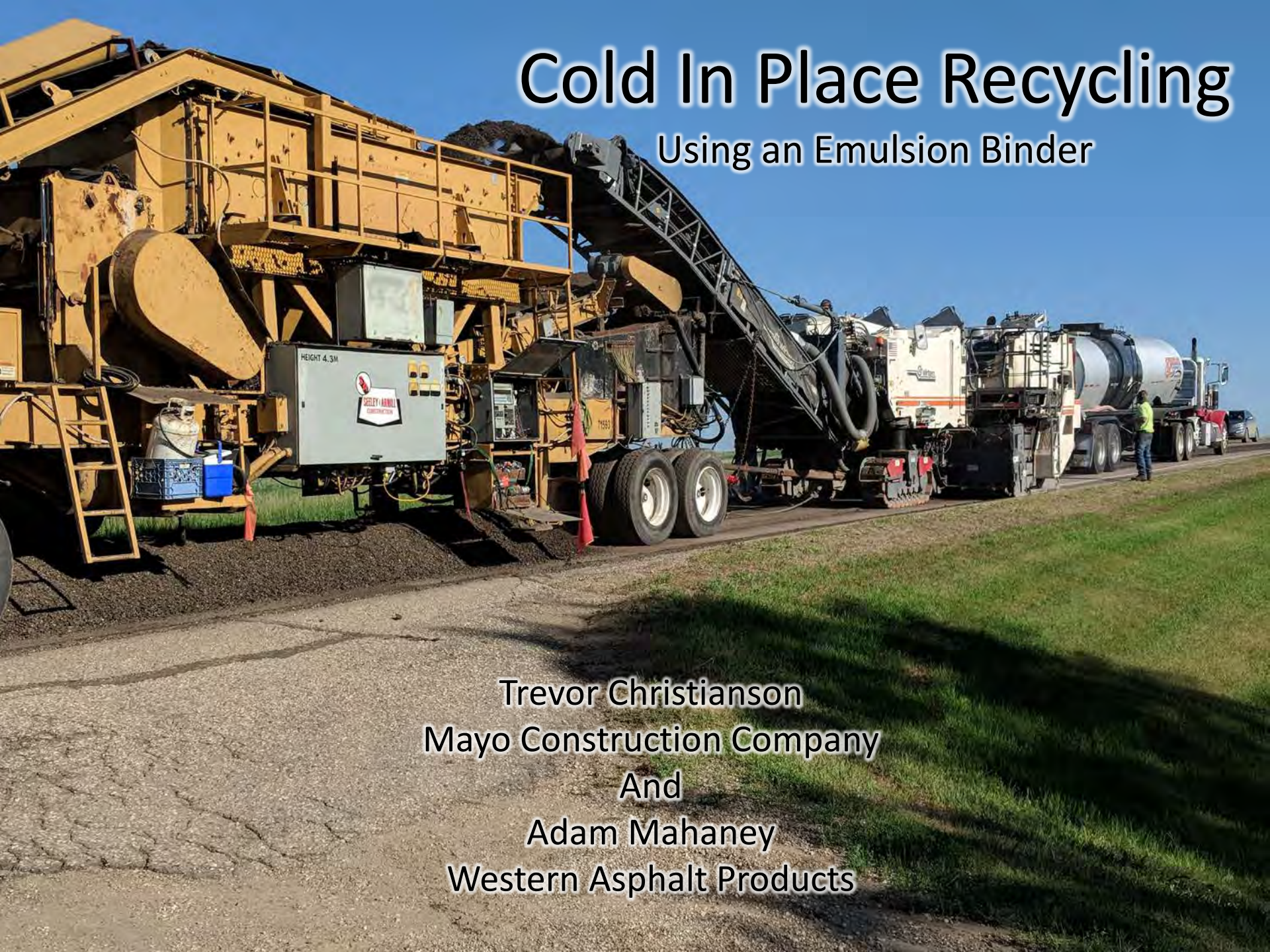


Cold In Place Recycling

Using an Emulsion Binder

Trevor Christianson
Mayo Construction Company
And
Adam Mahaney
Western Asphalt Products

Before the Project Starts

- Proper core Sampling of the existing road is very important, multiple locations throughout the road should be sampled. Width of the road should also be checked.
- Random Core sampling will identify areas of concern.

Including

- Shallow asphalt depth
- Variance in existing asphalt gradations/residual content
- Fiber/fabric membranes

Williams County Road 17
Existing Road Condition

- Large amount of Asphalt crack sealer present in some areas
- Fabric interlayer was present between overlays
- Previously chip sealed
- Roadways had been narrowed from multiple overlays

Emulsion Binder

- Emulsion Binder
  - Typical CIP Emulsion Binder Variance 1.2% to 2.2%
  - Wild Rose Mix Design called for 1.4% CSS-HY +- 0.2%
    - Higher Emulsion
      - Highly Oxidized Roads
      - Widening Existing road widths (incorporation of shoulder gravel)
      - Hot weather
      - Cooler weather requires more emulsion for compaction
    - Lower Emulsion
      - High residual asphalt cement content
      - Soft existing binder (cutbacks)

Cold In-Place Recycling Representative

- "A representative of the emulsion supplier, who is a recognized expert in the asphalt cement recycling process as determined by the engineer, shall be present at the beginning of the job, and available as needed throughout the duration of the job, to ensure proper application and field QC of the recycled roadway material."

CSS-HY

Test on Emulsion:

Test on Emulsion	Test Method	WAP Results	Min	Max
Viscosity SFS @ 77 F, s	AASHTO T59	23	20	100
Residue, w %, min.	AASHTO T59	63.07%	63%	-
Sieve, w% max.	AASHTO T59	0.00%	-	0.1
Oil Distillate, w% max	AASTHO T59	0.25%	-	0.5

Test on Residue:

Test on Residue	Test Method	WAP Results	Min	Max
Penetration @ 77F, min	AASTHO T49	210	180	-

Test on Rejuvenating Agent:

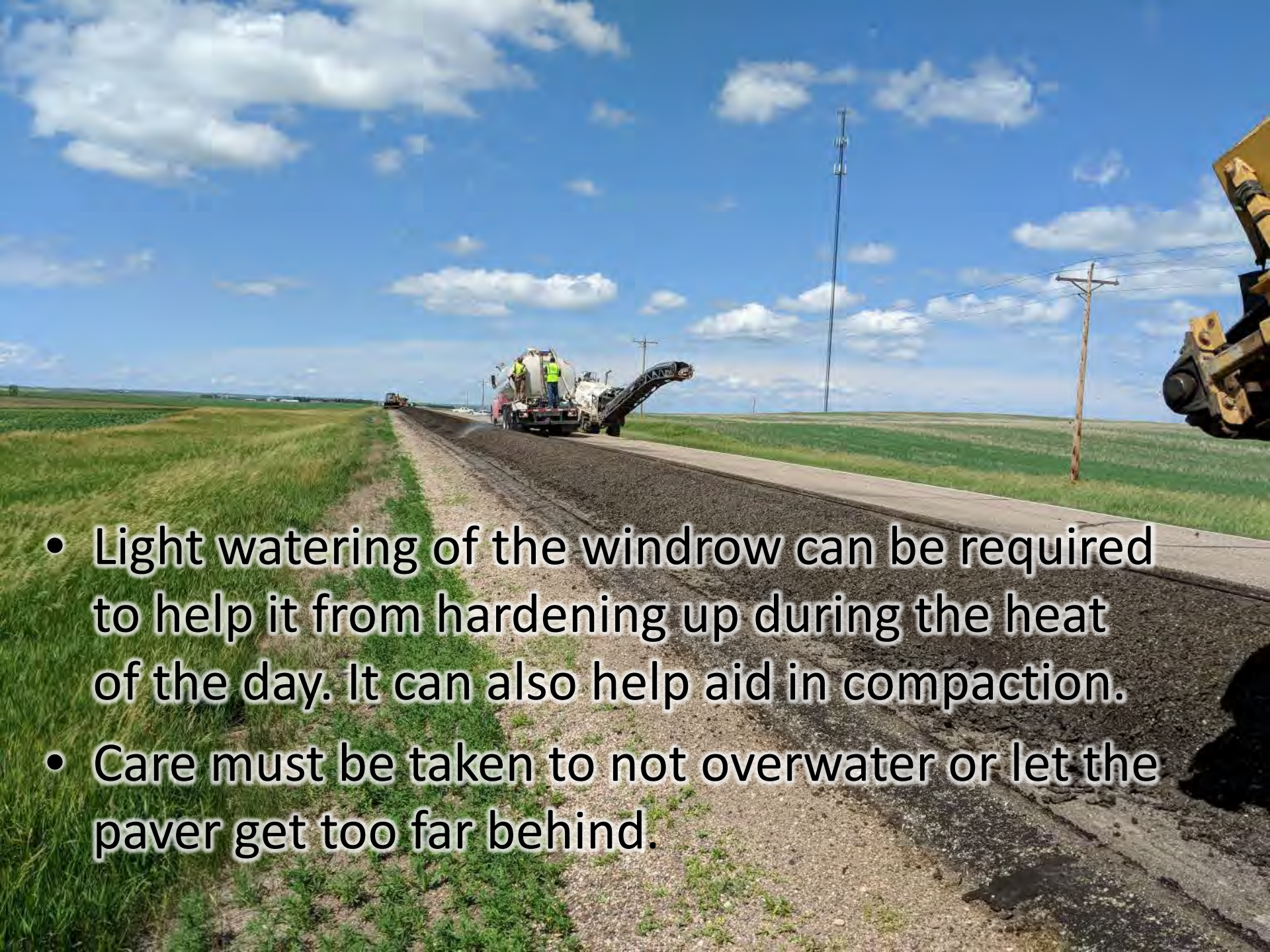
Test on Rejuvenating Agent	Test Method	WAP Results	Min	Max
Flash Point, COC, F	AASHTO T48	423	380	-
Hot Mix Recycling Agent Classification	ASTM D4552	RA1	-	-
Rejuvenating Agent, BWOA %	-	12.3%	12	

Equipment

- Job was paved with a Cat 1055F Paver and BG-650 Windrow elevator
- Wirtgen Full lane Milling machine 12.5’ feet cutter drum
- Asphalt Recycling Train with closed loop crushing to ensure proper sizing of material. Computer controlled asphalt rate based on belt scales
- Small Wirtgen Milling machine to remove excess shoulder asphalt material the larger machine was not wide enough for
- Conventional Steel and Rubber tire rolling equipment
- Tanker capable of being pushed ahead of the recycling train

Introduction

- The recycled RAP was placed in a windrow by the train and picked up by the windrow elevator similar to other Paving operations in North Dakota.

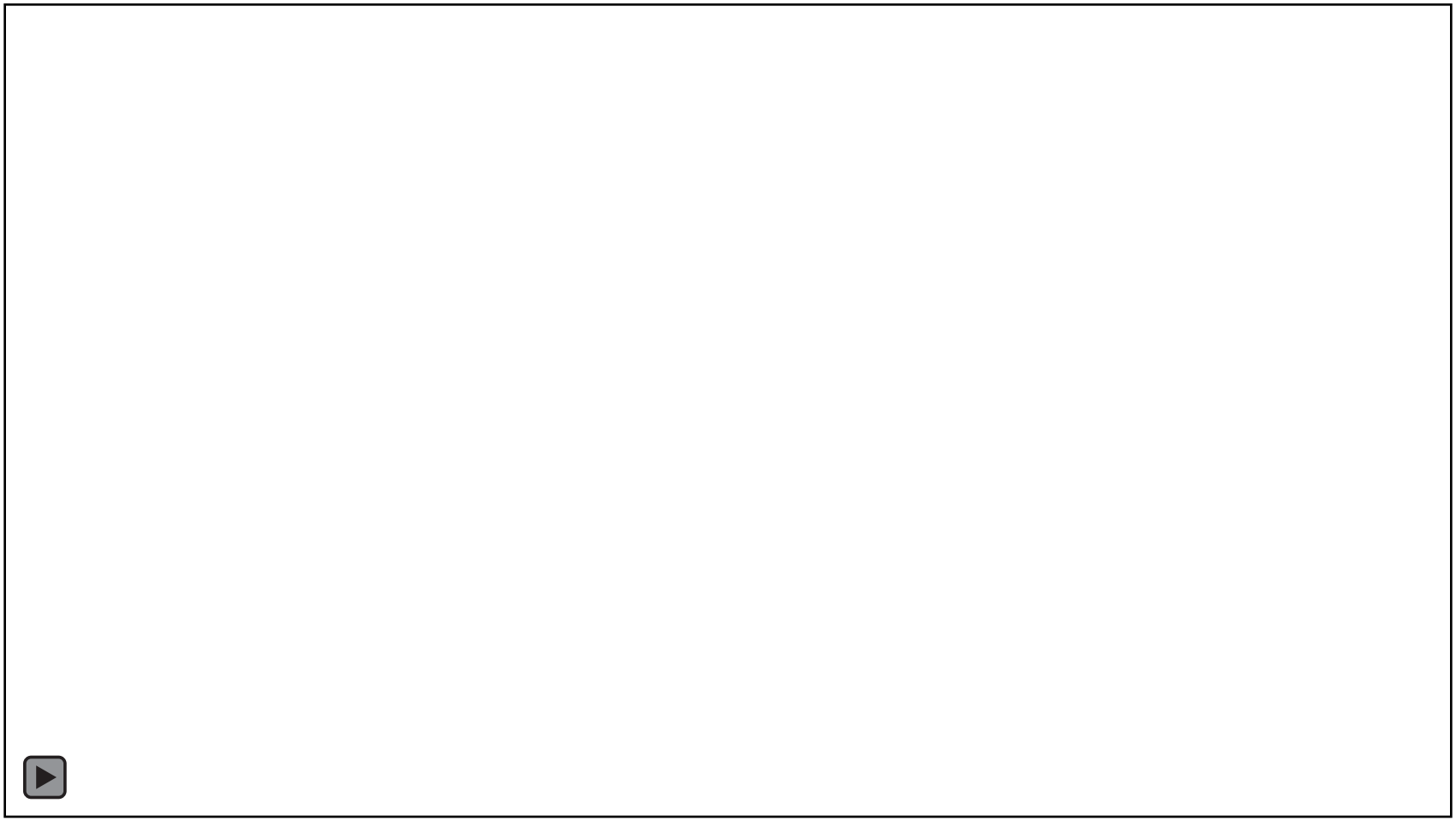


- Light watering of the windrow can be required to help it from hardening up during the heat of the day. It can also help aid in compaction.
- Care must be taken to not overwater or let the paver get too far behind.

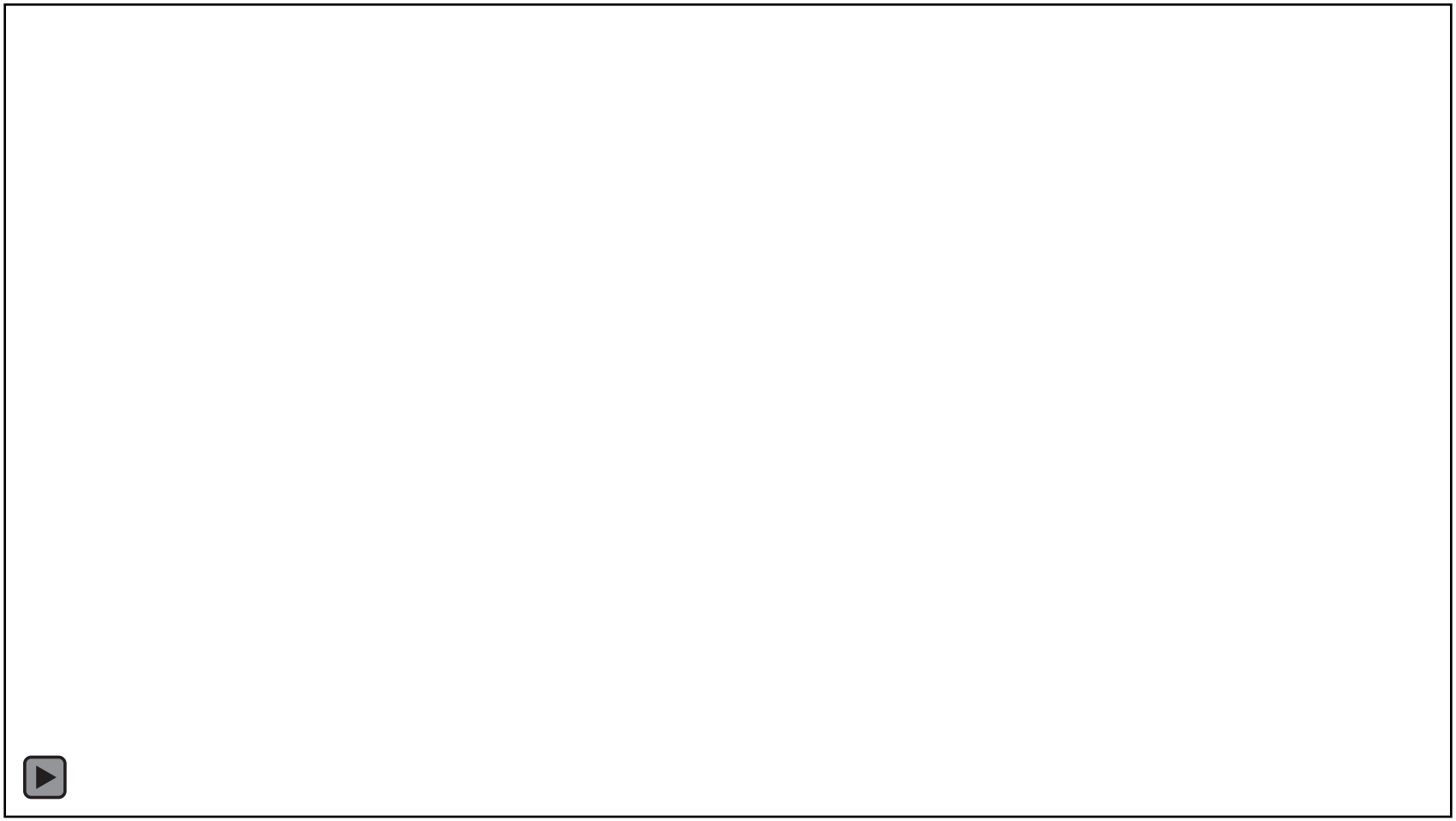
- The milling machine was not wide enough to get some of the existing slough material.

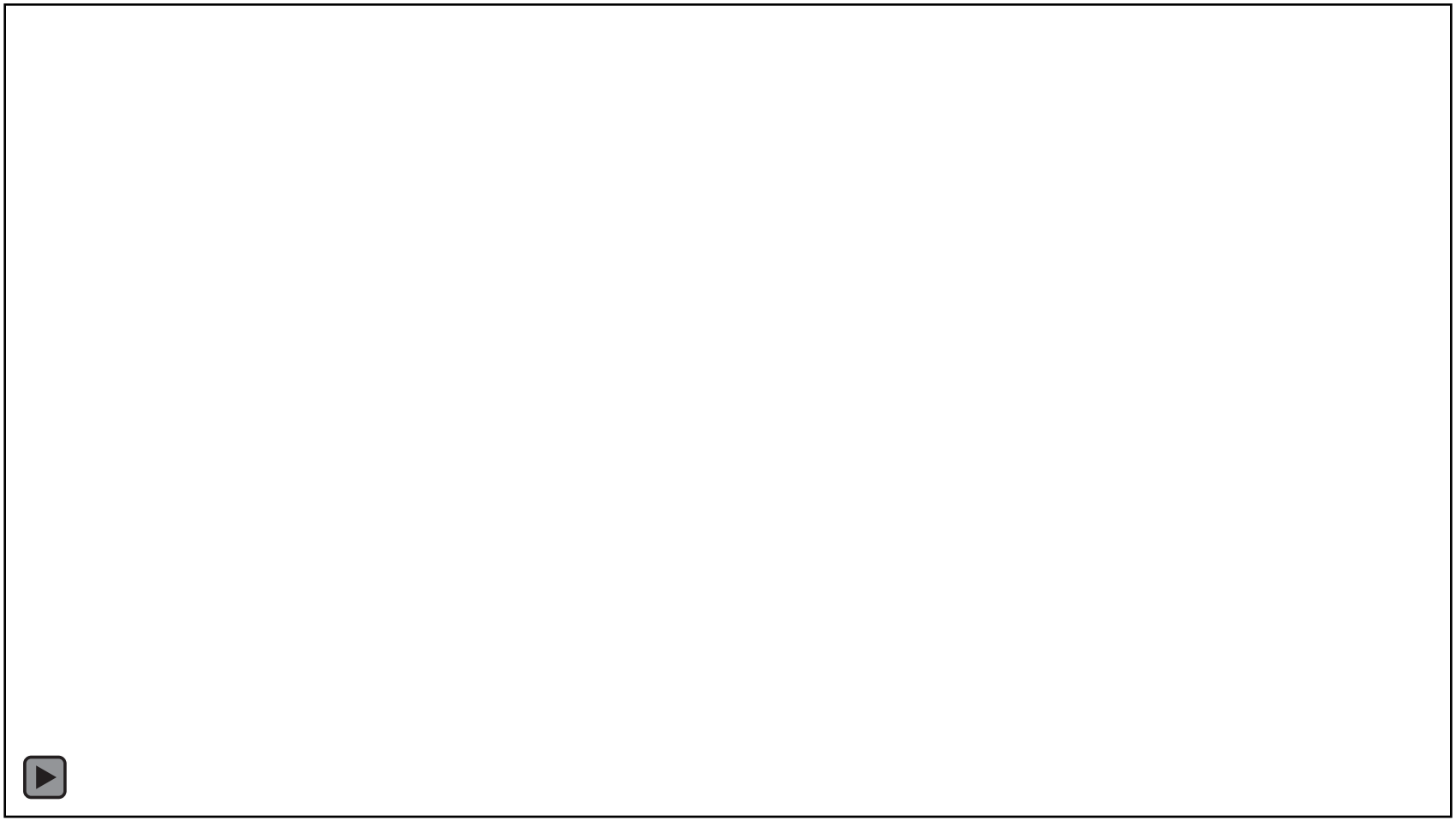
- We used a small 4’ milling machine to remove the slough that was remaining and allow wider paving.

- The valley hills were easily navigated without issue by the recycling train.



Paving





Testing

Sample	1	2	3	4	5	6								
Sampled	06/25/18	06/26/18	06/27/18	06/28/18	06/29/18	06/30/18								
Tested	06/25/18	06/26/18	06/27/18	06/28/18	06/29/18	07/02/18								
Sieve Analysis (AASHTO/ND T 11, T 27, % Passing)												Average	Milling Bands	
1"	100.0	100.0	100.0	100.0	100.0	100.0						**100.0**	100	100
3/4"	100.0	96.7	97.5	98.7	99.1	99.0						**98.5**	95	100
1/2"	97.2	88.6	91.8	91.7	94.1	95.7						**93.2**	65	70
3/8"	91.3	79.5	82.9	83.1	86.9	87.5						**85.2**	55	60
#4	65.9	53.0	54.9	55.1	61.8	59.2						**58.3**	40	45
#8	32.4	13.6	24.4	21.4	29.2	29.1						**25.0**	30	35
#16	14.9	5.0	12.2	9.0	12.8	15.7						**11.6**	20	25
#30	6.2	2.5	6.3	4.0	5.1	8.0						**5.4**	10	15
#50	2.1	2.0	3.9	2.1	3.9	4.3						**3.1**	5	10
#100	1.0	1.9	3.3	2.0	3.8	2.9						**2.5**	2	5
#200	0.9	1.9	3.2	1.9	3.7	2.7						**2.4**	1	3
% MOISTURE	2.8	4.8	3.5	4.8	5.3	3.5						**4.1**		
S.E.														
F.A.A.														
Light Weight														

- The milling machines micro milling drum produced a very fine mix.

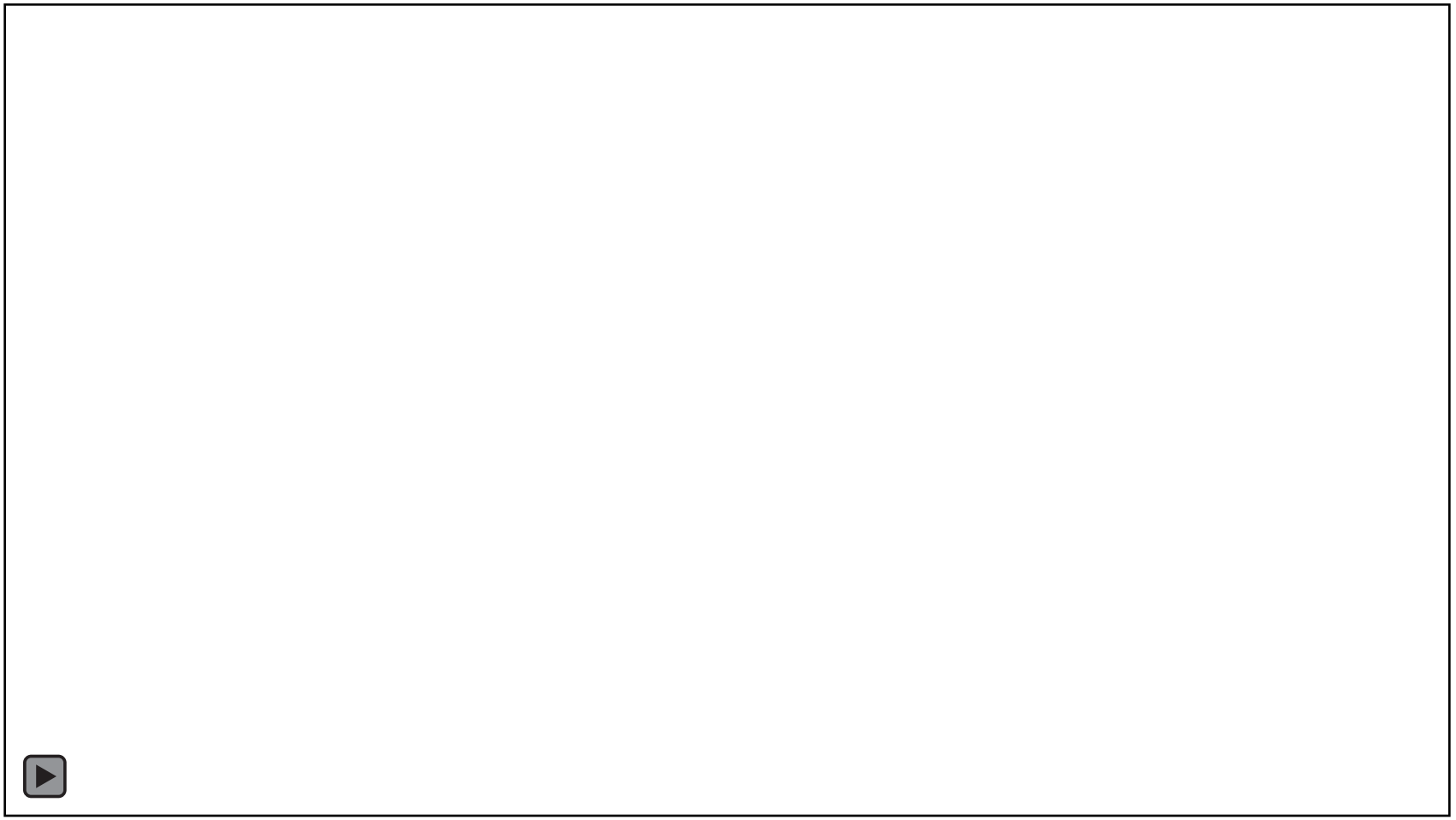
Density

Test Number	Date	Proctor Number	Test Location		Probe Depth	Depth Below Final Grade	Wet Density	Rel. Dens. % Max Given*	Moisture Content	Dry Density	Rel. Dens. % (Proctor **)
			Cold-In-Place Recycled Asphalt								
			Station	Lane							
1	6/25/18	REC-1	222+00	west	BS	at	124.3	82.0	12.1	110.9	102.3
2			212+00	west	BS	at	122.8	81.0	12.4	109.3	100.8
3			202+00	west	BS	at	125.5	82.8	13.0	111.1	102.5
4			192+00	west	BS	at	128.8	85.0	12.9	114.1	105.2
5			182+00	west	BS	at	131.7	86.9	13.3	116.2	107.2
6			172+00	west	BS	at	127.7	84.2	13.4	112.6	103.9
7			162+00	west	BS	at	126.6	83.5	12.6	112.5	103.7
8			152+00	west	BS	at	125.0	82.5	13.0	110.6	102.0
9			142+00	west	BS	at	124.9	82.4	11.9	111.6	103.0
10			138+00	west	BS	at	125.9	83.0	12.6	111.8	103.1
11	6/26/18	REC-1	137+50	west	BS	at	116.6	76.9	10.2	105.8	97.6
12			127+50	west	BS	at	115.9	76.5	10.7	104.7	96.6
13			117+50	west	BS	at	114.9	75.8	11.1	103.4	95.4
14			107+50	west	BS	at	115.9	76.5	10.7	104.7	96.6
15			97+50	west	BS	at	121.2	79.9	13.4	106.9	98.6
16			87+50	west	BS	at	118.8	78.4	14.1	104.1	96.1
17			77+50	west	BS	at	119.6	78.9	13.3	105.6	97.4
18			69+00	west	BS	at	122.0	80.5	12.0	108.9	100.5

Challenges

- Fabric Interlayer would not break down small enough to pass through the screen deck in some areas of the road.

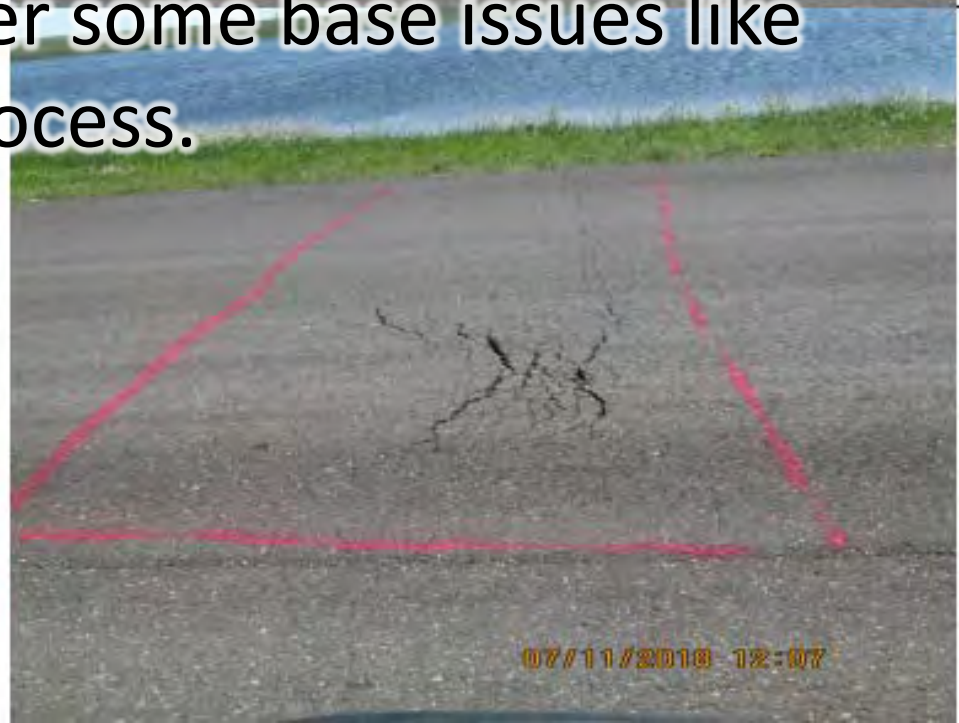
Fabric



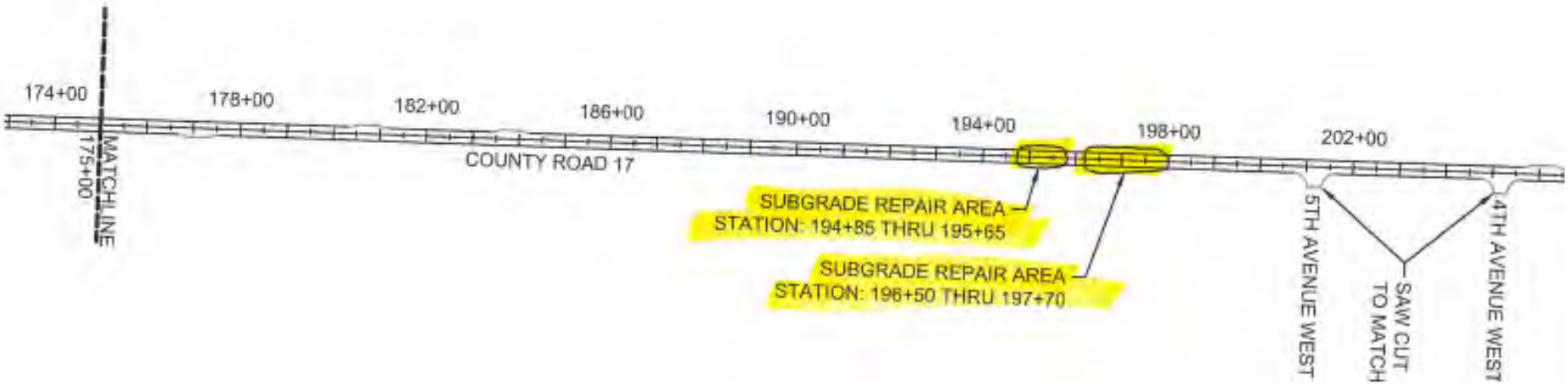
Localised Failures

- We ran into 2 localised base problems which were repaired with a thin overlay. Its not uncommon to discover some base issues like this during the CIR process.



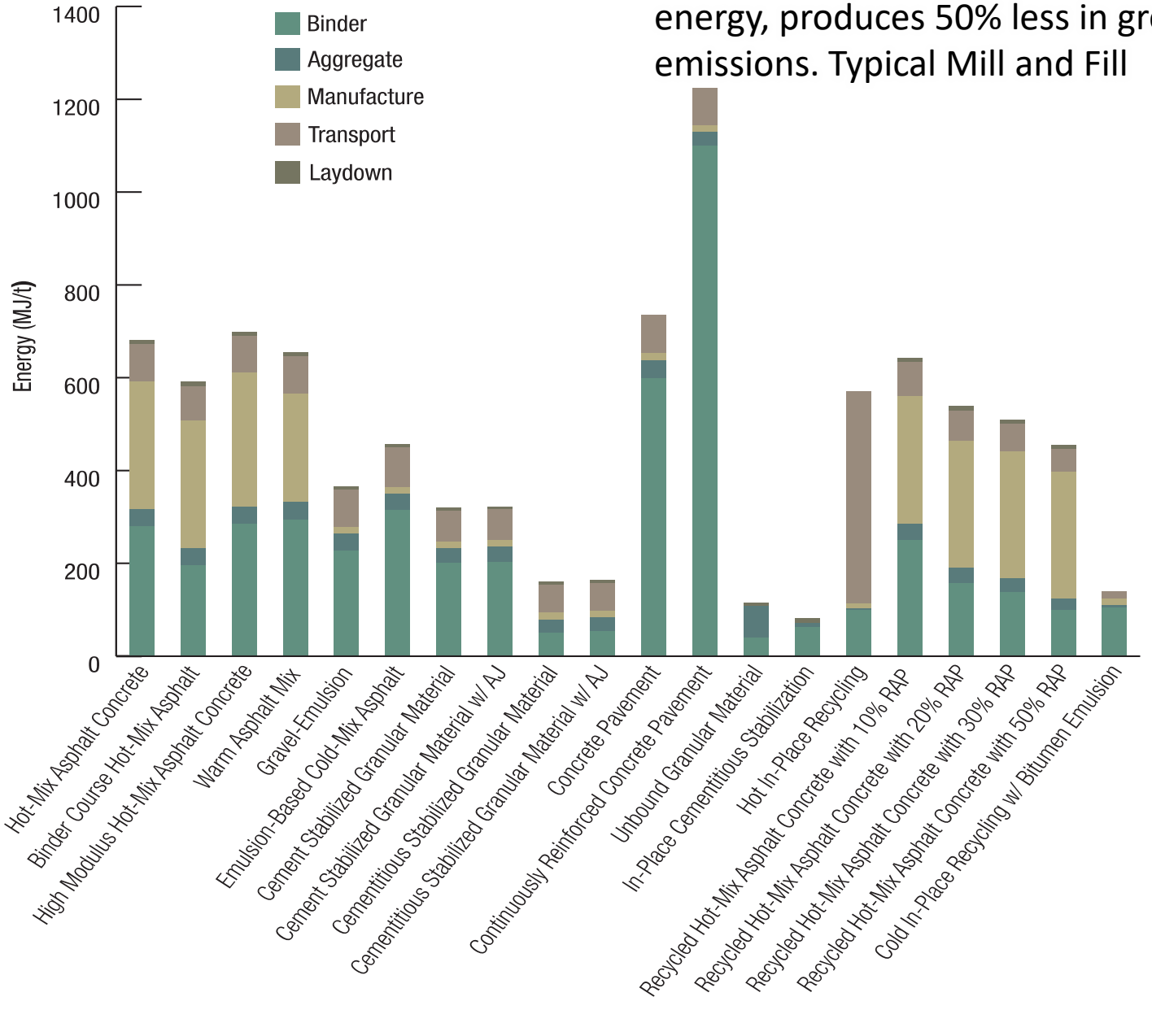
Sub cut


174+00
175+00
MATCHLINE
178+00
182+00
186+00
190+00
194+00
198+00
202+00
COUNTY ROAD 17
SUBGRADE REPAIR AREA
STATION: 194+85 THRU 195+65
SUBGRADE REPAIR AREA
STATION: 196+50 THRU 197+70
5TH AVENUE WEST
SAW CUT
TO MATCH
4TH AVENUE WEST


Breakdowns

FIGURE 2 ENERGY USE PER TONNE OF MATERIAL LAID DOWN

✓ Support sustainability: uses up to 80% less energy, produces 50% less in greenhouse gas emissions. Typical Mill and Fill



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Completed CIP