DEPARTMENT OF TRANSPORTATION

LRRB
LOCAL ROAD RESEARCH BOARD

MnROAD Research Advancements though National Partnerships

December 12, 2018

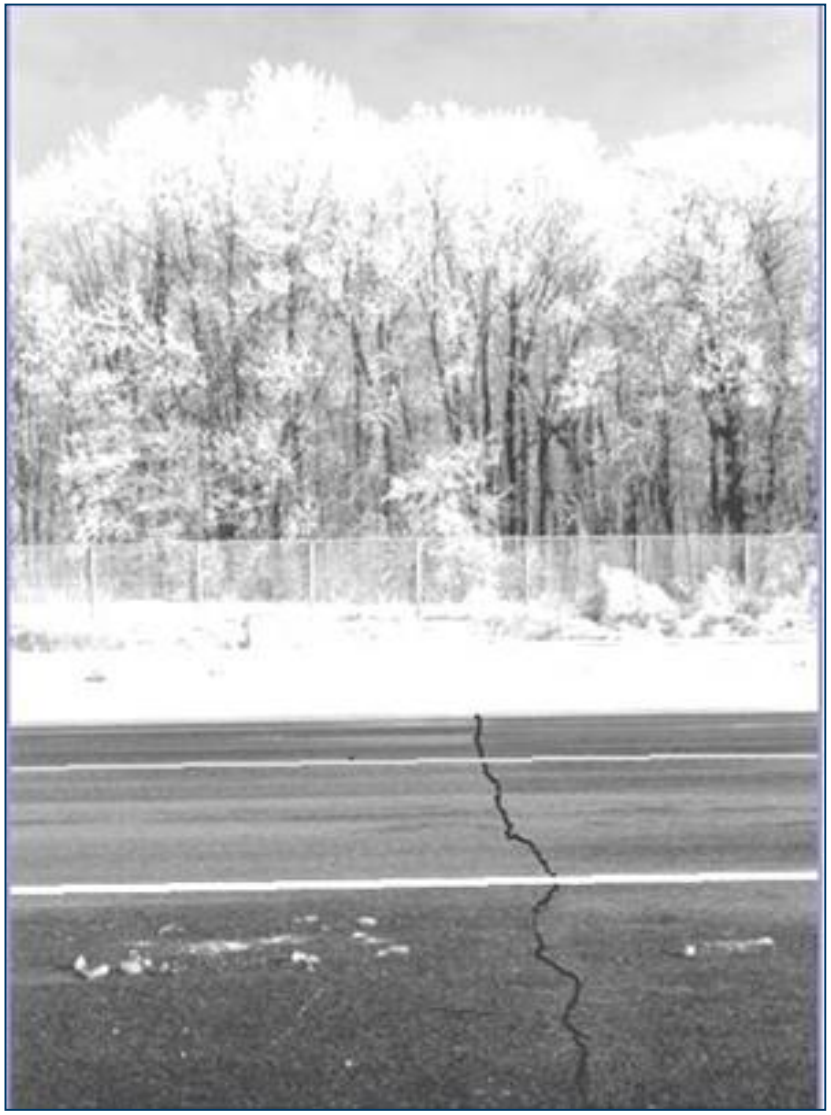
Ben Worel – MnROAD Operations Engineer

NRRA
National Road Research Alliance

MnROAD
Safe, Smooth, Sustainable Pavements Through Innovative Research

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

MnROAD Research Advancements though National Partnerships



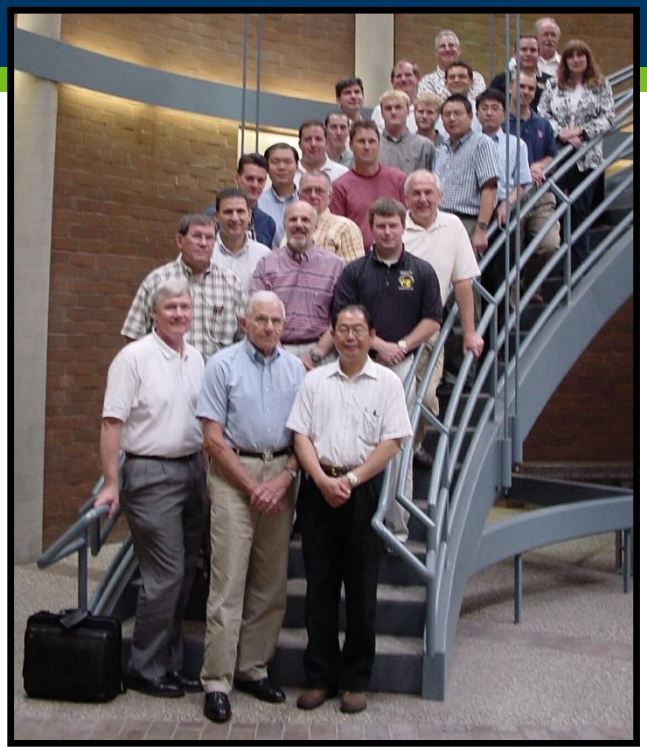
Why Research

MnROAD Background

Partnerships/Advancements

Outreach/Future

First of All – Thank you Illinois



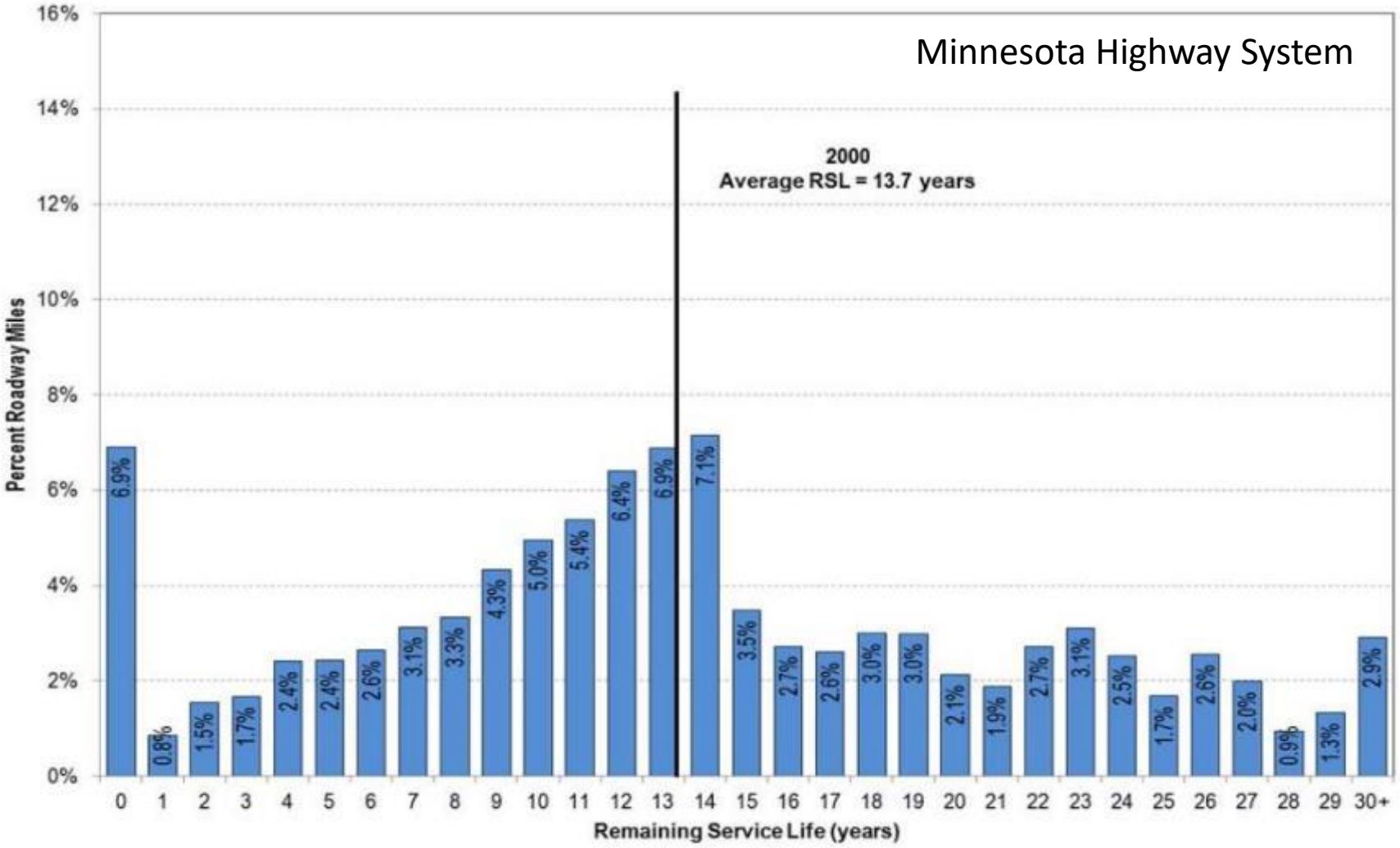
Current Pooled Funds (MnDOT)

- National Accessibility
- Clear Roads
- National Road Research Alliance
- Enhancement Intelligent Construction Data Management System (Veta)
- NCAT Pooled Fund
  - Cracking Experiment
  - Preservation Experiment

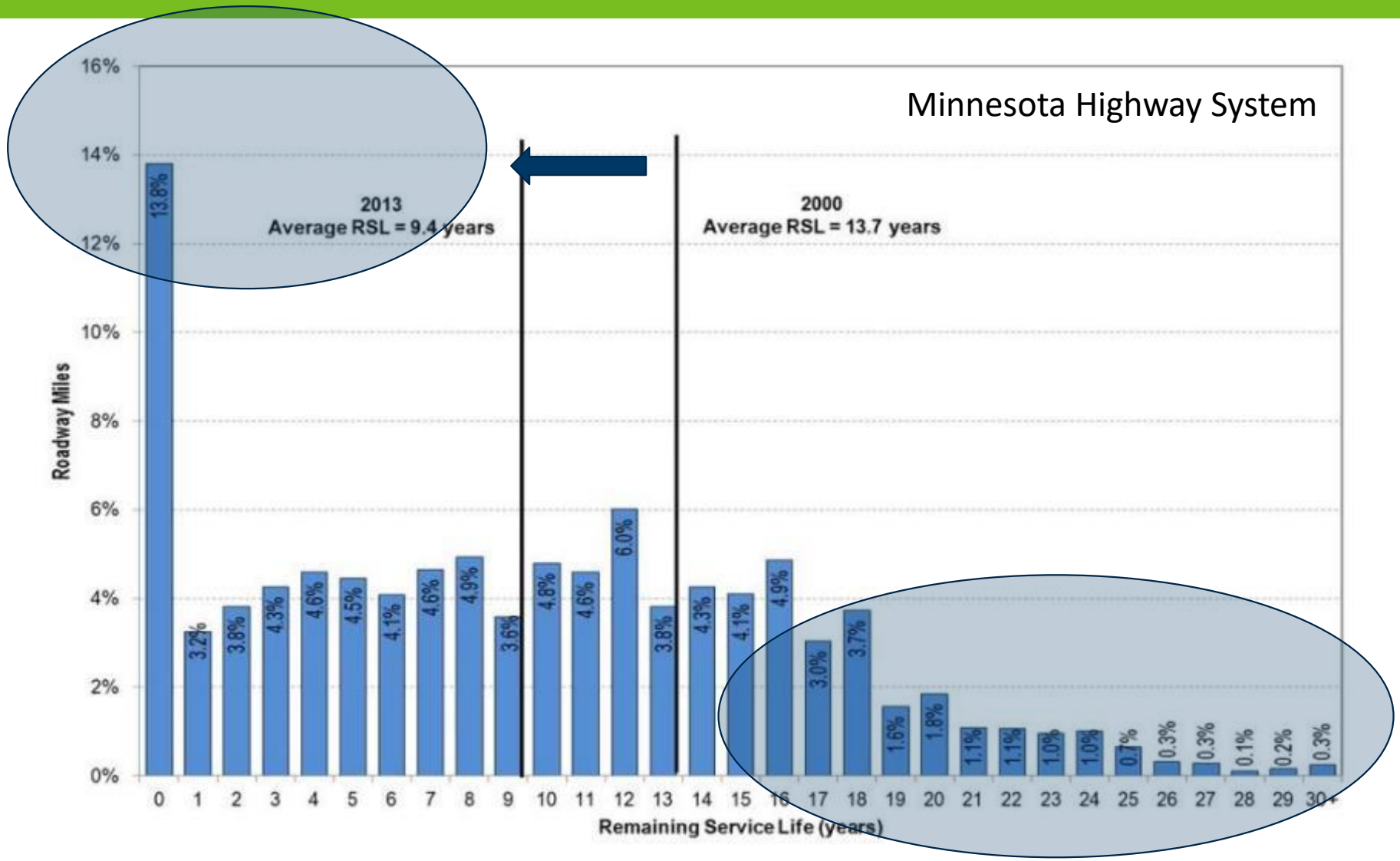
Past Pooled Funds

- Low Temperature Cracking (phase-I and II)
- 2008 MnROAD Phase-II Research
- Wide Based Tires
- Many others + University of Illinois Studies

Why Invest into Pavement Research?



Why Invest into Pavement Research?



MnROAD History

- **MnROAD Owned and Operated by Minnesota DOT**
- **23-Years of Long Term Customer Service**
  - Minnesota Department of Transportation
  - Minnesota Local Road Research Board
  - SHRP II / NCHRP / FHWA
  - Pooled Funds Efforts (States) / Industry

- **HMA and PCC Pavements**
- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Phase III (2017 -)

NRRA

MnROAD and Minnesota Test Sections

MnROAD Overall Studies

- **35 unique ongoing studies**
- **141 unique test sections**

Interstate 94 Westbound

- **Mainline (3.5 miles)**
  - 12 ongoing studies / 44 test sections
- **Old Westbound (3.5 miles)**
  - 4 ongoing studies / 48 test sections

Low Volume Road

- Local Road Research Board
- (MN - City and Counties)
- 19 Studies / 49 test sections

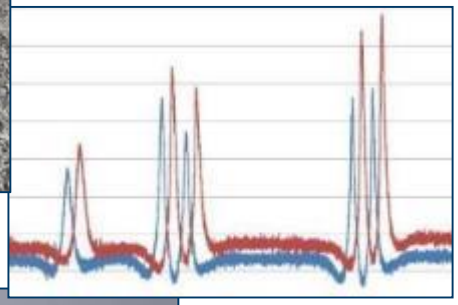
Additional Offsite Test Sections

- Partnership - National Center Asphalt Technology (NCAT)
  - US-169 and CSAH-8
  - 70th and 80th Street (2019)

MnROAD Operations Research Support

- **Research Development**
- **Partnerships**
- **Construction**

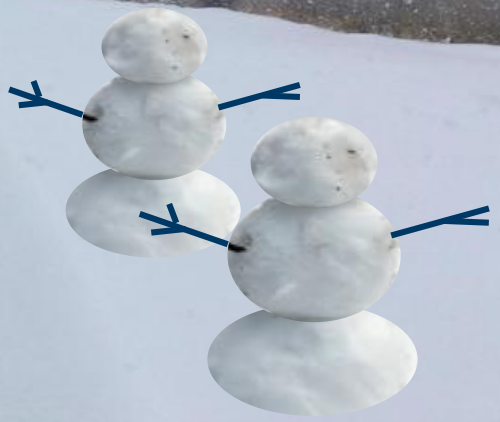
- **Traffic Loadings**
- **Performance Monitoring**
  - Pathways Van
  - Cracking / Rutting / Ride / FWD, …..



- **Sensors**
  - Static (Environmental)
  - Dynamic (Traffic Loading)

- **MnROAD Database**

MnROAD Winter Operations



Plow and Salt

Interstate 94 – Bare Pavement Policy

Low Volume Road – Like a county road

Limited Performance Monitoring

National Research Initiatives

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

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National Pavement Preservation Study

Development of a National HMA Cracking Test


ADEM
Alabama Department of Environmental Management


ALABAMA
Department Of Transportation


Ad Astra Per Aspera
Kansas
Department of Transportation


CDOT
CO
COLORADO
Department of
Transportation


Department of Transportation
United States of America


COLLABORATIVE
AGGREGATES LLC


ARDOT
ARKANSAS DEPARTMENT
OF TRANSPORTATION


FP2


State of Florida
Department of Transportation


Illinois Department
of Transportation


GDOT
Georgia Department of Transportation


KENTUCKY
TRANSPORTATION
CABINET


SHA
State Highway
Administration


MDOT
Michigan Department of Transportation


MDOT
Mississippi Department of Transportation


Minnesota Department of Transportation


MoDOT


NEW YORK
STATE OF
OPPORTUNITY.
Department of
Transportation


DOT
Oklahoma Department
of Transportation


SCDOT
South Carolina Department of Transportation


TN
TDOT
Department of
Transportation


VDOT
Virginia Department of Transportation


Wisconsin
Department of Transportation


MnROAD
Safer, Smarter, Sustainable Pavements Through Innovative Research


Texas
Department
of Transportation


Cargill


State of West Virginia
Department of Transportation


National Center for
Asphalt Technology
NCAT
at AUBURN UNIVERSITY

MnROAD/NCAT Partnership

- **Partnership**
  - Build Off of Lee Road 159 Experience
  - MnROAD (North) / NCAT (South)
    - Offsite Low and High Volume Road Installations
  - FP^2 / National Center for Pavement Preservation
  - Government / Academia / Industry involvement
- **Goals**
  - National Study (Climatic zones)
  - Construction Consistency
  - Provide consistently collected data / analysis
  - Quantify the life extending benefits

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National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

FP^2

ncpp National Center for Pavement Preservation

National Center for Pavement Preservation

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Preservation Group (PG) Experiment

- Performance = *f* (condition, traffic, climate)
- Good team(!), materials, designs, placements
- Design verifications using actual onsite materials
- All rates pre-calibrated and verified as placed
- MAP-21 (cracking, rutting, roughness) focus
- Many other non MAP-21 performance measures
- Consistent Contractor
- MnDOT Lead State for Phase-II

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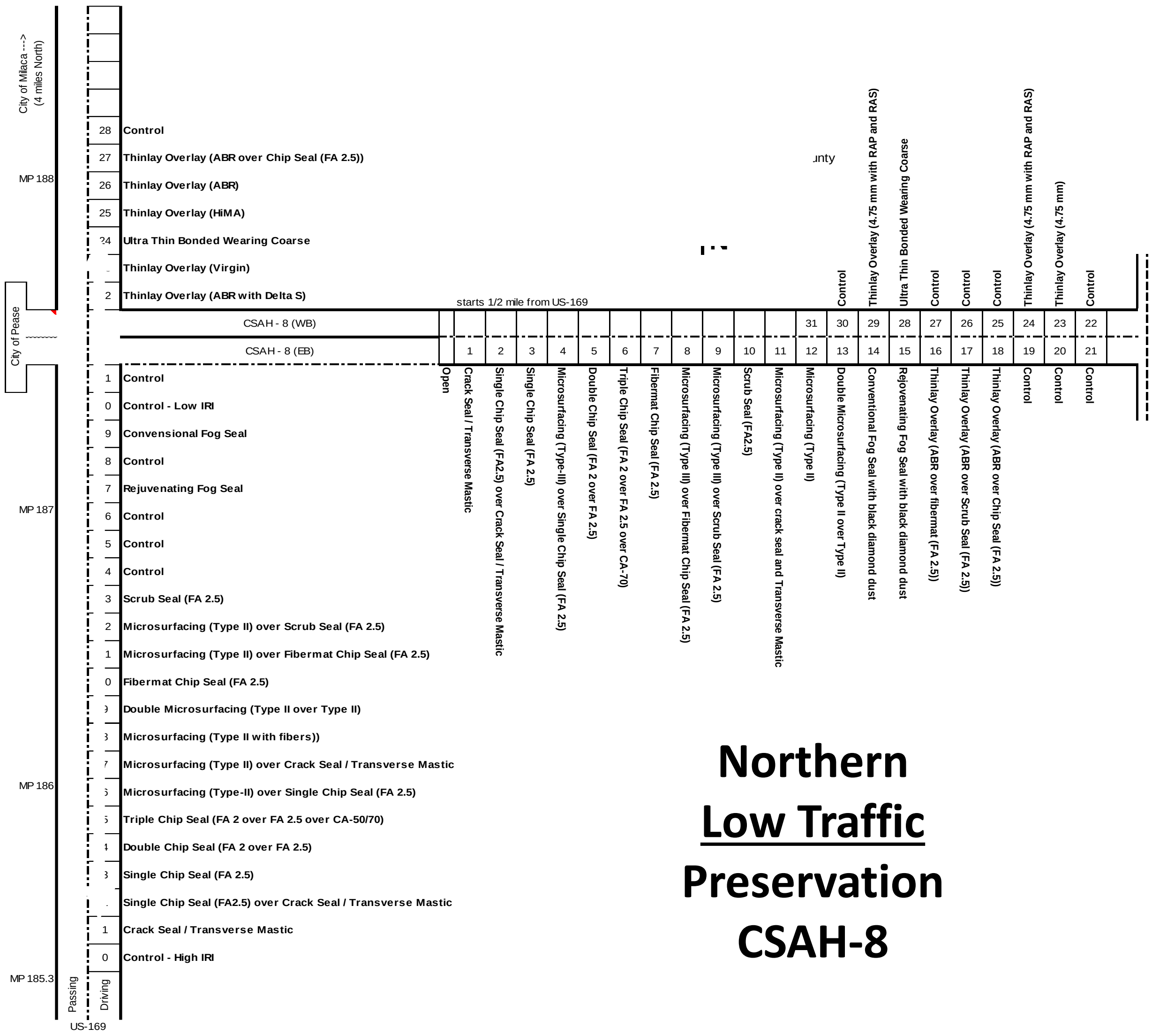
Roadway Details

Roadway	LR-159	US-280	CSAH-8	US-169
Traffic volume	Low	High	Low	High
Thickness (inch)	5.5	9.9	7.0	6.5
Section length (feet)	100	528	528	528
# Test Sections	23	34	22	21
Age (Years) @placement	14	9	6	6

Northern Layout of US-169/CSAH-8

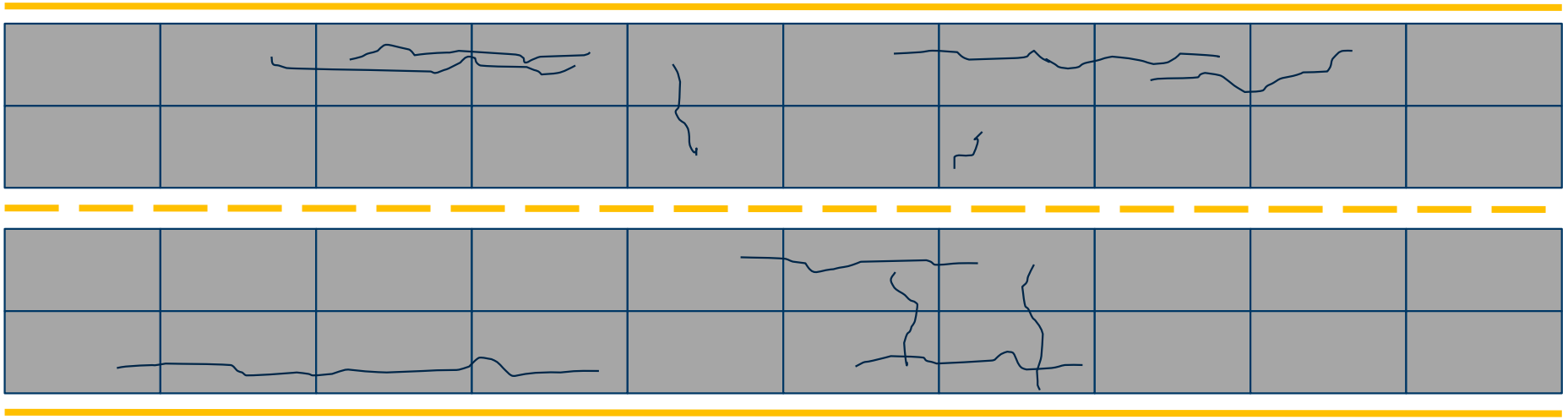
Northern
<u>High Traffic</u>
Preservation
on US-169



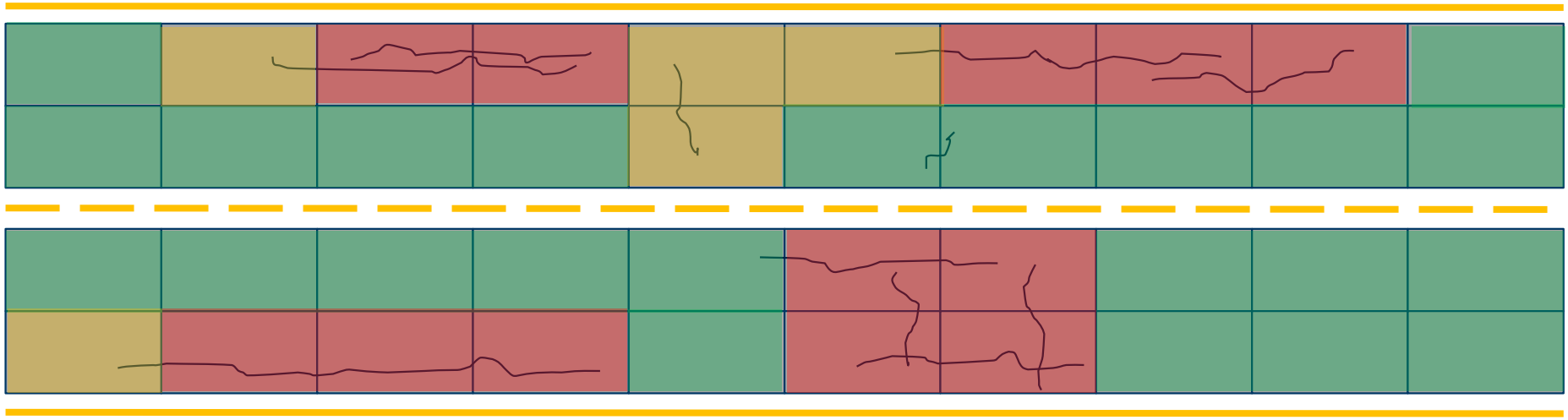
Northern
<u>Low Traffic</u>
Preservation
CSAH-8

Test Section Layout - Assessment

Test Sub-Sections



Test Sub-Sections



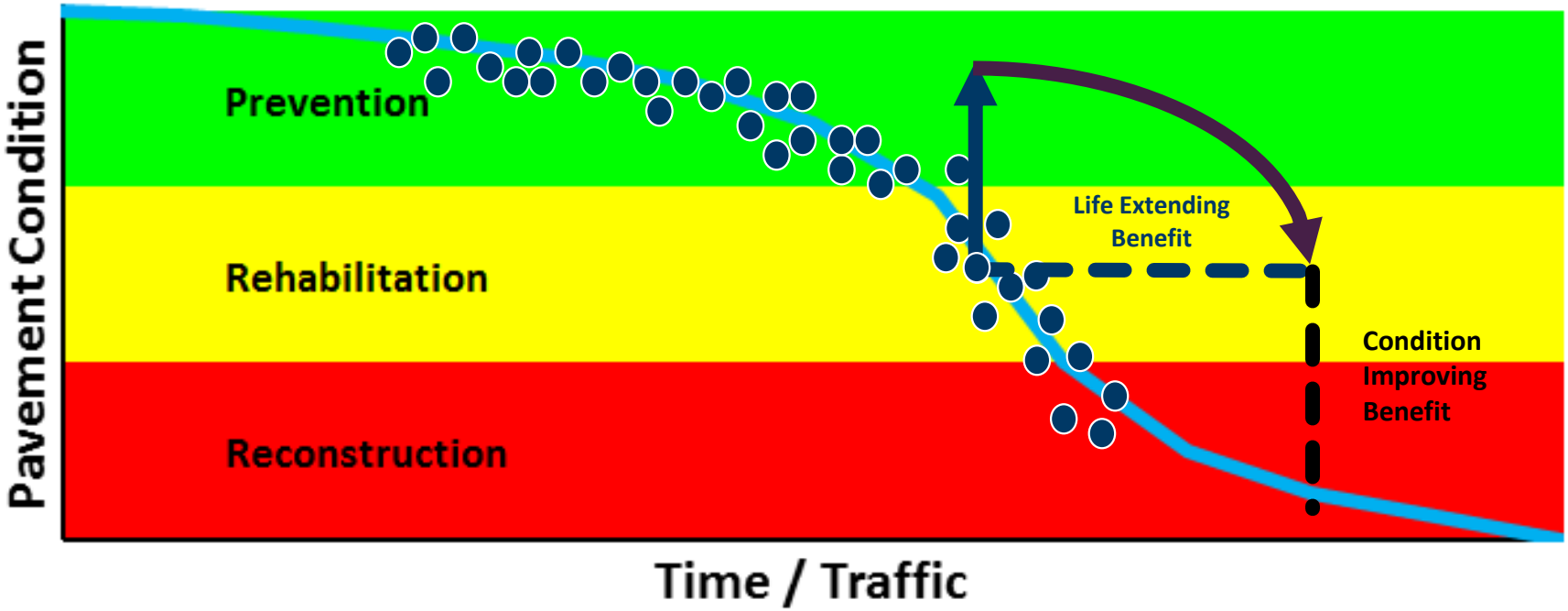
Good: < 5%

Fair: 5 - 20%

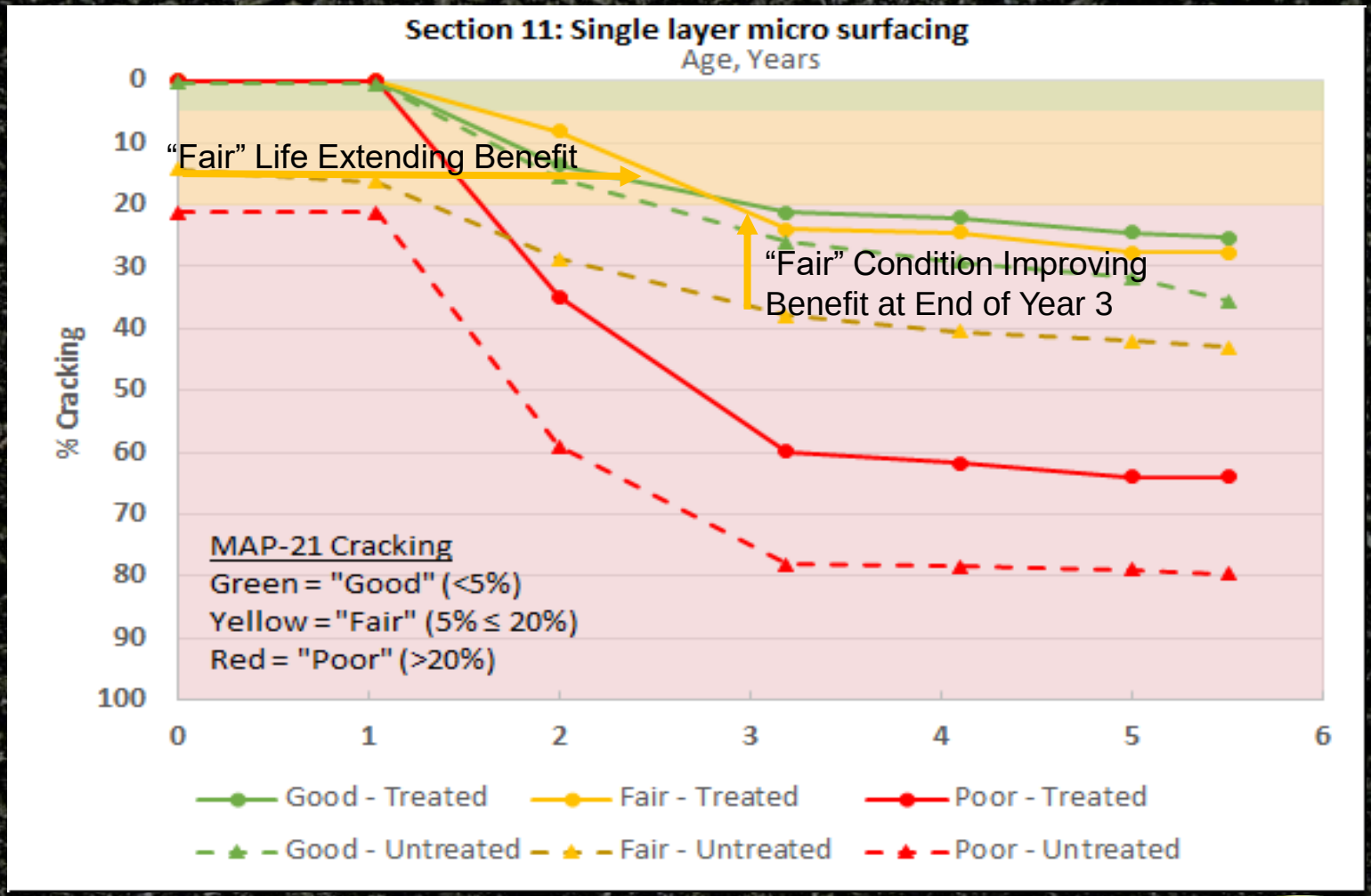
Poor: > 20%

Utilizing FHWA Performance Measures

Pavement Preservation Benefits/Analysis



Benefits = *f*(Pretreatment Condition)



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Crack Sealing

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Chip Seal Over Crack Sealing

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Chip Seal

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Double Chip Seal

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Triple Chip Seal

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Cape Seal

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Micro Surface

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Virgin Thinlay

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ABR Thinlay

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UTB Thinlay

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Open Graded Friction Coarse “OGFC”

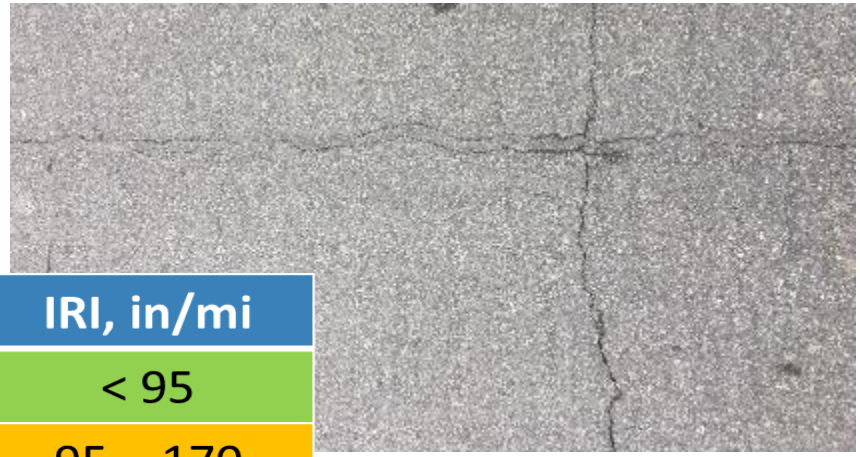
August 2016 – Hardrives Contractor

OGFC/PCC conventional tack
OGFC/PCC ultrafuse tack

OGFC/HMA ultrafuse tack
OGFC/HMA conventional tack

Alabama Study Observations

- **Lee Road – 159 Initial Analysis Starting Place**
  - Developing the subsection analysis
  - Tied to FHWA performance measures
- **Route and Seal – Good as a stand alone treatment**
- **Overbanding – Good with Treatment Combinations**
- **3X Chips (High Vol) – Bleeding tendency**
- **Thinlays good performance**



Category	% Cracking	Rutting, mm	IRI, in/mi
Good	< 5	< 5	< 95
Fair	5 – 20	5 – 10	95 – 170
Poor	> 20	> 10	> 170

Minnesota Study Observations

- **Early – only 2 winters**
- **Thermal Cracking Observations**
- **Snow Plow Damage**
- **Development of a MicroSurfacing Field Test**

Northern Cold Recycle, HIR, FDR

80th Street (lower volume)
1 mile – 4 methods
est sections
y intersections

70th Street (higher volume)
1 mile – 4 methods
4 - 500' test sections within each area
away from turn lanes and CR-19 traffic circle)

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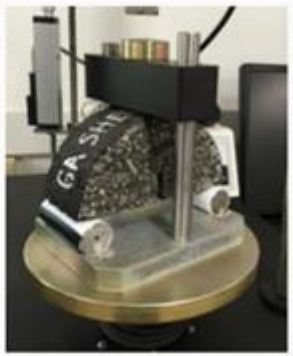
Cracking Group (CG) Study


BBF


SCB-LA


I-FIT

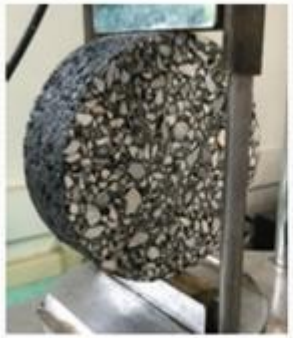

OT-TX


OT-NCAT


SVECD


DCT


Energy Ratio


Nflex Factor

Cantabro

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Alabama Lead State for Phase-II

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2016 MnROAD Mix Designs
HMA Performance Test Experiment

MIX DESCRIPTION	RAP	RAS	CELL	BINDER	Aggregate Size	POLY	CRACK POTENTIAL
High Temp Mix	~30	5	16	PG 64S-22	12.5mm	No	High
High Temp Mix	<20	3	17	PG 64S-22	12.5mm	No	High
High Temp Mix	<20	0	18	PG 64S-22	12.5mm	No	Med/High
High Temp Mix + regressed voids (3.0)	<20	0	19	PG 64S-22	12.5mm	No	Med/High
Soft Binder Mix	>30	0	20	PG 52S-34	12.5mm	No	Med
Typical Low-Temp Mix	<20	0	21	PG 58H-34	12.5mm	Yes	Low
Typical Low-Temp Mix + limestone	<20	0	22	PG 58H-34	12.5mm	Yes	Low/Med
HiMA Mix	<15	0	23	PG 64E-34	12.5mm	Yes	Low

MnROAD

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

National Road Research Alliance

Pooled Fund Project

- **Phase-I (2016-2019)**
- **7 States**
- **~50 Associates**

Membership

- **Big States – 150K/year**
- **Small States – 75K/year**

(based on more/less than MnDOT SPR $)

Associate Members

(Universities, Industry, Associations, Consultants)

- **2K/year**

Looking for future partners -

http://www.dot.state.mn.us/mnroad/nrra/index.html


NRRA
National Road Research Alliance
Strategic Implementation Through Cooperative Pavement Research
Trimble
Leica Geosystems
MIDSTATE RECLAMATION & TRUCKING
BRAUN INTERTEC
The Science You Build On.
NDSU
UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM
FLINT HILLS resources
FIRST STATE TIRE RECYCLING
AMPP
ASPHALT MATERIALS & PAVEMENTS PROGRAM
paviasystems
UMD
UNIVERSITY OF MINNESOTA DULUTH
Michigan Technological University
1885
Michigan Tech Transportation Institute
UNIVERSITY OF St.Thomas
THE TRANSTEC GROUP
The World's Pavement Engineering Specialists
ARRA
Responsible Renewal. Reliable Results.
DIAMOND SURFACE INC.
CENTER FOR TRANSPORTATION STUDIES
UNIVERSITY OF MINNESOTA
3M
ingios GEOTECHNICS
APA ASPHALT PAVEMENT ALLIANCE
TESTQUIP
University of New Hampshire
BASF
We create chemistry
CONCRETE PAVING ASSOCIATION OF MINNESOTA
CPAM
MATHY CONSTRUCTION CO. ONALASKA, WIS.
INFRASENSE
HELIX
A Pensmore™ Company
PAYNE & DOLAN INCORPORATED
All States Materials Group®
MOBA CONSTRUCTION
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY
AGGREGATE & READY MIX ASSOCIATION OF MINNESOTA
National Concrete Pavement Technology Center
Tech Center
UCPRC
UNIVERSITY of CALIFORNIA Davis • Berkeley
PAVEMENT RESEARCH CENTER
MINNESOTA STATE UNIVERSITY MANKATO
IGGA
International Grooving & Grinding Association
Minnesota Asphalt Pavement Association
COLLABORATIVE AGGREGATES LLC
wsb
Center for Transportation Infrastructure Systems
CTIS
PITT SWANSON ENGINEERING
AMERICAN ENGINEERING TESTING, INC.
CAT
Cargill
DOW
Husky Energy
HARDY
GSE ENVIRONMENTAL
ROADSCANNERS

National Road Research Alliance

How it works

- **Funded So Far:**
  - 8 Long Term Research Projects
  - 8 Short Term State of Practice
  - Implementation
  - Technology Transfer
  - 6-8 more projects in 2019

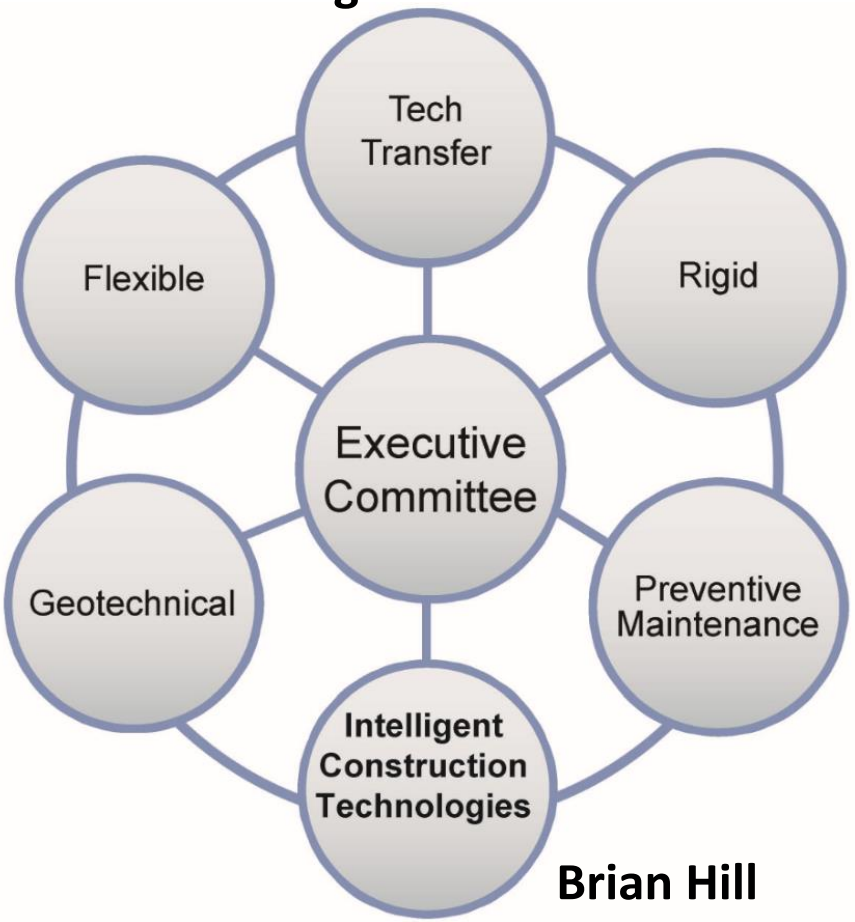
- **Proposed Future Use**
  - NCAT type of overall pooled fund expected in 2021

Looking for future partners -

http://www.dot.state.mn.us/mnroad/nrra/index.html

National Road Research Alliance
Illinois DOT Representatives

Executive Committee
Brian Pfeifer
Charles Wienrank



Megan Swanson

Jim Trepanier
Charles Wienrank

James Krstulovich
Charles Wienrank

Heather Shoup
Andrew Stolba

Mark Gawedzinski

Brian Hill

Looking for future partners -

http://www.dot.state.mn.us/mnroad/nrra/index.html

NRRA
National Road Research Alliance

Technology Transfer Short Term Research

NRRA Team	Topic
Flexible	Tack Coats
	Longitudinal Joint Construction Performance
Rigid	Design and Performance of Concrete Unbonded Overlays
	Repair of Joint Associated Distress Pavements
Geotechnical	Larger Subbase Materials
	Subgrade Design for New and Reconstructed Roadways
Pavement Maintenance	Surface Characteristics of Diamond Ground PCC Surfaces
	Pavement Preservation Approaches for Lightly Surface Roadways

SRF Consulting

Develop Collaborate Research Implement Sustain.

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Long Term Research

Flexible Team

Rigid Team

Team	Project	Contractor
Flexible	HMA Overlay of PC and Methods of Enhancing Compaction	University of New Hampshire
	Cold Central Plant Recycling	American Engineering and Testing
Rigid	Fiber Reinforced Concrete	University of Minnesota Duluth
	Early Opening Strength to Traffic	University of Pittsburg
	Optimizing Concrete Mix Components	Iowa State

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Long Term Research

Geotechnical Team

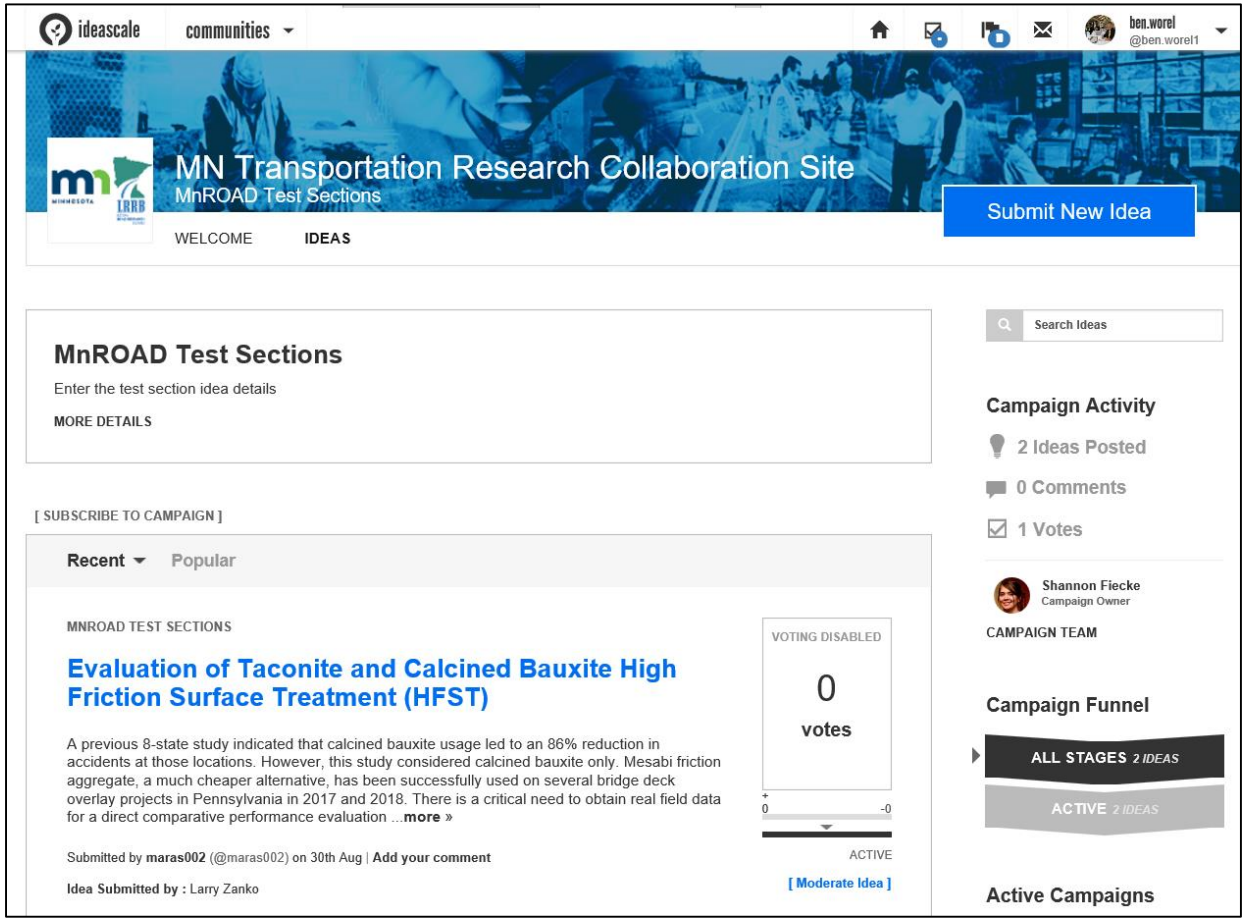
Pavement Maintenance Team

Team	Project	Contractor
Geotechnical	Recycled Aggregates	Iowa State
	Large Stone Subbase	
Pavement Maintenance	Maintaining Poor Pavements	SRF Consulting
	Partial Depth Repair	Braun Intertec

MnROAD Construction Tools

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

National Request for Ideas



- **New Test Sections**
  - New Construction
  - Rehabilitation
  - Maintenance
  - NRRA or Other Interests
- **Research Ideas**
  - NRRA Funding
  - Ties other funding

MnROAD Website or
http://www.dot.state.mn.us/mnroad/newideas.html

2019 NRRA Ideas

NRRA teams developing ideas to be funded

- Each Teams ~$180,000 each – contracted this winter 2019
- Intelligent Construction Technology Team ~$480,000

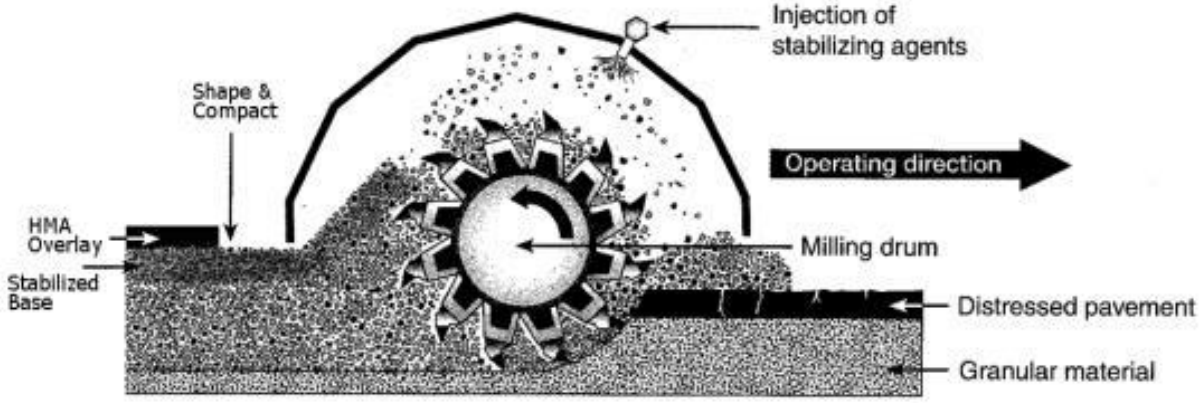
Ideas being considered (both Technology Transfer / Long Term)

- Flexible Group
  - Mix Rejuvenator Synthesis
  - Mix Rejuvenator Test Sections
- Pavement Maintenance
  - Service life enhancement of substrates overlaid with thin overlays (UTBWC, chip seals, & micro surfacing) – 30K
  - Synthesis in spray surface rejuvenators – 20K
  - Test sections with rejuvenators – 100K
  - PCC Rehabilitation Project – 30K

Full Depth Reclamation (Industry Partnership)

- **Road Science Partnership**
  - 3 Cells (mainline) / 1 Cell (LVR)
- **Observations**
  - 2.75” Interstate surface on engineered FDR
  - Engineered emulsion → balance stiffness/flexibility
- **Benefits**
  - Design for distressed pavements/Full depth repairs

Sustainable practice



Importance of Drainage

Asphalt

- Deterioration asphalt
- Increased roughness (ride)

Concrete

- ML Observations (high traffic)
  - None - PASB used
  - Some - Class-5 / well sealed joints / edge drain
  - High amount - Class-5 / no edge drains
- LVR Observations (low traffic)
  - If sealed class-5 is not as destructive
  - If not-sealed class-5 can develop joint damage

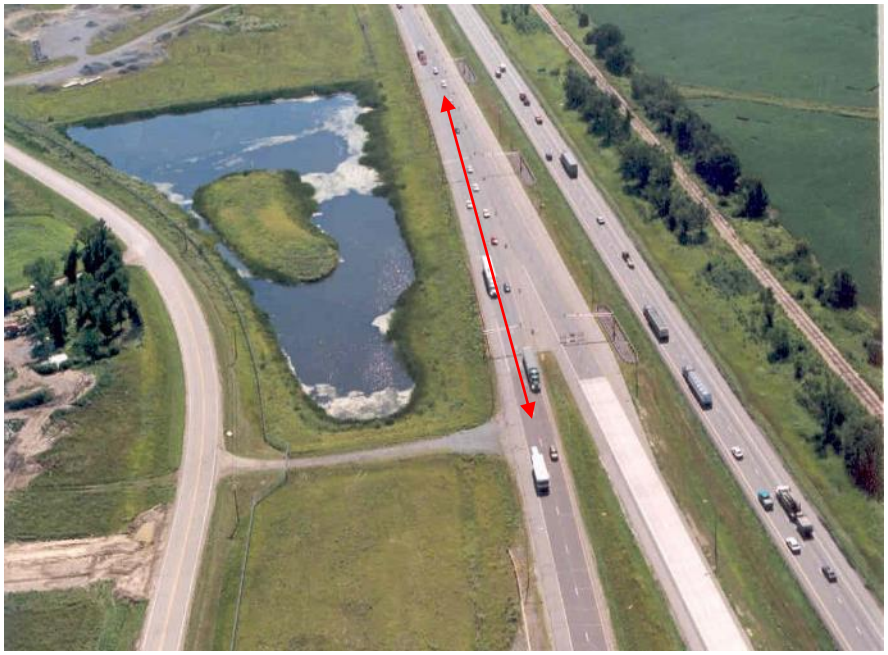
Benefits

- Importance of drainable bases / sealing
- Effect on ride

MnROAD Partnership

October 2018 - Cargill and Hardrives

East Transition I-94



West Transition I-94

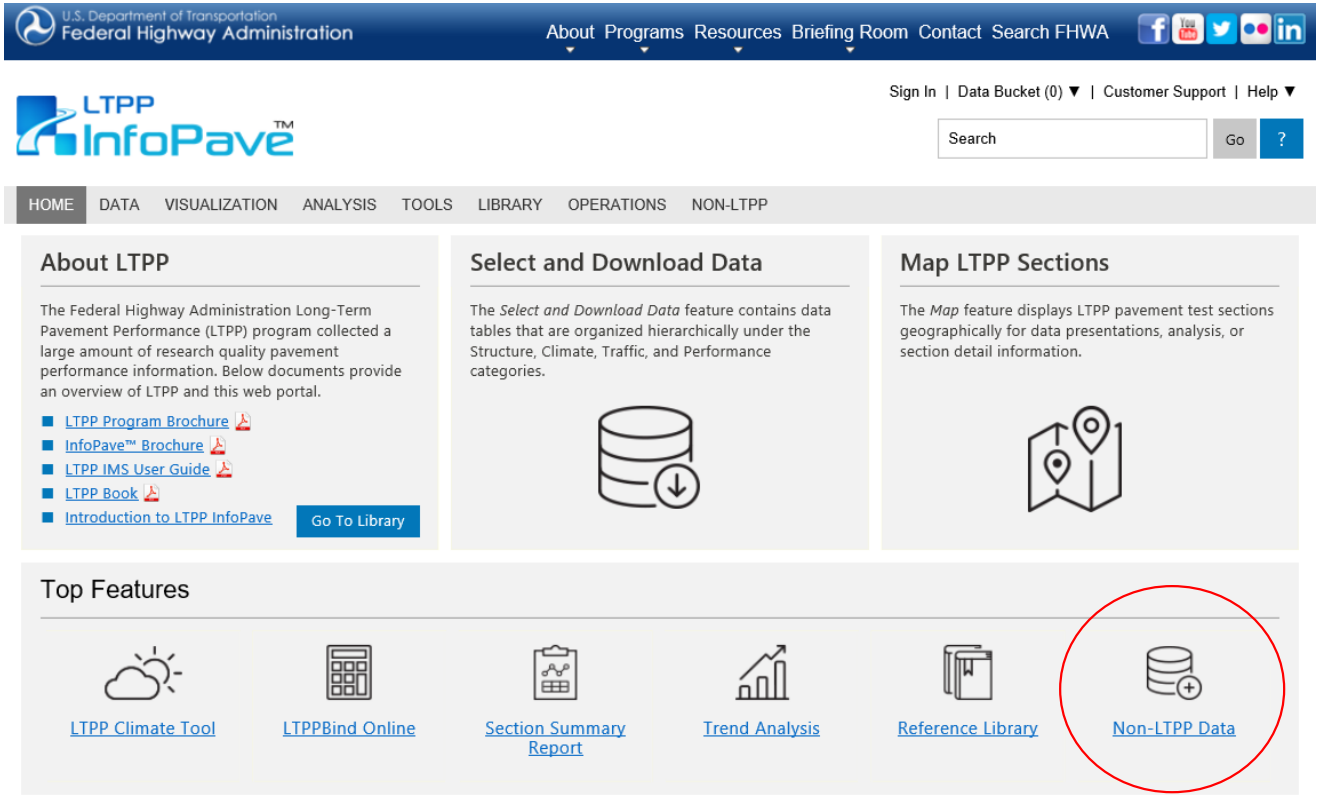
2 Mix Designs / 4 New Test Sections

- Control - 25% RAP Superpave (SPWEB540 / PG 58S-28)
- High RAP - 45% RAP Superpave (SPWEB540 / PG 58S-28 / Anova)
- Lab Testing / Long Term Monitoring

Example of successful partnership for both industry and the state

MnROAD and LTPP InfoPave

FHWA and i-Engineering



MnROAD Access

- Data
- Pictures
- Reports/Software

Ties to

- LTPP Data
- Westrack
- C-SHRP

MnROAD Website Soon!

TRB 2019

Autonomous Bus Testing at MnROAD

DEPARTMENT OF TRANSPORTATION

DOT
Colorado Department of Transportation

3M

First Transit

Technology Transfer Efforts

Research Pays Off Seminar Series

- Every 3rd Tuesday
- 10-11 am

NRRA

- Follow NRRA on Linkedin
- May 22-23 2019 Workshop

Newsletters

- Highlight Members
- Highlight NRRA Projects
- Highlight Emerging Technology

NCAT Partnership Meetings

- 2019 Spring (NCAT)
- 2019 Fall (Minnesota)

Questions / Comments