4.75mm/6.3mm/9.5mm NMAS Superpave Mixes

(NMAS = Nominal Maximum Aggregate Size)

A Valuable Tool for the Pavement Design Toolbox

WHY?

WHY?

WHY?

The need to build “constructable” lifts

Lift Thickness = 3x-5x NMAS (Nominal Max. Aggr. Size)

The need to build “compactable” lifts

Lift Thickness = 3x-5x NMAS (Nominal Max. Aggr. Size)

The need to build “impermeable” lifts

Lift Thickness = 3x-5x NMAS (Nominal Max. Aggr. Size)

What are Thin Lifts?

THINLAY

SAFE. SMOOTH. DURABLE.

Thin Overlays

A new generation of thin-lift asphalt overlays called Thinlays™ are a popular approach to pavement preservation because of their ability to provide improved ride quality, reduce pavement distresses, maintain surface geometrics, reduce noise levels, reduce life-cycle costs, and provide long-lasting service.

TABLE 2 Typical Unit Costs (2009) and Pavement Life for Specific Maintenance and Preservation Treatments *(2)*

Treatment	Initial Costs $/sq.yd.	Expected Extended Life of Pavement, yrs	Annualized Cost $/sq.yd/yr
Crack Treatment	0.32	2	0.16
Fog Seals	0.99	4	0.25
Chip Seals	1.85	6	0.31
Microsurfacing	3.79	6	0.63
Slurry Seals	4.11	5	0.82
Thin HMA Overlay	5.37	13	0.41

Note: In areas where the use of one of these treatments within the state DOTs was

TABLE 6 Properties of 9.5mm Mix Placed 1-inch Thick at NCAT Test Track *(10)*

Property		Gradation	
Asphalt content, %	6.1	3/8 inch	100
Air voids, %	5.5	No. 4	81
VMA, %	19.0	No. 8	61
		No.16	49
		No. 30	37
		No. 50	21
		No. 100	12
		No. 200	6.7

Thin Lift Applications

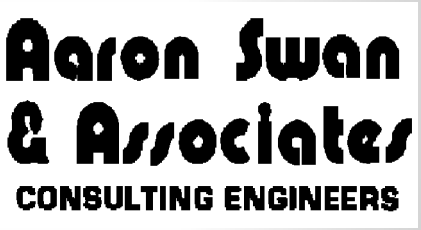
- Pavement Preservation
- Wearing Course
- Urban Section Overlays
- Leveling Course
- Maintenance and Patching
- Airport Overlays
- Dual Purpose Applications: Modified TLO
- Secondary Road Treatments: Top Width Restricted

A lot of research and performance data is verifying these findings

Of particular interest is the use of fractionated RAP in these mixes

The City of Pierre placed 3/8” NMAS Superpave Mix as part of their Street Overlay contract in 2017

Asphalt Specifications Update 2017



Kyle Kurth - Staff Engineer, City of Pierre
Steve McCarty – Technical Advisor, Aaron Swan & Associates
Blake Barringer – City Commissioner, City of Pierre

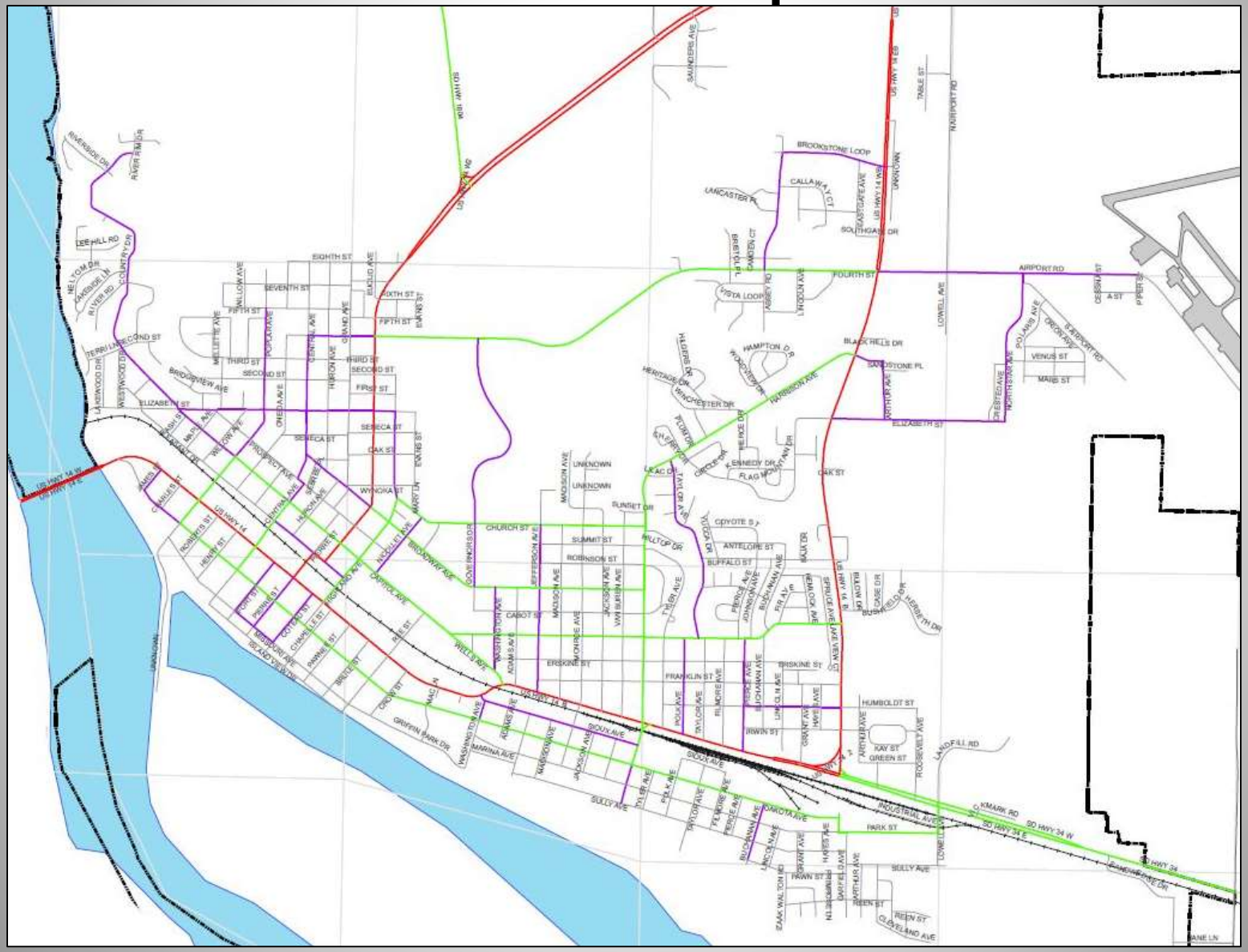
Overview

- Background
- Items Addressed
- Cost Comparison
- Mix Designs & Testing
- Questions

Background

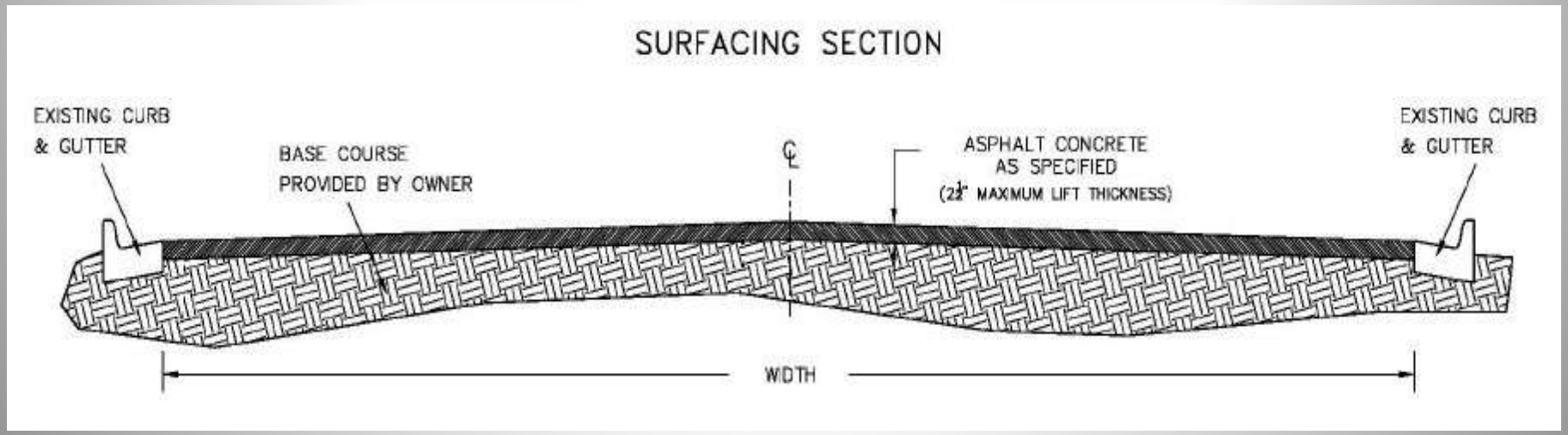
- Approximately 14,000 Residents
- 1,141 Blocks in City of Pierre System
- 43 Blocks +/- Rehabbed Annually (3.77%)
- 26 Year Cycle

Local Road Options



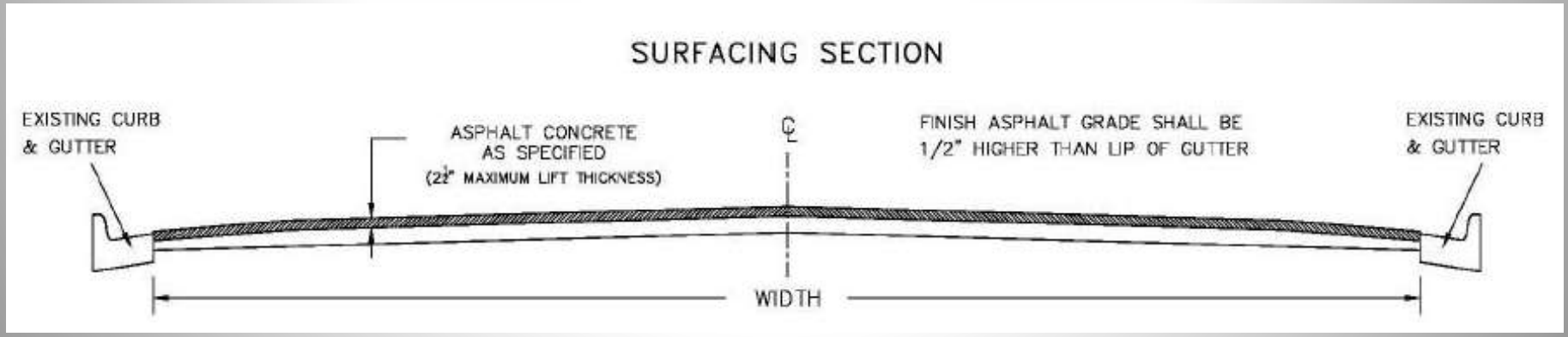
Typical Sections - Rebuild

- Full Rebuild
  - 4” HMA PG 58-28/34 over 8” SDDOT Aggregate Base Course
  - $ 30.02/SY ($48,031/Block)



Typical Sections – Mill & Overlay

- Mill & Overlay
  - 2” HMA PG 58-34 after 2” mill
  - $ 18.56/SY ($29,680/Block)



Preventative Maintenance

- Chip Sealing
  - 3-6 years post-resurfacing
  - City Staff
  - 18 Experimental Sections Utilizing Fractionated (Screened -1/4”) RAP as Cover Coat Aggregate (Chip) Replacement
- Crack Sealing
  - 2-3 years post-resurfacing
  - Also prior to Chip Sealing
  - City Staff
- Fog Seals with Blotter (40+ Blocks)
- Scrub Seals (Experimental 2018, Evaluating Use of Screened RAP) with Broom

Typical Contract

- Modified Class “E” – Type I (1/2” NMAS) HMA
- PG 58-34 on M&O vs. PG 58-34 on Rebuilds
- 10,000-12,000 Tons of HMA annually
- $1.84M - annual value
- Contractor supplied, batched, and laid
- Contractor responsible for milling

Items Addressed

- Use of outdated specifications
- Over-abundance of RAP
- Emergence of new technologies
- Presence of iron-oxides in local aggregates
- Options for local roads

2015 SDDOT Standard Specifications

- Updated to 2015 Edition (With Modifications)
  - Slight change to gradation table
  - Gyratory vs. Marshall
    - Better mimics field compaction methods and provides more parameters to dial-in design
    - Provides a higher level of comfort to both the Owner and the Contractor

MIX DESIGN SPECIFICATIONS

MIX DESIGN PARAMETERS	Class D	Class E	Class G
% Air Voids	4.0 Min.	4.0 Min.	4.0 Min.
% VMA*[1] 3/4 inch nominal maximum size	13.5 Min.	13.5 Min.	13.5 Min.
1/2 inch nominal maximum size	14.5 Min.	14.5 Min.	14.5 Min.
Gyratory Gyrations	40	50	60
Dust/Binder Ratio (based on effective binder)	0.6-1.4	0.6-1.4	0.6-1.4
Moisture Sensitivity*[2]	NA	NA	70 Min.

Requirements	Class D		Class E		Class G		Class S	
	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1*'	Type 2*'
Sieve	Percent Passing							
1 inch	100		100		100			
3/4 inch	97-100	100	97-100	100	97-100	100	100	
5/8 inch							97-100	100
1/2 inch	75-95	97-100	75-95	97-100	75-95	97-100	88-100	97-100
3/8 inch							68-80	80-100
#4	45-75	60-80	45-75	60-80	45-75	60-80	24-34	24-45
#8	30-55	40-60	30-55	40-60	30-55	40-60	10-20	10-22
#16	20-45	25-50	20-45	25-50	20-45	25-50		
#40	10-30	15-35	10-30	15-35	10-30	15-35		
#200	3.0-7.0	4.0-8.0	3.0-7.0	4.0-8.0	3.0-7.0	4.0-8.0	6.0-10.0	4.0-8.0
Other Properties								
Processing Required	Crushed		Crushed		Crushed		Crushed	
Liquid Limit (max)	25		25		25		25	
Plasticity Index, (max)	3		Non-Plastic		Non-Plastic		Non-Plastic	
LA Abra. Loss, (max)	45%		40%		35%		40%	
Absorption (max)*'							1.5%	
Sodium Sulfate Soundness (Maximum)								
+#4 sieve	15%		15%		12%		8%	
-#4 sieve	15%		15%		12%		8%	
Lightweight Particles (Maximum)								
+#4 sieve	4.5%		3.0%		1.0%		1.0%	
-#4 sieve	4.5%		3.0%		1.0%		1.0%	

Over-Abundance of RAP

- Sources
  - Rebuild Sections (2-1/2” to 6+”)
  - Water Main Trench Sections (2-1/2” to 6+”)
    - Both stripped by City Staff & stockpiled
    - Crushed annually (11,000 Tons/yr.)
  - M&O Material (2” +/-)
    - Hauled & stockpiled by Contractor

Over-Abundance of RAP

RAP – Continued

- New Specification
  - Bid as an Alternate
  - 20% (+/- 5%)
  - City supplied & hauled to Contractor
- PG 58-34 for both Rebuilds and M&O Sections

New Technologies - Evotherm

- Pitched as a “season-extender”
- City Staff attended a WMA presentation
  - Environmentally friendly
  - Better working conditions
  - Compaction aid
- Required at a rate of 0.50% (by weight % of total asphalt binder

4. **Evotherm™**

Evotherm is a product developed by MeadWestvaco Asphalt Innovations, Charleston, South Carolina. Evotherm uses a chemical additive technology and a "Dispersed Asphalt Technology" delivery system. MeadWestvaco states that by using this technology a unique chemistry customized for aggregate compatibility is delivered into a dispersed asphalt phase (emulsion). During production, the asphalt emulsion with Evotherm chemical package is used in place of the traditional asphalt binder. The emulsion is then mixed with the aggregate in the HMA plant. MeadWestvaco reports that this chemistry provides aggregate coating, workability, adhesion, and improved compaction with no change in materials or job mix formula required.

MeadWestvaco reports that field testing has demonstrated a 100° F reduction in production temperatures. MeadWestvaco also reports that the decreased production temperatures of the Evotherm process can lead to plant energy savings of 55 percent; which results in a 45 percent reduction in CO_2 and SO_2 emissions, a 60% reduction in NOX, a 41% reduction in total organic material, and benzene soluble fractions below detectable limits.

MeadWestvaco has introduced its third generation of the technology co-developed by Paragon Technical Services, Inc & Mathy Technology and Engineering Services. The technology called Evotherm 3G and also branded as REVIX™ Reduced Temperature Asphalt is water free and does not rely on the principles of asphalt binder foaming or other methods of viscosity reduction. Mathy states that the technology is based on work that shows the additives provide a reduction in the internal friction between aggregate particles and the thin films of binders used to produce bituminous mixtures when subjected to high shear rates during mixing and high shear stresses during compaction; and rheological testing is used to determine the mix production and compaction temperatures.

Presence of Iron-Oxides

- Recent rise in the presence of Iron-Oxides
  - Rust Streaks
  - Pop Outs
  - Earlier and faster degradation of asphalt surfacing

Presence of Iron-Oxides

Presence of Iron-Oxides

Flush & Sand Seal

- Provide weather protection against any Iron-Oxides still present
- Sand
  - Allows re-opening of roadway sooner with minimized tracking
  - Provides a friction surface for winter weather events
- SS-1h or CSS-1h @ minimum of 0.05 gal/SY
- Sand applied @ minimum of 8 lbs/SY
- 2018 – Demonstration project utilizing fractionated RAP for blotter

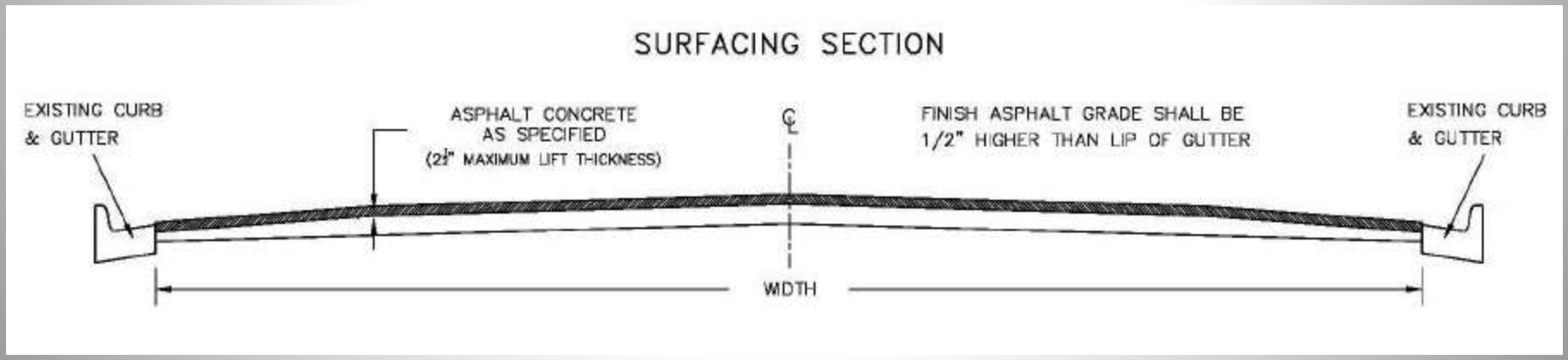
Flush & Sand Seal

Local Roads (Straight Overlay)

- Straight Overlay
  - Not used in the past
  - Class “E” Modified Type II Mix
  - $ 6.21/SY ($9,950/Block)

THIN LIFT ASPHALT -MINIMUM AIR TEMPERATURES & SEASONAL LIMITATIONS				
Compacted Thickness	Surface Course		Subsurface Course & Shoulder Course	
	Minimum Temperature*1	Seasonal Limits	Minimum Temperature*1	Seasonal Limits
1.5 inch or less	60	June 1 - Sep. 15 (inclusive)	N/A	N/A

*1 Minimum air and surface temperature in the shade.



Straight Overlay – Thin Mix

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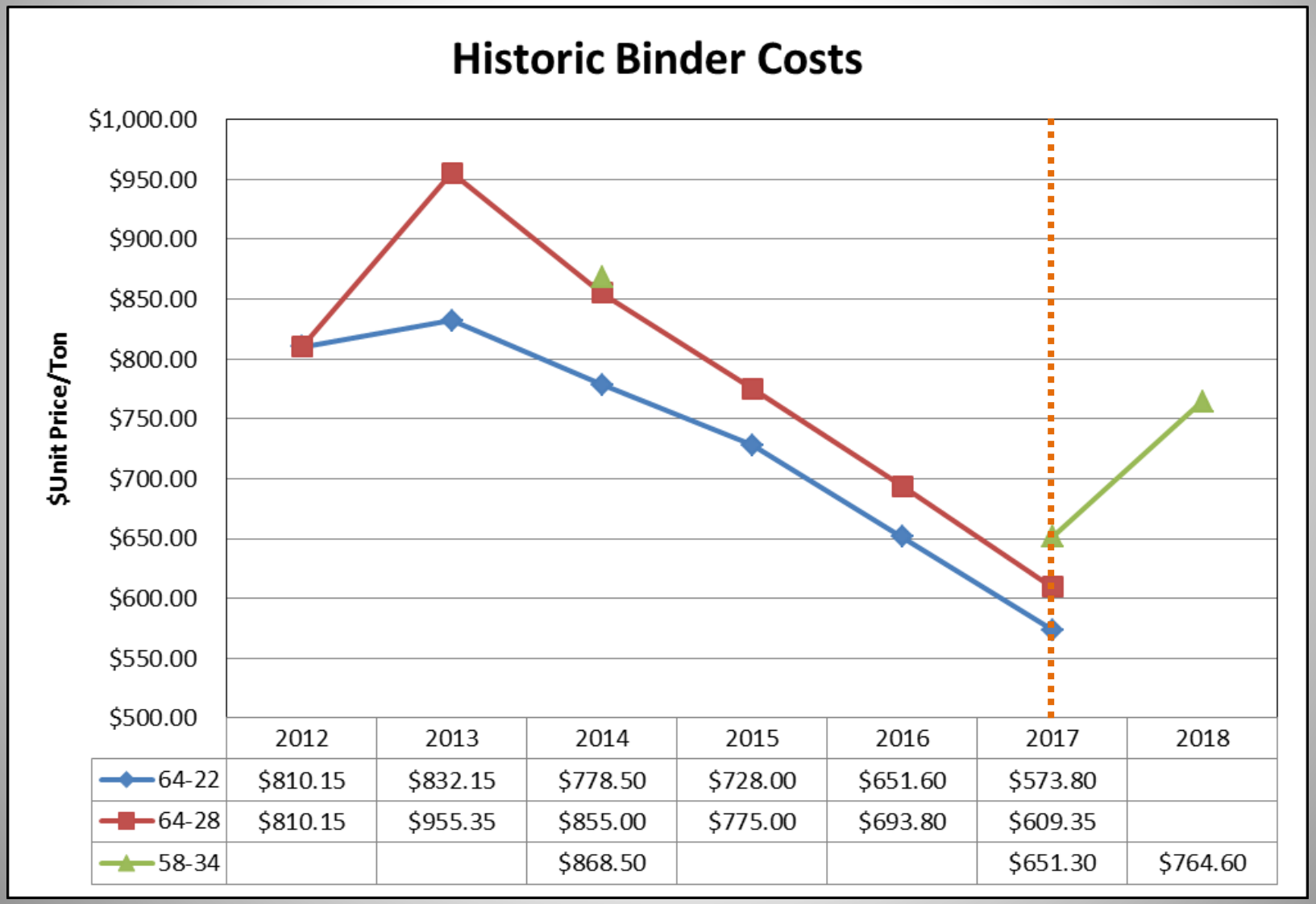
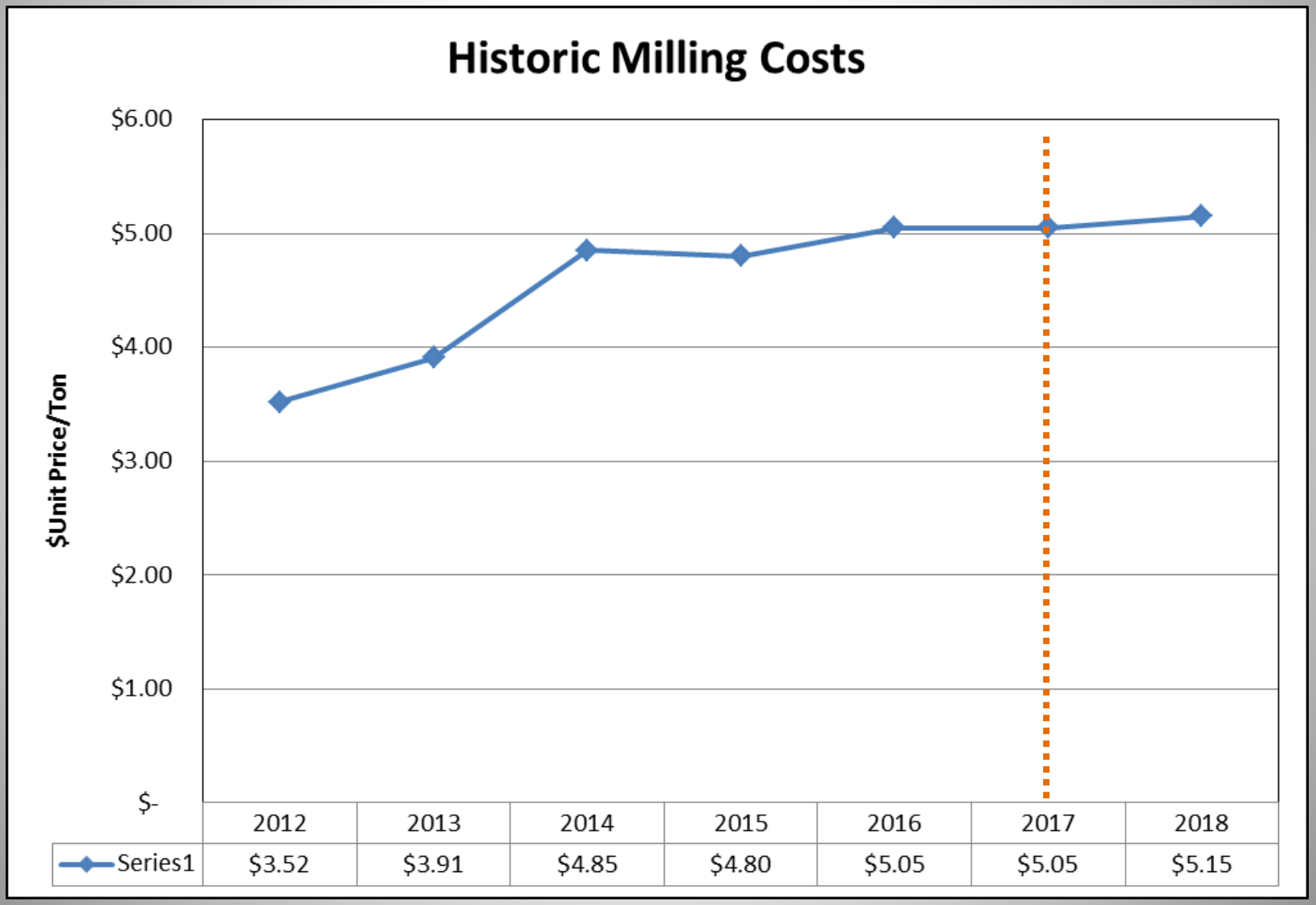
Cost Comparison



	2012	2013	2014	2015	2016	2017	2018
64-22	$810.15	$832.15	$778.50	$728.00	$651.60	$573.80	
64-28	$810.15	$955.35	$855.00	$775.00	$693.80	$609.35	
58-34			$868.50			$651.30	$764.60

Cost Comparison



Cost Comparison - RAP

Bid Schedule "A" Alternate 1	Units	Unit Price	Total
Tack, SS-1h or CSS-1h (min .05 gal/SY)	36.6	$775.00	$28,365.00
Performance Grade 64-22 Asphalt Binder	386.2	$573.80	$221,601.56
Performance Grade 64-28 Asphalt Binder	393.1	$609.35	$239,535.49
Cold Milling Asphalt 0-2" Full Depth	49205	$5.05	$248,485.25
Additional Depth Cold Milling (>2")	100	$3.00	$300.00
Asphalt Concrete Class E (Modified)	11486	$68.85	$790,811.10
Asphalt Concrete Class E (Thin Lift)	820	$69.85	$57,277.00
Total Bid Schedule "A" - Alternate 1		**$1,586,375.40**	

Bid Schedule "A" Alternate 2	Units	Unit Price	Total
Tack, SS-1h or CSS-1h (min .05 gal/SY)	36.6	$775.00	$28,365.00
Performance Grade 58-34 Asphalt Binder	659.4	$651.30	$429,467.22
Cold Milling Asphalt 0-2" Full Depth	49205	$5.05	$248,485.25
Additional Depth Cold Milling (>2")	100	$3.00	$300.00
Asphalt Concrete Class E (Modified)	11486	$66.30	$761,521.80
Asphalt Concrete Class E (Thin Lift)	820	$69.85	$57,277.00
Total Bid Schedule "A" - Alternate 2		**$1,525,416.27**	

Bid Schedule "B"	Units	Unit Price	Total
Tack, SS-1h or CSS-1h (min .05 gal/SY)	18.0	$745.00	$13,410.00
Sand for Flush Seal (min 8 lbs/SY)	347	$65.00	$22,555.00
Total Bid Schedule "B"		**$35,965.00**	

$221,601.56 $461,137.05

$239,535.49 $429,467.22

$461,137.05 **$ 31,669.83**

Oil Savings

$790,811.10 HMA Savings

$761,521.80

$ 29,289.30

Total Savings $ 31,669.83

$ 29,289.30

$ 60,959.13

$5.31/Ton Savings

Asphalt Specifications Update

2018

2018

Guidelines & Best Practices for Local Road and Street Design and Construction

Referencing 2015 SDDOT Standard Specifications

Dakota Asphalt Pavement Association, Inc.

Ken Swedeen, Exec. Director
Dakota Asphalt Pavement Association
3/1/2018

Asphalt Specifications Update

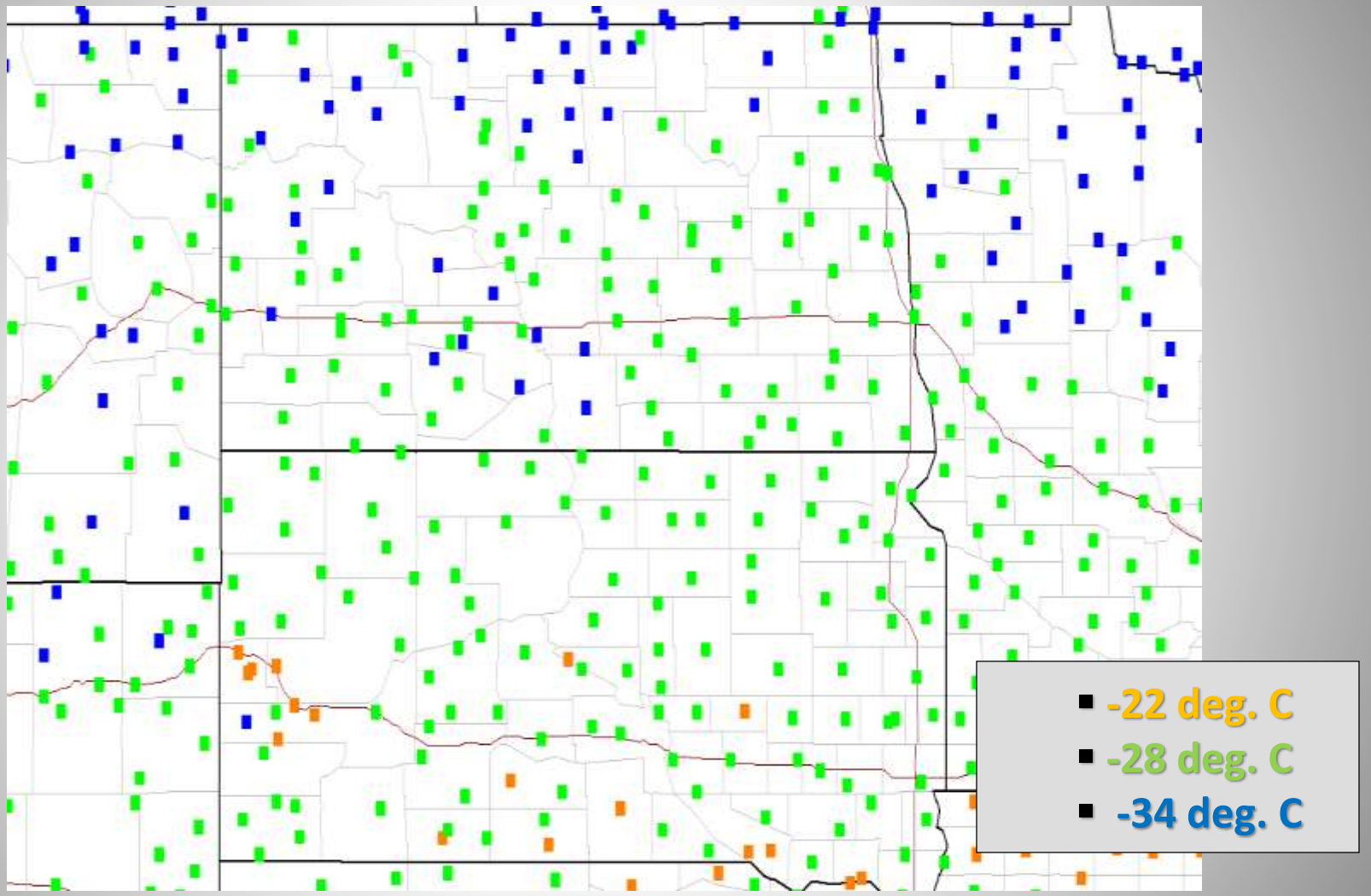


Figure 1 Low Temp 50% Reliability

Asphalt Specifications Update

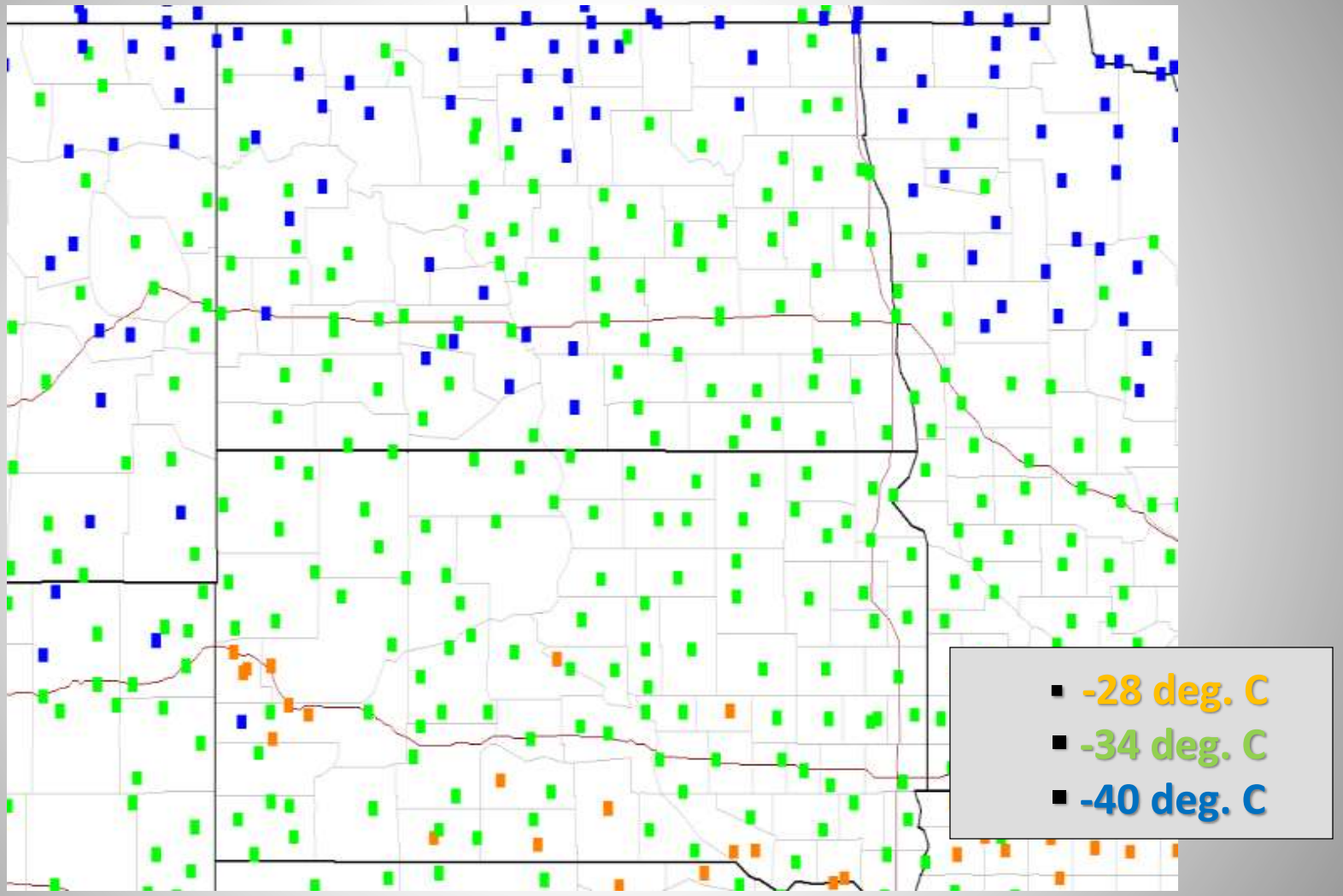


Figure 2 Low Temp 98% Reliability

Asphalt Specifications Update

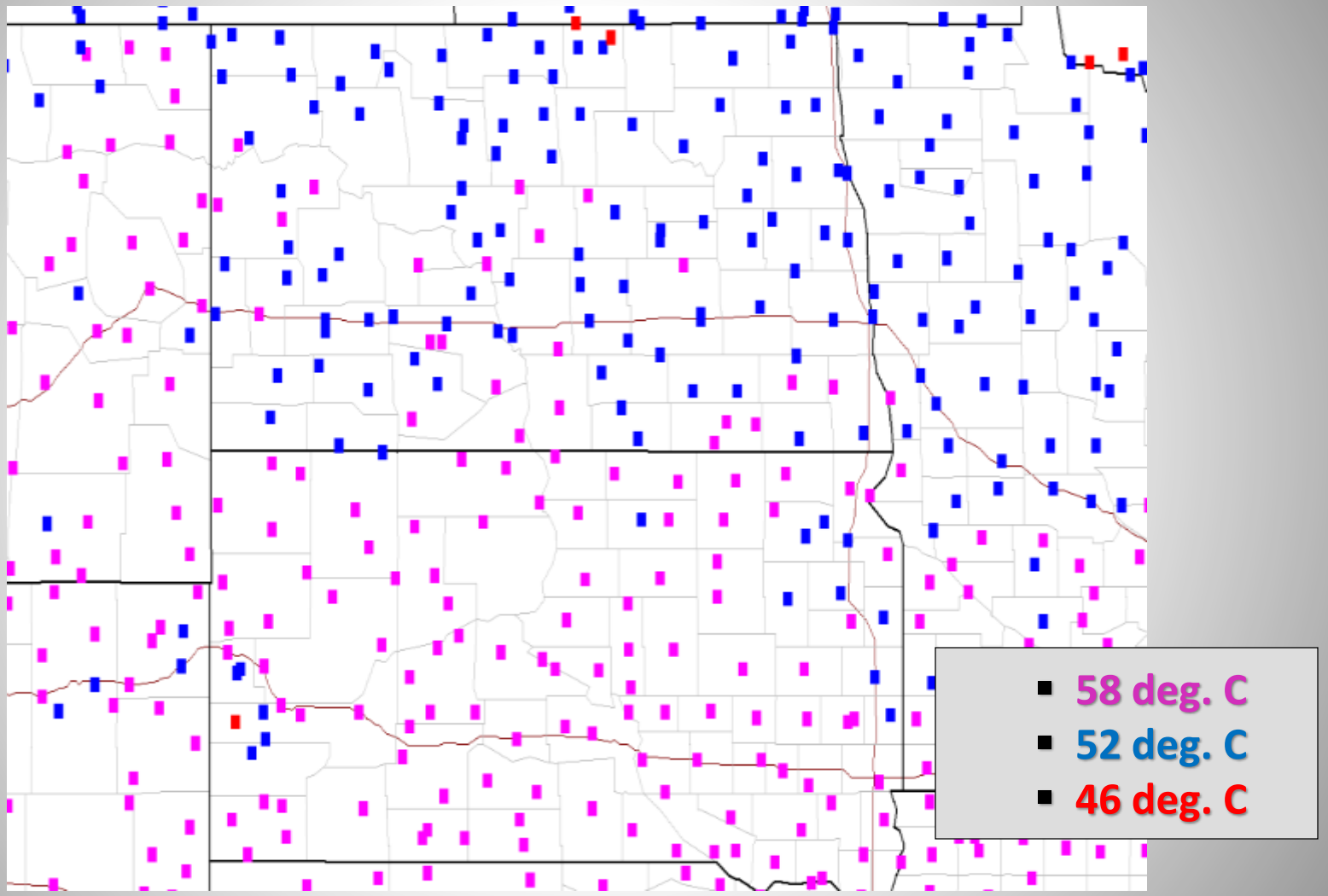


Figure 3 High Temp 50% Reliability

Asphalt Specifications Update

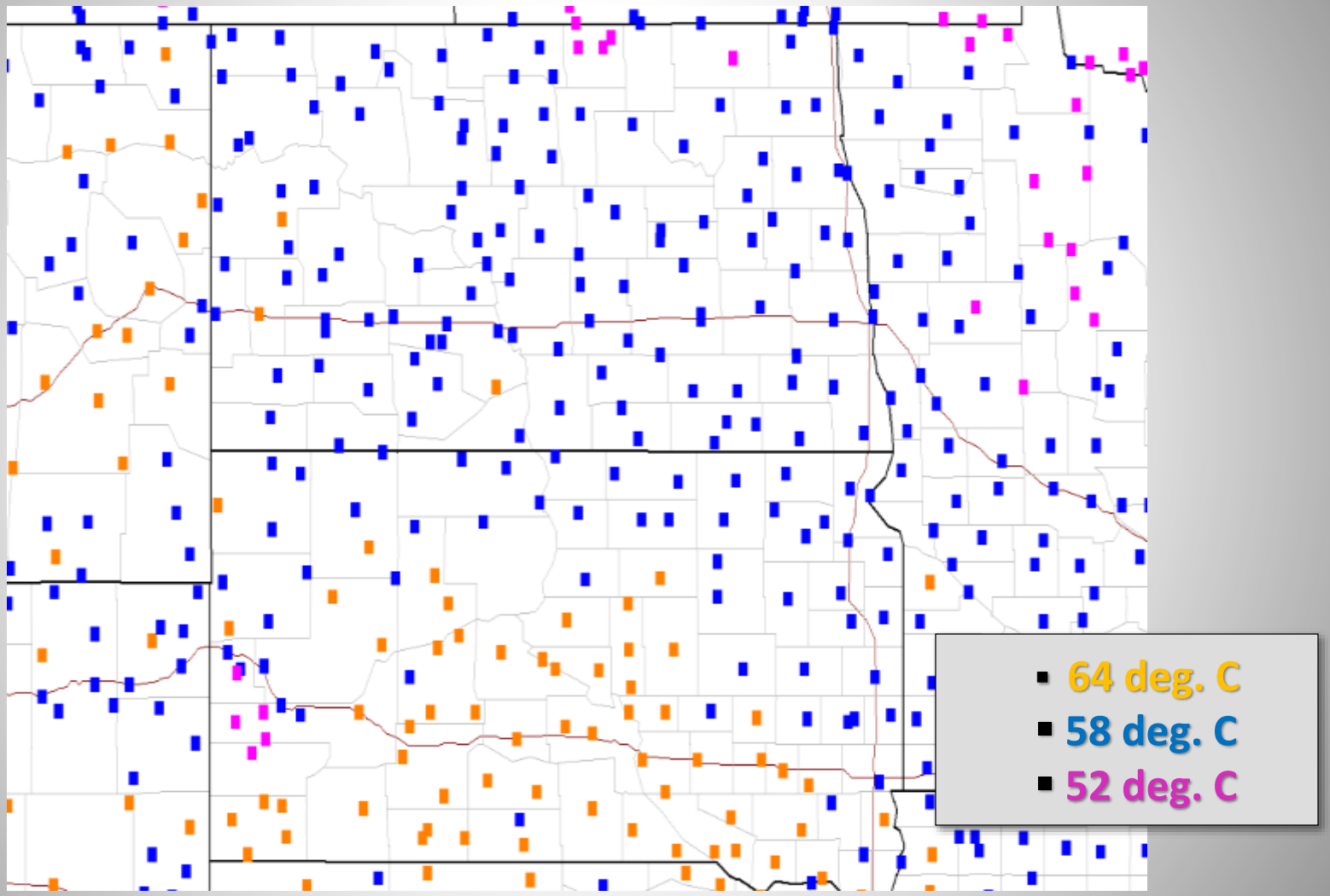


Figure 4 High Temp 98% Reliability

Questions