

Experience With Cold In-Place Recycling

SHRP R26 Workshop

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Technical Director

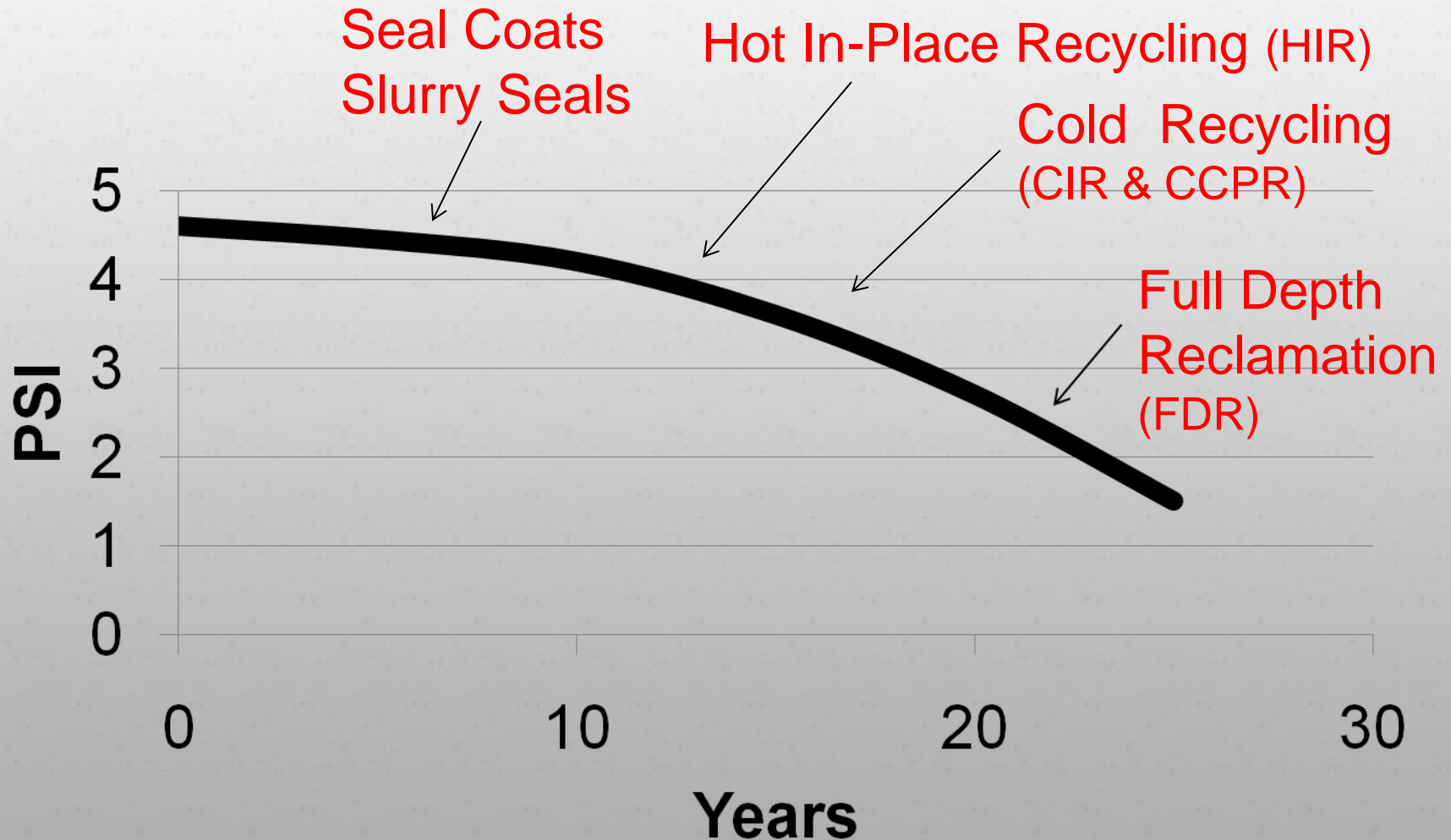
Asphalt Recycling & Reclaiming

Association



- ▶ **Asphalt Recycling & Reclaiming Association** www.ARRA.org
- ▶ **Industry Segments**
 - **Cold Planing**
 - **Hot In-Place Recycling**
 - **Cold Recycling**
 - **Full Depth Reclamation**
 - **Soil Stabilization**
 - **Hot Recycling**

Pavement Management



Recycling & Reclaiming Strategies

M&R	Strategy	Method	CP	HIR	CR	FDR
Construction	New					
	Reconstruction		X			X
Rehabilitation	Major		X		X*	X
	Structural Overlay		X	X*	X*	X*
Maintenance	Minor	PP	X	X	X	
	Preventative		X	X	X	
	Routine		X			
	Corrective		X	X	X	
	Catastrophic		X			

*With HMA Overlay

PP = Pavement Preservation

Cold Planing



- ▶ **Surface or grade preparation for other rehabilitation techniques**
- ▶ **Temporary driving surface**
- ▶ **Improving ride quality**
- ▶ **Fine & Micro-Milling**



Hot In-place Recycling

- ▶ HIR uses heat to soften the existing asphalt cement, mill or scarify the pavement, add rejuvenating agent and an additive (if desired), relay and compact the pavement in one continuous process.



HIR Benefits



- ▶ **Repairs distress**
- ▶ **Extends life**
- ▶ **Improves ride quality**
- ▶ **Eliminate need for a leveling course**
- ▶ **Improved bonding**
- ▶ **Environmentally friendly**
- ▶ **Cost savings**

Surface Recycling

Heating, reworking and rejuvenating top 1-2 inches of existing asphalt pavement in preparation of wearing surface.



Surface Remixing

Heating, reworking, and rejuvenating the top 1 to 2 inches of an existing asphalt pavement, adding new aggregate or admixture (HMA) and mixing the newly recycled mix material in a pugmill or mixing drum prior to laying, either

as a binder or surface course.



Surface Repaving

- ▶ Heating, reworking and rejuvenating the top 1-2 inches of an existing asphalt pavement and simultaneously applying an overlay resulting in a single, thermally bonded layer



Types of Cold Recycling

- ▶ **Cold Central Plant Recycling (CCPR)**



- ▶ **Cold In-Place Recycling (CIR)**

Cold Central Plant Recycling

A viable alternative when stockpiles of high quality RAP are available or when it is not possible to in-place recycle the pavement. Requires different emulsion formulations depending upon use (immediate lay or stockpile).

I-81 Virginia

NCAT



CCPR

- ▶ Using existing RAP stockpile to make stockpiled shoulder mix for Oklahoma DOT



CIR Process Description

- ▶ **Restricted to asphalt pavement & minor amounts of base**
- ▶ **Pulverizing existing pavement 2-5” depth**
- ▶ **Sizing of the reclaimed asphalt (RAP)**
- ▶ **Addition of recycling agent and additives**
- ▶ **Mixing all component materials**
- ▶ **Placement and compaction of mixture**
- ▶ **Placement of surface course**

Multi-Unit CIR Train



Pulverize, Screen, Crush, Add Recycling Agent based on weight of RAP, Mix in Pugmill



Single Unit Trains

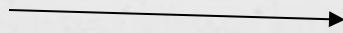


Pulverize, add Recycling Agent based on Depth of Treatment and Forward Speed, Mix –All in Cutting Chamber of Recycler



CR – Placement & Compaction

Traditional
Asphalt
Pavers Used



Heavy (22-25 ton) pneumatic roller(s) and 10-12 ton vibratory steel wheel roller(s)

Bituminous Recycling Agents

■ Emulsified Asphalts

- **Engineered Emulsions**
- **Solvent Free Emulsions (CSS)**
- **High Float Emulsions**
- **With or Without Polymers**

■ Expanded Asphalt (Foam)

- ## **■ Cement or Lime can be added in small quantities (Recycling Additives) to improve**
- **Moisture Resistance**
 - **Decrease Curing Time**
 - **Increase Initial Strength**

CIR – Additive Application

Slurry Application. →

Cement and Lime may be applied in slurry form.



Dry Application.

Cement or Hydrated Lime may be spread dry in front of the recycling train (environmental issues).

Curing

- ▶ **All Agencies Allow Traffic on CIR Prior to Placement of Wearing Surface**
- ▶ **Some Require Additional Rolling**
- ▶ **Most Require Minimum Moisture Content and/or Time Before Placing Surface Course**
- ▶ **Specifications**
 - **Minimum 3 days**
 - **< 3.0% Total Moisture**
 - **Maximum 7-14 Days**

Thickness Design

- ▶ **Surface Course Must be Designed to Carry Anticipated Traffic**
- ▶ **From: No Structural Improvement for CIR – (Functional Failures Only)**
- ▶ **To: Assigning AASHTO “a” coefficient of 0.25 to 0.35 to CIR layer**
- ▶ **Virginia I-81 Study recommending > 0.35**

Surface Course



- Seals for low volume roads
- Minimum 1.5" HMA medium traffic
- 3-4" HMA for high traffic

Recent Survey of 13 Agencies using Partial Depth CIR in USA

- **10 of 13 Agencies Reported No Official Traffic Restrictions on CIR Usage**
- **Majority of CIR has been Performed on Low to Moderate Trafficked Pavements**
- **6 of 13 Agencies Reported using CIR on Interstate Pavements**
- **Performance Studies Indicate Traffic has no Adverse Affect on Performance**

No Traffic Restrictions

- **Chesner, et al. NYSDOT CIR (TRB 2011)**
 - Higher traffic = longer service life
 - Attributed to better quality of base
- ***NCHRP Synthesis 421 Recycling and Reclamation of Asphalt Pavements Using In-Place Methods***
 - Over utilized on lower volume pavements
 - Under utilized on higher volume pavements

CR Advantages



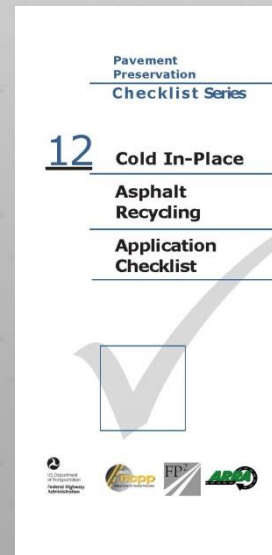
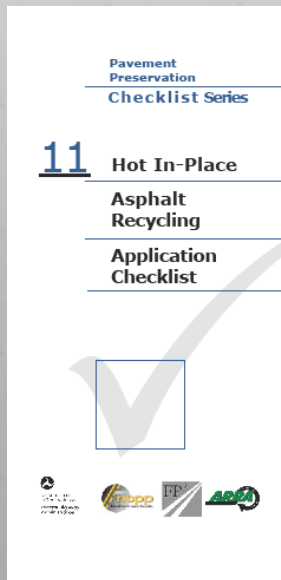
- ▶ **Conserves energy**
- ▶ **Conserves materials**
- ▶ **Improved mix characteristics**
- ▶ **Cracks eliminated/reduced**
- ▶ **Cost effective**
- ▶ **Saves time**
- ▶ **May be performed under traffic**

Keys to Long Life CIR

- ▶ **Project Selection And Site Investigation**
- ▶ **Informed Pavement Design**
- ▶ **Proper Material Selection And Mix Design**
- ▶ **Experienced Contractor And Proper Construction Conditions**

Education Resources

- ▶ Pavement Preservation Application Checklist Series
- ▶ Updated HIR & CIR, New FDR
- ▶ www.pavementpreservation.org
- ▶ www.arrya.org & www.fhwa.gov



Training Resources

- ▶ ***TCCC Inspector Training for Cold In-Place Recycling (CIR) Web Based***
FHWA-NHI-134114
- ▶ **http://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=colId&typ=3&sf=0&course_no=134114**
- ▶ **www.tccc.gov**
- ▶ **TCCC Inspector Training for HIR and FDR under development.**

Training Resources

- ▶ **FHWA - National Highway Institute
FHWA-NHI-131050 Asphalt
Pavement In-Place Recycling
Techniques**
- ▶ **http://www.nhi.fhwa.dot.gov/training/course_search.aspx?tab=0&key=131050&course_no=131050&res=1**
- ▶ **Two day course plus web based pre-course session**

ARRA Construction Guidelines

- ▶ **It is not intended or recommended that these guidelines be used verbatim within a specification. Owner agencies should use them to help establish their particular project specification.**

**Recommended
Quality Assurance Sampling and Testing Guidelines
For
Cold Recycling Using Bituminous Recycling Agents
CR301**

Last Revised 2-1-14



**Recommended Construction Guidelines
For
Full Depth Reclamation (FDR)
Using Cementitious Stabilization
FDR102**

Last Revised 1-11-14



ARRA Construction Guidelines

- ▶ **100 Series - Recommended Construction Guidelines**
- ▶ **200 Series - Recommended Mix Design Guidelines**
- ▶ **300 Series - Recommended Quality Assurance Sampling and Testing Guidelines**
- ▶ **400 Series – Recommended Project Selection Guidelines**

ARRA CR Construction Guidelines



- **CR101 Recommended Construction Guidelines For Cold In-place Recycling (CIR) Using Bituminous Recycling Agents**
- ***CR201 Recommended Mix Design Guidelines For Cold Recycling (CR) Using Bituminous Recycling Agents***
- **CR301 Recommended Quality Assurance Sampling and Testing Guidelines For Cold Recycling Using Bituminous Recycling Agents**

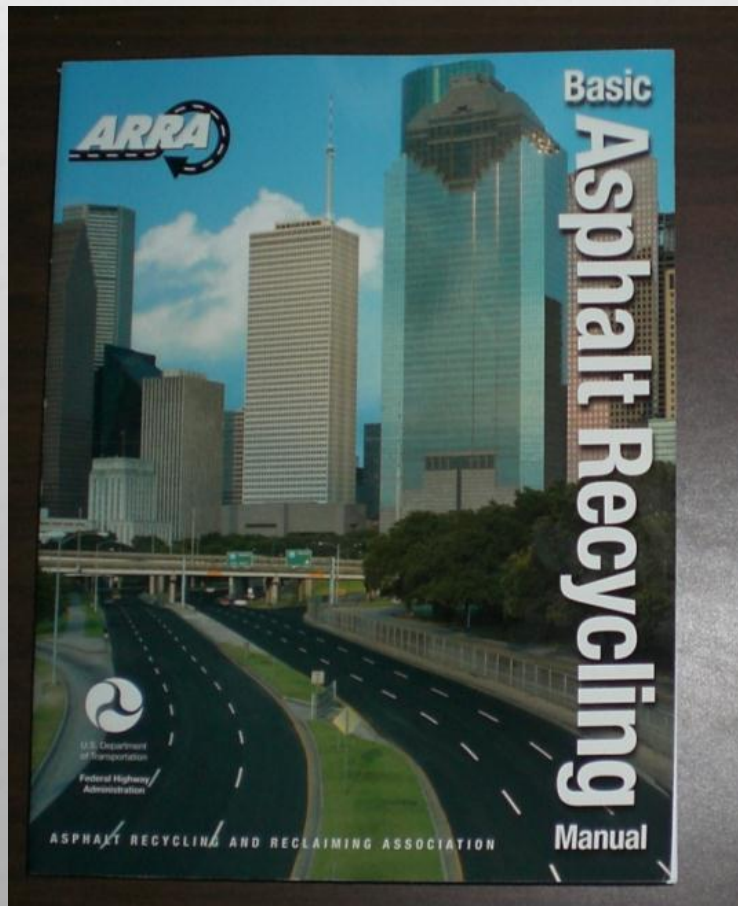
ARRA FDR Construction Guidelines



- **FDR101 Recommended Construction Guidelines For Full Depth Reclamation (FDR) Using Bituminous Stabilization**
- **FDR102 Recommended Construction Guidelines For Full Depth Reclamation (FDR) Using Cementitious Stabilization**
- **FDR103 Recommended Construction Guidelines For Full Depth Reclamation (FDR) Using Lime Stabilization**

Basic Asphalt Recycling Manual

2nd Edition



► Chapters on:

- Preconstruction Activities (project selection)
- Mix Design
- Construction
- QA Sampling & Testing
- Available Summer 2014

Thank You www.ARRA.org

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Magnitude 3.0 Earthquakes

