

# ***Performance Based In-Place Recycling Specifications***



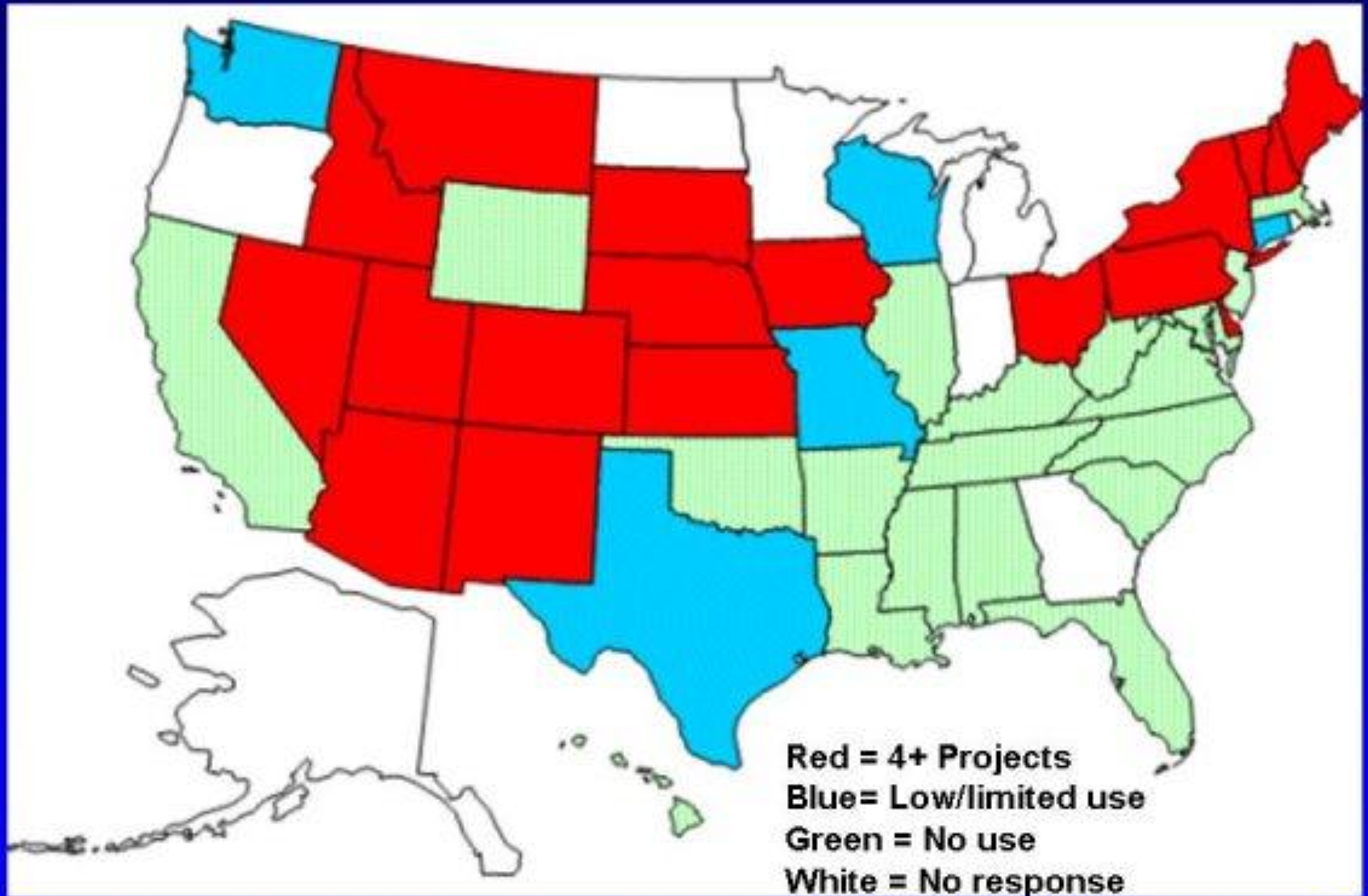
**Midwestern States  
In-Place Recycling Conference  
August 11-13, 2009      Bloomington, MN**



# *Outline*

- ❖ Project Selection
- ❖ Cold In-Place Recycling (CIPR)
- ❖ Hot In-Place Recycling (HIPR)
- ❖ Environmental Impact
- ❖ Summary

## *States Use of CIPR*





## *Specification / Information Review*

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- ❖ Arizona
- ❖ California
- ❖ Colorado
- ❖ Iowa
- ❖ Kansas
- ❖ Nevada
- ❖ New Mexico
- ❖ Pennsylvania
- ❖ South Dakota
- ❖ Utah
- ❖ Vermont
- ❖ Wisconsin
- ❖ Ontario
- ❖ FHWA
- ❖ ARRA
- ❖ PCCAS

## *Specification Sections*

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- ❖ Description
- ❖ Materials
- ❖ Mix Design
- ❖ Construction QC/QA
- ❖ Equipment
- ❖ Climatic Conditions
- ❖ Measurement/Payment
- ❖ Layer Coefficient

## *Description*

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- ❖ Partial Depth (Cold In-Place)
- ❖ Full Depth (FDR)

## *Description (General)*

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- ❖ Milling existing asphalt pavement
- ❖ Mixing the millings with an emulsion
- ❖ Placing
- ❖ Compacting



## *Materials - Binders*

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State	Asphalt Binder
Arizona	HFE-XXP
California	Emulsified RA
Colorado	HFE (Polymer) / emulsified RA
Iowa	Contractor select
Kansas	Emulsified asphalt / asphalt RA
Nevada	CMS-2S
New Mexico	HFE-150P
Pennsylvania	MS, CMS, SS, CSS, HMFS / polymer grades
South Dakota	Emulsified asphalt
Utah	Shown on plans



## *Materials - Additives*

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State	Additive
Nevada	1.5% quicklime slurry
New Mexico	1.5% hydrated lime slurry
Utah	1.5% quicklime slurry

## *Mix Design*

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State	Method
Arizona	Contractor performed
California (Project)	Marshall stability, retained stability, emulsion, cement
Iowa	Gyratory compactor, Marshall stability, retained stability, raveling test
Vermont	50 blow Marshall



## ***QC/QA - Gradation***

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State	% Passing			
	2-in	1 ½-in	1 ¼-in	1-in
Arizona			100	
California				100
Colorado			100	
Nevada		100		
New Mexico			100	90 - 100
South Dakota			100	95
Utah		100		
Wisconsin	97			

## ***QC/QA - In-Place Density***

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State	Density Requirement
Arizona	Specified in plans
California	95 to 105% of max density on test strip
Colorado	100% of field mixed/lab compact
New Mexico	96% of field mixed/lab compact
South Dakota	97% of target density
Utah	96% of field mixed/lab compact



## ***QC/QA - Surface Tolerance / Smoothness***

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State	Smoothness Requirement
Arizona	1/4-in longitudinal
California	1/4-in transverse
Colorado	3/16-in transverse & 3/16-in longitudinal
Nevada	1/4-in transverse & 1/4-in longitudinal
New Mexico	1/4-in transverse
South Dakota	0.04-ft transverse
Utah	3/8-in transverse

## *Equipment (Typ.)*

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- ❖ Self propelled machine 12-ft in width
- ❖ Capability to crush and screen material
- ❖ Capable of processing and spreading material in one pass
- ❖ Capable of producing homogeneous material
- ❖ One pneumatic roller at least 25-tons
- ❖ One double drum roller at least 10-tons
- ❖ Rotary broom on site



## *Climatic Conditions – Do Not Construct*

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- ❖ Ambient air temperature
  - ❖ ex. below 45 to 65°F
- ❖ Pavement temperature below
  - ❖ ex. below 50 to 70°F
- ❖ Over night temperature at or below freezing
- ❖ Weather is rainy or foggy
- ❖ When proper mixing, spreading and compaction cannot be accomplished
- ❖ Between specific months
  - ❖ ex. October 1 to April 30

## ***Climatic Conditions – Curing Conditions***

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- ❖ No vehicles on material until 2-hrs have passed
- ❖ Surface treatment/wearing course placed when moisture content is below a certain point
  - ❖ Free moisture content – below 1.0 to 1.5%
  - ❖ Total moisture content – below 1.5 to 3.0%
- ❖ Wearing course must be placed within a certain timeframe
  - ❖ Between 14- to 30-days

## *Measurement / Payment*

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- ❖ Payment based on square yard or unit price per station
- ❖ Payment may include bituminous materials on a volume or weight basis



## *Layer Coefficients*

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State	Layer Coefficient
California	Gravel Factor – 1.5
Kansas	0.25 – 0.28
NCHRP 224	0.35 (0.22 – 0.49)
Nevada	0.26
New Mexico	0.25
Wisconsin	0.10-0.25 (depends if stabilized)

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## *Specification / Information Review*

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- ❖ Kansas
- ❖ New Mexico
- ❖ Ohio
- ❖ Utah
- ❖ Washington
- ❖ British Columbia
- ❖ Ontario
- ❖ ARRA



# *Specification Sections*

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- ❖ Description
- ❖ Materials
- ❖ Mix Design
- ❖ Construction QC/QA
- ❖ Equipment
- ❖ Climatic Conditions
- ❖ Measurement/Payment
- ❖ Layer Coefficients

## *Description (ARRA)*

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- ❖ Surface Recycling
- ❖ Remixing
- ❖ Repaving

## ***Materials - Binders***

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<b>State</b>	<b>Asphalt Binder</b>
<b>British Columbia</b>	<b>Emulsified recycling agent / Recycling agent</b>
<b>Colorado</b>	<b>Asphalt rejuvenating agent</b>
<b>New Mexico</b>	<b>Emulsified recycling agent (blend meet PG binder grade)</b>
<b>Ontario</b>	<b>Select material to provide blend that meets 50 to 80 pen</b>
<b>Utah</b>	<b>Emulsified recycling agent</b>
<b>Washington</b>	<b>Emulsified recycling agent / PG 58-22</b>



## *Mix Design*

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State	Method
Kansas	Air voids, TSR, rutting resistance, thermal cracking
New Mexico	Must meet specifications for HMA – Section 423
Ohio	Marshall stability, penetration
Washington	Superpave, air voids

## ***QC/QA - In-Place Density***

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<b>State</b>	<b>Density Requirement</b>
<b>British Columbia</b>	<b>97% of lab density</b>
<b>Colorado</b>	<b>92 to 96% of maximum theoretical</b>
<b>New Mexico</b>	<b>92 to 98% of maximum theoretical</b>
<b>Ontario</b>	<b>Lab compacted air voids between 2.5% and 5.5% (75b Marshall)</b>

## ***QC/QA – Surface Tolerance & Thickness***

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State	Surface Tolerance	Thickness
Colorado	Profile Index – dependent upon roadway traffic volume	
New Mexico	1/8-in transverse 1/8-in longitudinal	As specified
Ontario		2-in max, 1.5-in typ



## *Equipment (Typ.)*

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- ❖ Remove all material from pavement surface  
- broom
- ❖ Self propelled
- ❖ Enclosed combustion area
- ❖ No open flame in direct contact with pavement
- ❖ Capable of heating pavement to desired temperature
- ❖ Capable of scarifying the heated pavement to the desired depth

## *Equipment (Typ.)*

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- ❖ Requirements on laydown temperature of material
  - ❖ Typ. Min. 190°F to 230°F
  - ❖ Typ. Max. 300°F to 315°F
- ❖ Scarification does not break the aggregate particles
- ❖ Heating does not char the asphalt surface
- ❖ Uniformly distribute material
- ❖ Rolling operation must obtain the desired pavement density



## *Climatic Conditions – Do Not Construct*

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- ❖ Ambient air temperature
  - ❖ ex. below 40 to 50°F
- ❖ Pavement temperature below
  - ❖ ex. below 50°F
- ❖ When roadway surface is wet
- ❖ Weather conditions prevent proper placement
- ❖ Between specific months
  - ❖ ex. October 16 to May 14



## *Measurement / Payment*

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- ❖ Payment based on square yard or unit price per station
- ❖ Payment may include bituminous materials on a volume or weight basis

## *Layer Coefficients*

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State	Layer Coefficient
None	None Available
Suggested Value	0.40 – 0.44

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## ***Value of Recycling - Percent Savings Relative to Conventional Construction - Initial Construction\****

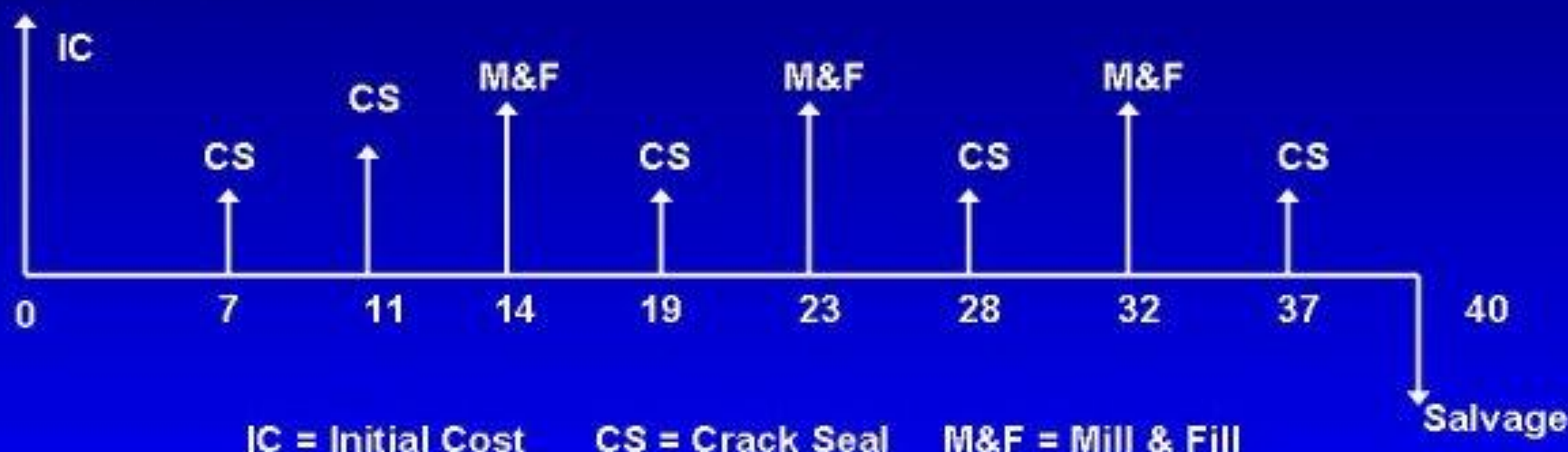
	CIPR	FDR	HIPR - Remix
Energy, BTU	22	16	25
AC Consumed, tons	16	-2	35
Aggregate Consumed, tons	33	72	44
Price, \$	23	52	16**
CO <sub>2eq</sub> <sup>1</sup> lb	30	60	22

\*equivalent square yards

\*\*Based on limited information

# *Life Cycle Assessment Format*

## Reconstruction



- ❖ 40-year period was selected
- ❖ 4-percent discount rate

# ***Value of Recycling - Percent Savings Relative to Conventional Construction - LCA\****

	CIPR	FDR	HIPR - Remix
Energy, BTU	9	25	10
AC Consumed, tons	6	14	13
Aggregate Consumed, tons	14	63	18
Price, \$	14	48	10**
CO <sub>2eq</sub> <sup>1</sup> lb	13	54	10

\*equivalent square yards

\*\*Based on limited information



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# *Performance Specifications*

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# Questions

