Quieter (?) Pavements in Washington State

Past, Present, and Future

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Conclusions

- Initially, OGFC pavements showed audible benefits compared to standard DGFC pavements in Washington State. However, these benefits generally disappeared in about 6 – 12 months.

- Currently, OGFC pavements are equivalent to, or louder than, standard DGFC pavements installed at the same time.

Rutted section of pavement installed in the 1990's.

Outline

- Why is WSDOT is looking at quieter pavements?
- What pavements are being evaluated?
- How is WSDOT evaluating performance?
- What was done in the past?
- How have the pavements performed so far?
- Conclusions to date
- What's next?

Why is WSDOT testing quieter pavements?

- Potential for mitigation, impact avoidance, lower noise walls
- Public interest: citizens, legislator, media
- Noise walls are expensive and don't always work
- Future capacity increases

Design visualization of noise wall in Seattle, WA, USA

What does WSDOT consider as “quieter pavements?”

- Pavements that create an audible, **3 dB(A)**, reduction in tire-pavement noise compared to a standard WSDOT pavement.
- *“A low noise road surface is a road surface which, when interacting with a rolling tire, influences vehicle noise in such a way as to cause at least 3db(A) lower vehicle noise than that obtained on conventional and most common road surfaces.”*

  - The Little Book of Quieter Pavements

Signage indicating OGFC-AR test section on SR 520

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What pavements has WSDOT evaluated?

- Test sections compare pavements installed at the same time
- Open-graded friction course (OGFC) asphalt overlay
  - Rubber-modified binder (**OGFC-AR**)
  - Polymer-modified binder (**OGFC-SBS**)
  - Slightly different mixes and construction conditions
  - ~20% air voids
- Standard HMA overlay
  - Installed at the same time
  - "Control" variable

Newly installed OGFC-AR on I-5 (2006)

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How does WSDOT evaluate quieter pavement?

Acoustic Performance

- Monthly OBSI measurements
- Surface and air temperatures
- Consistent with provisional AASHTO standard for OBSI

On-Board Sound Intensity (OBSI)

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How does WSDOT evaluate quieter pavement?

Wear Performance/Durability

- Friction, smoothness, rut depth – 2x's per/year

Pavement distress van

Friction testing

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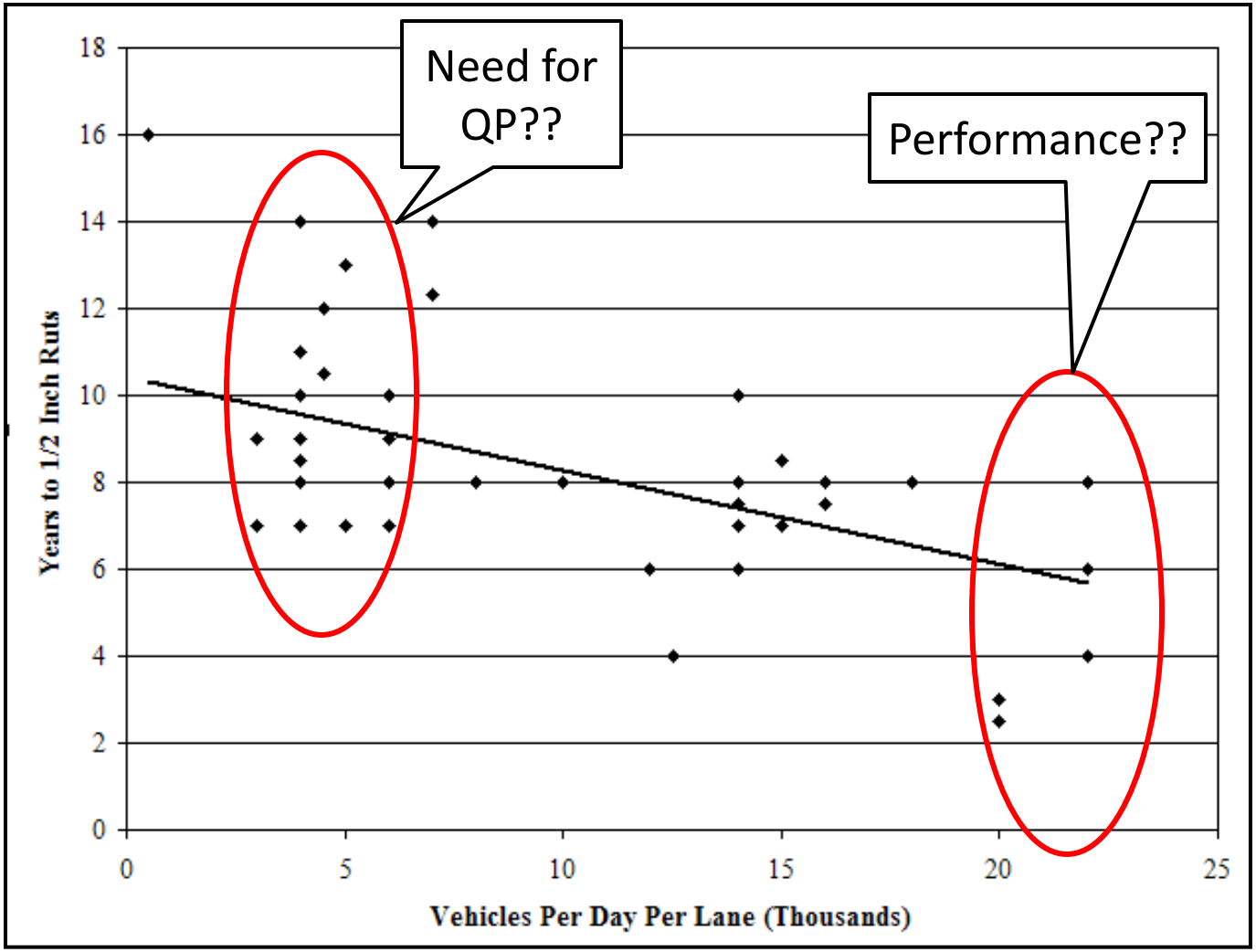
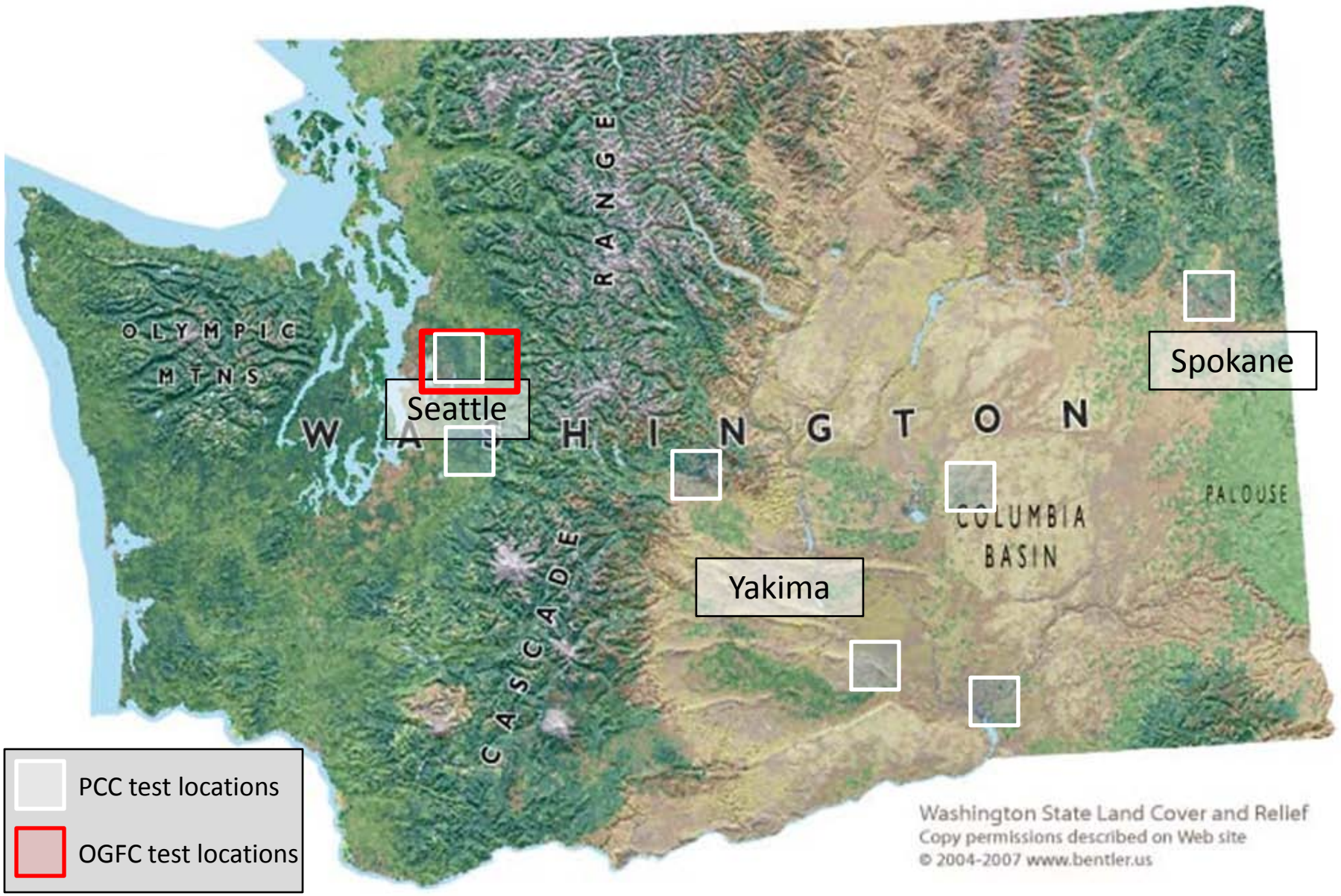
What happened in the past?



OGFC pavements in WA during the 1980s/1990s



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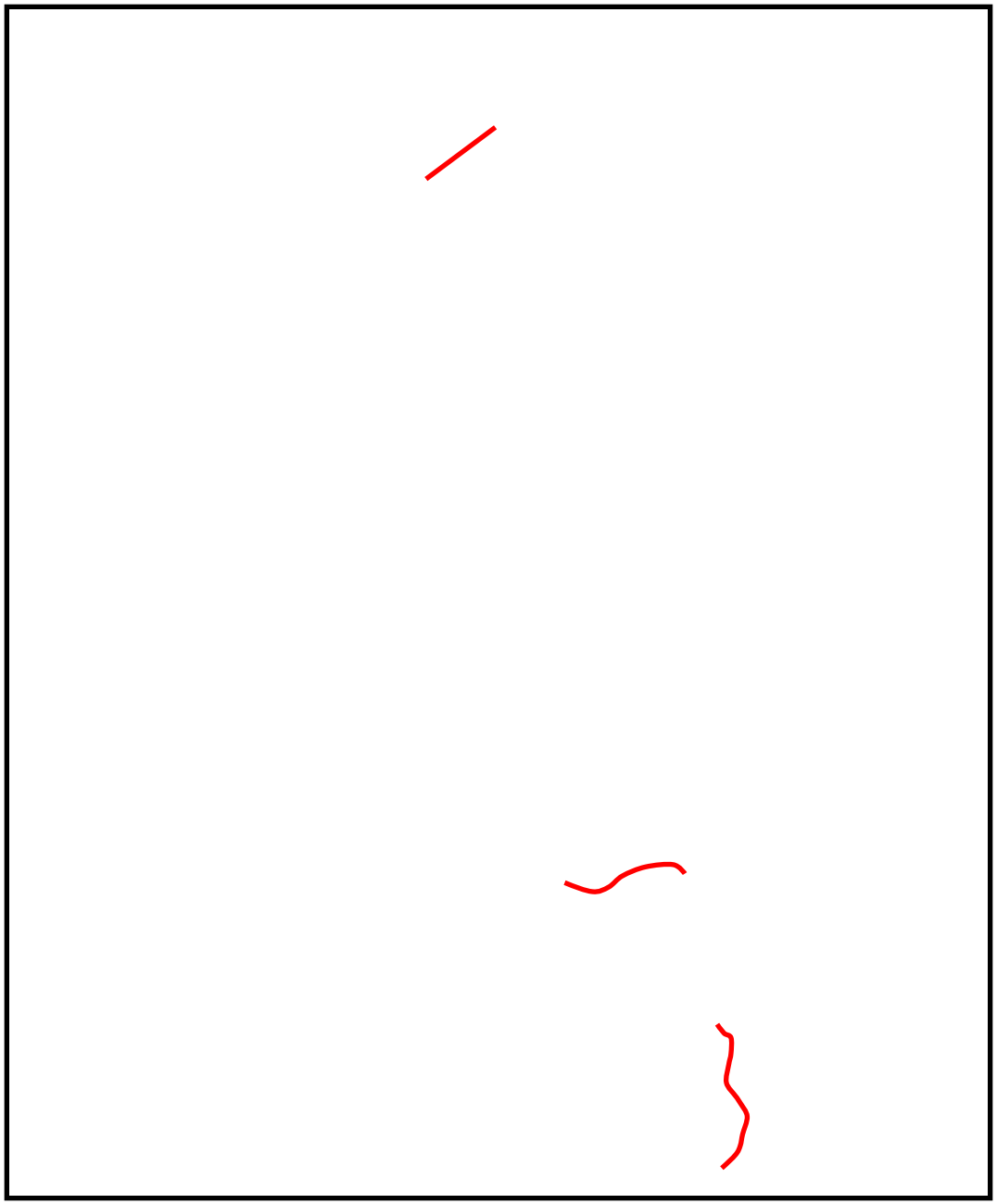

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Source: Google Maps

Differences between Sections

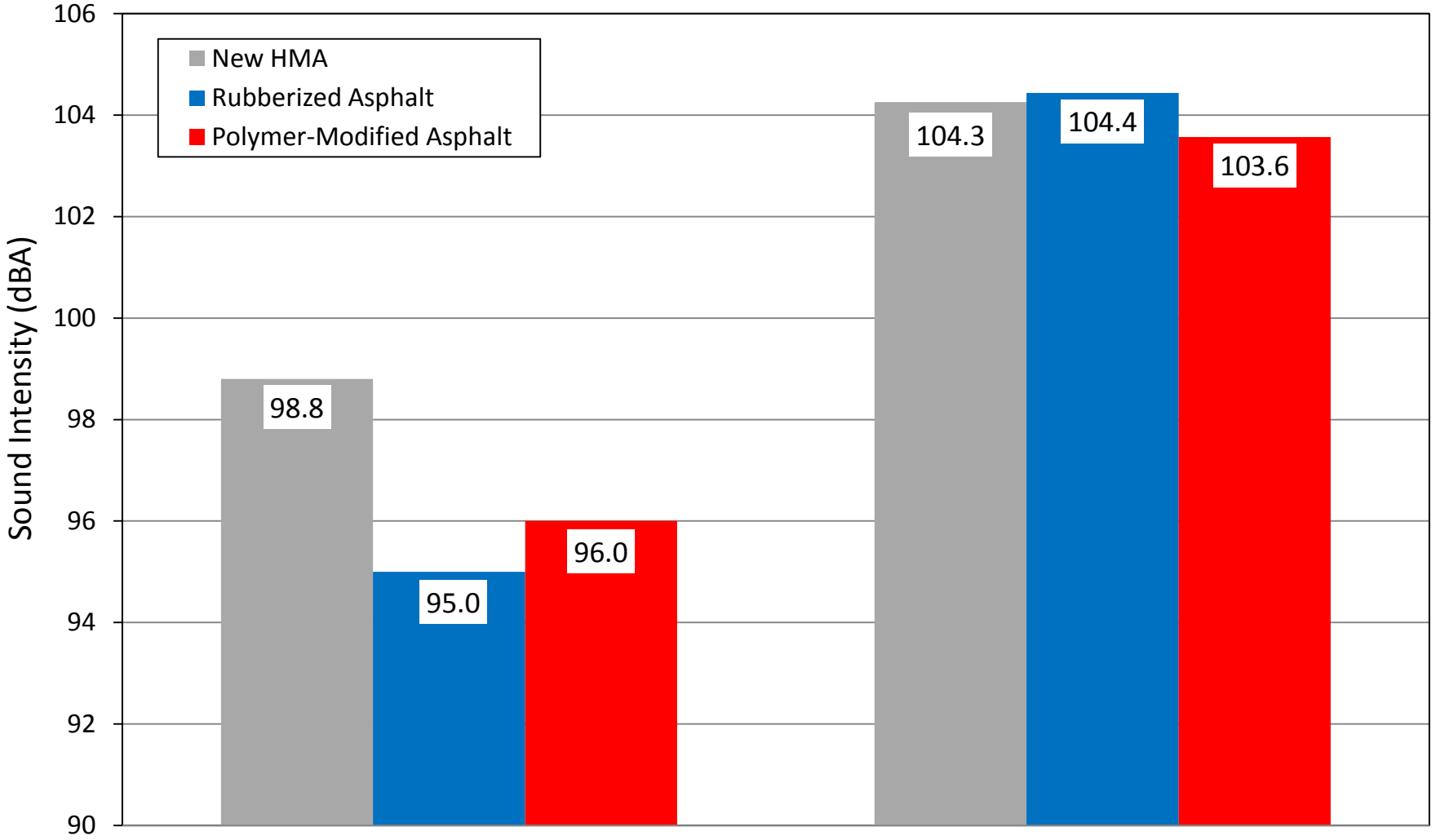
I-5	SR 520	I-405
• Age: Aug 2006 (59 months)	• Date: July 2007 (48 months)	• Date: August 2009 (11 months)
• Straight flat	• Hills, curves	• Slight grade, curves
• Traffic: 160,000 AADT	• Traffic: 95,000 AADT	• Traffic: 160,000 AADT
• Trucks: 7%	• Trucks: 3%	• Trucks: 7%
• Base: HMA	• Base: HMA	• Base: PCC
• Thickness: 1.83 cm	• Thickness: 1.83 cm	• Thickness: 2.44 cm
• Ambient: Night, 70^{o} F	• Ambient: Day, 72^{o} F	• Ambient: Day, 75^{o} F
• Asphalt: 314 ^{o}F	• Asphalt: 282 ^{o}C	• Asphalt: 345 ^{o}C
• Anti-Strip: liquid, 0.5%	• Anti-Strip: liquid, 0.25%	• Anti-Strip: , hydrated lime 0.5%

OGFC Test Section: I-5

OGFC-Test Section on I-5 near Lynnwood, WA

Initial & Current OBSI Levels

I-5 Lynnwood Test Section



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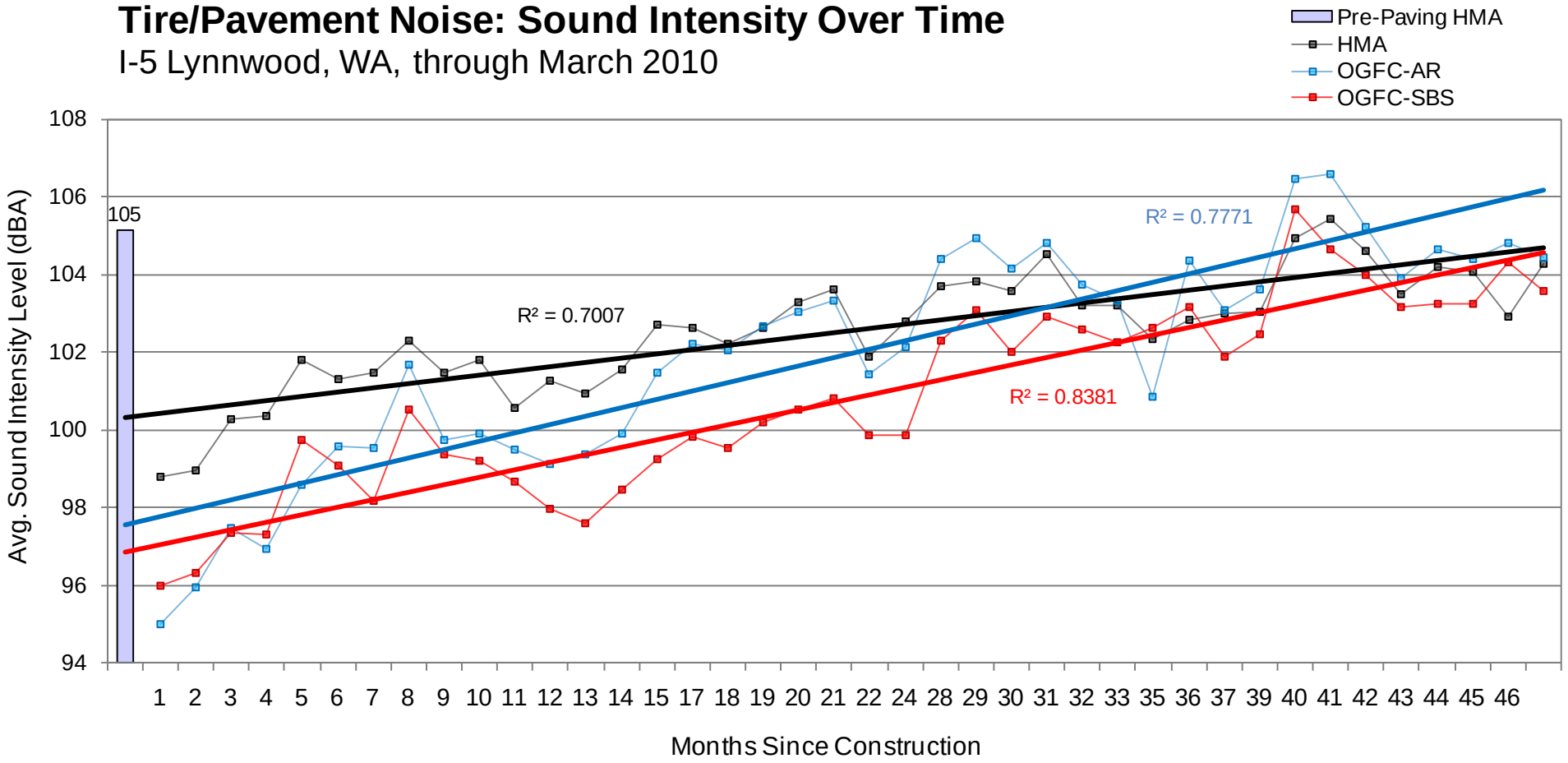
Tire/Pavement Noise: Sound Intensity Over Time

I-5 Lynnwood, WA, through March 2010



New HMA
Low - 98.8
High - 105.4
Max Variation - 6.6

OGFC-AR
Low - 95.0
High - 106.6
Max Variation - 11.6

OGFC-SBS
Low - 96.0
High - 105.7
Max Variation - 9.7

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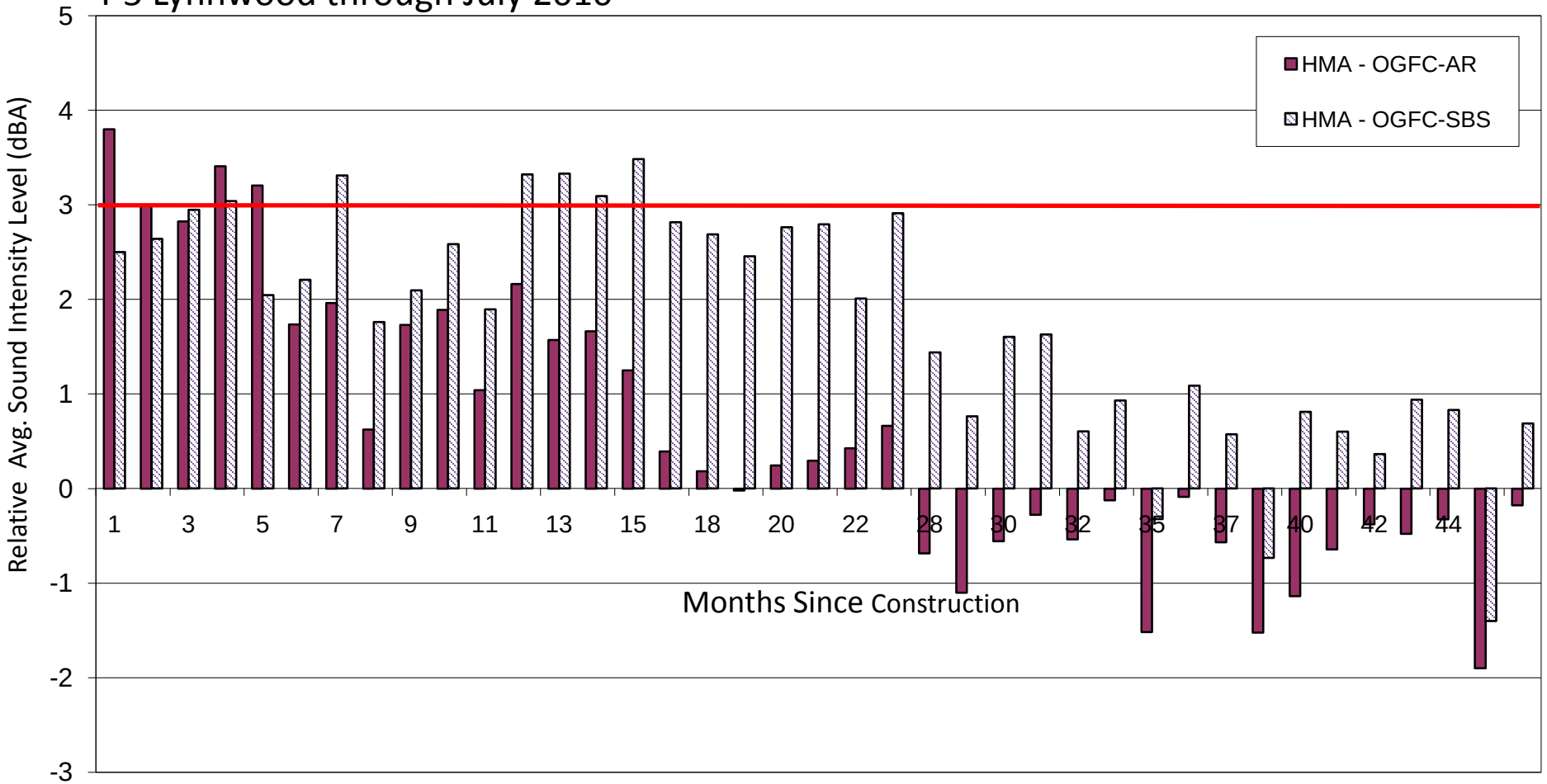
Relative Performance

I-5 Lynnwood through July 2010



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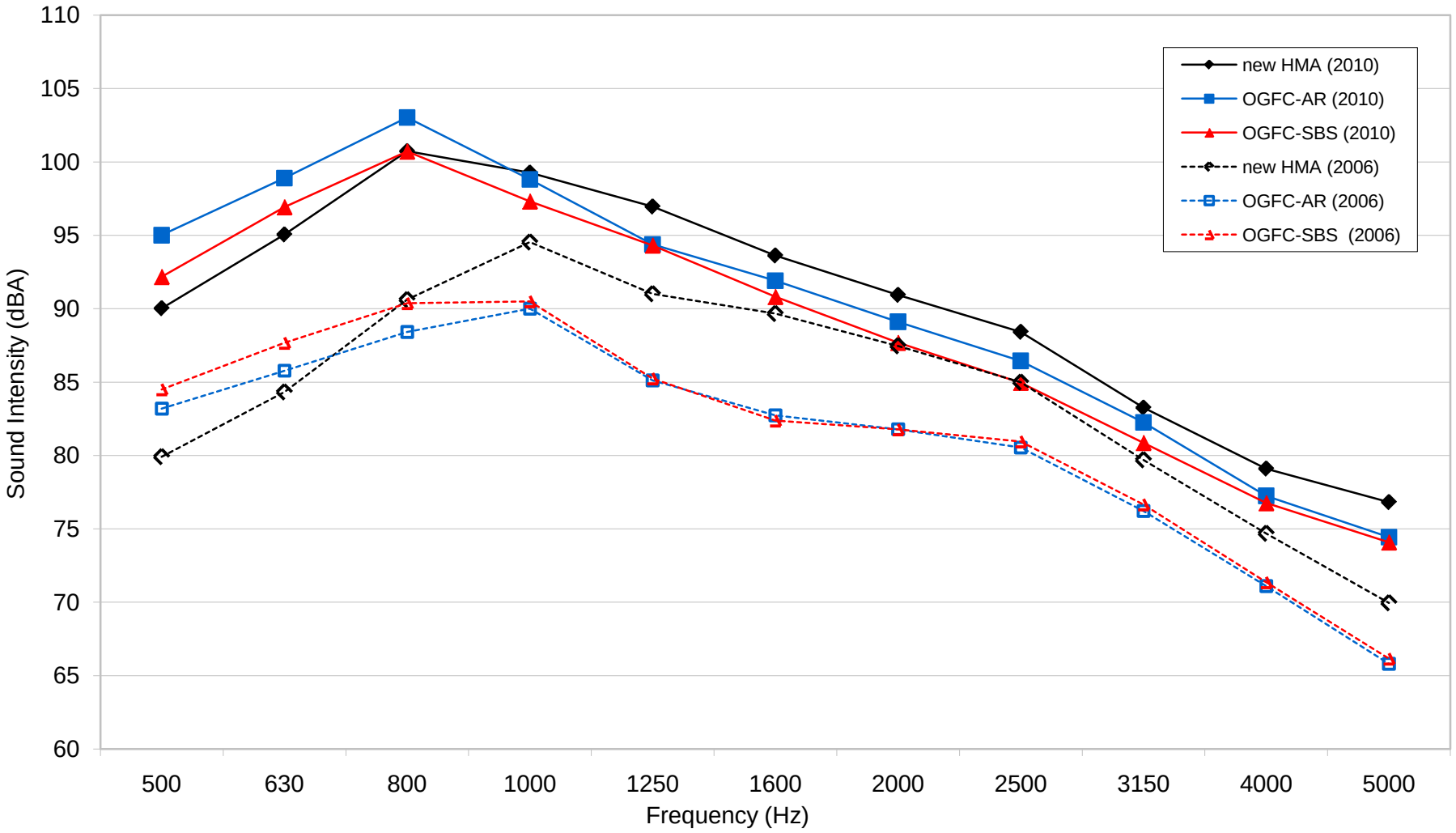
Frequency Comparison Over Time

I-5 OGFC Pavement Test Section



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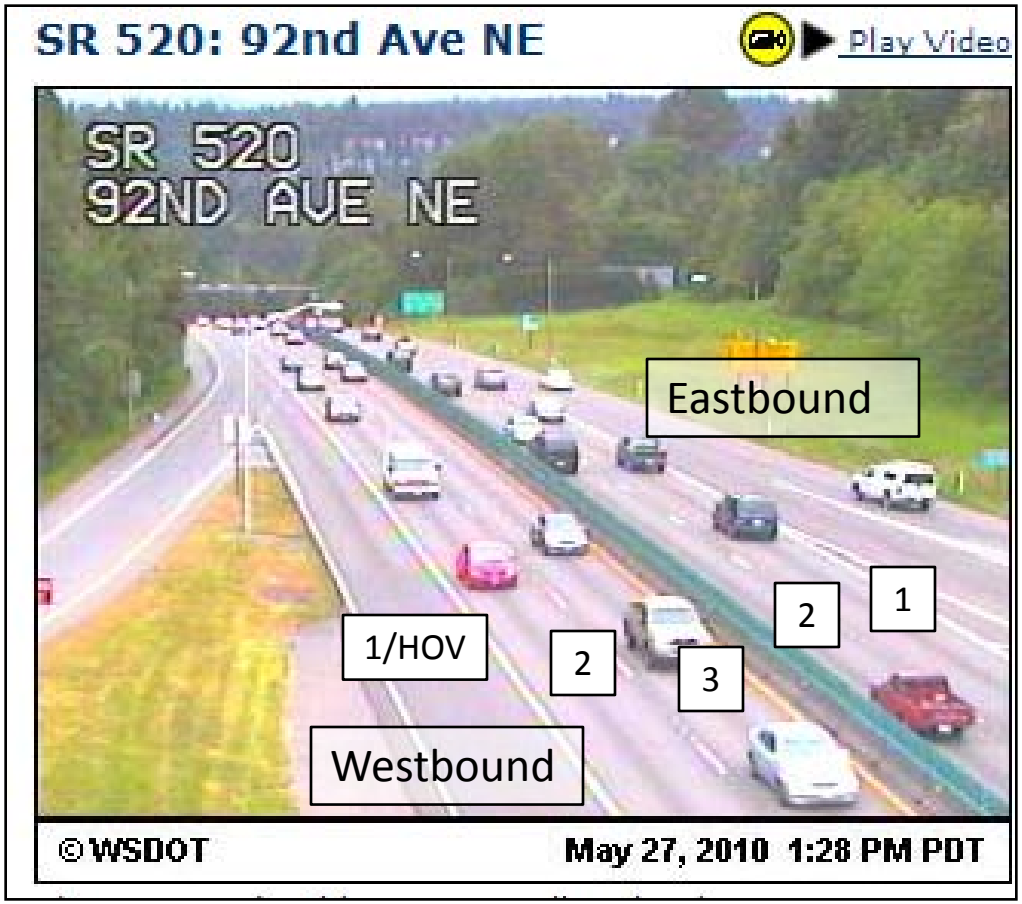
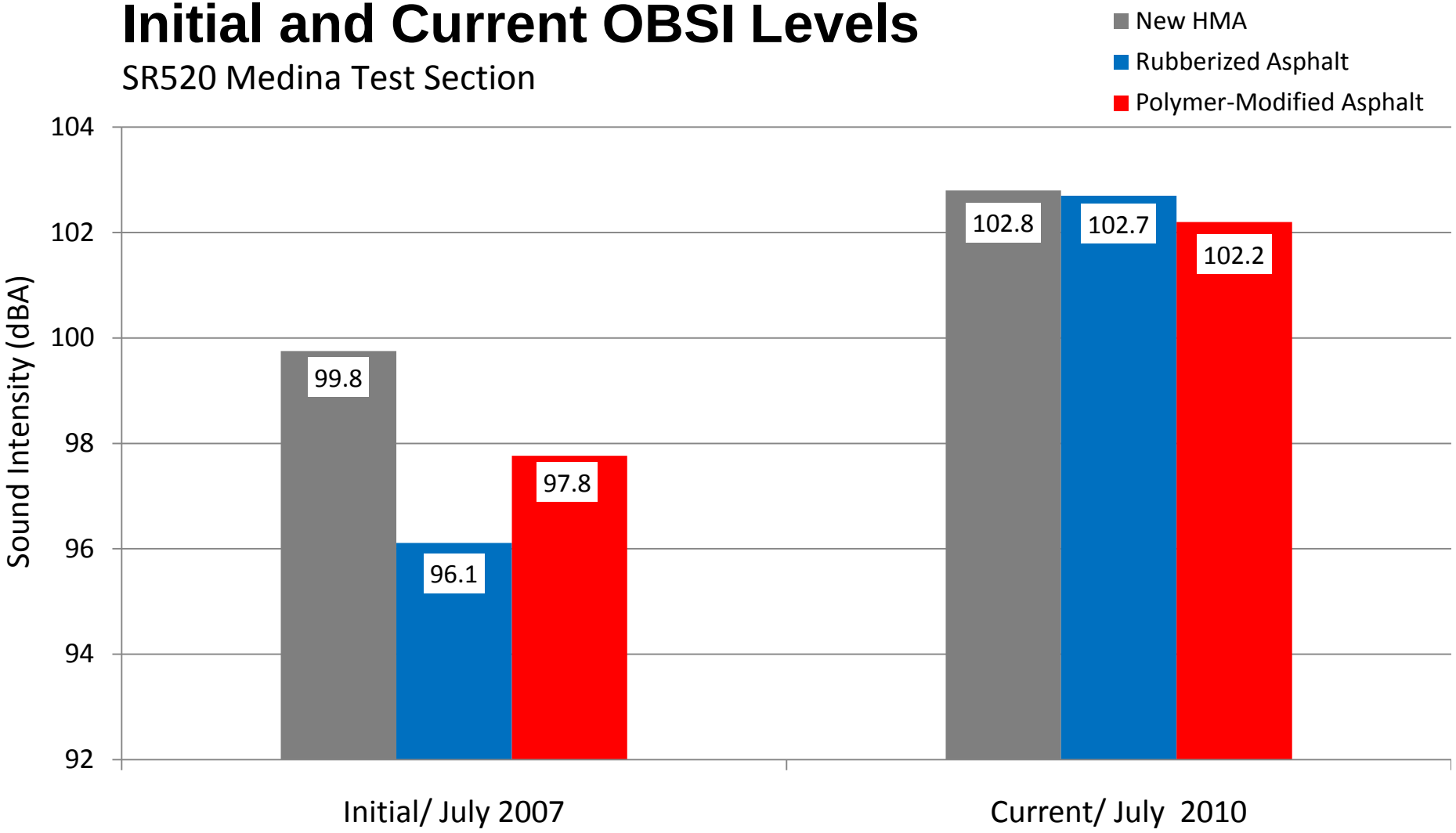
OGFC Test Section: SR 520



OGFC-Test Section on SR 520 near Medina, WA

Initial and Current OBSI Levels

SR520 Medina Test Section



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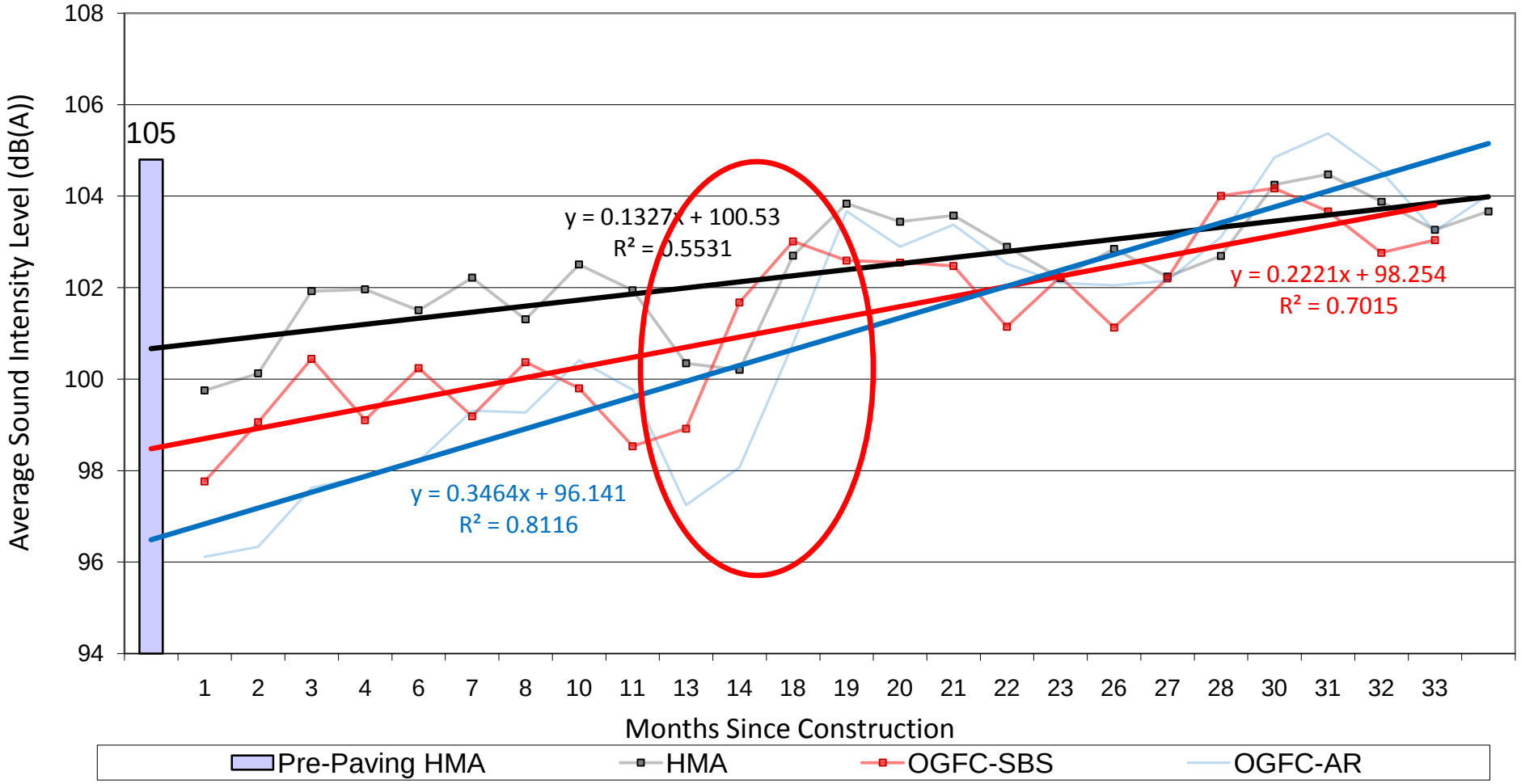
Tire/Pavement Noise: Sound Intensity

SR 520 Medina, WA, through April 2010



New HMA
Low – 99.8
High – 104.5
Max Variation – 4.7

OGFC-AR
Low – 96.1
High – 105.4
Max Variation – 9.3

OGFC-SBS
Low – 97.8
High – 104.2
Max Variation – 6.4

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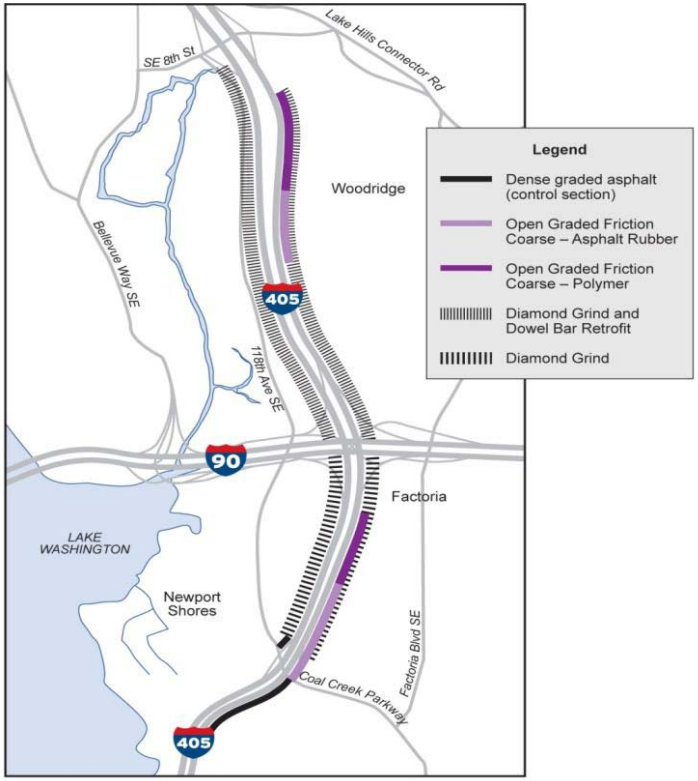
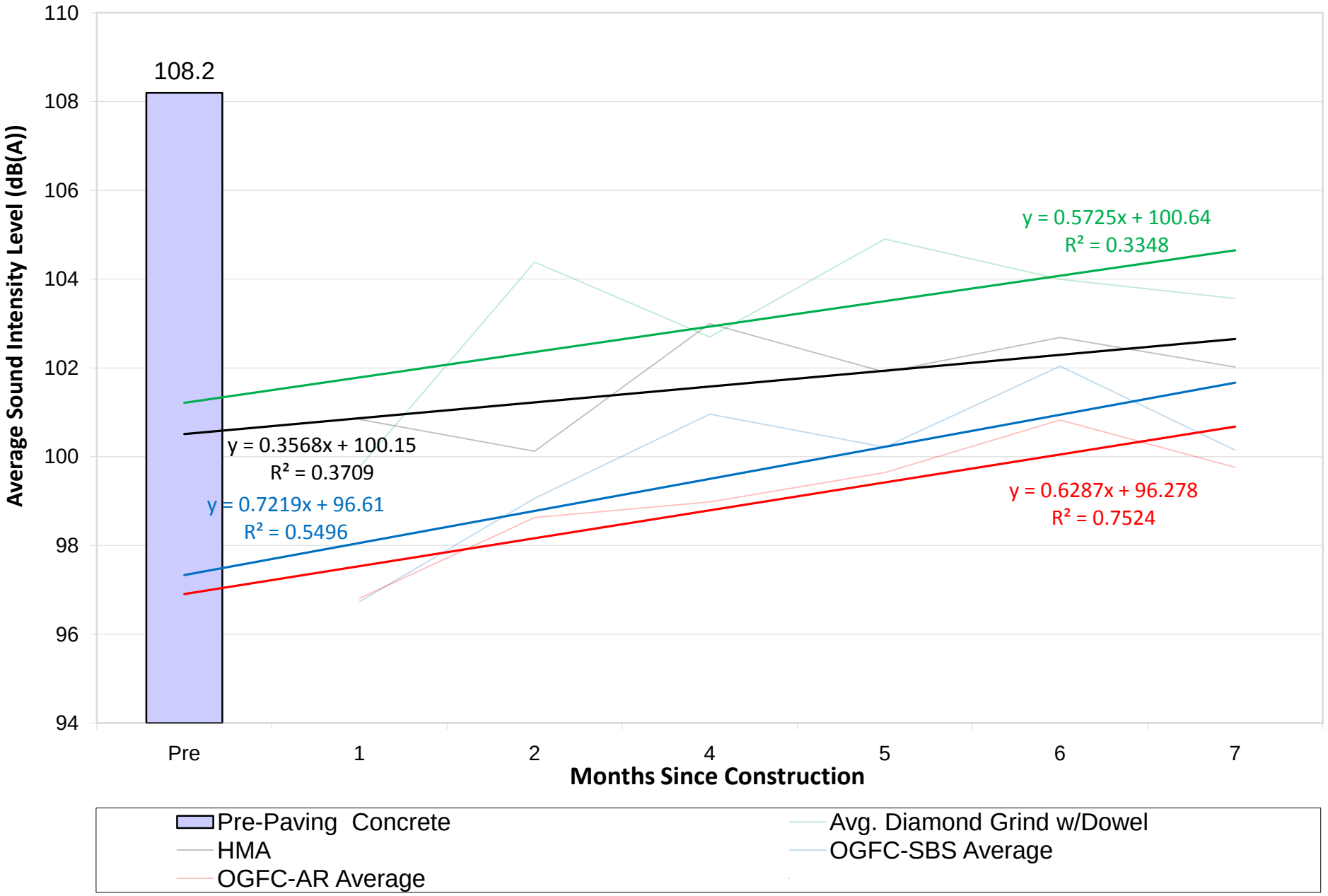
OGFC Test Section: I-405

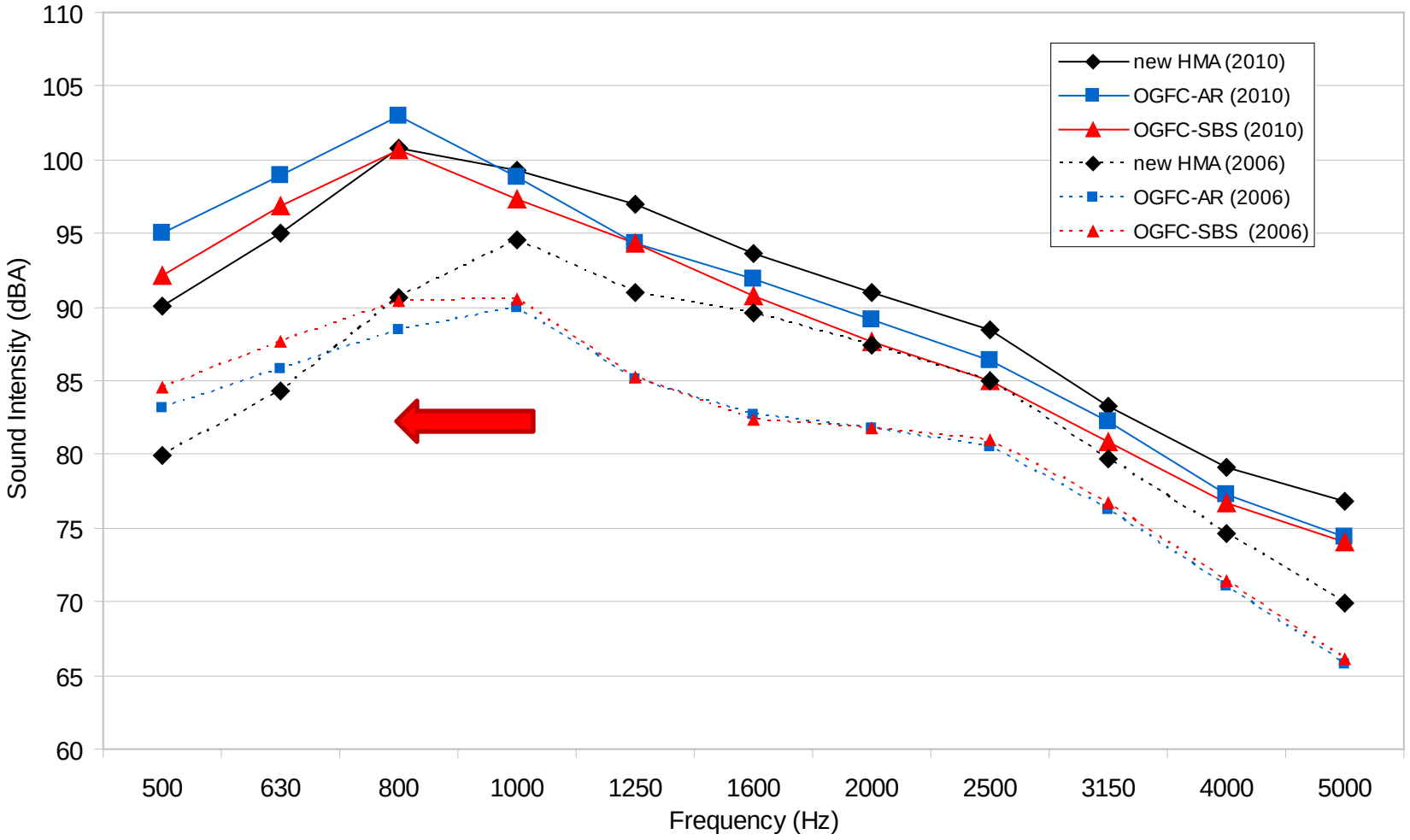


Tire/Pavement Noise: Sound Intensity

I-405 Bellevue, WA, through March 2010



Frequency Analysis: I-5 OGFC Test



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Pavement raveling on I-5 OGFC-AR test section two years after install.

Raveled pavement and visible rutting on SR 520 OGFC-AR test section

Challenges to QP in Washington

- High traffic volumes
- Winter conditions
  - Studded Tires
  - Snow Chains
  - Snow Plows
- Frequent Precipitation
- Cooler summer temps
  - Rarely exceed 70 F at night
  - Daytime temps >80 F hard to predict
- Freeze-Thaw Cycling
  - Temperate climate: temps hover above/below 0 C

Carbide studded tire

Snow chains on King County Metro bus

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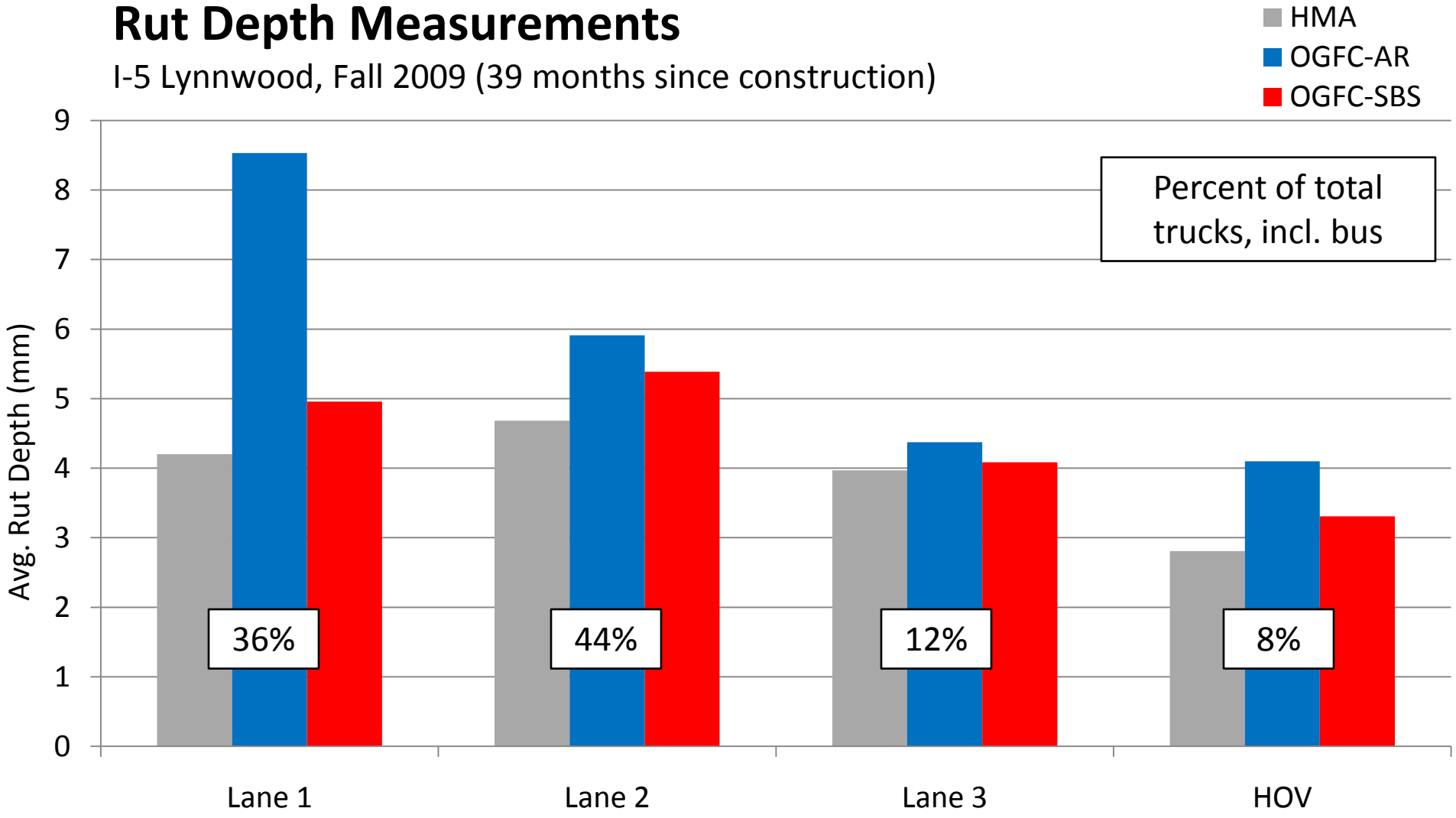
Rut Depth Measurements

I-5 Lynnwood, Fall 2009 (39 months since construction)



Program for replacement around 10.5 mm.

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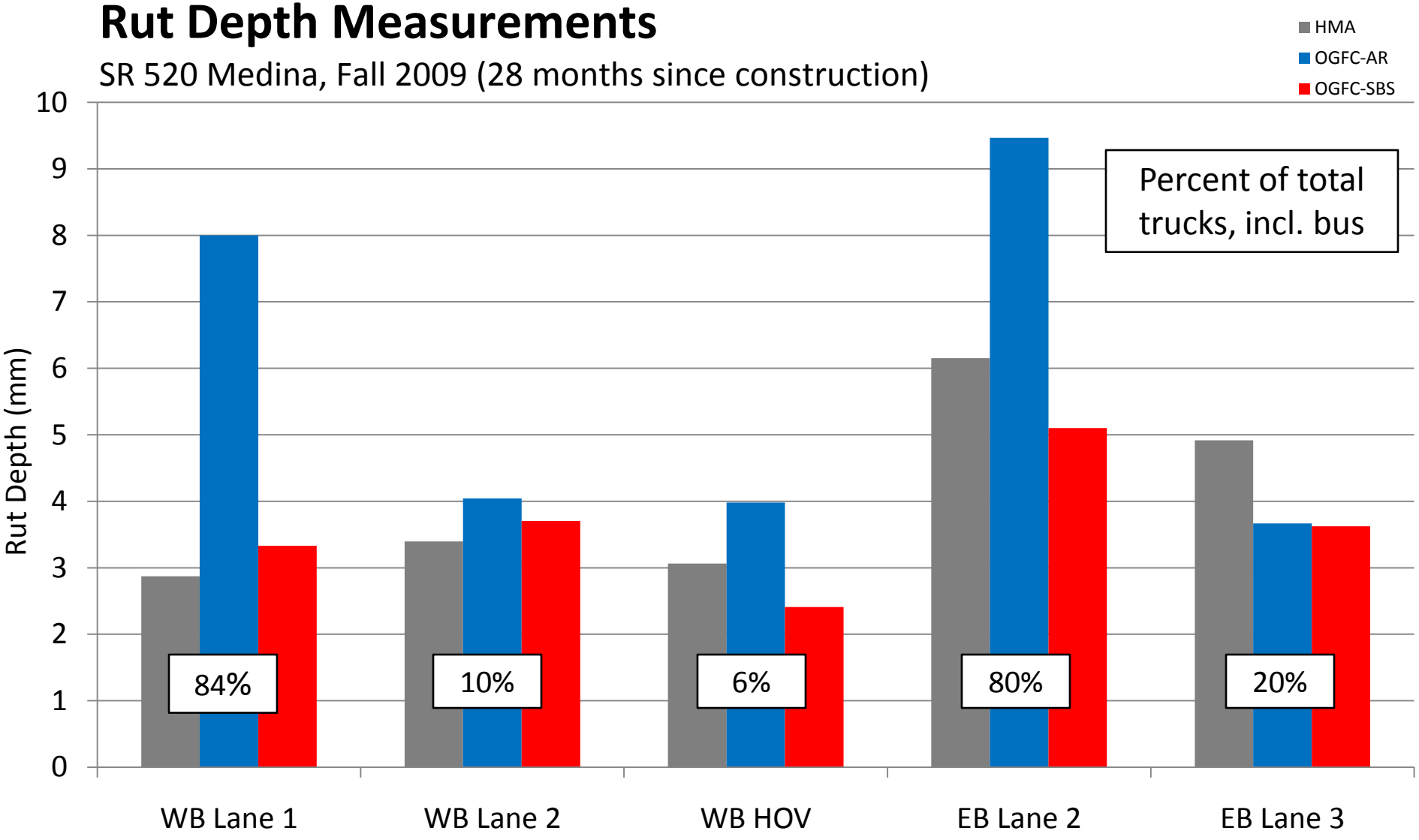
Rut Depth Measurements

SR 520 Medina, Fall 2009 (28 months since construction)



Program for replacement around 10.5 mm.

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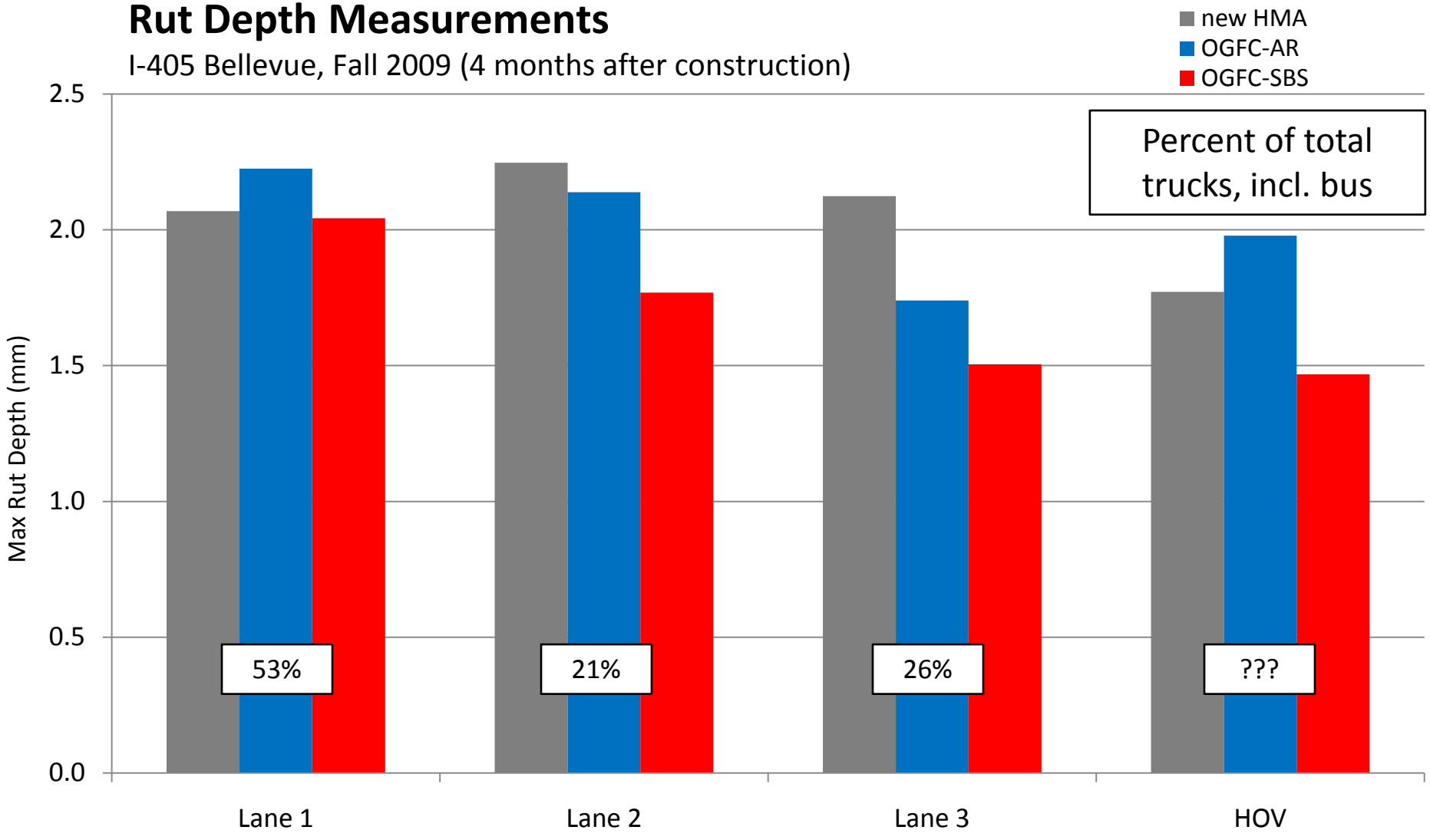
Rut Depth Measurements

I-405 Bellevue, Fall 2009 (4 months after construction)



Program for replacement around 10.5 mm.

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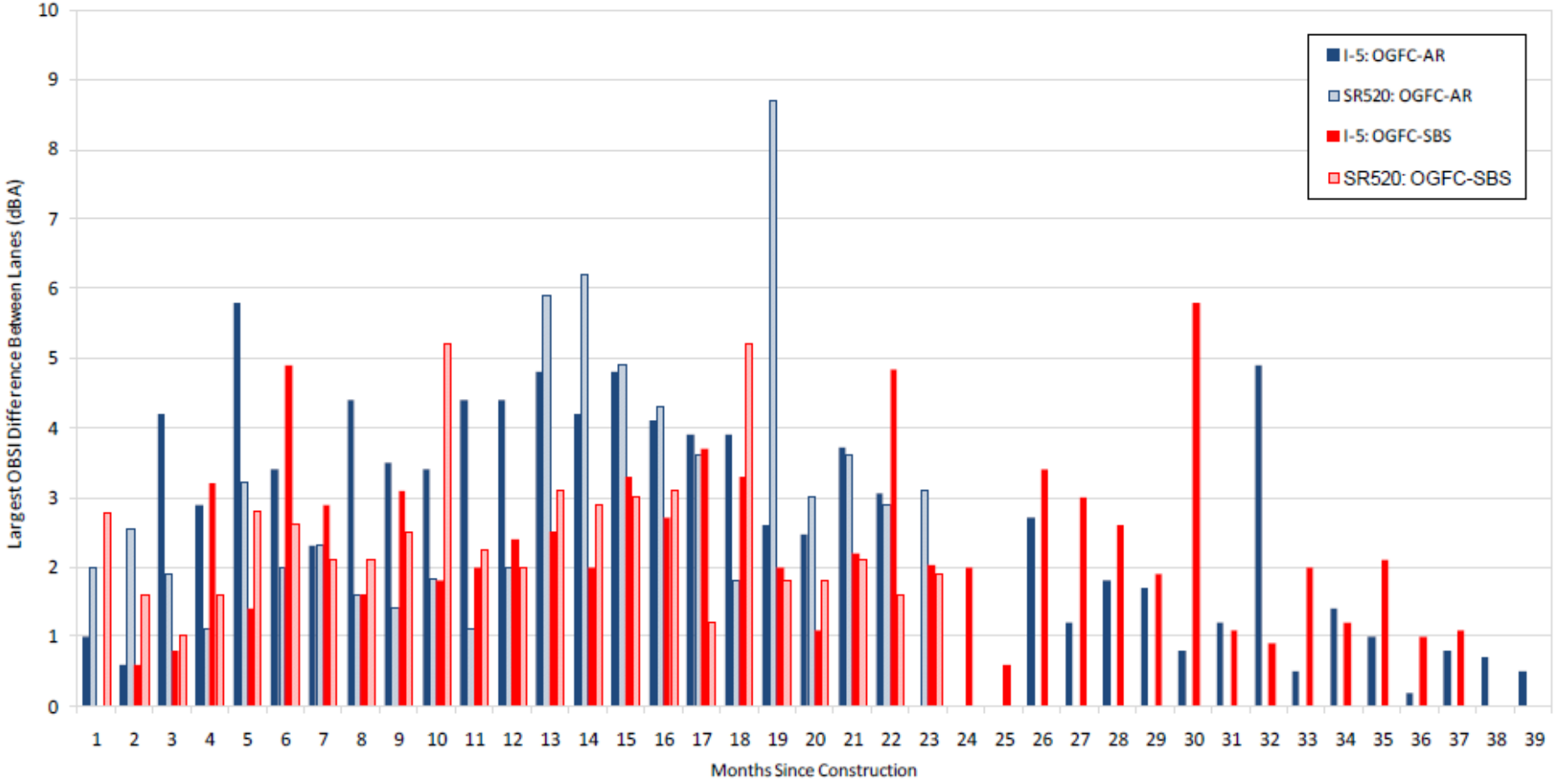
Largest Measured OBSI Difference between Lanes within OGFC Test Sections: I-5 and SR520 Test Sections



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Conclusions

- Initially: noise reductions from OGFC pavements compared to standard HMA. However, the reductions were lost within in about 6 months for most pavements.
- Primary cause for deterioration remains unclear.
  - Traffic appears to play a major role
  - Temperature and precipitation effects harder to quantify, but likely contributors
- WSDOT will continue monitoring pavements until end of useful life before making conclusions.

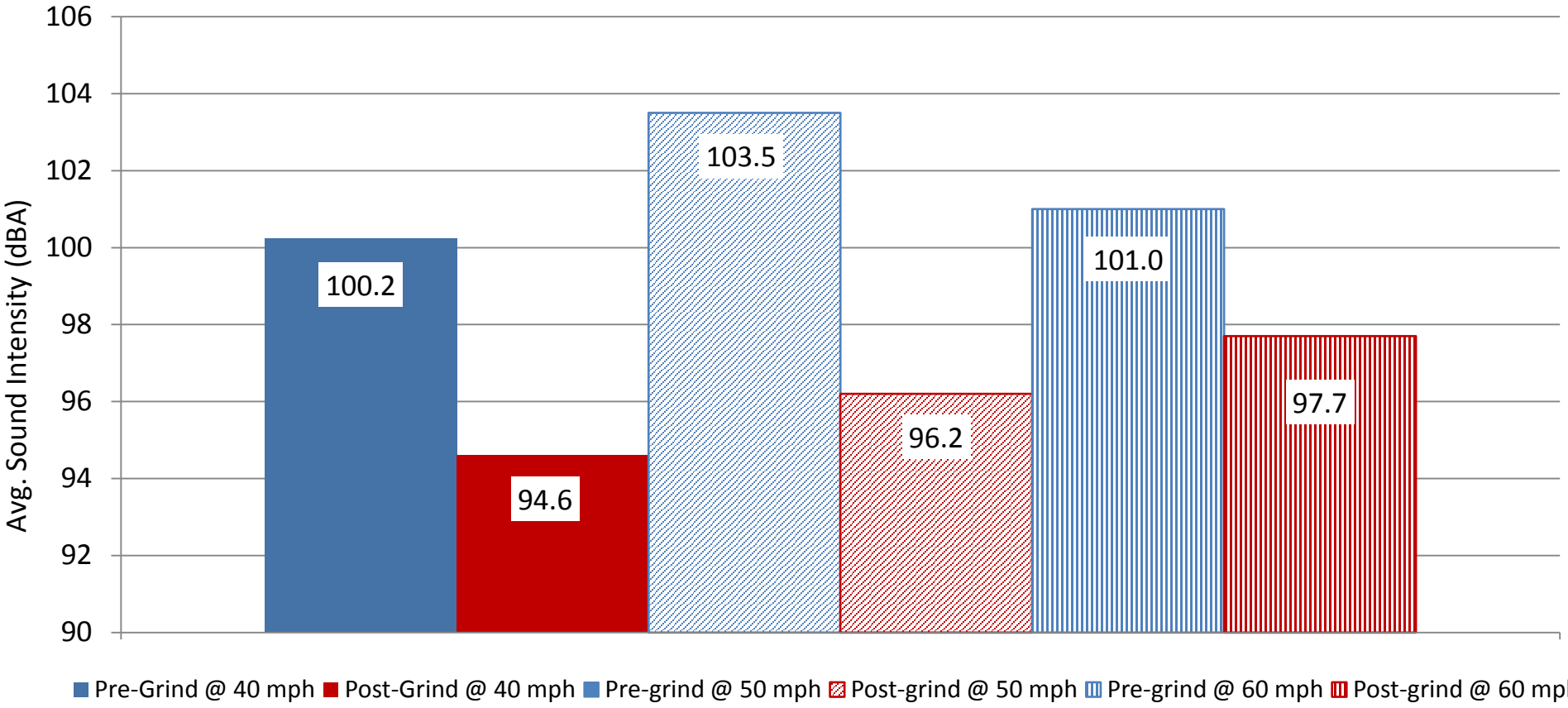
Other testing

- Two sections of NGCS
- One section of diamond ground pavement

Preliminary Results

Before and After Grinding: NGCS

Avondale Road between NE 144th Place and NE 151st Street at 40 , 50, & 60 mph



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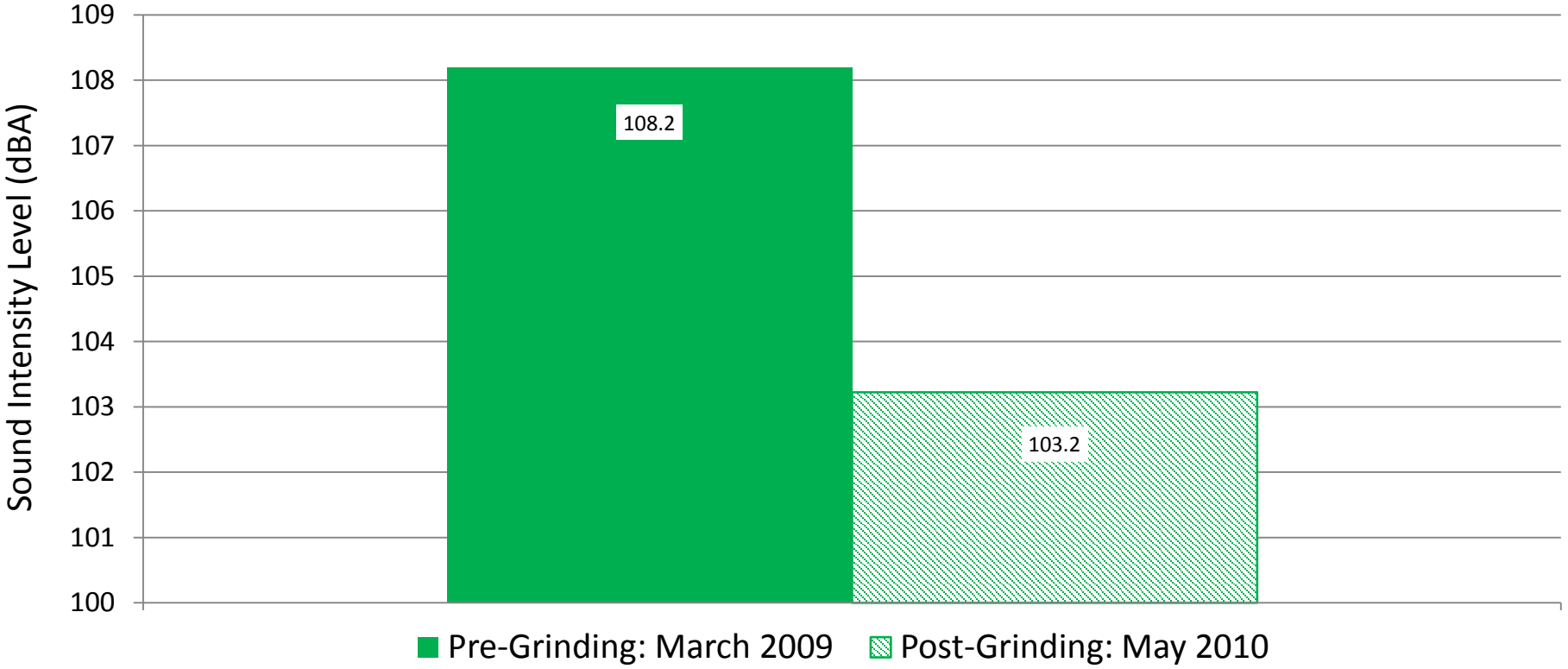
Before and After Grinding

Diamond Grind on I-5, Seattle vic. between 60th Street North and NE 163rd Street

Average OBSI at 60 mph



- Lowest post grind value = 102.4 dBA

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Questions?

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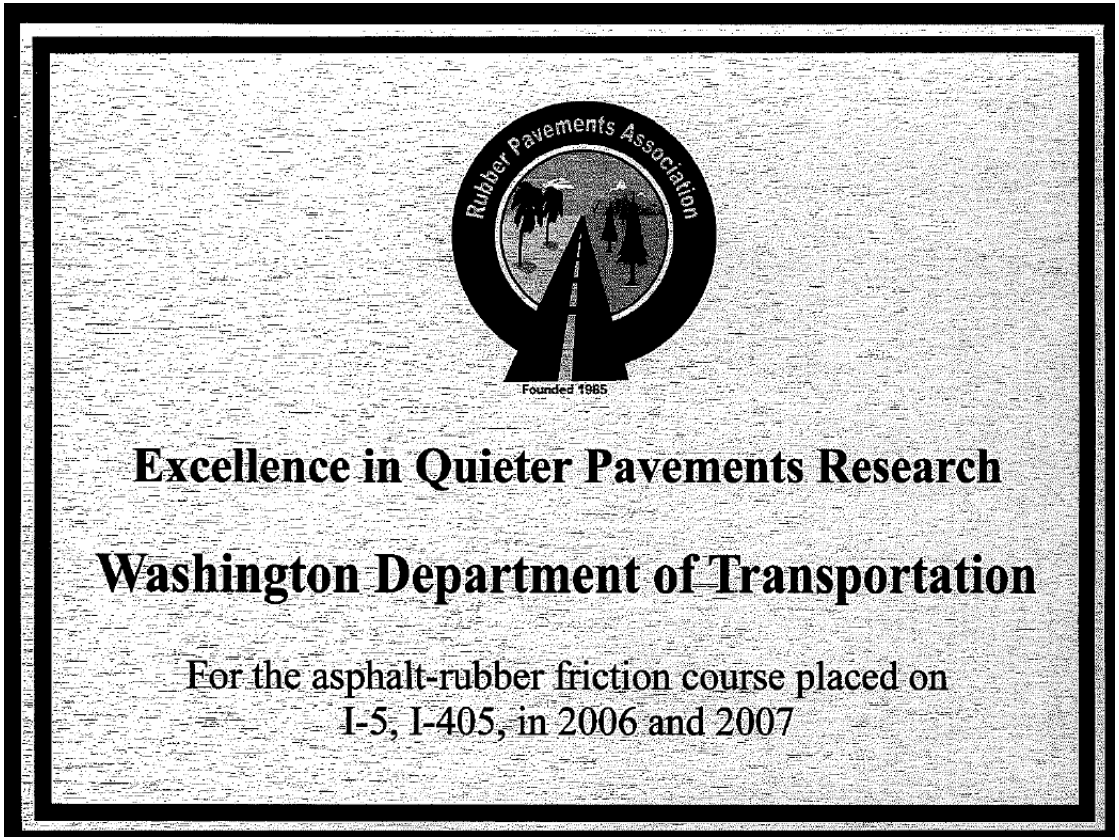

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