# Develop Guidelines for Pavement Preservation Treatments and for Building a Pavement Preservation Program Platform for Alaska


R. Gary Hicks and DingXin Cheng
California Pavement Preservation Center

Hannele Zubeck
University of Alaska Anchorage

Jenny Liu and Tony Mullins
University of Alaska Fairbanks



Nov. 2012


**Prepared By:**


**Alaska University Transportation Center**
**Duckering Building Room 245**
**P.O. Box 755900**
**Fairbanks, AK 99775-5900**

**California Pavement Preservation Center**
**35 Main Street, Suite 205**
**California State University**
**Chico, California98929-0603**



**INE/AUTC 12.07**

**FHWA-AK-RD-12-14**


California Pavement Preservation Center
Alaska University Transportation Center

| REPORT DOCUMENTATION PAGE | | | Form approved OMB No. |
|---|---|---|---|
| Public reporting for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestion for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-1833), Washington, DC 20503 | | | |
| 1. AGENCY USE ONLY (LEAVE BLANK)<br>FHWA-AK-RD-12-14 | 2. REPORT DATE<br>November 12, 2012 | 3. REPORT TYPE AND DATES COVERED<br>Final (Nov. 2010 – Nov. 2012) | |
| 4. TITLE AND SUBTITLE<br>Develop Guidelines for Pavement Preservation Treatments and for Building a Pavement Preservation Program Platform for Alaska | | | 5. FUNDING NUMBERS |
| 6. AUTHOR(S)<br>R. Gary Hicks, DingXin Cheng, Hannele Zubeck, Jenny Liu, and Tony Mullins | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br>Alaska University Transportation Center<br>P.O. Box 755900<br>Fairbanks, AK 99775-5900 | | | 8. PERFORMING ORGANIZATION REPORT NUMBER<br>INE/AUTC 12.07 |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)<br>Alaska Department of Transportation<br>Research, Development, and Technology Transfer<br>2301 Peger Road<br>Fairbanks, AK 99709-5399 | | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER<br>FHWA-AK-RD-12-14 |
| 11. SUPPLEMENTARY NOTES<br>Performed in cooperation with the California Pavement Preservation Center | | | |
| 12a. DISTRIBUTION / AVAILABILITY STATEMENT<br>No restrictions | | | 12b. DISTRIBUTION CODE |

13. ABSTRACT (Maximum 200 words)


This reports summarizes the project findings including the following:

- An evaluation of the current pavement preservation program used in Alaska and a roadmap to grow the program
- A summary of the best practices in terms of pavement preservation for cold regions and for Alaska DOT &PF
- The development of a pavement preservation database which contains information on pavement preservation projects placed in Alaska. This also includes the development of a strategy selection program for determining the best treatments to use under Alaska conditions
- Conclusions and recommendations resulting from the study including the collection of pavement data to support pavement preservation and the modification of the pavement management system to include pavement preservation treatments

Finally, an implementation plan is included to help Alaska grow the pavement preservation program using workshops and other planned efforts.


| 14- KEYWORDS:<br>Pavement Preservation, Pavement Management, Asset Management, Road Map, Pavement Preservation Database, Strategy Selection Program | | | 15. NUMBER OF PAGES<br>158<br>16. PRICE CODE<br>N/A |
|---|---|---|---|
| 17. SECURITY CLASSIFICATION OF REPORT<br>Unclassified | 18. SECURITY CLASSIFICATION OF THIS PAGE<br>Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT<br>Unclassified | 20. LIMITATION OF ABSTRACT<br>N/A |


NSN 7540-01-280-5500

STANDARD FORM 298 (Rev. 2-98)
Prescribed by ANSI Std. 239-18 298-1

# Acknowledgements

We appreciate the financial support of the Alaska University Transportation Center (AUTC) and the Alaska Department of Transportation and Public Facility (Alaska DOT&PF) for providing the funding for this important and meaningful project. We also extend our gratitude to Angela Parsons (DOT project manager), Jim Horn, Steve Saboundjian, Tom Williams, Victor Winters, and Clint Adler from Alaska DOT&PF, and Billy Connor of AUTC who provided continuous support to this project and served on the advisory panel for the Alaska DOT&PF strategy selection online program.


# Disclaimer

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The content does not necessarily reflect the official views or policies of the Alaska Department of Transportation and Public Facilities and the State of Alaska.

# Table of Contents

## List of Figures

LIST OF TABLES

# EXECUTIVE SUMMARY

## *Background*

The Alaska Department of Transportation and Public Facilities (Alaska DOT&PF) is implementing a Transportation Asset Management (TAM) Program. They have conducted several workshops with the Federal Highway Administration (FHWA) and others to evaluate their program for managing assets such as pavements, bridges, and other facilities. This report is intended to evaluate their existing pavement preservation program and to develop a roadmap for the development of an enhanced pavement preservation program for Alaska DOT&PF.

Pavement preservation represents a proactive and cost effective approach to maintain existing pavements. A pavement preservation program consists primarily of three components: preventive maintenance, minor rehabilitation (non-structural), and some routine maintenance activities. It has been proven in several areas to be an effective approach to extend pavement's service life, maintain safety and improve pavement service condition. Alaska DOT&PF would like to increase the use of pavement preservation techniques that would reduce the life cycle cost of the pavement treatments currently used. Although Alaska DOT&PF routinely uses some preventive pavement maintenance applications (such as chip seals, mill and fill, and crack seals), some of these continue to face many obstacles, such as:

- Lack of proof that certain preventive maintenance treatments can perform in cold regions and are cost effective
- Insufficient guidance on identifying roadway candidates for pavement preservation treatment in cold regions (i.e. when preservation treatments should be applied), and

## *Current Alaska practices with pavement preservation*

Alaska has been using selected pavement preservation treatments for a number of years with varying degrees of success. The treatments that have been used in Alaska include:

- Crack sealing
- Chip seals and bituminous surface treatments
- Thin hot mix overlays (mill and fill)
- Slurry surfacing including slurry seals and microsurfacings (not used by Alaska DOT&PF)

However, there are many other treatments that have not been used due to a lack of equipment or experienced contractors. There is not a formal pavement preservation program nor is the pavement management system collecting information that would trigger pavement preservation treatments. The results of this study include the development of a road map to establish a proactive pavement preservation program which is included in Appendix A of this report.

## *Items learned from the literature review and the survey*

A survey of agencies in cold regions was conducted. The survey results provided the following findings:

- All surveyed pavement preservation treatments (crack sealing, patching, fog seals, chip seals, slurry seals, AST/BST, microsurfacing, thin overlays, bonded wearing courses, interlayers and in-place recycling) have been used in cold regions for over 30 years.
- Crack sealing and patching are the most extensively used pavement preservation techniques.
- Chip seals, thin overlays and in-place recycling are also used extensively, although not as widely as crack sealing and patching.
- Fog seals, chip seals, microsurfacing, thin overlays, interlayers and in-place recycling are used in special cases.
- Traffic volume does not affect the use of crack seals, patching, thin overlays, or in-place recycling.
- The use of fog seals, chip seals and slurry seals decreases with the increasing traffic volume.
- The use of microsurfacing, bonded wearing courses and interlayers increase with the increasing traffic volume.
- Crack sealing, patching and thin overlays are the most commonly used treatments in heavy studded tire usage areas followed by microsurfacing, bonded wearing courses and in-place recycling. The surface treatments and seals as well as interlayers are seldom used.
- All treatments are used in moist climates; fog seals are least popular. Crack sealing, patching and thin overlays are used extensively in moist climates.
- Crack sealing and patching are the most used treatments for late season application, whereas all the surface treatments as well as bonded wearing courses and interlayers are seldom used.
- All of the aforementioned treatments (see the first bullet) have potential for use in Alaska.
- Most of the treatments are applied only once. Crack sealing and patching are applied also at intervals from more than once per year to every 4 years.
- The average service life of the treatments varies from about 3 to 7 years. Crack sealing, patching and fog seals have the lowest service lives of about 3 years, whereas AST/BST, thin overlays, bonded wearing courses, and in-place recycling last on average 6 years or more. In-place recycling has the longest average service life of 7.8 years. The great variability of service lives warrant further research about affecting factors and predicted service lives for Alaskan conditions.
- Many regions have dedicated budgets for pavement preservation. Comments typically state the need for more funds.
- Most regions use several performance measures to determine trigger values for the due time of pavement preservation treatments. IRI, rutting, cracking and expert opinions are used extensively.

- The costs of treatments vary from one region to another. The data presented in Chapter 2 provides an idea about the magnitude of the cost for each treatment.

The literature review also confirmed that pavement preservation treatments are widely used in the world's cold regions.

## *Review of Alaska Pavement Preservation Projects*

As part of this overall project, road sections in Alaska that had received a pavement preservation treatment were surveyed in person. Data was also available from the Alaska DOT&PF. Road sections were evaluated during the summer of 2011in five cities/towns: Anchorage, Fairbanks, North Pole, Juneau, and Gokana. The purpose of these inspections was to identify the types of treatments used in Alaska, identify how the treatments had performed, and determine which treatments should be considered in the future.

In Alaska, five preservation treatments have been used to date, including:

- Thin HMA overlays,
- Chip seals,
- Slurry surfacings (slurry seals and microsurfacings),
- Crack sealing, and
- Pre-saw cut joints.

More details on the performance of these sections are discussed in Chapter 4. The results clearly show that pavement preservation treatments in Alaska have been placed and can perform well. More information on the life of the treatments and its effect on the life of the underlying structure are still needed.

## *Pavement Preservation Database to Document Early Performance and Share Technologies*

The pavement preservation concept in Alaska has been around for many years. Although several pavement preservation projects have been done in the past, the detailed records for these projects are hard to find. The Alaska DOT&PF realizes the potential benefits of keeping the records of pavement preservation projects. They want to make pavement preservation an integral part of the larger asset management program that Alaska DOT&PF wants to implement. In order to promote effective pavement preservation techniques in cold regions, an online pavement preservation database was created for Alaska.

The database stores the pavement preservation project related information such as existing pavement condition, Google map location display, construction information, multiple year pavement preservation survey in PASER format, supplemental reports, and pictures. After collecting enough data, the Department should be able to determine the treatment life, derive pavement preservation performance curves, and estimate pavement life extension.

The database has three user groups: general user, advanced user, and administrator. General users can only view the project information stored in the database but they will not be able to add new projects or make any changes to the existing projects. Advanced users can add new projects to the database and make modifications only on the projects created by them. An administrator helps manage the knowledge in the database, including adding or editing treatment types. An administrator can also manage user accounts. Currently, Alaska DOT&PF has the administration account for the pavement preservation database.

The database can be found on the Alaska Pavement Preservation website https://sites.google.com/site/alaskap2/. Anyone can create a general user account with a username and password by filling out a form on the website. If they want to be an advanced user, they can contact the administrator, whose email is on the website.

## *Development of a Strategy Selection Program*

A computer program has been preliminarily developed for the Alaska DOT&PF to assist with strategy selection and was integrated into the Alaska Pavement Preservation Database. This program is a starting point for users to explore options in treatments. With more usage, it can be fine-tuned to become a valuable tool to assist in making engineering decisions. After the project survey information is collected, the user can start to access the project information to select treatments from the current available Alaska pavement treatment strategies, ranging from pavement preservation to rehabilitation and reconstruction. More details on this program can be found in Chapter 5 of this report.

In summary, the online program can streamline the strategy selection process. It has a life cycle cost analysis function to help engineers to find cost effective treatments. This is a preliminary program. With more usage and verification, the program can be refined for wide usage by the Alaska DOT&PF staff.

## *Where Does Alaska Go From Here?*

Recommendations for the study are that Alaska continues to use its current pavement preservation strategies and expands the tool kit to include other strategies such as:

- Thin bonded wearing courses
- Cold in-place recycling
- Microsurfacings to fill studded tire rutting
- Thin rubber modified asphalt wearing courses

Early documentation of the benefits of the treatments in terms of cost savings and extended life are needed. This can only be accomplished through the pavement preservation database or by implementing pavement preservation treatments into the current pavement management system. Currently, the data collected for the pavement management system is not sufficient for pavement preservation triggers. It lacks necessary data, such as information on cracking and other surface distresses; however, this data collection effort was initiated in the summer of 2012.

Alaska also needs to expand its training efforts to include more on pavement preservation treatments, timing for treatments, and benefits of the treatments. It is suggested that Alaska work with FHWA and others to secure the necessary training. As far as information sharing, the use of the pavement preservation database will allow the State and local agencies in Alaska to share information on pavement preservation treatments used throughout the state. This is a valuable tool and its use needs to continue until all agencies have been exposed to its use and capabilities. Agencies should be encouraged to continue to populate the database and track the performance of the various treatments.

Performance curves for pavement preservation treatments are needed so they can be included in the Alaska PMS. This study made an attempt to develop some performance curves, but there was not enough information available to produce good models. As additional performance data is collected and added to the database, it will be possible to develop performance curves for the various pavement preservation treatments that have been used by Alaska.

Treatment lives and costs were not readily available for this study. Alaska needs to begin to collect information on the lives and costs of the various treatments as well as determine the life extension associated with the various treatments. This data is vital in the strategy selection process in order to determine the most cost effective treatments.

Finally, Alaska needs to integrate pavement preservation into its pavement management system. The following are the recommendations from the study in order to proceed with this effort:

- Determine the capabilities of the existing PMS. According to Dynatest, the existing system can accommodate preservation treatments. They would need to know the specific treatments to be added to the PMS, along with the treatment costs and some estimate of the treatment lives.
- Can this be accomplished in a short time frame? The simple answer is yes. Pavement preservation treatments can be added to the pavement management system. However, it may take time to develop treatment lives or performance models for preservation treatments. It is still unclear how well the existing performance models for pavement preservation treatments work or if they are used to a great extent in the PMS.

# 1.0 INTRODUCTION

## *1.1 Background*

Pavement preservation represents a proactive approach to maintaining our existing highways. A pavement preservation program consists primarily of three components: preventive maintenance, minor rehabilitation (nonstructural), and some routine maintenance activities. It has been proven to be an effective approach to extend pavement's effective service life, improve safety and pavement service condition, and is a cost effective approach in general climate and traffic conditions. Alaska DOT&PF would like to utilize effective pavement preservation techniques and better serve the public road system in Alaska. However, many pavement preservation techniques may not be suitable in cold regions where logistics impact the viability of treatments due to increased cost and timing constraints or where projects are in remote locations which limit the types of treatments that might be considered. Although Alaska DOT&PF has introduced some preventive pavement maintenance applications (such as chip seals, mill and fill, and crack seals) that have resulted in certain benefits, these practices continue to face many obstacles such as:

- Lack of proof that preventive maintenance treatments can perform and are cost effective, and
- Insufficient guidance on identifying roadway candidates for pavement preservation treatment (i.e. when preservation treatments should be applied) and what preservation treatments should be applied.

A comprehensive study on the performance of various pavement preservation techniques in cold regions need to be undertaken. In addition, guidelines need to be developed to better utilize pavement preservation techniques and integrate pavement preservation into their pavement management system (PMS) in Alaska. This report addresses some of these issues.

In most of the United States, pavement preservation is a core business of future highway programs. With most of the highway network completed, the major tasks of highway agencies are shifting to preservation and rehabilitation of the existing roadway system in terms of extended service life, ride quality and safety. However, in Alaska the road network continues to expand in both length and capacity of the network. Even in areas of network expansion, pavement preservation still makes sense for the existing network.

Alaska's pavement preservation program is at its beginning stages. Based on the 2008 Alaska DOT&PF Road Pavement Conditions and 2009 Pavement Preservation Recommendations, the current pavement preservation program is based on a reactive approach, which means the projects are triggered based on Roughness, Rut Depth, Asphalt Modulus Ratio, and Maintenance Expenditures (Alaska DOT&PF, 2008). The reactive approach is not the best approach for the network optimization. In fact, pavement preservation emphasizes the proactive approach plus rehabilitation. There is a need to build a sound platform of pavement preservation for the Alaska DOT&PF. This will provide Alaska DOT&PF with a step by step process for introducing pavement preservation into their pavement management program.

Pavement preservation has proven to be a cost effective approach to maintain a roadway system in good condition and improve ride quality. Based on national experience, every dollar spent on effective pavement preservation could potentially eliminate or delay $6 to10 on major rehabilitation or $25-75 on reconstruction (Galehouse et al. 2006). By adopting effective preservation methods that proactively correct minor road deficiencies early, the roadway lives can be extended at a comparatively low cost.

The steps that need to be taken in the development of a pavement preservation program for the Alaska DOT&PF include the following:

1. Identify where Alaska stands in terms of its asset management program (pavements, bridges, drainage structures, geotechnical structures, and the like). Identify where they would like to be within a 5 to 10 year time horizon and develop a roadmap to accomplish this. The major focus was on the pavement preservation program which is discussed in the Appendix A.
2. Identify pavement preservation techniques that work for cold region pavements. This will help agencies to adapt pavement preservation techniques to their own conditions. Identify the performance of pavement preservation techniques used in other similar climatic conditions. New preservation methods and improvement on existing pavement preservation methods are possible.
3. Create a pavement preservation treatment database to help track the performance of the present and future pavement preservation treatments. This is an online database that users can access at any time and at any location as long as an internet connection is available.
4. Develop performance models for pavement preservation techniques. This is the key for selecting pavement preservation methods and implementing a successful PMS. The performance model can be recalibrated using the performance data in the proposed Alaska pavement preservation treatment database.
5. Incorporate pavement preservation into the PMS. This will improve the programming of pavement preservation and rehabilitation activities. A PMS with pavement preservation components is more effective than a PMS with a worst first approach.

## *1.2 Objectives*

The objective of this report is to address Steps 1 to 4 and help the Alaska DOT&PF to conduct Step 5 in the aforementioned list of steps.

The end result of this project will be the development of guides for assisting the Department to build a pavement preservation platform. This should also allow the Department to better understand the philosophy of pavement preservation and provide the needed funding to support pavement preservation efforts.

## *1.3 Definition of Pavement Preservation*

According to FHWA (2005), "pavement preservation represents a proactive approach in maintaining existing highways.  It enables agencies to reduce cost, time consuming rehabilitation and reconstruction projects and the associated traffic disruptions. With timely preservation, we can provide the traveling public with improved safety and mobility, reduced congestion, and smother, longer lasting pavements. This is the true goal of pavement preservation, a goal in which FHWA, through its partnership with states, local agencies, industry organizations, and other stakeholders, is committed to achieve".

Pavement preservation according to FHWA consists of preventive maintenance, routine maintenance and minor rehabilitation. An effective pavement preservation program can benefit agencies by preserving their road investments, enhancing pavement performance, extending pavement life, and providing improved safety and mobility. For a treatment to be considered pavement preservation, its intended purpose must be to restore the function of the existing system and extend its service life. The purpose is not to increase the capacity or the strength of the pavement.

Pavement preservation is different than pavement management; however, one cannot have a successful pavement preservation program without a pavement management system. Alaska DOT&PF's pavement management system is summarized in Appendix B of this report.

## *1.4 Organization of the Report*

This guide is organized into several chapters including the following:

- Chapter 2 summarizes the results of an international survey on the use of pavement preservation in cold regions.
- Chapter 3 summarizes the results of the literature review on the use of preservation treatments in cold regions.
- Chapter 4 summarizes the results of a monitoring program on pavement preservation treatments used in the State of Alaska. These projects are included in the pavement preservation database, which can be found at http://sites.google.com/ssite/alaskap2.
- Chapter 5 summarizes the process for selecting the appropriate pavement preservation strategy for a given road and in a given climate.
- Chapter 6 provides the conclusions as well as recommendations for further development.
- Chapter 7 presents an implementation plan for Alaska to move the pavement preservation program forward.

## *1.5 Relevance of Project to MAP-21*

"Moving Ahead for Progress in the 21st Century Act" or MAP-21 defines the implications of Infrastructure Asset Management, Pavement management, and Pavement Preservation Programs. The full document can be found at www.fhwa.dot.gov . The Act defines pavement preservation in Section 116 and asset management in Section 119.

The Asset management plan is required for the NHS only and requires states to meet minimum standards for the Interstate Highways and the NHS. It will require the establishment of Performance Measures as state in Section 150 of the Act. These measures have not yet been established, but could include ride, rutting, cracking or a combination of these. Each state is to set performance standards targets and will have to submit annual reports on the progress in achieving these standards.

# 2.0 PAVEMENT PRESERVATION TREATMENTS USED IN COLD REGIONS - RESULTS OF AN INTERNATIONAL SURVEY

A survey on pavement preservation issues was created and sent to pavement experts across the cold regions of the world, including the U.S. states impacted by frost, and agencies in Canada, the Nordic Countries, China, Japan and Russia (Zubeck et al. 2012). The survey can be found on the project web site, http://sites.google.com/ssite/alaskap2.

A total of 43 pavement experts completed the survey. Responses were obtained from all other regions except for Russia. The pavement preservation issues are grouped into the following areas:

- Extent of treatments used
- How often are treatments repeated
- Average service life for each treatment type
- Dedicated budgets for preservation
- Performance measures used
- Cost of treatments
- Overall summary from the survey

## *2.1 Extent of Treatments Used*

The survey investigated the use of the following pavement preservation treatments:

- Crack Sealing
- Patching
- Fog Seals
- Chip Seals
- Slurry Seals
- Asphalt Surface Treatment/Bituminous Surface Treatment (AST/BST)
- Microsurfacing
- Thin Overlays
- Bonded Wearing Courses
- Interlayers
- In-place Recycling
- Other treatments

The following descriptions of the treatments were provided with the survey to the responders:

- Crack Sealing – Placement of asphalt emulsions/cement at elevated temperatures into road openings and cracks, ranging from 5mm to 25mm. Sometimes fillers need to be added before applying the actual asphalt emulsion on larger openings.
- Patching – First, a highly distressed area of asphalt or pavement is removed in a localized area, the edges and the bottom layer of the hole are prepared according to what the nature

of the distress dictates, the bottom is compacted, and then the hole is refilled with new material and compacted as well. Often this is in preparation for subsequent surface treatments.

- <u>Fog Seals</u> – This is a light spray application of asphalt emulsions and water. It is used primarily to seal and waterproof existing asphalt surfaces and also to hold stone or tire chips in place.
- <u>Chip Seals</u> – A chip seal is the application of a bituminous layer followed by a layer of single sized aggregate that is imbedded into the binder. Multiple layers can be applied depending on the need.
- <u>Slurry Seals</u> – Mixture of asphalt emulsions, graded aggregate, mineral filler, water and additives. The slurry is mixed and placed on a continuous flow basis through a paving machine.
- <u>Surface treatment (AST/BST</u>) – This consists of a thin layer of asphalt binder, typically high float emulsion, covered with well-graded aggregate. (This is unlike the uniform particle size in a chip seal).
- <u>Microsurfacing</u> – This treatment can be used for similar situations as slurry seals, but better graded aggregates and polymer additives are always used. Curing is provided chemically instead of through the evaporation of water; therefore, much shorter curing times are needed versus slurry sealing.
- <u>Thin HMA Overlays</u> – This is typically a layer of hot mix asphalt of 37 mm or less. It is not meant to be structural but preventative with some correction of current conditions such as light rutting or minor crack distress. Overlays can be of dense-graded, gap-graded, or open-graded aggregate.
- <u>Bonded Wearing Courses</u> – First, a thick polymer modified asphalt emulsion is applied. This is followed within 5 seconds by a thin layer of a gap-graded or open-graded hot mix asphalt applied using a specialized paving machine. An open surface texture does exist after treatment is complete.
- <u>Interlayers</u> – These are layers that are placed in conjunction with an overlay or surface treatment. Interlayers can be, but are not limited to, paving textile, paving mat, paving grids, paving composite grids, asphalt rubber chip seal, polymer modified asphalt rubber chip seal, polymer modified rejuvenating emulsion, or microsurfacing.
- <u>In-place Recycling</u> – This technique is usually performed either cold or hot. Both methods start by milling to a partial depth ranging from 50mm to 100mm, size the reclaimed material, mix it with additives and/or virgin material, and repave. With the hot technique, heat is applied to the existing asphalt surface as it is being milled.

According to the survey results (Figure 2-1), all of the aforementioned treatments are used to some extent in cold regions, some extensively and others only in special cases. On the other hand, for each treatment, there are regions in the world that never utilize these treatments, except for patching. Crack sealing and patching are the most extensively used pavement preservation techniques. Chip seals, thin overlays and in-place recycling are also used extensively, although not by as many users as crack sealing and patching. Fog seals, chip seals, microsurfacing, thin hot mix overlays, interlayers and in-place recycling are used in special cases in many cold regions. Note that the use of AST/BST is limited to permafrost areas (Doré and Zubeck 2009).

The survey also asked how long have the pavement preservation treatments been in use. The data shows that all of the treatments have been used in some region for almost as long as paved roads have been around and others for at least for 30 years. Some newer treatments include microsurfacing, bonded wearing courses, interlayers, and in-place recycling. But, even these "newer" techniques have been used in some cold regions for more than 30 years. Based on these results, all of the aforementioned pavement preservation treatments have potential for use in Alaska.

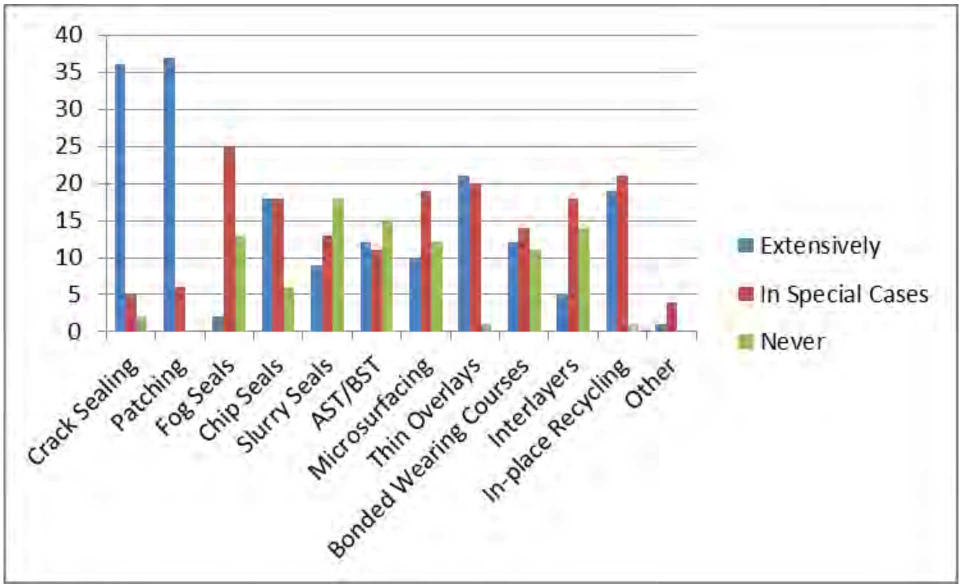



**Figure 2-1. Extent of treatments used (Y axis =number of responses)**

The survey also asked about which pavement preservation treatments are used under different traffic volumes and in other specific conditions typical to cold regions. Figure 2-2 presents the treatments used under different traffic volumes. Crack seals, patching, thin overlays, and in-place recycling are used in many areas at all traffic levels. The use of fog seals, chip seals, slurry seals and AST/BST (with the exception of ADT 500-2500) decreases with the increasing traffic volume. The use of microsurfacing, thin bonded wearing courses and interlayers increase with the increasing traffic volume. The gray shaded cells in Table 2-1 show the most popular traffic levels for each technique, which could also be considered as the recommended traffic levels for Alaska.

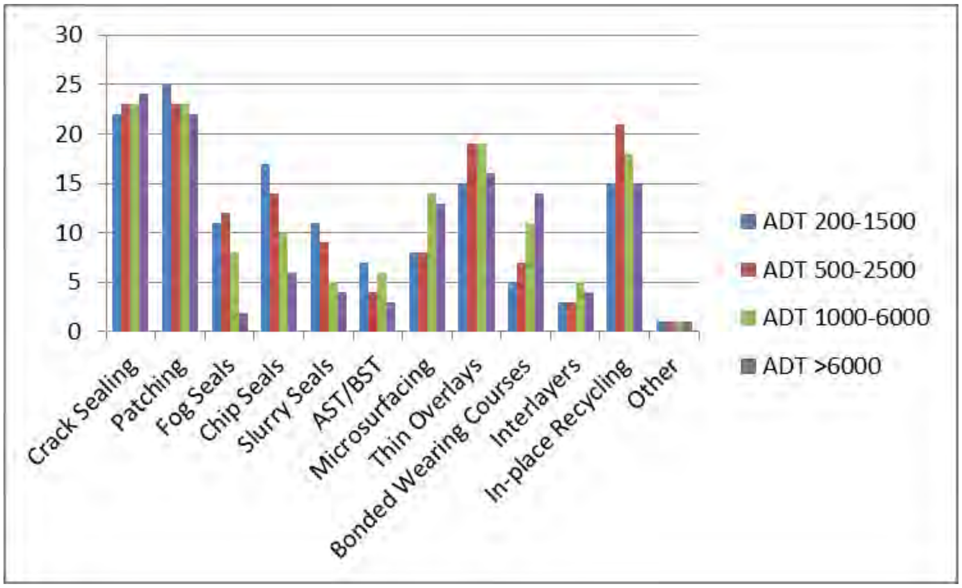



**Figure 2-2. Extent of treatments used under different traffic volumes (ADT = annual daily traffic and Y axis = number of responses)**

**Table 2-1. Use of pavement preservation techniques at various traffic volumes (number of responses)**

| | ADT 200-1500 | ADT 500-2500 | ADT 1000-6000 | ADT >6000 |
|---|---|---|---|---|
| Crack Sealing | 22 | 23 | 23 | 24 |
| Patching | 25 | 23 | 23 | 22 |
| Fog Sealing | 11 | 12 | 8 | 2 |
| Chip Sealing | 17 | 14 | 10 | 6 |
| Slurry Seals | 11 | 9 | 5 | 4 |
| AST/BST | 7 | 4 | 6 | 3 |
| Microsurfacing | 8 | 8 | 14 | 13 |
| Thin Overlays | 15 | 19 | 19 | 16 |
| Bonded Wear Courses | 5 | 7 | 11 | 14 |
| Interlayers | 3 | 3 | 5 | 4 |
| In-place Recycling (hot or cold) | 15 | 21 | 18 | 15 |
| Treatment is well accepted at gray shaded traffic volumes | | | | |

Studded tires are used in many cold regions to provide traction in winter driving conditions (Zubeck et al. 2004). The studs abrade the pavement surface at various degrees depending on the stud size, which may prevent the use of certain pavement preservation treatments in areas where studded tires are used extensively. Figure 2-3 shows the extent of treatments used under heavy studded tire usage. Crack sealing, patching and thin overlays are the most commonly used treatments in these conditions, followed by microsurfacing, thin bonded wearing courses, and in-place recycling (hot or cold). The other surface treatments and seals as well as interlayers are seldom used.

Figure 2-4 shows the extent of treatments used in moist climates and for late season application (approaching fall and winter). All treatments are used in moist climates, fog seals being the least popular. Crack sealing, patching and thin overlays are used extensively in moist climates. Crack sealing and patching are the most commonly used treatments for late season application, whereas all of the surface treatments, bonded wearing courses and interlayers are seldom used.

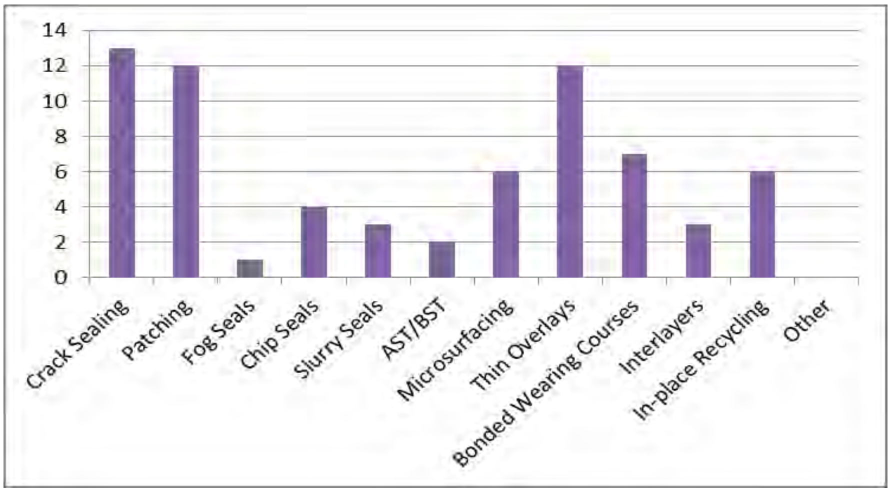



**Figure 2-3. Extent of treatments used under heavy studded tire usage (Y axis=number of responses)**

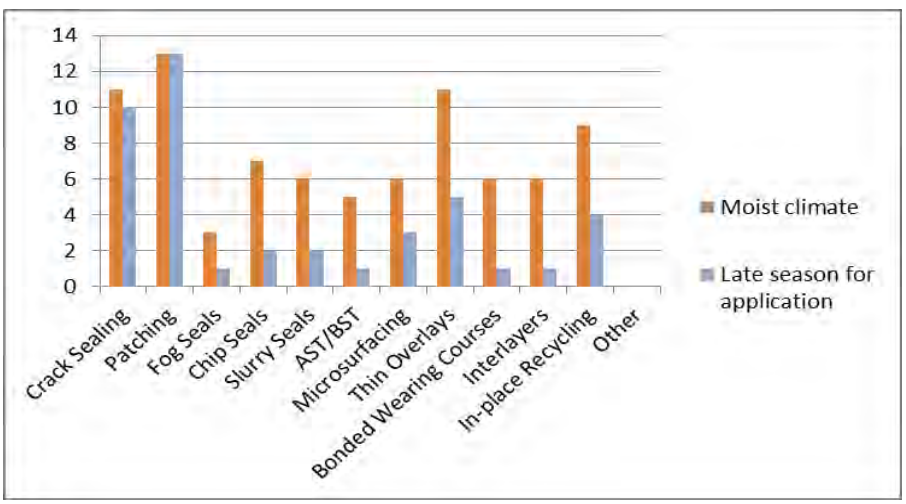



**Figure 2-4. Extent of treatments used in moist climates and for late season application (Y axis =number of responses)**

## *2.2 How Often Are the Treatments Repeated?*

The research team wanted to chart how often each treatment is applied in cold regions. The results are given in Figure 2-5. Many agencies reported applying treatments only once. Crack sealing and patching were reported to be applied at frequencies of less than 1 to 4 years. The average frequency between the treatments cannot be calculated because "only one application" gives a spacing of infinity. However, the next question asked the average service life of the treatment used. The timing between the treatments and the service life do not necessarily match. Current policy and available funding affect the spacing between the treatments in addition to the actual pavement surface condition.

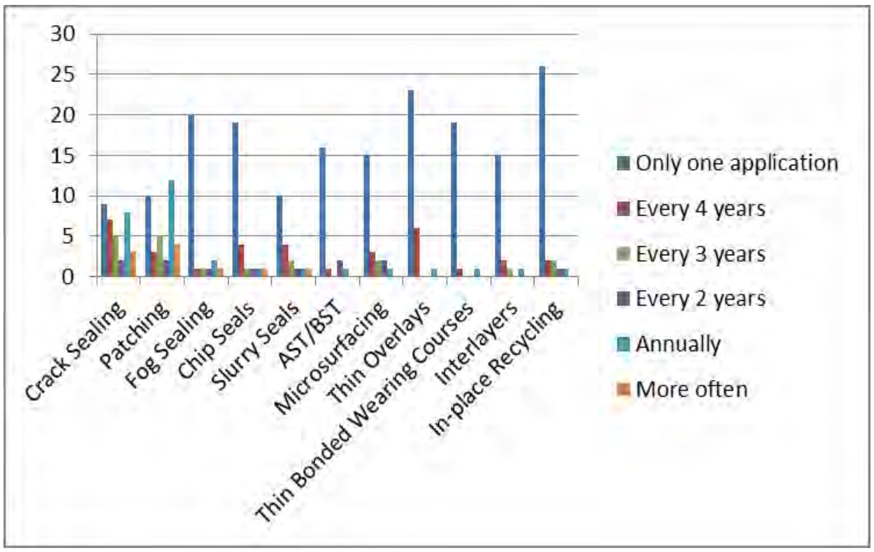



**Figure 2-5. Time between treatments (Y axis=number of responses)**

## *2.3 Average Service Life for each Treatment*

The data for the average service life of each treatment is given in Figure 2-6. This figure presents the weighted averages for service life calculated using the median values for each life bracket (e.g.  for 1 - 2 years, a value of 1.5 was used in the calculations). The weighted average = n (number of responses * service life)/number of total responses). The average service life of the treatments varies from about 3 to 7 years. Crack sealing, patching and fog seals have the lowest reported service lives of about 3 years, whereas AST/BST, thin overlays, bonded wearing courses, and in-place recycling last on average 6 years or more. In-place recycling had the longest average service life of 7.8 years. The large variability in service lives warrants further research about affecting factors and predicted service lives for Alaskan conditions.

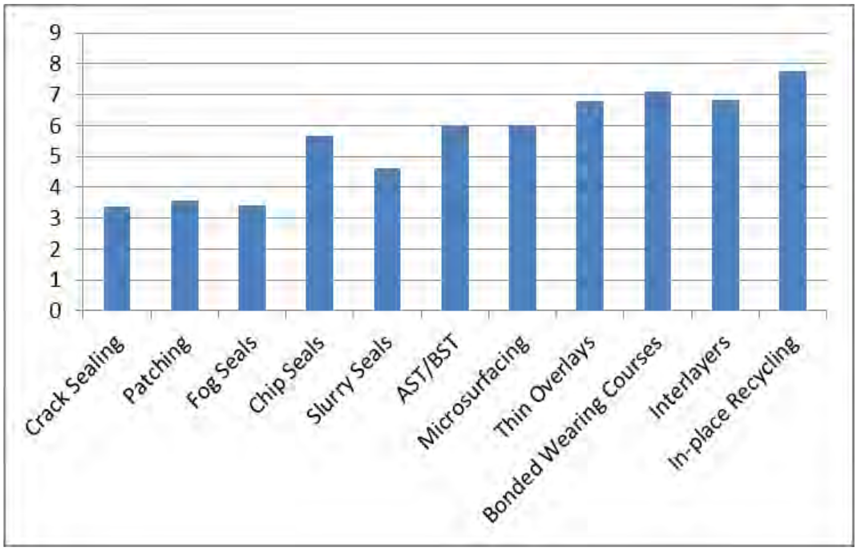



**Figure 2-6. Weighted average treatment service life (Y axis in years)**

## *2.4 Dedicated Budgets for Preservation*

Ideally, road agencies would budget separate funds for the pavement preservation. The responses (see Table 2-2) show that many agencies indeed have dedicated budgets for pavement preservation. However, most agencies clearly indicated the need for additional funds.

**Table 2-2. Survey responses (number) for yes/no for dedicated budget for pavement preservation**

| | Yes | No | Not sure | % Yes |
|---|---|---|---|---|
| All responders | 24 | 14 | 3 | 59 |
| USA | 5 | 5 | 0 | 56 |
| Canada | 9 | 3 | 0 | 75 |
| Nordic Countries | 5 | 5 | 1 | 45 |
| Hokkaido, Japan | 1 | 0 | 0 | 100 |
| China | 4 | 2 | 2 | 50 |

## *2.5 Performance Measures Used*

Different performance measures are used to determine trigger values for the due time of pavement preservation treatments. The survey results are shown in Table 2-3. All agencies except Hokkaido, Japan use several performance measures (133 total responses by 38 responders). All identified measures are used extensively, including IRI, rutting, cracking and expert opinion. The "other" measures included distress index, falling weight deflectometer (FWD), PCI rating in MicroPaver, and pavement strength.

**Table 2-3. Region-specific survey responses (number) for performance measures for pavement performance**

| | IRI | Rutting | Cracking | Expert Opinion | Other (methods) |
|---|---|---|---|---|---|
| USA | 8 | 7 | 7 | 6 | 1 (distress index) |
| Canada | 10 | 10 | 11 | 9 | 3 (FWD, MicroPaver, pavement strength) |
| Nordic Countries | 10 | 11 | 6 | 9 | - |
| Hokkaido, Japan | - | 1 | - | - | - |
| China | 6 | 6 | 7 | 5 | - |
| Total | 34 | 35 | 31 | 29 | 4 |
| Total responses | 133 | | | | |
| Total responders | 38 | | | | |

## *2.6 Cost of Treatments*

The responses for question "what was the average cost for each treatment in 2010 US dollars (USD)" are listed in Table 2-4 (not all responders answered the question). The costs vary from one region to another as expected. The data provides an idea about the magnitude of the cost for each treatment.

**Table 2-1. Cost of pavement preservation treatments (2010 USD)**

| | Crack Sealing | Patching | Fog Seals | Chip Seals | Slurry Seals | AST/BST | Microsurfacing | Thin Overlays | Bonded Wearing Courses | Interlayers | In-place Recycling |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **USA** | | | | | | | | | | | |
| Maine | 7,500/ mile | | 17,000/ mile | | | | 91,800/ mile | 150,000/mile | | | 500,000/ mile |
| Michigan | 4,500/ mile | | 0.50/yd$^2$ | 1.51/yd$^2$ (single chip seal) | | | 3.50/yd$^2$ (two course) | 60/ton | 5.5/yd$^2$ | | |
| Minnesota | 2,500/mile | | | 26,000/ mile | | | 37,000/ mile | 60,000/ mile | 65,000/ mile | | 400,000/ mile |
| New Hampshire | 0.90/ lb | | | 2.15/yd$^2$ | | | 3.00/yd$^2$ | 2.70/yd$^2$ | 6.0/yd$^2$ | 10.0/yd$^2$ | 6.0/yd$^2$ |
| New York | 5,000/lane mile | | 10,000/ lane mile | 20,000/ lane mile | 15,000/ lane mile | | 40,000/ lane mile | 50,000/ lane mile | 50,000/ lane mile | | 120,000/ lane mile |
| Wisconsin (Dane County) | 5,000/lane mile | 8,000/ lane mile | varies | 13,000/ lane mile | varies | | 28,000/ lane mile | 40,000/ lane mile | | | |
| **Canada** | | | | | | | | | | | |
| Entire Country | 2-4 /m | 30-40 /m$^2$ | 11 /m$^2$ | 10 /m$^2$ | 11 /m2 | 16 /m$^2$ | 7 /m$^2$ | 20 /m$^2$ | 45 /m$^2$ | | 50 /m$^2$ |
| British Colombia | 10 /m | 20/m$^2$ | | 10/m$^2$ | 120,000/ lane km | 100,000/ lane km | 10/m | 20/m$^2$ | | 10/m$^2$ | $120,000/ lane km |
| Northern Canada | | 300/km | | | | 50,000/km | 75,000/km | 225,000/ km | | 250,000/km | |
| **Nordic Countries** | | | | | | | | | | | |
| Denmark | 3.40/m | 37.00/m | 1.80/m$^2$ | 5.80/m$^2$ | | 5.60/m$^2$ | | | 24.80/m$^2$ | 3.40/m | 37.00/m |
| Sweden | 37/m$^2$ | 22/m$^2$ | 2.3/m$^2$ | 2.4/m$^2$ | 2.4/m$^2$ | 2.0/m$^2$ | | 9.0/m$^2$ | 9.8/m$^2$ (incl. surface planing) | 13/m$^2$ | 6.8/m$^2$ |
| Finland | | | | | | | | | | | 3.0/m$^2$ |
| **China** | | | | | | | | | | | |
| Northeast | 2/m$^2$ | 2/m$^2$ | 1/m$^2$ | 2/m$^2$ | 1.5/m$^2$ | 1/m$^2$ | 4/m$^2$ | 7/m$^2$ | | 8/m$^2$ | |

## *2.7 Summary of the Survey*

The survey results provided the following findings:

- All surveyed pavement preservation treatments (crack sealing, patching, fog seals, chip seals, slurry seals, AST/BST, microsurfacing, thin overlays, bonded wearing courses, interlayers and in-place recycling) have been used in cold regions for over 30 years.
- Crack sealing and patching are the most extensively used pavement preservation techniques.
- Chip seals, thin overlays and in-place recycling are also used extensively, although not by as many users as crack sealing and patching.
- Fog seals, chip seals, microsurfacing, thin overlays, interlayers and in-place recycling are used in special cases.
- Traffic volume does not affect the use of crack seals, patching, thin overlays, or in-place recycling.
- The use of fog seals, chip seals and slurry seals decreases with increasing traffic volume.
- The use of microsurfacing, bonded wearing courses and interlayers increases with the increasing traffic volume.
- Crack sealing, patching and thin overlays are the most commonly used treatments in heavy studded tire usage areas followed by microsurfacing, bonded wearing courses and in-place recycling. The surface treatments and seals as well as interlayers are seldom used.
- All treatments are used in moist climates, fog seals being the least popular. Crack sealing, patching and thin overlays are used extensively in moist climates.
- Crack sealing and patching are the most used treatments for late season application, whereas all of the surface treatments as well as bonded wearing courses and interlayers are seldom used.
- All of the aforementioned treatments (see the first bullet) have potential for use in Alaska.
- Most of the treatments are applied only once. Crack sealing and patching are applied at intervals from more often than annually to every 4 years.
- The average service life of the treatments varies from about 3 to 7 years. Crack sealing, patching and fog seals have the lowest service lives of about 3 years, whereas AST/BST, thin overlays, bonded wearing courses, and in-place recycling last in average 6 years or more. In-place recycling has the longest average service life of 7.8 years. The great variability of service lives warrant further research about affecting factors and predicted service lives for Alaskan conditions.
- Many regions have dedicated budgets for pavement preservation. Comments typically state the need for more funds.
- Most regions use several performance measures to determine trigger values for the due time of pavement preservation treatments. IRI, rutting, cracking and expert opinion are used extensively.
- The costs of treatments vary from one region to another. The data in Table 2-4 provides an idea about the magnitude of the cost for each treatment.

# 3.0 PRESERVATION PRACTICES IN COLD REGIONS - RESULTS OF A LITERATURE REVIEW

This chapter is based on a literature review of pavement preservation practices in cold regions. The term "pavement preservation" is not necessarily used in the current literature. Some regions use pavement preservation treatments as a part of preventive maintenance or as a part of their asset management program. The literature covered here includes publications about pavement preservation, preventative maintenance and asset management pertaining pavement preservation treatments. The following topics are collected from the literature:

- Treatments used
- Expected life of treatments
- Problems encountered with using pavement preservation treatments
- Other issues.

## *3.1 Treatments Used*

As evident also from the survey results (Chapter 2), pavement preservation treatments are widely used around the world's cold regions. Table 3-1 lists the treatments and the publications that cover information on the treatments. More details are given in the following sections.

**Table 3-1. Treatments used in cold regions**

| Treatment | Pertaining literature |
|---|---|
| Crack Sealing | Canada: Wei and Tighe 2004, Chan et al. 2010, Indiana: Lee and Shields 2010, Illinois: Wolters et al. 2009, China: Xue et al. 2003, Yuan 2004 |
| Patching | Canada: Wei and Tighe 2004 |
| Fog Seals | Indiana: Lee and Shields 2010, Illinois: Wolters et al. 2009 |
| Chip Seals | Montana: Baladi et al. 2002, Minnesota: Wood and Olson 2007, Indiana: Lee and Shields 2010, Canada: Chan et al. 2010, Illinois: Wolters et al. 2009 |
| Slurry Seals | Canada: Croteau et al. 2005 [cape seal = slurry + chip seal], Chan et al. 2010, Illinois: Wolters et al. 2009 |
| Asphalt Surface Treatment/Bituminous Surface Treatment (AST/BST) | Alaska: Connor, 1981, McHattie 2001, Canada: McLeod 2000 |
| Microsurfacing | Canada: Erwin and Tighe 2008, Croteau et al. 2005, Chan et al. 2010, Indiana: Lee and Shields 2010, Illinois: Wolters et al. 2009 |
| Thin Overlays | N/A |
| Bonded Wearing Courses | Indiana: Lee and Shields 2010, Illinois: Wolters et al. 2009, Canada: Chan et al. 2010 |
| Interlayers | N/A |
| In-place Recycling | Indiana: Lee and Shields 2010, Illinois: Wolters et al. 2009, Canada: Chan et al. 2010, Finland: Rantanen and Suikki 2009 |
| Other treatments | Alaska: Berg and Esch 1983 [painted surface], Canada: Chan et al. 2010 [warm mix asphalt], Illinois: Wolters et al. 2009 [ultrathin whitetopping] |

Baladi et al. (2002) report case studies of preventive maintenance in Montana, where the annual temperature may vary from above 100°F to less than -50°F. Based on the success of the initial investments on preventive maintenance (PM) in the mid 90s, the Montana Department of Transportation (DOT) has increased the budget for PM from $2 to $55 million. The Montana DOT has abandoned the old policy of constructing pavements and letting them go to rehabilitation or reconstruction. Examples of projects in their PM program include (Baladi et al. 2002):

- I-15 chip seal (10 mm) in 1997 and crack seal in 1998. After 3 years it is in good condition.
- U.S. 287 chip seal in 1991. After 9 years, it is in very good condition (ADT 4,100).
- MT 84: 4.6 mm HMA overlay in 1996 and latex modified chip seal in 1997. After 3 years, it is in good condition.
- MT 69: 4.6 mm overlay and chip seal in 1996. After 4 years, it is in good condition.

Lee and Shields (2010) present treatment guidelines for pavement preservation for the Indiana Department of Transportation (INDOT). The following treatments for flexible pavements are used in Indiana (included in Table 3-1):

- Crack sealing (either filling with emulsion or routing and sealing with crumb rubber asphalt sealant)
- Fog seal
- Scrub seal (sand seal)
- Seal coat (chip seal)
- Flush seal (fog seal on the surface of chip seal)
- Microsurfacing
- Ultra-thin bonded wearing course (UBWC)
- Profile milling (treatment itself or preparation for thin HMA overlay)
- Thin HMA mill and fill (milling of the existing pavement with minor deterioration to a certain depth and filling it with a new HMA mixture to the original surface elevation
- Thin HMA overlay with profile milling (shallower milling depth than for the traditional "HMA mill and fill")

The Illinois Department of Transportation (IDOT) conducted its first pavement preservation projects using appropriated funds in 2004 (Wolters et al. 2009). IDOT has created pavement preservation guidelines for local agencies. Guidance is provided in planning, financing, design, construction and maintaining local highway and street systems. The guidelines also include a detailed summary and treatment selection guide. The following treatment options are available for local agency use (included in Table 3-1):

- Crack filling
- Crack sealing
- Fog seals
- Sand seals
- Scrub seals

- Rejuvenators
- Slurry seals
- Microsurfacing
- Chip seals Pavement
- Cape seals
- Cold in-place recycling
- Hot in-place recycling
- Ultrathin bonded wearing course
- Ultrathin whitetopping
- Cold milling

The following list includes pavement preservation projects (the number is parenthesis is the number of projects completed) in Illinois since fiscal year 2005 (Wolters et al. 2009):

- Bituminous surface treatments; 1-pass BST (6)
- Single-pass slurry seal (5)
- Single-pass microsurfacing (15)
- Two-pass microsurfacing (23)
- Cape seal; 1-pass BST and 1-pass microsurfacing (14)
- Half-SMART overlay; leveling binder and 1-pass BST (8)

The Minnesota Department of Transportation (MNDOT) has rejuvenated its chip seal program with success (Wood and Olson 2007). MNDOT currently uses chip seals for both high and low trafficked roads. The average service life has increased from 5-7 years in the 1990s to 8-10 years today. This increase is credited mainly to the use of a larger chip size (from 100% passing the ¼ inch sieve to 100% passing the 3/8-in. sieve) and use of polymer modified asphalt. Other factors include proper mix design, clean pavement surface, single course of chips and proper construction techniques.

Chan et al. (2010) present pavement preservation treatments utilized by the Ministry of Transportation in Ontario, Canada (MTO). The treatments include (included in Table 3-1):

- Crack sealing
- Slurry surfacings
- Chip seals
- Ultra-thin bonded friction course (10 to 20 mm gap-graded polymer modified HMA on polymer modified emulsified asphalt tack coat)
- Fiber modified chip seal (chip seal with addition of fiberglass strands in the polymer modified emulsion hot mix patching
- Hot in-place recycling (HIR; heated surface is milled down to 40 to 50 mm, scarified material is rejuvenated and re-profiled).

Croteau et al. (2005) studied the practice of chip seals and graded seals (called BST in Chapter 2) in Canada as well as in other countries. Detailed instructions on how to select the aggregate and binder and their spread rate, prepare the site and schedule the work, select the equipment and the actual placement can be found from Croteau et al. (2005).

## *3.2 Expected Life of Treatments*

The service lives do not refer to how long the treatment lasts, but rather to how long the treatment serves the purpose for which it was placed, i.e. provides benefit (Peshkin et al. 2011). Further, treatment performance is measured in terms of the extension in service life imparted to the existing pavement by the treatment. These extensions can be used in cost effectiveness analysis. Peshkin et al. (2011) list service lives for several pavement preservation treatments (see Table 3-2). The ranges in Table 3-2 are collected from various sources, representing a variety of conditions and using different performance measures. Hence, according to Peshkin et al. (2011) the ranges may be based on perception rather than quantitative analysis. The ranges do not necessarily apply for cold regions. The MTO in Canada (Wei and Tighe 2004) reported service lives and costs for several treatments which are listed in Table 3-3.

Ong et al. (2010) developed long term pavement performance models for existing pavements as part of INDOT's pavement preservation program. The models for flexible pavements were developed for functional performance indicators such as pavement roughness and rut depth using regression analysis. Using pavement performance data from the Indiana PMS, models were developed for interstates/national highway systems (Ong et al. 2010):

$$IRI = \exp\ 4.023 + 0.0040AADTT * t + 0.0025ANDX * t$$

$$PCR = \exp\ 4.572 - 0.0012AADTT * t - 0.0023ANDX * t$$

$$Rut = \exp\ -3.760 + 0.0095AADTT * t + 0.0068ANDX * t$$

where

IRI = international roughness index
PCR = pavement condition rating
Rut = rut depth (inch)
AADTT = average annual daily truck traffic
t = time (years)
ANDX = average annual freezing index (°F-days)

Ong et al. (2010) also developed short and long term performance models for the following pavement preservation treatments: crack seal, patching, microsurfacing and thin overlay. The concept of performance jump (PJ) and deterioration rate reduction (DRR) is applied to determine the short term effectiveness. PJ is the difference between the condition before and after the treatment. In some cases, there might not be a discernible performance jump associated with the treatment but a reduction in the deterioration rate is experienced. Then it is more appropriate to use DRR as a measure of effectiveness of a preservation treatment. DRR is the difference between deterioration rate before and after treatment. The deterioration rate is determined as the difference in condition between two observations divided by the time between the observations. Table 3-4 shows the short term effectiveness models.

**Table 3-2. Expected performance of preservation treatments (Peshkin et al. 2011)**

| | Expected Performance | |
|---|---|---|
| Treatment | Treatment Life (yr) | Pavement Life Extension (yr) |
| Crack filling | 2–4 | NA |
| Crack sealing | 3–8 | 2–5 |
| Slurry seal | 3–5 | 4–5 |
| Microsurfacing | | |
| Single course | 3–6 | 3-5 |
| Double course | 4-7 | 4-6 |
| Chip seal | | |
| Single course | 3–7 | 5–6 |
| Double course | 5–10 | 8–10 |
| Ultra-thin bonded wearing course | 7–12 | NA |
| Thin HMA overlay | | |
| Dense-graded | 5–12 | NA |
| Open-graded (OGFC) | 6–12 | NA |
| Gap-graded (SMA) | NA | NA |
| Cold milling and thin HMA overlay | 5-12 | NA |
| Ultra-thin HMA overlay | 4-8 | NA |
| Hot in-place recycling | | |
| Surface recycle and thin HMA overlay | 6-10[b] | NA |
| Remixing and thin HMA overlay | 7-15[c] | NA |
| Repaving | 6–15 | NA |
| Cold in-place recycling and thin HMA overlay | 7–15[d] | NA |
| Profile milling | 2–5 | NA |
| Ultra-thin whitetopping | NA | NA |

[a] Current indications are that SMA overlays perform the same or slightly better than dense-graded overlays.
[b] Range based on reported performance of surface recycle and subsequent surface treatment.
[c] Range based on reported performance of remixing and subsequent HMA overlay of unspecified thickness.
[d] Range based on reported performance of CIR and subsequent surface treatment (6 to 8 years) and CIR and subsequent HMA overlay of unspecified thickness (7 to 15 years).

**Table 3-3. Service life and cost of treatments in Ontario (adapted from Wei and Tighe 2004)**

| Treatments | Life Year | Cost (CAD/lane/km) |
|---|---|---|
| Spray Patch | 2 | 3.375 |
| Machine Hot-Mix Patch | 4 | 1.386 |
| Chip Seals | 5 | 10.125 |
| Hot-Mix Patch | 5 | 1.246 |
| Rout and Seal | 6 | 375 |
| Mill and Patch 10% | 6 | 2.450 |
| Mill and Patch 20% | 7 | 4.900 |
| 1 Lift Overlay | 7 | 26.250 |

**Table 3-4. Short term effectiveness models for asphalt preservation treatments (Ong et al. 2010)**

| Treatment | Short Term Effectiveness Models |
|---|---|
| Thin Preventive Maintenance Overlay | $PJ_{IRI} = \exp(-1.5748 \times 10^{-8} IRI_b^2 - 0.01097 IRI_b + 4.7087)$<br>Fully restores PCR to 100<br>Fully restores rut depth to zero |
| Microsurfacing | $PJ_{IRI} = 11.4995 + \exp(0.01874 IRI_b)$<br>$PJ_{PCR} = 20.07 - 0.198 PCR_b$<br>$PJ_{Rut} = 0.03002 + 2.4805 Rut_b^2$ |
| Crack Seal | $DRR_{IRI} = (1 - 3.7600 \times 10^{-4} IRI_b)^* f'_b(t)$<br>$PJ_{PCR} = 19.73 - 0.213 PCR_b$<br>No effect on rut depth |
| Patching | $DRR_{IRI} = (1 - 3.5712 \times 10^{-4} IRI_b)^* f'_b(t)$<br>Fully restores PCR to 100<br>No effect on rut depth |
| $_b$ = condition before treatment<br>$f'_b(t)$ = deterioration before the treatment | |

Certain preservation treatments, such as thin overlays and microsurfacing, produce slower deterioration rates than the existing pavements. Therefore, long term effectiveness models of these pavement preservation treatments are needed (Ong et al. 2010). Using the pavement condition data from the pavement management databases, traffic data and work/contract information, long term performance models for the PM overlays and microsurfacing for Indiana pavement were developed: Table 3-5 shows the performance models in the form of:

$$y_i = \exp\beta_0 + \beta_1 *AADTT * t + \beta_2 *ANDX * t$$

where

$y_i$ = the performance model (IRI, PCR or rut depth)
AADTT = average annual daily truck traffic
t = time (years)
ANDX = average annual freezing index (°F-days)
$\beta_0$, $\beta_1$ and $\beta_2$ = regression coefficients.

**Table 3-5. Long term performance models for preservation treatments (Ong et al. 2010)**

| Treatment | Functional Class | Performance Measure | Regression coefficients | | |
|---|---|---|---|---|---|
| | | | $\beta_o$ | $\beta_1$ | $\beta_2$ |
| Thin PM Overlay | Interstate/NHS | IRI (in/mile) | 4.174 | 0.0064 | 0.0038 |
| | | PCR | 4.571 | -0.0075 | -0.0048 |
| | | Rut Depth (in) | -3.760 | 0.0506 | 0.1730 |
| | Non-NHS | IRI (in/mile) | 4.223 | 0.0094 | 0.0072 |
| | | PCR | 4.571 | -0.0091 | -0.0069 |
| | | Rut Depth (in) | -3.760 | 0.0604 | 0.1950 |
| Microsurfacing | All | IRI (in/mile) | 4.140 | 0.0045 | 0.0018 |
| | | PCR | 4.578 | -0.0030 | -0.0058 |
| | | Rut Depth (in) | -3.760 | 0.0169 | 0.0457 |

With the pavement performance models and the triggers determined, it is possible to evaluate pavement preservation strategies using a "remaining service life" approach. The remaining service life is (Ong et al. 2010):

$t = [\ln y_{treshold} - \ln y_i] / [\beta 1 * AADTT * t + \beta_2 * ANDX]$

where $y_{treshold}$ = threshold value for the performance measure, and others as above.

The remaining service life approach for strategy selection is given in Figure 3-1.

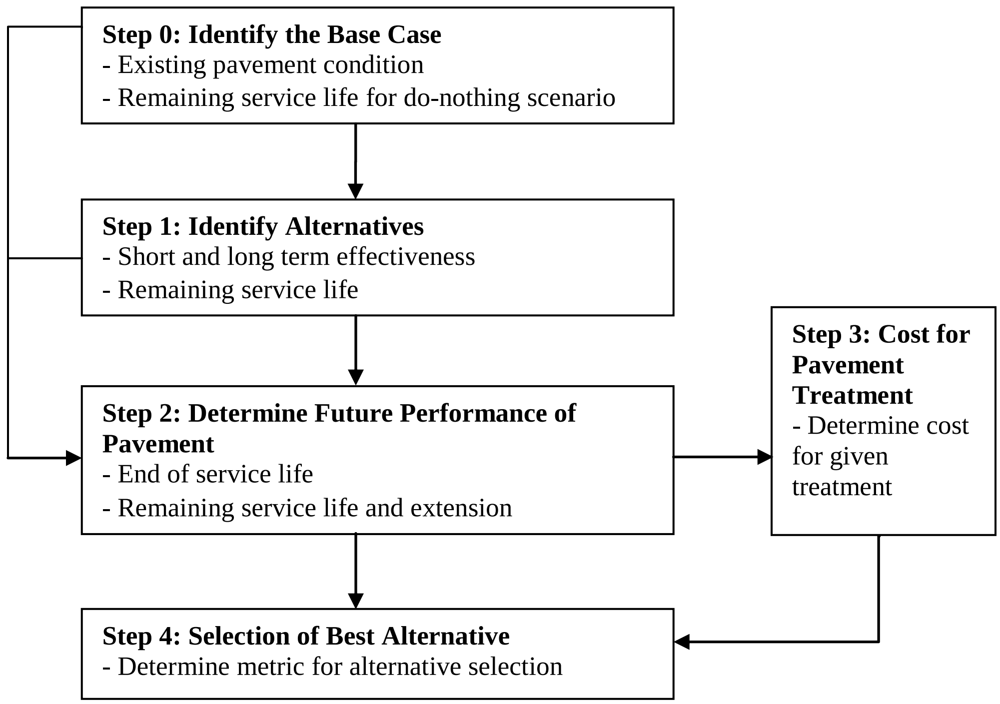



**Figure 3-1. Remaining service life approach for strategy selection (Ong et al. 2010)**

Rantanen and Suikki (2009) investigated use of in-place recycling and alternative treatments based on the experiences of the road agencies and contractors in southern Finland via road statistics, interviews and surveys. Table 3-6 represents the average service lives of three treatments, comparing in-place recycling to a thin overlay. The trigger value for the service life is related to rutting (but not reported in more detail). There was not enough data to present service life of three consecutive in-place recycling applications or service life for roads with a smaller traffic volume. The analysis data agreed with current expert opinions in Finland that thin overlays last longer than in-place recycled road sections. Also, one or two in-place recycling applications have about an equal service life, i.e. the service life of twice recycled material is the same as once recycled material. Rantanen and Suikki (2009) conclude that even if the in-place recycled pavement does not last as long as a thin overlay or regular overlay, it is still cost effective in cases where limitations do not restrict its use (see Sections 3.3 and 3.4).

**Table 3-6. Service life based on rutting (in years), after Rantanen and Suikki (2009).**

| ADT | In-place recycling | 2 consecutive in-place recycling (each) | Thin overlay |
|---|---|---|---|
| > 6000 | 6 | 6 | 8 |
| 3000 - 6000 | 7 | 7 | 9 |
| 1500 - 3000 | 8 | 8 | 10 |

Chan et al. (2010) listed the following expected pavement extension lives for pavement preservation treatments in Ontario:

- Crack sealing - 3 years
- Slurry seal - 3 to 5 years
- Microsurfacing - 7 to 9 years
- Chip seal - 4 to 6 years
- Ultra-thin bonded friction course (10 to 20 mm gap-graded polymer modified HMA on polymer modified emulsified asphalt tack coat) - high initial cost and limited use by the MTO
- Fiber modified chip seal (chip seal with addition of fiberglass strands in the polymer modified emulsion) - new treatment which performance is currently monitored
- Hot in-place recycling (HIR; heated surface is milled down to 40 - 50 mm, scarified material is rejuvenated and re-profiled) - 10 to 12 years similar to an HMA overlay

Table 3-7 summarizes treatment service lives found in literature and compares them with service lives from the survey (Chapter 2). The service lives from the survey and from the literature are in agreement. The values in Table 3-7 can be used as a guide when estimating service lives for Alaska. Selecting either low or high end value depends on site specific circumstances.

**Table 3-7. Summary of pavement preservation treatment service lives**

| | Service life, years | |
|---|---|---|
| Treatment | Literature | Survey |
| Crack Sealing | 3-8 | 3.4 |
| Patching | 4 | 3.6 |
| Fog Sealing | - | 3.4 |
| Chip Sealing | 3-10 | 5.6 |
| Slurry Seals | 3–5 | 4.6 |
| AST/BST | - | 6.0 |
| Microsurfacing | 3-9 | 6.0 |
| Thin Overlays | 5-12 | 6.8 |
| Bonded Wear Courses | 7–12 | 7.1 |
| Interlayers | | 6.8 |
| In-place Recycling | 6-15 | 7.8 |

## *3.3 Problems Encountered with using Pavement Preservation Treatments in Cold Regions*

Cold regions have many challenges which may prevent the use of certain pavement preservation treatments. These challenges include issues with construction as well as issues while the treated road is in-service. Construction challenges include short and relatively (when compared to temperate regions) cold construction seasons, and in some cases poor availability of materials, construction equipment and skilled labor as well as long hauling distances (Doré and Zubeck 2009). In-service challenges include usage of studded tires for winter traction, snow and ice removal operations and exposure to cold and moisture. Pavements in perennial frost areas are experiencing local failures due to degradation of the underlying permafrost.

Pavement failure modes and mitigation in cold regions are explained in detail by Doré and Zubeck (2009). Pavement preservation treatments and their applicability in either preventing or mitigating failure modes in cold regions are summarized in Table 3-8. The "mitigation" in Table 3-8 indicates when a treatment *corrects* the defects caused by a certain failure mode. The "prevention" indicates when a treatment *aids in prevention* of a certain failure mode. Table 3-8 is not inclusive but provides general guidelines on when and for what purpose to consider each treatment.

One of the challenges in cold regions is the aforementioned low temperature and its effects on the performance of pavement preservation treatments. Kim and Lee (2007) considered low temperatures in their research on the performance of chip seals constructed with polymer modified emulsions (PME). They compared the performance of PME chip seals to those constructed with unmodified emulsion. The evaluation was based on aggregate retention, bleeding, rutting, and life-cycle cost analysis (LCCA). Three kinds of emulsion (CRS-2, CRS-2P, and CRS-2L) were used to fabricate samples in the laboratory and in the field. The results indicated that the PMEs (CRS-2P and CRS-2L) enhance chip seal performance. This improvement is due specifically to the fast and improved adhesion of PMEs and their ability to enhance the aggregate retention at low temperatures. The aggregate retention was measured at -20°C (-4°F) and at 4.4°C (40°F). Also, PMEs reduced bleeding and rutting. The performance data indicated that the use of PMEs can extend the service life of chip seals for more than two years. According to the LCCA, this extension is enough to make the use of PMEs cost-effective. Expanded use of PMEs should be considered in Alaska.

Croteau et al. (2005) state that the success of seal coat treatments is not only related to favorable weather conditions during the placement, but also the following weeks after the placement of the treatment. The traffic contributes to the embedment of the aggregate into the binder and the substrate, which does not happen if the pavement surface is cold. If the aggregate is not properly embedded into the substrate, snow plow damage may occur during the winter months. As mitigation for late season work, Croteau et al. (2005) suggest use of multi-layer systems with fine aggregate or use of premium binder.

Weather may also limit the treatments used in cold regions. For example, Lee and Shields (2010) stated that crack sealing should not be conducted on wet surfaces due to problems with adhesion between the crack face and seal or fill material. They recommended an operation temperature of close to 40°F (on the warm side, due to the INDOT specification of a minimum temperature of 40°F and the fact that cracks are wider when the temperature is colder). The moisture limitations apply for fog seals and scrub seals as well. Fog seals, scrub seals, flush seals, chip seals and UBWC need to be applied at temperatures > 60°F, which is a temperature range that may not appear in parts of Alaska for weeks at a time even in summer. Microsurfacing should be applied at temperatures > 50°F, and not applied if there is a possibility that the finished product will freeze within 24 hours after application. Connor (1981) investigated BSTs in Alaska and

**Table 3-8. Primary uses of pavement preservation treatments relating to cold regions failure modes**

| Failure Mode | Crack Sealing | Patching | Fog Seals | Chip Seals | Slurry Seals | AST/BST | Microsurfacing | Thin Overlays | Bonded Wearing Courses | Interlayers | In-place Recycling |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Thermal cracking | m | | | | | | | | | m[3] | |
| Frost cracking | m | p[1] | | | p[1] | p[1] | p[1] | p[1] | p[1] | m[3] | |
| Fatigue cracking | p[1] | | p[2] | p[2] | p[1,2] | | p[1,2] | p[1,2] | p[1,2] | m[3] | |
| Crack deterioration | p | m | | | | | | | | m[3] | |
| Rutting<br>-stud wear<br>- permanent deformation | | | | | | | | m | m | | m<br>m |
| Aging | | | p | p | p | | p | p | p | | m |
| Pavement disintegration due to water, deicing, frost | p[1] | p[1]/ m | | p | p | p | p | p | p | | m[4] |
| Potholes | p[1] | m | | | | | | | | | m[5] |
| Thaw consolidation of frozen soils in permafrost areas | | m[6] | | | | m[7] | | | | p | |

p = prevention, m = mitigation
[1] indirectly by keeping water out of pavement structure
[2]indirectly by reducing aging rate
[3]in some cases by reducing reflective cracking
[4]applies for pavement surface disintegration
[5]applies only for a small amount of patched potholes
[6]applies for small breaches
[7]AST/BST treated road can be re-profiled easier than treated with any HMA applications
Sources: Doré and Zubeck 2009, Rantanen and Suikki 2009, McLeod 2000

concluded that treatments placed after August 20th (which corresponds to construction temperatures dropping below 5°C) fail due to loss of aggregate.

Peshkin et al. (2011) do not recommend the use of slurry seals (Type III) in deep freeze areas (deep freeze is not defined by Peshkin et al. 2011). Ultrathin HMA pavement overlay, profile milling and ultra-thin white topping are only recommended provisionally.

As shown in Section 2.1, surface treatments and seals are not used under heavy studded tire usage. Instead, crack sealing, patching and thin overlays are common treatments followed by microsurfacing, bonded wearing courses and in-place recycling. Studded tire wear also had an effect on test section performance, as studied by Berg and Esch (1983). The test section included painted HMA surfaces as well as light colored and dark colored chip seals. The aim of the study was to investigate if permafrost degradation could be prevented with light colored surfaces. The yellow and white painted surfaces had the lowest pavement temperatures, but the effect was diminished by studded tire wear.

Rantanen and Suikki (2009) investigated applicability of in-place recycling in Finland. Two regional road agencies, one in central and one in southern Finland, wanted to expand the use of in-place recycling and wanted to investigate the limitations of the technique. The investigation was based on the experiences of the road agencies and contractors in southern Finland via road statistics, interviews and surveys. The situation in the rest of Finland was charted by conducting a literature review.

In-place recycling (called REM) has been used in Finland since 1991 and has recently become more popular due to many factors, mainly the lack of road maintenance funding. The capital cost of in-place recycling is reportedly lower when compared to an overlay (thin or regular HMA). In-place recycling of rutted wheel paths also became popular in early 1990s.

The common practice is to recycle the road surface on the main road network from 1 to 3 consecutive times. However, the expert opinion of the road authorities as well as the contractors is that 2 consecutive applications of in-place recycling is a maximum. The expert opinion was that recycled road surfaces rut faster than new overlays (no distinction of the cause of rutting was reported) and the risk for immediate failure increases especially for SMA mixtures.

Reported risks relating to this technique:

- Mix design: Too coarse or dry mixture leads to raveling and pot holes and increased traffic noise. Too fine or wet mixture leads to increased rutting and slick driving surface.
- Construction: Failures relate to inadequate warming of the old pavement mixture, too fast advancing speed or inadequate milling depth.
- The existing bitumen hardens with every warming event, which leads to decreased resistance against several failure modes.

Limitations of the technique include:

- In cases of significant raveling of the pavement surface, in-place recycling is not recommended.

- Problems have been observed in keeping the crown of the cross section at a correct grade when recycling lane by lane. In-place recycling causes rounding up of the pavement surface and, as a consequence, a channel between the lanes.
- The technique is not suitable for narrow roads or roads with soft shoulders due to the size and weight of the equipment.
- The technique is not recommended for intersections or small parking lots or other small areas.
- The quality of the recycled mixture decreases with increasing amount of patches in the existing pavement.
- In-place recycling is not recommended for thin pavements. This is due to the risk that the unbound base course material gets mixed with the HMA.

Cost considerations associated with recycling include:

- Contractors consider the absolute minimum square area of a contract to be 10,000 $m^2$, with 15,000 $m^2$ as a recommended minimum size.
- For in-place recycling to be profitable for a contractor, the total size of contracts should be at least 1 to 1.5 million square meters annually.

## *3.4 Cost Effectiveness*

According to Peshkin et al. (2011), the cost of treatments depends on the size and location of the project, severity and quantity of distress, the quality of treatment's materials, amount of surface preparation and degree of traffic control. Table 3-9 lists typical unit cost ranges and corresponding relative costs of preservation treatments. The costs represent the in-place costs of the treatments, exclusive of traffic control costs and any surface preparation costs. Peshkin et al. (2011) present a detailed treatment selection process including cost effectiveness analysis. However, they point out that the decision-making process includes many other factors, such as availability of qualified (and properly equipped) contractors and materials, anticipated level of traffic disruption and surface characteristics issues, which are valid for the Alaskan condition.

The ranges in Table 3-9 are not necessarily for cold regions. The costs could be higher due to longer transportation distances for equipment, materials and labor, and due to a short construction season.

Wei and Tighe (2004) list treatment costs for MTO. The costs can be found in Table 3-3. Wei and Tighe (2004) also present a decision tree for treatment selection based on the values found in Table 3-3.

Rantanen and Suikki (2009) list the costs for in-place recycling and costs for alternative treatments. The cost data is based on the experiences of the road agencies and contractors in southern Finland via road statistics, interviews and surveys. The unit prices are given in Table 3-10, and Table 3-11 gives the annual cost per unit area of each treatment based on the average service life (see Table 3-6).

**Table 3-9. Estimated treatment costs for preservation treatments (Peshkin et al. 2011)**

| Treatment | Relative Cost ($ to $$$$) | Estimated Unit Cost |
|---|---|---|
| Crack filling | $ | $0.10 to $1.20/ft |
| Crack sealing | $ | $0.75 to $1.50/ft |
| Slurry seal | $$ | $0.75 to $1.00/yd$^2$ |
| Microsurfacing (single-course) | $$ | $1.50 to $3.00/yd$^2$ |
| Chip seal (single-course) | $$(conventional) | $1.50 to $2.00/yd$^2$ (conventional) |
| Chip seal (single-course) | $$$ (polymer modified) | $2.00 to $4.00/yd$^2$ (polymer modified) |
| Ultra-thin bonded wearing course | $$$ | $4.00 to $6.00/yd$^2$ |
| Thin HMA overlay (dense-graded) | $$$ | $3.00 to $6.00/yd$^2$ |
| Cold milling and thin HMA overlay | $$$ | $5.00 to $10.00/yd$^2$ |
| Ultra-thin HMA overlay | $$ | $2.00 to $3.00/yd$^2$ |
| Hot in-place recycling (excluding thin HMA overlay for surface recycle and remixing types) | $$/$$$ | $2.00 to $7.00/yd$^2$ |
| Cold in-place recycling (excluding thin HMA overlay) | $$ | $1.25 to $3.00/yd$^2$ |
| Profile milling | $ | $0.35 to $0.75/yd$^2$ |
| Ultra-thin whitetopping | $$$$ | $15.00 to $25.00/yd$^2$ |
| Note: $ = low cost; $$ = moderate cost; $$$ = high cost; $$$$ = very high cost. | | |

**Table 3-10. Treatment unit prices (after Rantanen and Suikki 2009)**

| Technique | Price ($/m^2$)[1] |
|---|---|
| HMA 16[2]/20[3] in-place recycling | 3.3 |
| HMA 16[2]/100[3] overlay on existing surface[4] | 6.2 |
| Cold milling + HMA 16[2]/100[3] overlay | 7.6 |
| HMA 16[2]/80[3] thin overlay on heated and milled surface | 5.6 |
| SMA 11[2]/20[3] in-place recycling | 3.5 |
| SMA 16[2]/100[3] overlay on existing surface[4] | 7.7 |
| Cold milling + SMA 16[2]/100[3] overlay | 9.0 |
| SMA 16[2]/80[3] thin overlay on heated and milled surface | 6.9 |

[1] converted from Euros; 1 Euro = 1.3 USAD in 2010

[2]maximum aggregate size (mm)

[3]amount of mixture added (kg/$m^2$)

[4]no milling

**Table 3-11. Annual treatment costs (after Rantanen and Suikki 2009)**

| Annual cost $\$/m^2$ | ADT | | |
|---|---|---|---|
| | 1500 - 3000 | 3000 - 6000 | > 6000 |
| HMA 16[2]/20[3] in-place recycling | $0.39 | $0.48 | $0.55 |
| HMA 16[2]/20[3] in-place recycling - twice | $0.39 | $0.49 | $0.59 |
| HMA 16[2]/100[3] overlay on existing surface[4] | $0.62 | $0.72 | $0.79 |
| Cold Milling + HMA 16[2]/100[3] overlay | $0.74 | $0.87 | $0.95 |
| HMA 16[2]/80[3] thin overlay on heated and milled surface | $0.56 | $0.64 | $0.70 |
| SMA 11[2]/20[3] in-place recycling | $0.42 | $0.51 | $0.59 |
| SMA 11[2]/20[3] in-place recycling - twice | $0.43 | $0.53 | $0.62 |
| SMA 16[2]/100[3] overlay on existing surface[4] | $0.75 | $0.88 | $0.98 |
| Cold milling + SMA 16[2]/100[3] overlay | $0.88 | $1.03 | $1.13 |
| SMA 16[2]/80[3] thin overlay on heated and milled surface | $0.69 | $0.79 | $0.87 |

[1] converted from Euros; 1 Euro = 1.3 USAD in 2010

[2]maximum aggregate size (mm)

[3]amount of mixture added (kg/m$^2$)

[4]no milling

## *3.5 Other Issues*

There is a perception that the public will not support pavement preservation, but prefer the "worst-first" strategy. However, issues such as sustainability and use of green products and/or technologies are becoming driving market forces. Traffic safety directly affects the quality of life of road users. When these issues are considered, pavement preservation could be seen and marketed in a new light.

### 3.5.1 Sustainability

Chan et al. (2010) reported that the MTO uses numerous innovative pavement preservation technologies that conserve aggregates, reduce GHG emissions, and minimize energy consumption. MTO's sustainability strategy is to implement these technologies on a larger scale, since they support a "zero-waste" approach and will assist in meeting the GHG reduction commitments. Also the triple-bottom line is addressed: Social, Economic and Environmental. Chan et al. (2010) recommend quantifying the benefits by life cycle cost analysis (economic) which utilizes PaLATE software (Pavement Life-cycle Assessment for Environmental and Economic Effect by the University of California, Berkeley) to assess GHG emissions and energy consumption.

The MTO is also developing a Green Pavement Rating System to quantify and encourage pavement sustainability (Chan et al. 2010). The rating system is based on the one developed by the University of Washington and CH2MHill (2011). The Greenroads rating system is a collection of sustainable roadway design and construction best practices. Each sustainable practice is assigned a point value according to its impact on roadway sustainability. There are 11 "Project Requirements" that must be done in order for a roadway to be considered a Greenroad:

- PR-1 Environmental Review Process
- PR-2 Lifecycle Cost Analysis
- PR-3 Lifecycle Inventory
- PR-4 Quality Control Plan
- PR-5 Noise Mitigation Plan
- PR-6 Waste Management Plan
- PR-7 Pollution Prevention Plan
- PR-8 Low Impact Development
- PR-9 PMS
- PR-10 Site Maintenance Plan
- PR-11 Educational Outreach

A Green Paving Rating System could be implemented in Alaska to promote pavement preservation for pavement sustainability.

### 3.5.2 Traffic safety

One of primary roles of pavements is to provide a safe driving surface. Yet, traffic safety is seldom, if ever considered in a PMS and decisions relating the selection of treatments. Erwin and Tighe (2008) investigated the effect of preventive maintenance techniques on road safety in York Region in the northeast of Toronto, Ontario, Canada. The preventive maintenance techniques were microsurfacing and other resurfacing treatments. The study was based on the comparison of before and after treatment traffic accident data for a total of 40 sites. Erwin and Tighe (2008) determined that microsurfacing has a positive safety effect when applied at locations with an AADT > 3,000 vehicles/lane. This relationship was confirmed through data analysis to be statistically significant and sensitive to the treatment year data. The results were not as strong for resurfacing; although, analysis revealed that resurfacing has a statistically significant safety effect when AADT is 3,000 - 6,999 vehicles/lane.

Before and after studies could also be conducted for pavement preservation sites in Alaska. The cost of crashes potentially reduced could be calculated using data by the National Highway Transportation Safety Board (Blincoe et al. 2002). Blincoe et al. (2002) provide estimates for dollar values of motor vehicle crashes.

### 3.5.3 Trends in asset management

Thirteen European countries (Belgium (Flanders), Denmark, Finland, France, Germany, Ireland, Lithuania, Netherlands, Norway, Slovenia, Sweden, Switzerland, and the United Kingdom) are currently conducting a research program called Effective Asset Management Meeting Future Challenges (ERA-NET ROAD 2011). The aim of the program is to improve technical, economical and sustainable performance of the European road network. It focuses on a cross asset approach, key performance indicators and the incorporation of environmental issues.

The most interesting topic relating to pavement preservation, learned from the work currently in progress, is the ASCAM, Asset Service Condition Assessment Methodology (ERA-NET ROAD 2011). The ASCAM will relate asset condition prediction to measures and network values. It will create a framework to connect existing asset management practices into a holistic, integrated cross asset, pro-active approach. It will relate technical and societal issues, like pavement degradation or failures in the "dynamic traffic management systems" to end-user service levels, such as efficient traffic flow, safety, reliability of travel time, noise hindrance or other environmental issues. Specifically, it will:

- Connect (technical) measures to end-user service levels,
- Add value by connecting inspection and monitoring information to the necessary measures,
- Compare maintenance strategies (measures and costs) in terms of end-user service level, and
- Add relevant topics like "grand societal challenges" (mobility, climate change) to the end-user service levels.

The work is anticipated to be completed by the end of 2012 (Finnra 2011).

Sarkka and Talvitie (2008) investigated the use of models among the road authorities in decision making and planning. These models included those relating to road procurement as well as maintenance and operation. The scope of work included surveys among the experts, administrators and users. According to the survey results, the models are not used widely. Reasons for the lack of utilizing the models are mainly due to the fact that the models are not required by the decision makers, and the authorities do not know how to use the models or their potential. However, the models relating to road operation and maintenance are the most common amongst all existing models in the industry.

The models relating to pavement planning include:

- HIBRIS: analysis software for maintenance and rehabilitation investments (considers current structures, condition, age, past maintenance/rehabilitation operations, effect of potential operation on condition and economics)
- PMS_Pro: model for pavement condition (rutting, roughness, other failure mechanisms, bearing capacity)
- TARVA: models predicting driving safety
- Life-cycle cost

- Models for user costs (IVAR)
- Job specific cost/benefit models
- Simulation models (e.g.,Paramics, Hutsim, Dynameq)
- Models for noise and other environmental effects.

Dietrich and Männistö (2007) point out that the outcome of PMS_Pro, a list of potential road sections for treatment, ignores user costs as well as some of the owner costs. The authors suggest an optimization model that would produce a list of potential road sections with specific treatment techniques by minimizing the costs for the owner and the user. The model would help eliminate the treatment of road sections too early or too late and consider combining jobs within one contract. The object is to minimize the total rehabilitation/treatment cost over a time period for the PMS_Pro selected road sections within a region. The variables in the optimizing model are the timings of the operations for each road section or combination of sections. The optimization could be conducted using several methods, such as brute-force technique. The following factors should be considered:

- Effect of the length of the section to the cost
- User costs due to construction
- Effect of early treatment to the remaining service life
- Effect of late treatment to user costs
- Effect of timing to the total cost

Part of the optimization process (Dietrich and Männistö 2007) is the use of road condition prediction models. These models predict future deterioration based on past measurements as well as the effect of future maintenance/rehabilitation events. The authors state that the current models (part of PMS_Pro and HIBRIS) apply at a network level. Therefore, they are not accurate enough to predict the road condition for a specific road section selected for treatment. In Finland, the aim is to develop accurate models for job specific predictions.

# 4.0 PRESERVATION TREATMENTS USED IN ALASKA

## *4.1 Pavement Survey Approach*

As part of this project, road sections in Alaska that had received a pavement preservation treatment were surveyed during the summer of 2011. Available data from the Alaska DOT&PF was also studied. Road sections were evaluated during the summer of 2011in five cities/towns: Anchorage, Fairbanks, North Pole, Juneau, and Gokana (see Figure 4-1). The purpose of these inspections was to identify the types of treatments used in Alaska, how the treatments had performed, and which treatments should be considered in the future.

The PASER manual for asphalt roads (Walker 2002) was used to evaluate the distresses on the road sections. The process was selected because of its simplicity and because it quantifies the type and extent of pavement distress related to pavement preservation treatments.

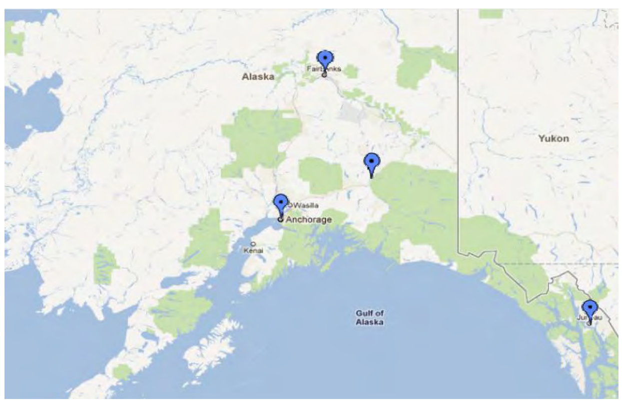



**Figure 4-1. Locations for pavement surveys**

## *4.2 Survey Results*

In Alaska, five preservation treatments have been used to date, including:

- Thin HMA overlays
- Chip seals
- Slurry surfacings
- Crack sealing
- Pre-saw cut joints

Table 4-1 lists the results of the surveys for thin HMA overlays. The project surveys were from 2010 to 2011. Thin HMA is one of the most popular preservation treatment used in Alaska. It is used in each of the three regions of the Alaska DOT&PF. The typical HMA overlay thickness is 2 inches. Figures 4-2 to 4-15 show the sections surveyed. The Central Region (Anchorage) uses this treatment to mitigate existing rutting, while the Northern Region (North Pole) attempts to address thermal cracking, permafrost degradation, and other distresses.

**Table 4-1. Thin HMA overlays monitored in 2011**

| No | Town/City | Year | Road | From | To | Current conditions |
|---|---|---|---|---|---|---|
| 1 | Anchorage | 2010 | Debarr | Boniface | Beaver | Low transverse cracks, potholes. Figure 4-2. |
| 2 | Anchorage | 2011 | Lake Otis | 39th | 42nd | New. No distress. Figure 4-3. |
| 3 | North Pole | 2011 | Finnel | Cross Way | Terriault | New, but has some construction holes. Figures 4-4 and 4-5. |
| 4 | North Pole | 2011 | Cross Way | Railway Crossing | S Santa Claus Lane | Prior – thermal cracking and degrading permafrost, Figures 4-6 and 4-7. |
| 5 | North Pole | 2011 | North Pole High School Blvd | Holiday Rd | Owents St | Prior – thermal cracking. Figures 4-8 and 4-9. |
| 6 | North Pole | 2011 | Snowman Ln | E 8th Ave | E 5th Ave | Prior – thermal cracking. Figures 4-10 and 4-11. |
| 7 | North Pole | 2011 | Davis Blvd | E 8th Ave | E 5th Ave | Prior – thermal cracking and degrading permafrost, Figures 4-12 and 4-13. |
| 8 | North Pole | 2011 | H and H Rd | Old H and H Rd | H and H Ln | Prior – rutting, thermal cracking, wheel path cracking, permafrost. Figures 4-14 and 4-15. |

**Figure 4-2. Debarr Rd, Anchorage, thin HMA overlay, placed in 2010**

**Figure 4-3. Lake Otis Parkway, milling prior to HMA overlay, 2011**

**Figure 4-4. Finnel Dr, North Pole, just prior to thin HMA overlay 2011**

**Figure 4-5. Finnel Dr, North Pole, just after thin HMA overlay, 2011**

**Figure 4-6. Cross Way, North Pole, just prior to thin HMA overlay, 2011**

**Figure 4-7. Cross Way, North Pole, just after thin HMA overlay, 2011**

**Figure 4-8.North Pole High School Boulevard, North Pole, just prior to thin HMA overlay, 2011**

**Figure 4-9. North Pole High School Boulevard, North Pole, just after thin HMA overlay, 2011**

**Figure 4-10. Snowman Lane, North Pole. Transverse cracking just prior to thin HMA overlay, 2011**

**Figure 4-11. Snowman Lane, North Pole. Just after thin HMA overlay placed in 2011**

**Figure 4-12. Davis Blvd, North Pole. Transverse cracking and permafrost degradation, 2011**

**Figure 4-13. Davis Blvd, North Pole just after thin HMA overlay placed 2011**

**Figure 4-14. H&H Rd, North Pole. Rutting, transverse cracking, wheel path cracking, and permafrost degradation just prior to thin HMA overlay placed in 2011**

**Figure 4-15. H & H Blvd, North Pole during thin HMA overlay construction**

Table 4-2 shows two slurry surfacing projects evaluated (a microsurfacing and a slurry seal). The first is in the housing area of Eielson Air Force Base while the other is on Chief Thomas Dr. in Fairbanks. Figure 4-16 shows the microsurfacing being applied at Eielson in 2003, and Figure 4-17 shows the pavement after the application. Figure 4-18 shows the microsurfacing in 2011. It is approximately eight years old with a smooth surface. It shows no signs of rutting or cracking. Figure 4-19 shows the slurry seal section on Chief Thomas Dr. in Fairbanks that was applied in 2003 and evaluated in 2011. This one was also installed about 8 years ago but has thermal cracking. Both projects have performed well in the Northern Region of Alaska.

**Table 4-2. Slurry Surfacings monitored in 2011**

| No | Town/City | Year | Road | Comments and current conditions |
|---|---|---|---|---|
| 1 | Eielson Air Force Base | 2003 | Housing Area | Microsurfacing, traffic level and speed very controlled. Good condition, 2011. Figures 4-16, 4-17 and 4-18. |
| 2 | Fairbanks | 2003 | Chief Thomas Dr. | Slurry seal, thermal cracking, low edge deterioration. Figure 4-19. |

**Figure 4-1.Microsurfacing being applied at Eielson Air Force Base in 2003**

**Figure 4-2. Eielson Air Force Base after microsurfacing application in 2003**

**Figure 4-3. Eielson Air Force Base microsurfacing application, photo taken in 2011**

.

**Figure 4-19. Slurry seal, Chief Thomas Dr., Fairbanks, applied in 2003, photo taken in 2011**

Table 4-3 summarizes the 25 road sections with chip seal treatments which were evaluated. One was in Juneau, one in Gokana-Tok Cutoff, four in Anchorage, and 19 in Fairbanks, of which 12 were on the Farmers Loop Rd. The chip seal treatments applied in Anchorage were all double chip seals with E chips for the first layer and F chips for the second layer. Most of chip seal treatments in Juneau and Fairbanks were double chip seals, except for the Fairbanks' road sections from Teal Avenue to Western. These were single C chip ASTs. Although the age of the chip seals surveyed varies, ranging from new to 10 years old, different sections have exhibited different problems. In Fairbanks, most of the sections have transverse cracking at different severity levels and permafrost degradation, which are very common distresses in the Northern Region. In the Anchorage area, issues found in the chip seal projects include bleeding, snow plow damage, distortion from poor drainage, and cracking. However, when placed correctly (in areas with good drainage and in low traffic residential settings), chip seals performed well, such as on Duben St. in the northeast part of Anchorage. The road section in Juneau has low raveling and longitudinal cracks mainly due to milder weather and lighter traffic. The chip seal project at Tok Cutoff is also a double chip seal performed this past summer, but was also full depth reclamation of the previous AST. The Tok Cutoff pavement is on permafrost and has a low ADT (about 300 veh/day).

**Table 4-3. Chip seal projects monitored in 2011**

| No | Town/City | Year | Road | From | To | Current conditions |
|---|---|---|---|---|---|---|
| 1 | Juneau | 2006 | Twin Lakes | Eagan | 1.7 mi | Low raveling and low longitudinal cracks. Figure 4-20. |
| 2 | Anchorage | 2001 | 19th St | Arctic | Aurora | Mostly low transverse and longitudinal cracks except for an area with poor drainage. More severe cracks with potholes, and some construction patches. Figure 4-21. |
| 3 | Anchorage | 2010 | Bellevue | 0.0 mi | 1.0 mi | Bleeding with snow plow damage, and a few surface potholes. Figure 4-22. |
| 4 | Anchorage | 2001 | Duben | Patterson | Oklahoma | Low transverse cracks and some raveling. (Slow traffic) Figure 4-23. |
| 5 | Anchorage | 2003 | Pioneer | Muldoon | 1.1 mi | Fatigue cracking in some wheel paths, and block cracking near Muldoon intersection. Figure 4-24. |
| 6 | Fairbanks | 2008 | Farmers Loop | Steese Hwy | End of Farmers Loop Rd | Minor cracking. |
| 7 | Fairbanks | 2008 | Farmers Loop | Steese Hwy | Farmers Loop Ext | Low transverse cracking and low |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | longitudinal edge cracking. Figure 4-25. |
| 8 | Fairbanks | 2008 | Farmers loop | Spur Rd | McGrath Rd | Block cracking and some patching. Figure 4-26. |
| 9 | Fairbanks | 2008 | Farmers loop | McGrath Rd | Fairweather Rd | Transverse and longitudinal cracks opened more than ¼”. Figure 4-27. |
| 10 | Fairbanks | 2008 | Farmers loop | Fairweather Rd | Summit Rd | Transverse cracks opened more than ¼”. Figure 4-28. |
| 11 | Fairbanks | 2008 | Farmers loop | Summit Rd | Grenac Rd | Moderate raveling with some potholes and permafrost deformation. Figure 4-29. |
| 12 | Fairbanks | 2008 | Farmers loop | Grenac Rd | Viewpoint Dr | Low transverse cracking with permafrost deformation and some patches. Figure 4-30. |
| 13 | Fairbanks | 2008 | Farmers loop | Viewpoint Dr | Scenic Heights Loop | Low transverse and longitudinal cracks with some permafrost deformation and patches. Figure 4-31. |
| 14 | Fairbanks | 2008 | Farmers loop | Scenic Heights Loop | Ballaine Rd | Low transverse cracking. Figure 4-32. |
| 15 | Fairbanks | 2008 | Farmers loop | Ballaine Rd | Tanana Dr | Block cracks starting with transverse cracks opened more than ¼”, and some permafrost deformation. Figure 4-33. |
| 16 | Fairbanks | 2008 | Farmers loop | Tanana Dr | Taku Dr | Low transverse cracking with some construction joint cracks. Figure 4-34. |
| 17 | Fairbanks | 2008 | Farmers loop | Taku Dr | College Rd | Low transverse cracking with center joint cracking. Figure 4-35. |
| 18 | Fairbanks | 2011 | Teal Ave | Fairbanks St | Ramola St | Thermal cracking, patches, potholes, and |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | degrading permafrost. Figures 4-36 and, 4-37. |
| 19 | Fairbanks | 2011 | Halvorson Rd | Goldizen Ave | Widener Ln | Thermal cracking, patches, and degrading permafrost. Figures 4-38 and 4-39. |
| 20 | Fairbanks | 2011 | Mack Blvd | Morgan Way | Old Pioneer Way | Thermal cracking, patches, potholes, and degrading permafrost. Figures 4-40 and 4-41. |
| 21 | Fairbanks | 2011 | Old Pioneer Way | Luke St | Mack Blvd | Thermal cracking, patches, large pothole, and degrading permafrost. Figures 4 -42 and 4-43. |
| 22 | Fairbanks | 2011 | Totem Dr | Morgan Way | Luke St | Thermal cracking, patches, raveling, and degrading permafrost. Figures 4-44 and 4-45. |
| 23 | Fairbanks | 2011 | Broadmoor Ave | Dale Rd | Beechcraft Ave | Thermal cracking, patches, potholes, and raveling. Figures 4-46 and 4-47. |
| 24 | Fairbanks | 2011 | Western Ave | Dale Rd | Beechcraft Ave | Thermal cracking, potholes, and degrading permafrost. Figures 4-48 and 4-49. |
| 25 | Gokana | 2011 | Tok Cutoff | 0, 5 | 2, 24 | New. Figure 4-50. |

**Figure 4-4. Twin Lakes Rd, Juneau, Chip seal placed in 2006. Photo from the Dynatest vehicle in 2010**

**Figure 4-5. 19th St, Anchorage, chip seal applied in 2001, photo taken in 2011**

**Figure 4-6. Bellevue Ave, Anchorage, double chip seal applied in 2010, bleeding, snowplow damage, and surface wear through the chip seal, photo taken in 2011**

**Figure 4-7.Duben St, Anchorage, chip seal applied in 2001, photo taken in 2011**

**Figure 4-8. Pioneer Ave, Anchorage, double chip seal applied in 2003, fatigue cracking in wheel path, photo taken in 2011**

**Figure 4-95.Farmers Loop Rd. between Steese Highway and Farmers Loop Ext, Fairbanks, chip seal applied in 2008, photo taken in 2011**

**Figure 4-10. Farmers Loop Rd between Spur Rd and McGrath Rd, Fairbanks, chip seal applied in 2008, photo taken in 2011**

**Figure 4-11. Farmers Loop Rd between McGrath Rd and Fairweather Rd, Fairbanks, chip seal applied in 2008, photo taken in 2011**

**Figure 4-12. Farmers Loop Rd between Fairweather Rd and Summit Dr, Fairbanks, chip seal applied in 2008, photo taken in 2011**

**Figure 4-29. Farmers Loop Rd between Summit Rd and Grenac, Fairbanks, double chip seal applied in 2008, potholes and permafrost damage, photo taken in 2011**

**Figure 4-30. Farmers Loop Rd between Grenac and Viewpoint, Fairbanks, double chip seal applied in 2008, thermal cracking, patches, permafrost, photo taken in 2011**

**Figure 4-13. Farmers Loop Rd between Viewpoint and Scenic Hts, Fairbanks, double chip seal applied in 2008, thermal cracking, patches, degrading permafrost, photo taken in 2011**

**Figure 4-14. Farmers Loop Rd between Scenic Hts and Ballaine, Fairbanks, double chip seal applied in 2008, thermal cracking, photo taken in 2011**

**Figure 4-15. Farmers Loop Rd between Ballaine and Tanana, Fairbanks, double chip seal applied in 2008, thermal cracking and degrading permafrost, photo taken in 2011**

**Figure 4-16. Farmers Loop Rd between Tanana and Taku, Fairbanks, double chip seal applied in 2008, thermal cracking and center joint cracks, photo taken in 2011**

**Figure 4-17. Farmers Loop Rd between Taku and College, Fairbanks, double chip seal applied in 2008, thermal cracking and center joint cracks, photo taken in 2011**

**Figure 4-36. Teal Ave between Fairbanks St and Ramola St, Fairbanks, single C chip AST applied in 2011, thermal cracking, patches, potholes, and degrading permafrost, photo taken in 2011**

**Figure 4-37. Teal Ave between Fairbanks St and Ramola St, Fairbanks, single C chip AST applied in 2011, post application, photo taken in 2011**

**Figure 4-18. Halvorson Rd between Goldizen Ave and Widener Ln, Fairbanks, single C chip AST applied in 2011, thermal cracking, patches, and degrading permafrost, photo taken in 2011**

**Figure 4-39. Halvorson Rd between Goldizen Ave and Widener Ln, Fairbanks, single C chip AST applied in 2011, post application, photo taken in 2011**

**Figure 4-19. Mack Blvd between Morgan Way and Old Pioneer Way, Fairbanks, single C chip AST (before application), thermal cracking, patches, potholes, and degrading permafrost, photo taken in 2011**

**Figure 4-20. Mack Blvd between Morgan Way and Old Pioneer Way, Fairbanks, single C chip AST (post application), 2011**

**Figure 4-21. Old Pioneer Way between Luke St and Mack Blvd, Fairbanks, single C chip AST (before application), thermal cracking, patches, large pothole, and degrading permafrost, photo taken in 2011**

**Figure 4-43. Old Pioneer Way between Luke St and Mack Blvd, Fairbanks, single C chip AST applied in 2011, post application, photo taken in 2011**

**Figure 4-44. Totem Dr between Morgan Way and Luke St, Fairbanks, single C chip AST (before application), thermal cracking, patches, raveling, and degrading permafrost, photo taken in 2011**

**Figure 4-22. Totem Dr between Morgan Way and Luke St, Fairbanks, single C chip AST applied in 2011, post application, photo taken in 2011**

**Figure 4-23. Broadmoor Ave between Dale Rd and Beechcraft Ave, Fairbanks, single C chip AST (before application), thermal cracking, patches, potholes, and raveling, photo taken in 2011**

**Figure 4-24. Broadmoor Ave between Dale Rd and Beechcraft Ave, Fairbanks, single C chip AST applied in 2011, post application, photo taken in 2011**

**Figure 4-25. Western Ave between Dale Rd and Beechcraft Ave, Fairbanks, single C chip AST (before application), thermal cracking, potholes, and degrading permafrost, photo taken in 2011**

**Figure 4-49. Western Ave between Dale Rd and Beechcraft Ave, Fairbanks, single C chip AST applied in 2011, post application, photo taken in 2011**

**Figure 4-26.Tok Cutoff, Gokana, Double chip seal over cold in place recycling, photo taken in 2011**

Table 4-4 summarizes eight sections with crack sealing treatments that were surveyed. Two sections were evaluated in Anchorage and six in Fairbanks. All eight jobs surveyed were from this past construction season (2011). Among all crack sealing projects surveyed, no matter if they are newly or previously applied, cracks of different types with different severity levels can be seen. As M&O personnel generally don't seal all of the cracks, it's hard to tell old cracks from new cracks after crack sealing is applied. Further information, such as previous pavement records and construction history, is needed to evaluate the effectiveness of crack sealing treatment.

**Table 4-4. Crack sealing projects monitored in 2011**

| No | Town/City | Year | Road | From | To | Current Conditions |
|---|---|---|---|---|---|---|
| 1 | Anchorage | 2011 | Abbott | Lake Otis Parkway | Hilltop Ski Area | Cracks went from low to medium going towards Lake Otis Parkway. Figure 4-51. |
| 2 | Anchorage | 2011 | Old Seward | 36th | Dimond | Medium cracking for the whole length. New seal. Figure 4-52. |
| 3 | Fairbanks | 2011 | Wembly | Aurora | Danby | New. Medium transverse and longitudinal, and low block cracking. Figure 4-53. |
| 4 | Fairbanks | 2011 | Trainor | Steese Hwy | River Rd | New. Medium transverse and low longitudinal cracking. Figure 4-54. |
| 5 | Fairbanks | 2011 | South Cushman | Old Richardson | 26th | New. Medium transverse and low longitudinal and low block cracking. Some permafrost distortion. Figure 4-55. |
| 6 | Fairbanks | 2011 | Lacey St | 4th | Wendell | Medium transverse and longitudinal, and low alligator cracking. Figure 4-56. |
| 7 | Fairbanks | 2011 | 2nd | Cushman | Nobel | Medium transverse and longitudinal cracking. Low block and alligator cracking. Figure 4-57. |
| 8 | Fairbanks | 2011 | 3rd | Cushman | Lacey | Low transverse and longitudinal cracking, and a few potholes. Figure 4-58. |

**Figure 4-27. Abbott Rd, Anchorage, crack seal, thermal crack and frost damage, photo taken in 2011**

**Figure 4-28. Old Seward Highway, Anchorage, crack seal, thermal and frost cracking, photo taken in 2011**

**Figure 4-29.Wembley Ave, Fairbanks, crack seal in 2011**

**Figure 4-30.Trainor Gate Rd, Fairbanks, crack seal in 2011**

**Figure 4-31. South Cushman St, Fairbanks, crack seal in 2011**

**Figure 4-32. Lacey St, Fairbanks, crack seal, thermal cracking, alligator cracking, and degrading permafrost, 2011**

**Figure 4-33. 2nd Ave, Fairbanks, crack seal, thermal cracking in  2011**

**Figure 4-34. 3rd Ave, Fairbanks, crack seal, thermal cracking in  2011**

Table 4-5 shows a short section on Philips Road in Fairbanks where a series of pre-saw cut joints were made on a new section of HMA with approximately 50ft spacing. These pre-cut joints have never been sealed.  In over a decade there is no substantial deterioration to warrant any rehabilitation work.  There are not any substantial cracks in between most pre-cut joints. The main reason is that the pre-cuts initiate stress concentrations at the cut locations while relieving stresses at other locations in the pavement.

**Table 4-5. Pre-saw cut projects monitored**

| No | Town/City | Year | Road | Comments |
|---|---|---|---|---|
| 1 | Fairbanks | 2000 | Philips Rd | No sealing has been done. Figure 4-59. |

**Figure 4-59. Philips Rd, Fairbanks, pre-saw cut joints applied in 2000, no sealing, photo taken in 2011**

## *4.3 PASER Evaluations*

Evaluations for all road distresses were done in accordance with the Wisconsin Transportation Information Center *Pavement Surface Evaluation and Rating* (PASER) manual for asphalt roads (Walker 2002). The "PASER-Manual Asphalt Roads" is a simplified rating system for assessing the condition of any road surface. Roads are evaluated for distresses such as rutting, raveling, polishing, potholes, patching, and cracking. All distress ratings are one of the following – low, medium, or high with corresponding photos illustrated in the PASER manual. The rating ranges from 1 to 10 with 1 being a failed road and 10 being new construction performed correctly (as shown in Figure 4-60). The PASER manual has photos along with a rating and a description to explain why the road section in the photo received the rating given.

In an effort to rate consistently among the raters performing the evaluations, an Excel spreadsheet was developed for asphalt road distresses that can occur in Alaska. Figure 4-61 shows this customized blank PASER evaluation form. Pictures can be inserted below the comments section.

## Rating system

| Surface rating | Visible distress* | General condition/ treatment measures |
|---|---|---|
| **10 Excellent** | None. | New construction. |
| **9 Excellent** | None. | Recent overlay. Like new. |
| **8 Very Good** | No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater). All cracks sealed or tight (open less than ¼"). | Recent sealcoat or new cold mix. Little or no maintenance required. |
| **7 Good** | Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open ¼") due to reflection or paving joints. Transverse cracks (open ¼") spaced 10' or more apart, little or slight crack raveling. No patching or very few patches in excellent condition. | First signs of aging. Maintain with routine crack filling. |
| **6 Good** | Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open ¼"–½"), some spaced less than 10'. First sign of block cracking. Sight to moderate flushing or polishing. Occasional patching in good condition. | Shows signs of aging. Sound structural condition. Could extend life with sealcoat. |
| **5 Fair** | Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open ½") show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition. | Surface aging. Sound structural condition. Needs sealcoat or thin non-structural overlay (less than 2") |
| **4 Fair** | Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½" deep or less). | Significant aging and first signs of need for strengthening. Would benefit from a structural overlay (2" or more). |
| **3 Poor** | Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (1" or 2" deep). Occasional potholes. | Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay. |
| **2 Very Poor** | Alligator cracking (over 25% of surface). Severe distortions (over 2" deep) Extensive patching in poor condition. Potholes. | Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective. |
| **1 Failed** | Severe distress with extensive loss of surface integrity. | Failed. Needs total reconstruction. |

** Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.*

**Figure 4-35. PASER rating system (Walker 2002)**

# PASER FORM

| | | |
|---|---|---|
| Date | | GPS |
| Evaluating Person | | |
| Road Name | | |
| Section ID | | |
| Region | | |
| Town/City | | |
| Beginning Mileage | | |
| Ending Mileage | | |
| Last Treatment | | |
| Date of Last Treatment | | |
| Original Construction Type | | |
| Date of Original Construction | | |
| ADT | | |
| Last IRI averaged over section | | |
| Last Rut averaged over section | | |
| Last PSR averaged over section | | |
| Speed Limit | | |
| Road Category | | |

| | Distress Type | none | low | medium | severe |
|---|---|---|---|---|---|
| 1 | Raveling | | | | |
| 2 | Flushing | | | | |
| 3 | Polishing | | | | |
| 4 | Rutting | | | | |
| 5 | Transverse Cracks | | | | |
| 6 | Reflection Cracks | | | | |
| 7 | Slippage Cracks | | | | |
| 8 | Longitudinal Cracks | | | | |
| 9 | Block Cracks | | | | |
| 10 | Alligator Cracks | | | | |
| 11 | Patches | | | | |
| 12 | Potholes | | | | |
| 13 | Frost Heaves | | | | |
| 14 | Permafrost | | | | |
| 15 | Deformation | | | | |
| 16 | Drainage | | | | |

| | |
|---|---|
| **Paser Number** | |

Comments:

**Figure 4-61. PASER rating evaluation form**

## 4.4 Summary of Monitoring Effort

In summary, 44 road sections were monitored in five cities/towns for pavement preservation treatments using five different treatments, thin HMA overlays, slurry seals, chip seals, ASTs, crack sealing, and pre-saw cut joints. The evaluations were documented using the PASER method into a spreadsheet form.

The Central Region (Anchorage) uses thin HMA overlays to mitigate existing rutting, while the Northern Region (North Pole) attempts to address thermal cracking, permafrost degradation, and other distresses. A total of 25 road sections with chip seal treatments were evaluated and it was found that different areas exhibited different problems, such as transverse cracking and permafrost degradation in the Fairbanks area and bleeding and cracking in the Anchorage area. However, when place correctly for areas with good drainage and low traffic, the chip seals performed well. The chip seal application at Duben St. in the northeast part of Anchorage was a good example.

Crack sealing is a very common practice in Alaska. Among all crack sealing projects surveyed, no matter if they are newly or previously applied, cracks of different types with different severity levels can be seen. However, generally M&O personnel don't seal all cracks; further information is needed to evaluate the effectiveness of crack sealing treatments.

Two slurry surfacing projects (a microsurfacing and a slurry seal) and one pre-cut project appeared to be successful in terms of distresses observed. More projects are needed to confirm the effectiveness of these pavement preservation treatments. Therefore, it is necessary to create a pavement preservation database and keep good records of current and future pavement preservation projects for better evaluation and application.

It should be noted that pavement preservation projects were not monitored in the Southeast Region because of funding issues. Projects in the Southeast should be monitored and included in the database

## 4.5 Pavement Preservation Database

The pavement preservation concept in Alaska is growing. Several pavement preservation projects have been done in the past; however, detailed records for these projects are hard to find. Alaska DOT&PF realizes the potential benefits of keeping the records of pavement preservation projects. The Department wants to make pavement preservation an integral part of the larger asset management that Alaska DOT&PF wants to implement. In order to promote effective pavement preservation techniques in cold regions, an online pavement preservation database was created for Alaska. The major objectives of the database are to:

- Promote effective pavement preservation techniques
- Keep track of the performance of pavement preservation projects
- Monitor pavement preservation innovation projects with mapping capabilities, which help people identify locations of the projects

- Share the information among interested parties, since most engineers have internet service and can access the database
- Enhance collaboration and technical transfer among state and local agencies, industry partners, and AUTC
- Prevent the loss of important project information. The database is stored in a secured server. The information stored in the database will not be lost.

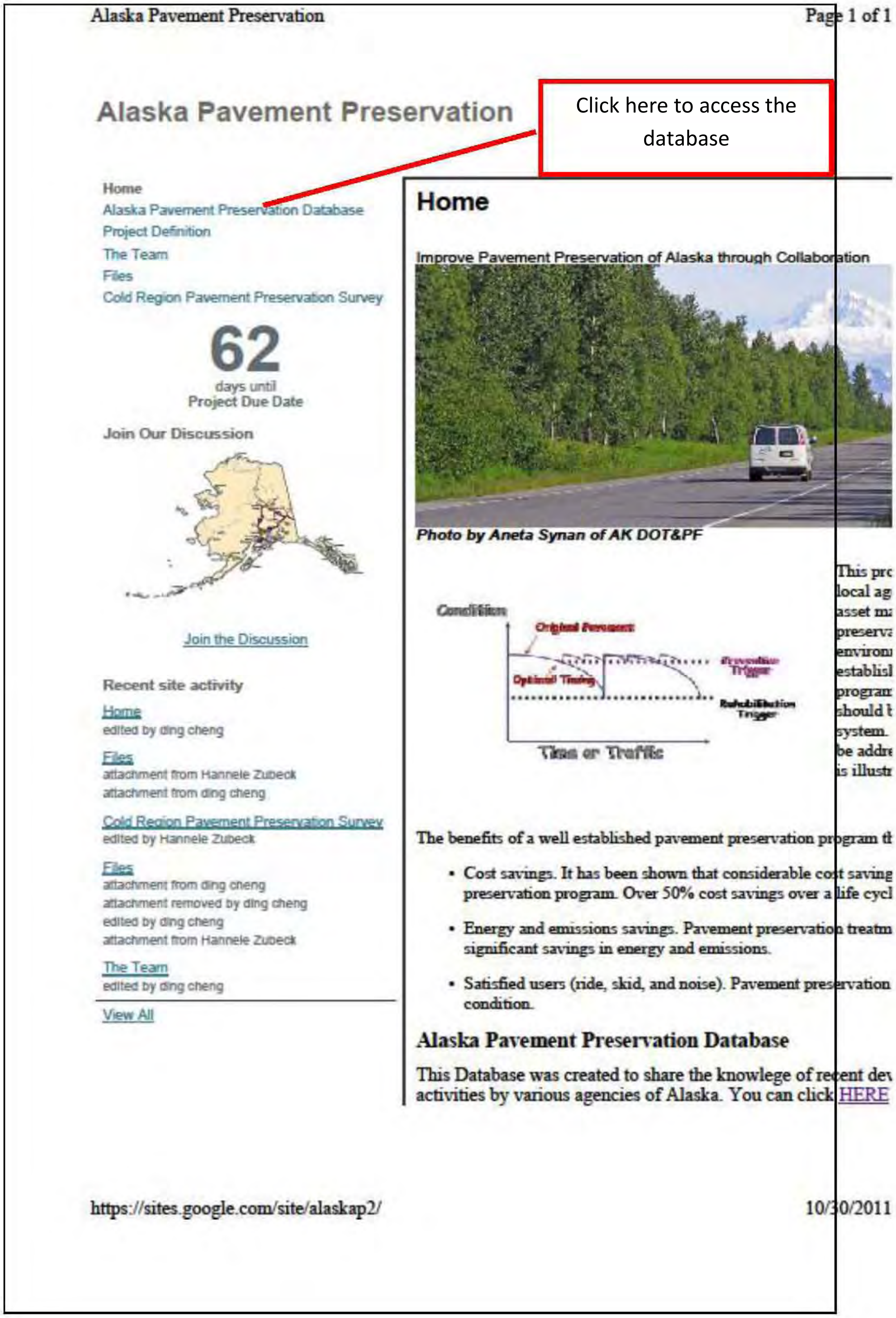
The database stores the pavement preservation project related information, such as existing pavement condition, Google map location display, construction information, multiple year pavement preservation survey in PASER format, supplemental reports, and pictures. After collecting enough data, the Department should be able to determine the treatment life, derive pavement preservation performance curves, and estimate pavement life extension.

The database has three user groups: general user, advanced user, and administrator. General users can only view the project information stored in the database but they will not be able to add new projects or edit the existing projects. Advanced users can add new projects to the database and make modifications only on the projects created by them. An administrator helps manage the knowledge in the database, including adding or editing treatment types. An administrator can also manage user accounts. Currently, Alaska DOT&PF has the administration account for the pavement preservation database.

The database can be found on the Alaska Pavement Preservation website: https://sites.google.com/site/alaskap2/. Anyone can create a general user account with a username and password by filling out a form on the website. If they want to be an advanced user, they can contact the administrator whose email is on the website.

Figure 4-62 shows how to access the data base.

- Once clicked, the login page shown in Figure 4-63 will appear.
- After entering an acceptable username and password the main page for the database will appear as in Figure 4-64.
- From the main page, the most common areas to access are “View My Flexible Treatment” and “Add New Flexible Pavement Treatment.” In “View My Flexible Treatment,” treatments that have already been entered can be accessed. Once clicked Figure 4-65 will appear.
- From the “View My Flexible Treatment” page, any treatment listed can be viewed as shown in Figure 4-66.
- If the “Flexible Project Surveys” button is clicked, data such as rut, IRI, cracking, etc. can be viewed or edited, as shown in Figure 4-67.
- New treatments evaluated can be entered as shown in Figure 4-68.


Alaska Pavement Preservation Page 1 of 1

Click here to access the database

## Alaska Pavement Preservation

Home
Alaska Pavement Preservation Database
Project Definition
The Team
Files
Cold Region Pavement Preservation Survey

62
days until
Project Due Date

Join Our Discussion

Join the Discussion

Recent site activity

Home
edited by ding cheng

Files
attachment from Hannele Zubeck
attachment from ding cheng

Cold Region Pavement Preservation Survey
edited by Hannele Zubeck

Files
attachment from ding cheng
attachment removed by ding cheng
edited by ding cheng
attachment from Hannele Zubeck

The Team
edited by ding cheng

View All

## Home

Improve Pavement Preservation of Alaska through Collaboration

*Photo by Aneta Synan of AK DOT&PF*



This prc
local ag
asset ma
preserva
environ
establisl
program
should b
system.
be addre
is illustr

The benefits of a well established pavement preservation program th

- Cost savings. It has been shown that considerable cost saving preservation program. Over 50% cost savings over a life cycl
- Energy and emissions savings. Pavement preservation treatm significant savings in energy and emissions.
- Satisfied users (ride, skid, and noise). Pavement preservation condition.

### Alaska Pavement Preservation Database

This Database was created to share the knowlege of recent dev activities by various agencies of Alaska. You can click HERE

https://sites.google.com/site/alaskap2/ 10/30/2011

**Figure 4-36. Alaska Pavement Preservation site and database access**

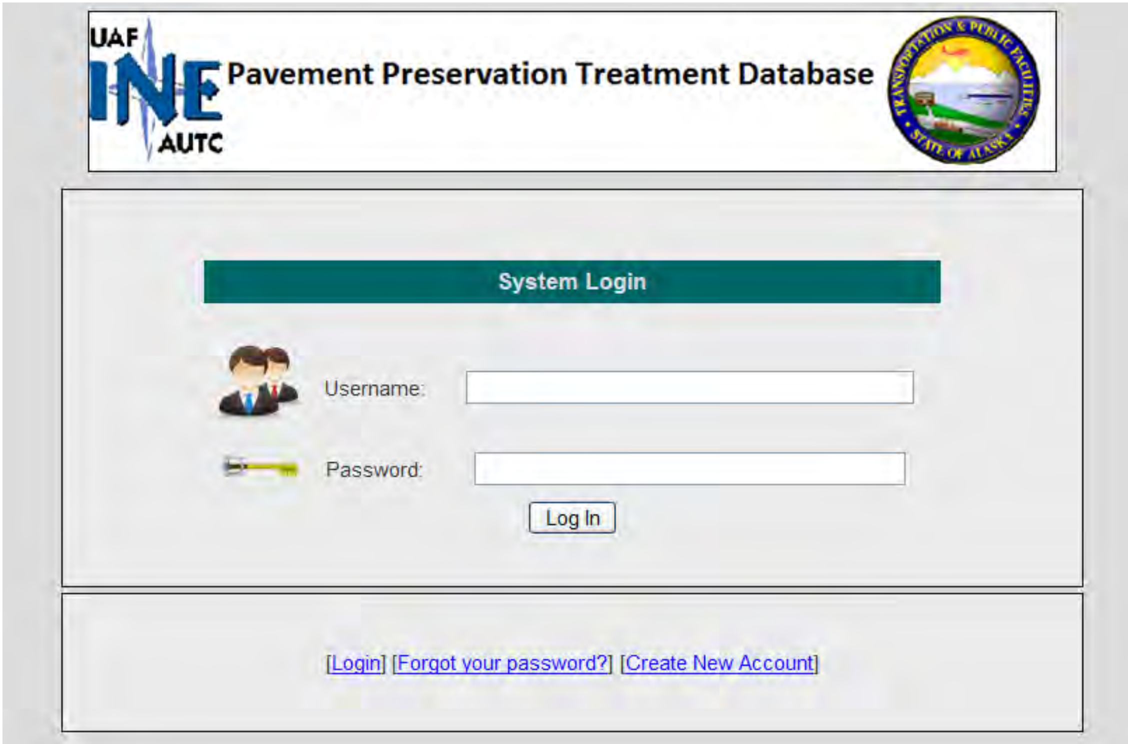



**Figure 4-37. Database login screen**

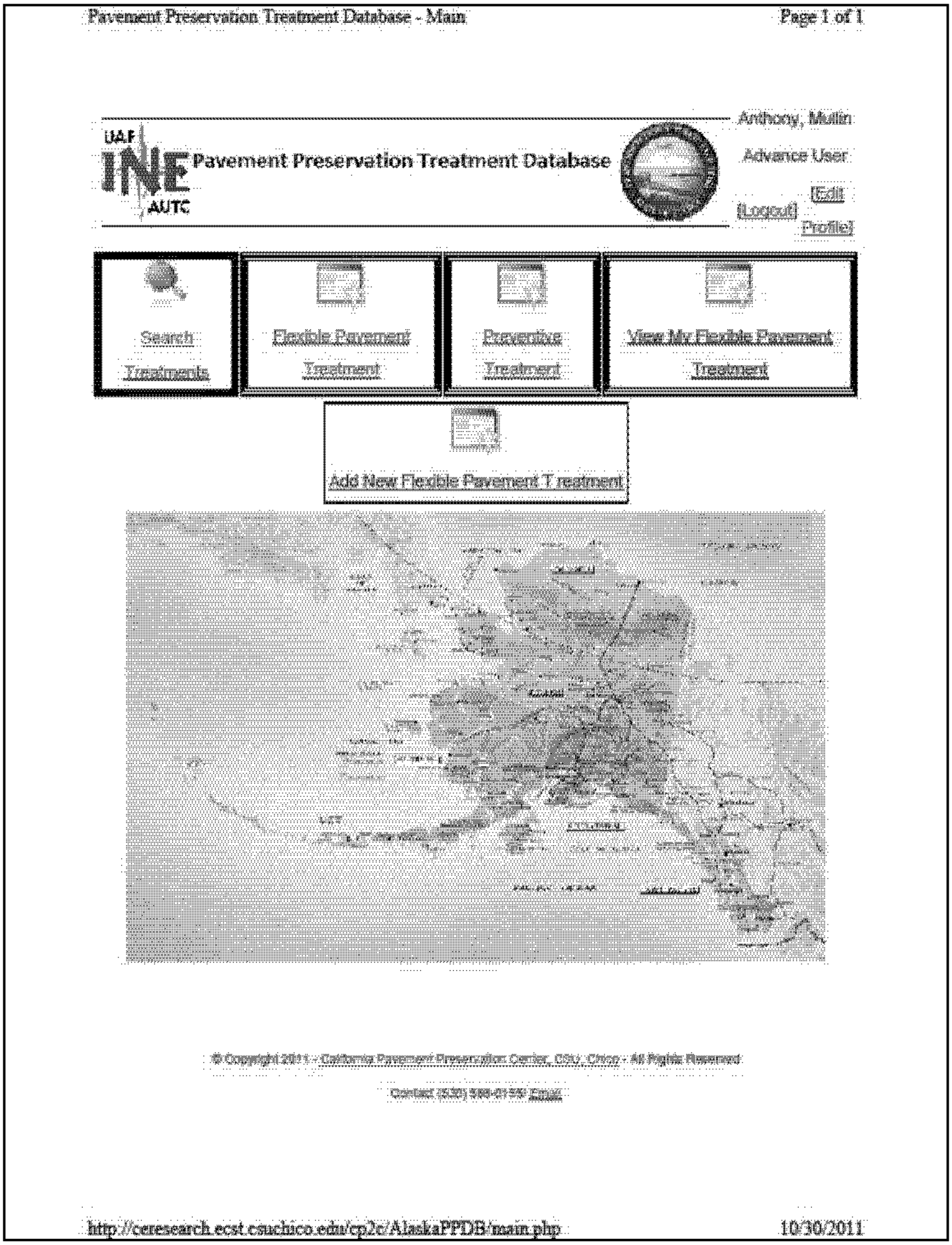
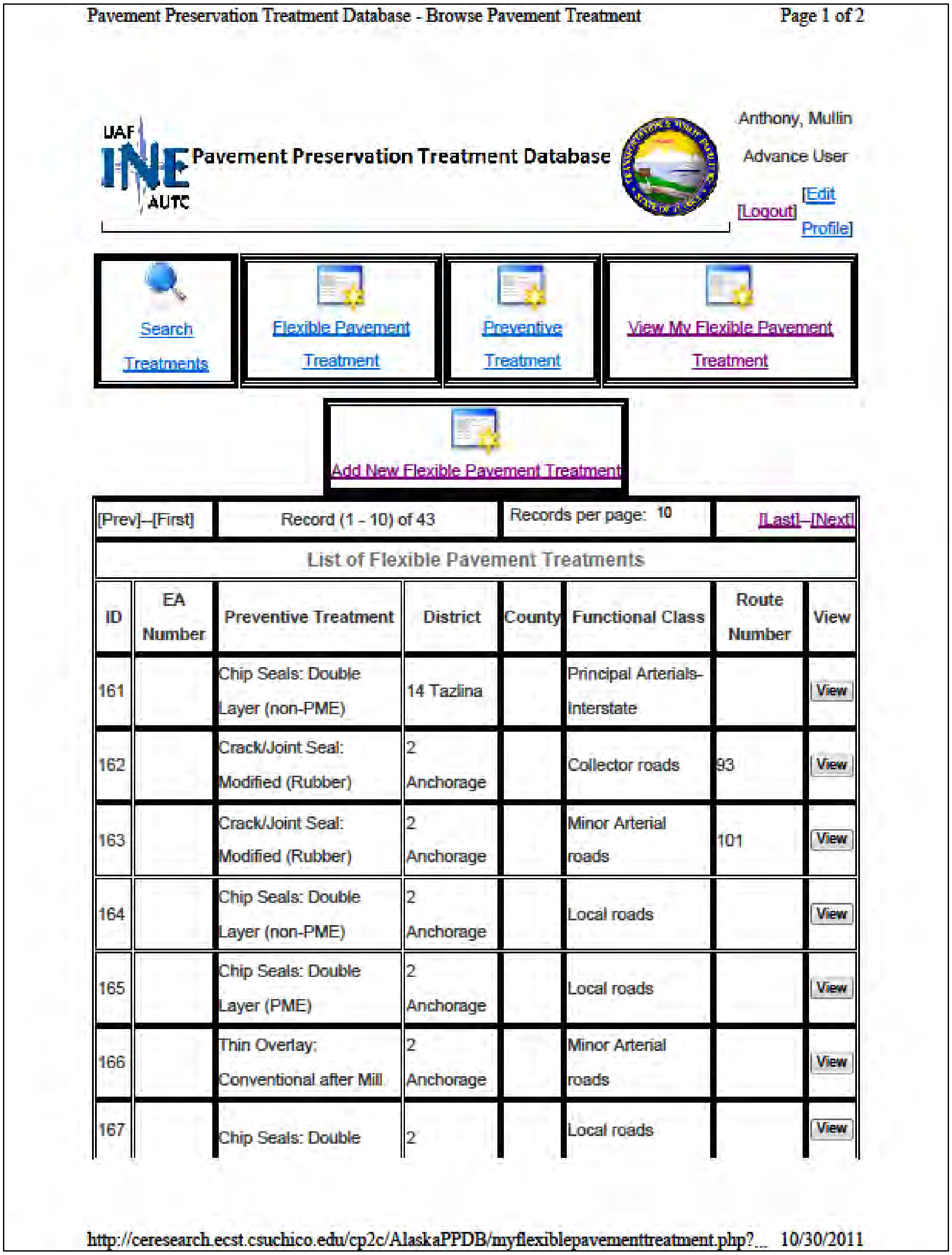



**Figure 4-64. Database main page**



Pavement Preservation Treatment Database - Browse Pavement Treatment Page 1 of 2

UAF INE AUTC Pavement Preservation Treatment Database

Anthony, Mullin
Advance User
[Logout] [Edit Profile]

Search Treatments | Flexible Pavement Treatment | Preventive Treatment | View My Flexible Pavement Treatment

Add New Flexible Pavement Treatment

[Prev]--[First] | Record (1 - 10) of 43 | Records per page: 10 | [Last]--[Next]

List of Flexible Pavement Treatments

| ID | EA Number | Preventive Treatment | District | County | Functional Class | Route Number | View |
|---|---|---|---|---|---|---|---|
| 161 | | Chip Seals: Double Layer (non-PME) | 14 Tazlina | | Principal Arterials-Interstate | | View |
| 162 | | Crack/Joint Seal: Modified (Rubber) | 2 Anchorage | | Collector roads | 93 | View |
| 163 | | Crack/Joint Seal: Modified (Rubber) | 2 Anchorage | | Minor Arterial roads | 101 | View |
| 164 | | Chip Seals: Double Layer (non-PME) | 2 Anchorage | | Local roads | | View |
| 165 | | Chip Seals: Double Layer (PME) | 2 Anchorage | | Local roads | | View |
| 166 | | Thin Overlay: Conventional after Mill | 2 Anchorage | | Minor Arterial roads | | View |
| 167 | | Chip Seals: Double | 2 | | Local roads | | View |

http://ceresearch.ecst.csuchico.edu/cp2c/AlaskaPPDB/myflexiblepavementtreatment.php?... 10/30/2011

**Figure 4-38. “View My Flexible Treatment” page**

Pavement Preservation Treatment Database - Pavement Treatment Page 1 of 3

UAF INE AUTC Pavement Preservation Treatment Database

Anthony, Mullin
Advance User
[Logout] [Edit Profile]

Search Treatments | Flexible Pavement Treatment | Preventive Treatment | View My Flexible Pavement Treatment

Flexible Project Surveys | Edit Flexible Pavement Treatment

| View Agency/Company Contact Information | | | |
|---|---|---|---|
| Client | AKDOT&PF | Contractor | |
| **View Flexible Pavement Treatment** | | | |
| Preventive Treatment | Chip Seals: Double Layer (non-PME) | Project Title | Double chip Seal Project - Tok |
| Is it an Experimental Feature? | No | District | 14 Tazlina |
| Section ID | 1174 | Project Status | In Progress |
| CDS MilePoint Start | 0 | CDS MilePoint End | 2 |
| City | Gokana | Region | Northern Region |
| Borough | City and Borough of Wrangell | State | Alaska |
| CDS Route Number Lookup | | Functional Class | Principal Arterials-Interstate |
| Length of the Project (Lane miles) | 4 | Total Number of Lanes | 2 |
| Start Construction Date | 06-01-2011 | End Construction Date | 09-30-2011 |
| Project Input Date | 06-14 00:00:00-2011 | Two way or One way Street | 2 Way |
| Starting Point Elevation | | Ending Point Elevation | |
| | Road - 1 | | |

http://ceresearch.ecst.csuchico.edu/cp2c/AlaskaPPDB/viewflexiblepavementtreatment.php 10/30/2011

**Figure 4-39. The first page for treatment for "Tazlina"**

Pavement Preservation Treatment Database - Flexible Pavement Treatment Survey Page 1 of 1

UAF INE AUTC Pavement Preservation Treatment Database

Anthony, Mullin

Advance User

[Logout] [Edit Profile]

Search Treatments | Flexible Pavement Treatment | Preventive Treatment | View My Flexible Pavement Treatment

Browse Project Surveys | Edit Project Survey | View Flexible Pavement Treatment

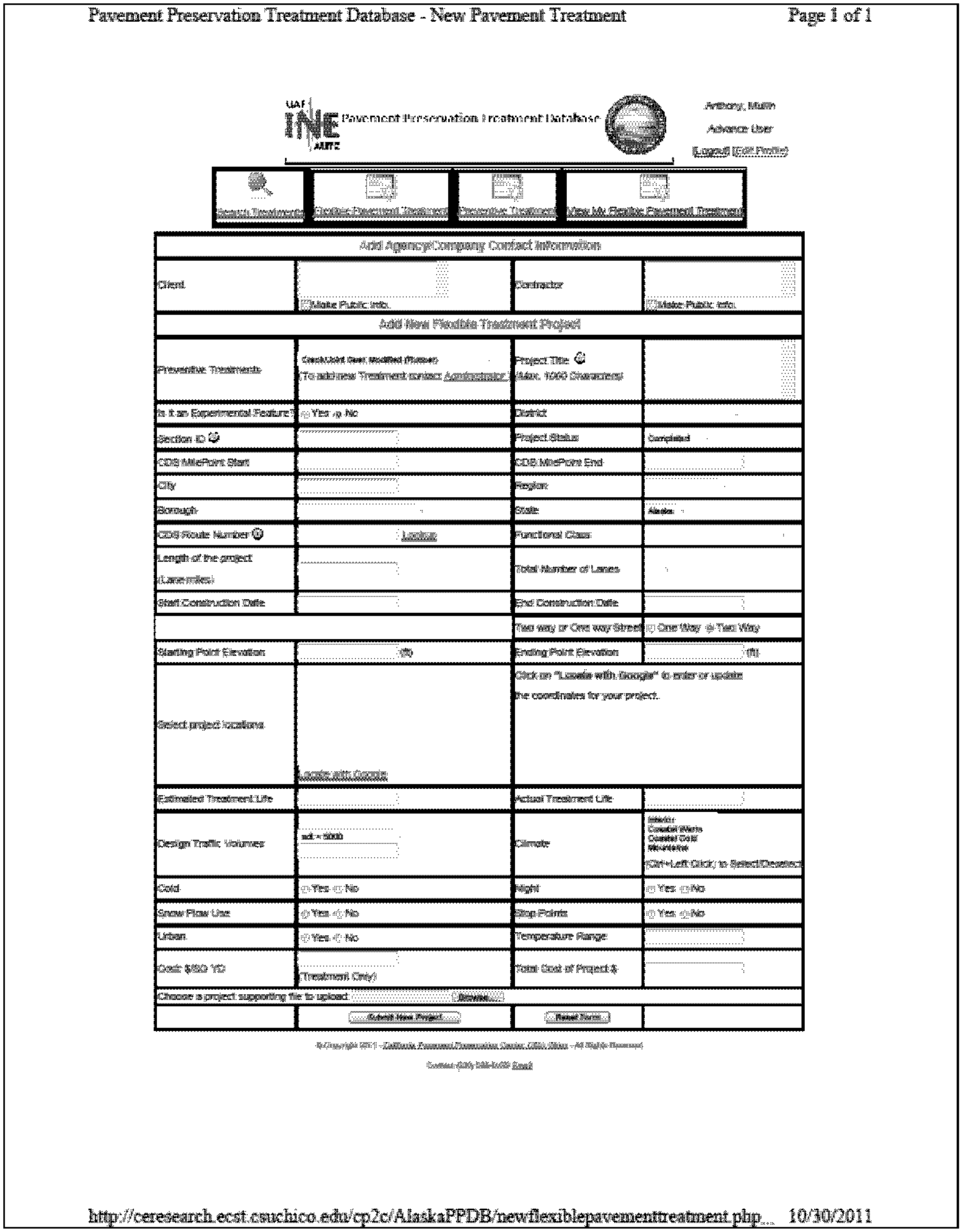
| Project Title: Double chip Seal Project - Tok Cutoff | | | |
|---|---|---|---|
| View Flexible Project Survey | | | |
| **Survey Date** | 2000-06-01 | **Surveyer** | Dynatest |
| **Rutting** | 0.06 inch | **IRI** | 182 inch/mile |
| **Raveling** | No | **Oxidation** | No |
| **Bleeding** | No | **Low Severity Fatigue** | |
| **Moderate Severity Fatigue** | | **High Severity Fatigue** | |
| **Longitudinal** | | **Transverse** | |
| **Traffic Volume Category** | adt <= 5000 | **Traffic Volumes** | |
| **PSR Rating** | 2.8 | **PASER Rating** | 0 |
| Treatments | | | |



Contact (530) 588-0155/ Email

http://ceresearch.ecst.csuchico.edu/cp2c/AlaskaPPDB/viewprojectsurveyflexible.php 10/30/2011

**Figure 4-40. Flexible treatment survey form**



Pavement Preservation Treatment Database - New Pavement Treatment Page 1 of 1

Pavement Preservation Treatment Database

Anthony, Mullin
Advance User
[Logout] [Edit Profile]

Search Treatments | Flexible Pavement Treatment | Preventive Treatments | View My Flexible Pavement Treatment

| | | | |
|---|---|---|---|
| Add Agency/Company Contact Information | | | |
| Client | Make Public Info. | Contractor | Make Public Info. |
| Add New Flexible Treatment Project | | | |
| Preventive Treatments | Crack/Joint Seal: Modified (Rubber)<br>(To add new Treatment contact Administrator) | Project Title:<br>(Max. 1000 Characters) | |
| Is it an Experimental Feature? | Yes No | District | |
| Section ID | | Project Status | Completed |
| CDS MilePoint Start | | CDS MilePoint End | |
| City | | Region | |
| Borough | | State | Alaska |
| CDS Route Number | Lookup | Functional Class | |
| Length of the project (Lane-miles) | | Total Number of Lanes | |
| Start Construction Date | | End Construction Date | |
| | | Two way or One way Street | One Way Two Way |
| Starting Point Elevation | (ft) | Ending Point Elevation | (ft) |
| Select project locations | Locate with Google | Click on "Locate with Google" to enter or update the coordinates for your project. | |
| Estimated Treatment Life | | Actual Treatment Life | |
| Design Traffic Volumes | adt < 5000 | Climate | Interior<br>Coastal Warm<br>Coastal Cold<br>Mountains<br>(Ctrl+Left Click) to Select/Deselect |
| Cold | Yes No | Night | Yes No |
| Snow Plow Use | Yes No | Stop Points | Yes No |
| Urban | Yes No | Temperature Range | |
| Cost: $/SQ YD | (Treatment Only) | Total Cost of Project $ | |
| Choose a project supporting file to upload: | Browse... | | |
| | Submit New Project | Reset Form | |

http://ceresearch.ecst.csuchico.edu/cp2c/AlaskaPPDB/newflexiblepavementtreatment.php... 10/30/2011

**Figure 4-41. "Add a New Flexible Treatment" page**

## *4.6 Performance Models for Preservation Treatments*

Performance models are normally a part of a PMS. Performance models reflect the pavement condition over the time after treatments are applied. If a performance model is available for a section of road, the future pavement condition can be estimated using the model. The model is also very useful to demonstrate the effectiveness of pavement preservation treatments. For example, the pavement condition index (PCI) used by a number of agencies is composed of various pavement performance information including IRI, rutting, and cracking information. Alaska use the pavement serviceability rating (PSR) to combine rutting and IRI

IRI and rut data are collected for roads maintained by the Alaska DOT&PF for inclusion into their PMS. This data has been collected for all three regions of Alaska, Southeast, Central, and Northern, since 1998. On an automated survey vehicle, seven lasers mounted on a modified front bumper are used to collect pavement information and transfer the detected results to a laptop computer. Appropriate software is used for IRI calculations and rut determination. A present serviceability rating (PSR) is then calculated from the IRI and rut data for each pavement management section (usually 1 mile long). IRI, rut, and PSR are stored in the Alaska DOT&PF PMS database. People can export the IRI, RUT, and PSR from the PMS to a spreadsheet. The spreadsheet can be color coded so that distress conditions can be roughly recognized at a glance.

The following are the different forms of regression analysis presently used in the PMS:

- Excel Linear Model
- SPSS Linear Model
- SPSS Non Linear Model
- Dynatest Model

The SPSS is a statistical program used for stochastic and regression analysis. Because of the lack of quality data for preservation treatments, only one or two section histories were used for each model.

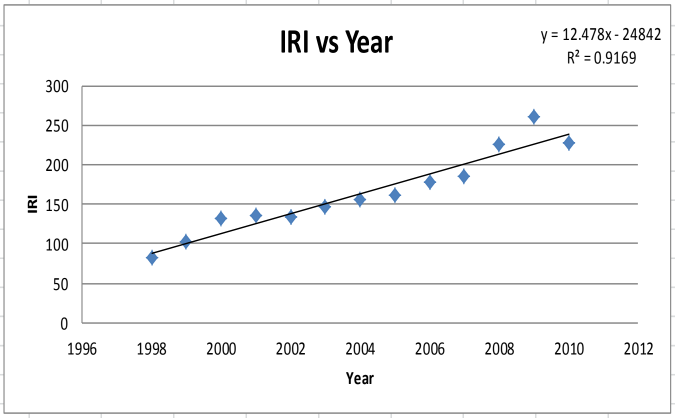
The Excel model consisted of the year as the independent variable and IRI and/or rut as the dependent variable. The PSR is a calculated number from the IRI and rut with the following equations shown in Table 4.6 along with plots of IRI vs year and rut depth vs year.

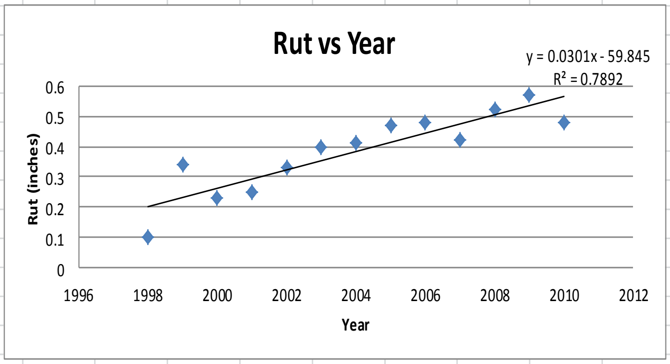
**Table 4-6. Dynatest models**

| | |
|---|---|
| Interstate: | PSR = 5* e(-0.0041 *IRI) for section with average rut depth <0.5"<br>PSR = 5* e((-0.0041*IRI)-(0.7*Rut)) for section with average rut depths > 0.5" |
| Other: | PSR = 5* e(-0.0031 *IRI) for section with average rut depth <0.5"<br>PSR = 5* e((-0.0031*IRI)-(0.7*Rut)) for section with average rut depths > 0.5" |

Linear Regression Model
Debarr Rd from Boniface to Beaver
Thin overlay treatment in 2010

| Year | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IRI | 83 | 103 | 132 | 136 | 134 | 147 | 155 | 162 | 178 | 185 | 225 | 260 | 227 |
| Rut | 0.1 | 0.34 | 0.23 | 0.25 | 0.33 | 0.4 | 0.41 | 0.47 | 0.48 | 0.42 | 0.52 | 0.57 | 0.48 |
| PSR | 3.9 | 3.6 | 3.3 | 3.3 | 3.3 | 3.2 | 3.1 | 3 | 2.9 | 2.8 | 1.7 | 1.5 | 2.5 |




Using SPSS modeling for a non-linear regression with IRI and rut as the dependent variables and year as the independent variable gives the following equations:

$IRI = b1 + (b2xYear^{b3})$ with b1=-24,104.540, b2=9.610, b3=1.030 and $R^2$= 0.917

$Rut = b1 + (b2xYear^{b3})$ with b1=-168.769, b2=11.284, b3=.356 and $R^2$= 0.789

As a check to Dynatest's PSR calculation, a linear regression was performed with PSR as the dependent and IRI and rut as the independent variables. Table 4.7 summarizes the results of this work.

**Table 4.7. Linear regression model statistical analysis results**

**a) Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .959[a] | .921 | .905 | .21209 |

a. Predictors: (Constant), Rut, IRI

**b) ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5.218 | 2 | 2.609 | 57.998 | .000[a] |
| | Residual | .450 | 10 | .045 | | |
| | Total | 5.668 | 12 | | | |

a. Predictors: (Constant), Rut, IRI

b. Dependent Variable: PSR

**c) Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 5.055 | .207 | | 24.476 | .000 |
| | IRI | -.013 | .002 | -.978 | -5.457 | .000 |
| | Rut | .109 | .934 | .021 | .117 | .909 |

a. Dependent Variable: PSR where $PSR = -.013xIRI + .109xRut + 5.055$

Values for PSR for Alaska are summarized in Table 4.8.

The analysis of the models should continue (e.g. generalized non-linear models will be analyzed). The final results of the performance models may be added in a future study.

**Table 4.8. Comparing linear model PSR with real PSR**

| Year | IRI | Rut | PSR | PSR - SPSS IRI & Rut Linear |
|---|---|---|---|---|
| **1998** | 83 | 0.1 | 3.9 | 3.99 |
| **1999** | 103 | 0.34 | 3.6 | 3.75 |
| **2000** | 132 | 0.23 | 3.3 | 3.36 |
| **2001** | 136 | 0.25 | 3.3 | 3.31 |
| **2002** | 134 | 0.33 | 3.3 | 3.35 |
| **2003** | 147 | 0.4 | 3.2 | 3.19 |
| **2004** | 155 | 0.41 | 3.1 | 3.08 |
| **2005** | 162 | 0.47 | 3 | 3.00 |
| **2006** | 178 | 0.48 | 2.9 | 2.79 |
| **2007** | 185 | 0.42 | 2.8 | 2.70 |
| **2008** | 225 | 0.52 | 1.7 | 2.19 |
| **2009** | 260 | 0.57 | 1.5 | 1.74 |
| **2010** | 227 | 0.48 | 2.5 | 2.16 |

## *4.7 Summary of Modeling Effort*

At this point in time, it is difficult to model a family of treatments based on the data that is stored on an annual basis in the Alaska PMS, since there is no direct link of which treatment, rehabilitation, or new construction has been performed for each section in the past. Further, there is a lack of historical information on distresses other than IRI and rutting. Cracking data, as well as other distresses such as raveling and delamination, are needed for selecting pavement preservation treatments. Information is needed to obtain the performance curves for some pavement preservation treatments. A manual effort could be made to create a file for this effort. There is a spreadsheet at Alaska DOT&PF that depicts the data in a color format where changes in numerical values are obvious at a quick glance. From here research would be needed to discover what was done on a specific road section at that time.

Cracking is a distress that some agencies find value in quantifying, recording, and using in pavement management decision making. Cracking is a part of the asphalt condition assessment for airports in Alaska. Other distress types have been included in the strategy selection system which is discussed in the next chapter.

Regression analyses could be performed in Dynatest's database using a power equation. This can provide end of life estimates. Further research could be done to ascertain if this regression best represents Alaska's conditions by comparing with other possible models.

Of the five types of pavement preservation treatments evaluated, thin HMA overlays, various chip seals, and crack sealing are the most widely used in Alaska. Slurry surfacing and pre-saw cut joints should be researched and tested more to evaluate their effectiveness for Alaska.

# 5.0 STRATEGY SELECTION GUIDE

This chapter presents a summary of the approach recommended for Alaska to select appropriate preservation treatments. It is based on extensive work by the California Department of Transportation and discussion with pavements personnel at the Alaska DOT&PF to modify it to fit Alaska's conditions. It is also based on the data presented in Chapters 2 and 3.

## *5.1 General Considerations*

There are many factors that are considered in the process of selecting an appropriate treatment for a pavement. These include pavement age, condition, traffic levels, expected future plans, as well as available funding and agency policy. At the network level, a general relationship exists between pavement condition and pavement age. For a properly constructed new pavement, the only treatments that are required are preventive maintenance (maintenance performed to delay the onset of distress such as fog seals, slurry surfacings and the like). Then, as the pavement ages, it may become a candidate for routine maintenance (crack sealing or chip sealing), rehabilitation and eventually reconstruction. The purpose of this chapter is to provide guidance on treatment strategy selection for Alaska. Figure 5-1 illustrates the treatment strategies employed based on the condition index of the existing pavement.

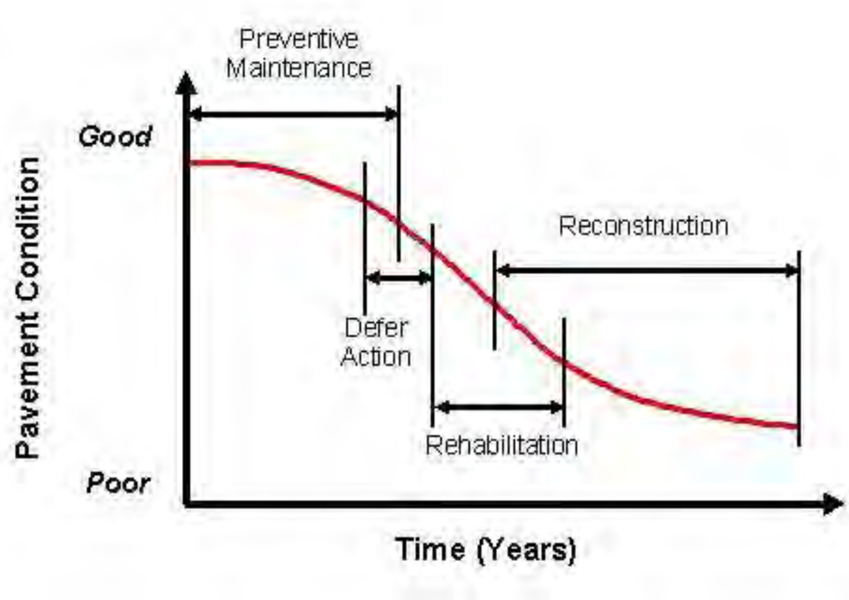



**Figure 5-1. Treatment Strategy Based on Pavement Condition**

Once an appropriate maintenance strategy has been chosen, a specific treatment is selected to address the specific distress mechanism for the pavement. The most important factors to consider when choosing a maintenance treatment include:

- Will the treatment address the distresses present? (i.e., Will it work?)
- Can the required preparation for the treatment be carried out?
- Is the treatment cost effective?
- Will the treatment be performed before the situation being addressed changes? For example, a slurry seal was planned two years ago for a section of minor distressed road. By the time it was constructed, the pavement already cracked up and a slurry seal wouldn't be effective any more.

## *5.2 Selection Process*

There are three basic steps in the maintenance treatment selection process. These steps include:

- Assess the existing conditions,
- Determine the feasible treatment options, and
- Analyze and compare the feasible options with each other

### 5.2.1 Assess the Existing Conditions

The first step of the treatment selection process is to perform an evaluation of the existing conditions. This evaluation can be broken down into three processes, which include:

- Visual site inspection and/or inspection of project information from a database and/or records,
- Test the existing pavement, as conditions require, and
- Define the performance requirements for the treatment.

It is helpful to assess pavements using a pavement assessment form of some kind. A well-developed form promotes uniformity in the assessment process. The District Maintenance Engineer or other reviewer should fill out the pavement assessment form on site, for each pavement being considered for treatment. Figure 4-61 illustrates an example of the PASER assessment form (Walker 2002) and the type of information that should be collected.

Sometimes, testing the conditions of the existing pavement is necessary. It may involve taking cores, measuring the properties of existing pavements such as consistency of existing binder, binder content, gradation, and the like.

The new treatment should also meet the performance expectation of the road section. It should meet the requirement of traffic level, climate condition, studded tire usage, and expected life.

### 5.2.2 Determine the Feasible Treatment Options

Once the pavement condition has been quantified, test results collected and analyzed, and other available data are reviewed, feasible treatments can be identified. In this context, “feasibility” is determined by a treatment’s ability to address the functional and structural condition of the pavement while also meeting any future needs. Note that feasibility is not a function of affordability, because at this stage of the selection process the primary purpose is to determine what treatments might work. Figures 5-2 and 5-3 illustrate the matrix developed for Alaska DOT&PF for treatment options. These matrices are good starting points, but need to be refined and improved in the future. Please note, not all the distress types are currently collected by the current PMS. As a start, Alaska DOT&PF should consider to collect data on distresses, such as cracking and weathering, from a pool of preliminary targeted preservation candidates.

| Treatments | Smoothness (high IRI) | Tire Rutting | | Struct. Rutting | | Raveling | Oxidation | Polished Aggregate | Bleeding | Skid Resistance | Potholes | Drainage or Grading | Permafrost | Traffic Volume ADT | | | Climate Zone | | | | | Treatment Cost: $/sq. yd | | | Expected Treatment Life: Year | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | <0.5" | >=0.5" | <0.5" | >=0.5" | | | | | | | | | < 5000 | 5000 to 30,000 | >30,000 | Interior | Southeast | SouthCentral | Mountains | | Average | Low | High | Average | Low | High |
| Routine Maintenance | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cleaning of roadside ditches and structures | N | N | N | N | N | N | N | N | N | N | N | G | N | G | G | G | G | G | G | G | | NA | NA | NA | NA | NA | NA |
| Pothole Patching | N | N | N | N | N | N | N | N | N | N | G | N | N | G | G | G | G | G | G | G | | NA | NA | NA | NA | NA | NA |
| Preventive Maintenance | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Crack/Joint Seal: Modified (Rubber) | P | N | N | N | N | N | N | N | N | N | N | N | N | G | G | G | G | G | G | G | | 0.79 | 0.11 | 1.26 | 3 | 1 | 5 |
| Crack/Joint Route and Seal: Modified (Rubber) | P | N | N | N | N | N | N | N | N | N | N | N | N | G | G | G | G | G | G | G | | 1.24 | 0.79 | 1.58 | 3 | 1 | 5 |
| Crack Banding, Transverse | F | N | N | N | N | N | N | N | N | N | N | N | N | G | G | G | G | G | G | G | | 0.24 | 0.19 | 0.29 | 3 | 1 | 5 |
| High Float Surface Treatment | P | N | N | N | N | G | G | G | N | G | N | N | N | G | F | P | G | G | G | G | | 1.33 | 1.15 | 1.5 | 3 | 1 | 5 |
| Chip Seals: Single Layer, PME | P | N | N | N | N | G | G | G | G | G | N | N | N | G | F | P | G | G | G | G | | 3 | 2 | 4 | 6 | 3 | 10 |
| Chip Seals: Double Layer, PME | P | P | N | P | N | G | G | G | G | G | N | N | N | G | G | F | G | G | G | G | | 5.4 | 3.6 | 7.2 | 7 | 3 | 10 |
| Chip Seals: Single Layer, non-PME | P | N | N | N | N | G | G | G | G | G | N | N | N | G | F | P | G | G | G | G | | 1.75 | 1.5 | 2 | 5 | 3 | 10 |
| Chip Seals: Double Layer, non-PME | P | P | N | P | N | G | G | G | G | G | N | N | N | G | G | F | G | G | G | G | | 3.15 | 2.7 | 3.6 | 6 | 3 | 10 |
| Minor (Light) Rehabilitation | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Thin Overlay: RHMA | G | F | P | F | P | G | G | G | G | G | N | N | P | G | G | G | G | G | G | G | | 23.40 | 18.7 | 28.1 | 6.8 | 5 | 12 |
| Thin Overlay: RHMA after Mill | G | G | G | P | P | G | G | G | G | G | N | N | P | G | G | G | G | G | G | G | | 76.50 | 61.2 | 91.8 | 6.8 | 5 | 12 |
| Thin Overlay: RHMA with prelevel | G | G | G | F | F | G | G | G | G | G | N | N | P | G | G | G | G | G | G | G | | 23.40 | 11.7 | 28.1 | 6.8 | 5 | 12 |
| Thin Overlay: Conventional | G | F | P | F | P | G | G | G | G | G | N | N | P | G | G | G | G | G | G | G | | 21.24 | 17 | 25.5 | 6.8 | 5 | 12 |
| Thin Overlay: Conventional after Mill | G | G | F | P | P | G | G | G | G | G | N | N | P | G | G | G | G | G | G | G | | 72.00 | 57.6 | 86.4 | 6.8 | 5 | 12 |
| Thin Overlay: Conventional with prelevel | G | G | F | F | F | G | G | G | G | G | N | N | P | G | G | G | G | G | G | G | | 21.24 | 17 | 25.5 | 6.8 | 5 | 12 |
| Corrective Maintenance | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| High Severity Pothole Repair | N | N | N | N | N | N | N | N | N | N | G | N | N | G | G | G | G | G | G | G | | 10 | 8 | 12 | 1.5 | 1 | 3 |
| Reclaim, Reshape, Resurface | P | G | G | G | G | N | N | F | F | F | G | N | F | G | G | G | G | G | G | G | | 20 | 16 | 24 | 3 | 2 | 7 |
| Structural Overlay | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rehab Overlay (more than 2") | G | G | G | G | G | G | G | G | G | G | G | G | F | G | G | G | G | G | G | G | | 42.5 | 34 | 51 | 10 | 8 | 15 |
| Major (Heavy) Rehabilitation | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Full Depth Reclaimation (FDR) and 2"-4" HMA | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | | 60 | 45 | 72 | 10 | 8 | 15 |
| Reconstruction | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reconstruction | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | G | | 72 | 54 | 86.4 | 15 | 10 | 20 |

Note: G- Good Performance; F – Fair Performance; P – Poor Performance; N – Not recommended
Red color numbers are estimated from literature or assumptions.

**Figure 5-2. Alaska non-crack related treatment selection matrix**

| | Fatigue | | | Block Cracking | | | Longitudinal or Transverse Cracking | | | Edge Cracking | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Severity Level | L | M | H | L | M | H | L | M | H | L | M | H |
| | or | or | or | or | or | or | or | or | or | or | or | or |
| Quantity | | | | | | | | | | | | |
| Routine Maintenance | | | | | | | | | | | | |
| Cleaning of roadside ditches and structures | N | N | N | N | N | N | N | N | N | N | N | N |
| Pothole Patching | N | N | N | N | N | N | N | N | N | N | N | N |
| Preventive Maintenance | | | | | | | | | | | | |
| Crack/Joint Seal: Modified (Rubber) | N | N | N | N | G | G | N | G | G | N | F | N |
| Crack/Joint Route and Seal: Modified (Rubber) | N | N | N | N | G | N | N | G | N | N | N | N |
| Crack Banding, Transverse | N | N | N | N | N | N | N | G | G | N | N | N |
| High Float Chip Seal (gravel road only) | N | N | N | N | N | N | N | N | N | N | N | N |
| Chip Seals: Single Layer, PME | N | N | N | P | P | P | P | P | P | N | N | N |
| Chip Seals: Double Layer, PME | N | N | N | F | F | F | F | F | F | N | N | N |
| Chip Seals: Single Layer, non-PME | N | N | N | P | P | P | P | P | P | N | N | N |
| Chip Seals: Double Layer, non-PME | N | N | N | F | F | F | F | F | F | N | N | N |
| Minor (Light) Rehabilitation | | | | | | | | | | | | |
| Thin Overlay: RHMA | G | F | N | F | P | P | F | P | P | F | P | P |
| Thin Overlay: RHMA after Mill | N | N | N | F | P | P | F | P | P | F | P | P |
| Thin Overlay: RHMA with prelevel | N | N | N | F | P | P | F | P | P | F | P | P |
| Thin Overlay: Conventional | G | F | N | F | P | P | F | P | P | F | P | P |
| Thin Overlay: Conventional after Mill | N | N | N | F | P | P | F | P | P | F | P | P |
| Thin Overlay: Conventional with prelevel | N | N | N | F | P | P | F | P | P | F | P | P |
| Corrective Maintenance | | | | | | | | | | | | |
| High Severity Pothole Repair | N | N | N | N | N | N | N | N | N | N | N | N |
| Reclaim, Reshape, Resurface | F | F | F | G | G | G | G | G | G | G | G | G |
| Structural Overlay | | | | | | | | | | | | |
| Rehab Overlay (more than 2") | F | F | P | G | F | F | G | F | F | G | F | F |
| Major (Heavy) Rehabilitation | | | | | | | | | | | | |
| Full Depth Reclaimation (FDR) and 2"-4" HMA | G | G | G | G | G | G | G | G | G | G | G | G |
| Reconstruction | | | | | | | | | | | | |
| Reconstruction | G | G | G | G | G | G | G | G | G | G | G | G |

Note: G- Good Performance; F – Fair Performance; P – Poor Performance; N – Not recommended

**Figure 5-3. Alaska crack related strategy selection matrix**

Once the feasible options have been determined, the limitations of each of the options should be taken into account in relation to its suitability versus the other feasible options. Treatment limitations are imposed by such factors as roadway geometric constraints, roughness and permeability. The most inexpensive option that satisfies the maintenance requirements within its limitations should be considered first. At this point, a life cycle analysis or other cost effectiveness measure should be made as discussed in the next section.

### 5.2.3 Analyze and Compare the Feasible Treatment Options

It is likely that there will be several treatments that are identified as feasible. In comparing these different treatments, thought should be given to the treatment placement cost, the life of the treatment and whether or not the treatment extends the life of the pavement. Additional factors to consider when analyzing and comparing treatment options are: the cost effectiveness, traffic level, construction limitations, and other factors such as weather, curing times or local issues that affect a specific treatment. The most desirable treatment is the one that provides the greatest benefit (whether that benefit is measured in terms of improvement in condition, extension of pavement life, or even, more simply, the life of the treatment) for the lowest life cycle costs. At this point a life cycle or other cost effectiveness measure should be made.

Reconstruction and maintenance costs rise as a pavement ages. However, if maintenance and/ or rehabilitation (M&R) is carried out too early the costs are prohibitively high. There is an optimum time at which maintenance should be performed to provide the maximum cost effectiveness. Figure 5-4 shows a typical cost effectiveness relationship with respect to timing of treatment applications. Optimum timing was also discussed in Chapters 2 and 3 of this document.

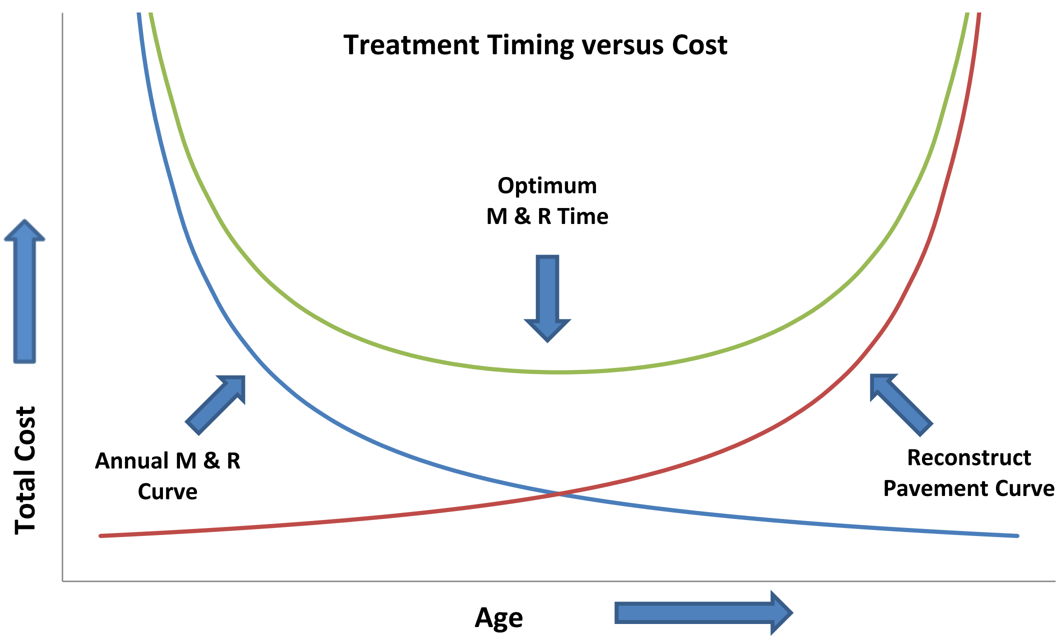



**Figure 5-4. Treatment Timing versus Costs (Hicks 2000)**

### 5.2.4 Cost Effectiveness

Caltrans calculates cost effectiveness using the Caltrans Pavement Condition Report system (Caltrans 2000). However, for an initial assessment, a more simplified approach may be employed (Hicks 2000). This simplified approach is useful as costs and actual bid prices fluctuate. Equivalent Annual Cost (EAC) can be calculated and used to compare alternatives with different service lives (Cheng and Hicks 2012) using:

$$EAC = (A/P, i, n) * NPV = \left( \frac{i(1+i)^n}{(1+i)^n - 1} \right) * NPV$$

where: A/P=ratio of the EAC to the NPV (net present worth or project present cost)
i=annual percent increase in cost index
n=treatment life (in years)

At this stage the treatment that meets the performance requirements with the lowest EAC may be selected.

### 5.2.5 Choosing from the Maintenance Treatment Matrix

The main issues to consider when selecting between accepted treatments listed in the Alaska treatment selection matrix are:

- Performance and Constructability
- Customer Satisfaction

Performance and constructability factors include the expected life of a treatment, seasonal effects on a treatment, existing pavement conditions, the existing pavement structure and the EAC calculated for the treatment. The contractor's experience, materials availability and weather limitations should also be taken into account. Each of these items is rated on a scale of 1 to 5. The District Maintenance Engineer or local supervisor should assign the ratings based on their individual experience. The ratings are based on the fact that a treatment is suitable when it is properly applied; however, project limitations such as climate conditions and material limitations may prohibit proper procedures from being followed. In situations where new products or material sources are being introduced, a risk factor should be considered, and a lower rating given to these materials. Similarly, if a contractor is unfamiliar with the new product or new material a lower rating should be given, despite the technical properties of a new product.

Customer satisfaction factors are social factors, such as traffic disruption, skid resistance achieved and noise level. Aesthetic factors such as dust and general appearance are also included. This allows a feasible option to be evaluated on factors other than cost and performance. The most cost effective and long lasting treatment may not be the right treatment for the right pavement at the right time under some conditions.

## *5.3 Computer Program for the Strategy Selection Process*

A computer program has been preliminarily developed for the Alaska DOT&PF as a part of this project to assist with strategy selection and was integrated into the Alaska Pavement Preservation Database (see discussion in Chapter 4). This program is a starting point for users to explore options in treatments. With more usage, it can be fine-tuned to become a valuable tool to assist in making engineering decisions. After the project survey information is collected, the user can start to use the project information to select a series of treatments from the currently available Alaska pavement treatment strategies which range from pavement preservation to rehabilitation and reconstruction.

Only Advanced Users and the Administrator can perform Strategic Selection and Cost Analysis by clicking on the “Strategy Selection” button. It will open a popup box containing the distress values. The program has multiple pages which can be used. To navigate through different pages, one can click on “NEXT” or “PREV” buttons. To reset the selections, one should click on the “RESET” button. To close the popup without saving the values, one should click on the “CLOSE[X]” button. To save the selections, one should click on the “SAVE AND CLOSE” button.

A detailed illustration of using the online strategy selection program is listed in Appendix C. The following are the major steps to complete one analysis.

1. Login to the Alaska Pavement Preservation Database as an advanced user.
2. Locate the project using embedded Google map, or browsing projects, or searching the database.
3. View the project survey page, from which one can select Strategy Selection to start the treatment selection process.
4. Fill out the non-crack related pavement conditions including rutting, bleeding, traffic level, climate region, etc. Then click on Next.
5. Fill out the crack related pavement conditions including fatigue cracking, longitudinal/transverse cracking, and edge cracking information. Then click on Next.
6. A series of qualified treatments will be displayed on this page. One should select the feasible treatments for further analysis and comparison.
7. The default values of treatment cost, expected life, and interest rates for each treatment will be displayed in a table. These values can be customized by the user.
8. Calculate the annual life cycle cost for each treatment.
9. Generate and print the report.
10. Save the project for future reference or editing.
11. The program also has a function to generate a sequence of treatment over a long analysis period based on life cycle cost analysis.

In summary, the program streamlines the strategy selection process. It has a life cycle cost analysis function to support engineers to find cost effective treatments. This is a preliminary program. With more usage and verification, the program can be fine-tuned for wide usage by the Alaska DOT&PF staff.

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

## *6.1 Conclusions*

On the basis of the literature review and the cold regions survey, the following conclusions were made:

- Pavement preservation treatments, such as crack sealing, patching, fog seals, chip seals, slurry seals, AST/BST, microsurfacing, thin overlays, bonded wearing courses, interlayers and in-place recycling, are used in cold regions and have potential for use in Alaska.
- Crack sealing and patching are the most extensively used pavement preservation techniques and their use in Alaska should be continued.
- Use of chip seals, fog seals, and slurry surfacings s should be considered job specifically. Construction is limited to temperatures > 60°F. These treatments are not used in cold regions with heavy studded tire usage.
- Traffic volume affects applicability of certain treatments. Table 2-1 suggests recommended traffic levels for pavement preservation treatments for Alaska.
- The service life of the treatments varies from about 3 to 12 years. The literature and the survey agree that microsurfacing and thin overlays have the longest service life.
- Many regions have dedicated budgets for pavement preservation. Comments typically state the need for more funds.
- Most regions use several performance measures to determine trigger values for the due time of pavement preservation treatments. IRI, rutting, cracking and expert opinion are used extensively.
- The costs of treatments vary from one region to another as well as from one project to another. Cost data from the survey is given in Table 2-4 and from the literature review are given in Tables 3-3 and Tables 3-9 to 3-11.

Other issues than cost effectiveness should be considered when marketing pavement preservation. These issues include sustainability, green products and technologies and traffic safety.

The performance monitoring effort, presented in Chapter 4, indicated that several pavement preservation treatments have and continue to be used in Alaska including:

- Chip seals,
- Slurry surfacings,
- Crack seals, and
- Thin HMA overlays.

The results show that Alaska uses pavement preservation treatments in most regions and has had good success with each type.

Project information was stored in the pavement preservation database. This was also discussed in Chapter 4, along with typical pavement performance models developed for preservation treatments. The value of this database is important for inventorying and monitoring future pavement preservation projects, especially as a service to the broad community of road custodians in Alaska.

The process for selecting a given pavement preservation treatment is given in Chapter 5. The process was modeled after the Caltrans process, but adapted for Alaska using input from Alaska DOT&PF staff. It is important to note that for this work to proceed, it will be necessary for Alaska DOT&PF to collect the additional distress data that is used in the suggested strategy selection process.

The software for the database and the strategy selection program has been tested and is ready for use.

## *6.2 Recommendations*

The following recommendations are provided for Alaska DOT&PF to consider in the implementation of the findings from this project:

- Schedule future workshops to present the pavement preservation concept and implementation of the findings of this study. This would include the use of the pavement preservation database and the strategy selection program.
- Implement the uses of the database by adding preservation projects from all regions. These projects should continue to be monitored in future years to assist with the development of performance curves for preservation treatments.
- Develop performance models for preservation treatments. Dynatest uses a power equation which is similar to what was considered in this project. It is recommended that the study review a sampling of these curves as they exist now to see if the prediction curves make sense from the historical data that was input into them. In addition, performance curves with independent variables other than rutting and ride should be developed for pavement preservation treatments.
- Continue to expand the use of pavement preservation treatments to include slurry surfacings and thin bonded wearing courses. These materials could possibly be used as a solution to studded tire wear in the Central region.
- Conduct a follow-up study to integrate pavement preservation into the PMS developed by Dynatest (PERS-Performance and Economic Rating System). This would involve the following steps:
    - Determine the capabilities of the existing PMS. According to Bob Briggs of Dynatest, the existing system can accommodate preservation treatments. He would need to know the treatments to be added, the treatment costs, and some estimate of the treatment lives.
    - Can this be accomplished in a short time frame? The simple answer is yes. Pavement preservation treatments can be added to the PMS. However, it may take time to develop treatment lives or performance models for preservation treatments. It is still unclear how well the existing performance models work or if they are used to a great extent in the PMS.
    - The project should also begin to answer the “what if" questions on at least the NHS to start with.

- Expand the pavement preservation program starting with the NHS by placing treatments on pavements in relatively good condition. It is unlikely pavement preservation treatments will be useful to correct problems associated with permafrost.
- Begin to document the benefits of pavement preservation treatments used in Alaska and where different treatments are most suitable for use. Include the performance of pavement preservation treatments in future state of the pavement reports.
- Initiate work on developing performance measures (Ride, rutting, pavement cracking) for use in pavement preservation and rehabilitation to meet the requirements of MAP-21. Alaska currently uses the pavement serviceability rating (PSR) by combining the rut and IRI measurements. The recent addition of cracking to the data collection process is a step in the right direction for performance measures.

# 7.0 IMPLEMENTATION RECOMMENDATIONS FOR ALASKA DOT&PF

## *7.1 Elements of a Pavement Preservation Program*

The elements of an ideal pavement preservation program are shown in Figure 7.1. Each of the items in Figure 7.1 is discussed more in the following:

- Develop program guidelines. This should consist of a policy manual containing the overall strategies and goals of the program. A good start was developed as a part of this study for AUTC/Alaska DOT&PF.
- Determine pavement maintenance needs. This step consists of periodic condition surveys to identity the network condition. This is currently being done in Alaska using systems such as:
    - Automated vehicles
    - Non-destructive testing

  The data should also include distresses that trigger treatments which are discussed in more detail in the report. In addition, other project data such as project location, traffic, climate, and pavement distress including cracking and raveling needs to be collected and included in a database( such as the pavement management database or the pavement preservation database developed as a part of this project). Treatment costs need to be quantified by the Department. Finally, the current PMS does not include performance models for pavement preservation treatments. The existing system needs to be modified to account for pavement preservation.
- Identify treatments that work in cold regions. The work reported in this report series clearly identifies the treatments that work in cold regions. Alaska needs to consider placing pilot projects using some of the more promising treatments identified in the report, such as slurry surfacings and thin bonded wearing courses.
- Framework for Treatment Selection. This consists of selecting the "right" treatment at the "right" time on the "right" pavement. Key factors in this process are lives of treatments as well as their unit costs. Included in report is a description of the strategy selection process developed specifically for Alaska DOT&PF. Though this is based on the work previously done for Caltrans (Cheng et.al. 2010), an entirely new approach was developed for Alaska.
- Develop Analysis Procedures for selecting the most effective treatments. This is also included in the strategy selection process. Procedures for determining the most cost effective treatment are developed. However, cost is not the only consideration. Other factors such as availability of materials, qualified contractors, available time for construction, and department policies must be considered in the strategy selection process. The strategy selection program should be used by all Districts to assist in selecting the most cost effective preservation treatments

- Feedback mechanism. Generally this is a weakness in many management processes. Continuous feedback is needed in order to know how the system is working. The feedback would be used to adjust the program as needed. The communication plan given in Appendix D and developed by the Department must consider this as well.

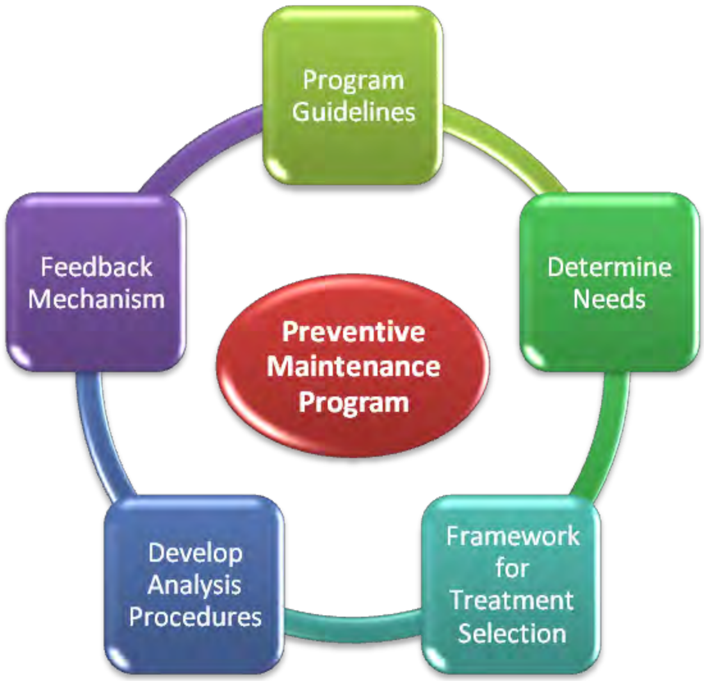



**Figure 7-1. Elements of an Ideal Pavement Preservation Program**

## *7.2 Pavement Preservation is Part of Asset Management*

Asset Management has received executive level support, and has been codified in the departmental strategic planning objectives. However, the multiple supporting efforts within Alaska DOT&PF's broad TAM initiative have evolved with varying levels of speed and implementation. These include retaining wall management, geotechnical asset management, and other less formalized efforts. For that reason, pavement management's integration into the broader TAM effort is an important item to communicate to internal stakeholders. It becomes helpful to note that pavement preservation is part of the total asset management program. Other assets managed by the Alaska DOT&PF include items such as:

- Bridges
- Ports and harbors
- Airports
- Buildings
- Geotechnical assets

As Alaska DOT&PF moves forward with the development of their asset management program, they need to recognize that pavements are but one of the assets they manage. The proposed pavement preservation program can move forward without the other components, but eventually needs to be integrated into the final asset management program as it evolves. Other asset management systems, such as bridges and geotechnical, can learn from the pavement preservation program and establish database and performance measures.

## *7.3 Document Benefits to Gain the Support of Decision Makers and the Public*

One of the early deliverables from the pavement preservation program is to document the benefits of keeping good roads in good condition. As can been seen from some of the case histories, if benefits can be documented early on then dedicated funding for preservation is often the result. The types of benefits discussed earlier need to be validated for Alaska conditions, including:

- Lower life cycle costs
- Fewer premature failures
- Better overall network conditions
- Reduced user delays and costs (including traffic accidents)
- Ability to answer “what if” questions
- Protection of environment and saving of natural resources

Communicating these benefits to the stakeholders identified internally will significantly enhance departmental support for PMS with pavement preservation.

## *7.4 Resources needed for Implementation of a Pavement Preservation Program*

The resources needed to implement a pavement preservation program can vary considerably depending on how the State wants to proceed. At present, the TAM program has one staff member as well as an assistant. The same is true for the pavement management program, but the assistant has yet to be hired. Due to the reliance on Federal funding, one of the issues is that many of Alaska’s roads may be beyond the point of preservation.

To implement the program, the following changes are recommended:

- Additional pavement data needs to be collected for pavement preservation, including cracking and surface distress. This data collection process was initiated in 2011 and should be continued as a future endeavor. This will require the use of automated or manual collection systems. Alaska should probably proceed by monitoring only the NHS roads and roads not in permafrost areas where many roads are past the point of preservation. Preservation treatments may also be used to help with surface rutting due to studded tires.
- Additional staffing is needed to enable the PMS to work. Assuming the pavement management engineer gains an assistant to help with reporting, data analysis, running the strategy selection program, and conducting life cycle cost analysis, the additional data collection could be done using the present contractor, Dynatest.

- Additional staff would also be needed for the pavement preservation program. This could include a pavement preservation engineer and perhaps an assistant to start with.
- Stable for pavement preservation treatments is needed. At present, the statewide maintenance engineer has about $50,000,000 per year for preservation treatments and other preventive maintenance. Most of the funding goes to the northern and central regions with only about $2 million going to the southeast region. It is important for the Department to evaluate this amount to determine whether additional funding is necessary for all the three regions.

## *7.5 Resources for Pavement Preservation*

There are several national resources available to help support pavement preservation. These include the following:

- Federal Highway Administration (FHWA), http://www.fhwa.dot.gov/pavement/pres.cfm
- AASHTO TP2, http://www.tsp2.org/
- National Center for Pavement Preservation (NCPP), http://www.pavementpreservation.org/
- Foundation for Pavement Preservation (FP2 Inc), http://www.fp2.org/
- AEMA-ARRA-ISSA, http://ppralliance.org/index.php/what-is-ppra
- Rubber Pavements Association, http://www.rubberpavements.org/
- National Asphalt Paving Association, http://www.asphaltpavement.org/

Similarly, there are regional organizations that can provide input into pavement preservation including:

- Rocky Mountain West Pavement Preservation Partnership (RMWPPP), http://www.tsp2.org/pavement/rmwppp/
- California Pavement Preservation Center (CP2 Center), http://www.cp2info.org/Center
- California Chip Seal Association (CSSA), http://www.chipseal.org
- Pacific Northwest Pavement Management Association, http://nwpma-online.org/

# 8.0 REFERENCES


Alaska DOT & PF (2009), 2008 Road Conditions and 2009 Pavement Preservation Plans, Feb 2009

Alaska DOT&PF (2008), Alaska DOT&PF 2007 Road Pavement Conditions and 2008 Pavement Preservation Recommendations, Feb 14, 2008

Alaska DOT&PF (2008), Let's Get Moving 2030, Alaska's statewide long-range transportation plan, Technical Appendix, Alaska Department of Transportation and Public Works.

Baladi, G.Y., Svasdisant, T., Van, T., Buch, N. and Chatti, K. (2002), "Cost-effective preventive maintenance - Case *Studies*." *Transportation Research Record 1795*, Transportation Research Board of the National Academies, Washington, D.C., (02-3026), pp. 17-26.

Berg, R.L. and D.C Esch, (1983), "Effect of color and texture on the surface temperature of asphalt concrete pavements" Proceedings of the 4th International Conference on Permafrost, Vol. 1. National Academy Press, p. 57-67.

Blincoe, L., Seay, A., Zaloshnja, E., Miller, T., Romano, E., Luchter, S., and Spicer, R. (2002), The Economic Impact of Motor Vehicle Crashes 2000, National Highway Traffic Safety Administration, US Department of Transportation. http://www.nhtsa.dot.gov/people/economic/econimpact2000/.

Bradshaw, Jerry (2011), The City of El Cerritos Pavement Preservation Program, Prepared for the CP2 Center newsletter, 2011.

Caltrans (2000), Caltrans Pavement Condition Report.

Caltrans (2008a), Maintenance Technical Advisory Guide, Volume I – Flexible Pavement Preservation, Second Edition, California Department of Transportation, Sacramento, CA.

Caltrans (2008b), Maintenance Technical Advisory Guide, Volume II – Rigid Pavement Preservation, Second Edition, California Department of Transportation, Sacramento, CA,

Capps, Scott (2007), Building North Carolina's Pavement Preservation Program, State of North Carolina, Presentation at the Louisiana Maintenance Conference, February 2007.

Chan, S., Lane, B., Kazmierowski, T. (2010), "Pavement Preservation – A Solution for Sustainability," *Proc. 2010 Annual Conference of the Transportation Association of Canada*, Transportation Association of Canada, Ottawa, Ontario, Canada.

Chen, Y. (2007), "Analysis of Pavement Preventive Maintenance."*HeilongjiangJiaotong Science, No.4,* 25-26 & 28.

Cheng, D., Hicks, R.G., and Ochoa, A. (2010), Improving Pavement Preservation Treatment Strategy Selection using Expert System Approach. Paper accepted for presentation at the 2010 annual meeting of TRB, Washington D.C.

Cheng, D., Hicks, R.G. (2012), Life-Cycle Cost Analysis Comparison of Rubberized and Conventional Hot-Mix Asphalt in California, the 91st Transportation Research Board Meeting, Washington, DC. January 2012.

Connor, B. (1981), "Performance of Bituminous Surface Treatments in Alaska." Final Report, Alaska Department of Transportation and Public Facilities, Fairbanks, Alaska. http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_82_09.pd ( 5/09/2012).

Croteau, J., Linton, P., Davidson, J., Houston, G. (2005), "Seal Coat Systems in Canada: performances and practice," *Proc. 2005 Annual Conference of the Transportation Association of Canada*, Transportation Association of Canada, Ottawa, Ontario, Canada.

Dietrich, J. and Männistö, V. (2007), *The use of optimization in road management, applications in management, network level programming and procurement*. Helsinki 2007. Finnish Road Administration. Finnra reports 17/2007, 48 p. + app. 3 p. ISSN 1459-1553, ISBN 978-951-803-780-7, TIEH 3201043-v *(in Finnish).*

Dong, R., and Sun, L. (2004), "Analysis of Benefit of Pavement Preservation and Pavement Preventive Maintenance." *Highway, (3*), 121-125 *(in Chinese)*.

Doré, G. and Zubeck, H. (2009), *Cold Regions Pavement Engineering*, McGraw-Hill/ASCE Press, Reston, VA.

ERA-NET ROAD (2011), Asset Management portal and work space https://sites.google.com/site/assetcall/home (accessed 6/8/2011).

Erwin, T., and Tighe, S. (2008), "Safety Effect of Preventive Maintenance, A Case Study of Microsurfacing," Journal of the Transportation Research Board, No. 2044, pp. 79-85, Transportation Research Board of the National Academies, Washington, D.C.

FHWA (2005), Memorandum on Pavement Preservation Definitions, FHWA, September 12, 2005. http://www.fhwa.dot.gov/pavement/preservation/091205.pdf. (accessed 7/1/2011).

FHWA (1998), Pavement Preservation – A Roadmap for the Future, Kansas City, Missouri, October, 1998.

FHWA, (2005), http://www.fhwa.dot.gov/pavement/preservation/091205.cfm , Memorandum, accessed February 9, 2009 on the World Wide Web.

FHWA, (2008), http://www.fhwa.dot.gov/preservation/100804.cfm, Memorandum, accessed February 9, 2008 on the World Wide Web.

Finnra (2011*), Liikennejärjestelmän taloudellisuuden tutkimusohjelma. Loppuraportti*. Liikennevirasto, kunnossapito-osasto. Liikenneviraston tutkimuksia ja selvityksiä 9/2011. Finnish Road Administration, Helsinki, Finland. In Finnish.

Galehouse, L., Moulthrop, J., Hicks, R.G. (2006), Principles of Pavement Preservation, Definitions, Benefits, Issues, and Barriers, Compendium of Pavement Preservation II.

Hicks, R.G., Seeds, S., Peshkin, D. (2000), Select a Preventive Maintenance Treatment for Flexible Pavements, Foundation for Pavement Preservation. Prepared for the Foundation for Pavement Preservation

Kim, Y.R. and Lee, J. (2007), Performance-based Analysis of Polymer Modified Emulsions in Asphalt Surface Treatments. *Final Report. Report No. FHWA/NC/2007-06*. North Carolina State University, Raleigh, NC .http://www.ncdot.org/doh/preconstruct/tpb/research/download/2007-06finalreport.pdf (accessed 7/26/2011).

Lee, J., Shields, T. (2010), "Treatment Guidelines for Pavement Preservation," *FHWA/INDOT/SPR-3114*, West Lafayette, IN

McHattie, R.L. (2001), *Asphalt Surface Treatment Guide*, Alaska Department of Transportation & Public Facilities – Research and Technology Transfer, Fairbanks, AK, http://www.dot.state.ak.us/stwddes/research/assets/pdf/fhwa_ak_rd_01_03.pdf

McLeod, D.R., (2000), "BST Management Systems in the Yukon Territory," *Technology for Alaskan Transportation*, vol. 25, no 4.

NCHRP, (2009), Communicating the Value of Transportation Research Guidebook, NCHRP Report 610, Transportation Reach Board, Washington D.C.

Ong, G. P., Nantung, T., Sinha, K. C. (2010), Indiana Pavement Preservation Program, *FHWA/IN/JTRP-2010/14*, West Lafayette, IN

Parsons, Angela (2008), Pavement Preservation Activities: An Overview. Alaska DOT and PF, prepared for the 2008 RMWPPP annual meeting.

Peshkin,D., Smith, K.L., Wolters, A., Krstulovich, Moulthrop, J., Alvarado, C. (2011), Guidelines for the Preservation of High-Traffic-Volume Roadways, *SHRP 2 Report S2-R26-RR-2*, Transportation Research Board of the National Academies, Washington, D.C.

Rantanen, T. and Suikki, L. (2009), *Uusiopäällysteiden käyttö päällysteiden ylläpidossa*. Tiehallinnon sisäisiä julkaisuja 56/2009. Finnish Road Administration, Helsinki, Finland. In Finnish.

Safronetz, J., Hansen, D., Gerke, R. (2005), "Saskatchewan's Asset Management Cycle," *Proc. 2005 Annual Conference of the Transportation Association of Canada*, Transportation Association of Canada, Ottawa, Ontario, Canada.

Sarkka, T. and Talvitie A. (2008), *Tieliikenteen ja tienpidon mallien kaytto tienpidon suunnittelussa – Esiselvitys*. Tiehallinnon sisaisia julkaisuja 57/2008. Finnish Road Administration, Helsinki, Finland. In Finnish.

Saucedo, Nazario (2009), The City of Los Angeles Pavement Preservation Program, Bureau of Street Services, prepared for the CP2 Center newsletter, 2009.

Sims, Tammy Booker (2009), Texas Pavement Preservation Program, State of Texas.

University of Washington and CH2M-Hill (2011), The Greenroads Rating System http://www.greenroads.org/1/home.html <accessed 8/15/2011>.

Walker, D (2002), "PASER-Manual Asphalt Roads," Wisconsin Transportation Information Center, College of Engineering, University of Wisconsin, Madison, WI

Wei, C., and Tighe, S. (2004), "Development of Preventive Maintenance Decision Trees Based on Cost-Effectiveness Analysis," *Transportation Research Record, No. 1866*, pp. 9-19, Surrey, BC V3V 7Y3, Canada

Wolters, A., Peshkin, D. Rowden, L., and Burke, K. (2009), "Implementation of a Pavement Preservation Program in Illinois*." TRB Circular E-C135, Maintenance Management*. Transportation Research Board of the National Academies, Washington, D.C. http://onlinepubs.trb.org/onlinepubs/circulars/ec135.pdf (9/14/2011)

Wood, T.J., Olson, R.C. (2007), Rebirth of chip sealing in Minnesota, *Transportation Research Record 1989* vol. 1, pp. 260-264, Transportation Research Board of the National Academies, Washington, D.C.

Xue, Y., Yang, M., and Wang, Y. (2003), Crack sealing - important early age pavement preservation treatment. *Highway, No. 9*, 170-171.

Yuan, L. (2004), Discussion of early age asphalt pavement distresses and preservation treatments. China *Highway, No. 22*, 118-119.

Zubeck, H., Harvey, S., Aleshire, L. and Porhola, S. (2004), *Socio-economic Effects of Studded Tire Use in Alaska*. University of Alaska Anchorage, Anchorage, Alaska. http://dot.alaska.gov/stwddes/dcstraffic/assets/pdf/socio_economic_effects_studded_tires_ak.pdf (Nov, 2, 2012).

Zubeck, H., Liu, J., Mullin, A. (2012), Pavement Preservation Practices in Cold Regions. Final Report, INE/AUTC 12.08, Fairbanks, Alaska.

# APPENDIX A: REVIEW OF CURRENT ALASKA PAVEMENT PRESERVATION PROGRAM, IDENTIFICATION OF FUTURE NEEDS, AND DEVELOPMENT OF PAVEMENT PRESERVATION ROADMAP

## Introduction

### Background

The Alaska Department of Transportation and Public Facilities (Alaska DOT&PF) is implementing a Transportation Asset Management (TAM) Program to manage their facilities. They have conducted several workshops with the Federal Highway Administration (FHWA) and others to evaluate their program for managing assets such as pavements, bridges, and other facilities. This report is intended to evaluate their existing pavement preservation program and to develop a roadmap for the development of an enhanced pavement preservation program for Alaska DOT&PF.

Pavement preservation represents a proactive and cost effective approach to maintain existing pavements. A pavement preservation program consists primarily of three components: preventive maintenance, minor rehabilitation (non- structural), and some routine maintenance activities. It has been proven in several areas to be an effective approach to extend pavement's service life, maintain safety, and improve pavement service condition. Alaska DOT&PF would like to utilize pavement preservation techniques that would reduce the life cycle cost of the pavement treatments currently used. Although Alaska DOT&PF routinely uses some preventive pavement maintenance applications (such as chip seals, mill and fill, and crack sealing), some of the other pavement preservation treatments continue to face many obstacles, such as:

- Lack of proof that certain preventive maintenance treatments can perform in cold regions and are cost effective
- Insufficient guidance on identifying roadway candidates for pavement preservation treatment in cold regions (i.e. when preservation treatments should be applied), and
- Lack of skill or experience with some treatments for use in cold regions.

Pavement preservation is expected to be a core business of future highway programs. With most of the national highway network completed, the major tasks of most state DOTs are shifting to preservation and rehabilitation of the existing roadway system in terms of extended service life, ride quality and safety. However, Alaska DOT&PF's current strategic vision calls for expanding the transportation system by 30% by 2030 and its current Long Range Transportation Plan 2030 acknowledges a widening gap between identified needs and projected available funding.

Alaska's pavement preservation program is limited in scope and structure and it is not being used to its full potential. It has used thin HMA overlays, chip seals, and crack seals for some time, but has not used many other pavement preservation treatments. Based on the 2008 Alaska DOT&PF Road Pavement Conditions and 2009 Pavement Preservation Recommendations, the current pavement preservation program is a somewhat reactive approach, which means the projects are triggered based on Roughness, Rut Depth, and Maintenance Expenditures (Alaska DOT&PF 2009).

Another important thing to note is that some lack of pavement preservation treatments is a deliberate trade off. In some remote locations, it is less cost effective to forgo pavement preservation due to mobilization costs or availability of equipment and just rebuild the pavement when no longer serviceable. The reactive approach is not the best approach for lowering life cycle costs. In fact, pavement preservation emphasizes a proactive approach which also includes some minor rehabilitation. There is a need to build a sound platform of pavement preservation for the Alaska DOT&PF and provide it with adequate dedicated funding on an annual basis. This will assist Alaska to maintain their existing roads in a more cost effective manner and to avoid the very high cost of constantly reconstructing the existing road system.

### Purpose of this Roadmap

This report consists of documenting the current pavement preservation program and determining where the State would like to be in 2016. The pavement preservation program is part of the overall asset management initiative that Alaska DOT&PF is implementing. The results from the study are based on a brainstorming meeting between the project staff and personnel from Alaska DOT&PF conducted on December 2-3, 2010 in Anchorage, Alaska. It is also based on a review of the materials provided at that meeting, and follow-up calls and meetings with Alaska DOT&PF. This report also includes a roadmap for Alaska DOT&PF to implement a pavement preservation program.

## Current Pavement Preservation Program

### Overview of Current Transportation Asset Management (TAM) Program

The TAM program that exists within Alaska DOT&PF consists of the following components:

- Highway pavements
- Airport pavements
- Bridges
- Other assets

Most of the assets to be managed fall under the direction of the Deputy Commissioner for Highways and Public Facilities while the responsibility for pavement preservation policy falls under the Division of Statewide Maintenance.

Alaska is still a developing state and, as such, is still building new pavements. Therefore, it is somewhat different than other states where the focus is on preserving the existing assets using preservation treatments or rehabilitation.

**Assessment of Pavement Preservation Program**

During the period of 2005 to 2010, a number of studies were conducted related to asset management (of which pavement preservation is an integral part) in the State of Alaska. These studies included:

- ***2005 FHWA Assessment.*** The FHWA along with the National Center for Pavement Preservation (NCPP) conducted an assessment of the pavement preservation program in Alaska during the week of September 12, 2005 (NCPP 2005). The full report provides other observations and recommendations on topics including public and legislative relations as well as some recommendations on research and development needs (NCPP 2005).
- ***Alaska DOT&PF Road Conditions and Pavement Preservation Recommendations.*** This is a typical report that is submitted annually to the Pavement Management Engineer by the developer of the pavement management system, Dynatest Consulting Inc. (Alaska DOT&PF 2009). The report has been developed since 1998 and its purposes are to:
    - Summarize the current conditions on the Alaska highway system and other major roads,
    - Compare and contrast current vs. historical conditions to identify trends in performance, and
    - Provide a recommended pavement preservation work plan to improve the condition of the highway network.

  Each year, Dynatest conducts statewide measurements of pavement roughness and wheel path rutting on approximately 3,200 lane miles of pavements on the Alaska DOT&PF highway system. The measurements are performed with a Dynatest RSP 5051 road surface profiler (http://www.dynatest.com/hardware/rsp.htm).

  The report also includes a recommended work plan which contains only four strategies (all considered preservation):
    - 2 inch HMA overlay
    - Asphalt surface treatment (AST)
    - 2 inch mill and fill Base reclamation followed by a 2 inch HMA overlay
    - ○ 2 inch asphalt rubber overlay
    - ○ 2 inch mill and fill with asphalt rubber
    - ○ Rut fill and chip seal

  The work plan is considered a start[i]ng point and includes individual pavement management sections (usually 1 mile in length) for a given treatment. The final recommendation provides sections statewide for consideration. It is not clear whether these work plans are fully funded or whether they are work plans to fit existing budgets. The work plans should be able to answer various “what if” questions. It would be useful if the work plans are compared with the actual work done during the reporting period.

  What it does not include is any mention of new research, experimental features tried, new mix designs, or how the plans track with actual work. It also does not include any “what if' discussions, such as the funding needed to bring the performance levels up to specific standards for mainline roads. Alaska prepared a 2009 Pavement Preservation Recommendations report, and it is now 3 years later. An important question to ask is what happened to these recommendations. Did they get done? Are they working? The current 2012 report just issued also needs to be tracked to make sure its recommendations are carried out.

- ***2010 Transportation Asset Management Executive Workshop.*** On August 5, 2010, another workshop was held in Anchorage to discuss ideas as to how asset management principles can be applied within the state of Alaska (FHWA 2010). The workshop built on the concepts introduced at the NHI training course on Transportation Asset Management which was held the day before. The August 5, 2011 workshop was facilitated by Ralph Haas who also prepared a participant package which included a scope and agenda, the terms of reference for the breakout sessions, and a set of background notes. The breakout sessions included the following:
  - Organizational structure needed to support asset management
  - Key performance indicators that should be considered
  - Key assets to address
  - Plans for a scanning tour on asset management to learn about practices of peer institutions.

  A summary of the recommendations from this workshop for each of the above topics is included in the final report.

### Relationship of TAM to Pavement Preservation

Pavement preservation is an integral part of asset management. The other parts of an asset management system include pavement management, bridge management, and other facility management. Alaska DOT&PF has already implemented a PMS that has been in place for a number of years. As such, the development of a pavement preservation program can proceed independently of other asset management activities as long as it can be linked to the appropriate databases.

## Future Needs in Terms of Pavement Preservation

### Principles

The Alaska DOT&PF has defined some of its principles in the 2030 vision (Alaska DOT&PF 2008) which can be found at the following link, http://dot.alaska.gov/stwdplng/areaplans/lrtpp/SWLRTPHome.shtml, and in the workshops conducted in May and August 2010. This chapter summarizes the aspirations of the Department in terms of pavement preservation.

The plan was signed by the Alaska DOT&PF commissioner and adopted by the Department and should provide the guidance of where the Department wants to be in 2030. On the first page of the plan, the Commissioner states that the plan will be used as a framework to set priorities and guide our work to ensure that Alaskans continue to enjoy the benefits of mobility and safety. On page 11 of the plan, he states in policy 3 that the Department should:

- Strengthen our highway and airport PMS and practices;
- Work towards optimal life cycle management practices for pavement and bridge treatments; and
- Use the management systems to support our asset management practice.

On page 11, policy 4, the Commissioner states the following:

- The Department will monitor and report annually, to the extent practicable, the condition and value of our assets,
- We will communicate the anticipated level of service and predict future system conditions based on the allocation of funds for preservation and maintenance treatments.

This project should provide guidance to the state on the process to implement a pavement preservation program to protect the pavement assets. Basically, the Department wants to move away from the worst-first concept and move into the concept of pavement preservation as defined by the FHWA. The guiding principles identified in the 2030 document included the following:

- Alaskans must plan based on a realistic assessment of transportation revenue sources.
- The plan must provide specificity to guide implementation.
- It is imperative that Alaskans get the most value possible from transportation funding through the efficient use of funds.
- Statewide planning will provide a framework for resource allocation.
- The statewide planning process establishes statewide agreement on broad strategic priorities for the preservation, operation, and future development of the system.
- Managing Alaska's transportation systems efficiently, with careful use of available funding, is critical to maintain existing facilities and services.
- Optimizing the use of new technologies to continue innovation in order to increase efficiency is essential to successfully deliver transportation options to Alaska.

The concept of pavement preservation is to treat pavements early in their life using thin innovative treatments to extend the life of the existing pavement structure and to defer the need for costly major rehabilitation.

It should be pointed out that Alaska runs studded tires about 7.5 months out of the year. This makes the thin innovative treatments more difficult to use. These products would have to meet the same Prall test standards when used in heavy studded tire use areas.

**Suggested Organization Chart for Pavement Preservation Activities**

Based on the workshops in 2010, the chart developed in the August 2010 workshop for asset management was a recommended starting point for Alaska for pavement preservation. It should involve the following organizational groups at first:

- Maintenance and Operations
- Regional Preconstruction
- Statewide and Regional Materials
- Research, Development, and T2
- Program Development
- Administrative Services (Especially Information Technology)
- Statewide Design & Engineering Services (in coordinating/facilitating role)

Pavement preservation should be directed by headquarters, but likely implemented by the regions. The existing TAM manager would be the leader for this program, but there would be a need for a regional pavement preservation champions to make sure the program is successful.

### Marketing the Program

There were numerous challenges identified in the May 2010 workshop (FHWA 2010) to the development of a TAM program. These same challenges apply to the development of a pavement preservation program and are discussed briefly below:

- Selling the concept to everyone that the pavement preservation program will be fair – “Buy-in” and the “What’s in it for me?” perspectives. This includes the agencies, the legislature, and the public.
- Concern about TAM being data-driven: What data is needed and how much? Getting data into a useful format.
- Getting people to use the data and information to make decisions.
- Making data valuable to employees so they will use it.
- Overcoming the fear of change with employees. Alaska DOT&PF are currently working to change management training for employees.
- Documenting existing practices.
- Prioritizing needs according to staff time and workload.
- Managing expectations of employees and legislature concerning TAM.

The system must include a project delivery pipeline that delivers the correct mix of fixes and be able to answer the “what if” questions and also have a performance measuring system to track effectiveness.

Senior leadership already supports the concept as outlined by the LRP and the most recent strategic vision statement. So the main marketing effort will be packaging the annual funding request in a way that the Office of Management and Budget will buy into the program and include the funding in the Governor’s annual budget request.

## Roadmap to Success

### How do we get from A to Z?

This chapter identifies the steps needed to enhance the pavement preservation program and for integrating pavement preservation into the PMS. Currently, the pavement preservation program consists of using a few treatments, which are not well monitored. The lives and costs of these treatments need to be documented. The Dynatest PMS does not yet include pavement preservation treatments, nor does it collect all the needed information for pavement preservation. This chapter provides some of the steps needed to accomplish these goals.

A roadmap starts with "you are here" and ends with "you have arrived at your destination." The background section already tells us where we are, and the 2030 strategic plan tells us where we want to end up. The roadmap should also have a realistic timeline. The first known firm destination is the Governor's budget for State FY 14 which came out December 15, 2012. To reach this destination successfully, the state needs a map to this waypoint. The state can get there by identifying (with existing resources) those pavements that are young enough to benefit from pavement preservation and propose a treatment for all of them (some may be experimental for Alaska). Then the cost and anticipated benefits need to be identified and state and/or federal funds should be requested to support the effort. This waypoint may only be partially successful, but it's a start to demonstrate that enhanced pavement preservation is something that should and can survive in Alaska. The roadmap must explain the cycle of project identification, locating money, doing the work, documenting results, identifying the next round of projects, reviewing successful/unsuccessful techniques. This should be repeated until there is continuous improvement in the network.

## Enhancing the Existing Pavement Preservation Program

The steps to accomplish this are included in the project proposal and are discussed below:

- Identify where Alaska stands in terms of their pavement preservation program. This was discussed earlier in the report. Pavement preservation is an initiative in Alaska that has commenced, but needs to develop further.
  - Alaska DOT&PF established a PMS to track the condition of the existing roadways. This system has not tracked cracking or other surface distresses that are important triggers for pavement preservation. However, in the summer of 2012 cracking information was collected and will be collected in the future for establishing preservation needs.
  - They have used some preservation treatments, but might be able to expand the tool box to include other treatments based on the experiences of other cold region agencies.
  - They have not yet established which roadways would be the best candidates for pavement preservation.
- Identify where they would like to be in terms of pavement preservation within a fixed time horizon and develop a road map to accomplish this. The 2030 strategic plan should be the ultimate target. Alaska is very interested in enhancing their pavement preservation program and already has a workable PMS. It uses several different pavement preservation treatments, including crack sealing, chip seals, slurry surfacing and thin HMA overlays. Some of the things needed to improve pavement preservation are the following:

   - Track the performance of pavement preservation treatments and estimate the life of the treatments,
   - Document the costs of the treatments, and
   - Identify the resources needed to enhance the pavement management program and implement a pavement preservation program.
- Identify pavement preservation techniques that work for cold region pavements. The results of this work should identify the performance of pavement preservation techniques used in other similar climatic conditions. New preservation methods and improvement in existing pavement preservation methods are possible. This work was accomplished using the following tasks:
   - Survey other cold region agencies for the types of treatments they use, including the estimated lives and costs. Review pavement preservation literature in addition to document the treatments used and more.
   - Document the pavement preservation treatments used in Alaska and evaluate the current performance of these projects.
- Create and populate a pavement preservation treatment database to help with tracking the performance of the present and future pavement preservation treatments. It is important that this database is developed so information on preservation treatments can be shared easily among users. At some point in time, the database can be transferred to the pavement management system, once it is able to accommodate pavement preservation treatments. The database should include:
   - Construction information
   - Performance information
   - Performance models for preservation treatments
- Develop performance models for pavement preservation techniques. At the present time, the PMS is not capable of doing this without some modifications. This is the key for selecting pavement preservation methods and implementing a successful PMS. The performance model can be recalibrated using the performance data in the proposed Alaska pavement preservation treatment database. Once the PMS is capable of accommodating pavement preservation treatments, all the data can be transferred.
- Incorporate pavement preservation into the PMS. This will improve the programming of pavement preservation and rehabilitation activities. A PMS with pavement preservation components is more effective than a PMS with a worst first approach. The following need to be done:
   - Identify how the PMS is working. Is it capable of addressing the “what if” questions?” Is it reducing any of the backlog in needs, or is it just managing to a fixed budget? Is there a feedback loop to show how the state is doing with their pavement assets?
   - Assess the ease with which pavement preservation can be incorporated into the PMS.

  - Identify how to begin this process, maybe limiting the implementation only to main roads in Alaska and roads not in the Permafrost areas.
  - Demonstrate the cost effectiveness of pavement preservation treatments using the PMS.
  - Show early benefits of pavement preservation treatments.
- Develop an implementation plan for moving forward with a pavement preservation plan. This is included in Volume 4 of the project reports.

The end result of this project will include the development of guides for helping the Department build a pavement preservation platform. This will allow the State to better understand the philosophy of pavement preservation and provide the needed dedicated funding to support pavement preservation efforts.

**Integration of Pavement Management and Pavement Preservation**

Pavement preservation is a cost effective way to extend a pavement's life, improve safety and pavement service condition. There are many benefits of adding pavement preservation into a PMS. PMSs are generally designed to identify pavement preservation needs and help program pavement preservation projects. However, the Alaska system does not collect some of the distress information which triggers pavement preservation. This section of the report provides guidance on how to integrate the pavement preservation components to PMSs at both project and network levels.

***PMS Supports Pavement Preservation Efforts***

A PMS can be used as a tool to effectively program preservation treatments for an agency. An effective PMS identifies good candidates for preventive maintenance since it has the roadway distress survey and maintenance history. Good candidates for preservation treatments generally are ones in fair to good condition based on the PSR used in Alaska. The PMS can also provide support to determine the optimum time for performing maintenance treatments. Reconstruction and maintenance costs rise as a pavement ages. Because of this the State needs to make the argument that by spending state money on PPM to maximize life cycle cost, it frees up federal funds for new construction, major reconstruction, and the like.

However, if maintenance or rehabilitation is carried out too early, the life cycle costs are high. There is an optimum time at which maintenance should be performed to provide the maximum cost effectiveness (Caltrans MTAG, 2008; Peshkin et Al. 2004). In the lower 48, this is normally between 5 and 10 years or more, depending on the treatment. If an agency's PMS does not include a pavement preservation component, the history of pavement preservation activities may not be traceable since maintenance crews do not always record preservation activities. However, it may be possible to find some meaningful data from selective sampling.

***Pavement Preservation Increases Effectiveness of PMS***

A pavement preservation component within a PMS can help an agency allocate funding more cost effectively. It can support the PMS to prioritize and select projects for the right treatment.

Different pavement treatments have very different treatment lives. Treatment lives are typically defined by the time the PCI drops to a level requiring more maintenance or a rehabilitation treatment. A higher PCI value means the road is providing good service. The pavement preservation approach (dashed line in Figure A.1) keeps good roads in good condition and provides the best service to travelers. The rehabilitation strategy (thin solid line) has intermediate serviceability while the reconstruction approach (thick solid line) has the poorest serviceability because it allows the pavement deteriorate until it needs to be replaced.

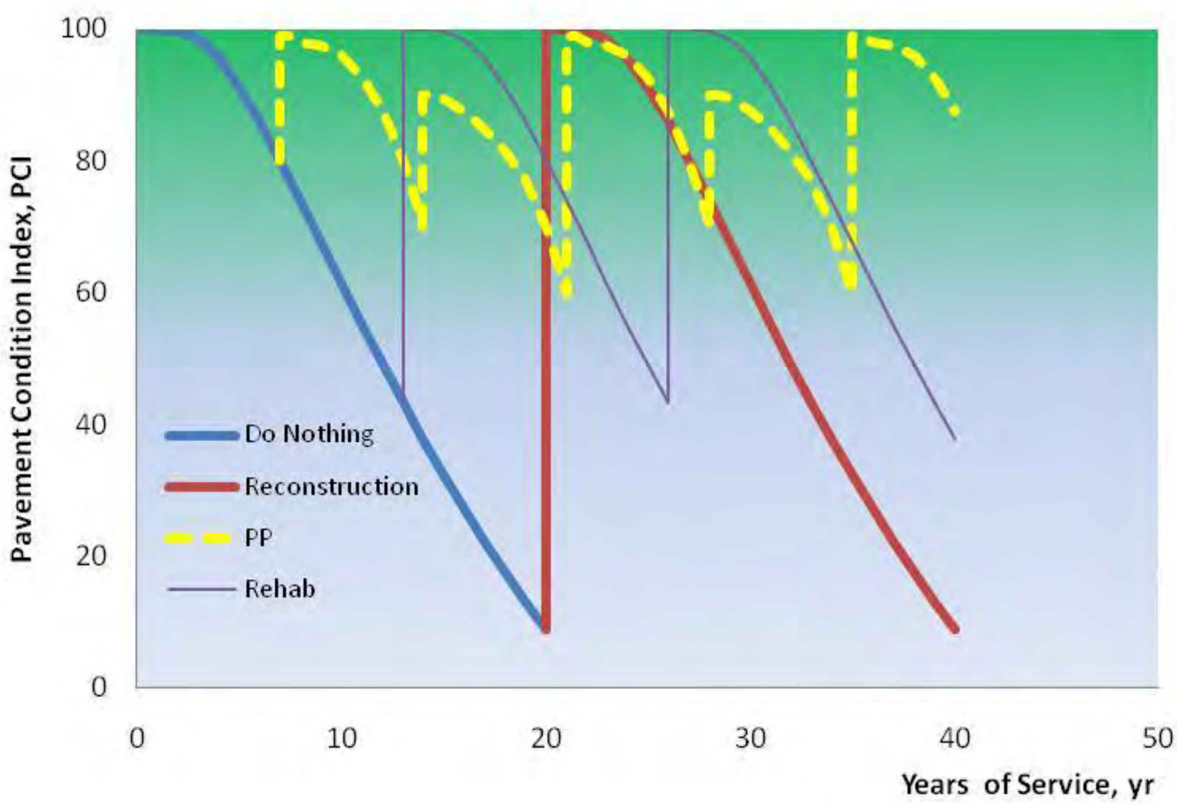



**FIGURE A.1 Serviceability of Different Treatment Strategies**

***Guidance on Adding Pavement Preservation Components to PMS***

Adding a pavement preservation component to a PMS system requires several steps including the following:

- Conduct an inventory and pavement condition survey as well as other information (such as construction history, weather and traffic data) that supports pavement preservation activities It might be best to start with a sample, such as the primary highways in Alaska.
- Identify pavement preservation techniques that reflect the current state of practice in cold regions. Also, identify the cost of these techniques.
- Develop family performance curves for grouped pavement preservation activities at the

network level. Develop performance curves for individual pavement preservation techniques so that project level pavement management analysis can be conducted. These were attempted as part of this project.

- Create multiple year project assignments for each pavement management section based on either critical pavement condition rating (Shahin 2005) or a dynamic programming procedure (Feighan et al. 1989). This was not done as part of this project.
- Include remaining life analysis or life extension associated with the treatment. This was not done as part of this project.
- Be able to answer the "what if" questions to meet the objectives of backlog elimination, maintaining condition, or reaching a specific PSR. This needs to be accomplished in a future project

Although there are numerous benefits of the integration, it will require some additional funding and other resources including additional data collection, computer programming, training, and operation costs. Figure 4.2 shows a guideline flowchart for integrating PP into PMS. Based on the funding level and available resources, three different PP and PMS integration levels can be implemented. The network level integration requires the least effort and lowest funding level, and integration at both network and project levels requires the highest funding level and the most work. The integration of PP with PMS can be started from either a network (Step 1) or project level (Step 2). Eventually, a full integration at both network and project levels with a feedback loop (step 3) can be developed as shown in Figure A.2.

Alaska DOT&PF already has a workable PMS. The recommended integration of pavement preservation with PMS for the Department should start at the network level. At the network level, it should answer the following questions: (1) how much funding is needed for proactive pavement preservation and how much funding is needed for rehabilitation and new construction; (2) what will be the network performance measures for the next five to ten years if under the current funding level; and (3) how much funding is needed for targeting the pavement network level to good conditions?

In summary, the authors recommend Alaska DOT&PF start the integration of pavement preservation with pavement management at a network level (Step 1 in Figure A.2). After the development of the pavement preservation treatment selection, some project level integration could be started (Step 2 in Figure A.2). Finally, fully integrated pavement preservation with PMS at both network and project levels can be developed for Alaska DOT&PF (Step 3 in Figure A.2). This will have to be done as a part of another project.

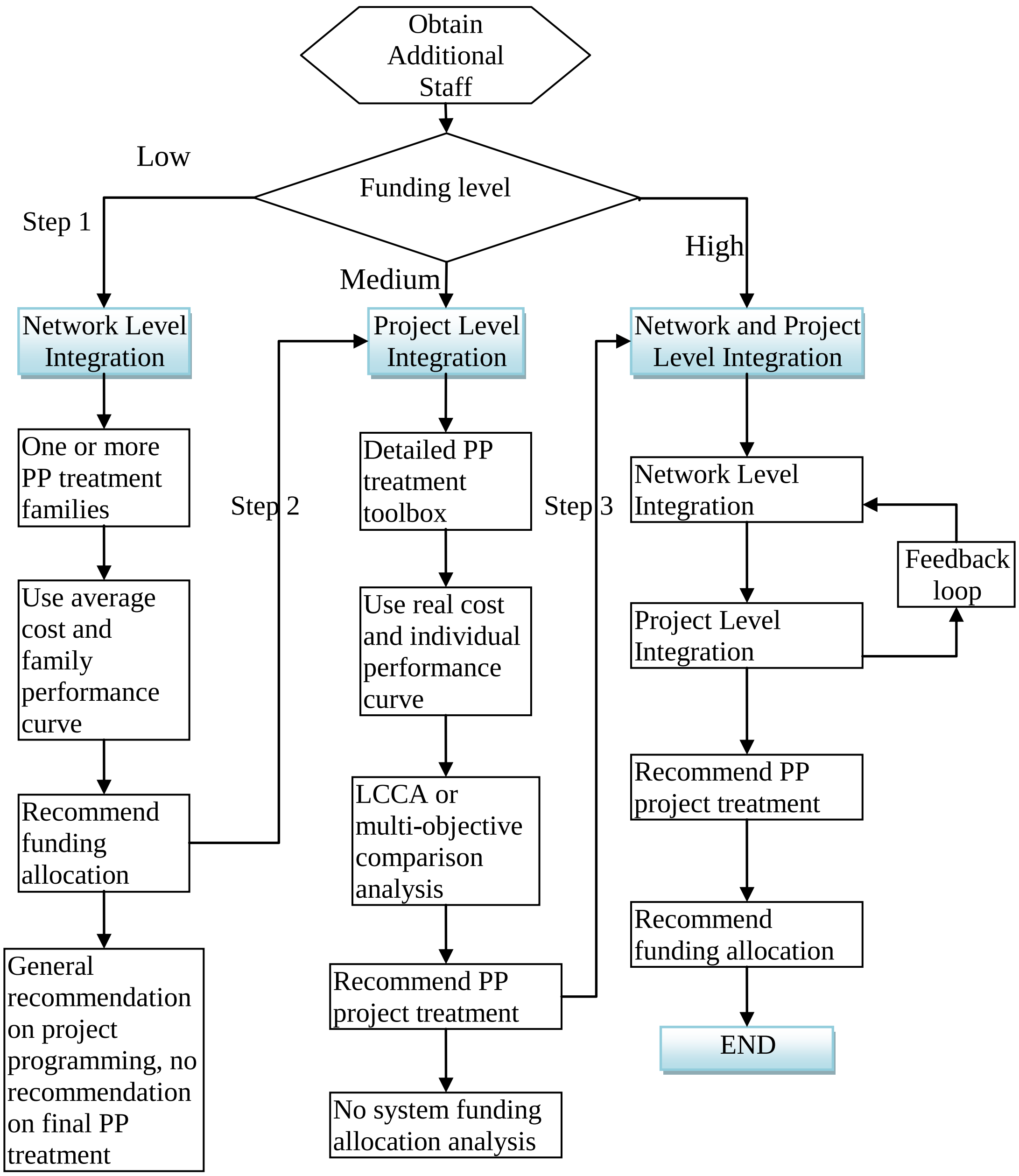



**Figure A.2. Flowchart for Developing Different Levels of Integrating PP with PMS**

# Summary and Recommendations

## Summary

This report presents a status of the current asset management program in the State of Alaska. It shows that the TAM program in the State is in it is early stages of development. It also discusses the needs for a future asset management program based on workshops conducted by FHWA and others.

Based on these findings, the report also identifies a road map for developing a pavement preservation program for Alaska DOT&PF. It suggests how Alaska can develop this program during the next few years and indicates that the pavement preservation program can proceed without a fully developed TAM program, but not without getting dedicated funding for the effort. The State is already doing pavement preservation activities, but has not documented the performance of these treatments or the extended life associated with the treatment. This can only be done by monitoring the life of these treatments using their PMS.

## Recommendations

Specific recommendations resulting from this project report included the following:

- Currently most of the pavement preservation activities include mill and fill or thin overlays. The use of other treatments such as chip seals and slurry seals needs to be tested in the various regions. This work should be able to identify:
    - Other preservations treatments which could be tried
    - Where pavement preservation treatments should be tried first
    - Where pavement preservation treatments will not likely work
- Develop a pavement preservation program using the steps identified in this report. The State does not have to wait for the entire TAM program to be in place to do this. Most of the resources to develop a pavement preservation program are already in place. Items to include in the implementation plan are:
    - Resources to implement this effort (staffing, consultants, or contractors)
    - Potential cost savings from doing this work using a Life Cycle Cost Analysis approach
    - Other benefits in using pavement preservation treatments
    - Identify funding needs for pavement preservation. This needs to be a separate pot of money from rehabilitation projects.
    - Which roads should be candidates for preservation treatments and which should not
    - Be able to answer the “what if questions” associated with variations in funding and future conditions.
    - What kind of Return on Investment (ROI) might Alaska expect if they go from current practices to best practices of PMS and pavement preservation?

- How many years should it take to start seeing a positive ROI?

- Develop a pavement preservation strategy selection program. This will essentially be a modification of the program developed for Caltrans based on Alaska conditions. However, it will make use of the treatments used by Alaska and be based on the experiences with pavement preservation in colder regions.
- Develop a plan to integrate the pavement management program with pavement preservation.

**References**

AASHTO TAM GUIDE I (2002) and TAM GUIDE II (2010)

Alaska DOT&PF (2008), Let's Get Moving 2030, Alaska's statewide long-range transportation plan, Technical Appendix, Alaska Department of Transportation and Public Works. http://dot.alaska.gov/stwdplng/areaplans/lrtpp/SWLRTPHome.shtml

Alaska DOT&PF, 2008), 2008 Strategic plan: http://www.dot.state.ak.us/comm/documents/Strategic-Plan-2008.pdf

Alaska DOT&PF (2009), 2008 Road Conditions and 2009 Pavement Preservation Plans, Feb 2009

Alaska DOT&PF (2011), Searchable research library:http://www.dot.state.ak.us/stwddes/research/search_lib.shtml

Caltrans (2008). Maintenance Technical Advisory Guide, Volume I – Flexible Pavement Preservation, Second Edition, California Department of Transportation, Sacramento, CA. http://www.dot.ca.gov/hq/maint/MTA_GuideVolume1Flexible.html

Caltrans (2008). Maintenance Technical Advisory Guide, Volume II – Rigid Pavement Preservation, Second Edition, California Department of Transportation, Sacramento, CA, http://www.dot.ca.gov/hq/maint/MTA_GuideVolume2Ridgid.html

Cheng, D., Hicks, R.G., and Ochoa, A. (2010), Improving Pavement Preservation Treatment Strategy Selection using an Expert System Approach. The 2010 TRB Annual Meeting Compendium of Papers DVD.

Feighan, K.J., Shahin, M.Y., Sinha, K.C., and White, T.D. (1989), A Prioritization Scheme for the Micro PAVER Pavement Management System, Transportation Research Record 1215, pp. 89 – 100, Transportation Research Board, Washington D.C.

FHWA (1998), Pavement Preservation – A Roadmap for the Future, Kansas City, Missouri, October, 1998. FHWA-SA-99-015

FHWA, (2005), Memorandum on Pavement Preservation Definitions, FHWA, September 12, 2005.

FHWA (2010), Transportation Asset Management Assessment, Draft report prepared by the Office of Asset Management, Assessment conducted May 3-7, 2010

FHWA (2010), Transportation Asset Management Executive Workshop, Workshop conducted August 5, 2010

Galehouse, L., Moulthrop, J., Hicks, R.G. (2006), Principles of Pavement Preservation, Definitions, Benefits, Issues, and Barriers, Compendium of Pavement Preservation II.

National Center for Pavement Preservation (2005), Pavement Preservation Technical Assessment, prepared for Alaska DOT&PF, Interviews conducted September 2005

Peshkin, D.G., Hoerner, T.E., and Zimmerman, K.A., (2004), "Optimal Timing of Pavement Preventive Maintenance Treatment Applications." NCHRP Report 523, Transportation Research Board, Washington D.C.

Shahin, M.Y. (2005), Pavement Management for Airports, Roads, and Parking Lots, Second edition, Springer Science Business Media, Inc., New York, NY, USA

# APPENDIX B. ALASKA DOT&PF PAVEMENT MANAGEMENT SYSTEM

Pavement Management is defined as a set of tools or methods that assist decision makers in finding cost-effective strategies for maintaining, upgrading, and operating a network of pavements. The pavement management system for Alaska includes both roadway and airport pavements.

The Pavement Management Engineer employs technical expertise and equipment to accomplish the statewide pavement management function and to develop a systematic approach to maintaining the Department's highway and airport paved networks. This function is located within the Department's Transportation Management and Security Section and is overseen by the Statewide Maintenance Engineer.

The Pavement Management Engineer is the Department's technical expert on pavement management and pavement preservation and is responsible for directly managing the State's paved assets. This role includes the annual assessment and reporting of pavement conditions for the State's roads and airports and maintaining the Alaska DOT&PF's pavement management database systems. These systems are utilized to help Alaska DOT&PF staff and managers to create project recommendations to preserve and repair the State's paved assets.

Pavement Management for the road system involves automated data collection of pavement condition (smoothness and rutting) on over 3700 lane miles. The data collection is performed under contract with Dynatest Consulting, Inc. using Road Surface Profiling (RSP) equipment. The condition data is uploaded into the Department's Pavement Management System database along with updated traffic data, new construction, and maintenance repair information. The database is maintained in Dynatest's Performance and Economic Rating System (PERS), and can be updated with repair and maintenance options and budget constraints. This information is necessary to forecast condition deterioration and cost/benefit analysis to optimize network-level budgets and work scenarios. Summary reports and condition mapping are created and published annually.

Pavement Management of Alaska's 55 paved airports includes inspections of pavement conditions on a 3-year cycle (one third annually). The inspections involve visual assessment of representative sample units to quantify the extent and severity of various distresses. The inspection information is entered into a MicroPAVER database with pavement age and construction/maintenance histories. The software generates PCI (Pavement Condition Index) values presented in annual reports and maps. The MicroPAVER software is used to predict condition deterioration and develop project budgeting scenario options.

The Department is in transition from traditional pavement maintenance practices to a pavement asset management program that relies on increased use of data and analysis to support a program of pavement preservation. It is recognized that the successful practice of asset management will result in improved pavement conditions while avoiding the more expensive rehabilitation costs. The environment of Alaska presents unique challenges not faced elsewhere yet the benefits of pavement preservation remain desirable and achievable.

# APPENDIX C. ILLUSTRATION OF USING THE ONLINE STRATEGY SELECTION PROGRAM

This topic has been discussed in in Chapter 5. An online strategy selection program based on Alaska pavement preservation treatment matrices has been developed for Alaska DOT&PF. It can quickly identify the preliminary selected treatments based on existing pavement condition, traffic level, environment, studded tire usage, and other conditions. Then a life cycle cost approach was used to calculate the equivalent annual cost for each feasible alternative. The final ranking of treatment can be listed and saved. The strategy selection program was integrated into the pavement preservation database. The user can review the project information including Google map and survey, and then run the strategy selection program to recommend future treatment. The following are some important processes of the strategy selection program:

Figure C-1 shows the non-crack related distresses. One should select all the distresses and other conditions that are related to the project.

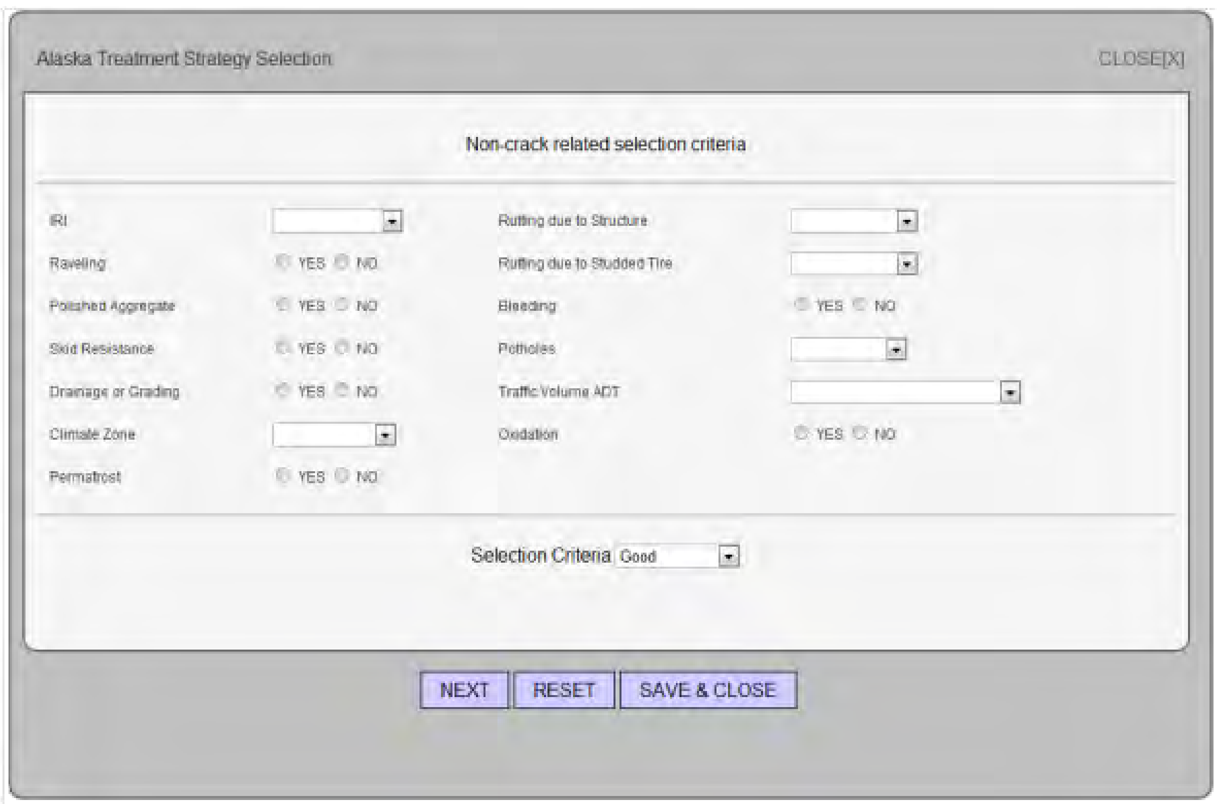



**Figure C-1. Non-Crack related selection criteria**

Figure C-2 shows the crack related pavement distresses. One should choose the distress level and select NEXT to proceed to the next page.

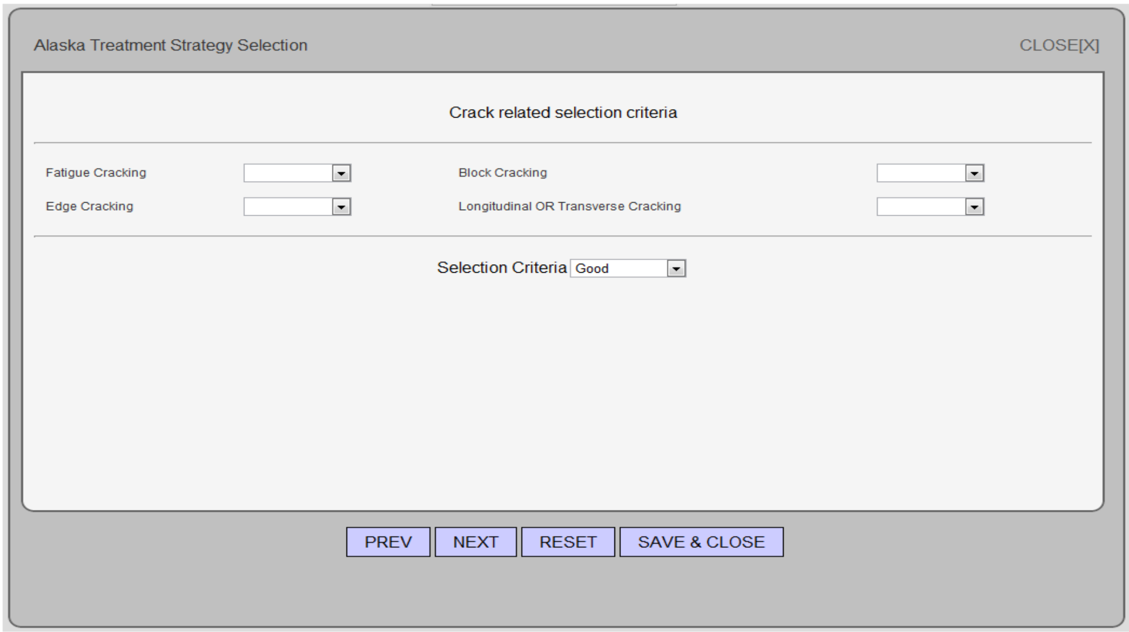



**Figure C-2. Crack related selection criteria**

Figure C-3 contains a list of all the selected treatments based on the distress selections for "Non-Crack related" and "Crack related" values selected by users. Users can select any number of these preliminary treatments and click next button for further analysis. To select multiple treatments hold control (Ctrl) key and then select multiple treatments.

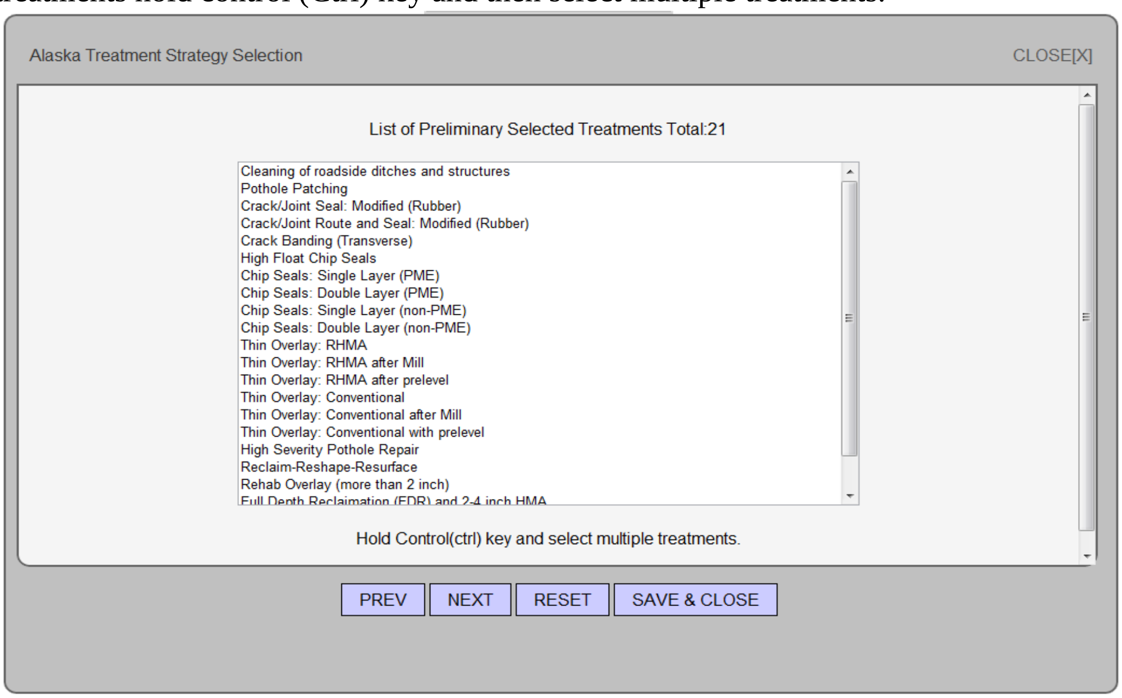



**Figure C-3. Preliminary selected treatments**

Figure C-4 shows a short list of pavement treatment for further life cycle cost analysis. For each treatment, it includes information such as expected life, current treatment price in terms of costs per square yard, and a discount rate. The default values are provided. However, users can refine and revise the information based on real knowledge.


**Figure C-4. Treatment matrix**

Users can edit or delete any particular treatment by clicking on ( ) and ( ) respectively.


Once the user enters edit mode, he can save the changes or discard the changes by clicking on ( ) or ( ) respectively.


To calculate the Annual life cycle cost click on "CALCULATE" button. Once the calculation is completed users can view or generate a report by clicking on "REPORT" button. This report can be printed and kept for records as shown in Figure C-5.

- Thin Overlay: RHMA after Mill
- Thin Overlay: RHMA after prelevel
- Thin Overlay: Conventional
- Thin Overlay: Conventional after Mill

**Life Cycle Cost Analysis**

| TreatmentID | TreatmentName | ExpectedLife | TreatmentCost | TreatmentInterest | Anual Life Cycle Cost | Notes |
|---|---|---|---|---|---|---|
| 13 | Thin Overlay: RHMA after prelevel | 12 | 23.4 | 4 | 2.49 | |
| 14 | Thin Overlay: Conventional | 9 | 21.24 | 4 | 2.86 | |
| 12 | Thin Overlay: RHMA after Mill | 12 | 76.5 | 4 | 8.15 | |
| 15 | Thin Overlay: Conventional after Mill | 11 | 72 | 4 | 8.22 | |

**Recommended Ranking**

| Ranking Order | Treatment Name | EAC |
|---|---|---|
| 1 | Thin Overlay: RHMA after prelevel | 2.49 |
| 2 | Thin Overlay: Conventional | 2.86 |
| 3 | Thin Overlay: RHMA after Mill | 8.15 |
| 4 | Thin Overlay: Conventional after Mill | 8.22 |

CANCEL PRINT

**Figure C-5. Strategy selection report**

Cost Analysis with different treatment alternative sequence. To perform cost analysis click on “Alternate” button. It will display the following.

Discount Rate: 0.03 Analysis Period(Years): 20 CALCULATE COMBINATIONS

Users can select the discount rate and the analysis period and then click on “CALCULATE COMBINATIONS” to generate sequences. This will generate all the possible treatment sequences and sort them in the order of Present Worth. Users can select any number of treatments and click on save and close to save all the selected values. A salvage value will be calculated if the total life of treatment is greater than the selected analysis period. A sample result of the treatment sequence selection is shown in Figure C-6.

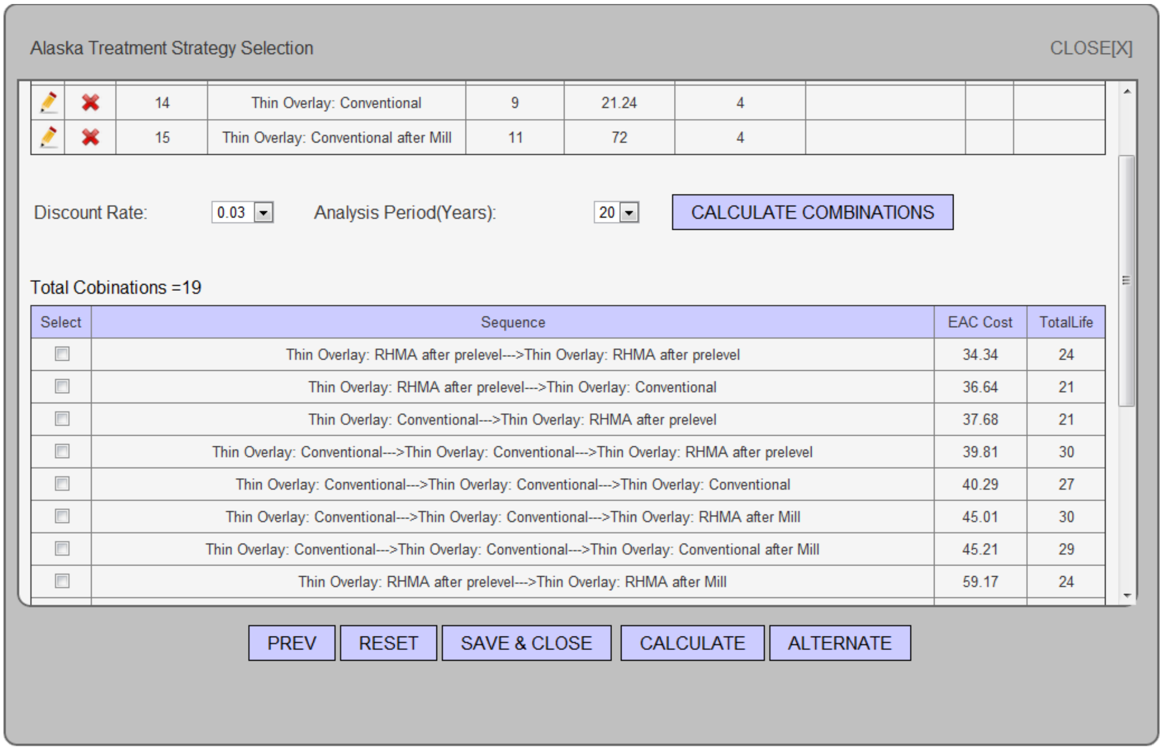



**Figure C-6. Cost analysis**

# APPENDIX D - ALASKA ASPHALT PAVEMENT SUMMIT CPT: DEBRIEF REPORT

By Rob Harper

Communication Specialist
Alaska University Transportation Center

December 7, 2011

**Executive Summary**

Imminent discussions about transportation funding necessitated this plan's need to inform specific transportation stakeholders. Federal and state policymakers entered a phase of decision making that necessitated a need for budget-related information about nationally-significant transportation research. As November, 2011 approached, both houses of the U.S. Congress debated competing transportation funding bills. This period also preceded the buildup to the Alaska State Legislature's 2012 session, creating an informative need for pertinent information in a public forum on transportation spending issues. Alaska's transportation funding comes largely from Federal funds, but is often prioritized and administered at the State level, creating two stakeholder groups. Whereas up to $140 Million is spent annually on Alaska surface maintenance, these groups needed information about the value of pavement preservation activities in Alaska.

To meet this informative communication need, a Communication Planning Team (CPT) assembled under one objective: communicate the value of pavement preservation to target stakeholders and their constituents. This effort was guided by a modified implementation of planning outlined in the Transportation Research Board's report, *NCHRP-610 Communicating the Value of Transportation Research*. The CPT implemented this process to reach target audiences through media outreach in Alaska's largest media market and constituent base in the south-central region (Anchorage, Mat-Su Valley, and Kenai Peninsula respectively).

They developed and communicated three audience-specific messages about pavement preservation: Cost-savings, collaboration, and innovation. Delivering these messages, the team executed two phases of outreach supporting the 2011 Alaska Asphalt Pavement Summit in Anchorage (Oct. 31-Nov.11, 2011). Utilizing this event's promotional capacity, the team relied upon planning, coordination, and subject matter experts to saturate Alaska's South Central media market. These efforts delivered audience-specific messages to well-over 122,000 target Alaskans through confirmed news stories in 14 different print, radio, TV, online, and specialty media outlets. Follow-up evaluation also confirmed message reception among target federal and state audiences.

This report outlines these efforts, including each component of the communication plan:

**Research/Situation Analysis**

Our communication needs arose from developments with Federal and State legislative bodies that directly impact transportation infrastructure funding in Alaska, specifically dealing with highway maintenance and preservation.

November offered the ideal time to reach specific Federal audiences. During this time, the U.S. Congress negotiated competing versions of a national transportation bill with the White House. As these bodies proposed fundamental changes in transportation infrastructure funding, great uncertainty faced states like Alaska. By November 9th, 2011, momentum toward Congressional debate on this issue grew as a U.S. Senate Panel approved a transportation funding plan, initiating internal dialogue on this issue within both houses. A need arose to inform and communicate the value of pavement preservation research to the largest constituencies of Alaska's Senate Delegation, which includes members of both the Committee on Commerce, Science, and Transportation, and the Committee on Appropriations.

At the State level, the approaching 2012 Legislative Session (beginning January) follows the December media market saturation, making November ideal for reaching state policy stakeholders. The Alaska Legislature, Alaska DOT&PF, and the Office of the Governor have discretion on the allocation and prioritization of both State and Federal dollars on state transportation projects, giving them an informative priority.

Meeting these communication needs, The 2011 Alaska Asphalt Pavement Summit occurred October 31st and November 1st. This event provided the best platform for using visibility to communicate messages to specific Federal and State stakeholders.

**Goal**

The goal for this effort: Communicate the value of AUTC and Alaska DOT&PF pavement preservation research to shared funding audiences at the state and federal level at a time when they would be most receptive to such a message.

The primary objective that best met this goal entailed saturating a broad section of the South-Central Alaska media market with targeted messages to the largest constituent base in the state for Alaska's Federal and State policy and transportation decision makers.

The most effective method to facilitate this objective came from utilizing an inter-disciplinary CPT, to implement a modified version of the planning strategy outlined in the Transportation Research Board's NCHRP-610 Report. The aim: deliver consistent, repeated messages through multiple media outlets in the (1) South Central Alaska, and 2) statewide media markets.

**Target Audiences**

As mentioned above under "Research/Situation Analysis," the CPT's target audiences for these informative efforts included:

- Alaska Federal Delegation, (U.S. Senate Committee on Commerce, Science, and Transportation; Committee on Appropriations.): Senators Mark Begich, Lisa Murkowski, and Congressman Don Young.
- Alaska State Legislature (House and Senate Finance Subcommittees on Transportation and Public Facilities): added informative value for Senators Linda Menard, Albert Kookesh, Kevin Meyer, and Representatives Neal Foster, Wes Keller, Kurt Olson, Peggy Wilson, David Guttenberg, and Peter Petersen.
- Office of Alaska Governor Sean Parnell and Lt. Governor Mead Treadwell.
- Alaska DOT&PF: added informative value for Commissioner Marc Luiken; Deputy Commissioners Patrick Kemp, Steven Hatter, and Michael Neussl; Project managers, regional directors, subject area managers, such as statewide materials or maintenance and operations leadership.

**Message Development and Testing**

*Message Development*

As each of our target audiences' interest in transportation arises from both budgetary and constituent services perspectives, so the CPT's informative messages highlighted 1) how pavement preservation cuts short- and long-term costs, and 2) how it improves services. The CPT identified and prioritized three aspects of pavement preservation worth communicating: *cost savings*, *collaboration*, and *innovation.*

*Cost Savings*
Pavement preservation significantly reduces maintenance budgets on road agencies. By preserving pavement through research, improved practices, and prioritizing key projects vis-à-vis Service Based Budgeting strategies, pavement preservation speaks volumes to fiscal conservation interests. Complimentary themes identified by the CPT included: life-cycle extensions, maintenance reduction, improved efficiency, cost prevention. An example of the cost-savings message appeared in a quote integrated into press releases disseminated to media, and integrated into TV and radio interviews on the summit:

> *" … 'With Asphalt in Alaska, the dollar you spend today on maintenance is ten dollars you will save down the road on repairs, replacement, or safety issues,' explains Mike Coffey, Statewide Maintenance and Operations Chief for Alaska DOT&PF."*

*Innovation*

New technology and best-practices make pavement preservation cost less and improve services to the public. When professionals do their jobs better, it's cheaper and more effective for the public. Complimentary themes included: new approaches, technologies, research advances. An example of the innovation message appeared in a November 2nd *Alaska News* story on the summit:

> *"… The main agenda of the event was to discuss and address ways to make pavement last longer and cost less in Alaska and other cold regions. Topics included methods of making stronger warm mix asphalt, recycled asphalt applications, and the use of thermal imaging on the Seward Highway."*

*Collaboration*

Collaboration saves money and improves services. Alaska DOT&PF and AUTC have a partnership whereby resources, expertise, and skills are leveraged to maximize service, knowledge, and performance outcomes from a budgetary perspective. The summit brings together a variety of stakeholders involved in pavement preservation—contractors, researchers, managers, planners, consultants, and decision-makers. The cross-pollination of knowledge, expertise, experience, and research results in more cost-efficient practices and improved service to the public. Complimentary communication themes included: information sharing among varied professionals, discussion and dialogue, connecting techniques and players. An example of the collaboration message appeared in a November 2nd story in the *Alaska Dispatch*:

> "*… Attendees from all levels of the international asphalt and paving industry, including scientists, researchers, and officials from the state Department of Transportation met to discuss the industry's toughest challenge: Holding northern roads together."*

The CPT identified and prioritized these messages through discussion, captured by a facilitator (Rob Harper), who evaluated and ranked responses by category according to their frequency of mention. The results are shown below in Table D.1:

Table D.1 Section of the CPT "Message Tier Sheet"

| **Message Priority** | **Phrase/Concept/Message** | **# of Mentions** |
|---|---|---|
| 1 | "Collaboration/Partnership" | 9 |
| 2 | "Innovation" | 6 |
| 3 | "Cost Savings" | 5 |
| 4 | "Longevity/Improvement" | 4 |

*Message Testing*

Testing how effectively these messages reached target audiences came from both qualitative and quantified sources.

Qualitative measures came from many internal and external channels. CPT members had direct access to audience members and their staff, and direct knowledge of their day-to-day media consumption activities. For example, Brenda Hewitt, Communications and Legislative Liaison for Transportation Commissioner Marc Luiken disseminated news release to counterparts in the legislature and Governor's office—two target audiences. Through anecdotal accounts, and verifiable follow-up communication, CPT members confirmed message reception by each audience, often in multiple instances. In another instance, Mike Coffey, Statewide Maintenance and Operations Chief, relayed information in response to specific questions about our event from both state and out-of-state stakeholders, who made specific reference to published stories about the event? These qualitative channels indicated moderate to extensive message saturation within our desired audiences. Pat Kemp, Alaska Deputy Commissioner for Highways and Public Facilities, explicitly referenced two different announcements he'd seen.

Quantitative measurements of message penetration arose through several channels. First, market distribution figures from target media outlets tell the level to which our messages reached specific constituencies. Figures such as newspaper and online readership, television and radio market distribution, and similar marketing research offered finite specificity (outlined under "Evaluation" below).

Secondly, numerically adding our confirmed media coverage instances allows us to multiply the figure of our messaging saturation. For example, if we know one message flows through three media outlets that each reach an audience of 1,000 within the same geographic area, we can reason that the majority of roughly 1,000 media consumers received our message up to three times. Lastly, approximately 75% of attendants will come from within Alaska DOT&PF, our third target audience. Survey and attendance data offers a numerical picture of this audience. (See "Evaluation" section below for finite numbers on media market saturation.)

**Messengers**

Message delivery came from materials, online content, internal documents, and most significantly, from subject matter experts who spoke to the media. In addition to summit presentations, they helped convey our message by enhancing credibility and audience-rapport.

Primary sources for media interviews included:

- Billy Connor, Director of AUTC;
- Mike Coffey, Chief of Statewide Maintenance and Operations for Alaska DOT&PF;
- Angela Parsons, Research Engineer for Alaska DOT&PF;
- Summit presenters, subject matter experts;
- Rob Harper, Communication Specialist for AUTC/Alaska DOT&PF.

Key message delivery assets for this effort, each of these subject matter experts demonstrated varying combinations of professional expertise, academic credibility, and personal rapport with lay audiences, reporters, legislators, Senate delegation staff, and Alaska DOT&PF personnel.

**Strategies and Tactics**

The CPT's general strategy sought to stimulate and leverage the 2011 Alaska Asphalt Pavement Summit's promotional capacity as a message vehicle. This strategy relied upon generating event visibility to draw reporters and use their coverage to repeat and reinforce the CPT's three primary messages of *cost savings, collaboration,* and *innovation*. Extending this promotional effort to a broad spectrum of multi-media outlets in the CPT's target markets/constituencies facilitated the desired market saturation needed to deliver repeated messages. Two phases of outreach targeted separate primary media formats.

*Phase One*

Phase one targeted online media to establish multiple searchable stories on our event. This effort established an online collection of news stories that reporters found later when pitched stories during phase two. These media included: Internal PR distribution on institutional websites like Alaska DOT&PF, AUTC, INE, UAF, CEM, T2, UAFNEWS, GOVDELIVERY, and various internal announcement boards, list serves, and distribution channels with online content linked to them. These are administered by staff of partner agencies that offered helpful message control. Documents and materials used during this phase included: pre-approved formatted press releases for Alaska DOT&PF and UAF; pre-approved media release content; fact-checked and edited talking points and subject matter expert quotes; online news announcements; event website/s; event program and flyer. Channels included: list serves; internal online news sites; internal media distribution lists and membership/attendant distribution lists; and lists managed by various members of the CPT.

*Phase Two*

Phase two entailed a broad, targeted, pitch-based earned media push aimed at traditional—Print, TV, Radio, and specialty/online—media in the Anchorage Market. Relying upon the visible momentum developed during phase one, the second phase found little difficulty in attracting the attention and coverage commitment from these outlets, with one exception due to unusual mitigating circumstances. Supporting documents and materials for this phase included: Disseminated press releases and media advisories; talking points and quotes developed for interviews and news stories; customized email pitches derived from pre-approved outreach content (press releases and media advisories); on-record interview transcripts; pre-rehearsed background pitches; existing website stories generated during phase one; pre-approved facts, and in-person interviews with subject matter experts. Channels included event presentations, television, online, radio, specialty, and telephone communication (for interviews and pitching).

## Implementation: CPT, House Organs, and Subject Matter Experts

Three factors played key roles in implementing this plan: the CPT, internal "house organs," and subject matter experts. These are discussed below.

*Communication Planning Team (CPT)*

Rosemarie Bierfreund, Kim Hays, and Rob Harper organized and facilitated three phases of conference meetings with an interdisciplinary CPT (not to be confused with the two phases of communication plan discussed above under "Strategies and Tactics"):

> Phase I (Discussion): Brainstorming, information-sharing, document drafting, feedback;
> Phase II (Planning): Checklist prioritization, task delegation, materials creation;
> Phase III (Execution): Coordination, logistics, approval, event and outreach activities.

The team included multiple subject matter experts, Alaska DOT&PF administrators with direct knowledge of key audiences, funding, and subject matter. The team also included key players in the event's planning, management, and logistics. The team was facilitated by a communication specialist who moved the group through discussions of various items outlined in the NCHRP-610 communication planning checklist.

For recording purposes, CPT members included:

- Clint Adler, Chief of Research and Development, Alaska DOT&PF;
- Steve Saboundjian, State Pavement Engineer, Alaska DOT&PF;
- Rosemary Bierfreund, Admin., Alaska DOT&PF;
- Kim Hays, Statewide Materials, Alaska DOT&PF;
- Angela Parsons, Research and Development Engineer, Alaska DOT&PF;
- Rob Harper, Communication Specialist, AUTC;
- Jim Sweeney, Research Engineer, Alaska DOT&PF;
- Michael San Angelo, Statewide Materials Engineer, Alaska DOT&PF;
- Mike Coffey, Chief of Maintenance and Operations, Alaska DOT&PF;
- Gary Hicks, Technical Director, California Pavement Preservation Center.

Numerous other internal and external partners helped assist, coordinate, approve, disseminate, revise, advise, or otherwise aid these efforts and are not listed above. The above listed members specifically participated in regular conference calls to plan efforts.

*Internal 'House Organs'*

So called 'house organs,' or the internal newsletters, email updates, distribution lists, list serves, dissemination networks, and other internal mechanisms maintained by partner organization staff and CPT members were vital to communication plan phase one implementation. Offering message control, content consistency, and timing flexibility, these outlets were key to creating the online presence needed to execute phase two, drawing wide media interest into a story with perceived momentum behind it. Facilitation of approval for widely disseminated documents such as press releases and media advisories was a key function of this outreach, and occurred through the house organ publication process.

*Subject Matter Experts*

Experts were imperative to both the CPT conference meetings and the execution of communication plan phase two. During conferences, they offered the feedback and ideas on messages, research, audiences, timing, and implementation needed for a successful effort. During communication plan phase two, they served not only as the Summit presenters, but delivered messages during media interviews. Their role was central.

Figure D.1 Summit presenter Gary Hicks, Technical Director for the California Pavement Preservation Center, subject matter expert, and AUTC research partner. Hicks tailored his presentation to highlight the team's central messages: cost-savings, collaboration, and innovation. (Photo credit: R. Harper, AUTC)

**Evaluation**

Stories framed by our outreach materials containing messages delivered by our subject matter experts appeared in 14 confirmed stories in TV, online, print, radio, and specialty media (See Table A.2). This effort achieved the CPT's goal of saturating the South Central and statewide Alaska media markets. This market saturation occurred largely during phase two of our communication outreach, through television and radio coverage on KTUU, KTVA, and Alaska Public Radio.

KTUU Channel 2 News broadcasts in Anchorage, Juneau, and simulcast on Anchorage radio stations KHAR and KFQD, as well as broadcast live statewide to more than 230 rural communities on the Alaska Rural Communications System (ARCS). News stories and newscast segments can also be found on the station's web site, KTUU.com. Channel 2 News consistently reaches 70 percent of households per week in Anchorage, Palmer, Wasilla, and Kenai regions respectively. Statewide, nearly 83 percent of all Alaskans watch a KTUU newscast every week. Based on these figures, our message reached an estimated 82,000 statewide viewers. On the Internet, KTUU.com receives nearly 40,000 hits per day. Added with its broadcasting base, our KTUU delivered our message to an estimated 122,000 viewers.

Table D.2 Target media reach (* Indicates Phase 2 target).

| *Name* | Print | Online | Radio | TV | Specialty |
|---|---|---|---|---|---|
| *KTUU** | | X | | X | |
| *KTVA** | | X | | X | |
| *APR** | | X | X | | |

| | | | | | |
|---|---|---|---|---|---|
| *AUTC/INE* | | X | | | X |
| *Insurance News* | | X | | | X |
| *UAFNEWS* | | X | | | |
| *AKNEWS* | | X | | | |
| *SitNews* | | X | | | |
| *AK Dispatch* | | X | | | |
| *AK Business Monthly* | X | X | | | X |
| *Rabine Group* | | X | | | X |
| *Anchorage.net* | | X | | | X |
| *Niuzer* | | X | | | |
| *GOVDELIVERY* | | X | | | |

KTVA, Channel 11 news reaches 154,820 TV households including 106,000 in Anchorage, 20,220 in Mat-Su Valley, and 28,000 in Kenai. Depending upon daily viewer news consumption, KTVA delivered our message to as many as 154,000 Alaska households.

Figure D.2 Angela Parsons, Research and Development Engineer, Alaska DOT&PF, conducts an interview for a story on Channel 11 News. A key CPT member, Parsons was also a subject matter expert for message delivery efforts. (Photo credit: R. Harper, AUTC)

Alaska Public Radio: APTI's combined broadcast and programming services are accessible by 90 percent of the Alaska population, serving more than 600,000 people living in urban, rural and Alaska Native village settings. While APTI may have delivered our message to as many as 600,000 Alaskans, it is difficult to estimate the number of active vs. potential listeners. If, for example, APTI was consumed by one third of its potential listeners on November 1$^{st}$, then our message reached 200,000 Alaska listeners.

It is also difficult to estimate the number of overlapping, or repeat media consumers. Some KTUU viewers, for instance, might also listen to APTI. Nonetheless, our multiple-media targeting efforts ensure that our message reached well beyond 122,000 Alaskans, with an emphasis on Alaska's South Central region.

**Timeline**

The Summit proceedings occurred October 31st (Monday) and November 1st (Tuesday). The event's occurrence on a Monday, and Halloween evening posed difficulties in gaining story coverage within a saturated daily news cycle.

Phase one occurred October 15th-31st. This period allowed for extensive internal coordination both to prepare for CPT's execution of phase two activities, and to edit, revise, and gain approval and publication for content on institutional, partner, and related online sources.

Phase two activities occurred the weekend preceding the event, and then in coordination with the event itself (October 27th-November 1st).

This timing, and our efforts to precede the December media saturation, proved successful with one exception relating to print media. The *Anchorage Daily News* had two staff reporters on vacation, and also responded to Halloween events, priority items being promoted by the Governor's office, and a bizarre murder event downtown, which dominated their coverage. Secondly, the *Anchorage Press* had an editor and staff writer leave just before our event, and was left with only one writer acting as editor during our promotions efforts; while interested, he apologized that he just couldn't leave the office.

**Finance**

Aside from event sponsorship, the only budgetary consideration was the hotel, flight, transportation, and per-diem costs associated with the Communication Specialist (R. Harper). In addition, billable hours to the AUTC/Alaska DOT&PF partnership, and related internal staff FTE required to coordinate CPT activity, as well as research, planning, coordination, and other correspondence and document drafting in support of this effort. Travel and other arrangements supporting presenter/subject matter expert presence were also factors. Contractors and other sponsors' contributions are not known at this time, but played a role in the event's activities. Kim Hays, Steve Saboundjian, and Billy Connor have information on the event management budget.

# APPENDIX E - CASE HISTORIES SHOWING THE BENEFITS OF PAVEMENT PRESERVATION

This appendix presents a summary of a few case histories for agencies that have installed successful pavement preservation programs. The information was provided by the various agencies to the Center and is included in the following sections. It may be useful to Alaska to demonstrate how other agencies have sold the decision makers and public on" keeping good roads good."

**Case A: City of Los Angeles (Developed by Nazario Saucedo, Bureau of Street Services, City of Los Angeles)**

With a street network comprised of approximately 6,500 centerline miles of streets and 800 centerline miles of alleys, the City of Los Angeles not only has the largest municipal street system in the nation, but also the most congested.

To monitor, maintain, and manage this gigantic street network, the Bureau of Street Services relies on its Pavement Preservation Program which gravitates around a solid and dependable PMS.

Pavement Management by definition is a systematic, consistent method for selecting maintenance and rehabilitation needs, and for determining the optimal time of repair by predicting future pavement condition. It is a methodology that provides information for maintenance and rehabilitation (M&R) planning, programming and budgeting. Furthermore, it is an analysis tool that provides statistical and historical data and an instrument to support the decision making process. Ultimately, a PMS is used in the Bureau of Street Services (BSS) to cost-effectively manage street pavements.

In addition to its remarkable magnitude and heavy congestion, the City of Los Angeles' street network is also one of the oldest in the country. A significant number of streets were originally constructed almost one hundred years ago and approximately fifty percent of the entire street network was built before World War II; consequently, pavement preservation has been a challenge for quite some time and has forced the BSS to consistently go through a "pavement preservation metamorphosis."

Pavement preservation in the "Good Old Days" included among some other strategies:

- Setting routine maintenance cycles
- Prioritizing on a "worst first" basis
- Scheduling work based on "citizen complaints"
- Considering political priority and
- Following the recommendation from the "old Superintendent"

However, during the mid nineties, there was a noticeable need to modernize the Bureau's methodologies by incorporating computers and sophisticated engineering-based knowledge and technologies. The BSS acknowledged that taking this step would fully provide the organization with the benefits of a modern PMS.

In 1998, the BSS adopted Micro PAVER™, a "State of the Art" PMS that allows the selection of the most economical maintenance and rehabilitation strategy for the street system. Projection of future condition requires the ability to measure street condition in an objective, repeatable scale, such as the Pavement Condition Index (PCI).

The PCI is a numerical index ranging from 0 for a failed pavement to 100 for a pavement in perfect condition (Fig. B.1). Developed at the U.S. Army Construction Engineering Research Laboratory, the PCI is obtained by analyzing type, severity, and quantity of pavement distresses identified during a pavement condition survey. The use of PCI for roads and airports has received an overwhelming acceptance worldwide and has been adopted as standard to rate pavement condition by the American Society of Testing Materials (ASTM).

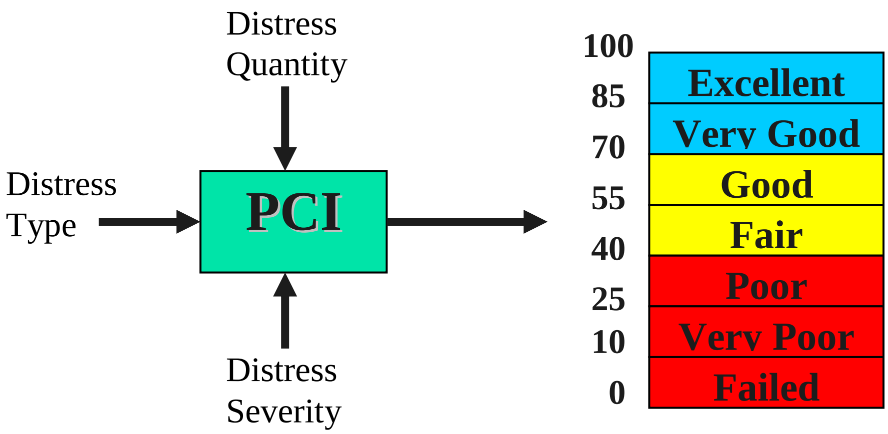



**Fig. E.1 Pavement Condition Index (PCI)**

To get the average PCI of the entire street network, the Pavement Management Section of the Bureau of Street Services follows the typical Micro PAVER™ five-step methodology:

- *Inventory:* The City's street network has over 69,000 pavement segments that were inventoried and entered into a computer database.
- *Routing:* Prior to performing the survey of the pavement sections, all 69,000 segments were routed manually. Routing of the streets in the network ensures the most time efficient way for the survey teams to capture accurate pavement data.
- *Survey (Gathering of Data):* The BSS currently utilizes two automated vans to collect pavement distress data. Each van is equipped with a computerized work station, cameras to take digital images of the street surface, and lasers to capture roadway roughness and rutting data (Fig. B. 2).

**Fig. E.2 Semi-Automated Survey Van**

- *Data Processing:* The surface distress information captured by the City vans is processed at a workstation in the office. Laser data and digital images are analyzed using custom software. The distresses on each one of the 69,000 street segments are identified and evaluated for type, quantity and severity. Each segment is equivalent to one city block.
- *Micro PAVER™ Analysis:* The processed information is imported into Micro PAVER™, which analyzes the distress information and calculates a PCI for the pavement. Life Cycle curves are developed and the critical PCI is established. Using the critical PCI, an optimum maintenance/rehabilitation strategy can be developed, budget needs can be determined, and future roadway conditions can be projected based on different budget scenarios. This is shown in Figure E.3.

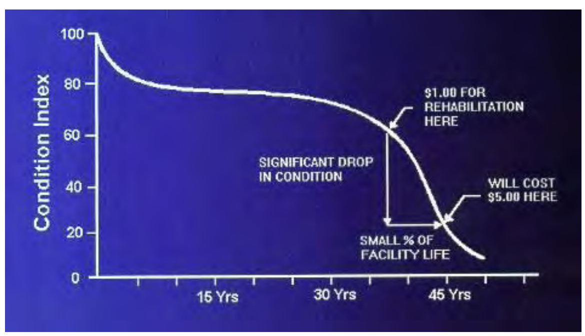



**Fig. E.3a Pavement Management Life Cycle Curve**

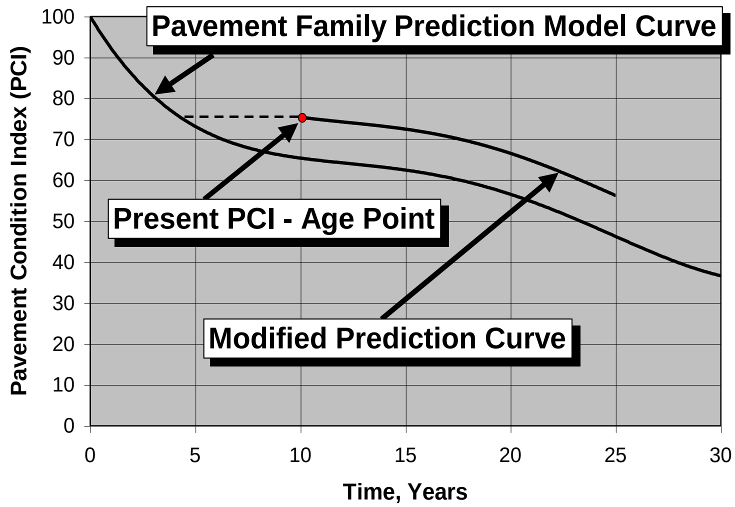



**Fig. E.3b Condition Prediction Modeling, Section Prediction in relation to Family Model**

With a strong commitment to pavement preservation, the BSS must ensure that every single dollar allocated for street maintenance and rehabilitation is intelligently and strategically expended; therefore, the Bureau has focused its attention on determining the optimal time of repair of the streets by predicting future pavement condition. Acknowledging that the current budget allocation is not sufficient to improve the current pavement condition of the street network, the Bureau's pavement preservation strategy has placed an emphasis on "saving" as many streets as possible before they get to the point in their life cycle where it will cost three to five times to repair them. The Bureau has adopted a "sustainability mode" until the right level of resurfacing funding is available.

The M&R work planning of the BSS is comprised as follows:

- Maintenance -Pothole Repairs, Crack Sealing, and Slurry Sealing
- Rehabilitation -Asphalt Overlays. Resurfacing, and Reconstruction

In a typical year, the BSS repairs approximately 250,000 potholes. The Fiscal Year 2006-2007 saw this number increase to 300,000, and for the 2007-2008 Fiscal Year, the Bureau has raised its goal to 350,000; an unprecedented number considering that additional maintenance funding was not allocated to accomplish this monumental task.

Crack sealing and Slurry Sealing are two Bureau operations that take place in a correlated fashion. The annual goal for crack sealing is 100 miles and generally speaking, the goal is accomplished while preparing streets that are part of the Slurry Seal Program. A rubberized sealer is used to successfully fill the street cracks.

Slurry sealing has been proven to be one of the most efficacious and economical preventive methods to extend the life of the pavements in the City of Los Angeles. For decades, the BSS used conventional slurry seal with a decent level of success; however, there were always several problems associated with its use. For example, inconvenient base camps in neighborhoods were required to stage large pieces of equipment and materials; in addition, environmental concerns such as dust, noise, and odors were a constant point of discontent for the neighborhood residents. Lastly, constant failed test results forced the Bureau to perform several “re-dos” which subsequently increased the cost of the program.

Approximately eight years ago, the BSS set a goal to improve the quality and productivity of the slurry sealing program; the goal also contemplated the reduction of the environmental impact to the community. After testing different options, a pre-mixed rubberized application was determined to be the best solution and the Bureau partnered with Petrochem Marketing, Inc. (PMI) to utilize a slurry seal material produced at a central mix plant and delivered ready for application on the project site. The Bureau’s Slurry Seal Program in accomplished through the use of PMI applicator trucks under the direction and labor work of Bureau forces.

While historically, the slurry program was typically funded for 100 miles, the last two fiscal years saw an increase to 300 miles and the current 2007-2008 Fiscal Year has been augmented to an unprecedented 400 miles.

The use of a pre-mixed, rubberized slurry seal has proven to be an excellent and intrinsic part of the Bureau’s Pavement Preservation Program not only because it provides consistent acceptable test results (improved quality) but also because it eliminates the need for equipment and materials storage in the neighborhoods. Moreover, it reduces the street closing time, and overall, it provides neighborhoods with a fresh and clean new appearance that result in increased customer satisfaction. Furthermore, the use of a rubberized mix provides the city with the following crucial environmental benefits:

- Recycling of 26,000 waste tires for every 100 miles of streets slurry sealed
- Conservation of valuable landfill capacity
- Reduction in dust and noise pollution, and
- Elimination of noxious odors during the on-site mixing of materials

The BSS’ Rehabilitation Program is typically funded for 200 miles per year although during the last decade, the annual resurfaced miles fluctuated from 135 to 270 miles.

Through the use of Micro PAVER™, the BSS has determined that in order to maintain the current average PCI of the street network, it is required to resurface 275 centerline miles every year; consequently, every year that the Bureau is not funded for such mileage, the condition of the street system is negatively impacted.

Since the right level of funding is not foreseeable in the near future, the Bureau has proactively adopted a stronger recycling approach. Currently, the Bureau’s two municipal asphalt plants are capable of producing approximately 600, 000 tons of hot mix per year that contain 20% to 25% Reclaimed Asphalt Pavement (RAP). Efforts and studies are currently taking place to elevate the use of RAP to 50% in the near future.

The latest addition to the Bureau’s Pavement Preservation Program is the acquisition of the Cold-In-Place Recycling (CIPR) technology (Fig. E.4). In 2004, the BSS conducted its first pilot project and immediately it was determined that when CIPR is compared to the conventional methods of street reconstruction, the most noticeable advantages are:

- Reduction in the demand for virgin aggregates
- Reduction of construction time
- Reduction in truck traffic through city neighborhoods
- Reduction on environmental impact, and
- Reduction on traffic congestion

**Fig. E.4 Cold-In-Place Recycling Machine**

All the preceding advantages can be simply summarized into two words: cost savings. In times of limited funding, it is always gratifying to know that that the efficiencies generated by incorporating the CIPR technology to the Bureau's Pavement Preservation Program generate enough savings to pay for an additional ten miles of asphalt overlays.

With almost a century of Pavement Preservation experience, the BSS of the City of Los Angeles has clearly demonstrated that the main benefits of a Pavement Preservation Program are:

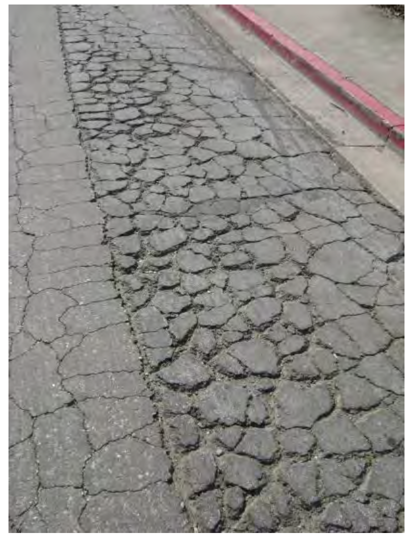
- Higher customer satisfaction with the street network
- Enhanced ability to make better and more intelligent decisions
- Use of the most appropriate maintenance or rehabilitation techniques
- Significant improvement of pavement conditions over time and
- Remarked reduction of the overall costs for maintaining the street network

Managers and engineers in all levels of government who have adopted a Pavement Preservation Program understand and agree that street management is a matter of "Pay now, or pay much more later"

**Case B: City of El Cerrito (Developed by Jerry Bradshaw, Director of Public Works, City of El Cerrito, CA)**

When Jerry Bradshaw came to work with the City of El Cerrito as the new Public Works Director in 2004, he learned that the condition of city streets was a concern of his predecessor. The City had just invested about $3 million in paving projects, but the funding source for this capital work was no longer available. El Cerrito is a small city with about 68 miles of street centerline, so a $3 million investment was significant.

By early 2006 the City was finishing its Pavement Management Program (PMP) update. The results were astonishing: The system PCI was 53 out of 100 (down from 63 two years earlier); and the backlog was now $21.2 million (up from $7 million). In addition, it was going to take $1.3 million per year just to keep the PCI from falling even lower. At that time, the available funding for pavement maintenance was a measly $250,000 per year. At that rate, the PCI would drop to 44 in five years with the backlog growing to $25.5 million.



This was a truly dismal picture. The city staff took this update to the City Council in July 2006. This wasn't something that could be ignored or minimized – it would factor into all of the City's capital improvement programming for the foreseeable future. On the day of the Council meeting, there was an article in the local paper about the sharp rise in asphalt costs, so that just added salt to the wound. Although the engineering staff received no direction from Council at that meeting, staff was already planning to do some public opinion surveys to determine how the community felt about the condition of the streets when compared to other major capital improvement needs such as a new police station, library or senior center – all equally dismal situations. As a public works professional, the engineering staff, of course, felt the street condition crisis was most important. But as a Department Head, Jerry Bradshaw also knew that the Police Chief and Recreation Director felt just as strongly about their facilities' importance to the community.

In February 2007, staff presented the results of the statistically-valid public opinion polling to the Council. It was at that meeting that the staff revealed that the poor condition of the streets was, indeed, rated as the highest need by city citizens. They also presented some options about how to fund a major street improvement program all while keeping in mind that the other needs would soon be considered for funding, too. The City Council directed staff to develop a funding program based on a local sales tax that would require a two-thirds voter approval.

The mission would be accomplished in two phases: Develop a ballot measure with a realistic improvement plan; and, if approved, implement the plan in quick fashion. Phase 1 had already been drafted, but the Public Works Department had until November 2007 to fully develop a new ordinance, a complete work plan, and ballot language. The engineering staff also launched a public information campaign with two goals in mind: letting the community know what our intentions were, and hearing back from the community about what they would want to see in a successful ballot measure and work plan. Jerry Bradshaw spent his summer making presentations to various community groups including PTAs, the Chamber of Commerce, the local Rotary Club, and anyone else who would listen. The Public Works Department included itself in every community event such as the July 4th celebration and National Night Out parties.

By November, the Department was ready for the Council to place this measure on the February 2008 primary election ballot. Both political parties were in full swing for the presidential primary, and people expected a large turnout. All of the hard work paid off when it received a 71% majority in favor of the ballot measure, formally named the ***"El Cerrito Pothole Repair, Local Street Improvement and Maintenance Measure."***

For the Phase 1 success, there was much due to many people. Public Works Directors are not always well equipped to strategize and organize a campaign like this under the scrutiny of public opinion. The City hired two great consultants to help, and the City Manager has an amazing talent for this sort of thing. They, along with the courageous City Council deserve the credit for this success. The full story of how to wage a successful campaign is the subject of another article.

Now it was time to launch Phase 2 – Implementation. After enjoying a collaborative team during Phase 1, the Public Works Director realized that Phase 2 was going to be up to "me, myself and I". Of course, Jerry Bradshaw wasn't able to do this alone; he had already been using a consulting project manager, Avila Project Management, with experience in street paving to help develop the work plan. Avila continued playing a critical role in the implementation phase. In addition, for over a year the public work had been relying heavily on StreetSaver, the PMP software developed by the Metropolitan Transportation Commission (MTC), to develop this improvement program. With the assistance of Nichols Consulting Engineers, who are experts with StreetSaver, they "sliced and diced" the street data, such as PCI and geometrics, many ways to figure out a plan of attack. It was now time to produce bid documents.

First, Jerry Bradshaw summarized what was promised to the voters. Although the ordinance was written to allow many peripheral improvements such as sidewalks, traffic control facilities, and street-related storm drainage, the overt promise to voters was to tackle the pavement condition, beginning with the worst streets. Public Works estimated that they would *not* have enough funding to bring all the streets up to good condition, and they predicted that they might be able to pull their average PCI up to 70 (from 53). They also promised to perform the bulk of the "catch up" work in four years. Year 1 (2008 construction season) was to be preparatory work only (patch paving, curb ramps) in order to give the utility companies time to complete any urgent underground work before many of their streets were repaved and the inevitable pavement excavation moratoria would begin. Years 2, 3 and 4 would see the actual paving work.

This was a very aggressive schedule – truly a fast-track program containing several contracts each year. Year 1 included three contracts: patch paving, curb ramps (for streets that would eventually receive an overlay or reconstruction), and a full paving project on three streets utilizing a federal STP grant. They also began developing the schedule for the 2009 projects with an eye toward years 3 and 4. The past experience with street paving projects was in small cities with very modest budgets. Jerry had usually relied on StreetSaver to layout the treatments with some minor modifications based on in-house knowledge of the streets. Bid documents were usually last year's bid package with a new location map attached. Full blown design documents were *not* the norm. With the upcoming fast track program, the same was true.

But the prep work was dependent on the future treatment, so the City had to have at least a preliminary treatment assigned to each street. With 44% of their streets in the Very Poor category (PCI < 25), they were facing a huge list of streets that needed reconstruction. But Jerry Bradshaw was not satisfied with the prescribed treatments suggested by StreetSaver. He had been considering the virtues of Asphalt Rubber Cape Seal ever since attending a seminar a few years earlier. The claims were fantastical – you can take a street that has extreme alligator cracking and simply apply an AR cape seal. No need to even do crack sealing beforehand. Could that be true? Further research revealed that if the underlying structure was sound and the alligator cracking was due to age and weathering instead of structural failure, then the AR cape would be an appropriate treatment. We made the decision to proceed with AR cape as a treatment for many of their broken up streets, and to patch pave the failed sections in preparation. This included about a third of the City's streets, and the cost effectiveness helped carry the program further than they had envisioned.

Another factor in their favor was the construction market and its sagging bid prices. The Department consistently received bids well below engineer's estimates. This opened to door to have our City Council authorize larger-than-normal contingency funding. The fast-track nature of the program led the City to issue bid documents with rough estimates of quantities, and they found themselves designing specific treatments in the field with a can of marking paint while the contractor was mobilizing. The City rationalized the large contingency funding with the promise to add more work at the favorable pricing to carry closer to their goal.

This modus operandi proved to be exhausting yet fruitful. As the City was wrapping up the 2009 projects with significant extra work included, they decided to compress the overall schedule into a 3-year program instead of the promised four years. While this would deprive them of one year's worth of revenue (approximately $600,000), they had saved more than that amount in low bid prices. In addition, they had strategically added significant grant funding into the program such as a federal stimulus grant (being shovel ready) and two CalRecycle grants for the AR cape and some rubberized asphalt concrete work.

After only three years, the Street Improvement Program spent $14.4 million: Bond proceeds = $10.5 million, Annual Revenues = $2.1 million and Grants = $1.8 million. They resurfaced 68% of our streets, built over 400 new curb ramps, and replaced 50 storm drain crossings. Their fast-track program enabled them to keep their soft costs of design, inspection, and administration below 20%.

But the big news is the resulting pavement condition. In 2010, they commissioned Nichols Consulting Engineers (through the MTC T-TAP program) to perform another update to their PMP and ended up with a system-wide average PCI of 85 and a backlog of only $500,000!!!! This exceeded their wildest fantasies of success. The long term benefit of this is that their annual maintenance costs would now be a modest $500,000 per year instead of the $1.3 million they faced in 2006. The new backlog of $500,000 is basically next year's workload, and the system average PCI of 85 is about as good as it can physically be since a street is not normally treated until its PCI is near 70.

The take away from this success is that IT CAN BE DONE!! Of course, it wasn't easy, and they were lucky in a few of their steps along the way. But Jerry Bradshaw believes one makes their own luck. It is said that Luck favors the Prepared Mind, and the City's collective mind was extremely prepared in this case. And that was not due to luck. The City's management team had the foresight and talent to explore options and prepare recommendations to their City Council. Their City Council had the courage to move forward with a ballot measure and authorize to move quickly and flexibly in the implementation. But most of the credit goes to the citizens of El Cerrito. They weren't afraid to impose a sales tax upon themselves in order to make a profound difference in their community. The trust that the City's management team had been building through years of honest, transparent, and productive work paid huge dividends in this instance. Mr. Bradshaw stated, "I feel privileged to be working for this community and its citizens. Perhaps there are other communities out there with the character to perform a similar miracle".