

Use of Warm Mix/RAP in New Brunswick

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Outline of Presentation

- **Warm Mix**
History in NB
Experience to date
Issues/Discussion
- **Recycled Hot Mixes (HRB/HRD)**
History in NB
Current Approach
Cost Comparison
Issues/Discussion
- Questions

NBDOT Warm Mix Projects

Projects to Date:

- 2007 -1 contract 1,000 t (Evotherm emulsion)
- 2008 -2 contracts (WMA vrs HMA trials)
- 2009 -8% of program
- 2010 -13 contracts 100,000 t
 - 13% of program
 - Evotherm/Advera/Foaming Systems/Sonne Warm Mix

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- Projects to Date

- 2011 -25 contracts 65,000 t

- 23 % of program

- Evotherm/Foaming Systems/Sonne

- WarmMix/Cecabase

- 2012-All collectors/locals-Approx 50% of program

- No projects in North Western NB- stone absorption > 1%

- Trial project-1km using Recycle Base Warm Mix

Temperature Specs

- Spec Evolution:

- 1st contract-Additive suppliers recommendation
- 2009-2011 Max 130C mixing temperature
- 2012 -Max 125C behind spreader prior to compaction

- mix temp can vary (haul distance/air temp)
- checked with a stem thermometer or probe
- contractor can request an increase in temp after October 1st

Other Specifications

- List of approved technologies in the spec
4 foaming systems/4 chemicals/1 powder
- Asphalt Binder must meet grade with additive
- Minimum TSR =80%
- Min. temp prior to compaction from supplier
- Max moisture content in mix=0.10%
- Mat temp below 90 c -transverse joint

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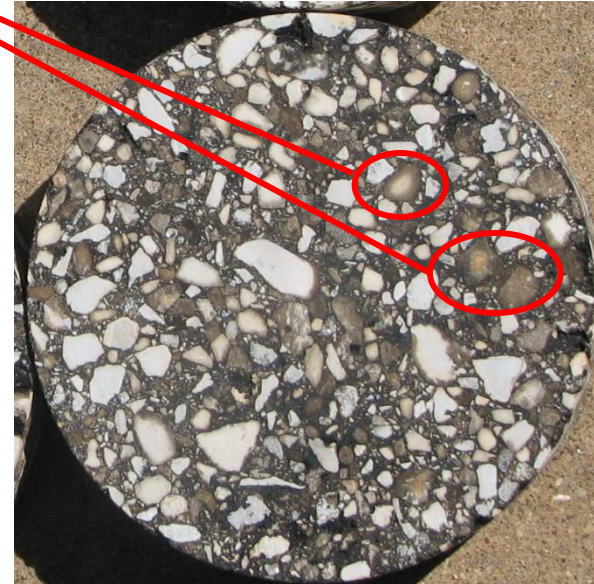
Overall results have been very positive:

- Reduced need for anti-strip additives with certain technologies
- Reduction in Binder content due to less absorption

Warm Mix Asphalt



Hot Mix Control



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Overall results have been very positive (cont'd):

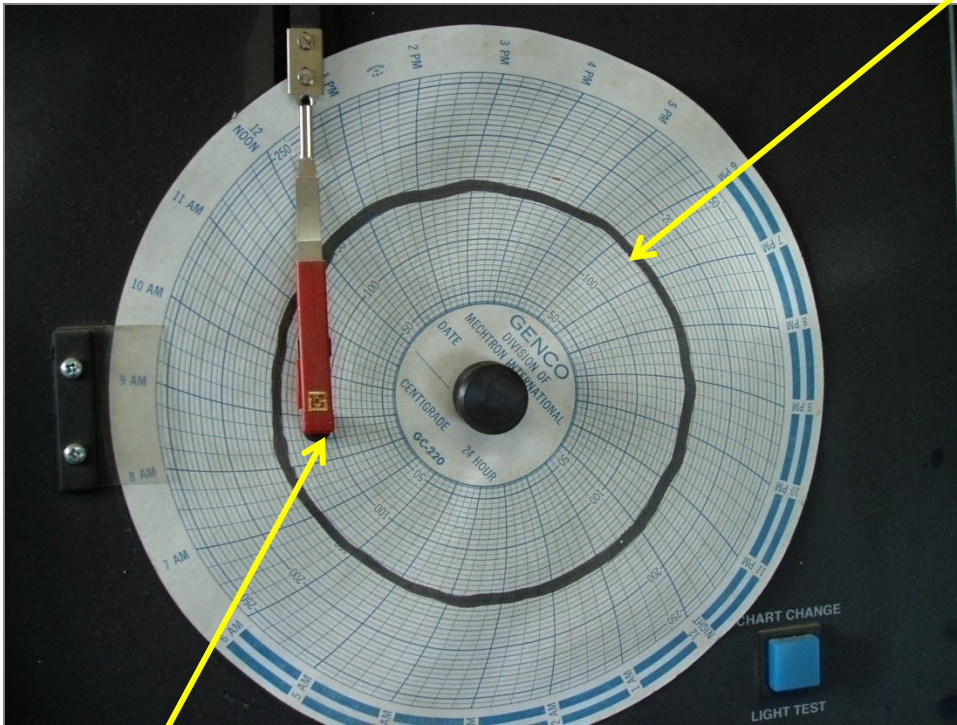
- Decrease in emissions at plant/road; environmentally/politically friendly
- Fuel savings at plant
- Decreased oxidation of mix = better durability

freshly crushed dry aggregate
Burner setting while producing WMA with



- 4000 lb batch; baghouse
- Plant fired with propane

Black Line – HMA Agg
Temp = 160C



Tracer for WMA Agg
Temp = 125C

Burner Position:

- HMA typically at 2.5.
- WMA was at 1.6
- ~ 36% if dir. prop'l

Practical Benefits of WMA

- Decrease Oxidation of mix:
 - Each 25F decrease in mix temp = 50% less oxidation of the binder 😊.
- Evotherm binder after 7-10 years of laboratory simulated aging = New HMA binder 😊
- Studies have shown it to be more resistant to reflective and fatigue cracking.
 - More testing/trials needed; would depend on underlying crack movement/type

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Overall results have been very positive



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Overall results have been very positive (cont'd):

- Longer time available for compaction
- Extended paving season
- Quality of longitudinal joints improved; seamless

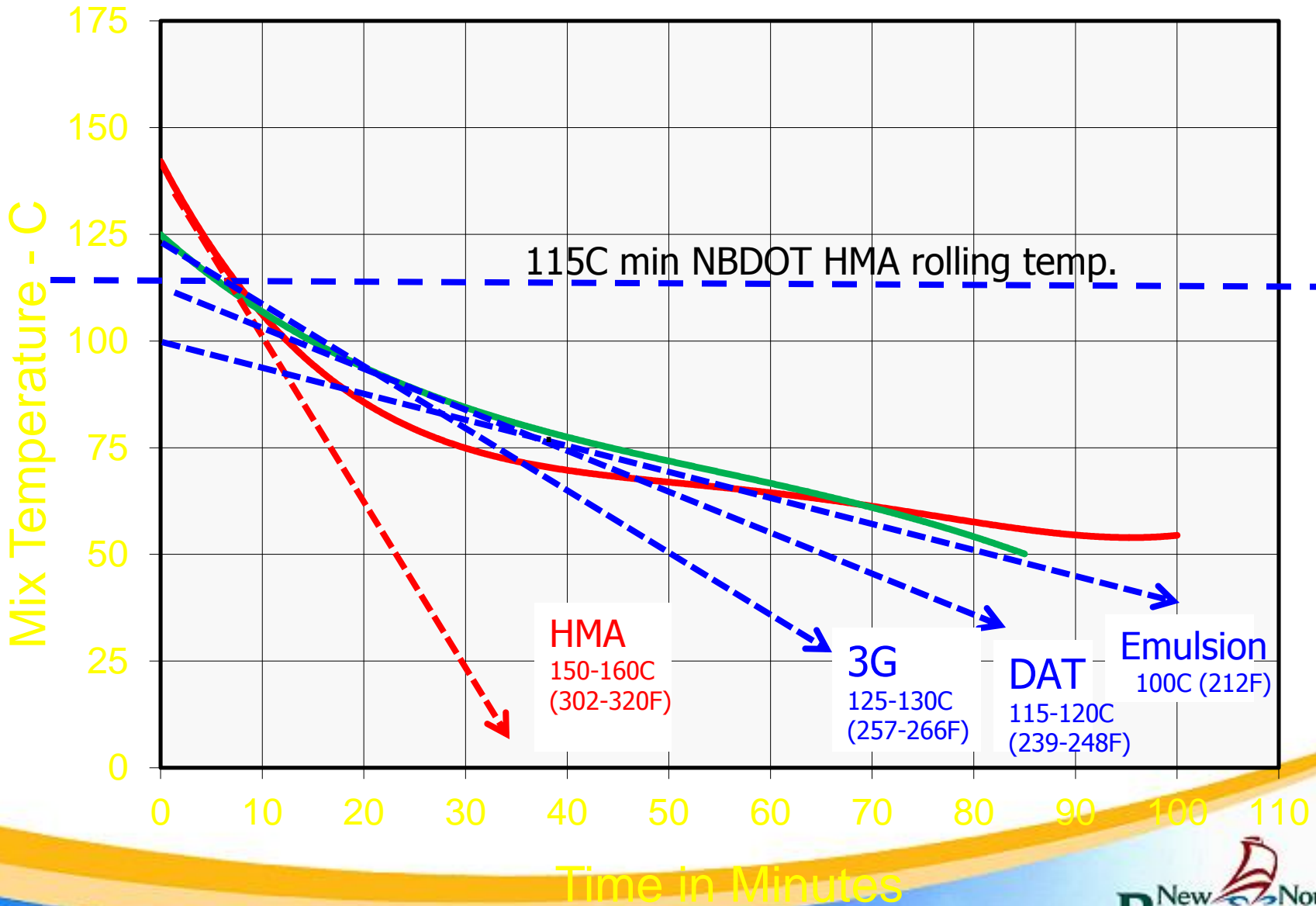


Rte 106 April'11 WMA



Rte 106 April'11 HMA

Typical Summer Cooling Curve - 50mm



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Overall results have been very positive (cont'd):

- Mixes tend to be more stable



- Consistency of finished mat improved

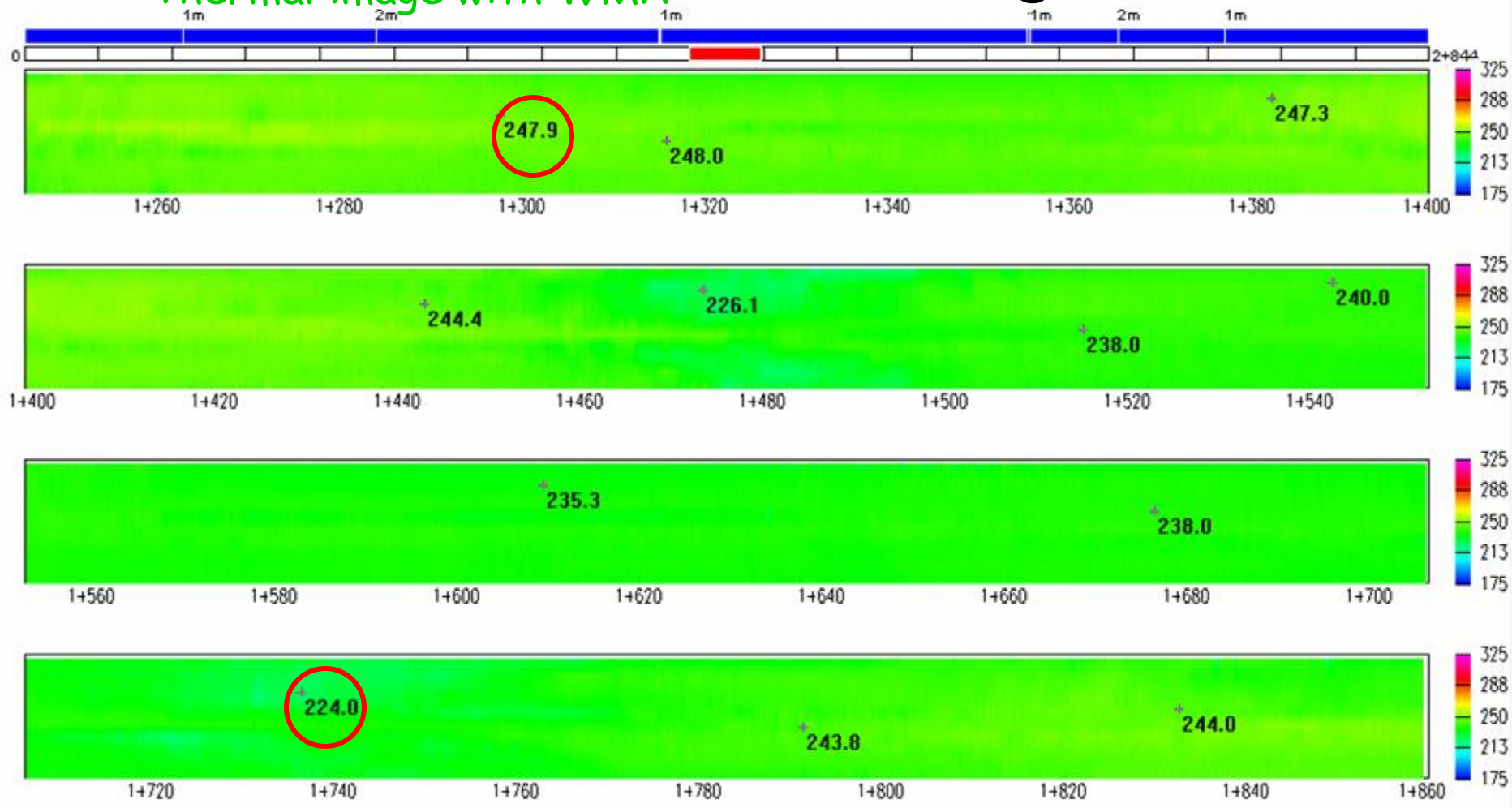
Options Tools Help Old Tools

Check Sensors Field Sens Verified TEST Bad Sensor Open File View DATA File View in Segment Bar Chart GPS Setting

MI 1 FT 833 LC 0 TM 244 WT

24 Deg Difference

Thermal image with WMA



End of Load Segregation



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Issues:

- Temperature modifications for late season work
- Effect of low temperatures on dust collection systems
- Potential production limitations if piles too wet
- Contractor following specified WMA temps

Moisture Management

- It is crucial to minimize stockpile moisture.
Especially with WMA.
- Lower WMA temperatures = less drying potential
- The key is to:
 - Minimize aggregate H₂O before it enters the drier/drum

Ideal scenario



Stockpile Drainage



Work Pile to Control H2O

Hey!!!!
Let me dry out
the pile !!
Oldest Material
First



21. 6. 2001

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Issues (cont'd):

- Dust balls(check moisture in fine aggregate), flights modifications, stockpile moisture management/limit washed sand



Cost Analysis

- Chemical Additives
 - Cost= \$30-\$50/t of binder (\$2.40/t of mix)
 - Savings
 - =no anti-strip (\$1.50/t of mix)
 - =fuel savings at plant (\$1.50/t of mix)
 - =reduction in binder (\$1.30/t of mix)
 - Cost of WMA should be =/less than HMA

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Issues:

- Temperature modifications for late season work
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Issues / Discussion

- Should WMA be used for other purposes?
 - Compaction aid on HMA contracts
 - Bridge decks/compaction aid
 - Anti-strip additive
- Long term performance of different technologies
- Approval process for new technologies
- Testing issues with certain processes
 - Foam mix design
 - Recompaction of older samples
- How to incorporate WMA into future years
 - Allow use as an alternate on all work
 - Offer incentives

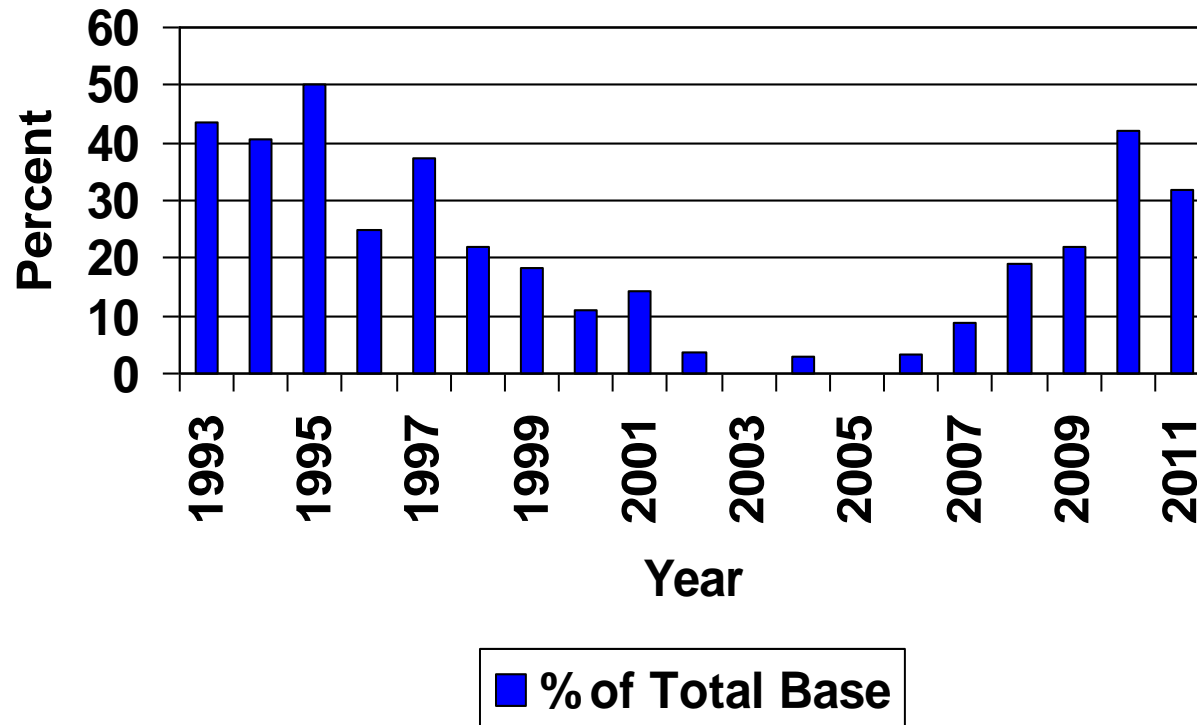
Conclusion

- Placing WMA is just like placing HMA
- It's just a better alternative!
 - Decreased life cycle cost
 - Increased longevity
 - Performance
 - Environmentally friendly
 - Politically correct
- Better product for same price

History of RAP Mixes in N.B.

- 1st Contract in 1981-14,500 t @ 50 % RAP
 - RAP removed by Grader/scarifier
- Since 1981 N.B.D.O.T
 - 2.8 Million tonnes of Recycle Base Mixes @35-40 % RAP
 - approx. 1700 km. paved with RAP
 - conservation -1 million t of aggregate
 - 60,000 t of binder
- \$\$\$ Savings Approx \$28 Million

HRB % of Total Base Placed



NBDOT'S CURRENT APPROACH

- Recap Contracts >3,000t of mix
 - Contracts called with option to use HRB @30%+/- 5 RAP
 - Started using recycle surface mixes HRD @15% RAP
 - 2 contracts in 2101/1 contract in 2011
 - RAP being milled within contract limits
 - Contractor responsible for extra costs if using virgin mix-Binder/Aggregate
 - Contractor allowed to keep an equivalent amount of RAP which would have been used in recycle mix
 - Excess RAP generated on the contract utilized as shouldering/local roads



Preparation/Stockpiling RAP

- Must be processed within 14 Days of the introduction into the cold feed
- All particles passing 50 mm sieve
 - screening vrs crushing
 - fractionation not required
- Maximum height of stockpile 3 m to prevent consolidation



Mix Design Procedures

- Obtain 6 samples of RAP (approx 20 kg each) during milling operation
- Split a 2400 g sample from each 20 kg sample
 - 2011-Ignition Oven used for extractions vrs chemicals
 - Recovered aggregate used for gradation/RD's
 - Assume a correction factor for % binder in RAP
- Split a 3.3 kg sample from each RAP sample for mix design/field ignition oven calibration
- Above 20% RAP-need softer Binder
 - If required grade PG 58-28
 - New Binder PG 52-34
- Recycle surface mix (HRD) use same binder PG 58-28

Mix Designs

- Gradation finer than virgin aggregate mix
- Higher dust contents than virgin mix
- Results in lower VMA
- May require adding clean blending sand or washed sand
 - tender mixes?
- Results in tighter finished surface-less permeability

Mix Designs-Excess Washed Sand



Cost Comparison

- 30 % RAP Mix vrs. Virgin Aggregate Mix
- Assumptions
 - 5.7 % A.C. in RAP(A.C. =\$650/t)
 - Cost of aggregate delivered to plant
 - = 25 mm stone \$11.50/t
 - = crusher sand \$12.00/t
 - Cost to haul/screen/stockpile RAP
 - =\$ 7.00/t (20 km haul)
- Cost savings approx \$12/t

Mix Variability

- Historical data indicates RAP mixes equal/more consistent
- 2007 Contract
10,000 t HRB -13 tests
14,500 t B -21 tests
- Proper QC practices are essential to consistent RAP mixes
- % passing 4.75 mm
HRB- Std Dev =3.8
B - Std Dev =3.3
- % passing 75 um
HRB- Std Dev =0.4
B - Std Dev =0.5
- Asphalt Content
HRB -Std Dev =.21
B -Std Dev =.24

Issues

- Quality of RAP from private stockpiles
- Stack Emissions-older plants
- Value of RAP if contractor purchases/replaces
- Use of RAP & Warm Mix

2011-12 Toronto
Maple Leafs Team
Photo



THE END-----QUESTIONS?

