Federal Lands Highway

In-Place Recycling Experience

Southeastern States Regional In-Place Recycling Conference
Atlanta, GA

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US Federal and Tribal Lands
Federal Partner Agencies

Accessing America’s Treasures
Additional Partners

- Federally-recognized Indian tribal governments
- State DOTs
- Counties
- Virgin Islands
- District of Columbia
- Other Federal Agencies
Hoover Dam Bypass Complete
FLH Core Business

- Program Administration
  - About $1.3 Billion/year
- Project Delivery
  - Engineering Services
  - Technical Expertise
- Liaison with Federal Land Management Agencies
- Training and Development
- Deployment of New Technologies
- 660 FHWA Employees (approx. 23% of all FHWA employees)
FLH Field Division
Service Areas

Western Federal Lands
Central Federal Lands
Eastern Federal Lands
Office of Federal Lands
Outline

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

- FDR pulverize
- FDR with cement
- FDR with foam
- FDR with emulsion
- Cold In-Place Recycling
In-Place Recycling in FLHD

- 72% CIR
- 15% FDR-Pulv
- 6% FDR-Bitumen
- 7% FDR-Cement

6.8 Million SQYD last 5 years (2009 data)
Project Selection

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

- Let field investigation guide decision
- FLHD management and decision-makers present few challenges to in-place recycling use.
- No cut-offs or pre-set requirements for use – it’s an engineering decision
Candidate for In-Place Recycling
<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></td>
<td></td>
<td>-Feasibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Recycling Depth</td>
</tr>
<tr>
<td>Subgrade soil</td>
<td>Minimum 1 per mile</td>
<td>-Structural design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Support for equipment</td>
</tr>
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<td>Reconnaissance</td>
<td>Sampling Frequency</td>
<td>Purpose</td>
</tr>
<tr>
<td>--------------------------------------</td>
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<td>--------------------------------------------------</td>
</tr>
<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 represent differing project conditions</td>
<td>-Determine mix quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Estimate application rates</td>
</tr>
</tbody>
</table>

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

- Project Selection / Investigation
- Design
- Performance History
- Summary
FDR Project Selection

- FDR is best suited for low to medium volume roads.
- The pavement distress should be to the point that a surface treatment or an overlay is not effective.
- Minor widening of the road can be easily accommodated.
- Very week/wet subgrade cannot be addressed by FDR along.
CIR 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.
## Project Selection - Example

<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>
<tbody>
<tr>
<td><strong>8” Full-depth reclamation (FDR) – stabilized</strong>&lt;br&gt;<strong>2” HACP</strong></td>
<td>20 – 30 years</td>
<td>• Stabilization reduces risk for pumping (and potential for subexcavation overrun)&lt;br&gt;• Reuses/recycles materials&lt;br&gt;• Efficient/smaller “carbon footprint”&lt;br&gt;• Favorable life-cycle costs&lt;br&gt;• Minimal dust</td>
<td>• Contractor availability / mobilization&lt;br&gt;• Slight grade raise&lt;br&gt;• More intensive inspection during construction</td>
<td>$600 k</td>
</tr>
<tr>
<td><strong>4” Cold in-place recycling (CIPR)</strong>&lt;br&gt;<strong>3” HACP</strong></td>
<td>20 – 30 years</td>
<td>• History of long-term performance&lt;br&gt;• Reuses/recycles materials&lt;br&gt;• Efficient/smaller “carbon footprint”&lt;br&gt;• Favorable life-cycle costs&lt;br&gt;• No dust</td>
<td>• Contractor availability / mobilization&lt;br&gt;• Treating some base materials&lt;br&gt;• Not suitable for pullouts &amp; parking areas&lt;br&gt;• Grade raise&lt;br&gt;• Subgrade/base may not have sufficient strength to support CIPR train</td>
<td>$600 k</td>
</tr>
<tr>
<td><strong>Mill 4” of existing material</strong>&lt;br&gt;<strong>Recondition base</strong>&lt;br&gt;<strong>4” HACP</strong></td>
<td>15 – 20 years</td>
<td>• Zero grade raise&lt;br&gt;• Conventional construction / ample contractor availability</td>
<td>• No in-place recycling&lt;br&gt;• Requires 3 separate operations (mill, recondition, pave)&lt;br&gt;• Lower structural value&lt;br&gt;• Requires dust abatement</td>
<td>$650 k</td>
</tr>
<tr>
<td><strong>6” FDR – pulverize</strong>&lt;br&gt;<strong>4” HACP</strong></td>
<td>20 – 30 years</td>
<td>• Reuses/recycles materials&lt;br&gt;• Favorable life-cycle costs&lt;br&gt;• History of long-term performance</td>
<td>• 4-inch grade raise (may lead to significant issues with existing features such as walls and roadway width)&lt;br&gt;• Requires dust abatement&lt;br&gt;• Some risk for dumping prior to</td>
<td>$600 k</td>
</tr>
</tbody>
</table>
Why complete a design?

- Fairly compare rehabilitation alternatives & additives
- Programmatic approach is not practical when you work in all 50 states (much variability)
- Justify chosen method to client-agency
<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 (pulverize)</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>
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## FLH Structural Guidelines

<table>
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<th>Treatment Type</th>
<th>Minimum Thickness of Riding Surface</th>
<th>Typical Structural Coefficient</th>
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<tr>
<td>CIR</td>
<td>Surface Treatment or Structural HMA</td>
<td>0.28</td>
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FDR Mix Design

- FDR Pulverize – N/A
- FDR Cement ✔
- FDR Bituminous – (foam & emulsion) ✔
- Need standardized method: ASTM/ AASHTO acceptance

Accessing America’s Treasures
CIR Mix Design

- CFLHD performs a mix design and provides initial application rates - Hveem method (AASHTO Task Force 38)
- WFLHD determines application rate during test strip
- Future: Use Superpave Gyratory Compactor? Project underway designed with SGC.
Key Specification Components

- **Density, Density, Density**
  - How to measure & enforce?
- **Place riding surface within 14 days**
  - Consider use of fog seal prior to overlay.
- **Weather restrictions and seasonal cut-off dates**
- **Top size gradation requirements - FDR**
Outline

◆ Project Selection / Investigation
◆ Design
◆ Performance History
◆ Summary
Performance

- Performance has exceeded expectations
- Nearly all of FLHD’s CIR projects are still in-service
- A couple case studies follow…
Baltimore - Washington Parkway (Springfield Rd.) - Maryland

FDR
1 year
Pulverize 8”, Base course 3”, HACP 2”
Great Smokey Mountain National Park (Cades Cove Loop Rd.) - Tennessee

FDR w/cement
2 years
Pulverize 6”, Two lift 2.5” HACP
10 miles
Cape Cod National Seashore - Massachusetts

FDR w/cement
1 year
Pulverize 3”, Two lift 2.5” HACP
0.2 mile
Prince William Forest Park - Virginia

FDR w/cement
1 year
Pulverize 7”, Two lift 2.5” HACP
3.5 miles
Big Bend National Park - Texas

FDR and double chip seal
Lake Mead N.R.A. - Nevada

FDR with 6’ of widening
Zion National Park - Utah

FDR with foamed asphalt
FLHD’s first CIR Project

- Location: Rocky Mountain N.P.
- Year: 1982
- Typical Structural Section
  - 4 inches CIR
  - 2 inches HACP
- CIR Contractor: Valentine Surfacing
FLHD’s first CIR 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. CIR - 1982
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Rocky Mountain N.P. CIR - 1982
Rocky Mountain N.P. project ... 

...after 26 years!
Rocky Mountain N.P. project...

...after 26 years!
Rocky Mountain N.P. Project - 2007
Eldorado National Forest - CA

- Location: Ice House Road
- Year: 1988
- Typical Structural Section
  - 4-5 inches CIPR
  - 2 inches HMA
- CIPR Contractor: Valentine Surfacing
Eldorado National Forest - CA

- Recycling agent: HFMS-2
- Project length: 13 miles
- Traffic: 1000 vpd (1988) with heavy logging trucks
Eldorado National Forest - CA
Eldorado National Forest - CA

23 year & counting!
Twin Lakes Rd - California

CIR
18 years and counting
HFMS-2s

09/03/2008
Grand Canyon – Center Rd

CIR
18 years and counting
HFE-300s
Mendocino Pass - California

CIR
15 years and counting

HFMS-2s

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

CIR
13 years and counting

HFMS-2sP
FLHD Pavement Research

- CIR Construction QC/QA Study
  - FWD (before CIR, right after CIR, and post overlay)
  - Volumetrics (Gmm, Gmb, VTM, gradations)
  - Performance (retained stability, TSR, dynamic modulus)
- Light-Weight Deflectometer (LWD) for Construction QC/QA Validation
Questions?

www.efl.fhwa.dot.gov