HIR in Washington State

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Ontario, California
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Overview

- HIR Candidate Projects
- Recommendations for not using HIR
- Why HIR
- WSDOT HIR History
- SR 542
HIR Candidate Projects

- 2.5 to 3 inches of existing HMA
- Surface distress within the HMA layer only, no base or subgrade failure
- Weathered/oxidized pavements
- Sites with limited aggregate supplies
- Rutted roadways
- Roadways with generally uniform materials
- Traffic and geometrics
- Experienced contractor is beneficial
HIR Projects Recycling - Not Recommended

- High ADT – delay concerns
- Urban environments
- Structural problem in subgrade
- Excessively inconsistent pavement width
- Flushing or bleeding pavement
- Multiple pavement types
- Multiple physical obstructions
Why HIR?

- **Driving Factors**
  - Diminishing natural resources
  - Conserving energy, fuels and aggregates
  - Construction costs
  - Construction advantages
    - One operation – avoids the need to mill and fill as separate operations

- Standard practice for British Columbia, some states
WSDOT HIR History

- 1995 HIR project
  - South Central Region (Yakima) overlaid with OGFC
- HIR has been considered for use by WSDOT in the past – “Things never worked out”
  - Existing fabric
  - High asphalt binder content
  - Traffic impacts
- SR 542 construction east of Bellingham (2009)
SR 542 Project

- Constructed August/September 2009
- Contractors
  - Granite Construction – Prime
  - GreenRoads Recycling – HIR Subcontractor
- 31 lane miles constructed
- ADT
  - 5,400 to 12,500
- Pavement Structure
  - 0.40’ to 0.60’ HMA over 0.50’ PCCP or 0.60’ to 1.25’ Crushed Stone Base
SR 542 Project

- HIR Recycled 1.75 to 2 inches of surface distressed “only” pavement
- Coordination Meetings (WSDOT/Industry/Granite/GreenRoads)
  - August 11, 2008 (WSDOT/Industry Workshop)
  - January 12, 2009 (Project Awarded)
  - May 4, 2009 (HIPR Orientation)
  - June 5, 2009 (Test Plan Meeting)
  - July 17, 2009 and August 5, 2009 (Project Meeting)
  - November 5, 2009 (HIPR Recap Meeting)
SR 542 Project

- **Recycled Mixture**
  - Existing reclaimed asphalt pavement (RAP)
    - 5.8 percent asphalt binder, PG76-16
  - “Make-up” mixture
    - 20 percent with 4.5 percent asphalt binder
    - BC gradation (graded aggregate seal)
  - Recycling agent
    - 0.20 to 0.25 percent
SR 542 Project

- **Construction**
  - Two stage process with equipment manufactured by Pyrotech and modified by GreenRoads
  - Conventional compaction equipment/roller pattern
  - Constructed in 25 working days
    - Average 10 hour shift
    - 1.3 lane miles per shift
Mix Design/Calibration

Issues

– What Mix design?
– Not able to replicate HIR process
  – Used gyratory volumetrics to determine VA
– Trial blend process
  – Done by Contractor (Prime)
  – Core samples used with “admixture” gradation (empirical design)
– Final HIR Contractor (Sub) recommendations
  – HIR made “admixture” adjustments based on experience
– Samples were taken during production
– In-place density used to determine feasibility of use
Mix Design/Calibration (cont.)

What is working for emulsion based HIR . . . .

– Slight adjustments made for variability
– Adjustment recommendations by Contractor’s staff
– Adjustments are monitored and documented
Challenges faced for using HIR

Issues
– Mix calibration is always a “discussion”
– Inspectors/decision makers feel very uncomfortable for a process in which they have little control
– One major failure will stunt future HIR work in Washington
– Contractor experience
Contractor Experience

- Have they properly constructed a HIR project?
Contractor Experience

- The operation is “like” a paving operation
Contractor Equipment
Contractor Equipment
SR 542 Results

Hot In-Place

End Dumped HMA

220 -230 F Typical compaction temperature
## Material Conservation, Energy and Emissions

<table>
<thead>
<tr>
<th>Operation</th>
<th>Width</th>
<th>Energy, BTU</th>
<th>CO$_{2eq}$ (lb)</th>
<th>Asphalt (ton)</th>
<th>Aggregate (ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inch HMA Inlay</td>
<td>Shoulder to shoulder</td>
<td>19,735,400,000</td>
<td>3,265,000</td>
<td>1,533</td>
<td>27,950</td>
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<tr>
<td>2 inch HMA Inlay</td>
<td>Lanes only</td>
<td>16,916,060,000</td>
<td>2,789,000</td>
<td>1,314</td>
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<tr>
<td>2 inch HMA Overlay</td>
<td>Shoulder to Shoulder</td>
<td>18,150,370,000</td>
<td>3,007,000</td>
<td>1,533</td>
<td>27,950</td>
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<tr>
<td>2 inch HMA w/ 20 percent RAP Inlay</td>
<td>Lanes only</td>
<td>15,843,750,000</td>
<td>2,624,000</td>
<td>1,112</td>
<td>19,105</td>
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<tr>
<td>2 inch HIR - remixing</td>
<td>Lanes only</td>
<td>13,022,140,000</td>
<td>1,960,000</td>
<td>159</td>
<td>3,836</td>
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*Source: Granite Construction 2009*
## HIR Performance

<table>
<thead>
<tr>
<th>Project</th>
<th>Original HIR Construction</th>
<th>2010</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Year</td>
<td>Depth</td>
</tr>
<tr>
<td>SR 97</td>
<td>1999</td>
<td>1.48</td>
</tr>
<tr>
<td>SR 542</td>
<td>2009</td>
<td>0.90 - 1.39</td>
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</tbody>
</table>
Current Performance
Current Performance
Current Performance
Current Performance
Current Performance
Current Performance
WSDOT HIR Results

- Less construction noise
- No abrupt lane edge during construction
- Reduced traffic disruptions
- Limited by geometrics – turn lanes
- Night joints need to be sealed
- Total HIR cost $165,000 lane/mile vs. $200,000 lane/mile for traditional HMA mill and fill
- The SR 542 project shows there is potential for HIR in Washington State
- Life cycle break even cost is 12 years (based on typical 16 year HMA life in Western Washington)
Thank You

www.wsdot.wa.gov/research/reports/fullreports/738.1.pdf