A stylized illustration of a road scene. The road is dark grey asphalt with white dashed lines in the center and a solid white line on the right edge. The road curves to the left. On the right side of the road, there are two blue rectangular signs on white poles. The background consists of a dense line of green trees and bushes. The sky is a plain, light grey color.

# 2021 NCAT Pavement Test Track Research Update

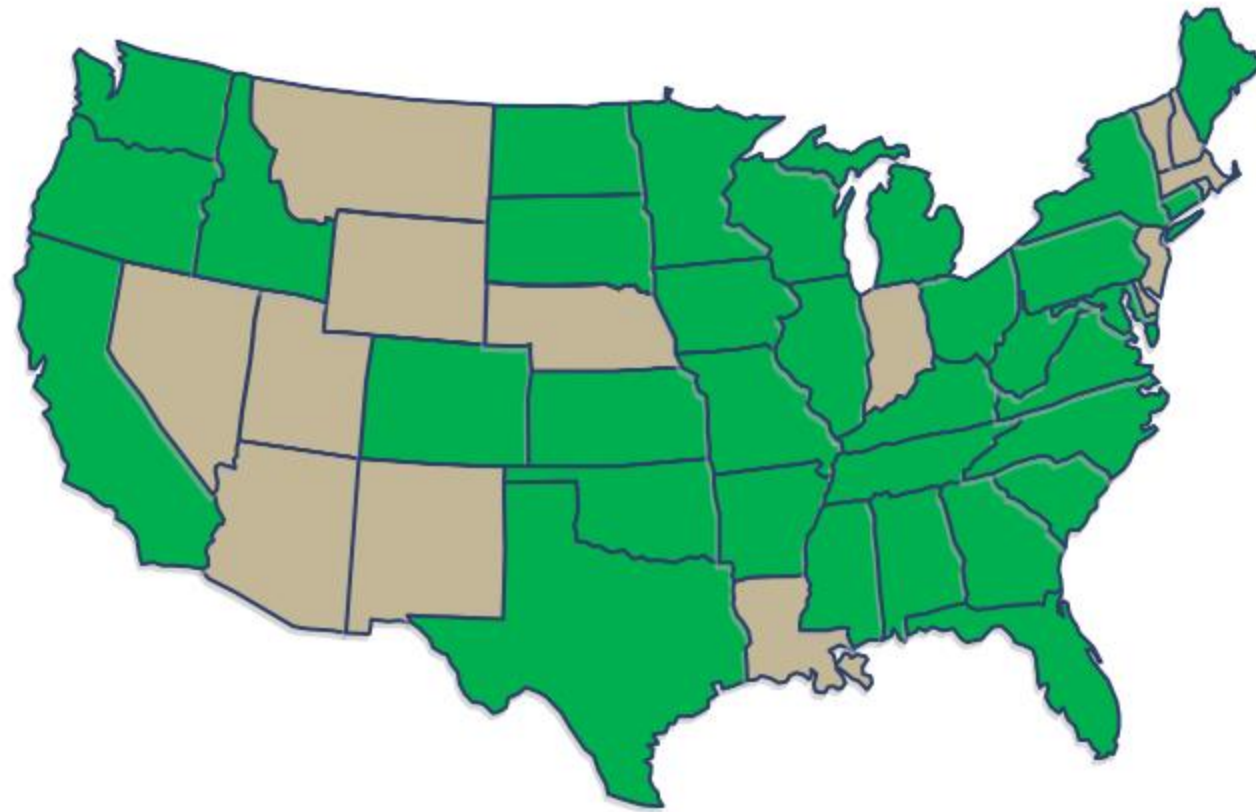
2021 (Eighth)  
Research Cycle

NCAT Pavement Test Track

# NCAT Pavement Test Track

An aerial photograph of the NCAT Pavement Test Track. The track is a long, winding road that curves through a dense forest. In the foreground, there is a parking lot with several cars and a few buildings. The sky is clear and blue.

- National Center for Asphalt Technology<sub>86</sub>
- 1.7-mile, 45 mph Pavement Test Track<sub>00</sub>
- Innovative, relevant, and implementable research
- Safe, sustainable, and affordable asphalt pavements
- Mix/materials<sub>86</sub>, thickness design<sub>03</sub>, preservation<sub>12</sub>



# 2021 NCAT Pavement Test Track

- 32 sponsored sections
  - ▣ 16 traffic continuations
  - ▣ 7 mill/inlay sections
  - ▣ 9 structural sections
- 16 repaved/rebuilt sections
  - ▣ ~1/3 of the Track (typical).



# 2024 NCAT Pavement Test Track

- 38 sponsored sections
  - ▣ 22 traffic continuations
  - ▣ 11 mill/inlay sections
  - ▣ 5 structural sections
- 16 repaved/rebuilt sections
  - ▣ ~1/3 of the Track (typical).



# 2021 Traffic Continuations<sub>16</sub>

- Higher RAP with recycling agents – CA<sub>N3</sub>
- Foamed cold recycle (CCPR) base – VA<sub>N4</sub>
- High performance thinlays (DGA, SMA) – AL<sub>N10,N11</sub>
- Crack prevention interlayer strategies – GA<sub>N12,N13</sub>
- Soybean based polymer modified asphalt – SB<sub>W10</sub>
- BMD via recycling agents, gradation, etc. – OK<sub>S1</sub>, TX<sub>S10,S11</sub>
- Impact of base stabilization, subgrade modification – MS<sub>S2</sub>
- Long term benefit of surface rejuvenators – MS<sub>S3</sub>
- Full depth rapid rebuilds (grinding vs thinlays, HiMA) – SC<sub>S9</sub>
- Open graded friction surface rejuvenation – SR<sub>E1</sub>
- Impact of density on performance – FL<sub>E5,E6</sub>

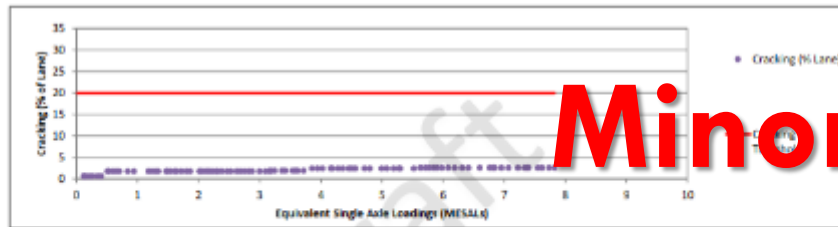


# Higher RAP with Rejuvenation N3A vs N3B

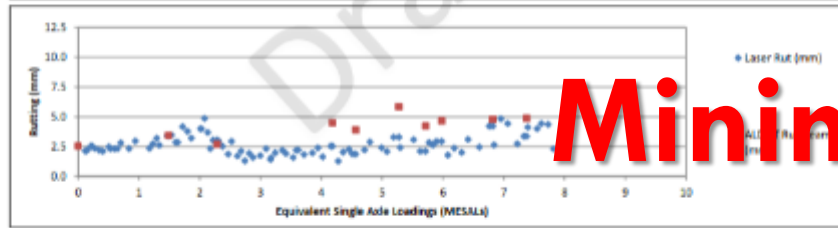
Quadrant: N Section: 3A		11/12/2023 78% Traffic		Quadrant: N Section: 3B		11/12/2023 78% Traffic	
<b>Surface Mix and Materials</b>				<b>Structural Buildup Information</b>			
Year of Completion:	2018	Study Layer (in):	1.5	Year of Completion:	2018	Study Layer (in):	1.5
Surface Design Method:	Superpave	Total HMA (in):	11.0	Surface Design Method:	Superpave	Total HMA (in):	11
Specified Binder:	PG64-22	Base Material:	Granite	Specified Binder:	PG64-22	Base Material:	Granite
Surface Mix Stockpiles:	Traprock (30% RAP)	Subgrade:	Stiff	Surface Mix Stockpiles:	Traprock (30% RAP)	Subgrade:	Stiff
Research Objective: Dense Graded VDOT Inlay with Standard 30% RAP in BMD				Research Objective: Dense Graded VDOT Inlay with Standard 45% RAP in BMD			
Principle Investigator: Nam Tran				Principle Investigator: Nam Tran			

**18½ million ESALs**

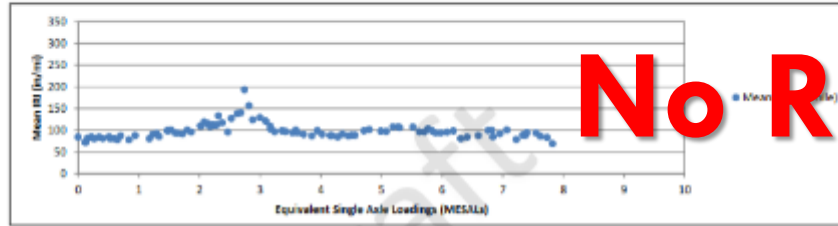
Preliminary Field Performance Data for the 2021 Research Cycle



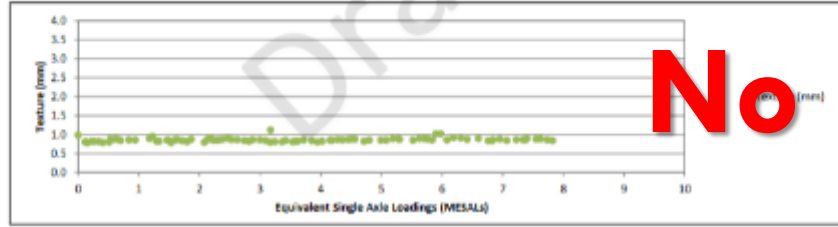
**Minor Cracking**



**Minimal Rutting**

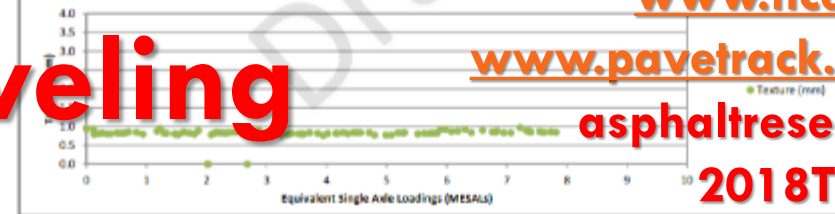
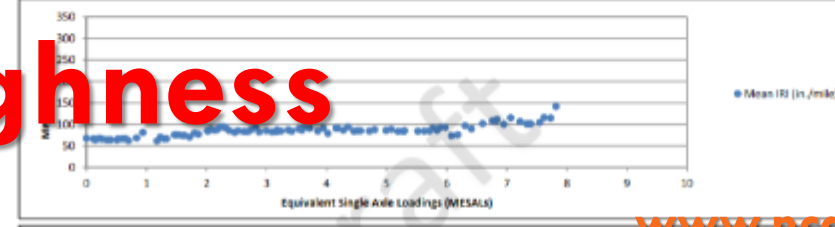
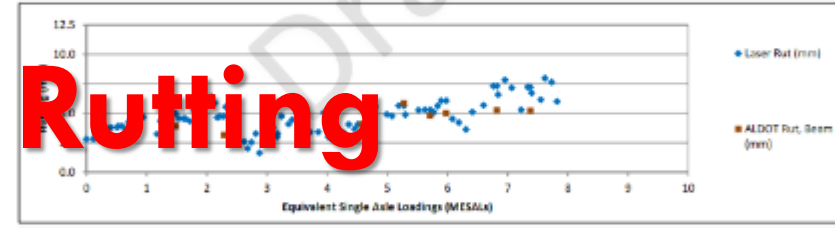
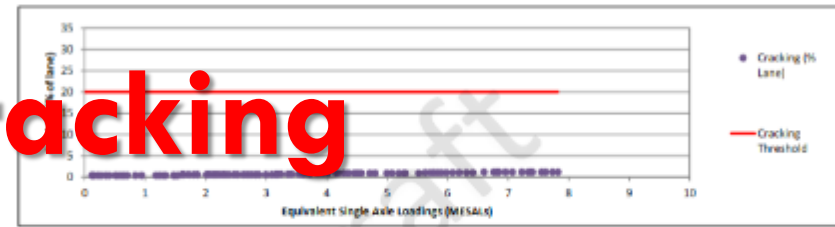


**No Roughness**



**No Raveling**

Preliminary Field Performance Data for the 2021 Research Cycle



[www.ncat.us](http://www.ncat.us)

[www.pavetrack.com](http://www.pavetrack.com)

asphaltresearch

2018Track

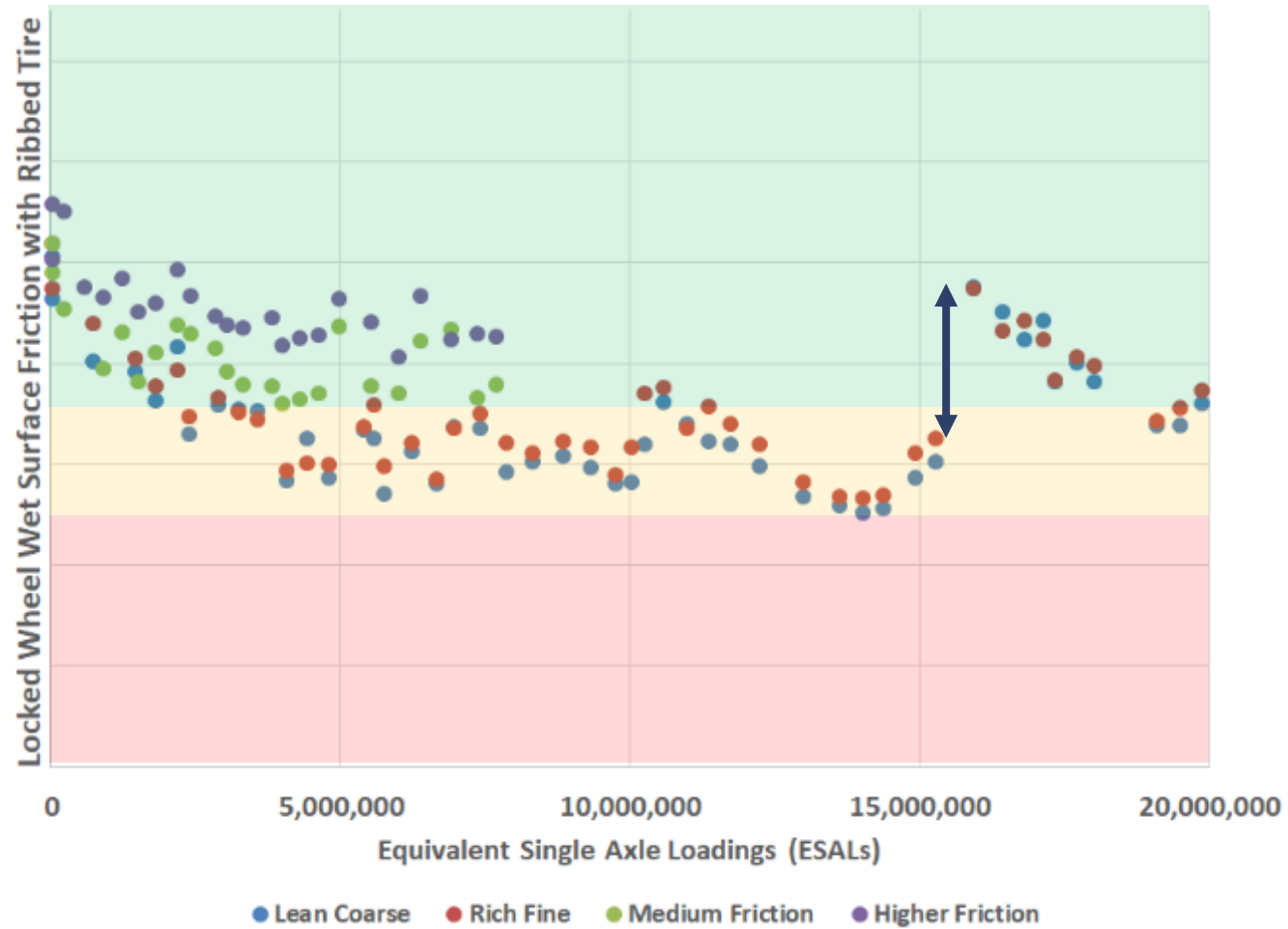
# 2021 Mill/Inlay Sections<sub>7</sub>

- BMD via additives, gradation, etc. – OK<sub>N8,N9</sub>, TX<sub>N6</sub>
- BMD with SGC for design and Marshall for QC – TN<sub>S4</sub>
- Bond strength with different tack products and/or rates – NC<sub>W4</sub>
- Friction performance mix optimization – KY<sub>S7</sub>
- High performance open graded friction course surface – AL<sub>E9</sub>





# Track Friction- 2015, 2018, 2021 Tracks



# 2021 Structural Sections<sub>9</sub>

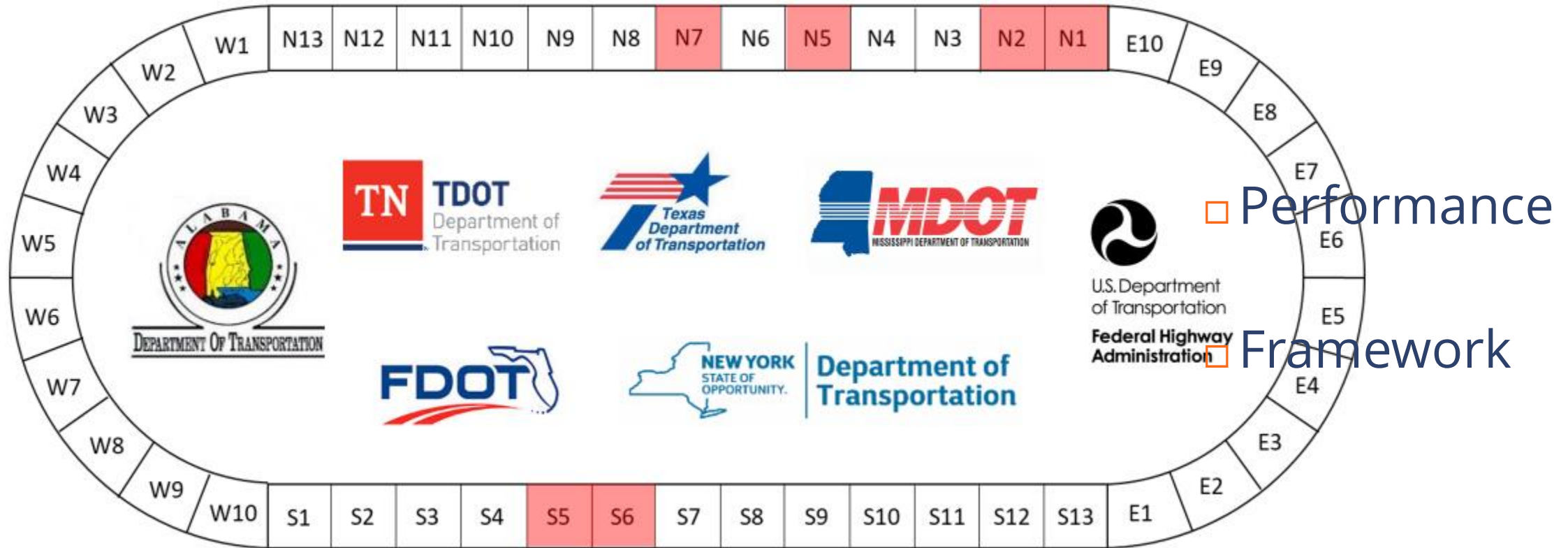
- Minimum HMA thickness over cold (re)recycling – VA<sub>S12</sub>
- Additive Group (AG) study for impact on pavement life
- “AG+” New polymer from old recycled tire rubber – Sigmabond HP<sub>S8</sub>
- “AG+” High polymer performance with reduced viscosity – BASF<sub>S13</sub>



# Cold Re-Recycling with Minimum Overlay<sub>S12</sub>



# 2021 Additive Group (AG) Study



# Phase 1 Studies (BMD+Fatigue)

Category	Mix ID	Company
Control	PG 76-22	
	PG 67-22 (reference only)	
Recycled Rubber	Rheopave™	Lehigh
	SmartMIX™	Liberty
	TB Rubber Binder	Entech
	TOR Coated Rubber	Evonik-Entech
Recycled Plastics	CERANOVUS® A115	GreenMantra
	LLDPE+ELVALOY™ RET	Dow
	NecoPlastic	NecoTech
	NecoFibers	NecoTech
Aramid Fibers	Ctrl for FORTA FI®	
	FORTA FI®	FORTA
	Ctrl for ACE XP®	
	ACE XP®	SurfaceTech
Reactive Polymer	B2Last®	BASF

# Agency Selected AG Treatments

- Recycled tire rubber
  - ▣ “Wet” Entech PG76-22<sub>N2</sub>
  - ▣ “Dry” Smart Mix in PG67-22<sub>N1</sub>
- Recycled low density plastic
  - ▣ “Wet” Dow with Elvaloy PG76-22<sub>S6</sub>
  - ▣ “Dry” pellets with PG76-22<sub>S5</sub>
- High strength aramid fibers
  - ▣ Surface Tech ACE XP with PG76-22<sub>N5</sub>
- Control with PG76-22<sub>N7</sub>

- MnROAD in 2022

Structure (Cells 16-23)

2"	Mix / Treatment to test
2"	Common Mix / sawn
2"	Common Mix / sawn
12"	Existing Granular (Common Base)
12"	Existing Granular (Common Subbase)
	Clay subgrade

# Hi-Tech Asphalt Solutions Feed System



← Smart Mix<sub>12</sub>



← Asphalt Plus<sub>12</sub>

Dry Plastic<sub>8½</sub> →



# Takeaways

- Importance of understanding and accounting for re-recycling
- Minimum SMA overlay thickness (friction design on 2024 Track?)
- Improved performance with recycling agents & higher RAP content
- Additive utilization is nothing to fear by industry/agencies, noting...
- Importance of production BMD testing (especially for “dry” options)
- Track “ground truth” for included additives, validated lab process (others)
- >8 million ESALs on ~5½” AG+ sections (2003 ~2M for 5”, ~4M for 7”)
- BMD<sub>2021</sub> mixes with 20% RAP outperforming virgin<sub>2003</sub> volumetric mixes!
- Safe and sustainable pavement at lowest possible life cycle cost!





**End-of-Cycle Conference for the  
2021 NCAT Pavement Test Track and the  
MnROAD Pavement Research Partnership**

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**May 7-9, 2024  
Auburn, AL**

# Questions and Answers

- [www.pavetrack.com](http://www.pavetrack.com)
- [asphaltresearch](http://asphaltresearch)
- [2018Track](http://2018Track)

- [buzz@auburn.edu](mailto:buzz@auburn.edu)
- [bpowell@asphaltpavement.org](mailto:bpowell@asphaltpavement.org)