

# A Brief History of the Performance of Rubberized Pavements in Washington State



# Special Report

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## Introduction

This report traces the performance history of pavements built in the state of Washington using recycled tire rubber. The history begins in 1977 with the construction of a rubber asphalt chip seal used as an interlayer to prevent reflection cracking and concludes with a brief description of the current use of rubber in open-graded friction courses placed to mitigate the noise generated between the pavement and vehicle tires. Sandwiched between those two historical end points is a history of successes and failures with rubberized chip seals and stress absorbing membrane interlayers, open-graded pavements with rubber asphalt binders mixed on the job, proprietary PlusRide® dense graded pavements, and open-graded and dense-graded pavements with asphalt binders modified with rubber that is shipped to the job site from asphalt suppliers. The overriding purpose of this report is to evaluate if the rubber is providing enhanced pavement performance and at what cost.

## Historical Perspective

The Washington State Department of Transportation (WSDOT) has been experimenting with the use of recycled tire rubber in pavements since 1977, a total of 30 years. The initial experiments used the “Arizona Process” in which the granulated tire rubber is mixed with hot asphalt and allowed to cook until a portion of the rubber unites with the asphalt. The portion not combined with the asphalt serves as filler. Special storage requirements need to be followed and reheating remixing are required if the asphalt is allowed to cool since the rubber tends to separate from the liquid asphalt. This process was developed in the state of Arizona and is also known as the “wet process”.

The first experiments involved the use of the rubber asphalt binder in chip seal applications both as a wearing surface and an interlayer to prevent reflection cracking. The performance of the chip seals used as a wearing surface was comparable to standard chip seals, but at two to three times the cost. The performance of rubber asphalt chip seals as an interlayer was more successful than standard chip seals in retarding the reflection of alligator cracks, but equivalent to standard chip seal interlayers in retarding the reflection of transverse and

longitudinal cracks. However, this was again four times the cost of a standard chip seal interlayer.

Between 1982 and 1991 the focus for the use of rubber asphalt binders shifted from chip seals to open-graded and dense graded overlays. The wet process was used to produce a number of open-graded experimental projects that included both bridge overlays and mainline paving. The performance of the open-graded pavements was found to be equivalent to open-graded pavements constructed without rubber, however, at a cost between 1.1 and 3.7 times that of the conventional binder pavements.

The dense graded pavements were constructed using a proprietary product called PlusRide®. PlusRide® was made using the dry process. In the dry process, granulated rubber is added to the aggregate to replace some of the finer aggregate particles. The performance of PlusRide® was very mixed. Approximately half of the projects had problems during construction, some to the extent that failure was immediate. Those that were successfully constructed had performance histories that were equivalent to pavements built with conventional methods. The average cost of the PlusRide® mixes were 1.9 times more than conventional dense graded mixes.

The use of recycled tire rubber in pavements got a huge boost by the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) in December of 1992. In an effort to reduce the number of used tire stockpiles the federal government mandated the use of recycled rubber in federally funded, state implemented department of transportation projects. The mandate required the use of recycled rubber in five percent of the hot mix asphalt (HMA) tonnage used in federally funded project in 1994, 10 percent in 1995, 15 percent in 1996, 20 percent in 1997 and each year thereafter. The mandate was removed as part of the appropriations process in 1994, after pressure was put on the federal government by the states.

In the period between 1992 and 1994, before the mandate was removed, many states experimented with the use of recycled rubber tires in pavements. WSDOT, with its background in the use of rubber in pavements, looked for an easier and cheaper way to incorporate rubber into pavements that would not involve the on site complicated and expensive wet process or the proprietary dry process (PlusRide®). In 1992 a new asphalt binder labeled PBA-6GR was



introduced by a local asphalt supplier, US Oil, Tacoma, Washington. It contained very finely ground (80 to 200 mesh) recycled crumb rubber from tires added to the liquid asphalt at the suppliers plant. The PBA-6GR had a minimum rubber content of 10 percent by weight of the liquid asphalt. The product was used just like any other conventional asphalt binder and no special storage or reheating and remixing limitations were imposed. The first project that used this new binder was Contract 4036, Lewis County Line to SR-12, on I-5 south of Olympia, WA. It is at this point that the use of rubber in pavements becomes current history.

## Current History

The current history of the use of recycled rubber in pavements begins with the evaluation of four projects that were constructed between 1992 and 1997. All of the projects used the PBA-6GR binder previously described. Two of the projects used open-graded mixes and the other two dense graded mixes. Two of the projects are located in the Olympic Region and one each in the Northwest and South Central Regions. The Olympic Region projects include one south of Olympia on I-5 between the Lewis County Line and the junction of SR-12. The second Olympic Region project is also on I-5 located between the bridge over the Nisqually River and the Gravelly Lake interchange. The South Central Region project is located on I-90 between Ellensburg and Ryegrass summit. The Northwest Region project is located on SR-520 and included the paving to the Evergreen Point Floating Bridge and an additional two miles east toward Bellevue.

### ***Lewis County Line to SR-12***

Contract 4036, Lewis County Line to SR-12, was built in 1992 and was the first WSDOT project that used the US Oil PBA-6GR rubber modified performance based asphalt binder. The designation PBA stands for performance based asphalt. The performance based asphalt binders were developed by the West Coast User/Producer Group which was composed of State Highway Agencies, the Federal Highway Administration, and asphalt producers and suppliers. The PBA grading system was performance driven and utilizes both conventional and modified binders. This binder grading system was based on selecting an asphalt binder taking into account the climate and environmental conditions of the project location. The PBA grading system was eventually replaced by the Superpave binder classification system that is based on climate, environment, and traffic.

The project was located on I-5 from Milepost (MP) 85.51 to 88.03. The Modified Class D HMA with PBA-6GR binder was placed in the northbound lanes at the northern end of the project between MP 87.14 and MP 88.03, see Figure 1. The remaining 1.63 miles of the northbound lanes used a Modified Class D with a PBA-6 binder. The Modified Class D open-graded mix used a larger one inch maximum size aggregate (the maximum size for conventional Class D aggregate was 1/2 inch). The change to a larger aggregate size was prompted by the desire for a pavement with greater resistance to rutting. The southbound lanes were paved with a Class A HMA dense graded mix. The Class A HMA mix has a higher fracture requirement than Class B HMA which was the standard design for most projects at that time. Again the Class A HMA with greater fracture was chosen because of its reported greater resistance to rutting.

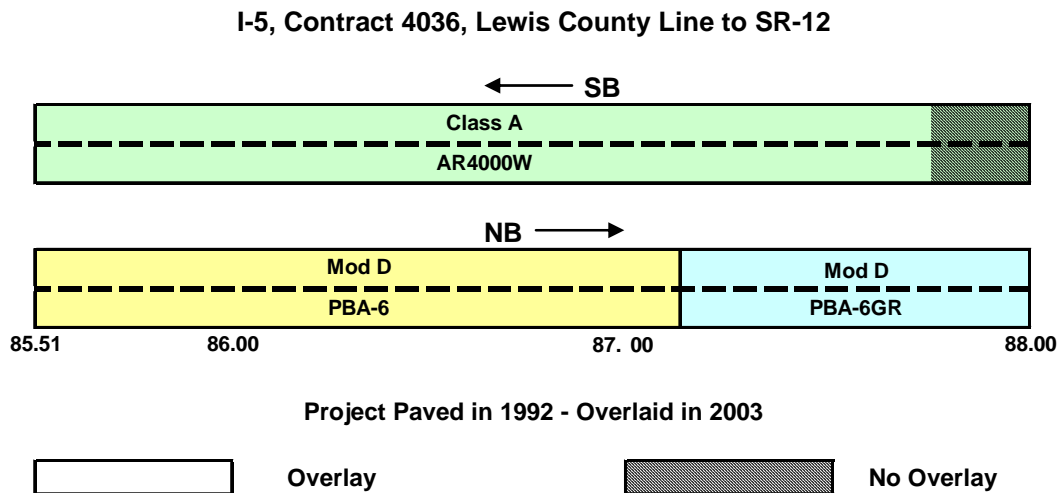


Figure 1. Lewis County Line to SR-12 section locations.

There was a significant design issue that tainted the experiment right from the beginning. The asphalt content of the mix design used for the PBA-6GR pavement was significantly higher than the mix design for the PBA-6 pavement (6.6 percent versus 5.4 percent asphalt). As a result, the PBA-6GR flushed almost immediately after it was opened to traffic. The section with PBA-6, in contrast, looked like a well constructed open-graded pavement. The drain down test used to design both mixes indicated that the PBA-6GR should have 1.1 percent more asphalt in spite of the fact that the same aggregate source gradation were being used for both designs. There was also some thought that the use of vibratory rollers during construction caused a migration of the binder to the surface of the pavement. In any case, it did alter the validity and value of the experiment.

The northbound lanes of PBA-6GR and PBA-6 pavement were milled and filled in 2003 yielding a pavement life of 11 years. Table 1 summarizes the structural performance of the two pavements from the Washington State Pavement Management System (WSPMS) for the 2003 survey taken just before repaving. The structural performance of the pavement is expressed in terms of Pavement Structural Condition (PSC) which is calculated based on the amount and severity of longitudinal, transverse and alligator cracking and patching. PSC has an upper limit

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of 100 (no distress) and a lower limit of zero (extensive distress). When a pavement reaches a PSC of 50, (approximately 10% medium severity alligator cracking), rehabilitation is triggered.

At the time of the mill and fill in 2003, the PSC for both the northbound PBA-6GR and PBA-6 open-graded sections and the southbound Class A HMA were in the 97-99 range, indication that there were very few problems with cracking or patching. Wear/rutting was the condition that triggered the rehabilitation of this section. The rehabilitation trigger for wear/rutting is 10 mm. The PBA-6GR and PBA-6 sections had exceeded the 10 mm trigger value with average wear/rutting of 11 and 10 mm, respectively and maximum readings in the 13-14 mm range. The section not overlaid had a wear/rutting average of 5.5 mm in 2003 with a maximum reading of 7 mm. Detailed WSPMS data can be found in Appendix A for this project.

**Table 1. Lewis Count Line to SR-12 pavement condition data prior to overlay.**

Section	Dir.	Milepost Limits	PSC		Distress Noted
			Average	Range	
PBA-6	NB	85.51 to 87.14	98.9	95-100	Minor amounts of low severity longitudinal and transverse cracking.
PBA-6GR	NB	87.14 to 88.03	99.1	99-100	Minor amounts of low severity longitudinal cracking
Class A HMA	SB	85.51 to 88.03	99.3	90-100	Minor amounts of low severity longitudinal and transverse cracking.

**Table 2. Lewis County Line to SR-12 wear/rutting and IRI data.**

Section	Dir.	Milepost Limits	Wear/Rutting (mm)		IRI (inches/mile)	
			AVE	Range	AVE	Range
PBA-6	NB	85.51 to 87.14	11	10-13	129	111-153
PBA-6GR	NB	87.14 to 88.03	10	2-14	126	101-134
Class A HMA	SB	85.51 to 88.03	7.6	5-10	100	88-125

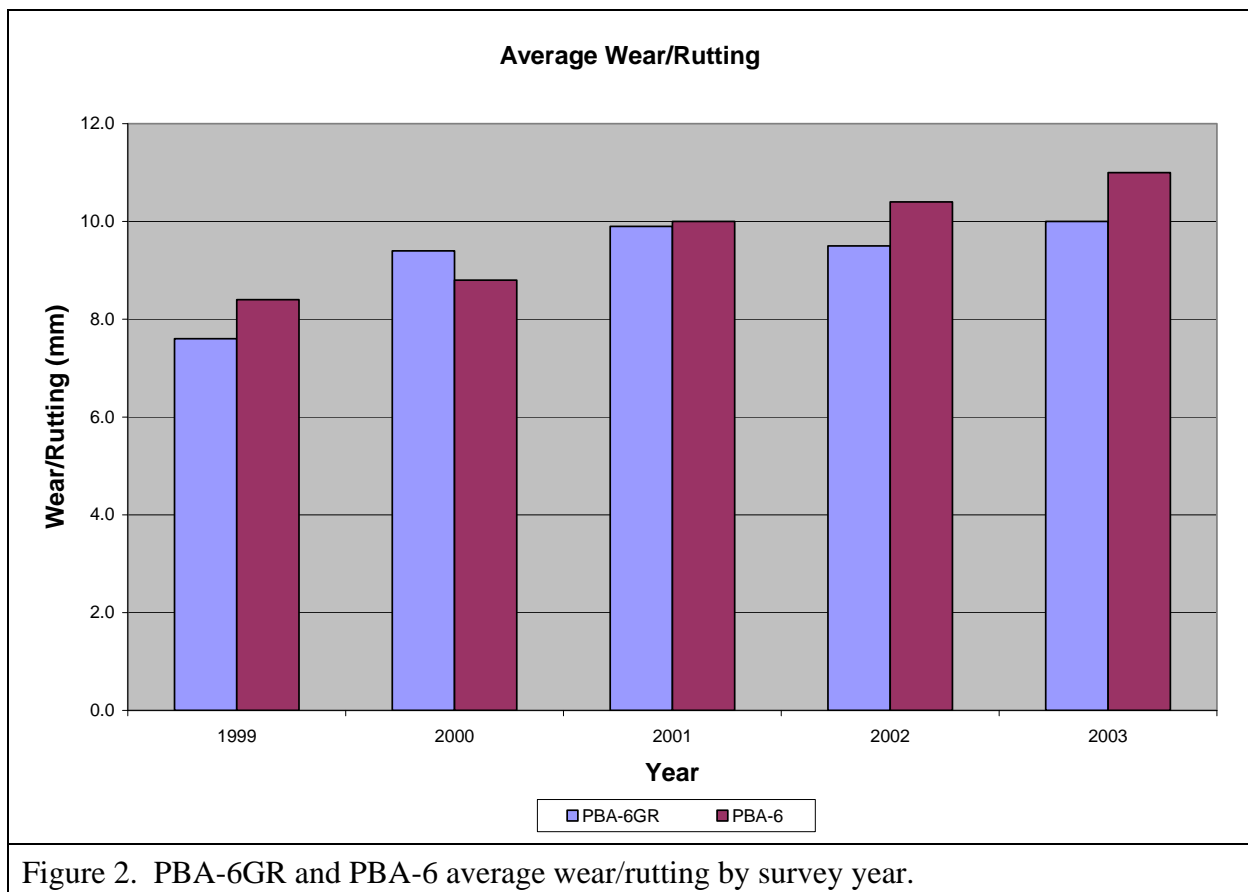
A service life of 11 years obtained for this project is slightly better than the 8-10 year average life for open-graded pavements. However, with wear/rutting measurements approaching 10-11 mm just prior to overlay one might question that any increase in pavement life was gained if the section had been rehabilitated when the rutting reached 10 mm trigger value. The

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wear/rutting measurements from surveys prior to 2003, see Appendix A, indicates that the 10 mm trigger value was achieved in 2001 for the PBA-6GR and 2003 for the PBA-6 as shown in Figure 2. This would give the PBA-6GR a pavement life of nine years and the PBA-6 a life of 11 years.

A resurfacing report issued in February of 2002 by the Olympic Region indicated that wheel path rutting and general poor roadway condition prompted the plan to overlay the majority of both the north and southbound lanes. The report states that the WSPMS indicated that northbound lanes were due in 2000 and the southbound in 2006. The report also states that the existing roadway was in good condition with scattered areas of low severity longitudinal, transverse, and alligator cracking, low severity patching and low to medium severity wheel rutting varying from 9 to 12 mm in depth. A copy of the resurfacing report is found in Appendix E.



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The cost of the PBA-6GR and PBA-6 (see Table 3) was approximately 1.5 times that of the conventional Class A HMA. The majority of the southbound Class A HMA was overlaid at the same time as the northbound open-graded sections yielding a life of 11 years. The very small portion of Class A HMA at the north end of the southbound lanes that was not overlaid has a projected life of 24 years. Its current age is 16 years which matches the Olympic Regions' average pavement life of 15.9 years.

**Table 3. Lewis County Line to SR-12 bid prices and estimated quantities.**

Item	Bid Price	Quantity	Total Cost
PBA-6	\$51.25	4,107 tons	\$210,484
PBA-6GR	\$51.25	2,243 tons	\$114,954
Class A HMA	\$34.75	7,350 tons	\$255,413

## Nisqually River to Gravelly Lake I/C

The primary objective of this experimental feature was to evaluate the performance of two performance based asphalt (PBA) binders against the performance of conventional AR4000W. The primary goal of the project was to develop a mix which would be resistant to raveling and rutting.

The experiment was designed to place two mile sections of PBA-6 and PBA-6GR in both the northbound and southbound lanes with the remainder of the project receiving the standard AR4000W binder. A Class A dense graded mix design was used for all of the binders and the material was placed at a depth of 0.15 feet. The roadway consists of three twelve foot lanes with a four foot left shoulder and a ten foot right shoulder, in both directions. The northbound lanes were paved in 1993 and the southbound lanes in 1994. Figure 2 shows the layout of the pavement sections and Table 2 summarizes important aspects of each of the mixes placed on the project.

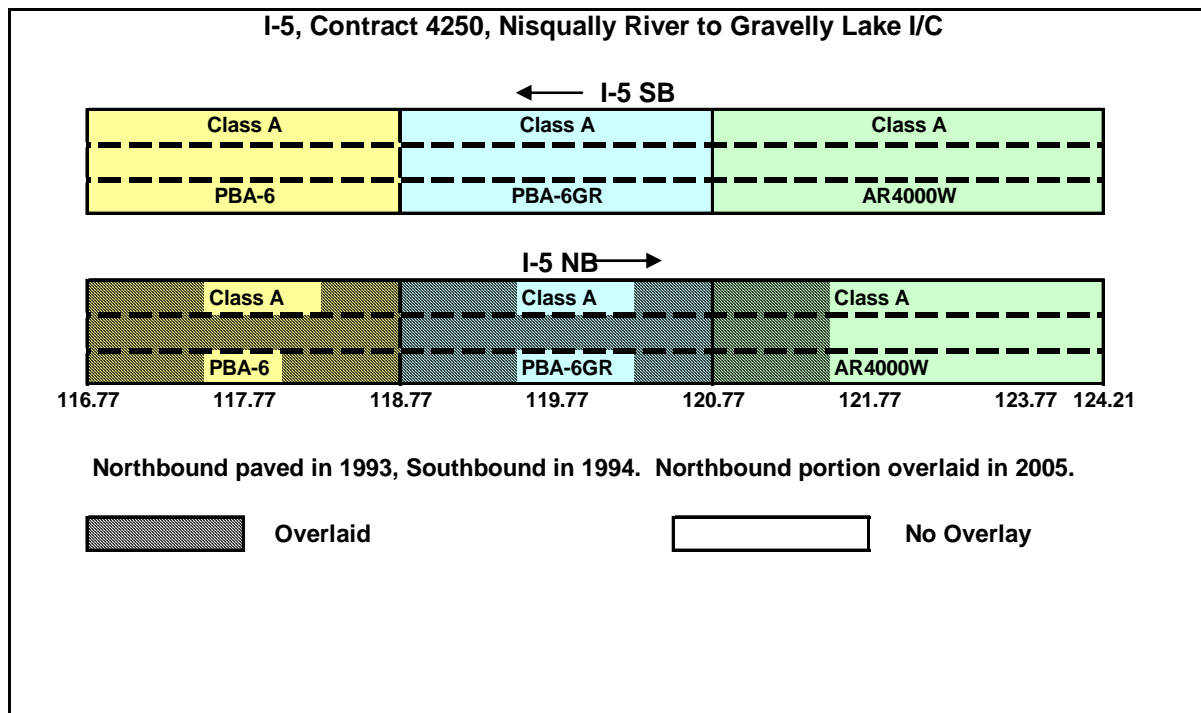


Figure 3. Nisqually River to Gravelly Lake I/C section locations.

**Table 4. Nisqually River to Gravelly Lake I/C summary of mix design properties.**

<b>Property</b>	<b>AR4000W</b>	<b>PBA-6</b>	<b>PBA-6GR</b>
ACP Tons Placed	38,460	9,070	9,100
Asphalt Content (%)	5.0	4.9	5.4
Mixing Temperature (°F)	Data not available	330	340
Lay Down Temperature (°F)	Data not available	300	300
Ambient Air Temperature (°F) 1993 Paving	Data not available	40-56	42-52
Ambient Air Temperature (°F) 1994 Paving	Data not available	58-82	53-71
Cost Per Ton	\$27.00	\$30.00	\$36.00
Liquid Asphalt Supplier	Chevron	Chevron	US Oil

Cyclic segregation occurred during the paving of the northbound lanes in 1993. WSDOT determined that cyclic segregation is most often caused by temperature differentials that exist in each load of mix caused by the cooling of the upper portions of the HMA in each truck when exposed to the air during transport. The cooler mix cannot be compacted to the required density thus giving the appearance of segregation in the final mat. Since this occurs with every truck load the area of poorly compacted HMA occurs in a cyclic pattern. Temperature differentials can be minimized by remixing the HMA prior to its delivery to the paving machine. A material transfer device (MTV) was used on the southbound lanes which minimized the cyclic segregation effect.

The cyclic segregation in the northbound lanes led to premature failure and repaving of this section was done in 2005. A resurfacing report, see Appendix E, issued in March of 2002 by the Olympic Region stated that the project experienced severe temperature differential problems and multiple truck fans. Excessive raveling was occurring in the area of the truck fans. The report further states that maintenance forces have done extensive repair work on the northbound lanes to address the worst of the raveled areas.

The southbound lanes are still in excellent condition as noted in Table 5. The sections of the table that are shaded are the locations that have been overlaid. The section with PBA-6GR binder is performing marginally better than either the section with PBA-6 or AR4000W binders. The sections with AR4000W binders are performing the worst, however, at an age of 13 years it



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would be expected that all of the sections would begin to show signs of distress given that the average life for all asphalt pavements in the Olympic Region is 15.9 years. The detailed WSPMS data can be found in Appendix B.

**Table 5. Nisqually River to Gravelly Lake I/C pavement condition data.**

Binder Type	Dir.	Milepost	PSC		Description of Defects in Section
			Average	Range	
PBA-6	NB	116.77 - 118.77	90	57-100	Low severity longitudinal and alligator cracking.
PBA-6GR	NB	118.77 – 120.77	86	55-100	Low severity longitudinal, transverse and alligator cracks throughout.
AR4000W	NB	120.77 – 121.41	92	85-99	Low severity longitudinal and alligator cracking.
AR4000W	NB	121.41 - 124.21	96	76-100	Low severity longitudinal and transverse cracking, low to moderate severity alligator cracking.
PBA-6	SB	116.77 – 118.77	95	91-100	Minor amounts of low severity longitudinal, transverse and alligator cracking.
PBA-6GR	SB	118.77 – 120.77	100	97-100	Minor amounts of low severity longitudinal cracking
AR4000W	SB	120.77 -124.21	96	64-100	Low severity longitudinal and transverse cracking and some moderate severity patching at the northern end of the section.

Note: Shading indicates section was overlaid in 2005.

Rutting or pavement wear from studded tires seems to be an issue with the remaining Class A HMA in the northbound lanes. It does not seem to be an issue in the southbound lanes for any of the pavement types. It is suspected that the segregation caused by temperature differentials is the likely cause of the continued problems in the section of the northbound lanes that was not overlaid 2005.

**Table 6. Nisqually River to Gravelly Lake I/C wear/rutting and IRI data.**

Binder Type	Dir.	Milepost Limits	Wear/Rutting (mm)		IRI (inches/mile)	
			AVE	Range	AVE	Range
PBA-6	NB	116.77 - 118.77	2.8	1-5	125	87-288
PBA-6GR	NB	118.77 - 120.77	4.6	2-7	127	96-189
AR4000W	NB	120.77 - 121.41	3.7	3-5	162	101-242
AR4000W	NB	121.41 - 124.21	4.7	1-11	86	66-138
PBA-6	SB	116.77 - 118.77	1.8	1-3	95	69-211
PBA-6GR	SB	118.77 - 120.77	1.5	1-3	83	69-95
Ar4000W	SB	120.77 - 124.21	2.3	1-4	93	66-128

The bid prices for the HMA with PBA-6GR and PBA-6 binders were 33 and 11 percent higher, respectively, than the Class A HMA with AR4000W binder. The sections with PBA-6GR and PBA-6 binders would need to last for 21 and 18 years, respectively, to warrant the added cost of the mix. The WSPMS predicts a due year of 2015 for the sections in the southbound lanes with PBA-6GR and PBA-6 binders yielding a projected life of 21 years. This would indicate that the premium paid for the two modified binders did result in added life and the premium paid for the mixes was recovered. However, since the 21 years is based on a prediction, the actual pavement life for each of the sections is still unknown.

**Table 7. Nisqually River to Gravelly Lake I/C bid prices and estimated quantities.**

Item	Bid Price	Quantity	Total Cost
PBA-6	\$30.00	8,566 tons	\$256,980
PBA-6GR	\$36.00	8,070 tons	\$290,520
Class A HMA	\$27.00	45,086 tons	\$1,217,322

## West Ellensburg I/C to Ryegrass Rest Area

This project used PBA-6 and PBA-6GR binders with a modified Class D open-graded mix design. Approximately equal lengths of each type of binder were used in the two lanes of both the eastbound and westbound directions. US Oil was the supplier of the PBA-6GR binder and Chevron supplied the PBA-6 binder. Figure 4 shows the layout of the sections.

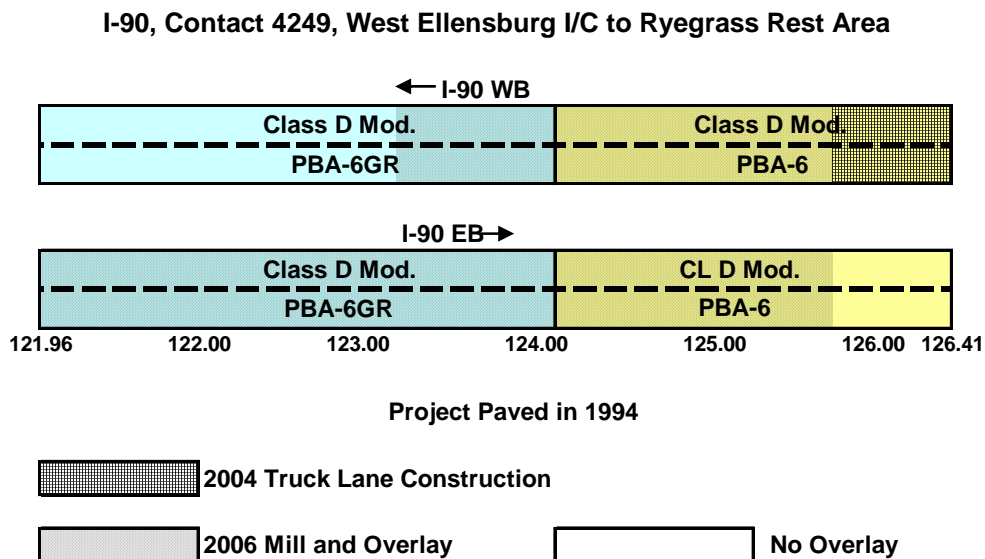


Figure 4. West Ellensburg I/C to Ryegrass Rest Area section locations.

In 2004 a truck climbing lane was added in the westbound direction. This project milled out and overlaid the eastern end of the section with PBA-6 binder between MP 125.51 and 126.41. The eastbound lanes and shoulders were milled and overlaid in 2006 between MP 121.96 and 125.51. This completely removed the section with PBA-6GR binder and a large portion of the section with PBA-6 binder. At the same time the westbound lanes were milled and overlaid from MP 123.21 to the beginning of the truck overlay section at 125.51. This removed about 42 percent of the PBA-6GR and the remainder of the PBA-6 that had not been replaced by the truck lane construction. As a result of the 2004 and 2006 projects, only 1.25 miles of sections with PBA-6GR binder and 0.81 miles of the sections with PBA-6 binder remain from the original project as shown in Figure 4.

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Pavement condition data for the sections with PBA-6GR and PBA-6 binder are shown in Table 8 and the rutting and ride data are shown in Table 9. For the sections that have been overlaid or reconstructed the data in the tables is from the last survey prior to the improvement. The detailed WSPMS data can be found in Appendix C for this project. Once again the locations that have been overlaid are shown shaded in the table.

<b>Table 8. West Ellensburg I/C to Ryegrass Rest Area pavement condition data.</b>					
<b>Binder Type</b>	<b>Dir.</b>	<b>Milepost</b>	<b>PSC</b>		<b>Description of Defects in Section</b>
			<b>Average</b>	<b>Range</b>	
PBA-6GR	EB	121.96 - 124.11	76	25-95	Low severity longitudinal cracking, low to moderate severity transverse cracking, low to moderate severity alligator cracking, low severity patching and moderate severity raveling.
PBA-6	EB	124.11 - 125.59	86	51-95	Low severity longitudinal cracking, low to moderate severity transverse cracking, and low severity alligator cracking.
PBA-6	EB	125.59 - 126.40	94	91-95	Low severity longitudinal and transverse cracking.
PBA-6GR	WB	121.96 - 123.21	73	29-91	Low to moderate severity longitudinal, transverse and alligator cracking and low to moderate severity patching
PBA-6GR	WB	123.21 - 124.11	64	28-91	Low severity longitudinal cracking, low, moderate and high severity transverse cracking, low to moderate severity alligator cracking, low to moderate severity patching, and low and high severity raveling
PBA-6	WB	124.11 - 125.51	66	1-100	Low to moderate severity longitudinal cracking, moderate to high severity transverse cracking, low and high severity alligator cracking, moderate severity patching, and high severity raveling.
PBA-6	WB	125.51 - 126.12	92	85-100	Low severity longitudinal cracking, low to moderate severity transverse cracking, high severity alligator cracking, and moderate severity flushing.

Note: Light shading is section milled and overlaid in 2006. Darker shading is 2004 truck lane construction.

**Table 9. West Ellensburg I/C to Ryegrass Rest Area wear/rutting and IRI data.**

Binder Type	Dir.	Milepost Limits	Wear/Rutting (mm)		IRI (inches/mile)	
			AVE	Range	AVE	Range
PBA-6GR	EB	121.96 - 124.11	5.4	1-11	184	135-323
PBA-6	EB	124.11 - 125.59	3.5	1-6	156	139-178
PBA-6	EB	125.59 - 126.40	4.5	3-7	151	134-164
PBA-6GR	WB	121.96 - 123.21	9.7	7-12	171	140-223
PBA-6GR	WB	123.21 - 124.11	7.7	5-10	165	136-199
PBA-6	WB	124.11 - 125.51	8.7	4-13	190	143-247
PBA-6	WB	125.51 - 126.12	4.9	2-8	118	71-168

Note: Light shading indicates 2006 mill and overlay. Darker shading is 2004 truck lane construction.

In the eastbound direction, all of the section with PBA-6GR binder and two thirds of the section with PBA-6 binder that were overlaid in 2006 yielded a service life of 12 years. The remaining portion of the PBA-6 section is still under traffic and has a projected service life of 20 years. In the westbound direction, the section with the PBA-6GR binder that is still under traffic has a projected life span of 14 years. The portions of the sections with PBA-6GR and PBA-6 binder that were overlaid in 2006 have a service life of 12 years, the same as the sections in the eastbound direction. The remaining portion of the section with PBA-6 binder that was overlaid as a result of the truck lane addition was not included in the performance summary calculation for the PBA-6. A summary of performance in years is shown in Table 10. The weighted average life for both the PBA-6 and PBA-6GR sections are very similar at around 12.6 to 13.8 years. This exceeds the South Central Region average pavement life that is 11.6 years by 1.0 to 2.2 years. It is also apparent that wear/rutting from raveling was a major factor in triggering the overlaying of the sections that were rehabilitated in 2006.

A resurfacing report issued in August of 2003 by the South Central Region stated that the major distress in the section overlaid by the 2006 project was raveling which is causing rutting in the traveled lanes, see Appendix E. Also noted was low severity transverse cracking that extended all the way to the untreated base. Cores taken at the time of the report showed deterioration in the upper part of the Modified Class D that appeared to be caused by the movement of the binder to the bottom of the layer.

**Table 10. West Ellensburg I/C to Ryegrass Rest Area performance summary.**

Section	Miles In Each Actual Life or Projected Life Category			Weighted Average (years)
	12 Years	14 Years	20 Years	
PBA-6	2.88		0.81	13.75
PBA-6GR	3.05	1.25		12.58

Bid prices and quantities for the PBA-6 and PBA-6GR mixes are shown in Table 11. The premium paid for the PBA-6 and PBA-6GR was 7 and 11 percent, respectively, over the bid price for the Class A HMA. This would translate to a service life of 12.4 years for the PBA-6 and 12.9 years for the PBA-6GR as the break even point for the added cost. Both mixes slightly exceeded these extended service life values; therefore, one might conclude that the added cost was justified.

**Table 11. West Ellensburg I/C to Ryegrass Rest Area bid prices and estimated quantities.**

Item	Bid Price	Quantity	Total Cost
PBA-6	\$23.50	11,010 tons	\$258,735
PBA-6GR	\$24.50	9,700 tons	\$237,650
Class A HMA	\$22.00	24,480 tons	\$538,560

### ***Evergreen Point Br. Rehab. Stage 2 & to 104<sup>th</sup> Avenue***

The final project, constructed in 1997, was located on SR-520 and included the paving of the Evergreen Point Floating Bridge. This project again used the PBA-6GR and PBA-6 binders, again with a Class A HMA dense graded mix. The bridge was paved with the PBA-6GR binder and the remainder of the project, which extended to 104<sup>th</sup> Avenue, used the PBA-6 binder. Figure 5 shows the layout of the project showing the location of the two types of mix designs.

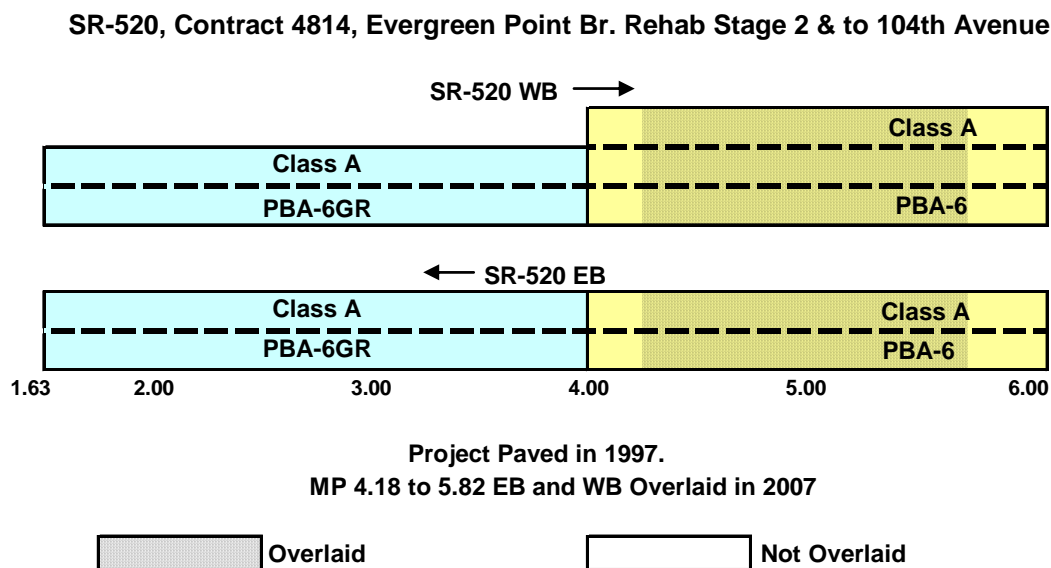


Figure 5. Evergreen Point Br. Rehab. Stage 2 & to 104<sup>th</sup> Avenue section locations.

In 2007 a major portion of the PBA-6 section was overlaid under Contract 7353, Eastside Quieter Pavement Evaluation Project. Three types of pavement were placed under this contract; (1) an open-graded friction course with styrene-butadiene-styrene polymer modified binder (OGFC-SBS), (2) an open-graded friction course with recycled tire rubber modified binder (OGFC-AR), and (3) a dense graded Class ½ Inch HMA with PG64-22 binder, that serves as the control section for the two open-graded sections. The overlay extended from MP 4.18 to 5.82 in both the eastbound and westbound lanes including the westbound HOV.

## Special Report

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The pavement condition information, prior to the 2007 contract, is summarized in Table 12. The high PSC scores and the absence of significant rutting after nine years of traffic since the section opened in 1997 indicate good performance by both the PBA-6 and PBA-6GR. The WSPMS predicts the PBA-6GR will be due for rehabilitation in 2030 for the eastbound lanes and 2029 for the westbound lanes. The PBA-6 will be due in 2015 for the eastbound lanes and 2020 for the westbound lanes. This would yield a service life of approximately 33 years for the PBA-6GR and 20 years for the PBA-6, not entirely believable, but given that there were no defects noted in the PBA-6GR and only minimal cracking noted in the PBA-6, the prediction reflect performance curves that are essentially flat. The detailed PMS data can be found in Appendix D.

**Table 12. Evergreen Point Br. Rehab. Stage 2 & to 104<sup>th</sup> Avenue pavement condition data.**

Section	PSC		Description of Defects in Section
	Average	Range	
PBA-6GR EB	100	All 100	Minor amounts of low severity longitudinal and alligator cracking
PBA-6 EB	99.5	90-100	Minor amounts of low severity longitudinal and alligator cracking.
PBA-6GR WB	100	All 100	Minor amounts of low severity longitudinal cracking.
PBA-6 WB	99.6	94-100	Minor amounts of low severity longitudinal cracking.

The wear/rutting and roughness measurements are listed in Table 13 for the project. The IRI readings for the PBA-6GR are adversely affected by the numerous expansion joints in the bridge. A calculation of the rate of wear can be made by dividing the total wear by 9, the years of service. The average rate of wear on the PBA-6GR on the bridge sections is between 0.2 and 0.33 mm per year. The PBA-6 has a somewhat higher average rate of wear between 0.28 and 0.53 mm per year. At those rates the PBA-6GR could reach 10 mm as soon as 2027 using the highest wear rate. Ten millimeters is the trigger point for rehabilitation in the WSPMS. The PBA-6 could reach the 10 mm limit as soon as 2016 using the highest wear rate.



**Table 13. Evergreen Point Br. Rehab. Stage 2 & to 104<sup>th</sup> Avenue wear/rutting and IRI data.**

Section	Dir.	Milepost Limits	Wear/Rutting (mm)		IRI (inches/mile)	
			AVE	Range	AVE	Range
PBA-6GR	EB	1.63 - 3.98	1.8	1-6	175	105-351
PBA-6	EB	3.98 - 6.08	2.5	1-4	115	89-184
PBA-6GR	WB	1.63 - 3.98	3.0	2-4	158	103-274
PBA-6	WB	3.98 - 6.08	4.8	3-6	98	79-161

The bid costs as estimated quantities for the PBA-6 and PBA-6GR are listed in Table 14. There was no control section of conventional mix placed on the project; however, data collected from 10 projects bid in the Northwest Region in 1997 had an average price of \$32.77 for Class A HMA. The PBA-6 was therefore 10 percent greater in cost than the Class A HMA and the PBA-6GR was 22 percent more. Increasing the NW Region average pavement life by 10 and 22 percent would give a break even service life of 19 years for the PBA-6 and 21 years for the PBA-6GR. Based in the due year prediction of a 33 year life for the PBA-6GR it would certainly exceed the break even point for the added cost. The PBA-6 service life prediction of 20 years will also exceed the break even point.

**Table 14. Evergreen Point Br. Rehab. Stage 2 & to 104<sup>th</sup> Avenue bid prices and estimated quantities.**

Section	Bid Price	Estimated Quantity	Total Cost
PBA-6	\$36.00	15,779	\$568,044
PBA-6GR	\$40.00	8,163	\$326,520
Class A HMA	\$32.77	N.A.	N.A.

## Summary

The performance of each project is listed below along with a summary of all of the sections.

### **Lewis County Line to SR-12**

#### **Modified Class D PBA-6GR and PBA-6**

The service life of the Modified Class D PBA-6GR and PBA-6 was about the same as the average for Class D pavements at 9 and 11 years, respectively. The performance of the PBA-6GR was tainted by an over asphalted mix. Both section failed by excessive wear/rutting.

### **Nisqually River to Gravelly Lake I/C**

#### **Class A PBA-6GR and PBA-6**

The northbound lanes suffered from cyclic temperature differentials and failed prematurely. The southbound lanes are performing very well with a predicted due year of 2015. This would yield a life of 21 years, four years over the average pavement life for the Olympic Region. The added expense of the rubber and polymer binders requires that a pavement life 21 years for the PBA-6GR and 18 years for the PBA-6 to break even on the added cost.

### **West Ellensburg I/C to Ryegrass Rest Area**

#### **Modified Class D PBA-6GR and PBA-6**

The sections of Modified Class D PBA-6GR and PBA-6 were milled and overlaid at a life of 12 years, which is slightly longer than the South Central Region average. The due year predictions for the sections not overlaid range from 14 to 20 years. A combination of the sections overlaid with those not overlaid yielded prorated service life predictions of 12.6 for the PBA-6GR and 13.8 for the PBA-6. The added cost of each of the binders requires that the PBA-6GR last for 12.4 years and the PBA-6 for 12.9 years. Therefore, each of the mixes exceeded the break even point, but not by a large margin.

### **Evergreen Point Br. Rehab. Stage 2 & to 104<sup>th</sup> Avenue**

#### **Class A PBA-6GR and PBA-6**

Service life predictions for the Class A PBA-6GR on the bridge would result in a life of 33 years. The rate of wear/rutting would indicate that the 10 mm trigger would be reached at an age of 30 years. The service life prediction for the Class A PBA-6 is 20 years and the rate of wear/rutting would indicate a life of 19 years to reach the 10 mm trigger. The break even point for the added cost of both the PBA-6 and PBA-6GR would be met or exceeded if each of the sections realized the service life predicted by the WSPMS.

### Conclusions

Several conclusions can be drawn regarding the performance and use of rubberized pavements in the State of Washington

- Modified Class D HMA are more susceptible to raveling and wear from studded tires than dense graded pavements and adding rubber to the binder does not result in any greater resistance to this type of damage.
- It is unknown at this point in time if the Class A dense graded HMA with PBA-6GR and PBA-6 binders will have service lives that will justify their added cost, however, the WSPMS does predict that the remaining sections of PBA-6 and PBA-6GR on the Nisqually and SR-520 projects will meet or in some cases exceed the break even point on the added cost of the modified binders.
- The use of rubberized binders is allowed in our Standard Specifications, however, anyone specifying the use of such binders should be aware of the added cost and resultant added service life necessary to justify that cost.

### **Appendix A**

**WSPMS Data for Contract 4036, Lewis County Line to SR-12**

## Special Report

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Appendices A thru D containing summaries of WSPMS data for the four projects. The abbreviations used in the summaries are defined below:

The rating categories are:

Rut – wear or rutting measured in millimeters

PSC – pavement structural condition

IRI – International Roughness Index in inches per mile

The defects noted are:

L – longitudinal cracking

T – transverse cracking

A – alligator cracking

P – patching

R – raveling

F - flushing

The severity of the defect:

Single letter = Low severity, example T

Letter with a + = Medium severity, example T+

Letter with ++ = High severity, example T++

# Special Report

## Contract 4036, Lewis County Line to SR-12, MP 85.51 to 88.02

The first section in the northbound lanes is the PBA- 6 section that runs from the beginning of the project at MP 85.51 to MP 87.14. This section was overlaid in 2003 as indicated by the yellow shading.

Table 15. Contact 4036, Modified Class D PBA-6 NB.							
2003 PMS Data					Overlaid in 2003		
MP 85.51 to 87.14 NB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
85.50	85.60	10	95	127		T	
85.60	85.70	11	100	133			
85.70	85.80	10	100	153			
85.80	85.90	11	100	137			
85.90	86.00	11	100	128			
86.00	86.10	12	100	136			
86.10	86.20	11	100	120			
86.20	86.30	11	95	127	L	T	
86.30	86.40	11	99	134	L		
86.40	86.50	10	100	119			
86.50	86.60	11	100	122			
86.60	86.70	11	100	133			
86.70	86.80	13	100	124			
86.80	86.90	11	96	111	L		
86.90	87.00	10	100	113			
87.00	87.10	10	100	135			
87.10	87.20	13	96	133	L		
	Average	11.0	98.9	129			
	Min	10	95	111			
	Max	13	100	153			
Minor amounts of low severity longitudinal and transverse cracking.							
Rutting average 11.0 mm, range 10-13 mm.							
PSC average 98.9, range 95-100							
IRI average 129 inches/mile, range 111-153 inches/mile.							
Pavement Life: 11 years							

## Special Report

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The next section is the PBA-6GR that runs from MP 87.14 to the end of the project at MP 88.02. The entire project in the northbound direction was overlaid in 2003 as noted in the yellow shading.

**Table 16. Contract 4036, Modified Class D PBA-6GR NB.**

2003 PMS Data					Overlaid 2003		
MP 87.14 to 88.02 NB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
87.20	87.30	14	100	120			
87.30	87.40	10	100	115			
87.40	87.50	13	100	116			
87.50	87.60	14	100	101			
87.60	86.70	12	99	114	L		
86.70	87.80	7	100	134			
87.80	87.90	2	100	134			
87.90	88.02	6	100	125			
	Average	10.0	99.1	126			
	Min	2	99	101			
	Max	14	100	134			
Minor amounts of low severity longitudinal cracking.							
Rutting average 10.0 mm, range 2-14 mm.							
PSC average 99.1, range 99-100							
IRI average 126 inches/mile, range 101-134 inches/mile.							
Pavement Life: 11 years							

## Special Report

The first section in the southbound direction runs from the beginning of the project at MP 85.51 to MP 87.51 and consists of Class A AR4000W that was overlaid in 2003 along with the northbound lanes.

Table 17. Contact 4036, Class A AR4000W SB.							
2003 PMS Data					Overlaid 2003		
MP 85.51 to 87.51 SB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
85.50	85.60	5	100	113			
85.60	85.70	7	100	91			
85.70	85.80	8	100	94			
85.80	85.90	8	100	90			
85.90	86.00	8	100	101			
86.00	86.10	7	100	104			
86.10	86.20	8	100	92			
86.20	86.30	9	100	101			
86.30	86.40	8	100	95			
86.40	86.50	8	100	90			
86.50	86.60	8	100	92			
86.60	86.70	6	100	90			
86.70	86.80	6	100	88			
86.80	86.90	5	100	103			
86.90	87.00	10	100	98			
87.00	87.10	8	95	92		T	
87.10	87.20	9	100	97			
87.20	87.30	7	100	103			
87.30	87.40	9	99	104	L		
87.40	87.50	8	100	99			
87.50	87.60	5	98	96	L		
	Average	7.5	99.6	97			
	Min	5	95	88			
	Max	10	100	113			
Minor amounts of low severity longitudinal and transverse cracking.							
Rutting average 7.5 mm, range 5-10 mm.							
PSC average 99.6, range 95-100							
IRI average 97 inches/mile, range 88-113 inches/mile.							
Pavement Life: 11 years							



## Special Report

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The remaining section beginning at MP 87.51 to the end of the project at MP 88.02 was also Class A AR4000W. It is separated from the previous southbound section because it was not overlaid in 2003.

Table 18. Contract 4036, Class A AR4000W SB.							
2006 PMS Data					No Overlay		
MP 87.51 to 88.02 SB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
87.60	86.70	9	90	125	L	T	
86.70	87.80	9	100	110			
87.80	87.90	8	100	105			
87.90	88.02	6	100	118			
	Average	8.0	97.5	115			
	Min	6	90	105			
	Max	9	100	125			
Minor amounts of low severity longitudinal and transverse cracking.							
Rutting average 8.0 mm, range 6-9 mm.							
PSC average 97.5, range 90-100							
IRI average 115 inches/mile, range 105-125 inches/mile.							
Due Year: 2016 Current Life: 16 years as of 2008							

## Special Report

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Additional data was collected from previous PMS surveys on the wear/rutting of both the Modified Class D PBA-6 and Modified Class D PBA-6GR to determine at what point the 10 mm trigger point was reached.

**Table 19. Wear/rutting data for Modified Class D PBA-6 NB.**

Begin MP	End MP	Rutting in (mm)			
		1999	2000	2001	2002
85.51	85.60	8	9	9	9
85.60	85.70	9	9	10	10
85.70	85.80	8	9	9	9
85.80	85.90	9	9	9	10
85.90	86.00	8	9	10	10
86.00	86.10	8	10	11	11
86.10	86.20	8	10	11	12
86.20	86.30	8	9	10	11
86.30	86.40	8	10	11	10
86.40	86.50	9	9	11	10
86.50	86.60	9	9	10	11
86.60	86.70	8	10	9	10
86.70	86.80	10	1	10	12
86.80	86.90	9	9	11	12
86.90	87.00	8	9	9	10
87.00	87.10	7	8	9	9
87.10	87.20	8	10	11	11
Average		8.4	8.8	10.0	10.4
Minimum		7	1	9	9
Maximum		10	10	11	12

**Table 20. Wear/rutting data for Modified Class D PBA-6GR NB.**

Begin MP	End MP	Rutting in (mm)			
		1999	2000	2001	2002
87.20	87.30	10	12	14	13
87.30	87.40	11	12	12	11
87.40	87.50	11	12	13	13
87.50	87.60	9	11	13	13
87.60	87.70	9	8	12	10
87.70	87.80	4	5	6	6
87.80	87.90	3	3	5	4
87.90	88.02	4	4	4	6
Average		10.0	10.4	9.9	9.5
Minimum		9	9	4	4
Maximum		11	12	14	13

### **Appendix B**

**WSPMS Data for Contract 4250, Nisqually River to Gravelly Lace I/C**

## Special Report

### Contract 4250, Nisqually River to Gravelly Lake I/C, MP 116.77 to 124.21

The first section northbound is Class A PBA-6 that beginning at MP 116.77 and ends at MP 118.77. The section was overlaid in 2005 as noted by the yellow shading.

Table 21. Contract 4250, Class A PBA-6 NB.							
2005 PMS Data					Overlaid 2005		
MP 116.77 to 118.77 NB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
116.70	116.80	3	100	165			
116.80	116.90	4	95	147	L		
116.90	117.00	5	80	140	L		A
117.00	117.10	1	93	118	L		
117.10	117.20	3	82	103	L		
117.20	117.30	1	91	87	L		
117.30	117.40	2	97	103	L		
117.40	117.50	1	100	89			
117.50	117.60	3	90	92	L		A
117.60	117.70	3	96	101	L		
117.70	117.80	2	99	92	L		
117.80	117.90	3	93	106	L		
117.90	118.00	2	100	118			
118.00	118.10	1	92	102	L		
118.10	118.20	3	96	123	L		
118.20	118.30	4	96	122	L		
118.30	118.40	3	100	288			
118.40	118.50	3	95	115	L		
118.50	118.60	3	57	128			A
118.60	118.70	4	58	131			A
118.70	118.80	4	73	156			A
	Average	2.8	89.8	125			
	Min	1	57	87			
	Max	5	100	288			
Low severity longitudinal and alligator cracking							
Rutting average 2.8 mm, range 1-5 mm.							
PSC average 89.8, range 57-100							
IRI average 125 inches/mile, range 87-288 inches/mile.							
Pavement Life: 12 years							

## Special Report

The second section northbound is the Class A PBA-6GR which runs from MP 118.77 to MP 120.77 and it too was overlaid in 2005.

Table 22. Contract 4250, Class A PBA-6GR NB.							
2005 PMS Data					Overlaid 2005		
MP 118.77 to 120.77 NB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
118.70	118.80	4	73	156			A
118.80	118.90	4	64	144	L	T	A
118.90	119.00	5	55	146	L	T	A
119.00	119.10	4	87	121	L	T	A
119.10	119.20	4	100	111			
119.20	119.30	4	99	122	L		
119.30	119.40	5	90	189	L		A
119.40	119.50	6	73	147	L		A
119.50	119.60	6	77	114	L		A
119.60	119.70	6	76	110	L		A
119.70	119.80	7	82	106	L	T	A
119.80	119.90	6	95	111	L		
119.90	120.00	4	75	99	L		A
120.00	120.10	5	96	114	L		
120.10	120.20	5	99	112	L		
120.20	120.30	6	100	135			
120.30	120.40	4	100	96			
120.40	120.50	3	97	112	L		
120.50	120.60	4	81	166	L	T	A
120.60	120.70	2	91	147	L		A
120.70	120.80	3	97	104	L		
	Average	4.6	86.0	127			
	Min	2	55	96			
	Max	7	100	189			
Low severity longitudinal, transverse and alligator cracking.							
Rutting average 4.6 mm, range 2-7 mm.							
PSC average 86.0, range 55-100							
IRI average 127 inches/mile, range 96-189 inches/mile.							
Pavement Life: 12 years							

## Special Report

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The next section northbound is the Class A AR4000W that begins at MP 120.77 and continues to MP 121.41. The section was also overlaid in 2005. The remainder of the Class A AR4000W was not overlaid.

Table 23. Contract 4250, Class A AR4000W NB.							
2005 PMS Data					Overlaid 2005		
MP 120.77 to 121.41 NB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
120.80	120.90	4	88	214	L		A
120.90	121.00	5	94	138	L		A
121.00	121.10	3	99	130	L		
121.10	121.20	4	94	242	L		
121.20	121.30	3	85	101	L		
121.30	121.40	3	93	145	L		
	Average	3.7	92.2	162			
	Min	3	85	101			
	Max	5	99	242			
Low severity longitudinal and alligator cracking.							
Rutting average 3.7 mm, range 3-5 mm.							
PSC average 92.2, range 85-99							
IRI average 162 inches/mile, range 101-242 inches/mile.							
Pavement Life: 12 years							

## Special Report

This is the last section northbound and it runs from MP 121.41 to MP 124.21. It is Class A AR4000W and it was not overlaid in 2005.

Table 24. Contract 4250, Class A AR4000W NB.							
2006 PMS Data					No Overlay		
MP 121.41 to 124.21 NB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
121.40	121.50	6	99	138	L		
121.50	121.60	11	98	91	L		
121.60	121.70	6	100	85			
121.70	121.80	3	95	101		T	
121.80	121.90	6	92	84		T	
121.90	122.00	6	100	81			
122.00	122.10	7	100	112			
122.10	122.20	5	100	93			
122.20	122.30	8	100	93			
122.30	122.40	6	100	74			
122.40	122.50	7	100	85			
122.50	122.60	7	100	66			
122.60	122.70	3	97	87	L		
122.70	122.80	4	96	96	L		
122.80	122.90	5	93	76	L		
122.90	123.00	3	96	91	L		
123.00	123.10	1	99	72	L		
123.10	123.20	3	87	75	L		A
123.20	123.30	3	100	69			
123.30	123.40	2	100	90			
123.40	123.50	3	95	97		T	
123.50	123.60	5	98	87	L		
123.60	123.70	5	83	103			A
123.70	123.80	4	76	76	L		A+
123.80	123.90	2	91	73	L		A
123.90	124.00	3	100	74			
124.00	124.10	4	100	77			
124.10	124.20	4	100	75			
	Average	4.7	96.3	85			
	Min	1	76	66			
	Max	11	100	112			
Low severity longitudinal and transverse cracking, low to medium severity alligator cracking.							
Rutting average 4.7 mm, range 1-11 mm.							
PSC average 96.3, range 76-100							
IRI average 85 inches/mile, range 66-112 inches/mile.							
Due Year: 2016 Current Life: 15 years as of 2008							

## Special Report

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The first section in the southbound lanes runs from MP 116.77 to MP 118.77 and it is Class A PBA-6. None of the southbound lanes have been overlaid.

Table 25. Contract 4250, Class A PBA-6 SB.							
2006 PMS Data					No Overlay		
MP 116.77 to 118.77 SB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
116.70	116.80	1	94	122	L	T	
116.80	116.90	2	95	93		T	
116.90	117.00	2	100	97			
117.00	117.10	2	100	105			
117.10	117.20	2	100	96			
117.20	117.30	2	100	81			
117.30	117.40	2	99	109	L		
117.40	117.50	2	91	71	L		
117.50	117.60	2	76	70	L		
117.60	117.70	1	76	69	L		
117.70	117.80	2	83	72	L		
117.80	117.90	1	100	83			
117.90	118.00	2	100	74			
118.00	118.10	3	100	109			
118.10	118.20	2	100	92			
118.20	118.30	1	100	96			
118.30	118.40	3	100	211			
118.40	118.50	2	100	87			
118.50	118.60	1	94	83			A
118.60	118.70	1	97	83	L		
118.70	118.80	2	100	87			
	Average	1.8	95.5	95			
	Min	1	76	69			
	Max	3	100	211			
Low severity longitudinal, transverse and alligator cracking.							
Rutting average 1.8 mm, range 1-3 mm.							
PSC average 95.5, range 76-100							
IRI average 95 inches/mile, range 69-211 inches/mile.							
Due Year: 2015    Current Life: 14 years as of 2008							



## Special Report

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The next section southbound is the PBA-6GR that runs from MP 118.77 to MP 120.77.

Table 26. Contract 4250, Class A PBA-6GR SB.							
2006 PMS Data					No Overlay		
MP 118.77 to 120.77 SB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
118.70	118.80	2	100	87			
118.80	118.90	2	97	84	L		
118.90	119.00	2	99	87	L		
119.00	119.10	2	100	87			
119.10	119.20	1	100	83			
119.20	119.30	1	100	79			
119.30	119.40	1	100	94			
119.40	119.50	1	100	77			
119.50	119.60	1	100	76			
119.60	119.70	2	100	82			
119.70	119.80	1	100	74			
119.80	119.90	1	100	69			
119.90	120.00	2	100	89			
120.00	120.10	1	100	81			
120.10	120.20	1	100	73			
120.20	120.30	1	100	87			
120.30	120.40	1	100	92			
120.40	120.50	1	100	95			
120.50	120.60	1	99	85	L		
120.60	120.70	3	100	90			
120.70	120.80	3	100	75			
	Average	1.5	99.8	83			
	Min	1	97	69			
	Max	3	100	95			
Minor amounts of low severity longitudinal cracking.							
Rutting average 1.5 mm, range 1-3 mm.							
PSC average 99.8, range 97-100							
IRI average 83 inches/mile, range 69-95 inches/mile.							
Due Year: 2015    Current Life: 14 years as of 2008							

The final section southbound is the Class A AR4000W section that runs from MP 120.77 to the end of the project at MP 124.21.

# Special Report

Table 27. Contract 4250, Class A AR4000W SB.								
2006 PMS Data					No Overlay			
MP 120.77 to 124.21 SB					Defects			
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P
120.80	120.90	1	100	90				
120.90	121.00	3	100	96				
121.00	212.10	1	98	96	L			
121.10	121.20	1	100	92		T		
121.20	121.30	1	96	97	L	T		
121.30	121.40	1	95	92	L			
121.40	121.50	2	88	79	L			
121.50	121.60	1	100	76				
121.60	121.70	1	100	73				
121.70	121.80	2	96	81	L			
121.80	121.90	1	96	66	L			
121.90	122.00	3	100	73				
122.00	122.10	2	100	83				
122.10	122.20	3	100	76				
122.20	122.30	4	100	83				
122.30	122.40	3	95	92		T		
122.40	122.50	3	100	96				
122.50	122.60	2	99	82	L			
122.60	122.70	4	86	110	L	T		P+
122.70	122.80	2	64	113	L			P+
122.80	122.90	1	94	80	L	T		
122.90	123.00	2	100	91				
123.00	123.10	2	100	83				
123.10	123.20	2	100	92				
123.20	123.30	2	100	96				
123.30	123.40	3	97	93	L			
123.40	123.50	1	100	83				
123.50	123.60	3	80	110				P+
123.60	123.70	3	83	101				P+
123.70	123.80	3	100	100				
123.80	123.90	4	100	122				
123.90	124.00	4	100	112				
124.00	124.10	4	97	112	L			
124.10	124.20	3	100	128				
	Average	2.3	96.0	93				
	Min	1	64	66				
	Max	4	100	128				
Low severity long. and trans. cracking and med. severity patching.								
Rutting average 2.3 mm, range 1-4 mm.								
PSC average 96.0, range 64-100								
IRI average 93 inches/mile, range 66-128 inches/mile.								
Due Year: 2015    Current Life: 14 years as of 2008								

### **Appendix C**

**WSPMS Data for Contract 4249, West Ellensburg I/C to Ryegrass Rest Area**

# Special Report

## Contract 4249, West Ellensburg I/C to Ryegrass Rest Area, MP 121.96 to 126.41

The first section eastbound is Modified Class D PBA-6GR that runs from the beginning of the project at MP 121.96 to MP 124.11. This section was milled and overlaid with Class ½ inch HMA in 2006.

Table 28. Contract 4249, Modified Class D PBA-6GR EB.									
2005 PMS Data					Overlaid 2006				
MP 121.96 to 124.11 EB					Defects				
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R
121.90	122.00	2	79	151	L	T			R+
122.00	122.10	6	66	216	L		A		R+
122.10	122.20	2	68	155			A		R+
122.20	122.30	3	88	163	L	T			R+
122.30	122.40	4	92	147		T			R+
122.40	122.50	6	85	141		T			R+
122.50	122.60	6	92	146		T			R+
122.60	122.70	8	86	175		T	A		R+
122.70	122.80	9	92	194	L	T			R+
122.80	122.90	10	82	203		T			R+
122.90	123.00	11	83	209		T			R+
123.00	123.10	9	35	323	L	T	A	P	R+
123.10	123.20	11	77	240		T	A	P	R+
123.20	123.30	5	25	213		T	A++		R+
123.30	123.40	5	48	225	L	T	A++		R+
123.40	123.50	5	82	247	L	T	A		R+
123.50	123.60	4	60	176		T+	A		R+
123.60	123.70	1	95	135		T			R+
123.70	123.80	2	86	150		T+			
123.80	123.90	3	86	148		T+			
123.90	124.00	4	86	141		T+			
124.00	124.10	3	86	152		T+			
	Average	5.4	76.3	184					
	Min	1	25	135					
	Max	11	95	323					
Low severity longitudinal cracking, low to medium severity transverse cracking, low and high severity alligator cracking, low severity patching and medium severity raveling.									
Rutting average 5.4 mm, range 1-11 mm.									
PSC average 76.3, range 25-95									
IRI average 184 inches/mile, 135-323 inches/mile.									
Pavement Life: 12 years									

## Special Report

The second section in the eastbound direction is the Modified Class D PBA-6 that runs from MP 124.11 to MP 125.59. This section was also milled and overlaid in 2006 with Class ½ inch HMA.

Table 29. Contract 4249, Modified Class D PBA-6 EB.									
2005 PMS Data					Overlaid 2006				
MP 124.11 to 125.59 EB					Defects				
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R
124.10	124.20	1	92	139		T			
124.20	124.30	2	95	141		T			
124.30	124.40	2	90	143		T	A		
124.40	124.50	5	74	157		T	A		
124.50	124.60	5	51	159		T	A		
124.60	124.70	1	92	143		T			
124.70	124.80	5	92	165		T			
124.80	124.90	5	77	178		T+	A		
124.90	125.00	4	86	150		T+	A		
125.00	125.10	3	86	156		T+	A		
125.10	125.20	3	95	174		T			
125.20	125.30	5	91	166		T+			
125.30	125.40	6	95	152		T			
125.40	125.50	4	87	175		T+	A		
125.50	125.60	2	91	143		T+			
	Average	3.5	86.3	156					
	Min	1	51	139					
	Max	6	95	178					
Low to medium severity transverse cracking and low severity alligator cracking.									
Rutting average 3.5 mm, range 1-6 mm.									
PSC average 86.3, range 51-95									
IRI average 156 inches/mile, 139-178 inches/mile.									
Pavement Life: 12 years									

## Special Report

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The remaining section eastbound is also Modified Class D PBA-6 that was overlaid in 2006. It runs from MP 125.59 to the end of the project at MP 126.40.

**Table 30. Contract 4249, Modified Class D PBA-6 EB.**

2006 PMS Data					No Overlay				
MP 125.59 to 126.40 EB					Defects				
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R
125.60	125.70	3	95	134		T			
125.70	125.80	4	94	140	L	T			
125.80	125.90	4	91	155	L	T			
125.90	126.00	4	92	142	L	T			
126.00	126.10	5	95	156		T			
126.10	126.20	7	92	159		T			
126.20	126.30	3	95	157		T			
126.30	126.40	6	95	164		T			
	Average	4.5	93.6	151					
	Min	3	91	134					
	Max	7	95	164					
Low severity longitudinal and transverse cracking.									
Rutting average 4.5 mm, range 3-7 mm.									
PSC average 93.6, range 91-95									
IRI average 151 inches/mile, 134-164 inches/mile.									
Due Year: 2014    Projected Life: 20 years									

## Special Report

The first section in the westbound direction is the Modified Class D PBA-6GR that runs from MP 121.96 to 123.21. This section remains the original material placed under Contact 4249.

Table 31. Contract 4249, Modified Class D PBA-6GR WB.									
2006 PMS Data					No Overlay				
MP 121.96 to 123.21 WB					Defects				
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R
121.90	122.00	7	90	140	L+	T			
122.00	122.10	9	87	172		T+		P+	
122.10	122.20	8	77	171	L	T+	A		
122.20	122.30	11	29	223		T+	A		
122.30	122.40	9	88	165	L	T	A	P+	
122.40	122.50	12	91	155	L	T+			
122.50	122.60	10	78	156		T+	A		
122.60	122.70	9	78	182		T+	A	P	
122.70	122.80	8	90	162		T+			
122.80	122.90	11	78	147		T+			
122.90	123.00	12	48	151		T+	A		
123.00	123.10	11	68	220	L	T+	A		
123.10	123.20	9	53	181	L	T+	A		
	Average	9.7	73.5	171					
	Min	7	29	140					
	Max	12	91	223					
Low to medium severity longitudinal, transverse and alligator cracking and low to medium severity patching.									
Rutting average 9.7 mm, range 7-12 mm.									
PSC average 73.5, range 29-91.									
IRI average 171 inches/mile, 140-223 inches/mile.									
Due Year: 2008    Projected Life: 14 years									

## Special Report

The next section westbound is Modified Class D PBA-6GR that was milled and overlaid in 2006 as noted by the yellow shading. It runs from MP 123.21 to MP 124.11. The 2006 survey was done prior to the construction, therefore its results are valid for the original surface placed under Contract 4249.

Table 32. Contract 4249, Modified Class D PBA-6GR WB									
2006 PMS Data					Overlaid 2006				
MP 123.21 to 124.11 WB					Defects				
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R
123.20	123.30	10	63	142	L	T	A+	P	
123.30	123.40	8	41	199	L	T	A+		R
123.40	123.50	7	79	151	L	T	A	P+	
123.50	123.60	9	56	198	L	T++	A	P+	R++
123.60	123.70	9	68	167		T	A	P+	R++
123.70	123.80	5	91	194		T+			R++
123.80	123.90	10	56	148			A		R++
123.90	124.00	5	28	136	L	T+	A		
124.00	124.10	6	90	149		T+			R++
	Average	7.7	63.6	165					
	Min	5	28	136					
	Max	10	91	199					
Low severity longitudinal cracking, low, medium and high severity transverse cracking, low to medium severity alligator cracking, low to medium severity patching and low and high medium severity raveling.									
Rutting average 7.7 mm, range 5-10 mm.									
PSC average 63.6, range 28-91.									
IRI average 165 inches/mile, 136-199 inches/mile.									
Pavement Life: 12 years									



## Special Report

The next section westbound is the Modified Class D PBA-6 that runs from MP 124.11 to MP 125.51. This section was milled and overlaid in 2006, but again the 2006 survey results are valid.

Table 33. Contract 4249, Modified Class D PBA-6 WB.									
2006 PMS Data					Overlaid 2006				
MP 124.11 to 125.51 WB					Defects				
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R
124.10	124.20	12	81	167		T++		P+	R++
124.20	124.30	11	64	189		T++	A	P+	R++
124.30	124.40	7	1	247		T++	A++	P+	R++
124.40	124.50	6	1	220	L	T++	A++	P+	
124.50	124.60	13	93	180	L	T++			R++
124.60	124.70	12	100	199					R++
124.70	124.80	9	100	186					R++
124.80	124.90	9	91	160		T+			R++
124.90	125.00	11	90	195		T+		P+	R++
125.00	125.10	8	38	186	L	T++	A	P+	R++
125.10	125.20	4	44	187	L+	T+	A	P+	
125.20	125.30	7	59	214		T+	A++	P+	
125.30	125.40	8	80	187		T++	A++		
125.40	125.50	5	86	143	L	T+			
	Average	8.7	66.3	190					
	Min	4	1	143					
	Max	13	100	247					
Low to medium severity longitudinal cracking, medium to high severity transverse cracking, low and high severity alligator cracking, medium severity patching and high severity raveling.									
Rutting average 8.7 mm, range 4-13 mm.									
PSC average 66.3, range 1-100.									
IRI average 190 inches/mile, 143-277 inches/mile.									
Pavement Life: 12 years									

## Special Report

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The last section westbound is small section that was rebuilt as part of a project that added a truck lane on the Vantage hill. It runs from MP 125.51 to 126.12. The truck lane project was done in 2004 and the valid survey data used is from 2002. A new lane was added and the existing lanes were milled and overlaid.

Table 34. Contract 4249, Modified Class D PBA-6 WB.										
2002 PMS Data					Overlaid 2004					
MP 125.51 to 126.12 WB					Defects					
Beg MP	End MP	Rut	PSC	IRI	L	T	A	P	R	F
125.50	126.60	5	90	113	L	T+				
125.60	125.70	6	92	118	L	T				
125.70	125.80	7	95	120	L	T				
125.80	125.90	2	91	141		T+				
125.90	126.00	3	85	168		T	A++			
126.00	126.10	3	88	94	L	T	A++			F+
126.10	126.20	8	100	71						F+
	Average	4.9	91.6	118						
	Min	2	85	71						
	Max	8	100	168						
Low severity longitudinal cracking, low to moderate severity transverse cracking, high severity alligator cracking and moderate severity flushing.										
Rutting average 4.9 mm, range 2-8 mm.										
PSC average 91.6, range 85-100										
IRI average 118 inches/mile, 71-168 inches/mile.										
Pavement Life: 10 years (not replaced because of bad performance)										

### **Appendix D**

**WSPMS Data for Contract 4814, Evergreen Point Bridge Rehabilitation  
Stage 2 & to 104<sup>th</sup> Avenue**

## Special Report

### Contract 4814, Evergreen Point Bridge Rehabilitation Stage 2 & to 104<sup>th</sup> Avenue, MP 1.63 to MP 6.08

The first section eastbound begins at the west end of the Evergreen Point Floating Bridge at MP 1.63 and runs to the east end of the bridge at MP 3.98. Class A PBA-6GR was used on this section.

Table 35. Contract 4814, Class A PBA-6GR EB.							
2006 PMS Data					No Overlay		
MP 1.63 to 3.98 EB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
1.63	1.70	3	100	341			
1.70	1.80	2	100	175			
1.80	1.90	2	100	144			
1.90	2.00	2	100	153			
2.00	2.10	1	100	154			
2.10	2.20	1	100	156			
2.20	2.30	1	100	133			
2.30	2.40	1	100	113			
2.40	2.50	1	100	279			
2.50	2.60	2	100	200			
2.60	2.70	2	100	239			
2.70	2.80	2	100	129			
2.80	2.90	2	100	137			
2.90	3.00	1	100	136			
3.00	3.10	2	100	156			
3.10	3.20	2	100	315			
3.20	3.30	2	100	125			
3.30	3.40	1	100	120			
3.40	3.50	1	100	107			
3.50	3.60	3	100	105			
3.60	3.70	2	100	145			
3.70	3.80	1	100	201			
3.80	3.90	2	100	272			
3.90	4.00	1	100	174			
	Average	1.8	100	175			
	Min	1	100	105			
	Max	6	100	341			
No defects recorded.							
Rutting average 1.8 mm, range 1-6 mm.							
PSC average 100.0, no range.							
IRI average 175 inches/mile, 105-341 inches/mile.							
Due Year: 2030    Projected Life : 33 years							

## Special Report

The next section eastbound runs from the east end of the bridge at MP 3.98 to the end of the project at 6.08. Class A PBA-6 was used on this section. A portion of this section was overlaid in 2007 (MP4.18 to MP 5.82) as noted in the yellow shading.

Table 36. Contract 4814, Class A PBA-6 EB.							
2006 PMS Data							
MP 3.98 to 6.08 EB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
4.00	4.10	4	100	184			
4.10	4.20	3	100	136			
4.20	4.30	2	100	143			
4.30	4.40	3	100	113			
4.40	4.50	3	100	123			
4.50	4.60	3	90	119	L		A
4.60	4.70	2	99	106	L		
4.70	4.80	3	100	99			
4.80	4.90	1	100	103			
4.90	5.00	3	100	107			
5.00	5.10	1	100	89			
5.10	5.20	2	100	105			
5.20	5.30	3	100	99			
5.30	5.40	3	100	109			
5.40	5.50	3	100	106			
5.50	5.60	3	100	100			
5.60	5.70	1	100	127			
5.70	5.80	2	100	98			
5.80	5.90	3	100	93			
5.90	6.00	2	100	124			
6.00	6.10	2	100	133			
	Average	2.5	99.5	115			
	Min	1	90	89			
	Max	4	100	184			
Minor amounts of low severity longitudinal and alligator cracking.							
Rutting average 2.5 mm, range 1-4 mm.							
PSC average 99.5, range 90-100.							
IRI average 115 inches/mile, 89-184 inches/mile.							
Due Year: 2015    Projected Life: 18 years							

## Special Report

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The first section in the westbound direction is the Class A PBA-6GR place on the bridge. It runs from MP 1.63 to MP 3.98.

Table 37. Contract 4814, Class A PBA-6GR WB.							
2006 PMS Data					No Overlay		
MP 1.63 to 3.98 WB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
1.63	1.70	4	100	341			
1.70	1.80	4	100	175			
1.80	1.90	3	100	144			
1.90	2.00	3	100	153			
2.00	2.10	2	100	154			
2.10	2.20	2	100	156			
2.20	2.30	2	100	133			
2.30	2.40	2	100	113			
2.40	2.50	3	100	279			
2.50	2.60	3	100	200			
2.60	2.70	3	100	239			
2.70	2.80	3	100	129			
2.80	2.90	3	100	137			
2.90	3.00	4	100	136			
3.00	3.10	3	100	156			
3.10	3.20	4	100	315			
3.20	3.30	3	100	125			
3.30	3.40	3	100	120			
3.40	3.50	3	100	107			
3.50	3.60	3	100	105			
3.60	3.70	2	100	145			
3.70	3.80	3	100	201			
3.80	3.90	4	100	272			
3.90	4.00	4	100	174			
	Average	3.0	100	158			
	Min	2	100	103			
	Max	4	100	274			
No defects recorded.							
Rutting average 3.0 mm, range 2-4 mm.							
PSC average 100.0, no range.							
IRI average 158 inches/mile, 103-274 inches/mile.							
Due Year: 2029    Projected Life: 32 years							

## Special Report

The second section westbound is the Class A PBA-6 that runs from MP 3.98 to MP 6.08. A portion of this section was overlaid in 2007 as noted in the yellow shading.

Table 38. Contract 4814, Class A PBA-6 WB.							
2006 PMS Data							
MP 3.98 to 6.08 WB					Defects		
Beg MP	End MP	Rut	PSC	IRI	L	T	A
4.00	4.10	4	100	121			
4.10	4.20	4	100	140			
4.20	4.30	4	100	92			
4.30	4.40	6	100	87			
4.40	4.50	6	100	99			
4.50	4.60	4	100	86			
4.60	4.70	3	100	79			
4.70	4.80	3	100	92			
4.80	4.90	5	100	83			
4.90	5.00	6	100	92			
5.00	5.10	6	100	85			
5.10	5.20	3	100	91			
5.20	5.30	5	100	87			
5.30	5.40	6	100	87			
5.40	5.50	6	100	91			
5.50	5.60	5	100	92			
5.60	5.70	6	100	86			
5.70	5.80	6	94	97	L		
5.80	5.90	6	100	102			
5.90	6.00	4	97	108	L		
6.00	6.10	3	100	161			
	Average	4.8	99.6	98			
	Min	3	94	79			
	Max	6	100	161			
Minor amounts of low severity longitudinal cracking.							
Rutting average 4.8 mm, range 3-6 mm.							
PSC average 99.6, range 94-100.							
IRI average 98 inches/mile, 79-161 inches/mile.							
Due Year: 2020    Projected Life: 23 years							

### **Appendix E**

#### **Resurfacing Reports**





Washington State  
Department of Transportation

## Memorandum

February 26, 2002

TO: Linda Pierce/Jeff Uhlmeyer, 4-7365  
FROM: Mel Hitzke, <sup>mail</sup>357-2653  
SUBJECT: SR 5 XL 1506 Group 04 Pin # 300510C  
MP 85.51 to MP 87.96  
Including Grand Mound I/C Ramps  
Surfacing Recommendations

This is the Olympic Region Materials recommendation for the proposed resurfacing of this section of SR 5 located in Thurston County. We request that the Headquarters Materials Lab review and concur with these recommendations.

### RECOMMENDATIONS:

#### SR 5 Mainline NB & SB

The roadway consists of ACP placed over PCCP, all alligator cracked areas shall be excavated to a minimum depth of 0.5-ft. or sound material. The maximum depth shall be determined as per Section 5-04.3(5)E of the Standard Specifications. All excavated areas shall be backfilled with ACP to match the existing roadway.

Plane 0.15-ft. from the traveled way and replace with 0.15-ft. ACP Class A (PG 64-22). The limits of planing should extend outside fog stripe to outside fog stripe. The existing rumble strips are to remain. The existing shoulders should be fog sealed with 0.03 gal/sy residual asphalt.

#### Grand Mound I/C

Seal all cracks greater than 1/4 inch.

Excavate alligator cracked areas to a minimum depth of 0.50-ft or sound material. Backfill the excavated areas with ACP to match the existing roadway.

# Special Report

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Linda Pierce/Jeff Uhlmeier, 4-7365

February 26, 2002

SR 5 XL 1506 Group 04 Pin# 300510C

MP 85.51 to MP 87.96 Including Grand Mound & Maytown I/C Ramps

Page 3

## ANALYSIS:

This portion of SR 5 is a Rural Interstate. The existing roadway consists of a divided highway with two 12.0-ft. lanes each direction. The ACP shoulders vary from 3.0-ft. to 10.0-ft. in width.

This project proposes to plane and inlay the existing roadway on mainline SR 5, MP 85.81 to MP 87.96 due to wheel rutting and roadway condition. The WPMS indicates the northbound lanes were due in 2000 with the southbound lanes being due in 2006.

Our investigation consisted of a record and field review of the existing surfacing. The equivalent single axle loads (ESAL'S) are 60,000,000 for the design period of (15 years).

According to the pavement management system files, the existing roadway was constructed with the following roadway sections:

### SR 5 Mainline

Pavements:	1994	0.15' ACP
	1976	0.35' ACP
	1976	0.00' Fabric Interlayer
	1956	0.75' PCCP
Base:	1956	0.84' Untreated Base

The existing roadway is in good condition with scattered areas of the following:

- Low severity alligator cracking
- Low severity longitudinal cracking
- Low severity transverse cracking
- Low severity maintenance patching
- Low to medium severity wheel rutting varying from 1/8 to 3/8 of an inch in depth

# Special Report

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Linda Pierce/Jeff Uhlmeyer, 4-7365

February 26, 2002

SR 5 XL 1506 Group 04 Pin# 300510C

MP 85.51 to MP 87.96 Including Grand Mound & Maytown I/C Ramps

Page 4

The Grand Mound I/C ramps and overcrossing (Exit 88A&B) were constructed in 1962 and last overlaid in 1983.

1962	0.25 to 33-ft	ACP
1962	0.33-ft	CSTC
1962	0.42 to 0.34-ft	Select Roadway Borrow
1983	0.25-ft	ACP (Ramps only)
1983	0.08-ft	ACP Class D (Overcrossing only)
2001		Maintenance BST

# Special Report

## Performance Grade Asphalt Cement Type

Project Number:

Project Name:

State Route: 5

Begin MP: 85.51

RRType: Main Line

End MP: 87.96

Direction: Decreasing

RRQualifier:

Begin MP	End MP	Speed (MPH)
9.51	102.00	70

Overlay/Lift Thickness (ft):

WSPMS ESAL: 59,107,000

Class of Mix: 3/8 in

Design ESAL: 59,107,000

Traffic Condition: Free

Base PG: PG 58-22

PG Bumping (Traffic Volume): Increase high temperature by 1 grade (6 degrees)

PG Bumping (Traffic Location): No adjustment

PG to be Used: PG 64-22

### Roadway

85.51	87.96
-------	-------

### Specification Tables

Mix Class	
Minimum Lift Thickness	Class of Mix
0.10 ft	3/8 in
0.15 ft	1/2 in
0.20 ft	3/4 in
0.25 ft	1.0 in
0.40 ft	1.5 in

Traffic Location	
Speed (MPH)	Traffic Condition
0 - 10	Standing
10 - 45	Slow
45 +	Free

Traffic Control	
Code	Description
AF	AMBER FLASHING
FS	FIRE SIGNAL
NO	NO TRAFFIC
OF	OFFICER OR
OT	OTHER TRAFFIC
PC	PEDESTRIAN
RF	RED FLASHING
RS	RAILROAD SIGNAL
SG	STOP AND GO
SS	STOP SIGN
SZ	SCHOOL ZONE
YS	YIELD SIGN

Base PG	
Location	PG
West of Cascades	PG 58-22
East of Cascades and North of I-90 and all Mountain Passes	PG 58-34
East of Cascades and South of I-90	PG 64-28

Adjustment for Traffic Location	
Traffic Location	Adjustment
Standing (0 - 10 MPH)	Increase high temperature by 2 grades (12 degrees)
Slow (10 - 45 MPH)	Increase high temperature by 1 grades (6 degrees)
Free (45 + MPH)	No Adjustment

Adjustment for Traffic Volume	
Traffic Volume	Adjustment
0 - 10,000,000 ESAL	No Adjustment
10,000,000 - 30,000,000 ESAL	Consider increasing high temperature by 1 grades (6 degrees)
30,000,000 + ESAL	Increase high temperature by 1 grades (6 degrees)

Note: Class of Mix is designated by the NOMINAL SIEVE SIZE. Nominal Sieve size is the first sieve where 10% or more of the material is retained.



Washington State  
Department of Transportation

## Memorandum

March 25, 2002

TO: Linda Pierce/Jeff Uhlmeyer, 4-7365

FROM: Mel Hitzke, 357-2653 *msh*

SUBJECT: SR 5 XL 1506 Group 05 Pin #300508C  
NB—MP 114.97 to MP 121.41  
Mounts Road Overcrossing, Weigh Station Off Ramp & Parking Area  
Surfacing Report

This is the Olympic Region Materials report of our investigation for the proposed resurfacing of this section of SR 5 located in Pierce County. We request that Headquarters Materials Lab review and concur these recommendations.

### RECOMMENDATIONS:

#### SR 5 Mainline NB

The roadway consists of ACP placed over CTB; with the exception of ACP being placed over PCCP from MP 115.24 to MP 115.77. All alligator cracked areas shall be excavated to a minimum depth of 0.5-ft. or sound material. The maximum depth shall be determined as per Section 5-04.3(5)E of the Standard Specifications. All excavated areas shall be backfilled with ACP to match the existing roadway.

Wheel rutting varies in depth from 1/16 to 1/4 of an inch.

**NB mainline only**, (excluding ramp tapers and auxiliary lanes), plane 0.15-ft. from the traveled way and replace with 0.15-ft. ACP Class A (PG 64-22). The limits of planning should extend one-foot outside fog stripe to one-foot outside fog stripe. The existing shoulders should be fog sealed with 0.03-gal/sy residual asphalt.

#### Mounts Road Overcrossing & I/S-South Side Only- (Excluding Off & On Ramps)

Seal all cracks 1/4" or greater in width.

Excavate all spalled or depressed alligator cracked areas to a minimum depth of 0.5-ft. or sound material. Backfill the excavated areas with ACP to match the existing roadway.

# Special Report

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Linda Pierce/Jeff Uhlmeier, 4-7365  
March 21, 2002  
SR 5 XL 1506 Group 05 Pin #300508C  
MP 114.97 to MP 121.41  
Page 2

Overlay 0.15-ft. ACP Class A (PG 64-22) from edge of paved shoulder to edge of paved shoulder from south bridge seat to existing W.S.D.O.T. right of way, see attached plan view.

## **Weigh Station Off Ramp & Weigh Station Parking Area**

Seal all cracks 1/4" or greater in width.

Excavate alligator cracked areas to a minimum of 0.5-ft. or sound material. Backfill the excavated areas with ACP to match the existing roadway.

Off ramp to the weigh station, place 0.15-ft. from the traveled way to approximately the beginning of the gore area and replace with 0.15-ft. ACP Class A (PG 64-22). The limits of planning should extend 1-foot outside fog stripe to 1-foot outside fog stripe. The existing shoulders should be fog sealed with 0.03-gal/sy residual asphalt.

Overlay the weigh station parking area edge of paved shoulder to edge of paved shoulder with 0.15-ft. ACP Class A (PG 64-22).

See attached plan view.

Prior to determining pavement repair quantities, contact the Olympic Region Materials Office.

MH:tm  
TM  
Attachment

cc: John Wynands 4-7448, w/attachments



# Special Report

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Linda Pierce/Jeff Uhlmeier, 4-7365  
March 21, 2002  
SR 5 XL 1506 Group 05 Pin #300508C  
MP 114.97 to MP 121.41  
Page 3

## ANALYSIS:

This portion of SR 5 is a Rural Interstate. The existing roadway consists of a divided highway with three 12.0-ft. lanes each direction. The ACP shoulders vary from 0.00-ft. to 10.0-ft. in width.

This project proposes to plane and inlay the existing roadway on mainline SR 5, MP 114.97 to MP 121.41 (excluding auxiliary lanes and ramp tapers), overlay the South side of Mounts Road Overcrossing, plane and inlay the weigh station off ramp, and overlay the weigh station parking area. The WPMS indicates this section of northbound SR 5 being due for rehabilitation from 2006 to 2010. This section of SR 5 was last planed and overlayed with 0.15-ft ACP in 1995. The paving project experienced severe temperature differential problems and multiple truck fans. The pavement has excessive raveling in the area of the truck fans and is not truly reflected in the WPMS ratings. Pavement repair has been done by State forces to address some of the worst raveled areas. Due to the extensive raveling, roadway condition and high volume of traffic, we recommend this project be scheduled for pavement rehabilitation in the 03-05 biennium.

Our investigation consisted of a record and field review of the existing surfacing. The equivalent single axle loads (ESAL'S) are 50,000,000 for the design period of (15 years).

According to the pavement management system files, the existing roadway was constructed with the following roadway sections:

Pavements:	1995	0.15-ft.	ACP Class A
	1995	0.15-ft.	Grinding ACP
	1980	0.06-ft.	ACP Class D
	1970	0.25-ft.	ACP Class B
	1957	0.33-ft.	ACP Class B
Base:	1957	0.50-ft.	CTB
	1957	0.25-ft.	Untreated Base

# Special Report

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Linda Pierce/Jeff Uhlmeyer, 4-7365  
March 21, 2002  
SR 5 XL 1506 Group 05 Pin #300508C  
MP 114.97 to MP 121.41  
Page 4

The existing roadway is in fair condition with scattered areas of the following:

- Low severity longitudinal cracking
- Low severity transverse cracking
- Low severity maintenance patching
- Low severity flushing
- Medium to High severity raveling (Due to temperature differential during construction)
- Low severity wheel rutting varying from 1/16 to 1/4 of an inch in depth



# Special Report



Washington State  
Department of Transportation

## Memorandum

August 13, 2003

TO: Thomas E. Baker/ Linda L. Pierce  
FOSSC/OSC: MS-47365  
Materials Laboratory

OSC Concurrence: Jeff Hilsinger  
Date of Concurrence: 9-4-03

FROM: Don Whitehouse/ George R. Hilsinger GRH  
SCR Regional Administrator/ Project Development Engineer  
P.O. Box 12560, Yakima, WA 98909-2560

SUBJECT: **Pavement Rehabilitation Report transmittal**; MP's 121.96 to 126.40; "SR90 Boylston to Ryegrass"

The attached pavement rehabilitation report is being transmitted to you for review. This memorandum describes pavement rehabilitation recommendations for SR-90 from Boylston Rd. to Ryegrass MP's 121.96-126.40 Eastbound and MP's 121.96 to 125.51 Westbound. Ad date for this project has not been established but is being proposed for the 2005-2007 biennium.

GRH:BWB

Attachment: SCR Material Engineer's Report

cc: SCR Project Development Engineer  
SCR Consultant Liaison  
SCR Area 1 Maintenance Superintendent  
SCR Materials Engineer (3)  
SCR Program Management  
SCR Project Control  
File

Baker/Pierce  
August 13, 2003  
Page 2

## **GENERAL:**

This project is located between Ellensburg and Vantage in Kittitas County along SR-90. The project lies between mileposts 121.96 and 126.40. This four-lane highway is classified as an Interstate. The Westbound lane's Eastern project limit ends at the start of the new truck-climbing lane. **See attachment 1 for vicinity map of the project**

### **Construction History:**

The Eastbound and Westbound lanes were originally constructed in 1967 with 0.83 ft of ACP Class B over 0.25 of Untreated Base. In 1977, Contract 10758 planed 0.15 ft of ACP and placed an overlay of 0.15 ft Recycled ACP and 0.06 ft of Class D throughout most of the Eastbound and Westbound lanes. In 1994, Contract 14249 planed 0.08 ft of ACP and placed 0.15 ft of Modified ACP Class D the entire length of the project both Eastbound and Westbound. The existing shoulders have 0.30 ft ACP. **See attachment 2 has a detail diagram of construction history.**

## **ANALYSIS:**

### **Visual Survey:**

The major distress of this section of I-90 is raveling of the Modified ACP Class D asphalt placed in 1994. The raveling of the Modified Class D has caused rutting in the travel lanes. There is also a low level of transverse cracking throughout the length of the project. Several of these cracks were cored; these cracks went all the way through the ACP layer to the untreated base. **See attachment 3 for photographs of the pavement surface.**

### **Core Observations:**

Eleven 4-inch diameter cores were taken to the top of the untreated base. The cores show that the Modified Class D layer is losing part of its integrity because of draining of the binder to the bottom of the layer. The other layers of ACP show limited signs of deterioration and are in overall good condition. **See attachment 4 for photograph of deteriorating modified D Layer**

### **Analysis Summary:**

An EVERCALC/EVERPAVE structural analysis was performed to determine the required ACP overlay thickness for a full 15-year life span. An additional analysis using the WSPMS SCOPER was performed to determine the required depth for a 15-year design life as well. Both EVERPAVE and SCOPER analysis were run with the 0.15 ft

# Special Report

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Baker/Pierce  
August 13, 2003  
Page 3

rotomill already removed. The results from both of these design tools were combined with a fair amount of engineering judgment to determine the most reasonable method of rehabilitation for this roadway.

EVERCALC results for all modes (stiff/non-stiff) are unreliable. All % RMS values were greater than 2% and most were in the teens or higher.

EVERPAVE results require an overlay of 0.01 ft to 0.10 ft. for the Eastbound Section. Westbound section results indicate a 0.01 ft to 0.06 ft overlay.

WSPMS SCOPER results require an overlay of 0.15 ft to 0.20 ft. for the Eastbound Section. Westbound section results indicate a 0.25 ft overlay. SCOPER overlay recommendations tend to be high for deep sections of ACP.

The cores show that the under lying pavement is good shape. Due to good shape of the underlying ACP and the knowledge that SCOPER produces, high overlay depths for deep section of ACP. It is believed that rotomilling 0.15 ft of ACP and replacing it with 0.15 ft. ACP will give this section of roadway the required structural integrity for a 15 year design life.

**Complete results of Analysis have been tabulated on attachment 5**

## **Availability of State Material Source:**

Recommended material source for this project is QS-S-214 it within the project limits.

Whistle  
RCY/bwb  
BWB

cc: SCR Project Development Engineer  
SCR Consultant Liaison  
SCR Area 1 Maintenance Superintendent  
SCR Materials Engineer (3)  
SCR Program Management  
SCR Project Control  
FOSSC/OSC Records Management; MS-47410  
File

## June 2008

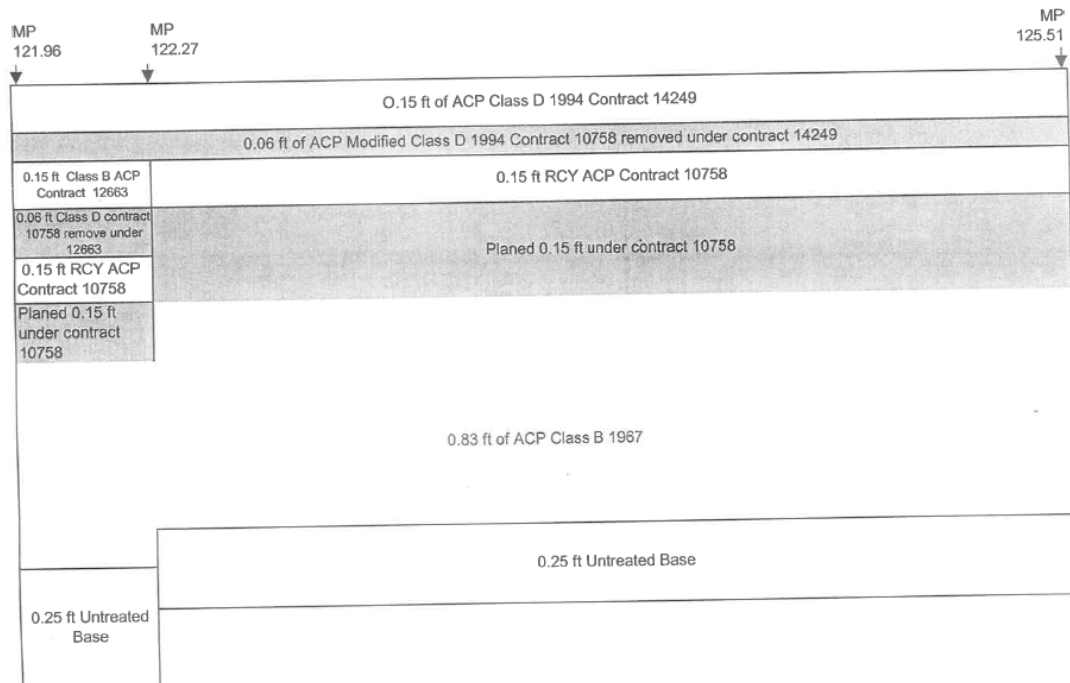


# Special Report

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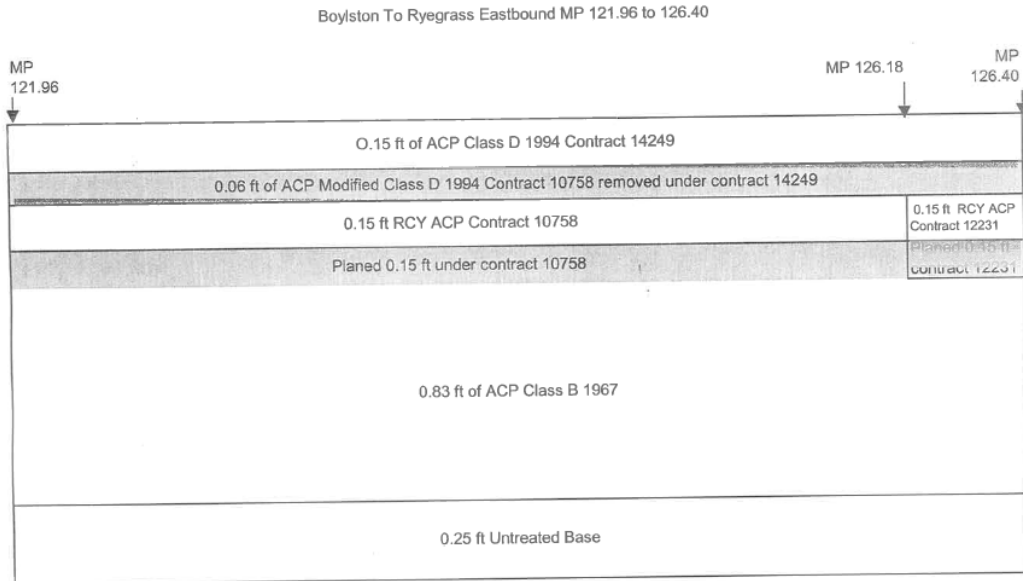
Attachment 2

Boylston To Ryegrass Westbound MP 121.96 to 125.51



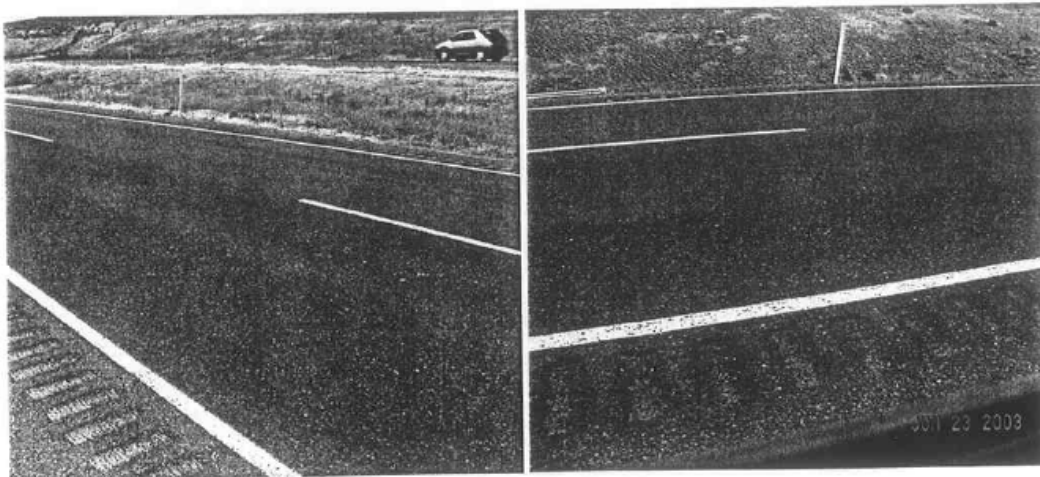
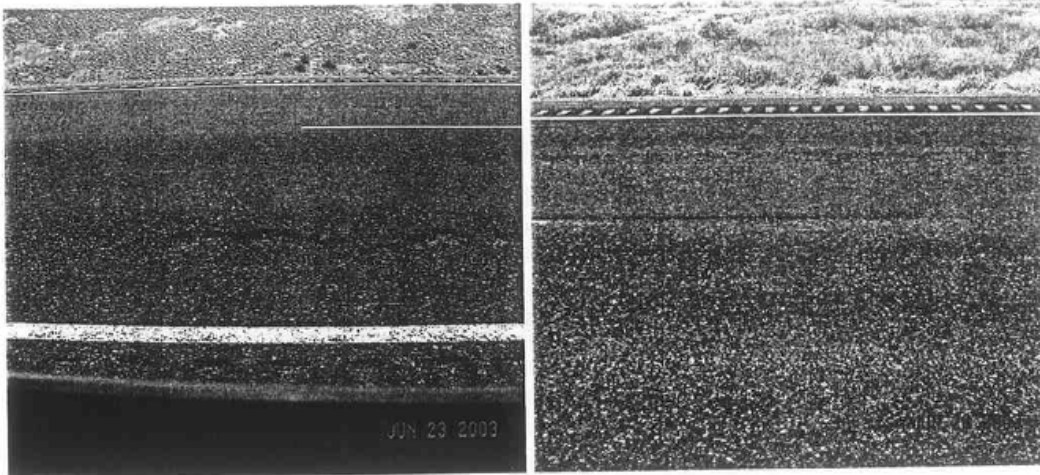
# Special Report

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Attachment 3

## Photos of Boyston to Ryegrass



# Special Report

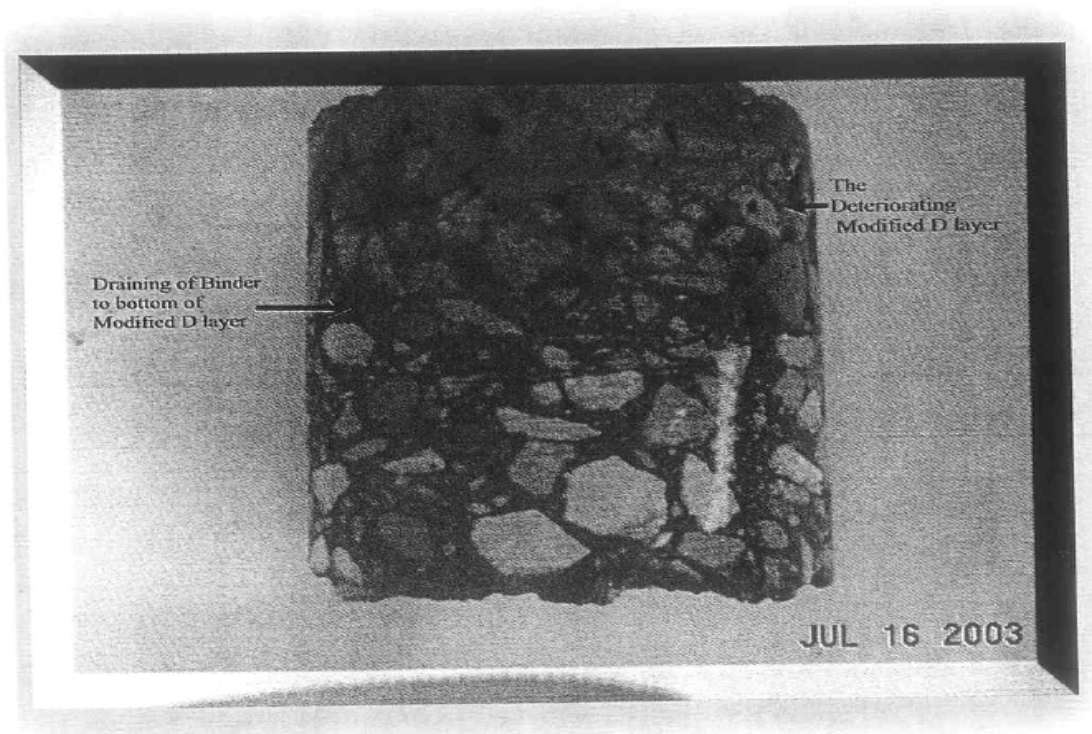
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Attachment 4

SR-90 MP-MP	Existing (Plan Depths) After Rotomill		Core Avg. Depths (ft) for section After Rotomill	Subgrade Modulus (psi)used for Everpave Cals	Everpave	WSPMS
	BASE(ft)	ACP(ft)			Results (ft)	Scoper(ft)
Eastbound						
121.96 to 126.18	0.25	0.98	0.90	26000	0.10	0.20
126.18 to 126.40	0.25	0.98	0.85	30000	0.01	0.15
Westbound						
121.97 to 122.27	0.25	1.13	1.00	30000	0.01	0.25
122.27 to 125.51	0.25	0.98	0.88	30000	0.06	0.25



Attachment 5



# Special Report

Class Superpave 1/2"  
10 to <30 million ESAL's

PG 70-28

Standard Sieves	Control Points		Percent Passing Criteria Recommended Restricted Zone		Tolerance Limits	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
3/4"	100				99	100
1/2"	90	100			+/-6%	
3/8"		90			+/-6%	
# 4					+/-5%	
# 8	28	58		39.1	+/-4%	
# 16			25.6	31.6		
# 30			19.1	23.1		
# 50				15.5		
# 100						
# 200	2.0	7.0			+/-2%	
% Asphalt Cement					+/-0.5%	
Dust to Asphalt Ratio (D/A)					0.6	1.6
Voids Filled with Asphalt					65	75

## Aggregate Requirements

Voids in Mineral Aggregate	14.0% Minimum
Coarse Aggregate Angularity	90% Double Face Fracture*
Los Angeles Wear, 500 rev.	30% Maximum
Degradation Factor, Wearing Course	30 Minimum
Degradation Factor, Non-Wearing Course	20 Minimum
Flat and Elongated Particles	5:1 Ratio
Sand Equivalent	37 Minimum
Uncompacted Void Content of Fine Aggregate	45% Minimum
*Fracture applies to the material retained on each specified sieve # 10 and above if that sieve retains more than 5 percent of the total material.	

	N <sub>initial</sub>	N <sub>design</sub>	N <sub>maximum</sub>
Density Requirements for Mix Design	89.0	96.0	98.0
Gyratory Compaction	8	100	160

Date printed: 7/15/2003

# Special Report

GSP Section	Fill-ins needed	Fill-in	Description of what the fill-in is referring to:
04021.FR5	\$\$1\$\$	Contact Joe DeVol (360) 709-5421*	Approximate %AC
04027.FR5	\$\$1\$\$	2	Fracture requirements
	\$\$2\$\$	8	# gyrations @ $N_{initial}$
	\$\$3\$\$	100	# gyrations @ $N_{design}$
	\$\$4\$\$	160	# gyrations @ $N_{maximum}$
	\$\$5\$\$	N/A	Minimum % VFA for 3/8" mix
	\$\$6\$\$	N/A	Maximum % VFA for 3/8" mix
	\$\$7\$\$	65	Minimum % VFA for 1/2" mix
	\$\$8\$\$	75	Maximum % VFA for 1/2" mix
	\$\$9\$\$	N/A	Minimum % VFA for 3/4" mix
	\$\$10\$\$	N/A	Maximum % VFA for 3/4" mix
	\$\$11\$\$	N/A	Minimum % VFA for 1" mix
	\$\$12\$\$	N/A	Maximum % VFA for 1" mix
	\$\$13\$\$	N/A	% $G_{mm}$ @ $N_{initial}$ for 3/8" mix
	\$\$14\$\$	89.0	% $G_{mm}$ @ $N_{initial}$ for 1/2" mix
	\$\$15\$\$	N/A	% $G_{mm}$ @ $N_{initial}$ for 3/4" mix
	\$\$16\$\$	N/A	% $G_{mm}$ @ $N_{initial}$ for 1" mix
04054.GR5	Superpave____ PG____	1/2 Inch 70-28	ACP Class Superpave____ PG____

\* Please contact Joe DeVol at the Materials Laboratory, Asphalt Section for this fill-in.

Date printed: 7/15/2003