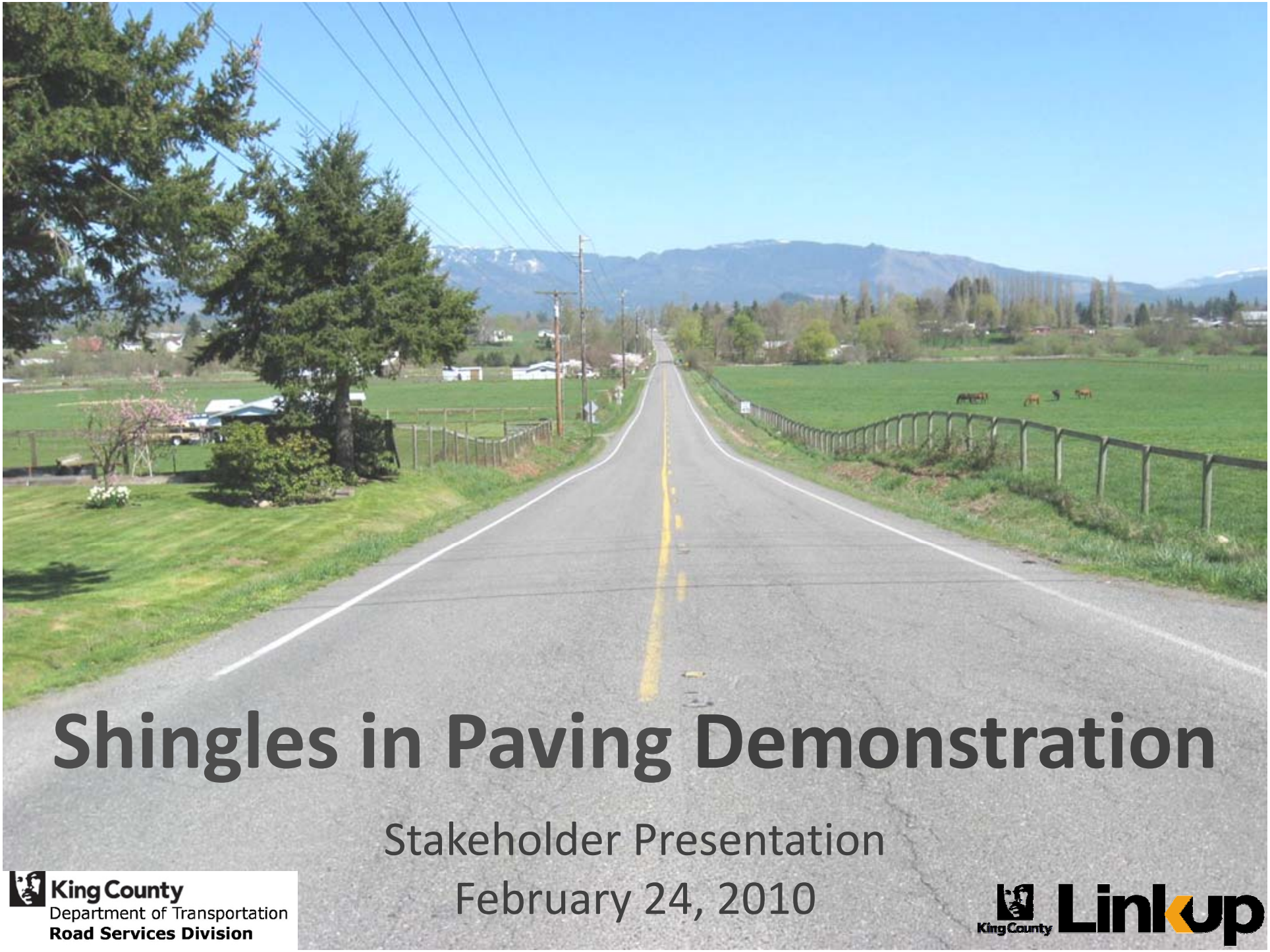


Shingles in Paving Demonstration

Stakeholder Presentation

February 24, 2010

King County
Department of Transportation
Road Services Division

King County Linkup

We did it – Thank you!

Paving completed in South King County in September, 2009

Agenda & Panel Members

1-2pm: Panel Presentation

- **Kris Beatty, LinkUp Manager**
  - Project overview, recycled asphalt shingles specification, next steps
- **Frank Overton, Supervising Engineer**
  - King County Road Services Division participation and study objectives
- **Kevin Kelsey, Geotechnical Engineer**
  - Study design, testing, findings
- **Joe DeVol, State Bituminous Engineer**
  - Hot mix asphalt (HMA) mix design
- **John Grisham, Project Manager**
  - Contractor perspective

2-2:30pm: Questions

2:30-3pm: Open networking

King County LinkUp

King County Department of Transportation Road Services Division

Washington State Department of Transportation

GENERAL CONTRACTORS WOODWORTH & COMPANY A Division of Miles Resources LLC

Shingles in Paving Project Overview

2006-2007: Background Research

- Identify shingles as a priority
- Explore potential end markets
- Research local and national efforts
- Engage stakeholders

2007-2009: Paving Demonstration

- Establish team, secure sponsor
- Select roadway, design study
- Establish specifications
- Procure RAS and HMA
- Install pavement
- Conduct initial testing

2010 and Beyond: Next Steps

- Complete Final Report
- Share results
- Carryout research
- Conduct annual pavement testing
- Implement another demonstration?

http://your.kingcounty.gov/solidwaste/linkup/shingles/

Market Development Advances

- **10 states now have specifications or procedures for using RAS in HMA**
  - Alabama, Georgia, Iowa, Minnesota, Missouri, Pennsylvania, South Carolina, Texas, Virginia, and Wisconsin
- **More local recyclers are processing shingles; at least three local pavers are using RAS in HMA on private roads**
- **Growing body of research in our region**
  - Metro Vancouver is initiating a pilot
  - Oregon State University is researching mix design using RAS for ODOT
  - Ecology recently published test results on shingles; deem the use of shingles in HMA as acceptable

Shingles in Paving Demonstration

Establish a strong local paving end market for recycled asphalt shingles (RAS) that captures the resource value of shingles and diverts this material from landfills

Partnership of LinkUp, KCRSD, and WSDOT

Develop RAS and HMA specifications

Pave wear course with 3% RAS with 15% RAP

Collect local engineering data; conduct performance testing

Design considerations:

- Minimize risk
- Performance over time
- Health, environmental and safety standards
- Recognition by industry and public agencies

RAS Specification

- Designed to ensure a high quality product that performs and meets health, safety, and environmental standards
- Guidance from national research and the American Association of State Highway and Transportation Officials (AASHTO)
- Collaborative process with leading transportation and regulatory agencies
- Involvement of private industry to ground requirements in reality
  - Product samples
  - Specification review
  - Outcome-oriented approach

Specification

- **Asphalt shingles only**
- **Extraneous waste up to 3%**
- **Moisture content up to 5%**
- **Gradation 100% ½", 95% 3/8"**
- **Sampling per AASHTO**
- **Asbestos sampling and testing on incoming shingles**
- **Other regulatory issues**

Environmental, Health, and Safety Standards

Key agencies, regulations and rules

- **Washington State Department of Ecology** – solid waste handling and storage
- **Washington State Department of Labor & Industries** – workplace safety rules
- **Puget Sound Clean Air Agency** – asbestos testing and handling
- **Local Health Department(s)** – general compliance, notification of grinding

Took asbestos issue seriously

- Restricted supply to asphalt shingles only
- Inspections of incoming loads
- Rigorous sampling and testing standards confirmed no asbestos in shingles
    - *Suspect materials include felt paper, mastic, built up roofing, and shingles with patching or aluminum coating*

What We Learned…

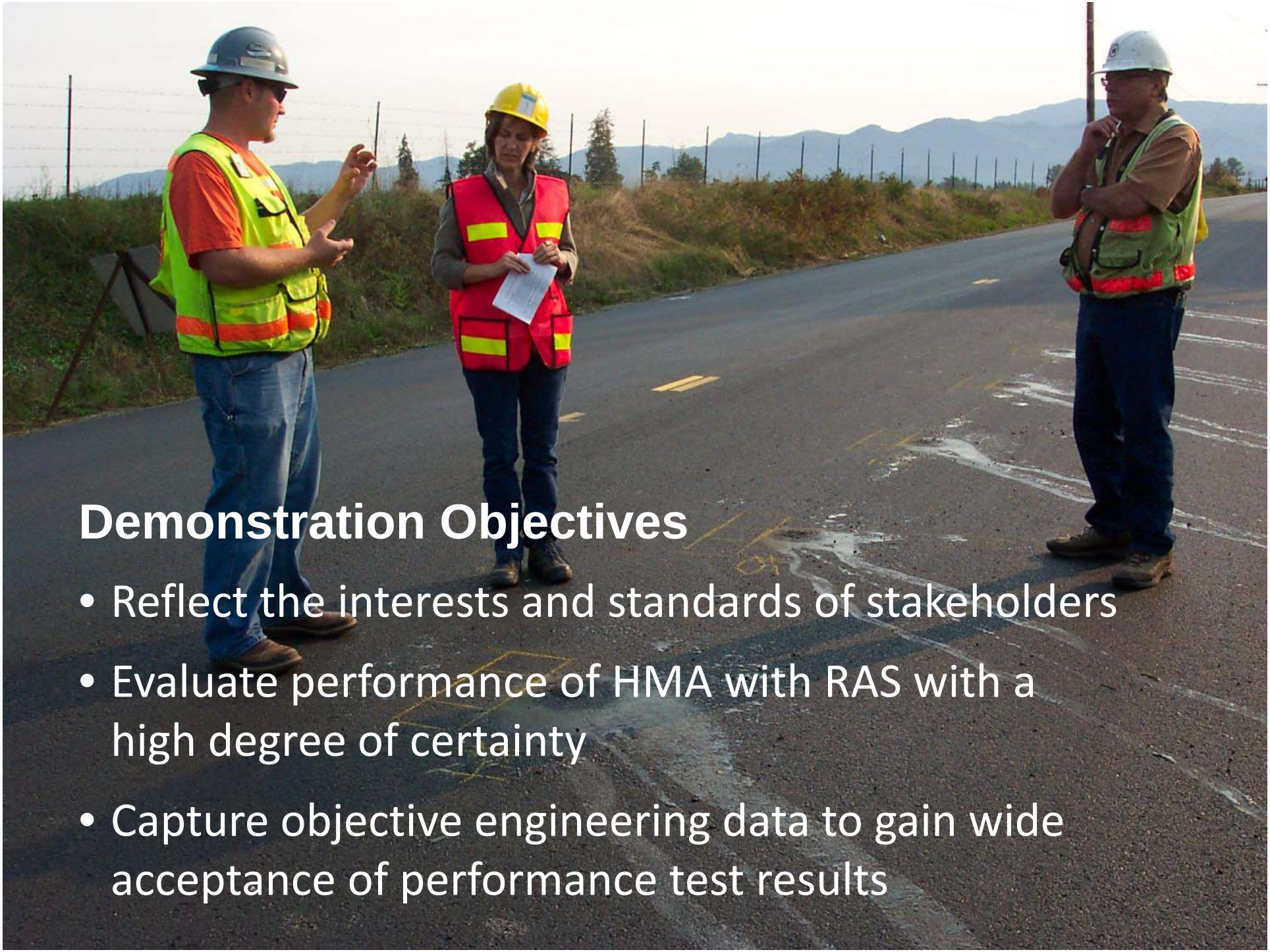
Confirmation that there is a low to none probability of asbestos in shingles.

Suspect materials identified include patching and aluminum coating.

Importance of visual inspections and sorting of mixed roofing material to remove suspect materials.

Need for additional research and guidance regarding asbestos sampling and testing.

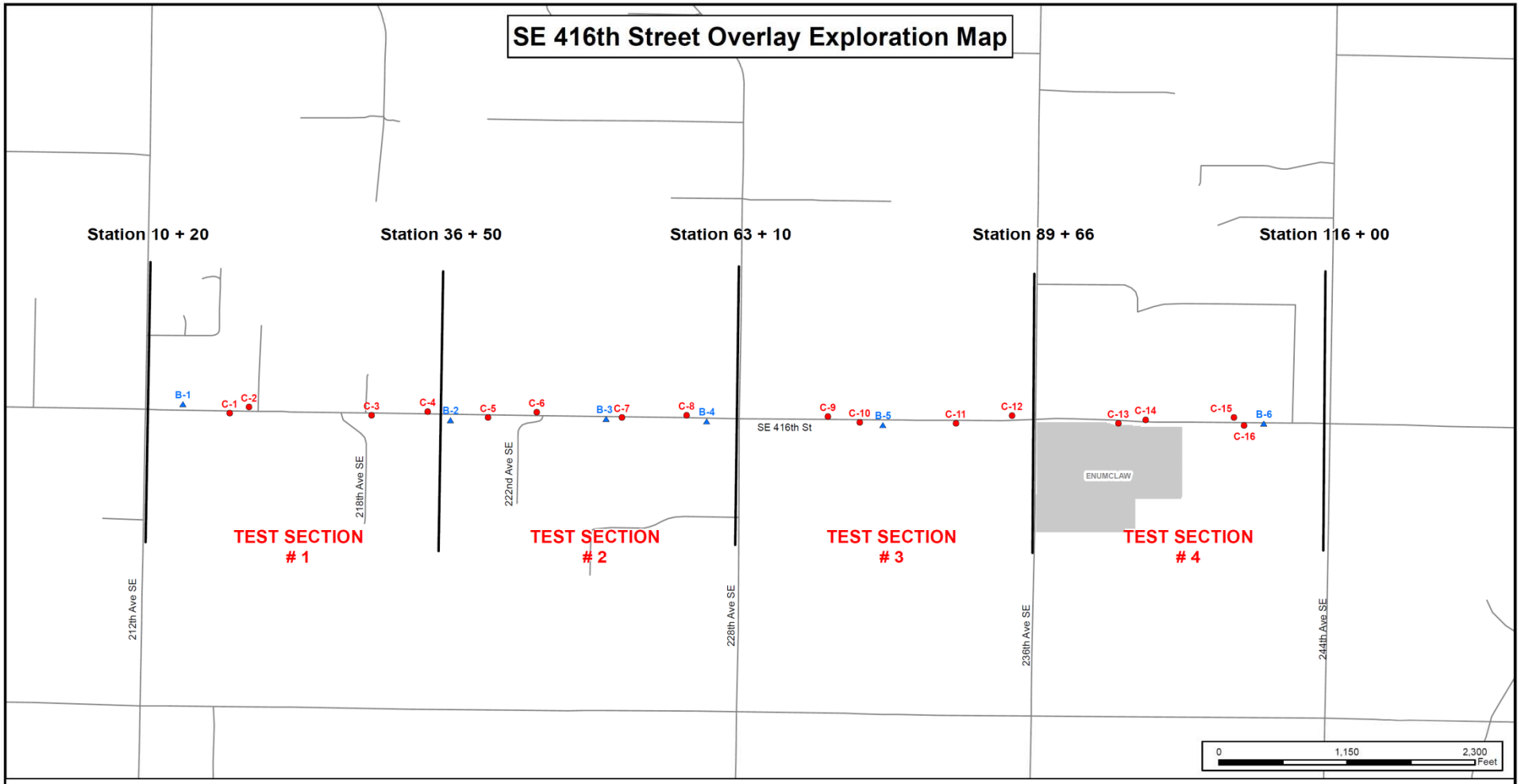
Core Project Team



Demonstration Objectives

- Reflect the interests and standards of stakeholders
- Evaluate performance of HMA with RAS with a high degree of certainty
- Capture objective engineering data to gain wide acceptance of performance test results

SE 416th Street Overlay Exploration Map



King County Materials Laboratory

SE 416th Street Overlay
Shingles in Paving Demonstration

SITE EXPLORATION MAP

- Approximate Boring Location
- Approximate Core Location
- Station Line
- Street Network
- City

N

January 7, 2010

File Name:
KG TUdevelopment\ArcMap\ArcMapProjects\SE_416th_St_exploration_map.mxd
Data Sources:
Standard King County datasets used include: trans_network, City
Roads Datasets Include: SE416thSt_stationing, Boring_Location, Core_Location

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King County
Department of Transportation
Road Services Division
Technology Unit

Road Selection and Study Design

Road selection criteria

- Overlay paving
- Two miles in length
- Consistent pavement and subsurface conditions
- Two-lane, relatively straight with limited variable surface conditions

	Test Section #1	Test Section #2	Test Section #3	Test Section #4
1000 tons/day	½ mile	½ mile	½ mile	½ mile
Lane 1 (eastbound)	HMA Mix with 15% RAP	HMA Mix with 3% RAS and 15% RAP	HMA Mix with 3% RAS and 15% RAP	HMA Mix with 15% RAP
Lane 2 (westbound)	HMA Mix with 15% RAP	HMA Mix with 3% RAS and 15% RAP	HMA Mix with 3% RAS and 15% RAP	HMA Mix with 15% RAP

Results from extensive initial material engineering tests indicate that using RAS in HMA has no negative impact on pavement performance.

- All but one Test Section substantially met project specifications and materials standards.
- The finished roadway surface is in near perfect visual condition.
- Skid resistance testing shows no noticeable change in resistance.
- Further testing, analysis, and documentation will continue to verify the impact on using RAS on public roadways.

HMA Specifications

- Design considerations
  - Amount of RAS
  - Estimated binder replacement from RAS
  - Use of recycled asphalt pavement (RAP)
- Design process
  - RAS samples
  - AASHTO guidance
  - Testing and team discussions

Volumetric Comparisons of Preliminary RAS Samples

Mix Design	Material %			Volumetric Data										
	Virgin	*RAP*	*RAS*	*Pb*	*Gmb*	*Gmm*	*Gmm @ Ndes*	*Gmm @ Nini*	*Va*	*VMA*	*VFA*	*Pbe*	*Gse*	*D/A*
Virgin	100	0	0	5.5	2.378	2.478	96.0	86.3	4.0	14.4	72	4.5	2.700	1.4
RAP	80	20	0	5.5	2.392	2.478	96.5	86.8	3.5	13.9	75	4.5	2.700	1.4
RAS #1	97	0	3	5.5	2.359	2.466	95.7	86.1	4.3	15.1	72	4.7	2.685	1.3
RAS #1	95	0	5	5.5	2.323	2.464	94.3	85.4	5.7	16.4	65	4.7	2.682	1.3
RAS #1	77	20	3	5.5	2.365	2.474	95.6	86.0	4.4	14.9	71	4.5	2.695	1.4
RAS #1	75	20	5	5.5	2.350	2.460	95.5	86.4	4.5	15.4	71	4.8	2.677	1.3
RAS #2	97	0	3	5.5	2.351	2.472	95.1	85.9	4.9	15.4	68	4.6	2.692	1.3
RAS #2	95	0	5	5.5	2.349	2.458	95.6	86.4	4.4	15.4	71	4.8	2.675	1.3
RAS #2	77	20	3	5.5	2.385	2.466	96.7	87.5	3.3	14.1	77	4.7	2.685	1.3
RAS #2	75	20	5	5.5	2.363	2.468	95.7	85.8	4.3	14.9	71	4.6	2.687	1.3
RAS #3	97	0	3	5.5	2.345	2.467	95.1	85.5	4.9	15.6	69	4.7	2.686	1.3
RAS #3	95	0	5	5.5	2.317	2.485	93.2	84.2	6.8	16.6	59	4.4	2.708	1.4
RAS #3	77	20	3	5.5	2.368	2.463	96.1	86.7	3.9	14.8	74	4.7	2.681	1.3
RAS #3	75	20	5	5.5	2.327	2.463	94.5	85.2	5.5	16.2	66	4.7	2.681	1.3
Specifications							Approx. 96.0%	≤ 89.0	Approx. 4.0%	Min. 14.0%	65 - 75			0.6 - 1.6

Volumetric Data for Test Sections 4 and 1 (RAP only)

Test Section	Material %			Volumetric Data										
	Virgin	*RAP*	*RAS*	*Pb*	*Gmb*	*Gmm*	*Gmm @ Ndes*	*Gmm @ Nini*	*Va*	*VMA*	*VFA*	*Pbe*	*Gse*	*D/A*
Section 4 (9/22/2009)	85	15	0	5.3	2.399	2.485	96.5	N/A	3.5	13.9	75	4.5	N/A	1.3
Section 4 (9/22/2009)	85	15	0	5.5	2.409	2.483	97.0	N/A	3	13.7	78	4.6	N/A	1.3
Section 1 (9/24/2009)	85	15	0	5.7	2.426	2.481	97.8	N/A	2.2	13.3	84	4.7	N/A	1.4
Section 1 (9/24/2009)	85	15	0	5.4	2.426	2.485	97.6	N/A	2.4	13	82	4.5	N/A	1.4
Average				5.5	2.415	2.484	97.2	N/A	2.8	13.5	80	4.6	N/A	1.4
JMF	100	0	0	5.3	2.374	2.475	95.9	86.4	4.1	14.4	71	4.5	2.686	1.4

Aggregate Gradation and Asphalt Content Results for Test Sections 4 and 1 (RAP only)

Test Section	3/4”	1/2”	3/8”	#4	#8	#16	#30	#50	#100	#200	Pb
Section 4 (9/22/2009)	100	94	82	58	39	26	18	12	9	5.9	5.3
Section 4 (9/22/2009)	100	95	83	55	36	25	18	12	9	5.9	5.5
Section 1 (9/24/2009)	100	92	83	57	38	26	18	13	9	6.5	5.7
Section 1 (9/24/2009)	100	95	84	57	37	26	18	13	9	6.4	5.4
Average	100	94	83	57	38	26	18	13	9	6.2	5.5
JMF	100	93	82	55	36	25	17	12	8	6.0	5.3

Volumetric Data for Test Sections 3 and 2 (RAP and RAS)

Test Section	Material %			Volumetric Data										
	Virgin	*RAP*	*RAS*	*Pb*	*Gmb*	*Gmm*	*Gmm @ Ndes*	*Gmm @ Nini*	*Va*	*VMA*	*VFA*	*Pbe*	*Gse*	*D/A*
Section 3 (9/23/2009)	82	15	3	6.4	2.423	2.450	98.8	N/A	1.1	14.0	92	5.5	N/A	1.3
Section 3 (9/23/2009)	82	15	3	6.3	2.428	2.451	99.1	N/A	0.9	13.7	93	5.4	N/A	1.3
Section 2 (9/25/2009)	82	15	3	5.5	2.383	2.489	95.7	N/A	4.3	14.6	71	4.5	N/A	1.6
Section 2 (9/25/2009)	82	15	3	5.7	2.404	2.464	97.6	N/A	2.4	14.0	83	5	N/A	1.4
Section 2 (9/25/2009)	82	15	3	5.8	2.405	2.472	97.3	N/A	2.7	14.1	81	4.9	N/A	1.4
Average				5.9	2.409	2.465	97.4	N/A	2.3	14.1	84	5.1	N/A	1.4
JMF	82	15	3	5.6	2.369	2.466	96.1	86.7	3.9	14.2	72	4.4	2.632	1.4

Aggregate Gradation and Asphalt Content Results for Test Sections 3 and 2 (RAP and RAS)

Test Section	3/4”	1/2”	3/8”	#4	#8	#16	#30	#50	#100	#200	Pb
Section 3 (9/23/2009	100	91	82	58	39	27	19	14	10	7.2	6.4
Section 3 (9/23/2009	100	91	81	56	38	27	19	13	9	6.8	6.3
Section 2 (9/25/2009)	100	95	87	61	42	29	21	15	11	7.0	5.5
Section 2 (9/25/2009)	100	95	84	57	39	27	19	14	10	7.2	5.7
Section 2 (9/25/2009)	100	92	83	57	38	26	19	13	10	6.8	5.8
Average	100	93	83	58	39	27	19	14	10	7.0	5.9
JMF	100	94	84	57	39	27	19	13	8	6.3	5.6

Production and Paving

- Contractor perspective
- Was it successful, was it beneficial to Woodworth?
- Lessons learned and what's on the horizon

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