

# ASPHALT

## THE SMOOTH QUIET RIDE



# Warm Mix Asphalt



MICHIGAN RIDES ON US

Asphalt.

# Presentation Outline



- What is WMA?
- State of the Practice
- Benefits of using WMA technology
- Michigan Examples

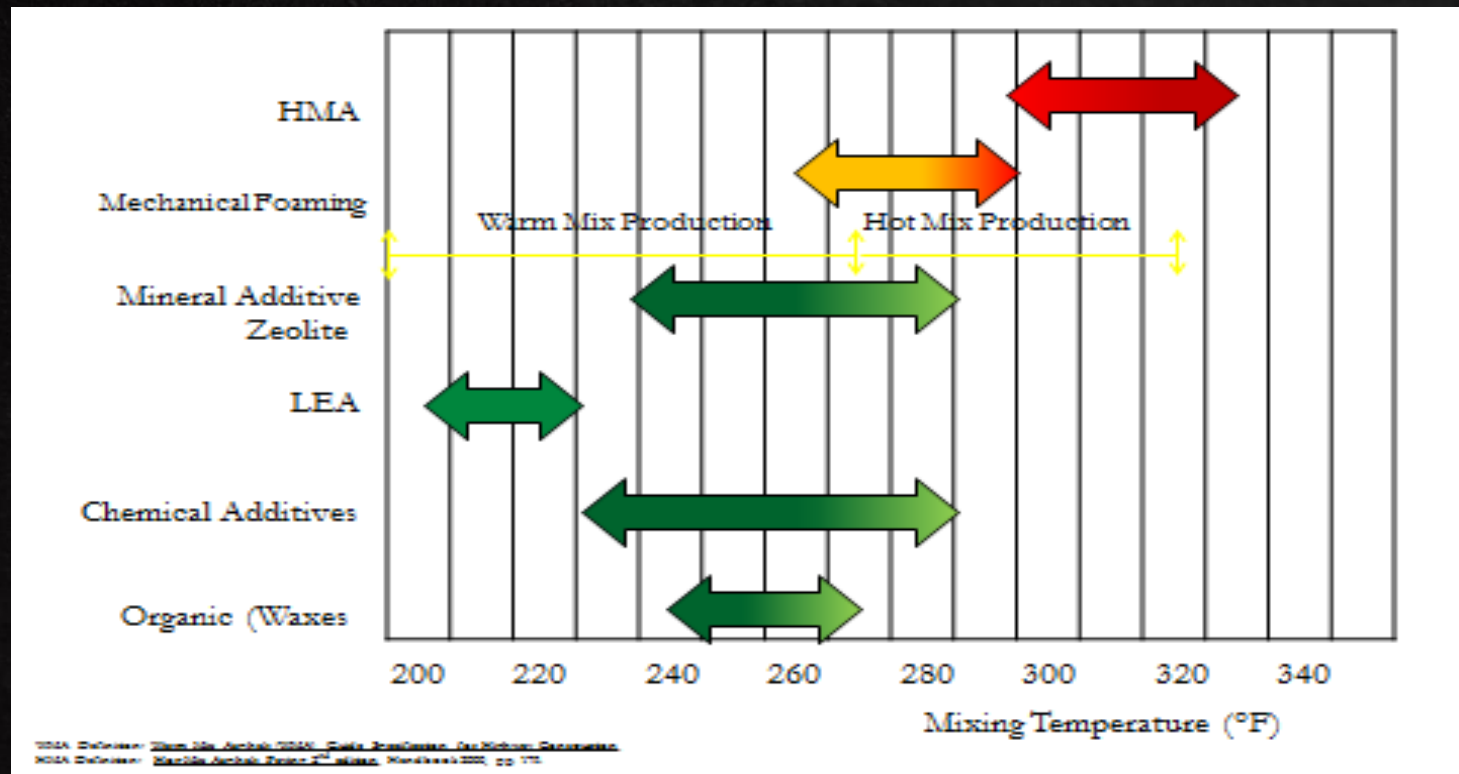


# WMA – What is it?

- Hot Mix Asphalt adjusted in order for it to be produced and placed at lower temperatures; “Warm Mix”.
- Production and placement temperature **MAY** be lowered by 50°F – 70°F +.
- Conventional Definitions

# Mixing Temperature

## Typical Mixing Temperature Ranges





# Warm Mix Asphalt

WMA encompasses a wide range of enabling technologies that enhance asphalt production and/or lay-down properties...



# Warm Mix Asphalt

## General Technology Categories:

- Organic Additives
- Chemical Additives
- Foaming Processes
- Hybrid Systems  
(combination of technologies)





# Warm Mix Asphalt



Mathy Tech. & Eng. Services  
and



Paragon Technical Services.



Currently Twenty Two (+)  
Technologies Marketed and  
Available in the US.



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# Warm Mix Asphalt

## State of the Practice





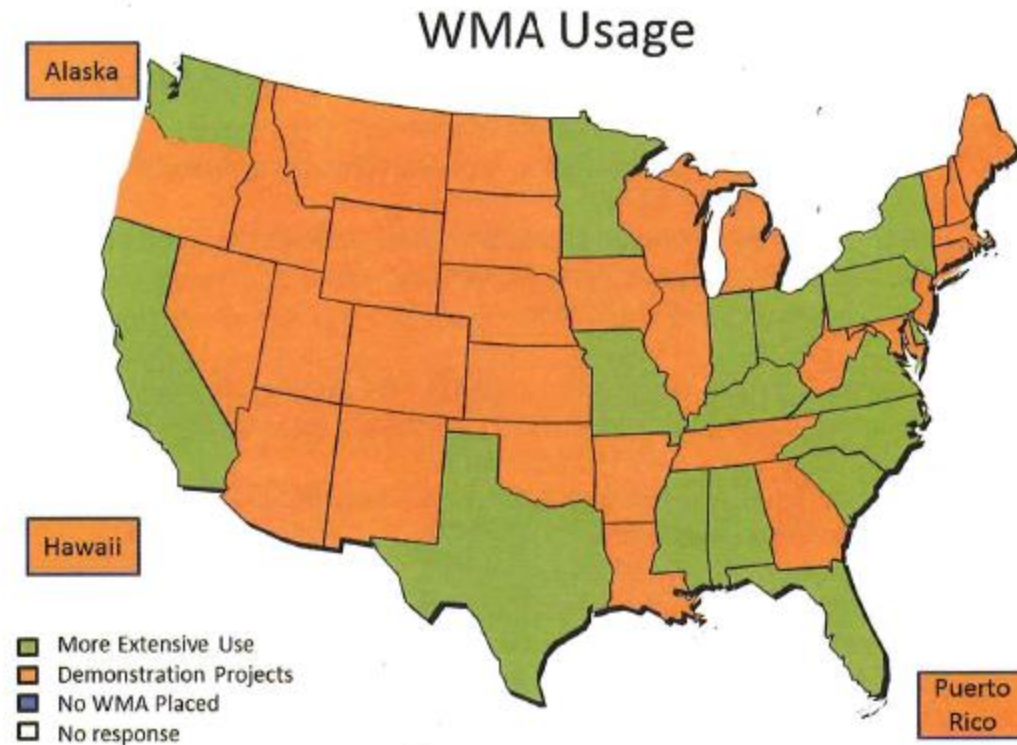
Federal Highway Administration  
**Every Day Counts**  
Innovation Initiative



# Warm Mix Asphalt

FIGURE 2

State usage of WMA, circa December 2011

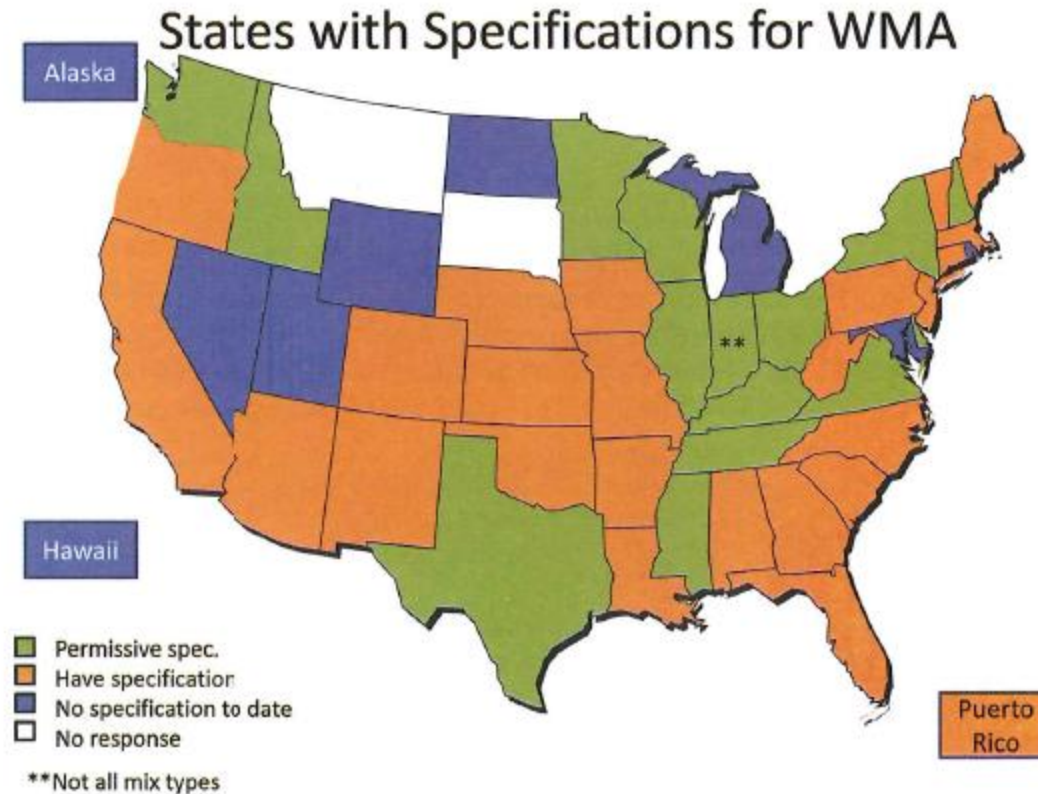




# Warm Mix Asphalt

FIGURE 3

States with WMA specifications, circa December 2011



# MDOT WMA Permissive Use

12SP501(Z) dated 07-31-12

- Allows only water-injection foaming device or water foaming additive to make WMA.
- Only E10 and below mixes.





# MDOT WMA Permissive Use

12SP501(Z) dated 07-31-12

- WMA mixes must meet all acceptance test methods and procedures.
- Temperature must be greater than 225 degrees F, and cannot be greater than 20 degrees F above the maximum recommended mixing temp.
- No change to bid prices.

# MDOT WMA Permissive Use

12SP501(aa) dated 12-21-12

- Local Agency warm mix specification
- Same requirements as MDOT projects.



# MDOT WMA Permissive Use

Specification Changes, approved at Feb. EOC

- Allow the use of WMA on E30, E50 & GGSP mixes
- Allow the use of additives
  - Based on Colorado DOT approved products list.
  - Currently allow 4 additives:
    - Advera
    - Evotherm 3G
    - Evotherm DAT
    - Evotherm ET

# Warm Mix Asphalt

## Concerns being researched:

- Incomplete drying of aggregate
- Reduced production aging of binder
- Possible Perf. issues
  - Moisture susceptibility
  - Early rutting



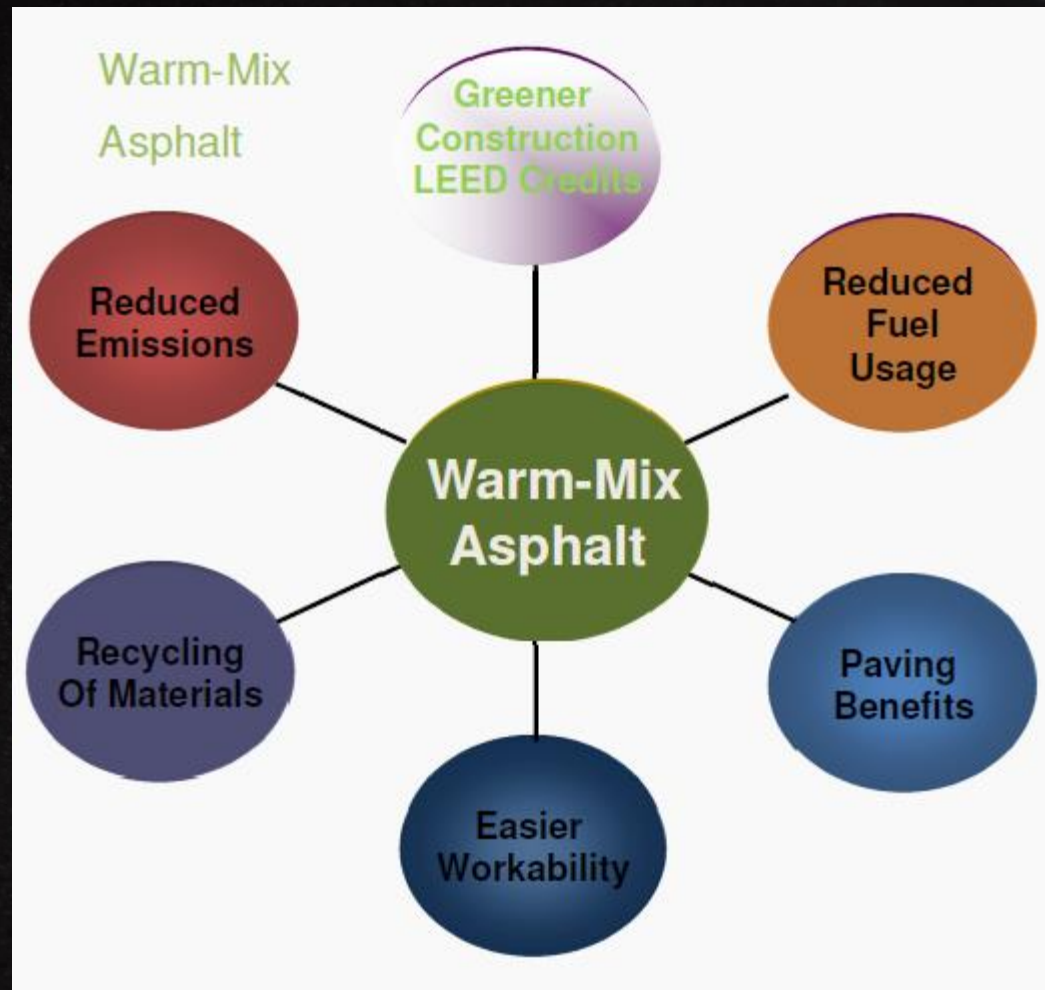


# National Research Initiatives

- NCHRP 9-43 *“Mix Design Practices for Warm Mix Asphalt”*
- NCHRP 9-47A *“Engineering Properties, Emissions, and Field Performance”*
- NCHRP 9-49 *“Long Term Field Performance of Warm Mix Asphalt Technologies”*
  - Phase I, Moisture Susceptibility
  - Phase II, Long-Term Performance



# Benefits of using WMA technology





# Benefits of using WMA technology

A method used to achieve one or more of the following:

- Compaction Aid
- Increased Workability
- Allow increased haul distances from the asphalt plant to the jobsite
- Allow for Cold Weather paving and extend the paving season
- Improve Ride “Paving over Crack sealant”

# Benefits of using WMA technology

The benefits of WMA are numerous.  
also include:

- Reduction in fuel consumption
- Reduction in plant emissions
- Worker comfort





# Presentation Outline

## Michigan Examples



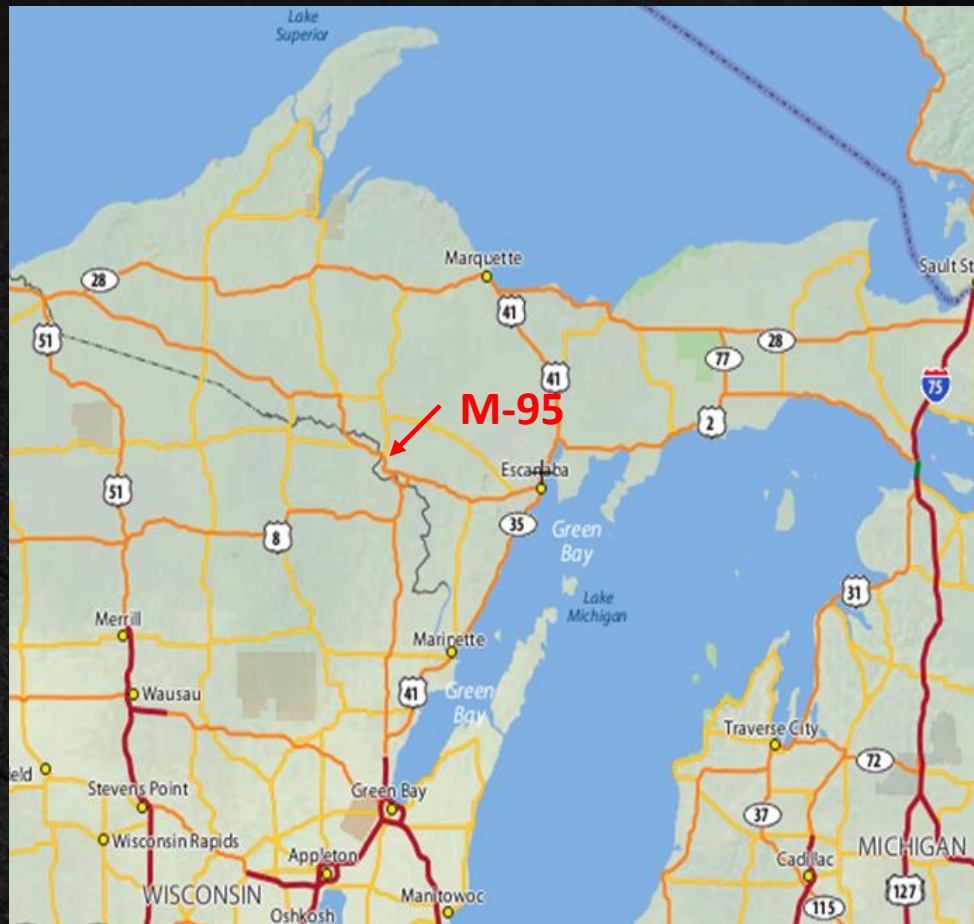
# Cases Studies

- M-95, Iron Mountain – Sasobit
- County Road 513, Rapid River – Advera & Evotherm
- Rice Lake Road – Evotherm
- M-59 – Water Injection (Foaming)



# M-95, Iron Mountain

- 2006
- Passing relief lane
- MDOT PWL specification



# M-95, Iron Mountain

- Mix Design
  - Existing approved MDOT design
  - Binder: PG 58-34
  - AC Target: 5.52%
  - Recycle: 14% RAP
- Project Specifics
  - Surface Layer: 1-¾ 5E3 (i.e. E-3 9.5 mm)
  - Normal Mix Temperature: 317° F



# M-95, Iron Mountain



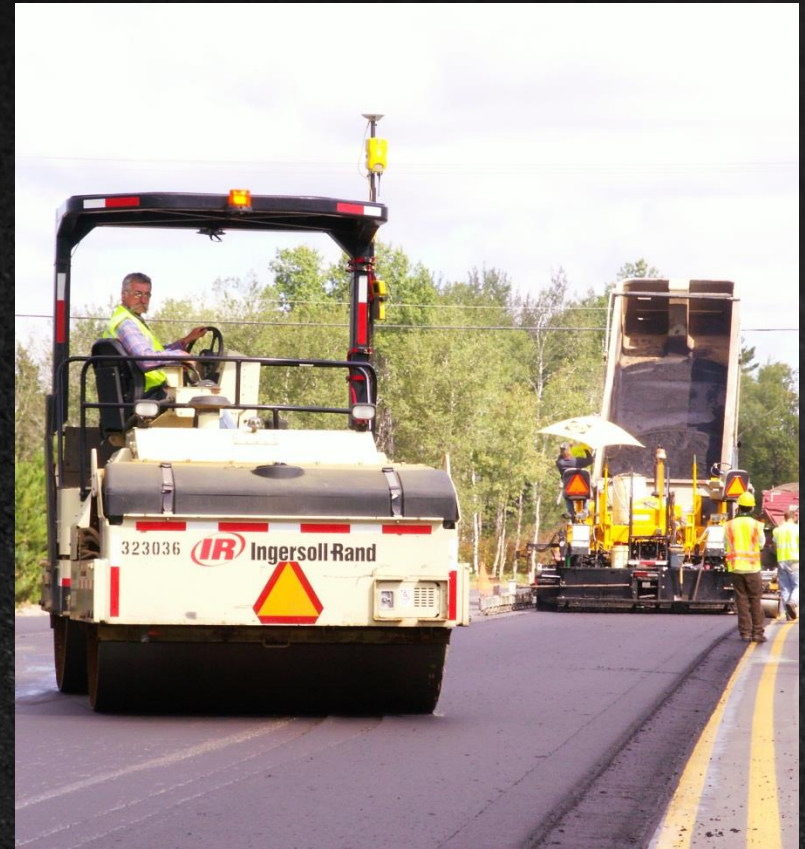
**HOT MIX PAVING**

**WARM MIX PAVING**





# M-95, Iron Mountain





# M-95, Iron Mountain

PWL = 100 for both Control and WMA sections

| Property | JMF   | Control | Sasobit |
|----------|-------|---------|---------|
| $G_{mm}$ | 2.552 | 2.582   | 2.575   |
| $G_{mb}$ | 2.450 | 2.466   | 2.471   |
| $V_a$    | 4.00% | 4.52%   | 4.04%   |
| VMA      | 16.2  | 15.8    | 15.3    |
| VFB      | 75.4  | 71.3    | 73.6    |
| $P_b$    | 5.52% | 5.61%   | 5.32%   |

# M-95, Iron Mountain

Final product

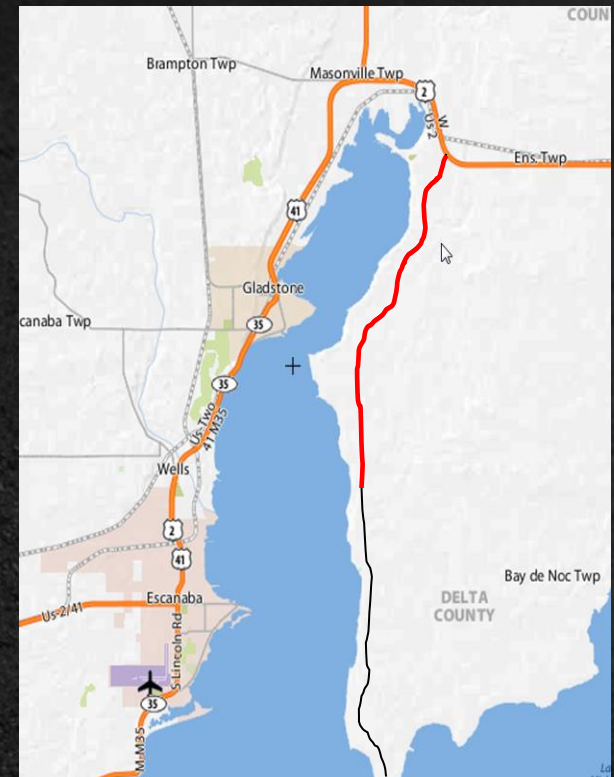




# County Road 513, Rapid River

2010

- Mix Design
  - MDOT approved mix design
  - Binder: PG 52-34
  - AC Target: 5.30%
  - Recycle: 17% RAP
- Project Specifics
  - Lower Layer: 2" 12.5mm
  - Surface Layer: 2" 12.5mm
  - Length: 11.25 miles
  - Tonnage: 25,000



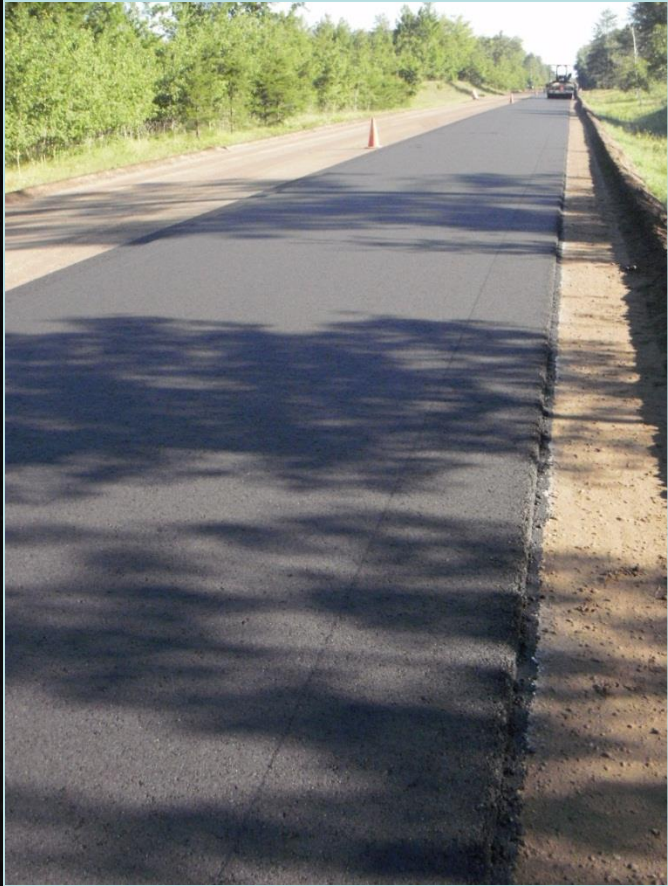
# County Road 513, Rapid River

- Funded by MDOT and the Delta County Road Commission
- Part of NCHRP 09-47A, Being conducted by the National Center for Asphalt Technology (NCAT) in cooperation with Advanced Materials Services, LLC





# County Road 513, Rapid River





# County Road 513, Rapid River

| Property | JMF   | Advera |        | Evotherm |        | Control (HMA) |        |
|----------|-------|--------|--------|----------|--------|---------------|--------|
|          |       | HOT    | REHEAT | HOT      | REHEAT | HOT           | REHEAT |
| $G_{mm}$ | 2.489 | 2.489  | 2.488  | 2.489    | 2.488  | 2.481         | 2.484  |
| $G_{mb}$ | 2.389 | 2.394  | 2.399  | 2.400    | 2.407  | 2.392         | 2.407  |
| $V_a$    | 4.0%  | 3.8%   | 3.6%   | 3.6%     | 3.3%   | 3.6%          | 3.1%   |
| VMA      | 14.6  | 14.5   | 14.2   | 14.3     | 13.9   | 14.7          | 14.0   |
| VFB      | 72.6  | 73.7   | 74.8   | 75.0     | 76.6   | 75.5          | 77.7   |
| $P_b$    | 5.30% | 5.39%  | 5.25%  | 5.37%    | 5.25%  | 5.52%         | 5.32%  |



# County Road 513, Rapid River

- Plant Production Benefits
  - Energy Savings (>15%)
  - Lower Emissions
    - Improve Air Quality
  - Lower Drum Temps (-15%)
  - Decrease Inlet / Exit Temps of Baghouse
  - Wearpart Longevity
    - Flighting / Gearboxes / Motors

# County Road 513, Rapid River

## ***Fuel & Emissions***

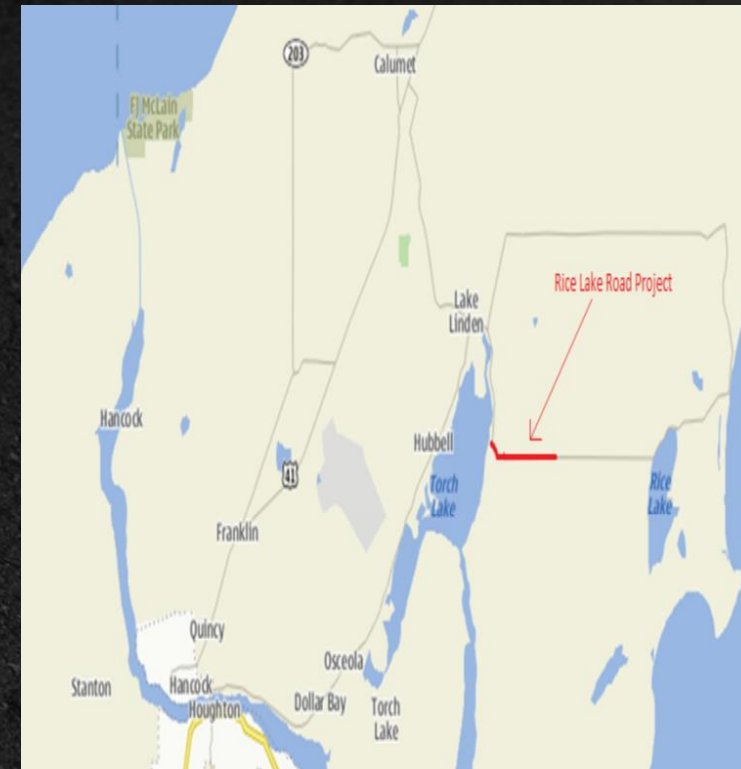
| <b><i>Data Type</i></b> | <b><i>Control HMA</i></b> | <b><i>Advera</i></b> | <b><i>Evotharm 3G</i></b> |
|-------------------------|---------------------------|----------------------|---------------------------|
| <b>Mix Temp (f)</b>     | <b>305</b>                | <b>265</b>           | <b>265</b>                |
| <b>Production (TPH)</b> | <b>309</b>                | <b>330</b>           | <b>330</b>                |
| <b>Burner Position</b>  | <b>55%</b>                | <b>38%</b>           | <b>42%</b>                |
| <b>Fuel Savings</b>     |                           | <b>21%</b>           | <b>15%</b>                |
| <b>CO</b>               |                           | <b>-45%</b>          | <b>-17%</b>               |
| <b>SO2</b>              |                           | <b>-54%</b>          | <b>-54%</b>               |
| <b>VOC</b>              |                           | <b>-43%</b>          | <b>-41%</b>               |



# Rice Lake Road

- Mix Design
  - MDOT approved 13A
  - Binder: PG 58-28
  - AC Target: 5.42%
  - Recycle: 27% RAP
- Project Specifics
  - One Lift at 2" 12.5mm
  - Length: 1.41 miles
  - Tonnage: 2,500

2011



# Rice Lake Road

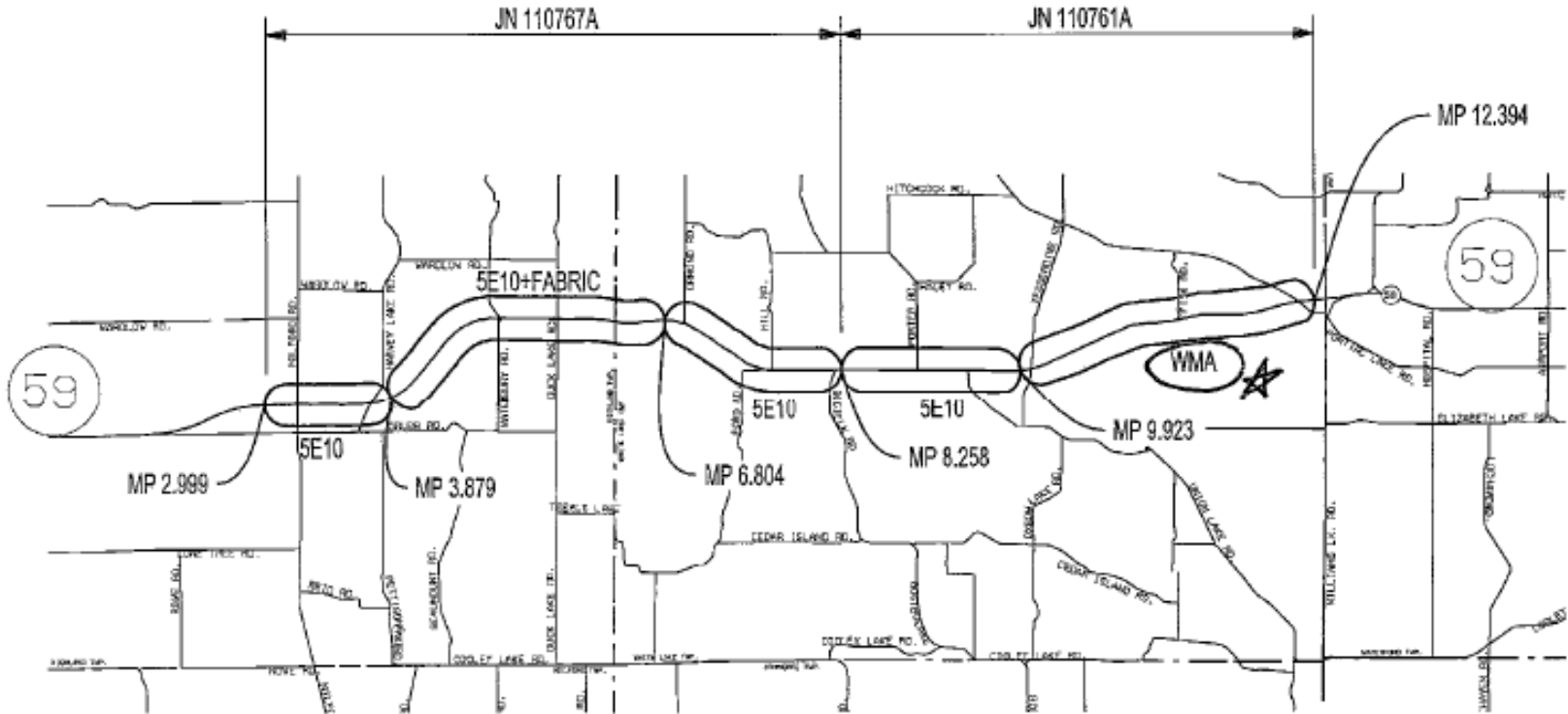




# Rice Lake Road

| Property | JMF   | Evotherm | Control (HMA) |
|----------|-------|----------|---------------|
| Gmm      | 2.506 | 2.508    | 2.499         |
| Gmb      | 2.431 | 2.421    | 2.432         |
| Va       | 3.00  | 3.48     | 2.70          |
| VMA      | 14.64 | 14.93    | 14.79         |
| VFB      | 79.51 | 76.70    | 81.77         |
| Pb       | 5.42  | 5.36     | 5.61          |

# M-59, Oakland County (2011)



ALL MILE POINTS ARE BASED ON CS 63041



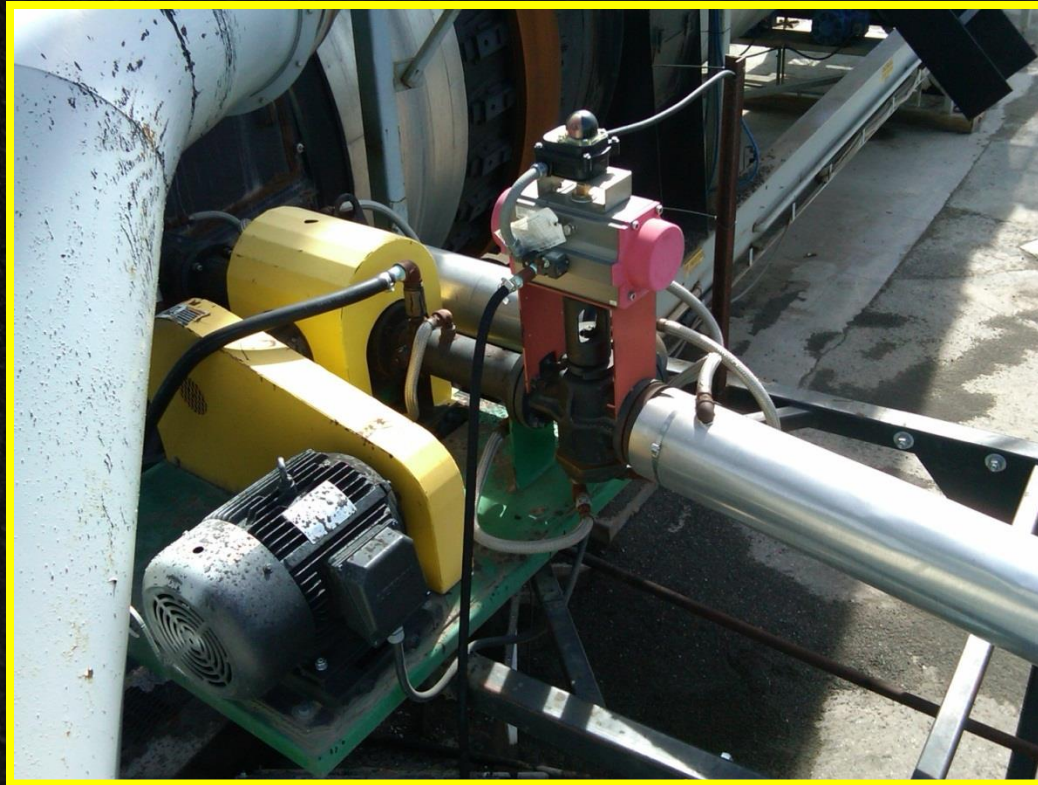
# M-59, Oakland County

## Foaming Process:

- Increases the volume of the liquid
  - Better coating of the aggregate particles
  - Mix is more workable
- Water can be introduced to the mix by metering and injecting the water into the asphalt binder through a mechanical system at the asphalt plant.

# M-59, Oakland County

## Warm Shear Mix Machine





# M-59, Oakland County

- Job Details – 45 Minute Haul to Project loss of 10 degrees of heat vs HMA 25 Minute Haul 20 degree heat loss
- Mix – No change in virgin AC from HMA to WMA, Added 1.25% water (1/2 gallon of water per ton of WMA)
- Density – Compaction Window 170 degrees, WMA 140 degrees

# Summary

- The data collected thus far is consistent with national results and there has not been a significant difference between HMA and WMA testing results
  - Hot sample volumetrics are not significantly different than reheated sample volumetrics
  - No concern with early rutting



# Summary

- Most WMA additives don't require the mix design to be recreated
  - Field trials have shown that mixture volumetrics are nearly identical between HMA and that same HMA mix design with WMA additives.

Note: Depending on what WMA technology used, a new mix design or at least initial laboratory work may be required prior to field production.

# Summary

In the end you still need to know your stuff

- Know your WMA product
- Know your aggregates
- Know your processes (BMP'S)



# Summary

- Finally, WMA is really just HMA with improved workability and the ability to be produced at lower temperatures if desired.
- a.k.a. It's another tool in the contractor's toolbox!



# Resources

[www.asphaltpavement.org](http://www.asphaltpavement.org)

– Online Store

## Guide Specifications for Highway Construction

2008



American Association of State Highway  
and Transportation Officials

INTERNATIONAL TECHNOLOGY SCANNING PROGRAM

## Warm-Mix Asphalt: European Practice



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American Association of State Highway  
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3rd Edition



## Warm-Mix Asphalt: Best Practices

3rd Edition



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Thank You

A. John Becsey, P.E.  
Executive Director

Chuck Mills, P.E.  
Director of Engineering



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[www.apa-mi.org](http://www.apa-mi.org)