

# AAPA's 14<sup>th</sup> International Flexible Pavements Conference

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## Turning RAP into a value added pavement asset

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# Overview

- What is the value of RAP
- Barriers to using RAP
- USA experience with RAP
- NSW experience with up to 30% RAP
- RAP monitoring
- Performance properties
- Environmental benefits
- Conclusions



# What is the value of RAP

- Mixture of aged bitumen and sound mineral aggregates
- The value of RAP is that of the materials it replaces
  - Bitumen
  - Mineral aggregates
- Extract best value by optimising use by replacing bitumen and aggregates in upper pavement layers
- Key driver for using RAP is economics
  - Reduces demand for new bitumen and aggregates
- RAP is an appreciating asset and a hedge against rising bitumen prices
- Cost of transporting and processing RAP must be cheaper than virgin aggregates and bitumen including savings on transporting and heating bitumen
- Using RAP will reduce cost of asphalt which will ensure asphalt remains a competitive pavement material

***'Trade in your old pavement for a new one'***

# Barriers to using RAP

- Perception that RAP will have an adverse impact on the performance of asphalt
- Concern that variability of RAP and aged binder will:
  - Lead to premature cracking and ravelling in wearing courses due to binder hardening
  - reduced skid resistance of wearing courses
  - negate the benefits of using PMBs
- Lack of QC by contractors
- Difficulty in procuring and processing RAP
- Limitations of asphalt plants to heat RAP and handle >10% RAP
- Road authorities specifications which restrict the usage of RAP

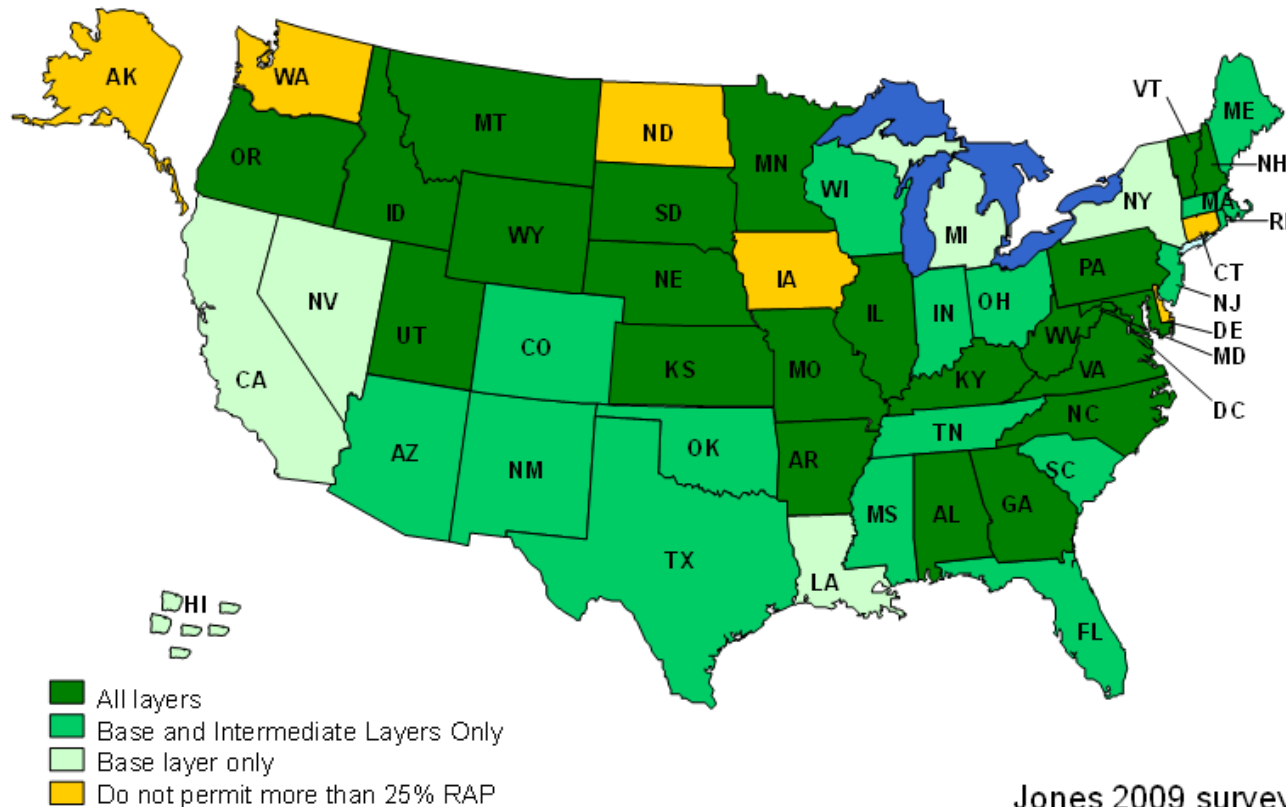
# Max % RAP in SRA specs

SRA	Surface	Inter-mediate	Base	Comment
WA	Nil	Nil	Nil	<i>Considering 15% in non surface</i>
QLD	Nil	15	15	<i>Recent amendment</i>
SA	Nil	15/20	15/20	<i>&gt;15% use C170</i>
NSW	15/20 <sub>2</sub>	15/25 <sub>2</sub> /30 <sub>2</sub>	15/25 <sub>2</sub> /30 <sub>3</sub> /40 <sub>5</sub>	<i>Based on 2/3/5 year experience</i>
VIC	10/20	20	30/40	<i>&gt;15% use C170 in local wc &gt;30% additional testing + years</i>

# USA experience with RAP

80% of RAP is recycled which equates to 17% of all HMA

## States that *Permit* More than 25% RAP in HMA Layers



# USA experience with RAP

Studies conducted the National Centre for Asphalt Technology showed that:

- Increasing % RAP reduces rutting potential of mix
- Adding RAP stiffens the binder to a high performance grade
- Increasing % RAP up to 40% does not increase variability of the mix provided the RAP is properly managed

Long term pavement performance monitoring of 18 test sections across USA over 17 years showed that:

- Mixes with >30% RAP were performing equally to virgin mixes in respect to rutting
- Transverse and fatigue cracking was observed more frequently in some mixes with RAP
  - could be due to lower binder or high filler contents and freeze/thaw cycles

# USA experience with RAP

Latest thinking to decide on maximum RAP % should be based on the net effect that aged binder will have on the new mix

- Properties of recovered binder and binder content
- Coarse RAP will have much lower binder content than finer RAP eg 4% vs 7%
  - can use higher % coarse RAP in base courses and lower % fine RAP in wearing courses
- <15% RAP use normal grade binder(<25%)
- >15%<25% use one grade softer(<25< 35%)
- >25% use blending charts(>35%)

(Warm mix)



# NSW experience using 30% RAP

Boral Asphalt embarked on plant trials to evaluate the performance of AC14 mix with:

- varying % RAP up to 30%
- Astec double drum plant in Sydney
- C450 grade bitumen



Collected data to improve understanding on the impact RAP would have on the performance of asphalt by:

- Monitoring consistency of processed RAP
- Conducting performance tests on plant mix
- Monitoring in-service performance of mix after 2 years

# Processing RAP

Fractionated RAP into 3 sizes by passing over a vibratory multi-deck screening plant

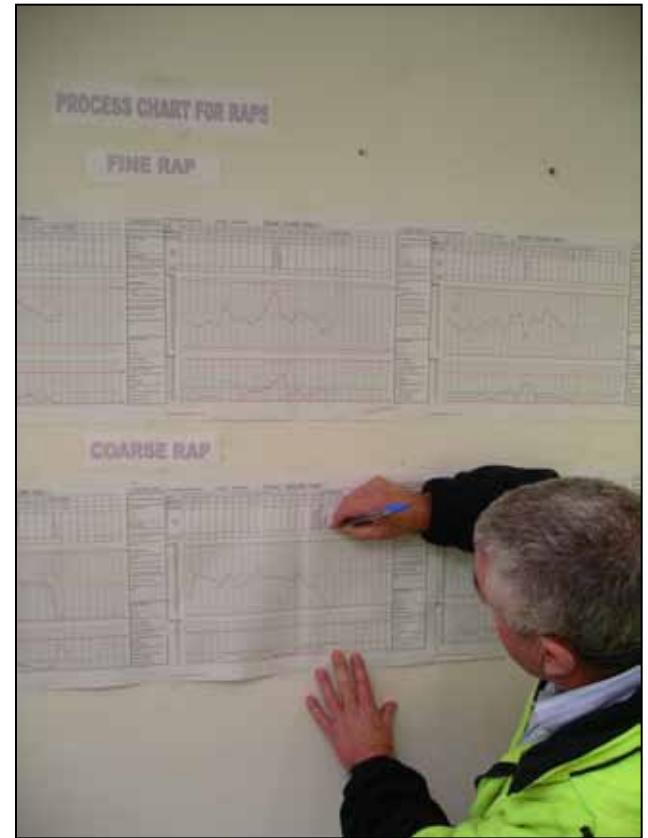
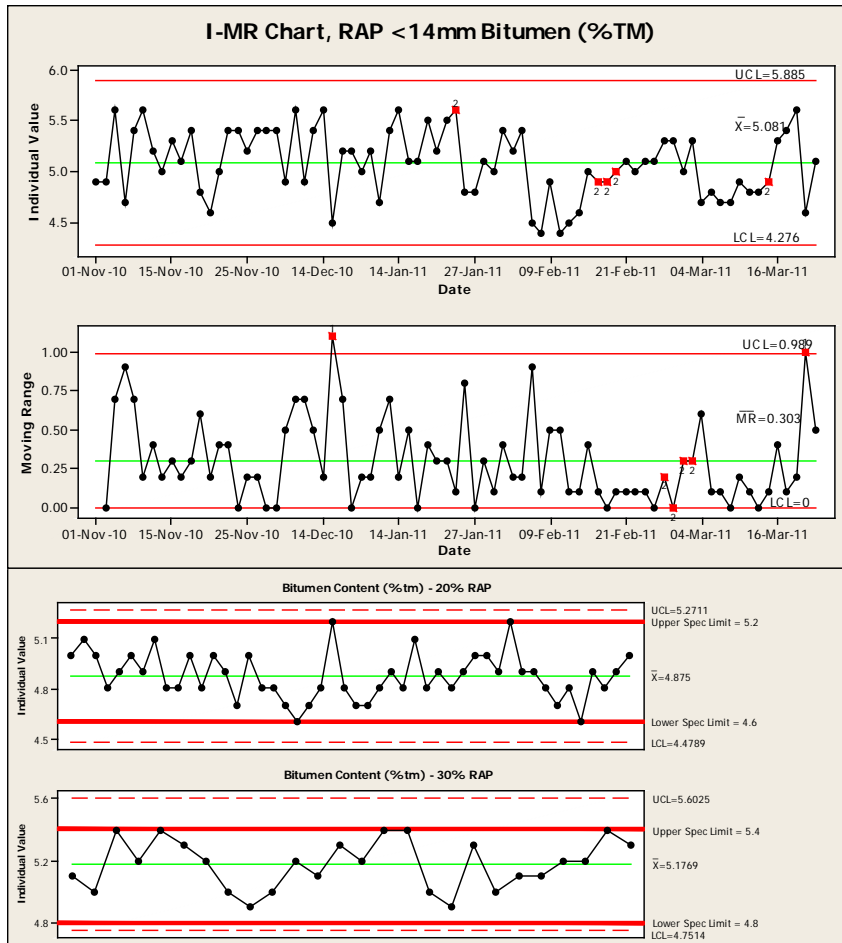
- < 19mm
- < 14mm
- < 7mm

Monitored variability in following RAP properties for:

- Binder content
- Moisture content
- % passing < 0.075mm
- % passing < 2.36mm
- Other sieve sizes as needed

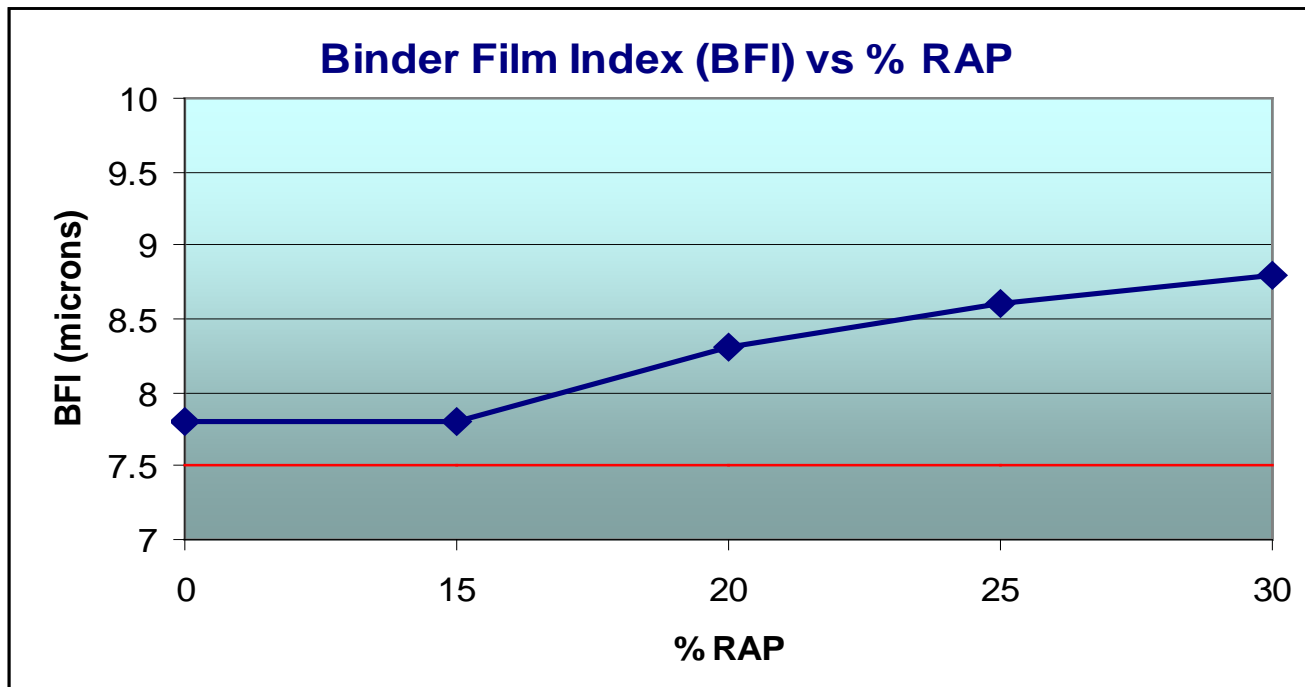


# Binder content variability

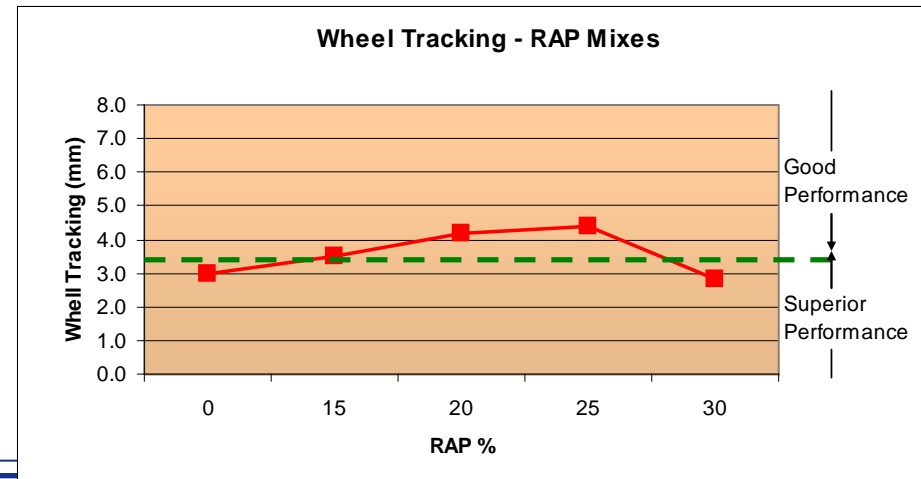
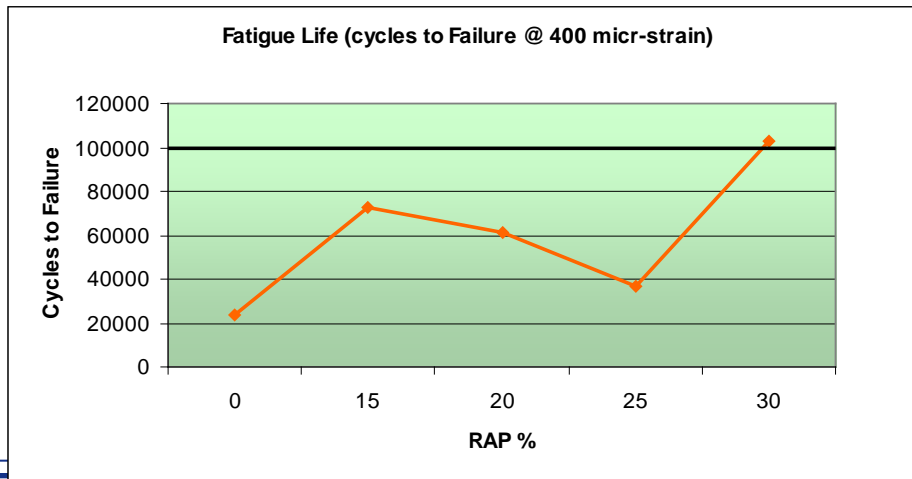
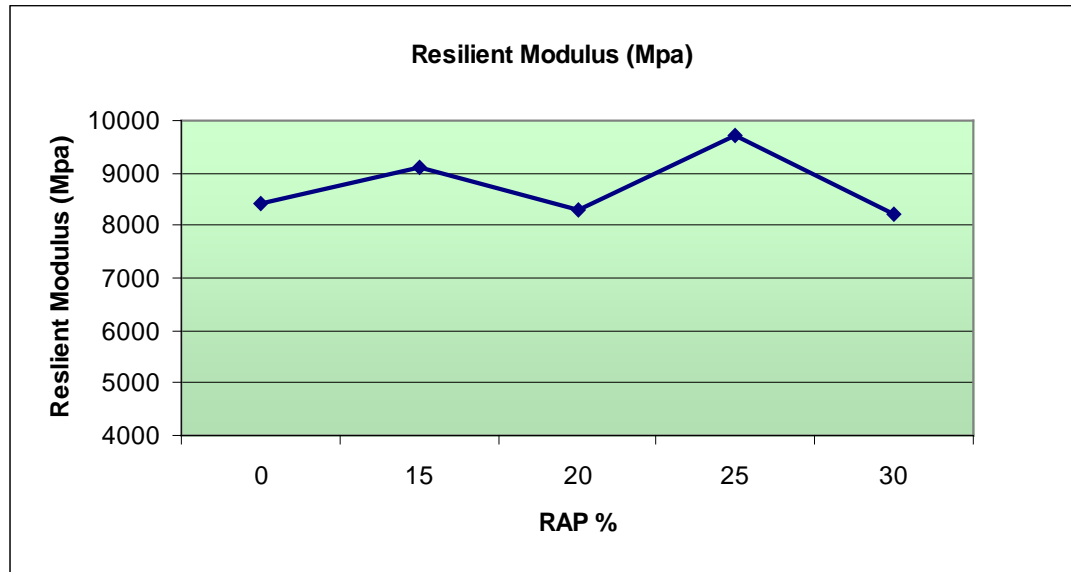


# Mix design

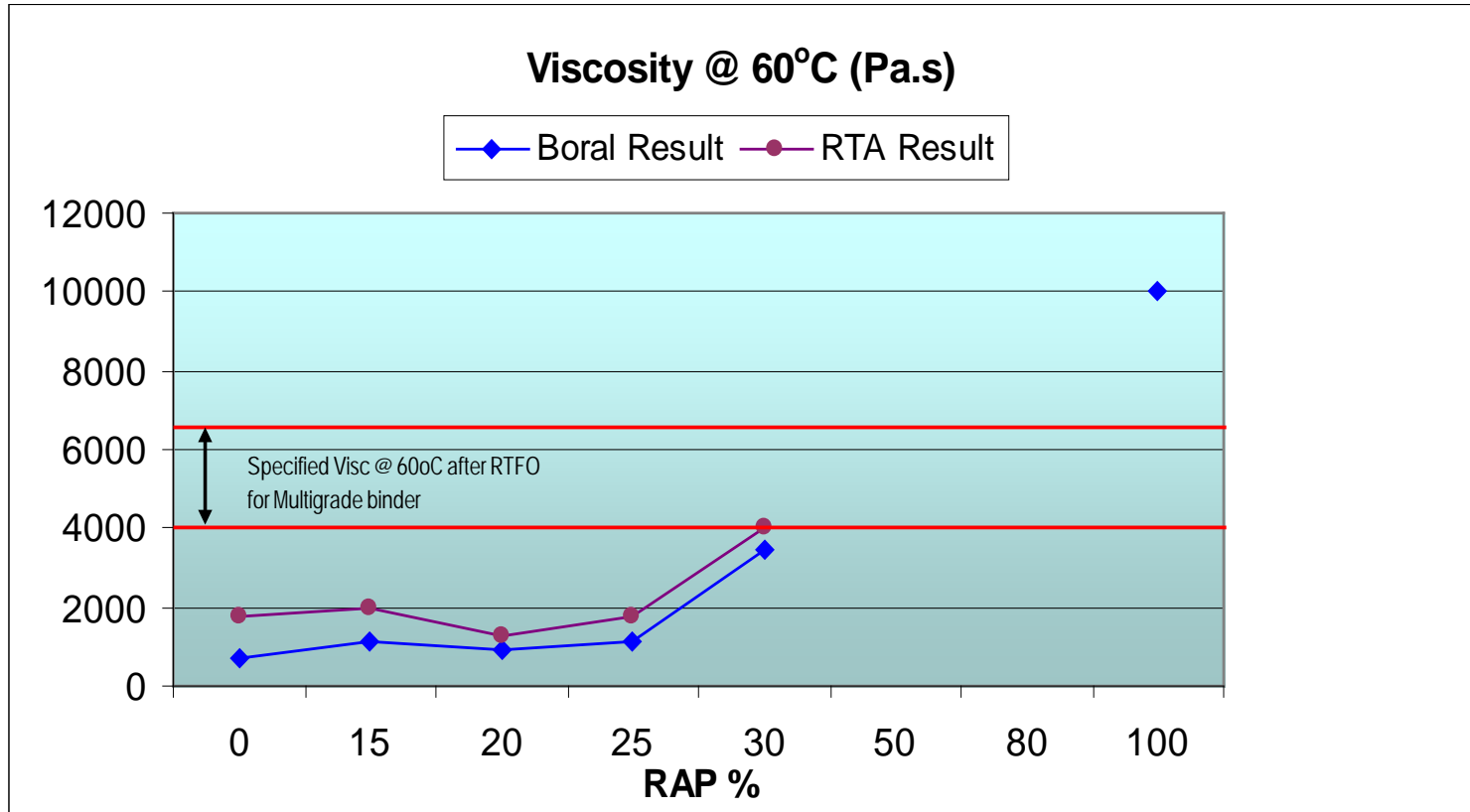
- Incorporate RAP into mix by adjusting proportions of coarse and fine particles
- Make allowance for RAP binder and filler to achieve target air voids and binder film thickness
- Binder film thicknesses increased with % RAP while maintaining same air voids



# Lab performance tests

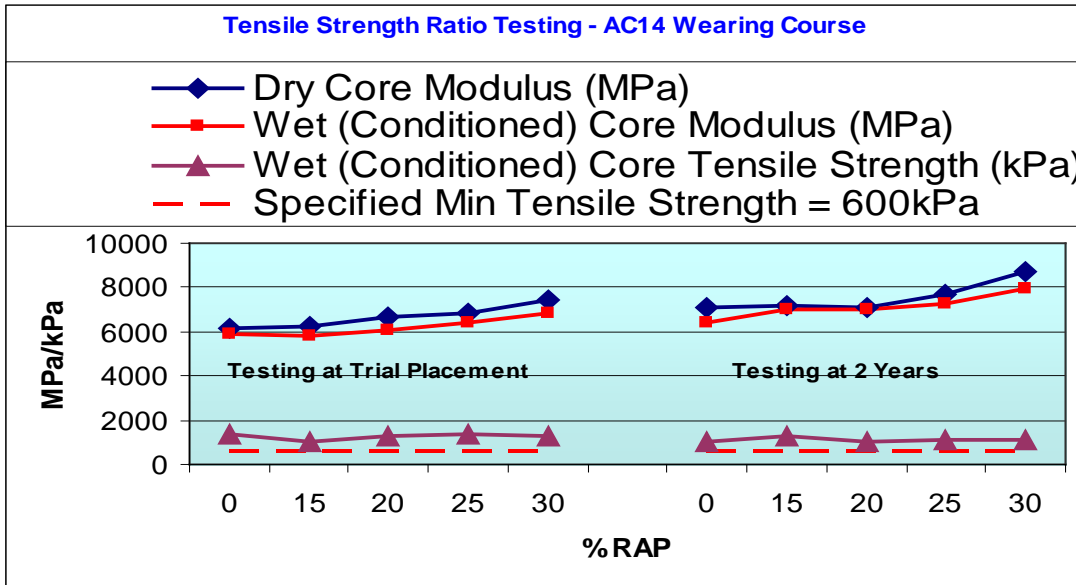


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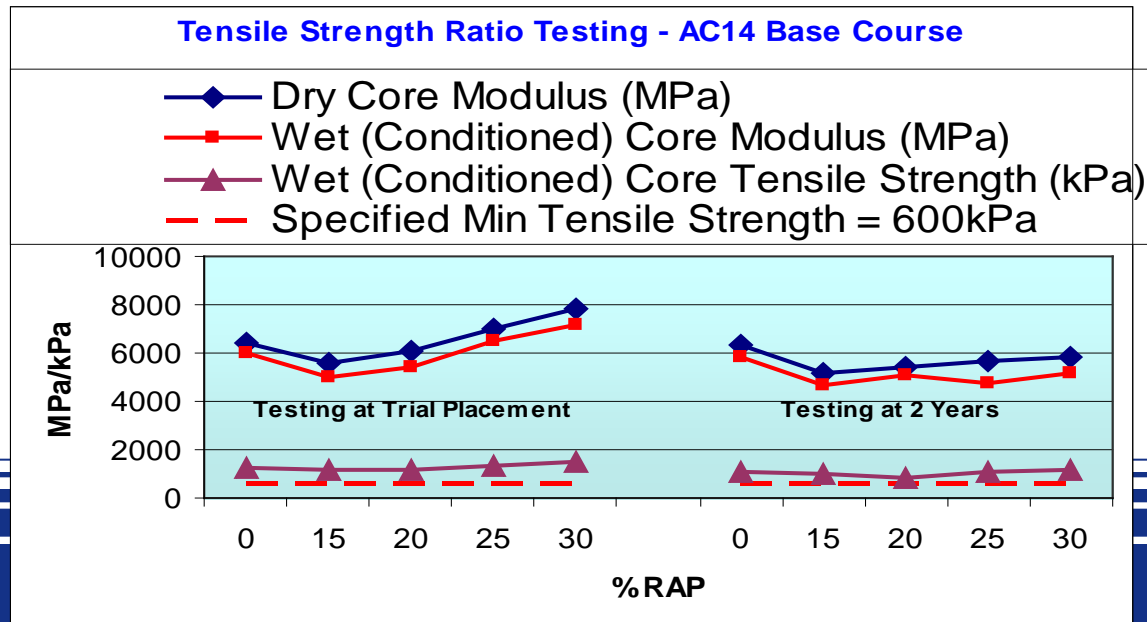


# Lab performance tests

Tensile Strength Ratio Testing - AC14 Wearing Course

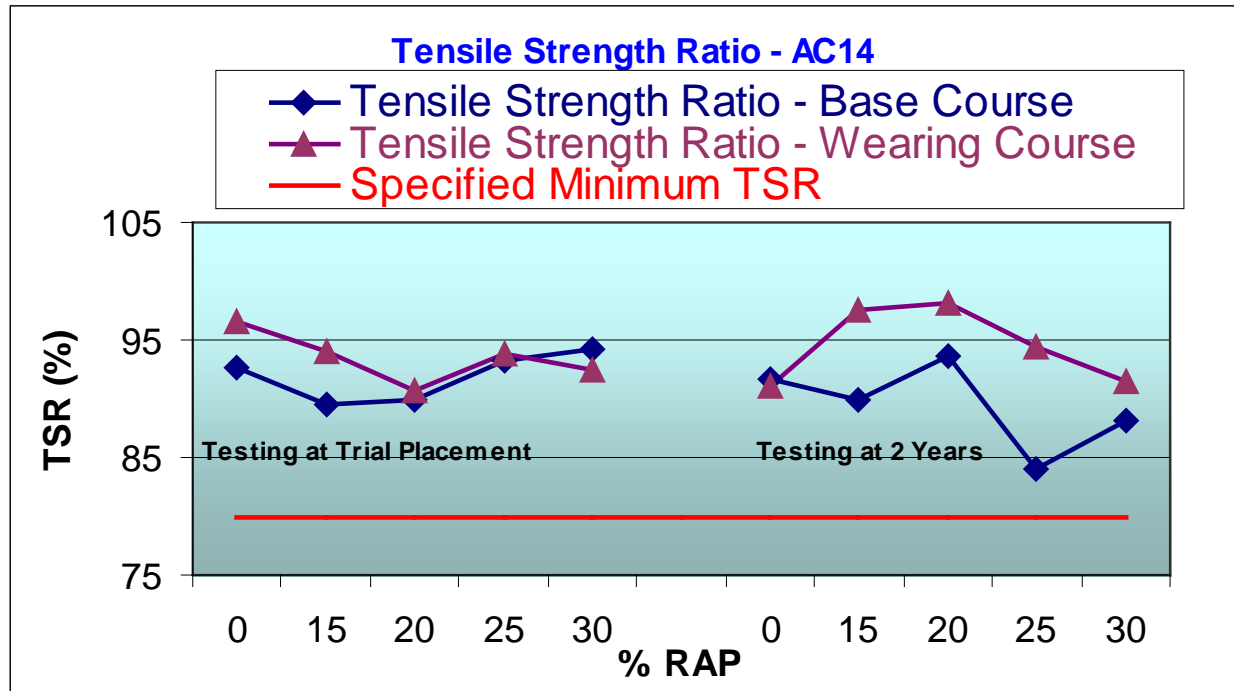


Tensile Strength Ratio Testing - AC14 Base Course



# Lab performance tests

Our observation is that because the mineral aggregates are pre-coated with bitumen, the potential for moisture damage is not increased and in some cases improved





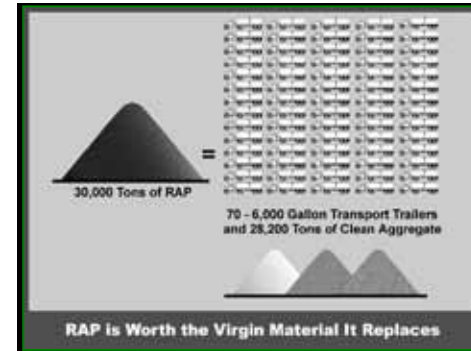
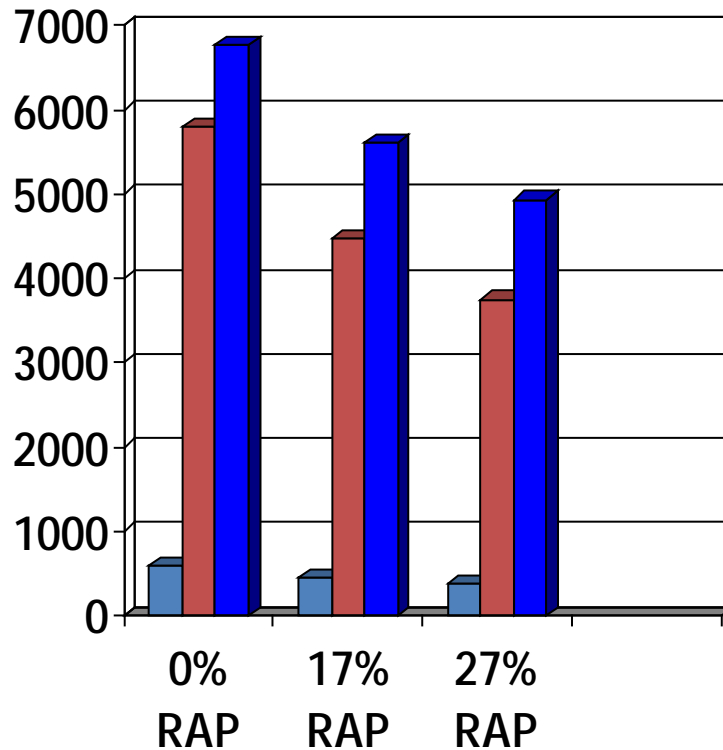
# In-service performance

After 2 years in service the high RAP mix placed on Henry Lawson Drive is performing the same as normal asphalt with no visible signs of any distress

Note: The test sections are subjected to very heavy loading and high traffic volumes



# Environmental benefits



- Energy (GJ)
- GHG's (tonnes)
- Bitumen (tonnes)

Based on 123,163 tonnes of asphalt produced for RTA in 2009/10

# Conclusions

- Results obtained with up to 30% RAP are in-line with USA experience
  - Equivalent performance to virgin HMA with regard to rutting, fatigue, stiffness & moisture sensitivity
- Use up to 25% RAP in wearing course without changing grade of bitumen
- Increasing use of RAP will help
  - reduce energy consumption
  - reduce GHG emissions
  - conserve scarce raw materialswithout compromising performance of HMA
- Use of RAP will help industry meet sustainability targets



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