NCAT Pavement Test Track

at Auburn University

National Center for Asphalt Technology

NCAT

at AUBURN UNIVERSITY

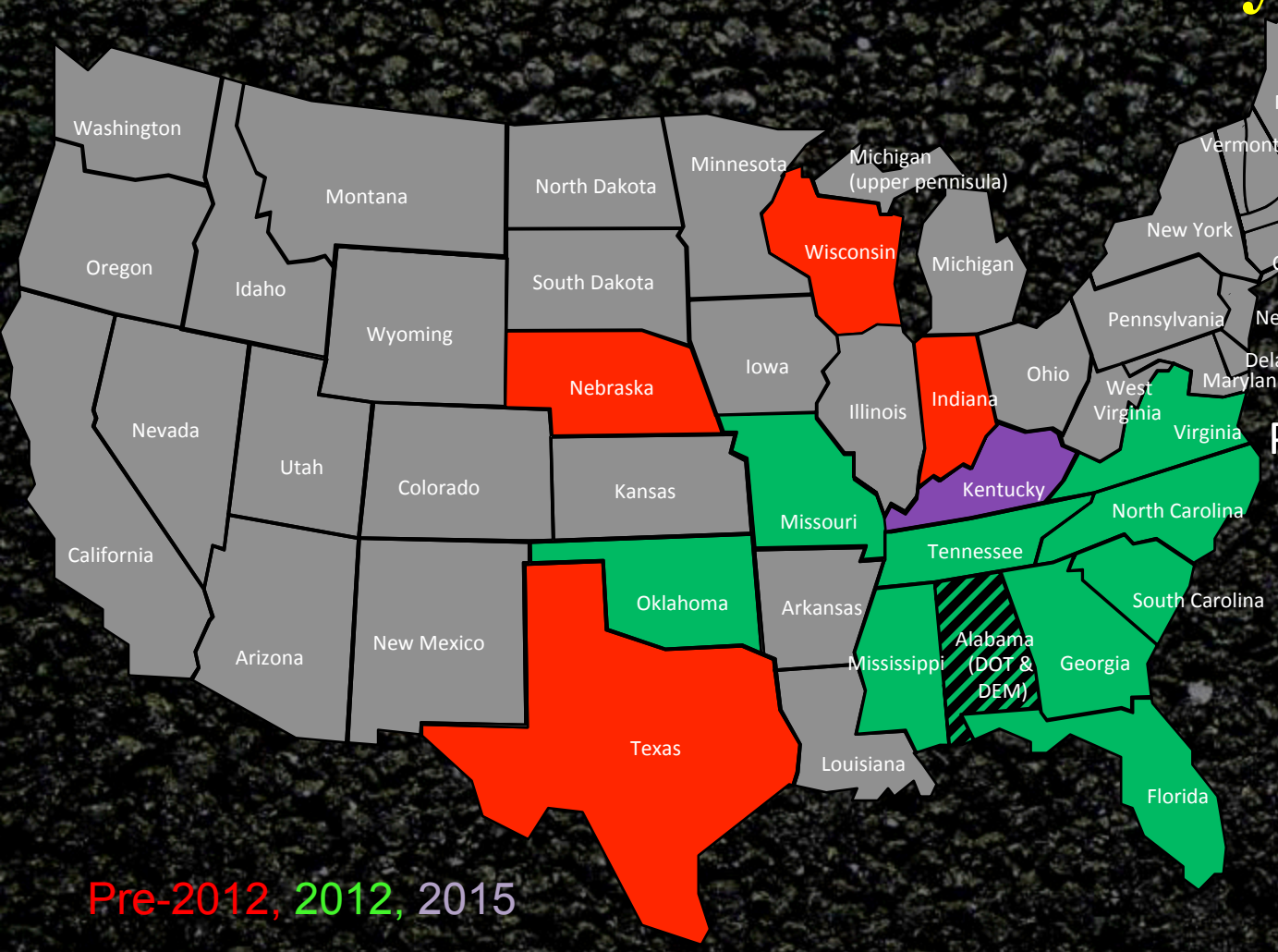
Research Update

WAPA Conference

Madison, WI

December 3, 2014

NCAT Pavement Test Track
at Auburn University



Pre-2012, 2012, 2015

FHWA

Private Sector Sponsors

- Cargill Deicing Technology
- FP2
- Kraton Polymers
- Modified Asphalt Solutions
- Oldcastle Materials
- Polycon Manufacturing
- Seneca Petroleum
- Shell Sulfur Solutions
- Trinidad Lake Asphalt

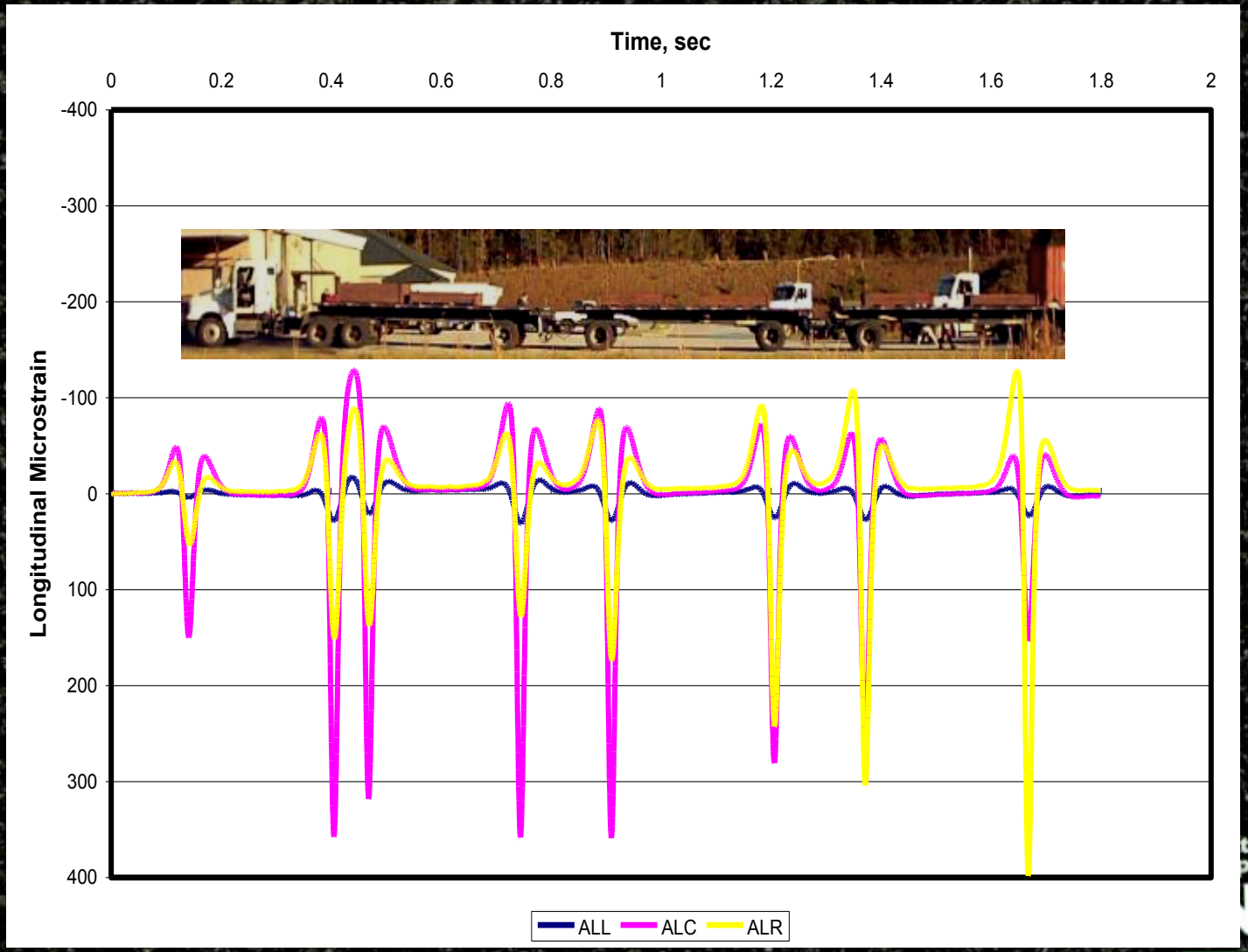
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Track Research Testing

- Weekly
  - Rutting
  - Roughness
  - Raveling
  - Cracking
  - High-Speed Response
- Monthly
  - Friction
- Quarterly
  - Density
  - Permeability
  - Noise
  - Reflectivity

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Track Research Introduction



Status of 2012 Research Cycle

- Fleet operations completed October 2014
- Terminal 10M ESAL performance measurements made
- Forensic trenching/coring in progress
- Track Conference March 3rd through 5th, 2015
- Remove sections to make way for 2015 Track

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Content

- Implemented findings from the past
- Preliminary 2012 Track findings
- 2012 preservation group (PG) study
- Implementation mechanisms
- Expectations for 2015 research cycle.

Implemented Findings

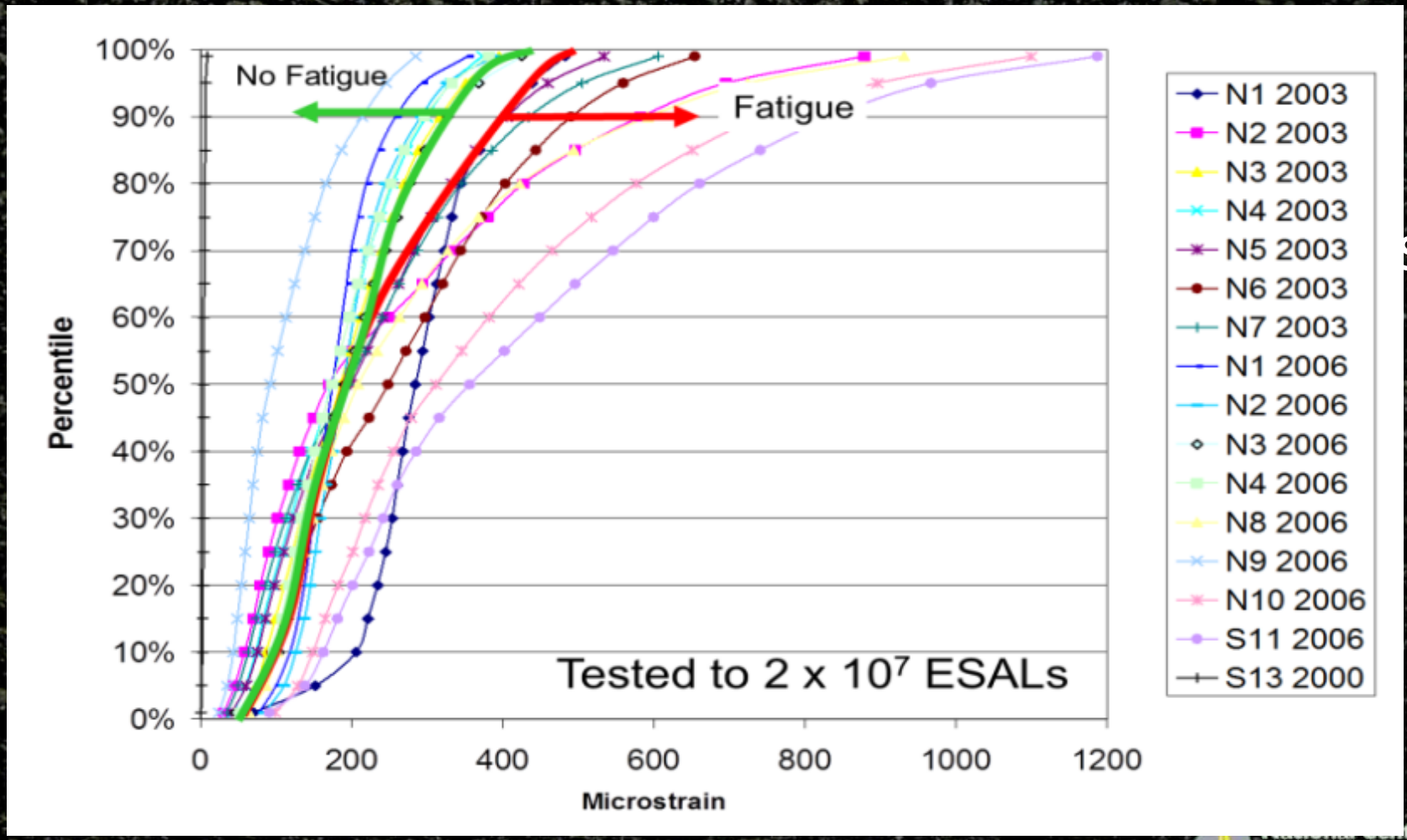
- Improvements in mix design methodologies
- Optimized use of constituent materials
- Promotion of innovative new technologies
- Mechanistic-Empirical pavement designs
- Traditional empirical pavement designs.

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

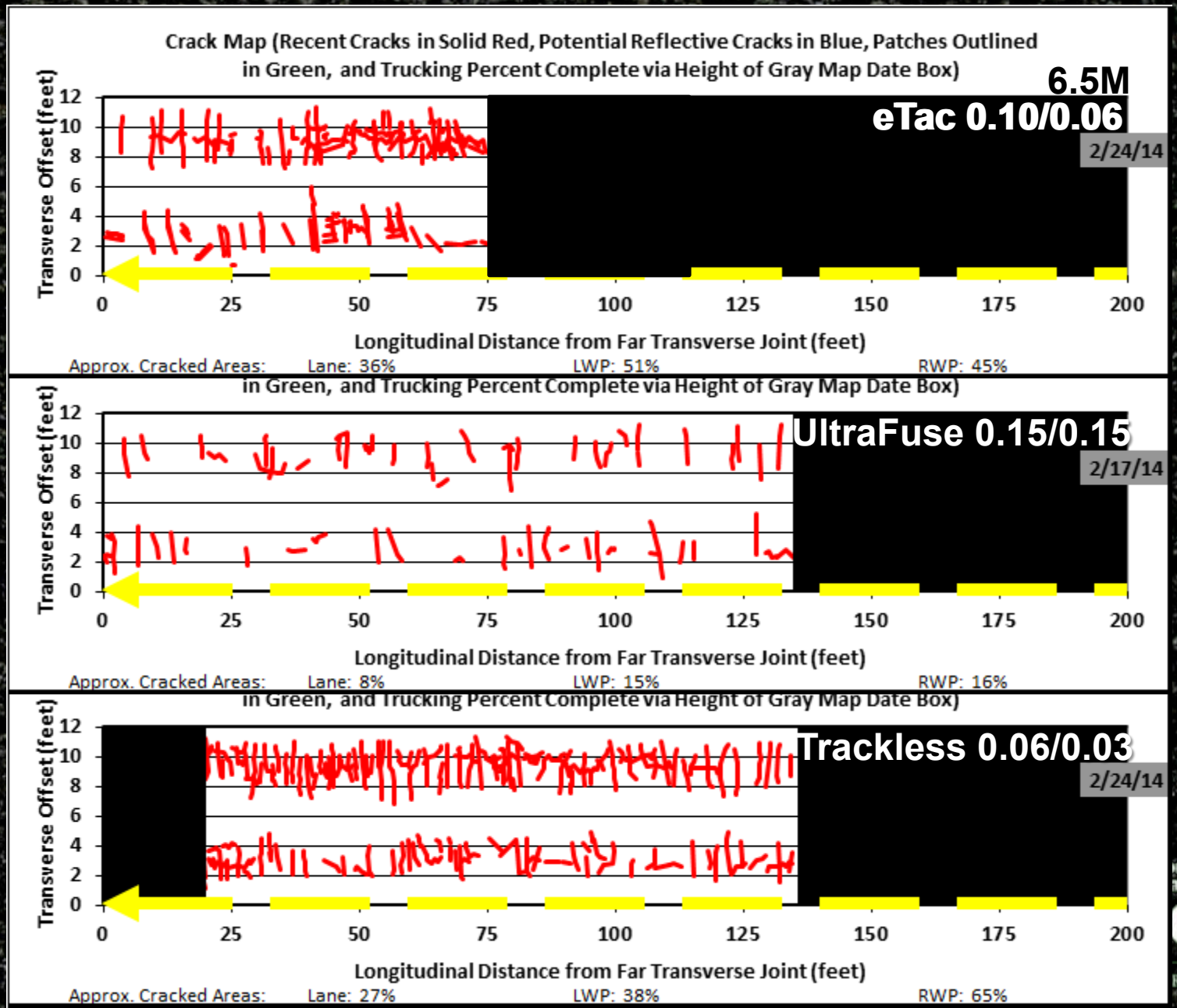
Empirical Pavement Design

- AASHO layer coefficient recalibration/update (0.54)
- Porous friction course (PFC) contribution (0.15)
- Cold central plant recycle (CCPR) mix (0.36 to 0.39)
- Proper credit for all asphalt pavement layers.

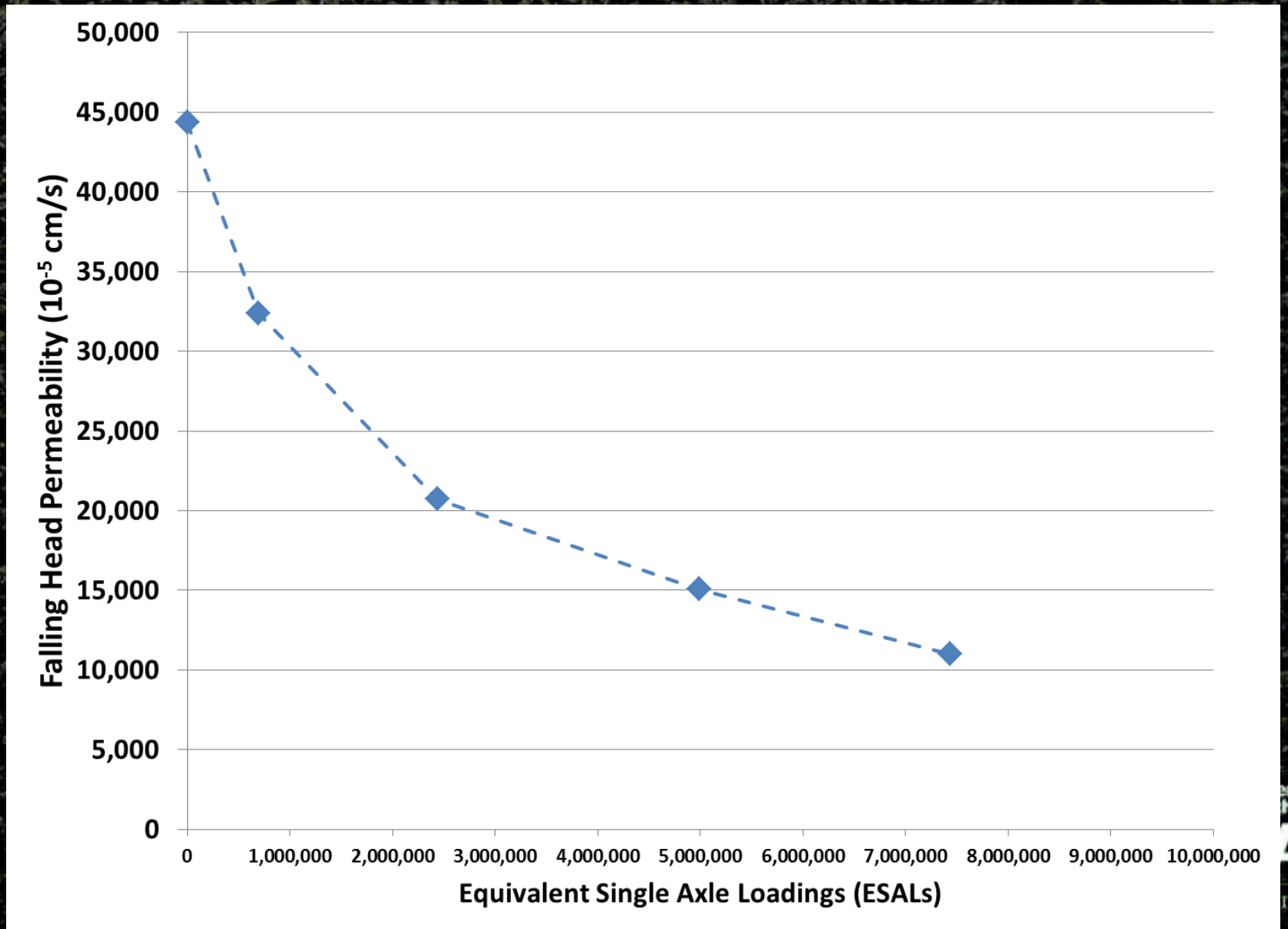
Mechanistic-Empirical Design



Surface Crack Prevention



Porous Friction Course Permeabilities



Lower Cost and Longer Life (GG)

Purpose of Each Layer	N5 Control	S5 Higher RAP	S6 RAP+RAS	S13 Recyc Tires
Durable, Rut Resistant Surface	20% RAP_{20} 67-22 DG	25% RAP_{11} 67-22 SMA	5% RAS_{21} 67-22 SMA	VIRGIN 82-22(12) SMA
Stiff, Strain Reducing Middle	35% RAP_{39} 67-22 DG	50% RAP_{41} 67-22 DG	50% $AGED_{26-24}$ 67-22 DG	35% RAP_{37} 82-22(12) DG
Fatigue Resistant Base Layer	4.7, 4.5, 93.5 35% RAP_{39} 67-22/88-10 DG	4.7, 3.7, 92.8 35% RAP_{34} 94-28/94-10 DG	25% RAP_{24} 76-22+ DG	VIRGIN 88-22(20) AZ

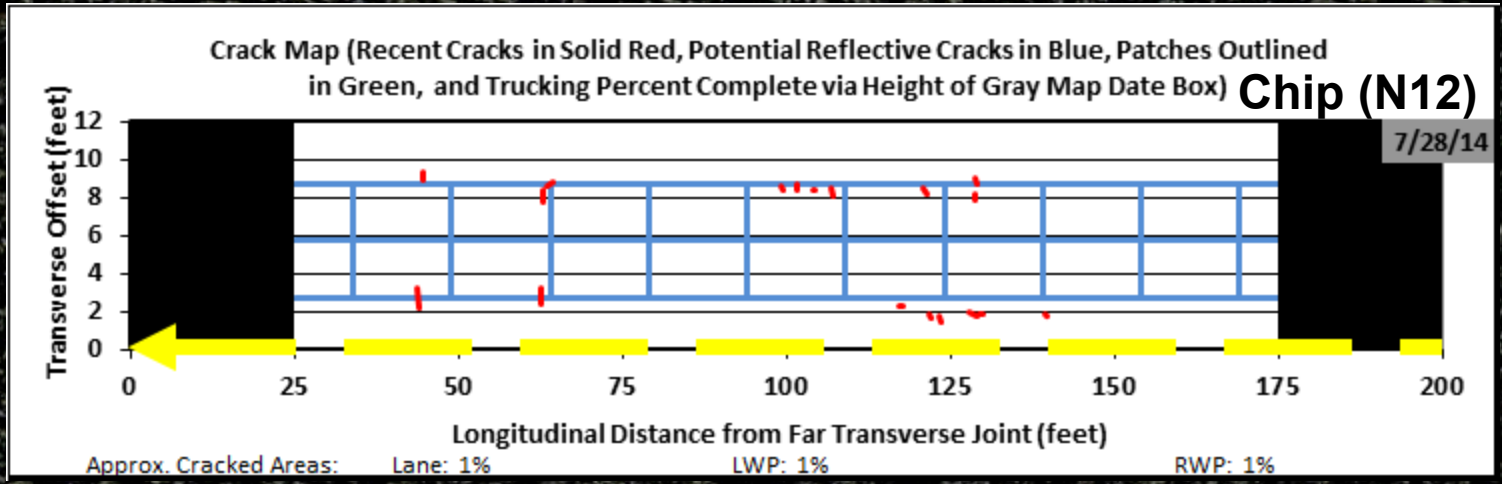
Green = Evotherm Q1 Additive, Blue = Astec Green Foamer

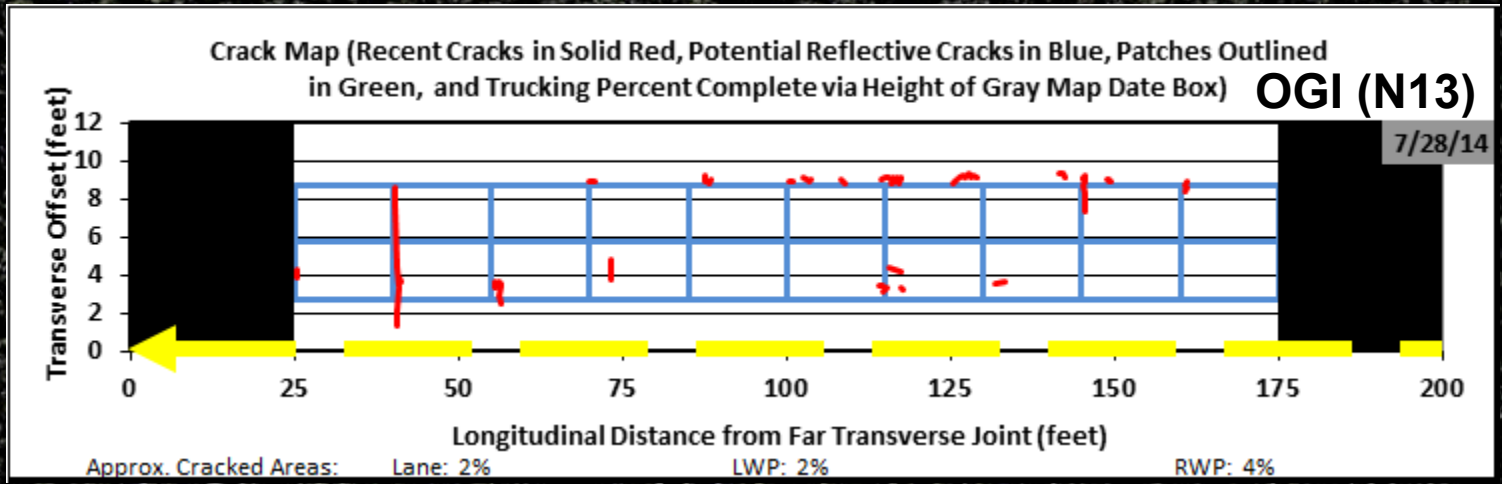
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Lower Cost and Longer Life (GG)

- 80 gyrations to 50 blows for SMA surface
- Foamed binder mix but ran hot at 325°F
- Bumped asphalt content in binder layer 2 tenths
- Doubled tack bar rate from 0.05 to 0.10 GSY

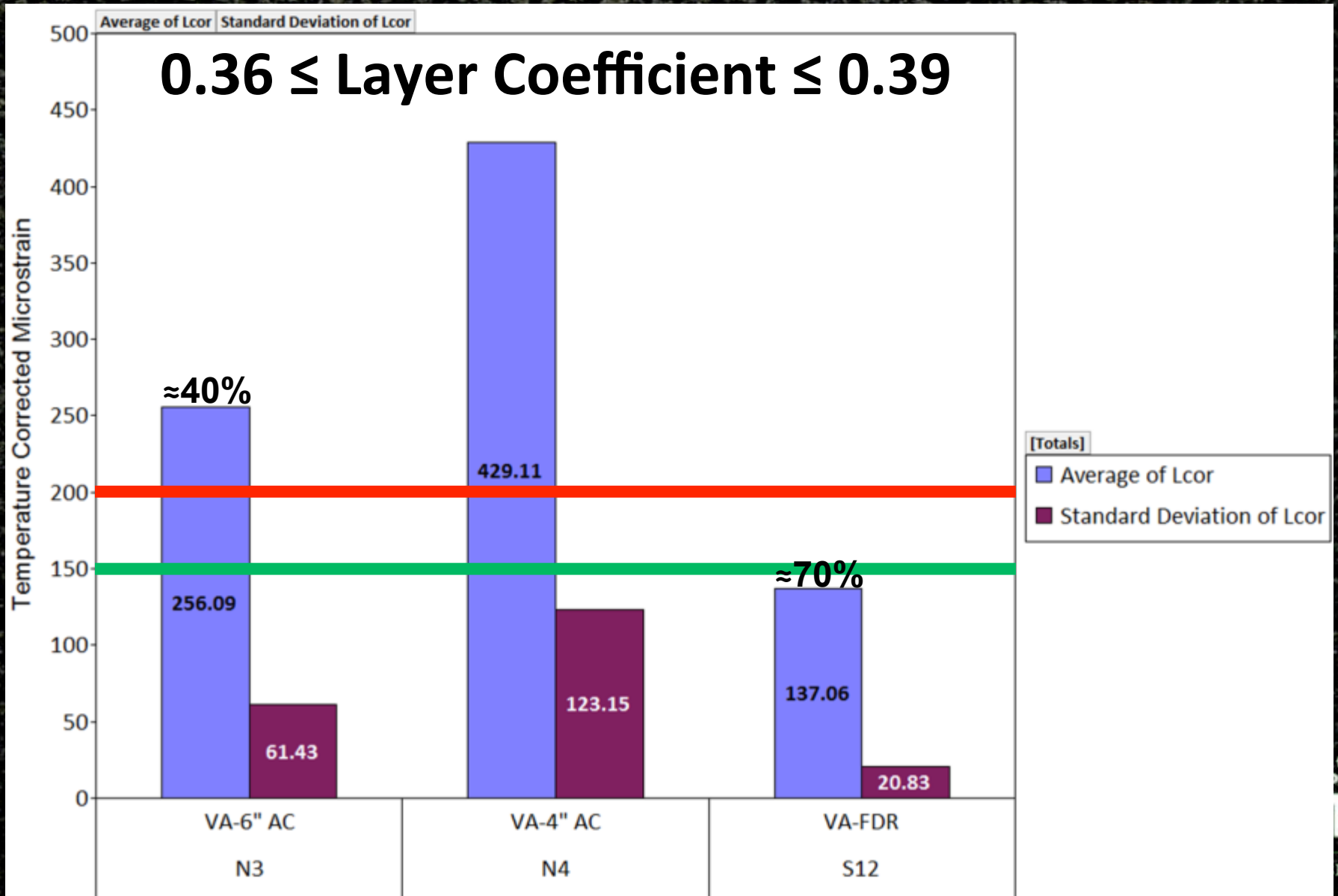
Prevention of Reflective Cracking





National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

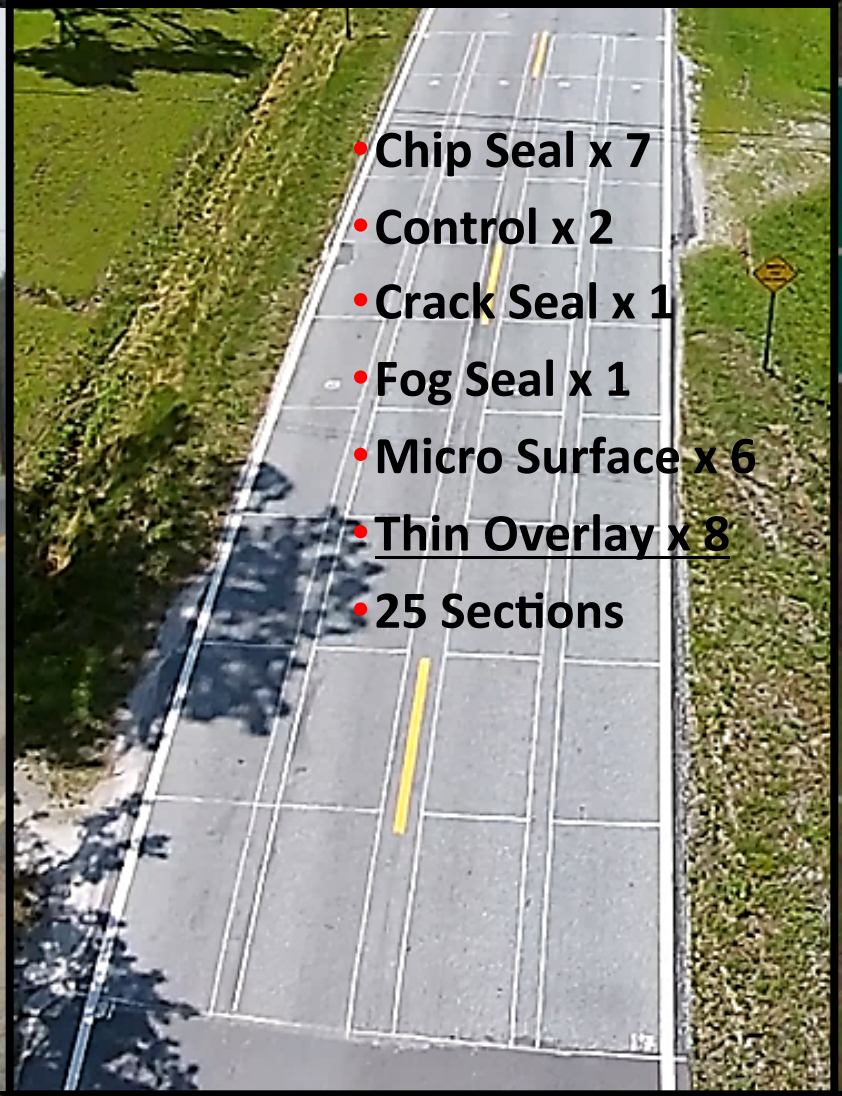
Cold Recycle Structural Contribution



Pavement Preservation

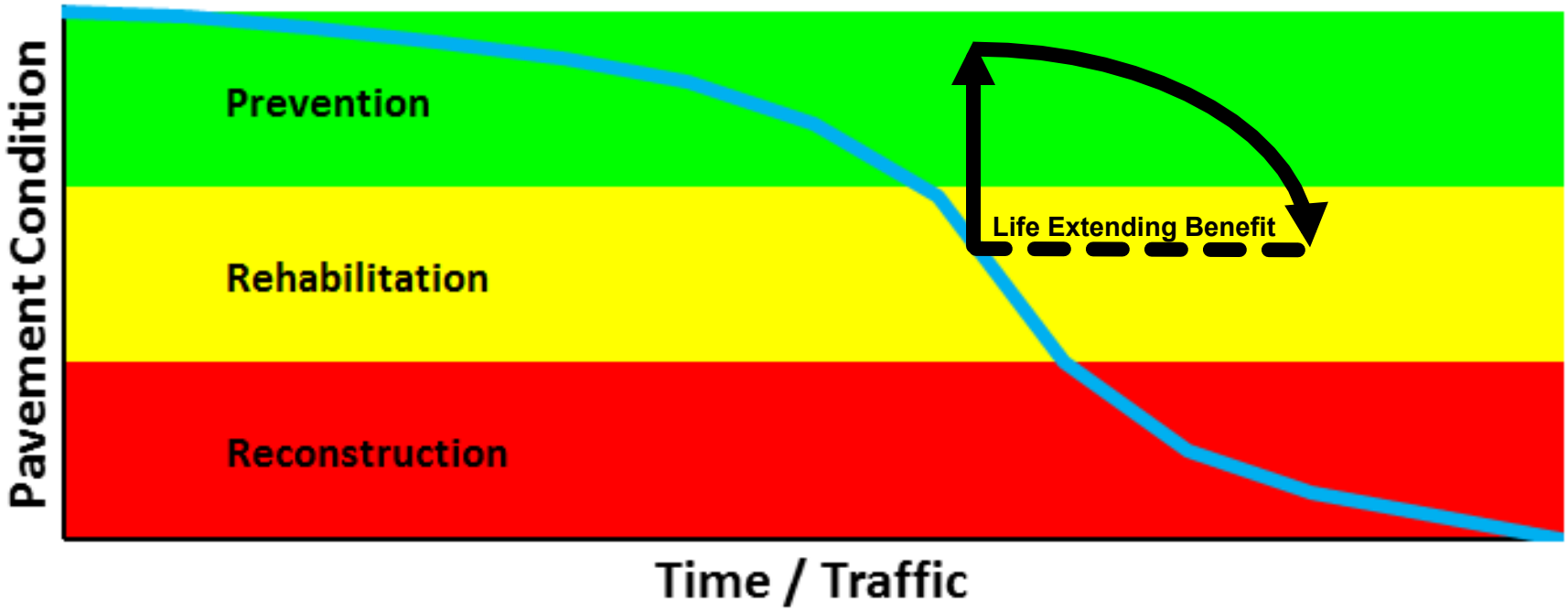
at AUBURN UNIVERSITY

Pavement Preservation



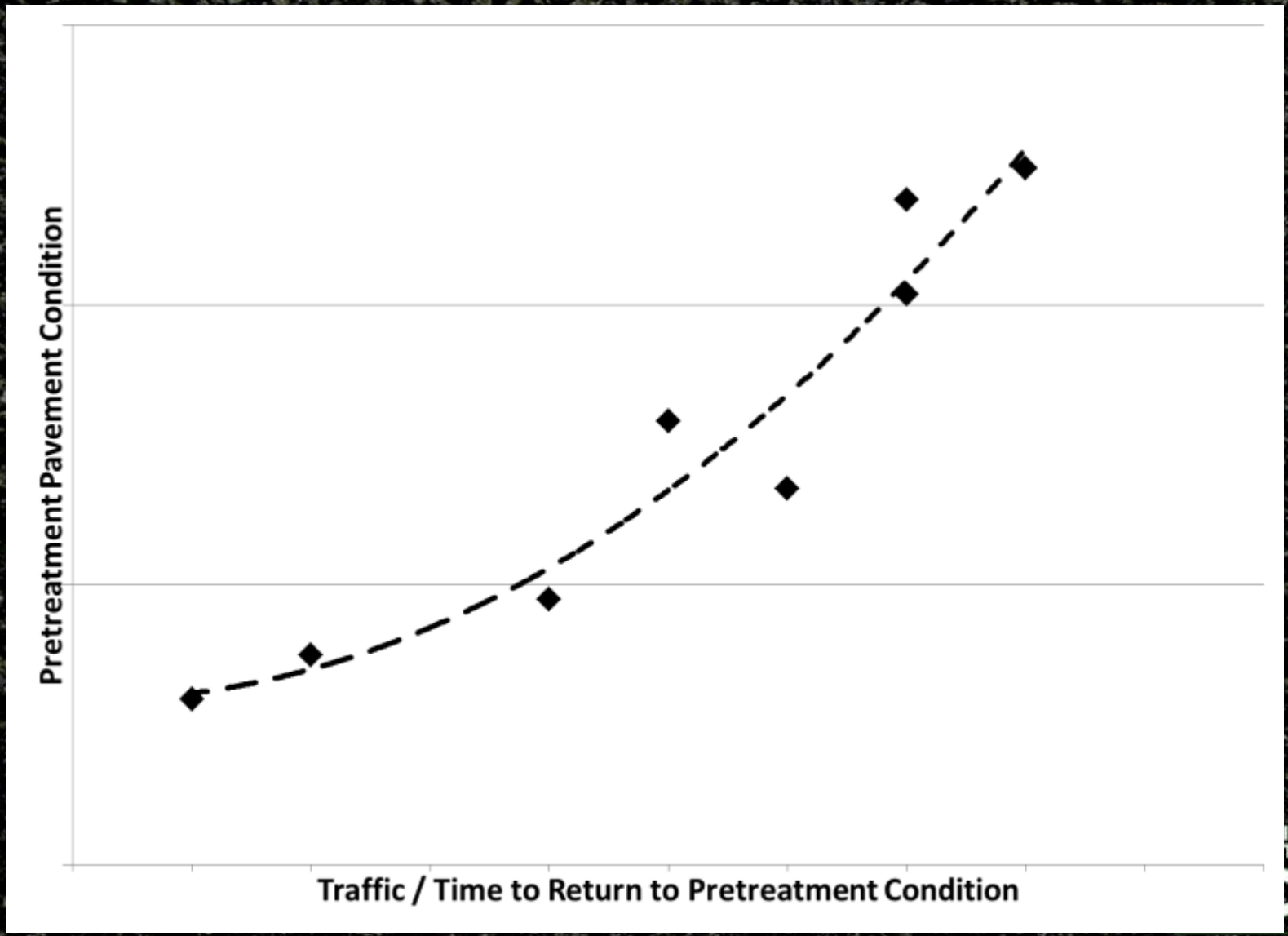
- Chip Seal x 7
- Control x 2
- Crack Seal x 1
- Fog Seal x 1
- Micro Surface x 6
- Thin Overlay x 8
- 25 Sections

Pavement Preservation

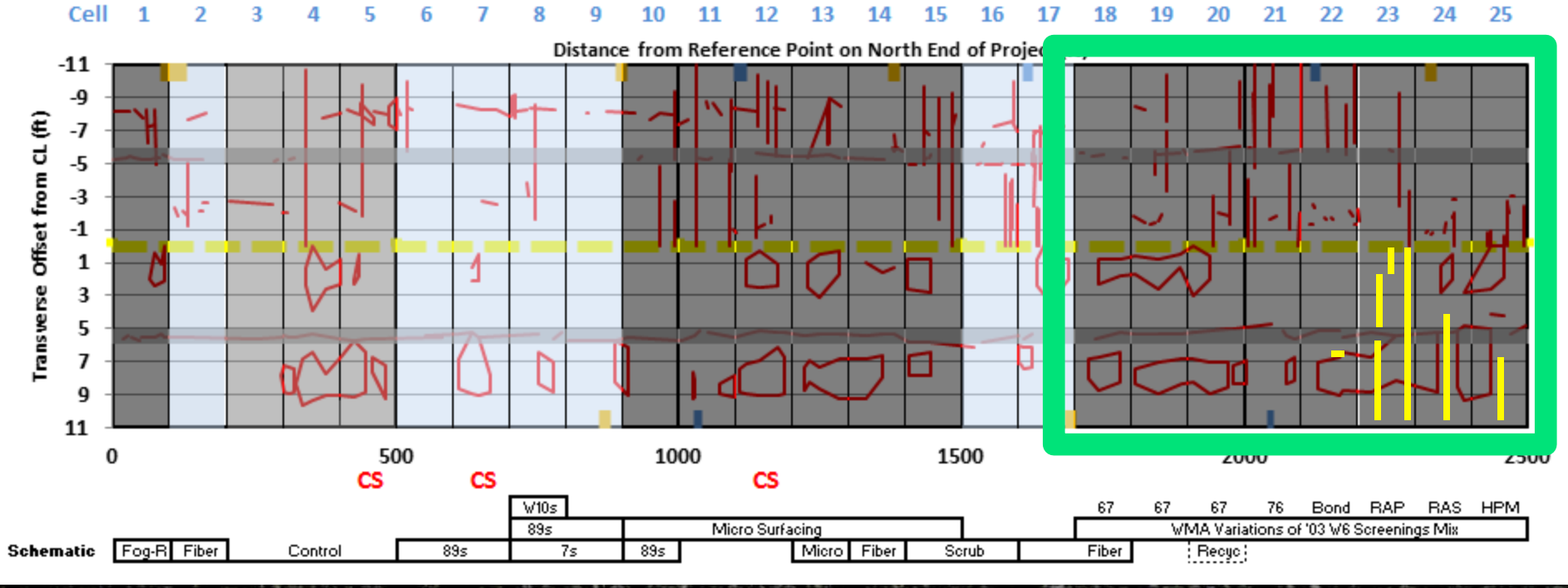


National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Pavement Preservation



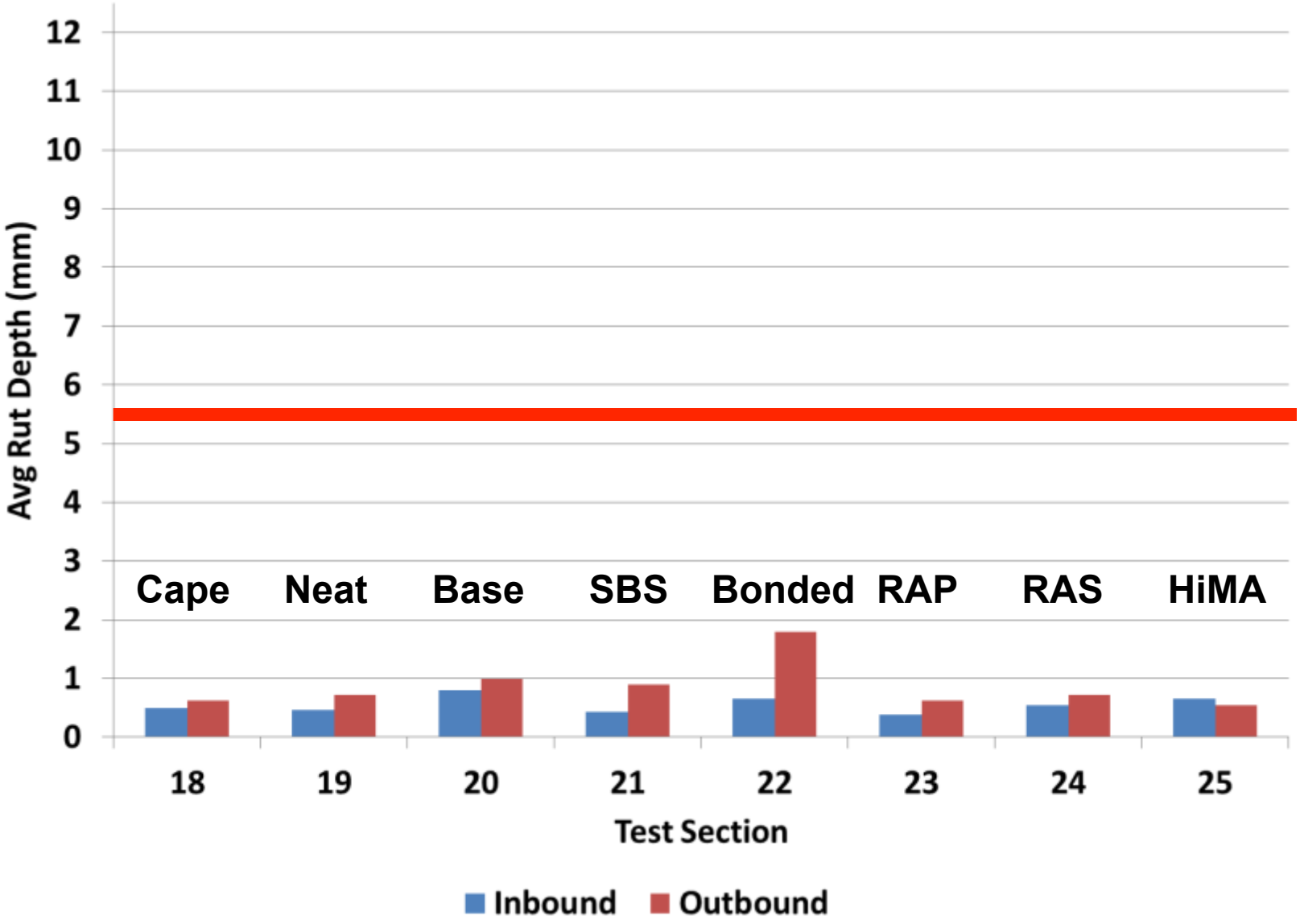
Pavement Preservation



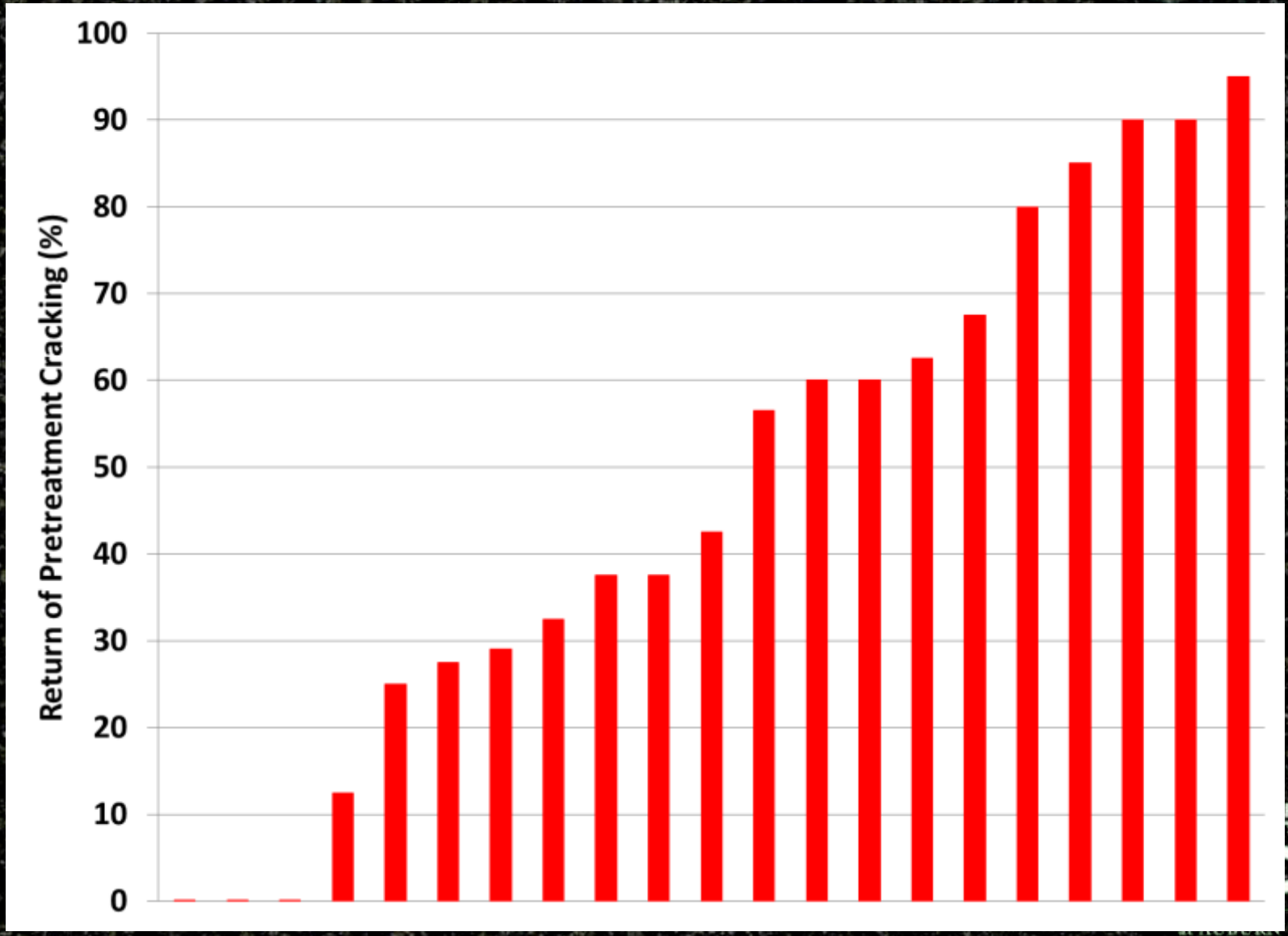
18	19	20	21	22	23	24	25
Cape	67	CCPR	76	Bond	RAP	RAS	HiMA

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Thin Overlay Rutting Performance



Overall Cracking Performance



Implementation Mechanisms

- Form … ent
- Test s … ght
- 6-mo … gs
- Requ … ations
- Const … avetrack.com
- Repo … .us

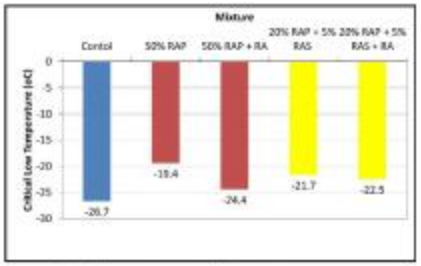


Figure 2 Critical low temperatures of mixtures.

(IDT) to determine the critical low-temperature cracking properties, and energy ratio (ER) and overlay tester (OT) to determine the mixture's resistance to cracking at intermediate temperatures.

Conclusions

This study evaluated the effect of a rejuvenator on the performance properties of recycled binders and mixtures with high RAP and RAS contents. The following conclusions were made based on the results:

1) The desired amount of rejuvenator was determined based on a linear relationship between the rejuvenator content and critical low temperature of the blend of recycled binder and rejuvenator. In this study, an optimum rejuvenator content of 12 percent by the total weight of recycled binders was selected to restore the performance properties of the recycled binders to meet the requirements for a PG 67-22 (the performance grade of the virgin binder).

2) The rejuvenator content of 12 percent restored the critical low temperature of 1) the 50 percent RAP and virgin binder blend from -18.2 to -21.2 and 2) the 20 percent RAP plus 5 percent RAS and virgin binder from -19.4 and -21.3. However, these blends narrowly failed the low critical temperature requirement for a PG 67-22.

3) The virgin binder and the 20 percent RAP plus 5 percent RAS blend with rejuvenator had the greatest resistance to fatigue cracking, followed by the 50 percent RAP blend with rejuvenator and the 20 percent RAP plus 5 percent RAS blend without rejuvenator.

4) Tensile strength ratio values for all mixtures were equal or greater than the commonly accepted failure threshold of 0.8. Using rejuvenator in the RAP/RAS mixtures improved the TSR values.

5) After both long- and short-term aging of two sets of specimens from each mixture, the two mixtures with rejuvenator appeared to age faster than the other mixtures. The use of rejuvenator decreased the stiffness of these mixtures based on dynamic modulus testing; however, these mixtures were still stiffer than the virgin mix in both long- and short-term aged conditions.

6) Using rejuvenator improved all four fracture properties — fracture energy (FE), dissipated creep strain energy at failure ($DCSE_f$), minimum dissipated creep strain energy ($DCSE_{min}$) and energy ratio (ER) — for the 50 percent RAP mix, and improved the FE, DCSE, and $DCSE_{min}$ of the 20 percent RAP plus 5 percent RAS mix. All the mixes except the 50 percent RAP mix without rejuvenator met the proposed minimum DCSE, and ER requirements.

7) The control mixture exhibited the lowest critical failure temperature (-27.7°C), followed by the 50 percent RAP mixture with rejuvenator, the 20 percent RAP plus 5 percent RAS mix with rejuvenator and then the 20 percent RAP plus 5 percent RAS mix without rejuvenator. Mixtures with a lower critical failure temperature are likely to have a better resistance to low-temperature cracking.

8) Using the overlay test (OT) test procedure, the virgin control mix was found to have the highest average number of cycles to failure, which was statistically different from those of the recycled mixes. Among the recycled mixtures, the 20 percent RAP plus 5 percent RAS with rejuvenator had the highest average number of cycles to failure, followed by the 50 percent RAP mix with rejuvenator, the 20 percent RAP plus 5 percent RAS mix, and the 50 percent RAP mix. However, the differences in the number of cycles to failure among the recycled mixes were not statistically significant.

9) All the mixtures exhibited APA manual rut depths less than 5.5 mm. Thus, all five mixtures would be expected to have good rutting resistance in the field.

10) Based on a cost comparison, using 50 percent RAP mix, 50 percent RAP mix with rejuvenator, 20 percent RAP plus 5 percent RAS mix or 20 percent RAP plus 5 percent RAS mix with rejuvenator can result in significant cost savings: about 36, 29, 21 and 16 percent, respectively, compared to the cost per ton of virgin mix.

Recommendations for Implementation

The use of rejuvenator in recycled mixtures appears to improve the cracking resistance of these mixtures without adversely affecting their resistance to moisture damage and permanent deformation. It is recommended that the rejuvenator, which should be pre-blended with the virgin binder, be used to improve cracking resistance of asphalt mixtures with high RAP and RAS contents. However, further research is needed to evaluate other rejuvenators and the use of rejuvenators in asphalt mixtures with tear-off RAS.

Acknowledgements and Disclaimer

This study was sponsored by the Alabama Department of Transportation. This research synopsis provides a brief summary of the study's final publication. This document is for general guidance and reference purposes only. NCAT, Auburn University, and the listed sponsoring agencies assume no liability for the contents or their use.

EMF1205NC3

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

www.pavetrack.com

NCAT Pavement Test Track

Performance

PAVE

Home | Sponsors | Information | Construction | Trucking | Performance

Click here for the official NCAT web site, Tracks in US, or Tracks Worldwide

Opelika, AL

Get the 10 day forecast

61°F
Cloudy
Feels Like: 61°F
Humidity: 81%
Wind: SE at 8 mph

Enter city/zip GO!

The Weather Channel weather.com

Vacation Planner
Hit the Road
Travel Top 10s

Weather at 30,000 feet

HOTLINKS to download PAVE reports, review upcoming NCAT training courses, query historical weather data, view current color radar or preview local forecast

0, ESALs as of 2300 hours on

Performance data for each section can be viewed by positioning your mouse over the section in question and left-clicking. Based on feedback from our research sponsors, the performance reports have been revised to include crack maps. The 2009 performance reports are now a fully integrated and active part of the web presentation.

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

www.ncat.us

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Google™ Custom Search Search

NCAT
- About NCAT
- Education/Training
- Facilities & Equipment
- NCAT Reports & Publications
- Subscribe to NCAT List Serv
- Newsroom
- Employment Opportunities
- Graduate Studies at Auburn
- Related Links
- Research
- Staff Directory
- Contact NCAT
- Southeastern Superpave Center
- SEAUPG AMPT User Group
- NCAT Board of Directors Files

Spotlight

Fall 2014 Newsletter

Upcoming Events

Graduate Engineering Research Showcase

NCAT News

NCAT Is Now on Facebook

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY


2015 Pavement Test Track Conference
March 3-5, 2015
The Hotel at Auburn University and Dixon Conference Center
Auburn, Alabama
WMA & High RAP/RAS/GTR Mixes
Optimized Structural Design
Pavement Preservation
Implementation
Official registration information will soon be available at www.ncat.us
National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Options in the 2015 Research Cycle

- Traffic continuation
- Mill/inlay sections
- Structural sections
- Pavement preservation

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

NCAT Expectations for 2015 Track

- Durability of innovative OGFC surfaces
- Surface crack prevention
- 100% RAP foamed CCPR base mix continuation
- Expanded study of thin overlay mixes
- Asphalt based high friction surfaces
- Crack prediction test for ALL mix types (CG)
- Continuation/expansion of preservation (PG15).

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Cracking Group (CG) Study

- Focus on surface layer (top-down cracking)
- Mixes with a range of cracking susceptibilities
- Choose thickness design to yield rapid results
  - Under designed 6-inch thickness from 2012 GG study
- Plant run mix subjected to battery of lab tests
- Same mix in base/binder layers reduces lab costs.

Surface	HiMA	Virgin	20% RAP_{20}	35% RAP_{35}	5% RAS_{25}	15+5	30+5	AZ-GTR
Binder								
Base								

Preservation Group (PG15) Study

- Continue monitoring '12 sections (Track & 159)
- Capture life extending benefit curve data
- Build new sections on higher ADT roadway
- Partnership with MnRoad for nationwide scope.

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Preservation Group (PG15) Study

- Continue monitoring '12 sections (Track & 159)
- Capture life extending benefit curve data
- Build new sections on higher ADT roadway
- Partnership with MnRoad for nationwide scope.

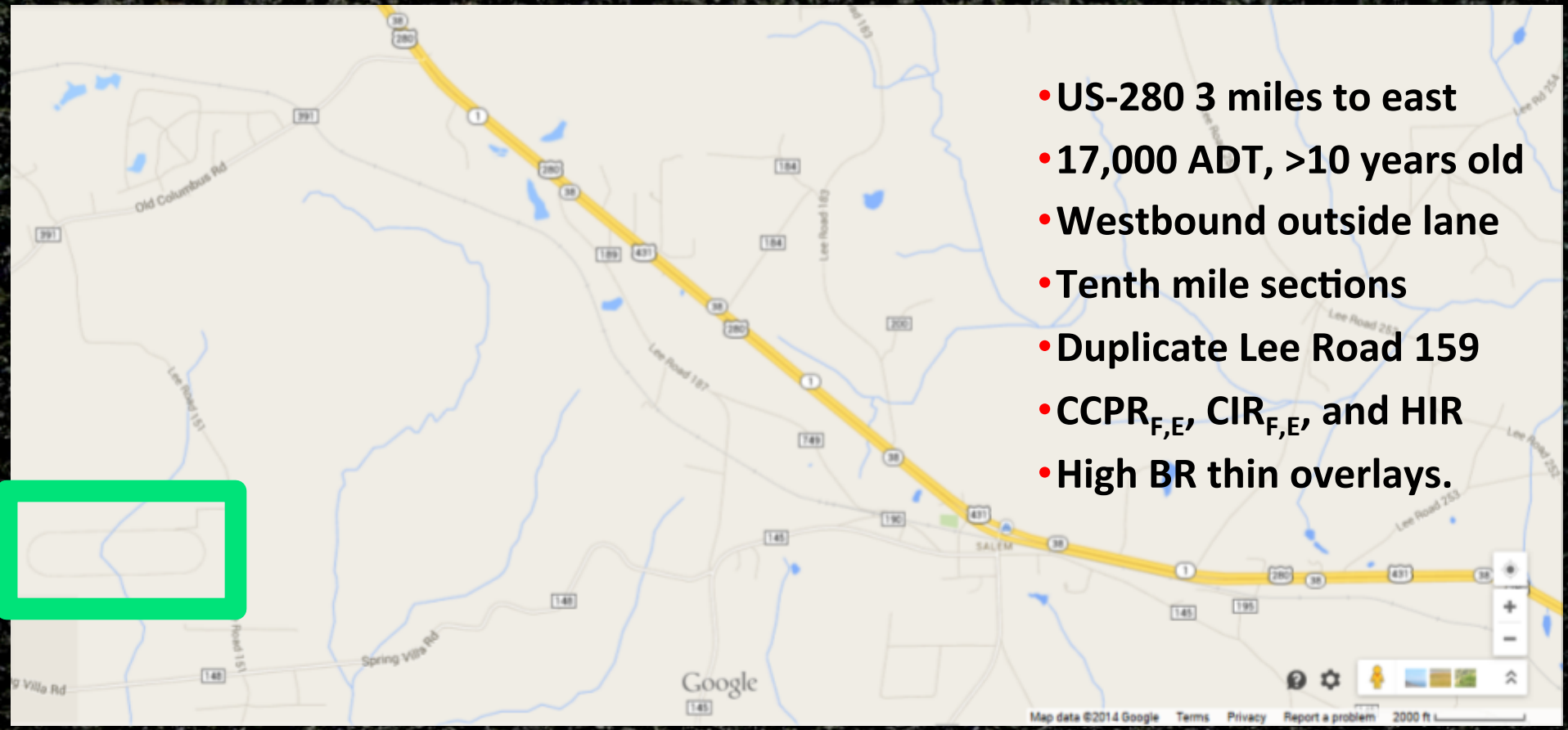
Minnesota Department of Transportation

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

National Pavement Preservation Research Initiative

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Higher ADT Off-Track Preservation

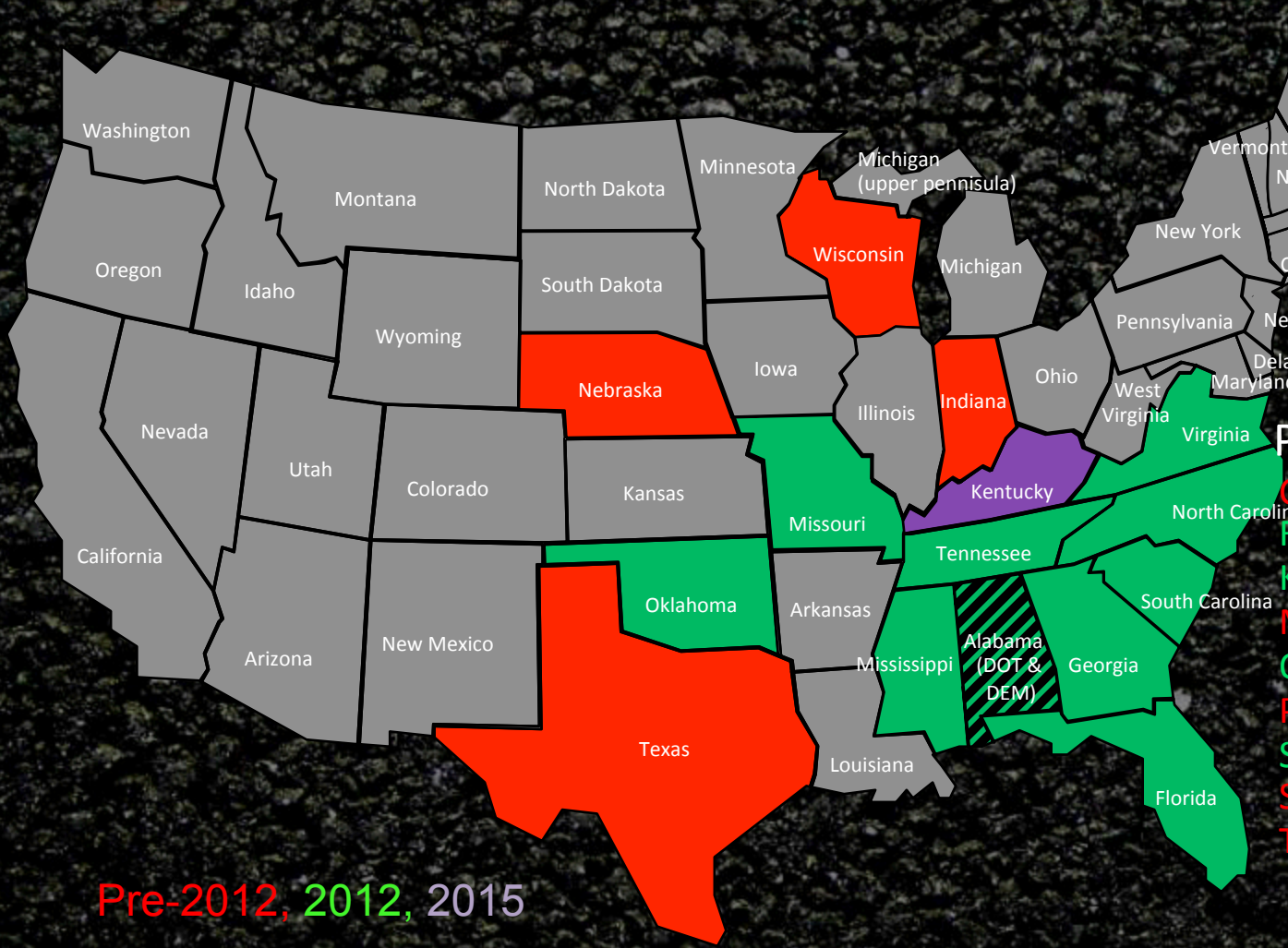


- US-280 3 miles to east
- 17,000 ADT, >10 years old
- Westbound outside lane
- Tenth mile sections
- Duplicate Lee Road 159
- $CCPR_{F,E}$, $CIR_{F,E}$, and HIR
- High BR thin overlays.

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

Higher ADT Off-Track Preservation

NCAT Pavement Test Track



Pre-2012, 2012, 2015

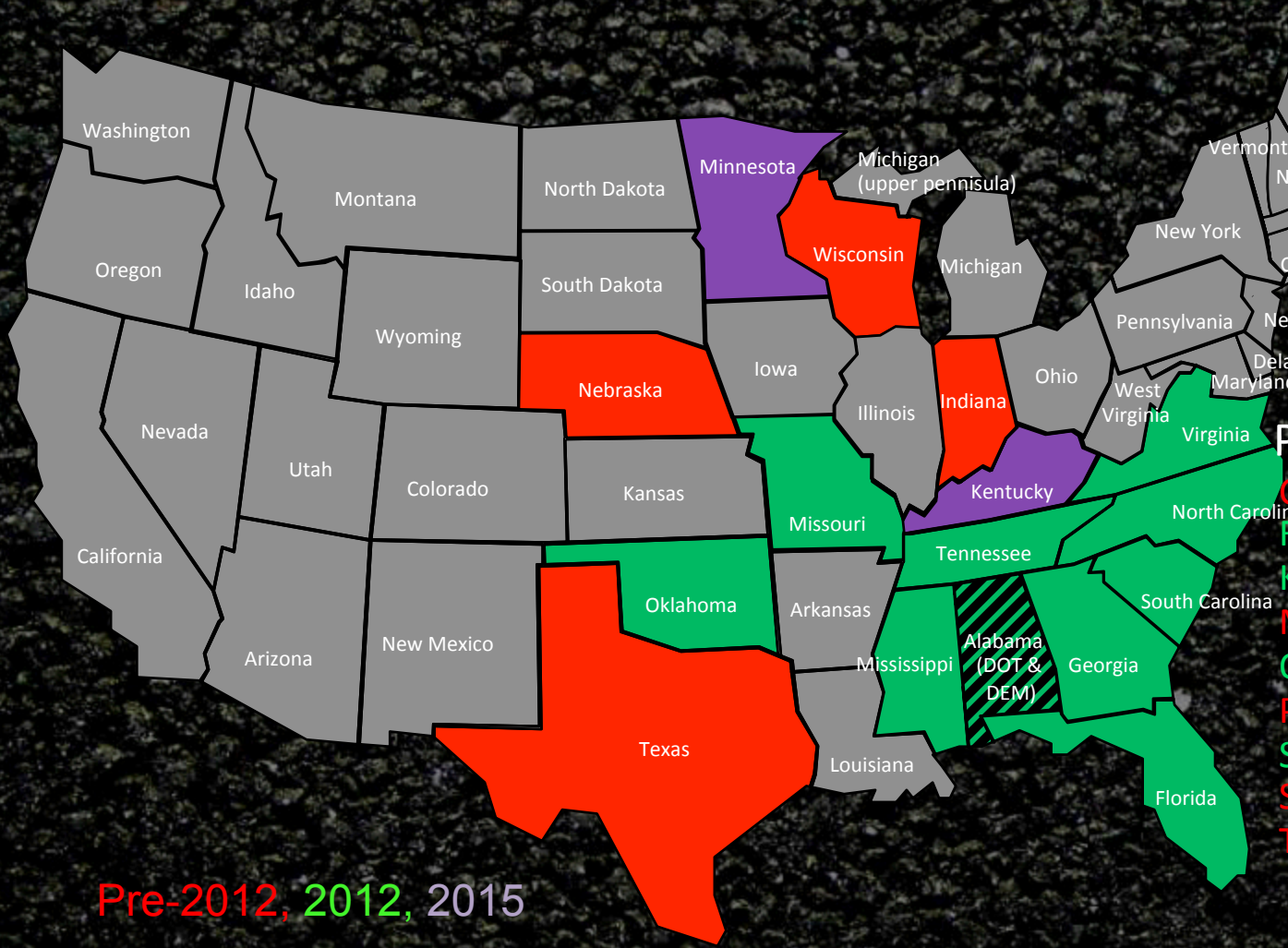
FHWA

Private Sector Sponsors

Cargill Deicing Technology
FP2
Kraton Polymers
Modified Asphalt Solutions
Oldcastle Materials
Polycon Manufacturing
Seneca Petroleum
Shell Sulfur Solutions
Trinidad Lake Asphalt

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

NCAT Pavement Test Track



Pre-2012, 2012, 2015

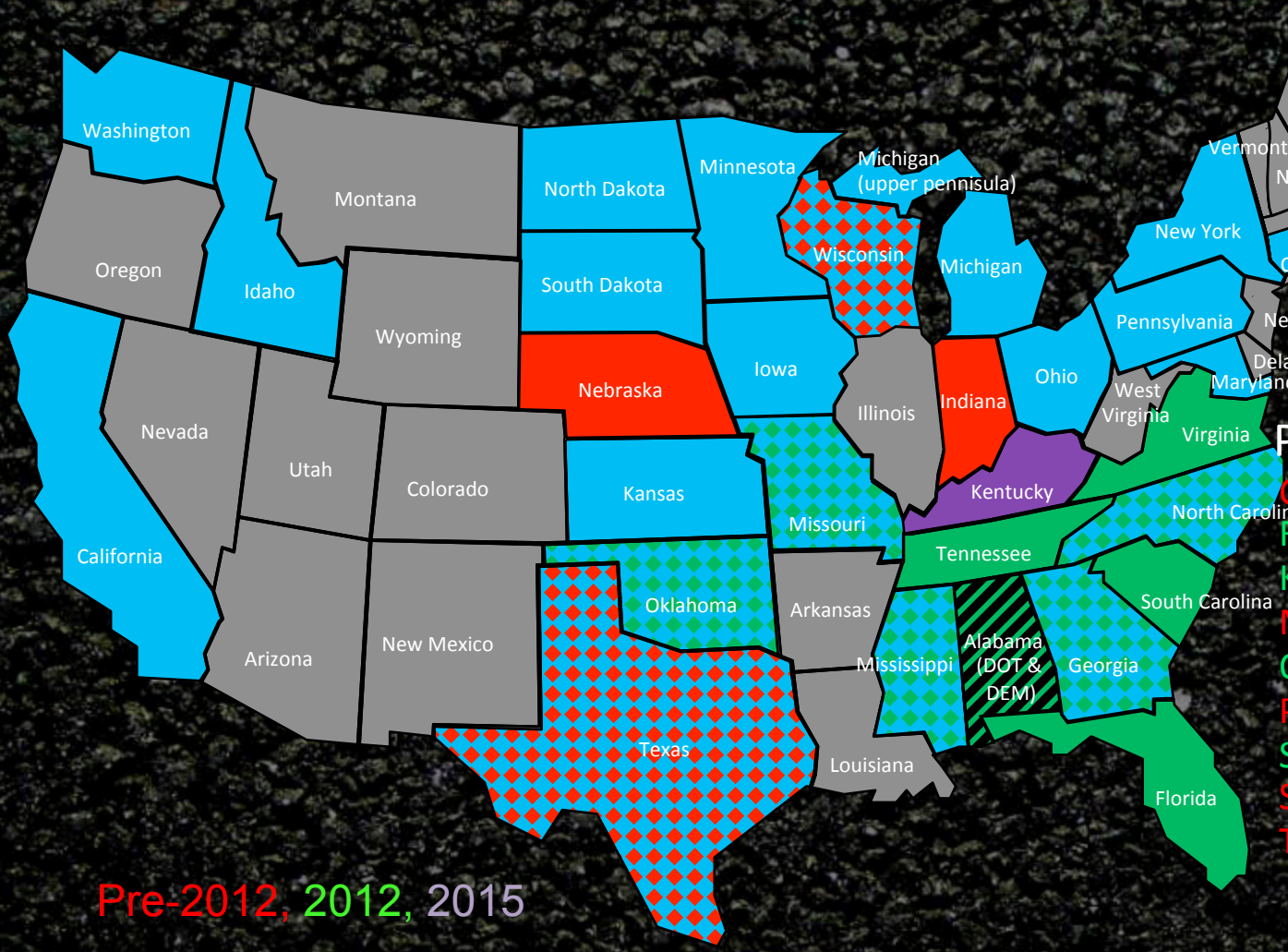
FHWA

Private Sector Sponsors

Cargill Deicing Technology
FP2
Kraton Polymers
Modified Asphalt Solutions
Oldcastle Materials
Polycon Manufacturing
Seneca Petroleum
Shell Sulfur Solutions
Trinidad Lake Asphalt

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

NCAT+MnRoad National Experiment



Pre-2012, 2012, 2015

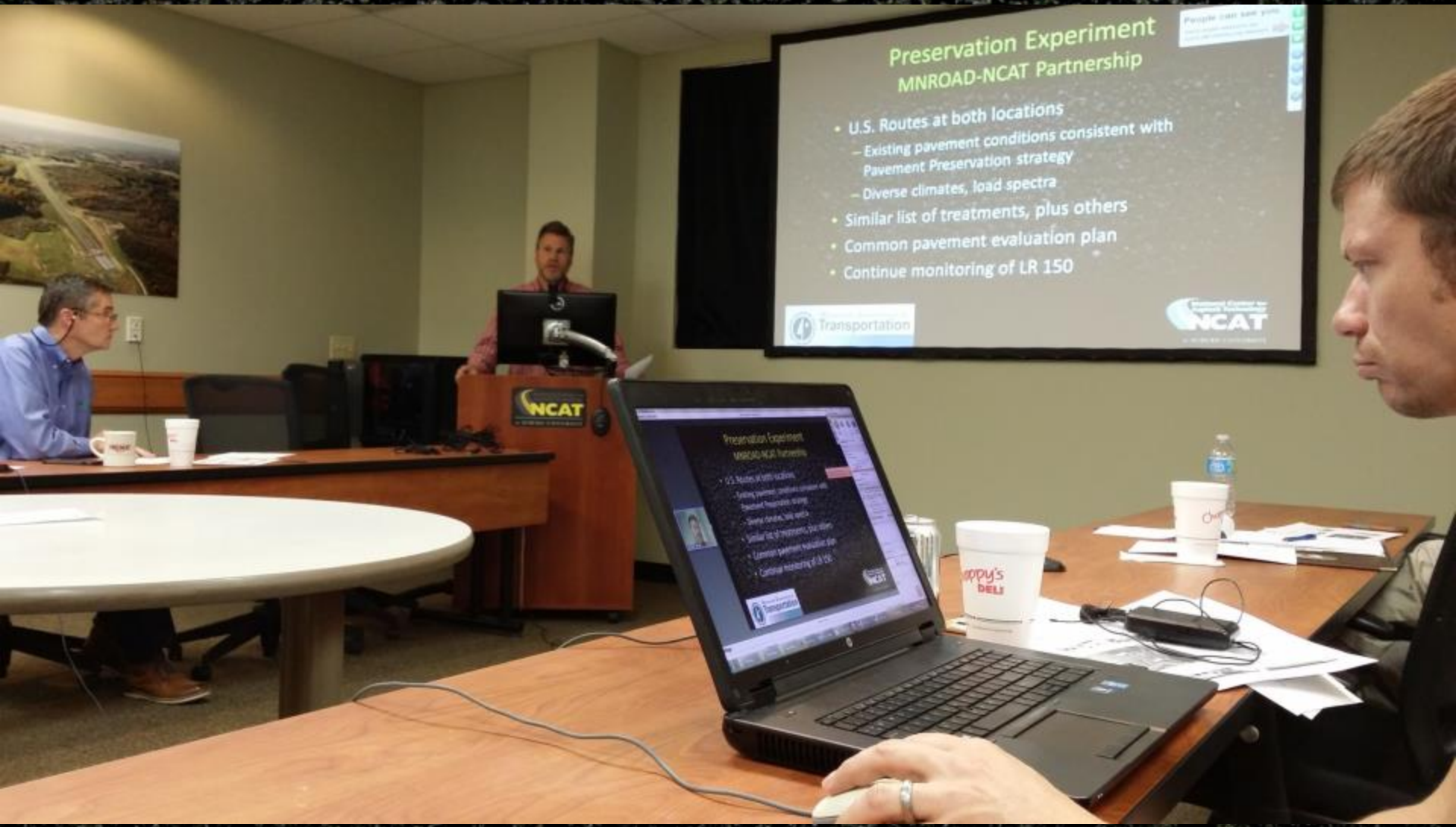
FHWA

Private Sector Sponsors

- Cargill Deicing Technology
- FP2
- Kraton Polymers
- Modified Asphalt Solutions
- Oldcastle Materials
- Polycon Manufacturing
- Seneca Petroleum
- Shell Sulfur Solutions
- Trinidad Lake Asphalt

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

NCAT+MnRoad National Experiment



National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY

www.ncat.us

Dr. Mary M. Robbins

Assistant Research Professor

277 Technology Parkway
Auburn, AL 36830

Phone: (334) 844-7303
Cell: (334) 750-2076

Email: mmr0001@auburn.edu

National Center for Asphalt Technology
NCAT
at AUBURN UNIVERSITY