

TRENDS IN ASPHALT PAVING: ECONOMICS AND THE ENVIRONMENT

Rebecca S. McDaniel
Rhode Island Transportation Forum
October 26, 2012



Economics and the Environment

- Primary drivers of innovation in the industry today.
- Sustainability
 - Of materials
 - Of pavements
 - Of energy
 - Of funding
 - Of market share



SUSTAINABILITY

- Meeting the needs of the present without compromising the ability of future generations to meet theirs.
 - Conservation of resources (materials and energy)
 - Reduction of environmental impacts (GHG, carbon footprint, landfills, quarries, etc.)
- Growing awareness and demand from the public for sustainable practices.

OLD NEWS



- Asphalt pavement is *the* most widely recycled material in the USA.
- 100 million tons reclaimed annually.
- 95% is reused or recycled.
- \$1.8 billion in savings each year.
- Reduces demand for new aggregates and binder and the energy to produce them.



MORE OLD NEWS

- *Beneficial* reuse of waste materials and by-products in asphalt mixes
 - Slag
 - Asphalt Shingles
 - Crumb Rubber
 - Glass
 - Waste Oils
 - Foundry Sands

RECENT DEVELOPMENTS



- Warm Mix Asphalt
 - Reduced fuel used for heating (15 to 30% reduction)
 - Reduced Greenhouse Gases
 - Construction benefits
- Porous or Open Graded Mixes
 - Reduced noise, improved safety (reduced splash and spray)
 - Improved water quality, stormwater management

ON THE (NEAR) HORIZON

- Biofuels and Biobinders
 - Plant based
 - Algae
 - Animal based
- Alternate Energy Sources
- Harvesting Energy
- Removing Pollutants
 - Photocatalytic pavements



RAP – An Oldie but Goodie



- Used in US since the 1970s
 - Spurred by high prices, Arab Oil Embargo
 - Development of milling technology
- Today – strong incentives to use higher amounts of RAP in more mixes
 - High prices again
 - Helps contractors stay competitive
 - Helps asphalt compete with concrete

TYPICAL ASPHALT MIX

- 95% aggregate
- 5% asphalt binder
- Reusing:
- Reduces need to quarry more aggregate
 - Increasingly difficult to open a new pit or quarry
- Reduces energy/costs to produce, process, transport aggregate
- Reduces asphalt demand

Fractionated RAP = Crushed and screened into different sizes



- Improves uniformity (remixes)
- Allows use of different sizes to meet mix design
- Better control of gradation (and binder content)



Recycled Shingles



RAS = Recycled Asphalt Shingles

- Asphalt shingles can have very high binder contents, as high as 30%.
 - Greatly reduces demand for new binder
 - Contain hard, angular fine aggregate and fibers
- But, shingle binder is very stiff (oxidized) so there is concern about cracking.
- So, allowable shingle content is about 20-25% as high as allowable RAP content.



Other Recycled Materials Used



- Ground tire rubber
 - Economical substitute for polymers
 - Keeps tires out of landfills
 - Reduces tire disposal costs
- Slag
 - Premium, high friction aggregate
- Others in lesser quantities

Environmentally Friendly Plant Production

Warm Mix Asphalt

- Energy Savings
- Decreased Emissions
 - Visible and Non-Visible
- Decreased Fumes
- Decreased Binder Aging
- Extended Paving Season
- Compaction Aid
- Increased RAP usage



Environmentally Friendly Pavements

- Growing interest in 100% recycling
 - Cold In Place Recycling
 - Hot In Place Recycling
 - Full Depth Reclamation
- Perpetual Pavements
 - Leave in place for 50+ years with minimal surface renewal
- Porous Asphalt Pavements

Office Complex 1982 – 20 years old



Roadway Applications



Intelligent Compaction

- Inadequate compaction is major cause of pavement distress
- Intelligent Compaction allows:
 - Monitoring coverage during rolling to improve rolling patterns
 - Monitoring strength gain or increased density
 - Mapping underlying layers to identify weak areas



Importance of Compaction

Each 1% increase in air voids
(over 7%) reduces pavement life
by about 1 year!

Intelligent Compaction can help
us ensure good compaction.

GPS Set Up

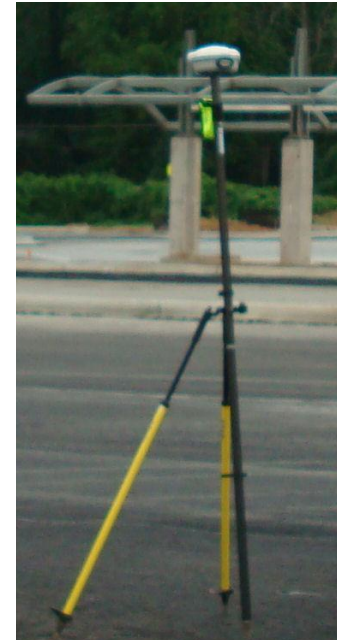
GPS Base Station



GPS Radio & Receiver

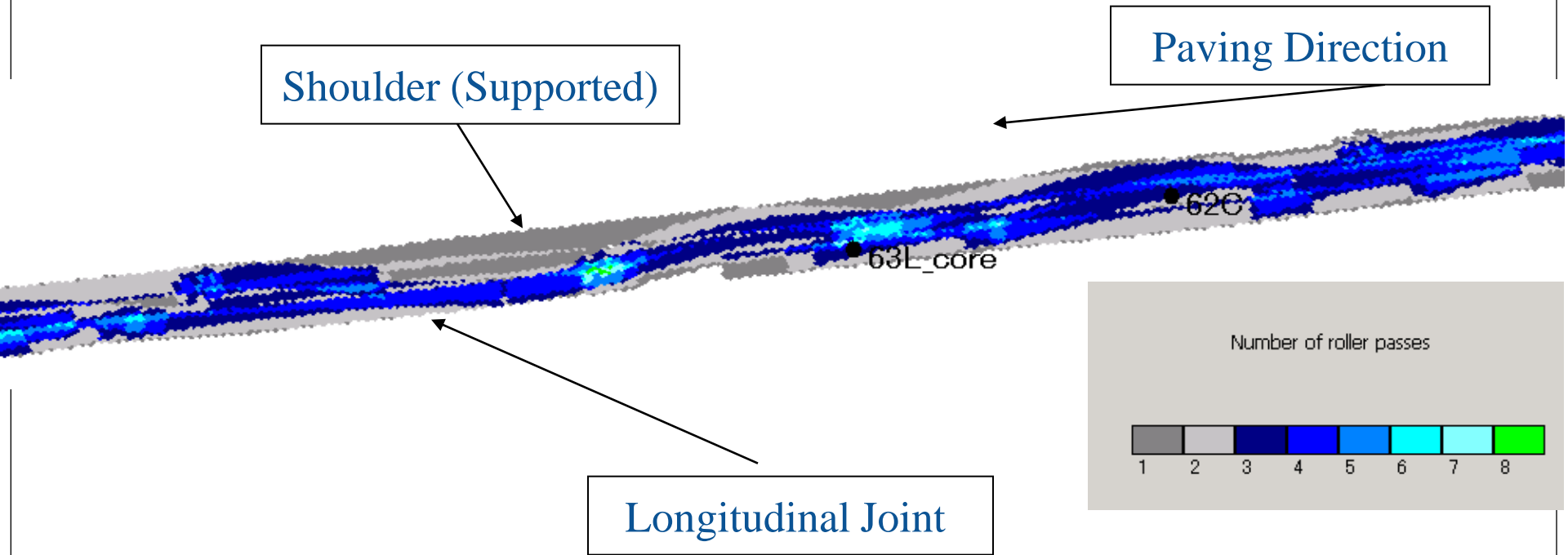


GPS Rover



Real Time Kinematic (RTK) GPS Precision

Mapping of Roller Passes

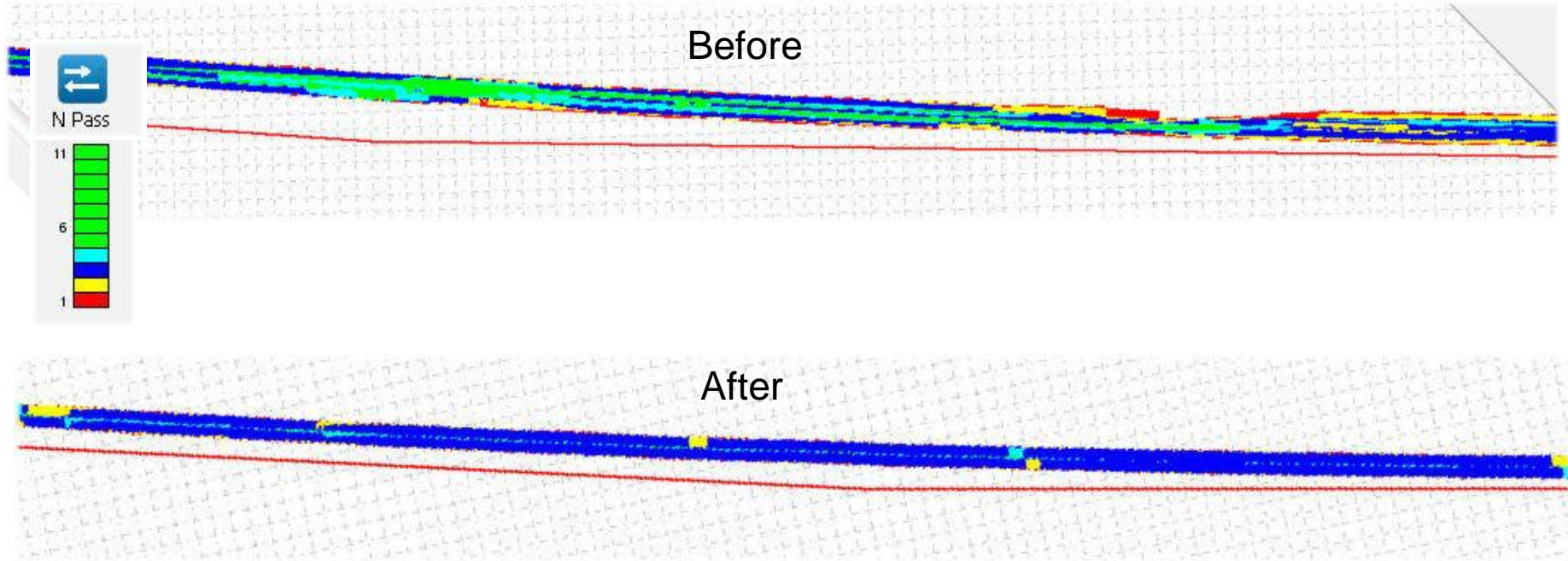


Courtesy Sakai America

Infra-Red Thermal Sensor



Improved Rolling Pattern

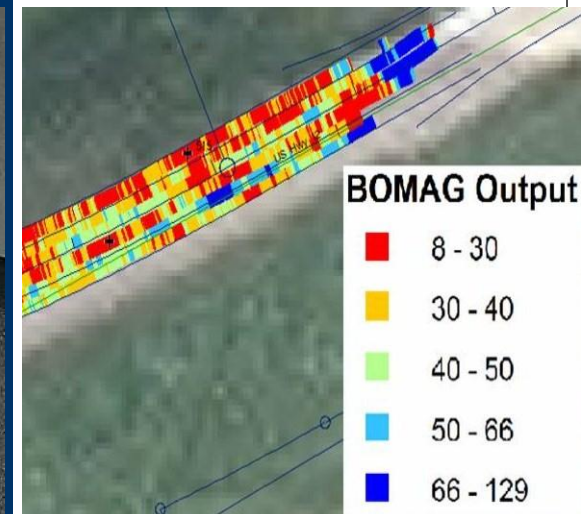


Improved Night Paving



Benefits of IC for HMA

- Improve density....**better performance**
- Improve efficiency....**cost savings**
- Increase information...**better QC/QA**



Intelligent Compaction and Pave-IR in Minnesota



2012 NCAUPG Technical Conference

February 16, 2012

Greg Johnson

Mn/DOT - Asst. Bituminous Engr.



Pave-IR Purpose

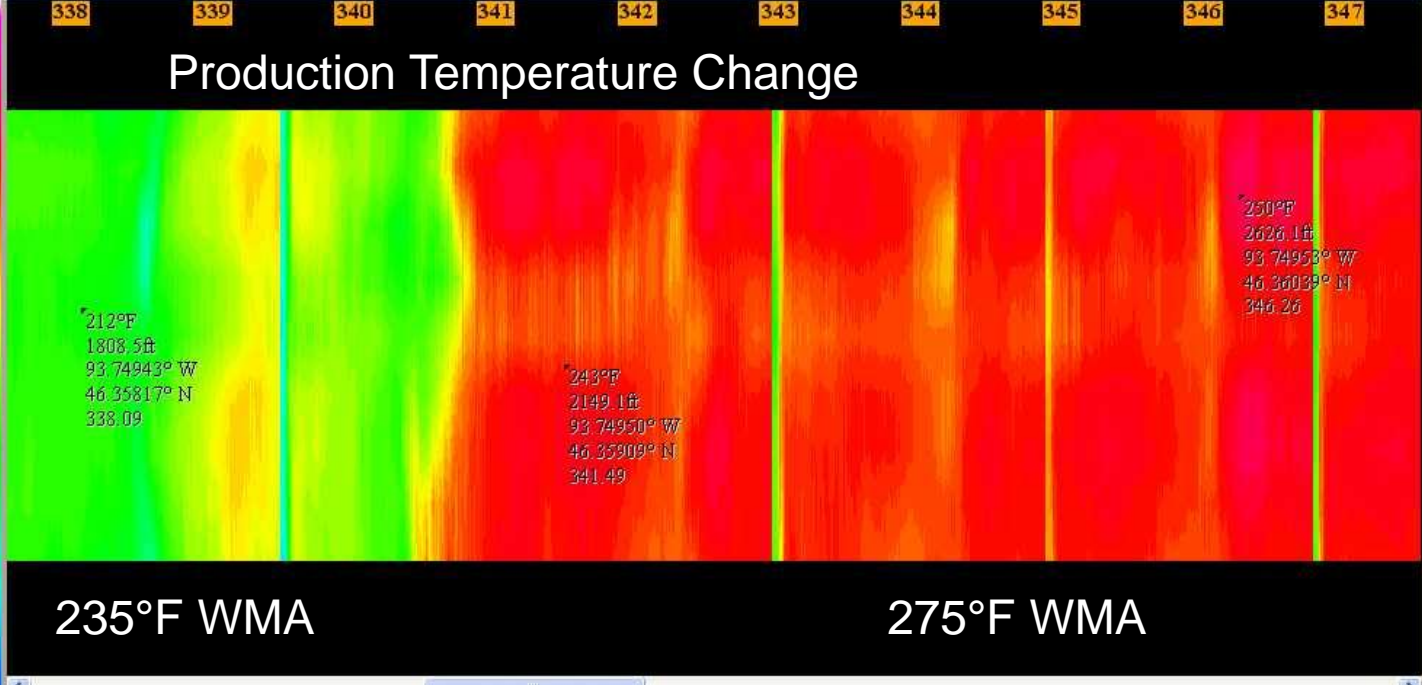
- Promote more uniform, higher quality pavements
- WaSDOT, NCAT, And TTI found thermal uniformity useful for detecting segregation.
- A segregated mat increases the contractor's chances of QC/QA core being in a poor/low density area.
- A segregated mat increases agency's risk of early distress.

MOBA Pave-IR

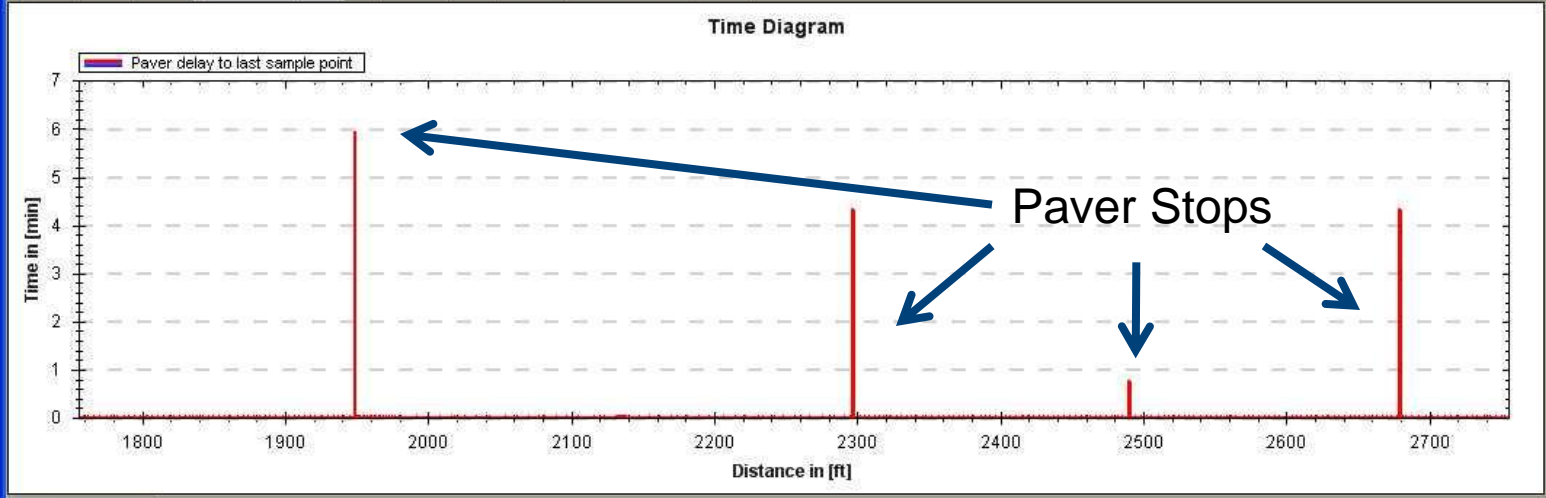


12 sensors spaced 1 foot apart,
reading interval = every 6 inches



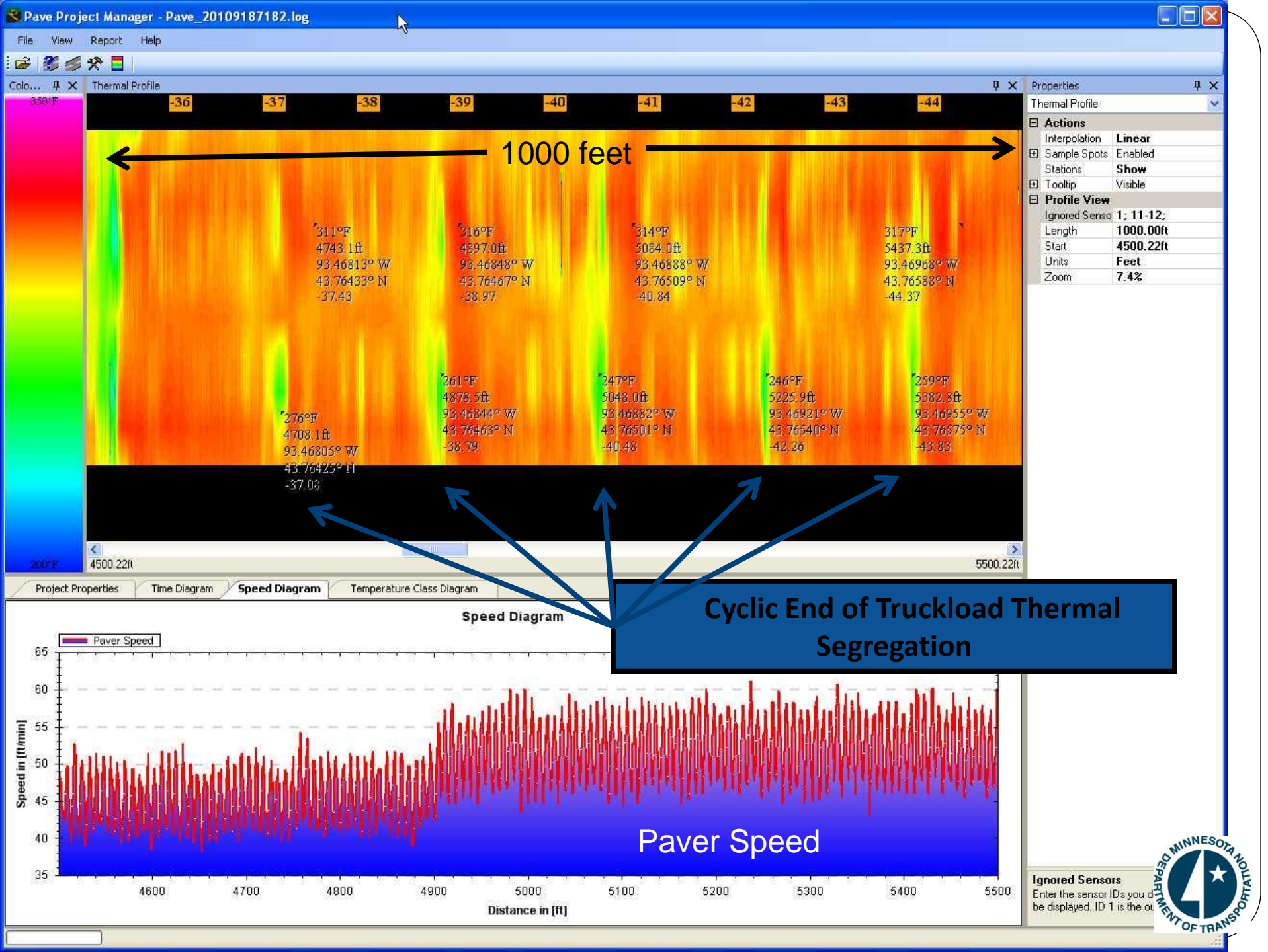


| Thermal Profile | |
|---------------------|-------------|
| Actions | |
| Interpolation | Linear |
| Sample Spots | Enabled |
| Stations | Show |
| Tooltip | Visible |
| Profile View | |
| Ignored Senses | 1-2; 11-12; |
| Length | 1000.00ft |
| Start | 1755.25ft |
| Units | Feet |
| Zoom | 16.3% |



Length
The Profile's length in the P Window.





Cyclic End of Truckload Thermal Segregation



Ignored Sensors
Enter the sensor IDs you'd like to be displayed. ID 1 is the out...



Conclusion

IC and Pave-IR together can provide:

- Feedback and control of the paving process
- Increase uniformity of mix placement and compaction
- Increase the performance of our pavements
- Ability to decrease the amount of QC/QA testing needed
- Proof of quality placement and compaction
- Increased accountability



Increasing Trends in Asphalt Paving

- Recycling
 - Reclaimed Asphalt Pavement
 - Recycled Shingles
 - Ground Tire Rubber
 - Other waste or by-product materials
- Warm Mix Asphalt
- Porous Pavements
 - Stormwater and Noise Control



Future Trends in Asphalt



- Bio-Binders
- Harvesting energy from pavements
- Pavements that clean the environment (photo-catalytic pavements)
 - Cermak Road, Chicago

Motivation for Innovation

- Sustainability
- Performance
- Economy



Totally Recyclable

THANK YOU!

Rebecca S. McDaniel
Technical Director
North Central Superpave Center
Purdue University
West Lafayette, IN
rsmcdani@purdue.edu
<https://engineering.purdue.edu/NCSC>

