RoadResource.org
A Comprehensive Resource for Optimizing Network Management
Lindsay Matush  
CEO & Founder  
Vario Consulting

Scott Assenmacher  
Professional Engineer Sales  
Asphalt Materials, Inc.  
Road Resource Trained Super User

Brought to you by:
AGENDA

1 | Background

2 | Tools & Features
   - Decision-Making Tools
   - Ensure Treatment Success
   - 40 Years or More
   - Network Strategies

3 | Additional Resources
   - Ask an Expert
   - Ahead of the Curve
   - Social Channels

RoadResource.org
## Traits of successful road managers & agencies

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Robust arsenal of asphalt treatments, applied appropriately</td>
</tr>
<tr>
<td>2</td>
<td>Network-level considerations and concepts applied with each treatment plan</td>
</tr>
<tr>
<td>3</td>
<td>Draw upon the success and innovation of others in similar regions and climates</td>
</tr>
<tr>
<td>4</td>
<td>In-touch with the industry at-large</td>
</tr>
</tbody>
</table>
Three Associations Join Together to Support the Industry
Objectives

1. Expand understanding of various asphalt treatments and demystify emulsions

2. Teach network-level thinking to make better use of resources for the long-term

3. Equip with technical information and best practices to increase success

4. Align consistent information into a single easy-to-understand resource
# 3 Years of Research & Collaboration

<table>
<thead>
<tr>
<th>Competitive exploration &amp; industry affiliations</th>
<th>North American data survey</th>
<th>Retreats with ISSA, AEMA &amp; ARRA leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input from over 45 agency and industry leaders</td>
<td>Interviews &amp; beta-testing with agency users, pavement managers, DOTs, &amp; roadway engineers</td>
<td>Page by page technical review from multiple committees</td>
</tr>
</tbody>
</table>
What treatment is best for my road?

Decision-making tools
Compare treatment costs & environmental impact
Decision-Making Tools
Which treatment is best for my road?

Input pavement criteria or select photos for treatment options

* This tool is designed to help explore possible solutions but should not be regarded as a formal recommendation for your pavement. Contact a supplier or contractor near you for a specialized consultation.
Compare Treatments
My PPRA Account

Input costs and life extension in your area to make the most of the site & tools

NOTE:
Change averaged costs, life extension, and structural numbers relevant to you. Tools throughout the site automatically re-populate with your data every time you log in.
Equivalent Annualized Cost

Compare treatment cost based on Life Extension

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Cost Per Sq Yard</th>
<th>Life Extension</th>
<th>Equivalent Annualized Cost/SV/YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack Seal</td>
<td>$0.50</td>
<td>2</td>
<td>$0.25</td>
</tr>
<tr>
<td>Fog Seal</td>
<td>$1.00</td>
<td>3</td>
<td>$0.33</td>
</tr>
<tr>
<td>Single Surface Tr.</td>
<td>$2.00</td>
<td>5</td>
<td>$0.40</td>
</tr>
<tr>
<td>Double Surface Tr.</td>
<td>$4.25</td>
<td>8</td>
<td>$0.53</td>
</tr>
<tr>
<td>Thin Overlays</td>
<td>$7.00</td>
<td>10</td>
<td>$0.70</td>
</tr>
<tr>
<td>Mill-and-Fill</td>
<td>$12.00</td>
<td>12</td>
<td>$1.00</td>
</tr>
<tr>
<td>Cold In Place</td>
<td>$17.00</td>
<td>15</td>
<td>$1.13</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>$25.00</td>
<td>20</td>
<td>$1.25</td>
</tr>
</tbody>
</table>

Use our nationally aggregated data or enter your own data.

Clear Data / Chart Your Own

CHART IT
Compare Cost & Environmental Impact
Project Cost & Environmental Benefits

By choosing a preservation & recycling approach...

**COST SAVINGS**
$340,000
54% LESS THAN MILL & FILL

**ENVIRONMENTAL SAVINGS**
- REDUCE GREENHOUSE GAS EMISSION BY 90%
- REDUCE ENERGY CONSUMPTION BY 63%

That’s the green equivalent of removing 17 passenger vehicles from US roadways for a year!
South Stony Creek

**Situation:** 12 Mile Corridor of county primary road all season truck route. Road was neglected, deteriorated beyond reasonable repair, but reactionary maintenance costs forced county to rebuild the road. Generally 7-8” of bituminous surface, over good base & subgrade.

**Comparison:** 4” CIR and 8”FDR, both topped with single lift HMA

**Outcome:** County recognized value in added structure and chose FDR.
Structural Comparison

Compare treatment cost based on Life Extension

**Conventional: Mill & Fill**

Many agencies are learning that the use of limited funds toward a “worst first” approach accelerates the decline of their overall network, as miles of good roads go untreated each year.

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Depth (in)</th>
<th>Co-Eff</th>
<th>$/Yr</th>
<th>SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; HMA Mix &amp; Fill</td>
<td>3</td>
<td>0.46</td>
<td>$18.64</td>
<td>1.32</td>
</tr>
<tr>
<td>Remaining Asphalt (Existing)</td>
<td>3</td>
<td>0.20</td>
<td></td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Optimized: Cold In Place**

Consider an Optimized approach, which reallocates funds across more efficient strategies to keep good roads good and help you get ahead of the curve.

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Depth (in)</th>
<th>Co-Eff</th>
<th>Cost/yr</th>
<th>SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin Lift HMA</td>
<td>1</td>
<td>0.44</td>
<td>$6.97</td>
<td>0.44</td>
</tr>
<tr>
<td>Cold-in-Place Recycling</td>
<td>3</td>
<td>0.35</td>
<td>$4.70</td>
<td>1.05</td>
</tr>
<tr>
<td>Remaining Asphalt</td>
<td>3</td>
<td>0.20</td>
<td></td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Total Sq. Yards To Be Treated:** 100,000

**Conventional Approach**

- **Overall Structural Number:** 2.32
- 100,000 SY x $13.94 /SY = $1,394,000 total

**Optimized: Recycling First**

- **Overall Structural Number:** 2.36
- 100,000 SY x $9.56 /SY = $956,000 total

**By choosing the recycling first approach...**

**TOTAL OPTIMIZED STRATEGY COST SAVINGS**

$438,000
Conventional Approach

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Depth (in)</th>
<th>Coefficient</th>
<th>Cost/SY</th>
<th>SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill &amp; Fill 2”</td>
<td>2.0</td>
<td>0.44</td>
<td>9.60</td>
<td>0.88</td>
</tr>
<tr>
<td>Mill &amp; Fill 2”</td>
<td>2.0</td>
<td>0.44</td>
<td>9.60</td>
<td>0.88</td>
</tr>
<tr>
<td>Remaining Asphalt (Exist)</td>
<td>3.0</td>
<td>0.2</td>
<td>0.00</td>
<td>0.60</td>
</tr>
<tr>
<td>Granular Base (Existing)</td>
<td>4.0</td>
<td>0.1</td>
<td>0.00</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Optimized: Recycling First

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Depth (in)</th>
<th>Coefficient</th>
<th>Cost/SY</th>
<th>SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA 2”</td>
<td>2.0</td>
<td>0.44</td>
<td>8.40</td>
<td>0.88</td>
</tr>
<tr>
<td>Cold Recycling 4”</td>
<td>4.0</td>
<td>0.32</td>
<td>8.00</td>
<td>1.28</td>
</tr>
<tr>
<td>Remaining Asphalt (Exist)</td>
<td>3.0</td>
<td>0.2</td>
<td>0.00</td>
<td>0.60</td>
</tr>
<tr>
<td>Granular Base (Existing)</td>
<td>4.0</td>
<td>0.1</td>
<td>0.00</td>
<td>0.40</td>
</tr>
<tr>
<td>Select...</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Overall Structural Number: **2.76**
161,000 SY x **$19.20** /SY = **$3,091,200** total

Overall Structural Number: **3.16**
161,000 SY x **$16.40** /SY = **$2,640,400** total
### Conventional Approach

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Depth (in)</th>
<th>Coefficient</th>
<th>Cost/SY</th>
<th>SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mill &amp; Fill 2”</td>
<td>2.0</td>
<td>0.44</td>
<td>9.60</td>
<td>0.88</td>
</tr>
<tr>
<td>Mill &amp; Fill 2”</td>
<td>2.0</td>
<td>0.44</td>
<td>9.60</td>
<td>0.88</td>
</tr>
<tr>
<td>Remaining Asphalt (Exist)</td>
<td>3.0</td>
<td>0.2</td>
<td>0.00</td>
<td>0.60</td>
</tr>
<tr>
<td>Granular Base (Existing)</td>
<td>4.0</td>
<td>0.1</td>
<td>0.00</td>
<td>0.40</td>
</tr>
</tbody>
</table>

**Overall Structural Number:** 2.76

161,000 SY x $19.20 /SY = $3,091,200 total

### Optimized: Recycling First

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Depth (in)</th>
<th>Coefficient</th>
<th>Cost/SY</th>
<th>SN</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA 2”</td>
<td>2.0</td>
<td>0.44</td>
<td>8.40</td>
<td>0.88</td>
</tr>
<tr>
<td>Full Depth Reclamation E</td>
<td>8.0</td>
<td>0.3</td>
<td>8.80</td>
<td>2.40</td>
</tr>
<tr>
<td>Granular Base (Existing)</td>
<td>4.0</td>
<td>0.075</td>
<td>0.00</td>
<td>0.30</td>
</tr>
<tr>
<td>Select...</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Select...</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Overall Structural Number:** 3.58

161,000 SY x $17.20 /SY = $2,769,200 total
How can I ensure treatment success?
Treatment Resource Center

Ensure treatment success with comprehensive information on 18 treatments

FOR PAVEMENT CONDITIONS (C-D-F) (PCI of less than 70)

A cost-effective, long-lasting, greener alternative to conventional maintenance and rehabilitation techniques. Cold in-place recycling (CIR) is a process that cools the mill and recycles the top 0.5 inches of asphalt using a continuous train operation. Through the complete reuse of existing material, CIR greatly reduces trucking, time and natural resources to significantly lower project costs. Generally, any road that is a candidate for mill & fill is a candidate for CIR.

$ 20%-50% less expensive than conventional maintenance and reconstruction methods

Reduce Greenhouse emissions by Up to 90%

Reuse 100% of existing materials

20%-40% faster construction times

Add 15-20 years (combined with appropriate wearing course)

Most agencies use STCs between 0.36-0.38 [Recent research indicates values from 0.36-0.44 may be more appropriate]

ISSUES ADDRESSED

- Frequent, severe, non-load distresses in top lift of hot mix
- All distresses within the recycling depth (2.5 inches)
- Reflective cracking from below CIR layer
- See all

ATTRIBUTES

- Eliminates defects within the recycling depth
- Blocks or slows reflective cracking
- Reuses existing material in place
- Replaces 1 or 2 lifts of hot mix
- Allows for road widening where desired

COMMON COMBINATIONS

CIR TABLE

<table>
<thead>
<tr>
<th>Types of Distress</th>
<th>Optimum Performance</th>
<th>Average Performance</th>
<th>Stop-Gap Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Transverse, longitudinal, multiple cracking</td>
<td>• Wheelpath cracking</td>
<td>• Alligator cracking from base failure</td>
<td></td>
</tr>
<tr>
<td>• Raveling</td>
<td>• Ruting (asphalt or subgrade)</td>
<td>• Distortion</td>
<td></td>
</tr>
<tr>
<td>• Oxidation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Depth of Distress

- Within treatment depth (2”-5”)
- 1”-3” below treatment depth
- More than 4”-6” below treatment depth

Life Extension

- 20-25 years
- 10-20 years
- 5-10 years

EXAMPLES OF ROADS THAT HAVE BEEN TREATED WITH COLD IN-PLACE RECYCLING OVER VARIOUS STAGES IN SERVICE LIFE:

If a CIR mix ravel excessively due to rain, the mat can be re-processed with or without adding cement to facilitate drying.
Success Stories & Research
Use, performance & best practices in your region

APRN Journal of Earth Sciences

AUTHORS
Onyelowe Ken C.1 and Okoafe F. O.2

SUMMARY
This study was centered on elucidating the chemical reactions that bring about soil stabilization and modification. It has been established that the chemical compounds found in soil, quartz, feldspar, dolomite, calcite, montmorillonite, kaolinite etc. react with the chemical constituents found in different identified chemical stabilizers. This research work will better place designers, constructors and researcher on the choice of soil chemical stabilizer and techniques and the extent of chemical reactions that take place during soil chemical stabilization.

CITATIONS
Onyelowe Ken C.1 and Okoafe F. O.2 1Department of Civil Engineering, College of Engineering and Engineering Technology, Umunah, Nigeria Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria 2Faculty of Engineering, University of Nigeria, Nsukka, Nigeria

MnDOT Experiments with micro-milling and micro surfacing to improve ride quality and treatment performance

INNOVATION SUMMARY:
Progressive agencies are constantly seeking the most cost effective methods to improve ride quality and decrease cracking as part of their overall pavements management strategy. More and more agencies like MnDOT are finding the use of micro-milling and high-performance micro-surfacing mixes to be worthwhile investments of their limited funding.

BACKGROUND:
MnDOT has had a long history of successes using micro surfacing. With its harsh wet-for-wet climate and frequent snow plowing, the Minnesota agency needed new ways to further improve the crack resistance and plow abrasion durability of their micro surfacing mixes.

“Future monitoring will determine how cost effective this process is for ride improvement and preservation of the pavements, but initial results are promising.” — Jerry Oail, MnDOT

APPROACH:
Beginning in 2005, MnDOT began experimenting with some softer base asphalts (PG64-34) and higher emulsion contents (from 10% up to as high as 16%) in some micro surfacing mixes. And then in 2012, the agency started testing a higher polymer loading on selected micro surfacing projects, increasing the polymer from 3% to as high as 6.5%.
Plan for 40 years or more

How do savings add up over time?
Deterioration Curve

Understanding the life cycle of a road
Deterioration Curve

Understanding the life cycle of a road
Life Cycle Cost Calculator

Save big over the life of your pavement with progressive maintenance
Create a Network Plan & Stretch Resources Further

What is the impact on my network?
How should I prioritize projects?
What is the impact on my network?
Remaining Service Life

How much life is your network gaining or losing each year?

**Critical Concept**

A 500-mile network loses 500 mile-years of life annually. Every year, every mile of your network loses 1 mile-year of life. To avoid losing ground, the roadway owner must design a treatment plan that adds 500 mile-years of life or more!

See how this agency reallocated funds to inject more life into their network, using the same budget.

RSL Calculator

How to use this Tool:

Use the calculator below to explore how different treatment combinations can be varied to inject maximum life into your network and use your resources more wisely. See examples and learn more about remaining service life [here](#).

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Category</th>
<th>Life Extension</th>
<th>Lane-Mile-Years Treated</th>
<th>Lane-Mile-Years</th>
<th>Unit Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Strip Sealed</td>
<td>Preservation</td>
<td>3.0</td>
<td>25</td>
<td>75</td>
<td>0.87</td>
<td>$141,400</td>
</tr>
<tr>
<td>Micro Surfaceing - Double Lift</td>
<td>Preservation</td>
<td>8.0</td>
<td>34</td>
<td>277</td>
<td>3.02</td>
<td>$1,172,014</td>
</tr>
<tr>
<td>Chip Seal</td>
<td>Preservation</td>
<td>6.0</td>
<td>40</td>
<td>240</td>
<td>2.06</td>
<td>$725,120</td>
</tr>
<tr>
<td>Crack Seal</td>
<td>Preservation</td>
<td>10.0</td>
<td>24</td>
<td>240</td>
<td>5.20</td>
<td>$1,090,240</td>
</tr>
<tr>
<td>Micro RAS U-Pave</td>
<td>Rehabilitation</td>
<td>11.0</td>
<td>2</td>
<td>22</td>
<td>9.09</td>
<td>$172,480</td>
</tr>
<tr>
<td>Cold Masticating - 1.5” Thinner</td>
<td>Rehabilitation</td>
<td>15.0</td>
<td>4</td>
<td>60</td>
<td>12.99</td>
<td>$492,998</td>
</tr>
<tr>
<td>Full Depth Rehabilitation - 4” Thinner</td>
<td>Rehabilitation</td>
<td>25</td>
<td>2</td>
<td>50</td>
<td>24.54</td>
<td>$502,304</td>
</tr>
<tr>
<td>Full Depth Removal &amp; Replace</td>
<td>Rehabilitation</td>
<td>25</td>
<td>2</td>
<td>50</td>
<td>38.01</td>
<td>$580,516</td>
</tr>
</tbody>
</table>

Congratulations

You added 1,009 lane-mile-years of life

9 lane-mile-years of life

13% of roads addressed
How should I prioritize my projects?
Cost-Benefit Value
Which projects will give me the “biggest bang for the buck?”

Cost-Benefit Value

With limited funding, how do I prioritize my projects?

CBV offers roadway managers a way to prioritize projects while accounting for the variables relevant to you and the realities of life extension.

CBV = \( \frac{(\text{Trafﬁc / Constraint Factor}) \times (\text{Life Extension})}{(\text{Unit Cost}) \times (\text{PCI})} \)

Two road comparison: Which road should I treat ﬁrst?

ROAD 1
- Worst First
- AADT: 5000
- PCI: 90
- \( \frac{(5000 \times 7)}{25} \times 30 \) PCI
- \( \$39 \) per SF x 30 PCI

ROAD 2
- Pavement Preservation
- Chip Seal
- AADT: 5000
- PCI: 75
- \( \frac{(5000 \times 7)}{6} \times 30 \) PCI
- \( \$2 \) per SF x 75 PCI

= 11 CBV
= 29 CBV

Critical Concept
For Equal Traffic, Preservation Has a Higher Benefit.
Additional Resources

AEMA, ISSA, ARRA members
Ahead of the Curve - PPRA Newsletter
Social Channels
AEMA, ARRA, ISSA members
Subscribe to Ahead of the Curve

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Questions?

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