




NRRA
National Road Research Alliance

MnROAD
SAFER, SMARTER, SUSTAINABLE PAVEMENTS THROUGH INNOVATIVE RESEARCH

National Road Research Alliance Update

Wisconsin Asphalt Paving Association 64th Annual Conference
Wisconsin Dells, Wisconsin -- November 29, 2023

Benjamin Worel, P.E.(MN)

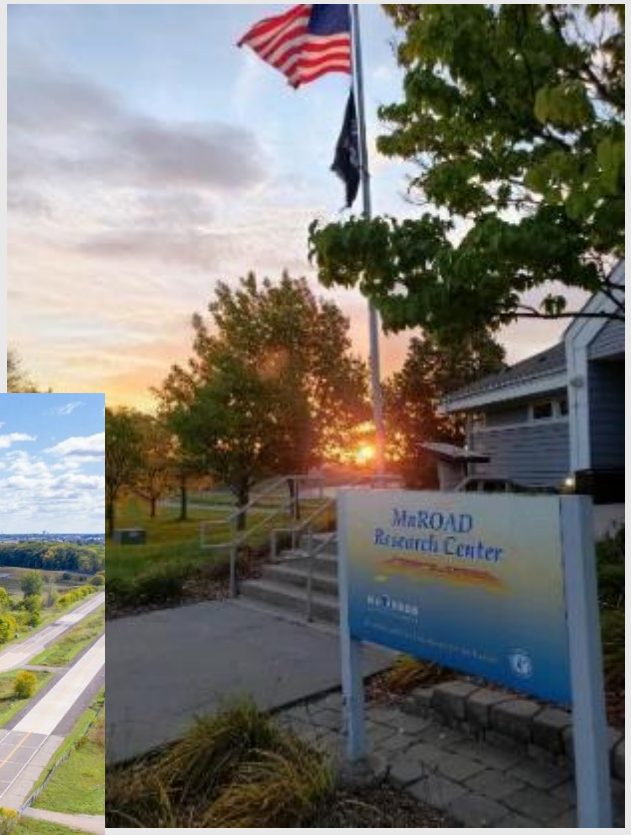
MnROAD Operations Engineer

NRRA Executive Director

DEPARTMENT OF TRANSPORTATION

Outline

Focus on the power of good people, quality data, and Partnership Opportunities



- MnROAD Relationship with NRRA
- National Road Research Alliance (NRRA)
- MnROAD / NCAT Partnership

MnROAD and NRRA

- **MnROAD Owned and Operated by Minnesota DOT**
  - **27 Dedicated Road Research Staff**
  - **10 MnROAD Staff**
- **HMA and PCC Research**
- **30 Years of Long-Term Customer Service**
  - Minnesota Department of Transportation (MnDOT)
  - Minnesota Local Road Research Board (LRRB)
  - National Partnerships (SHRP II / NCHRP / FHWA)
  - National Center of Asphalt Technology (NCAT)
  - National Road Research Alliance (NRRA)

LRRB

NRRA National Road Research Alliance

Strategic Implementation Through Cooperative Pavement Research

DEPARTMENT OF TRANSPORTATION

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

MnROAD SAFER, SMARTER, SUSTAINABLE PAVEMENTS THROUGH INNOVATIVE RESEARCH

MnROAD- Minnesota Road Research Facility

Also includes

- **MnROAD Farm Loop**
- **MN-6**
- **US-169 / CSAH-8**
- **15th Street**
- **70th Street**
- **+ Others**

mndot.gov

Mack Tractor (93406) with Fruehauf Trailer (93410)

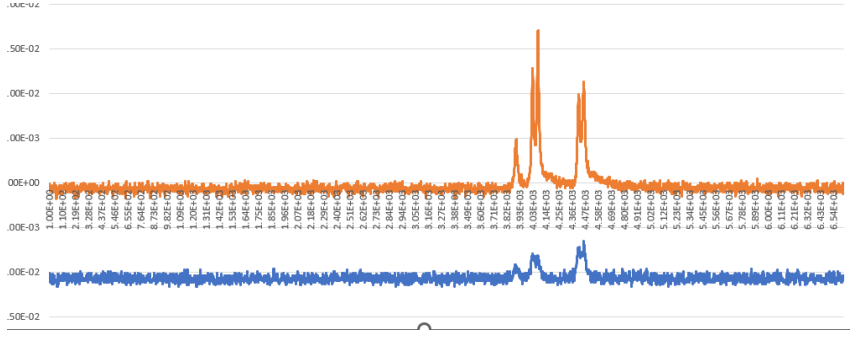
MnROAD Sensor Data

- **Sensors**
  - MnROAD Data Collection Network
  - ~15,000+ Sensors Installed
  - Static (every 15 min)
    - Temperature
    - Moisture
    - Joint Opening
    - Concrete Maturity
    - Environmental Stain
    - Pressure
    - Ground Water
    - Frost Depth

Each Data type has detailed information on the equipment and data collection used

- Dynamic Data
  - Live Traffic Loading - Controlled Loading
  - Earth Pressure Cells
  - Pore-Water Pressure
  - Asphalt and Concrete Stains
  - Displacement

- 2 Weather Stations
- Traffic Data
  - 2022 Installing a new systems

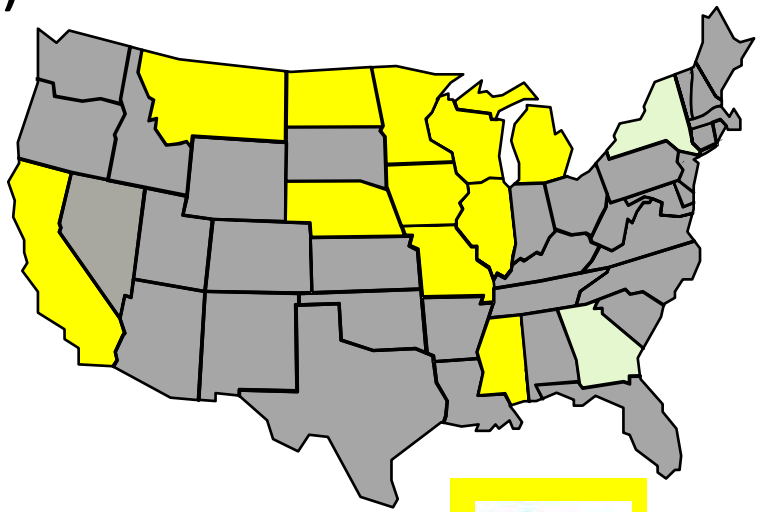


National Road Research Alliance Membership Overview

NRRA National Road Research Alliance

TPF-5(466) - Fee Structure / year (five years)

- **Phase-1 complete** (5 yr) **– Now into Phase-2** (year 2/5)
- **13 Full Agency Commitments (yellow)**
  - $75K /$150K Annual Commitment
  - 11 States, Illinois Tollway, LRRB
  - FHWA is also a contributing partner
- **2 ICT Commitments (Green)**
  - $25K (ICT Team only – Veta Efforts)
  - GA and NY
- **~85+ Associate membership**
  - 2K/year - Associations, Industry, Consultants, Universities
  - Upper Great Plains Transportation Institute



Illinois Tollway

LRRB Local Road Research Board

U.S. Department of Transportation Federal Highway Administration

National Road Research Alliance Overview

- **NRRA has averaged ~$1 million research/year**
- **NRRA Funded 48 projects (phase1) and 14+13 (phase2)**
  - Short and long term research
  - Multiple Researchers Contracted
- **2023 Call for Innovation ~$1.7 million**
  - 55 Proposals Received
  - 22 Proposals Prioritized by the Technical Teams
  - **13** Projects being funded (counted above)
    - TAP being developed
    - TAP finalize workplans
    - MnDOT contracting
- **2017 & 2022 MnDOT provided MnROAD construction funding**
- **2024 MnROAD is receiving 1 million in mainline construction funding**

National Road Research Alliance Overview

- **Organizational Structure**
  - Executive Committee (2 reps/agency)
  - 5 Technical Teams (agency and associate reps)
    - Technical Chairs
    - MnDOT Representative
  - MnROAD Facility Utilized

  - Outreach is done in the technical teams
    - Lauren Dao, MnDOT

MnROAD
SAFER, SMARTER, SUSTAINABLE PAVEMENTS
THROUGH INNOVATIVE RESEARCH

National Road Research Alliance (Flexible Technical Team Membership)

Caltrans
Kee Foo*
Raghubar Shrestha*

FHWA
Peter Eakman

Illinois
Brian Hill*
James Trepanier
Charles Wienrank*

Illinois Tollway
Jay Behnke*
Ross Bentsen*
John Lavallee

Iowa
Chris Brakke*
Ashley Buss*

Michigan
Andrew Bennet
Tyler Hunt
Kevin Kennedy
Nathan Maack*

Minnesota
Michael Vrtis, MnDOT
Ryan Baasen
Emil Bautista
Shongtao Dai*
John Garrity*
Jerry Geib
Joseph Podolsky
Dave Van Deusen
Ben Worel
Eyoab Zegeye Teshale

Minnesota LRRB
James Foldesi*

Mississippi
Heath Patterson*
Griffin Sullivan*

Missouri
Jason Blomberg*
Paul Denkler
Willie Johnson*
Dan Oesch

Montana
Josh Heck*
Oak Metcalfe*
Matt Needham

Nebraska
Bruce Barrett*
Lieska Halsey
Wally Heyen
Robert Rea
Brandon Varilek

North Dakota
Curt Dunn, chair
Andy Ayash
Amy Beise
Brandon Bennes
Matt Kurle
Matt Linneman
Arlen Norris
Korby Seward
Tyler Wollmuth*

Wisconsin
Ali Arabzadeh*
Dan Kopacz*
Tirupan Mandal
Ali Morovatdar
Barry Paye*

* indicates voting agency member

National Road Research Alliance (Flexible Technical Team Associate Membership)

Mohiuddin Ahmad, University of Texas-El Paso (UTEP)
Riaz Ahmad, iENGINEERING Corporation
Allen Akowicz, Pacific Geosource
Edith Arambula, Texas A&M Transportation Institute
Jason Bausano, Ingevity
Thomas Bennert, Rutgers University
Jay Bianchini, Collaborative Aggregates
Justin Black, Cargill
Andrea Blanchette, Terracon
Brandon Brever, Minnesota Asphalt Pavement Association (MAPA)
Tom Brovold, Testquip
Bill Buttlar, University of Missouri - Columbia
Mike Byrnes, Mathy Construction Co.
Douglas Carlson, Liberty Tire Recycling
Eshan Dave, University of New Hampshire
Jonathan Davis, Uberbinder
Mohamed Elkashef, University of California Pavement Research Center
Amy Epps Martin, Texas A&M Transportation Institute
Rouzbeh Ghabchi, South Dakota State University
Oliver Giraldo-Londono, University of Missouri - Columbia
Stacy Glidden, Payne & Dolan
Jonathan Groeger, iENGINEERING Corporation
Fan Gu, NCAT
Elie Hajj, University of Nevada - Reno
Bill Hall, Resource Recycling Systems
Katie Hasslett, HRG Lab
Majeed Hayat, Marquette University
David J. Jones, University of California Pavement Research Center
Dennis Kelley, J. Rettenmaier USA LP
Lev Khazanovich, University of Pittsburgh
Candice Kohn, Pacific Geosource
Emin Kutay, Michigan State University
Brett Lambden, Husky Energy
Fabricio Leiva, Pacific Geosource
Chad Longcore, J. Rettenmaier USA LP
Rajib Mallick, UTEP
Todd Mansell, Caterpillar Paving Products
Mihai Marasteanu, University of Minnesota - Twin Cities
Ken Maser, Infrasense
Luke Meyer, Bio-Based Spray Systems
Danial Mirzaiyanrajeh, Solmax
Kiran Mohanraj, The Transtec Group
Pete Montenegro, Collaborative Aggregates
Raquel Moraes, NCAT
Chibuike Ogbo, Terracon
Eric Olson, Solmax
Brian Orr, BASF
Andrew Peterson, South Dakota State's Local Transportation Program
Hadi Rashidi, National Stone Sand and Gravel Association (NSSGA)
Dave Rettner, American Engineering Testing
Farhad Reza, Minnesota State University - Mankato
Roger Roberts, GSSI
Mohammad Reza Sabouri, Braun Intertec
Baris Salman, Syracuse University
Michael Scardina, Surface Tech
Nick Schaefer, Surface Systems and Instruments, Inc. (SSI)
Debbie Schwerman, Wisconsin Asphalt Pavement Association
Jo Sias, University of New Hampshire
Dan Staebell, Asphalt Pavement Alliance (APA)
Dave Stanczak, Asphalt Materials, Inc.
Brandon Strand, Asphalt Pavement Alliance (APA)
Nabil Suleiman, University of North Dakota
Hassan Tabatabaee, Cargill
Cheng Thao, Payne & Dolan
Chris Theriot, Resource Recycling Systems
Kim Tolzmann, Hardrives
Derek Tompkins, American Engineering Testing
Feng Wang, Texas State University
Hao Wang, Rutgers University
Randy West, National Center for Asphalt Technology (NCAT)
Jason Wielinski, ARRA
R. Chris William, Asphalt Materials & Paving Program (Iowa State)
Richard Willis, National Asphalt Pavement Association (NAPA)
Trey Wurst, Ingevity
Jett Yang, Uberbinder
Fan Yin, NCAT
Hao Yin, Horizon Engineering Consulting
Zhanping You, Michigan Tech Transportation Institute
Fujie Zhou, Texas A&M Transportation Institute

2022 MnROAD Construction Overview

Main theme from NRRA: Sustainability and Resilience

What new materials will help meet future sustainability guidelines?

NRRA
National Road Research Alliance

45 New Test Sections

- 4 – In-Place Recycling
- 4 – Preventive Maintenance
- 6 – PCC Innovative Patching / Diamond Grinding
- 16 – PCC Reduced Cement
- 1 – PCC WIM area
- 2 – PCC Recycled Fiber
- 2 – HMA Perpetual Pavement
  - 1 of 2 with Wicking Geotextile
- 10 – Reflective Cracking Challenge

Partners Donated Materials

- CAT – HMA Milling
- Geotextile Fabric
- VRAM – J-Band
- CIR Rejuvenator Donation

MnDOT Furnished Materials

- HMA Plant Mix Furnished (~1/2 mixes)
  - Additive Suppliers
- PCC Plant Mix Furnished (all mixes)
  - Additive Suppliers

National Road Research Alliance (Flexible Technical Team Projects)

Asphalt Mix Rejuvenator Test Sections (added 50K in April 2020)	UNH
Asphalt Mixture Rejuvenator Synthesis	WSB
Cold Asphalt Recycling Technologies using Rejuvenating Asphalt Emulsion: Impact; Implementation; Specification	UNH
Cold Central Plant Recycling	AET
Continued Monitoring of Original I-94 Westbound Asphalt Overlay Sections	UNH
Continued Monitoring of TH6 RA Field Sections	UNH
Field Validation of Using Warm Mix Asphalt at Reduced Production Temperatures for Balanced Mix Design	Auburn University
HMA Overlay and Rehab of Concrete and Methods of Enhancing Compaction	UNH
Impact of Polymer Modification on IDEAL-CT and I-FIT for Balanced Mix Design	NCAT
Innovative Practical Approach To Assessing Bitumen Compatibility As A Means Of Material Specification	Cargill
Longitudinal Joint Construction Performance	SRF
Maintaining Poor Pavements	SRF
MnROAD Reflective Cracking Challenge (NRRA)	UNH / Auburn
Novel Methods for Adding Rejuvenators in Asphalt Mixtures with High Recycled Binder Ratios	Auburn University
Perpetual Pavements in Wet Freeze Climate	RFP
Reclamation and Recycling Techniques to Achieve Perpetual Pavements Characteristics	Braun Intertec
Recycled Binder Availability	RFP
Reflective Cracking Challenge Coordination (Missouri - 400K)	University of Missouri-Columbia
Standardization of SIP Calculation for Hamburg Wheel Tracking Test	Auburn University
Tack Coats	SRF
Understanding and Improving Pavement Milling Operations	University of New Hampshire
Validation of Loose Mix Aging Procedures for Cracking Resistance Evaluation in Balanced Mix Design	Auburn University / UNH - TTI

NRRA Spray-Applied Rejuvenator Study

- **12 different products applied in 2021**
- **Applied at 3 locations**
  - MnROAD 58-28 (50’)
  - MnROAD 58-34 (50’)
  - St. Michael (500’)
- **Measuring long-term:**
  - Friction, paint reflectivity, permeability, asphalt binder
- **Over 1,500 cores taken in first 2 years of study**

2019 NRRA Mix Rejuvenator Study

- 2019 mill/inlay job in Northern Minnesota (Emily, MN)
- 7 Rejuvenating Products
- 40% RAP content – targeted xx-34 (original 58-28)
- Measuring long-term:
  - Field performance, asphalt binder + mix properties,
- NRRA Funded for additional 4 years!

NRRA HMA Perpetual Pavement

- **Test Sections Built**
  - 2022 – Minnesota 8.5” HMA perpetual pavement
  - 2023 – Wisconsin Deep Strength HMA 2 sections (12.5” HMA) Osseo, WI on I-94
  - All sections have instrumentation for temperature, moisture, strain and pressure
- **Combined Research – RFP coming out 2024**

2022 MnROAD Reflective Cracking Challenge

- **Study Designed to match research to Typical agency applications**
  - BOB = bituminous over bituminous ~50% network

Statewide (All Districts)

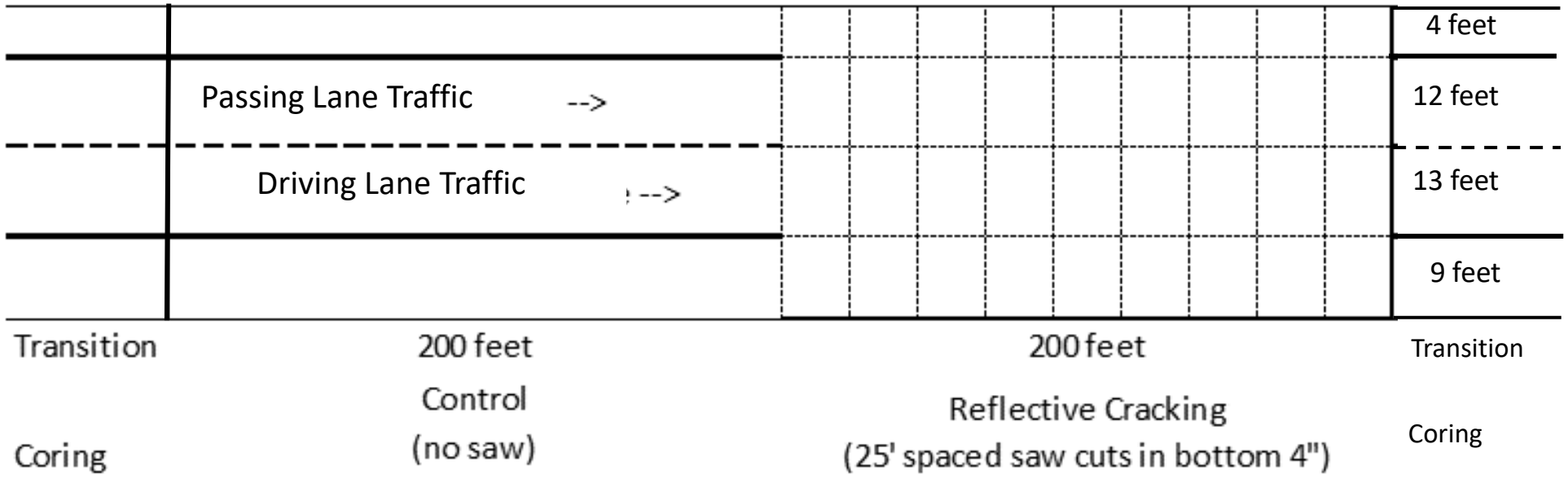
Pavement	Percent	Miles
BIT	12%	1,682
BOB	50%	7,104
BOC	22%	3,136
CON	17%	2,377
CRCP	0%	2
All	**100%**	**14,301**

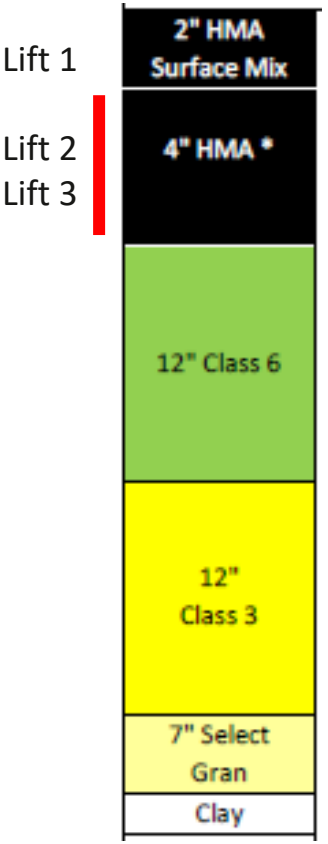
Pavement	PQI	RQI	SR
BIT	3.6	3.5	3.8
BOB	3.3	3.2	3.4
BOC	3.4	3.3	3.6
CON	3.6	3.4	3.9
CRCP	3.8	3.6	4.0
All	**3.4**	**3.3**	**3.6**

NRRA Reflective Cracking Challenge
MnROAD Test Sections

10 Test Sections with different HMA surfaces

- Tied to NCAT additive group 2021 construction (NY contribution)
- Missouri funded 400K to tie Missouri Test Sections (HMA/PCC)
- ~450’ of paving per surface mix (50’ transitions)
- 200’ of sawing to recreate/induce reflective cracking
- Milled before final 2” was placed
- VRAM Utilized





Saw-cutting (reflective cracks)

- Full depth (5”) saw cuts were made 24’ through travel lanes
- Cuts were minimally cleaned with leaf blower and wire
- No cleaning after milling

NCAT Additive Group -Surface HMA Mix Details

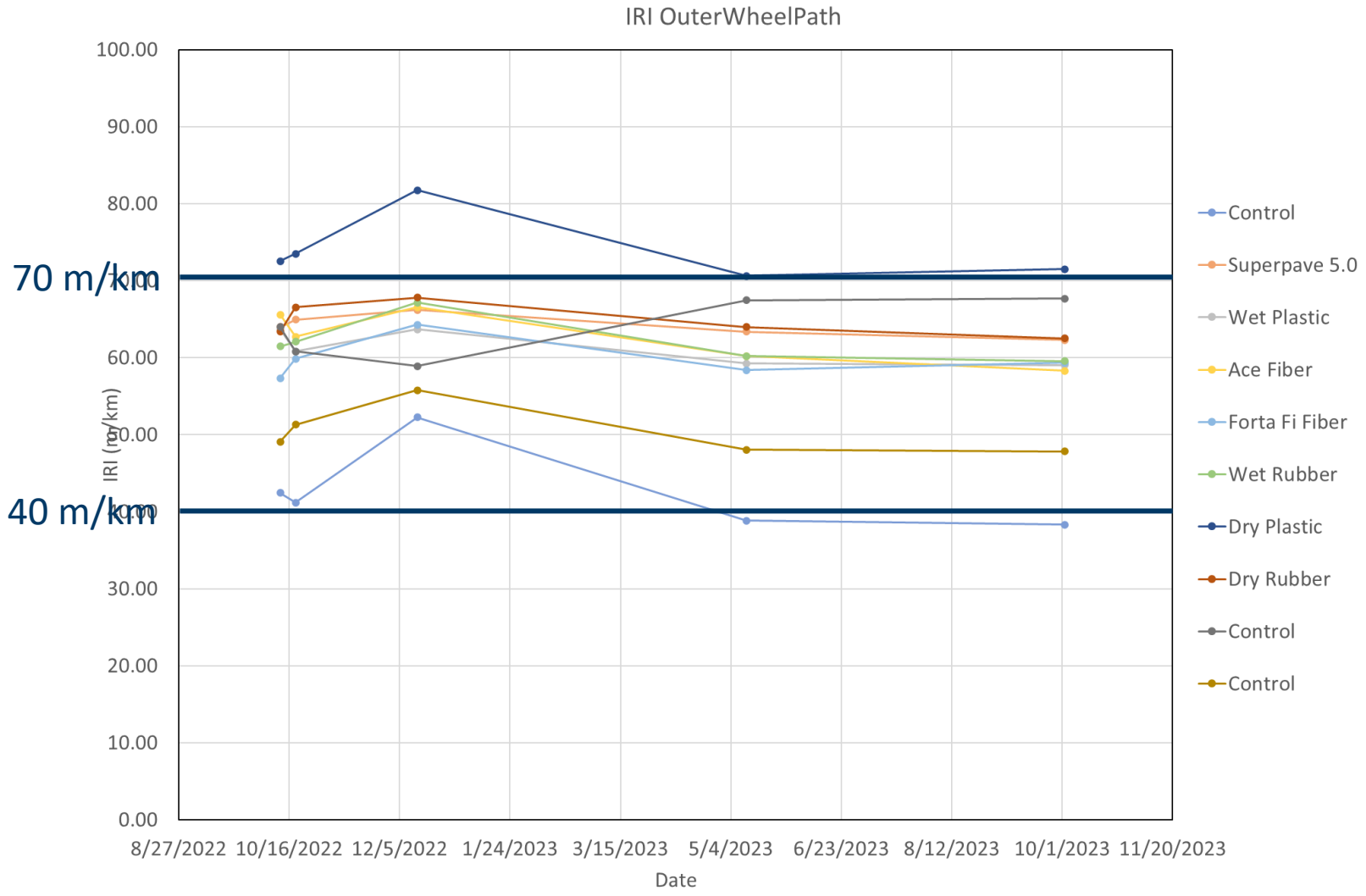
- **10 Sections with differing surface HMA**
  - Controls
    1. PG 58H -34 (modified)
    2. PG 58S -28 (unmodified)
    3. PG ~49 -34 (unmodified)
  - Additive Sections
    4. Aramid Fiber 1 w/ PG 58H -34 (modified)
    5. Aramid Fiber 2 w/ PG 58H -34 (modified)
    6. Dry Plastic Additive w/ PG ~49 -34
    7. Dry Rubber Additive w/ PG ~49 -34
    8. Wet Plastic Additive
    9. Wet Rubber Additive

    w/ PG 52-34 from Mathy
  - Super Pave 5.0
    10. PG 58V -34 (modified) (NRRA)

- **All mixes contain**
  - MnDOT Traffic Level 5 (10<30 mESALS)
  - Superpave Gyratory BMD
  - ¾” Max Agg (SP 12.5mm)
  - 20% RAP

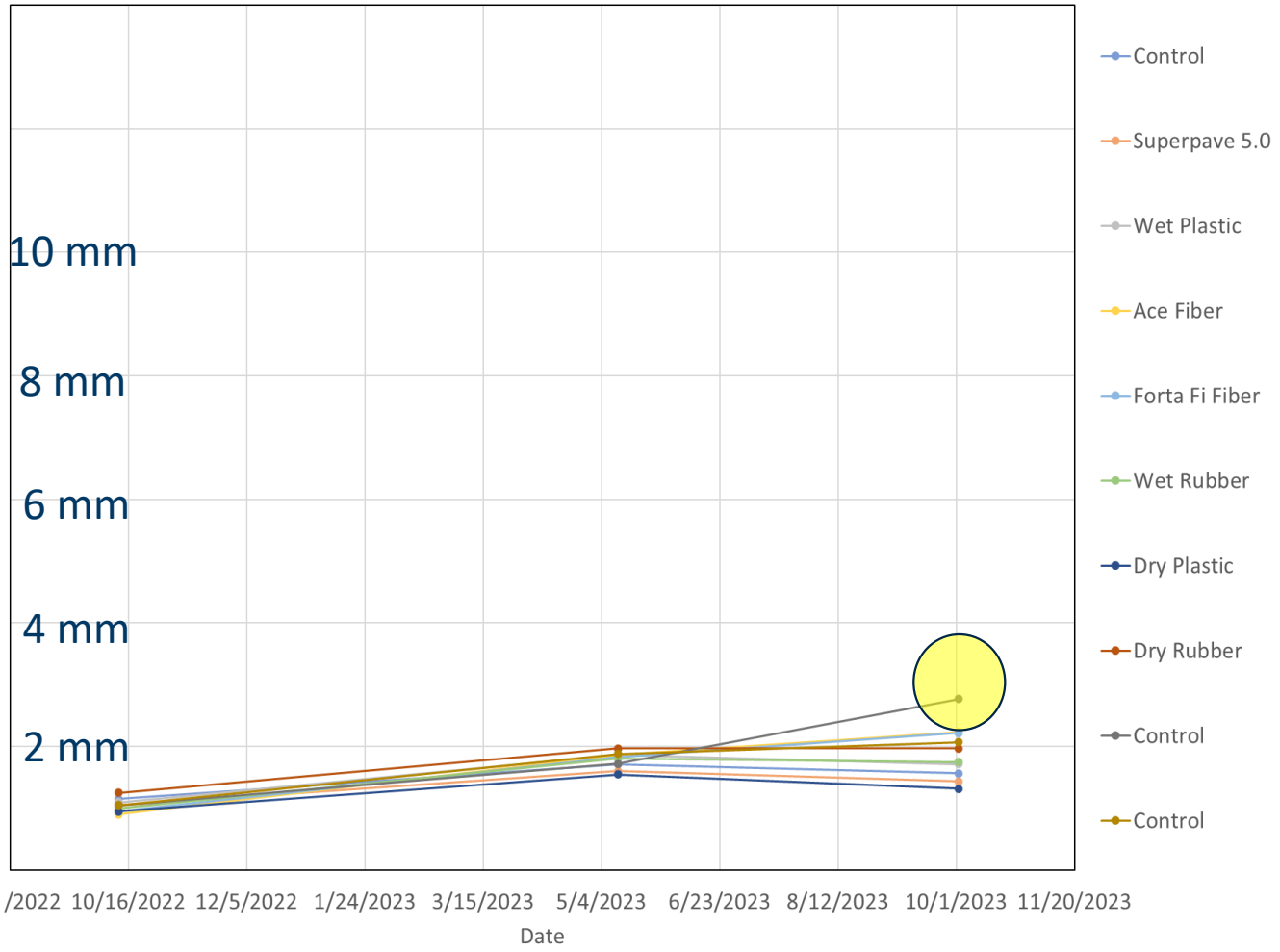
Reflective Cracking Challenge Performance

Good initial ride and no change over 1st year



Reflective Cracking Challenge Performance

No rutting over 1st year but maybe developing in PG49-34 Control Section



National Road Research Alliance (ICT Technical Team Projects)

Levels 3-4 Intelligent Compaction Measurement Values (ICMV) for Soils Subgrade/Aggregate Subbase Compaction	Transtec Group
Support Importing, Viewing and Analysis of Dielectric Constant Data in Veta (paid by Veta pooled fund)	Transtec Group
HD and VHD Seismic Approaches for Roadway Evaluation	Park Consulting
Asphalt Real Time Smoothness (ARTS) for Asphalt Paving	Transtec Group
Veta Web and Veta MDMS Standardized Platform	Transtec Group
InfoPAVE MnROAD Database Support and Development	i-Engineering
Effective Use of Traffic Speed Deflectometer for Network-based and Project-based Applications	UTEP
Establishing Applicability of NDT Methods for Project-Level Evaluation	UTEP
E-Ticketing	SRF

- **Veta Software** TPF-5(334) now NRRA
- HMA Rolling Patterns
- Paver Operations / IR Temperature Bar
- 3D GPR / Rolling Density Meter

MnROAD / NCAT Partnership

Formalized Partnership working on National Needs:

- Full scale accelerated test facilities
- North / South Climatic Zones / Sections
- CAPRI (NCAT Lead National HMA Consortium)

Cracking Group Experiments

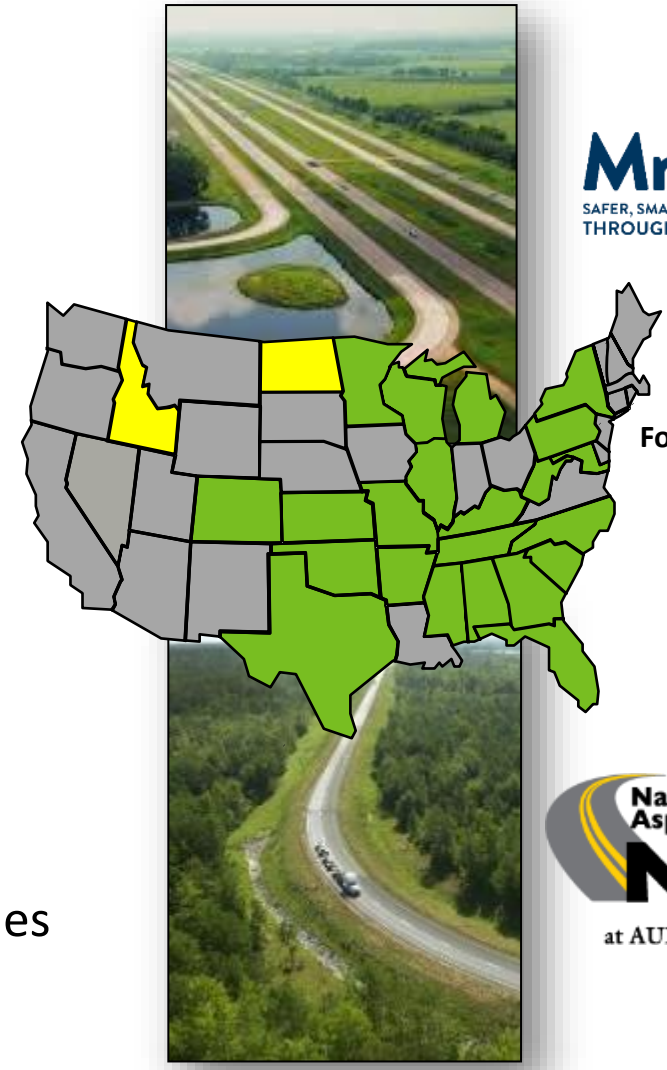
- 6 year of partnership with 10 Government Agencies
- HMA cracking test for LTC and fatigue cracking

Additive Group Experiment

- NCAT focus on fatigue cracking
- MnROAD focus on Reflective Cracking
- Continued National Research Coordination

Preservation Group Experiments

- Life extending benefits of pavement preservation techniques
- 8 year of partnership with over 24+ agencies
- Developing next phase – starting in January 2024



MnROAD
SAFER, SMARTER, SUSTAINABLE PAVEMENTS THROUGH INNOVATIVE RESEARCH

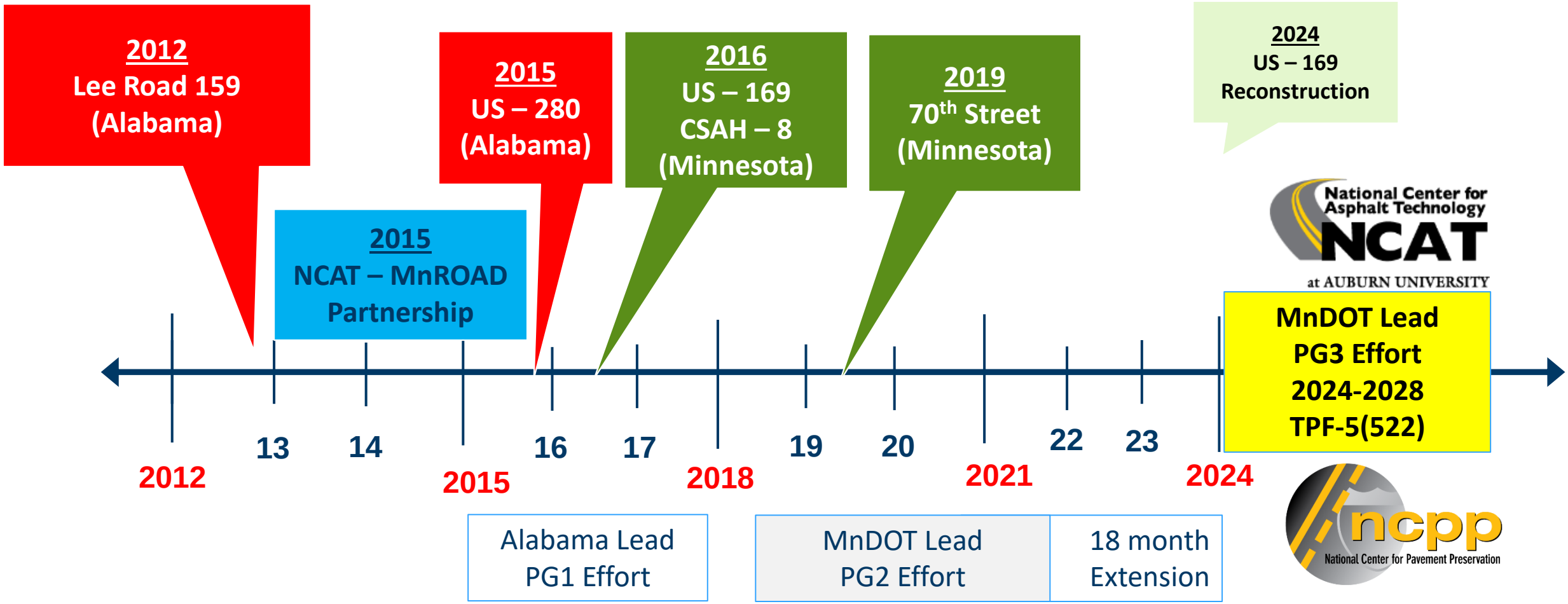
Foundation for Pavement Preservation

Industry members

FHWA

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Preservation Group Study



NCAT/MnROAD Preservation Group (PG) Effort (Northern In-Place Recycling – 70th Street)

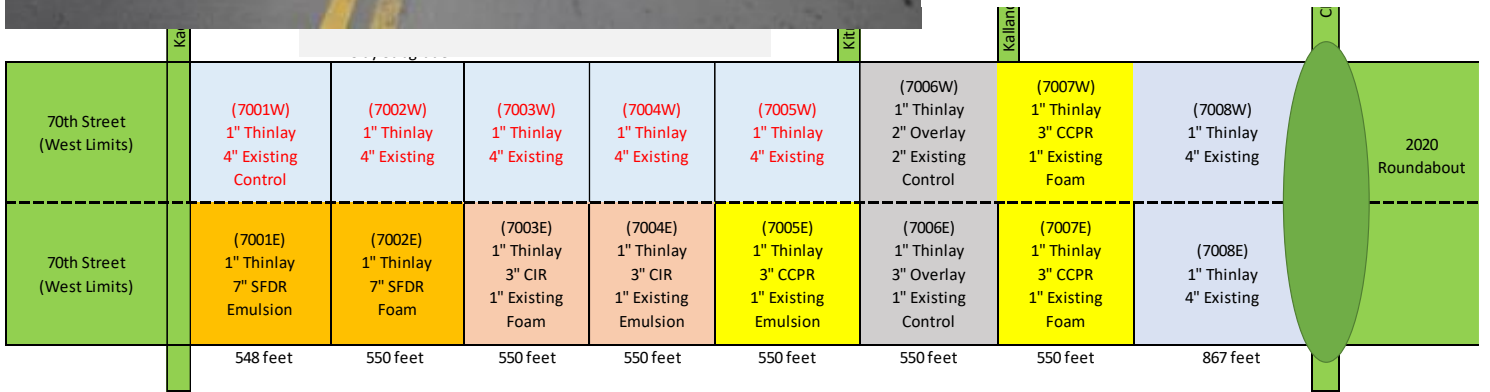
2019 Construction (Thinlays over)

- Control (no other work)
- SFDR (foam-emulsion)
- CIR (foam-emulsion)
- CCPR (foam-emulsion)
- 2 Regular Mill/Fills

2 Year Observations

- Ride (IRI)
  - 2019 IRI over 300 in/mi
  - 2021 IRI 60-100 in/mi
- Reflective Cracking
  - Difference in controls and recycled sections cracking
- Rutting – not an issue

1 Mile
16 Test Sections

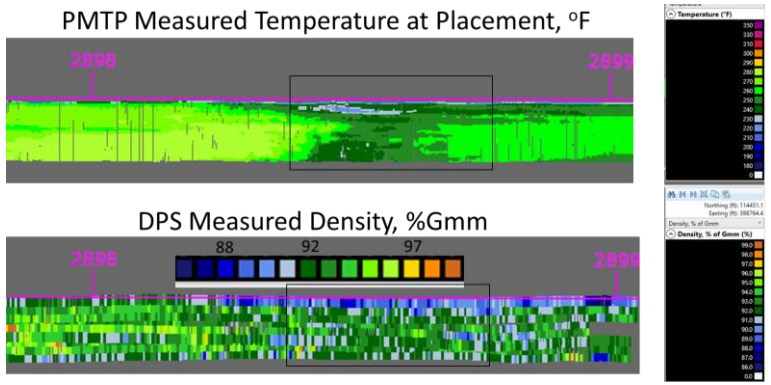


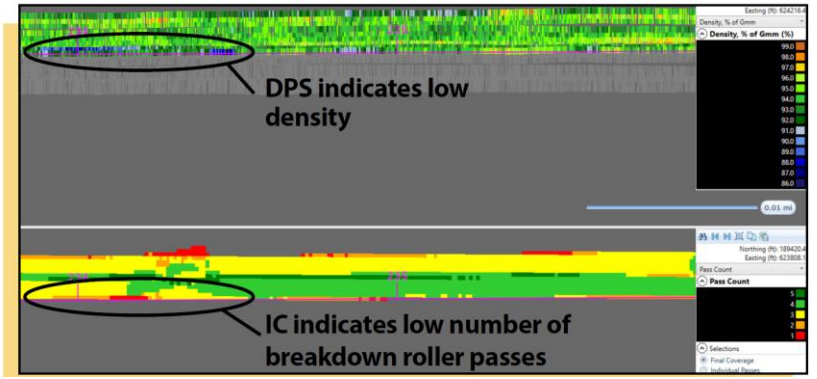
DPS National Pooled Fund Program

DPS Contacts - Materials & Road Research - MnDOT
www.dot.state.mn.us

Continuous Asphalt Mixture Compaction Assessment Using Density Profiling System (DPS) [TPF-5(443)]

- **Objective:** Use the DPS method to improve asphalt pavement density
  - Increased coverage and comprehensiveness of assessment
  - Timely information to improve construction process
  - Reduce coring
- **Lead Agency:** MnDOT
  - Contact: Kyle Hoegh, kyle.hoegh@state.mn.us (MnDOT)
- **Committed agencies:** MN, FHWA, GA, ID, MD, ME, MO, MS, ND, NY, OH, PADOT, UT, WA, WI
- **Commitment level**: $25K/year





Continuous Bituminous Pavement Stripping Assessment Through Non-Destructive testing

TPF-5(504): Continuous Bituminous Pavement Stripping Assessment Through Non-Destructive testing (4 years)

- **Objective:** Develop testing and analysis procedures for automatic detection and rating of stripped section for project and network level pavement evaluations
- **Lead Agency:** MnDOT
  - Contact: Eyoab Zegeye, eyoab.zegeye@state.mn.us (MNDOT)
- **Committed agencies:** MN, IL, MO, TN, MS, TX, GA & FHWA
- **Pending**: CA, KS, WI, VA and IN
- **100% SP&R Approval:** Approved
- **Commitment level**: $25K/year

U.S. Department of Transportation
Federal Highway Administration

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DEPARTMENT OF TRANSPORTATION

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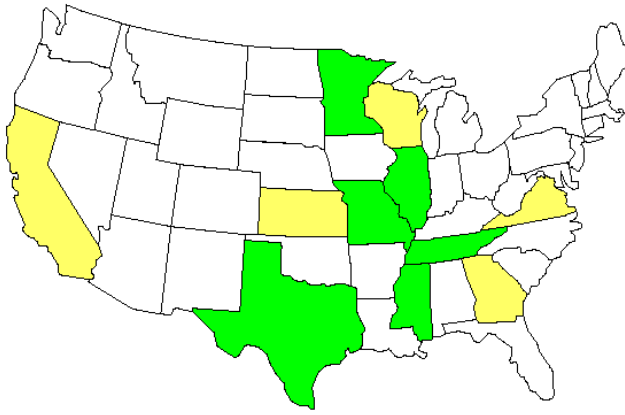

SCAN US

“MnROAD Construction Prospects”

Fall of 2023

- Wisconsin Perpetual Pavement Installation (done)
- Local Reflective Cracking Experiment (done)
  - 4 Cells on the LVR (31,77,78,79)
- Unbound Water Repellency (done) - NRRA/NSF – 2 Cells (NW corner of the LVR)

2024

- HMA Stripping Calibration Sections – Pooled Fund – 12 Cells (LVR service road)
- 11 Mainline Test Sections (Open for NRRA Planning)
  - NRRA Cement Alternatives
  - NRRA Thick Lift HMA

Questions / Comments

Working together you can be a part of something bigger than yourself

Ben Worel
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How to get involved?

- TPF-5(466) NRRA Membership
- TPF-5(TBD) NCAT 2024 Test Track
- TPF-5(522) PG3 Pavement Preservation
- TPF-5(443) Density Profile System
- TPF-5(504) Non-Destructive Testing
- Research Pays off Webinars (free)