WVDOH's Enhanced Friction Asphalt Overlay

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Special Thanks: Greer (Bryce Coen), Shelly Company (Shawn Scott), Vince Allison, Shawn Jack

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How many people die in RURAL road departure crashes each day in the US?

30

Important Issue Across the Country

EDC

Case Study: West Virginia Department of Transportation

West Virginia has a high number of run-off-the-road crashes. Their goal of applying HFST at these locations is to reduce the number of crashes. They intend to look at the total number of accidents 3 years after application.

WIRT COUNTY – WV 14 AT MP 15.48

WV 14 is a typical two-lane road in West Virginia with an ADT of 3400. The site is located at a six-degree horizontal curve. Prior to application, this site had four wet weather crashes in a span of 3 years. No skid testing reading was available prior to the project, but it had a reading higher than 69 after installation. The project was completed in October 2012. Total linear feet of installation is 420.

MERCER COUNTY – WV 20 AT MP 16.42 BETWEEN PRINCETON AND ATHENS, WV

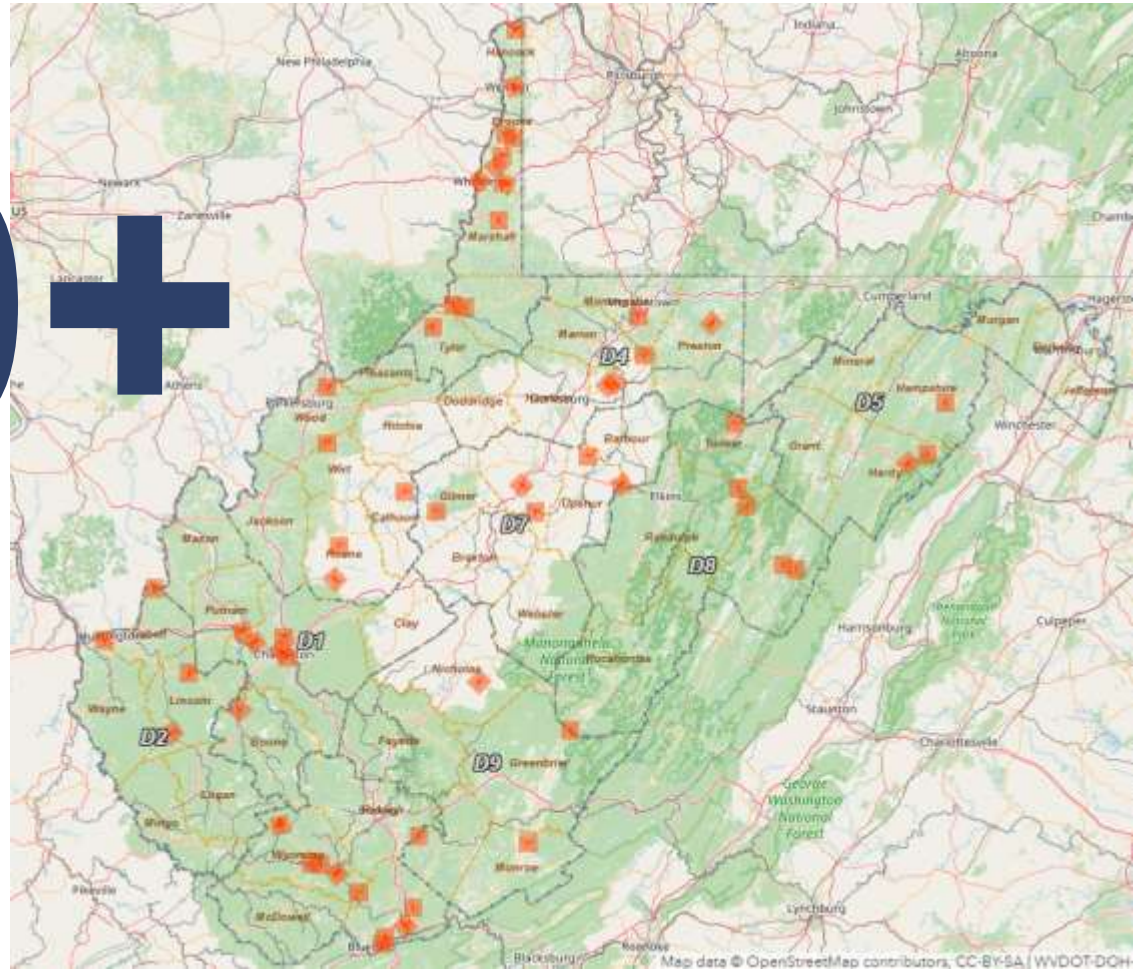
WV 20 is a two-lane road in southern West Virginia with an ADT of 7200 compromising mostly of commuters. The site is located at a series of horizontal curves. Prior to the application, this site had four run-off-the-road crashes in a span of 3 years. No skid testing reading was available prior to the project, but it had a reading higher than 69 upon project completion. The project was completed in August 2011. Total linear feet of installation is 2,200.

WV 14

WV 20

HFST in West Virginia

100+




WV-20

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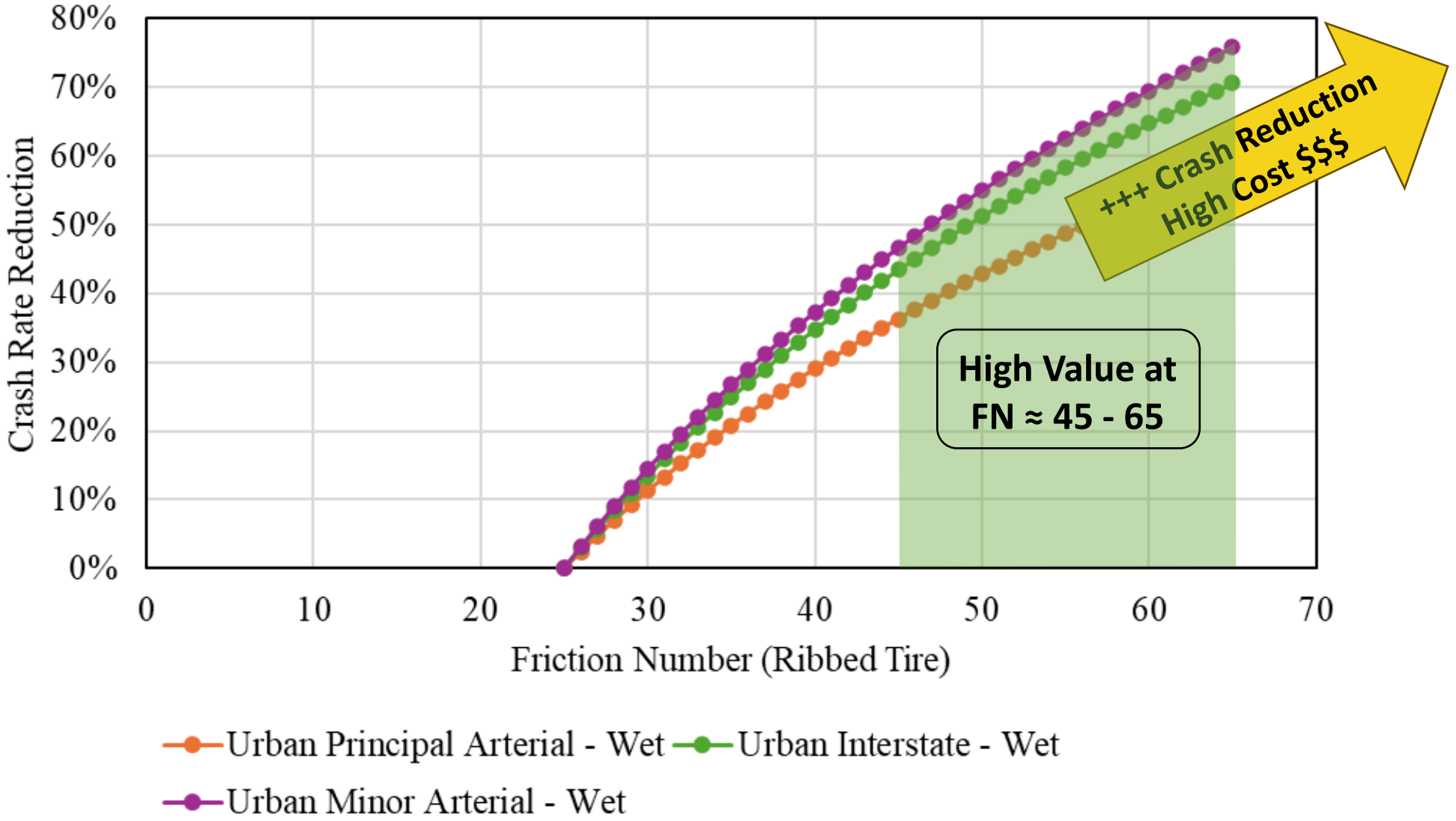
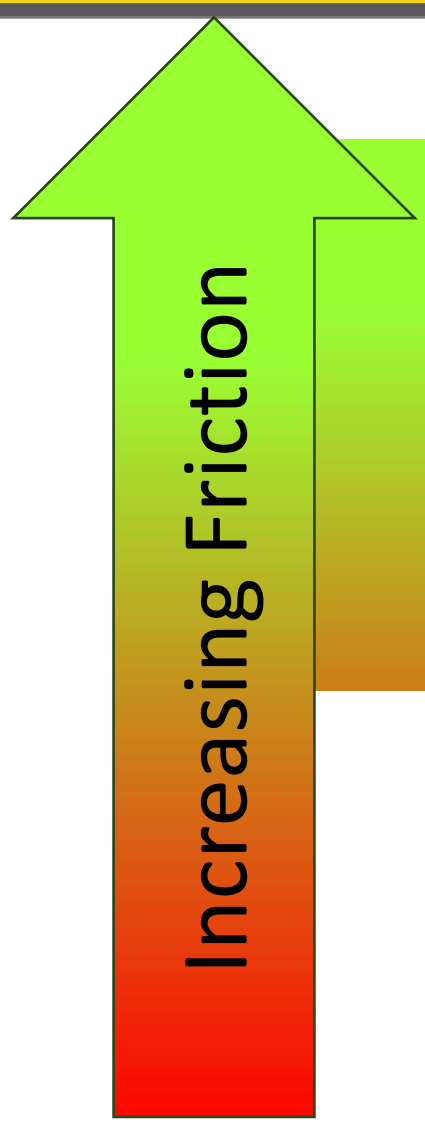
Friction Level Basics

Example of Crash Rate vs. Friction



Source: Najafi et al., 2017

Friction Levels



High Friction Surface Treatment (High $$$)

Large gap in possible friction values from traditional surfaces. (A few temporary solutions do exist)

New traditional surfaces with skid aggregates, etc.

Overlays w/ traditional non-skid aggregates

Do nothing


Traditional Asphalt Surfaces
High Friction Surface Treatment

What options do we have?

Do we have other material/pavement options?

Enhanced friction aggregate in thinlays, microsurfacing, chip seals, etc.

Long-term, sustainable friction > 50

Examples

- Lightweight aggregate chip seal (W2)
- Bauxite in thinlays and Microsurfacing

Can this work in a dense-graded HPTO?

- Will it work in DGA?
- Will it work with WV materials?
- What friction level should we target during design?
- How much bauxite is enough to get the friction we want?
- Are we wasting bauxite by burying it in the mix?
- Can we fit the bauxite within the HPTO gradation band?
- How will we handle large differences in Gsb?
- Can we get enough macrotexture?
- Many more questions!

New WVDOH Test Section (E1) Enhanced Friction Asphalt Overlay

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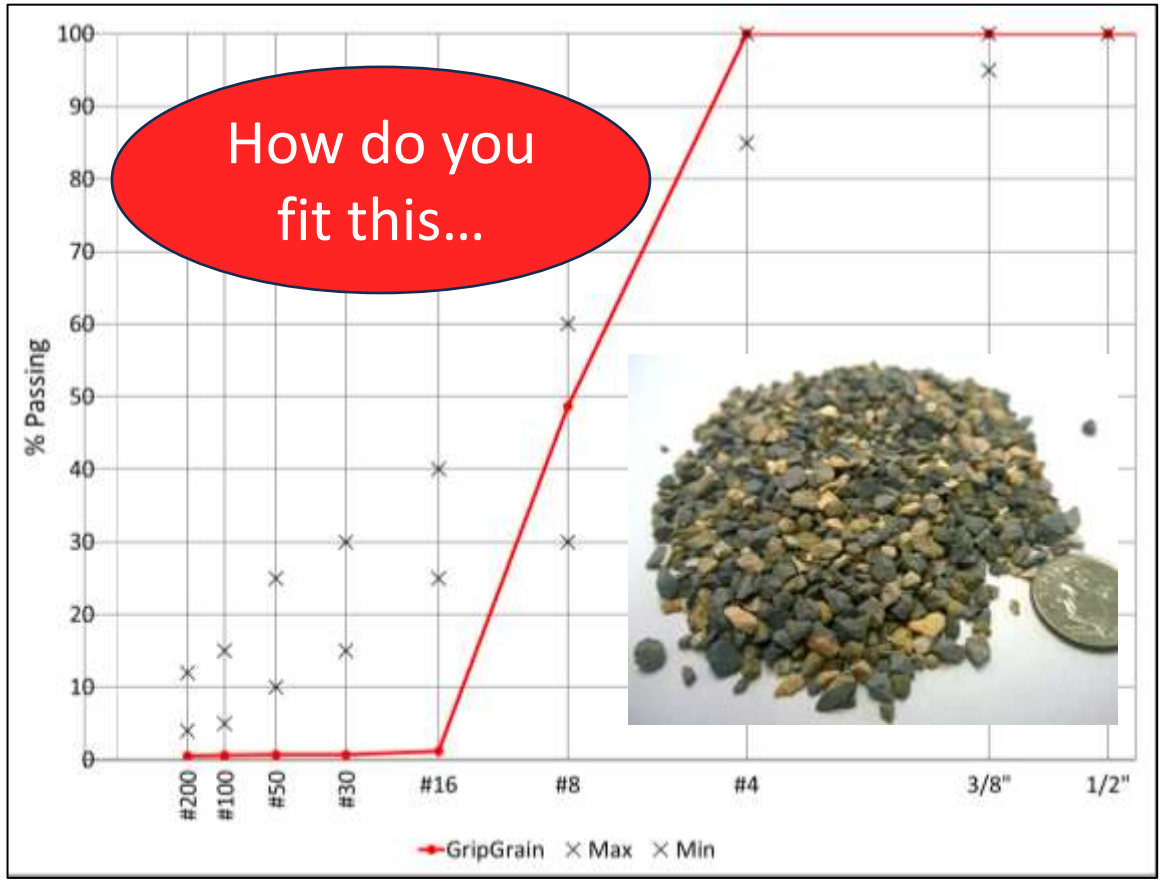
Will this work in WVDOH HPTO spec?

How do you fit this…



Into this?

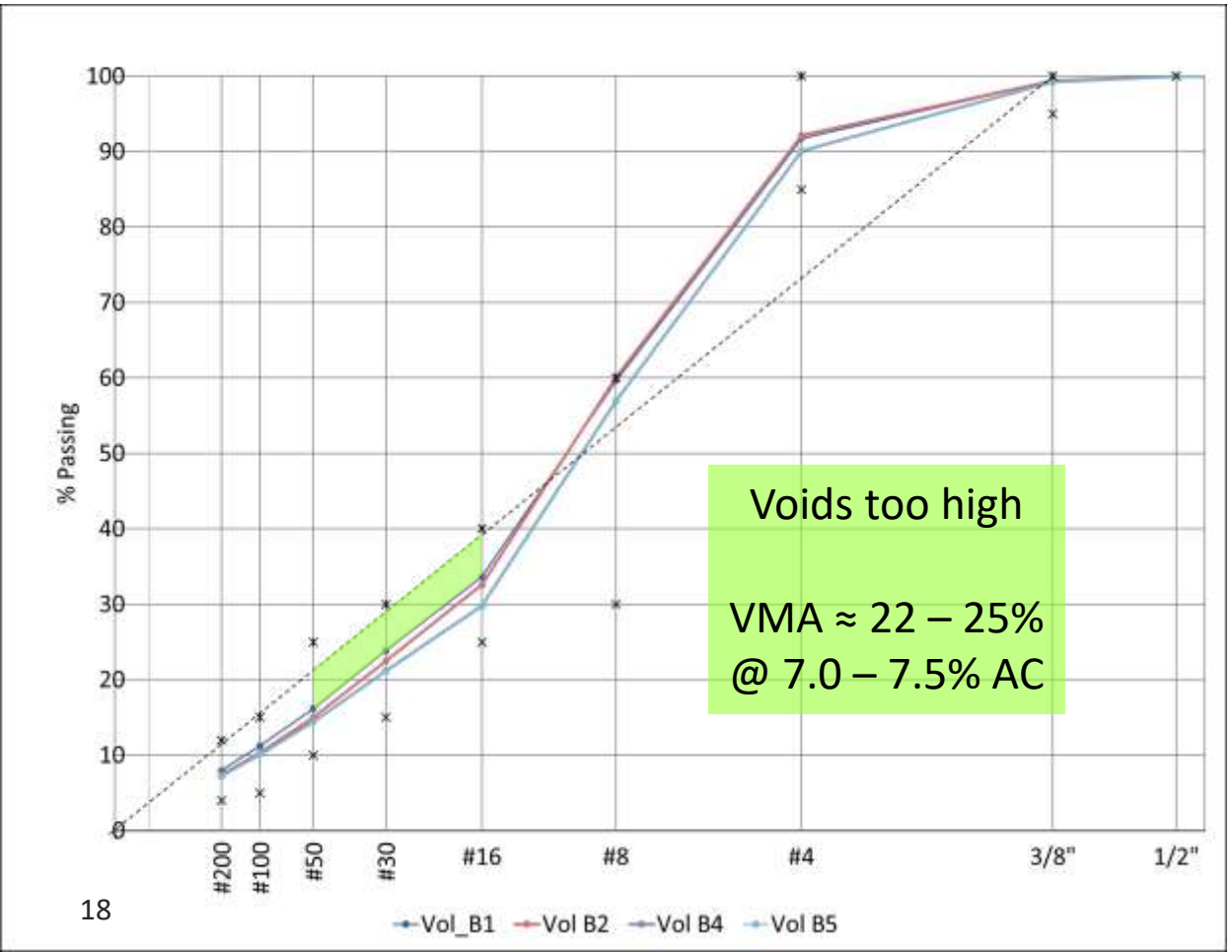
Standard Sieve Size	Percent Passing
1/2 in. (12.5 mm)	100
3/8 in. (9.5 mm)	90-100
No.4 (4.75 mm)	95 max
No.8 (2.36 mm)	30-60
No.16 (1.18 mm)	25-40
No.30 (600 µm)	15-30
No.50 (300 µm)	10-25
No.100 (150 µm)	5-15
No. 200 (75 µm)	4-12
Asphalt Content	7.0 Min

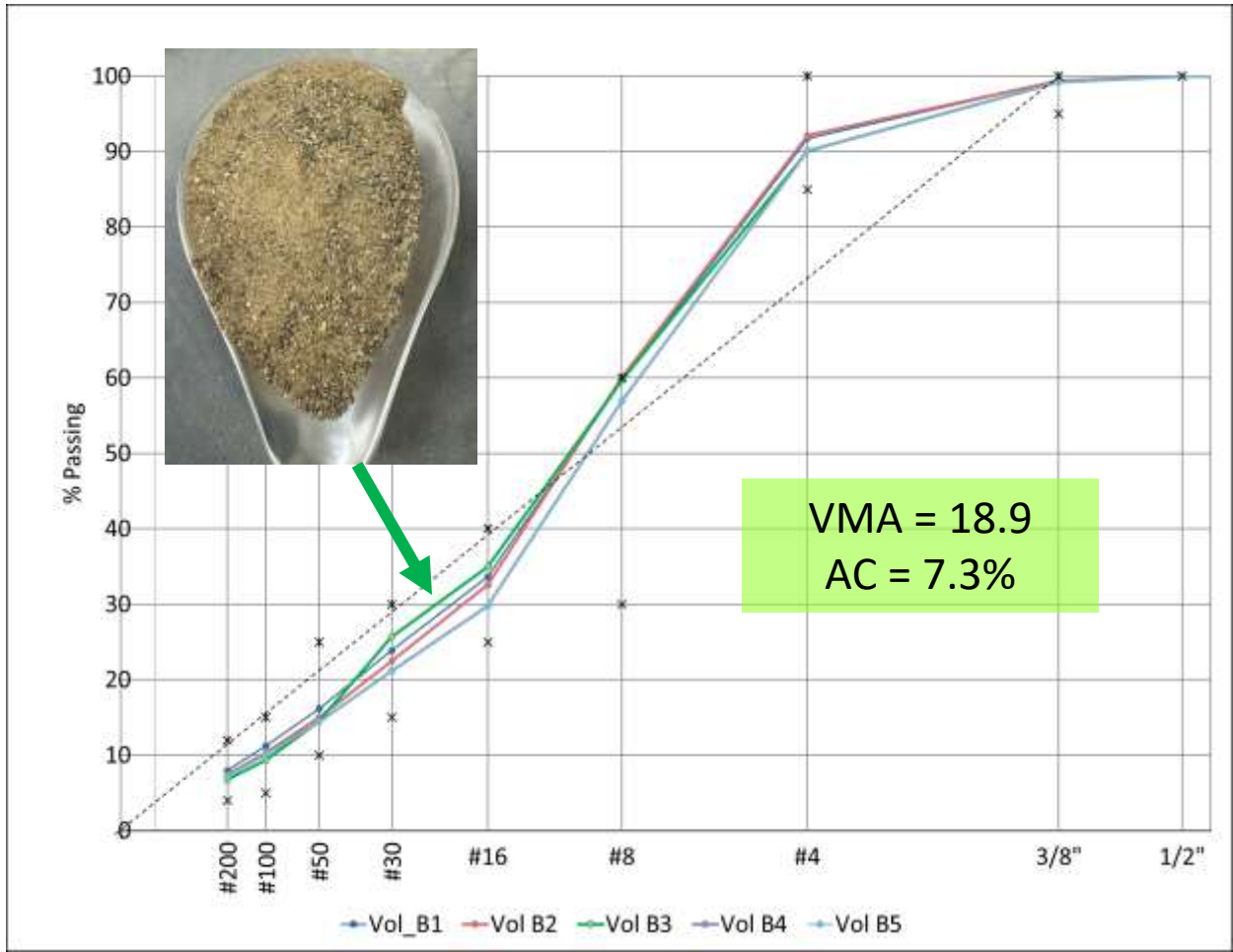
TABLE 496.4.2B

Design Volumetric Property Requirements for HPTO Mix Design [Note-3]	
Design Criteria	**Ndesign**
Number of Design Gyrations	50
Air Voids (%)	3.0
Voids-in-Mineral Aggregate (%)	18.0 minimum
Fines-to-Effective Asphalt Ratio	0.6-1.2
Tensile strength ratio (AASHTO T283) [Note-3]	85% minimum

Will this work in WVDOH HPTO spec?

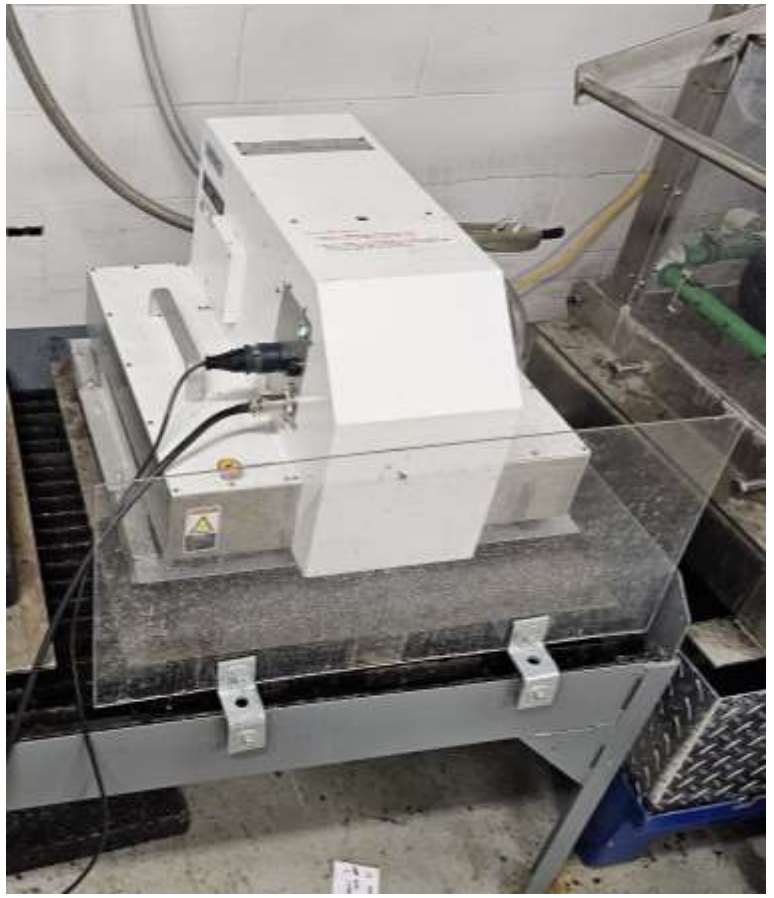
- Managed to get up to 40% bauxite to fit gradation band

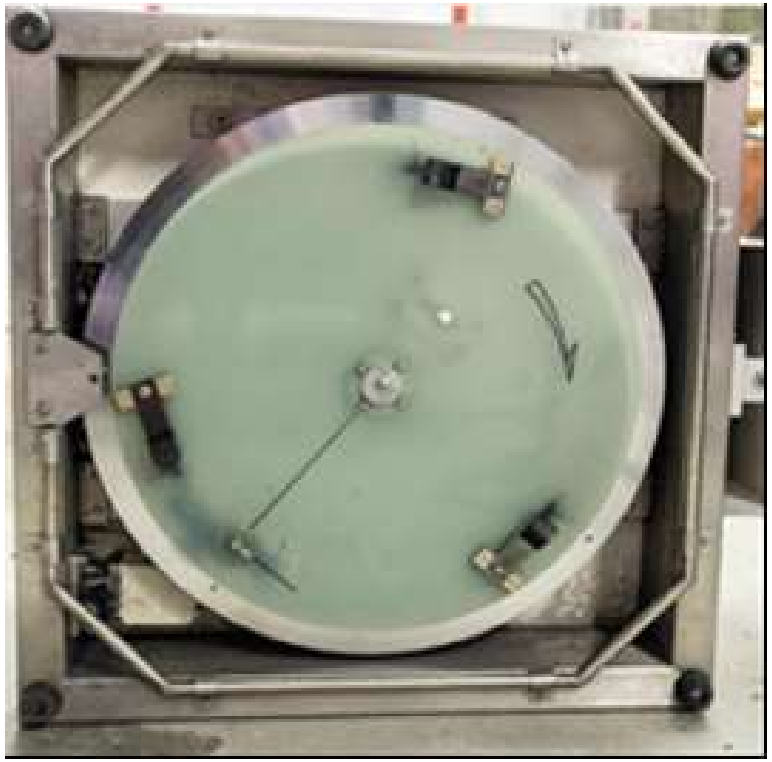




How much bauxite is enough?

- Targeting DFT (friction) > 0.50 after polishing



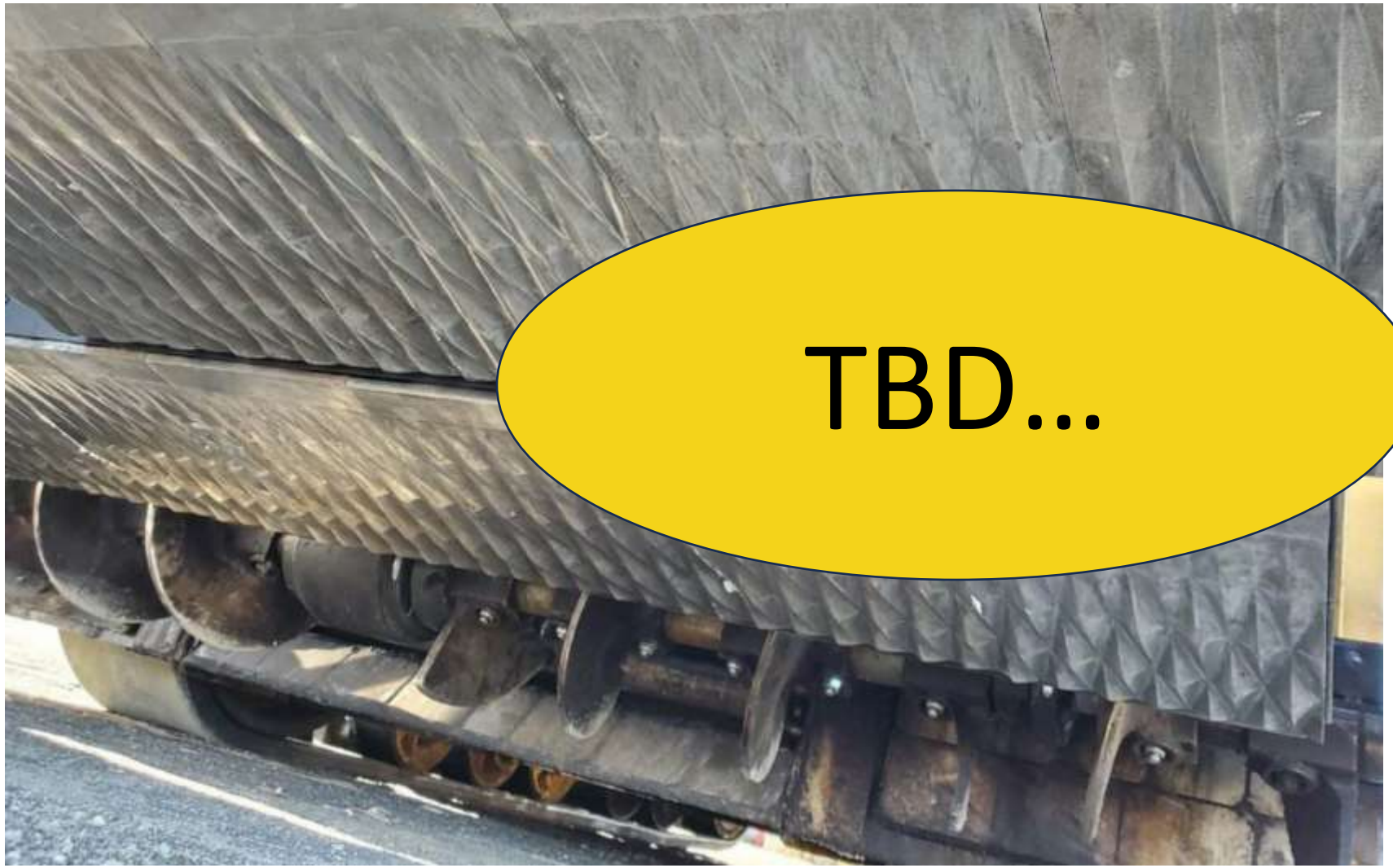


How much bauxite is enough?

- Targeting DFT (friction) > 0.50 after polishing
- Achieved with 3 blends (22 – 30%)
- Chose mix with stable volumetrics and checked rutting
- 25% baux. in Blend 3 ► DFT = 0.52

Are we wasting bauxite by burying it?

Will we have enough macrotexture?



Production

Paving

Paving

Compaction

Final Surfaces

Notable QC/Acceptance Results

	E1 (Design)	E1 (Acceptance)
AC%	7.3%	7.2%
Air Voids, %	3.2%	1.8%
VMA, %	18.9%	17.6%
In-place Density, %	94 – 97%	94.5%
Thickness, in		1.0 - 1.2”
Production Temp, °F		335 °F

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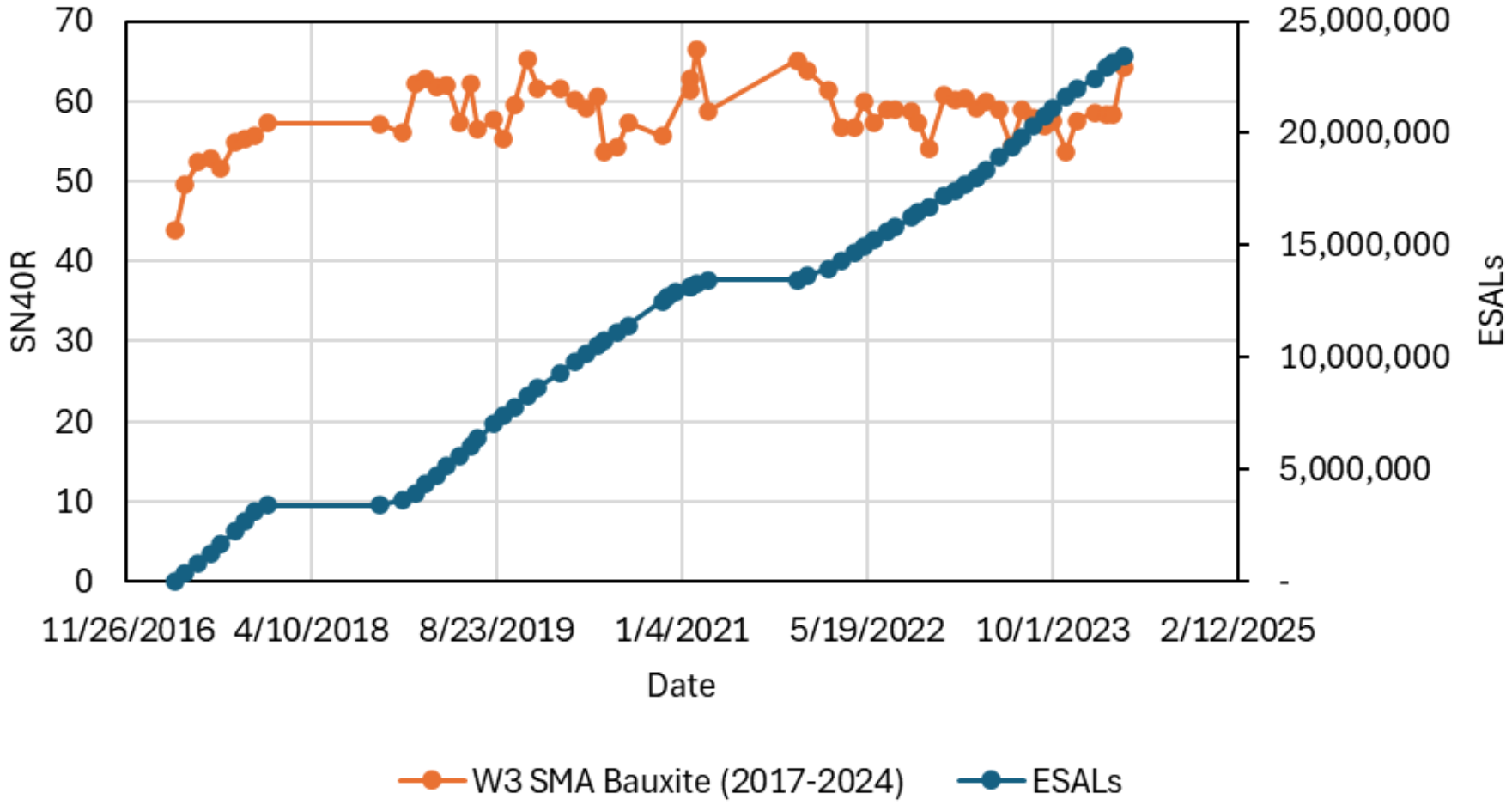
Performance

- Checked rutting in lab ► OK!
- DFT testing on plant mix ► In the queue.

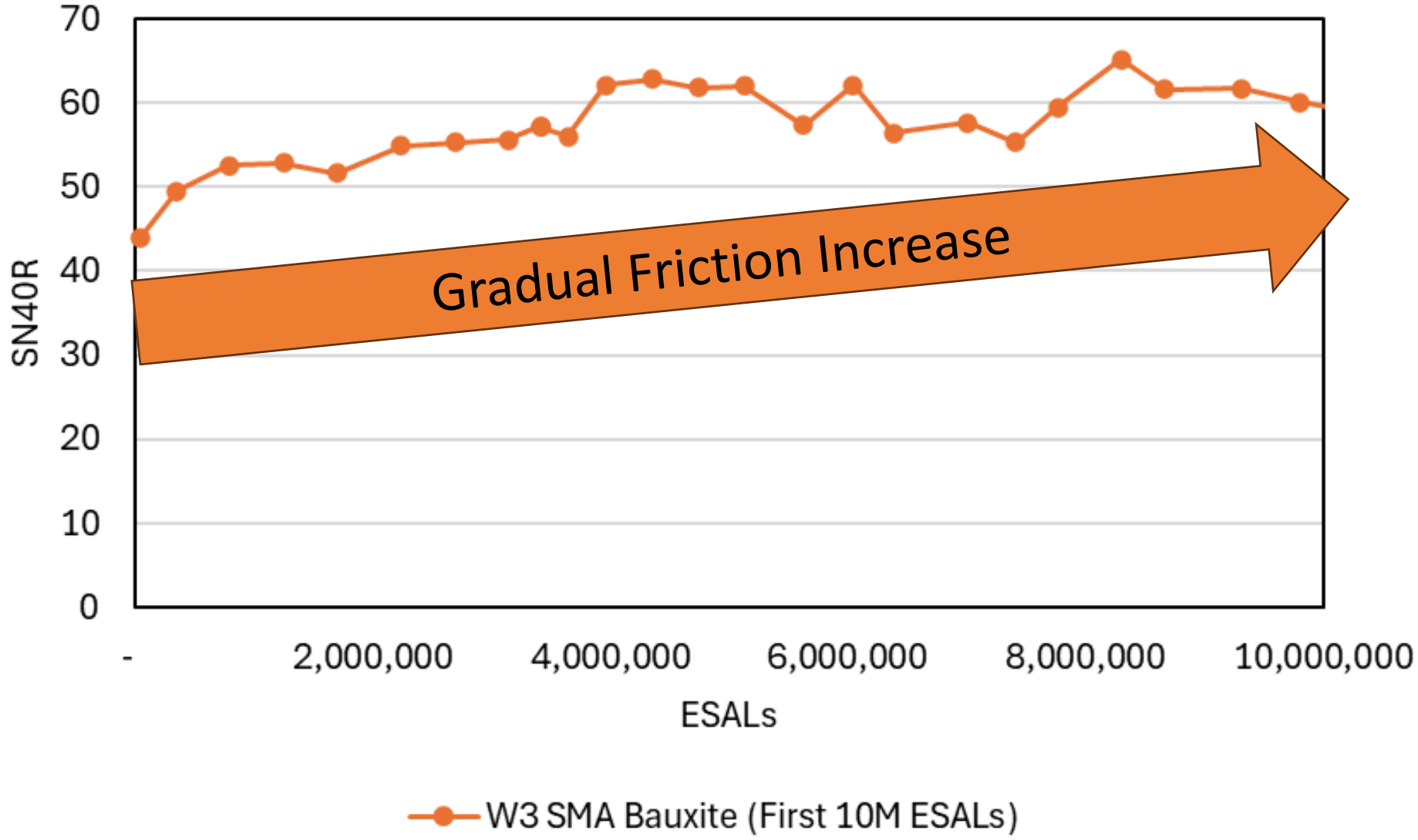
- No cracking or rutting changes

- Texture still too early to tell (MPD ≈ 0.4 mm)
  - Similar to previous bauxite SMA (for now…)
  - No differences between screed types.

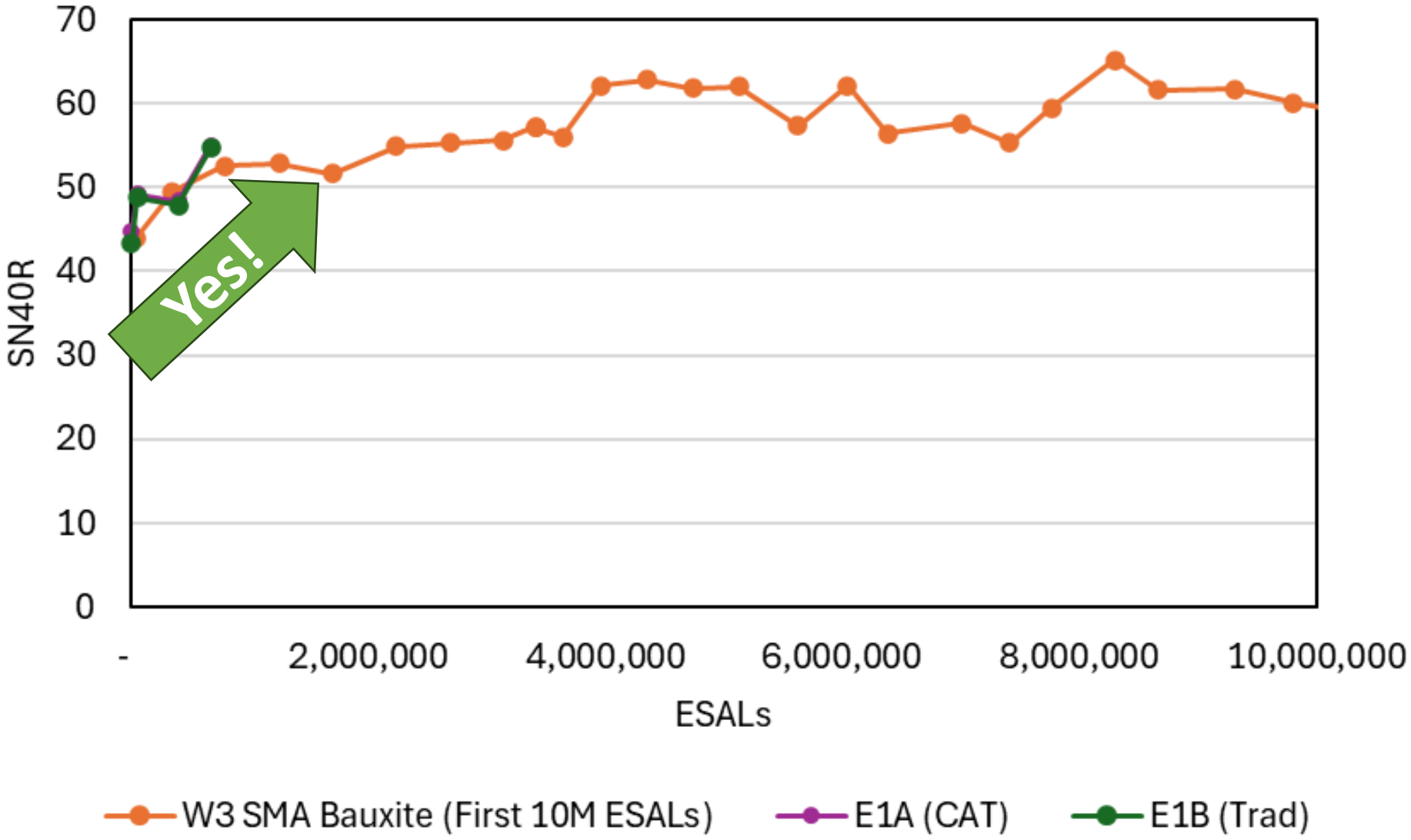
W3 Performance (prev. bauxite mix)



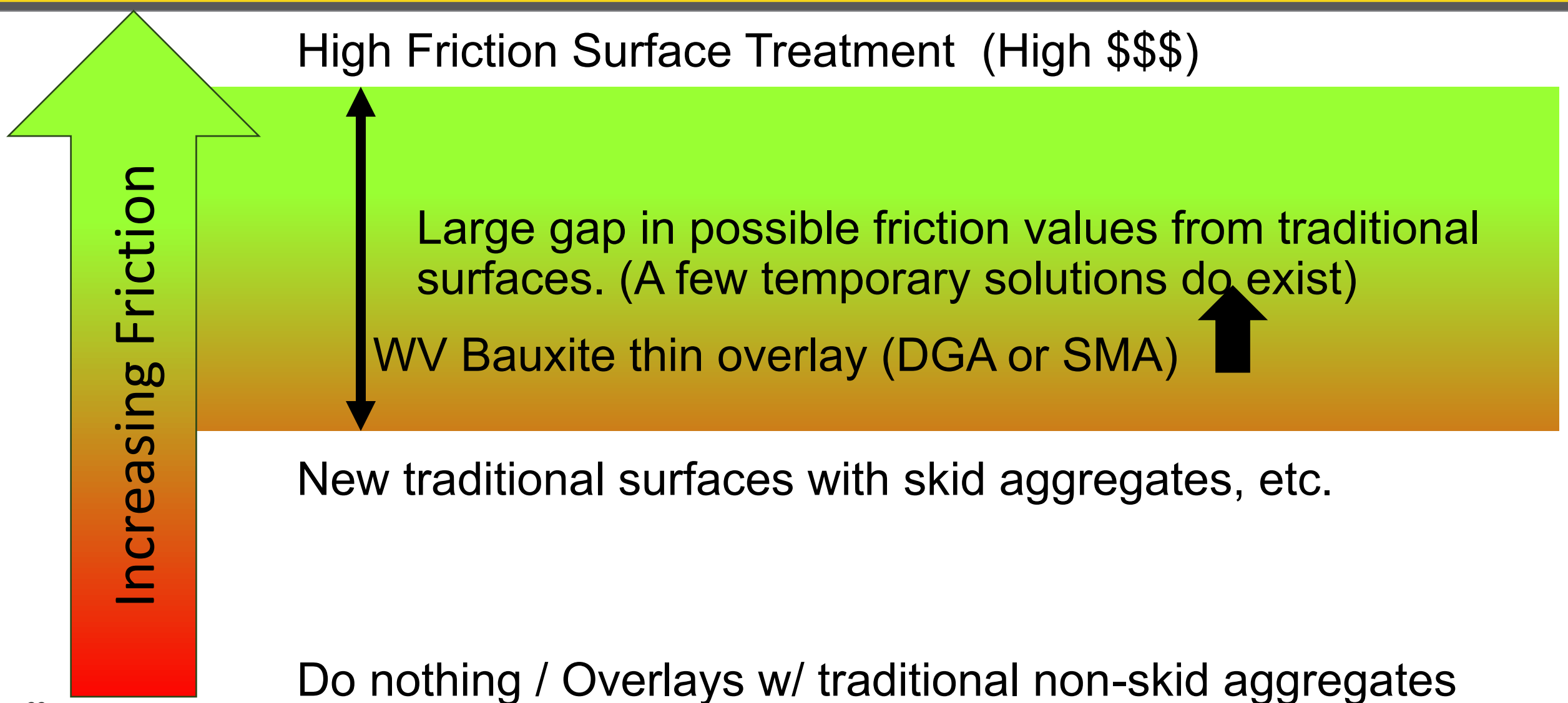
W3 Performance (first 10M ESALs)



E1 Performance



Back to Friction Levels



Summary

- Few asphalt surfaces can provide enhanced friction (>50) long term.
- Bauxite can be used in fine DGA and SMAs to improve friction.
- Embedding bauxite inside the mix increases friction with time (early on).
- Texture remains a question. Stay tuned!
  - Improve mechanically? With Gradation? TBD?

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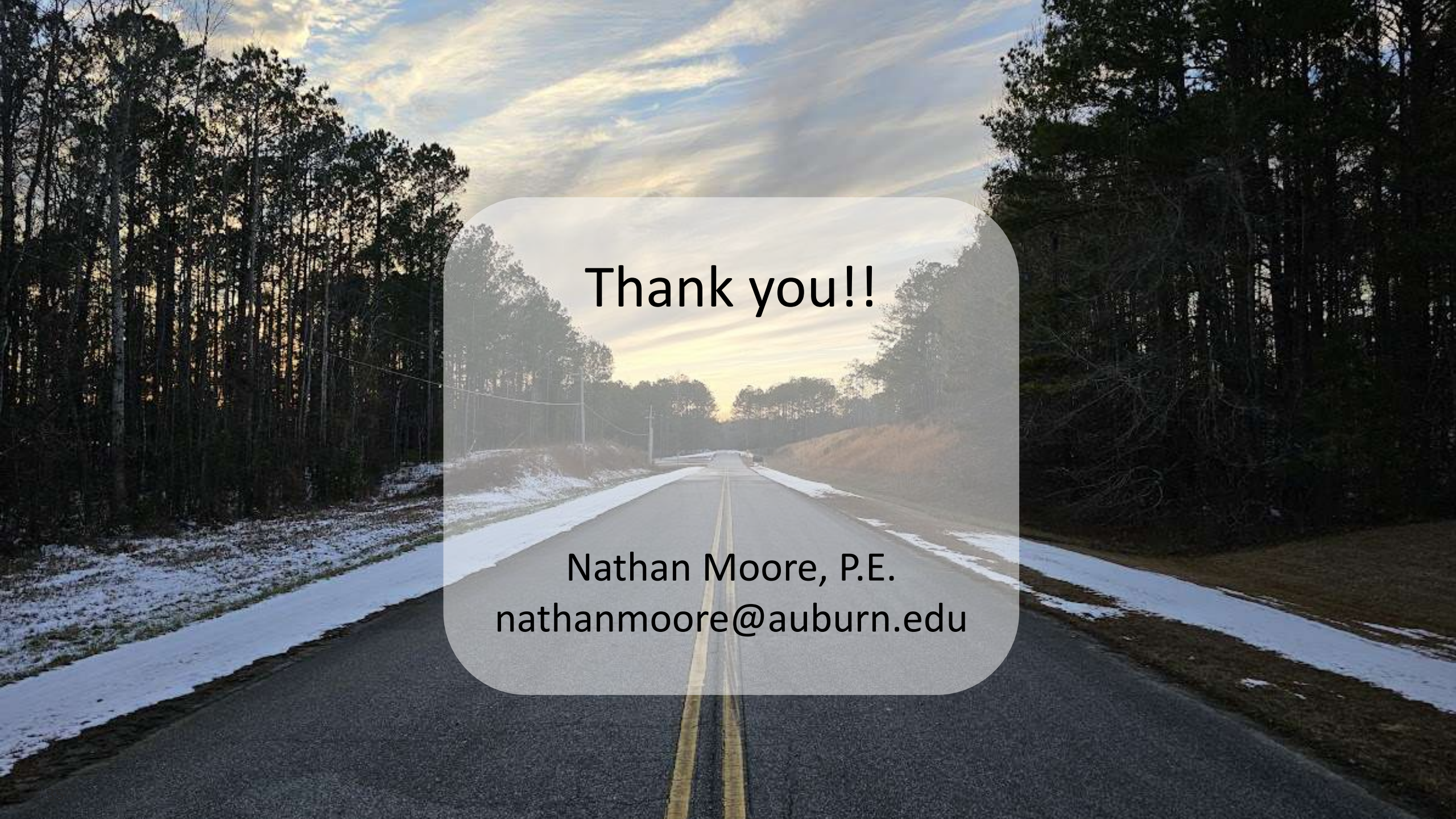
Thank you!!
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