

2026 RAP Tech: Recycle More, Spend Less



51 years ago at Cragun's...



Why is RAP given away today?

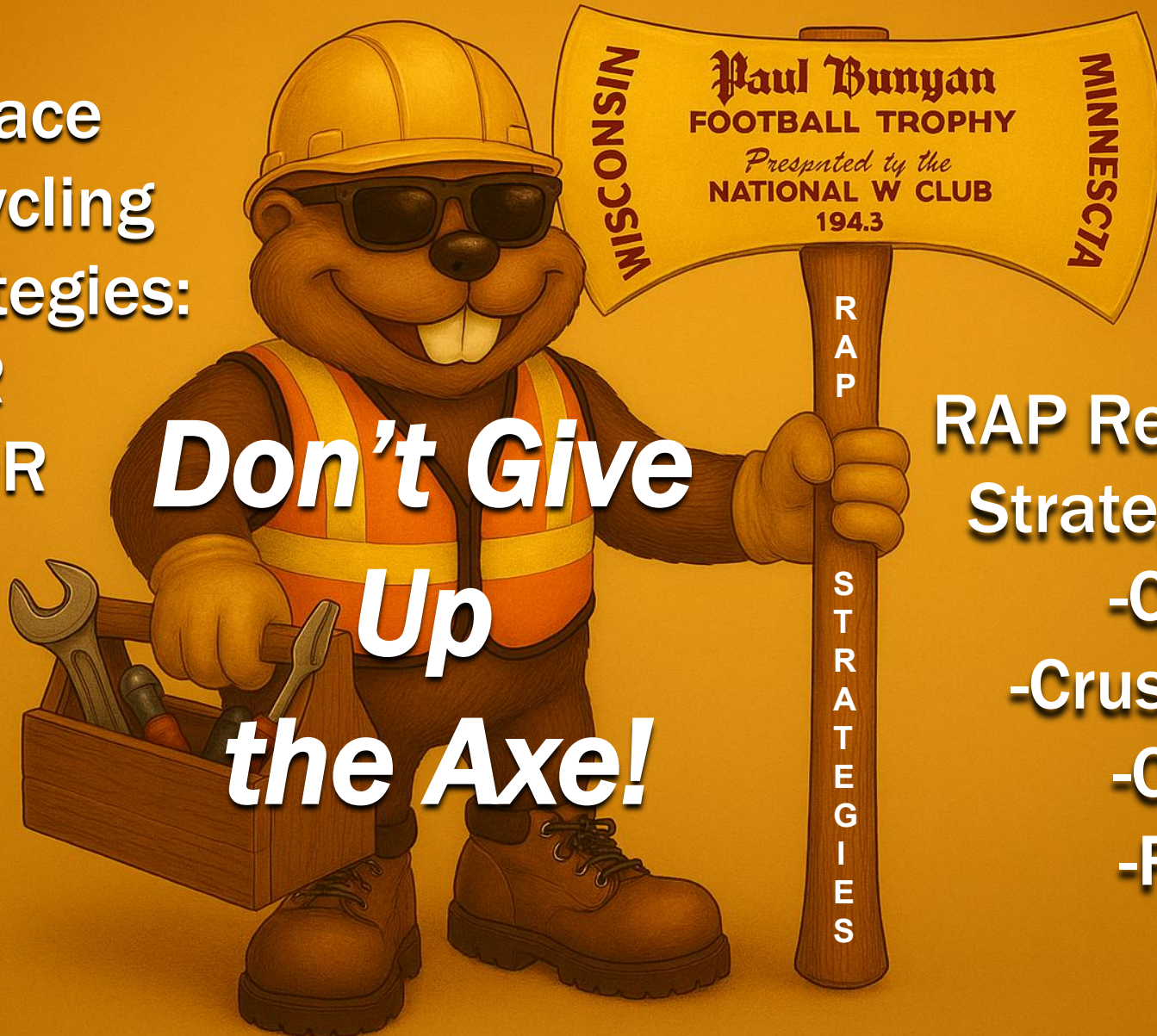
- Lower the cost of HMA by providing HMA producer a free source of RAP.
- Owner doesn't have a place to put it (stockpile).
- Potential regulatory issues for a stockpile (SWPPP, permits, etc.)
- Owner does not have the equipment/staff to process RAP for reuse.
- RAP management (Inconsistent quality from different roadways).
- Maybe we should consider keeping it...

Unlock your RAP's Potential

In-place
Recycling
Strategies:

- FDR
- SFDR
- CIR

**Don't Give
Up
the Axe!**



RAP Re-Use
Strategies:

- CCPR
- Crushing
- Chips
- Fines

Right Tool, Right Place, Right Time

Save Money

Save Time

Reset Pavement Design Process

Extend the Life of Pavement

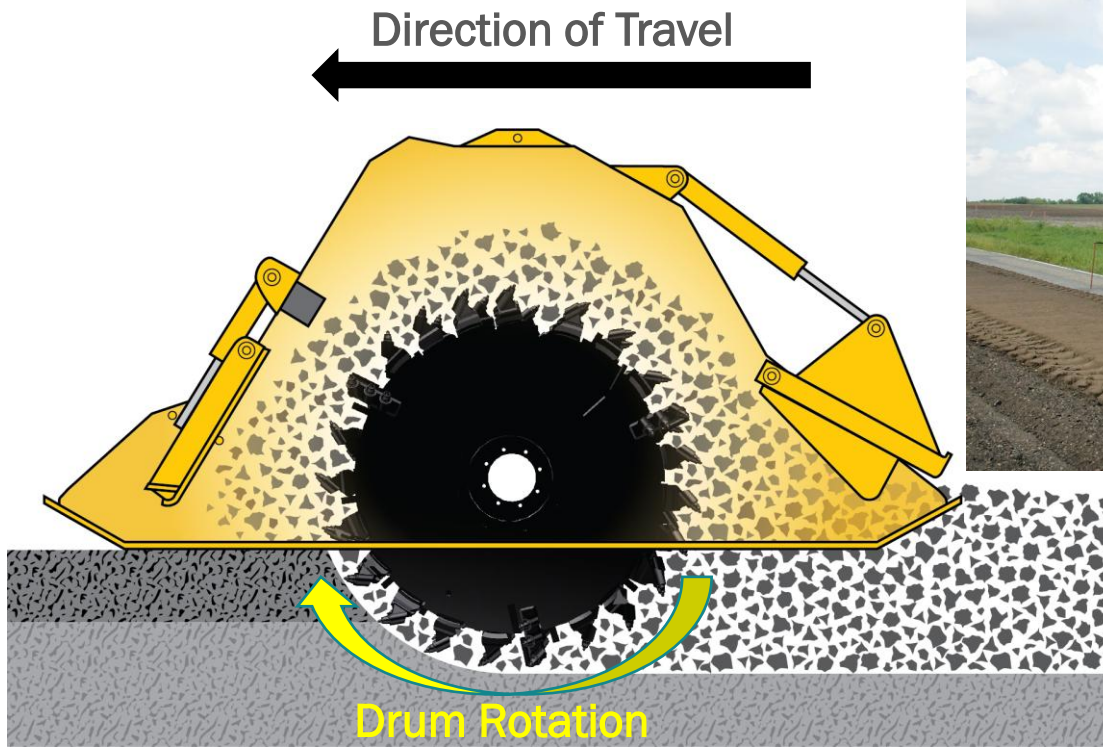
Reduce Maintenance Costs

Reduce Carbon Emissions

Recycle and Re-Use



IN-PLACE: Full Depth Reclamation (FDR)



IN-PLACE: Stabilized Full Depth Reclamation (SFDR)



MnROAD SFDR Test Cells

- Built in 2008, SFDR with Engineered Emulsion
- Designed for 3.5 million ESALs
- 8.5 Million ESALs in 2019 (looked brand new)
- Gave up on the chance they'd fail in 2022 and started new experiment by re-recycling SFDR with CIR

2008

Stabilized Full Depth Reclamation		
2	3	4
1" TBWC 2" 64-34	1" TBWC 2" 64-34	1" 64-34 2" 64-34
6" FDR + EE	6" FDR + EE	8" FDR + EE
6" FDR	2" FDR 2" C 5	9" FDR + Fly Ash
26" Class 4	33" Class 3	Clay

2022

2208	2207
1" UTWBC	1" UTWBC
2" 64-34	2" HMA
4" CIR without Rejuvenator	4" CIR with Rejuvenator
4" FDR + EE	4" FDR + EE
9" FDR + Fly Ash	9" FDR + Fly Ash
Clay	Clay

Keys to a successful SFDR project



- **Pulverize existing asphalt pavement structure prior to stabilization**
- **Compact and shape pulverized material to desired cross-slope prior to injection**
- **Ensure pulverized layer is 1 to 2 points below OMC prior to injection**
- **Great way to build additional structure into a roadway**
- **Stabilization additives vary in price and strengths**

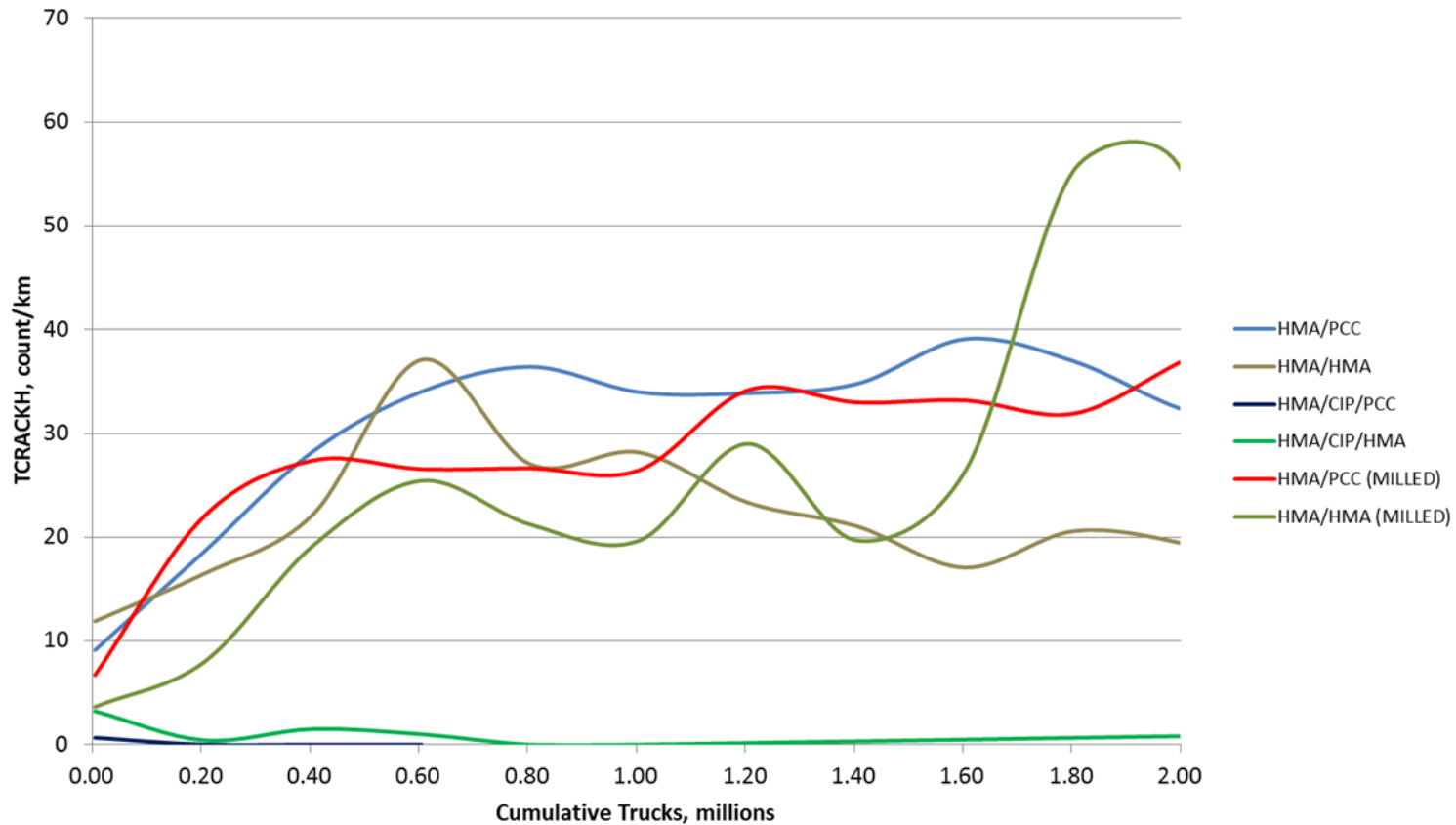
IN-PLACE: Cold In-Place Recycling (CIR)



CIR

IowaDOT Research on CIR Crack Resistance, 100 CIR Roads included in the Research

Average High Severity Transverse Cracking
10 Year Span (3-4 inches HMA Surface)



Source: Long-Term Evaluation of Cold In-Place Recycling and Factors Influencing Performance, Ashley Buss, Ph.D.1; Marie Grace Mercado2; and Scott Schram, Ph.D., P.E.3, DOI: 10.1061/(ASCE)CF.1943-5509.0000985. © 2016 American Society of Civil Engineers.

Maximize Benefits of CIR

- CIR reduces cracking frequency
- CIR roads are able to maintain their smoothness for longer periods of time (better IRI numbers)
- Lower Maintenance Costs over time
- Research shows increased crack resistance and lower IRI values at CIR depths of 4 inches vs. 3 inches (deeper CIR treatment leads to: fewer cracks, better IRI, longer service life)
- REMINDER: Right Tool, Right Place, Right Time

RE-USE: Cold Central Plant Recycling (CCPR)



CCPR (Cold Mix) Use



- Replacement of base course HMA
- Pothole Repair
- Trench Backfill
- Yard Surfacing (Midstate has had our heavy haul yard surfaced with cold mix for 20 years)
- Customize Mix Design for Use Case, High Performance vs. Stockpile Time

RE-USE: Custom Crushing of RAP



RAP Chips – Chip Seal
RAP Fines – Micro-Surfacing



RAP Chips

Fines

AUTOMATED MACHINE GUIDANCE (AMG) MILLING



Fine RAP gradation from AMG Milling is a great material to use on shoulders, especially if you place and compact.

Use the design phase to determine exact quantities for removals, improve ride and roadway geometry prior to pavement preservation treatment.

Environmental Benefits of RAP Use



Environmental Process Declaration (EPD)

- Product vs. Process
- Construction Emissions Reduction
- CIR – 15 TNs of cold mix = 1 metric tonne of CO₂ saved
- CCPR – 18 TNs of cold mix = 1 metric tonne of CO₂ saved
- SFDR – 25 TNs of cold mix = 1 metric tonne of CO₂ saved

EPD “Nutrition” Label

Your Building Product

Amount per Unit

LCA IMACT MEASURES	TOTAL
Primary Energy (MJ)	12.4
Global Warming Potential (kg CO ₂ eq)	0.96
Ozone Depletion (kg CFC-11 eq)	1.80E-08
Acidification Potential (mol H ⁺ eq)	0.93
Eutrophication Potential (kg N ⁻ eq)	6.43E-04
Photo-Oxidant Creation Potential (kg O ₃ eq)	0.121

Your Product's Ingredients: Listed Here

EPD “nutrition label” for concrete mixes

Metric Tonnes of Emissions saved in 2021 with CIR in Minnesota (County and DOT projects)

Mower - 3,975 TN

Hennepin – 922 TN

Brown – 4,899 TN

Martin – 1,012 TN

St. Louis – 2,950 TN

Clay – 1,037 TN

Pine – 502 TN

Scott – 2,004 TN



Additional Resources

- RoadResource.org

- ✓ PPRA
 - ✓ AEMA/ISSA/ARRA
- ✓ Information on All Treatments
- ✓ Success Stories

Explore by Pavement Criteria

PAVEMENT CRITERIA PAVEMENT PHOTOS

This tool is designed to explore cost-effective solutions to pavement at varying levels of distress. Input your pavement criteria for potential solutions relevant to you.

Though these tools use distress to identify potential treatment solutions, the savviest pavement managers are stretching budgets further by preventatively addressing deterioration before it starts. Link treatments together to make pavement last 40 years or more, or consider using innovative recycling methods to cost-effectively reengineer your pavement cross-section to meet increased load or traffic requirements and increase strength and longevity.

PAVEMENT CONDITION PRIMARY DISTRESS ROAD TYPE SURFACE TYPE OTHER FACTORS TO CONSIDER

PLEASE SELECT PLEASE SELECT PLEASE SELECT PLEASE SELECT !

- FOG SEAL
- REJUVENATING FOG SEAL
- SLURRY SEAL
- MICRO SURFACING
- CAPE SEAL
- ULTRA THIN LIFT HMA
- CHIP SEAL
- CRACK SEAL
- SCRUB SEAL
- TACK COAT
- PRIME COAT
- COLD PLANING & MICRO MILLING
- HOT IN-PLACE RECYCLING
- COLD IN-PLACE RECYCLING
- COLD CENTRAL PLANT RECYCLING
- FULL DEPTH RECLAMATION
- BASE STABILIZATION
- SOIL STABILIZATION & SOIL MODIFICATION

Optimize Your Network

- ▶ [How-To-Guide](#)

Life Cycle Cost *Get 40 years of life or more*

- ▶ [About](#)
- ▶ [Life Cycle Cost Calculator](#)
- ▶ [Video Tutorial](#)

Network Success Stories

Equivalent Annualized Cost *Applies to apples cost comparisons*

- ▶ [EAC: About & Calculator](#)

Remaining Service Life *Add maximum life to your network*

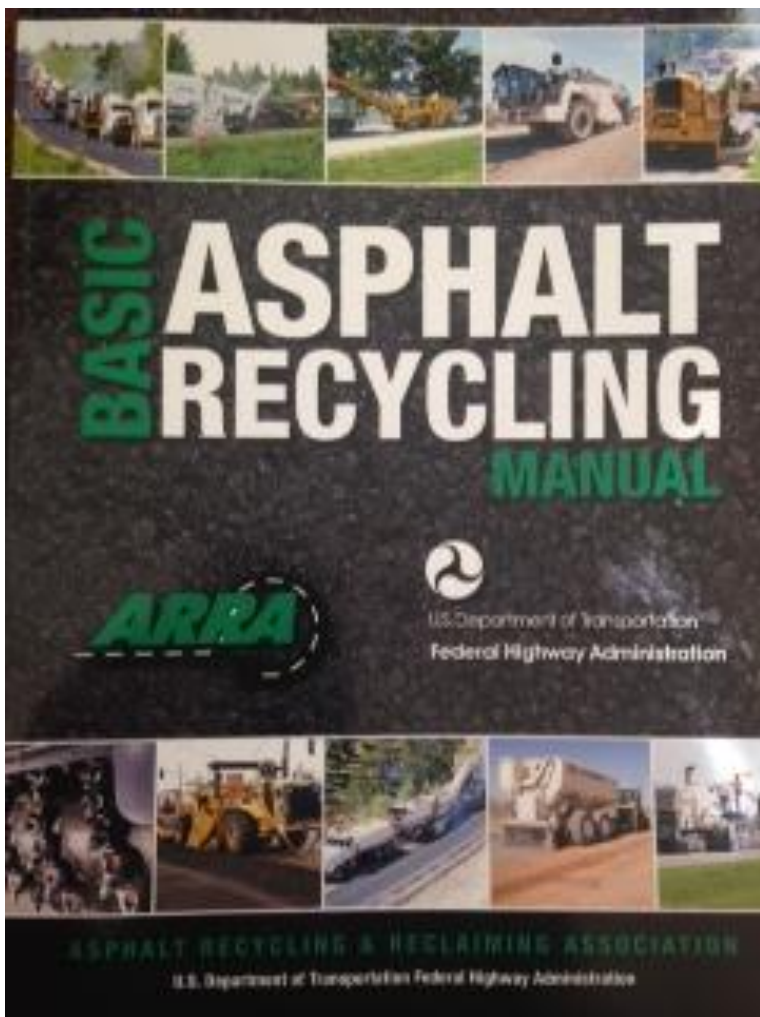
- ▶ [About](#)
- ▶ [Remaining Service Life Calculator](#)
- ▶ [Video Tutorial](#)

Cost Benefit Value *How-To Prioritize Projects*

- ▶ [About](#)
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SOIL STABILIZATION & S
MODIFICAT

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QUESTIONS?

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