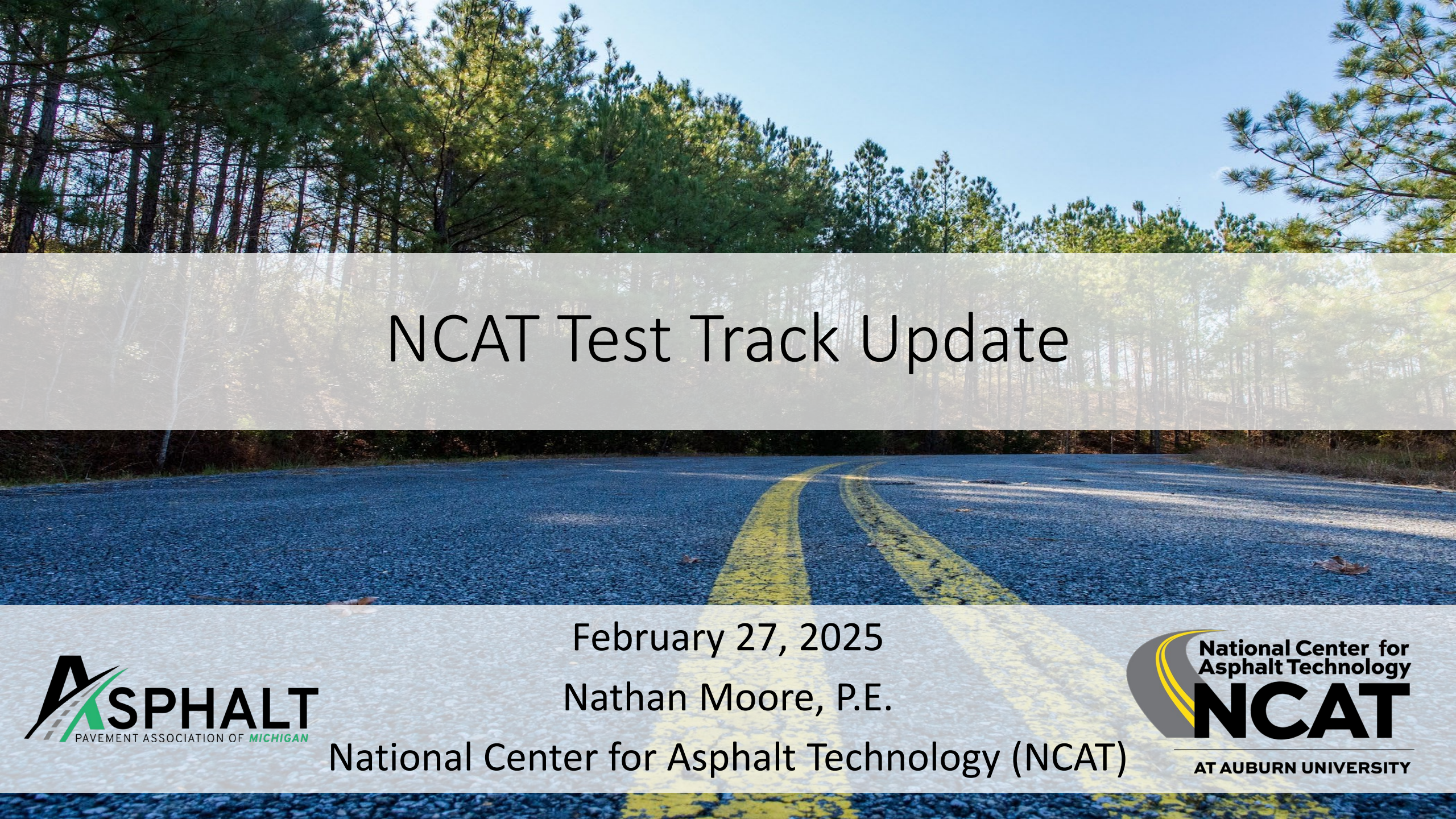

NCAT Test Track Update

February 27, 2025

Nathan Moore, P.E.
National Center for Asphalt Technology (NCAT)

ASPHALT PAVEMENT ASSOCIATION OF MICHIGAN

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Plastic-Modified Asphalt
Wet process (wet plastic mix)
NCAT
MnROAD


MAY 7-9 2024 EIGHTH


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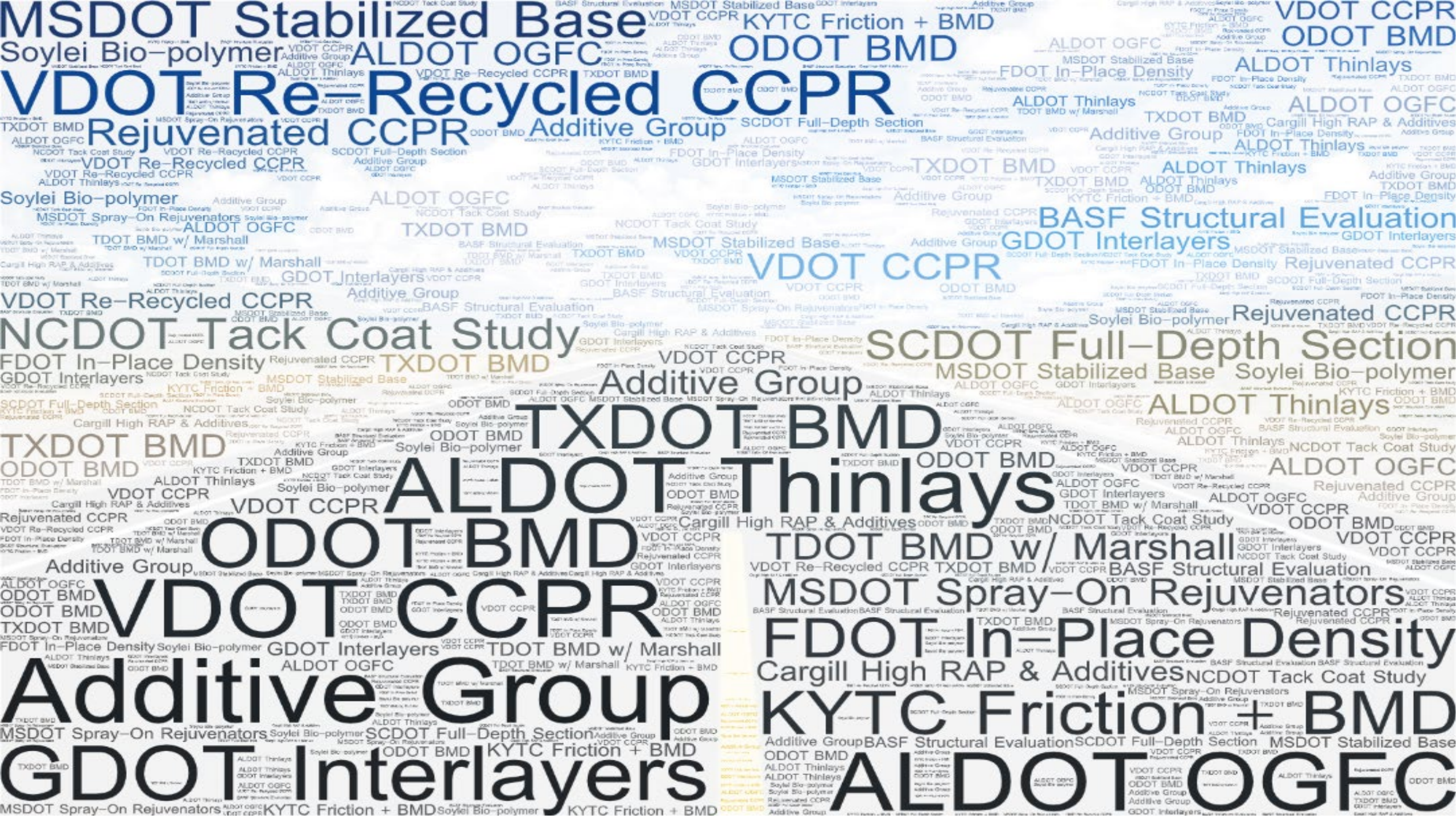
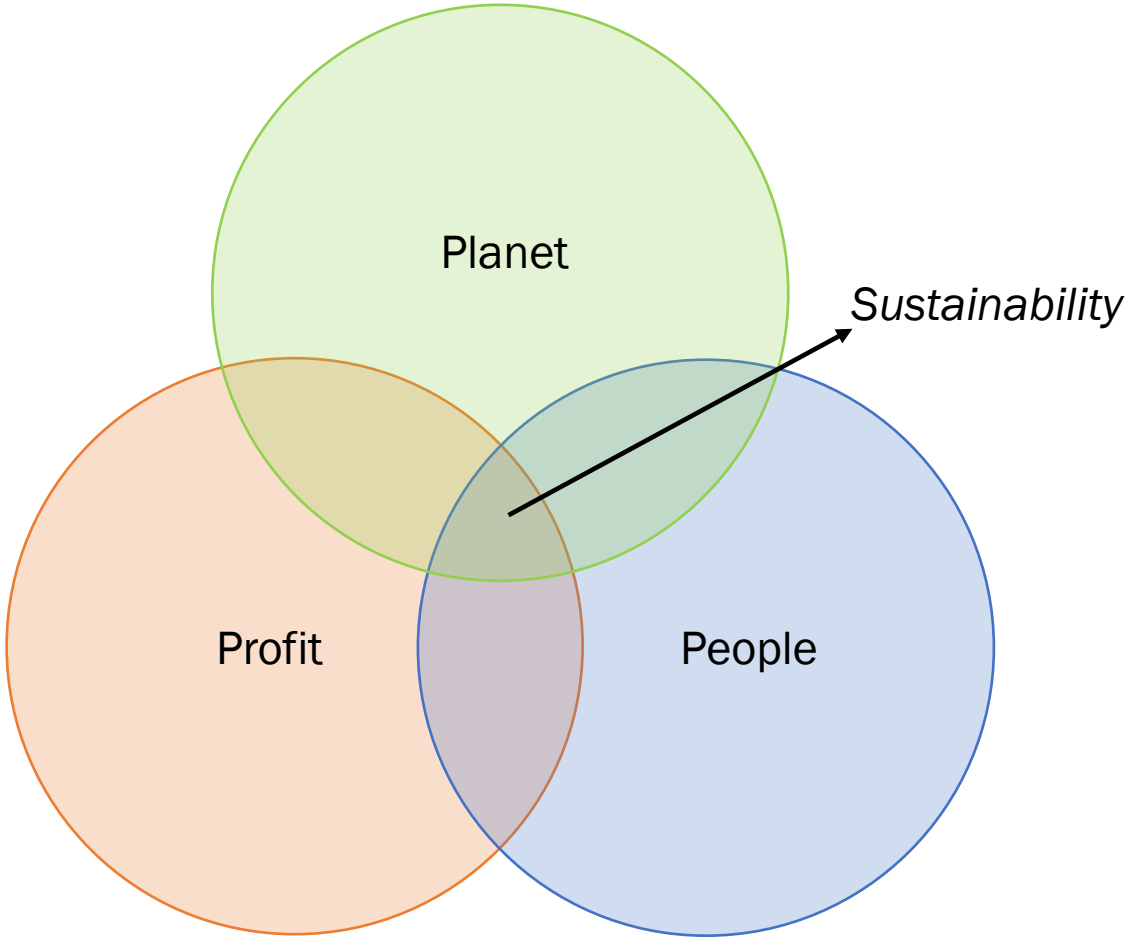

MSDOT Stabilized Base
Soylei Bio–polymer
ALDOT OGFC
VDOT Re–Recycled CCPR
Rejuvenated CCPR
Additive Group
KYTC Friction + BMD
ODOT BMD
VDOT CCPR
ALDOT Thinlays
FDOT In–Place Density
TXDOT BMD
SCDOT Full–Depth Section
BASF Structural Evaluation
GDOT Interlayers
NCDOT Tack Coat Study
Cargill High RAP & Additives
TDOT BMD w/ Marshall
MSDOT Spray–On Rejuvenators

Focus on sustainability… What is sustainability?

- Remember the "triple bottom line"
  - **Profit** – are we maintaining / growing the economy?
  - **People** – are we caring for all people?
  - **Planet** – are we taking care of our environment?

- ***Each part of the triple bottom line relies on performance.***



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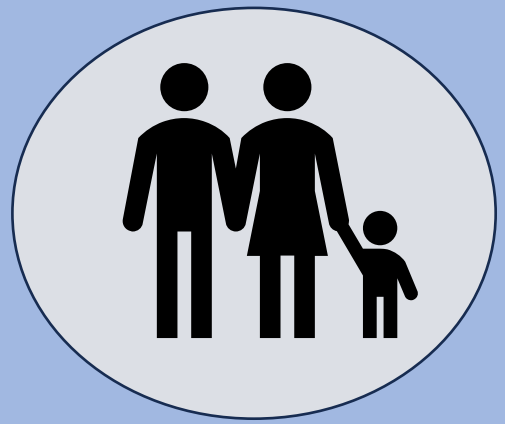
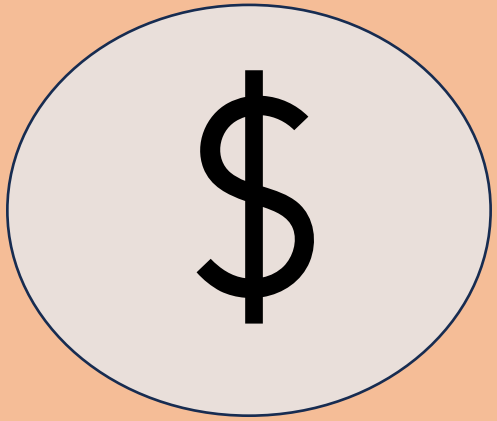
Triple Bottom Line - Sustainability



Safety

Health

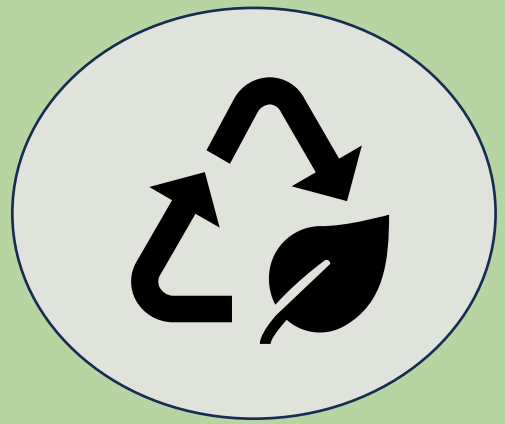
Mobility



Taxpayers

Economy

Life-Cycle Cost



Stewardship

Local Materials

Recycling

Sustainability on the 2021-2024 Test Track

High RAP

Cold-Central Plant Recycling

Recycling Agents

Additives

Warm Mix

Local Materials

Safety

Balanced Mix Design with Recycling Agent

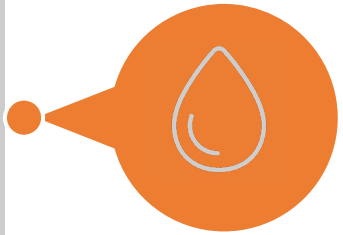
Both designed as BMD mixtures

- APA: rut ≤ 8.0mm
- IDEAL-CT: $CT_{index} \geq 70$
- Cantabro: mass loss ≤ 7.5%

N3B (45%RAP+RA): 45% RAP, PG 64-22 and recycling agent

N3A (30%RAP): 30% RAP, PG 64-22, compaction aid

Summary of Mixes



Design Method:	BMD		
Ndes:	50 gyrations		
Binder PG:	64-22		
Mix Properties	30% RAP	45% RAP, Anova	Criteria
% Total AC (Pb):	5.5	5.8	
% Virgin Binder:	4.17	3.59	
% AC from RAP:	1.33	2.21	
APA Rut (mm)	3.2	3.4	Max. 8.0
CTIndex	75	76	Min. 70
Design Air Voids (Va):	2.9	2.4	3.0 – 4.5

Mixes are volumetrically and BMD-ly similar

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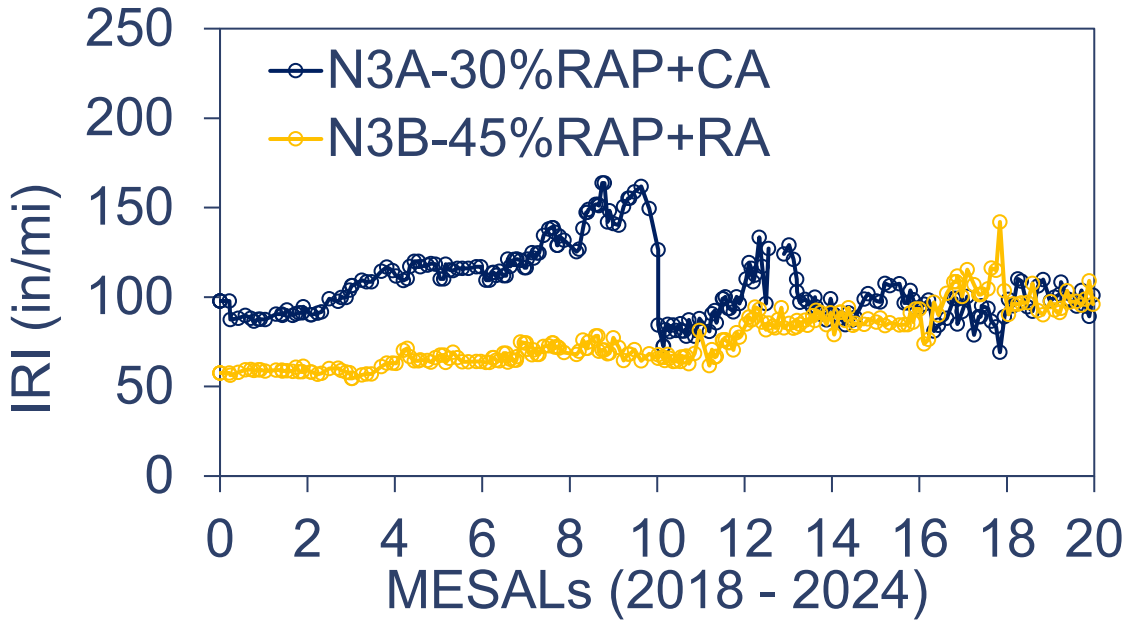
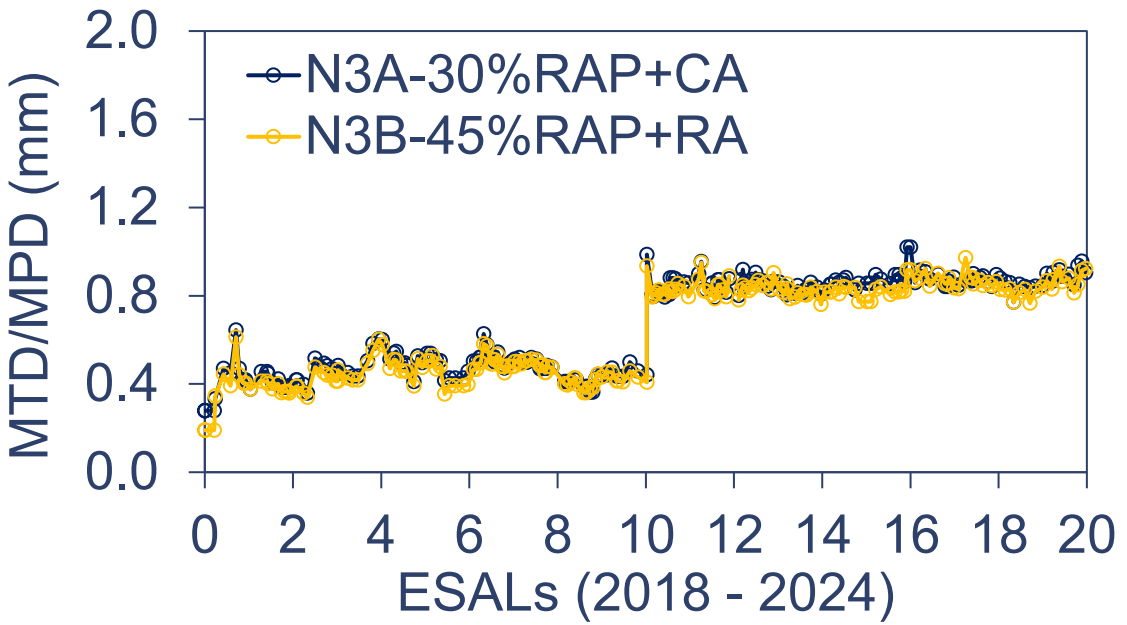
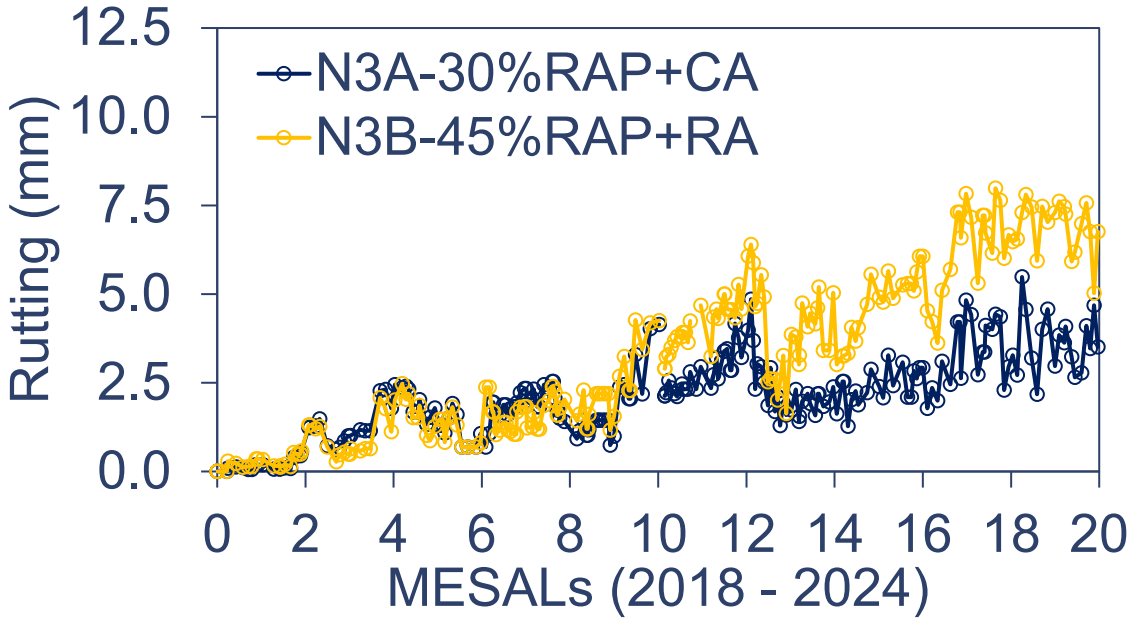
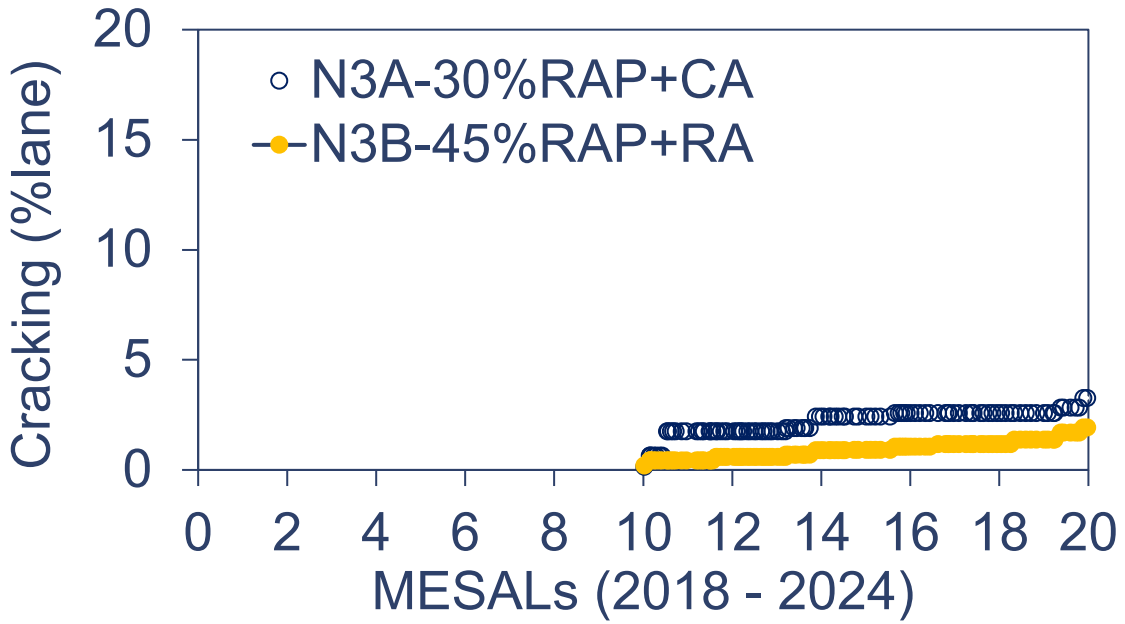

250
200
150
100
50
0
IRI (in/mi)
N3A-30%RAP+CA
N3B-45%RAP+RA
0 2 4 6 8 10 12 14 16 18 20
MESALs (2018 - 2024)


2.0
1.6
1.2
0.8
0.4
0.0
MTD/MPD (mm)
N3A-30%RAP+CA
N3B-45%RAP+RA
0 2 4 6 8 10 12 14 16 18 20
ESALs (2018 - 2024)

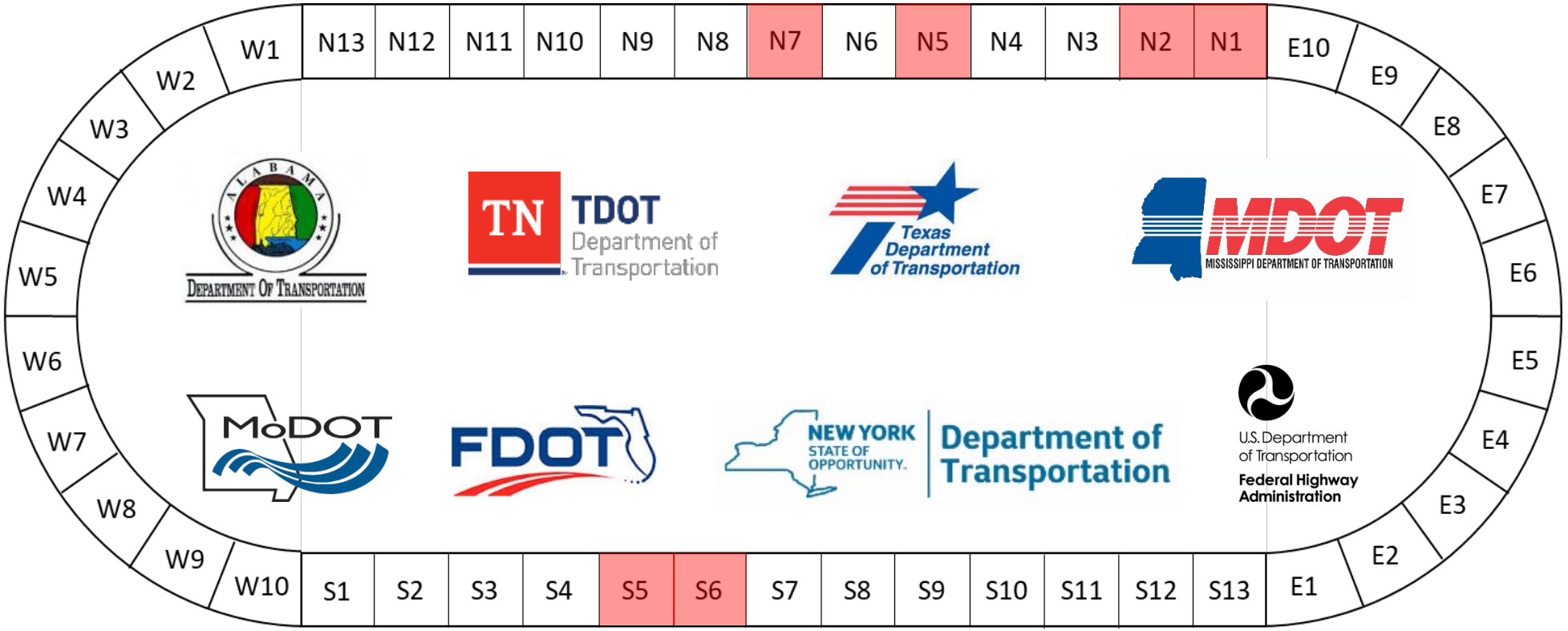

12.5
10.0
7.5
5.0
2.5
0.0
Rutting (mm)
N3A-30%RAP+CA
N3B-45%RAP+RA
0 2 4 6 8 10 12 14 16 18 20
MESALs (2018 - 2024)


20
15
10
5
0
Cracking (%lane)
N3A-30%RAP+CA
N3B-45%RAP+RA
0 2 4 6 8 10 12 14 16 18 20
MESALs (2018 - 2024)

Traffic Continuation – 2024 – 2027

The Additive Group Experiment

2021 Additive Group Sponsors



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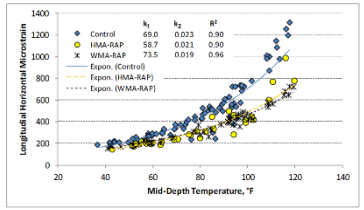
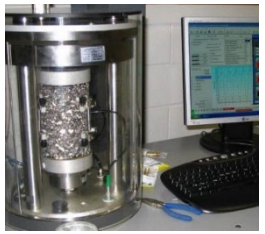
Additive Group Experimental Scope

Performance Data

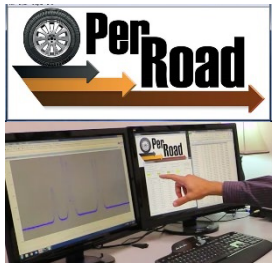
Structural Response



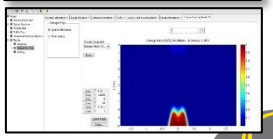
Materials Characterization



Pavement Analysis



FlexPAVE™



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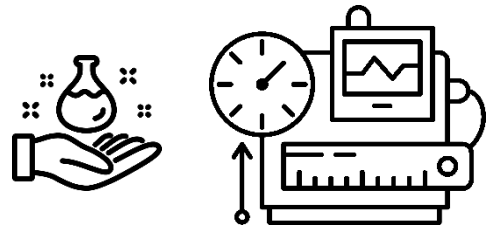
Overall Additive Group Plan

Agencies committed to sponsoring the AG experiment



NCAT conducted Phase I lab study to evaluate additive products

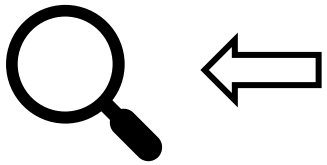
NCAT shared Phase I results with sponsors

Sponsors select additives for the AG experiment

Construct AG test sections on Test Track

Trafficking of Test Sections

Repeat for MnROAD



Assess Performance

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Selected Phase 2 Additives

Recycled Tire Rubber

wet process

dry process

Recycled Plastics

wet process

Generic LLDPE rich

dry process

Fibers

Summary (plastic)

Comparison vs. SBS Control		Wet Plastic	Dry Plastic
Mix characterization	Stiffness	=	↑
	Rutting resistance	=	↑
	Cracking resistance	↓	↓↓
Field Performance (10 MESALs)	Rutting	=	=
	Cracking	=	↓*

** pending further monitoring*

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Summary (rubber)

Comparison vs. SBS Control		Wet Rubber	Dry Rubber
Mix characterization (Plant Mix)	Stiffness (E*)	≤	≤
	Fatigue Resistance (CF)	↑	↑
	Fatigue Resistance (BBF)	↑	=
	Cracking resistance (IDEAL-CT)	↓	↓
	Rutting resistance (HWTT)	=	=
Field Performance (10M ESALs)	Rutting	=	=
	Cracking	↓	↓

Summary (fiber)

Comparison vs. SBS Control		Dry Fiber
Mix characterization	Stiffness	=
	Cracking resistance	↓
	Rutting resistance	↑
Field Performance	Rutting	=
	Cracking	=

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Final Summary

- Continuing traffic on AG sections
- Monitoring performance and understanding effects of differences in base stiffness and mat density
- Differences in laboratory results will hopefully yield differences in performance
- Development of framework underway

Local Materials in Thinlays (ALDOT)

- Limited funds to preserve road
- Agencies need alternative preservation treatments to provide:
  - Improve surface characteristics
  - Protect underlying pavement structure
  - Extend the life of the pavement

Objective

Evaluate the long-term performance of an SMA (N10) thinlay and a DGA “ultra” thinlay (N11) to provide ALDOT with thinner overlay alternatives for pavement preservation on high-volume roads

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Local Materials in Thinlays (ALDOT)

Section	Mix Description	As built-thickness
N10(SMA)	• SMA-4.75mm NMAS • 50 blow Marshall Design • 6.0%$AC_{76\text{-}22}$ • 62% LMS, 13% GRN, 5% Fly ash, 20% F-RAP	0.8 in
N11 (DGA)	• 4.75mm NMAS • 60 gyration Superpave design • 6.1% $AC_{67\text{-}22}$ • 58% LMS, 22% Sand, 20% F-RAP	0.5 in

ALDOT limits the % of carbonate aggregate on surface mixes

Waiver was granted by ALDOT to be able to use higher % of limestone to rely on locally available materials

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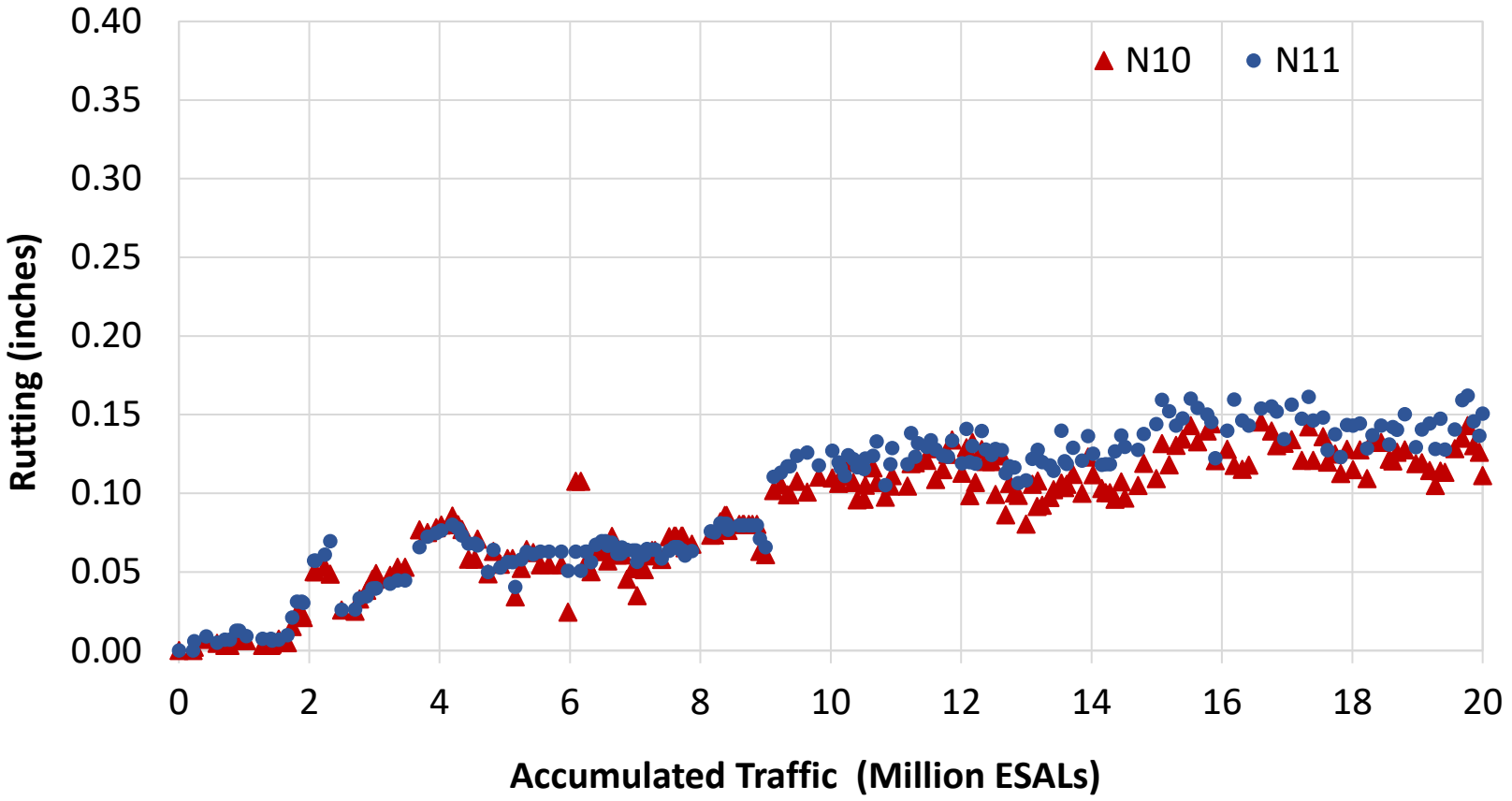
DYNAPAC

Field Rutting



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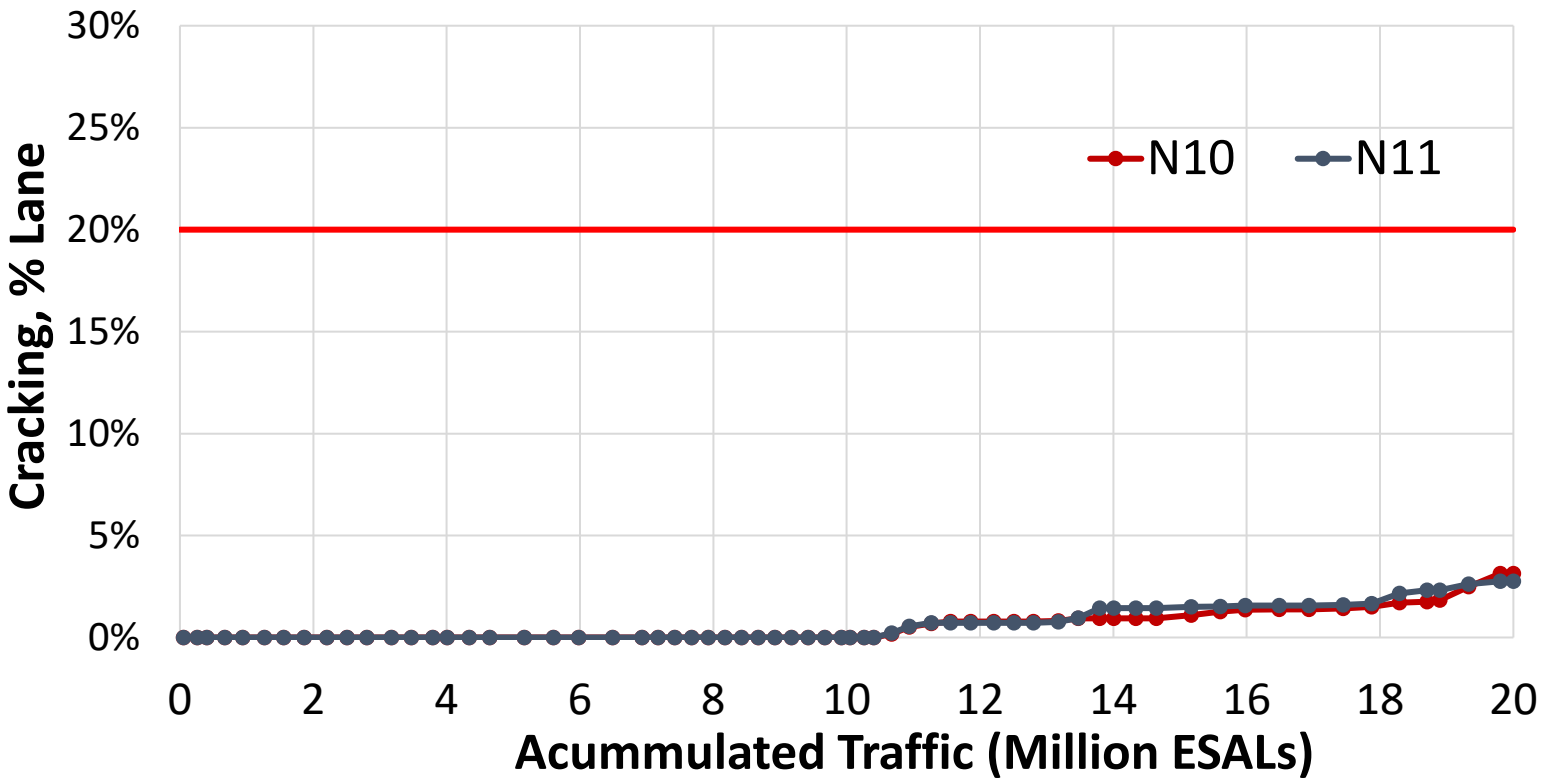
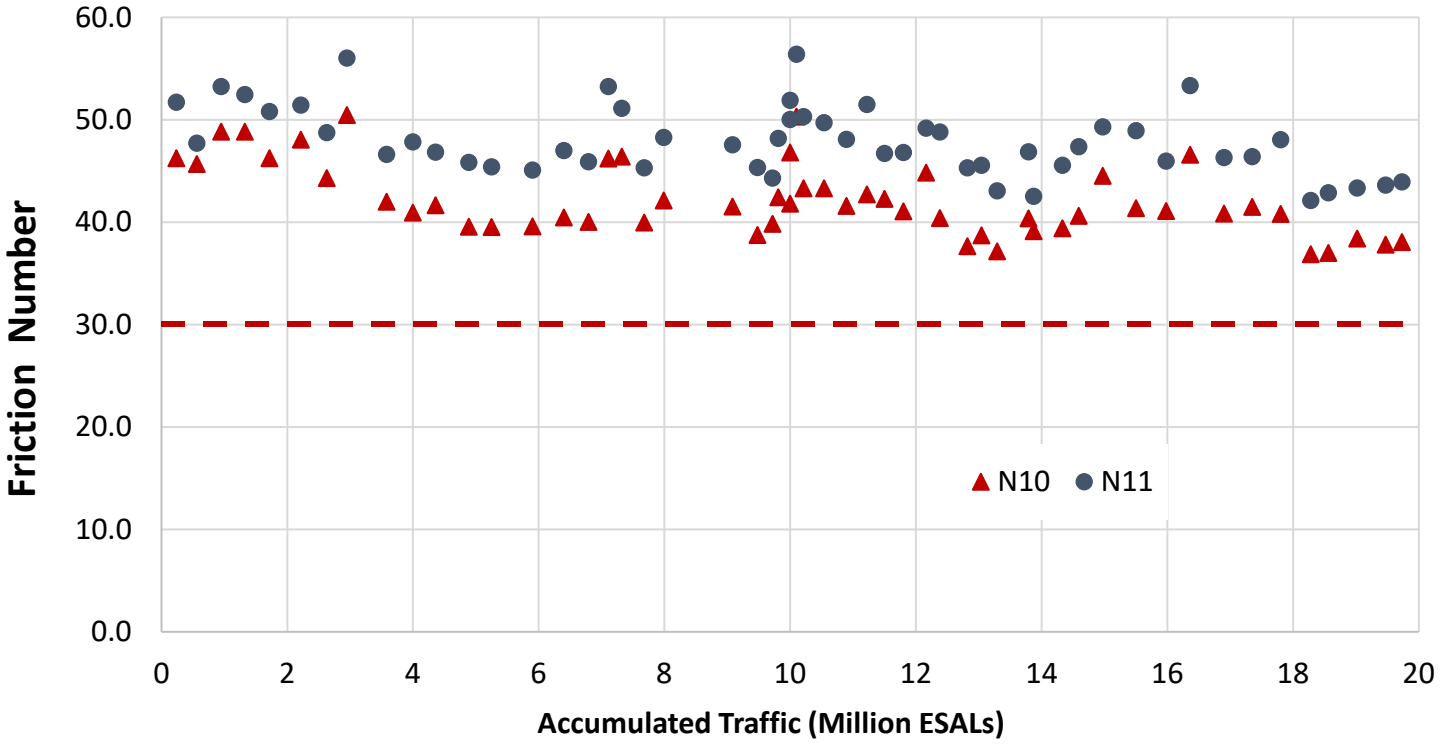
Field Cracking



Cracking ~ 3% of lane area

Surface Friction



Track Watch Threshold

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Summary of Thinlay Preservation Sections

- Both sections performed very well after 20 million ESALs with minimal rutting and cracking

- Demonstrates the ability to use “just enough” friction aggregate with limestone to keep roads safe

- The good performance gives ALDOT two thinlay options for high-traffic volume roads

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NCAT Draft Synopsis 24-01

May 2024

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Phase VIII (2021-2024) NCAT Test Track Findings: Implementation Synopses

Randy West, Raymond (Buzz) Powell, David Timm, Nam Tran, Fan Yin, Nathan Moore, Thomas Harman, Benjamin Bowers, Adriana Vargas, Carolina Rodezno, Raquel Moraes Puchalski, Chen Chen, Surendra Chowdari (Suri) Gatiganti, Jason Nelson, Grant Julian, Jason Moore, Adam Taylor, Pamela Turner, Matthew Kmetz, Elizabeth Turochy

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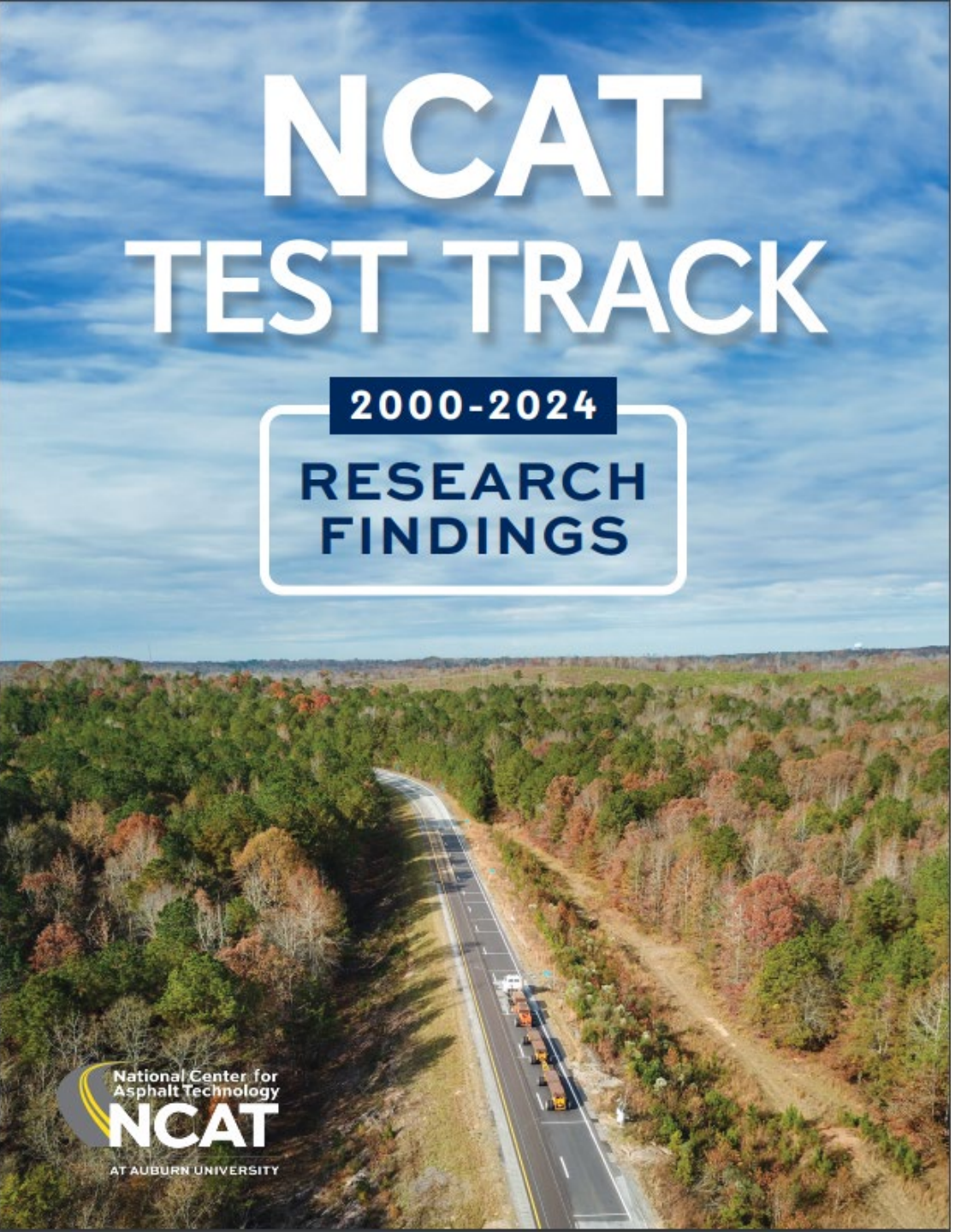

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2024-2027 NCAT Test Track Overview

- $16M+ in funding for on-Track research
- 13 states + 6 private industry sponsors on Track
- 39 sponsored sections
  - 20 traffic continuations
  - 12 mill/inlay sections
  - 6 structural sections
  - 1 off-ramp section
- Common themes:
  - Innovation, sustainability, safety, BMD and performance

2024-2027 NCAT Test Track Sponsors

2024 Track Build by the Numbers

- 58 unique aggregate/RAP stockpiles
- >300 truck loads of aggregate/RAP hauled in
- 6 different asphalt binders + 3 tack products + 1 VRAM
- 10+ different additives/recycling agents.
- 4 asphalt plants (2 HMA + 1 Wirtgen KMA + 1 PRI Pugmill)
- 30 unique mixes + 31 trial runs (practice runs)
- 3 CCPR + 23 HMA + 4 WMA mixes

2024 Track Build by the Numbers

- 36 working days (7 weeks + 1 day)
- 2 hurricane delays (Helene & Milton)
  - Delayed by only 3 days
- 850+ buckets of mix sampled
- 7 new NCAT personnel in critical roles during build process
- 72+ visitors during Track construction

50% RAP + Soybean-based RA (S1)

Dry Rubber Additives

New Structural Sections

Soybean-Modified CCPR

Re-Recycle CCPR

GTR-Modified SMA

New Additives in AG+ Sections

Enzyme-Based Soil Stabilization

BMD with Absorptive Gravel (E2/E3)

Enhanced Friction Thinlay (E1)

Longitudinal Grooving (W4)

Thank you!
Questions?

February 27, 2025

Nathan Moore, P.E.

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