Warm Mix Implementation: New Brunswick's Experience

OAPC 2020 Fall Asphalt Seminar

November 26, 2020

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New Brunswick Dept. of Transportation & Infrastructure

New Nouveau Brunswick

Outline

- Paving in New Brunswick
- Binder Evaluation
- History of WMA in NB
- Warm Mix Asphalt Usage
- Why?
- Where?
- Specification
- Challenges/Issues
- Warm Mix Approval process
- Recommendations

New Brunswick

- Population: 775,000
- 3 major cities
  - Fredericton, Moncton & Saint John
- Bay of Fundy
- Longest covered bridge
- Largest lobster
- Warmest saltwater beaches north of Virginia

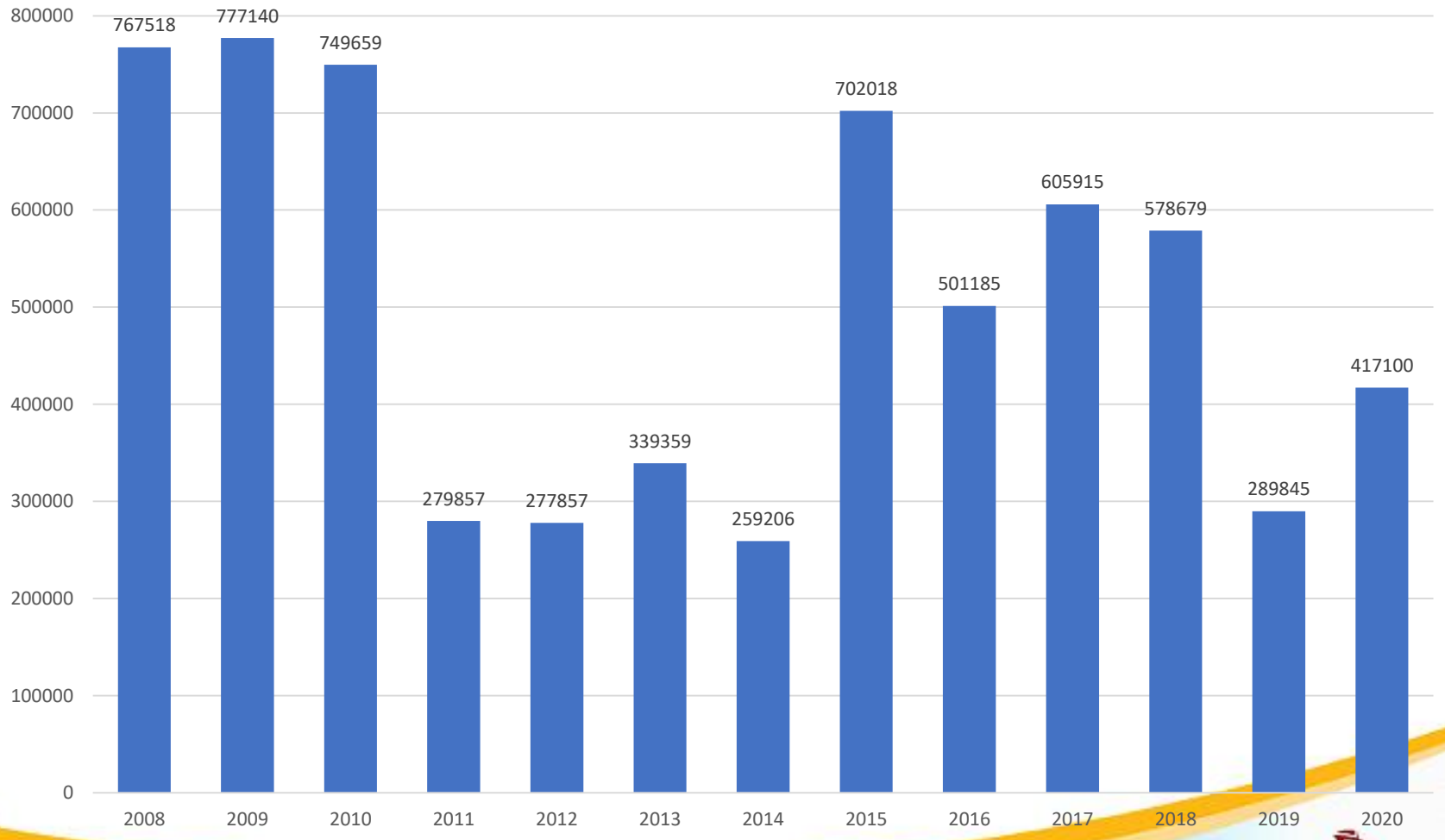
NB Road Network

- Total Network: 47,500 ln-km
  - Asphalt: 15,500 ln-km
  - Chip seal: 18,400 ln-km
  - Other: 13,600 ln-km
- Arterials (5,900 km):
  - 24000 – 38000 AADT (urban)
  - 1000 – 17000 AADT (rural)
- Collectors (6,400km):
  - 7000 – 11000 AADT (u) & 600 – 22000 (r)
- Locals (6,650km)
  - 500 – 1000 AADT

Paving in NB

- NB Dept. of Transportation & Infrastructure (DTI)
  - Capital Paving Program:
  - Municipal Paving Programs:
    - Small municipalities:
      - DTI administered contracts with DTI specifications
    - Large:
      - Administer their own contracts and have their own specific
      - Some specifications reference DTI spec
  - P3 projects:
    - Administer their own projects with their own specs

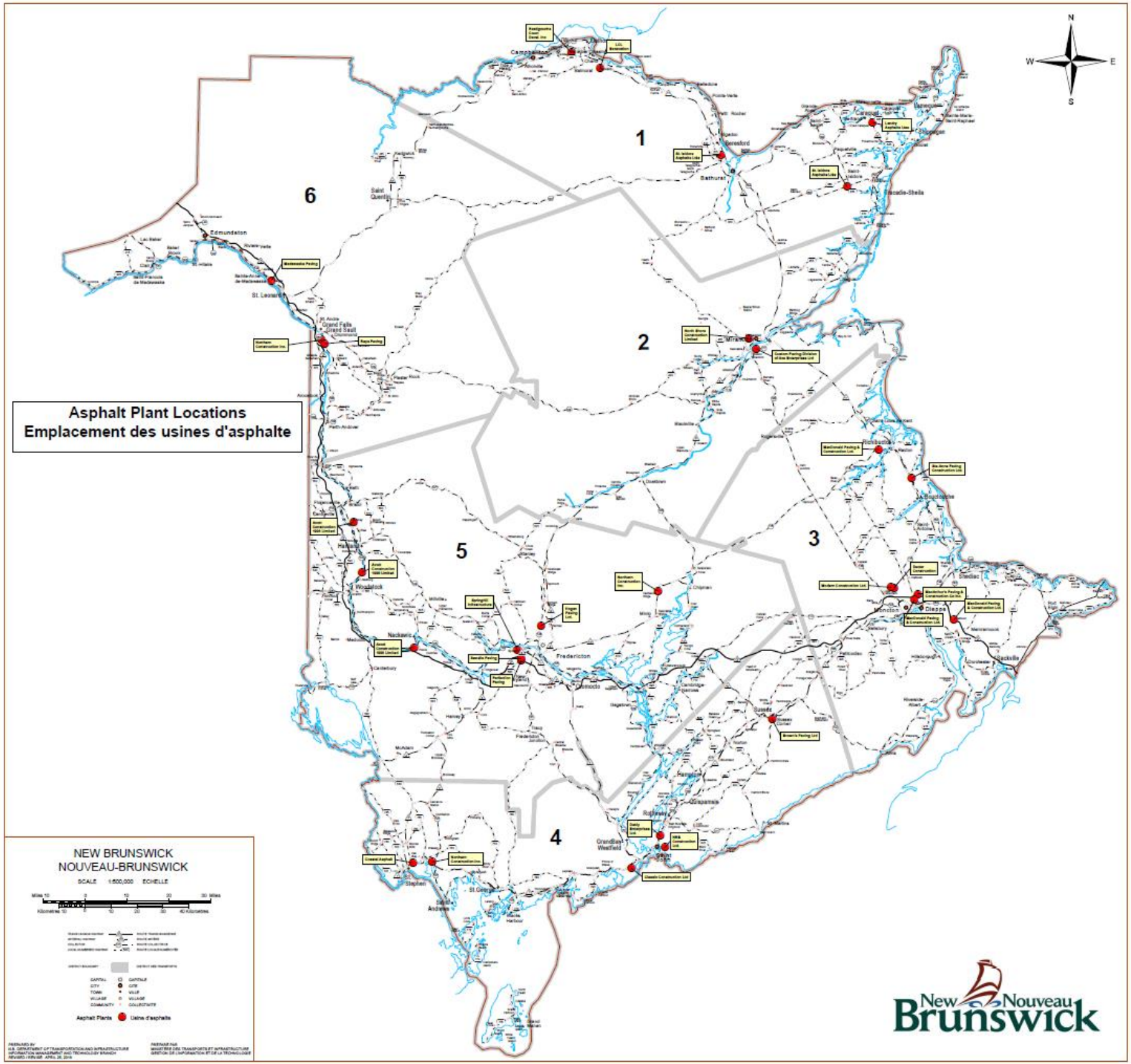
Paving program



NB Paving Industry

- 13 Contractors
  - Small Contractors: 2,000 – 5,000 t annually
  - Large Contractors: 70,000 – 100,000+ annually

- 22 Asphalt plants
  - Drum & batch plants
  - Permanent/Portable
  - Warm Mix
    - All plants are capable of producing WMA
    - Most contractors utilize chemical
    - 3 contractors utilize foam kits

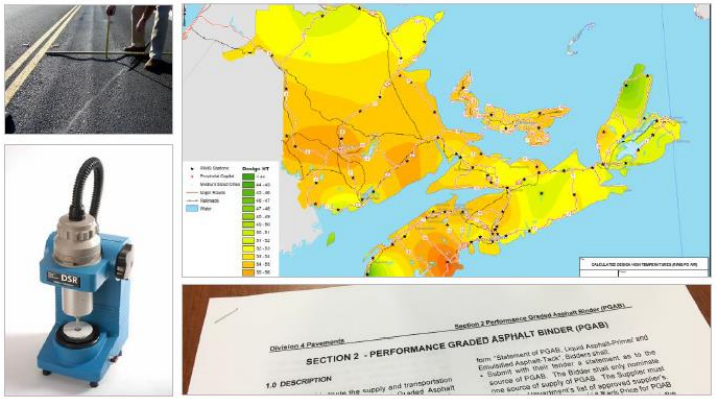

Asphalt Plant Locations
Emplacement des usines d'asphalte
1
2
3
4
5
6
N
W
E
S
NEW BRUNSWICK
NOUVEAU-BRUNSWICK
Asphalt Plants
Usine d'asphalte
New Nouveau Brunswick

NBDTI PG Binder Grade Evaluation

wood.

Report No. TV175003.181001

Review of Performance Graded Asphalt Binder Requirements in the Maritime Provinces



Wood Environment & Infrastructure Solutions,
A Division of Wood Canada Limited
50 Troop Avenue, Unit 300
Dartmouth, NS B3B 1Z1

March 28, 2018

New Nouveau Brunswick

NBDTI PG Binder Grade Evaluation

- Original Study looked at using 24 RWIS stations from around the province (noted in the table)
- Was expanded by a few site to better define the boarder between the -28 and -34
- RWIS stations have sensors that measure air and asphalt temperatures in real time
- Utilized both air and asphalt, recommendation was to use the asphalt temperature for evaluation

RWIS sites for PGAC classification	
Route 1	Waweig
	Rothesay
	Penobsquis
Route 2	Quisibis Hill
	Aroostoock River
	Longs Creek
	Mill Cove
	Magnetic Hill
	Sackville
Route 3	Flume Ridge Road
Route 7	Camp Petersville
	Grand Bay-Westfield
Route 8	New Bandon
Route 11	Blackland
	Bathurst
	Miramichi
	Bouctouche
Route 15	Cap Pele
Route 17	Glenwood
	Saint-Martin-de-Restigouche
Route 95	Route 95
Route 113	Shippagan
Route 148	Durham Bridge
Route 175	Pennfield Ridge

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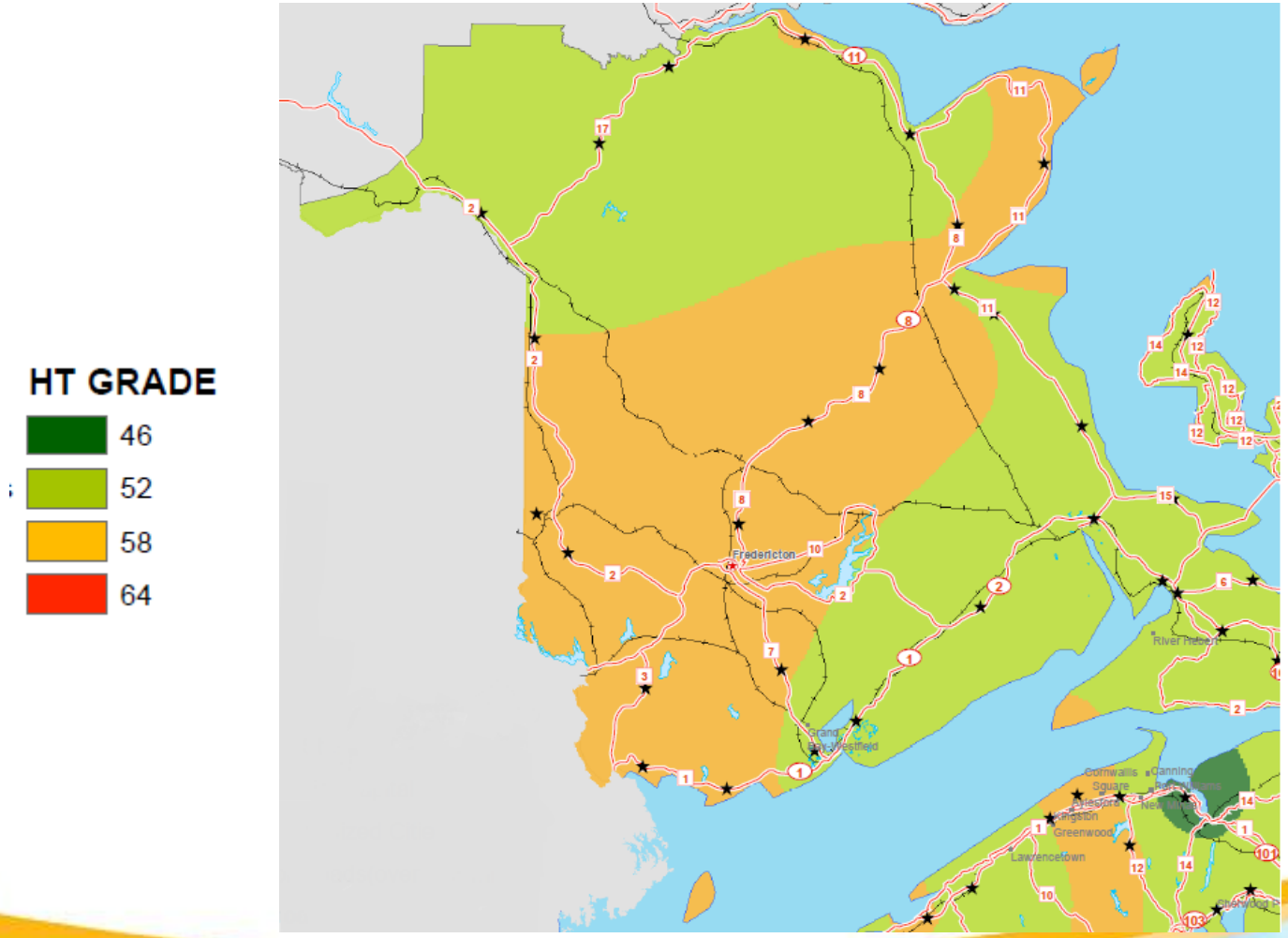
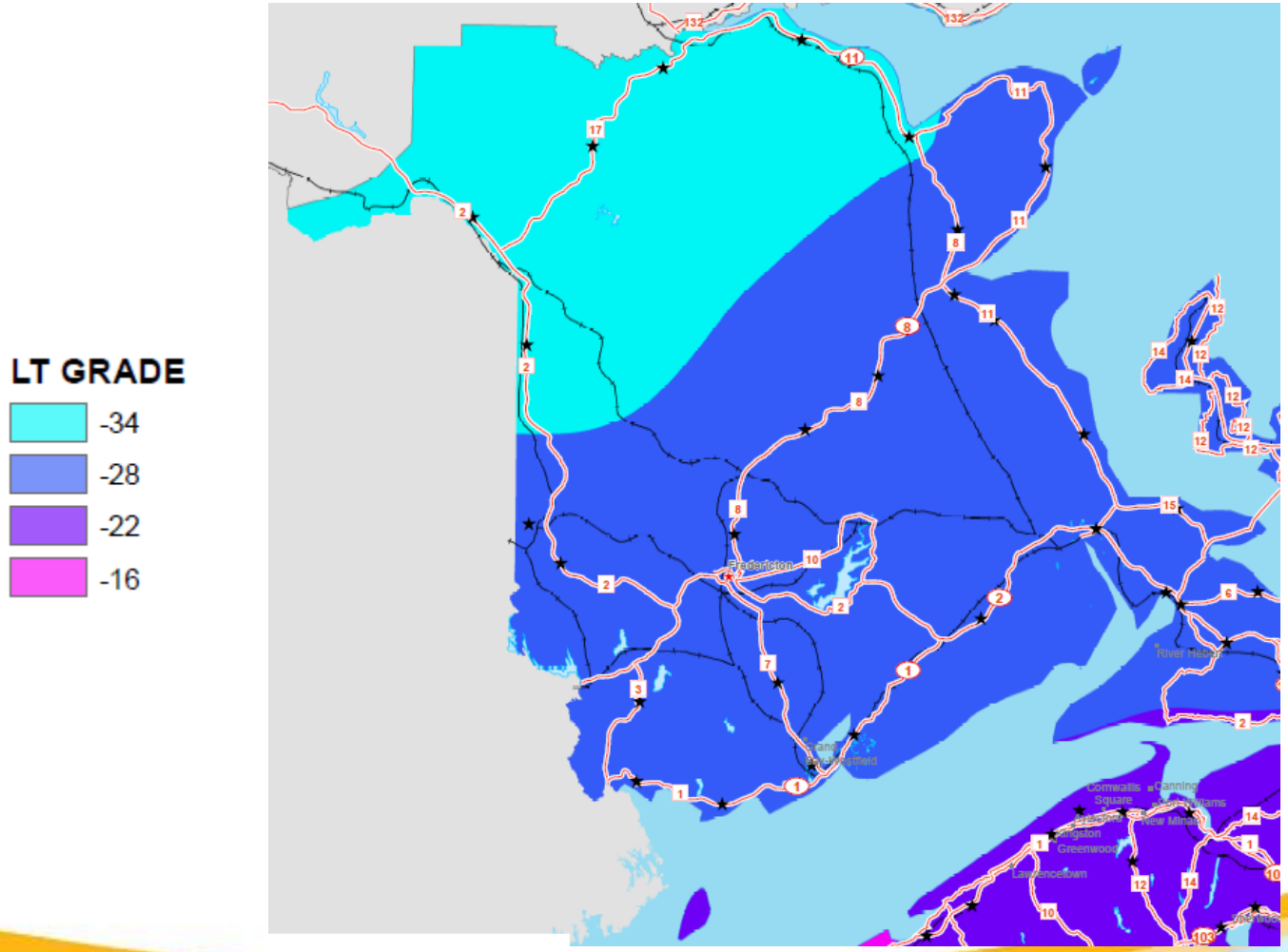
NBDTI PG Binder Grade Evaluation



NBDTI PG Binder Grade Evaluation



NBDTI Binder Specification

- AASHTO M332
- Implemented for the 2019 construction season

Replace

261.2.1.1.3 **Performance Grade (PG) asphalt binder shall meet the requirements of AASHTO M332, Table 1 – Performance Graded Asphalt Binder Specification and Table 261-1A.**

Add

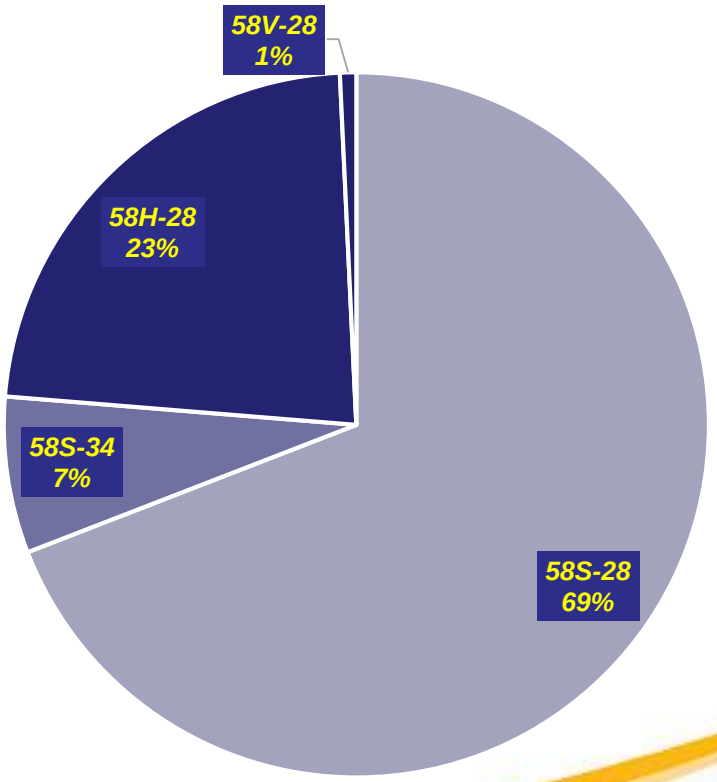
Table 261-1A
MSCR % Recovery Requirements

Traffic Designation	J_{nr} (@ 3.2 kPa)	% Recovery (min)
S	≤ 4.5 kPa^{-1}	-
H	≤ 2.0 kPa^{-1}	30%
V	≤ 1.0 kPa^{-1}	35%
E	≤ 0.5 kPa^{-1}	45%
	≤ 0.25 kPa^{-1}	55%

Asphalt Binder Grades

- Common Grades
  - 58S-28
  - 58H-28
  - 58S-34
- Uncommon
  - 58V-28
  - 58H-34
  - 52S-34
- WMA is used with all grades of binder

- 2019 Usage



NB Asphalt Binder Suppliers

BITUMAR

GLC GENERAL LIQUIDS CANADA

MC A McASPHALT

IRVING

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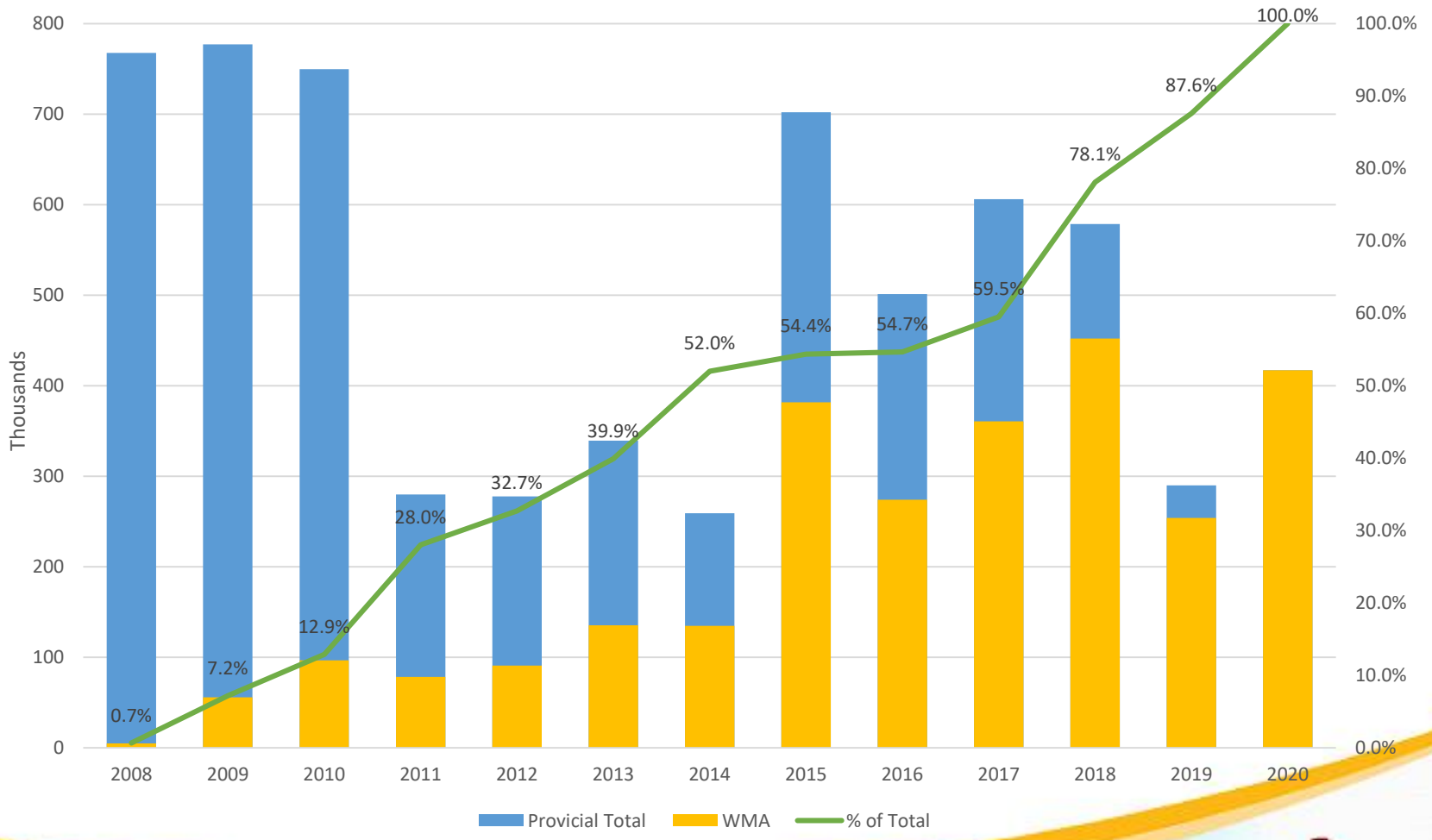
History of WMA

- 2008:
  - 2 trial sections were completed, ~5000t
  - Low volume local roads
  - Followed our method specification
- 2009:
  - Nine projects were completed, ~56,000t
  - Various road classification and traffic levels
  - Combination of Method/ERS specification
  - Late season tenders
- 2010: regular usage as part of the program

Warm Mix Asphalt Usage in NB



Why WMA?: Agency Perspective

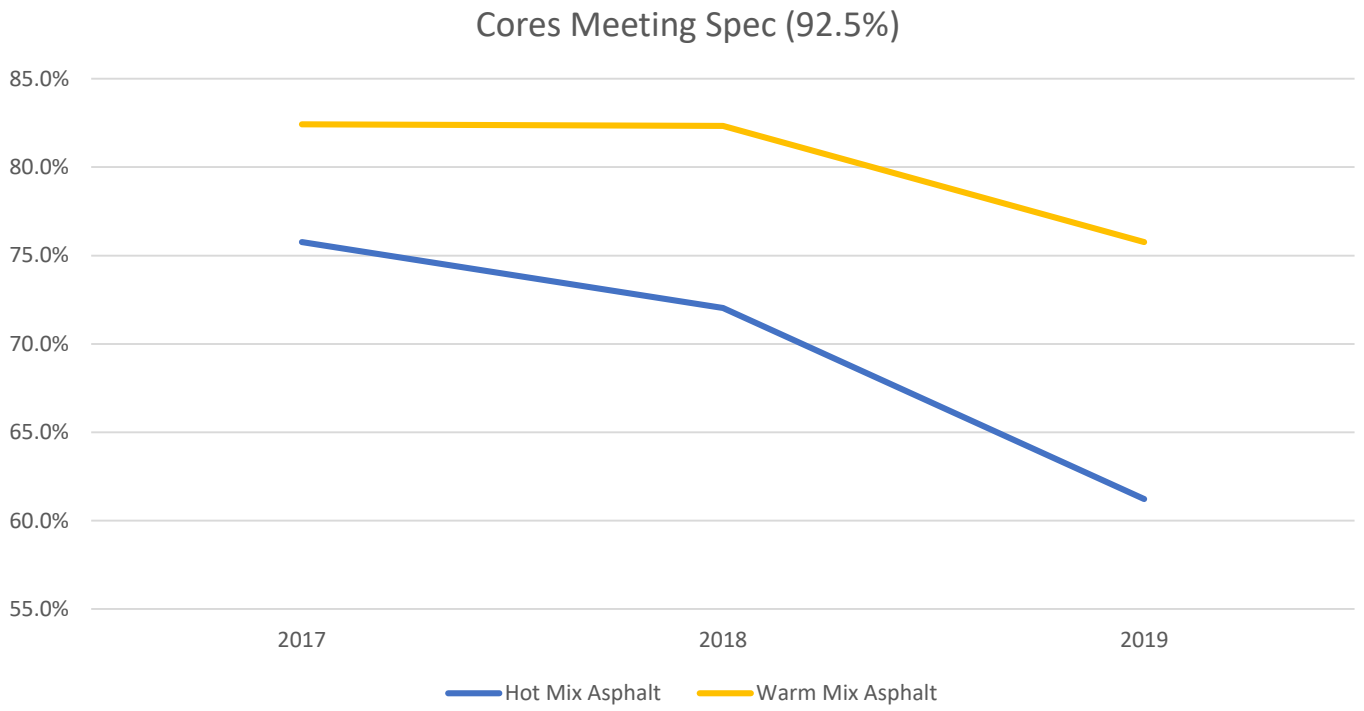
- Green aspects
  - Reduced Emission
  - Reduced fuel consumption
- Less fumes (blue smoke)
- Improved longitudinal joints
- Less oxidization/aging of the binder

Why WMA?: Agency Perspective

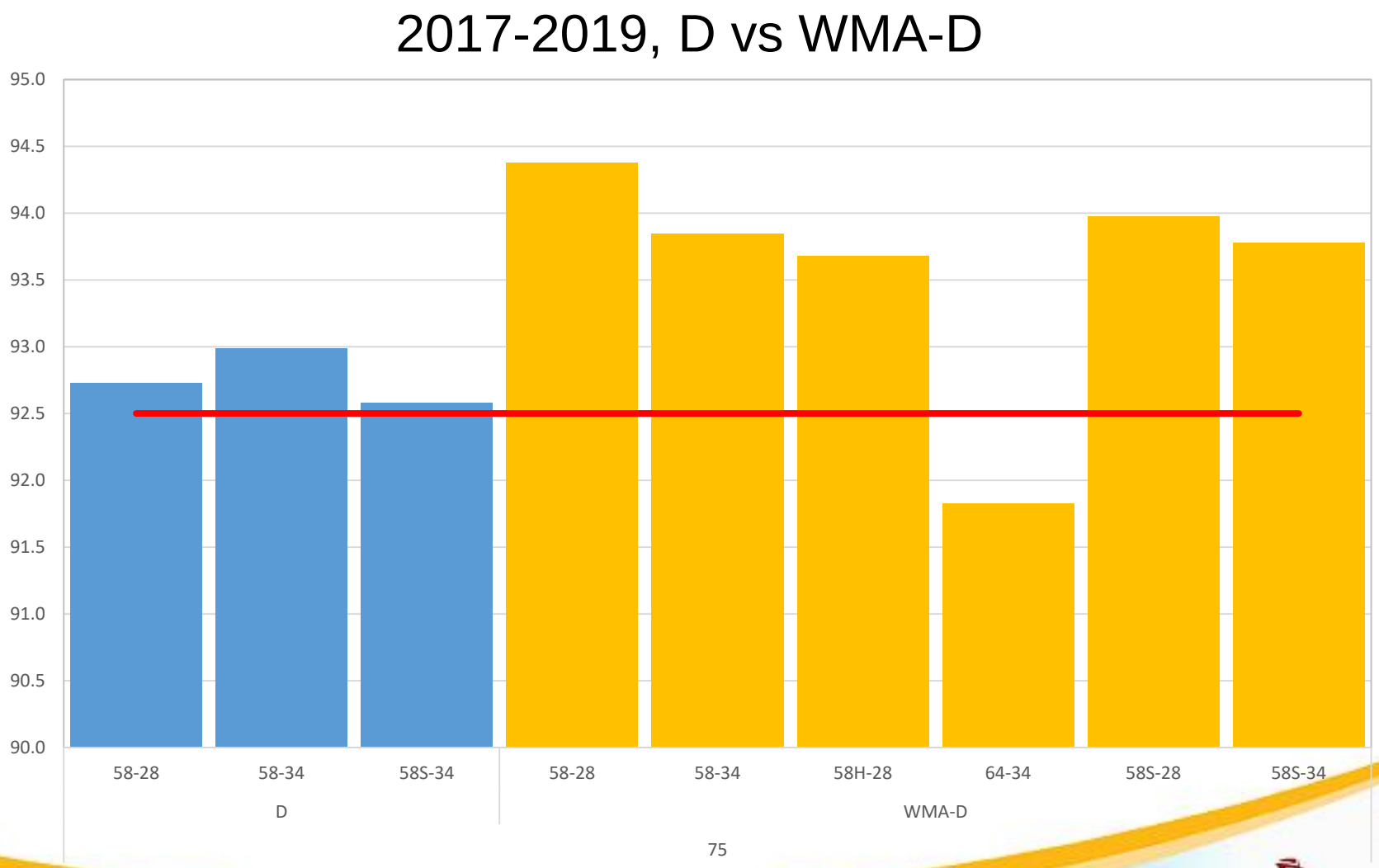
- Dual purpose anti-strip & WMA (chemical)
  - Improved moisture susceptibility
- Extended paving season
  - Improved compaction at lower temperatures when compared to HMA
- Longer haul distances
- Compaction Aid

Why WMA?: Agency Perspective

- Compaction Aid

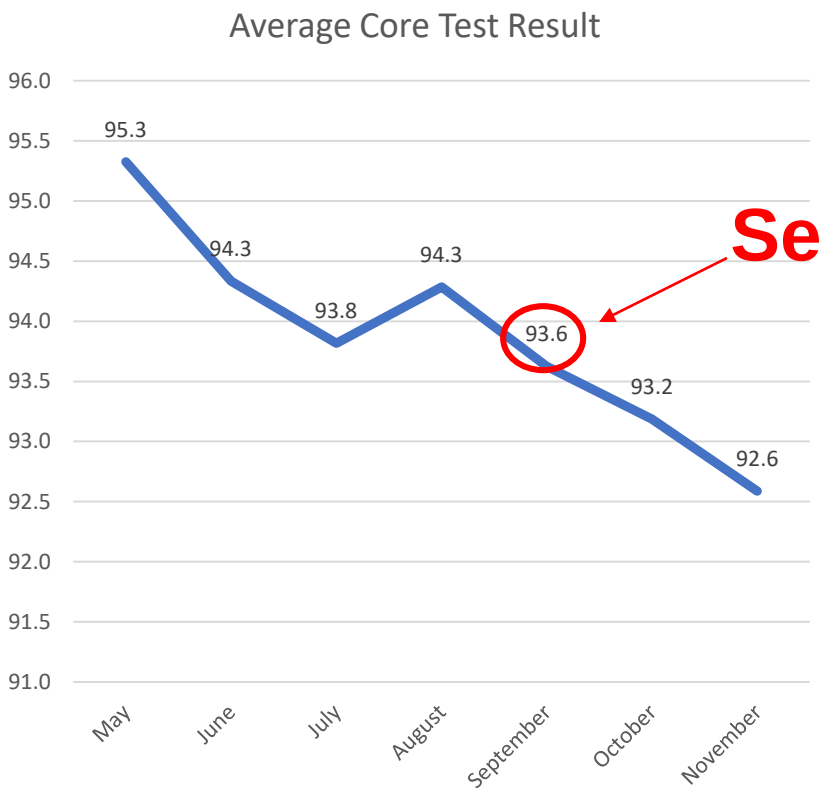


Compaction by Mix Type

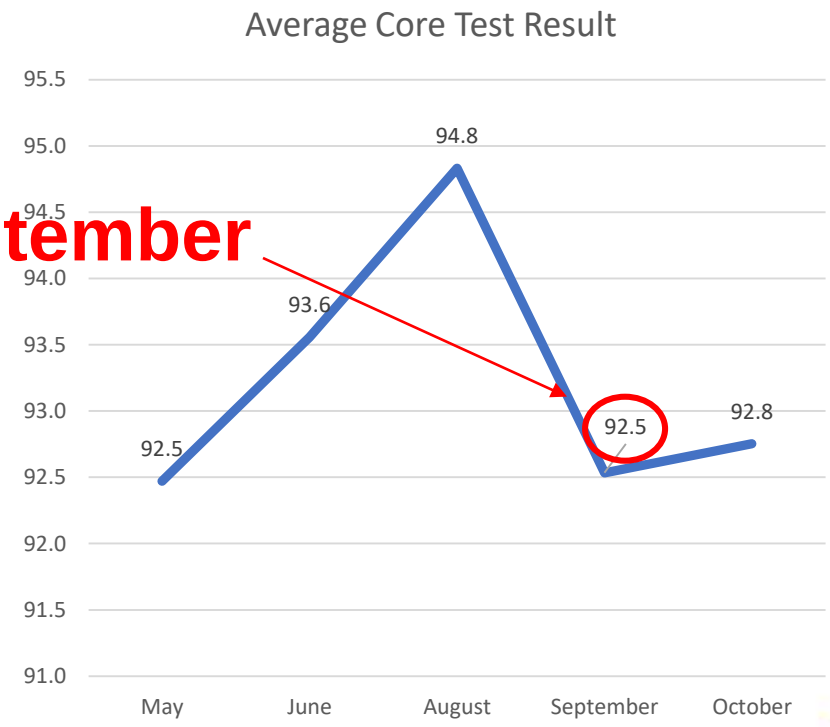


2019 – Avg % Compaction

WMA



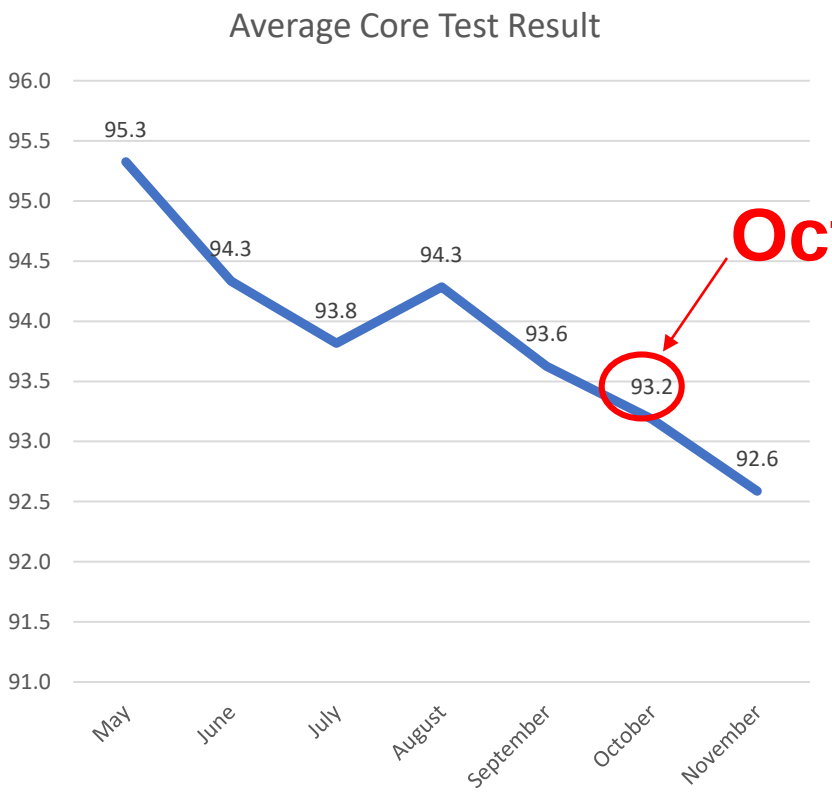
HMA



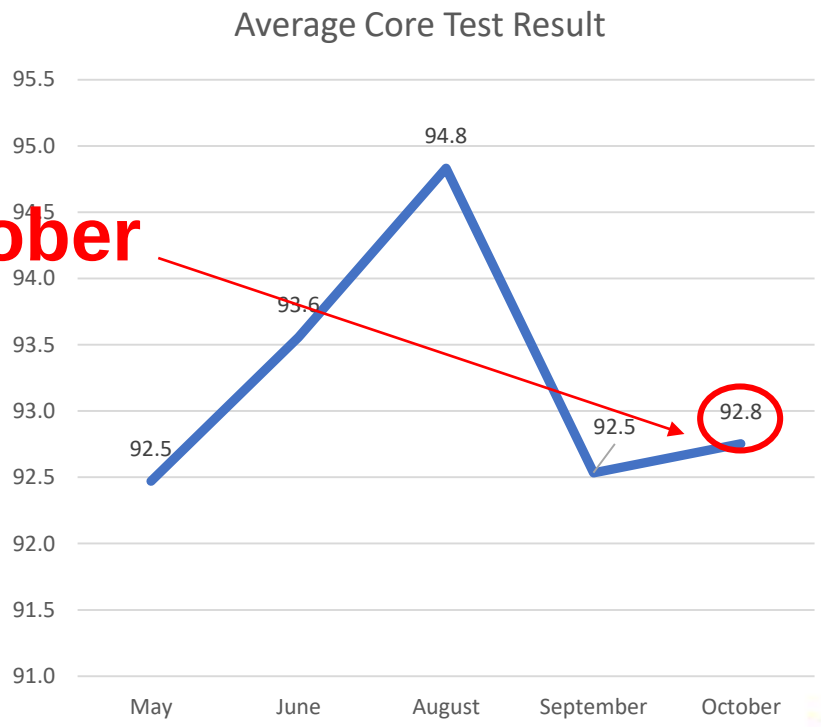
September

2019 – Avg % Compaction

WMA



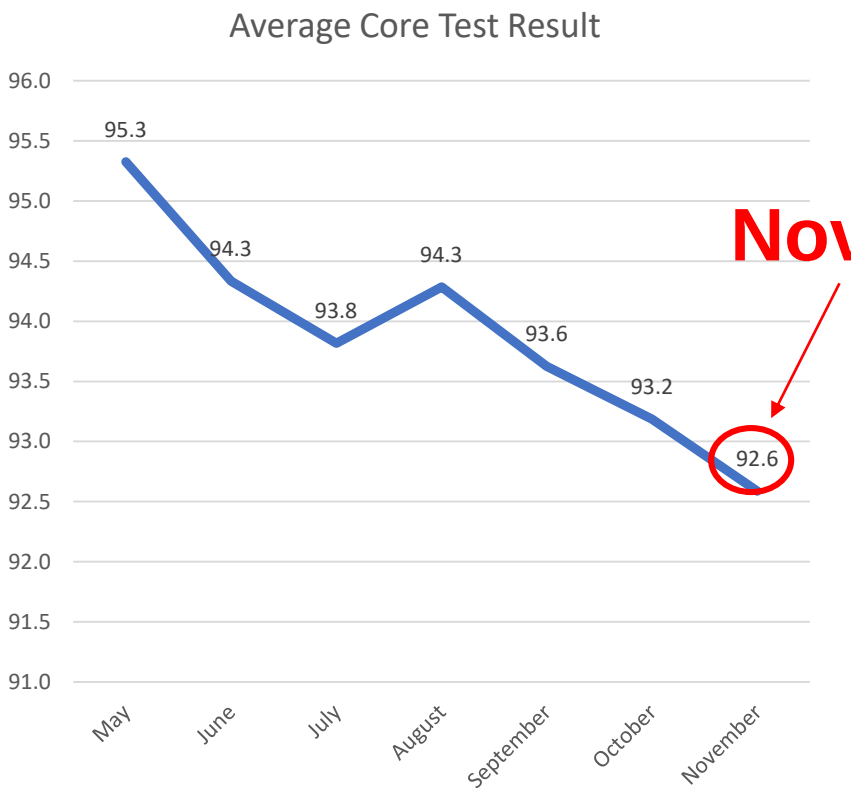
HMA



October

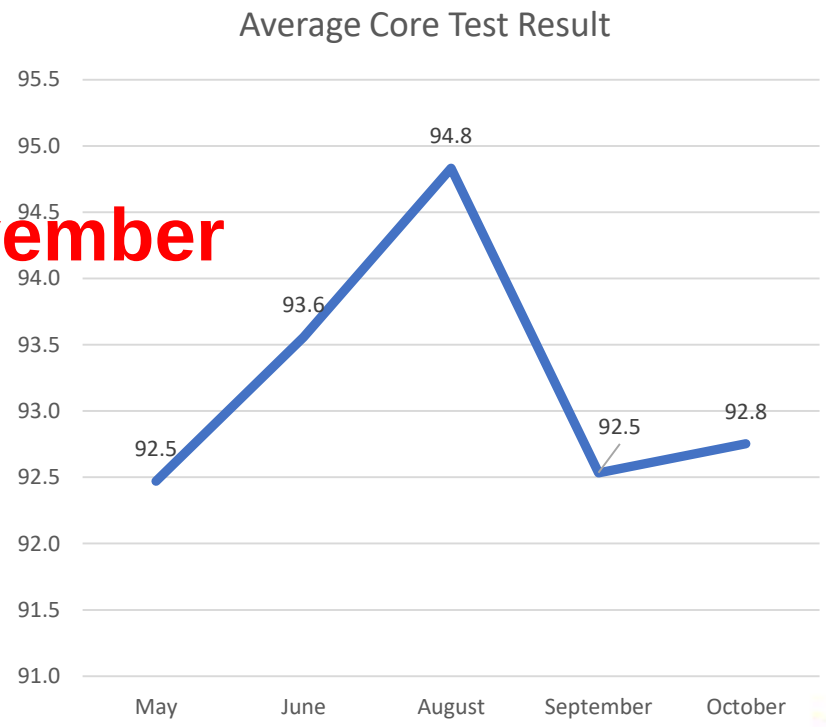
2019 – Avg % Compaction

WMA



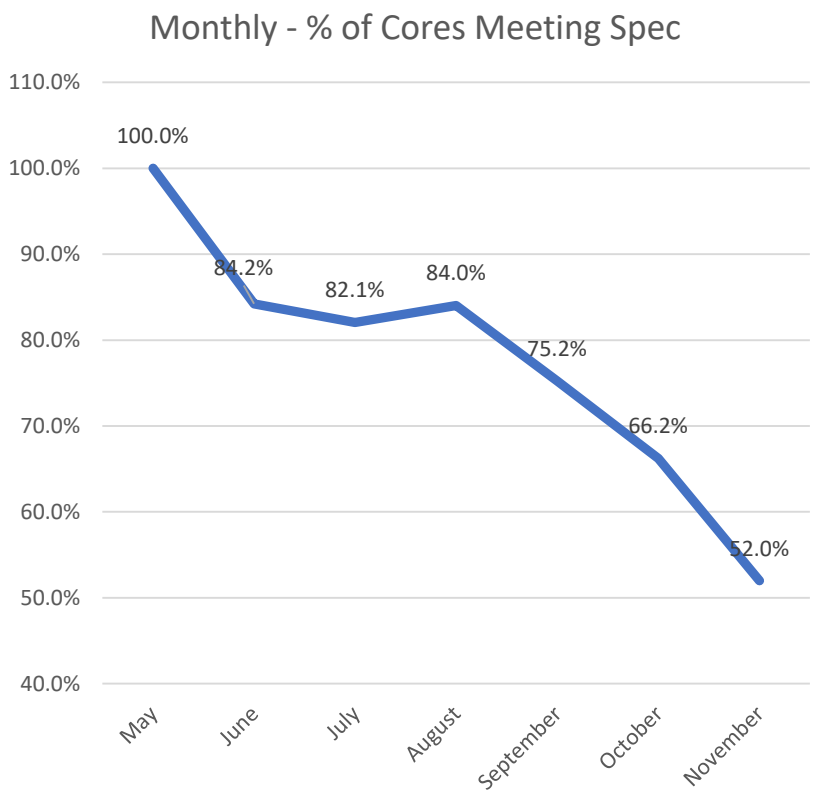
November

HMA

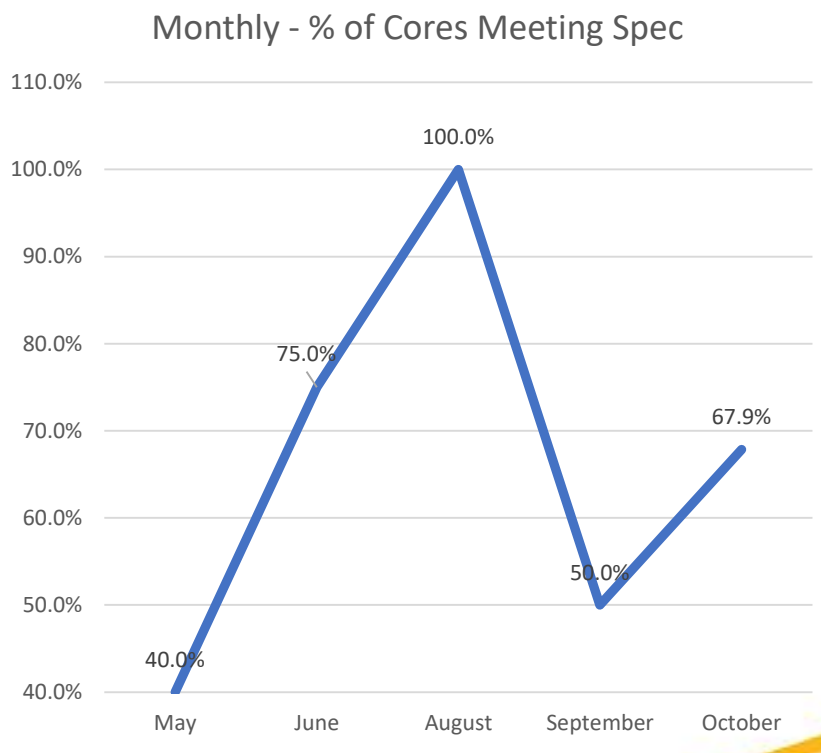


2019 –% Cores Meeting Spec

WMA



HMA



Where does NBDTI use WMA?

- Everywhere!
- New construction
- Rehabs/Reconstructions
- Leveling
- Bridge Decks
  - Will allow temperature to be increased depending on the waterproofing system
- With polymer binders
- RAP mixes
  - Limited experiences

WMA Usage: Treatments

- One lift (rehabs)
  - 50mm minimum lift thickness
    - Milled surface, FDR, PDR, Pulverized surface with aggregate base & Chip seal, existing surface
- Two lifts (rehabs)
  - 50mm base course, 38mm surface course
    - Milled surface, FDR, PDR Pulverized surface with or with aggregate base
- Three lifts (new construction or rehab)
  - 2 x 50mm base course, 38mm surface course
    - New aggregate subbase & base

RAP in New Brunswick

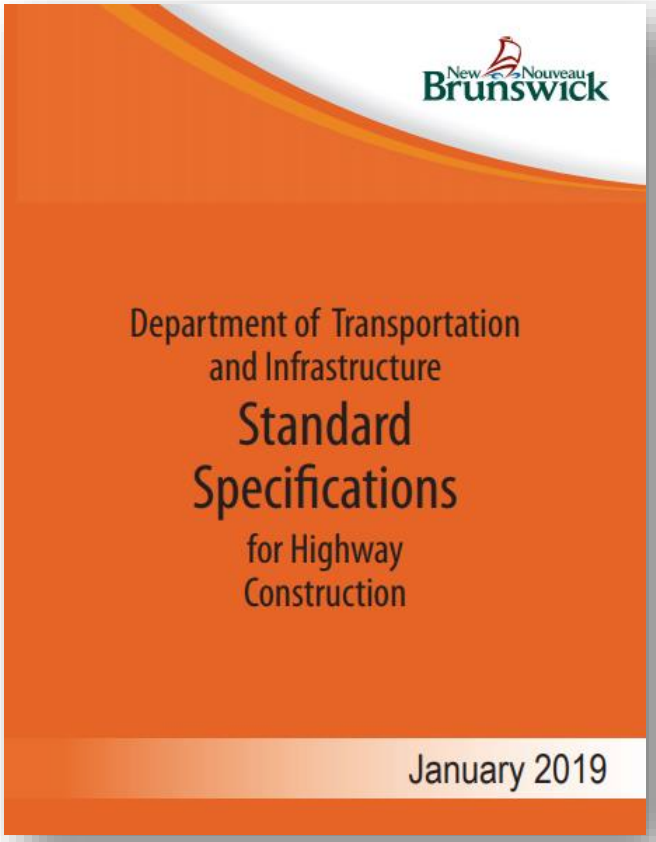
- All RAP remains property of DTI
  - Shoulder material
  - Leveling for chip seal
  - Road surfacing & other maintenance activities
  - Asphalt mixes
- RAP in mixes
  - Typically on contract with >5000t of mix
  - Close to asphalt plant
  - Contractor's ability to recycle

RAP & Warm Mix Asphalt

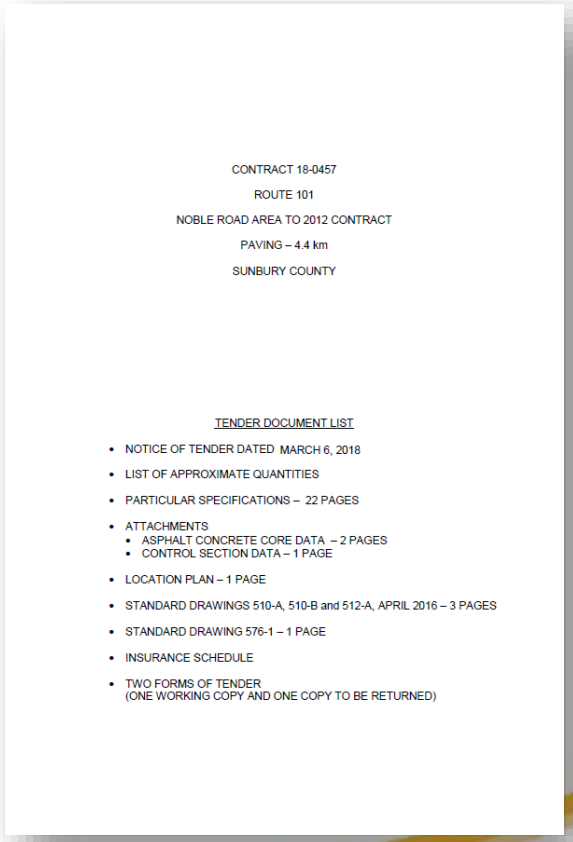
- RAP Mixes:
  - HRB/WMA-RB: 30 ± 5% RAP
    - PG 52S-34
  - HRD/WMA-RD: 15 ± 5% RAP
    - PG 58S-28
- Limited Experience with RAP and WMA
- Two contracts;
  - 19-0624, Route 3, 7.1km, mill/fill
  - 20-0854, Route 7 & Kimble Dr., 6.3km, mill/fill

NBDTI Specification

Standard Specification



Particular Specification



CONTRACT 18-0457

ROUTE 101

NOBLE ROAD AREA TO 2012 CONTRACT

PAVING – 4.4 km

SUNBURY COUNTY

TENDER DOCUMENT LIST

- NOTICE OF TENDER DATED MARCH 6, 2018
- LIST OF APPROXIMATE QUANTITIES
- PARTICULAR SPECIFICATIONS – 22 PAGES
- ATTACHMENTS
  - ASPHALT CONCRETE CORE DATA – 2 PAGES
  - CONTROL SECTION DATA – 1 PAGE
- LOCATION PLAN – 1 PAGE
- STANDARD DRAWINGS 510-A, 510-B and 512-A, APRIL 2016 – 3 PAGES
- STANDARD DRAWING 576-1 – 1 PAGE
- INSURANCE SCHEDULE
- TWO FORMS OF TENDER
  (ONE WORKING COPY AND ONE COPY TO BE RETURNED)

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Standard Specifications

- Forms the basis of understanding of our work
- Broken up into distinct sections
  - 100 Grading
  - 200 Pavement Structure
  - 300 Structures
  - 400 Municipal
  - 500 Traffic Control Devices
  - 600 Environmental
  - 800 Payments and Adjustments
  - 900 Standard Conditions

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Standard Specifications

- Appendix contains Terms of Payment marked “A”, and General Conditions marked “B”
- Terms of Payment:
  - Progress Estimates, Holdback, Stat Decs, etc.
- General Conditions: contain everything from removal of work from the Contractor to the clauses that allow the Resident to access the worksite and everywhere else related to the project

Standard Specifications

- 200 Series:
  - Aggregate Base/Subbase
  - Shoulder Material
  - Cold Milling
  - Bituminous Tack Coat
  - Asphalt Concrete
  - Partial Depth Recycling
  - Full Depth Recycling
  - Microsurfacing
  - Chip Seal

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Particular Specifications

- Allows the Standard Specifications to be uniquely applied to each contract
- Requires understanding of Standard to make sense
- Add/Delete/Replace
- Job Specifics:
  - Mix types, WMA vs HMA
  - PG Binder Grade
  - Application rates
  - Locations, widths, etc.

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Asphalt Specifications

- Item 261: Asphalt Concrete - End Results Specification
  - Supply & placement of asphalt concrete
  - Supply of asphalt binder and any additives are included in this item
  - Follows Superpave
- In NB, WMA is mandated and specified in the Particular Specifications
- It is not a permissive specification

Specifications: Mix designations

- Hot Mix:
  - B: asphalt concrete base mix
  - C: asphalt concrete base/surface mix
  - D: asphalt concrete surface mix
  - HRB: recycled asphalt concrete base mix
  - HRD: recycled asphalt concrete surface mix
- Warm Mix:
  - WMA-B: asphalt concrete base mix
  - WMA-C: asphalt concrete base/surface mix
  - WMA-D: asphalt concrete surface mix
  - WMA-RB: recycled asphalt concrete base mix
  - WMA-RD: recycled asphalt concrete surface mix

Specification: Gradation

Sieve Size ASTM Designation		Type B/HRB/WMA-B	Type C/WMA-C	Type D/HRD/WMA-D
		% (by mass) Passing Each Sieve		
Coarse Aggregate	25.0 mm	100.0	-	-
	19.0 mm	84.0-98.0	-	-
	16.0 mm	72.0-94.0	100.0	-
	12.5 mm	60.0-87.0	88.0-98.0	100.0
	9.5 mm	51.0-75.0	68.0-90.0	76.0-98.0
	6.3 mm	41.0-66.0	54.0-77.0	60.0-84.0
Fine Aggregate	4.75 mm	34.0-60.0	46.0-69.0	52.0-70.0
	2.36 mm	22.0-50.0	28.0-58.0	36.0-65.0
	1.18 mm	12.0-42.0	20.0-50.0	25.0-55.0*
	600 µm	6.0-32.0	13.0-40.0	16.0-44.0
	300 µm	3.0-20.0	7.0-27.0	8.0-26.0
	150 µm	2.0-8.0	3.0-10.0	4.0-12.0
	75 µm	2.0-6.0 (B) 2.0-6.5 (HRB)	2.0-6.0	2.0-6.0
*Note: For 75 gyration mix the percent passing the 1.18 mm sieve shall be 20.0 – 55.0.				

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Specification: Materials

- Contractor supplies all material required to produce WMA
- Contractor shall obtain from the supplier all information required for the proper preparation, handling and storage and use of WMA material

Specification: Materials

- Approved list of WMA Technologies:
  - Almix Foaming Systems
  - Meeker Foaming Systems
  - Gencor Ultraform GX
  - Astec Double Barrel Green Foaming
  - Cecabase RT & RT 2N1
  - Zydex Zycotherm, SP & EZ
  - Road Science WarmGrip N1
  - Sonne Warmmix
  - Rediset LQ
  - Evortherm 3G & M1
  - Advera

Specification

- Mix Design
  - AASHTO M323
  - WMA is the same as HMA
  - Contractor chooses the WMA Technology
  - Foam vs Chemical
  - Chemical: Contractor chooses the dosage rate
    - Most common additives/dosage rates:
      - Evotherm 3G or M1: 0.3% or 0.5%
      - Zycotherm SP: 0.05% or 0.1%

Specification: Temperatures

- Mixing:
  - Follow the recommendation of the WMA/binder supplier
  - Typical mixing temperatures:
    - “S”: 125 – 145 C
    - “H”: 135 – 145 C
- Placing:
  - Maximum temperature of the warm mix asphalt behind the screed shall be 125C
  - This is increase to 135C when using modified binders (“H” traffic designation or higher)
  - Internal temperature measures with a stem thermometer or temperature probe

Specification: Temperatures

- Compaction:
  - A minimum of 90C for warm mix asphalt prior to initial compaction
  - Typical compaction temperatures
    - “S”: 115 – 125 C
    - “H”: 120 – 135 C

- Fall Paving
    - After October 1st, the allowable maximum temperature behind the screen may be increased, if approved by the Engineer

Specification

- Binder
  - Asphalt binder must meet the requirements of the specified grade when incorporating a WMA additive
  - No separate payment item for asphalt binder or any additives

- Submittals
  - Binder manufacturers Certificate of Analysis
  - Binder delivery slips indicating WMA additive & dosage rate

Binder Documentation

Binder Deliver Slips

Contrat No.:

Produit	Brut	Vide	Net KG	Rés	SG@15C	Temp	Quantité	Unité
PG 58S-34 WMA .5 Asphalt	53 350	19 160	34 190	804	1,024	165C	34,19	MT

Certificate of Analysis

PG 58S-34 WMA .5

PG GRADE	PG 58S-34 WMA .5
TERMINAL	
LOT NO	LOT155973
TESTING DATE	23-Sep-20
REPORTING DATE	25-Sep-20

TESTS ON ORIGINAL ASPHALT	TEST NO.	TEMP, °C	RESULT	SPEC	STATUS
Brookfield Viscosity, Pa.s	AASHTO T 316	135	**0.429**	3.0 max	Pass
Flash Point, COC, °C	AASHTO T 48	...	**288**	230 min	Pass
G*/sin(δ), kPa	AASHTO T 315	58	**1.210**	1.00 min	Pass
Ash Content, % mass	ASTM D8078	600	**0.040**	0.6 max	Pass
TESTS ON RTFO RESIDUE					
Mass Change, %	AASHTO T 240	163	**-0.608**	1.000 max	Pass
G*/sin(δ), kPa	AASHTO T 315	58	**2.470**	2.20 min	Pass
MSCR Jnr, 3.2 kPa, 1/kPa	AASHTO T350		**2.71**	Max - 4.5 kPa-1	Pass
MSCR Recovery, 3.2 kPa, %	AASHTO T350	58	**20.03**	Z condition	n/a
MSCR Percent Jnr-difference, %	AASHTO T350		**46.4**	75 max	Pass
Z Factor	AASHTO T350		**-2.560**	...	...
TESTS ON PAV RESIDUE (AFTER RTFO)		100			
G*. sin(δ), kPa	AASHTO T 315	16	**2900**	5000 max	Pass
Creep Stiffness, MPa	AASHTO T 313	-24	**248**	300 max	Pass
m-value	AASHTO T 313		**0.329**	0.300 min	Pass

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Specifications: Payment

- Separate Unit Price (t) for each mix type identified in the contract
  - This includes price of binder, additives
- Binder Adjustments
  - Content: Difference b/w bid and actual
  - Price Index Adjustment: if price changes by ±5%, credit/debit to contractor
- ERS Payment adjustments
- Compaction Payment adjustment
  - <92.5% Penalty, >92.5% Bonus ($1.00 max/t)

Challenges/Issues

- Most municipalities/private sector still call HMA
- Lack of knowledge/understanding of WMA
- Temperatures

WMA Approval Process

- Product review
  - Past projects, test results, data sheets, etc.
- Lab testing
  - Typically perform a TSR with the proposed product against several source that are prone to stripping
- Field trial(s)
  - DTI or other project
- Conditional approval
  - Contracts < 5,000 t
  - No arterial or high volumes collectors/locals
- Full approval
  - Added to approved list of technologies

Recommendations

- Educate yourself
  - Agency, Contractor, Consultant
- Don’t have to reinvent the wheel
  - Lots of agencies using it now
- Specify it
  - Levels the playing field for all contractors
  - Try one of the additives that are dual purpose anti-strip/WMA
  - Start small; locals, low volume, etc.

Questions

- Contact Information
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