



PAVEMENT PRESERVATION TREATMENTS & LIFE CYCLE COST EVALUATION

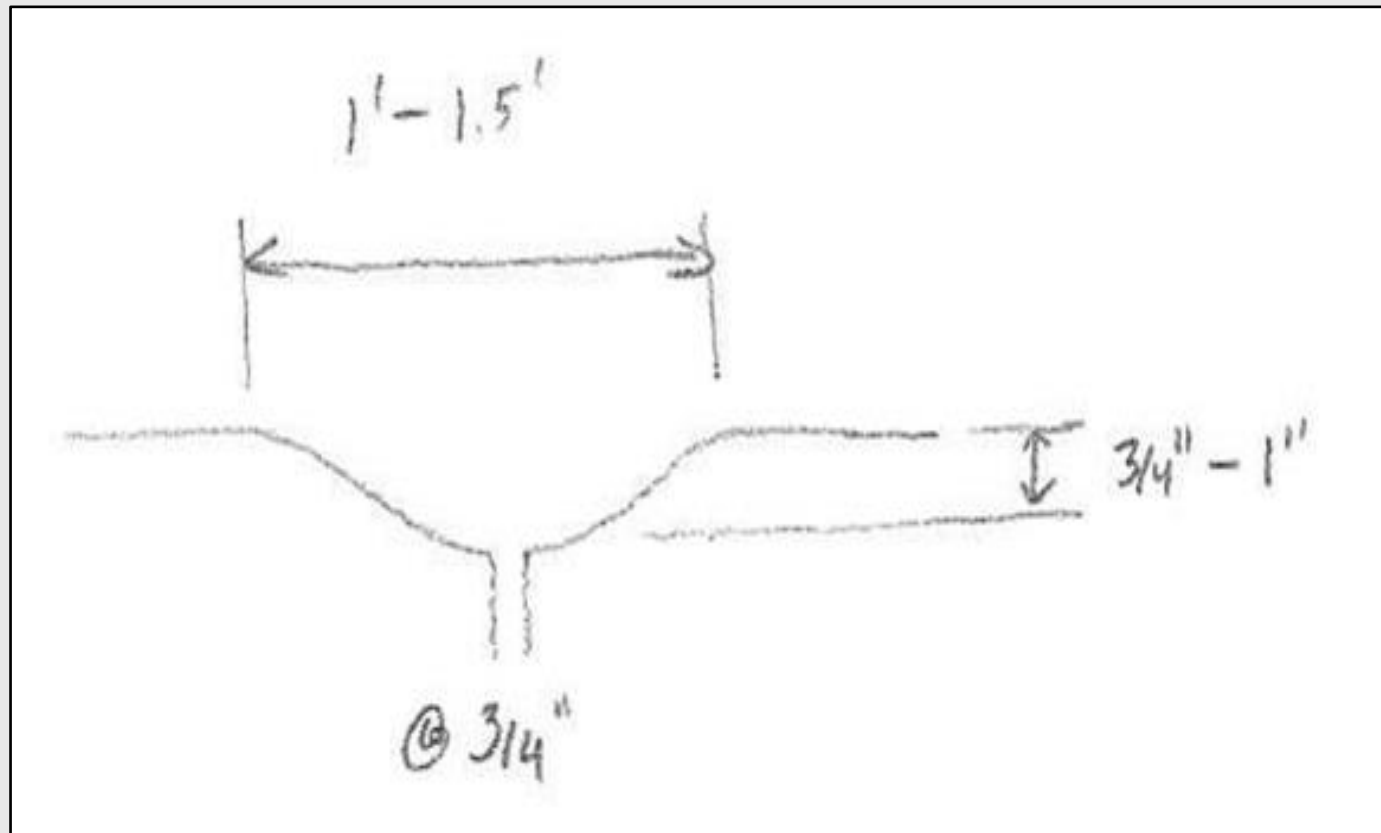
**Joel Uling | Pavement Preservation Engineer
Office of Materials and Road Research**

**Minnesota County Engineers Association Annual Conference
January 18, 2022**

- **Pavement Treatment Scenario**
- **Review Life Cycle Costs of Various PM Treatments**
- **Resources**
- **Questions**

Pavement Treatment Scenario

I received this drawing in an email from a County Engineer:



Pavement Treatment Scenario

Background:

- 25 year old pavement
 - oxidized surface
 - High severity transverse cracking
 - cupped cracks ($\frac{3}{4}$ "-1" deep x 12"-18" wide)
- AADT \approx 300 and serves local grain elevator
- Pavement strength is sufficient
- County is planning a 2" overlay

What to do?



Pavement Treatment Scenario

Options:

- Do nothing and overlay
- Tack and fill (level) cupped cracks with fine HMA mix
- Fill (level) with void filler (Mastic)
- Mill and overlay with HMA
- Micromill and place a thin surface treatment



How is the “Best Option” evaluated & selected?

- Past practice/experience
DWHAD - Do what we have always done
- Try something new and observe
- Ask others
- Life Cycle Cost Analysis - LCCA

Life Cycle Cost Analysis for PM Treatments

- Calculate treatment cost
- Understand the treatment life expectancy
- Assess the treatment's annualized Life Cycle Cost

(Looking at total cost doesn't always give true picture)

Annualized Treatment LCCA

Treatment Cost ÷ Life Expectancy (years)

**Let's evaluate the Life Cycle Cost for
the Pavement Preservation
Treatments in this situation.**

Pavement Treatment Scenario

A per mile cost is being used to more easily compare annualized life cycle costs between treatments.

Treatment Life Cycle (expectancy) defined:

When pavement distresses (cracking, rutting, ride, etc.) have reached a level requiring action. Not necessarily that the treatment itself has failed.

Do nothing and overlay

- No crack repair cost
- Reflective cracking and cupped cracks will return
- Expect initial fair ride improvement, but this will decline more quickly than the other options.
- Expected treatment life of 8 years
- Overlay cost (2" thick by 24' wide at \$60/ton) = \$93,000/mile
- Life cycle cost = $\$93,000/\text{mile}/8 \text{ years} = \$11,625/\text{mile}/\text{year}$

Tack and fill with fine gradation HMA mix and overlay

- Crack repair cost \approx \$6,000/mile (materials & labor)
- Reflective cracking will return
- Expect fair ride improvement
- Expected treatment life of 10 years
- Overlay cost (2" thick by 24' wide at \$60/ton) = \$93,000/mile
- Life cycle cost = \$99,000/mile/10 years = \$9,900/mile/year

Fill with Mastic and overlay

- Crack repair cost \approx \$7,000/mile (\$4,000 + labor/mile)
- Reflective cracking will return
- Expect fair ride improvement
- Expected treatment life of 10 years
- Overlay cost (2" by 24' wide at \$60/ton) = \$93,000/mile
- Life cycle cost = \$100,000/mile/10 years = \$10,000/mile/year

Mill and overlay

- Traditional milling cost (2" @ \$0.95 SY) \approx \$16,000/mile
- Reflective cracking will return
- Expect excellent ride improvement
- Expected treatment life of 10 years
- Overlay cost (2" by 24' wide at \$60/ton) = \$93,000/mile
- Life cycle cost = \$109,000/mile/10 years = \$10,900/mile/year

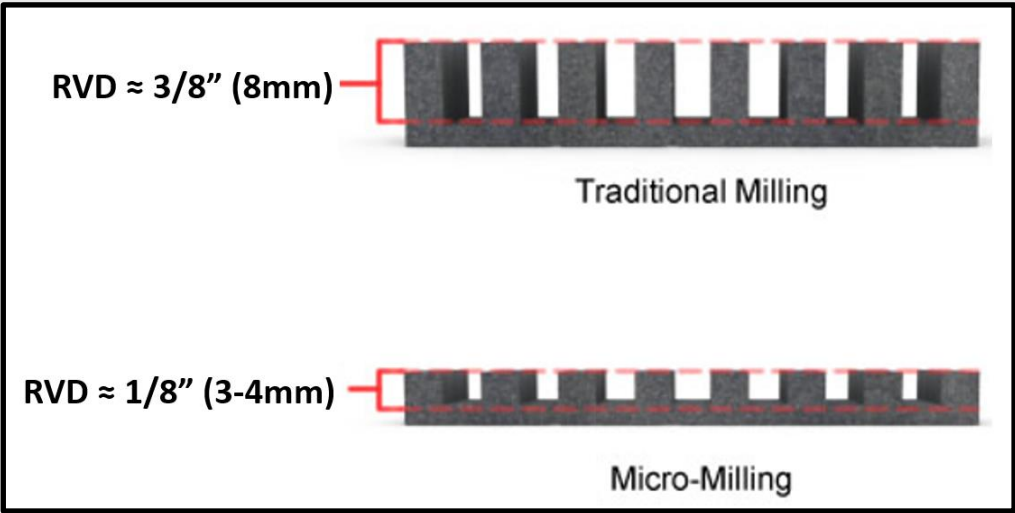
Other Options: Thin Surface Treatments

- Chip Seal
- Slurry Seal
- Micro-surfacing
- Thinlay (≤ 1 " thick)
- UTBWC ($\frac{3}{8}$ " - $\frac{3}{4}$ " thick)



Not all Thin Surface Treatments improve ride quality

Combine with Micromilling



What is Pavement Micromilling?

Micromilling vs traditional milling:

- *Ideal for removing ≈ 1 " of pavement.*



Traditional Milling Head
Teeth spaced about 0.625 inches apart

Micromilling Head
Teeth spaced 0.200 inches apart



- *Micromilling head has 3 times the number of milling teeth or points.*
- *Tighter lacing pattern = smoother finished surface.*

Micromill and chip seal

- Micromilling cost ($\$1.00/\text{SY} = \$17,080/\text{mile}$)
- Expect excellent ride improvement
- Expected treatment life of 8 years
- Chip seal cost = $\$25,000/\text{mile}$
- Life cycle cost = $\$42,080/\text{mile}/8 \text{ years} \approx \$5,250/\text{mile}/\text{year}$

Micromill and micro-surfacing

- Micromilling cost (\$1.00 SY) = \$17,080/mile
- Expect excellent ride improvement
- Expected treatment life of 8 years
- Micro-surfacing cost (2 lifts @ \$5.75 SY) = \$40,500/mile
- Life cycle cost = \$98,080/mile/8 years = \$12,260/mile/year
- LCC based on 10 year life = \$9,800/mile/year

Micromill and thinlay overlay

- Micromilling cost (\$1.00) = \$17,080/mile
- Expect excellent ride improvement
- Expected treatment life of 8 years
- Thinlay cost (1" by 24' wide at \$75/ton) = \$60,000/mile
- Life cycle cost = \$67,080/mile/8 years = \$8,400/mile/year

Micromill and UTBWC

- Micromilling cost (\$1.00 = \$17,080/mile)
- Expect excellent ride improvement
- Expected treatment life of 12 years
- UTBWC cost ($\frac{1}{2}$ " by 24' wide at \$120/ton) = \$63,400/mile
- Life cycle cost = \$80,480/mile/12 years = \$6,700/mile/year



Let's Summmerize

Life Cycle Cost Analysis

<u>Treatments</u>	<u>Initial Cost/Mile</u>	<u>Expected Treatment Life</u>	<u>Annualized Cost/Mile</u>
Do nothing and overlay	\$93,000	8 Years	\$11,625
Tack and fill with fine HMA mix and overlay	\$98,080	8 Years	\$ 9,900
Fill with Mastic and overlay	\$100,000	10 Years	\$10,000
Mill and overlay	\$109,000	10 Years	\$10,900
Micromill and chip seal	\$42,080	8 Years	\$ 5,250
Micromill and micro-surfacing	\$98,080	8 Years	\$ 9,800
Micromill and thinlay	\$67,080	8 Years	\$ 8,400
Micromill and UTBWC	\$80,480	12 Years	\$ 6,700

To get the most out of your
Pavement Preservation budget
you should be looking at
Life Cycle costs!

Two questions drive pavement management

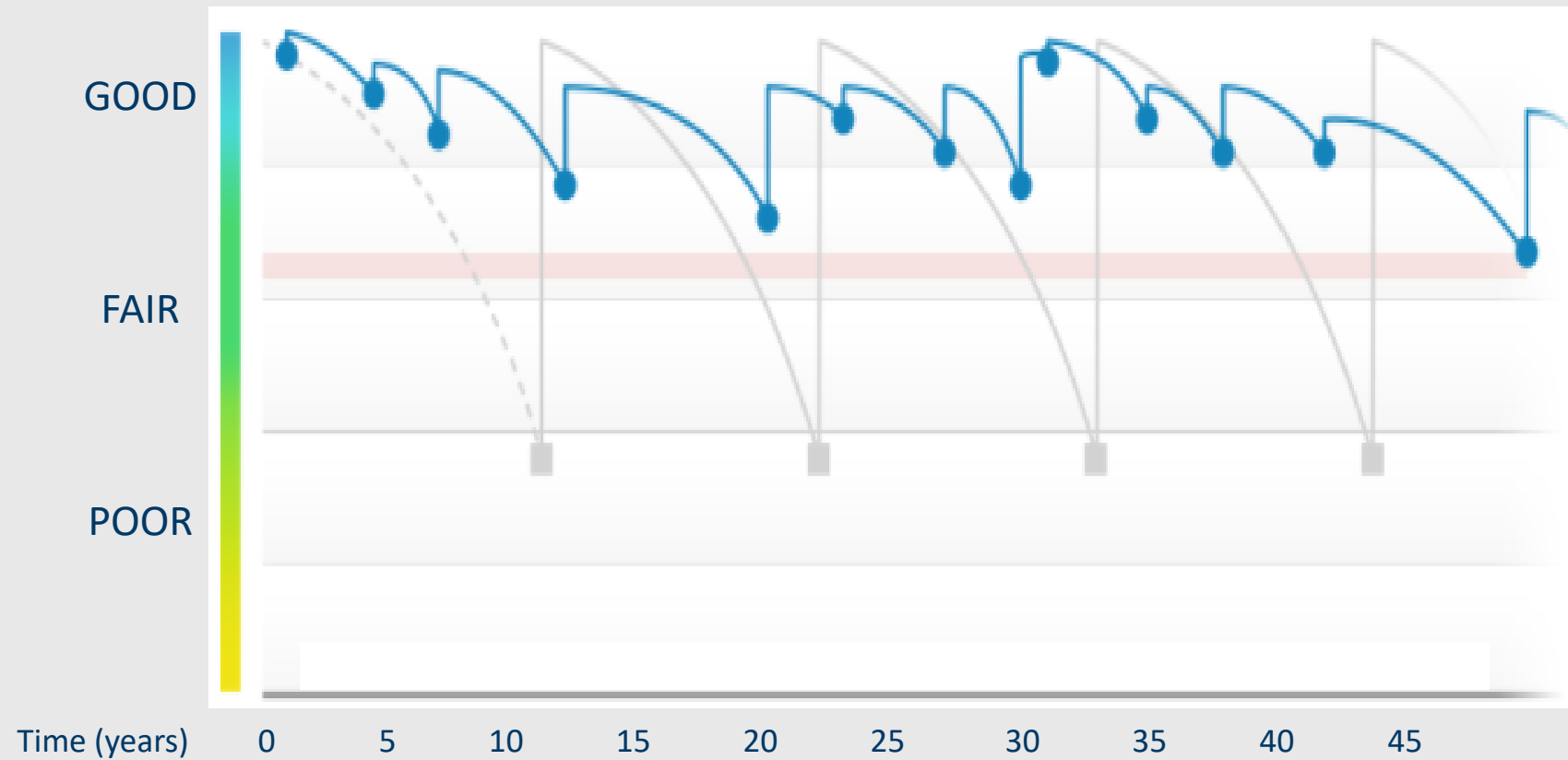
- **What is the best treatment for this pavement now?**
- **What combinations of treatments over time will maximize the life of this pavement?**

Today's presentation focused on the first question.

Your challenge is to address the second question.

Costs less to keep
a pavement in
GOOD
condition

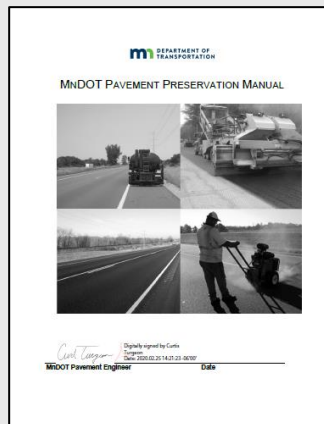
Pavement Condition



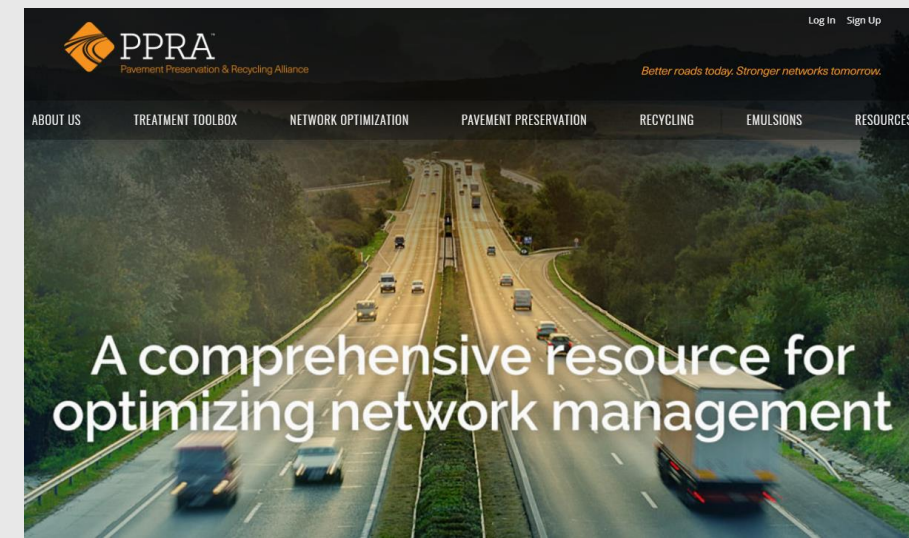
RESOURCES:

- MnDOT Pavement Preservation Manual
- MnDOT Maintenance Manual – Chapter 3: Smooth Roads
- PPRA – Pavement Preservation & Recycling Alliance

www.roadresource.org



November 29, 2018 Maintenance Manual Smooth Roads		
Chapter 3		
SMOOTH ROADS		
Table of Contents		
3.1.0	INTRODUCTION	4
3.2.0	GLOSSARY OF PAVEMENT MANAGEMENT TERMS AND DEFINITIONS	4
3.2.01	Pavement Structure and Base/Shoulder Components	5
3.2.02	Pavement Features	5
3.2.03	Pavement Metrics	7
3.2.04	Pavement Construction	9
3.3.0	OPERATIONS SAFETY	10
3.4.0	MAINTENANCE OF ROADWAY SURFACE	10
3.4.01	Maintenance Practices	11
3.4.01.01	Fast Repairs	11
3.4.01.02	Sealing Cracks	11
3.4.01.03	Joint Repairs	11
3.4.02	Aggregate Pavement Maintenance	12
3.4.03	Concrete Pavement Maintenance	12
3.4.04	Maintenance Surface Treatments for Asphalt Pavements	14
3.4.04.01	Seal Coats	14
3.4.04.01.01	Crack Seals	14
3.4.04.01.02	Foil Seals	14
3.4.04.01.03	Chip Seals	15
3.4.04.01.04	Slurry Seals	15
3.4.04.01.05	Microemulsions	15
3.4.04.02	Thin Hot Mix Overlay	16
3.4.04.03	Joint Sealing on Asphalt Drums	16
3.4.04.04	Pavement Patching	18
3.4.04.04.01	Hot Mix Patching	18
3.4.04.04.02	Gravel Seals	20
3.4.04.04.03	Gravel Seals	20
3.5.0	GENERAL CONCRETE PAVEMENT MAINTENANCE	21
3.6.0	CONCRETE PAVEMENT DEFICIENCY DISTRESS	22
3.6.01	Surface Cracks	24
3.6.02	Spalling	24
3.6.03	Joint Sealing on Concrete Slabs	26
3.6.04	Joint Sealing on Concrete Slabs	26
3.6.05	Seals on Slab Joints	26



Optimizing Your Network *How to Guide*

Calculators

- *Life Cycle Cost*
- *Equivalent Annualized Cost*
- *Remaining Service Life*
- *Cost Benefit Value*

The screenshot shows the website for the Pavement Preservation & Recycling Alliance (PPRA). The URL in the browser is https://roadresource.org. The navigation menu includes: ABOUT US, TREATMENT TOOLBOX, NETWORK OPTIMIZATION (highlighted with a red box), PAVEMENT PRESERVATION, RECYCLING, EMULSIONS, and RESOURCES. The NETWORK OPTIMIZATION dropdown menu is open, displaying the following items:

- Optimize Your Network**
 - ▶ [How-To-Guide](#)
- Life Cycle Cost**
 - ▶ [About](#)
 - ▶ [Life Cycle Cost Calculator](#)
- Equivalent Annualized Cost**
 - ▶ [EAC: About & Calculator](#)
- Remaining Service Life**
 - ▶ [About](#)
 - ▶ [Remaining Service Life Calculator](#)
- Cost Benefit Value**
 - ▶ [About](#)
 - ▶ [Cost Benefit Value Calculator](#)



THANK YOU!
Questions?

Joel Ulring, MnDOT Pavement Preservation Engineer