



Preservation Of High Traffic Volume Roadways

An Overview of SHRP 2 Project R26

MnDOT R26 Pavement Preservation

Workshop

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Federal Highway Administration

Overview

- R26 Background
- Findings
- Deliverables
- And Beyond!



Background

- Use of pavement preservation is growing
- Use on high-traffic volume (HTV) roadways not as widely accepted, not well documented
- Formal guidelines being developed by many agencies do not include pavements with higher average daily traffic (ADT)



Project Objectives

- Develop preservation guidelines for HTV roads
- Identify promising preservation strategies for HTV roads



Literature Search, Compilation, and Review

Key findings

- Most preservation occurs on low traffic volume roads (varying definitions of “low”)
- However, 2004 NCHRP survey indicated most agencies apply preservation to BOTH low and high traffic volume roads

**Concerns on HTV roads: durability,
performance, negative public perception,
and risk**



Literature Search, Compilation, and Review (continued)

- Each preservation treatment has unique capabilities/functions that enable it to:
 - Prevent or delay occurrence of new distresses and/or slow development of existing distresses
 - Restore pavement integrity and functionality and/or improve its surface characteristics



Selected R26 Findings

- Broad range of practices and experiences
- No standard definition of “high volume”
- At higher volumes less likelihood of using a mix of treatments
- Different practices in urban areas



High-Traffic Categories

Green

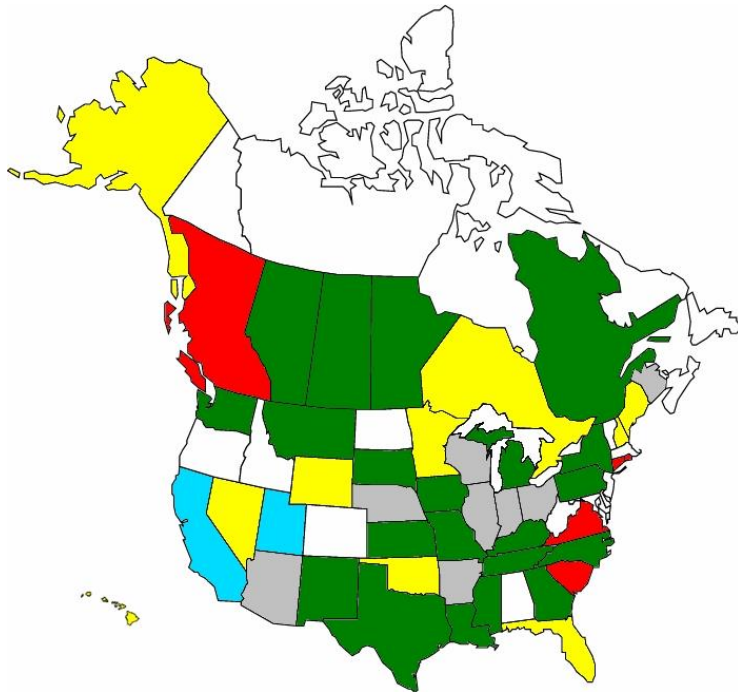
Low
($<10,000$)

Yellow

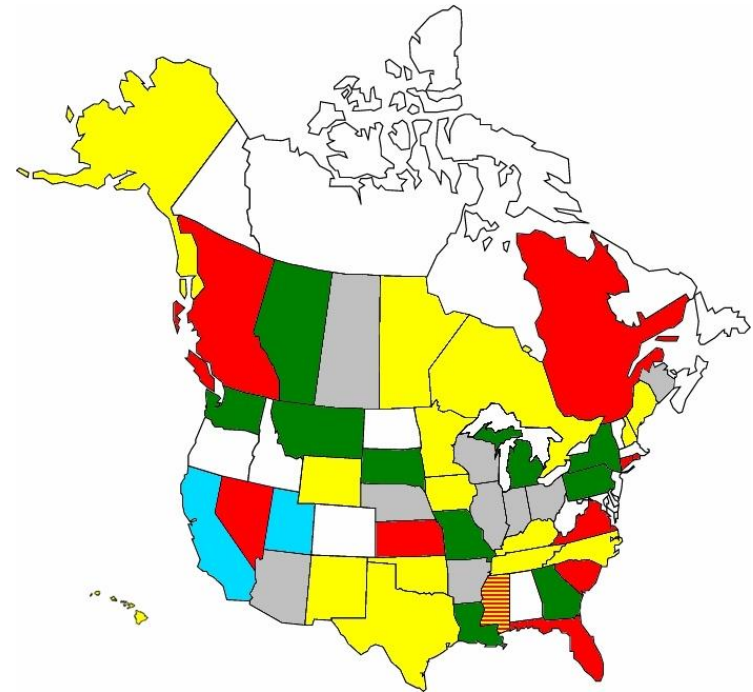
Medium
($10,000-19,999$)

Red

High
($\geq 20,000$)



Rural High-Volume Limits



Urban High-Volume Limits



Preservation on HMA HVR ($\geq 20,000$ ADT)

Widely used treatments

- Crack seal
- Crack fill
- Drainage preservation

Treatments with limited use

- Cape seal, scrub seal, chip seals, cold in-place recycling, ultra-thin whitetopping



Preservation on PCC HVR ($\geq 20,000$ ADT)

Widely used treatments

- Joint seal
- Diamond grinding
- Full-depth patching

Treatments with limited use

- Diamond grooving, thin bonded wearing course, thin HMA or PCC overlay



Decision Overview, Part 1

Evaluate Current and Historical Pavement Performance Data

(from field surveys and testing and/or agency PMS database)

- Overall Condition Indicator (PCI, PSR, etc.)
- Individual Distress Types, Severities, and Extents
- Smoothness (IRI, PI, etc.)
- Surface and Subsurface Drainage Characteristics
- Safety Characteristics
 - friction/texture (FN, MPD/MTD, IFI, etc.)
 - crashes
- Pavement–Tire Noise

Review Historical Design, Construction, and Maintenance and Rehabilitation (M&R) Data

- Pavement Type and Cross-Sectional Design
- Materials and As-Built Construction
- M&R Treatments (materials, thicknesses, etc.)

Decision

Develop Preliminary Set of Feasible Preservation Treatments



Decision Overview, Part 2

Develop Preliminary Set of Feasible Preservation Treatments

Assess Specific Needs and Constraints of Project

Performance Needs

- Treatment Life
 - traffic effects (functional class and/or traffic level)
 - climate/environment effects
- Risk
 - Availability of qualified contractors
 - Availability of quality materials

Construction Constraints

- Funding
- Time (of year) of construction
- Geometrics
- Work duration (facility downtime)
- Traffic accommodation

Develop Final Set of Feasible Preservation Treatments

Select the Preferred Preservation Treatment

- Conduct Cost-Effectiveness Analysis
 - Benefit-Cost Analysis
 - Life-Cycle Cost Analysis (LCCA)
- Evaluate Economic and Non-Economic Factors



Feasibility Matrix – Bituminous

Preservation Treatment	Window Of Opportunity		Distress Types and Severity Level (L=Low Severity, M=Medium Severity, H=High Severity)													Surface Characteristics Issues			
			Surface Distress					Cracking Distress				Deformation Distress							
	PCI/PCR	Age, yrs	Ravel/Weather	Bleed/Flush	Polish	Segre- gation	Water Bleed/ Pump*	Fatigue/ Long WP/ Slippage	Block	Trans- verse	Joint Reflect	Long/ Edge	Wear/ Stable Rutting*	Corros/ Shove	Bumps/ Sags	Patches	Ride Quality	Friction	Noise
		LM/H	—	—	LM/H	—	LM/H	LM/H	LM/H	LM/H	LM/H	LM/H	LM/H	LM/H	LM/H	—	—	—	
Crack Fill	75-90	3-6*						xxx	⊗ox	○xx	○xx	●⊗○							
Crack Seal	80-95	2-5*						xxx	⊗ox	●⊗○	●⊗○	○xx							
Slurry Seal (Type III)	70-85	5-8	⊗●⊗	x	⊗	⊗○x	⊗	⊗○x	●⊗○	⊗○x	⊗○x	⊗○x	○xx	xxx	xxx	⊗○x	x	⊗	⊗
Microsurfacing-Single	70-85	5-8	⊗●⊗	x	⊗	●⊗○	⊗	⊗○x	●⊗○	⊗○x	⊗○x	⊗○x	○xx	○xx	⊗○x	⊗○x	○	●	⊗
Microsurfacing-Double	70-85	5-8	⊗●⊗	x	⊗	●⊗○	○	⊗○x	●⊗○	●⊗○	●⊗○	●⊗○	●⊗○	○xx	○xx	●⊗○	⊗	●	⊗
Chip Seal-Single Conventional	70-85	5-8	⊗●⊗	○	●	●⊗○	⊗	⊗xx	●⊗○	●⊗○	●⊗○	⊗⊗○	⊗○x	○xx	○xx	⊗⊗○	○	●	x
Polymer-modified	70-85	5-8	○⊗⊗	x	●	⊗⊗○	○	⊗○x	●⊗⊗	●⊗⊗	●⊗⊗	⊗○x	○xx	○xx	⊗⊗○	○	●	x	
Chip Seal-Double Conventional	70-85	5-8	○⊗⊗	x	⊗	⊗⊗○	x	⊗○x	●⊗⊗	●⊗⊗	●⊗⊗	●⊗⊗	●⊗○	⊗○x	⊗○x	●⊗⊗	⊗	⊗	○
Polymer-modified	70-85	5-8	○○⊗	x	⊗	○⊗○	x	●⊗○	●⊗⊗	●⊗⊗	●⊗⊗	●⊗⊗	●⊗○	⊗○x	⊗○x	●⊗⊗	⊗	⊗	○
Ultra-Thin Bonded Wearing Course	65-85	5-10	⊗●⊗	x	●	⊗⊗○	○	⊗○x	⊗⊗○	⊗⊗○	⊗⊗○	⊗○x	⊗○x	⊗○x	⊗⊗○	⊗	●	⊗	
Ultra-Thin HMAOL	65-85	5-10	⊗●⊗	x	●	⊗⊗○	○	⊗○x	⊗⊗○	⊗⊗x	⊗⊗x	⊗○x	⊗○x	⊗○x	⊗⊗○	⊗	●	●	
Thin HMAOL	60-80	6-12	⊗●⊗	○	●	⊗⊗○	○	●⊗○	●⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	●⊗○	●⊗○	●⊗⊗	●	●	●
Cold Milling and Thin HMAOL	60-75	7-12	○⊗●	○	○	⊗●⊗	x	⊗⊗○	○⊗⊗	⊗⊗●	⊗⊗●	○⊗⊗	⊗⊗⊗	●⊗⊗	●⊗○	●⊗⊗	●	⊗	○
Hot In-place Recycling Surf Recycle HMAOL	70-85	5-8	○⊗●	○	○	⊗⊗⊗	○	⊗⊗○	●⊗○	○⊗●	○⊗●	⊗⊗○	⊗⊗⊗	⊗⊗○	⊗⊗○	⊗⊗○	⊗	⊗	○
Removing HMAOL	60-75	7-12	x○○	○	⊗	x○○	x	⊗⊗⊗	●⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	○⊗●	○⊗⊗	●	⊗	○
Repaving	60-75	7-12	x○○	○	⊗	x○○	x	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	○⊗●	○⊗⊗	●	⊗	○
Cold In-place Recycling and HMAOL	60-75	7-12	xxx○	○	○	x○○	x	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	⊗⊗⊗	○⊗●	○⊗⊗	●	⊗	○	
Profile Milling	80-90	3-6	○⊗⊗	⊗	○	x○○	x	xxx	xxx	xxx	xxx	xxx	●⊗○	○xx	⊗⊗○*	⊗⊗○*	⊗	○	x
Ultra-Thin White-topping	60-80	6-12	xxx○	○	⊗	x○○	x	○⊗⊗	○⊗⊗	○⊗⊗	○⊗⊗	○⊗⊗	○⊗⊗	○⊗⊗	x○○	○⊗⊗	⊗	○	x

● Highly Recommended ⊗ Generally Recommended ○ Provisionally Recommended x Not Recommended

* Requires surface mix problem.

* Rutting primarily confined to HMA surface layer and largely continuous in extent.

* Corrosion showing primarily HMA surface layer mix problem and frequent in extent.

* For composite AC/POC pavements, a more probable window of opportunity is 2-4 years for crack filling and 1-3 years for crack sealing.

* Localized application in the case of bumps.

Feasibility Matrix – PCC

Preservation Treatment	Window Of Opportunity		Distress Types and Severity Level (L=Low Severity, M=Medium Severity, H=High Severity)										Surface Characteristics Issues			
			Surface Distress					Joint Distress		Cracking Distress		Deformation Distress	Ride Quality	Friction	Noise	
			Polish	Map Crack/Scale (non-ASR)	D-Crack	Popouts	Water Bleed/Pump	Joint Seal Damage	Joint Spall	Corner	Long/ Tram	Faulting				Patches
	PCI/ PCR	Age, yrs	—	—	LM/H	—	—	LM/H	LM/H	LM/H	LM/H	LM/H	—	—	—	
Concrete Joint Resealing	75-90	5-10						○●●	○××							
Concrete Crack Sealing	70-90	5-12								●●○	●●○					
Diamond Grinding	70-90	5-12	●	⊗	×××	×	×	×××	×××	×××	××○*	⊗●⊗	⊗●⊗	●	⊗	●
Diamond Grooving	70-90	5-12	○	×	×××	×	×	×××	×××	×××	×××	×××	×××	×	⊗	●
Partial-depth Concrete Patching	65-85	6-15	×	○	×××	⊗	×	×××	⊗●●	×××	×○⊗	×××	○●○	×	×	×
Full-depth Concrete Patching	65-85	6-15	×	○	○●●*	×	⊗	×××	×○⊗	⊗●●	××○	×○⊗*	○●●	⊗	×	×
Dowel Bar Retrofitting	65-85	6-15	×	×	×××	×	⊗	×××	×××	×○○	×××	○●●*	×××	×	×	×
Ultra-Thin Bonded Wearing Course	70-90	5-12	⊗	●	⊗○×	○	×	×××	×××	○××	○●○	⊗○×	⊗●⊗	●	●	⊗
Thin HMA Overlay	70-90	5-12	⊗	●	⊗○×	○	×	×××	×××	○××	○●○	⊗○×	⊗●⊗	●	●	●

● Highly Recommended ⊗ Generally Recommended ○ Provisionally Recommended × Not Recommended

* May be appropriate in conjunction with partial- and/or full-depth repairs to ensure smooth profile.

⊗ Isolated incidences of D-cracking only.

⊗ Isolated incidences of faulting only.

⊗ Likely needed in conjunction with diamond grinding.

Secondary Selection – Bituminous

Preservation Treatment	Treatment Durability								Work Zone Duration Restrictions			Expected Performance on High Volume Facility, yrs	Relative Cost
	Rural Roads				Urban Roads				Overnight or Single-Shift	Weekend	Longer		
	High Traffic ADT > 5,000 xpd	Climatic Zone			High Traffic ADT > 10,000 xpd	Climatic Zone							
		Deep-Freeze	Moderate-Freeze	Non-Freeze		Deep-Freeze	Moderate-Freeze	Non-Freeze					
Crack Fill	●	●	●	●	●	●	●	●	●			2-3	5
Crack Seal	●	●	●	●	●	●	●	●	●			2-6	5
Slurry Seal (Type III)	○	×	⊗	⊗	○	×	⊗	⊗	●			3-5	SS
Microsurfacing-Single	⊗	⊗	●	⊗	⊗	⊗	●	⊗	●			3-5	SS
Microsurfacing-Double	⊗	⊗	●	⊗	⊗	⊗	●	⊗	●			4-6	SS SSS
Chip Seal-Single Conventional Polymer-modified	⊗	●	⊗	⊗	⊗	⊗	⊗	⊗	●			4-6	SS SSS
Chip Seal-Double Conventional Polymer-modified	⊗	●	⊗	⊗	⊗	⊗	⊗	⊗	●			6-8	SS SSS SSS
Ultra-Thin Bonded Wearing Course	⊗	⊗	●	⊗	⊗	⊗	●	⊗	●			5-8	SSS
Ultra-Thin HMAOL	○	○	⊗	×	⊗	⊗	●	○	●			4-7	SS
Thin HMAOL	●	●	●	⊗	●	●	●	⊗	●			5-10	SSS
Cold Milling and Thin HMAOL	●	●	●	⊗	●	●	●	●	●			6-11	SSS
Hot In-place Recycling Surf Recycle and HMAOL Removing and HMAOL Repaving	○	○	○	×	○	○	⊗	○	●			5-8 6-12 6-12	SSS SSS SSS
Cold In-place Recycling and HMAOL	⊗	⊗	⊗	○	⊗	⊗	⊗	⊗	●			5-11	SSS
Profile Milling	⊗	○	⊗	⊗	⊗	○	●	⊗	●			2-4	5
Ultra-Thin White Topping	○	○	○	○	○	○	⊗	○	×	○	⊗	NA	SSSS

● Highly Recommended ⊗ Generally Recommended ○ Provisionally Recommended × Not Recommended
 5 (lowest relative cost) ⊗ SSSS (highest relative cost)

Secondary Selection – PCC

Preservation Treatment	Treatment Durability								Work Zone Duration Restrictions			Expected Performance on High Volume Facility, yrs	Relative Cost
	Rural Roads				Urban Roads				Overnight or Single-Shift	Weekend	Longer		
	High Traffic ADT > 5,000 vpd	Climatic Zone			High Traffic ADT > 10,000 vpd	Climatic Zone							
		Deep-Freeze	Moderate-Freeze	Non-Freeze		Deep-Freeze	Moderate-Freeze	Non-Freeze					
Concrete Joint Resealing	●	⊗	●	●	●	●	●	●	●			4-7	\$
Concrete Crack Sealing	●	⊗	●	●	●	⊗	●	●	●			4-6	\$
Diamond Grinding	●	⊗	●	●	●	⊗	●	●	●			6-12	\$\$
Diamond Grooving	⊗	x	⊗	x	●	x	⊗	⊗	●			6-12	\$\$
Partial-depth Patching	●	●	●	●	⊗	⊗	●	●	● ¹	● ¹	●	5-15	\$\$ \$\$\$
Full-depth Patching	●	●	●	●	●	●	●	●	● ¹	● ¹	●	10-15	\$\$ \$\$\$
Dowel Bar Retrofitting	⊗	●	●	●	⊗	⊗	⊗	●	● ¹	● ¹	●	10-15	\$\$\$
Ultra-Thin Bonded Wearing Course	○	⊗	⊗	x	⊗	x	⊗	⊗	●			5-7	\$\$\$
Thin HMA Overlay	○	x	●	x	⊗	x	⊗	⊗	●			5-8	\$\$\$

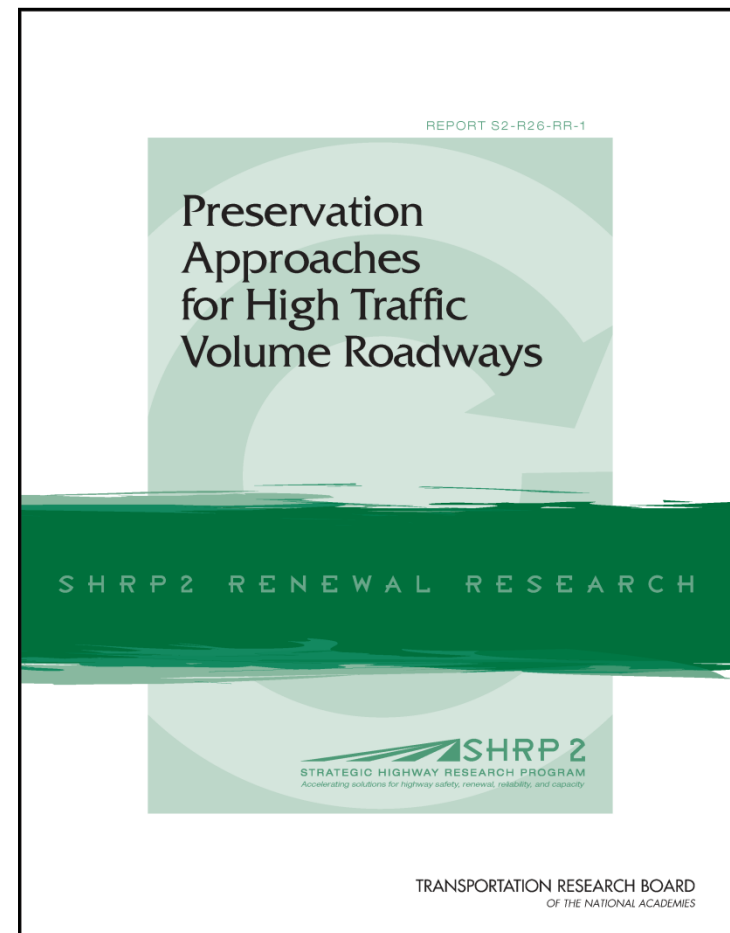
● Highly Recommended ⊗ Generally Recommended ○ Provisionally Recommended x Not Recommended

\$ (lowest relative cost) ↔ \$\$\$\$ (highest relative cost)

¹ Use of high early strength or fast-track proprietary materials make these treatments viable options for overnight, single-shift, and weekend closures. Use of conventional PCC repair materials generally require "longer" closures.

Project Deliverables

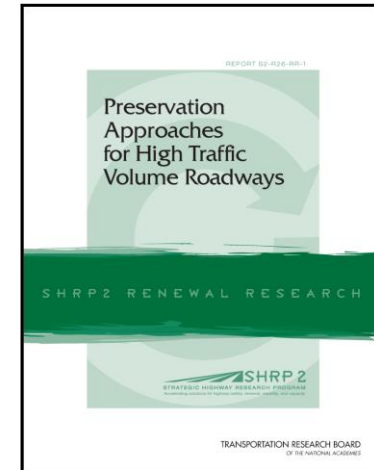
- Guidelines document
 - *Guidelines for the Preservation of High Traffic Volume Roadways*
- Final report
 - *Preservation Approaches for High Traffic Volume Roadways*



Beyond the Research: Implementation Ideas

Suggested keys:

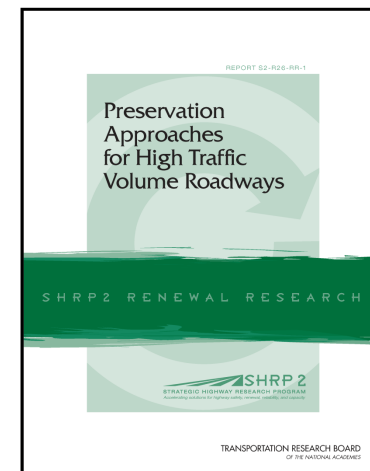
- Identify, publicize successful practices
- Promote research and test sections
- Document and promote benefits of preservation
- Improve record-keeping of use and performance



Implementation Ideas (continued)

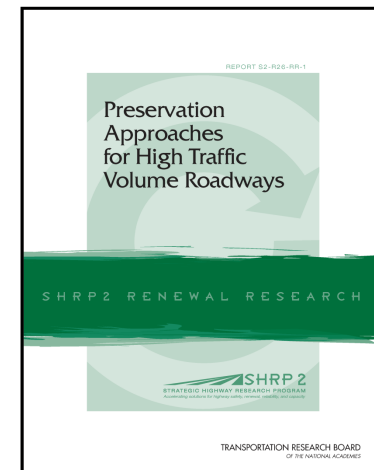
Suggested keys (continued)

- Reduce risk through better project selection, good design, QA practices
- Obtain top management buy-in
- Work through champions
- Track cost effectiveness



Report Recommendations

- Develop more comprehensive treatment-condition matrix
- Improve HTV roadway treatment performance estimates
- Investigate more fully effect of variables on treatment performance
- Generate better unit cost estimates for this class of project



Introduction to Implementation

- R26 project identified by AASHTO as a high priority for implementation
- Knowledge Transfer and Implementation Plan Workshops outlined implementation framework
- Implementation includes 14 participating agencies as well as several supporting activities and products



Questions/Contact Info

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