COLD IN-PLACE RECYCLING UTILIZING ENGINEERED EMULSION: PROJECT SELECTION AND CONSTRUCTION PRACTICES

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ASPHALT RECYCLING METHODS

MATERIALS

- Engineered Emulsion (approx. 3%)
- Lime or cement (approx. 1%, used as a mineral filler and curing aid)
- Water (approx. 1%)
- Recycled asphalt pavement

- Fog Seal (application rate 0.05 to 0.15 gal/sqyd)
- Blotter

ASPHALT RECYCLING METHODS

- Cold In-Place Recycling (C-I-R)
  - Milling
  - Re-mixing
  - Placing and compacting
  - Same day operation
- Central Plant Recycling
  - Milling and removal
  - Line and grade adjustments
  - Central plant mixing
  - Hauling, placing and compacting

C-I-R PROCESS

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CENTRAL PLANT RECYCLING

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- Requires a lot of storage space
- Multiple handling operations

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LAYDOWN PROCESS

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- C-I-R: Leave thin section of existing asphalt in place
  - Provides support for the milling train
  - Uniform material

LAYDOWN PROCESS

- Utilize pickup machines or
- End dumps directly into the paver

LAYDOWN PROCESS

- Material uniformly coated with emulsion
- Reduce down to 1.5 inch minus

LAYDOWN PROCESS

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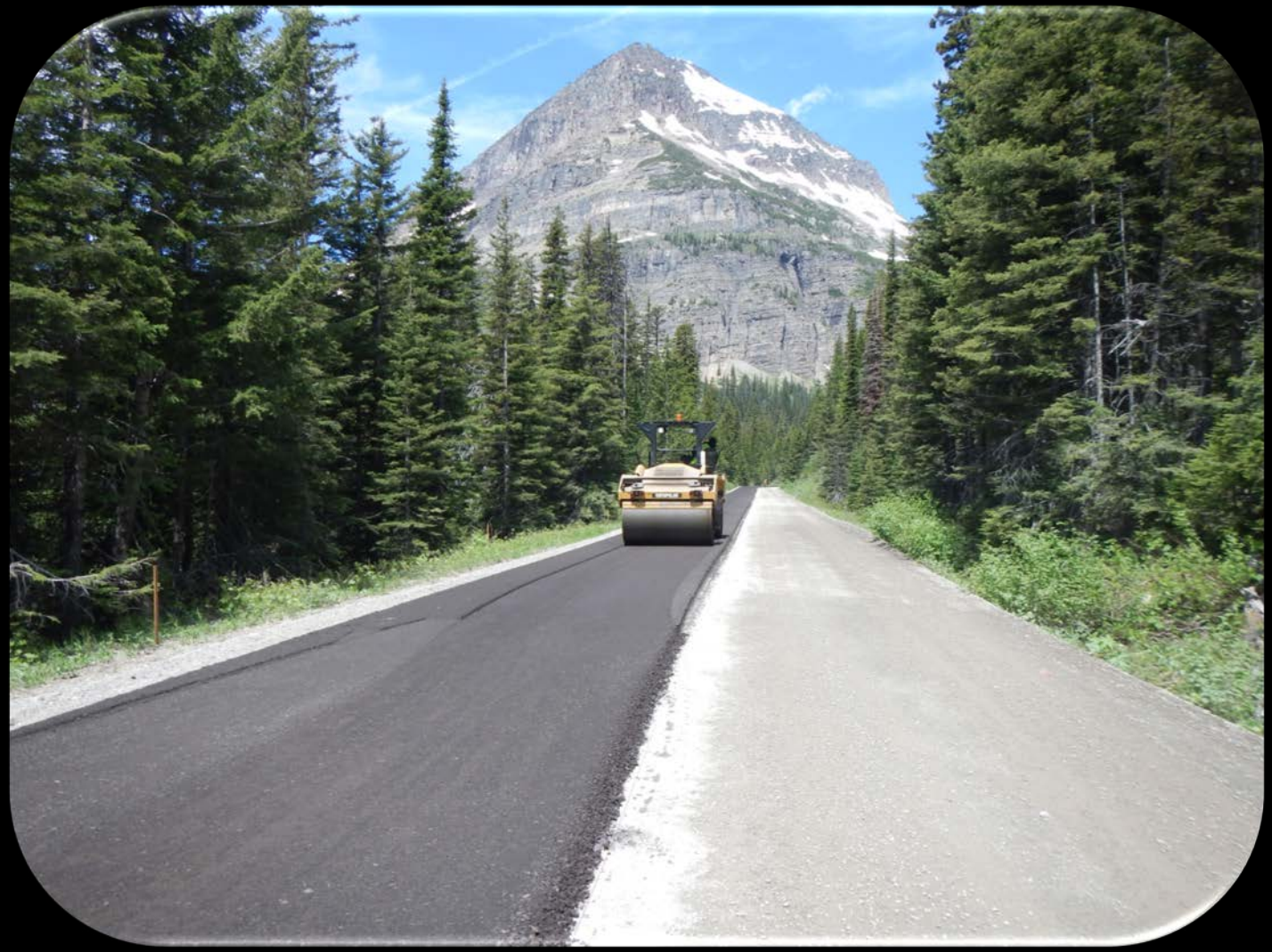
- Allow material to begin cure prior to compaction
- Climate will adjust cure time
  - Shaded
  - High humidity
  - Temperature
- Emulsion supplier can provide cure accelerant

LAYDOWN PROCESS

- Keep rollers back from paver
- Rapid compaction prevents efficient curing

LAYDOWN PROCESS

LAYDOWN PROCESS



- Initial breakdown with smooth vibratory double drum
- Pneumatic as Intermediate
- Finish with smooth drum to remove roller marks

FINAL SURFACE: PRIOR TO FOG

- Micro cracking is acceptable
- Traffic will aid in kneading together

LAYDOWN PROCESS

- When to fog
  - Product stability
- Using blotter
- Traffic control and timing

LAYDOWN PROCESS

- Fogged surface vs. open surface
- Cure times – minimum two hours after compaction

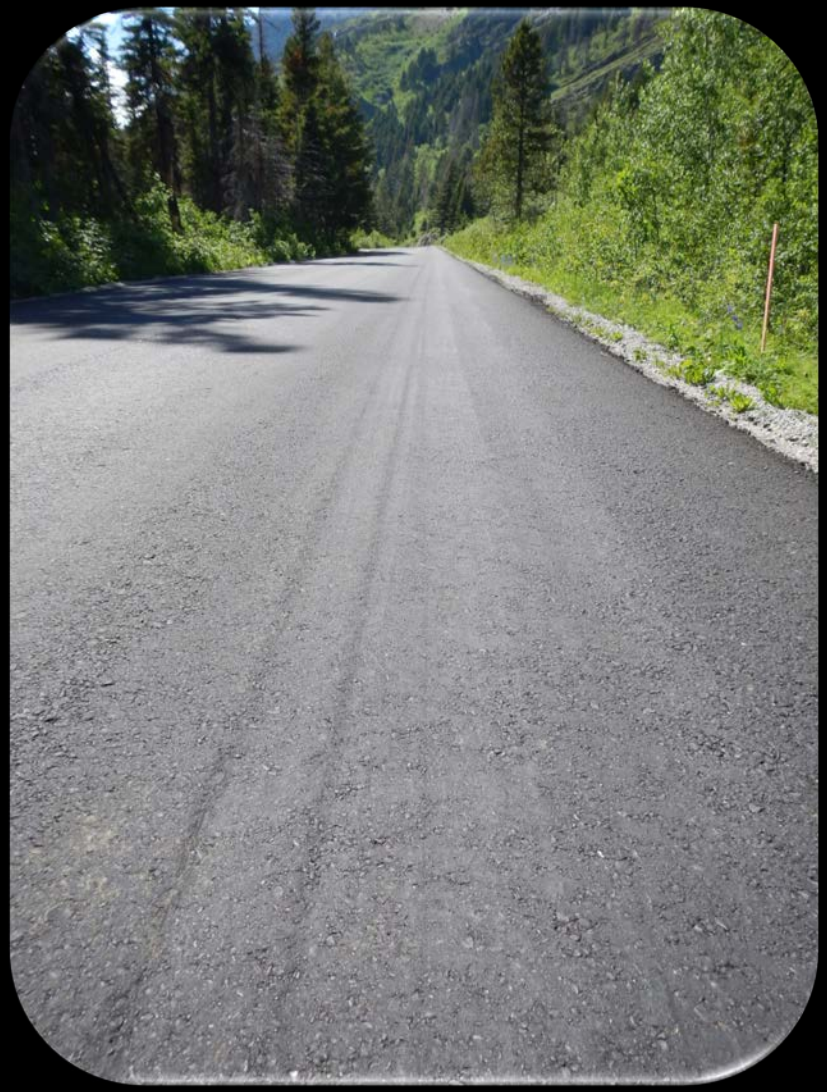
FINAL SURFACE

CONSTRUCTION INSPECTION

- Monitor cutting depth / milling operation
- Do not include any base material (C-I-R)
- Emulsified asphalt addition rate (approx. 3%)
  - Established at start as part of mix design
  - Adjustments may be necessary
  - Mix will look dry
- Lime or cement addition rate (1%)
- Pavement laydown – placement depth and width
- Compaction (Don’t rush it!)
- Fog coat and blotter application

CONSTRUCTION CHALLENGES

CHALLENGES: RUTTING



CHALLENGES: RAVELING

PROJECT SELECTION

PROJECT SELECTION

- Estimated at approx. ¾ strength of HMA
- Provides opportunity to reuse existing materials
- Reduces pavement structure
- C-I-R needs reasonably consistent pavement depth. Approx ½” depth more than design
  - Do not include aggregate base with layer

PROJECT SELECTION: C-I-R OR CENTRAL PLANT RECYCLING

- Boring logs with depths of layers from subsurface investigation
- Project constraints / considerations
  - Adjusting grade
  - Sound existing structure with old pavement
  - Room for overlay
  - Excessive sub-excavation required
- Structural pavement analysis
- Sustainability concept

PROJECT SELECTION: ESTIMATION OF QUANTITIES

- In-place hot mix asphalt pavement = 150 pounds per cubic foot
  - In-place air voids approx. 5%
- C-I-R pavement = 135 pound per cubic foot
  - In-place air voids approx. 14%
  - No handling loss
- Central plant mixed
  - In-place air voids approx. 14%
  - Assume 5 to 10% handling and floor loss
- Approximately 10% increase in volume

PROJECT SELECTION

- Good candidate
  - End of service life
  - Minor patching
  - Fatigue cracking
  - 3 inch depth minimum

PROJECT SELECTION

- Poor candidate
  - Consistent recent crack seal
  - Less than 3 inches
  - Need to tie in to existing structures (C-I-R)

PROJECT SELECTION: BORING LOG EXAMPLE

FEDERAL HIGHWAY ADMINISTRATION
VANCOUVER, WASHINGTON
GEOTECHNICAL SECTION

BORING LOG (English Units)

6 in H-S AUGER	☐	BEGAN:	9/16/03
8 in H-S AUGER	☐	COMPLETED:	9/16/03
NQ CORE	☐	DRILL:	Unknown
HQ CORE	☐	DRILLER:	Unknown
OTHER:		WEATHER:	Heavy snow

LATITUDE (DEGREES):48.67487800
LONGITUDE (DEGREES):-113.60747500

DEPTH (ft)	DESCRIPTION	GRAPHIC LOG	SAMPLE # / SAMPLE	BLOW COUNT
0	Asphalt.			
0.5	Red to gray, silty fine to coarse SAND, some fine to coarse gravel, some clay, subangular to angular fragments, damp (SM) (BASE).			
2.0	Red, fine to coarse GRAVEL, some fine to coarse sand, little silt, trace cobbles, subangular to angular fragments, damp (GP-GM). Hard drilling.			
3.0	Laboratory testing completed. Laboratory Control Number: W-08-0284-SO 42.4% Gravel, 47.3% Sand, 10.3% Silt GP-GM; Poorly graded gravel with silt and sand. Moisture at R Value is 131.8% at 300 psi. Boring completed at 3 feet.			

▼ WATER CONTENT (%)
PLASTIC LIMIT ⊢——⊣ LIQUID LIMIT
● SAMPLE PENETRATION RESISTANCE STANDARD BLOWS PER FOOT (140 lb mass, 30 in drop)
0 20 40 60

DEPTH (ft): 0, 1, 2, 3

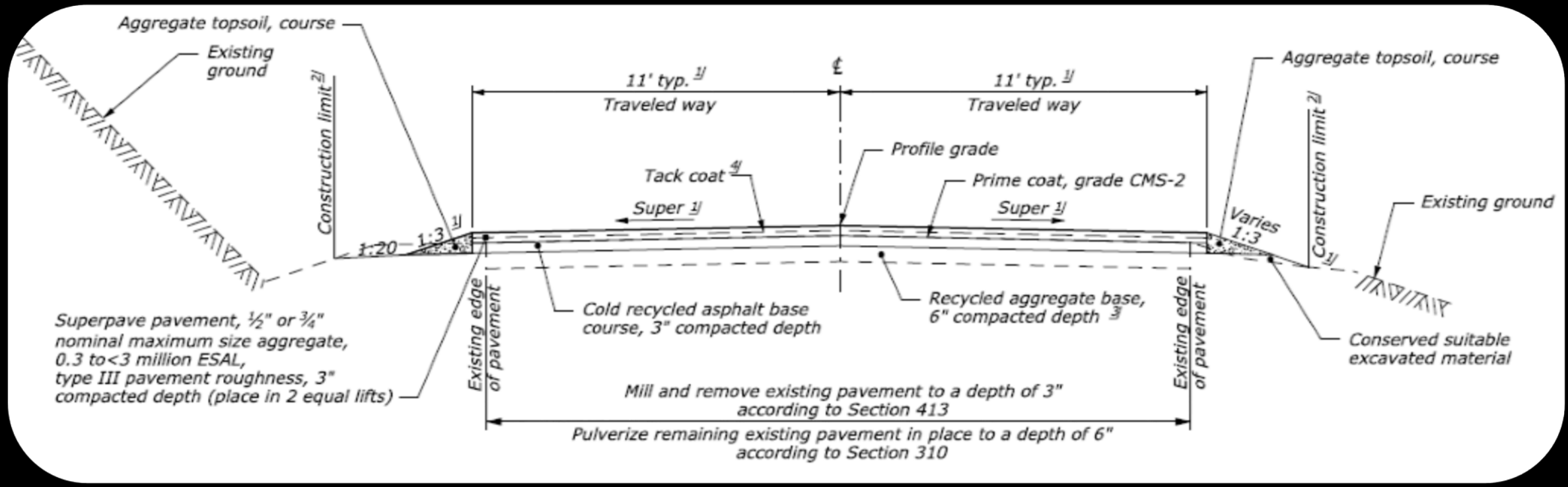
PROJECT SELECTION: BORING LOG DATA

Average Distance between Borings	2674 feet
Average Thickness of Pavement	6 inches
Controlling Thickness	3.6 inches

Boring No.	Station	Distance Between Borings (ft)	Pavement Depth (in)
SG03-37	1846+20	2580	6
SG03-38	1872+00	2780	9.6
SG03-39	1899+80	2590	8.4
SG03-40	1925+70	2680	6
SG03-41	1952+50	2680	6
SG03-42	1979+30	2700	6
SG03-43	2006+30	2655	7.2
SG03-44	2032+85	2685	6

Boring No.	Station	Distance Between Borings (ft)	Pavement Depth (in)
SG03-45	2059+70	2640	6
SG03-46	2086+10	2700	6
SG03-47	2113+10	2640	3.6
SG03-48	2139+50	2680	7.2
SG03-49	2166+30	2676	7.2
SG03-50	2193+06	2680	3.6
SG03-51	2219+86	2654	6
SG03-52	2246+40	2760	4.8
SG03-53	2274+00		6

PROJECT SELECTION: TYPICAL SECTION



CONCLUSIONS

- Utilizes existing materials
- Can be done in place or offsite
- Provides a flexible pavement layer
- Reduces pavement distress
- Decreases pavement structure thickness

THANK YOU!

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