Cationic Very Rapid Setting Polymer Modified Chip Seal Emulsion

WA-RD 866.1

Keith W. Anderson
Mark Russell
Jeff S. Uhlmeyer

Chad Simonson
Kevin Littleton
Joe DeVol

May 2017

Washington State Department of Transportation

Office of Research & Library Services

WSDOT Research Report

17-06-0275

Post-Construction Report
Experimental Feature 16-01

Cationic Very Rapid Setting Polymer Modified Chip Seal Emulsion

Contract 8864
2016 Eastern Region Chip Seal
US 2 ET AL

Washington State Department of Transportation

Engineering and Regional Operations
Construction Division-Pavements Office

May 2017

Experimental Feature Report

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
WA-RD 866.1		

4. TITLE AND SUBTITLE	5. REPORT DATE
Cationic Very Rapid Setting Polymer Modified Chip Seal Emulsion	May, 2017
	6. PERFORMING ORGANIZATION CODE
	WA 16-01
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
Keith W. Anderson, Mark Russell, Jeff S. Uhlmeyer, Chad Simonson, Kevin Littleton, and Joe DeVol	
. PERFORMING ORGANIZATION NAME AND ADDRESS	10. WORK UNIT NO.
Washington State Department of Transportation Materials Laboratory, MS-47365 Olympia, WA 98504-7365	11. CONTRACT OR GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
Washington State Department of Transportation Transportation Building, MS 47372 Olympia, Washington 98504-7372 Project Manager: Lu Saechao, 360-705-7260	Post-Construction Report
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

This study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

16. ABSTRACT

A regional chip sealing project installed test sections of very rapid setting emulsions (CVRS-2P) to determine if the curing time of the chip seal could be shortened as compared to conventional chip seals using CRS-2P binders. The test sections cured very rapidly allowing initial brooming to be completed in less than 25 minutes following placement and opening to posted speed operation in less than 3 hours after the brooming. This is in contrast to control sections of conventional chip seals using CRS-2P binders, which required 8 to 12 hours of reduced speed curing before final brooming and opening to posted speed operation.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Chip seal, rapid setting emulsion, Washington state	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22616

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
None	None	49	

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Introduction

The Washington State Department of Transportation's (WSDOT) chip seal process currently requires three separate stages: application of chip seal, sweeping of excess rock and application of a fog coat. The stages are separated by lengthy periods to allow for proper setting and curing of the emulsion to ensure strong embedment and bonding of the chip to the asphalt binder and the binder to the pavement surface. The waiting time for proper setting and curing of the emulsion is a period during which there is a risk of flying chip damage and traffic delays to the traveling public. The challenge is to speed up the construction process and thus mitigate the problems associated with the curing time of the asphalt emulsion.

Background

The increased use of chip seals on WSDOT roadways is the result of shrinking budgets and the need to maintain the state's pavements in an acceptable condition. As a result, the Regions have turned to hot bituminous surface treatments (HBST) on higher traffic roadways to reduce construction time, limit the risk of flying chip damage, and reduce traffic delays. HBST's use a hot applied binder (AC-15P) rather than the emulsified binder used for conventional BST's (CRS-2P). HBST's spray the hot binder on the roadway at about 340°F followed immediately by aggregates coated with 0.5 to 1.0 percent of asphalt. The roadway is ready for traffic after the excess aggregate is broomed off the chip seal. The total time from the oil application to complete finish brooming can be as short as 20 minutes.

The initial HBST was constructed in the North Central Region in 2014 with four additional projects built in 2015. A meeting to discuss all types of chip sealing was held in October of 2015. In attendance were WSDOT construction and materials personnel, contractors, asphalt suppliers, and others interested in the subject. After lengthy discussion of hot seals, the subject of conventional chip seals was initiated. Two of the suppliers of asphalt binders indicated that changes could be made to CRS-2P to shorten the curing time and speed up the process of opening the roadway to traffic. Following the meeting one of the suppliers, Western States Asphalt met with the Eastern Region to discuss the experimental use of different

formulations of CRS-2P on a 2016 chip seal project. This experimental feature is a result of the Eastern Region agreeing to the trial project.

Study Design

The research plan called for constructing of three test sections of very rapid setting emulsion (CVRS-2P) at three locations on a region wide chip seal project. The remaining portion of the locations will be constructed using conventional CRS-2P binder and will serve as control sections for the test sections. Three different binder formulas were to be used on the three test sections. Western States Asphalt Inc. (WSA) located in Spokane, WA would be responsible for developing the CVRS-2P formulas for the project. Data would be collected on pavement and air temperatures, time from the application of the CVRS-2P to brooming and time until open to traffic. These were to be compared to similar records taken from the control sections built using the conventional binder to quantify the benefits of using a more rapid setting binder. Data will also be collected on oil shot rate, rock rate, and the additional cost to the project for using the rapid setting binders. The properties of the binders will be documented with test data from the supplier and the State Materials Laboratory. The performance of the rapid setting binders will be monitored for a period of five years to determine possible negative impacts on their use. The work plan for the experimental feature is included as Appendix A.

CVRS-2P Formulas

As noted previously, WSA developed the three formulas used for the test sections. Their process involved modifications of the basic properties of the emulsions to decrease the set time of the final product. The viscosity or hardness of the binder was increased so that the binder could withstand sweeping within an hour of application. The elastic recovery and percent residue of the emulsions were not changed. The binder had to be fast breaking, but still be stable during storage. The formulation process involved the mating of the binder with the aggregate similar to a mix design for a hot-mix asphalt (HMA). WSA indicated that it was a trial and error process because conventional binder tests cannot predict which combination of aggregate and

binder would result in a quicker set time. The formulas are proprietary, but the supplier revealed some details about the make-up of the three formulas as noted below:

- The same percentage of polymer was used in all three formulas
- Formulas 1 and 2 have the same chemistry, but different oil source.
- Formulas 1 and 3 have different chemical additives.

Tables 1 and 2 list the properties of the three emulsions. The viscosity differences between the two sets of laboratory data are the result of the short set times built into the binders. As a result, the properties change rapidly over time. The WSA values are in the high 200's to middle 300's whereas the Materials Lab results are in the 100's to 200's. Formula 1 was tested three days after sampling, Formula 2 five days and Formula 3 was tested ten days after sampling. Formula 3 could not be tested for viscosity due to the changes that occurred in the binder over the 10-day time span between sampling and testing.

Table 1. HQ Materials Laboratory emulsified asphalt test report.

Property	Formula 1		Formula 2		Formula 3
Saybolt Viscosity@50°C, SFS	106	117	165	215	-
Particle Charge	Positive	Positive	Positive	Positive	Positive
Residue %	67	67	68	68	67
Oil %	0.3	0.3	0.2	0.2	0.3
Penetration @ 77°F, dmm	88	85	57	57	89
Elastic Recovery @ 25°C, %	75	74	66	62	72

Table 2. Western States Asphalt certificate of analysis.

Property	Formula 1	Formula 2	Formula 3
Saybolt Viscosity@50°C, SFS	341	339	284
Particle Charge	Positive	Positive	Positive
Residue %	67.5	67.66	66.80
Oil %	No Data	No Data	No Data
Penetration @ 77°F, dmm	85	59	83
Elastic Recovery @ 25°C, %	75	77	83.75

CVRS-2P Construction

The test sections were constructed on Contract 8864, 2016 Eastern Region Chip Seal. The contract called for nine chip seal applications on six different routes located throughout the region (see Table 3). The CVRS-2P test sections were used on the yellow highlighted locations. Formula 1 was used on Section 4, a full lane chip seal on US 2; Formula 2 was used on Section 2, a wheel path chip seal on US 2; and Formula 3 was used on Section 7, a wheel path chip seal on I-90.

Table 3. Contract 8864, 2016 Eastern Region Chip Seal, sections.

Section	Route	Description	MP to MP	Chip Seal	Chip Seal Ruts	HMA
1	US 2	Davenport To Reardan	250.54 to 263.44		X	
2**	US 2	Reardan to Espanola Rd	263.44 to 271.02		X	
3	US 2	Colbert Rd to Westwood Rd	300.75 to 302.35		X	
4*	US 2	SR 211 to South Shore Rd	321.83 to 328.60	X		
5	SR 20	Narcisse Rd to Spruce Canyon Rd	363.61 to 372.99			X
6	SR 27	Pullman-Albion Rd to Palouse-Albion Rd	2.22 to 8.87	X		
7***	I 90	SR 21 to Ritzville	208.16 to 218.03		X	
8	US 195	Idaho State Line to Colton	0.008 to 8.61	X		
		Idaho State Line to Colton-Spur	0.06 to 0.60	X		
9	SR 291	Charles Rd. to Stevens Co Line	9.36 to 11.07		X	

* Formula 1 used from MP 321.77 to 322.71 both directions
** Formula 2 used from MP 265.02 to 271.02 both directions
*** Formula 3 used from MP 208.16 to 218.03 WB outside lane only

Central Washington Asphalt was the contractor for the project. The test sections were paved between August 2 and August 15, 2016. A representative from WSA was on hand at each installation to provide technical assistance. In addition to the change in formulation of the binder, a steel wheel roller was added to the compliment of pneumatic rollers for the full lane chip seal used on the Formula 1 binder for Section 4. The steel wheel roller was added to enhance the embedment of the chips due to the expected quick breaking of the emulsion. The steel wheel roller was not used on the other two test sections because they were wheel path

applications to fill ruts and would not be effective due to bridging. A description of the construction of the three test sections follows.

Formula #1

The Formula 1 test section was installed between Milepost (MP) 321.77 and 322.77 on US 2 between the junction of SR 211 and the South Shore Road in Newport (Figure 1). The additional cost of the Formula 1 emulsion was in $2,500.

The remainder of the section was paved with hot bituminous surface treatment (HBST) using modified AC-15P binder and, as a result, there is no control section for Formula 1.

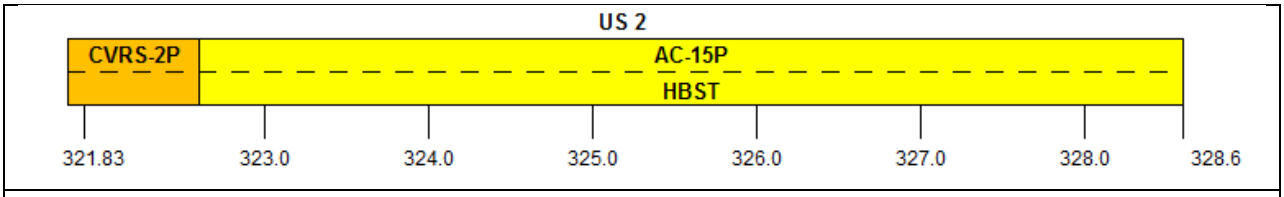

Figure 1. Section 4 which included both lanes of US 2 from MP 321.77 to MP 328.60.

Photos and rut measurements of the pavement taken prior to construction are shown in Figures 2-4 and Table 4, respectively. The rut measurements were made using a straight edge and tape measure.

Figure 2. Rutting 1/8 inch at MP 321.80 looking East.

Figure 3. Rutting 1/8 inch at MP 321.80 looking East.

Figure 4. Rutting 1/8 inch at MP 322.5 looking East.

Table 4. Pre-installation rut measurements.

Milepost	Westbound		Eastbound	
	LWP (in.)	RWP (in.)	LWP (in.)	RWP (in.)
321.8	1/8	2/8	1/8	1/8
322.10	1/8	2/8	1/8	1/8
322.5	1/8	1/8	1/8	1/8

The Formula 1 test section was constructed on August 5, 2016. The process of placing the CVRS-2P bituminous surface treatment (BST) was similar to a conventional BST with the binder sprayed onto the pavement surface from a distributor truck followed by a chip spreader dropping coarse aggregate into the binder. Three pneumatic rollers were used to push the aggregate into the binder. This was followed by another chip spreader that dropped a much finer "choke" aggregate onto the surface of the coarse aggregate to fill in the voids between the larger particles. A pneumatic roller and steel wheel roller were used after the choke as the final rolling operation. The final operation was brooming of the excess aggregate off the roadway once the binder has hardened sufficiently. Figures 5-13 depict the construction process for the Formula 1 test section installation.

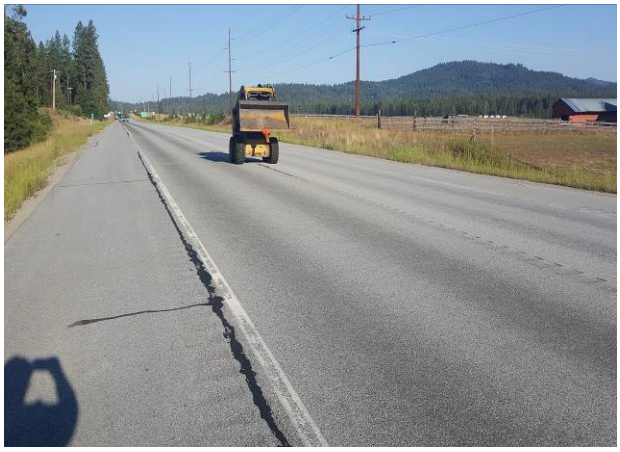

Figure 5. Prior to application of Formula 1 CVRS-P2.

Figure 6. Application of the Formula 1 CVRS-2P.

Figure 7. Aggregate applied to the emulsion with a chip spreader fed by a dump truck.

Figure 8. Close-up view of chips prior to rolling.

Figure 9. Rolling of chips with pneumatic rollers prior to application of choke stone.

Figure 10. Steel wheel roller used after the application of the choke stone.

Figure 11. Close-up of the Formula 1 chip seal after rolling.

Figure 12. Close-up of the Formula 1 chip seal after application of choke stone.

Figure 13. Finished Formula 1 CVRS-2P chip seal.

Inspector's Daily Report Comments

Paving on the Formula 1 test section began at 8:00 am on August 5, 2016 and was completed at 3:00 pm, for a total of 8 hours for the 1.88 lanes miles of roadway. The initial air temperature and ground temperatures increased from 71°F and 69°F, respectively, to 75°F and 97°F at the end of the construction process. The oil temperature remained at 165°F throughout the installation. The paving train consisted of three pneumatic rollers behind the chip spreader and one behind the choker. A steel wheel roller followed the pneumatic roller used behind the chip spreader placing the choke. The only problems encountered with the installation were the initial use of too much coarse aggregate, which caused excessive loss of rock during the

sweeping operation. The rock rate was decreased from 6.0 lbs/sy to 5.0 lbs/sy, which solved the problem. The inspector noted that when the road surface temperatures reached 115°F the aggregate began to be picked up by the sweeper. A water truck was used to cool the road to solve the picking problem. During the day, the build up of traffic interfered with the sweeping operation and the choke had to be delayed as much as one hour. Figures 14-19 show the condition of the BST 40 days after construction.

Figure 14. Formula 1 chip seal after 1.3 months (40 days). Some flushing in the wheel paths.

Figure 15. Formula 1 seal after 1.3 months (40 days). A slight hint of flushing in the wheel paths.

Figure 16. Close-up of the surface of the Formula 1 chip seal after 1.3 months (40 days).

Figure 17. Hint of flushing in the wheel paths of the Formula 1 seal after 1.3 months (40 days).

Figure 18. Tight surface of the Formula 1 chip seal. After 1.3 months (40 days).

Figure 19. Flushing in the wheel paths of the Formula 1 chip seal after 1.3 months (40 days).

Formula 2

Formula 2 was used to install a chip seal in the wheel paths of both lanes of US 2 from MP 265.52 to 271.02 west of Reardan (see Figure 20). The added cost of the test section using Formula 2 was $3,750.

The remainder of the section was paved using CRS-2P binder and serves as the control section for Formula 2.

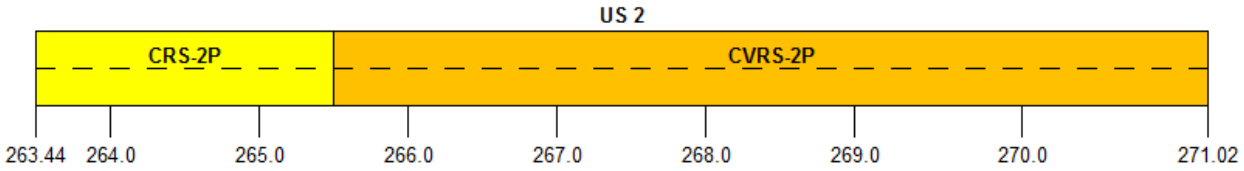

Figure 20. Section 2 which included both lanes of US 2 from MP 263.44 to MP 271.02.

Figures 21-23 show the condition of the pavement prior to construction and Table 5 lists the wheel path rutting measurements.

Figure 21. Rutting 5/8 inch at MP 266.00 looking East.

Figure 22. Rutting 5/8 inch at MP 267.00 looking East.

Figure 23. Rutting 5/8 inch at MP 269.00 looking East.

Table 5. Pre-installation rut measurements.

Milepost	Westbound		Eastbound	
	LWP (in.)	RWP (in.)	LWP (in.)	RWP (in.)
266.00	5/8	5/8	5/8	5/8
267.00	5/8	5/8	5/8	5/8
268.00	5/8	5/8	4/8	6/8
269.00	5/8	5/8	5/8	5/8

The Formula 2 test section was applied on August 2, 2016. The paving train consisted of a distributor, a chip spreader, three pneumatic rollers, a choke spreader, and a fourth pneumatic roller. The steel wheel roller used for the Formulas 1 test section was not used because it would be ineffective due to bridging over the chip seal in the rutted wheel paths. Figures 23-30 show the construction process for Formula 2.

Figure 24. Distributor applying the Formula 2 CVRS-2P in the wheel paths of US 2.

Figure 25. Close-up of distributor spraying the Formula 2 CVRS-2P.

Figure 26. Chip spreader and dump truck.

Figure 27. Chips prior to rolling.

Figure 28. Chips in wheel paths behind the spreader.

Figure 29. Break line between Formula 1 CVRS-2P and CRS-2P binders. CVRS-2P in the background, CRS-2P in the foreground.

Figure 30. Formula 2 chip seal in the foreground, with conventional chip seal in the background. Note the loss of aggregate at the edges of the wheel paths on the Formula 2 test section.

Inspector's Daily Report Comments

The construction of the Formula 2 test section was similar to Formula 1 except that the steel wheel roller was not used. The paving began at 7:00 am on August 2, 2016 and was completed at 7:15 pm, for a total of 12.25 hours for the 12.36 lane miles. The initial air and ground temperatures increased from 76°F and 79°F, respectively, to 85°F and 123°F at the completion of the section. The oil temperature remained at 165°F throughout the day. Some

problems were encountered due to the dampness of the aggregate, which did not allow the binder to break. The solution was to reduce the application rate of the coarse aggregate and move the choke spreader 200 feet behind the coarse aggregate spreader. The aggregate did not adhere to the binder from MP 265.02 to 265.52 due to pump failure on the distributor. This short section was redone the following day using conventional CRS-2P binder. Figures 31-36 show the condition of the Formula 2 chip seal 43 days after construction.

Figure 31. Formula 2 wheel path chip seal after 1.4 months (43 days). Edges of wheel path chip seals have lost chips.

Figure 32. Formula 2 wheel path chip seal after 1.4 months (43 days). Close-up showing missing chips.

Figure 33. Formula 2 wheel path chip seal after 1.4 months (43 days).

Figure 34. Formula 2 wheel path chip seal after 1.4 months (43 days).

Figure 35. Side view of Formula 2 wheel path chip seal after 1.4 months (43 days) showing no problems.

Figure 36. Close-up of the Formula 2 wheel path chip seal showing no problems at 1.4 months (43 days).

Formula 3

Formula 3 was used in the wheel paths of the westbound outside (travel) lane of I-90 between MP 208.16 and 218.03. The added cost for Formula #3 was $3,200.

The control section for Formula 3 is CRS-2P chip seal used on the eastbound outside lane of Section 7.

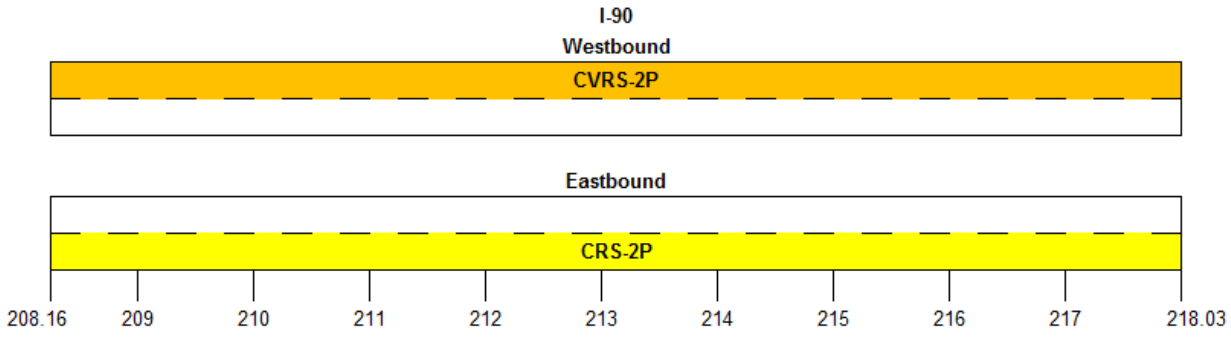

Figure 37. Plan map of Section 7, I-90 with CVRS-2P in the westbound outside lane and CRS-2P in the eastbound outside lane.

The condition of the pavement prior to construction is shown in Figures 38-45 and the rutting measurements are listed in Table 6.

Figure 38. Rutting 3/8 – 4/8 inch at MP 218.00 looking WB travel lane.

Figure 39. Rutting 3/8 – 4/8 inch at MP 217.00 in WB travel lane.

Figure 40. Rutting 4/8 inch at MP 216.00 in WB travel lane.

Figure 41. Rutting 3/8 – 6/8 inch at MP 215.29 in WB travel lane.

Figure 42. Rutting 4/8 – 5/8 inch at MP 215.00 in WB travel lane.

Figure 43. Rutting 4/8 – 5/8 inch at MP 214.50 in the WB travel lane.

Figure 44. Rutting 3/8 – 5/8 inch at MP 210.55 in the WB travel lane.

Figure 45. Rutting 3/8 – 3/8 inch at MP 208.25 in the WB travel lane.

Table 6. Pre-installation rut measurements.

Milepost	Westbound Outside Lane	
	LWP (in.)	RWP (in.)
218.00	4/8	3/8
217.00	5/8	3/8
216.00	4/8	4/8
215.29	6/8	3/8
215.00	5/8	4/8
214.50	5/8	4/8
210.55	5/8	3/8
208.25	3/8	3/8

The Formula 3 test section was paved on August 15, 2016. The paving train consisted of a distributor, a chip spreader, three pneumatic rollers, choke spreader and a fourth pneumatic roller. The steel wheel roller was again deleted because of it being a wheel path chip seal. Figures 46-48 show the paving train and views of the finished chip seal.

Figure 46. Paving train for Formula 3 test section showing distributor, chip spreader, dump truck and pneumatic rollers.

Figure 47. Finished Formula 3 wheel path chip seal with choke.

Figure 48. Close-up of the Formula 3 wheel path chip seal with choke.

Inspector's Daily Report Comments

Paving of the Formula 3 test section began at 7:00 AM at MP 208.16 heading east using three rollers behind the chipper and one behind the choker. The initial air and ground temperatures increased from 74 and 81°F respectively, to 93 and 122°F at the completion of the section. The chips were damp but this did not slow the breaking of the emulsion. Sweeping began 45 minutes after the surface was choked. The embedment was measured at 50 percent. At 1:00 PM, at approximately MP 214, the sweeping had moved up to 25 minutes behind the choke spreader. The paving was completed at 3:00 PM at MP 218.03. Final sweeping was completed by 6:00 pm. Figures 49-56 show the condition of chip seal 30 days after construction.

Figure 49. Minor chip loss at the edges of the Formula 3 wheel path chip seal after 1 month.

Figure 50. Minor chip loss at edges of the wheel paths Formula 3 chip seal after 1 month.

Figure 51. Choke filling areas between chips. Formula 3 test section after 1 month.

Figure 52. Loss of chips at the wheel path edges. Formula 3 test section after 1 month.

Figure 53. Coarse nature of the Formula 3 chip seal after 1 month.

Figure 54. Minor loss of chips at the edges of the wheel paths on the Formula 3 test section after 1 month.

Figure 55. Very minor loss of chips at the edges of the wheel paths on the Formula 3 test section after 1 month.

Figure 56. Very minor loss of chips at the edges of the wheel paths on the Formula 3 test section after 1 month.

CRS-2P Construction

Table 7 lists the milepost limits of both the test and control sections. As noted previously, there is no CRS-2P control section for Formula 1.

Table 7. Milepost limits for the test and control sections.		
	CVRS-2P Test Section Limits	CRS-2P Control Section Limits
Formula 1	321.77 to 322.71	No Control Section
Formula 2	263.44 265.02	265.02 to 271.02
Formula 3	208.16 to 218.03 Westbound	208.16 to 218.03 Eastbound

Tables 8 and 9 list the HQ Materials Laboratory and Western States Asphalt test report data on the CRS-2P emulsion used on the Formula 2 and 3 control sections. The viscosity values ranged from 282 to 288 as compared to the CVRS-2P, which ranged from 284 to 341 for the WSA testing. The other notable difference is in the penetration values, which ranged from 115 to 136 for the CRS-2P oil as compared to the CVRS-2P where it ranged from 59-85. As noted previously, the penetration or hardness of the binder was increased for the CVRS-2P to be able to withstand the early brooming and allow opening to traffic a much early times.

Table 8. HQ Materials Laboratory emulsified asphalt test report data for control sections of CRS-2P.			
Property	Formula 2 Control Section		Formula 3 Control Section
Saybolt Viscosity@50°C, SFS	126	162	174
Particle Charge	Positive	Positive	Positive
Residue %	66	66	65
Oil %	0.7	0.7	0.3
Penetration @ 77°F, dmm	131	136	115
Elastic Recovery @ 25°C, %	76	74	79

Table 9. Western States Asphalt certificate of analysis data for control sections.			
Property	Formula 2 Control Section		Formula 3 Control Section
Saybolt Viscosity@50°C, SFS	282	286	288
Particle Charge	Positive	Positive	Positive
Residue %	66	66	66
Oil %	No Data	No Data	No Data
Penetration @ 77°F, dmm	114	116	113
Elastic Recovery @ 25°C, %	79	79	79

The air and pavement temperatures, oil and rock rate, and time until final brooming and opening to traffic are summarized in Table 10.

Table 10. Control section construction data.

Property	Control Section for Formula 2	Control Section for Formula 3
Air Temperature (°F)	58 to 85*	57 – 85*
Pavement Temperature (°F)	55 - 61	67
Oil Rate (gal/sy)	0.40 – 0.42	0.40
Rock Rate (lbs/sy)	25	25
Time Until Fully Open To Traffic (hrs)	8-12	8-12

* National Weather Service high and low temperature for the days of paving, air temperatures were not recorded on the IDR's.

Inspector's Daily Report Comments

The paving of the control section for Formula 2 started at 7:00 am on August 1, 2016 and was completed at 7:00 pm, for a total of 12.25 hours to pave the 9.62 miles (0.79 lane miles per hour. Three rollers were used behind the chipper applying rock at 25 lb/sy and one behind the choker, which applied rock at 6.0 lb/sy. The oil was applied at a rate of 0.40 gal/sy. Progress was slowed due to delays caused by the long haul between the job site and the pit site located in Wilbur. Traffic control and speed restrictions were in place all night before final brooming the next day.

The paving of the control section for Formula 3 started at 8:30 am on August 4, 2016 and was completed at 3:00 pm, for a total time of 6.5 hours for the 9.87 miles. Three rollers were used behind the chipper applying rock at 25 lb/sy and one behind the choker, which applied rock at 6.0 lb/sy. The oil was applied at 0.40 gal/sy. Crack sealing preceded the chip sealing by only minutes due to a miscommunication within the Contractor's organization. The sealant was sanded to prevent the possibility that it could bleed through the chip seal. Traffic control and speed restrictions were in place all night before final brooming the next day.

Figures 57-70 show the construction process for the control section for Formula 3 installed on I-90. No photos were available for the construction of the Formula 2 control section.

Figure 57. Distributor applying CRS-2P on the I-90 control section.

Figure 58. Chip spreader applying aggregate on the I-90 control section.

Figure 59. Close-up of chip spreader dropping chips on the CRS-2P.

Figure 60. Dump truck loading chip spreader with aggregate.

Figure 61. Chip seal prior to application of the choke.

Figure 62. Close-ups of chip seal prior to applying the choke.

Figure 63. Second chip spreader applying the choke stone.

Figure 64. Close-up of the chip spreader for the choke stone.

Figure 65. Choke stone in the chip spreader.

Figure 66. Choked chip seal prior to rolling or sweeping.

Figure 67. Chip seal prior to final rolling.

Figure 68. Pneumatic rollers at work.

Figure 69. BST during the rolling operation.

Figure 70. Choke stone in the chip spreader.

CRS-2P Construction Summary

The IDR for the Formula 3 control section states that a 10-mile lane closure was in effect until the morning following the chip sealing with a 45 MPH speed limit on the open lane. The overnight closure was only possible because this is a four lane divided roadway. The restriction for the Formula 2 control section, which is a two-lane roadway, was a speed limit of 35 MPH for 8 to 12 hours after the completion of chip sealing.

Comparison of CVRS-2P and CRS-2P Processes

The comparison between the two processes is shown in Table 11. The time to initial brooming ranged from 25 to 60 minutes for all three of the CVRS-2P formulas (from information provided Kevin Littleton, ER Materials Engineer). Formula #3 was the most rapid curing with the chip seal ready right behind the rollers for sweeping. The conventional CRS-2P chip seal requires between 8 to 12 hours of curing time before traffic can use the roadway at its posted speed limit. The CVRS-2P chip seal process allows traffic in as little as 2.5 to 3.0 hours.

Table 11. Chip seal construction data for CVRS-2P and CRS-2P sections*.				
Property	Formula 1	Formula 2	Formula 3	CRS-2P
Air Temperature (°F)	76 - 85	70 – 78	74 – 93	57-85
Pavement Temperature (°F)	80 – 123	69 – 112	68 – 122	55 - 67
Oil Rate (gal/sy)	0.48	0.34	0.35	0.40 – 0.42
Rock Rate (lbs/sy)	25	25	23 – 25	25
Time Until Brooming (minutes)	30	30 – 60	>25	Next Day
Time Until Fully Open To Traffic (hrs.)	2.5 - 3.0	<3.0	<3.0	8-12

* Information provided by Kevin Littleton, Eastern Region Materials Engineer

Cost Data

The cost of the CVRS-2P calculated from the bid tabulations ranged from $1.81 to $2.02 per square yard with an average of $1.91 per square yard (see table 12). This includes the added cost of the CVRS-2P binder. The cost of the conventional CRS-2P BST was $1.84 per square yard. All the calculated costs include proportional amounts of the mobilization and traffic control costs. No adjustments were made for the possible reduced duration of traffic control allowed by the CVRS-2P binders. Appendix B contains the bid tabulation for Contract 8864.

The costs calculated indicate about seven cents per square yard higher cost for the CVRS-2P. The cost reported in the study seem to be balanced by the reduction in traffic control costs; however, hard numbers are difficult to produce since the bid tabulations did not break out traffic control costs separately for the CRS-2P and CVRS-2P applications. Additional CVRS-2P projects are needed to better understand the cost comparisons.

Table 12. Construction costs of the test sections.	
Test Section	Cost (S.Y.)
Formula 1	1.91
Formula 2	1.81
Formula 3	2.02
Average of Rapid Setting Test Section Construction	1.91
CRS-2P Chip Seals	1.84

An additional attempt was made to compare costs for the CRS-2P and AC-15P binders used for the two chip seals. Due to the experimental nature and small quantities used for the project, the results were not conclusive. Additional projects and analysis are needed in order to report accurate findings.

Discussion of Results

The increased hardness of the rapid setting CVRS-2P binder allowed initial brooming and opening to traffic of the test section much quicker than the conventional chip seal control sections. The rapid setting emulsion process, however, is not as fast as the HBST process used on this contract. The cost per square yard for the rapid setting emulsion test sections was higher than the conventional chip seal constructed and the HBST sections on the project. Additional projects are needed, however, to verify these cost comparisons.

Future Research

The CVRS-2P and CRS-2P sections will be monitored for a period of five years to determine the long-term performance of the test sections as compared to the controls. Friction measurements and visual inspections will be conducted with photos taken to document the conditions. A final report will be issued at the end of the evaluation period summarizing the performance.

Appendix A

Experimental Feature Work Plan

WORK PLAN

Use of Cationic Very Rapid Setting Polymer Modified Chipseal Emulsion on WSDOT Chip Seal Projects

Contract 8864 - US Et Al 2016 Eastern Region Chip Seal

June 16, 2016

Prepared by

Chad Simonson
Eastern Region Project Engineer
Washington State Department of Transportation

Jeff Uhlmeyer
State Pavement Engineer
Washington State Department of Transportation

Introduction

The Washington State Department of Transportation's (WSDOT) chip seal process currently requires three separate stages: application of chip seal, sweeping of excess rock and application of a fog coat. The stages are separated by lengthy periods to allow for proper setting and curing of the emulsion to ensure strong embedment and bonding of the chip to the asphalt residue and pavement surface prior to sweeping any excess chip, fogging the surface and striping before the roadway is returned to full traffic and permanently striped. The waiting time for proper setting and curing of the emulsion is a period during which there is a risk of flying chip damage and traffic delays to the riding public. The challenge to WSDOT is to speed up the chip seal process and reduce the risk of windshield damage and traffic delay resulting from that need to wait the long period for the chip seal emulsion to set and cure enough to allow the sweeping of excess rock from the pavement surface and move to the next stage of the process. Speeding up the process should result in reduced traffic control and damage claim costs.

Plan of Study

Try three separate very rapid setting emulsion formulas

This proposal would switch in very rapid setting emulsion (CVRS-2P) for the conventional (CRS-2P) at various times during the chip seal project. This would occur at three separate times as there are expected to be three separate formulas to evaluate. Western States Asphalt, Spokane, WA will be responsible for developing the CVRS-2P formulas for the project. During each evaluation, the emulsion will replace the current CRS-2P emulsion specified on the project. Recording of pavement and air temperature and humidity will be taken as well as timing the period from application to that point when the seal is deemed strong enough to attempt sweeping of the excess rock from the surface. These will be compared to similar records taken from the conventional seal (CRS-2P) to determine variance and benefit from the current process.

In addition, a steel wheeled roller will be added to the compliment of pneumatic rollers normally required. The pneumatic roller will make three passes and the steel wheel roller one pass. The steel wheel roller is expected to enhance the immediate embedment of the chips as the emulsion is expected to break quickly.

Scope

Section 4 (full roadway width BST application) will use Formula #1 CVRS-2P in lieu of AC-15P Asphalt Liquid. The shot rate will increase from a 0.40 Gal/SY for AC-15P to 0.45 Gal/ SY for the Formula #1 CVRS-2P. This will reduce the total quantity of AC-15P by 28 Tons and the quantity of item 16 by 16,562 SY. The change will result in the use of 33 Tons of Formula #1 CVRS-2P and 16,562 SY of 3/8 to #4 Chips.

Section 2 (wheel paths only BST application) will use Formula #2 CVRS-2P in lieu of CRS-2P Asphalt Liquid. The shot rate will be unaffected. This will reduce the total quantity of CRS-2P by 64 Ton and replace it with 64 Ton of Formula #2 CVRS-2P. Item 15, 3/8 to #4 Chips will remain unchanged.

Section 7 (wheel paths only BST application) will use Formula #3 CVRS-2P in lieu of CRS-2P Asphalt Liquid. 64 Tons of CRS-2P will be replaced with 64 Tons of Formula #3 CVRS-2P. The quantity of chips will remain unchanged.

Layout

Section 4 will use the Formula #1 CVRS-2P on US 2 from MP 321.83 to MP 322.77. Section 2 will use Formula #2 CVRS-2P on US 2 from MP 265.02 to MP 271.02. Section 7 will use Formula #3 CVRS-2P on I-90 from MP 208.16 to MP 218.03 Westbound only.

Construction

The CVRS-2P will be applied using conventional distributors at normal application temperatures. Clean damp chips will be applied over the surface immediately behind the distributor and no emulsion surfaces will remain open except for the usual 6-inch overlap that occurs at the meet line of the sealed lanes. The use of a steel wheeled roller in static mode to make one additional pass over the fresh chipseal will be added along with the current fleet of pneumatic rollers.

Staffing

The Region Project office will coordinate and manage all construction aspects. Representatives from HQ and Region Materials Laboratory will also be involved with documenting the construction and performance. In addition, Stephen Van De Bogert from Western States Asphalt will be on-site during the placement.

Jeff Uhlmeyer
State PavementEngineer
Washington State DOT
(360) 709-5485
Uhlmeyj@wsdot.wa.gov

Mark Russell
Pavement Design Engineer
Washington State DOT
(360) 709-5479
russelm@wsdot.wa.gov

Kevin Littleton
ER Materials Engineer
Washington State DOT
(509) 324-6170
LittleK@wsdot.wa.gov

Stephen A. Van De Bogert
General Manager
Western States Asphalt, LLC
4327 N. Thor St.
Spokane, WA 99217
(509) 487-4560
svandebogert@wsasphalt.com

Testing

The CVRS-2P emulsion acceptance will be based on pre certification of the material. A test report will be provided prior to application of the emulsion. Pavement performance will be monitored by the following methods:

- Friction testing will be conducted after construction and then annually.

- The performance of the three test sections will be evaluated visually and with appropriate photographs.

Reporting

A "Post-Construction" report will be written following completion of the project. This report will include construction details of the test sections, construction test results, and other details concerning the overall process. A final report documenting the performance of the test sections will be issued at the end of the five year evaluation period.

Cost Estimate

CONSTRUCTION COSTS

Section 4 Oil:
Section 4 savings: 28 Ton of AC-15P @ $475.00 = -$13,300.00
Section 4 Additional Cost: 33 Ton of CVRS-2P @ $450.00 = $14,850.00
Section 4 Net Oil Change: +$1,550.00
Section 4 Chips:
Chips are the same price per SY.
Section 2 Oil:
Section 2 Savings: 64 Tons of CRS-2P @ $375.00 per Ton = -$24,000.00
Section 2 Additional Cost: 64 Tons of CVRS-2P @ $450.00 per Ton = $28,800.00
Section 4 Net Oil Change: + $4,800.00
Section 7 Oil:
Section 7 Savings: 64 Tons of CRS-2P @ $375.00 per Ton = -$24,000.00
Section 7 Additional Cost: 64 Tons of CVRS-2P @ $450.00 per Ton = $28,800.00
Section 7 Net Oil Change: +4,800.00

TESTING COSTS

There will be no added testing costs for this proposal.

REPORT WRITING COSTS

Post-Construction Report – 20 hours = $2,600

Final Report – 20 hours = $2,600

Total Additional Cost: $16,350

Schedule

Construction Date –July/August 2016

Date	Condition Survey (Annual)	End of Construction Report	Friction Testing	Final Report
Fall 2016	X	X	X	
Fall 2017	X		X	
Fall 2018	X		X	
Fall 2019	X		X	
Fall 2020	X		X	
Fall 2021	X		X	
Spring 2022				X

Appendix B

Bid Tabulation

Experimental Feature Report

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — DATE: 02/10/2016

* * * BID CHECK REPORT * * * — TIME: 13:53

PS&E JOB NO : 16Z003 — REVISION NO :

CONTRACT NO : 008864 — REGION NO : 6

VERSION NO : 4 — WORK ORDER# : XL4753

HWY : SR 002,020,027,090,195,291

TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003

PROJECT : STPF-9999(689)

COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016

AWARDED ON : Apr 4 2016

				LOW BIDDER		2ND BIDDER		3RD BIDDER	
				CENTRAL WASHINGTON ASPHALT, IN		GRANITE CONSTRUCTION COMPANY		POE ASPHALT PAVING, INC.	
				13184 E WHEELER RD		80 POND ROAD		302 15TH ST	
				98837-9118				CLARKSTON WA 99403-2372	
				MOSES LAKE WA 988370142		YAKIMA WA 989019354		LEWISTON ID 835010449	
				CONTRACTOR NUMBER : 142600		CONTRACTOR NUMBER : 100102		CONTRACTOR NUMBER : 661800	
ITEM NO.	ITEM DESCRIPTION / EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT / TOTAL AMOUNT	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.
	PREPARATION								
1	MOBILIZATION								
		L.S.			-16.92 %		-8.23 %		-13.09 %
			391,200.00	325,000.00	-66,200.00	358,999.99	-32,200.01	340,000.00	-51,200.00
2	CLEARING AND GRUBBING - SITE QS-W-298								
	0.7700	ACRE	1,000.0000	6,000.0000	500.00 %	0.0000	-100.00 %	0.0000	-100.00 %
			770.00	4,620.00	3,850.00	0.00	-770.00	0.00	-770.00
3	STRIPPING INCL. HAUL - SITE QS-W-298								
	6245.0000	C.Y.	0.8500	1.8500	117.65 %	0.0000	-100.00 %	0.0000	-100.00 %
			5,308.25	11,553.25	6,245.00	0.00	-5,308.25	0.00	-5,308.25
4	REMOVING STOP LINE								
	7.0000	EACH	100.0000	250.0000	150.00 %	135.0000	35.00 %	125.0000	25.00 %
			700.00	1,750.00	1,050.00	945.00	245.00	875.00	175.00
5	REMOVING RECESSED PAVEMENT MARKER								
	13.0400	HUND	250.0000	325.0000	30.00 %	325.0000	30.00 %	325.0000	30.00 %
			3,260.00	4,238.00	978.00	4,238.00	978.00	4,238.00	978.00
	GRADING								
6	PAVEMENT REPAIR EXCAVATION INCL. HAUL								
	728.0000	S.Y.	10.0000	18.0000	80.00 %	7.7500	-22.50 %	12.0000	20.00 %
			7,280.00	13,104.00	5,824.00	5,642.00	-1,638.00	8,736.00	1,456.00

	STRUCTURE							
7	MODIFY BRIDGE DRAIN							
	4.0000	EACH	550.0000	950.0000	72.73 %	950.0000	72.73 %	950.0000	72.73 %
			2,200.00	3,800.00	1,600.00	3,800.00	1,600.00	3,800.00	1,600.00
	LIQUID ASPHALT							
8	EMULSIFIED ASPHALT CRS-2P							
	847.0000	TON	450.0000	375.0000	-16.67 %	420.0000	-6.67 %	300.0000	-33.33 %
			381,150.00	317,625.00	-63,525.00	355,740.00	-25,410.00	254,100.00	-127,050.00

Experimental Feature Report

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — DATE: 02/10/2016
* * * BID CHECK REPORT * * * — TIME: 13:53

PS&E JOB NO : 16Z003 — REVISION NO :
CONTRACT NO : 008864 — REGION NO : 6
VERSION NO : 4 — WORK ORDER# : XL4753
HWY : SR 002,020,027,090,195,291
TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003
PROJECT : STPF-9999(689)
COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016
AWARDED ON : Apr 4 2016

				LOW BIDDER		2ND BIDDER		3RD BIDDER	
				CENTRAL WASHINGTON ASPHALT, I		GRANITE CONSTRUCTION COMPANY		POE ASPHALT PAVING, INC.	
				13184 E WHEELER RD		80 POND ROAD		302 15TH ST	
				98837-9118				CLARKSTON WA 99403-2372	
				MOSES LAKE WA 988370142		YAKIMA WA 989019354		LEWISTON ID 835010449	
				CONTRACTOR NUMBER : 142600		CONTRACTOR NUMBER : 100102		CONTRACTOR NUMBER : 661800	
ITEM NO.	ITEM DESCRIPTION / EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT/ TOTAL AMOUNT	PRICE PER UNIT/ TOTAL AMOUNT	% DIFF./ AMT.DIFF.	PRICE PER UNIT/ TOTAL AMOUNT	% DIFF./ AMT.DIFF.	PRICE PER UNIT/ TOTAL AMOUNT	% DIFF./ AMT.DIFF.
	LIQUID ASPHALT								
9	CRS-2P COST PRICE ADJUSTMENT								
		CALC			0.00 %		0.00 %		0.00 %
			21,050.00	21,050.00		21,050.00		21,050.00	
10	MODIFIED ASPHALT CEMENT AC-15P								
	227.0000	TON	550.0000	475.0000	-13.64 %	510.0000	-7.27 %	390.0000	-29.09 %
			124,850.00	107,825.00	-17,025.00	115,770.00	-9,080.00	88,530.00	-36,320.00
11	AC-15P COST PRICE ADJUSTMENT								
		CALC			0.00 %		0.00 %		0.00 %
			5,641.00	5,641.00		5,641.00		5,641.00	
12	EMULSIFIED ASPHALT CSS-1								
	39.6000	TON	450.0000	500.0000	11.11 %	435.0000	-3.33 %	340.0000	-24.44 %
			17,820.00	19,800.00	1,980.00	17,226.00	-594.00	13,464.00	-4,356.00
13	ASPHALT FOR FOG SEAL								
	77.1000	TON	450.0000	500.0000	11.11 %	490.0000	8.89 %	390.0000	-13.33 %
			34,695.00	38,550.00	3,855.00	37,779.00	3,084.00	30,069.00	-4,626.00
14	ASPHALT FOR FOG SEAL COST PRICE ADJUSTMENT								
		CALC			0.00 %		0.00 %		0.00 %
			1,915.00	1,915.00		1,915.00		1,915.00	

	BITUMINOUS SURFACE TREATMENT							
15	FURNISHING AND PLACING CRUSHED SCREENING 3/8 TO NO. 4							
	419950.0000	S.Y.	0.7000	0.6500	-7.14 %	0.5000	-28.57 %	1.0000	42.86 %
			293,965.00	272,967.50	-20,997.50	209,975.00	-83,990.00	419,950.00	125,985.00
16	FURN AND PLACING PRECOAT CRUSHED SCREENING 3/8 TO NO. 8								
	135677.0000	S.Y.	1.0000	0.6500	-35.00 %	0.6500	-35.00 %	0.9300	-7.00 %
			135,677.00	88,190.05	-47,486.95	88,190.05	-47,486.95	126,179.61	-9,497.39
17	FURNISHING AND PLACING CRUSHED SCREENING NO. 4 TO 0								
	555627.0000	S.Y.	0.1500	0.1000	-33.33 %	0.1800	20.00 %	0.2500	66.67 %
			83,344.05	55,562.70	-27,781.35	100,012.86	16,668.81	138,906.75	55,562.70
18	BITUMINOUS SURFACE TREATMENT FOR ROAD APPROACH								
	6.0000	EACH	200.0000	150.0000	-25.00 %	200.0000	0.00 %	250.0000	25.00 %
			1,200.00	900.00	-300.00	1,200.00	0.00	1,500.00	300.00

Experimental Feature Report

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — DATE: 02/10/2016

* * * BID CHECK REPORT * * * — TIME: 13:53

PS&E JOB NO : 16Z003 — REVISION NO :

CONTRACT NO : 008864 — REGION NO : 6

VERSION NO : 4 — WORK ORDER# : XL4753

HWY : SR 002,020,027,090,195,291

TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003

PROJECT : STPF-9999(689)

COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016

AWARDED ON : Apr 4 2016

				LOW BIDDER		2ND BIDDER		3RD BIDDER	
				CENTRAL WASHINGTON ASPHALT, I		GRANITE CONSTRUCTION COMPANY		POE ASPHALT PAVING, INC.	
				13184 E WHEELER RD		80 POND ROAD		302 15TH ST	
				98837-9118				CLARKSTON WA 99403-2372	
				MOSES LAKE WA 988370142		YAKIMA WA 989019354		LEWISTON ID 835010449	
				CONTRACTOR NUMBER : 142600		CONTRACTOR NUMBER : 100102		CONTRACTOR NUMBER : 661800	
ITEM NO.	ITEM DESCRIPTION / EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT / TOTAL AMOUNT	PRICE PER UNIT / TOTAL AMOUNT	% DIFF./ AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF./ AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF./ AMT.DIFF.
	BITUMINOUS SURFACE TREATMENT								
19	ADDITIONAL BROOMING								
	37.0000	HR	200.0000	150.0000	-25.00 %	130.0000	-35.00 %	185.0000	-7.50 %
			7,400.00	5,550.00	-1,850.00	4,810.00	-2,590.00	6,845.00	-555.00
	HOT MIX ASPHALT								
20	CRACK SEALING - RUBBERIZED SEALANT								
	99.0400	MI.	1,600.0000	1,550.0000	-3.13 %	1,525.0000	-4.69 %	1,500.0000	-6.25 %
			158,464.00	153,512.00	-4,952.00	151,036.00	-7,428.00	148,560.00	-9,904.00
21	CRACK SEALING - SAND SLURRY								
	39.3000	MI.	1,350.0000	1,100.0000	-18.52 %	990.0000	-26.67 %	1,000.0000	-25.93 %
			53,055.00	43,230.00	-9,825.00	38,907.00	-14,148.00	39,300.00	-13,755.00
22	JOINT ADHESIVE FOR BITUMINOUS PAVEMENT								
	49530.0000	L.F.	0.5000	0.4800	-4.00 %	0.4500	-10.00 %	0.5000	0.00 %
			24,765.00	23,774.40	-990.60	22,288.50	-2,476.50	24,765.00	0.00
23	PLANING BITUMINOUS PAVEMENT								
	137600.0000	S.Y.	1.7000	1.5000	-11.76 %	1.6500	-2.94 %	4.2500	150.00 %
			233,920.00	206,400.00	-27,520.00	227,040.00	-6,880.00	584,800.00	350,880.00
24	HMA FOR PAVEMENT REPAIR CL. 3/8 IN. PG 64 -28								
	72.0000	TON	150.0000	250.0000	66.67 %	185.0000	23.33 %	170.0000	13.33 %
			10,800.00	18,000.00	7,200.00	13,320.00	2,520.00	12,240.00	1,440.00
25	HMA CL. 1/2 IN. PG 64 -28								
	21430.0000	TON	60.0000	62.0000	3.33 %	68.0000	13.33 %	58.0000	-3.33 %
			1,285,800.00	1,328,660.00	42,860.00	1,457,240.00	171,440.00	1,242,940.00	-42,860.00

26	JOB MIX COMPLIANCE PRICE ADJUSTMENT							
	CALC			0.00 %		0.00 %		0.00 %
		38,570.00	38,570.00		38,570.00		38,570.00	
27	COMPACTION PRICE ADJUSTMENT							
	CALC			0.00 %		0.00 %		0.00 %
		25,720.00	25,720.00		25,720.00		25,720.00	
28	ASPHALT COST PRICE ADJUSTMENT							
	CALC			0.00 %		0.00 %		0.00 %
		16,780.00	16,780.00		16,780.00		16,780.00	

Experimental Feature Report

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — DATE: 02/10/2016

* * * BID CHECK REPORT * * * — TIME: 13:53

PS&E JOB NO : 16Z003 — REVISION NO :

CONTRACT NO : 008864 — REGION NO : 6

VERSION NO : 4 — WORK ORDER# : XL4753

HWY : SR 002,020,027,090,195,291

TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003

PROJECT : STPF-9999(689)

COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016

AWARDED ON : Apr 4 2016

				LOW BIDDER		2ND BIDDER		3RD BIDDER	
				CENTRAL WASHINGTON ASPHALT, IN		GRANITE CONSTRUCTION COMPANY		POE ASPHALT PAVING, INC.	
				13184 E WHEELER RD		80 POND ROAD		302 15TH ST	
				98837-9118				CLARKSTON WA 99403-2372	
				MOSES LAKE WA 988370142		YAKIMA WA 989019354		LEWISTON ID 835010449	
				CONTRACTOR NUMBER : 142600		CONTRACTOR NUMBER : 100102		CONTRACTOR NUMBER : 661800	
ITEM NO.	ITEM DESCRIPTION / EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT / TOTAL AMOUNT	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.
	HOT MIX ASPHALT								
29	BRIDGE TRANSVERSE JOINT SEAL								
	52.0000	L.F.	25.0000	50.0000	100.00 %	50.0000	100.00 %	30.0000	20.00 %
			1,300.00	2,600.00	1,300.00	2,600.00	1,300.00	1,560.00	260.00
30	CYCLIC DENSITY PRICE ADJUSTMENT								
		CALC			0.00 %		0.00 %		0.00 %
			-1.00	-1.00		-1.00		-1.00	
31	ASPHALT BINDER REVISION								
		CALC			0.00 %		0.00 %		0.00 %
			-1.00	-1.00		-1.00		-1.00	
32	SMOOTHNESS COMPLIANCE ADJUSTMENT								
		CALC			0.00 %		0.00 %		0.00 %
			20,000.00	20,000.00		20,000.00		20,000.00	

	EROSION CONTROL AND ROADSIDE PLANTING							
33	ESC LEAD							
	29.5000	DAY	50.0000	50.0000	0.00 %	50.0000	0.00 %	600.0000	1,100.00 %
			1,475.00	1,475.00	0.00	1,475.00	0.00	17,700.00	16,225.00
34	SILT FENCE							
	1325.0000	L.F.	3.0000	4.7500	58.33 %	0.0000	-100.00 %	0.0000	-100.00 %
			3,975.00	6,293.75	2,318.75	0.00	-3,975.00	0.00	-3,975.00
35	EROSION/WATER POLLUTION CONTROL							
		EST.			0.00 %		0.00 %		0.00 %
			3,100.00	3,100.00		3,100.00		3,100.00	
36	TACKIFIER							
	2.0000	ACRE	500.0000	1,500.0000	200.00 %	0.0000	-100.00 %	0.0000	-100.00 %
			1,000.00	3,000.00	2,000.00	0.00	-1,000.00	0.00	-1,000.00
37	SEEDING, FERTILIZING, AND MULCHING - SITE QS-W-298							
	2.0000	ACRE	2,000.0000	2,000.0000	0.00 %	0.0000	-100.00 %	0.0000	-100.00 %
			4,000.00	4,000.00	0.00	0.00	-4,000.00	0.00	-4,000.00

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — DATE: 02/10/2016

* * * BID CHECK REPORT * * * — TIME: 13:53

PS&E JOB NO : 16Z003 — REVISION NO :

CONTRACT NO : 008864 — REGION NO : 6

VERSION NO : 4 — WORK ORDER# : XL4753

HWY : SR 002,020,027,090,195,291

TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003

PROJECT : STPF-9999(689)

COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016

AWARDED ON : Apr 4 2016

				LOW BIDDER		2ND BIDDER		3RD BIDDER	
				CENTRAL WASHINGTON ASPHALT, II 13184 E WHEELER RD 98837-9118 MOSES LAKE WA 988370142 CONTRACTOR NUMBER : 142600		GRANITE CONSTRUCTION COMPANY 80 POND ROAD YAKIMA WA 989019354 CONTRACTOR NUMBER : 100102		POE ASPHALT PAVING, INC. 302 15TH ST CLARKSTON WA 99403-2372 LEWISTON ID 835010449 CONTRACTOR NUMBER : 661800	
ITEM NO.	ITEM DESCRIPTION EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT/ TOTAL AMOUNT	PRICE PER UNIT/ TOTAL AMOUNT	% DIFF./ AMT.DIFF.	PRICE PER UNIT/ TOTAL AMOUNT	% DIFF./ AMT.DIFF.	PRICE PER UNIT/ TOTAL AMOUNT	% DIFF./ AMT.DIFF.
	EROSION CONTROL AND ROADSIDE PLANTING								
38	HIGH VISIBILITY FENCE								
	1500.0000	L.F.	3.0000	3.5000	16.67 %	0.0000	-100.00 %	0.0000	-100.00 %
			4,500.00	5,250.00	750.00	0.00	-4,500.00	0.00	-4,500.00
	TRAFFIC								
39	TRANSPORTABLE ATTENUATOR								
	1.0000	EACH	2,500.0000	4,500.0000	80.00 %	4,500.0000	80.00 %	4,300.0000	72.00 %
			2,500.00	4,500.00	2,000.00	4,500.00	2,000.00	4,300.00	1,800.00
40	OPERATION OF TRANSPORTABLE ATTENUATOR								
	93.5000	HR	60.0000	68.0000	13.33 %	66.0000	10.00 %	65.0000	8.33 %
			5,610.00	6,358.00	748.00	6,171.00	561.00	6,077.50	467.50
41	REPAIR TRANSPORTABLE ATTENUATOR								
		EST.			0.00 %		0.00 %		0.00 %
			4,800.00	4,800.00		4,800.00		4,800.00	
42	FLEXIBLE GUIDE POST								
	635.0000	EACH	25.0000	37.0000	48.00 %	40.0000	60.00 %	37.0000	48.00 %
			15,875.00	23,495.00	7,620.00	25,400.00	9,525.00	23,495.00	7,620.00
43	PAINTED STOP LINE								
	129.0000	L.F.	5.0000	5.0000	0.00 %	4.5000	-10.00 %	4.5000	-10.00 %
			645.00	645.00	0.00	580.50	-64.50	580.50	-64.50
44	CENTERLINE RUMBLE STRIP								
	9.3800	MI.	1,200.0000	975.0000	-18.75 %	1,000.0000	-16.67 %	925.0000	-22.92 %
			11,256.00	9,145.50	-2,110.50	9,380.00	-1,876.00	8,676.50	-2,579.50

45	TEMPORARY FLEXIBLE RAISED PAVEMENT MARKER							
	127350.0000	L.F.	0.1500	0.1400	-6.67 %	0.1400	-6.67 %	0.1400	-6.67 %
			19,102.50	17,829.00	-1,273.50	17,829.00	-1,273.50	17,829.00	-1,273.50
46	TEMPORARY PAVEMENT MARKING-SHORT DURATION								
	101370.0000	L.F.	0.1500	0.1300	-13.33 %	0.1300	-13.33 %	0.1200	-20.00 %
			15,205.50	13,178.10	-2,027.40	13,178.10	-2,027.40	12,164.40	-3,041.10
47	SEQUENTIAL ARROW SIGN								
	116.0000	HR	5.0000	9.2500	85.00 %	10.0000	100.00 %	8.7500	75.00 %
			580.00	1,073.00	493.00	1,160.00	580.00	1,015.00	435.00

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — * * * BID CHECK REPORT * * * — DATE: 02/10/2016 TIME: 13:53

PS&E JOB NO : 16Z003 REVISION NO :
CONTRACT NO : 008864 REGION NO : 6
VERSION NO : 4 WORK ORDER# : XL4753
HWY : SR 002,020,027,090,195,291
TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003
PROJECT : STPF-9999(689)
COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016
AWARDED ON : Apr 4 2016

				LOW BIDDER		2ND BIDDER		3RD BIDDER	
				CENTRAL WASHINGTON ASPHALT, IN		GRANITE CONSTRUCTION COMPANY		POE ASPHALT PAVING, INC.	
				13184 E WHEELER RD		80 POND ROAD		302 15TH ST	
				98837-9118				CLARKSTON WA 99403-2372	
				MOSES LAKE WA 988370142		YAKIMA WA 989019354		LEWISTON ID 835010449	
				CONTRACTOR NUMBER : 142600		CONTRACTOR NUMBER : 100102		CONTRACTOR NUMBER : 661800	
ITEM NO.	ITEM DESCRIPTION / EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT / TOTAL AMOUNT	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.	PRICE PER UNIT / TOTAL AMOUNT	% DIFF. / AMT.DIFF.
	TRAFFIC								
48	PORTABLE CHANGEABLE MESSAGE SIGN								
	637.0000	HR	5.0000	8.5000	70.00 %	8.0000	60.00 %	8.0000	60.00 %
			3,185.00	5,414.50	2,229.50	5,096.00	1,911.00	5,096.00	1,911.00
49	OTHER TEMPORARY TRAFFIC CONTROL								
		L.S.			33.33 %		415.56 %		19.33 %
			22,500.00	30,000.00	7,500.00	116,000.00	93,500.00	26,850.00	4,350.00
50	FLAGGERS								
	1255.0000	HR	51.0000	55.0000	7.84 %	51.0000	0.00 %	51.0000	0.00 %
			64,005.00	69,025.00	5,020.00	64,005.00	0.00	64,005.00	0.00
51	OTHER TRAFFIC CONTROL LABOR								
	1134.0000	HR	59.0000	63.0000	6.78 %	62.0000	5.08 %	60.0000	1.69 %
			66,906.00	71,442.00	4,536.00	70,308.00	3,402.00	68,040.00	1,134.00
52	TRAFFIC CONTROL SUPERVISOR								
	457.0000	HR	51.0000	56.0000	9.80 %	55.0000	7.84 %	53.0000	3.92 %
			23,307.00	25,592.00	2,285.00	25,135.00	1,828.00	24,221.00	914.00
53	CONSTRUCTION SIGNS CLASS A								
	7088.0000	S.F.	9.0000	9.5000	5.56 %	10.0000	11.11 %	9.0000	0.00 %
			63,792.00	67,336.00	3,544.00	70,880.00	7,088.00	63,792.00	0.00
54	PORTABLE SPEED DETECTION/DISPLAY TRAILER								
	2.0000	EACH	5,000.0000	1,600.0000	-68.00 %	1,600.0000	-68.00 %	1,500.0000	-70.00 %
			10,000.00	3,200.00	-6,800.00	3,200.00	-6,800.00	3,000.00	-7,000.00

	OTHER ITEMS						
55	REIMBURSEMENT FOR THIRD PARTY DAMAGE						
	EST.		0.00 %		0.00 %		0.00 %
		5.00	5.00	5.00		5.00	
56	MINOR CHANGE						
	CALC		0.00 %		0.00 %		0.00 %
		-1.00	-1.00	-1.00		-1.00	
57	EXCESS MATERIAL REIMBURSEMENT						
	CALC		0.00 %		0.00 %		0.00 %
		1.00	1.00	1.00		1.00	

Experimental Feature Report

DOT_RGGB01 — WASHINGTON STATE DEPARTMENT OF TRANSPORTATION — DATE: 02/10/2016
* * * BID CHECK REPORT * * * — TIME: 13:53

PS&E JOB NO : 16Z003 — REVISION NO :
CONTRACT NO : 008864 — REGION NO : 6
VERSION NO : 4 — WORK ORDER# : XL4753
HWY : SR 002,020,027,090,195,291
TITLE : US 2 ET AL
2016 EASTERN REGION
CHIP SEAL
16Z003
PROJECT : STPF-9999(689)
COUNTY(S) : ADAMS,LINCOLN,PEND OREILLE,SPOKANE,STEVENS,WHITMAN

BIDS OPENED ON : Mar 30 2016
AWARDED ON : Apr 4 2016

ITEM NO.	ITEM DESCRIPTION / EST. QUANTITY	UNIT MEAS	ENGR'S. EST. PRICE PER UNIT / TOTAL AMOUNT	LOW BIDDER: CENTRAL WASHINGTON ASPHALT, I — 13184 E WHEELER RD, 98837-9118, MOSES LAKE WA 988370142, CONTRACTOR NUMBER : 142600 — PRICE PER UNIT / TOTAL AMOUNT	% DIFF./ AMT.DIFF.	2ND BIDDER: GRANITE CONSTRUCTION COMPANY — 80 POND ROAD, YAKIMA WA 989019354, CONTRACTOR NUMBER : 100102 — PRICE PER UNIT / TOTAL AMOUNT	% DIFF./ AMT.DIFF.	3RD BIDDER: POE ASPHALT PAVING, INC. — 302 15TH ST, CLARKSTON WA 99403-2372, LEWISTON ID 835010449, CONTRACTOR NUMBER : 661800 — PRICE PER UNIT / TOTAL AMOUNT	% DIFF./ AMT.DIFF.
	OTHER ITEMS								
58	AGGREGATE COMPLIANCE PRICE ADJUSTMENT								
		CALC			0.00 %		0.00 %		0.00 %
			-1.00	-1.00		-1.00		-1.00	
59	SPCC PLAN								
		L.S.			0.00 %		-50.00 %		-25.00 %
			1,000.00	1,000.00	0.00	500.00	-500.00	750.00	-250.00
60	DUST PALLIATIVE								
	8500.0000	S.Y.	0.5000	0.6000	20.00 %	0.0000	-100.00 %	0.1500	-70.00 %
			4,250.00	5,100.00	850.00	0.00	-4,250.00	1,275.00	-2,975.00
	CONTRACT TOTAL		$3,741,170.30	$3,559,141.75	-4.87%	$3,789,135.00	1.28%	$3,977,803.26	6.33%
	BASE TOTAL		$3,741,170.30	$3,559,141.75	-4.87%	$3,789,135.00	1.28%	$3,977,803.26	6.33%

Americans with Disabilities Act (ADA) Information:
This material can be made available in an alternate format by emailing the Office of Equal Opportunity at wsdotada@wsdot.wa.gov or by calling toll free, 855-362-4ADA(4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

Title VI Statement to Public:
It is the Washington State Department of Transportation's (WSDOT) policy to assure that no person shall, on the grounds of race, color, national origin or sex, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its federally funded programs and activities. Any person who believes his/her Title VI protection has been violated, may file a complaint with WSDOT's Office of Equal Opportunity (OEO). For additional information regarding Title VI complaint procedures and/or information regarding our non-discrimination obligations, please contact OEO's Title VI Coordinator at (360) 705-7082.