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Micro Milling Combined with Thin Pavement Surface Treatments - MnDOT's Experience

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DEPARTMENT OF TRANSPORTATION

Outline

- What is pavement micromilling?
- Why would I micromill a pavement?
- Why combine it with a thin surface treatment?
- MnDOT's Experience
- NCAT/MnDOT Research

What is Pavement Micromilling?

Three types of milling:

- *Traditional Milling – Teeth spaced 0.625 inch (≈5/8”)*
- *Fine Milling – Teeth spaced 0.3125 inch (≈ 5/16”)*
- *Micromilling – Teeth spaced 0.200 inch (≈ 3/16”)*

  (About three times the teeth on a traditional milling drum)

What is Pavement Micromilling?

Micromilling is similar to traditional milling.

Ideal for removing ≈ 1” of pavement.

Traditional Milling Head

Micromilling Head

A micromilling head has about 3 times the number of milling teeth or points.

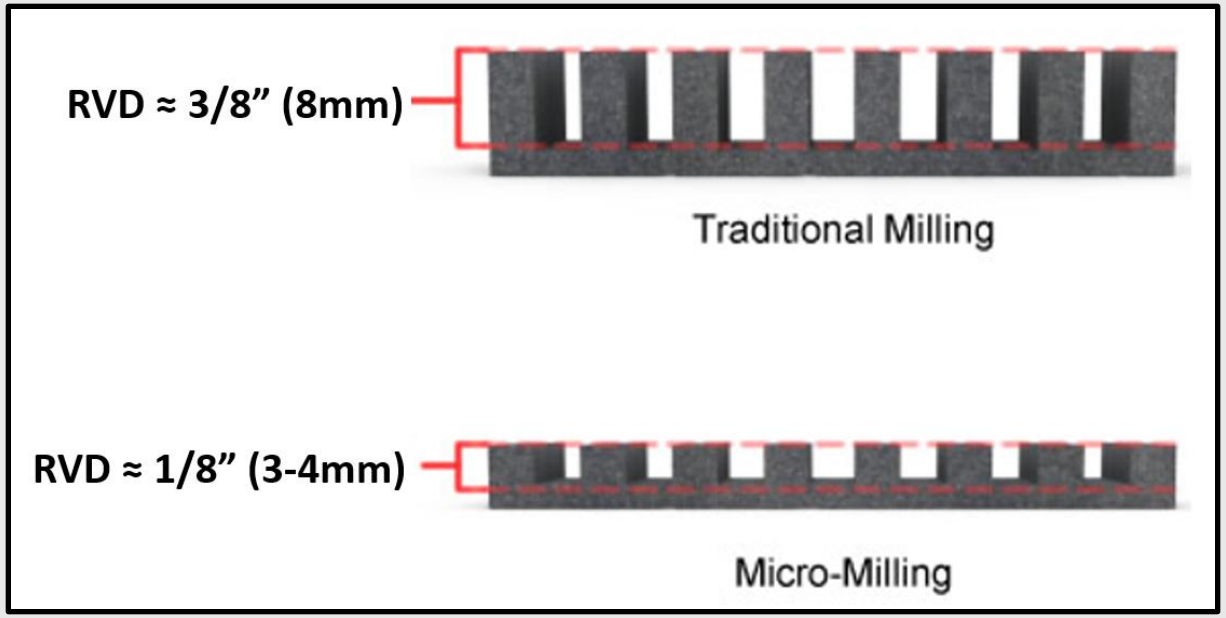
It has a tighter lacing pattern which creates a smoother finished surface.

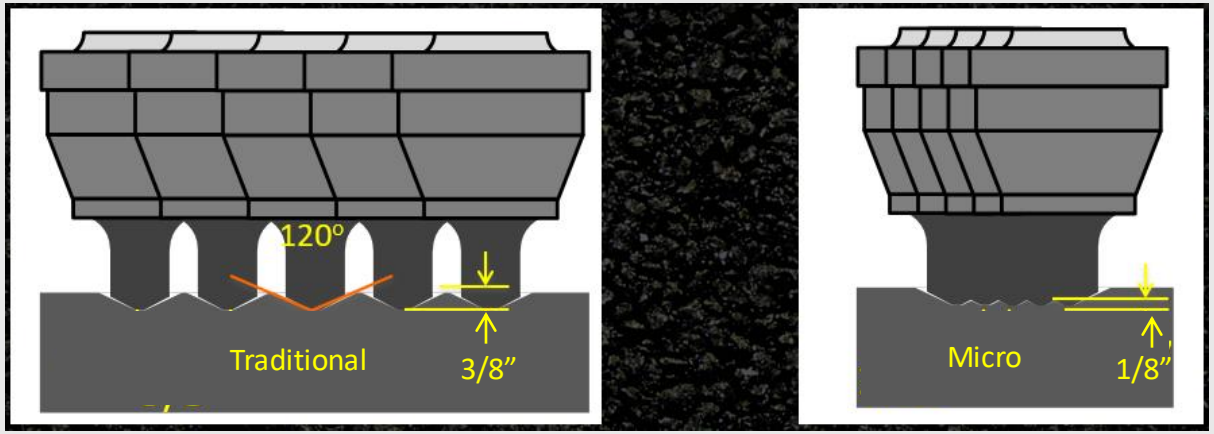
What is Pavement Micromilling?

Micromilling has a lower

<u>Ridge to Valley Depth – RVD</u>

- *RVD is the height difference between the lowest and highest points of the milled surface.*
- *Used to characterize a milled surface.*
- *Important when placing thin surface treatments.*





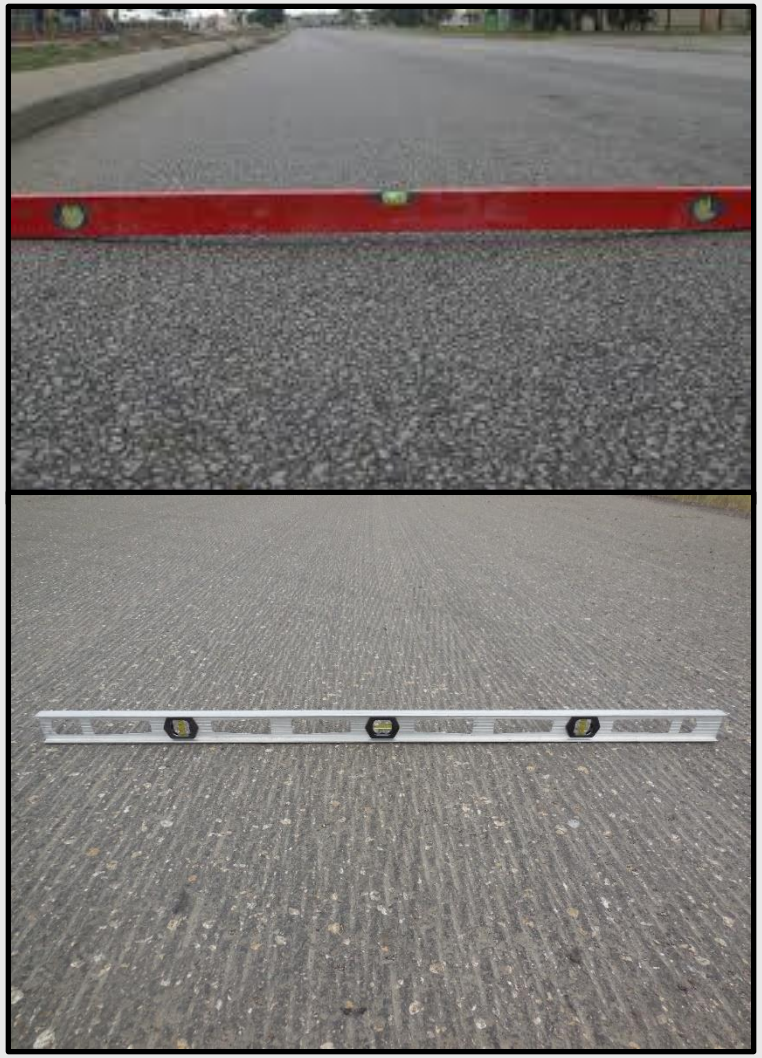
MnDOT's Experience

Why Would I Micromill a Pavement?

Why Micromill a Pavement?

Why Micromill a Pavement:

- *Improve ride*
- *Provide a lower RVD (Ridge to Valley Depth) milled surface*
  - *Lower RVD is a better surface for placing thin surface treatments on*
    - *Roughness of traditional milled surface can reflect through treatment*
    - *Higher RVD in milled surface can trap water causing treatment failure*
- *Remove surface oxidation*
- *Remove surface defects (cupped cracks, rutting, raveling)*
- *Remove a previous surface treatment*
- *Improve bond and life of treatment*
- *Re-establish or improve cross slope drainage*
- *Provide a smoother surface for interim traffic*



MnDOT's Experience Why Combine Micromilling with a Thin Surface Treatment?

Why Combine Micromilling with a Thin Surface Treatment?

Benefits of Micromilling a Pavement When Applying a Thin Surface Treatment:

- *Most thin surface treatments don't improve ride*
- *Provide a lower RVD (Ridge to Valley Depth) milled surface*
- *Remove surface oxidation*
- *Remove surface defects (cupped cracks, rutting, raveling)*
- *Remove a previous surface treatment*
- *Re-establish or improve cross slope drainage*
- *Provide a smoother surface for interim traffic*
- *Better bond of treatment to roadway*
- *Improve treatment performance (longer service life)*
- *Extend pavement life*

Why Combine Micromilling with a Thin Surface Treatment?

MnDOT Milling Specifications:

Traditional Milling (Standard Specification)

2232 – MILL PAVEMENT SURFACE

Micromilling (Special Provision)

2232 – MILL BITUMINOUS PAVEMENT (SPECIAL)

MnDOT's Experience

Thin Surface Treatments with Micromilling

Thin Surface Treatments with Micromilling

Chip Seal

Micro-surfacing

Ultra-Thin Bonded Wearing Course

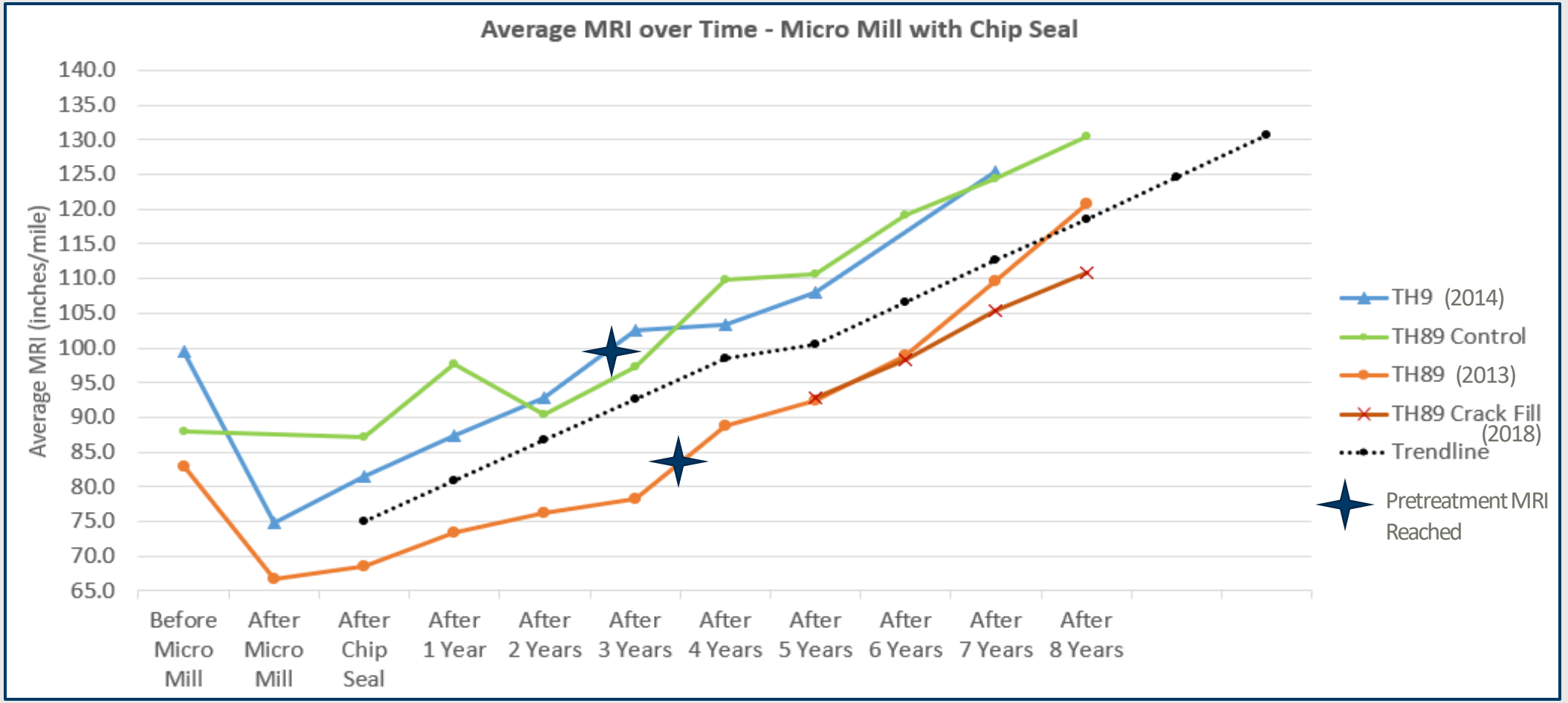
MnDOT's Experience

Chip Seal with Micromill

- TH 89 Grygla, MN
  (2013)
- TH 9 Breckenridge, MN
  (2014)

TH 89: After Chip Seal with Micromill (2013)

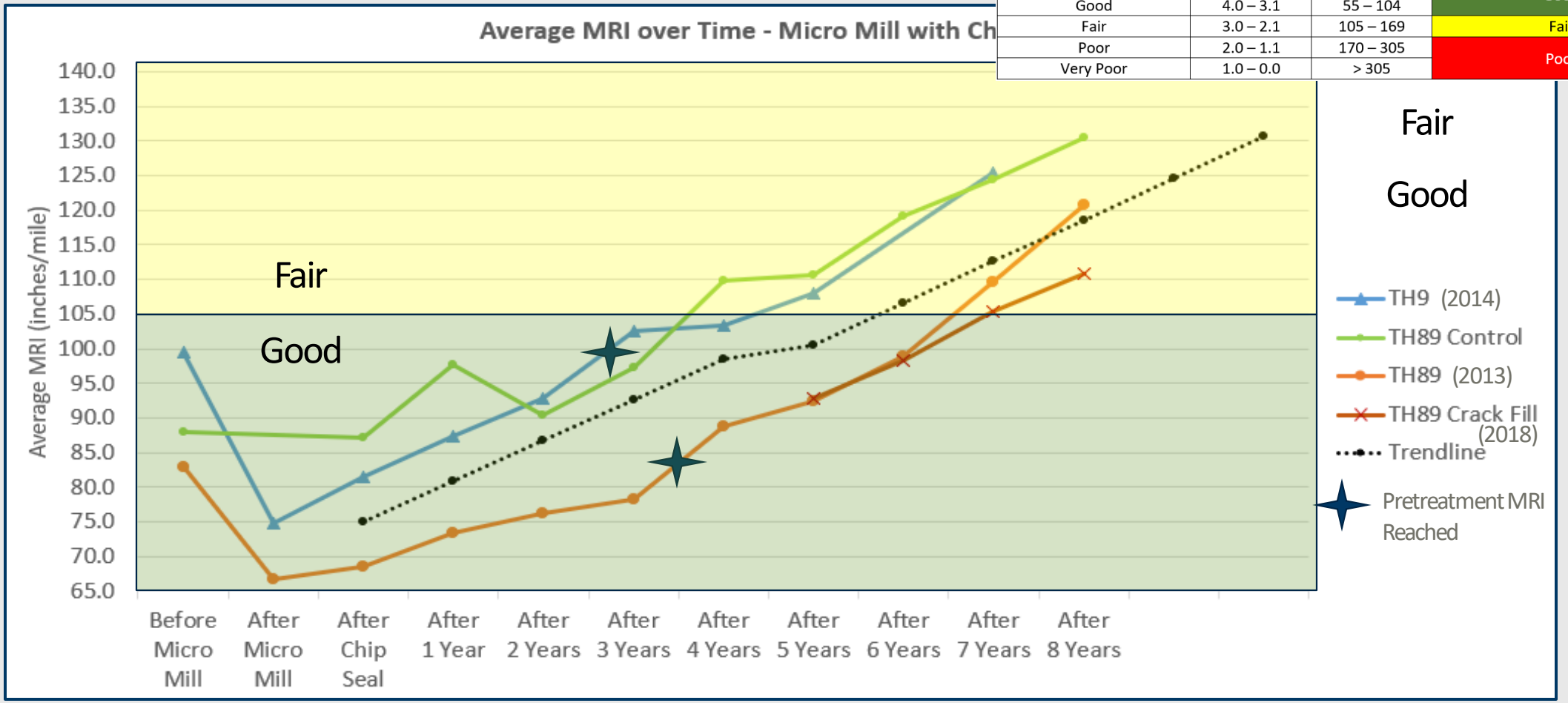
Chip Seal with Micromill



MnDOT's Experience

Chip Seal with Micromill

Descriptive Category	RQI Range	IRI Range	Performance Measure Category
Very Good	5.0 – 4.1	< 55	Good
Good	4.0 – 3.1	55 – 104	
Fair	3.0 – 2.1	105 – 169	Fair
Poor	2.0 – 1.1	170 – 305	Poor
Very Poor	1.0 – 0.0	> 305	



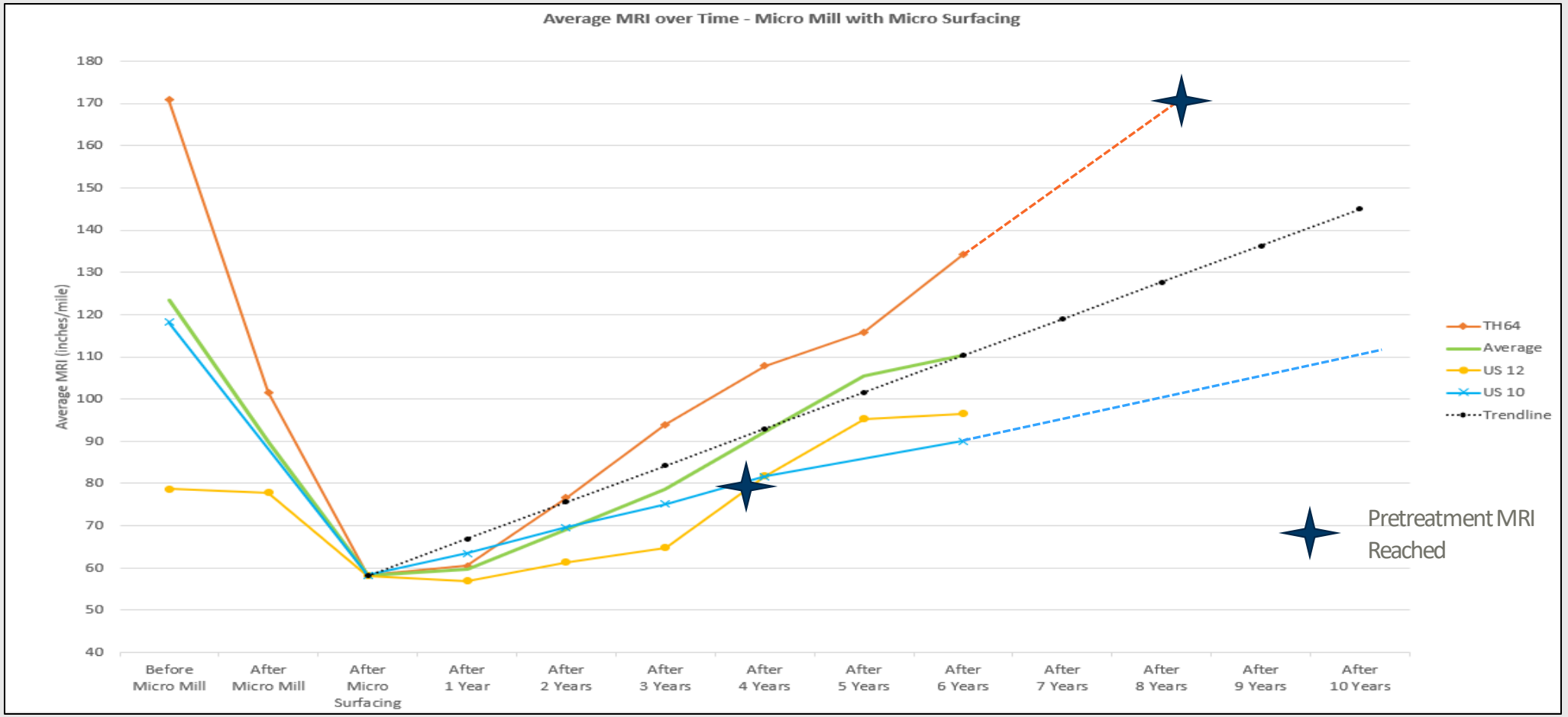
MnDOT's Experience

Micro-surfacing with Micromill

- TH 64 Motley
- TH 12 Willmar
- TH 10 EB New York Mills

TH 64 One Year (2015) After Micromill & Micro-surfacing

Micro-surfacing with Micromill



Micro-surfacing with Micromill

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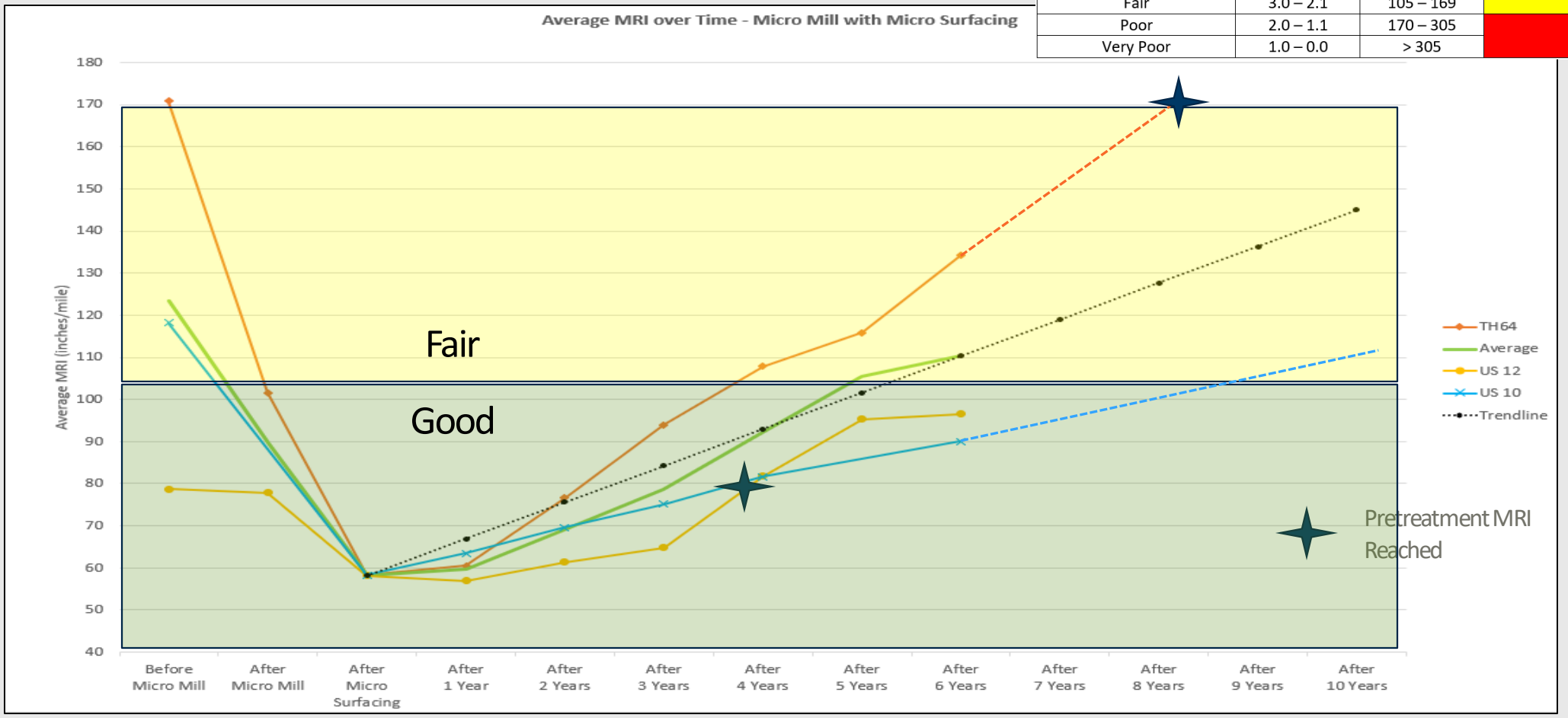
Very Good	5.0 – 4.1	< 55	Good
Good	4.0 – 3.1	55 – 104	
Fair	3.0 – 2.1	105 – 169	Fair
Poor	2.0 – 1.1	170 – 305	Poor
Very Poor	1.0 – 0.0	> 305	



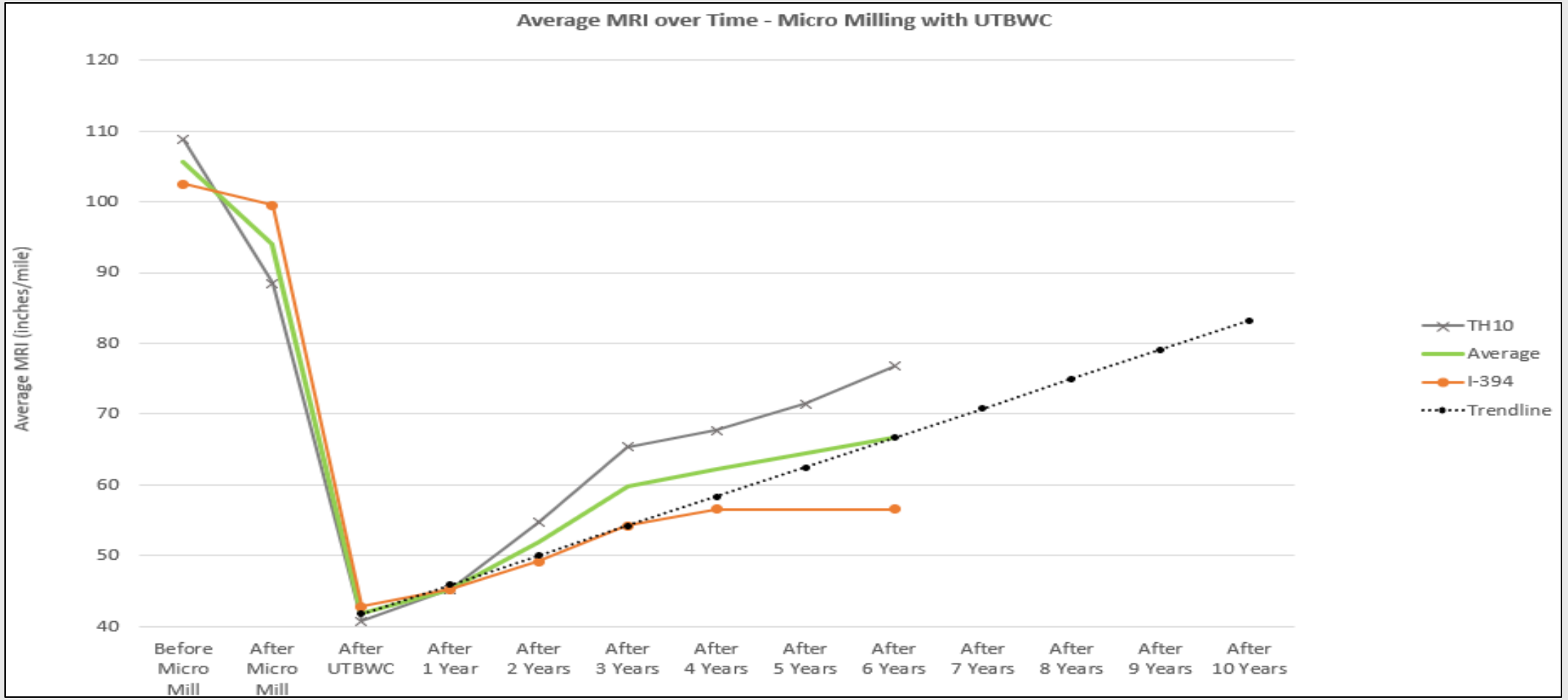
MnDOT's Experience

UTBWC with Micromill

- US 10 Motley
- I-394 Hwy 100 to I-494

US 10 After Micromill & UTBWC

UTBWC with Micromill



MnDOT's Experience

UTBWC with Micromill

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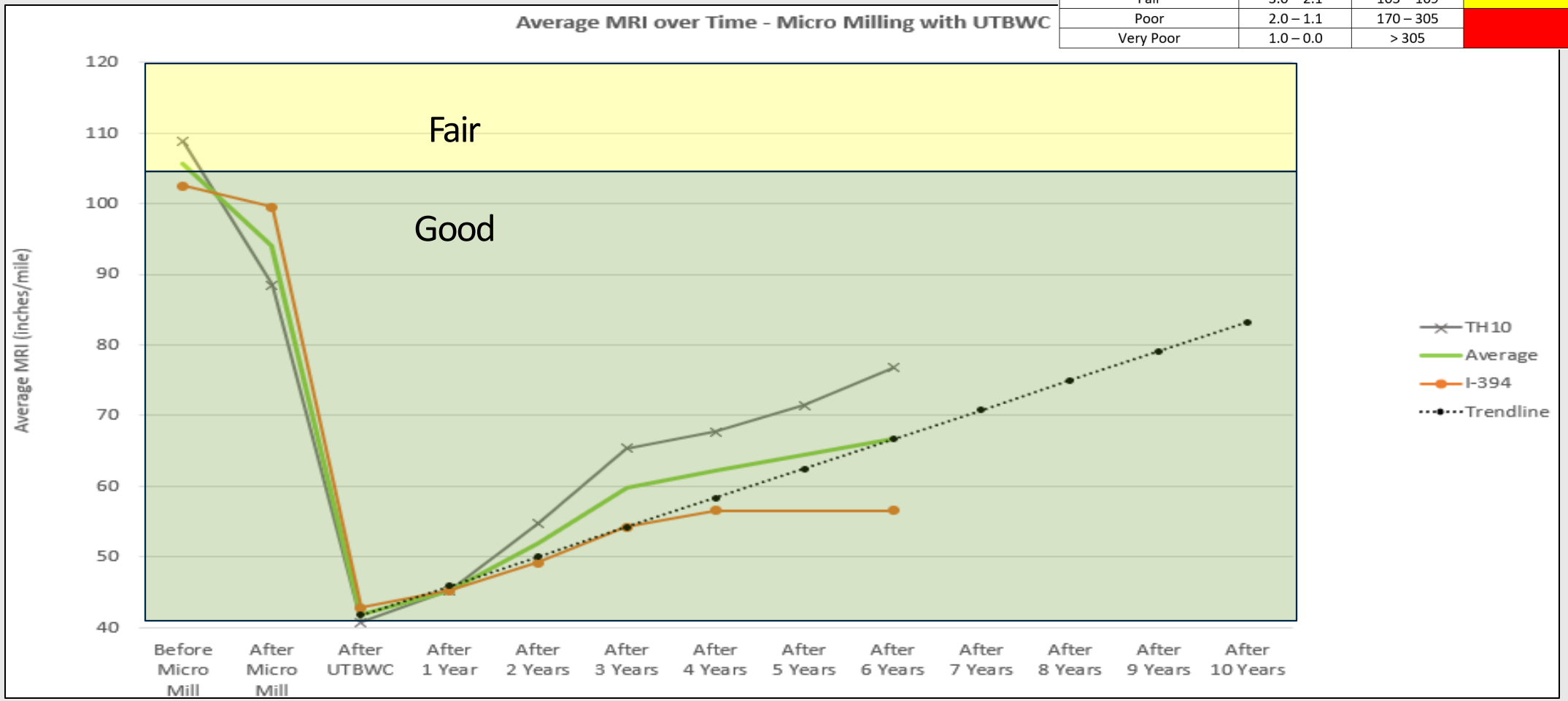
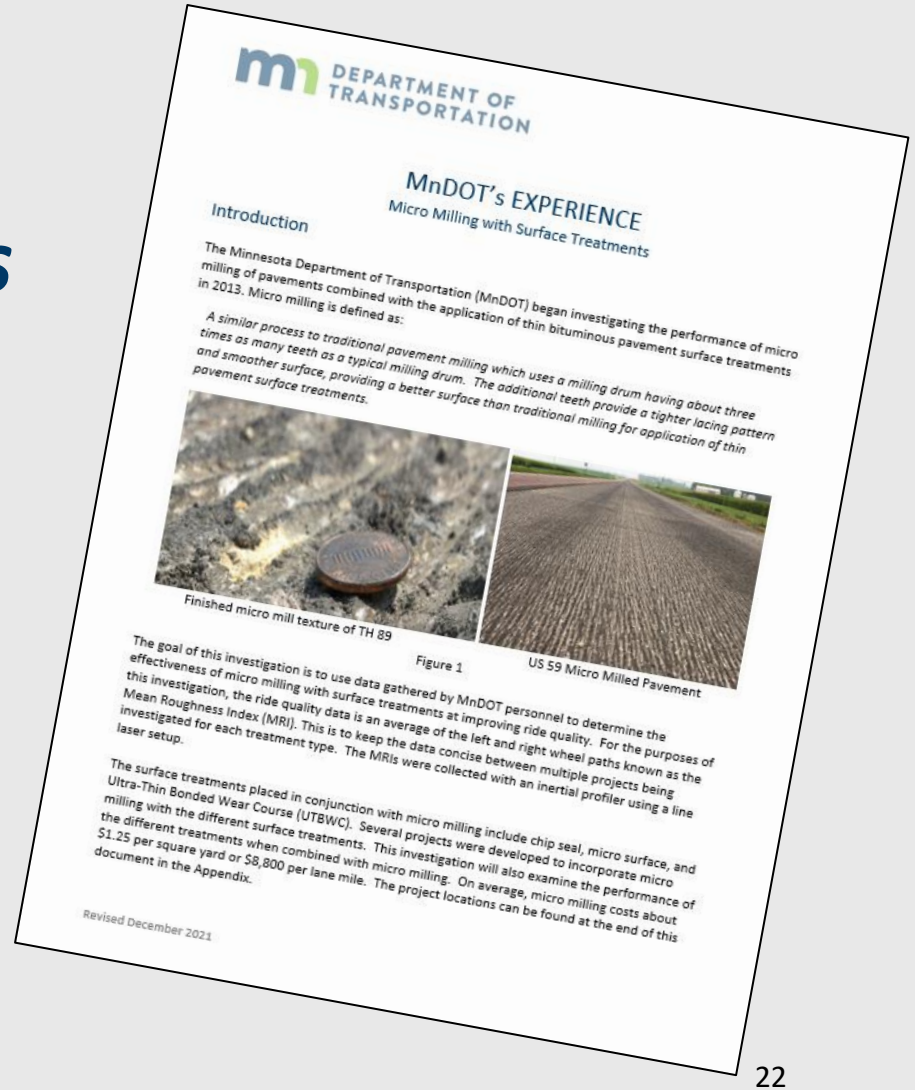


MnDOT's EXPERIENCE
Micro Milling with Surface Treatments

- **Updated annually**
- **Located on MnDOT's Pavement Preservation web page under Reports**



DEPARTMENT OF TRANSPORTATION

MnDOT's EXPERIENCE
Micro Milling with Surface Treatments

Introduction

The Minnesota Department of Transportation (MnDOT) began investigating the performance of micro milling of pavements combined with the application of thin bituminous pavement surface treatments in 2013. Micro milling is defined as:

A similar process to traditional pavement milling which uses a milling drum having about three times as many teeth as a typical milling drum. The additional teeth provide a tighter lacing pattern and smoother surface, providing a better surface than traditional milling for application of thin pavement surface treatments.

Finished micro mill texture of TH 89

US 59 Micro Milled Pavement

Figure 1

The goal of this investigation is to use data gathered by MnDOT personnel to determine the effectiveness of micro milling with surface treatments at improving ride quality. For the purposes of this investigation, the ride quality data is an average of the left and right wheel paths known as the Mean Roughness Index (MRI). This is to keep the data concise between multiple projects being investigated for each treatment type. The MRIs were collected with an inertial profiler using a line laser setup.

The surface treatments placed in conjunction with micro milling include chip seal, micro surface, and Ultra-Thin Bonded Wear Course (UTBWC). Several projects were developed to incorporate micro milling with the different surface treatments. This investigation will also examine the performance of the different treatments when combined with micro milling. On average, micro milling costs about $1.25 per square yard or $8,800 per lane mile. The project locations can be found at the end of this document in the Appendix.

Revised December 2021

Approximate Cost of Treatments and Micromilling

Treatment	Estimated Treatment Life	Cost/ Sq. Yd.	Cost/ Lane Mile	Annualized Cost/Lane Mile	Annualized Cost/Lane Mile with Micromilling
Micromilling (¾" to 1" at 12' wide)	n/a	$1.25	$ 8,800	n/a	n/a
Chip Seal	8 years	$2.15	$15,000	$2,150	$3,910
Micro-surfacing (two lifts)	8 years	$5.75	$40,500	$5,050	$6,150
UTBWC (≈¾" at $120/ton)	10 years	$4.50	$31,700	$3,170	$4,050
Thinlay (≤ 1" at $75/ton)	8 years	$4.25	$30,000	$3,750	$4,850

Note: All costs shown above are for the treatment cost itself. Other related typical construction costs of mobilization, traffic control, etc. are not included. Prices obtained from MnDOT 2016 – 2020 bid abstracts.

Recap - Why and When to Micromill

Why Micromill a Pavement?

- *Improve ride*
- *Remove a previous thin surface treatment*
- *Remove oxidation at the pavement surface*
- *Remove surface defects (cupped cracks, rutting, raveling)*
- *Improve bond and life of treatment*
- *Re-establish or improve cross slope drainage*

Recap - Why and When to Micromill

When to Consider Micromilling a Pavement:

- *When pavement ride is approaching the Good/Fair line*
  - *RQI = 3.0*
  - *IRI = 105 inches/mile*
- *Pavement is/has:*
  - *Oxidized surface*
  - *Distressed (cupped cracks, rutted, raveling)*
  - *Poor drainage*

RESEARCH

National Center for Asphalt Technology - NCAT And MnROAD study on Pavement Preservation Strategies

NCAT-MnROAD Partnership

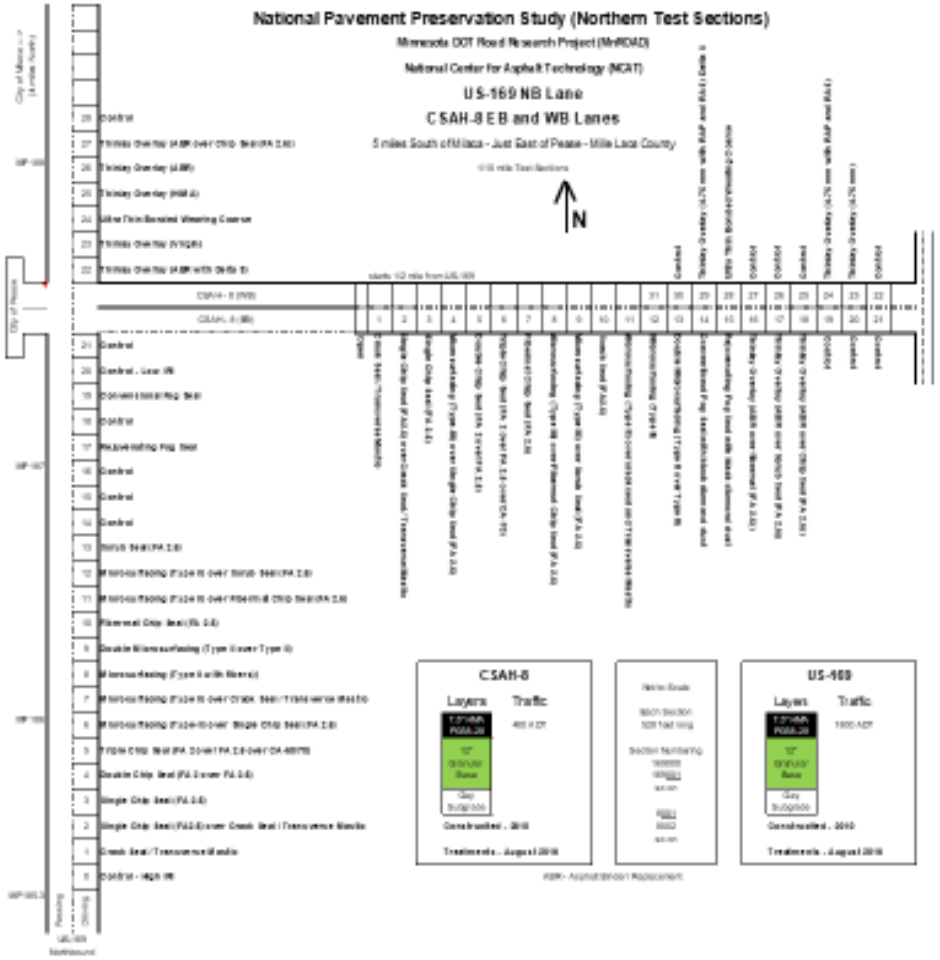
National Pavement Preservation Study

- 22 Agencies involved in Pooled Fund
- Looking at both warm and cold regions
- TH169 and CSAH 8 (Mille Lacs County)
- 70th St. NE in Albertville/Otsego (near MnROAD)

Current Research

TH169: 4 miles
CSAH 8: 2.5 miles
Mille Lacs County, MN

Northern
High Traffic
Preservation
on US-169



Northern
Low Traffic
Preservation
CSAH-8

DEPARTMENT OF TRANSPORTATION

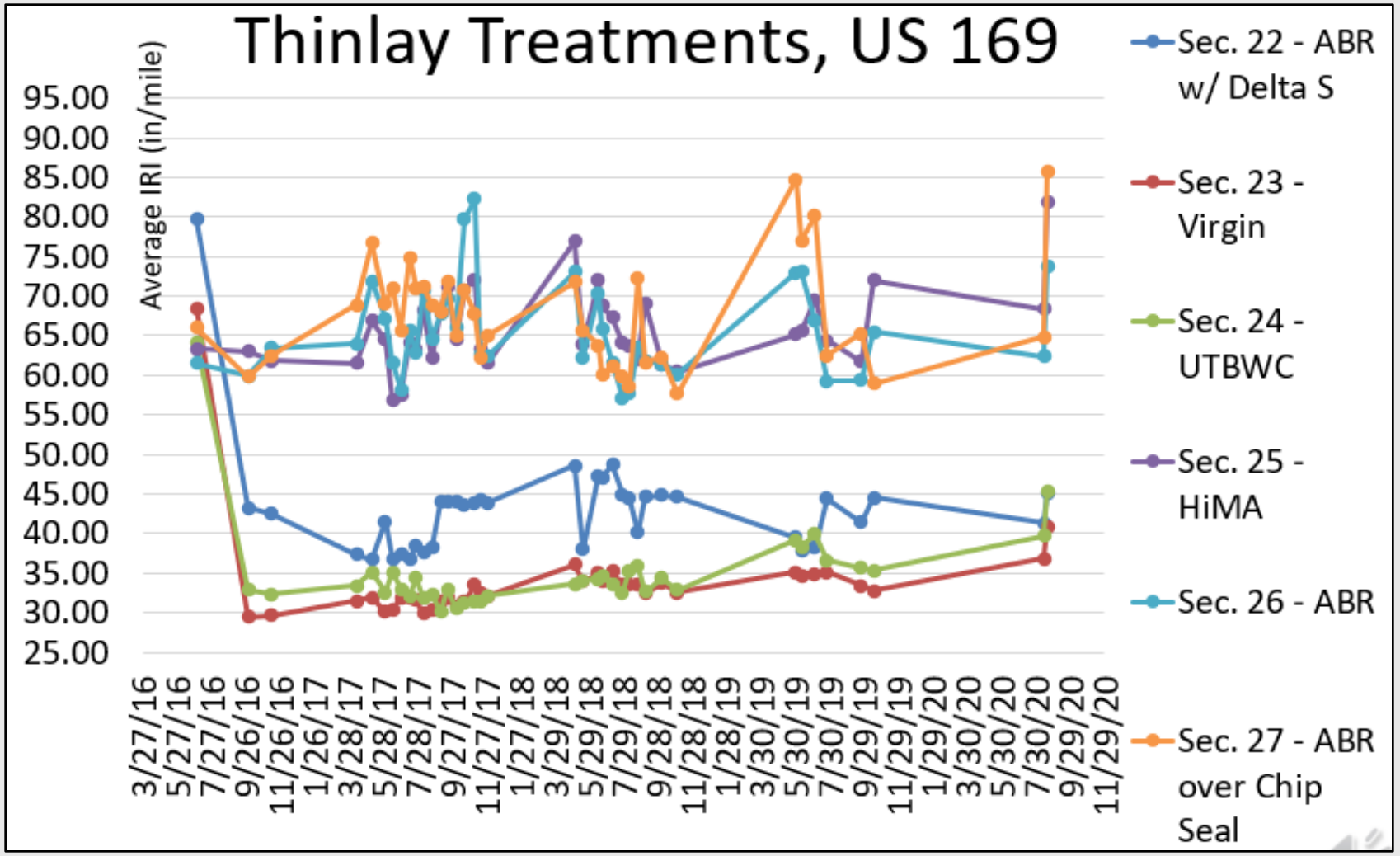
12/14/2021

TH169 and CSAH 8

- **Control Sections**
- **Surface Treatments**
  - Crack Sealing
  - Fog Seal
  - Chip Seals
  - Scrub Seals
  - Micro surfacing
  - Treatment Combinations
- **Thin Overlays (3/4”)**
  - Dense Graded (4.75 mm)
  - OGFC UTBWC
  - Treatment Combinations

Current Research

- Sections 22, 23 & 24 were micromilled with a machine fitted with a 12‘ wide milling head.
- Sections 25, 26 & 27 were micromilled with a machine fitted with a 7‘ wide milling head.
- ABR – Asphalt Binder Replacement can be a rejuvenator, RAP, RAS, etc.



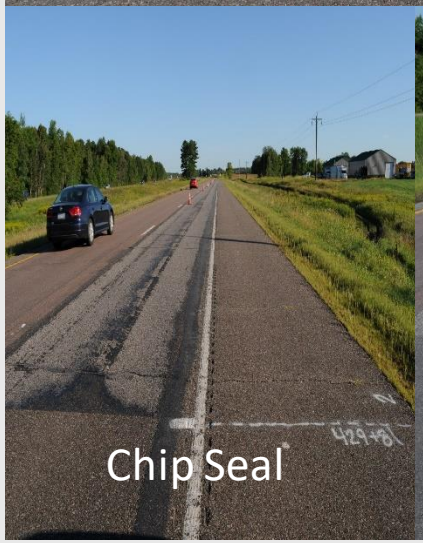
Current Research

Observations – TH 169 & CSAH 8

- Fibermat chip seal is performing better (less chip loss) than standard chip seal. Higher emulsion rate of about 0.40 gal./sy
- Cape Seal (chip seal covered with micro-surfacing, UTBWC or thinlay) is strong performer.
- Crack treating (sealing and filling) prior to placing a thin surface treatment is important.

Goal of Study

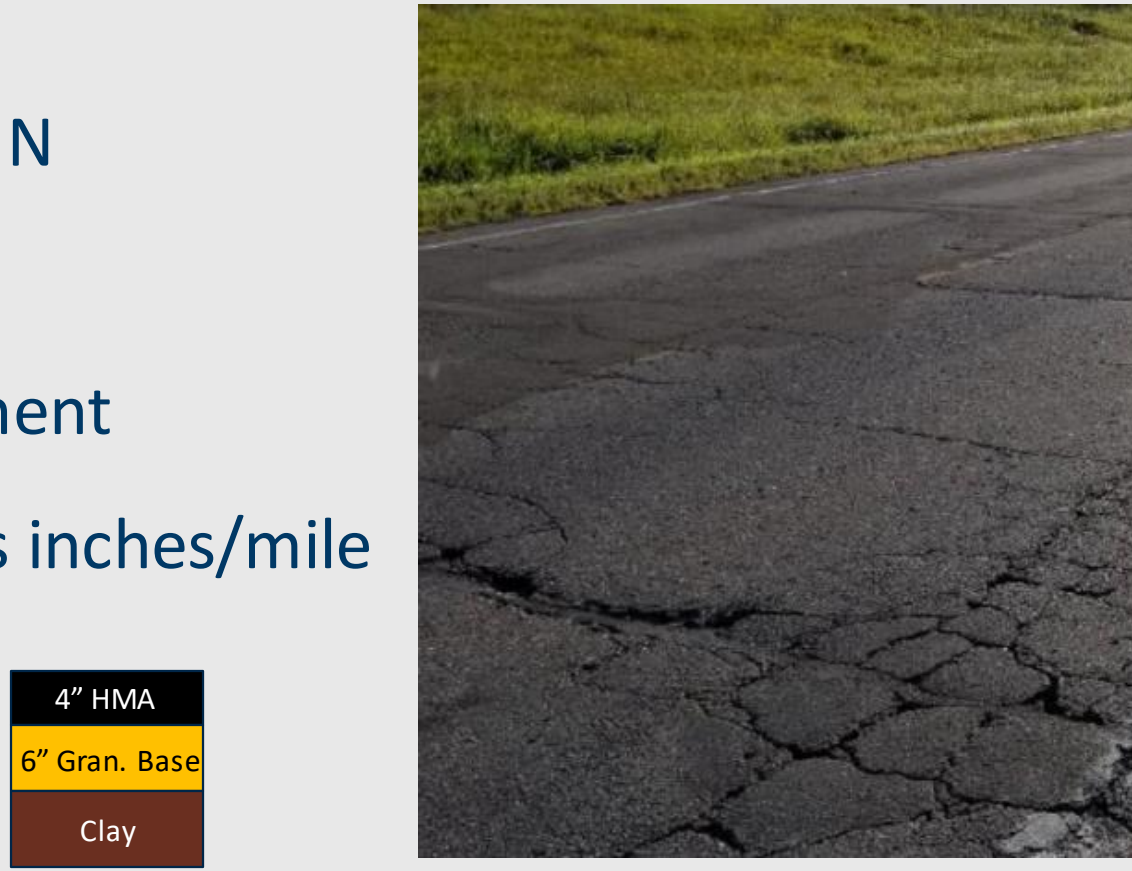
- National study looking at both warm and cold climates.
- Quantify the “Life Extending Benefit” of treatments.
  - Improve/extend pavement life
  - Cost effectiveness



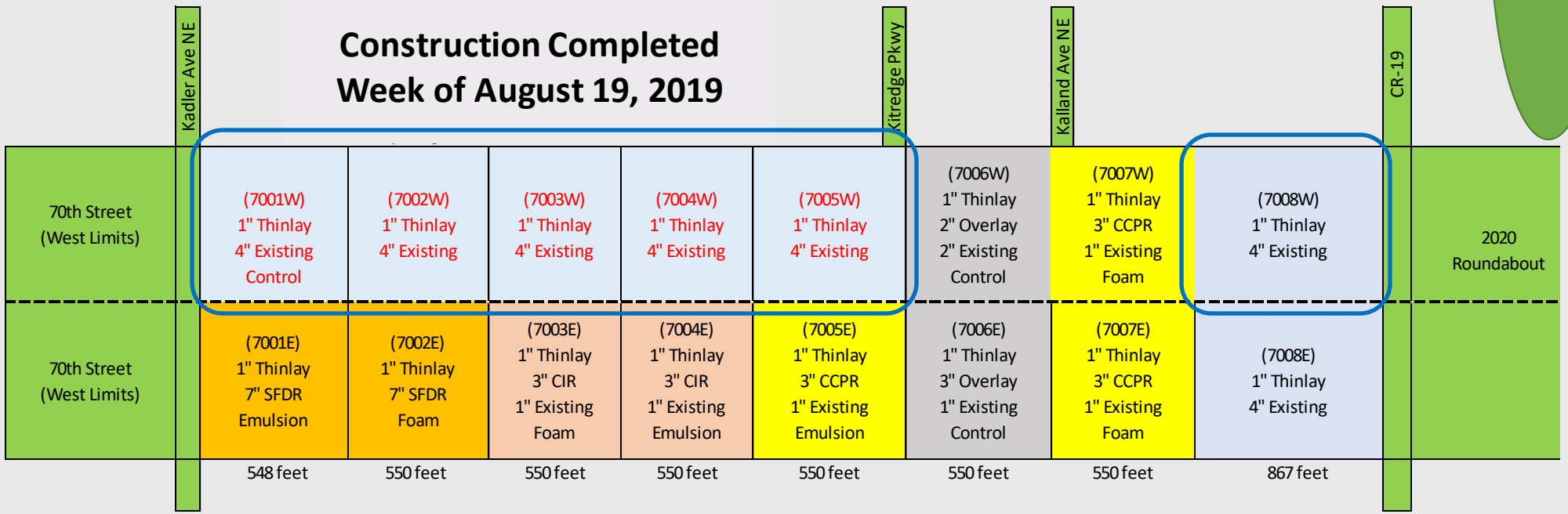
70th St. NE in Albertville/Otsego

Existing Conditions

- EB – Albertville, MN
- WB – Otsego, MN
- About 1 mile segment
- IRI = 270's to 420's inches/mile
- Existing section



70th St. NE in Albertville/Otsego



70th St. NE in Albertville/Otsego

Overview/Comments on Thinlays

- Test sections were constructed in 2019.
- No micromilling performed.
- Six thinlay (1”) test sections were placed over the existing pavement.
- 1” Thinlay was 4.75 mm gradation with 20% RAP and 6.4% binder (PG 58 -28).
- Post construction IRI’s ranged from mid 60’s to 90 in./mi. Initially 270’s to 330’s.
- Averaging 5-6 in./mi. IRI loss per year.
- After two years of observations IRI’s = mid 80’s to mid 100’s.

THANK YOU!

Questions?

Joel Ulring, MnDOT Pavement Preservation Engineer