Cold In-Place Recycling in the Federal Lands Highway Program
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Western Federal Lands
Central Federal Lands
Eastern Federal Lands

Western Region Recycling Conference, June 3-5, 2008
Topics

- Project Selection / Investigation
- Design
- Performance History
Recycling & Reclamation
Methods Used

- Cold In-Place Recycling
- FDR pulverize
- FDR with cement
- FDR with foam
- FDR with emulsion
CIPR Project Selection

- Federal Lands has had good success (long-term performance) with CIPR
- CIPR has proven to be a cost effective, good performing, rehabilitation method
- Structural design completed and compared with other rehabilitation alternatives.
CIPR Project Selection

- Let field investigation guide decision
- FLHD management and decision-makers do NOT present any challenges to CIPR use.
- No cut-offs or pre-set requirements for CIPR use – it’s an engineering decision
<table>
<thead>
<tr>
<th>Reconnaissance</th>
<th>Sampling Frequency</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Distress Survey</td>
<td>Project wide</td>
<td>-Document suitability; isolate problem spots</td>
</tr>
<tr>
<td>Pavement Layer Depths, Uniformity, Quality</td>
<td>Every ¼-mile</td>
<td>Determine:</td>
</tr>
<tr>
<td>Subgrade soil</td>
<td>Minimum 1 per mile</td>
<td>-Feasibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Recycling Depth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Structural design</td>
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<tr>
<td></td>
<td></td>
<td>-Support for equipment</td>
</tr>
</tbody>
</table>
# Field Investigation for CIPR

<table>
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<tr>
<th>Reconnaissance</th>
<th>Sampling Frequency</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWD Survey (not completed on all projects)</td>
<td>300 feet (maximum)</td>
<td>- Determine subgrade modulus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Delineate soft spots</td>
</tr>
<tr>
<td>Bulk Pavement Sampling*</td>
<td>As needed to</td>
<td>- Determine mix quality</td>
</tr>
<tr>
<td></td>
<td>represent differing</td>
<td>- Estimate application rates</td>
</tr>
<tr>
<td></td>
<td>project conditions</td>
<td></td>
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</tbody>
</table>

*Completed on projects with marginal conditions and there is a concern about being able to obtain a quality product*
CIPR Project Selection

- Subgrade and base must have the ability to support the recycling train.
- Adequate Geometrics: minimal steep grades and sharp curves, minimal widening.
- Consider economy of scale - project size > 5 mi.
# CIPR Project Selection - Example

**PAVEMENT REHABILITATION ALTERNATIVES** (long-term, structural improvements)

<table>
<thead>
<tr>
<th>Treatment Type / Method</th>
<th>Life Expectancy</th>
<th>Pros</th>
<th>Cons</th>
<th>Cost/Mile ($1000s)</th>
</tr>
</thead>
</table>
| 8” Full-depth reclamation (FDR) – stabilized | 20 – 30 years | ▪ Stabilization reduces risk for pumping (and potential for subexcavation overrun)  
▪ Reuses/recycles materials  
▪ Efficient/smaller “carbon footprint”  
▪ Favorable life-cycle costs  
▪ Minimal dust | ▪ Contractor availability / mobilization  
▪ Slight grade raise  
▪ More intensive inspection during construction | $600 k |
| 4” Cold in-place recycling (CIPR)  
3” HACP | 20 – 30 years | ▪ History of long-term performance  
▪ Reuses/recycles materials  
▪ Efficient/smaller “carbon footprint”  
▪ Favorable life-cycle costs  
▪ No dust | ▪ Contractor availability / mobilization  
▪ Treating some base materials  
▪ Not suitable for pullouts & parking areas  
▪ Grade raise  
▪ Subgrade/base may not have sufficient strength to support CIPR train | $600 k |
| Mill 4” of existing material | 15  20 | ▪ Zero grade raise  
▪ Conventional construction | ▪ No in-place recycling  
▪ Requires 3 separate operations (mill, |
Why complete a design?

- Fairly compare rehabilitation alternatives & additives
- Programmatic approach is not practical when you work in all 50 states
- Justify chosen alternative client-agency
## FLHD Structural Guidelines

<table>
<thead>
<tr>
<th>FDR Method</th>
<th>Minimum Thickness of Riding Surface</th>
<th>Typical Structural Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical</td>
<td>2” HMA</td>
<td>0.10 – 0.12</td>
</tr>
<tr>
<td>Bituminous</td>
<td>Surface Treatment or Structural HMA</td>
<td>0.20 – 0.28</td>
</tr>
<tr>
<td>Cement</td>
<td>Surface Treatment or Structural HMA</td>
<td>0.15 – 0.20</td>
</tr>
<tr>
<td>Minimum Thickness of Riding Surface</td>
<td>Typical Structural Coefficient</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>CIPR Surface Treatment or Structural HMA</td>
<td>0.28</td>
<td></td>
</tr>
</tbody>
</table>

Mix Design

- FLH performs a mix design and provides initial application (AASHTO Task Force 38) - Hveem
- Future: Use SGC?
Performance

- Performance has exceeded expectations
- Nearly all of FLHD’s CIPR projects are still in-service
- A couple case studies follow…
FLHD’s first CIPR Project

- Location: Rocky Mountain N.P.
- Year: 1982
- Typical Structural Section
  - 4 inches CIPR
  - 2 inches HMA
- CIPR Contractor: Valentine Surfacing
FLHD’s first CIPR Project

- Recycling agent: Rejuvenator (Reclamite)
- Application Rate: 0.9 to 1.2 percent
- Cost Effectiveness
  - About 40% savings from the alternative to place a 1.5-inch leveling course
- Elevation: 9,500 to 12,000 feet
Rocky Mountain N.P. CIPR - 1982
Rocky Mountain N.P. CIPR - 1982
Rocky Mountain N.P. project today.

After 26 years!
Rocky Mountain N.P. project today.

After 26 years!
First CIPR project in California

- Location: Ice House Road (Eldorado National Forest)
- Year: 1988
- Typical Structural Section
  - 4-5 inches CIPR
  - 2 inches HMA
- CIPR Contractor: Valentine Surfacing
First CIPR project in California

- Recycling agent: HFMS-2
- Project length: 13 miles
- Traffic: 1000 vpd (1988) with heavy logging trucks
First CIPR project in California

20 year & counting!
First CIPR project in California
First CIPR project in California

After 20 years of performance…
Performance

- Out of the 25 to 30 CIPR projects completed by Federal Lands, only one of these projects is no longer in service (the first CIPR project completed).
Twin Lakes Rd - California

15 years and counting

HFMS-2s

09/03/2008
Grand Canyon – Center Rd

15 years and counting
HFE-300s
Mendocino Pass - California

12 years and counting

HFMS-2s

26/05/2008
Colorado State Hwy 145 (Dolores to Rico)

10 years and counting

HFMS-2sP
Questions?

www.cflhd.gov