinding was done after dowels and CPR was complete.
14. PCC - DBR	MN	I-94	WF	3.0	2007	1986	21	13,950	16.0%	Cracked panels and ride	PQI=2.6	2007	PQI=3.1	2008	2 to-date (a projection of 2)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. This dowel bar retrofit also had diamond grinding. State suspected that the dowels were for mid panel cracks.
14. PCC - DBR	MN	TH 77	WF	2.2	2007	1982	25	70,000	2.9%	Cracked panels	PQI=3.0	2006	PQI=3.1	2008	2 to-date (a projection of 7)	PMS performance tracking PMS performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
15. PCC - full depth repair	MN	I-35	WF	8.6	1999	1995	4	17,600	7.1%	Transverse joints and cracked panels	PQI=3.0	1998	PQI=3.6	2000	9	PMS performance tracking	$102,162	HPMA	High	None
15. PCC - full depth repair	MN	TH 52	WF	2.8	1994	1983	11	18,000	11.0%	Cracked panels	PQI=3.2	1991	PQI=3.4	1994	14	PMS performance tracking	$102,162	HPMA	High	It is hard to identify how long the pavement would have lasted without major CPR.
15. PCC - full depth repair	MN	TH 10	WF	2.2	1997	1987	10	27,600	13.0%	A few cracked panels	PQI=3.7	1997	PQI=3.8	1998	11	PMS performance tracking	$102,162	HPMA	High	None
17. PCC - partial depth repair	MN	TH 169	WF	1.7	2005	1996	9	14,300	18.0%	A few cracked panels	PQI=3.3	2004	PQI=3.5	2005	4 to-date (a projection of 7)	PMS performance tracking PMS performance prediction	$95,853	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
18. PCC - HMA OL w/o slab frac	MN	I-35	WF	6.6	1997	1980	17	27,400	18.0%	Faulting and cracked panels and ride	PQI=2.6	1997	PQI=4.0	1998	12 to-date (a projection of 17)	PMS performance tracking PMS Performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
18. PCC - HMA OL w/o slab frac	MN	52	WF	6.4	1998	1986	12	19,560	11.0%	Ride, transverse joints, cracked panels	PQI=2.3	1998	PQI=3.9	1999	11 to-date (a projection of 17)	PMS performance tracking PMS Performance prediction	Unavailable	HPMA	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
18. PCC - HMA OL w/o slab frac	MN	44	WF	8.9	1992	1978	14	2,970	7.5%	Transverse joints, faulting, cracked and broken panels and ride	PQI=2.1	1990	PQI=4.1	1993	11	PMS performance tracking	Unavailable	HPMA	High	None
19. PCC - crack and seat/rubblize with HMA OL	MN	2	WF	10.8	2006	1984	22	3,080	10.0%	Ride and spalled transverse joints	PQI=2.9	2006	PQI=3.9	2007-8	3 to-date (a projection of 10)	PMS performance tracking PMS performance prediction	$174,594 - $236,530	HPMA	Medium for C&S and Low for Rubblize	Original PCC construction was 1974. The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
19. PCC - crack and seat/rubblize with HMA OL	MN	75	WF	7.3	1994	Unavailable	Unavailable	2,100	11.0%	Cracked and broken panels and ride	PQI=2.9	1992	PQI=3.7	1996	14	PMS performance tracking	$174,594 - $236,530	HPMA	Medium for C&S and Low for Rubblize	None
19. PCC - crack and seat/rubblize with HMA OL	MN	22	WF	6.8	1999	Unavailable	Unavailable	5,300	5.4%	Spalled transverse joints and ride	PQI=2.9	1998	PQI=4.0	2000	10 to-date (a projection of 15)	PMS performance tracking PMS performance prediction	$174,594 - $236,530	HPMA	Medium for C&S and Low for Rubblize	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment.
20. PCC - unbonded overlay	MN	10	WF	5.7	2003	1987	16	10,150	7.3%	Transverse joints, faulting, cracked panels, ride	PQI=2.8	2002	PQI=3.9	2004	At least 6 (expected 25)	HPMA performance (projection)	$396,367	HPMA	High	None
20. PCC - unbonded overlay	MN	I-35	WF	6.6	1998	1983	15	22,300	14.0%	Faulting, cracked panels, ride	PQI=2.8	1997	PQI=4.1	1999	At least 11 (expected 31)	HPMA performance (projection)	$396,367	HPMA	High	This is one of our best performing unbondeds. Our unbonded all perform well.
20. PCC - unbonded overlay	MN	212	WF	5.7	1986	Unavailable	Unavailable	9,700	12.0%	Transverse joints	PQI=2.8	1984	PQI=4.0	1986	At least 23 (expected 30)	HPMA performance (projection)	$396,367	HPMA	High	This is our oldest unbonded in the system and the main problems it has is some tipped dowel baskets during construction.

Notes:

1 Please refer to the observations section of the report for a discussion of limitations of data presented in these tables.
2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table D.3. Dry no-freeze zone

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
2. HMA - Chip Seal	TX	LP 1604 - Bexar County	DNF	4.8	2005	before 2004	Unavailable	7,700 (2007)	5.0% (2008)	Block, alligator & longitudinal cracks	CS=90.5	2004	CS=92.75	2005	5	Observation Engineering judgment/experience	$40,259	Site manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	TX	SH36 - Comanche County	DNF	7.2	2004	before 2004	Unavailable	3,000 (1999)	25.0% (2008)	Poor skid, longitudinal cracks	CS=60	2004	CS=97.95	2005	5	Observation Engineering judgment/experience	$145,976	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	TX	US90 - Val Verde County	DNF	16.6	2005	before 2004	Unavailable	1,150 (2007)	45.0% (2008)	Alligator and longitudinal cracks	CS=99.94	2005	CS=99.97	2006	5	Observation Engineering judgment/experience	$115,419	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
3. HMA - microsurfacing	TX	US277 - Jones County	DNF	14.3	2005	before 2004	Unavailable	3,300	20.0% (2008)	Flushing, patches	CS=95.4	2004	CS=99.4	2006	4 to-date (expected 8)	Observation Engineering judgment/experience	$28,202	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
3. HMA - microsurfacing	TX	US 180 - Shackelford County	DNF	6.9	2004	before 2004	Unavailable	2,100	30.0% (2008)	Flushing, longitudinal cracks, some shallow rutting	CS=84.6	2004	CS=94.8	2005	5 to-date (expected 8)	Observation Engineering judgment/experience	$19,436	Site Manager, PMIS, DCIS, Plans Online, TRM database	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	TX	SS 371	DNF	1.8	2005	1967	38	10,300	10.2%	Longitudinal and transverse cracks larger than seal coat can cover	CS=62	2008	CS=89	2009	1-2	Observation Engineering judgment/experience	$883	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	TX	SL 1604	DNF	10.3	2005	1981	24	4,500	7.2%	Longitudinal and transverse cracks larger than seal coat can cover	CS=93	2008	CS=92	2009	1-2	Observation Engineering judgment/experience	$883	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	TX	SL 1604	DNF	3.1	2005	1989	16	100,000	3.4%	Longitudinal and transverse cracks larger than seal coat can cover	CS=92	2008	CS=89	2009	1-2	Observation Engineering judgment/experience	$883	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	TX	BU 83-D - Taylor County	DNF	1.3	2006	2004	2	15,300	15.0% (2008)	Large number of longitudinal cracks	CS=41.8	2006	CS=97.4	2007	20 (expected)	Engineering judgment/ experience	$446,192	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	TX	US67 - Runnels County	DNF	12.9	2005	before 2004	Unavailable	2,100 (2003)	25.0% (2008)	Patches, longitudinal cracks	CS=12.4	2004	CS=39.6	2005	4 to-date (expected 5)	Observation Engineering judgment/experience	$1,029	Sitemanager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
10. HMA - full depth reclamation	TX	IH 35 - Travis County	DNF	2.8	2004	before 2004	Unavailable	14,000	15.0% (2008)	Subgrade rutting and alligator cracking	CS=99.2	2006	CS=79.3	2004	5 to-date (expected 20)	Observation Engineering judgment/experience	$193,502	Site Manager, PMIS, DCIS, Plans Online, TRM database	High	The current extended service life (ESL) is based upon observation. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
19. PCC - crack and seat/rubblize with HMA OL	TX	FM 2887 - Runnels County	DNF	7.8	2008	2005	3	610 (2007)	5.0% (2008)	Extremely high number of longitudinal cracks	CS=73	2006	CS=80	2007	Unavailable	Unavailable	$146,667	Site manager, PMIS, DCIS, Plans Online, TRM database	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
19. PCC - crack and seat/rubblize with HMA OL	TX	US 83 - Cottle County	DNF	6.7	2007	before 2004	Unavailable	700	45.0% (2008)	Large number of longitudinal cracks	CS=90	2006	CS=100	2008	Unavailable	Unavailable	$282,930	Site Manager, PMIS, DCIS, Plans Online, TRM database	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
19. PCC - crack and seat/rubblize with HMA OL	TX	US 83 - Wheeler County	DNF	6.1	2007	2005	2	1,700	25.0% (2008)	Numerous patches, longitudinal cracks, rough ride	CS=80.3	2006	CS=99.8	2008	Unavailable	Unavailable	$253,625	Site Manager, PMIS, DCIS, Plans Online, TRM database	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Notes:

1 Please refer to the observations section of the report for a discussion of limitations of data presented in these tables.
2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

Table D.4. Dry freeze zone

Treatment (note 1)	State	Route Number	Climatic Zone	Project Length (Miles)	Treatment Year	Last Rehab Year	Timing of Application (Years)	AADT (note 2)	% Trucks (note 3)	Distress Types and Values Used to Trigger Treatments	PCR Prior (note 4)	Date of Survey	PCR After	Date of Survey	Extended Service Life (years)	Method Used to Determine Pavement Life Extension	Cost/Lane-Mile $, 2009 (note 5)	Data Sources	Experience with Treatment	Comment
1. HMA OL (< 2 inches)	KS	US 75	DF	5.0	1994	1983	11	1,002	9.0%	Ride values	IRI = 113	1994	IRI = 109	1995	15 to-date	PMS performance tracking	$37,498	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	KS	I 70	DF	10.0	2002	Unavailable	Unavailable	5,967	30.0%	Ride values	IRI = 97	2002	IRI = 36	2003	3	PMS performance tracking	$50,722	PMIS	High	Cost/Lane Mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	KS	K 148	DF	15.0	2001	Unavailable	Unavailable	166	14.0%	Ride values, transverse cracking	IRI = 95	2001	IRI = 71	2002	5	PMS performance tracking	$29,409	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	KS	US 75	DF	5.0	2004	2002	2	1,002	9.0%	Cracking	IRI=64	2004	IRI=70	2005	4	PMS performance tracking	$8,696	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	KS	US 24	DF	10.0	2005	2002	3	347	14.0%	None stated	IRI=63	2005	IRI=80	2006	4 to-date (expected 8)	PMS performance tracking Engineering judgment/experience	$10,673	PMIS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	KS	US 24	DF	15.3	1999	Unavailable	Unavailable	713	5.0%	Ride, transverse cracking	IRI=87	1999	IRI=86	2000	4	PMS performance tracking	$7,548	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	KS	US 50	DF	5.0	2002	Unavailable	Unavailable	953	22.0%	Cracking	IRI=88	2002	IRI=95	2003	4	PMS performance tracking	$2,964	PMIS	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
4. HMA - crack sealing	KS	K 4	DF	10.0	2001	1991	10	472	12.0%	None stated	IRI=52	2001	IRI=56	2002	4	PMS performance tracking	$884	PMIS	Unavailable	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	KS	K 9	DF	5.0	2001	Unavailable	Unavailable	348	11.0%	Ride, cracking	IRI=94	2001	IRI=44	2002	3	PMS performance tracking	$31,136	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	KS	US 166	DF	10.0	2001	1990	11	1,295	14.0%	Cracking	IRI=73	2001	IRI=53	2002	8 to-date	PMS performance tracking	$41,889	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	KS	K 18	DF	14.2	1999	1993	6	376	13.0%	None stated	IRI=67	1999	IRI=55	2000	4	PMS performance tracking	$60,130	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
7. HMA - slurry seal	KS	I 135	DF	5.0	2004	1997	7	17,072	14.0%	Ride	IRI=111	2004	IRI=81	2005	5 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$32,542	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
7. HMA - slurry seal	KS	US 50	DF	10.0	2005	1994	11	1,980	14.0%	None stated	IRI=75	2005	IRI=81	2006	4	PMS performance tracking	$29,086	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
7. HMA - slurry seal	KS	US 54	DF	14.4	2004	1991	13	1,498	23.0%	Ride, cracking	IRI=116	2004	IRI=73	2005	4	PMS performance tracking	$26,505	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	KS	US 281	DF	5.0	1998	1990	8	368	16.0%	Ride, cracking	IRI=128	1998	IRI=49	1999	4	PMS performance tracking	$44,176	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	KS	US 183	DF	10.0	2004	1996	8	1,157	10.0%	Ride, cracking	IRI=118	2004	IRI=61	2005	5 to-date (expected 10)	PMS performance tracking Engineering judgment experience	$69,288	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	KS	US 24	DF	15.3	2003	Unavailable	Unavailable	713	5.0%	Ride, cracking	IRI=111	2003	IRI=78	2004	6 to-date (expected 9)	PMS performance tracking Engineering judgment experience	$67,193	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
12. HMA - whitetopping	KS	US 54	DF	0.8	2000	1969	31	2,465	13.0%	Rough ride, transverse cracking	IRI=106	2000	IRI=58	2001	3	PMS performance tracking	$105,814	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
12. HMA - whitetopping	KS	US 54	DF	1.4	2000	1969	31	2,010	8.0%	Transverse cracking	IRI=98	2000	IRI=66	2001	3	PMS performance tracking	$105,814	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
12. HMA - whitetopping	KS	US 54	DF	2.9	2000	1969	31	3,475	5.0%	Rough ride, transverse cracking	IRI=128	2000	IRI=72	2001	3	PMS performance tracking	$105,814	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	KS	US 54	DF	6.0	1998	1976	22	2,580	25.0%	Ride and faulting	IRI=146	1998	IRI=68	1999	9	PMS performance tracking	$65,069	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	KS	US 59	DF	8.4	2001	1960	41	1,814	7.0%	None stated	IRI=77	2001	IRI=76	2002	6	PMS performance tracking	$113,893	PMIS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

Table D.4. Dry freeze zone

13. PCC - diamond grinding	KS	US 166	DF	9.0	1998	1980	18	723	12.0%	Ride and faulting	IRI=168	1998	IRI=73	1999	11 to-date (expected 17)	PMS performance tracking Engineering judgment/experience	$42,489	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	KS	US 400	DF	5.0	2001	1987	14	2,206	16.0%	Ride and joint distress	IRI=128	2001	IRI=132	2002	8 to-date (expected 13)	PMS performance tracking Engineering judgment/experience	$127,764	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	KS	US 400	DF	7.0	2001	1988	13	1,818	19.0%	Ride, joint distress, and faulting	IRI=165	2001	IRI=148	2002	8 to-date (expected 13)	PMS performance tracking Engineering judgment/experience	$127,764	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	KS	US 36	DF	13.0	2004	1989	15	1,483	11.0%	Ride	IRI=101	2004	IRI=86	2005	5 to-date (expected 14)	PMS performance tracking Engineering judgment/experience	$135,000	PMIS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
15. PCC - full depth repair	KS	I 135	DF	5.0	1994	1971	23	17,072	14.0%	Ride, joint distress	IRI=122	1994	IRI=129	1995	9	PMS performance tracking	Unavailable	PMIS	Unavailable	None
15. PCC - full depth repair	KS	US 77	DF	8.0	1997	1972	25	5,656	11.0%	Ride	IRI=100	1997	IRI=99	1998	5	PMS performance tracking	Unavailable	PMIS	Unavailable	None
15. PCC - full depth repair	KS	I 70	DF	12.0	1992	1969	23	4,011	38.0%	Ride	IRI=110	1992	IRI=102	1993	9	PMS performance tracking	Unavailable	PMIS	Unavailable	None
17. PCC - partial depth repair	KS	K 23	DF	4.1	2004	1996	8	215	18.0%	None stated	IRI=70	2004	IRI=58	2005	4	PMS performance tracking	$773	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
17. PCC - partial depth repair	KS	US 50	DF	6.0	2001	1996	5	2,364	16.0%	Joint distress	IRI=59	2001	IRI=67	2002	1	PMS performance tracking	$4,437	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
17. PCC - partial depth repair	KS	K 23	DF	9.0	2004	1996	8	217	18.0%	Joint distress	IRI=77	2004	IRI=60	2005	4	PMS performance tracking	$773	PMIS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	KS	US 75	DF	5.0	2001	1991	10	3,311	5.0%	Joint distress	IRI=99	2001	IRI=79	2002	3	PMS performance tracking	$58,370	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	KS	US 77	DF	9.5	2001	1985	16	2,196	7.0%	Ride	IRI=104	2001	IRI=59	2002	1	PMS performance tracking	$80,272	PMIS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	KS	US 169	DF	11.6	2003	1980	23	2,924	11.0%	Ride, joint distress	IRI=99	2003	IRI=52	2004	6 to-date (expected 8)	PMS performance tracking Engineering judgment/experience	$48,725	PMIS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
1. HMA OL (< 2 inches)	WA	SR 20	DF	15.8	1999	1987	12	1,286	22.1%	PSC - Pavement Structural Condition	PSC = 61	1998	PSC = 99	2000	10 to-date (expected 11)	PMS performance tracking Engineering judgment/experience	$249,699	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 17	DF	20.5	2004	1998	6	1,964	22.2%	PSC - Pavement Structural Condition	PSC=73	2003	PSC=88	2005	5 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$71,015	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
2. HMA - Chip Seal	WA	SR 20	DF	20.6	2006	1999	7	1,510	14.0%	PSC - Pavement Structural Condition	PSC=75	2005	PSC=98	2007	3 to-date (expected 7)	PMS performance tracking Engineering judgment/experience	$91,339	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	I-90	DF	16.9	1993	1982	11	15,503	25.0%	PSC - Pavement Structural Condition	PSC=69	1992	PSC=99	1995	10	PMS performance tracking	$178,845	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
5. HMA - mill and resurfacing	WA	SR 195	DF	9.4	1999	1988	11	5,275	17.9%	PSC - Pavement Structural Condition	PSC=61	1998	PSC=99	2000	10	PMS performance tracking	$213,684	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	WA	SR 97	DF	4.9	1995	1985	10	12,985	9.5%	Transverse and longitudinal cracking	PSC=57	1984	PSC=98	1986	Unknown (little experience)	Unavailable	$34,131	WSPMS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
6. HMA - hot in-place recycling	WA	SR 542	DF	15.9	2009	1993	16	8,017	10.2%	Rutting	PSC=82	2008	Unavailable	Unavailable	Unknown (little experience)	Unavailable	$120,407	WSPMS	Low	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	WA	I-90	DF	10.6	2005	1995	10	15,788	25.0%	Rutting	PSC=96	2004	PSC=99	2006	4	PMS performance tracking	$108,600	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	WA	I-90	DF	9.2	2004	1994	10	9,151	23.1%	Unavailable	PSC=98	2004	PSC=99	2006	4	PMS performance tracking	$125,205	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
8. HMA - fog seal	WA	SR 211	DF	14.9	2006	1999	7	1,709	17.9%	Unavailable	PSC=99	2005	PSC=99	2006	4	PMS performance tracking	$211,579	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.

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9. HMA - cold in-place recycling	WA	SR 24	DF	7.4	2004	2000	4	1,478	29.8%	Unavailable	PSC=99	2003	PSC=100	2005	5 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$147,410	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	WA	SR 127	DF	3.4	2002	1987	15	745	32.9%	PSC - Pavement Structural Condition	PSC=42	2001	PSC=99	2003	7 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$163,702	WSPMS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	WA	SR 221	DF	3.0	1998	1987	11	2,212	46.9%	PSC - Pavement Structural Condition	PSC=32	1997	PSC=99	1999	11 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$315,891	WSPMS	Low	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
9. HMA - cold in-place recycling	WA	SR 28	DF	13.0	2004	1999	5	1,223	20.3%	PSC - Pavement Structural Condition	PSC=68	2003	PSC=99	2005	5 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$126,425	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
11. HMA - structural overlay	WA	SR 395	DF	6.8	1999	1986	13	1,927	14.8%	PSC - Pavement Structural Condition	PSC=57	1998	PSC=100	1999	10 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$242,497	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
11. HMA - structural overlay	WA	SR 12	DF	2.9	1998	Unavailable	Unavailable	6,168	16.2%	PSC - Pavement Structural Condition	PSC=51	1997	PSC=99	1999	12	PMS performance tracking	$183,586	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
11. HMA - structural overlay	WA	SR 12	DF	6.5	2007	1997	10	2,548	19.9%	PSC - Pavement Structural Condition	PSC=80	2006	PSC=99	2008	2 to-date (expected 12)	PMS performance tracking Engineering judgment/experience	$163,032	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	WA	I-5	DF	4.1	1999	1969	30	196,295	8.8%	PPC - Pavement Profile Condition	PSC=80	1998	PSC=86	2000	15 (expected)	Engineering judgment/experience	$218,210	WSPMS	Medium	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
13. PCC - diamond grinding	WA	I-5	DF	19.8	2009	1964-1967	42	184,057	6.8%	PPC - Pavement Profile Condition	PSC=76	2008	Unavailable	Unavailable	15 (expected)	Engineering judgment/experience	$113,428	WSPMS	High	Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	I-82	DF	20.6	1997	1971	26	15,132	24.2%	PPC - Pavement Profile Condition	PSC=90	1996	PSC=94	1998	12 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$383,532	WSPMS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
14. PCC - DBR	WA	SR 195	DF	5.3	1997	1959	38	4,125	21.6%	PPC - Pavement Profile Condition	PSC=58	1996	PSC=99	1999	12 to-date (expected 15)	PMS performance tracking Engineering judgment/experience	$488,757	WSPMS	Medium	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	WA	I-5	DF	3.3	1993	1966	27	38,773	9.0%	PSC - Pavement Structural Condition	PSC=44	1992	PSC=99	1994	16 to-date (expected 20)	PMS performance tracking Engineering judgment/experience	$1,655,590	WSPMS	High	The current extended service life (ESL) is based upon performance data in the PMS. The projected or estimated ESL is a prediction based upon PMS models or experience with the treatment. Cost/lane-mile is based on total cost of project. Data not available to break-out pavement costs explicitly.
18. PCC - HMA OL w/o slab frac	WA	I-5	DF	5.1	1970	1952	18	77,596	16.9%	Unavailable	PSC=75	1969	PSC=77	1971	20	PMS performance tracking	Unavailable	WSPMS	Low	PCCP Const. in 1955. Two overlays since original in 1970
18. PCC - HMA OL w/o slab frac	WA	I-5	DF	1.3	1974	1955	19	56,598	19.0%	Unavailable	PSC=75	1973	PSC=100	1975	20	PMS performance tracking	Unavailable	WSPMS	Medium	None
20. PCC - unbonded overlay	WA	I-90	DF	5.3	1973	1965	8	25,826	22.8%	PSC - Pavement Structural Condition	PSC=30	1971	PSC=60	1975	15	Experience	Unavailable	WSPMS	Medium	None

Notes:

1 Please refer to the observations section of the report for a discussion of limitations of data presented in these tables.
2 AADT - year of treatment unless otherwise indicated.
3 Percent Trucks - year of treatment unless otherwise indicated.
4 See Appendix B for a description of the Pavement Condition Rating value.
5 Cost per lane-mile based upon pavement related costs only unless otherwise noted. Cost converted to 2009 dollars using a 4% discount rate.

APPENDIX E - REFERENCES

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