

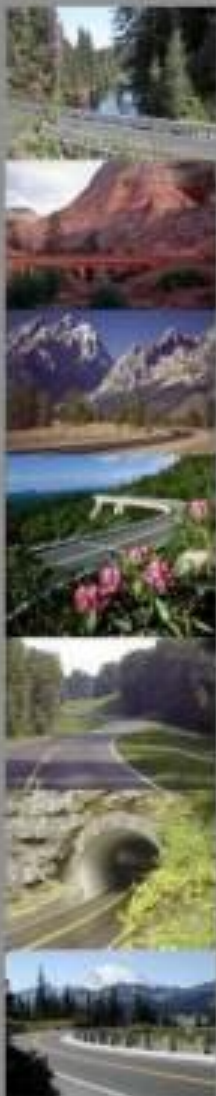
In-Place Recycling in the Federal Lands Highway Program

Mike Voth, FLH-FHWA



NE In-Place Recycling Conference

August 26, 2010



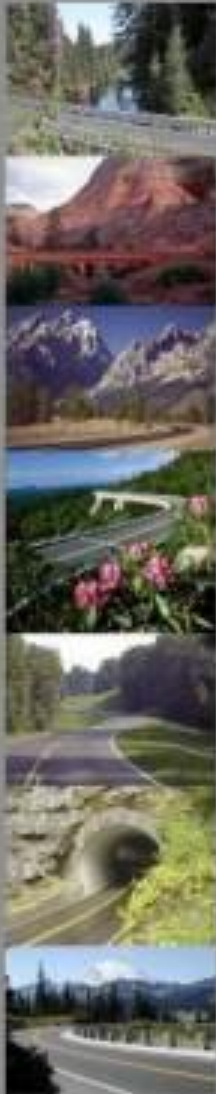
Topics

- ◆ Practices
- ◆ CIR Research Project
- ◆ Performance History



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Recycling & Reclamation Methods Used

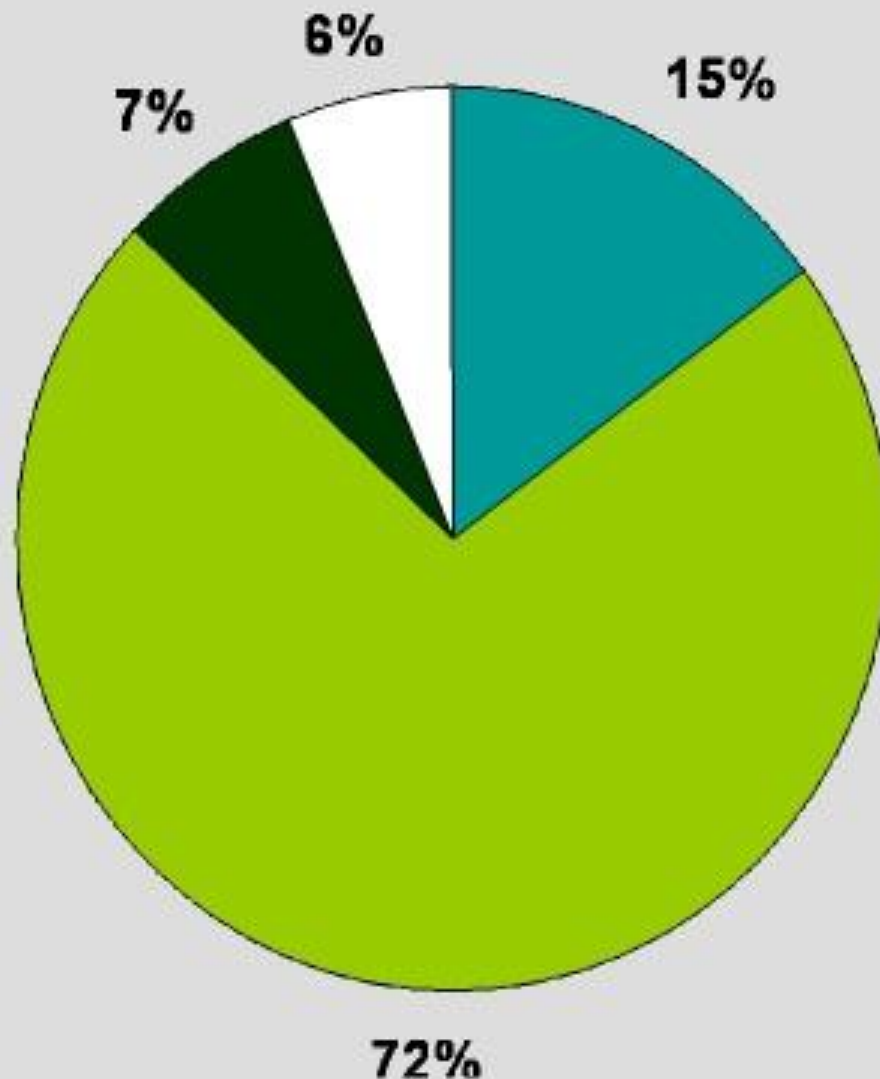
- ◆ Cold In-Place Recycling
- ◆ FDR pulverize
- ◆ FDR with cement
- ◆ FDR with foam
- ◆ FDR with emulsion



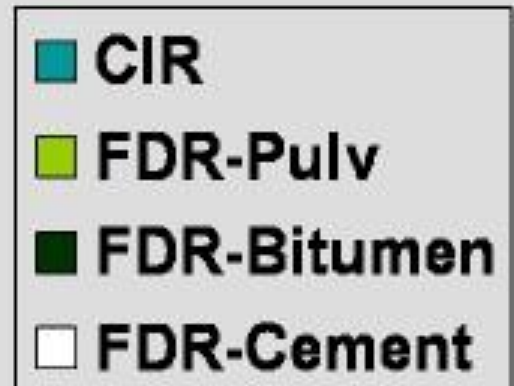
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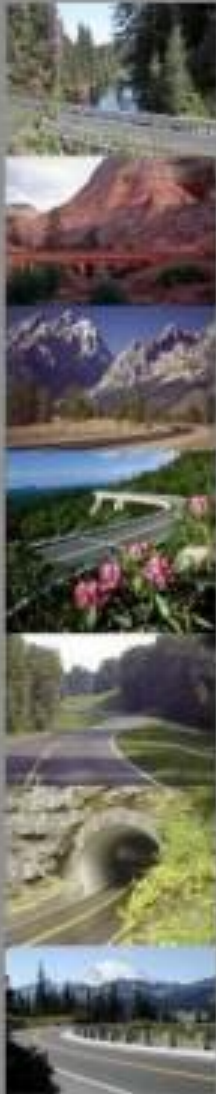
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In-Place Recycling in FLHD



6.8 Million SQYD
last 5 years

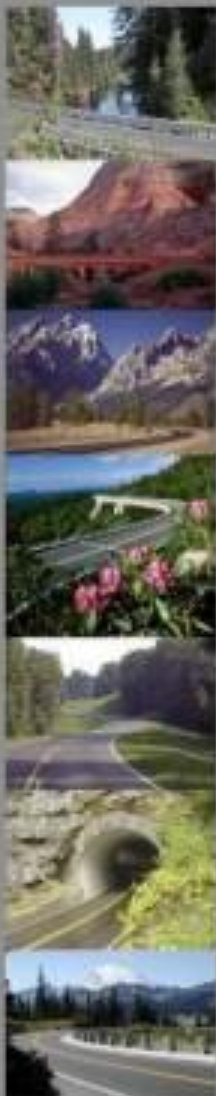




Project Selection

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

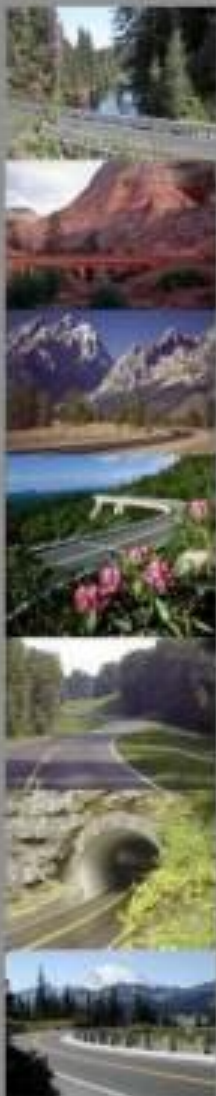




Project Selection

- ◆ 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



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Field Investigation for CIR/FDR

Reconnaissance	Sampling Frequency	Purpose
Pavement Distress Survey	Project wide	-Document suitability; isolate problem spots
Pavement Layer Depths, Uniformity, Quality	Every $\frac{1}{4}$ -mile	Determine: -Feasibility -Recycling Depth
Subgrade soil	Minimum 1 per mile (DCP supplements)	-Structural design -Support for equipment

Field Investigation for CIR / FDR

Reconnaissance	Sampling Frequency	Purpose
FWD Survey (not completed on all projects)	300 feet (maximum)	<ul style="list-style-type: none">-Determine subgrade modulus-Delineate soft spots
Bulk Pavement Sampling*	As needed to represent differing project conditions	<ul style="list-style-type: none">-Determine mix quality-Estimate application rates

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



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 weak/wet subgrade cannot be addressed by FDR alone





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

PAVEMENT REHABILITATION ALTERNATIVES (long-term, structural improvements)

Treatment Type / Method	Life Expectancy	Pros	Cons	Cost/Mile (\$1000s)
<ul style="list-style-type: none"> •8" Full-depth reclamation (FDR) – stabilized •2" HACP 	20 – 30 years	<ul style="list-style-type: none"> •Stabilization reduces risk for pumping (and potential for subexcavation overrun) •Reuses/recycles materials •Efficient/smaller "carbon footprint" •Favorable life-cycle costs •Minimal dust 	<ul style="list-style-type: none"> •Contractor availability / mobilization •Slight grade raise •More intensive inspection during construction 	\$600 k
<ul style="list-style-type: none"> •4" Cold in-place recycling (CIPR) •3" HACP 	20 – 30 years	<ul style="list-style-type: none"> •History of long-term performance •Reuses/recycles materials •Efficient/smaller "carbon footprint" •Favorable life-cycle costs •No dust 	<ul style="list-style-type: none"> •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
<ul style="list-style-type: none"> •Mill 4" of existing material •Recondition base •4" HACP 	15 – 20 years*	<ul style="list-style-type: none"> •Zero grade raise •Conventional construction / ample contractor availability 	<ul style="list-style-type: none"> •No in-place recycling •Requires 3 separate operations (mill, recondition, pave) •Lower structural value 	\$650 k

PAVEMENT REHABILITATION ALTERNATIVES (long-term, structural improvements)

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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



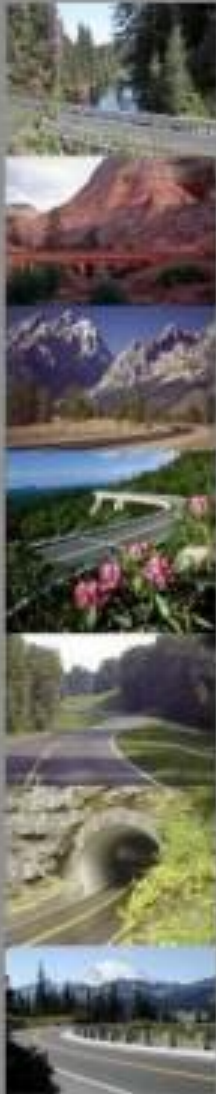
FLHD Structural Guidelines

FDR Method	Minimum Thickness of Riding Surface	Typical Structural Coefficient
Mechanical (pulverize)	2" HMA	0.10 – 0.12
Bituminous	Surface Treatment or Structural HMA	0.20 – 0.28
Cement	Surface Treatment or Structural HMA	0.15 – 0.20

FLHD Structural Guidelines

	Minimum Thickness of Riding Surface	Typical Structural Coefficient
CIR	Surface Treatment or Structural HMA	0.28

See Chapter 11 in the FLH Project Development and Design Manual for further details. Web link:
www.wfl.fhwa.dot.gov/design/manual/



CIR Mix Design

- ◆ CFLHD performs a mix design and provides initial application rates -Hveem or Super Gyratory Compactor method
- ◆ WFLHD determines application rate during test strip
- ◆ Future: Need standardized method :ASTM / AASHTO acceptance .





FDR Mix Design

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

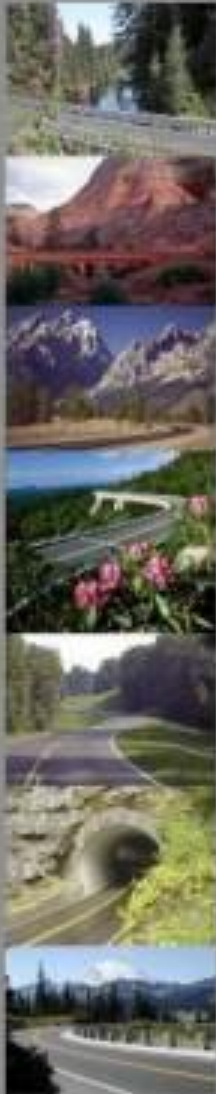




CIR Construction QC/QA Study

- ◆ Literature Review
- ◆ Regiment of Materials Testing on 3 projects
 - FWD (before CIR, right after CIR, and post overlay)
 - Volumetrics (Gmm, Gmb, VTM, gradations)
 - Performance (retained stability, TSR, dynamic modulus)





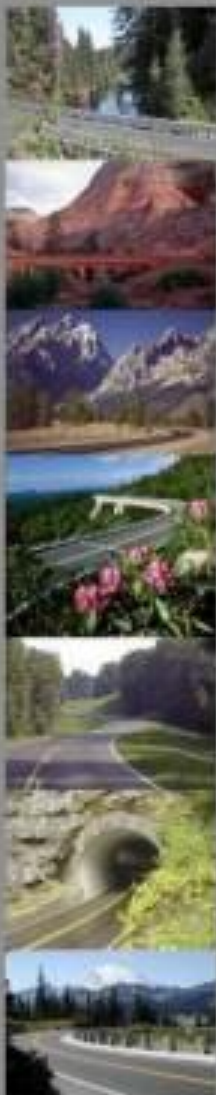
CIR Construction QC/QA Study

- ◆ Comparison of results with current acceptance tests
- ◆ Report with recommendations for improved construction QC/QA
- ◆ Complete by December, 2011

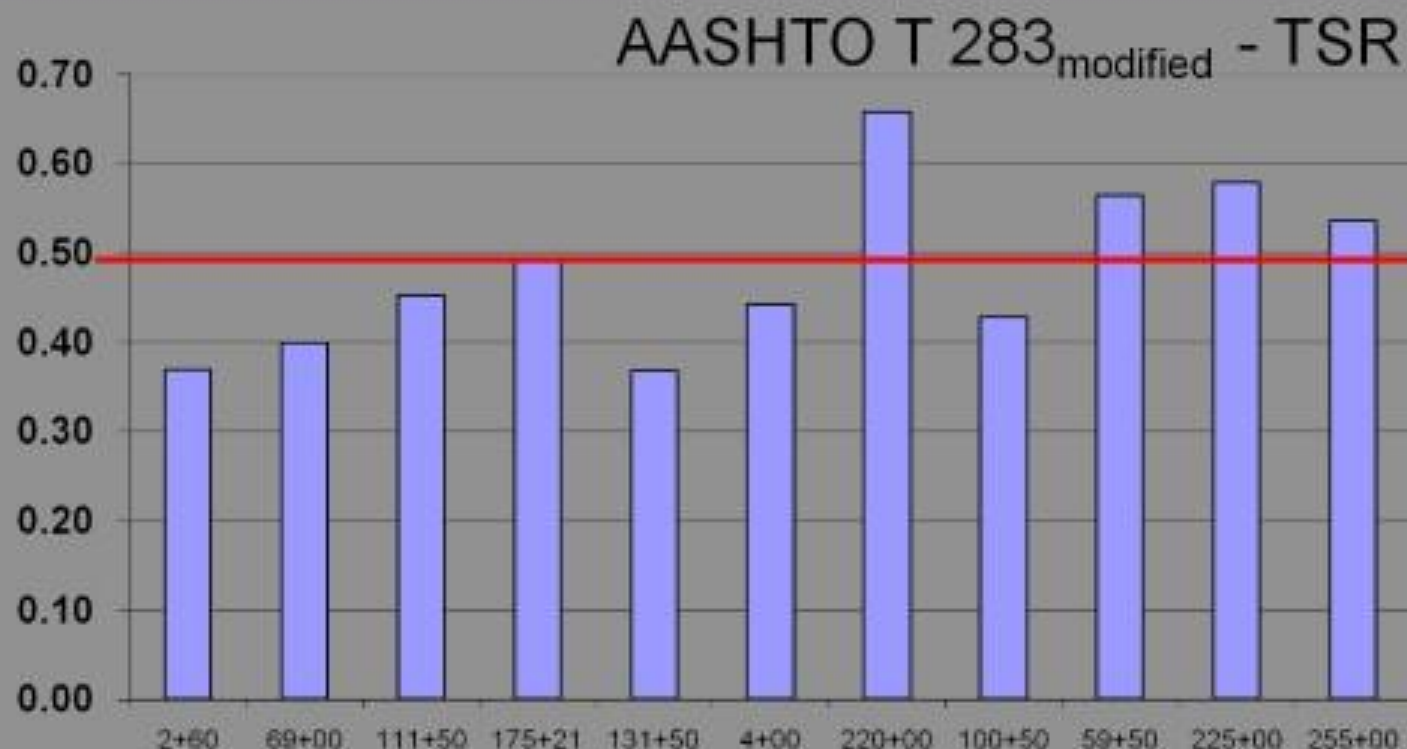


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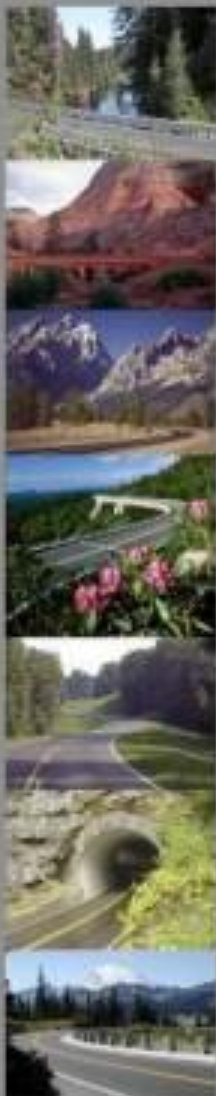


CIR Construction QC/QA Study



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CIR Construction QC/QA Study

Marshall Retained Stability



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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 - CIR
- ◆ Top size gradation requirement - FDR



Washington Rd – Sept 2009



Washington Rd, CIR - surface



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Washington Rd – Sept 2009

...after a few days



Washington Rd – Sept 2009

...after a few days



Wentworth Springs Rd – Oct 2009



Construction in the wrong season will lead to...

Wentworth Springs Rd – Oct 2009



...problems

Wentworth Springs Rd – Oct 2009



Wentworth Springs Rd – Oct 2009





FLHD's first CIR Project

- ◆ Location: Rocky Mountain N.P.
- ◆ Year: 1982
- ◆ Typical Structural Section
 - 4 inches CIPR
 - 2 inches HMA
- ◆ 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



Rocky Mountain
N.P. project ...

...after 26 years!



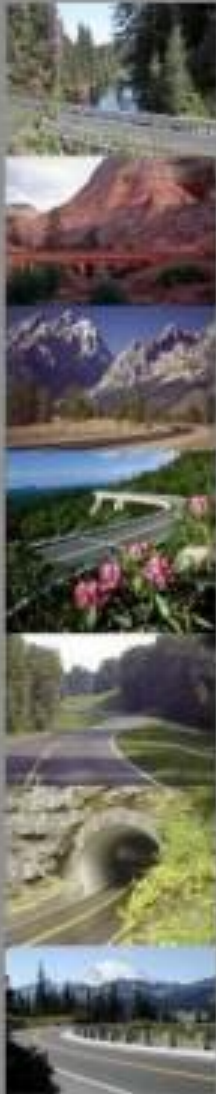
Rocky Mountain N.P.
project...

...after 26 years!



Rocky Mountain N.P. – June 2008

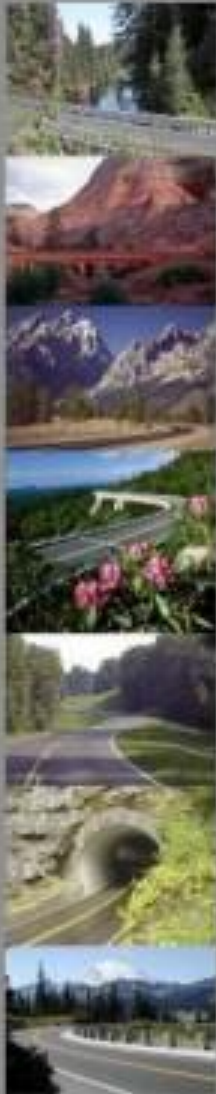




First CIR project in California

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





First CIR project in California

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



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First CIR project in California

22 years &
counting!



First CIPR project in California



First CIR project in California



After 22 years of
performance...



Twin Lakes Rd - California



CIR

**17 years
and
counting**

HFMS-2s

09/03/2008

Grand Canyon – Center Rd



CIR

**17 years
and
counting**

HFE-300s

Mendocino Pass - California



CIR

**14 years
and
counting**

HFMS-2s

26/05/2008

Colorado State Hwy 145 (Dolores to Rico)



CIR

**12 years
and
counting**

**HFMS-
2sP**

Big Bend National Park - Texas



**FDR and
double
chip seal**

Lake Mead N.R.A. - Nevada



**FDR with
6' of
widening**

Canyon de Chelly
Arizona



Core
from
FDR
foam

FDR Operation in Zion N.P. - Utah

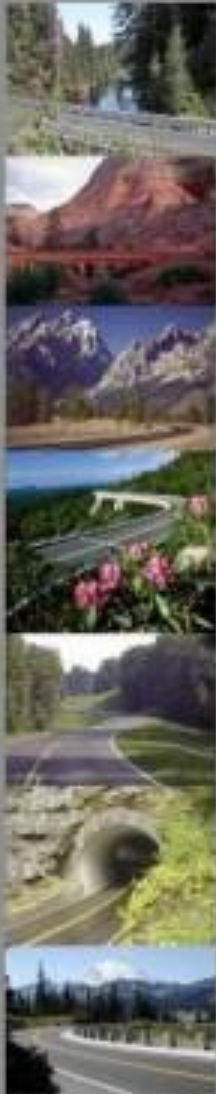


Zion National Park - Utah



**FDR with
foamed
asphalt –
constructed
under heavy
shuttle bus
traffic**

Questions?



www.cflhd.gov



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