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Evaluation of Maintenance Strategies

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Arizona Department of Transportation Research Center

ADOT

EVALUATION OF MAINTENANCE STRATEGIES

Final Report 628
November 2013

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16. Abstract
In the mid-1990s, the Arizona Department of Transportation (ADOT) initiated the Maintenance Cost Effectiveness study (SPR 371) with the development of plans and an experiment design to evaluate the effectiveness of a variety of asphalt pavement maintenance treatments. During 1999 and 2001, ADOT oversaw the construction of hundreds of experimental sections throughout the state under the Phase I, Wearing Course Experiment (nine treatments and 82 sections at three sites), and the Phase II, Preventive Maintenance Experiment (24 treatments and 137 sections at four sites). Work continued in 2006 and 2007 under the Evaluation of Maintenance Strategies study (SPR 628) for ADOT with a yearlong program of pavement performance monitoring involving manual pavement distress surveys and automated skid, friction, and surface texture measurements at all the experimental sites. The project culminated with a detailed analysis of key pavement performance data to compare the performance of the individual treatments and determine their overall effectiveness. This report documents the independent findings of both the Phase I and II experiments.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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List of Acronyms

AADT	average annual daily traffic
ACFC	asphalt concrete friction course
ADOT	Arizona Department of Transportation
ADT	average daily traffic
ANOVA	analysis of variance
AR-ACFC	asphalt rubber-asphalt concrete friction course
ASTM	American Standards Test Methods
B/C	benefit/cost
CalTrans	California Department of Transportation
CRA	crumb rubber asphalt
CRS	cationic rapid setting
CS	chip seal
CT	circular texture
DCOF	dynamic coefficient of friction
DF	dynamic friction
DOT	Department of Transportation
DV	deduct value
EB	eastbound
ESAL	equivalent single-axle load
FHWA	Federal Highway Administration
FI	flushing index
HMA	hot-mix asphalt
LTD	longitudinal, transverse, and diagonal
LTPP	Long Term Pavement Preservation (program)
MCES	mean cost-effectiveness score
MP	Milepost
MPD	mean profile depth
MTD	mean texture depth
NCHRP	National Cooperative Highway Research Program
P-ACFC	polymer modified-asphalt concrete friction course
PASS	polymerized asphalt surface sealer
PCI	Pavement Conditions Index
PEM	permeable European mixture
PG	performance grade
PPTG	Pavement Preservation Task Group (CalTrans)
SB	styrene butadiene
SBS	styrene butadiene styrene
SMA	stone matrix asphalt
SN	skid number

SPR	State Planning and Research
SR	State Route
TB-ACFC	terminal blend asphalt concrete friction course
TSA	top size aggregate
USAEC	United States Army Corps of Engineers
WB	westbound

EXECUTIVE SUMMARY

The Arizona Department of Transportation (ADOT) initiated the Maintenance Cost-Effectiveness study (SPR 371) in the mid-1990s, developing plans and an experiment design to evaluate the effectiveness of various asphalt pavement maintenance treatments. During 1999 and 2001, ADOT oversaw the construction of hundreds of experimental sections throughout the state under the Phase I, Wearing Course Experiment, and the Phase II, Preventive Maintenance Experiment. Work continued in 2006 and 2007 under Evaluation of Maintenance Strategies (SPR 628) for ADOT with a yearlong program of pavement performance monitoring involving manual pavement distress surveys and automated skid, friction, and surface texture measurements at all experimental sites. The project culminated with a detailed analysis of many key pavement performance data to compare the performance of the individual treatments and determine their overall effectiveness. This report documents the independent findings for both the Phase I and II experiments.

PHASE I: WEARING COURSE EXPERIMENT

The wearing course experiment was conducted on three Arizona highways with moderate to heavy traffic: Interstate 10 (I-10), Interstate 8 (I-8), and State Route 74 (SR 74). Nine treatments and 82 experimental sections were built at these sites. Sixty-four sections were constructed on I-10 and I-8 in 1999 and another 18 were constructed on SR 74 in 2001. Six treatments were placed on I-10 and I-8. Four were friction courses with different binders and top size aggregates (TSAs): asphalt concrete friction course (ACFC) (PG 64-16, 3/4-inch TSA); asphalt rubber-asphalt concrete friction course (AR-ACFC) (PG 64-16, CRA-1, 1/2-inch and 3/4-inch TSA); and polymer modified-asphalt concrete friction course (P-ACFC) (PG 76-22, 3/4-inch TSA). The remaining two were a stone matrix asphalt (SMA) mix (PG 70-28, 3/4-inch TSA) and a permeable European mix (PEM) (PG 76-22, 1-1/4-inch TSA). Three wearing course treatments were placed on SR 74. All three were friction courses with different binders and a single 3/8-inch TSA: AR-ACFC (PG 64-16, CRA-1), P-ACFC (PG 76-22+), and terminal blend asphalt concrete friction course (TB-ACFC) (PG 76-22 TR+). At all three sites, researchers performed milling and overlaying at preplanned depths and thicknesses (before applying the wearing course) to evaluate their impact on treatment performance.

When evaluating the wearing course treatments, researchers considered seven pavement performance measures: skid resistance; weathering; bleeding; fatigue cracking; longitudinal, transverse, and diagonal (LTD) cracking; rutting; and patching. The evaluation focused on the first five performance measures since a review of the data showed almost no rutting and no patching.

The wearing course experiment design made it possible to investigate the impact of milling depth and overlay thickness on the performance of the five key distress types. Overall, the results varied considerably and did not support a finding that milling depth (and its corresponding overlay thickness) had a consistent and meaningful effect on any performance measures. (The analysis did indicate that milling and overlay affected LTD cracking the most.) The variability associated with the milling and overlay effects is part of the overall performance variability of each treatment.

Several pavement performance measures originated from visual survey data where the distresses were rated in terms of severity and extent. The two components to the rating made it difficult to compare the performance between treatments. Consequently, researchers used the method that makes up part of the standard Pavement Condition Index (PCI) rating procedure to combine the two rating components for a given distress into a single deduct value (DV).

Researchers used two primary approaches to evaluate performance data and assess treatment performance and cost-effectiveness. One approach used statistical tools such as analysis of variance (ANOVA) and Student's *t* testing. Because of treatment variability, however, there were difficulties using this approach to make statistically valid performance comparisons between the treatments at each experimental site. Nevertheless, the approach did identify those treatments that performed as well as the best-performing treatment.

The second approach ranked the treatments within the different performance categories based upon their 60th percentile distress level. This approach provided a good, practical alternative for comparing treatment performance and, by extension, cost-effectiveness. The performance ranges were based upon the definitions used in the standard PCI rating procedure, and the treatments were grouped within the ranges based upon their 60th percentile performance measures (e.g., 60th percentile DV for weathering and 60th percentile skid number). After researchers ranked each treatment's five performance measures, the results were averaged to determine an average condition and overall treatment ranking. The best-performing treatment at the I-10 and I-8 sites was the AR-ACFC (PG 64-16, CRA-1, 1/2-inch TSA), while the AR-ACFC (PG 64-16, CRA-1, 3/4-inch TSA), PEM (PG 76-22, 1¼-inch TSA) and ACFC (PG 64-16, 3/4-inch TSA) were close seconds, and the P-ACFC (PG 76-22, 3/4-inch TSA) and SMA (PG 70-28, 3/4-inch TSA) a not-too-distant third. At the SR 74 site, the AR-ACFC (PG 64-28+, CRA-1, 3/8-inch TSA) performed the best, while the P-ACFC (PG 76-22+, 3/8-inch TSA) was a close second and the TB-ACFC (PG 76-22 TR+, 3/8-inch TSA) a distant third.

After the performance assessment, researchers evaluated the cost-effectiveness of the wearing course sections using a benefit/cost (B/C) approach. They calculated the benefit for each performance measure as the difference between the measured performance at the 2007 testing date and a nominal minimum performance level. The cost component of the B/C approach was the unit cost of the treatment (in $/sy). Researchers then assigned a cost-effectiveness level to the B/C value for each performance measure and treatment type, ranging from very low to very high. Then they calculated a mean cost-effectiveness score (MCES) for each treatment based upon the average of each treatment's cost-effectiveness values. (Since there are five cost-effectiveness levels, the MCES values can range from 0 to 5.) The MCES values then were used to rank each treatment's overall cost-effectiveness. Table 1 summarizes the results for the I-10, I-8, and SR 74 sites. At the I-10 and I-8 sites, the ACFC (PG 64-16, 3/4-inch TSA) was the most cost-effective and ranked in the

Table 1. Cost-Effectiveness Rankings for the Phase I Wearing Course Treatments.

Site	Cost-Effectiveness Ranking	Wearing Course Treatment	MCES	Performance Ranking
I-10 and I-8	A	ACFC (PG 64-16, 3/4-inch TSA)	4.3	2
	B	AR-ACFC (PG 64-16, CRA-1, 1/2-inch TSA)	4.0	1
	C	P-ACFC (PG 76-22, 3/4-inch TSA)	3.8	3
	D	AR-ACFC (PG 64-16, CRA-1, 3/4-inch TSA)	3.6	2
	D	SMA (PG 70-28, 3/4-inch TSA)	3.6	3
	E	PEM (PG 76-22, 1¼-inch TSA)	3.5	2
SR 74	C	AR-ACFC (PG 64-16, CRA-1, 3/8-inch TSA)	3.8	1
	D	P-ACFC (PG 76-22+, 3/8-inch TSA)	3.6	2
	F	TB-ACFC (PG 76-22 TR+, 3/8-inch TSA)	3.0	3

second performance level, while the AR-ACFC (PG 64-16, CRA-1, 1/2-inch TSA) was the second-most cost-effective and the only treatment ranked at the highest performance level. At the SR 74 site, the AR-ACFC (PG 64-16, CRA-1, 3/8-inch TSA) was the most effective and performed the best.

PHASE II: PREVENTIVE MAINTENANCE EXPERIMENT

Researchers conducted the Preventive Maintenance experiment on four Arizona state highway segments: SR 66, SR 83, SR 87, and U.S. 191. In this experiment, researchers used 24 treatments and 137 sections. SR 66 and SR 83 had 28 sections each, while SR 87 and U.S. 191 had 21 and 60 sections, respectively. The treatment applied to most of the sections was some form of chip seal; however, there were also some friction courses, a slurry seal, a microsurfacing, and a thin-bonded wearing course. The treatments were all constructed in 2000 and 2001.

For the Preventive Maintenance assessment, researchers only included weathering, flushing, and LTD cracking in the evaluation. Skid resistance was not included because skid testing was performed at only one of the four sites. Researchers made various attempts to consider other measures of surface friction and texture, but none was successful. (The localized field test data did indicate, however, that all preventive maintenance treatments maintained a very high level of surface texture and/or friction through 2007.) Since pretreatment rutting and fatigue cracking data were not available, these measures were not included in the evaluation. Instead of bleeding, flushing data were used to evaluate each treatment's propensity to bleed or flush under high temperatures and traffic loading. The same DV approach used for the wearing course treatments was used to compile the weathering and LTD cracking data for the preventive maintenance treatments.

The same rigorous statistical approach (involving ANOVAs and Student's *t* tests) used to compare wearing course treatment performance was applied to compare preventive maintenance treatment performance. In addition, researchers used the simple yet practical approach (involving the calculation of a 60th percentile DV and the ranking of each treatment at each site into one of eight different conditions) to compare treatments' overall performance. Following is a ranking of the treatments in the four identified performance levels. The number of sections representing each treatment ranges from two to 10 (so it is not exactly an "apples-to-apples" comparison).

- Level 1: Chip seal (PASS CR)/Western Emulsion, AR-ACFC/not identified, Novachip/Koch Materials, ACFC/ADOT, and microsurfacing/Southwest Slurry.
- Level 2: Chip seal (CRS-2P)/ADOT (future construction), AR-ACFC/ADOT, P-ACFC/Paramount, chip seal (CRS-2)/ADOT, AR-chip/International Slurry Surfacing, chip seal (CRS-2P)/ADOT, chip seal (HF CRS-2P)/Copperstate, chip seal (HF CRS-2P)/ADOT, and chip seal (CM-90)/Koch Materials.
- Level 3: Double chip seal/ADOT, DACS&B/ADOT, chip seal (PASS oil)/Western Emulsion, chip seal (CRS-2)/Copperstate, and double application/not identified.
- Level 4: Chip seal (AC15-5TR)/Paramount, slurry seal/Southwest Slurry, chip seal (CRS-2P)/Crown, and chip seal (CM-90)/Navajo Western. These treatments were ranked in this category because they had two or more sections that did not perform well. (Researchers recommend that they be investigated further.)

Researchers evaluated for cost-effectiveness of the preventive maintenance sections using the same B/C approach that was used for the wearing course treatments. They calculated the benefit for each of the three performance measures (weathering, flushing index, and transverse cracking) as the difference between the measured performance at the 2007 testing date and a nominal minimum performance level. The cost component of the B/C approach was the unit cost of the treatment (in $/sy).

Table 2 summarizes the results of the cost-effectiveness analyses for the preventive maintenance sections. Two treatments had the highest cost-effectiveness ranking and the highest performance ranking: chip seal (PASS) by Western Emulsion and microsurfacing by Southwest Slurry. Six of the remaining eight treatments—all chip seals—were also in the highest cost-effectiveness ranking; however, they were in the second performance ranking level. The last two treatments with the

Table 2. Cost-Effectiveness Rankings for Phase II Preventive Maintenance Treatments.

Cost-Effectiveness Ranking	Preventive Maintenance Treatment	MCES	Performance Ranking
A	Chip seal (PASS CR)/Western Emulsion	5.00	1
	Microsurfacing/Southwest Slurry	5.00	1
	Chip seal (CRS-2)/ADOT	5.00	2
	Chip seal (CRS-2P)/ ADOT (future construction)	5.00	2
	Chip seal (CM-90)/Koch Materials	4.83	2
	Chip seal (CRS-2P)/ADOT	4.78	2
	Chip seal (HF CRS-2P)/ADOT	4.67	2
	Chip seal (HF CRS-2P)/Copperstate	4.67	2
	Chip seal (CRS-2)/Copperstate	4.83	3
	Chip seal (AC15-5TR)/Paramount	4.67	4
B	ACFC/ADOT	4.33	1
	Chip seal (PASS Oil)/Western Emulsion	4.50	3
	Slurry seal/Southwest Slurry	4.50	4
	Chip seal (CRS-2P)/Crown	4.42	4
	Chip seal (CM-90)/Navajo Western	4.33	4
C	DACS&B/ADOT	4.17	3
	Double chip seal/ADOT	4.11	3
D	AR-ACFC/not identified	3.67	1
	AR-ACFC/ADOT	3.78	2
	P-ACFC/Paramount	3.67	2
	AR-chip/International Slurry	3.67	2
	Double application/not identified	3.67	3
F	Novachip/Koch Materials	2.42	1

highest cost-effectiveness ranking level were on the low end of the performance rankings. It is interesting to note that the chip seal (AC15-5TR) made the highest cost-effectiveness ranking since it had some sections that did not perform well. However, the rankings of the remaining preventive maintenance treatments clearly indicate that treatment cost has more of an impact on the assessment of cost-effectiveness than performance.

CHAPTER 1. INTRODUCTION

BACKGROUND

In 1995, the Arizona Department of Transportation (ADOT) initiated research project SPR 371, Maintenance Cost-Effectiveness study. Beginning in 1999, 193 test sections were constructed throughout Arizona following guidelines developed under that research project. Those test sections were divided into three experiments or phases: wearing courses (Phase I), surface treatments (Phase II), and sealer-rejuvenators (Phase III). Although the agency brought significant resources to bear in the experimental layout, design, and construction of these test sections, ADOT did not regularly or systematically monitor test section performance after construction.

A formal study of test section performance could provide invaluable information about pavement maintenance in Arizona at the state, district, and local levels. For example, by analyzing performance results from the various test sections, ADOT could better understand what pavement treatments work best under different pavement conditions, environments, and traffic; how various materials perform; and how the performance of proprietary and warranted treatments compares to more conventional applications. Because the test sections were repeated in multiple environmental conditions, a study of those sections would be expected to generate findings applicable in most areas of the state.

In 2007, recognizing that many of the test sections were reaching the point where meaningful performance trends could be identified, ADOT initiated SPR 628, Evaluation of Maintenance Strategies. This report presents that project's findings.

PROJECT OBJECTIVES

Specific objectives of SPR 628 included the following:

- Review ADOT's current maintenance strategies.
- Document the materials used in each of the test treatments of SPR 371.
- Fully evaluate the test sections constructed under SPR 371.
- Evaluate the performance of the maintenance strategies used on the SPR 371 sections.
- Identify maintenance treatment effectiveness based on factors such as cost, type of distress, location, constructability, and service life.
- Develop a specific provisional guideline of effective maintenance strategies for ADOT.

This report addresses all of the Phase I and II objectives from the original SPR 371 project. The last objective was accomplished primarily by identifying the maintenance strategies that were the most and least cost-effective based on the study findings. Because the Foundation for Pavement

Preservation (King and King 2007) studied the Phase III test sections in greater detail, those sections were not examined in this project.

PROJECT APPROACH

Below is a summary of the project approach:

1. **Review available documentation about the test sections.** This review included studying information about the experiment design, section construction (including some field notes), materials specifications, laboratory test results, and initial performance findings taken immediately after construction.
2. **Interview ADOT staff.** Researchers contacted ADOT staff at headquarters and the districts to identify current strategies and learn where they are used, how well they perform, and their typical problems.
3. **Collect performance information.** Researchers collected pavement performance data under a cooperative effort with ADOT. Applied Pavement Technology staff conducted the pavement distress/condition surveys, including evaluating the pavement sections for weathering; bleeding; flushing; fatigue cracking; longitudinal, transverse, and diagonal (LTD) cracking; rutting; and patching. ADOT crews conducted field measurements to determine skid number (SN), texture, dynamic friction, and outflow. The primary emphasis was to collect information similar to how ADOT evaluates pavements as part of its pavement management data collection effort; the secondary focus was to collect data to evaluate the typical performance of selected treatments.
4. **Analyze performance information.** Using both statistical and practical engineering approaches, researchers evaluated select performance data for both the Wearing Course and Preventive Maintenance experiments. The results are presented in a series of tables that group or rank the treatments within different pavement conditions (performance levels) for several key performance criteria. The tables also reflect the Student's *t* test results that identify which treatments exhibited similar performance.
5. **Calculate treatment cost-effectiveness.** To determine the cost-effectiveness of the treatments, researchers compared the estimated cost and performance of treatments using different criteria and then ranked them into overall effectiveness levels.

REPORT OVERVIEW

The remainder of this report is organized into four chapters. Chapter 2 summarizes the design details for both the Wearing Course and Preventive Maintenance experiments. Chapter 3 describes the data collection activities, including pavement performance data and information obtained from ADOT staff about current maintenance strategies. Chapter 4 describes the statistical and engineering analyses conducted to assess treatment performance and estimated cost, and to identify those that may be best suited for future ADOT practice. Chapter 5 provides this study's key findings and recommendations.

CHAPTER 2. REVIEW OF EXPERIMENT DESIGN

Evaluating ADOT's maintenance strategies under this project focused on experimental sections constructed at the test sites for the Phase I, Wearing Course Experiment, and Phase II, Preventive Maintenance Experiment. This chapter presents the design, layout, and general description of the two experiments. Much of the documentation in this chapter was extracted from the original SPR 371 report (Peshkin 2006) and then revised and updated as appropriate.

PHASE I: WEARING COURSE EXPERIMENT

ADOT's traditional bituminous pavement wearing courses have been asphalt concrete friction courses (ACFCs) or asphalt rubber-asphalt concrete friction courses (AR-ACFCs). However, following construction, these traditional treatments often required applying flush coats to prevent future raveling. The Phase I test sections received premium treatments for wearing courses on Interstates and high-volume non-Interstate routes. One of the goals of the Phase I experiment was to evaluate treatments that could extend the life of a new bituminous pavement surface, with a target service life of 12 to 15 years that required little or no maintenance.

The primary objectives of Phase I were to generate performance data on the long-term benefits of different surfaces and determine how to improve ADOT practice. As part of the original experiment, 64 test sections were constructed on Interstate 8 (I-8) and Interstate 10 (I-10) during the summer and fall of 1999, covering the first five wearing course treatments shown in Table 3. Eighteen additional sections with three treatment types were then constructed on State Route 74 (SR 74).

Table 3. Description of Phase I Treatments.

Treatment	Description
ACFC	Asphalt concrete friction course was typically used as the main wearing course by ADOT until it was replaced by AR-ACFC.
AR-ACFC	Asphalt rubber-asphalt concrete friction course is a typical wearing course used by ADOT on Interstates and some non-Interstate roadways. Performance should be linked to ADOT's historical data.
P-ACFC	Polymer modified-asphalt concrete friction course is rarely used on ADOT roadways.
PEM	Permeable European mixture was developed by Georgia DOT for urban freeways that are three or more lanes wide. PEM typically has 18 to 20 percent porosity.
SMA	Stone matrix asphalt was developed by Maryland DOT as a wearing course.
TB-ACFC	Terminal blend asphalt concrete friction course employs an asphalt rubber binder prepared through a thorough mixing and blending of asphalt and ground tire rubber at the producer's terminal.

All of the treatments were designed to have a 3/4-inch top size aggregate (TSA) with the exception of the permeable European mixture (PEM), which was designed to have a 1-1/4-inch TSA. Similarly, except for the AR-ACFC, all polymer-modified treatments used the same PG 76-22 binder and were modified with either SB or SBS polymers. The PEM and stone matrix asphalt (SMA) used both polymer modification and fibers to control asphalt draindown, while the polymer modified-asphalt concrete friction course (P-ACFC) only used polymer modification. The binder for the terminal blend asphalt concrete friction course (TB-ACFC) is defined as a PG 76-22TR+ to indicate the use of ground tire rubber blended and mixed at the terminal (production facility).

While the wearing course treatments were placed on both the travel lane and the passing lane, only the travel lane is considered part of the experiment. As such, the passing lane had to be constructed first to refine the placement process for the travel lane construction.

Table 4 shows the overall layout of the sections in the Phase I, Wearing Course Experiment. Table 51 through Table 53 in Appendix A provide general information about the Phase I sections. Table 58 through Table 65 in Appendix B provide additional material details obtained from the available construction records.

I-10 and I-8 Test Sections

The 32 test sections on I-10 were located between milepost (MP) 186.48 and MP 195.0 in the eastbound direction; the 32 test sections on I-8 were located between MP 88 and MP 92.5 in both the eastbound and westbound directions. The average elevation of both of these sites is approximately 1400 ft. In 2001, ADOT reported the average annual daily traffic (AADT) at 35,200 to 38,700 vehicles on I-10 and 8800 vehicles on I-8 (Peshkin 2006).

To accelerate ADOT's ability to draw conclusions about these surfaces' performance, researchers milled off different thicknesses of the existing pavement's surface and constructed a hot-mix asphalt (HMA) overlay before applying the wearing course treatment. The milling depths and corresponding overlay thicknesses were 2.5 inches/2.0 inches, 3.5 inches/3.0 inches, and 4.5 inches/4.0 inches for the I-10 sections, and 1.0 inch/2.0 inches, 2.0 inches/2.0 inches, and 3.0 inches/2.0 inches for the I-8 sections. For the control sections, the milling depth/overlay thickness combinations were 2.5 inches/3.0 inches and 2.5 inches/2.0 inches for the I-10 and I-8 sites, respectively.

Researchers had expected to use the occurrence of similar distresses in the sections of different structural capacity to differentiate between the pavements' structural performance and their performance due to environmental factors. Also, with sections of different structural capacity, researchers could explore the effects of applying treatments at different times in the pavement's structural life. Each treatment was placed on two sections, including the control treatment (which consisted of a 1/2-inch TSA AR-ACFC).

Table 4. Overall Layout of Phase I, Wearing Course Experiment.
(Each cell shows the number of wearing course sections
followed by the milling depth and overlay thickness in parentheses.)

Wearing Course Treatment	Phase I Sites		
	I-10	**I-8**	**SR 74**
AR-ACFC (PG 64-16, CRA-1, 1/2-inch TSA) Control Section	2 (2.5/3.0 and 3.5/3.0)	2 (2.5/2.0)	
AR-ACFC (PG 64-16, CRA-1, 3/4-inch TSA)	2 (2.5/2.0)	2 (1.0/2.0)	
	2 (3.5/3.0)	2 (2.0/2.0)	
	2 (4.5/4.0)	2 (3.0/2.0)	
ACFC (PG 64-16, 3/4-inch TSA)	2 (2.5/2.0)	2 (1.0/2.0)	
	2 (3.5/3.0)	2 (2.0/2.0)	
	2 (4.5/4.0)	2 (3.0/2.0)	
P-ACFC (PG 76-22, 3/4-inch TSA)	2 (2.5/2.0)	2 (1.0/2.0)	
	2 (3.5/3.0)	2 (2.0/2.0)	
	2 (4.5/4.0)	2 (3.0/2.0)	
PEM (PG 76-22, 1-1/4-inch TSA)	2 (2.5/2.0)	2 (1.0/2.0)	
	2 (3.5/3.0)	2 (2.0/2.0)	
	2 (4.5/4.0)	2 (3.0/2.0)	
SMA (PG 70-28, 3/4-inch TSA)	2 (2.5/2.0)	2 (1.0/2.0)	
	2 (3.5/3.0)	2 (2.0/2.0)	
	2 (4.5/4.0)	2 (3.0/2.0)	
Control Section			1 (2.0/2.0)
AR-ACFC (PG 64-16, CRA-1, 3/8-inch TSA)			4 (0.0/0.0)
			1 (2.0/2.0)
			2 (3.5/3.5)
P-ACFC (PG 76-22+, 3/8-inch TSA)			0 (0.0/0.0)
			3 (2.0/2.0)
			2 (3.5/3.5)
TB-ACFC (PG 76-22TR+, 3/8-inch TSA)			2 (0.0/0.0)
			2 (2.0/2.0)
			2 (3.5/3.5)

SR 74 Test Sections

This site had 18 sections between MP 16.8 and MP 18.7 in both the eastbound and westbound directions (between Interstate 17 and U.S. Route 60 in the Phoenix area), plus one control section. These test sections were constructed on SR 74 in April 2001 by change order and include AR-ACFC, P-ACFC, and TB-ACFC. The average elevation of this site is 1500 ft, and the 2001 AADT was reported as 4500 vehicles. Some test sections were placed directly on the existing pavement, while others were placed over either a 2-inch or a 3-1/2-inch mill and overlay, as shown in Table 4.

PHASE II: PREVENTIVE MAINTENANCE EXPERIMENT

The Phase II test sections were part of the Preventive Maintenance experiment, which for ADOT typically involves surface treatment maintenance activities such as chip seals and slurry seals applied to lower volume bituminous-surfaced roadways. This experiment compares state-of-the-practice (and usually proprietary) treatments to ADOT's traditional chip seals to determine effectiveness. Test sections for the Phase II experiment were located on State Route 66 (SR 66), State Route 83 (SR 83), State Route 87 (SR 87), and U.S. Route 191 (U.S. 191).

All treatments were replicated and their locations were randomly assigned within a project location. The core experiment consisted of developing 3/4-mile-long test sections, one lane wide, on lower volume two-lane highways. The intent was to use one roadway direction for one replicate and the opposite roadway direction for the other, duplicating the same basic layout at all project sites.

This project's core experiment design was developed as part of the SR 66 test section preparation. At the SR 66 test site, the vendor/contractor selected the system to be tested and developed the specifications. As such, it was expected that the test sections represented the industry's best treatments for the pavement conditions. These systems and specifications were then meant to be used at the remaining project site locations. The original design consisted of 28 test sections: 16 designed and warranted by the contractor and 12 designed by ADOT. The proprietary products included as part of the SR 66 core experiment were:

- Paramount AC15-5TR, 5/8-inch chip size cover material only.
- Crown Asphalt CRS-2P (performance graded), 5/8-inch chip size cover material only.
- Koch Materials CM-90, 5/8-inch chip size cover material only.
- Copperstate HFE CRS-2P, 5/8-inch chip size cover material only.
- Southwest Slurry Type III slurry seal.
- International Slurry Surfacing asphalt rubber chip.
- Koch Materials Novachip.
- Copperstate CRS-2LM.
- Western Emulsion PASS CR, 5/8-inch chip size cover material only.

The following treatments were part of the core experiment:

- 5/8-inch cover material.
- 3/8-inch cover material.
- Double application chip seal.
- Double chip seal.
- ACFC.
- AR-ACFC.
- CRS-2.
- CRS-2P.

Investigators used the 5/8-inch cover material as the reference material for binder comparison test sections, such as with the CRS-2 and CRS-2P, because it was supposed to be the least sensitive to construction quality.

Table 5 provides the overall layout of the Preventive Maintenance experiment test sections. Because some of the treatments are the same but constructed by different contractors, the contractor (or producer) of the treatment is listed in the table. Additional information about the Phase II sections is provided in Appendix A (Table 54 through Table 57) and Appendix B (Table 66 through Table 91).

SR 66 Test Sections

The SR 66 test site was located between MP 110.25 and MP 123.17 in the westbound direction and between MP 110.75 and MP 123.17 in the eastbound direction. In 2000 this two-lane highway had an AADT of approximately 2200 vehicles and approximately 41,000 equivalent single-axle loads (ESALs) per year. The average elevation at this site is 4500 ft, and the surface (before applying a treatment) was an old chip seal. The 28 test sections were constructed from August 10 to 16, 2000.

Some highlights of the SR 66 test site follow:

- The contractor selected the surface treatment system and developed materials and construction specifications for the test sections.
- Construction specifications required a two-year warranty.
- Macrotexture was used as the performance criterion and measured using an outflow meter. The warranty was based on meeting a minimum mean texture depth (MTD) following construction and staying above that minimum for two years.

The test site was part of an overall 60-mi long construction project in which pavement conditions were similar. Prior to construction, participating material suppliers were required to visit the site and agree that pavement conditions throughout the test section were similar, so that differing pavement conditions for a specific test section were not later offered as an explanation for differential performance.

Table 5. Overall Layout of Phase II, Preventive Maintenance Experiment.

Preventive Maintenance Treatment	Producer	TSA (inches)	Phase II Sites[a]			
			SR 66	SR 83	SR 87	U.S. 191
Control	N/A	N/A			3[b]	4[c]
ACFC	ADOT	No information	2			
AR-ACFC	ADOT	3/8	2[d]	2		4
	No information	No information		3[e]		
P-ACFC	Paramount	3/8		2[d]		4
AR-chip	International Slurry Surfacing	No information	2	2		4
Chip seal (AC15-5TR)	Paramount	5/8	2	2	2	4
Chip seal (CM-90)	Navajo Western	5/8	2		2	
	Koch Materials	5/8		2		4
Chip seal (CRS-2)	ADOT	5/8, 3/8		2		4
	Copperstate	5/8	2		2	
Chip seal (CRS-2P)	ADOT	5/8	2	2		4
		3/8	2			
	ADOT (future construction)	No information				4
	Crown	5/8	2	1	2	4
Chip seal (HF CRS-2P)	ADOT	3/8				4
	Copperstate	5/8		2		4
Chip seal (PASS CR/Oil)	Western Emulsion	5/8	2	2	2	
DACS&B	ADOT	Blotter (B) on 1/2	2 B = 3/8		2 B = #4	
Double chip seal	ADOT	3/8 on 5/8		2	4	4
Double application	ADOT	No information	2			
Microsurfacing	Southwest Slurry	Type III	2			
Slurry seal	Southwest Slurry	Type III		2		4
Novachip	Koch Materials	1/2	2	2	2	4
Total sections (including control)			28	28	21	60

[a]The numbers in each cell represent the number of preventive maintenance sections.
[b]2-inch mill and overlay.
[c]No treatment (or overlay) applied.
[d]No information available on TSA.
[e]First chip seal (CRS-2P) section failed (due to rain) and was replaced by an AR-ACFC section.

SR 83 Test Sections

SR 83, a two-lane pavement, was constructed in 1960. The average elevation is 4895 ft. The 2001 AADT was 3200 vehicles. From June to August 2001, 28 test sections were constructed between MP 33.20 and MP 43.50. This site was laid out similarly to SR 66, used a Paramount PG 76-22TR+ P-ACFC, and incorporated AR-ACFC and ACFC sections with surface treatments.

SR 87 Test Sections

While the SR 66 project was advertised for bidding, an opportunity arose to place additional test sections on SR 87 north of Winslow, Arizona. Since the original intent was to duplicate the 16 vendor test sections to be placed on SR 66, a change order was executed and six of the eight vendors participated. Due to cost considerations and the available budget for the project, three options used on SR 66 were not used on SR 87: AR-chip, slurry seal, and AR-ACFC.

Another significant difference between the SR 66 test sections and the SR 87 test sections was that the SR 87 test sections were placed on a one-year-old, 2-inch overlay while the SR 66 test sections were placed over an old chip seal, which provided an additional opportunity to address treatment timing. Consequently, four test sections were left blank (i.e., control sections where no surface treatment was placed). Researchers planned to apply surface treatments to two of these test sections in five to seven years, and the remaining two sections would serve as control sections for the treated sections.

The 21 test sections on SR 87 were located north of Winslow between MP 393.463 and MP 385 in both the northbound and southbound directions, and were constructed in June and July of 2000. In 2000 this two-lane pavement had an AADT of approximately 500 vehicles and about 20,000 ESALs per year.

The final treatments placed on SR 87 were:

- Crown CRS-2P (5/8-inch aggregate and performance-graded binder).
- Copperstate CRS-2LM (5/8-inch aggregate and latex modified binder).
- Novachip.
- ADOT double chip seal (5/8-inch and 3/8-inch aggregate).
- ADOT double application (1/2-inch aggregate and blotter sand).
- Western Emulsion PASS oil (5/8-inch aggregate).
- Paramount AC15-5TR (tire rubber modified binder).
- Navajo Western CM-90 (5/8-inch aggregate).

Two sections of each of these treatments were constructed and five sections were left untreated. Three of the untreated sections are identified simply as “do nothing,” but the others were included to have untreated pavement to return to in five to seven years, place a treatment, and evaluate the effect of treatment timing on pavement performance.

In 2001 the SR 87 test site was also used as a sealer/rejuvenator test site (part of Phase III of ADOT’s Maintenance Cost-Effectiveness study). The Paramount AC15-5TR, a control section, and a portion of pavement outside the test section all received the sealer/rejuvenator treatments, creating a new set of side-by-side comparisons. While the sealer/rejuvenator test sections are addressed elsewhere, it is important to recognize that this test site was modified after construction to include these additional sections. The sealer/rejuvenator test sections are also significant because of the extensive testing and evaluation that have been planned at this location. Some key aspects of the sealer/rejuvenator study are briefly discussed in Appendix G of the SPR 371 report (Peshkin 2006).

U.S. 191 Test Sections

The U.S. 191 test site is located south of Alpine, Arizona, at an approximate elevation of 7000 ft. One portion of the site is located between MP 200.5 and MP 219.25, and a second portion of the site is located between MP 181 and MP 185. The site was constructed in June and July 2001. Between these two test sections, the pavement received a standard treatment of AC15-5TR (rubberized chip seal) with precoated chips, which was placed in May 2001. Available information for this pavement from MP 225 and higher (just north of the test sections) indicates that it was originally built in 1962 with 16 inches of base material and a 2.5-inch bituminous surface, and that the most recent treatment was a 2-inch asphalt rubber wearing course constructed in 1999. In August 2000 the pavement north of the test sections was reported to exhibit 20 to 30 percent small block cracking, and alligator cracking and transverse cracking at 20-ft to 25-ft intervals. The 2001 AADT reported was 100 vehicles.

Key characteristics of this test site include the following:

- It was the only high elevation location (i.e., cold climate).
- The incorporation of nontreated sections allowed for the eventual study of the effect of treatment timing on pavement performance (by applying treatments in the future).
- The overlap of treatments provided for a comparison between wearing course (Phase I) and surface treatment performance.

The portion of the test site between MP 181 and MP 185, where sections were left untreated, was overlaid in 1999. The treatments placed at U.S. 191 were:

- HF CRS-2P.
- Type III slurry seal.
- Novachip.
- ADOT double chip seal (5/8-inch and 3/8-inch aggregate).
- CRS-2 (3/8-inch aggregate).
- AR-ACFC.
- ACFC.
- CM-90 (5/8-inch aggregate).
- AC15-5TR.
- CRS-2P (5/8-inch aggregate).
- AR-chip seal.

CHAPTER 3. PROJECT DATA COLLECTION

Late in 2007, ADOT and Applied Pavement Technology collected pavement performance data from all the experimental sections at the Wearing Course and Preventive Maintenance treatment sites. The data, which included several different types of pavement distress as well as measures of roughness, friction, and surface texture, provide a sound basis for evaluating and comparing the performance of different treatments. This chapter briefly summarizes the data collection efforts; Appendix C provides supplemental details.

To gather information about ADOT's current maintenance strategies, researchers interviewed ADOT headquarters staff by phone in 2007 and submitted questionnaires to district staff in 2011. The survey results are documented in this chapter.

Finally, researchers obtained cost information for the various treatments from four primary sources that was used to estimate unit costs for many of the pavement maintenance treatments included in the project. Summary results are also provided in this chapter.

PERFORMANCE DATA

The primary basis for evaluating the performance of the Phase I and II experimental treatments is the field performance and condition data collected between October and December 2007. The data included the type of flexible pavement condition information that ADOT gathers for its pavement management process as well as data on pavement surface characteristics that impact pavement safety and ride quality (i.e., friction resistance, surface texture, and roughness). ADOT and Applied Pavement Technology staff gathered the data using both manual and automated data collection techniques. Table 6 identifies the specific performance data collected as part of the manual condition surveys, automated field testing, and other field testing.

Table 6. Types of Pavement Performance Data Collected.

Manual Condition Survey	Automated Field Testing	Other Field Testing
• Weathering (raveling) • Bleeding • Flushing • Longitudinal and transverse cracking • Fatigue cracking • Rutting • Patching	• Roughness • Friction	• Outflow meter • Dynamic Friction Tester • Circular Texture Meter

Appendix C provides summary tables on a site-by-site basis of all the performance data collected for this project. Following are descriptions of the different data collection operations as well as some important notes and observations about data collection at each test site.

Manual Condition Surveys

Applied Pavement Technology performed manual pavement condition surveys while ADOT provided traffic control. At the beginning of the survey, the field crew confirmed the site location information and pavement markings against original documentation. Then they identified representative 500-ft-long segments within each section. Typically these were located near the middle of the test section so any difficulties associated with "sympathetic" failure and construction variability at the start and end of each test section construction were not reflected in the section's performance evaluation.

In general, all surveys and measurements were made in the outer travel (truck) lane of the section. Of the seven distress types surveyed, four—weathering, bleeding, longitudinal and transverse cracking, and fatigue cracking—were surveyed and recorded according to distress definitions identified in the Federal Highway Administration's (FHWA) *Distress Identification Manual for the Long-Term Pavement Performance (LTPP) Program* (FHWA 2003). As the long-term pavement performance (LTPP) protocol requires, each of these four distresses were characterized by severity, extent, and type. The three remaining distress types (rutting, flushing, and patching) were surveyed according to ADOT definitions with threshold values as shown in Table 7. Maximum rut depths were measured at 50-ft intervals (50, 100, 150, 200, and so on) in the outer and inner wheel path using a ruler and 6-ft straightedge. All other distresses were measured over the entire section. Figure 1 shows the standard form used to record manual pavement condition survey data.

Table 7. Trigger and Failure Levels for ADOT Distresses.

Distress Type	Measurement Units	Range	Trigger	Failure
Rutting	Inches	0-2	0.5	1.0
Flushing	Rating	5[a]-0	3.5	2.5
Patching	Percent of area	0%-100%	25%	50%

[a]A rating of 5 indicates no flushing.

AC

ROADWAY PAVEMENT CONDITION INDEX (PCI) INSPECTION FORM

SPR 628: Evaluation of Maintenance Strategies for ADOT

SR / IR / US ____________________ INSPECTION DATE ____________________

01 ALLIGATOR CRACKING (SF: L, M,H)
02 BLEEDING (SF: N/A)
03 BLOCK CRACKING (SF: L,M,H)
04 BUMPS AND SAGS (LF: L,M,H)
05 CORRUGATION (SF: L,M,H)
06 DEPRESSION (SF: L,M,H)
07 EDGE CRACKING (LF: L,M,H)
08 JOINT REFLECTION CRACKING (LF: L,M,H)
09 LANE/SHOULDER DROP-OFF (LF: L,M,H)
10 LONG. AND TRANS. CRACKING (LF: L,M,H)
11 PATCH AND UTIL. CUT PATCH (SF: L,M,H)
12 POLISHED AGGREGATE (SF: N/A)
13 POTHOLE (SF: L,M,H)
14 RAILROAD CROSSING (SF: L,M,H)
15 RUTTING (SF: L,M,H)
16 SHOVING (SF: L,M,H)
17 SLIPPAGE CRACKING (SF: L,M,H)
18 SWELL (SF: L,M,H)
19 RAVELING AND WEATHERING (SF: L,M,H)

Section ID __________

Section Length, ft __________

SAMPLE UNIT SKETCH/COMMENTS

Rutting Measurements		
Dist.	L	R
50		
100		
150		
200		
250		
300		
350		
400		
450		

Oxidation	Description
5	All black / New
4	Mostly black
3	½ black / ½ worn
2	Little to no black
1	No black / All worn

Section sketch area

Flushing	Description
5	None
4	Slightly dark
3	Moder. dark
2	Very dark
1	75% - 100%

Pictures	Taken
0 Marker	
1 OV F	
2 Shldr	
3 Drnge	
4 Typ Dist	
5 Dist Cls	
6 OV B	

SAMPLE UNIT DISTRESSES & NOTES

TYPE	SEV.	QTY.
Flushing		Rating Level (5 to 1)
Oxidation		Rating Level (5 to 1)

Section ID __________

Section Length, ft __________

SAMPLE UNIT SKETCH/COMMENTS

Rutting Measurements		
Dist.	L	R
50		
100		
150		
200		
250		
300		
350		
400		
450		

Oxidation	Description
5	Very black / New
4	Mostly black
3	½ black / ½ worn
2	Little to no black
1	No black / All worn

Section sketch area

Flushing	Description
5	None
4	Slightly dark
3	Moder. dark
2	Very dark
1	75% - 100%

Pictures	Taken
0 Marker	
1 OV F	
2 Shldr	
3 Drnge	
4 Typ Dist	
5 Dist Cls	
6 OV B	

SAMPLE UNIT DISTRESSES & NOTES

TYPE	SEV.	QTY.
Flushing		Rating Level (5 to 1)
Oxidation		Rating Level (5 to 1)

Figure 1. Pavement Condition Survey Recording Form.

Digital photographs were also taken at each section to document typical pavement conditions. The photographs are stored in the electronic project archives and include the following for each section:

- Section overview (looking forward).
- View of shoulder.
- View of typical drainage conditions.
- Typical distresses and their severity levels.
- Close-up of typical surface conditions.
- Section overview (from the end of the section looking backward).

Automated Field Testing

ADOT performed surface profile and skid testing surveys using its van-mounted equipment at roughly the same time as the manual pavement condition surveys (between October and December 2007). Figure 2 is a photo of the ADOT profilometer used for surface profile measurement. It uses a series of lasers (mounted at the front of the van), vertical accelerometers (to correct for the effects of the vertical up and down movements of the van), and other internal instrumentation to record the longitudinal and transverse pavement surface profiles.

The surface profile data were used primarily to determine the average rut depths on the high-volume Interstate sections where lane closure (for manual measurement) was not possible. The data were also used to help develop correlations with other roughness measures and not intended for use in evaluating treatment performance. Appendix C includes rut depth data, but not the actual surface profile data. For automated friction testing, ADOT used its skid testing van (Figure 3), but only on higher volume Interstate highway sections where the manually operated field test devices could not be used. This served as the basis for the SNs presented in Appendix C.

Other Field Testing

ADOT used its outflow meter (Figure 4), Circular Texture (CT) meter (Figure 5), and Dynamic Friction (DF) Tester (Figure 6) to measure pavement surface and friction characteristics in the test sections. Since all three are manually operated devices, ADOT performed these tests on the test sections at the same time as the manual condition surveys. The outflow meter provides an estimate of the MTD using a correlation that is based upon the amount of time required for water to flow out of the cylinder. The CT meter (ASTM 2012) uses a laser to determine a pavement surface texture characteristic known as the mean profile depth (MPD) within an 11-inch diameter circle. The DF device measures the dynamic coefficient of friction (DCOF) that characterizes the pavement surface's frictional resistance.

Figure 2. ADOT Profilometer.

Figure 3. ADOT Skid Testing Van.

Figure 4. HydroTimer Outflow Meter.

Figure 5. CT Meter.

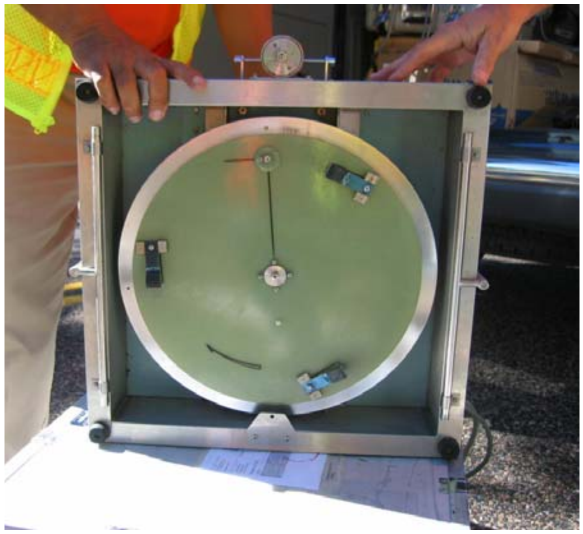

Figure 6. DF Tester.

Data Collection Notes (by Site)

Following are key observations recorded at each test site:

- **I-10 (Casa Grande, Arizona).** Researchers surveyed 32 test sections (all in the eastbound direction) at this location on December 5, 2007. Due to heavy highway traffic volumes, they conducted the manual survey from the shoulder with an ADOT attenuator following the survey crew. Distresses were estimated since the crew could not enter the lane of traffic. ADOT collected all of the data (including rutting depths) using its profilometer. No outflow or DF tests were conducted at this site.

- **I-8 (Gila Bend, Arizona).** Researchers surveyed the 16 test sections in the westbound direction on December 7, 2007, and the 16 test sections in the eastbound direction on December 8, 2007. The right (truck) lane was surveyed using a moving lane closure. ADOT performed in-place CT and outflow measurements while the manual distress surveys were conducted. ADOT also collected skid measurements using its automated van. DF tests could not be collected during the closure period.

- **SR 74 (Peoria, Arizona).** Researchers surveyed 18 sections in both directions on December 10, 2007. Full lane closures were employed at this site for the manual surveys. ADOT performed outflow and CT measurements during the manual condition surveys. ADOT was also able to collect friction data using its automated equipment as the DF equipment was malfunctioning during the closure period.

- **SR 66 (Kingman, Arizona).** Researchers surveyed 14 test sections in both directions, for a total of 28 sections, on December 11, 2007. Again, ADOT provided full lane closures, and the manual condition surveys were conducted in the outside (truck) lane. ADOT collected outflow, CT, and DF measurements while the manual distress surveys were conducted.

- **SR 83 (Sonoita, Arizona).** All 28 test sections were surveyed on December 6, 2007, with 14 sections in each direction of traffic. The manual distress surveys as well as ADOT's outflow, CT, and DF testing were conducted in the outside (truck) lane using a moving closure provided by ADOT. None of the test sections was marked along the highway right of way, and the mileposts had to be used to help locate each section.

- **SR 87 (Winslow, Arizona).** These 21 test sections were surveyed on December 12, 2007, nine in the northbound direction and 12 in the southbound direction. Once again, the manual condition surveys and ADOT's outflow, CT, and DF tests were conducted in the outside (truck) lane under lane closure provided by ADOT.

- **U.S. 191 (Alpine, Arizona).** These 60 test sections were located on a very remote mountain highway and were surveyed during the week of October 22, 2007. MP 181 to MP 185 included 12 test sections (six in each direction of traffic) while MP 200.5 to MP 219.25 included 48 test sections (24 in each direction of traffic). The manual condition surveys were performed in the outside (truck) lane using moving lane closure provided by ADOT. Outflow, CT, and DF tests were also completed during this closure.

ADOT STAFF SURVEYS

ADOT staff at headquarters (Phoenix) and in district offices were interviewed in July 2007 and July 2011, respectively, to identify ADOT's current maintenance strategies (with emphasis on ADOT policy related to the treatments used in the maintenance effectiveness test sections), problems with maintenance strategies, and potential solutions. The 2007 surveys were conducted by phone and included 11 questions. The 2011 surveys were questionnaires that sought more detailed treatment information about materials, selection criteria, construction problems, performance, and solutions.

2007 Phone Interviews

In July 2007, researchers interviewed Doug Forstie, Joel Miller, Bill Hurguy, and Yongqi Li by phone. Forstie described ADOT's pavement preservation program as a subset of the overall pavement program. According to Forstie, of the $120 million spent annually, about $100 million was spent on major projects and $7 million on the preventive maintenance surface treatment program. The latter was accomplished mostly through a procurement process and included flush coats, chip seals, slurry seals, and thin overlays. Contractors completed the construction work while ADOT provided traffic control and completed the striping. Li and Hurguy said that the pavement preservation program did not include treatments that add structure (including HMA overlay with a thickness greater than

1 inch). Since AADT was not always available for rural roads, average daily traffic (ADT) was used. The ADT is composed of traffic counts taken for more than one day but less than one year.

A compilation of the survey responses follows:

1. What treatments are currently specified by ADOT?

   The interviewees reported that ADOT did not have a specification and that the treatments were selected based upon past practice, where the district maintenance supervisors decide what, when, and where. (Note: ADOT's current 2008 Standard Specifications for Road and Bridge Construction includes Section 404 on bituminous treatments.) The typical treatments specified by the districts included:

   a) **Flush coats and fog seals.** These contain various types of emulsions and were used extensively by some districts and on a limited basis by others. (Note: One reviewer considered a flush coat to be a fog seal with a rejuvenating agent.)
   b) **Chip seals.** The typical emulsions for these included RS, polymer-modified CRS, and RS with PASS oil. Hot-applied AR binder has also been used, but not normally. The aggregate (chip) TSA was typically 3/8- or 1/2-inch and may be coated or uncoated. In some cases, double applications were used.
   c) **Cinder seals.** These were basically a chip seal with cinder aggregates (1/2-inch cinders and cinder fines) that allow for some aggregate buildup.
   d) **Sand seals.** Like chip seals, sand seals were shot a little lighter (0.2 gal/sy or less) and used washed fines or cinder fines. These were used by some districts that had poor experience with chip seals.
   e) **Scrub seals.** These typically involved applying an emulsified polymer- or latex-modified binder (usually PASS oil) followed by a system of shop brushes that worked the binder into the pavement surface. The surface was then covered with either sand (southern areas of the state) or cinders (northern areas).
   f) **Slurry seals and microseals (microsurfacings).** These were either Type I, II (most common), or III, and were completed under a statewide contract.
   g) **Thin HMA overlays.** These were less than 2 inches thick and saw limited use.
   h) **Novachip.** ADOT has used a thin-bonded wearing course, but only occasionally because of its proprietary nature.
   i) **Blade-laid overlays.** These were constructed with either cold-mix asphalt or HMA placed over short stretches, and were rarely used.
   j) **Crack sealing.** ADOT used both asphalt and AR sealant using a "blow-and-go" approach. Designations included ERA to CRF, PASS oil, and MC-250.

2. What are the applicable specifications for those treatments?

   The specifications came either from ADOT Contracts and Specifications or from the district. Typically, the aggregate specifications came from Contracts and Specifications while the asphalt binder specifications were provided by on-call vendors. Any new or unconventional treatment went through Contracts and Specifications or through ADOT Procurement. With a new treatment, an ADOT Regional Materials Lab engineer would have to review and approve the vendor's specification. If Procurement reviewed the treatment, it was typically written into the special provisions.

3. What guidelines are available to assist in the selection and scheduling of these treatments?

   There were no formal guidelines for project selection or scheduling. Treatment selection and timing were based on the local supervisor's background and experience.

4. How long do the treatments last and provide measureable benefit?

   a) **Flush coats and fog seals.** These provide a one- to two-year service life, depending on the pavement being treated. With rubberized asphalt and rubberized friction courses, the application can be lighter since they do not oxidize or begin raveling as soon. The first application on a rubber treatment will occur about three years after construction, where it may be one to two years for conventional HMA. Longevity depends on the condition of the surface. If the treatment was applied when it was first needed, it might last two to five years.
   b) **Chip seals.** Conventional chip seals may provide seven to 10 years of service on a good surface (level, no cracking, and limited rutting). If the pavement has a rough surface profile and experiences significant snowplow damage, the service life may be much shorter. Older pavements that have been crack sealed and exhibit some rutting, surface roughness, or patching may start peeling at the centerline (and not last very long). Chip seals placed early in the season (May or June) provide longer service lives since they have more time to cure.
   c) **Hot-applied chip seals with coated 1/2-inch chip.** These resist snowplow damage much better than conventional chip seals.
   d) **Cinder seals.** These provide a rough, noisy ride after construction; however, they do not peel like conventional chip seals. The service life is in the range of seven to 10 years on a smooth road, and five to seven years on a rough road.
   e) **Polymer-modified chip seals.** These perform better and can be placed later in the season, but cost more. They are more forgiving when the quality of the chip is less than desirable. The polymer-modified binder holds the aggregate better and may provide an additional one to two years of service as compared to a conventional chip seal.

f) **Sand seals.** These have a service life of five to seven years if the pavement surface condition is good, and three to five years if the pavement surface condition is poor.
g) **Scrub seals.** The service life may be five to seven years, depending on the surface condition. There may be flushing problems in southern areas of the state, especially if the sand is overapplied.
h) **Slurry seals.** These are rarely used as a preventive maintenance treatment. In most cases, they are used as a stop-gap measure to provide some life extension to a distressed pavement. Depending on the extent and severity of the distress, the amount of repair, and the environmental setting, the service life may be one to seven years.
i) **Microseals.** These are used primarily for rut filling, with a service life of seven to 10 years if the pavement condition is good, or three to seven years if the pavement condition is poor.
j) **Thin HMA overlays.** Not every district has the lay-down capability. A quality blade-laid overlay depends on the experience of the blade operator.
k) **Cold-mix overlays.** If sealed 60 days after placement, they can perform well. If they are sealed before the moisture is allowed to evaporate, ruts may return within six months.

5. What types of pavements are the treatments applied to?

a) **Flush coats and fog seals.** These are applied to all HMA-surfaced pavements, preferably soon after construction.
b) **Chip seals.** These are recommended for low-volume, HMA-surfaced roads (less than 3000 ADT), but can also be used on older HMA pavements that exhibit some cracking and distortion. They are not recommended for use on Interstate highways or in urban areas with a lot of turning movements.
c) **Sand, scrub, and cinder seals.** These are applicable for low-volume, HMA-surfaced roads, including those that exhibit some cracking and distortion. Cinder seals are used mostly in northern areas of the state. Sand and scrub seals are used mostly in southern areas (primarily because there are no cinders).
d) **Slurry seals and microseals.** These are used primarily on Interstate highways under most conditions, including high altitude, but operators must be aware of curing conditions.

6. Is there a retreatment schedule?

There is no formal schedule. However, there are some emerging guidelines. For example, highway sections should be examined or inspected every three years. (The range was two to five years.)

a) **Flush coats and fog seals:** two- to four-year rotation.
b) **Other treatments:** Three- to seven-year rotation.

7. What are the pavement distresses present when the treatments are applied?

   The maximum benefit from the various surface treatments was obtained when they were applied before any significant structural distress developed. However, there were no formal guidelines for targeting treatments to certain types, severities, and extents of distress. So, the practice was to place the treatments on pavements that exhibit a range of distress conditions, "from hairline cracks to block cracking" (and beyond). The secret to achieving the expected minimum service life was to crack seal and patch the existing pavement prior to treatment application.

8. What pavement distresses, when present, indicate that the treatments should <u>not</u> be applied?

   As indicated in question 7, there were no formal guidelines for targeting treatments to various types and ranges of pavement distress (minimum or maximum). However, the interviewees identified several general rules of thumb:

   a) Do not chip seal pavements with moderate to severe flushing. (Cinder seals, slurry seals, and microseals may be considered if the flushing is not severe.)
   b) In general, avoid pavements that exhibit severe cracking, rutting, and/or raveling.
   c) Do not chip seal during the monsoon season.
   d) Do not slurry seal or microseal if there is a chance of freezing.
   e) Do not place seals if it is too hot or too humid.

9. What specification modifications are needed to ensure improved treatment performance?

   a) Better guidance on what emulsions to use for flush coats and fog seals, and when to use them on rubberized asphalt mixes.
   b) More guidance on the asphalt (binder) to use for rubberized asphalt mixes.
   c) Guidance on when to use rejuvenators.
   d) No tolerances on the joints of friction courses.
   e) Tighter surface profile specifications, to avoid any irregularities that will increase snowplow damage.
   f) Specifications that are defined and made available to all.

10. What problems are experienced in the design, construction, or placement of the treatments?

    a) Because of low confidence in the flush coat application rate, ADOT often used the more expensive PASS treatment.

b) The lack of familiarity with some treatments led to design, construction, and performance problems and more hesitancy to use the treatments.

11. Are treatments in use that are not currently documented by DOT specifications?

    Only two proprietary treatments were identified: Novachip and Armor Coat.

Questionnaires

In June 2011, researchers distributed a questionnaire to representatives of all 10 ADOT districts. Custom data entry forms were provided to gather detailed information about spray-applied, slurry-applied, and paver-applied treatments. Four districts—Kingman, Safford, Tucson, and Yuma—replied with completed forms that characterized their use of flush coats, scrub seals, chip seals (conventional and polymer-modified), slurry seals, and microseals (microsurfacings). The results are compiled in Table 8 through Table 10.

Following are some general observations about the survey results for all treatments. All are consistent with phone survey results:

- There are essentially no standard specifications, although the Tucson District did reference relevant sections of ADOT's *Construction Manual* (ADOT 2008) for flush coats and polymer-modified chip seals.
- There is almost no information from which to estimate the range in pavement distress within which each treatment can be used.
- There is very little information about materials and construction problems. The Safford District indicated that dirty aggregate and excess rock/chip loss can be problems on its chip seal projects, and delayed curing, rapid wear or disintegration, and excessive aggregate loss can be problems with its slurry seal projects.
- The information provided on the altitude range for the different treatments may be influenced by the actual range in altitude within each district.

Table 8. Survey Results on Flush Coats (Fog Seals).

Treatment Type	Flush coat	Flush coat	Flush coat	Flush coat
District	Kingman	Safford	Tucson	Yuma
Treatment Designation	–	PASS	SR 86 (MP 115 to MP 122)	PASS oil
Unit Cost ($/sy)	0.19-0.21	0.50-1.00	0.20	0.25-0.30
Relevant Specifications	Not identified	Procurement state funded	404-3.13 Fog coat/flush	Not identified
Materials Information				
Binder/emulsion type	PASS	PASS	PASS	CSS-1
Dilution (%)	50:50	50:50	50:50	50:50
Binder application rate (gal/sy)	0.08-0.10	0.08-0.14	0.08	0.10
Additives	–	Rejuvenator, stabilizer	–	Rejuvenator
Allowable Road Conditions				
Roadway types	Interstate highway (IH)/rural, state highway (SH)/rural	IH/urban, IH/rural SH/urban, SH/rural	SH/rural	IH/urban, IH/rural SH/urban, SH/rural
ADT range (vehicles/day)	1,000-10,000	Unlimited	1,000-3,000	>3,000
Altitude range (ft above sea level)	2,000->5,000	>2,000	–	<2,000
Min./Max. Pavement Distress				
Raveling/weathering (% area)	–	–	–	N/A
SN/friction number	–	–	–	N/A
Flushing/bleeding (% area)	–	–	–	N/A
Transverse crack spacing (ft)	–	5 min./20 max.	–	N/A
Block cracking (% area)	–	–	–	N/A
Fatigue cracking (% area)	–	20 min./ 50 max.	–	N/A
Rut depth (inch)	–	1 min./2 max.	–	N/A
Treatment Performance				
Expected life (yr)	2	3	1-2	3
Distress type/level at failure	Cracking	Visual	Raveling	–
Material/Construction Problems				
Poor binder viscosity	–	–	–	N/A
Poor aggregate embedment	–	–	–	N/A
Dirty aggregate	–	–	–	N/A
Excess rock/chip loss	–	–	–	N/A
Premature flushing/fat spots	–	–	–	N/A
Other	–	None	–	N/A
Additional Comments	–	–	–	–

Table 9. Survey Results on Aggregate Seals.

Treatment Type	Scrub seal	Chip seal	Chip seal	Polymer-modified chip seal	Polymer-modified chip seal
District	Safford	Kingman	Safford	Tucson	Yuma
Treatment Designation	–	–	Double application emulsion	SR 85 (MP 57.9 to MP 61.2)	–
Unit Cost ($/sy)	1.00-1.50	0.45	2.00-3.00	0.97	3.10
Relevant Specifications	Not identified	Not identified	Special procurement	404-3.14 Chip seal coat	CRS-2P with SS-1
Materials Information					
Binder/emulsion type	CRS	PASS	CRS-2P	CRS-2P	CRS-2P
Dilution (%)	50:50	Con.	–	–	50:50
Binder application rate (gal/sy)	0.10-0.20	0.35-0.42	0.40-0.50	0.47	0.45
Aggregate type	No information	No information	Crushed stone	ADOT chip	Crushed rock
TSA (inch)	–	3/8	5/16-3/8	3/8	3/8
Aggregate application rate (lb/sy)	–	22	25-35	26	25
Additives	–	–	Polymer	–	–
Allowable Road Conditions					
Roadway types	SH/rural	SH/rural	SH/rural	SH/rural	SH/rural
ADT range (vpd)	<1,000	–	<1,000-10,000	1,000-3,000	3,000-10,000
Altitude range (ft above sea level)	<2,000-5,000	2,000-3,500	2,000->5,000	–	<2,000
Min./Max. Pavement Distress					
Raveling/weathering (% area)	20/50 norm.	–	Varies	–	N/A
SN/friction number	–	–	50	–	N/A
Flushing/bleeding (% area)	–	–	N/A	–	N/A
Transverse crack spacing (ft)	–	–	Varies	–	N/A
Block cracking (% area)	–	–	Varies	–	N/A
Fatigue cracking (% area)	–	–	Varies	–	N/A
Rut depth (inch)	–	–	1-2	–	N/A
Treatment Performance					
Expected life (yr)	–	–	5+	10	7-10
Distress type/level at failure	–	–	–	Stripping and raveling	–
Materials/Construction Problems					
Poor binder viscosity	–	–	–	–	N/A
Poor aggregate embedment	–	–	–	–	N/A
Dirty aggregate	–	–	Yes	–	N/A
Excess rock/chip loss	–	–	Yes	–	N/A
Premature flushing/fat spots	–	–	–	–	N/A
Other	Pavement failure/lost cause	–	–	–	N/A
Additional Comments	–	–	–	–	–

Table 10. Survey Results on Slurry Seals and Microseals (Microsurfacings).

Treatment Type	Slurry seal	Microseal/ microsurfacing	Microseal/ microsurfacing
District	Safford	Safford	Yuma
Treatment Designation	–	–	–
Unit Cost ($/sy)	Not identified	2.00-3.00	4.00
Relevant Specifications	–	Manufacturer or vendor	–
Materials Information			
Binder/emulsion type	CSS-1H, CQS-1H	CSS-1H	Polymer-modified emulsified asphalt
Binder content (% by weight of mix)	8-12	6-11	6-11.5
Aggregate type	Crushed stone	Crushed stone	Crushed stone
Application rate (lb/sy of dry aggregate)	25-30	25-35	32
Additives	–	Polymer	4% solid polymer
Allowable Road Conditions			
Roadway types	SH/urban, SH/rural	IH/urban, IH/rural, SH/urban, SH/rural	IH/urban, IH/rural, SH/urban
ADT range (vpd)	3,000-20,000	>3,000	>3,000
Altitude range (ft above sea level)	–	>2,000	<2,000
Min./Max. Pavement Distress			
Raveling/weathering (% area)	Varies	Varies	N/A
SN/friction number	–	Varies	N/A
Flushing/bleeding (% area)	–	Varies	N/A
Transverse crack spacing (ft)	–	Varies	N/A
Block cracking (% area)	–	Varies	N/A
Fatigue cracking (% area)	–	Varies	N/A
Rut depth (inch)	–	Varies	N/A
Treatment Performance			
Expected life (yr)	3-5	3-7	5
Distress type/level at failure	Block cracking	Raveling	–
Materials/Construction Problems			
Delayed curing (Late opening to traffic)	Yes	–	N/A
Excessive scuffing	–	–	N/A
Rapid wear or disintegration	Yes	–	N/A
Excessive aggregate loss	Yes	–	N/A
Premature flushing/fat spots	–	–	N/A
Other	–	–	N/A
Additional Comments	–	–	–

Following are more specific observations by treatment type.

Flush Coats/Fog Seals

All four districts responding provided feedback about flush coat or fog seal treatments:

- The range in unit cost for three of the districts was $0.19/sy to $0.30/sy. At $0.50/sy to $1.00/sy, the unit cost range in the Safford District seems very high.
- Three of the districts identified PASS as the choice of binder/emulsion. Yuma District, on the other hand, identified CSS-1 as its typical binder/emulsion.
- The dilution of the emulsion was the same for all four districts (50:50), and the binder application rates seemed very consistent (0.08 gal/sy to 0.14 gal/sy).
- Three of the four districts permit the application of flush coats on both Interstate and state highways. Only the Tucson District limits its application to state highways. The Safford and Yuma districts permit flush coats in both rural and urban settings, while the Kingman and Yuma districts limit their application to rural settings.
- Three of the districts permit using flush coats on pavements with relatively high-traffic levels. The Tucson District limits application to pavements with relatively low-traffic levels.
- The expected life of a flush coat in the Kingman and Tucson districts is about one to two years. In the Safford and Yuma districts, it is about three years.
- The Kingman District reported cracking as the distress type at failure (of the flush coat); the Tucson District reported raveling. The Safford and Yuma districts did not respond.

Scrub Seals

Only the Safford District provided feedback on scrub seals. This treatment is used only on rural state highways with ADT levels less than 1000 vehicles per day. The unit cost of $1.00/sy to $1.50/sy is relatively high compared to the conventional chip seals.

Chip Seals

All four districts provided information about their use of chip seals. The only consistent features are that they all use 3/8-inch TSA (which it is safe to assume is all crushed material) and they are only permitted on rural state highways.

- The treatment type and designation information are a little confusing, but it appears that three of the four districts employ a cationic, rapid-setting, polymer-modified emulsion (CRS-2P) while the Kingman District uses the PASS emulsion (which is also considered polymer-modified). The Safford District uses a double application of emulsion (and supposedly chip), while the other districts use a single application.
- The range in unit cost is $0.97/sy to $3.10/sy. (The $0.45/sy reported by the Kingman District is unusually low and may be due to a transcription error.)
- The binder application rate across all four districts ranges from 0.35 gal/sy to 0.47 gal/sy.

- The aggregate application rate across all four districts ranges from 22 lb/sy to 35 lb/sy.
- The allowable range in ADT is from about 1000 to 10,000 vehicles per day for both the Safford and Yuma districts. The high end of the ADT range for the Tucson District is only 3000 vehicles per day.
- The expected life of the chip seals that employ a CRS-2P binder is from five to 10 years. The Kingman District does not indicate an expected life for its PASS-based chip seal.
- Only one district (Tucson) identified the typical types of distress at failure of the chip seal. They were stripping and raveling.

Slurry Seals

Only one district provided information about slurry seals. The Safford District uses slurry seals on its state highways in both rural and urban settings. The allowable range in ADT is between 3000 and 20,000 vehicles per day while the expected life is between three and five years. No unit cost information was provided.

Microseals/Microsurfacings

Only the Safford and Yuma districts provided information about their use of microseals (microsurfacings). The Safford District uses microseals on both state and Interstate highways in both rural and urban settings. The Yuma District uses microseals on all but rural state highways. Both districts will use microseals on high-volume highways (ADT greater than 3000) and target an application rate of about 25 lb/sy to 35 lb/sy (of dry aggregate). The Yuma District expects a service life of five years, while the Safford District has a similar expectation (three to seven years).

TREATMENT COSTS

Because of the contracting method used to construct the experimental wearing course and preventive maintenance treatments, no information is available about unit construction costs of those treatments. Considering the size and nature of the experiment, there would probably be some questions about how representative those costs would be if they did exist. Accordingly, cost information was gathered from four sources to estimate each treatment's representative unit cost:

- **ADOT bid tabs.** In May 2011, ADOT analyzed its bid tabulations to determine the typical unit costs for various wearing course and preventive maintenance treatments.
- **ADOT questionnaire.** In the questionnaire circulated to all districts in July 2011, four ADOT districts provided unit cost information for the treatments they typically use.
- **California Department of Transportation (Caltrans) Pavement Preservation Task Group (PPTG).** In 2007, the PPTG Strategy Selection Committee surveyed DOT personnel and industry representatives to gather cost information about various preventive maintenance treatments used in the state.

- **HollyFrontier Companies.** 2011 estimates for most of the treatments used in the experiment were provided as a courtesy by an asphalt producer in Phoenix.

Table 11 presents the relevant cost data from these sources along with the recommended unit cost.

Table 11. Summary of Available Unit Cost on Experimental Treatments.

Type of Treatment	Unit Cost ($/sy)				
	ADOT Bid Tab Review 2011	**ADOT District Survey 2011**	**Caltrans PPTG/SSC Survey 2011**	**HollyFrontier Estimate 2011**	**Recom-mended**
Flush coat (fog seal)	0.25	–	0.15-0.30	–	0.25
Flush coat (PASS)	0.27	0.19-0.30	0.20-0.50	0.25-0.50	0.27
Scrub seal	–	1.00-1.50	–	0.75-1.50	1.25
Chip seal (CRS-2)	1.66-1.88	0.97-3.10	1.80-2.00	1.50-1.75	1.70
Chip seal (CRS-2P)	–	–	–	1.50-2.00	1.80
Chip seal (HF CRS-2P)	–	–	–	1.50-2.00	1.80
Chip seal (PASS oil/CR)	–	–	–	–	1.80
Chip seal (CM-90)	–	–	–	1.50	1.50
Chip seal (AC15-5TR, Paramount)	–	–	–	1.50-2.00	1.80
Double application chip seal	–	2.00-3.00	–	2.50-3.00	2.75
Double application chip seal and blotter	–	–	–	2.00-2.50	2.25
AR-chip seal	–	–	3.75-4.55	3.00-4.00	3.50
Slurry seal (Type III)	1.56	–	1.60-2.20	1.50-2.00	1.60
Microseal (Type III microsurfacing)	1.97	2.00-4.00	2.00-2.80	3.00+	2.00
ACFC	3.30	–	–	3.00-4.00	3.30
AR-ACFC	3.65	–	–	3.50-4.50	3.65
P-ACFC	–	–	–	3.00-3.50	3.20
P-ACFC (Paramount)	–	–	–	3:00-3.50	3.20
P-ACFC (PG 76-22+)	–	–	–	3.00-3.50	3.30
SMA	–	–	–	3.00-4.00	3.50
PEM	–	–	–	4.00	4.00
Bonded wearing course (Novachip)	–	–	10.00-14.00	6.00-7.00	6.50

CHAPTER 4. TREATMENT PERFORMANCE AND EFFECTIVENESS

This chapter summarizes the review of the performance and effectiveness of the treatments at both the wearing course experiment (Phase I) and the preventive maintenance experiment (Phase II) sites. Included are descriptions of the process used to format the pavement distress/condition data for analysis and comparison, the statistical and graphical approaches used to analyze the performance data, the steps followed to determine treatment effectiveness, and the findings of the treatment performance and effectiveness comparisons.

DETERMINATION OF DEDUCT VALUES FOR VARIOUS DISTRESS TYPES

For purposes of pavement condition assessment, most pavement distresses are characterized by their type, severity, and extent. Transverse cracking, for example, is measured in terms of crack width (severity) and length (extent). The problem with this method of characterizing pavement distress is that it makes it difficult to compare (on a uniform basis) the performance of different pavements or, in this case, different pavement treatments. For example, consider two pavements, the first exhibiting 200 ft of narrow (0.1-inch wide) transverse cracking and the second, 30 ft of wide (0.7-inch wide) transverse cracking. It's hard to answer which pavement is in better condition.

The U.S. Army Corps of Engineers (USACE) helped solve this problem by applying the Pavement Condition Index (PCI) rating procedure (ASTM 2011). In the PCI method, the overall pavement condition is given as a value between 0 (failed condition) and 100 (excellent condition). The PCI at any time is computed by subtracting the deduct values (DVs) associated with each observed distress type from 100. The DV for any given distress is calculated using a system of polynomial equations that were developed to translate the effect of extent and severity. A description of the DV equations developed by USACE is presented in Appendix D.

In the PCI procedure, a given pavement is characterized in one of seven conditions depending on its PCI value. These conditions are represented in Table 12.

Table 12. PCI Ranges for Each Pavement Condition.

PCI Range	Condition	Color Code	
85-100	Good	Green	
70-84.99	Satisfactory	Light green	
55-69.99	Fair	Yellow	
40-54.99	Poor	Light red	
25-39.99	Very poor	Red	
10-24.99	Serious	Dark red	
0-9.99	Failed	Gray	

For this study, these PCI ranges were converted to equivalent ranges in DV. Also the high end of the good range was divided into good and very good to better distinguish performance of the experimental treatments. Table 13 shows the pavement conditions associated with the new DV ranges.

Table 13. DV Ranges for Each Pavement Condition.

DV Range	Condition	Color Code	
0.00-5	Very good	Dark green	
5.01-15	Good	Green	
15.01-30	Satisfactory	Light green	
30.01-45	Fair	Yellow	
45.01-60	Poor	Light red	
60.01-75	Very poor	Red	
75.01-90	Serious	Dark red	
90.01-100	Failed	Gray	

REVIEW OF WEARING COURSE TREATMENTS AT PHASE I TEST SITES

The matrix in Table 4 illustrates the overall layout of the Phase I experiment, including the number of wearing course sections within each cell of the matrix. This table provides the basis for analyzing and comparing the performance of the different wearing course treatments seven years after construction. From an analytical standpoint, two important points must be made about the experiment's structure:

- It is valid to compare the performance of the wearing course treatments within an individual experimental site.
- Although near identical mixes were placed on the I-8 and I-10 sites at basically the same time (summer/fall 1999), it is not statistically valid to compare the wearing course treatments' performance between these sites because of the differences in traffic, environment, and underlying pavement structure. For these same reasons and because they were constructed significantly later (April 2001), it is also not statistically valid to compare the section performance at the SR 74 site with those in the I-8 and I-10 sites.

Researchers used a statistical approach to make valid performance comparisons between the wearing course treatments for the following pavement distress/performance criteria:

- Skid resistance.
- Weathering.
- Bleeding.
- Fatigue cracking.
- LTD cracking.

Rutting and patching were also initially considered; however, none of the sections exhibited any significant levels of these distresses. Surface texture, flushing, swelling, and edge cracking were not evaluated because these distresses were either considered surrogates for distresses that were being considered (e.g., surface texture for skid resistance) or were not worth the effort required to evaluate their impact on treatment comparisons (e.g., edge cracking).

Skid resistance was characterized by SN while all other distress/performance criteria were characterized by a DV that corresponds to the observed extent and severity. The DVs were calculated using the USACE DV equations (described earlier) and the pavement distress data obtained as part of the field performance data collection operations.

Analysis of Pretreatment Milling and Overlay

The wearing course experiment design made it possible to investigate the impact of milling depth and overlay thickness on wearing course performance. As shown in Table 4, the overlay thickness is constant (2 inches) while the milling depth varies from 1 to 3 inches in the I-8 sections. In the I-10 sections, the milling depth varies from 2.5 to 4.5 inches while the overlay thickness varies correspondingly from 2 to 4 inches. The fact that they vary in a colinear fashion means that it is not possible to determine their independent effects. Finally, for the SR 74 sections, the overlay thickness is identical to the milling depth, which varies from 0 to 3.5 inches.

The bar charts in Appendix E illustrate how the milling depth and overlay thickness affect different performance measures. In some cases—SN, for example (Table 102)—there is a clear correlation. In other cases, such as weathering (Table 103), there is no apparent correlation.

To investigate the relationships further, simple linear regression analyses were performed in which milling depth served as the independent (x) variable and the key performance measures served as the dependent (y) variable. If the correlation between x and y was significant (i.e., F greater than F_{crit}), then the coefficients (a_0 and a_1) generated for the linear relationship (below) are considered valid:

$$y = a_0 + a_1 \cdot x \qquad \text{(Eq. 1)}$$

The results of the regression analyses for four dependent variables—SN, weathering, fatigue cracking, and LTD cracking—are presented in Table 14 for the I-10, I-8, and SR 74 sites. Bleeding was not included because it was not observed on any of the sections.

Table 14. Equation Coefficients for Relationships between Pavement Performance Measures and Pretreatment Milling Depth.

Distress/ Performance Criteria	Treatment Type	I-10 Site			I-8 Site			SR 74 Site		
		a_0	a_1	r^2	a_0	a_1	r^2	a_0	a_1	r^2
SN	ACFC	71.0	-1.75	0.73	No correlation					
	AR-ACFC	76.0	-4.00	0.84	61.5	0.75	0.28	No correlation		
	P-ACFC	75.9	-2.25	0.84	62.2	0.50	0.15	No correlation		
	PEM	64.4	-2.25	0.79	No correlation					
	SMA	67.2	-2.25	0.65	64.0	-1.25	0.40			
	TB-ACFC							71.4	1.14	0.21
Weathering DV	ACFC	No correlation			No correlation					
	AR-ACFC	No correlation			No correlation			4.0	1.06	0.61
	P-ACFC	-1.1	4.03	0.25	No correlation			-25.9	18.3	0.59
	PEM	-3.4	1.60	0.26	No correlation					
	SMA	-3.8	1.33	0.30	No correlation					
	TB-ACFC							No correlation		
Fatigue Cracking DV	ACFC	64.1	-14.9	0.35	10.3	-3.88	0.30			
	AR-ACFC	No correlation			5.9	-2.20	0.65	2.7	5.07	0.49
	P-ACFC	51.8	-11.7	0.30	No correlation			66.3	-22.1	0.33
	PEM	30.3	-6.70	0.33	2.9	-1.10	0.30			
	SMA	-46.8	17.2	0.29	2.0	-0.75	0.30			
	TB-ACFC							87.6	-28.3	0.80
LTD Cracking DV	ACFC	81.4	-16.3	0.94	25.0	-5.18	0.43			
	AR-ACFC	7.3	5.55	0.30	43.0	-12.0	0.64	34.7	-3.98	0.21
	P-ACFC	73.0	-11.8	0.65	37.1	-7.13	0.34	No correlation		
	PEM	72.3	-13.9	0.93	53.2	-14.7	0.88			
	SMA	-8.1	10.1	0.38	44.8	-9.63	0.77			
	TB-ACFC							55.0	-13.1	0.80

Key observations from the I-8 site analysis follow:

- Researchers used milling depth as the independent variable (x) because it was the only factor that varied in the experiment. Overlay thickness was constant at 2.0 and, therefore, could not be used to explain variations in wearing course performance.
- The I-8 sections were constructed in 1999, so the performance of the wearing course treatments reflects eight years of service.

- For SN, a statistically significant correlation was found with milling depth for three of the five wearing course types: AR-ACFC, P-ACFC, and SMA. For the remaining two wearing course types (ACFC and PEM), no significant correlation in the data was detected. Although they were found to be significant, even the correlations for the AR-ACFC, P-ACFC, and SMA treatments are questionable. The coefficient of determination (r^2), which basically indicates how much of the variability in the data is explained by the relationship, for all three relationships is low (0.15 to 0.40). In addition, the sensitivity of the SN to milling depth for all three relationships is relatively low. For example, the SMA equation (which has the highest sensitivity) has an a_1 coefficient of -1.25, which means that an increase in milling depth of 2 inches translates to a reduction in SN of only 2.5. Overall, the experiment results indicate that the impact of pretreatment milling depth (along with a fixed 2-inch HMA overlay) on SN is small enough for all five wearing course treatments to be considered negligible.
- For weathering, no significant correlations were found for any of the wearing course treatments. Accordingly, the effect of pretreatment milling depth (along with a fixed 2-inch HMA overlay) on weathering is 0 for all five wearing course treatments.
- For fatigue cracking, statistically significant correlations were found for four of the five treatments. However, the r^2 values were low (0.30) for three of them. Of the four relationships, the one with the most sensitivity of DV to milling depth has an a_1 coefficient of -3.88, which means that for every inch of increased milling depth, there is a 3.88 reduction in DV after eight years of service. Interestingly, all of the equations have negative a_1 coefficients, giving some indication of a reasonable result. The relationship with the best fit (highest r^2) has a negative a_1 coefficient of -2.20, which translates to a 2.2-point DV reduction after eight years of service for every inch of milling depth. Overall, the low r^2 values and small a_1 coefficients make it difficult to conclude that pretreatment milling depth (along with a fixed 2-inch HMA overlay) has a meaningful impact on fatigue cracking performance of all five wearing course treatments.
- For LTD cracking, significant correlations were generated for all five wearing course treatments. Two of the relationships had relatively low r^2 values (0.34 and 0.43) while the remaining three had moderate to high r^2 values (0.64 to 0.88). Overall, the data strongly suggest that increased milling depth reduces the extent and/or severity of LTD cracking after eight years of service. The PEM wearing course treatment, where there is a 15-point DV reduction for every inch increase in milling depth, seems to be affected the most. The ACFC treatment has the least impact with only a 5-point DV reduction after eight years of service for every inch increase in milling depth. Overall, the magnitude of the r^2 values and a_1 coefficients indicates that milling depth (along with a fixed 2-inch HMA overlay) does have a meaningful impact on LTD cracking performance. Based upon the results, the impact is greatest for the PEM, AR-ACFC, and SMA treatments.

Key observations from the I-10 site analysis follow:

- Milling depth (instead of overlay thickness) was the independent variable for conducting the statistical analyses and developing the relationships for the I-10 experimental sections, primarily to maintain consistency with the relationships developed for the I-8 site. However, each milling depth has a corresponding HMA overlay with a thickness that is 0.5 inch thinner.

- The I-10 sections were constructed in 1999, so the wearing course treatment performance reflects eight years of service.
- For SN, good to very good correlations were found for all five wearing course treatments (r^2 values in the range of 0.65 to 0.85). Interestingly, the findings indicate that increasing the milling depth (and overlay thickness) results in lower SNs after eight years of service. The treatment with the greatest sensitivity is the AR-ACFC, which after eight years has an 8-point lower SN for a 4.5-inch mill and 4-inch overlay compared to a 2.5-inch mill and 2-inch overlay. Overall, the impact of milling depth (and corresponding HMA overlay thickness) on SN was significant, but relatively small, especially when considering how high the SNs were for all five treatments. All of the treatments had about the same level of sensitivity.
- For weathering, only three relationships for the wearing course treatments had a statistically significant correlation. However, the r^2 values were low (0.25 to 0.30). In addition, there is some additional uncertainty with the three relationships because the positive a_1 values mean higher DVs after eight years of service for the higher levels of milling and overlay performed prior to wearing course application. Overall, the impact of milling depth (and corresponding HMA overlay thickness) on weathering is not considered meaningful for any of the five wearing course treatments.
- For fatigue cracking, four of the five wearing course relationships had a statistically significant correlation. However, all five had low r^2 values (0.29 to 0.35). The a_1 values for three relationships are negative, indicating that after eight years of service, the DVs will be 13 to 30 points lower for a 4.5-inch mill and 4-inch overlay as compared to a 2.5-inch mill and 2-inch overlay. Only the relationship for the SMA wearing course, with a positive a_1 of 17.2, is questionable. Overall, it is difficult to conclude that the milling depth and the corresponding HMA overlay thickness have a meaningful impact on fatigue cracking performance. Despite the magnitude and reasonableness of the a_1 values for the ACFC, P-ACFC, and PEM treatments, the high positive a_1 value for the SMA treatment and the low r^2 values create too much uncertainty.
- For LTD cracking, relationships were developed for all five wearing course treatments. However, the r^2 values for two of the relationships were below 0.40. For both of those relationships, the a_1 values were positive, indicating that an increased milling depth (and overlay thickness) results in a higher (unreasonable) DV after eight years than a thinner milling depth and overlay thickness. The other three relationships (ACFC, P-ACFC, and PEM) have r^2 values in the range of 0.65 to 0.94 and negative a_1 values, which result in much lower (and more reasonable) DVs after eight years for the higher milling depths and thicker overlays. ACFC had the greatest sensitivity, which after eight years has a 32-point lower DV for a 4.5-inch mill and 4-inch overlay as compared to a 2.5-inch mill and 2-inch overlay. P-ACFC had the lowest sensitivity and a 24-point lower DV. Overall, there is a good indication that milling depth and the corresponding HMA overlay thickness have a meaningful impact on LTD cracking performance. The three relationships with good to high r^2 values all have a_1 values that reflect reasonable results. The two relationships that reflect questionable a_1 values also have poor r^2 values. The treatments that clearly show better LTD cracking performance with increased milling depth and overlay thickness (prior to wearing course placement) are the ACFC, PEM, and P-ACFC wearing courses.

Key observations from the SR 74 experimental section analysis follow:

- For consistency, milling depth was the independent variable. However, since milling depth and overlay thickness are the same for this part of the experiment, it did not matter whether milling depth or overlay thickness was used as the independent variable.
- The AR-ACFC and P-ACFC wearing course treatments used at this site were slightly different from the AR-ACFC and P-ACFC treatments used at the I-10 and I-8 sites.
- The SR 74 experimental sections were constructed in 2001, so the performance reflects six years of service.
- For SN, no correlation with milling depth was found for the AR-ACFC and P-ACFC wearing course treatments. In addition, the TB-ACFC treatment is suspect because its low r^2 value is so low. Accordingly, it is reasonable to conclude that milling depth and the corresponding overlay thickness have no impact on SN after six years.
- For weathering, no correlation with milling depth existed for the TB-ACFC wearing course treatment. With r^2 values of 0.61 and 0.59, the relationships for AR-ACFC and P-ACFC, respectively, have some validity; however, the positive a_1 values of 1.06 and 18.3, respectively produce results that are counterintuitive. Since the a_1 values for three of the I-10 treatments were positive, too, there is reason to question intuition and i this phenomenon further.
- For fatigue cracking, correlations were found for all three wearing course treatments. The relationship derived for the TB-ACFC treatment had the highest r^2 value (0.80) and, with an a_1 value of -28.3, exhibited the highest DV sensitivity for fatigue cracking to the milling depth. This means that the DV calculated for a 4.5-inch mill and 4-inch overlay after eight years of service is about 57 points lower than the DV calculated for a 2.5-inch mill and 2-inch overlay. The relationship derived for the P-ACFC treatment has a low r^2 value (0.33); however, with an a_1 value of -22.1, it has a sensitivity that is comparable to that of the TB-ACFC treatment. The relationship for the AR-ACFC treatment has an r^2 value of 0.49, but the a_1 value is +5.07 and inconsistent with the expected effect of increased mill depth and overlay thickness on DV. Overall, the results make estimating the impact of milling and overlay on fatigue cracking performance difficult. However, the results suggest that the TB-ACFC and P-ACFC treatments perform better with increased pretreatment milling and overlay.
- For LTD cracking, no correlation existed for the P-ACFC treatment. However, correlations were found for the AR-ACFC and TB-ACFC treatments. With r^2 values of 0.21 and 0.80, respectively, the AR-ACFC relationship is considered questionable and the TB-ACFC relationship is considered valid. The a_1 values are both negative and consistent with the negative a_1 values determined for the I-10 and I-8 LTD cracking relationships. Overall, the results indicate that LTD cracking is affected by milling depth and thickness of HMA overlay placed prior to the wearing course. The TB-ACFC treatment reflects the highest performance benefit.

Analysis of Treatment Performance

Researchers compared the individual treatment performance within each experimental site using a statistically rigorous approach and a basic ranking process. Since the pretreatment milling and overlay analysis did not show a consistent effect for any distress type (with the possible exception of LTD cracking), the mill and overlay variability was not considered in the comparison.

To determine if the overall variability of treatment performance was low enough to compare the differences in performance between treatments, researchers performed an analysis of variance (ANOVA). If the overall variability established by the ANOVA was too high, there was no statistical justification for comparing treatment performance within a given site. If the overall variability was low enough, then the mean performance of each treatment was compared against the treatment exhibiting the best performance using a Student's *t* test (Ross 2004). The *t* tests were performed assuming a null hypothesis that there is no difference between the mean performance of the two sections, a one-tail comparison, an alpha level of 0.10 (i.e., 90 percent confidence level), and equal section variances (most of the time). In some instances, the performance variability of one section was so different that it was necessary to assume unequal variances.

The output of the *t* test includes:

- A calculated t-value (t) for a given performance comparison between any one treatment and the treatment that exhibited the best performance.
- A critical t-value (t_{crit}) that is determined from the Student's *t* distribution (based upon the number of performance measurements within each section, the alpha level, and the one-tail comparison).
- A probability value (P) that represents the probability that t is less than or equal to t_{crit}.

In evaluating the test results, the null hypothesis is accepted if t is less than or equal to t_{crit}. If t is greater than t_{crit}, then the null hypothesis is rejected and the alternate hypothesis (i.e., the performance of the two sections is different) is accepted. In simpler terms, if t is greater than t_{crit}, then there is a statistically significant difference in the performance of the two sections. The P-value indicates the probability that the section with the poorer performance may actually perform better than the section with the best performance. Thus, a low P-value translates to a higher likelihood that performance of the two sections is different, and when P is less than the selected alpha level of 0.10, researchers reject the null hypothesis that the performance of the two sections is equal.

In addition to this more rigorous statistical approach, researchers devised a simpler yet practical approach for grouping the different treatments based upon their overall performance. For a given treatment and a given distress/performance measure, they calculated a 60^{th} percentile value for the distress measure (usually DV) using the mean and standard deviation of the distress as well as the standard normal deviate that corresponds to 60 percent of the area in a normal distribution. Then they used the 60^{th} percentile value to rank each treatment at each site within one of the eight conditions (defined in Table 13). Originally, the mean (or 50th percentile) value was used to rank the treatments, but it did not effectively discriminate against treatments with higher levels of performance variability. Researchers did not use the results of the Student's *t* analysis as a basis for grouping (or regrouping) the treatments into different conditions primarily because it is possible to have treatments that exhibit significantly different performance and still be in the same condition. It is also possible that a treatment in a poorer condition could have equal statistical performance (compared to the best-performing treatment) only because the treatment variability was high.

A discussion of the seven pavement performance categories follows.

SN

Table 102 in Appendix E provides the section data, measured SNs, mean and standard deviation of SNs, and graphical results used to visually compare the skid performance of the Phase I sections. ANOVAs conducted on the skid data from all three sites confirm what is apparent by visual examination—that the overall variability is low enough to compare the skid performance of the treatments within each site. Tables 15, 16, and 17 summarize the findings relative to the skid performance and treatment comparisons on the I-10, I -8, and SR 74 sections, respectively. The sections are sorted from apparent best to worst based on their 60th percentile SNs. In practice, an SN of 35 suggests the pavement should receive some type of treatment to restore skid resistance since values below 35 significantly increase the likelihood of wet weather accidents. Unlike most of the other pavement distress measures, the USACE did not develop any equations to relate SN to DV. Thus, for this study researchers employed engineering judgment to relate ranges in SN to different conditions:

- Failed: SN less than 30.
- Poor: SN between 30 and 34.99.
- Fair: SN between 35 and 39.99.
- Satisfactory: SN between 40 and 49.99.
- Good: SN between 50 and 59.99.
- Very good: SN greater than 60.

Table 15. Skid Performance of the I-10 Wearing Course Sections.

Wearing Course Treatment	Sections	SN					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
P-ACFC (¾-inch TSA)	6	68.0	65-71	2.2	67.4	Very good	–	–	–	–	–
ACFC (¾-inch TSA)	6	64.8	63-68	1.8	64.4	Very good	Equal	2.71	1.37	0.011	Reject
AR-ACFC Control (½-inch TSA)	2	63.5	58-69	7.8	61.5	Very good	Equal	1.47	1.44	0.096	Reject
AR-ACFC (¾-inch TSA)	6	62.0	57-68	3.9	61.0	Very good	Equal	3.29	1.37	0.004	Reject
SMA (¾-inch TSA)	6	59.3	57-64	2.5	58.7	Good	Equal	6.38	1.37	0.000	Reject
PEM (1¼-inch TSA)	6	56.5	53-59	2.3	55.9	Good	Equal	8.95	1.37	0.000	Reject

Table 16. Skid Performance of the I-8 Wearing Course Sections.

Wearing Course Treatment	Sections	SN					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp
P-ACFC (¾-inch TSA)	6	63.2	62-65	1.2	62.9	Very good	–	–	–	–	–
AR-ACFC (¾-inch TSA)	6	63.0	62-65	1.3	62.7	Very good	Equal	0.24	1.37	0.409	Accept
ACFC (¾-inch TSA)	6	62.7	62-63	0.5	62.5	Very good	Equal	0.96	1.37	0.181	Accept
SMA (¾-inch TSA)	6	61.5	59-64	1.8	61.1	Very good	Equal	1.93	1.37	0.041	Reject
PEM (1¼-inch TSA)	6	60.7	58-64	2.2	60.1	Very good	Equal	2.49	1.37	0.016	Reject
AR-ACFC (½-inch TSA) Control	2	No data	–	–	–	–	–	–	–	–	–

Table 17. Skid Performance of the SR 74 Wearing Course Sections.

Wearing Course Treatment	Sections	SN					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
P-ACFC (3/8-inch TSA, PG 76-22+)	5	73.8	69-81	4.4	72.7	Very good	–	–	–	–	–
TB-ACFC (3/8-inch TSA, PG 76-22 TR+)	6	73.3	67-76	3.4	72.5	Very good	Equal	0.20	1.38	0.424	Accept
AR-ACFC (3/8-inch TSA, PG 64-16, CRA-1)	7	68.9	66-71	1.7	68.4	Very good	Equal	2.73	1.37	0.011	Reject

Since all wearing course sections exhibited SN values greater than 50 after eight years of service, they all performed very well and any treatment can be used successfully to provide good skid resistance. A closer examination of the results from both statistical and practical perspectives indicates the following:

- **I-10 site.** Table 15 indicates that the skid performance of the P-ACFC treatment was significantly better than all the other treatments from a statistical standpoint. However, from a practical standpoint, the ACFC and both AR-ACFC treatments provided comparable skid performance. All three treatments were grouped in the very good range. With SN values roughly 10 points below the P-ACFC treatment, the SMA and PEM treatments exhibited poorer, but not much poorer, skid performance. They were both ranked good.
- **I-8 site.** Table 16 indicates that statistically, the skid performance of the P-ACFC, AR-ACFC, and ACFC treatments was the same, while the performance of the SMA and PEM treatments was significantly poorer. However, from a practical standpoint, all five treatments exhibited the same performance and were ranked very good.
- **SR 74 site.** Table 17 shows that from a statistical standpoint, the performance of the P-ACFC and TB-ACFC treatments was the same, while the performance of the AR-ACFC treatment was significantly poorer. From a practical standpoint, however, all the treatments provided excellent skid performance and were ranked very good.

Researchers noted an apparent correlation between skid resistance and the HMA overlay thickness at the I-10 site. However, they did not confirm or evaluate the correlation.

Weathering

Table 103 in Appendix E provides the section data, calculated DVs (for weathering), mean and standard deviation of DVs, and graphical results used to visually compare the weathering performance of the Phase I sections. ANOVAs conducted on the weathering data from all three sites indicate that the overall variability was low enough to compare the weathering performance of the treatments within each site. Tables 18, 19, and 20 summarize the findings relative to the weathering performance of the I-10, I-8, and SR 74 sections, respectively. The sections are sorted from best to worst based on their 60th percentile DVs.

The graphical results in Table 103 suggest that there is some consistency in weathering performance of the sections for a given treatment at a given site. This is also reflected in Table 18 and 19 by the low standard deviations in treatment performance at both the I-10 and I-8 sites. In addition, the treatments exhibit some meaningful differences in weathering performance:

- **I-10 site.** Based upon the results shown in Table 18, the AR-ACFC treatments (1/2-inch and 3/4-inch TSA) or the SMA treatment did not exhibit a significant difference in the weathering performance. Also, the PEM, ACFC, and P-ACFC treatment performance was significantly poorer. From a practical standpoint, however, the PEM treatment performance was the same as the top three treatments, and all four were grouped in the very good range. The ACFC and P-ACFC treatments exhibited slightly poorer performance and are grouped in the good range.
- **I-8 site.** The results in Table 19 indicate that the weathering performance of the SMA, ACFC, PEM, and AR-ACFC (3/4-inch TSA) treatments was the same, while the performance of the P-ACFC treatment was slightly poorer. From a practical standpoint, the weathering performance was the same for all five treatments, and all five were ranked very good.
- **SR 74 site.** Based upon the results in Table 20, there was agreement from both the statistical and practical perspectives. The weathering performance of the AR-ACFC treatment, which was ranked good, was clearly better than that of both P-ACFC and TB-ACFC treatments, which were ranked satisfactory.

Bleeding

Table 104 in Appendix E shows that of the 80 sections at all three wearing course sites, only one section—AR-ACFC on I-10—exhibited bleeding eight years after construction. Rigorous statistical analyses are not required to conclude that all the treatments in all the sites performed equally well and all were ranked in the very good range.

Table 18. Weathering Performance of the I-10 Wearing Course Sections.

Wearing Course Treatment	Sections	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
AR-ACFC (¾-inch TSA)	6	0.0	0	0.0	0.0	Very good	–	–	–	–	–
AR-ACFC (½-inch TSA) Control	2	0.0	0	0.0	0.0	Very good	–	–	–	–	–
SMA (¾-inch TSA)	6	0.9	0-5	2.2	1.4	Very good	Equal	1.00	1.37	0.170	Accept
PEM (1¼-inch TSA)	6	2.2	0-7	2.8	2.9	Very good	Equal	1.94	1.37	0.040	Reject
ACFC (¾-inch TSA)	6	6.7	0-10	4.1	7.8	Good	Equal	4.04	1.37	0.001	Reject
P-ACFC (¾-inch TSA)	6	13.0	2-22	7.2	14.8	Good	Unequal	4.43	1.48	0.003	Reject

Table 19. Weathering Performance of the I-8 Wearing Course Sections.

Wearing Course Treatment	Sections	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
SMA (¾-inch TSA)	6	0.0	0	0.0	0.0	Very good	–	–	–	–	–
ACFC (¾-inch TSA)	6	0.1	0-0.4	0.2	0.1	Very good	Equal	1.00	1.37	0.170	Accept
PEM (1¼-inch TSA)	6	0.2	0-1	0.4	0.3	Very good	Equal	1.25	1.37	0.120	Accept
AR-ACFC (¾-inch TSA)	6	0.3	0-2	0.8	0.5	Very good	Equal	1.00	1.37	0.170	Accept
P-ACFC (¾-inch TSA)	6	2.1	0-4	1.8	2.6	Very good	Equal	2.91	1.37	0.008	Reject
AR-ACFC (½-inch TSA) Control	2	No data	–	–	–	–	–	–	–	–	–

Table 20. Weathering Performance of the SR 74 Wearing Course Sections.

Wearing Course Treatment	Sections	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
AR-ACFC (3/8-inch TSA, PG 64-16, CRA-1)	7	5.2	3-8	2.0	5.7	Good	–	–	–	–	–
P-ACFC (3/8-inch TSA, PG 76 22+)	6	18.0	6-39	13.0	21.3	Satis-factory	Unequal	2.18	1.53	0.047	Reject
TB-ACFC (3/8-inch TSA, PG 76-22TR+)	5	24.7	15-47	11.9	27.7	Satis-factory	Unequal	3.97	1.48	0.005	Reject

Fatigue Cracking

Table 105 in Appendix E provides the section data, calculated DVs (for fatigue cracking), mean and standard deviation of DVs, and graphical results used to visually compare the fatigue cracking performance of the Phase I sections. ANOVAs conducted on data from each of the three sites indicate that the variability of performance is too large to make statistically valid performance comparisons between the treatments. This variability is likely due to the fact that fatigue cracking is affected more by site conditions (i.e., structure, traffic loading, subgrade soil conditions, and environment) than by the various treatments. Because of the high variability, no Student's *t* analyses were performed.

Tables 21, 22, and 23 summarize fatigue cracking performance of the I-10, I-8, and SR 74 sections, respectively. The sections are sorted from best to worst based on their mean DVs.

Table 21. Fatigue Cracking Performance of the I-10 Wearing Course Sections.

Wearing Course Treatment	Sections	Fatigue Cracking DV				
		Mean	Range	Std. Dev.	60th %ile	Condition
AR-ACFC (½-inch TSA) Control	2	0.0	0	0.0	0.0	Very good
PEM (1¼-inch TSA)	6	6.9	0-27	10.4	9.5	Good
P-ACFC (¾-inch TSA)	6	11.0	0-47	19.1	15.9	Satisfactory
ACFC (¾-inch TSA)	6	12.1	0-56	22.3	17.8	Satisfactory
SMA (¾-inch TSA)	6	13.5	0-72	28.7	20.7	Satisfactory
AR-ACFC (¾-inch TSA)	6	19.3	0-54	22.8	25.1	Satisfactory

Table 22. Fatigue Cracking Performance of the I-8 Wearing Course Sections.

Wearing Course Treatment	Sections	Fatigue Cracking DV				
		Mean	Range	Std. Dev.	60th %ile	Condition
P-ACFC (¾-inch TSA)	6	0.0	0	0	0.0	Very good
SMA (¾-inch TSA)	6	0.5	0-3	1.2	0.8	Very good
PEM (1¼-inch TSA)	6	0.7	0-4	1.8	1.2	Very good
AR-ACFC (¾-inch TSA)	6	1.5	0-6	2.4	2.1	Very good
ACFC (¾-inch TSA)	6	2.6	0-16	6.3	4.2	Very good
AR-ACFC (½-inch TSA) Control	2	No data	–	–	–	–

Table 23. Fatigue Cracking Performance of the SR 74 Wearing Course Sections.

Wearing Course Treatment	Sections	Fatigue Cracking DV				
		Mean	Range	Std. Dev.	60th %ile	Condition
AR-ACFC (3/8-inch TSA, PG 64-16, CRA-1)	7	8.5	0-27	10.6	11.2	Good
P-ACFC (3/8-inch TSA, PG 76-22+)	5	13.3	0-49	21.2	18.6	Satisfactory
TB-ACFC (3/8-inch TSA, PG 76-22 TR+)	6	40.4	0-99	43.2	51.3	Poor

The graphs presented in Table 105 as well as the data in Tables 21, 22, and 23 indicate the development of fatigue cracking in multiple sections of all but one of the wearing course treatments at the I-10 and SR 74 sites. Only the two 1/2-inch TSA AR-ACFC treatment sections did not exhibit fatigue cracking. Fatigue cracking was also seen in each of the treatments at the I-8 site, but at much lower levels than seen in the I-10 and SR 74 sites. Also, there is some indication that the thin overlay sections developed fatigue cracking earlier than the sections with the thicker overlays; however, researchers did not explore this finding.

Following are observations from a practical standpoint about the fatigue cracking performance of the treatments at each site:

- **I-10 site.** As can be seen in Table 21, the within-treatment variability of performance was high for five of the six treatments. Half of the sections within each of the five treatments exhibited no fatigue cracking, while the other half exhibited fatigue cracking in varying degrees. Based upon the results, it is difficult to conclude that the 1/2-inch TSA AR-ACFC treatment (control section) was the best-performing treatment since the near-identical 3/4-inch TSA AR-ACFC treatment was the worst performer. Treatment performance at this site clearly supported the ANOVA results. Overall, the range in treatment performance at this site was between fair and very good.
- **I-8 site.** Table 22 indicates that fatigue cracking was not a significant problem with any of the treatments at this site. In general, only one of the six sections within a given treatment exhibited fatigue cracking and it was not at a high level. Thus, the performance of all the treatments at this site was basically the same, and all were grouped in the very good range.
- **SR 74 site.** Table 23 indicates that like the I-10 site, the within-treatment performance of the SR 74 treatments was high (especially high for the TB-ACFC treatment). The range in performance was between poor and good, with the TB-ACFC treatment clearly performing worse than the AR-ACFC and P-ACFC treatments.

LTD Cracking

Table 106 in Appendix E provides the section data, calculated DVs (for LTD cracking), mean and standard deviation of DVs, and graphical results used to visually compare the LTD cracking performance of the Phase I sections. ANOVAs conducted on data from the three sites indicate that the variability of performance was too large to make statistically valid performance comparisons between the treatments. Consequently, no Student's *t* analyses were performed.

Tables 24, 25, and 26 summarize LTD cracking performance of the I-10, I -8, and SR 74 sections, respectively. The sections are sorted from best to worst based on their mean DVs.

Table 24. LTD Cracking Performance of the I-10 Wearing Course Sections.

Wearing Course Treatment	Sections	LTD Cracking DV				
		Mean	Range	Std. Dev.	60th %ile	Condition
AR-ACFC (½-inch TSA) Control	2	16.0	12-20	5.8	17.5	Satisfactory
PEM (1¼-inch TSA)	6	23.8	10-43	12.9	27.0	Satisfactory
ACFC (¾-inch TSA)	6	24.4	8-44	15.0	28.2	Satisfactory
AR-ACFC (¾-inch TSA)	6	26.8	15-41	9.1	29.1	Satisfactory
SMA (¾-inch TSA)	6	27.3	8-51	14.6	31.0	Fair
P-ACFC (¾-inch TSA)	6	31.9	17-48	13.1	35.2	Fair

Table 25. LTD Cracking Performance of the I-8 Wearing Course Sections.

Wearing Course Treatment	Sections	LTD Cracking DV				
		Mean	Range	Std. Dev.	60th %ile	Condition
ACFC (¾-inch TSA)	6	14.6	7-24	7.0	16.4	Satisfactory
AR-ACFC (¾-inch TSA)	6	19.0	0-37	13.5	22.4	Satisfactory
P-ACFC (¾-inch TSA)	6	22.8	14-43	10.9	25.6	Satisfactory
PEM (1¼-inch TSA)	6	23.7	7-45	14.0	27.3	Satisfactory
SMA (¾-inch TSA)	6	25.6	15-41	9.8	28.0	Satisfactory
AR-ACFC (½-inch TSA) Control	2	No data	–	–	–	–

Table 26. LTD Cracking Performance of the SR 74 Wearing Course Sections.

Wearing Course Treatment	Sections	LTD Cracking DV				
		Mean	Range	Std. Dev.	60^{th} %ile	Condition
P-ACFC (3/8-inch TSA, PG 76-22+)	5	29.5	17-39	8.2	31.6	Fair
AR-ACFC (3/8-inch TSA, PG 64-16, CRA-1)	7	30.1	9-47	12.9	33.4	Fair
TB-ACFC (3/8-inch TSA, PG 76-22 TR+)	6	33.3	11-61	20.0	38.3	Fair

Table 106 in Appendix E along with the summary results presented in Tables 24, 25, and 26, indicates LTD cracking in all treatment sections at all three sites. Like the fatigue cracking analysis, there is significant variability in performance within each treatment that can also be attributed to the effects of site conditions more than to the treatment effects. Below are general observations about the LTD crack performance at the three sites:

- **I-10 site.** The LTD crack performance for individual sections within the treatments ranges from fair to satisfactory (Table 24). The 1/2-inch TSA AR-ACFC (two control sections) showed slightly better performance than the rest. However, since the LTD crack performance of the near-identical 3/4-inch AR-ACFC is not good, it is difficult to conclude that the 1/2-inch TSA AR-ACFC is significantly better. Overall, the AR-ACFC (1/2-inch and 3/4-inch TSA), the PEM, and the ACFC treatments were ranked satisfactory, while the SMA and P-ACFC treatments were ranked fair.
- **I-8 site.** All five treatments at the I-8 site performed similarly with the ACFC treatment showing slightly better LTD crack performance (Table 25). All five treatments were grouped in the satisfactory range.
- **SR 74 site.** The performance of all three treatments at the SR 74 site is basically the same and not very good (Table 26). All three were ranked fair.

Rutting

Table 107 in Appendix E indicates that no rutting was present on any of the treatments at any of the sites. However, for most of the data collection, rutting was recorded as 0 unless it exceeded 0.25 inches. Overall, this is considered very good performance although it is likely more related to the stability and stiffness of the overlay placed before the wearing course treatment.

Patching

Table 108 in Appendix E indicates that no patching was observed on any of the treatments at the three sites, which is considered very good performance for all treatments.

Overall Assessment of Wearing Course Treatments

Treatment Performance

Table 27 provides a summary of the pavement performance rankings for all Phase 1 wearing course treatments. As previously described, these rankings are based upon the calculated 60th percentile DV (or SN, in the case of skid resistance) and the pre-established ranges for the different pavement conditions.

Using the summary performance results in Table 27 to identify which treatments are the best performers, which are satisfactory, and which should be avoided, rutting and patching can be eliminated as evaluation criteria because all the treatments performed identically. (No distress in these categories was observed.)

Table 27. Overall Performance Comparison of Phase I Wearing Course Treatments Based on 60th Percentile SNs and DVs.

Wearing Course Treatment	Skid Resistance (SN)			Weathering (DV)			Bleeding (DV)			Fatigue Cracking (DV)			LTD Cracking (DV)		
	I-10	I-8	SR 74	I-10	I-8	SR 74	I-10	I-8	SR 74	I-10	I-8	SR 74	I-10	I-8	SR 74
ACFC (3/4-in TSA)	64.4	62.5		7.8	0.1		0.0	0.0		17.8	4.2		28.2	16.4	
AR-ACFC (1/2-in TSA)	61.5			0.0			0.0			0.0			17.5		
AR-ACFC (3/4-in TSA)	61.0	62.7		0.0	0.5		2.4	0.0		25.1	2.1		29.1	22.4	
P-ACFC (3/4-in TSA)	67.4	62.9		14.8	2.6		0.0	0.0		15.9	0.0		35.2	25.6	
PEM (1 1/4-in TSA)	55.9	60.1		2.9	0.3		0.0	0.0		9.5	1.2		27.0	27.3	
SMA (3/4-in TSA)	58.7	61.1		1.4	0.0		0.0	0.0		20.7	0.8		31.0	28.0	
AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)			68.4			5.7			0.0			11.2			33.4
P-ACFC (PG 76-22+, 3/8-in TSA)			72.7			21.3			0.0			18.6			31.6
TB-ACFC (PG 76-22 TR+, 3/8-in TSA)			72.5			27.7			0.0			51.3			38.3

Legend:

Pavement Condition	Color Code
Very good	
Good	
Satisfactory	
Fair	
Poor	
Very poor	
Serious	
Failed	

Based upon the remaining pavement performance evaluation criteria, researchers made several observations about the I-10 and I-8 sites:

- Despite the differences in traffic and environment, it is reasonable to evaluate the overall performance of the I-10 and I-8 treatments together because they are the same at both sites. The I-10 sections experienced a higher rate of deterioration than the I-8 sites, but the difference was not so great that separate assessments were warranted.

- The AR-ACFC (1/2-inch TSA control) treatment clearly provided the best overall performance. Although no sections of this type were constructed along I-8, it is logical to assume that comparisons based solely on I-10 results are valid since the deterioration rate along I-10 was significantly greater, especially for fatigue cracking. The AR-ACFC (1/2-inch TSA control) exhibited very good skid resistance, weathering, bleeding, and fatigue cracking performance, and satisfactory LTD cracking performance; however, its 60th percentile DV was lower than any of the other treatments. This treatment's average condition was very good.

- The ACFC (3/4-inch TSA), PEM (1-1/4-inch TSA), and AR-ACFC (3/4-inch TSA) treatments all ranked second in overall performance. All three exhibited very good skid resistance and bleeding performance, although the PEM (1-1/4-inch TSA) treatment exhibited only good performance at the I-10 site. Each exhibited very good weathering performance, although the ACFC (3/4-inch TSA) exhibited only good performance at the I-10 site. All three exhibited satisfactory LTD cracking performance. In terms of fatigue cracking, the AR-ACFC (3/4-inch TSA) and ACFC (3/4-inch TSA) treatments were rated satisfactory to very good, while the PEM (1-1/4-inch TSA) treatment performed slightly better (in the good to very good range). The average condition of these treatments was good.

- The SMA (3/4-inch TSA) and P-ACFC (3/4-inch TSA) ranked third in overall performance. In terms of skid resistance, the P-ACFC (3/4-inch TSA) treatment was ranked very good, while the SMA (3/4-inch TSA) ranked in the good to very good range. In contrast, the SMA (3/4-inch TSA) performed slightly better in terms of weathering (very good) than the P-ACFC (3/4-inch TSA) treatment, which exhibited good to very good performance. Both treatments performed identically in terms of bleeding (very good), fatigue cracking (satisfactory to very good), and LTD cracking (fair to satisfactory). The average condition of these treatments was good.

- All of the wearing course treatments constructed at the I-10 and I-8 sites performed well in terms of the key pavement performance criteria (i.e., skid resistance, weathering, and bleeding). In general, they also all performed very well in terms of other pavement performance criteria typically applied to structural rehabilitation treatments—each of the wearing course treatments was preceded by some type of mill and overlay treatment that likely had the greater effect on structural performance.

Following are observations about the overall performance of the wearing course treatments constructed on the SR 74 site. Again, no rutting or patching was observed at these sites and, therefore, neither affects the performance assessment:

- The AR-ACFC (PG 64-28, CRA-1) and P-ACFC (PG 75-22+) treatments performed similarly to the typical AR-ACFC and P-ACFC treatments constructed on the I-10 and I-8 sites. However, they are two years younger and there are some differences in the binder types. Accordingly, no comparisons were made to treatment performance at the I-10 and I-8 sites.

- The AR-ACFC (PG 64-28, CRA-1) treatment provided the best overall performance at the SR 74 site. The levels of skid resistance and bleeding were very good while weathering was good. The AR-ACFC (PG 64-28, CRA-1) treatment also exhibited a relatively low level of fatigue cracking (ranked good), even though four of the seven sections were constructed on the original pavement (without an HMA overlay). Its LTD cracking performance was fair, which may be attributed to reflection cracking in the sections where the wearing course treatment was placed directly on the original pavement. The average condition of this treatment was good.

- The P-ACFC (PG 76-22+) treatment ranked second in terms of performance at the SR 74 site. Like the AR-ACFC (PG 64-28, CRA-1) treatment, it exhibited very good skid resistance and bleeding performance, and fair LTD cracking performance. However, the weathering and fatigue cracking performances were only satisfactory. The average condition of the treatment was good.

- As with the AR-ACFC (PG 64-28, CRA-1) and P-ACFC (PG 75-22+) treatments, the TB-ACFC (PG 76-22TR+) treatment exhibited very good skid resistance and bleeding performance, and fair LTD cracking performance. However, weathering was satisfactory and fatigue cracking was only poor. The higher levels of fatigue cracking and LTD cracking do not necessarily indicate a problem with the treatment, as the two sections which did not receive a mill and overlay exhibited the highest levels of fatigue cracking and LTD cracking. The average condition of this treatment was satisfactory.

Treatment Cost-Effectiveness

Since cost is an important factor in selecting an effective wearing course treatment, researchers compared the cost-effectiveness of each experimental treatment. They used a benefit/cost (B/C) approach in which the benefit (B) was a measure of treatment performance and the cost (C) was an estimate of the treatment unit cost. The basic formula used to calculate B was designed to consider an increasing B as good and a decreasing B as not good. Since a high DV is not good, this meant that B had to be determined based upon a reverse value (e.g., B = 100 - DV). To ensure that the performance was determined over a practical range of performance measure, researchers assigned a minimum threshold value. For SN, the minimum threshold selected was 30, which is five points below the typical minimum SN trigger value of 35. For DV, the minimum threshold value selected was 60, which corresponds to the typical PCI trigger value for pavement rehabilitation. Based on these criteria, the equation used to determine B based on SN was:

$$B_{SN} = SN - 30 \qquad \text{(Eq. 2)}$$

while the equation for B based upon the DV (for all other performance measures) was

$$B_{DV} = 60 - DV \qquad \text{(Eq. 3)}$$

Researchers determined each treatment's B/C as a ratio of B to C, where C was estimated based upon the treatment cost data presented in Table 11. The B/C calculations for each wearing course treatment were made and tabulated in a format similar to that used for the performance comparisons. To provide for a visual comparison, the cells were shaded from light to dark to represent a very low to very high range in B/C. Researchers established the SN and DV boundaries for each cost-effectiveness level based upon an analysis of a matrix of possible B/C ratios. Very high represents the top 10 percent of the distribution, high represents the distribution between 75 and 90 percent, moderate represents the distribution between 60 and 75 percent, low represents the distribution between 40 and 60 percent, and very low represents the distribution below 40 percent. Table 28 presents the final results.

Using the results of Table 28 for the I-10 and I-8 sites, researchers assigned a cost-effectiveness level (very high = 5, high = 4, moderate = 3, and so on) for each performance measure and then averaged all levels to calculate an overall mean cost-effectiveness score (MCES) for each treatment. The wearing course treatments were ranked based on the highest MCES.

- With an MCES of 4.3, the most cost-effective treatment is the ACFC (3/4-inch TSA) treatment. It was the lowest cost treatment and ranked in the second tier in terms of performance.
- With an MCES of 4.0, the AR-ACFC (1/2-inch TSA) treatment was the second-most cost-effective. All five performance measures had a high level of cost-effectiveness. Also, the treatment's performance was ranked best overall.
- The P-ACFC (3/4-inch TSA) treatment's MCES was 3.8, ranking third in cost-effectiveness. It was also ranked in the third tier in terms of performance.
- The MCES for both the AR-ACFC (3/4-inch TSA) and SMA (3/4-inch TSA) treatments was 3.6, which ranks them fourth in cost-effectiveness. In terms of performance, the AR-ACFR (3/4-inch TSA) was ranked in the second tier, while the SMA (3/4-inch TSA) was ranked in the third tier.
- The PEM (1-1/4-inch TSA) treatment, with an MCES of 3.5, ranked the lowest. This treatment had the highest estimated unit cost and did not perform as well as the other treatments in terms of skid resistance and LTD cracking. This treatment's performance, however, ranked in the second tier.

Table 28. Comparison of Cost-Effectiveness of Phase I Wearing Course Treatments.

Wearing Course Treatment	Estimated Cost ($/SY)	Skid Resistance (SN)			Weathering (DV)			Bleeding (DV)			Fatigue Cracking (DV)			LTD Cracking (DV)			Mean CE Score
		I-10	I-8	SR-74	I-10	I-8	SR-74	I-10	I-8	SR-74	I-10	I-8	SR-74	I-10	I-8	SR-74	
ACFC (3/4-in TSA)	3.30	10.4	9.8		15.8	18.2		18.2	18.2		12.8	16.9		9.6	13.2		4.3
AR-ACFC (1/2-in TSA)	3.55	8.9			16.9			16.9			16.9			12.0			4.0
AR-ACFC (3/4-in TSA)	3.70	8.4	8.8		16.2	16.1		15.6	16.2		9.4	15.6		8.4	10.2		3.6
P-ACFC (3/4-in TSA)	3.40	11.0	9.7		13.3	16.9		17.6	17.6		13.0	17.6		7.3	10.1		3.8
PEM (1 1/4-in TSA)	4.00	6.5	7.5		14.3	14.9		15.0	15.0		12.6	14.7		8.3	8.2		3.5
SMA (3/4-in TSA)	3.50	8.2	8.9		16.7	17.1		17.1	17.1		11.2	16.9		8.3	9.1		3.6
AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3.75			10.2			14.5			16.0			13.0			7.1	3.8
P-ACFC (PG 76-22+, 3/8-in TSA)	3.40			12.6			11.4			17.6			12.2			8.4	3.6
TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	3.50			12.1			9.2			17.1			2.5			6.2	3.0

Legend:

Cost Effectiveness	For SN	For DV
Very High	≥ 10.0	> 18.0
High	7.50-9.99	11.5-18.0
Moderate	5.25-7.49	8.5-11.49
Low	3.00-5.24	5.6-8.49
Very Low	< 3.0	< 5.6

The rankings of the three wearing course treatments constructed at the SR 74 site follow:

- The AR-ACFC (PG 64-28, CRA-1, 3/8-inch TSA) treatment was the most cost-effective because it had an MCES of 3.8. This treatment's performance was also ranked best.
- The P-ACFC (PG 75-22+, 3/8-inch TSA) treatment had an MCES of 3.6 and was ranked second in cost-effectiveness. It was also ranked second in performance.
- The TB-ACFC (PG 76-22TR+, 3/8-inch TSA) treatment had an MCES of 3.0 and was ranked last in terms of both cost-effectiveness and performance.

REVIEW OF PREVENTIVE MAINTENANCE TREATMENTS AT PHASE II TEST SITES

Researchers used the data in Table 5 to analyze and compare the performance of the different preventive maintenance treatments seven years after construction. From an analytical standpoint, three important points can be made about the structure of this experiment:

- Comparing preventive maintenance treatment performance within an individual experimental site is valid.
- Comparing preventive maintenance treatment performance between these sites is not statistically valid because of the likely differences in traffic, environment, and underlying pavement structure.
- Comparing treatment performance at the U.S. 191 sites are generally more meaningful than the other three sites because they are based on the performance of four sections for a given treatment rather than two.

As in the wearing course treatment evaluation, researchers used a statistics-based approach to make valid performance comparisons between the preventive maintenance treatments. In this case, only three pavement distress/performance criteria were evaluated: weathering, flushing, and LTD cracking.

Because of the importance of considering skid resistance in assessing and comparing individual treatment performance, the research team did plan to include SN as another performance criterion (as in the wearing course experiment). Unfortunately, skid test data were collected at only one of the four experimental sites: SR 83. Researchers attempted to compensate by estimating the SN for each preventive maintenance experimental section using a relationship developed from MPD and SN data from the wearing course experiment and using a correlation developed under NCHRP Project 1-43 (Hall et al. 2009) that relates friction number to the CT meter and DF test results. Unfortunately, the correlation between SN and MPD was not very good in the first case, and in the second case, the predicted SNs did not compare (at all) with the measured SNs at the SR 83 experimental site. However, the average and standard deviation of the CT meter test results for the preventive maintenance sections (1.49 mm and 0.43 mm, respectively) is basically the same as the average and standard deviation of the CT meter test results for the wearing course sections (1.35 mm and 0.41 mm, respectively), which suggests that the skid performance for the preventive maintenance sections was at least as good as that of the wearing course sections. Since the SNs for all the wearing course sections ranged from 54 to 75, it is reasonable to assume that all the preventive maintenance sections would rank in the good to very good range.

In addition to SN, several other pavement distress and performance criteria were not evaluated:

- CT meter, outflow meter, and DF Tester: There was no basis to rank the output of these friction testers into pavement conditions (good, satisfactory, fair, and so on) as was done for the other performance distress and performance criteria.
- Rutting and fatigue cracking: There were no data on these distresses at the time the treatments were placed, so it was not possible to estimate the increase in these distresses after the treatments were placed.
- Bleeding: This was considered a surrogate for flushing and was, therefore, redundant.

Weathering and LTD cracking were characterized by DVs calculated using the USACE DV equations (described in Appendix D) and the pavement distress data collected as part of the field performance data collection operations. Flushing was characterized as an index value, flushing index (FI) as defined by ADOT. The range of FI is between 0 and 5 where, according to ADOT criteria, 0 to 2 is objectionable and 3 to 5 is satisfactory. For this study, researchers employed engineering judgment to further parse ADOT's 0 to 5 range into different conditions used for the other distress and performance criteria:

- Failed: FI less than 2.0.
- Poor: FI between 2.0 and 2.99.
- Fair: FI between 3.0 and 3.49.
- Satisfactory: FI between 3.5 and 3.99.
- Good: FI between 4.0 and 4.49.
- Very good: FI between 4.5 and 5.0.

Researchers applied the same rigorous statistical approach (involving ANOVAs and Student's *t* tests) used to compare the wearing course treatments' performance to compare the preventive maintenance treatments' performance. In addition, they used the simple yet practical approach (involving the calculation of a 60^{th} percentile DV and the ranking of each treatment at each site into one of eight different conditions) to compare treatments' overall performance. Again, researchers did not attempt to introduce the results of the statistical analyses into the treatment rankings primarily because the treatments could exhibit significantly different performance and still be ranked in the same overall condition. It also did not make sense to rank a section higher just because its variability is unusually high.

Following is a discussion of the findings for the three pavement performance criteria.

Weathering

Table 109 in Appendix F provides the section data, calculated DVs (for weathering), mean and standard deviation of DVs, and graphical results used to visually compare the weathering performance of the Phase II sections. ANOVAs conducted on the weathering data from all four sites indicate that the overall variability is low enough to compare the weathering performance of the treatments within each site. Tables 29, 30, 31, and 32 summarize the weathering performance of the SR 66, SR 83, SR 87, and U.S. 191 sections, respectively. The sections are sorted from best to worst based on their 60th percentile DVs.

The graphical results in Table 109 suggest some consistency in weathering performance of the sections for a given treatment at a given site. This is also reflected in Tables 29, 30, 31, and 32 by the relatively low standard deviations in treatment performance at all four sites. In addition, some meaningful differences exist in the treatments' weathering performance:

- **SR 66 site.** As shown in Table 29, the 13 treatments constructed on SR 66 exhibited good to very good weathering performance. Thus, with the range in 60th percentile DVs only from 0 to 14, it is difficult to draw much practical significance from the results of the Student's *t* tests. Five of the treatments (chip seal AC15-5TR/Paramount, ACFC/ADOT, AR-chip/International Slurry Surfacing, microsurfacing/Southwest Slurry, and chip seal PASS oil/Western Emulsion) exhibited no weathering and were ranked very good. Based on the threshold between good and very good performance, another four treatments (AR-ACFC/ADOT, Novachip/Koch Materials, DACS&B/ADOT, and double application/unknown) were also grouped with the top five in the very good range. The remaining four treatments (chip seal CM-90/Navajo Western, chip seal CRS-2P/ADOT, chip seal CRS-2P/Crown, and chip seal CRS-2/Copperstate) were ranked good.

- **SR 83 site.** Table 30 shows that the weathering performance of the 14 treatments is in the good to very good range. The corresponding range in 60th percentile DVs is only 0 to 13, again making it difficult to draw much practical significance from the Student's *t* results. Four of the treatments (AR-chip/International Slurry Surfacing, chip seal HF CRS-2P/CS, chip seal PASS CR/Western Emulsion, and slurry seal/Southwest Slurry) exhibited no weathering and were grouped in the very good range. Six more treatments (double chip seal/ADOT, chip seal CM-90/Koch Materials, chip seal CRS-2/ADOT, AR-ACFC/unknown, chip seal CRS-2P/Crown, and chip seal CRS-2P/ADOT) were grouped with the top four treatments because their 60th percentile DVs were less than the threshold between good and very good performance. The remaining four treatments (P-ACFC/Paramount, chip seal AC15-5TR/Paramount, AR-ACFC/ADOT, and Novachip/Koch Materials) were grouped in the good range.

- **SR 87 site.** Table 31 shows the summary statistics for the nine treatments constructed along SR 87. At serious to very good, the range in weathering performance of these treatments is very wide. In this case, the Student's *t* test results clearly distinguish the difference in performance between the very good treatments and the rest. The control sections (three sections that received a 2-inch mill and overlay but no preventive maintenance treatment) along with three other treatments (chip seal AC15-5TR/Paramount, DACS&B/ADOT, and Novachip/Koch Materials) exhibited no weathering and were grouped in the very good range. The five remaining treatments were grouped into four conditions: the double chip seal/ADOT was ranked satisfactory; the chip seal CM-90/Navajo Western and chip seal CRS-2/Copperstate were ranked fair; the chip seal PASS oil/Western Emulsion was ranked poor; and the chip seal CRS-2P/Crown was ranked serious.

- **U.S. 191 site.** As noted earlier, the performance comparisons from the preventive maintenance treatments constructed along U.S. 191 are more meaningful than the other sites, primarily because the performance is based on four sections per treatment (rather than two). As can be seen in Table 32, the weathering performance of the 15 treatments varies from good to very good. Based on the DV threshold between good and very good weathering performance, 10 of the treatments (double chip seal/ADOT, chip seal CRS-2P/Crown, chip seal HF-CRS-2P/ADOT, chip seal CRS-2/ADOT, chip seal AC15-5TR/Paramount, AR-chip/International Slurry Surfacing, chip seal CRS-2P/ADOT, slurry seal/Southwest Slurry, chip seal HF-CRS-2P/Copperstate, and chip seal CM-90/Koch Materials) were ranked very good, while the remaining five treatments (P-ACFC/Paramount, Novachip/Koch Materials, control/no treatment, AR-ACFC/ADOT, and chip seal CRS-2P/ADOT future construction) were ranked good. The Student's *t* test results indicate that like the other sites, statistically valid performance comparisons can be made between individual treatments and the best-performing treatment. However, these comparisons do not offer much insight when the 60th percentile DVs for all treatments are only between 1 and 11.

Table 29. Weathering Performance of the SR 66 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Vari-ance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Chip seal AC15-5TR/ Paramount	2	0	0	0	0	Very good	–	–	–	–	–
ACFC/ ADOT	2	0	0	0	0	Very good	–	–	–	–	–
AR-chip/ International Slurry Surfacing	2	0	0	0	0	Very good	–	–	–	–	–
Microsurfacing/ Southwest Slurry	2	0	0	0	0	Very good	–	–	–	–	–
Chip seal PASS oil/ Western Emulsion	2	0	0	0	0	Very good	–	–	–	–	–
AR-ACFC/ ADOT	2	1.0	0-2	1.4	1.4	Very good	Equal	1.00	1.89	0.211	Accept
Novachip/ Koch Materials	2	1.3	0-2.5	1.8	1.7	Very good	Equal	1.00	1.89	0.211	Accept
DACS&B/ ADOT	2	1.8	1.5-2	0.4	1.8	Very good	Equal	7.00	1.89	0.010	Reject
Double application/ unknown	2	2.7	0-5.3	3.7	3.6	Very good	Equal	1.00	1.89	0.211	Accept
Chip seal CM-90/ Navajo Western	2	4.4	0-8.7	6.2	5.9	Good	Equal	1.00	1.89	0.211	Accept
Chip seal CRS-2P/ ADOT	4	6.1	2.5-11.3	3.7	7.0	Good	Equal	2.19	1.53	0.047	Reject
Chip seal CRS-2P/ Crown	2	7.8	0-15.6	11.0	10.6	Good	Un-equal	1.00	3.08	0.250	Accept
Chip seal CRS-2/ Copperstate	2	12.4	7.9-16.8	6.3	13.9	Good	Equal	2.78	1.89	0.055	Reject

Table 30. Weathering Performance of the SR 83 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
AR-chip/ International Slurry Surfacing	2	0	0	0	0	Very good	–	–	–	–	–
Chip seal HF CRS-2P/ Copperstate	2	0	0	0	0	Very good	–	–	–	–	–
Chip seal PASS CR/ Western Emulsion	2	0	0	0	0	Very good	–	–	–	–	–
Slurry seal/ Southwest Slurry	2	0	0	0	0	Very good	–	–	–	–	–
Double chip seal/ADOT	2	0.5	0-0.9	0.6	0.6	Very good	Equal	1.00	1.89	0.211	Accept
Chip seal CM-90/Koch Materials	2	1.0	0-2.0	1.4	1.4	Very good	Equal	1.00	1.89	0.211	Accept
Chip seal CRS-2/ ADOT	2	1.3	0-2.5	1.8	1.7	Very good	Equal	1.00	1.89	0.211	Accept
AR-ACFC/ unknown	3	2.3	1.5-3.0	0.8	2.5	Very good	Equal	4.10	1.64	0.013	Reject
Chip seal CRS-2P/ Crown	1	3.1	3.1	–	3.1	Very good	–	–	–	–	Accept
Chip seal CRS-2P/ ADOT	2	2.8	0-5.5	3.9	3.7	Very good	Equal	1.00	1.89	0.211	Accept
Chip seal P-ACFC/ Paramount	2	5.8	5.3-6.2	0.6	5.9	Good	Equal	12.8	1.89	0.003	Reject
Chip seal AC15-5TR/ Paramount	2	6.3	0.9-11.6	7.6	8.2	Good	Unequal	1.17	3.08	0.225	Accept
AR-ACFC/ ADOT	2	9.4	5.5-13.3	5.5	10.8	Good	Equal	2.41	1.89	0.069	Reject
Novachip/ Koch Materials	2	10.4	4.4-16.3	8.4	12.5	Good	Unequal	1.74	3.08	0.166	Accept

Table 31. Weathering Performance of the SR 87 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Chip seal AC15-5TR/ Paramount	2	0	0	0	0	Very good	–	–	–	–	–
Control (2-inch mill and overlay)	3	0	0	0	0	Very good	–	–	–	–	–
DACS&B/ ADOT	2	0	0	0	0	Very good	–	–	–	–	–
Novachip/ Koch Materials	2	0	0	0	0	Very good	–	–	–	–	–
Double chip seal/ADOT	4	12.8	4.4-26.8	10.4	15.4	Satis-factory	Un-equal	2.45	1.64	0.046	Reject
Chip seal CM-90/ Navajo Western	2	30.9	22.8-38.9	11.4	33.7	Fair	Un-equal	3.83	3.08	0.081	Reject
Chip seal CRS-2/ Copperstate	2	31.9	41.8-21.9	14.1	35.4	Fair	Un-equal	3.20	3.08	0.096	Reject
Chip seal PASS oil/ Western Emulsion	2	47.4	43.6-51.1	5.3	48.7	Poor	Equal	16.9	1.64	–	Reject
Chip seal CRS-2P/ Crown	2	81.2	78.5-83.8	3.7	82.1	Serious	Equal	41.1	1.64	–	Reject

Table 32. Weathering Performance of the U.S. 191 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sec-tions	Weathering DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Vari-ance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Double chip seal/ ADOT	4	0.9	0.4-1.5	0.5	1.0	Very good	–	–	–	–	–
Chip seal CRS-2P/ Crown	4	1.4	0.4-2.5	1.0	1.6	Very good	Equal	0.80	1.44	0.228	Accept
Chip seal HF CRS-2P/ ADOT	4	1.5	0.9-2.0	0.5	1.6	Very good	Equal	1.73	1.44	0.067	Reject
Chip seal CRS-2/ ADOT	4	1.4	0.2-3.0	1.3	1.7	Very good	Equal	0.67	1.44	0.263	Accept
Chip seal AC15-5TR/ Paramount	4	1.6	0.4-2.5	0.9	1.9	Very good	Equal	1.37	1.44	0.109	Accept
AR-chip/ International Slurry Surfacing	4	2.0	1.5-2.5	0.6	2.1	Very good	Equal	2.94	1.44	0.013	Reject
Chip seal CRS-2P/ ADOT	4	2.3	0.4-4.8	1.9	2.8	Very good	Equal	1.43	1.44	0.101	Accept
Slurry seal/ Southwest Slurry	4	2.9	2.0-5.0	1.4	3.3	Very good	Equal	2.66	1.44	0.019	Reject
Chip seal HF CRS-2P/ Copperstate	4	3.1	0.4-8.9	4.0	4.1	Very good	Equal	1.05	1.44	0.167	Accept
Chip seal CM-90/Koch Materials	4	3.9	1.5-8.6	3.2	4.7	Very good	Equal	1.84	1.44	0.057	Reject
P-ACFC/ Paramount	4	6.4	4.8-7.9	1.4	6.7	Good	Equal	7.51	1.44	0.000	Reject
Novachip/ Koch Materials	4	7.5	3.4-10.2	2.9	8.3	Good	Equal	4.46	1.44	0.002	Reject
Control (no treatment)	4	6.6	1.5-19.8	8.8	8.8	Good	Un-equal	1.28	1.64	0.145	Accept
AR-ACFC/ ADOT	4	8.5	4.4-14.8	4.4	9.6	Good	Equal	3.41	1.44	0.007	Reject
Chip seal CRS-2P/ ADOT future construction	4	8.2	1.5-23.8	10.6	10.8	Good	Un-equal	1.37	1.64	0.133	Accept

Flushing

Table 110 in Appendix F provides the section data, FI, mean and standard deviation of FIs, and graphical results used to visually compare the flushing performance of the Phase II sections. ANOVAs conducted on the flushing data from all four sites indicate that the overall variability was low enough to compare the flushing performance of the treatments within each site. Tables 33, 34, 35, and 36 summarize the flushing performance of the SR 66, SR 83, SR 87, and U.S. 191 sections, respectively. The sections are sorted from best to worst based on their 60th percentile FIs.

The graphical results in Table 110 along with the summary results in Tables 33, 34, 35, and 36 indicate that there were some meaningful differences in the flushing performance of the different treatments. The variability of flushing performance within the different treatments was generally low, providing a better basis for performance comparisons. Following are more specific observations about treatment performance at each site from both a statistical and practical standpoint:

- **SR 66 site.** Table 33 shows a wide range (poor to very good) in flushing performance of the 13 treatments. Novachip/Koch Materials exhibited no flushing, while microsurfacing/Southwest Slurry exhibited very little. Both ranked very good. ACFC/ADOT, AR-ACFC/ADOT, AR-chip/International Slurry Surfacing, and chip seal CRS-2/Copperstate were ranked good, while DACS&B/ADOT, chip seal CRS-2P/ADOT, chip seal PASS oil/Western Emulsion, and double application/unknown were ranked satisfactory. Of the remaining three treatments, chip seal AC15-5TR/Paramount and chip seal CRS-2P/Crown were ranked fair, and chip seal CM-90/Navajo Western was ranked poor. Overall, the Student's *t* tests showed a clear distinction in the performance of the best-performing treatments and the lesser treatments. (It occurs at a 60th percentile FI of 4.25.) Also, the results indicate that the flushing performance of the top two sections in the good range was basically the same as the two sections in the very good range.

- **SR 83 site.** Table 34 shows a relatively wide range (fair to very good) in flushing performance of the 14 treatments. Three of the treatments (AR-ACFC/unknown, Novachip/Koch Materials, and P-ACFC/Paramount) exhibited no flushing and were ranked very good. Based on the Student's *t* test results, the performance of these three treatments was significantly better than the remaining 11 treatments. However, because they exhibited a very minor amount of flushing, it was practical to include three more treatments (AR-ACFC/ADOT, chip seal PASS CR/Western Emulsion, and chip seal CRS-2P/Crown) that were ranked very good. Of the remaining eight treatments, one (chip seal CM-90/Koch Materials) was ranked good; five (chip seal AC15-5TR/Paramount, double chip seal/ADOT, chip seal HF CRS-2P/Copperstate, AR-chip/International Slurry Surfacing, and chip seal CRS-2/ADOT) were ranked satisfactory; and two (chip seal CRS-2P/ADOT and slurry seal/Southwest Slurry) were ranked fair.

- **SR 87 site.** Table 35 also shows a relatively wide range (fair to very good) in flushing performance of the nine treatments. Four treatments (chip seal CRS-2/Copperstate, chip seal CRS-2P/Crown, Novachip/Koch Materials, and chip seal PASS oil/Western Emulsion) showed no flushing and were ranked very good. Two more treatments (double chip seal/ADOT and the control treatment [2-inch mill and overlay]) exhibited only a minor amount of flushing and were ranked very good. According to the Student's *t* test results, all six treatments performed the same and significantly better than the three remaining treatments. Two of those treatments (chip seal AC15-5TR/Paramount and DACS&B/ADOT) were ranked good, and the last (chip seal CM-90/Navajo Western) was ranked fair.

- **U.S. 191 site.** As previously noted, the performance comparisons of treatments constructed along U.S. 191 are more meaningful than the other sites, primarily because the performance is based on four sections per treatment instead of two. That noted, the data for the 15 treatments in Table 36 show some similarities with the other three sites, including a relatively wide range (poor to good) in flushing performance. Only one section (slurry seal/Southwest Slurry) did not exhibit flushing and was ranked very good. Based upon the Student's *t* test results, this section's performance was significantly better than any of the other treatments. Nevertheless, five more treatments (control/no treatment, Novachip/Koch Materials, AR-ACFC/ADOT, chip seal HF CRS-2P/Copperstate, and P-ACFC/Paramount) were ranked very good because they exhibited only a minor amount of flushing. Of the remaining nine treatments, four (chip seal CRS-2P/ADOT, chip seal CRS-2P/ADOT future construction, chip seal HF CRS-2P/ADOT, and chip seal CRS-2/ADOT) were ranked good; two (chip seal CRS-2P/Crown and AR-chip/International Slurry Surfacing) were ranked satisfactory; two (chip seal CM-90/Koch Materials and chip seal AC15-5TR/Paramount) were ranked fair; and one (double chip seal/ADOT) was ranked poor.

Table 33. Flushing Performance of the SR 66 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Flushing Index					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P $(t<t_{crit})$	Null Hyp.
Novachip/ Koch Materials	2	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Microsurfacing/ Southwest Slurry	2	4.8	4.5-5.0	0.4	4.7	Very good	Equal	1	1.89	0.211	Accept
ACFC/ ADOT	2	4.5	4.0-5.0	0.7	4.3	Good	Equal	1	1.89	0.211	Accept
AR-ACFC/ ADOT	2	4.5	4.0-5.0	0.7	4.3	Good	Equal	1	1.89	0.211	Accept
AR-chip/ International Slurry Seal	2	4.3	4.0-4.5	0.4	4.2	Good	Equal	3	1.89	0.048	Reject
Chip seal CRS-2/ Copperstate	2	4.0	4.0-4.0	0	4.0	Good	Equal	65535	1.89	–	Reject
DACS&B/ ADOT	2	3.8	3.5-4.0	0.4	3.7	Satis-factory	Equal	5	1.89	0.019	Reject
Chip seal CRS-2P/ ADOT	4	3.8	3.5-4.5	0.5	3.6	Satis-factory	Equal	3.33	1.53	0.014	Reject
Chip seal PASS oil/ Western Emulsion	2	3.8	3.0-4.5	1.1	3.5	Satis-factory	Equal	1.67	1.89	0.119	Accept
Double application/ unknown	2	3.5	3.5-3.5	0	3.5	Satis-factory	Equal	65535	1.89	–	Reject
Chip seal AC15-5TR/ Paramount	2	3.0	3.0-3.0	0	3.0	Fair	Equal	65535	1.89	–	Reject
Chip seal CRS-2P/ Crown	2	3.0	3.0-3.0	0	3.0	Fair	Equal	65535	1.89	–	Reject
Chip seal CM-90/ Navajo Western	2	2.8	2.5-3.0	0.4	2.7	Poor	Equal	9	1.89	0.006	Reject

Table 34. Flushing Performance of the SR 83 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Flushing Index					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60th %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
AR-ACFC/ Unknown	3	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Novachip/ Koch Materials	2	5.0	5.0-5.0	0	5.0	Very good	Equal	–	–	–	Accept
P-ACFC/ Paramount	2	5.0	5.0-5.0	0	5.0	Very good	Equal	–	–	–	Accept
AR-ACFC/ ADOT	2	4.5	4.5-4.5	0	4.5	Very good	Equal	65535	1.64	–	Reject
Chip seal PASS CR/ Western Emulsion	2	4.5	4.5-4.5	0	4.5	Very good	Equal	65535	1.64	–	Reject
Chip seal CRS-2P/ Crown	1	4.5	4.5	0	4.5	Very good	–	–	–	–	–
Chip seal CM-90/ Koch Materials	2	4.0	4.0-4.0	0	4.0	Good	Equal	65535	1.64	–	Reject
Chip seal AC15-5TR/ Paramount	2	4.0	3.5-4.5	0.7	3.8	Satis-factory	Equal	2.68	1.64	0.037	Reject
Double chip seal/ADOT	2	4.0	3.5-4.5	0.7	3.8	Satis-factory	Equal	2.68	1.64	0.037	Reject
Chip seal HF CRS-2P/ Copperstate	2	4.0	3.5-4.5	0.7	3.8	Satis-factory	Equal	2.68	1.64	0.037	Reject
AR-chip/ International Slurry Surfacing	2	3.8	3.5-4.0	0.4	3.7	Satis-factory	Equal	6.71	1.64	0.003	Reject
Chip seal CRS-2/ ADOT	2	3.8	3.5-4.0	0.4	3.7	Satis-factory	Equal	6.71	1.64	0.003	Reject
Chip seal CRS-2P/ ADOT	2	3.5	3.0-4.0	0.7	3.3	Fair	Equal	4.02	1.64	0.014	Reject
Slurry seal/ Southwest Slurry	2	3.5	2.5-4.5	1.4	3.1	Fair	Equal	2.01	1.64	0.069	Reject

Table 35. Flushing Performance of the SR 87 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Flushing Index					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Chip seal CRS-2/ Copperstate	2	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Chip seal CRS-2P/ Crown	2	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Novachip/ Koch Materials	2	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Chip seal PASS oil/ Western Emulsion	2	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Double chip seal/ADOT	4	4.9	4.5-5.0	0.3	4.8	Very good	Equal	0.67	1.53	0.270	Accept
Control (2-inch mill and overlay)	3	4.7	4.5-5.0	0.3	4.6	Very good	Equal	1.55	1.64	0.110	Accept
Chip seal AC15-5TR/ Paramount	2	4.3	4.0-4.5	0.4	4.2	Good	Equal	3	1.89	0.048	Reject
DACS&B/ ADOT	2	4.0	4.0-4.0	0	4.0	Good	Equal	65535	1.89	–	Reject
Chip seal CM-90/ Navajo Western	2	3.5	3.0-4.0	0.7	3.3	Fair	Equal	2	1.89	0.048	Reject

Table 36. Flushing Performance of the U.S. 191 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	Flushing Index					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Slurry seal/ Southwest Slurry	4	5.0	5.0-5.0	0	5.0	Very good	–	–	–	–	–
Control (no treatment)	4	4.8	4.5-5.0	0.3	4.7	Very good	Equal	1.73	1.44	0.067	Reject
Novachip/ Koch Materials	4	4.8	4.5-5.0	0.3	4.7	Very good	Equal	1.73	1.44	0.067	Reject
AR-ACFC/ ADOT	4	4.5	4.5-4.5	0	4.5	Very good	Equal	65535	1.44	–	Reject
Chip seal HF CRS-2P/ Copperstate	4	4.5	4.5-4.5	0	4.5	Very good	Equal	65535	1.44	–	Reject
P-ACFC/ Paramount	4	4.5	4.5-4.5	0	4.5	Very good	Equal	65535	1.44	–	Reject
Chip seal CRS-2P/ ADOT	4	4.6	3.5-5.0	0.8	4.4	Good	Equal	1	1.44	0.356	Accept
Chip seal CRS-2P/ ADOT future construction	4	4.4	4.0-5.0	0.5	4.3	Good	Equal	6	1.44	0.020	Reject
Chip seal HF CRS-2P/ ADOT	4	4.3	3.5-4.5	0.5	4.1	Good	Equal	3	1.44	0.012	Reject
Chip seal CRS-2/ ADOT	4	4.1	3.5-4.5	0.5	4.0	Good	Equal	3.66	1.44	0.005	Reject
Chip seal CRS-2P/ Crown	4	4.0	3.5-4.5	0.6	3.9	Satis-factory	Equal	3.46	1.44	0.007	Reject
AR-chip/ International Slurry Seal	4	3.9	3.5-4.0	0.3	3.8	Satis-factory	Equal	9	1.44	–	Reject
Chip seal CM-90/ Koch Materials	4	3.1	3.0-3.5	0.3	3.1	Fair	Equal	15	1.44	–	Reject
Chip seal AC15-5TR/ Paramount	4	3.3	2.0-4.0	1.0	3.0	Fair	Equal	3.66	1.44	0.005	Reject
Double chip seal/ADOT	4	2.8	2.0-4.0	0.9	2.5	Poor	Equal	5.2	1.44	0.002	Reject

LTD Cracking

Table 111 in Appendix F provides the section data, LTD cracking DVs, mean and standard deviation of DVs, and graphical results used to visually compare the LTD cracking performance of the Phase II sections. ANOVAs conducted on the LTD cracking data from all four sites indicate that the overall variability was low enough to compare the LTD cracking performance of the treatments within each site. Tables 37, 38, 39, and 40 summarize the LTD cracking performance of the SR 66, SR 83, SR 87, and U.S. 191 sections, respectively. The sections are sorted from best to worst based on their 60th percentile DVs.

The graphical results in Table 111 along with the summary results in Tables 37, 38, 39, and 40 indicate that there are some meaningful differences in the treatments'LTD cracking performance. The variability of flushing performance within the different treatments was generally low, providing a better basis for performance comparisons. Following are more specific comments about treatment performance at each site from both a statistical and practical standpoint:

- **SR 66 site.** Table 37 shows a wide range (poor to very good) in LTD cracking performance in the 13 treatments. Only one treatment (chip seal CRS-2P/Crown) exhibited low LTD cracking that could be ranked very good based upon the threshold between the good and very good range. However, the Student's *t* test results indicate that the next five treatments (with 60th percentile DVs less than 16.2) exhibited equal performance. Four treatments (chip seal CRS-2P/ADOT, chip seal CM-90/Navajo Western, Novachip/Koch Materials, and ACFC/ADOT) were ranked good. Of the next eight treatments, six (chip seal PASS oil/Western Emulsion, AR-chip/International Slurry Surfacing, chip seal CRS-2/Copperstate, microsurfacing/Southwest Slurry, AR-ACFC/ADOT, and chip seal AC15-5TR/Paramount) were ranked satisfactory; one (double application/unknown) was ranked fair; and one (DACS&B/ADOT) poor.

- **SR 83 site.** The 14 preventive maintenance treatments shown in Table 38 also exhibit a relatively wide range (fair to very good) in LTD cracking. Three of the treatments (chip seal CRS-2P/Crown, chip seal PASS CR/Western Emulsion, and AR-chip/International Slurry Surfacing) were ranked very good. The Student's *t* test results suggest that eight of the next nine treatments exhibited the same performance; however, many of them have higher levels of variability that make discriminating performance among them more difficult. Of the remaining 11 treatments, five (AR-ACFC/ADOT, Novachip/Koch Materials, chip seal CM-90/Koch Materials, chip seal HF CRS-2P/Copperstate, and chip seal AC15-5TR/Paramount) were ranked good; five more (chip seal CRS-2/ADOT, slurry seal/Southwest Slurry, chip seal CRS-2P/ADOT, double chip seal/ADOT, and AR-ACFC/unknown) were ranked satisfactory; and one (P-ACFC/Paramount) was ranked fair.

Table 37. LTD Cracking Performance of the SR 66 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	LTD DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Chip seal CRS-2P/ Crown	2	3.6	3.1-4.0	0.6	3.7	Very good	–	–	–	–	–
Chip seal CRS-2P/ ADOT	4	5.5	0-21.8	10.9	8.3	Good	Unequal	0.36	1.64	0.370	Accept
Chip seal CM-90/ Navajo Western	2	8.1	3.3-12.9	6.8	9.8	Good	Equal	0.94	1.89	0.222	Accept
Novachip/ Koch Materials	2	8.5	0-17.0	12.0	11.5	Good	Unequal	0.58	3.08	0.332	Accept
ACFC/ ADOT	2	10.0	0.6-19.3	13.2	13.3	Good	Unequal	0.68	3.08	0.309	Accept
Chip seal PASS oil/ Western Emulsion	2	11.9	0-23.7	16.8	16.1	Satis-factory	Unequal	0.70	3.08	0.306	Accept
AR-chip/ International Slurry Surfacing	2	17.2	15.3-19.0	2.6	17.8	Satis-factory	Equal	7.14	1.89	0.010	Reject
Chip seal CRS-2/ Copperstate	2	15.0	5.6-24.3	13.2	18.3	Satis-factory	Unequal	1.22	3.08	0.219	Accept
Microsurfacing/ Southwest Slurry	2	21.3	18.4-24.2	4.1	22.3	Satis-factory	Equal	6.04	1.89	0.013	Reject
AR-ACFC/ ADOT	2	17.0	0-34.0	24.0	23.1	Satis-factory	Unequal	0.79	3.08	0.287	Accept
Chip seal AC15-5TR/ Paramount	2	22.3	16.5-28.1	8.2	24.4	Satis-factory	Unequal	3.22	3.08	0.096	Reject
Double application/ unknown	2	33.6	29.4-37.8	5.9	35.1	Fair	Equal	0.87	1.53	0.217	Accept
DACS&B/ ADOT	2	43.6	36.8-50.3	9.5	46.0	Poor	Unequal	5.91	3.08	0.053	Reject

Table 38. LTD Cracking Performance of the SR 83 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	LTD Cracking Deduct Value					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Chip seal CRS-2P/ Crown	1	1.5	1.5	0.0	1.5	Very good	–	–	–	–	–
Chip seal PASS CR/ Western Emulsion	2	2.0	0.8-3.2	1.7	2.4	Very good	–	–	–	–	–
AR-chip/ International Slurry Surfacing	2	3.0	1.4-4.5	2.2	3.5	Very good	Equal	0.49	1.89	0.338	Accept
AR-ACFC/ ADOT	2	6.3	3.8-8.7	3.5	7.1	Good	Equal	1.56	1.89	0.130	Accept
Novachip/ Koch Materials	2	6.9	4.3-9.5	3.7	7.8	Good	Equal	1.71	1.89	0.115	Accept
Chip seal CM-90/ Koch	2	7.1	3.7-10.5	4.8	8.3	Good	Equal	1.41	1.89	0.146	Accept
Chip seal HF CRS-2P/ Copperstate	2	9.3	8.8-9.7	0.6	9.4	Good	Equal	5.66	1.89	0.015	Reject
Chip seal AC15-5TR/ Paramount	2	7.0	0-14.0	9.9	9.5	Good	Unequal	0.70	3.08	0.305	Accept
Chip seal CRS-2/ ADOT	2	14.8	8.0-21.5	9.5	17.2	Satis-factory	Unequal	1.86	3.08	0.157	Accept
Slurry seal/ Southwest Slurry	2	14.8	7.9-21.7	9.8	17.3	Satis-factory	Unequal	1.83	3.08	0.159	Accept
Chip seal CRS-2P/ ADOT	2	13.9	6.7-33.4	17.1	18.2	Satis-factory	Unequal	1.35	3.08	0.203	Accept
Double chip seal/ ADOT	2	14.9	3.1-26.7	16.7	19.1	Satis-factory	Unequal	1.09	3.08	0.237	Accept
AR-ACFC/ unknown	3	18.6	13.0-22.8	5.0	19.8	Satis-factory	Equal	4.29	1.64	0.011	Reject
P-ACFC/ Paramount	2	34.0	28.2-39.7	8.1	36.0	Fair	Unequal	5.44	3.08	0.058	Reject

Table 39. LTD Cracking Performance of the SR 87 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	LTD Cracking DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Chip seal AC15-5TR/ Paramount	2	2.5	2.2-2.7	0.4	2.5	Very good	–	–	–	–	–
DACS&B/ ADOT	2	6.0	5.8-6.2	0.3	6.1	Good	Equal	11.09	1.89	0.004	Reject
Chip seal CM-90/ Navajo Western	2	9.5	4.1-14.8	7.6	11.4	Good	Unequal	1.31	3.08	0.208	Accept
Double chip seal/ADOT	4	10.6	6.3-14.7	3.7	11.6	Good	Equal	2.95	1.53	0.021	Reject
Chip seal PASS oil/ Western Emulsion	2	11.4	10.0-12.8	2.0	11.9	Good	Equal	6.29	1.89	0.012	Reject
Novachip/ Koch Materials	2	17.3	13.3-21.2	5.6	18.7	Satis-factory	Equal	3.74	1.89	0.032	Reject
Chip seal CRS-2P/ Crown	2	16.7	10.4-22.9	8.8	18.9	Satis-factory	Unequal	2.27	3.08	0.132	Accept
Control (2-inch mill and overlay)	3	20.6	13.0-31.4	9.6	23.1	Satis-factory	Unequal	3.28	1.89	0.041	Reject
Chip seal CRS-2/ Copperstate	2	21.0	14.4-27.5	9.3	23.3	Satis-factory	Unequal	2.82	3.08	0.108	Accept

Table 40. LTD Cracking Performance of the U.S. 191 Preventive Maintenance Sections.

Preventive Maintenance Treatment, Producer	Sections	LTD Cracking DV					Student's *t* Test Results				
		Mean	Range	Std. Dev.	60^{th} %ile	Cond.	Variance	t	t_{crit}	P ($t<t_{crit}$)	Null Hyp.
Double chip seal/ ADOT	4	6.1	0.2-15.5	6.9	7.8	Good	–	–	–	–	–
Chip seal CRS-2P/ ADOT (future construction)	4	7.1	0.0-15.6	8.2	9.1	Good	Equal	0.19	1.44	0.427	Accept
Control (no treatment)	4	7.9	0.0-15.2	7.3	9.7	Good	Equal	0.36	1.44	0.364	Accept
Chip seal CM-90/ Koch	4	10.5	0.8-20.4	10.8	13.2	Good	Equal	0.69	1.44	0.258	Accept
Chip seal AC15-5TR/ Paramount	4	11.6	7.4-23.7	8.1	13.6	Good	Equal	1.04	1.44	0.169	Accept
Chip seal CRS-2/ ADOT	4	14.4	11.6-16.9	2.4	15.0	Satis-factory	Equal	2.28	1.44	0.031	Reject
Chip seal CRS-2P/ Crown	4	14.8	6.0-22.2	6.7	16.5	Satis-factory	Equal	1.82	1.44	0.060	Reject
AR-ACFC/ ADOT	4	15.3	5.3-25.8	9.2	17.6	Satis-factory	Equal	1.60	1.44	0.081	Reject
P-ACFC/ Paramount	4	17.7	11.2-27.4	7.2	19.5	Satis-factory	Equal	2.34	1.44	0.029	Reject
Chip seal CRS-2P/ ADOT	4	15.9	0.5-44.1	19.5	20.8	Satis-factory	Equal	0.95	1.44	0.189	Accept
AR-chip/ International Slurry Surfacing	4	19.5	10.4-25.3	6.8	21.2	Satis-factory	Equal	2.79	1.44	0.016	Reject
Novachip/ Koch Materials	4	24.0	19.6-31.5	5.5	25.4	Satis-factory	Equal	4.08	1.44	0.003	Reject
Chip seal HF CRS-2P/ ADOT	4	24.8	10.8-40.5	13.2	28.1	Satis-factory	Equal	2.52	1.44	0.023	Reject
Chip seal HF CRS-2P/ Copperstate	4	37.9	31.1-46.1	6.2	39.5	Fair	Equal	6.88	1.44	–	Reject
Slurry seal/ Southwest Slurry	4	42.0	26.0-57.3	16.0	46.1	Poor	Equal	4.13	1.44	0.003	Reject

- **SR 87 site.** The performance of the nine preventive maintenance treatments in Table 39 shows a range in LTD cracking from satisfactory to very good. Only one treatment (chip seal AC15-5TR/Paramount) was ranked very good. Considering the Student's *t* test results as well as the performance variability, none of the remaining treatments performed as well. Four of the treatments (DACS&B/ADOT, chip seal CM-90/Navajo Western, double chip seal/ADOT, and chip seal PASS oil/Western Emulsion) were ranked good, and four (Novachip/Koch Materials, chip seal CRS-2P/Crown, control [2-inch mill and overlay], and chip seal CRS-2/Copperstate) were ranked satisfactory.

- **U.S. 191 site.** Table 40 shows a relatively wide range (poor to good) in LTD cracking performance for the 15 treatments. None of the treatments satisfied the 60th percentile DV criteria to be ranked very good. Five treatments (double chip seal/ADOT, chip seal CRS-2P/ADOT future construction, control [no treatment], chip seal CM-90/Koch Materials, and chip seal AC15-5TR/Paramount) were ranked good. According to the Student's *t* test results, these five treatments performed significantly better than the rest. Of the remaining 10 treatments, six (chip seal CRS-2/ADOT, chip seal CRS-2P/Crown, AR-ACFC/ADOT, chip seal CRS-2P/ADOT, P-ACFC/Paramount, and AR-chip/International Slurry Surfacing) were ranked satisfactory; three (Novachip/Koch Materials, chip seal HF CRS-2P/ADOT, and chip seal HF CRS-2P/CS) were ranked fair; and one (slurry seal/Southwest Slurry) ranked poor.

Overall Assessment of Preventive Maintenance Treatments

Treatment Performance

Table 41 summarizes the pavement performance rankings for all the preventive maintenance treatments in the Phase II experiment. As previously described, these rankings are based upon the calculated 60th percentile DV (or FI, in the case of flushing) and the pre-established ranges for the different pavement conditions. Several overall observations can be made about the treatments based upon the three pavement performance evaluation criteria used in this study:

- The overall assessment of treatment performance is based on an analysis of the performance data available for each preventive maintenance treatment. Each of the three distress types is weighted equally for comparison and ranking.
- As indicated in the experiment design, not all of the preventive maintenance treatments were placed at all four sites. Consequently, researchers evaluated treatment performance based on data from one, two, three, or four sites. In comparing treatment performance, researchers did not account for the higher uncertainty associated with the treatments constructed at only one or two sites. However, they gave more weight to the performance of treatments constructed on U.S. 191 because each treatment's performance was defined based on four sections (compared to two sections for the other three sites).

Table 41. Overall Performance Comparison of Phase I Wearing Course Treatments Based on 60th Percentile DVs and FIs.

Treatment		Weathering (DV)				Flushing (FI)				LTD Cracking (DV)			
		SR-66	SR-83	SR-87	US-191	SR-66	SR-83	SR-87	US-191	SR-66	SR-83	SR-87	US-191
Control	No treatment			0.0	8.8			4.6	4.7			23.1	9.7
ACFC	ADOT	0.0				4.3				13.3			
AR-ACFC	ADOT	1.4	10.8		9.6	4.3	4.5		4.5	23.1	7.1		17.6
AR-ACFC	Not Identified		2.5				5.0				19.8		
P-ACFC	Paramount		5.9		6.7		5.0		4.5		36.0		19.5
AR-Chip	International Slurry	0.0	0.0		2.1	4.2	3.7		3.8	17.8	3.5		21.2
Chip Seal (AC15-5TR)	Paramount	0.0	8.2	0.0	1.9	3.0	3.8	4.2	3.0	24.4	9.5	2.5	13.6
Chip Seal (CM-90)	Navajo Western	5.9		33.7		2.7		3.3		9.8		11.4	
	Koch Materials		1.4		4.7		4.0		3.1		8.3		13.2
Chip Seal (CRS-2)	ADOT		1.7		1.7		3.7		4.0		17.2		15.0
	Copperstate	13.9		35.4		4.0		5.0		18.3		23.3	
Chip Seal (CRS-2P)	ADOT	7.0	3.7		2.8	3.6	3.3		4.4	8.3	18.2		20.8
	ADOT (FC)				10.8				4.3				9.1
	Crown	10.6	3.1	82.1	1.6	3.0	4.5	5.0	3.9	3.7	1.5	18.9	16.5
Chip Seal (HF CRS-2P)	ADOT				1.6				4.1				28.1
	Copperstate		0.0		4.1		3.8		4.5		9.4		39.5
Chip Seal (PASS Oil)	Western Emulsion	0.0		48.7		3.5		5.0		16.1		11.9	
Chip Seal (PASS CR)	Western Emulsion		0.0				4.5				2.4		
DACS&B	ADOT	1.8		0.0		3.7		4.0		46.0		6.1	
Double Chip Seal	ADOT		0.6	15.4	1.0		3.8	4.8	2.5		19.1	11.6	7.8
Double Application	Not Identified	3.6				3.5				35.1			
Microsurfacing	Southwest Slurry	0.0				4.7				22.3			
Slurry Seal	Southwest Slurry		0.0		3.3		3.1		5.0		17.3		46.1
Novachip	Koch Materials	1.7	12.5	0.0	8.3	5.0	5.0	5.0	4.7	11.5	7.8	18.7	25.4

Legend:

Pavement Condition State	Color Code
Very Good	
Good	
Satisfactory	
Fair	
Poor	
Very Poor	
Serious	
Failed	

- Of the 24 sections in the preventive maintenance experiment (summarized in Table 41), six stand out in terms of the performance quality and consistency, and were assigned a performance ranking of 1:
  - **Chip seal PASS CR/Western Emulsion.** This treatment was constructed at only one site (SR 83); however, it exhibited the best performance (very good range) in all three categories (weathering, flushing, and LTD cracking). The average condition of this treatment would be considered very good.

- **AR-ACFC/not identified.** This treatment was also constructed only at SR 83. Weathering and flushing were both in the very good range, while LTD cracking was in the satisfactory range. The average condition of this treatment would be considered good.
- **Novachip/Koch Materials.** This treatment was one of three constructed at all four experimental sites. Weathering performance was in the good to very good range, while flushing performance was in the very good range. The LTD cracking performance was in the satisfactory to good range. This treatment's average condition would be considered good.
- **ACFC/ADOT.** This treatment was constructed at SR 66. Its weathering performance was very good, while the flushing and LTD cracking performance were both in the good range. The average condition of this treatment would be considered good.
- **Microsurfacing/Southwest Slurry.** This treatment was also only at SR 66, and its performance was identical to the AR-ACFC/not identified treatment. Weathering and flushing were both in the very good range while LTD cracking was in the satisfactory range. The average condition of this treatment would be considered good.
- **Control.** The control sections constructed at the SR 87 and U.S. 191 sites performed as well as the above sections. This is especially noteworthy for the four sections at the U.S. 191 site since they did not receive any treatment. It is less significant for the two sections at the SR 87 site since they received a 2-inch mill and overlay. Weathering performance was rated very good for the SR 87 sections and good for the U.S. 191 sections, while flushing was in the very good range at both sites. LTD cracking was rated satisfactory for the SR 87 sections and good for the U.S. 191 sections. The average condition of this treatment would be considered good.

- Nine more treatments provided evidence of good performance and received a performance ranking of 2. The average condition of all these treatments would be considered good.
  - **Chip seal CRS-2P/ADOT future construction.** This treatment was constructed at U.S. 191. It exhibited good weathering, flushing, and LTD cracking performance.
  - **AR-ACFC/ADOT.** This treatment was constructed at SR 66, SR 83, and U.S. 191. Weathering and flushing were both in the good to very good range while LTD cracking was in the satisfactory to good range.
  - **P-ACFC/Paramount.** This treatment was constructed at SR 83 and U.S. 191. It exhibited good weathering performance, very good flushing performance, and fair to satisfactory LTD cracking performance.
  - **Chip seal CRS-2/ADOT.** This treatment was constructed at SR 83 and U.S. 191. It provided very good weathering performance, satisfactory flushing performance, and satisfactory LTD cracking performance.
  - **AR-chip/International Slurry Surfacing.** This treatment was constructed at SR 66, SR 83, and U.S. 191. Its performance ranking was based upon weathering in the very good range, flushing in the satisfactory to good range, and LTD cracking in the satisfactory to very good range.

    - **Chip seal CRS-2P/ADOT.** This treatment was placed at SR 66, SR 83, and U.S. 191. It exhibited good to very good weathering performance, fair to good flushing performance, and satisfactory to good LTD cracking performance.
    - **Chip seal HF CRS-2P/Copperstate.** This treatment was constructed at SR 83 and U.S. 191. It exhibited very good weathering performance, satisfactory to very good flushing performance, and fair to good LTD cracking performance.
    - **Chip seal HF CRS-2P/ADOT.** This treatment was constructed at U.S. 191. It exhibited very good weathering performance, good flushing performance, and satisfactory LTD cracking performance.
    - **Chip seal CM-90/Koch Materials.** This treatment was constructed at SR 66 and SR 87. It exhibited very good weathering performance, fair to good flushing performance, and good LTD cracking performance.

- Five treatments exhibited generally good performance, but were assigned a performance ranking of 3 because of the ratings dropped off and because one site for each treatment exhibited a potential performance problem (i.e., poor or fair rating). The average condition of all of these treatments would be considered satisfactory.
    - **Double chip seal/ADOT.** This treatment was placed at SR 83, SR 87, and U.S. 191. Weathering performance was in the satisfactory to very good range while LTD cracking was in the satisfactory to good range. Flushing performance was satisfactory to very good at two sites, but poor at the third.
    - **DACS&B/ADOT.** This treatment was constructed at SR 66 and SR 87. It exhibited very good weathering performance and satisfactory to good flushing performance. However, LTD cracking was poor at one site and good at the other.
    - **Chip seal PASS oil/Western Emulsion.** This treatment was constructed at two sites (SR 66 and SR 83). It exhibited satisfactory to very good flushing performance and satisfactory to good LTD cracking performance. Weathering performance was very good at one site, but poor at the other.
    - **Chip seal CRS-2/Copperstate.** This treatment was constructed at SR 66 and SR 87. Its LTD cracking performance was satisfactory, while flushing was in the fair to good range. Its weathering performance was satisfactory at one site and fair at the other.
    - **Double application/not identified.** This treatment was placed only at SR 66. It exhibited very good weathering performance, satisfactory flushing performance, and fair LTD cracking performance.

- The last four of the 24 treatments were placed in a “questionable” performance category and assigned a performance ranking of 4 because two or more sites exhibited a potential performance problem. Since these treatments were characterized as questionable, there is some uncertainty about how future sections would perform. Thus, researchers recommend that these treatments be investigated further.

- **Chip seal AC15-5TR/Paramount.** This treatment was constructed at all four sites. It provided good to very good weathering performance, fair to good flushing performance, and satisfactory to very good LTD cracking performance. The average condition of this treatment would be considered satisfactory.
- **Slurry seal/Southwest Slurry.** This treatment was placed at SR 83 and U.S. 191. Weathering performance was very good, while flushing performance was fair to very good. LTD cracking was satisfactory at one site, but poor at the other. The average condition of this treatment would be considered satisfactory.
- **Chip seal CRS-2P/Crown.** This treatment was placed at all four sites. LTD cracking performance was satisfactory to very good. Three of the sections exhibited satisfactory to very good weathering performance; however, the fourth was very poor. Similarly for flushing, three of the sections exhibited satisfactory to very good performance, but the fourth was poor. The average condition of this treatment would be considered satisfactory.
- **Chip seal CM-90/Navajo Western (SR 66 and SR 87).** This treatment was constructed at two sites. LTD cracking performance was good. However, flushing performance was only poor to fair, and weathering performance was only fair to good. The average condition of this treatment would be considered fair.

Treatment Cost-Effectiveness

Researchers used the same B/C approach to evaluate the wearing course treatments that was used to evaluate the preventive maintenance treatments. The benefit equation used to calculate the benefit associated with DV was the same. The FI benefit equation was:

$$B_{FI} = \text{FI} - 2 \qquad \text{(Eq. 4)}$$

Researchers used a threshold value of 2 because it corresponds to the failed level for FI.

Like the wearing course treatments, the cost-effectiveness for each preventive maintenance treatment was determined as a ratio of B to C, where C was estimated based upon the treatment cost data presented in Table 11. The B/C calculations for each wearing course treatment were made and tabulated, and the cells were shaded from light to dark to represent a very low to very high range in B/C. The results are presented in Table 42. No B/C results are shown for the control sections since technically no cost is associated with these sections.

Table 42. Comparison of Cost-Effectiveness of Phase II Preventive Maintenance Treatments.

Treatment		Estimated Cost ($/SY)	[illegible] (%)				[illegible]				[illegible] (%)				MCES	Rank
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	18.2				0.70				14.2				4.33	B
[illegible]	[illegible]	[illegible]	16.1	13.5		13.8	0.63	0.68		0.68	10.1	14.5		11.6	3.78	D
[illegible]	[illegible]	[illegible]		15.8				0.82				11.0			3.67	D
[illegible]	[illegible]	[illegible]		16.9		16.7		0.94		0.78		7.5		12.7	3.67	D
[illegible]	[illegible]	[illegible]	17.1	17.1		16.5	0.63	0.49		0.51	12.1	16.1		11.1	3.67	D
Chip Seal [illegible]	[illegible]	[illegible]	33.3	28.8	33.3	32.3	0.56	1.00	1.22	0.56	19.8	28.1	31.9	25.8	4.67	A
Chip Seal [illegible]	[illegible]	[illegible]	36.1		17.5		0.47		0.87		33.5		32.4		4.33	B
	[illegible]	[illegible]		39.1		36.9		1.33		0.73		34.5		31.2	4.83	A
Chip Seal [illegible]	[illegible]	[illegible]		34.3		34.3		1.00		1.18		25.2		26.5	5.00	A
	[illegible]	[illegible]	27.1		14.5		1.18		1.76		24.5		21.6		4.83	A
Chip Seal [illegible]	[illegible]	[illegible]	29.4	31.3		31.8	0.89	0.72		1.33	28.7	23.2		21.8	4.78	A
	[illegible]	[illegible]				27.3				1.28				28.3	5.00	A
	[illegible]	[illegible]	27.4	31.6	-12.3	32.4	0.56	1.39	1.67	1.06	31.3	32.5	22.8	24.2	4.42	B
Chip Seal [illegible]	[illegible]	[illegible]				32.4				1.17				17.7	4.67	A
	[illegible]	[illegible]		33.3		31.1		1.00		1.39		28.1		11.4	4.67	A
Chip Seal [illegible]	[illegible]	[illegible]	33.3		6.3		1.00		1.67		24.4		26.7		4.50	B
Chip Seal [illegible]	[illegible]	[illegible]		33.3				1.39				32.0			5.00	A
[illegible]	[illegible]	[illegible]	25.9		26.7		0.76		0.89		6.2		24.0		4.17	C
[illegible] Chip Seal	[illegible]	[illegible]		21.6	16.2	21.5		0.65	1.02	0.18		14.9	17.6	19.0	4.11	C
[illegible]	[illegible]	[illegible]	20.5				0.55				9.1				3.67	D
[illegible]	[illegible] Slurry	[illegible]	30.0				1.35				18.9				5.00	A
Slurry Seal	[illegible] Slurry	[illegible]		37.5		35.4		0.69		1.88		26.7		8.7	4.50	B
[illegible]	[illegible]	[illegible]	9.0	7.3	9.2	8.0	0.46	0.46	0.46	0.42	7.5	8.0	6.4	5.3	2.42	F

Legend

Cost-Effectiveness		[illegible]	[illegible]
Very High		>0.92	[illegible]
High		[illegible]	[illegible]
Moderate		[illegible]	[illegible]
Low		[illegible]	[illegible]
Very Low		[illegible]	[illegible]

Using the B/C results, researchers calculated an overall MCES for each treatment by assigning a cost-effectiveness level (very high = 5, high = 4, moderate = 3, and so on) for each of the three performance measures and then calculating the average. The rankings of the preventive maintenance course treatments were calculated based on the MCES. The most cost-effective treatments were ranked in the A category if the MCES was greater than 4.6. The remaining rankings were based on the following: B (4.6 ≤ MCES > 4.25), C (4.25 ≤ MCES > 3.9), D (3.9 ≤ MCES > 3.5), E (3.5 ≤ MCES > 3.0), and F (3.0 ≤ MCES). The results of the ranking process are shown in the last column of Table 42.

Table 43 presents the results of the B/C analysis in which the preventive maintenance treatments are ordered by their cost-effectiveness ranking and then by their performance ranking. Also shown is the number of experimental sections, the estimated (unit) cost, and MCES for each treatment.

Following are comments about the treatments under each cost-effectiveness ranking in Table 43:

- **A cost-effectiveness ranking.** These treatments were all at the low end of the cost range and generally exhibited good to very good performance.

Table 43. Ranking of Phase II Preventive Maintenance Treatments Based on Cost-Effectiveness and Performance.

Cost Effectiveness Ranking	Treatment		No. of Sections	Estimated Cost ($/SY)	Mean Cost Effectiveness Score	Performance Ranking
A	Chip Seal (PASS CR)	Western Emulsion	2	1.80	5.00	1
	Microsurfacing	Southwest Slurry	2	2.00	5.00	1
	Chip Seal (CRS-2)	ADOT	6	1.70	5.00	2
	Chip Seal (CRS-2P)	ADOT (FC)	4	1.80	5.00	2
	Chip Seal (CM-90)	Koch Materials	6	1.50	4.83	2
	Chip Seal (CRS-2P)	ADOT	8	1.80	4.78	2
	Chip Seal (HF CRS-2P)	ADOT	4	1.80	4.67	2
	Chip Seal (HF CRS-2P)	Copperstate	6	1.80	4.67	2
	Chip Seal (CRS-2)	Copperstate	4	1.70	4.83	3
	Chip Seal (AC15-5TR)	Paramount	10	1.80	4.67	4
B	ACFC	ADOT	2	3.30	4.33	1
	Chip Seal (PASS Oil)	Western Emulsion	4	1.80	4.50	3
	Slurry Seal	Southwest Slurry	6	1.60	4.50	4
	Chip Seal (CRS-2P)	Crown	10	1.80	4.42	4
	Chip Seal (CM-90)	Navajo Western	4	1.50	4.33	4
C	DACS&B	ADOT	4	2.25	4.17	3
	Double Chip Seal	ADOT	8	2.75	4.11	3
D	AR-ACFC	Not Identified	2	3.65	3.67	1
	AR-ACFC	ADOT	8	3.65	3.78	2
	P-ACFC	Paramount	6	3.20	3.67	2
	AR-Chip	International Slurry	8	3.50	3.67	2
	Double Application	Not Identified	2	2.75	3.67	3
F	Novachip	Koch Materials	10	6.50	2.42	1

- The data for the chip seal PASS-CR/Western Emulsion and the microsurfacing/Southwest Slurry indicate that they are the best performing (level 1) as well as the most cost-effective. However, since both treatments are represented by only two sections each, there is some uncertainty about their future performance and cost-effectiveness.
- Compared to the chip seal PASS-CR/Western Emulsion and the microsurfacing/ Southwest Slurry treatments, the chip seal CRS-2/ADOT and the chip seal CRS-2P/ADOT future construction exhibited the same very high level of cost-effectiveness, but a slightly lower performance (level 2). On the other hand, because they were represented by six and four sections, respectively, there is less uncertainty in their rankings.
- The chip seal CM-90/Koch Materials, the chip seal CRS-2P/ADOT, chip seal HF CRS-2P/ADOT, chip seal HF CRS-2P/Copperstate, and chip seal CRS-2/Copperstate all exhibited slightly lower performance (level 2 or 3) and slightly lower cost-effectiveness. In addition, each was represented by four to eight sections, so the rankings are meaningful.

- Despite the low overall performance rating, the chip seal AC15-5TR/Paramount was still ranked in the highest cost-effectiveness level. This treatment was represented by 10 sections, so the findings are reasonably certain.

- **B cost-effectiveness ranking.** Four of the five treatments in this group were at the low end of the cost range and on the lower end of the performance range. The fifth treatment had a cost in the midrange and a high level of performance.
  - The ACFC/ADOT treatment had the lowest cost-effectiveness in this group because of the higher cost associated with a friction course. However, it was promoted to first because it had the high performance ranking (level 1). There is some uncertainty associated with this ranking since the treatment was represented by only two sections.
  - The chip seal PASS oil/Western Emulsion had the highest MCES in this group, but was listed second because of the lower performance ranking (level 3). This treatment was represented by four sections, so the ranking is less uncertain than those treatments represented by only two sections.
  - The slurry seal/Southwest Slurry, chip seal CRS-2P/Crown, and chip seal CM-90/Navajo Western were included in this group because of their relatively high cost-effectiveness. However, they were listed at the bottom of the group because of their low relative performance (level 4). Each of these treatments was well-represented by four to 10 sections, so the rankings are meaningful.
- **C cost-effectiveness ranking.** Only two treatments were assigned to this cost-effectiveness group—the DACS&B/ADOT and double chip seal/ADOT—because of their lower level of cost-effectiveness and performance (level 3). These treatments were represented by four and eight sections, respectively, so the findings are meaningful.
- **D cost-effectiveness ranking.** These treatments were generally twice the cost of the treatments in the other groups. However, with one exception, they each exhibited a relatively high level of performance.
  - As a friction course, the AR-ACFC/not identified treatment had a relatively high cost. However, it was ranked in the high level of performance (level 1). This treatment was represented by only two sections, so there is some uncertainty about its future performance and cost-effectiveness.
  - The AR-ACFC/ADOT, P-ACFC/Paramount, and AR-chip/International Slurry treatments all had a relatively high cost and generally good performance (level 2). Each was represented by six to eight sections, so the findings are reasonably certain.
  - The double application/not identified treatment had a significantly lower cost than any of the other treatments in this group. However, it also had lower overall performance (level 3). This treatment was represented by only two sections.
- **E cost-effectiveness ranking.** There were no treatments in this category.
- **F cost-effectiveness ranking.** There was only one treatment in this category—the Novachip/Koch Materials—because its cost was more than three times the cost of the lower cost treatments. Its performance, however, was among the best (level 1). It was represented by 10 sections, so its performance and cost-effectiveness are reasonably certain.

CHAPTER 5. SUMMARY FINDINGS AND RECOMMENDATIONS

This report summarizes the performance data gathered during the Phase I, Wearing Course Experiment, and the Phase II, Preventive Maintenance Experiment, and documents the findings of detailed data analyses based on condition survey data collected at a single time. Following is a summary of the key findings and recommendations:

- Seven pavement performance measures were considered in the evaluation of the wearing course treatments. They included skid resistance, weathering, bleeding, fatigue cracking, LTD cracking, rutting, and patching. Rutting and patching were dropped from the evaluation after a review of the data showed almost no rutting and no patching.

- For the preventive maintenance treatments, only weathering, flushing, and LTD cracking were used in the evaluation. Skid resistance was not included because skid testing was performed at only one of the four sites. Researchers made various attempts to consider other measures of surface friction and texture, but none was successful. (The one finding from reviewing the localized field test data, however, was that all of the preventive maintenance treatments maintained a very high level of surface texture and/or friction through 2007.) Rutting and fatigue cracking were not included in the evaluation because no data were available about conditions prior to the treatment. Therefore, there was no basis to determine the increase in either rutting or fatigue cracking after the treatment. Instead of bleeding, flushing data were used to evaluate each treatment’s propensity to bleed or flush under high temperatures and traffic loading. Patching was not evaluated in the evaluation because only two of the treatments required patching during the test period.

- The wearing course experiment design made it possible to investigate the impact of milling depth and overlay thickness on wearing course treatment performance in terms of SN, weathering, fatigue cracking, and LTD cracking. Milling depth was the key variable in the experiment. For the I-10 and SR 74 sections, the overlay thickness varied in a colinear fashion with milling depth, so it was not possible to evaluate the independent effects. For the I-8 sections, the overlay thickness was a constant 2 inches and only the milling depth varied. Overall, the analysis results varied considerably and did not support a finding that milling depth and its corresponding overlay thickness have a consistent and meaningful effect on any of the performance measures. (Of the four, the analysis for LTD cracking came the closest.) Table 44 summarizes the relevant findings for each experimental site-performance type combination.

Table 44. Effect of Milling Depth on Treatment Performance.

Distress/ Performance Type	I-10 Site	I-8 Site	SR 74 Site
SN	The correlations were generally good, but the results indicate that higher milling depth results in lower SNs over time. Sensitivity was low for all treatments.	No correlation (and no effect) for ACFC and PEM. Effect was small enough to be considered negligible for AR-ACFC, P-ACFC, and SMA.	No correlation (and no effect) for AR-ACFC and P-ACFC. Correlation for TB-ACFC is poor, and sensitivity is low.
Weathering	No correlation (and no effect) for ACFC and AR-ACFC. Correlations for remaining treatments were poor and produced counterintuitive results.	No correlation (and no effect) for any of the treatments.	No correlation (and no effect) for TB-ACFC. Correlations for AR-ACFC and P-ACFC are valid, but produce counterintuitive results.
Fatigue cracking	No correlation (and no effect) for AR-ACFC. Remaining correlations were significant despite having poor fits. SMA correlation showed effect opposite to expectation.	Correlations are mostly poor and sensitivity is low. For example, the reduction in DV after 8 years for AR-ACFC (the best relationship) is 4.4 for a 2-inch mill (and 2-inch overlay).	Good correlation for TB-ACFC and fair correlations for AR-ACFC and P-ACFC. TB-ACFC and P-ACFC correlations showed high sensitivity to milling depth. P-ACFC showed opposite effect.
LTD cracking	Correlations for AR-ACFC and SMA were poor and produced unreasonable results. Correlations for ACFC, PEM, and P-ACFC were good and produced valid results.	Correlations are significant and effect is meaningful for all five treatments. The effect of a 2-inch mill and overlay on the DV after 8 years ranges from 10 (ACFC) to 30 (PEM).	No correlation (and no effect) for P-ACFC. Good correlation for TB-ACFC that showed high sensitivity. Poor correlation for AR-ACFC that showed medium sensitivity.

- Because of the inconsistent results with regard to the effect of milling depth on treatment performance, no attempt was made to account for milling depth effects in the performance comparisons. Thus, the variability associated with those effects became part of the overall performance variability associated with each treatment.

- Data analyses involving the use of statistical tools (i.e., ANOVA and Student's *t* testing) were employed to compare treatment performance at each experimental site. The primary problem that made it difficult to make practical as well as statistically valid comparisons was high variability in the performance data. For example, when two sections with different mean performance values (such as SN = 55 vs. SN = 65) have high performance variability, the statistical result may indicate that the difference in the means is not significant (or the performance is the same). A second problem occurred at times when comparing treatments that exhibited very good performance and had low variability. For example, if two sections exhibited very little LTD cracking (such as DV = 0 vs. DV = 2) and had a corresponding low variability, the statistical result may indicate that difference is significant, although from an engineering standpoint, it was not. In the end, researchers used the primary result of the statistical analyses to determine which treatments performed as well as the best-performing treatment and which did not (for each treatment within each experimental site).

- Grouping (or ranking) the treatments within the different performance categories based upon their 60th percentile distress level provided a good practical approach for evaluating and comparing treatment performance. The performance ranges were based upon those used in the PCI rating procedure (ASTM 2011), and each treatment was grouped based upon its 60th percentile performance measures (e.g., 60th percentile DV).

  The experimental wearing course treatments along I-10 and I-8 were constructed in 1999 and were surveyed and tested in 2007 after eight years of service. Table 45 provides a performance summary and overall ranking of the wearing course treatments within the two sites. The performance ranking was divided into three levels. Since all of the treatments performed well overall, the distinctions between the three levels are relatively small, but worth defining.

  The AR-ACFC (1/2-inch TSA) control was the overall best-performing treatment. It was only applied at the I-10 site; however, that site exhibited more fatigue and LTD cracking than the I-8 site, so the assessment is reasonable.

- After the performance assessment, researchers evaluated the cost-effectiveness of the I-10 and I-8 wearing course sections using a B/C approach. The benefit for each performance measure was calculated as the difference between the measured performance at the 2007 testing date and a nominal minimum performance level. For example, in the case of LTD cracking where the DV at seven years was 11 and the selected nominal DV was 60 (which corresponds to a PCI trigger level for rehabilitation of 40), the calculated benefit is 60 minus 11, or 49. The cost component of the B/C approach was the unit cost of the treatment (in $/sy). If the unit cost of the treatment was $3.50/sy, the calculated B/C was 14.0 (for LTD cracking). Table 28 summarized the B/C values for all six wearing course treatments and all five performance measures. This table also shows that the B/C value for each performance measure and treatment type was assigned a cost-effectiveness level ranging from very low to very high. The breakpoints between the cost-effectiveness levels were determined by

Table 45. Performance Summary and Overall Ranking of Wearing Course Treatments at the I-10 and I-8 Experimental Sites.

Performance Ranking	Treatment	Performance Measure					Average Condition
		SN	Weathering	Bleed-ing	Fatigue Cracking	LTD Cracking	
1	AR-ACFC (1/2-inch TSA)	Very good	Very good	Very good	Very good	Satisfactory	Very good
2	AR-ACFC (3/4-inch TSA)	Very good	Very good	Very good	Satisfactory to very good	Satisfactory	Good
	PEM (1¼-inch TSA)	Good to very good	Good to very good	Very good	Good to very good	Satisfactory	Good
	ACFC (3/4-inch TSA)	Very good	Good to very good	Very good	Satisfactory to very good	Satisfactory	Good
3	P-ACFC (3/4-inch TSA)	Very good	Good to very good	Very good	Satisfactory to very good	Fair to satisfactory	Good
	SMA (3/4-inch TSA)	Good to very good	Very good	Very good	Satisfactory to very good	Fair to satisfactory	Good

examining a factorial of B/C combinations and dividing them into percentiles (very high = 90 to 100, high = 75 to 90, moderate = 60 to 75, low = 40 to 60, and very low = 0 to 40). Researchers then calculated an MCES for each treatment based upon the average of the cost-effectiveness values for each treatment. Since there are five cost-effectiveness levels, the MCES values can range from 0 to 5. The MCES values were then used to rank the overall cost-effectiveness of each treatment. Table 46 provides the overall cost-effectiveness ranking of each treatment. Letters were used to differentiate the cost-effectiveness rankings from performance rankings.

Table 46. Cost-Effectiveness Summary and Overall Ranking of Wearing Course Treatments at the I-10 and I-8 Experimental Sites.

Cost-Effectiveness Ranking	Wearing Course Treatment	MCES	Estimated Treatment Cost ($/sy)	Performance Ranking
A	ACFC (3/4-inch TSA)	4.3	3.30	2
B	AR-ACFC (1/2-inch TSA)	4.0	3.55	1
C	P-ACFC (3/4-inch TSA)	3.8	3.40	3
D	AR-ACFC (3/4-inch TSA)	3.6	3.70	2
D	SMA (3/4-inch TSA)	3.6	3.50	3
E	PEM (1-1/4-inch TSA)	3.5	4.00	2

The most cost-effective treatment, ACFC (3/4-inch TSA), was the least expensive and had a performance ranking of 2. The best-performing treatment, AR-ACFC (1/2-inch TSA), had the second highest cost-effectiveness ranking.

- The wearing course treatments at the SR 74 site were constructed in 2001 and were surveyed and tested six years later in 2007. Table 47 provides a performance summary and overall ranking of the wearing course treatments within the site. Again, the performance ranking was divided into three levels, but the distinction between the treatments is greater, especially between the P-ACFC (PG 76-22+) and the TB-ACFC (PG 76-22 TR+).

- The cost-effectiveness analysis of the SR 74 sections was done the same way as the I-10 and I-8 sections. The cost-effectiveness rankings mirrored the performance rankings (Table 48).

- The experimental preventive maintenance treatments along SR 66, SR 83, SR 87, and U.S. 191 were constructed in 2000 and 2001, and were surveyed and tested in 2007. Table 49 provides a summary and overall performance ranking of the preventive maintenance treatments at the four sites. The performance ranking was divided into four levels with five treatments and the control sections exhibiting the best overall performance. The treatments

Table 47. Performance Summary and Overall Ranking of Wearing Course Treatments at the SR 74 Experimental Site.

Performance Ranking	Treatment	Performance Measure					Average Condition
		SN	Weathering	Bleeding	Fatigue Cracking	LTD Cracking	
1	AR-ACFC (PG 64-28, CRA-1)	Very good	Good	Very good	Good	Fair	Good
2	P-ACFC (PG 76-22+)	Very good	Satisfactory	Very good	Satisfactory	Fair	Good
3	TB-ACFC (PG 76-22 TR+)	Very good	Satisfactory	Very good	Poor	Fair	Satisfactory

Table 48. Cost-Effectiveness Summary and Overall Ranking of Wearing Course Treatments at the SR 74 Experimental Site.

Cost-Effectiveness Ranking	Wearing Course Treatment	MCES	Estimated Treatment Cost ($/sy)	Performance Ranking
C	AR-ACFC (PG 64-16, CRA-1, 3/8-inch TSA)	3.8	3.75	1
D	P-ACFC (PG 76-22+, 3/8-inch TSA)	3.6	3.40	2
F	TB-ACFC (PG 76-22 TR+, 3/8-inch TSA)	3.0	3.50	3

Table 49. Performance Summary and Overall Ranking of the Preventive Maintenance Treatments at the SR 66, SR 83, SR 87, and U.S. 191 Experimental Sites.

Performance Ranking	Treatment	Performance Measure			Average Condition
		Weathering	Flushing	LTD Cracking	
1	Chip seal PASS CR/Western Emulsion	Very good	Very good	Very good	Very good
	AR-ACFC/not identified	Very good	Very good	Satisfactory	Good
	Novachip/Koch Materials	Good to very good	Very good	Satisfactory to good	Good
	ACFC/ADOT	Very good	Good	Good	Good
	Microsurfacing/Southwest Slurry	Very good	Very good	Satisfactory	Good
	Control sections	Good to very good	Very good	Satisfactory to good	Good
2	Chip seal CRS-2P/ADOT future construction	Good	Good	Good	Good
	AR-ACFC/ADOT	Good to very good	Good to very good	Satisfactory to good	Satisfactory
	P-ACFC/Paramount	Good	Very good	Fair to satisfactory	Satisfactory
	Chip seal CRS-2/ADOT	Very good	Satisfactory	Satisfactory	Satisfactory
	AR-chip/Internationall Slurry Surfacing	Very good	Satisfactory to good	Satisfactory to very good	Satisfactory
	Chip seal CRS-2P/ADOT	Good to very good	Fair to good	Satisfactory to good	Satisfactory
	Chip seal HF CRS-2P/Copperstate	Very good	Satisfactory to very good	Fair to good	Satisfactory
	Chip seal HF CRS-2P/ADOT	Very good	Good	Satisfactory	Satisfactory
	Chip seal CM-90/Koch Materials	Very good	Fair to satisfactory	Good	Satisfactory
3	Double chip seal/ADOT	Satisfactory to very good	Poor to very good	Satisfactory to good	Satisfactory
	DACS&B/ADOT	Very good	Satisfactory	Poor to good	Satisfactory
	Chip seal PASS oil/Western Emulsion	Poor to very good	Satisfactory to very good	Satisfactory to good	Satisfactory
	Chip seal CRS-2/Copperstate	Fair to satisfactory	Satisfactory to very good	Satisfactory	Satisfactory
	Double application/not identified	Good	Satisfactory	Fair	Satisfactory
4	Chip seal AC15-5TR/Paramount	Good to very good	Fair to good	Satisfactory to very good	Satisfactory
	Slurry seal/Southwest Slurry	Very good	Fair to very good	Poor to satisfactory	Satisfactory
	Chip seal CRS-2P/Crown	Satisfactory to very good	Poor to very good	Satisfactory to very good	Satisfactory
	Chip seal CM-90/Navajo Western	Fair to good	Poor to fair	Good	Fair

that are ranked in the second and third performance levels all had an average condition in the satisfactory range; however, the second tier was at the high end of the range and the third tier was at the low end. Although they exhibited satisfactory performance on the average, the treatments in the fourth performance tier were ranked in this category because they had two or more sections that did not perform well. Researchers recommend that these treatments be investigated further.

Table 49 lists the treatments in general ranking order of their performance; however, it should be emphasized that the number of sections representing each treatment ranges from two to 10, so it is not exactly an "apples to apples" comparison.

- The preventive maintenance sections were evaluated for cost-effectiveness using the same B/C approach used for the wearing course treatments. Researchers calculated the benefit for each of the three performance measures (weathering, flushing index, and transverse cracking) as the difference between the measured performance at the 2007 testing date and a nominal minimum performance level. The selected nominal DV was 60 for weathering and LTD cracking while the nominal FI was 2.0. The cost component of the B/C approach was the unit cost of the treatment (in $/sy).

  Table 42 summarized the B/C values for all 23 preventive maintenance treatments and each of the three performance measures. This table also shows that the B/C value for each performance measure and treatment type was assigned a cost-effectiveness level ranging from very low to very high. The breakpoints between the cost-effectiveness levels were the same as those used for the wearing course treatment (i.e., very high = 90 to 100, high = 75 to 90, moderate = 60 to 75, low = 40 to 60, and very low = 0 to 40). The MCES was calculated for each treatment based upon the average of the cost-effectiveness values for each treatment. (Since there are five cost-effectiveness levels, the MCES values range from 0 to 5.) The MCES values were then used to rank the overall cost-effectiveness of each treatment, which are summarized in Table 50. Note that letters were used to differentiate the cost-effectiveness rankings from the numerical performance rankings.

  Two treatments had the highest cost-effectiveness ranking and the highest performance ranking: chip seal (PASS) by Western Emulsion and microsurfacing by Southwest Slurry. Six of the remaining eight treatments—all chip seals—were also in the highest cost-effectiveness ranking; however, they were in the second performance ranking level. The last two treatments with the highest cost-effectiveness ranking level were on the low end of the performance rankings. The chip seal AC15-5TR treatment made the highest cost-effectiveness ranking since it had some sections that did not perform well. However, the rankings of the remaining preventive maintenance treatments clearly show that treatment cost has more of an impact on the assessment of cost-effectiveness than performance.

Table 50. Cost-Effectiveness Summary and Overall Ranking of the Preventive Maintenance Treatments at the SR 66, SR 83, SR 87, and U.S. 191 Experimental Sites.

Cost-Effectiveness Ranking	Preventive Maintenance Treatment	MCES	Estimated Treatment Cost ($/sy)	Performance Ranking
A	Chip seal PASS CR/Western Emulsion	5.00	1.80	1
	Microsurfacing/Southwest Slurry	5.00	2.00	1
	Chip seal CRS-2/ADOT	5.00	1.70	2
	Chip seal CRS-2P/ ADOT future construction	5.00	1.80	2
	Chip seal CM-90/Koch Materials	4.83	1.50	2
	Chip seal CRS-2P/ADOT	4.78	1.80	2
	Chip seal HF CRS-2P/ADOT	4.67	1.80	2
	Chip seal HF CRS-2P/Copperstate	4.67	1.80	2
	Chip seal CRS-2/Copperstate	4.83	1.70	3
	Chip seal AC15-5TR/Paramount	4.67	1.80	4
B	ACFC/ADOT	4.33	3.30	1
	Chip seal PASS oil/Western Emulsion	4.50	1.80	3
	Slurry seal/Southwest Slurry	4.50	1.60	4
	Chip seal CRS-2P/Crown	4.42	1.80	4
	Chip seal CM-90/Navajo Western	4.33	1.50	4
C	DACS&B/ADOT	4.17	2.25	3
	Double chip seal/ADOT	4.11	2.75	3
D	AR-ACFC/not identified	3.67	3.65	1
	AR-ACFC/ADOT	3.78	3.65	2
	P-ACFC/Paramount	3.67	3.20	2
	AR-chip/International Slurry Surfacing	3.67	3.50	2
	Double application/not identified	3.67	2.75	3
F	Novachip/Koch Materials	2.42	6.50	1

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APPENDIX A
TEST SECTION DESCRIPTIONS

Table 51. Test Section Descriptions for I-10 Wearing Course Treatments.

I-10 Eastbound (EB) MP 186.20 to MP 190.74								
Test Section ID	Material	Construction Date	Mill Thickness (in)	Overlay Thickness (in)	MP From	MP To	Length (mi)	Distance (ft)
99-1	AR-ACFC (1/2-in TSA) Control	5/19/1999	3.5	3.0	186.20	186.48	0.28	1478.40
99-2	AR-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	186.48	186.76	0.28	1478.40
99-3	SMA (3/4-in TSA)	5/19/1999	2.5	2.0	186.76	187.05	0.29	1531.20
99-4	P-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	187.05	187.33	0.28	1478.40
99-5	PEM (1 ¼-in TSA)	5/19/1999	2.5	2.0	187.33	187.61	0.28	1478.40
99-6	ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	187.61	187.90	0.29	1531.20
99-7	AR-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	187.90	188.18	0.28	1478.40
99-8	ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	188.18	188.47	0.29	1531.20
99-9	PEM (1 ¼-in TSA)	5/19/1999	2.5	2.0	188.47	188.75	0.28	1478.40
99-10	P-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	188.75	189.03	0.28	1478.40
99-11	SMA (3/4-in TSA)	5/19/1999	2.5	2.0	189.03	189.32	0.29	1531.20
99-12	PEM (1 ¼-in TSA)	5/19/1999	3.5	3.0	189.32	189.60	0.28	1478.40
99-13	P-ACFC (3/4-in TSA)	5/19/1999	3.5	3.0	189.60	189.89	0.29	1531.20
99-14	AR-ACFC (3/4-in TSA)	5/19/1999	3.5	3.0	189.89	190.17	0.28	1478.40
99-15	ACFC (3/4-in TSA)	5/19/1999	3.5	3.0	190.17	190.45	0.28	1478.40
99-16	SMA (3/4-in TSA)	5/19/1999	3.5	3.0	190.45	190.74	0.29	1531.20
99-17	ACFC (3/4-in TSA)	5/25/1999	3.5	3.0	190.74	191.02	0.28	1478.40
99-18	AR-ACFC (3/4-in TSA)	5/25/1999	3.5	3.0	191.02	191.31	0.29	1531.20
99-19	SMA (3/4-in TSA)	5/25/1999	3.5	3.0	191.31	191.59	0.28	1478.40
99-20	PEM (1 ¼-in TSA)	5/25/1999	3.5	3.0	191.59	191.88	0.29	1531.20
99-21	P-ACFC (3/4-in TSA)	5/25/1999	3.5	3.0	191.88	192.16	0.28	1478.40
99-22	ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	192.16	192.44	0.28	1478.40
99-23	AR-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	192.44	192.73	0.29	1531.20
99-24	SMA (3/4-in TSA)	5/25/1999	4.5	4.0	192.73	193.01	0.28	1478.40
99-25	P-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	193.01	193.30	0.29	1531.20
99-26	PEM (1 ¼-in TSA)	5/25/1999	4.5	4.0	193.30	193.58	0.28	1478.40
99-27	ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	193.58	193.86	0.28	1478.40
99-28	PEM (1 ¼-in TSA)	5/25/1999	4.5	4.0	193.86	194.15	0.29	1531.20
99-29	AR-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	194.15	194.43	0.28	1478.40
99-30	SMA (3/4-in TSA)	5/25/1999	4.5	4.0	194.43	194.72	0.29	1531.20
99-31	P-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	194.72	195.00	0.28	1478.40
99-32	AR-ACFC (1/2-in TSA) Control	5/25/1999	2.5	3.0	195.00	195.28	0.28	1478.40
Total Sections					32			

Table 52. Test Section Descriptions for I-8 Wearing Course Treatments.

I-8 Westbound (WB) MP 88.0 to 92.53								
Test Section ID	Material	Construction Date	Mill Thickness (in)	Overlay Thickness (in)	MP From	MP To	Length (mi)	Distance (ft)
99-34	AR-ACFC (3/4-in TSA)	6/16/1999	2.0	1.0	88.00	88.56	0.56	2956.80
99-35	ACFC (3/4-in TSA)	6/16/1999	2.0	1.0	88.56	88.84	0.28	1478.40
99-36	P-ACFC (3/4-in TSA)	6/16/1999	2.0	1.0	88.84	89.17	0.33	1742.40
99-37	PEM (1 ¼-in TSA)	6/17/1999	2.0	1.0	89.17	89.41	0.24	1267.20
99-38	SMA (3/4-in TSA)	6/18/1999	2.0	1.0	89.41	89.74	0.33	1742.40
99-39	AR-ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.74	89.99	0.25	1320.00
99-40	ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.99	90.26	0.27	1425.60
99-41	P-ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	90.26	90.50	0.24	1267.20
99-42	PEM (1 ¼-in TSA)	6/18/1999	2.0	2.0	90.50	90.83	0.33	1742.40
99-43	SMA (3/4-in TSA)	6/18/1999	2.0	2.0	90.83	91.11	0.28	1478.40
99-44	AR-ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	91.11	91.36	0.25	1320.00
99-45	ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	91.36	91.68	0.32	1689.60
99-46	P-ACFC (3/4-in TSA)	6/18/1999	3.0	2.0	91.68	91.98	0.30	1584.00
99-47	PEM (1 ¼-in TSA)	6/18/1999	3.0	2.0	91.98	92.25	0.27	1425.60
99-48	SMA (3/4-in TSA)	6/18/1999	3.0	2.0	92.25	92.53	0.28	1478.40
99-33	AR-ACFC (1/2-in TSA) Control	6/18/1999	2.5	2.0	92.53	92.80	0.27	1425.60
Total Sections					16			

I-8 Eastbound (EB) MP 88.0 to 92.53								
Test Section ID	Material	Construction Date	Mill Thickness (in)	Overlay Thickness (in)	MP From	MP To	Length (mi)	Distance (ft)
99-49	AR-ACFC (1/2-in TSA) Control	6/16/1999	2.5	2.0	87.50	88.00	0.50	2640.00
99-50	AR-ACFC(3/4-in TSA)	6/16/1999	1.0	2.0	88.00	88.28	0.28	1478.40
99-51	ACFC (3/4-in TSA)	6/16/1999	1.0	2.0	88.28	88.57	0.29	1531.20
99-52	P-ACFC (3/4-in TSA)	6/16/1999	1.0	2.0	88.57	88.85	0.28	1478.40
99-53	PEM (1 ¼-in TSA)	6/18/1999	1.0	2.0	88.85	89.04	0.19	1003.20
99-54	SMA (3/4-in TSA)	6/18/1999	1.0	2.0	89.04	89.42	0.38	2006.40
99-55	AR-ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.42	89.72	0.30	1584.00
99-56	ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.72	90.00	0.28	1478.40
99-57	P-ACFC(3/4-in TSA)	6/16/1999	2.0	2.0	90.00	90.26	0.26	1372.80
99-58	PEM (1 ¼-in TSA)	6/18/1999	2.0	2.0	90.26	90.39	0.13	686.40
99-59	SMA (3/4-in TSA)	6/18/1999	2.0	2.0	90.39	90.83	0.44	2323.20
99-60	AR-ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	90.83	91.11	0.28	1478.40
99-61	ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	91.11	91.38	0.27	1425.60
99-62	P-ACFC (3/4-in TSA)	6/15/1999	3.0	2.0	91.38	91.68	0.30	1584.00
99-63	PEM (1 ¼-in TSA)	6/18/1999	3.0	2.0	91.68	91.97	0.29	1531.20
99-64	SMA (3/4-in TSA)	6/18/1999	3.0	2.0	91.97	92.53	0.56	2956.80
Total Sections					16			

Table 53. Test Section Descriptions for SR 74 Wearing Course Treatments.

SR-74 Eastbound (EB) MP 17 to 19								
Sta 234+00 is MP 18 & Sta 181+10 is MP 19								
Test Section ID	Material	Construction Date	Mill Thickness (in)	Overlay Thickness (in)	MP From	MP To	Length (mi)	Distance (ft)
74-E11	P-ACFC (PG 76-22+, 3/8-in TSA)	4/3/2001	2.0	2.0	20050	20350	0.06	300.00
74-E10	P-ACFC (PG 76-22+, 3/8-in TSA)	4/3/2001	2.0	2.0	20350	20925	0.11	575.00
74-E09	TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	4/3/2001	2.0	2.0	20925	21720	0.15	795.00
74-E08	P-ACFC (PG 76-22+, 3/8-in TSA)	4/3/2001	2.0	2.0	21720	22250	0.10	530.00
74-E07	TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	4/3/2001	2.0	2.0	22250	23060	0.15	810.00
74-E06	TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	4/3/2001	3.0	3.0	23060	24095	0.20	1035.00
74-E05	TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	4/3/2001	3.0	3.0	24095	25150	0.20	1055.00
74-E04	P-ACFC (PG 76-22+, 3/8-in TSA)	4/3/2001	3.0	3.0	25150	26300	0.22	1150.00
74-E03	TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	4/3/2001	0.0	2.0	26300	27496	0.23	1196.00
74-E02	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/14/2001	0.0	2.0	27496	28715	0.23	1219.00
74-E01	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/14/2001	0.0	2.0	28715	29770	0.20	1055.00
Total Sections					11			

SR-74 Westbound (WB) MP 17 to 19								
Sta 234+00 is MP 18 & Sta 181+10 is MP 19								
Test Section ID	Material	Construction Date	Mill Thickness (in)	Overlay Thickness (in)	MP From	MP To	Length (mi)	Distance (ft)
74-W01	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/28/2001	2.0	2.0	21625	23060	0.27	1435.00
74-W02	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/28/2001	3.0	3.0	23060	24095	0.20	1035.00
74-W03	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/28/2001	3.0	3.0	24095	25370	0.24	1275.00
74-W04	P-ACFC (PG 76-22+, 3/8-in TSA)	4/3/2001	3.0	3.0	25370	26380	0.19	1010.00
74-W05	TB-ACFC (PG 76-22 TR+, 3/8-in TSA)	4/3/2001	0.0	2.0	26380	27496	0.21	1116.00
74-W06	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/28/2001	0.0	2.0	27496	28715	0.23	1219.00
74-W07	AR-ACFC (PG 64-16, CRA-1, 3/8-in TSA)	3/28/2001	0.0	2.0	28715	29770	0.20	1055.00
Total Sections					7			

Table 54. Test Section Descriptions for SR 66 Preventive Maintenance Treatments.

SR-66 Eastbound (EB) MP 110 to MP 123								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
66-E01	Double Application Chip Seal and Blotter, ADOT	8/29/2000	20 (1/2-in) ?? (3/8-in)	0.55 0.47	110.75	111.50	0.75	3960.00
66-E02	Double Application, ADOT	8/29/2000	No Info	No Info	111.50	112.75	1.25	6600.00
66-E03	AC15-5TR, Paramount	8/10/2000	27 (5/8-in)	0.50	112.75	113.50	0.75	3960.00
66-E04	CRS-2, Copperstate	8/11/2000	26 (5/8-in)	0.55	113.50	114.15	0.65	3432.00
66-E05	AR-ACFC, ADOT	4/30/2001	59 (??-in)	0.08 (tack)	114.15	115.00	0.85	4488.00
66-E06	Novachip, Koch	8/24/2000	65? (1/2-in)	0.19	116.25	117.00	0.75	3960.00
66-E07	Microsurfacing, SW Slurry	8/15/2000	33 (Type 3)	N/A	117.00	117.75	0.75	3960.00
66-E08	AR-Chip, Int'l Slurry Surfacing	8/11/2000	24 (??-in)	0.62	117.75	118.50	0.75	3960.00
66-E09	CRS-2P, ADOT	8/28/2000	?? (3/8-in)	No Info	118.50	119.23	0.73	3854.40
66-E10	CM-90, Navajo Western	8/11/2000	24 (5/8-in)	0.45	119.23	120.00	0.77	4065.60
66-E11	CRS-2P, Crown	8/11/2000	26 (5/8-in)	0.50	120.00	120.65	0.65	3432.00
66-E12	Pass Oil, Western Emulsion	8/12/2000	26 (5/8-in)	0.45	120.65	121.50	0.85	4488.00
66-E13	ACFC, ADOT	5/1/2001	No Info	No Info	121.50	122.25	0.75	3960.00
66-E14	CRS-2P, ADOT	8/28/2000	?? (5/8-in)	No Info	122.25	123.00	0.75	3960.00
Total Sections					14			

SR-66 Westbound (WB) MP 110 to MP 123								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
66-W01	Double Application Chip Seal and Blotter, ADOT	8/29/2000	28 (1/2-in) 22 (3/8-in)	0.55 0.47	110.25	111.50	1.25	6600.00
66-W02	Double Application, ADOT	8/29/2000	No Info	No Info	111.50	112.75	1.25	6600.00
66-W03	CRS-2P, Crown	8/11/2000	26 (5/8-in)	0.50	112.75	113.50	0.75	3960.00
66-W04	CRS-2, Copperstate	8/11/2000	23 (5/8-in)	0.55	113.50	114.25	0.75	3960.00
66-W05	CRS-2P, ADOT	8/28/2000	?? (3/8-in)	No Info	114.25	115.00	0.75	3960.00
66-W06	AC15-5TR, Paramount	8/10/2000	27 (5/8-in)	0.50	116.25	117.00	0.75	3960.00
66-W07	Pass Oil, Western Emulsion	8/12/2000	26 (5/8-in)	0.45	117.00	117.75	0.75	3960.00
66-W08	AR-Chip, Intl' Slurry Surfacing	8/11/2001	24 (??-in)	0.62	117.75	118.50	0.75	3960.00
66-W09	CM-90, Navajo Western	8/11/2000	23 (5/8-in)	0.47	118.50	119.35	0.85	4488.00
66-W10	ACFC, ADOT	5/1/2001	No Info	No Info	119.35	120.00	0.65	3432.00
66-W11	Novachip, Koch	8/24/2000	65 (1/2-in)	0.19	120.00	120.75	0.75	3960.00
66-W12	Microsurfacing, SW Slurry	8/16/2000	33 (Type 3)	N/A	120.75	121.50	0.75	3960.00
66-W13	AR-ACFC, ADOT	4/30/2001	59? (??-in)	0.08 (tack)	121.50	122.25	0.75	3960.00
66-W14	CRS-2P, ADOT 5/8"	8/28/2000	?? (5/8-in)	No Info	122.25	123.00	0.75	3960.00
Total Sections					14			

Table 55. Test Section Descriptions for SR 87 Preventive Maintenance Treatments.

SR-87 Winslow Northbound (NB)								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
87-N01	Double Application Chip Seal and Blotter, ADOT	6/16/2000	20 (1/2-in) 8 (No. 4)	0.47 0.45	385.000	385.750	0.750	3960.00
87-N02	CM-90, Navajo Western	6/13/2000	24 (5/8-in)	0.44	387.227	388.250	1.023	5401.44
87-N03	CM-90, Navajo Western	6/13/2000	24 (5/8-in)	0.44	388.250	389.000	0.750	3960.00
87-N04	Double Chip Seal, ADOT	6/15/2000	26 (5/8-in) ?? (3/8-in)	0.50 ??	389.000	389.748	0.748	3949.44
87-N05	Double Chip Seal, ADOT	6/15/2000	26 (5/8-in) ?? (3/8-in)	0.50 ??	389.748	390.477	0.729	3849.12
87-N06	Novachip, Koch	7/6/2000	65 (1/2-in)	0.16 (tack)	390.477	391.142	0.665	3511.20
87-N07	Pass Oil, Western Emulsion	6/15/2000	26 (5/8-in)	0.45	391.142	392.015	0.873	4609.44
87-N08	AC15-5TR, Paramount	6/12/2000	28 (5/8-in)	0.45	392.015	392.750	0.735	3880.80
87-N09	Pass Oil, Western Emulsion	6/15/2000	26 (5/8-in)	0.45	392.750	393.462	0.712	3759.36
Total Sections					9			

SR-87 Winslow Southbound (SB)								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
87-S12	Double Application Chip Seal and Blotter, ADOT	6/16/2000	20 (1/2-in) 8 (No. 4)	0.47 0.45	385.000	385.750	0.750	3960.00
87-S11	Control, 2-in Mill and Overlay	6/1/1999	N/A	N/A	385.750	386.500	0.750	3960.00
87-S10	Control, 2-in Mill and Overlay	6/1/1999	N/A	N/A	386.500	387.466	0.966	5100.48
87-S09	AC15-5TR, Paramount	6/12/2000	28 (5/8-in)	0.45	387.466	388.250	0.784	4139.52
87-S08	Double Chip Seal, ADOT	6/15/2000	26 (5/8-in) ?? (3/8-in)	0.50 ??	388.250	389.000	0.750	3960.00
87-S07	Double Chip Seal, ADOT	6/15/2000	26 (5/8-in) ?? (3/8-in)	0.50 ??	389.000	389.748	0.748	3949.44
87-S06	CRS-2, Copperstate	6/14/2000	26 (5/8-in)	0.50	389.748	390.477	0.729	3849.12
87-S05	Control, 2-in Mill and Overlay	6/1/1999	N/A	N/A	390.477	390.825	0.348	1837.44
87-S04	Novachip, Koch	7/6/2000	65 (1/2-in)	0.16 (tack)	390.825	391.251	0.426	2249.28
87-S03	CRS-2, Copperstate	6/14/2000	26 (5/8-in)	0.50	391.251	391.990	0.739	3901.92
87-S02	CRS-2P, Crown	6/14/2000	26 (5/8-in)	0.48	391.990	392.739	0.749	3954.72
87-S01	CRS-2P, Crown	6/14/2000	26 (5/8-in)	0.48	392.739	393.463	0.724	3822.72
Total Sections					12			

Table 56. Test Section Descriptions for SR 83 Preventive Maintenance Treatments.

SR-83 Northbound (NB) MP 32 to MP 43								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
83-001	Slurry Seal, SW Slurry	7/14/2001	36 (Type 3)	N/A	33.20	33.91	0.71	3748.80
83-002	Double Chip Seal, ADOT	No Info	No Info	No Info	33.91	34.52	0.61	3220.80
83-003	AR-ACFC	6/8/2001	No Info	No Info	34.52	35.14	0.62	3273.60
83-004	AR-ACFC, ADOT	No Info	No Info	No Info	35.14	35.75	0.61	3220.80
83-005	AR-ACFC (replaced CRS-2P)	7/20/2001	No Info	No Info	35.75	36.36	0.61	3220.80
83-006	AC15-5TR, Paramount	6/26/2001	37 (5/8-in)	0.51	36.36	36.97	0.61	3220.80
83-007	CRS-2P, ADOT	7/25/2001	30 (5/8-in)	0.48	36.97	37.58	0.61	3220.80
83-008	Asphalt Rubber Chip, ISS	7/14/2001	No Info	No Info	37.58	38.20	0.62	3273.60
83-009	P-ACFC, Paramount	6/11/2001	No Info	No Info	38.20	40.64	2.44	12883.20
83-010	Novachip, Koch	8/3/2001	No Info	0.20 (tack)	40.64	41.26	0.62	3273.60
83-011	CM-90, Koch	6/26/2001	27 (5/8-in)	0.53	41.26	41.87	0.61	3220.80
83-012	CRS-2, ADOT	No Info	26 (5/8-in)	0.50	41.87	42.48	0.61	3220.80
83-013	HF CRS-2P, Copperstate	7/24/2001	33 (5/8-in)	0.56	42.48	43.09	0.61	3220.80
83-014	Pass CR, Western Emulsion	7/23/2001	?? (5/8-in)	0.45	43.09	43.50	0.41	2164.80
Total Sections					14			

SR-83 Southbound (SB) MP 32 to MP 43								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
83-015	AR-ACFC	6/8/2001	No Info	No Info	33.20	33.91	0.71	3748.80
83-016	CRS-2, ADOT	No Info	26 (5/8-in)	0.50	33.91	34.52	0.61	3220.80
83-017	Asphalt Rubber Chip, ISS	7/14/2001	No Info	No Info	34.52	35.14	0.62	3273.60
83-018	CM-90, Koch	7/23/2001	No Info	0.51	35.14	35.75	0.61	3220.80
83-019	AR-ACFC, ADOT	No Info	No Info	No Info	35.75	36.36	0.61	3220.80
83-020	CRS-2P, ADOT	7/25/2001	No Info	No Info	36.36	36.97	0.61	3220.80
83-021	Slurry Seal, SW Slurry	7/14/2001	30 (Type 3)	N/A	36.97	37.58	0.61	3220.80
83-022	AC15-5TR, Paramount	6/26/2001	34 (5/8-in)	0.48	37.58	38.20	0.62	3273.60
83-023	P-ACFC, Paramount	6/12/2001	No Info	No Info	38.20	40.64	2.44	12883.20
83-024	HF CRS-2P, Copperstate	7/24/2001	No Info	No Info	40.64	41.26	0.62	3273.60
83-025	Double Chip Seal, ADOT	7/25/2001	25 (5/8-in) ?? (3/8-in)	0.58 0.64	41.26	41.87	0.61	3220.80
83-026	CRS-2P, Crown	7/26/2001	30 (5/8-in)	0.55	41.87	42.48	0.61	3220.80
83-027	Novachip, Koch	8/3/2001	No Info	No Info	42.48	43.09	0.61	3220.80
83-028	Pass CR, Western Emulsion	7/24/2001	?? (5/8-in)	No Info	43.09	43.50	0.41	2164.80
Total Sections					14			

Table 57. Test Section Descriptions for U.S. 191 Preventive Maintenance Treatments.

US-191 Northbound (NB) MP 181 to MP 185								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
191-001	CRS-2P, ADOT	7/2/2001	32 (5/8-in)	0.51	181.00	181.67	0.67	3537.60
191-002	Control	Original	N/A	N/A	181.67	182.34	0.67	3537.60
191-003	CRS-2P (future const), ADOT	Original	No Info	No Info	182.34	183.01	0.67	3537.60
191-004	CRS-2P, ADOT	7/2/2001	33 (5/8-in)	0.57	183.01	183.68	0.67	3537.60
191-005	CRS-2P (future const), ADOT	Original	No Info	No Info	183.68	184.35	0.67	3537.60
191-006	Control	Original	N/A	N/A	184.35	185.00	0.65	3432.00
Total Sections					6			

US-191 Southbound (SB) MP 181 to MP 185								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
191-007	CRS-2P, ADOT	7/2/2001	31 (5/8-in)	0.54	181.00	181.67	0.67	3537.60
191-008	Control	Original	N/A	N/A	181.67	182.34	0.67	3537.60
191-009	CRS-2P (future const), ADOT	Original	No Info	No Info	182.34	183.01	0.67	3537.60
191-010	CRS-2P, ADOT	7/2/2001	29 (5/8-in)	0.53	183.01	183.68	0.67	3537.60
191-011	CRS-2P (future const), ADOT	Original	No Info	No Info	183.68	184.35	0.67	3537.60
191-012	Control	Original	N/A	N/A	184.35	185.00	0.65	3432.00
Total Sections					6			

Table 57. Test Section Descriptions for U.S. 191 Preventive Maintenance Treatments (Continued).

US-191 Northbound (NB) MP 200.5 to MP 219.25								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
191-013	AR-Chip, ISS	No Info	No Info	No Info	200.50	201.25	0.75	3960.00
191-014	CRS-2, ADOT	6/27/2001	27 (3/8-in)	0.48	201.25	202.00	0.75	3960.00
191-015	CRS-2P, Crown	6/26/2001	28 (5/8-in)	0.571	202.00	202.75	0.75	3960.00
191-016	AC15-5TR, Paramount	6/21/2001	30 (5/8-in)	0.522	202.75	203.50	0.75	3960.00
191-017	CM-90, Koch	No Info	?? (5/8-in)	?? (5/8-in)	203.50	204.25	0.75	3960.00
191-018	AR-ACFC, ADOT	6/18/2001	No Info	No Info	204.25	205.00	0.75	3960.00
191-019	HF CRS-2P, ADOT	6/25/2001	27 (3/8-in)	0.462	205.00	205.75	0.75	3960.00
191-020	P-ACFC, Paramount PG 64-28	6/15/2001	No Info	No Info	205.75	206.50	0.75	3960.00
191-021	Double Chip Seal, ADOT	6/29/2001	29 (5/8-in) 23 (3/8-in)	0.548 0.501	206.50	207.25	0.75	3960.00
191-022	Novachip, Koch	6/21/2001	90 (?-in)	0.20 (tack)	207.25	208.00	0.75	3960.00
191-023	Slurry Seal, SW Slurry	6/27/2001	23 (Type 3)	N/A	208.00	208.75	0.75	3960.00
191-024	HF CRS-2P, Copperstate	6/25/2001	29 (5/8-in)	0.51	208.75	209.75	1.00	5280.00
191-025	CRS-2P, Crown	6/26/2001	29 (5/8-in)	0.547	210.25	211.00	0.75	3960.00
191-026	AC15-5TR, Paramount	6/21/2001	28 (5/8-in)	0.535	211.00	211.75	0.75	3960.00
191-027	CRS-2, ADOT	6/27/2001	27 (3/8-in)	0.475	211.75	212.50	0.75	3960.00
191-028	CM-90, Koch	No Info	?? (5/8-in)	?? (5/8-in)	212.50	213.25	0.75	3960.00
191-029	AR-Chip, ISS	No Info	No Info	No Info	213.25	214.00	0.75	3960.00
191-030	Slurry Seal, SW Slurry	6/27/2001	32 (Type 3)	N/A	214.00	214.75	0.75	3960.00
191-031	AR-ACFC, ADOT	6/19/2001	No Info	No Info	214.75	215.50	0.75	3960.00
191-032	Novachip, Koch	6/21/2001	90 (?-in)	0.20 (tack)	215.50	216.25	0.75	3960.00
191-033	HF CRS-2P, ADOT	6/25/2001	27 (3/8-in)	0.475	216.25	217.00	0.75	3960.00
191-034	P-ACFC, Paramount PG 64-28	6/15/2001	No Info	No Info	217.00	217.75	0.75	3960.00
191-035	HF CRS-2P, Copperstate	6/25/2001	32 (5/8-in)	0.50	217.75	218.50	0.75	3960.00
191-036	Double Chip Seal, ADOT	6/29/2001	29 (5/8-in) 22 (3/8-in)	0.569 0.495	218.50	219.25	0.75	3960.00
Total Sections					24			

Table 57. Test Section Descriptions for U.S. 191 Preventive Maintenance Treatments (Continued).

US-191 Southbound (SB) MP 200.5 to MP 219.25								
Test Section ID	Material	Construction Date	Aggregate Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length (mi)	Distance (ft)
191-037	AR-Chip, ISS	No Info	No Info	No Info	200.50	201.25	0.75	3960.00
191-038	CRS-2, ADOT	6/27/2001	27 (3/8-in)	0.444	201.25	202.00	0.75	3960.00
191-039	CRS-2P, Crown	6/26/2001	28 (5/8-in)	0.55	202.00	202.75	0.75	3960.00
191-040	AC15-5TR, Paramount	6/21/2001	29 (5/8-in)	0.52	202.75	203.50	0.75	3960.00
191-041	CM-90, Koch	No Info	?? (5/8-in)	?? (5/8-in)	203.50	204.25	0.75	3960.00
191-042	AR-ACFC, ADOT	6/18/2001	No Info	No Info	204.25	205.00	0.75	3960.00
191-043	HF CRS-2P, ADOT	6/25/2001	27 (3/8-in)	0.441	205.00	205.75	0.75	3960.00
191-044	P-ACFC, Paramount PG 64-28	6/15/2001	No Info	No Info	205.75	206.50	0.75	3960.00
191-045	Double Chip Seal, ADOT	6/29/2001	29 (5/8-in) 23 (3/8-in)	0.567 0.529	206.50	207.25	0.75	3960.00
191-046	Novachip, Koch	6/21/2001	90 (?-in)	0.20 (tack)	207.25	208.00	0.75	3960.00
191-047	Slurry Seal, SW Slurry	6/27/2001	31 (Type 3)	N/A	208.00	208.75	0.75	3960.00
191-048	HF CRS-2P, Copperstate	6/25/2001	29 (5/8-in)	0.45	208.75	209.75	1.00	5280.00
191-049	CRS-2P, Crown	6/26/2001	28 (5/8-in)	0.506	210.25	211.00	0.75	3960.00
191-050	AC15-5TR, Paramount	6/21/2001	28 (5/8-in)	0.496	211.00	211.75	0.75	3960.00
191-051	CRS-2, ADOT	6/27/2001	27 (3/8-in)	0.446	211.75	212.50	0.75	3960.00
191-052	CM-90, Koch	No Info	?? (5/8-in)	?? (5/8-in)	212.50	213.25	0.75	3960.00
191-053	AR-Chip, ISS	No Info	No Info	No Info	213.25	214.00	0.75	3960.00
191-054	Slurry Seal, SW Slurry	6/27/2001	30 (Type 3)	N/A	214.00	214.75	0.75	3960.00
191-055	AR-ACFC, ADOT	6/19/2001	No Info	No Info	214.75	215.50	0.75	3960.00
191-056	Novachip, Koch	6/21/2001	90 (?-in)	0.20 (tack)	215.50	216.25	0.75	3960.00
191-057	HF CRS-2P, ADOT	6/25/2001	27 (3/8-in)	0.469	216.25	217.00	0.75	3960.00
191-058	P-ACFC, Paramount PG 64-28	6/15/2001	No Info	No Info	217.00	217.75	0.75	3960.00
191-059	HF CRS-2P, Copperstate	6/25/2001	29 (5/8-in)	0.49	217.75	218.50	0.75	3960.00
191-060	Double Chip Seal, ADOT	6/29/2001	29 (5/8-in) ??	0.507 ??	218.50	219.25	0.75	3960.00
Total Sections					24			

APPENDIX B
AVAILABLE BINDER AND AGGREGATE DETAILS

Table 58. Binder and Aggregate Details Available for AR-ACFC I-10 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Cement type	PG 64-16	Aggregate type		Asphalt content	5.9%
Binder type	CRA-1	Max size	3/4 in.	Air void content	4.0%
Viscosity	3500	Specific gravity (Oven dry bulk)	2.619		
Penetration 32.9° F	36	Absorption	1.18%		
Resilience 77° F	33%	Sand equivalent	88		
Softening point	143° F	Flakiness index	16		
		LA abrasion (500)	22%		
		% Fractured	98%		
		% Carbonates	0.3%		

Source Comments

- Aggregate CM0151 "special," 3/16-inch and 1/4-inch from Salt River S&R (McKellips Rd Pit).
- PG 64-16 from Chevron.
- CRA-1 binder from FNF Construction.
- Rubber WRF-14 from Polytek Southwest.
- Hydrated lime from Chemical Lime Co.

Table 59. Binder and Aggregate Details Available for SMA I-10 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 70-28	Aggregate type		Asphalt content	6.6%
		Max size	3/4 in.	Air void content	4.0%
		Specific gravity (Oven dry bulk)	2.594	Cellulose fiber	0.3%
		Absorption	1.516%		
		Sand equivalent	67		
		LA abrasion (500)	20%		
		% Fractured	99.1%		

Source Comments

- Aggregate from United Metro Plants 14131 (Maricopa Rd and Gila River) and 11111 (19th Ave and Salt River).
- PG 76-22, mineral filler, and cellulose fibers from FNF Construction.
- Hydrated lime from Chemical Lime Co.

Table 60. Binder and Aggregate Details Available for PEM I-10 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 76-22	Aggregate type		Asphalt content	5.5%
		Max size	1-1/4 in.	Cellulose fiber	0.3%
		Specific gravity (Oven dry bulk)	2.588		
		Absorption	1.15%		
		Sand equivalent	72		
		Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		
Source Comments					
• Aggregate from United Metro Plants 14131 (Maricopa Rd and Gila River) and 11111 (19th Ave and Salt River). • PG 76-22, mineral filler, and cellulose fibers from FNF Construction. • Hydrated lime from Chemical Lime Co.					

Table 61. Binder and Aggregate Details Available for ACFC I-10 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-16	Aggregate type		Asphalt content	5.9%
Viscosity		Max size	3/4 in.	Air void content	4.0%
		Specific gravity (Oven dry bulk)	2.617	Cellulose fiber	0.3%
		Absorption	1.22%		
		Sand equivalent	88		
		Flakiness index	16		
		LA abrasion (500)	22%		
		% Fractured	98%		
		% Carbonates	0.3%		
Source Comments					
• Aggregate CM0151 "special," 3/16-inch and 1/4-inch from Salt River S&R (McKellips Rd Pit). • PG 64-16 from Chevron. • Hydrated lime from Chemical Lime Co.					

Table 62. Binder and Aggregate Details Available for P-ACFC I-10 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 76-22	Aggregate type		Asphalt content	5.9%
		Max size	3/4 in.	Air void content	4.0%
		Specific gravity (Oven dry bulk)	2.617	Cellulose fiber	0.3%
		Absorption	1.22%		
		Sand equivalent	88		
		Flakiness index	16		
		LA abrasion (500)	22%		
		% Fractured	98%		
		% Carbonates	0.3%		
Source Comments					
• Aggregate CM0151 "special," 3/16-inch and 1/4-inch from Salt River S&R (McKellips Rd Pit). • PG 76-22 from Navajo Western. • Hydrated lime from Chemical Lime Co.					

Table 63. Binder and Aggregate Details Available for AR-ACFC SR 74 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	CRA-1	Aggregate type	CM0288 C-1350 C-1349	Asphalt content	9.2%
Cement type	PG 64-16	Max size	3/8 in.	Rubber, WRF-14	22%
Viscosity 177° C	2.7 Pa·S	Specific gravity (oven dry bulk)	2.610		
Penetration 4° C	12	Absorption	1.92%		
Softening point	62° C	Sand equivalent	64		
		Flakiness index	20%		
		LA abrasion (500)	20%		
		% Fractured	85%		
		% Carbonates	1.2%		
Source Comments					

- Aggregate CM0288 3/8-inch: SR, 1/4" IN, and C-Fine from Salt River S&R (Sub City).
- Aggregate C-1350 3/8-inch H from Hanson Material (123rd Ave and Camelback).
- Aggregate C-1349 C-Fine from FNF New River Pit.
- Asphalt cement PG 64-16 from Koch Navajo.
- Binder CRA-1 from FNF Construction.
- Rubber WRF-14 from Polytek Southwest.
- Hydrated lime from Chemical Lime Co.

Table 64. Binder and Aggregate Details Available for P-ACFC SR 74 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 76-22+	Aggregate type		Asphalt content	
Viscosity 135° C	1.3 Pa·S	Max size	3/8 in.	Air void content	
Dynamic shear 76° C (original)	1.32 kPa	Specific gravity (oven dry bulk)			
Dynamic shear 76° C (RTFO)	2.88	Absorption			

Table 65. Binder and Aggregate Details Available for TB-ACFC SR 74 Wearing Course Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 76-22 TR	Aggregate type		Asphalt content	
Viscosity 135° C	4.2 Pa·S	Max size	3/8 in.	Air void content	
Dynamic shear 76° C (original)	2.1 kPa	Specific gravity (oven dry bulk)			
Dynamic Shear 76° C (RTFO)	4.75	Absorption			

Table 66. Binder and Aggregate Details Available for CRS-2P/Crown SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-28	Aggregate type		Asphalt content	6.0%
Viscosity 60° C	≥ 75, ≤ 400	Max size	5/8 in.	Air void content	7.7%
Softening point	133.5° F			Stability	1170
Float test 60° C	927			Flow	12
				Cellulose fiber	0.3%

Table 67. Binder and Aggregate Details Available for Novachip/Koch Materials SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 70-28	Aggregate type		Asphalt content	
Viscosity 135° C	≤ 3.0	Max size	1/2 in.	Air void content	10.8%
Softening point	≥ 60° C	Specific gravity (oven dry bulk)	2.743		
Penetration 25° C	33	Absorption	1.32		
Flash point	≥ 230° C	Sand equivalent	79.5		
		LA abrasion (500)	16.2		
Source Comments					
• PG 70-28 from United Metro.					

Table 68. Binder and Aggregate Details Available for PASS CR/Western Emulsion SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-16	Aggregate type			
Viscosity 77° F	≥ 15, ≤ 150	Max size	5/8 in.		
pH	≥ 2, ≤ 6				
Residue by evaporation	≥ 65				

Table 69. Binder and Aggregate Details Available for HF CRS-2P/Copperstate SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-22	Aggregate type		Asphalt content	
Viscosity 122° F	≥ 50, ≤ 400	Max size		Air void content	
Softening point	≥ 60° C			Polymer content	3%
Float test 60° C	≥ 1200				
Penetration 77° F	≥ 40, ≤ 100				
Source Comments					
• PG 64-22 from Diamond Shamrock (Ardmore, Oklahoma).					

Table 70. Binder and Aggregate Details Available for Microsurfacing/Southwest Slurry SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-16	Aggregate type		Asphalt content	12±1.0%
Viscosity 77° F	≥ 15, ≤ 100	Max size			
Softening point	≥ 140° F				
Residue by evaporation	≥ 60				
Penetration 77° F	≥ 40, ≤ 90				
Source Comments					

- Southwest Slurry Type III (ISS): RTE emulsion (Paramount, Phoenix, AZ, Product #512).
- HN-16 rubber scraps (ISS/Polytek Southwest Item #171860, Queen Creek, Arizona).
- PG 64-16 (Paramount Flagstaff, Arizona).

Table 71. Binder and Aggregate Details Available for AR-ACFC/ADOT SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Cement type	PG 58-22	Aggregate type			
Binder type	CRA-2	Max size	1/2 in.		
		Sand equivalent	63		
		Flakiness index	15%		
		% Carbonates	2.4%		
Source Comments					

- Aggregate CM0348 3/8-inch and CCFINE from Hamilton Pit.
- CRA-2 binder from FNF Construction.
- Asphalt PG 58-22 from Koch.
- Rubber WRF-14 from Polytek Southwest.
- Hydrated lime from Chemical Lime Co.

Table 72. Binder and Aggregate Details Available for AC15-5TR/Paramount SR 66 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type		Aggregate type			
Viscosity 135° C	≤ 2000	Max size	5/8 in.		
Softening point	≥ 60° C				
Penetration 25° C	33				
Flash point	≥ 232° C				
Source Comments					
• Mohave Cave (Kingman) source for AC 15-5 TR chips. • 1-1/2-inch Crushed Rock and 1/2-inch Chips from Mohave. • Emulsion from Channel View, Texas (Houston).					

Table 73. Binder and Aggregate Details Available for CRS-2P/Crown SR 83 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-28	Aggregate type		Asphalt content	6.0%
Viscosity 60° C	≥ 75, ≤ 400	Max size	5/8 in.	Air void content	7.7%
Softening point	133.5° F	Specific gravity (oven dry bulk)	2.588	Stability	1170
Float test 60° C	927	Absorption	1.15%	Flow	12
		Sand equivalent	72	Cellulose fiber	0.3%
		Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		

Table 74. Binder and Aggregate Details Available for AR-ACFC/ADOT SR 83 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 76-22 TR+	Aggregate type	CM0371	Asphalt content	6.5%
COC flash point	≥ 450° F	Max size	3/8 in.		
Softening point	≥ 140° F	Specific gravity (oven dry bulk)	2.528		
Tire rubber content	≥ 8%	Absorption	1.94%		
		Sand equivalent	65		
		Flakiness index	10%		
		LA abrasion (500)	19%		
		% Fractured	89%		
		% Carbonates	10.6%		
Source Comments					
• Aggregate CM0371 granite chips, chat, and sand from United Metro (Swan Pit, San Xavier 5/8-inch and 3/8-inch). • Asphalt PG 76-22TR+ from Koch Navajo. • Lime from Chemical Lime Co.					

Table 75. Binder and Aggregate Details Available for CM-90/Koch Materials SR 83 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	Multigrade	Aggregate type		Asphalt content	6.0%
Viscosity 60° C	≥ 400	Max size	5/8 in.	Air void content	7.7%
Viscosity 135° C	≤ 2000	Specific gravity (oven dry bulk)	2.588	Stability	1170
Flash point	≥ 66° C	Absorption	1.15%	Flow	12
		Sand equivalent	72	Cellulose fiber	0.3%
		Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		

Table 76. Binder and Aggregate Details Available for HF CRS-2P/Copperstate SR 83 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	Emulsion	Aggregate type		Asphalt content	6.0%
Viscosity 122° F	≥ 50, ≤ 400	Max size	5/8 in.	Air void content	7.7%
Softening point	≥ 63.5° C	Specific gravity (oven dry bulk)	2.588	Stability	1170
Float test 60° C	1503	Absorption	1.15%	Flow	12
Penetration 77° F	49	Sand equivalent	72	Cellulose fiber	0.3%
		Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		

Table 77. Binder and Aggregate Details Available for AC15-5TR/Paramount SR 83 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 70-22	Aggregate type		Asphalt content	6.0%
Viscosity 60° C	≥ 1500	Max size	5/8 in.	Air void content	7.7%
Viscosity 135° C	≤ 2000	Specific gravity (oven dry bulk)	2.588	Stability	1170
Flash point	≥ 232° C	Absorption	1.15%	Flow	12
Softening point	≥ 60° C	Sand equivalent	72	Cellulose fiber	0.3%
Penetration 25° C	55-90 dmm	Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		

Table 78. Binder and Aggregate Details Available for Slurry Seal/Southwest Slurry SR 83 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	emulsion, CSS-1h	Aggregate type		Asphalt content	6.0%
Viscosity 77° F	≥ 15 ≤ 100	Max size		Air void content	7.7%
Evaporation residue	≥ 60%	Specific gravity (oven dry bulk)	2.588	Stability	1170
Polymer content	≥ 4%	Absorption	1.15%	Flow	12
		Sand equivalent	≥ 50	Cellulose fiber	0.3%
		Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		

Table 79. Binder and Aggregate Details Available for AC15-5TR/Paramount SR 87 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-28	Aggregate type		Asphalt content	
Viscosity 60° C	≤ 1500	Max size	5/8 in.	Air void content	
Viscosity 135° C	≤ 2000				
Flash point	≥ 232				
Penetration 25° C	≥ 75, ≤ 125				
Soft point	≥ 50				

Table 80. Binder and Aggregate Details Available for CM-90/Navajo Western SR 87 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	multigrade	Aggregate type		Asphalt content	
Viscosity 60° C	≥ 400	Max size	5/8 in.	Air void content	
Viscosity 135° C	≤ 2000				
Flashpoint	≥ 66				
Float test 60° C	≥ 1200				

Table 81. Binder and Aggregate Details Available for PASS Oil/Western Emulsion SR 87 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	Patented emulsion	Aggregate type			
Viscosity 77° F	75.2	Max size	5/8 in.		
Viscosity 140° F	Too viscous				
Residue from evaporation	65.7				
pH	4.5				

Table 82. Binder and Aggregate Details Available for Novachip/Koch Materials SR 87 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 70-28	Aggregate type		Asphalt content	
Viscosity, 135° C	0.30 Pa·S	Max size	1/2 in.	Air void content	11.2%
Flash point	≥ 230° C	Specific gravity (oven dry bulk)	2.804		
		Absorption	1.92%		
		Sand equivalent	83		
		Flakiness index	15.3%		
		LA abrasion (500)	37.2%		
		% Carbonates	4.9%		

Table 83. Binder and Aggregate Details Available for CRS-2P/Crown SR 87 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-28	Aggregate type			
Viscosity 50° C	≥ 100, ≤ 400	Max size	5/8 in.		
Penetration 25° C	≥ 40, ≤ 100				
Residue from evaporation	≥ 66				

Table 84. Binder and Aggregate Details Available for CRS-2LM/Copperstate SR 87 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type		Aggregate type		Asphalt content	6.0%
Viscosity 122° F	≥ 75, ≤ 400	Max size	5/8 in.	Air void content	7.7%
Penetration 77° F	≥ 40, ≤ 90	Specific gravity (oven dry bulk)	2.588	Stability	1170
		Absorption	1.15%	Flow	12
		Sand equivalent	72	Cellulose fiber	0.3%
		Flakiness index	3.50%		
		LA abrasion (500)	20%		
		% Fractured	98.0%		
		% Carbonates	0.9%		

Table 85. Binder and Aggregate Details Available for CM-90/Koch Materials U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	Multigrade	Aggregate type		Asphalt content	
Viscosity 60° C	≥ 400	Max size	5/8 in.	Air void content	
Viscosity 135° C	≤ 2000				
Flash point	≥ 66° C				

Table 86. Binder and Aggregate Details Available for AC15-5TR/Paramount U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 70-22	Aggregate type		Asphalt content	
Viscosity 60° C	≥ 1500	Max size	5/8 in.	Air void content	
Viscosity 135° C	≤ 2000				
Flash point	≥ 232° C				
Softening point	≥ 60° C				
Penetration 25° C	55-90 dmm				

Table 87. Binder and Aggregate Details Available for CRS-2P/Crown U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-28	Aggregate type		Asphalt content	
Viscosity 60° C	≥ 75, ≤ 400	Max size	5/8 in.	Air void content	
Penetration 25° C	80-150 dmm				

Table 88. Binder and Aggregate Details Available for AR-ACFC/ADOT U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	CRA-2	Aggregate type	CM0017	Asphalt content	9.5%
Cement type	PG 58-22	Max size	3/8 in.	Rubber content	20.5%
Rubber type	Type B	Specific gravity (oven dry bulk)	2.565		
		Absorption	1.21%		
		Sand equivalent	65		
		Flakiness index	14%		
		LA abrasion (500)	19%		
		% Carbonates	0.3%		
Source Comments					
• Aggregate CM0017 from Brimhall (Snowflake). • Asphalt PG 58-22 from Copperstate. • Asphalt CRA-2 from ISS. • Rubber from FNRI.					

Table 89. Binder and Aggregate Details Available for P-ACFC/Paramount U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	PG 64-28 TR	Aggregate type	CM0017	Asphalt content	6.5%
		Max size	3/8 in.		
		Specific gravity (oven dry bulk)	2.565		
		Absorption	1.21%		
		Sand equivalent	65		
		Flakiness index	14%		
		LA abrasion (500)	19%		
		% Carbonates	0.3%		
Source Comments					
• Aggregate CM0017 from Brimhall (Snowflake). • Asphalt PG 64-28TR from Paramount.					

Table 90. Binder and Aggregate Details Available for HF CRS-2P/Copperstate U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	Emulsion	Aggregate type		Asphalt content	
Viscosity 122° F	≥ 50, ≤ 400	Max size	5/8 in.	Air void content	
Softening point	≥ 65° C				
Float test 60° C	≥ 1200				
Penetration 77° F	≥ 40, ≤ 100				

Table 91. Binder and Aggregate Details Available for Slurry Seal/Southwest Slurry U.S. 191 Preventive Maintenance Sections.

Common Properties					
Asphalt		Aggregate		Mix	
Binder type	Emulsion, CSS-1h	Aggregate type		Asphalt content	
Viscosity 77° F	≥ 15 ≤ 100	Max size		Air void content	
Evaporation residue	≥ 60%				
Polymer content	≥ 4%				

APPENDIX C
PERFORMANCE/CONDITION DATA FOR WEARING COURSES AND PREVENTIVE MAINTENANCE EXPERIMENTS

Table 92. Performance/Condition Data for I-10 Wearing Course Sections.

I-10 Eastbound (EB) MP 186.20 to MP 190.74																												
I-10 Eastbound (EB) MP 186.20 to MP 190.74									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Mill Thick. (in)	Overlay Thick (in)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
99-1	AR-ACFC (1/2-in TSA) Control	5/19/1999	3.5	3.0	186.20	186.48	0.28	1478.40	0.81	-	69	-	4.5	730														
99-2	AR-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	186.48	186.76	0.28	1478.40	0.79	-	68	-	4.0	880												45		
99-3	SMA (3/4-in TSA)	5/19/1999	2.5	2.0	186.76	187.05	0.29	1531.20	1.00	-	64	-	4.5	940												60		
99-4	P-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	187.05	187.33	0.28	1478.40	1.37	-	71	-	4.5	790	500						250					50		
99-5	PEM (1 ¼-in TSA)	5/19/1999	2.5	2.0	187.33	187.61	0.28	1478.40	1.26	-	59	-	5.0	760												40		
99-6	ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	187.61	187.90	0.29	1531.20	1.06	-	68	-	4.5	700	470						400					80		
99-7	AR-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	187.90	188.18	0.28	1478.40	0.77	-	65	-	4.5	786												350		
99-8	ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	188.18	188.47	0.29	1531.20	0.98	-	66	-	4.5	600	430						1100					800		
99-9	PEM (1 ¼-in TSA)	5/19/1999	2.5	2.0	188.47	188.75	0.28	1478.40	1.25	-	58	-	4.5	630	300											300		
99-10	P-ACFC (3/4-in TSA)	5/19/1999	2.5	2.0	188.75	189.03	0.28	1478.40	1.23	-	69	-	4.5	700	430						1200	150				600		
99-11	SMA (3/4-in TSA)	5/19/1999	2.5	2.0	189.03	189.32	0.29	1531.20	0.86	-	60	-	4.0	614										12		80		
99-12	PEM (1 ¼-in TSA)	5/19/1999	3.5	3.0	189.32	189.60	0.28	1478.40	1.23	-	58	-	4.5	490	300											100		
99-13	P-ACFC (3/4-in TSA)	5/19/1999	3.5	3.0	189.60	189.89	0.29	1531.20	1.18	-	69	-	4.5	636	350						1200					220		
99-14	AR-ACFC (3/4-in TSA)	5/19/1999	3.5	3.0	189.89	190.17	0.28	1478.40	0.74	-	61	-	4.5	526					0.1%									
99-15	ACFC (3/4-in TSA)	5/19/1999	3.5	3.0	190.17	190.45	0.28	1478.40	1.04	-	64	-	4.0	640										200		160		
99-16	SMA (3/4-in TSA)	5/19/1999	3.5	3.0	190.45	190.74	0.29	1531.20	1.06	-	58	-	4.5	442												20		
99-17	ACFC (3/4-in TSA)	5/25/1999	3.5	3.0	190.74	191.02	0.28	1478.40	1.09	-	64	-	4.5	538	200						1000					40		
99-18	AR-ACFC (3/4-in TSA)	5/25/1999	3.5	3.0	191.02	191.31	0.29	1531.20	0.83	-	61	-	4.0	600	310									450		350		
99-19	SMA (3/4-in TSA)	5/25/1999	3.5	3.0	191.31	191.59	0.28	1478.40	1.02	-	59	-	4.5	534	300											100		
99-20	PEM (1 ¼-in TSA)	5/25/1999	3.5	3.0	191.59	191.88	0.29	1531.20	1.38	-	56	-	4.5	536	250						800			4		120		
99-21	P-ACFC (3/4-in TSA)	5/25/1999	3.5	3.0	191.88	192.16	0.28	1478.40	1.32	-	68	-	4.5	510	500						2500					30		
99-22	ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	192.16	192.44	0.28	1478.40	1.03	-	64	-	4.5	430							1200							
99-23	AR-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	192.44	192.73	0.29	1531.20	0.78	-	60	-	4.0	490										12				
99-24	SMA (3/4-in TSA)	5/25/1999	4.5	4.0	192.73	193.01	0.28	1478.40	1.14	-	58	-	4.0	490										20				
99-25	P-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	193.01	193.30	0.29	1531.20	1.22	-	65	-	4.5	510	100						1200							
99-26	PEM (1 ¼-in TSA)	5/25/1999	4.5	4.0	193.30	193.58	0.28	1478.40	1.33	-	55	-	4.5	430							350							
99-27	ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	193.58	193.86	0.28	1478.40	1.05	-	63	-	4.5	322							1000							
99-28	PEM (1 ¼-in TSA)	5/25/1999	4.5	4.0	193.86	194.15	0.29	1531.20	1.34	-	53	-	4.5	370							400							
99-29	AR-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	194.15	194.43	0.28	1478.40	0.73	-	57	-	3.5	440	600									1400		750		
99-30	SMA (3/4-in TSA)	5/25/1999	4.5	4.0	194.43	194.72	0.29	1531.20	1.10	-	57	-	4.0	300	480						600					1200		
99-31	P-ACFC (3/4-in TSA)	5/25/1999	4.5	4.0	194.72	195.00	0.28	1478.40	1.29	-	66	-	4.5	390	300						3200					60		
99-32	AR-ACFC (1/2-in TSA) Control	5/25/1999	2.5	3.0	195.00	195.28	0.28	1478.40	0.82	-	58	-	4.5	442														
Total Sections					32																							

Table 93. Performance/Condition Data for I-8 Wearing Course Sections.

I-8 Westbound (WB) MP 88.0 to 92.53																												
I-8 Westbound (WB) MP 88.0 to 92.53									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Mill Thick. (in)	Overlay Thick (in)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
99-34	AR-ACFC (3/4-in TSA)	6/16/1999	2.0	1.0	88.00	88.56	0.56	2956.80	1.07	1.158	62	-	5.0	760	300											100		
99-35	ACFC (3/4-in TSA)	6/16/1999	2.0	1.0	88.56	88.84	0.28	1478.40	1.56	1.319	62	-	5.0	718	150									3		180		
99-36	P-ACFC (3/4-in TSA)	6/16/1999	2.0	1.0	88.84	89.17	0.33	1742.40	1.42	1.266	64	-	5.0	812	200						300							
99-37	PEM (1 ¼-in TSA)	6/17/1999	2.0	1.0	89.17	89.41	0.24	1267.20	1.26	1.373	61	-	5.0	766	250											90		
99-38	SMA (3/4-in TSA)	6/18/1999	2.0	1.0	89.41	89.74	0.33	1742.40	1.04	1.185	64	-	5.0	954	300													
99-39	AR-ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.74	89.99	0.25	1320.00	1.14	1.158	63	-	5.0	334														
99-40	ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.99	90.26	0.27	1425.60	1.49	1.266	63	-	5.0	322														
99-41	P-ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	90.26	90.50	0.24	1267.20	1.37	1.266	63	-	5.0	534														
99-42	PEM (1 ¼-in TSA)	6/18/1999	2.0	2.0	90.50	90.83	0.33	1742.40	1.09	1.239	62	-	5.0	796														
99-43	SMA (3/4-in TSA)	6/18/1999	2.0	2.0	90.83	91.11	0.28	1478.40	1.74	1.454	62	-	5.0	692														
99-44	AR-ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	91.11	91.36	0.25	1320.00	1.61	1.078	65	-	5.0	37														
99-45	ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	91.36	91.68	0.32	1689.60	1.28	1.212	63	-	4.5	298														
99-46	P-ACFC (3/4-in TSA)	6/18/1999	3.0	2.0	91.68	91.98	0.30	1584.00	1.32	1.292	65	-	4.5	660														
99-47	PEM (1 ¼-in TSA)	6/18/1999	3.0	2.0	91.98	92.25	0.27	1425.60	1.43	1.292	64	-	4.5	298														
99-48	SMA (3/4-in TSA)	6/18/1999	3.0	2.0	92.25	92.53	0.28	1478.40	1.49	1.292	59	-	5.0	722														
99-33	AR-ACFC (1/2-in TSA) Control	6/18/1999	2.5	2.0	92.53	92.80	0.27	1425.60	1.09	1.078	60	-	5.0	834														
Total Sections					16																							

I-8 Eastbound (EB) MP 88.0 to 92.53																												
I-8 Eastbound (EB) MP 88.0 to 92.53									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Mill Thick. (in)	Overlay Thick (in)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
99-49	AR-ACFC (1/2-in TSA) Control	6/16/1999	2.5	2.0	87.50	88.00	0.50	2640.00	0.93	0.863	63	-	5.0	400	190	50										1400		
99-50	AR-ACFC(3/4-in TSA)	6/16/1999	1.0	2.0	88.00	88.28	0.28	1478.40	0.55	0.433	62	-	5.0	600	214	50										80		
99-51	ACFC (3/4-in TSA)	6/16/1999	1.0	2.0	88.28	88.57	0.29	1531.20	1.16	1.024	63	-	5.0	550	188													
99-52	P-ACFC (3/4-in TSA)	6/16/1999	1.0	2.0	88.57	88.85	0.28	1478.40	1.48	1.266	62	-	4.5	620	500						300							
99-53	PEM (1 ¼-in TSA)	6/18/1999	1.0	2.0	88.85	89.04	0.19	1003.20	1.68	1.427	59	-	5.0	996	350						150							
99-54	SMA (3/4-in TSA)	6/18/1999	1.0	2.0	89.04	89.42	0.38	2006.40	1.28	1.266	62	-	5.0	690	250	50										80		
99-55	AR-ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.42	89.72	0.30	1584.00	1.57	1.131	64	-	5.0	586	200						250					35		
99-56	ACFC (3/4-in TSA)	6/16/1999	2.0	2.0	89.72	90.00	0.28	1478.40	1.37	1.185	63	-	5.0	394							100							
99-57	P-ACFC(3/4-in TSA)	6/16/1999	2.0	2.0	90.00	90.26	0.26	1372.80	1.33	1.346	62	-	5.0	408	100						400							
99-58	PEM (1 ¼-in TSA)	6/18/1999	2.0	2.0	90.26	90.39	0.13	686.40	1.10	1.212	60	-	4.5	658							80			15				
99-59	SMA (3/4-in TSA)	6/18/1999	2.0	2.0	90.39	90.83	0.44	2323.20	1.49	1.319	60	-	5.0	982														
99-60	AR-ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	90.83	91.11	0.28	1478.40	1.12	1.105	62	-	5.0	572														
99-61	ACFC (3/4-in TSA)	6/16/1999	3.0	2.0	91.11	91.38	0.27	1425.60	1.07	0.997	62	-	5.0	610	40													
99-62	P-ACFC (3/4-in TSA)	6/15/1999	3.0	2.0	91.38	91.68	0.30	1584.00	1.36	1.292	63	-	5.0	794							500							
99-63	PEM (1 ¼-in TSA)	6/18/1999	3.0	2.0	91.68	91.97	0.29	1531.20	1.22	1.319	58	-	5.0	471														
99-64	SMA (3/4-in TSA)	6/18/1999	3.0	2.0	91.97	92.53	0.56	2956.80	1.39	1.212	62	-	5.0	538														
Total Sections					16																							

Table 94. Performance/Condition Data for SR 74 Wearing Course Sections.

SR-74 Eastbound (EB) MP 17 to 19																												
Sta 234+00 is MP 18 & Sta 181+10 is MP 19																												
SR-74 Eastbound (EB) MP 17 to 19									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Mill Thick. (in)	Overlay Thick (in)	Sta From	Sta To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
74-E11	P-ACFC, PG 76-22+	4/3/2001	2.0	2.0	20050	20350	0.06	300.00	2.33	1.427	72	-	4.5	400	146						650					70		
74-E10	P-ACFC, PG 76-22+	4/3/2001	2.0	2.0	20350	20925	0.11	575.00	2.13	1.427	74	-	5.0	626	400						900	100				180		
74-E09	Paramount, PG 76-22, TR+	4/3/2001	2.0	2.0	20925	21720	0.15	795.00	2.61	1.534	75	-	5.0	660	350						1050	250				800		
74-E08	P-ACFC, PG 76-22+	4/3/2001	2.0	2.0	21720	22250	0.10	530.00	2.33	1.534	73	-	5.0	500	316						1200	200				650		
74-E07	Paramount, PG 76-22, TR+	4/3/2001	2.0	2.0	22250	23060	0.15	810.00	2.21	1.427	72	-	4.5	550							1000	200						
74-E06	Paramount, PG 76-22, TR+	4/3/2001	3.0	3.0	23060	24095	0.20	1035.00	2.55	1.534	75	-	4.5	410							1450	350				125		
74-E05	Paramount, PG 76-22, TR+	4/3/2001	3.0	3.0	24095	25150	0.20	1055.00	1.96	1.427	75	-	5.0	244	360						2100	400						
74-E04	P-ACFC, PG 76-22+	4/3/2001	3.0	3.0	25150	26300	0.22	1150.00	2.37	1.534	81	-	4.5	190	600						2250	750						
74-E03	Paramount, PG 76-22, TR+	4/3/2001	0.0	2.0	26300	27496	0.23	1196.00	2.01	1.427	76	-	5.0	900	750						2500	1000				2200		
74-E02	AR-ACFC, PG 64-16, CRA-1	3/14/2001	0.0	2.0	27496	28715	0.23	1219.00	1.33	1.292	70	-	4.5	660	500						700					60		
74-E01	AR-ACFC, PG 64-16, CRA-1	3/14/2001	0.0	2.0	28715	29770	0.20	1055.00	1.30	1.105	70	-	5.0	604	600	350					500					150		
Total Sections					11																							

SR-74 Westbound (WB) MP 17 to 19																												
Sta 234+00 is MP 18 & Sta 181+10 is MP 19																												
SR-74 Westbound (WB) MP 17 to 19									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Mill Thick. (in)	Overlay Thick (in)	Sta From	Sta To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
74-W01	AR-ACFC, PG 64-16, CRA-1	3/28/2001	2.0	2.0	21625	23060	0.27	1435.00	1.30	0.997	71	-	4.5	358							600							
74-W02	AR-ACFC, PG 64-16, CRA-1	3/28/2001	3.0	3.0	23060	24095	0.20	1035.00	1.85	1.319	69	-	4.5	360	300						800					200		
74-W03	AR-ACFC, PG 64-16, CRA-1	3/28/2001	3.0	3.0	24095	25370	0.24	1275.00	1.48	1.212	66	-	4.5	200	540						900					300		
74-W04	P-ACFC, PG 76-22+	4/3/2001	3.0	3.0	25370	26380	0.19	1010.00	2.09	1.427	69	-	4.5	216	450						1250	250						
74-W05	Paramount, PG 76-22, TR+	4/3/2001	0.0	2.0	26380	27496	0.21	1116.00	2.01	1.239	67	-	5.0	750	600						900	300				1400		
74-W06	AR-ACFC, PG 64-16, CRA-1	3/28/2001	0.0	2.0	27496	28715	0.23	1219.00	1.12	1.212	68	-	4.5	360	280						300							
74-W07	AR-ACFC, PG 64-16, CRA-1	3/28/2001	0.0	2.0	28715	29770	0.20	1055.00	1.40	1.212	68	-	4.5	486	300						350					80		
Total Sections					7																							

Table 95. Performance/Condition Data for SR 66 Wearing Course Sections.

SR-66 Eastbound (EB) MP 110 to MP 123																												
SR-66 Eastbound (EB) MP 110 to MP 123									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
66-E01	Double Application Chip, ADOT	n/a	1/2" chip @ 20, 3/8" chip n/a	0.55 & 0.47	110.75	111.50	0.75	3960.00	1.48	1.292	-	0.524	3.5	766	300						250			1200				
66-E02	Double Application	n/a	n/a	n/a	111.50	112.75	1.25	6600.00	1.49	1.454	-	0.387	3.5	600	400	50								700		2400		
66-E03	AC15-5TR, Paramount	8/10/2000	26	0.50	112.75	113.50	0.75	3960.00	0.72	1.266	-	0.348	3.0	596										1500		40		
66-E04	CRS-2, Copperstate	8/11/2000	5/8" agg @ 26	0.55	113.50	114.15	0.65	3432.00	1.00	1.319	-	0.441	4.0	600	172						900			450				
66-E05	AR-ACFC, ADOT	4/30/2001	59	0.08	114.15	115.00	0.85	4488.00	1.30	1.212	-	0.355	5.0	900	200													
66-E06	Novachip, Koch	8/24/2000	1/2" agg @ 65	0.19	116.25	117.00	0.75	3960.00	1.54	1.319	-	0.396	5.0	615														
66-E07	Type III Microsurface, SW Slurry	8/15/2000	33	n/a	117.00	117.75	0.75	3960.00	0.92	1.212	-	0.428	5.0	250	350	100										2000		
66-E08	AR-Chip, Intl' Slurry Surfacing	8/11/2001	24	0.62	117.75	118.50	0.75	3960.00	1.61	1.319	-	0.402	4.5	500	136	300								240				
66-E09	CRS-2P, ADOT 3/8"	n/a	n/a	n/a	118.50	119.23	0.73	3854.40	1.26	1.292	-	0.440	3.5	75		200	225				600			700				
66-E10	CM-90, Navajo Western	8/11/2000	5/8" agg @ 24	0.45	119.23	120.00	0.77	4065.60	0.91	1.212	-	0.434	2.5	180		50								2400				
66-E11	CRS-2P, Crown	8/11/2000	5/8" agg @ 26	0.50	120.00	120.65	0.65	3432.00	1.23	1.212	-	0.383	3.0	200		350								1600				
66-E12	Pass Oil, Western Emulsion	8/12/2000	5/8" agg @ 26	0.45	120.65	121.50	0.85	4488.00	0.76	0.675	-	0.523	3.0			500								180				
66-E13	ACFC, ADOT	5/1/2001	n/a	n/a	121.50	122.25	0.75	3960.00	1.32	1.105	-	0.391	4.0	400	186									150				
66-E14	CRS-2P, ADOT 5/8"	n/a	n/a	n/a	122.25	123.00	0.75	3960.00	1.87	1.427	-	0.478	3.5	60		150					600			800				
Total Sections					14																							

SR-66 Westbound (WB) MP 110 to MP 123																												
SR-66 Westbound (WB) MP 110 to MP 123									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
66-W01	Double Application Chip, ADOT	n/a	1/2" agg @ 28, 3/8" agg @ 22	0.55 & 0.47	110.25	111.50	1.25	6600.00	1.30	1.212	-	0.384	4.0	800	552						200			400		450		
66-W02	Double Application	n/a	n/a	n/a	111.50	112.75	1.25	6600.00	1.31	1.427	-	0.347	3.5	500	300	250					600			900		1800		
66-W03	CRS-2P, Crown	8/11/2000	5/8" agg @ 26	0.50	112.75	113.50	0.75	3960.00	1.24	1.534	-	0.397	3.0	174		50					2000			1500				
66-W04	CRS-2, Copperstate	8/11/2000	5/8" agg @ 23	0.55	113.50	114.25	0.75	3960.00	2.32	1.534	-	0.534	4.0	248							2200			300				
66-W05	CRS-2P, ADOT 3/8"	n/a	n/a	n/a	114.25	115.00	0.75	3960.00	1.48	1.427	-	0.441	4.5	550	156						300			100				
66-W06	AC15-5TR, Paramount	8/10/2000	28	0.50	116.25	117.00	0.75	3960.00	1.10	1.427	-	0.353	3.0	400	330									1200		600		
66-W07	Pass Oil, Western Emulsion	8/12/2000	5/8" agg @ 26	0.45	117.00	117.75	0.75	3960.00	0.47	0.353	-	0.533	4.5	300	310											500		
66-W08	AR-Chip, Intl' Slurry Surfacing	8/11/2001	24	0.62	117.75	118.50	0.75	3960.00	1.27	1.427	-	0.432	4.0	400	128									400				
66-W09	CM-90, Navajo Western	8/11/2000	5/8" agg @ 23	0.47	118.50	119.35	0.85	4488.00	1.21	0.326	-	0.335	3.0	474		50					1000			900		20		
66-W10	ACFC, ADOT	5/1/2001	n/a	n/a	119.35	120.00	0.65	3432.00	1.37	0.863	-	0.359	5.0	90														
66-W11	Novachip, Koch	8/24/2000	1/2" agg @ 65	0.19	120.00	120.75	0.75	3960.00	1.48	1.319	-	0.379	5.0	50							300			16				
66-W12	Type III Microsurface, SW Slurry	8/16/2000	33	n/a	120.75	121.50	0.75	3960.00	0.85	0.353	-	0.477	4.5	450	150	50												
66-W13	AR-ACFC, ADOT	4/30/2001	59	0.08	121.50	122.25	0.75	3960.00	1.20	0.782	-	0.411	4.0								250			100				
66-W14	CRS-2P, ADOT 5/8"	n/a	n/a	n/a	122.25	123.00	0.75	3960.00	1.83	1.534	-	0.463	3.5			50					800	150		450				
Total Sections					14																							

Table 96. Performance/Condition Data for SR 87 Wearing Course Sections.

SR-87 Winslow Northbound (NB)																												
SR-87 Winslow Northbound (NB)									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
87-N01	Double Application Chip, ADOT	6/16/2000	1/2" @ 20	0.47	385.000	385.750	0.750	3960.00	1.44	1.427	-	0.467	4.0	226	80													
87-N02	CM-90, Navajo Western	6/13/2000	5/8" @ 24	0.44	387.227	388.250	1.023	5401.44	1.78	1.534	-	0.484	3.0	204							400	240	180	1200				
87-N03	CM-90, Navajo Western	6/13/2000	5/8" @ 24	0.44	388.250	389.000	0.750	3960.00	1.47	1.346	-	0.440	4.0	220	208						650	350	300	180				
87-N04	Double Chip Seal, ADOT	6/15/2000	1/2" @ 26	0.50	389.000	389.748	0.748	3949.44	1.74	1.534	-	0.472	5.0	144	120						500	25						
87-N05	Double Chip Seal, ADOT	6/15/2000	1/2" @ 26	0.50	389.748	390.477	0.729	3849.12	1.77	1.427	-	0.450	5.0	350	110						600	250	200					
87-N06	Novachip, Koch	7/6/2000	1/2" @ 65	0.17	390.477	391.142	0.665	3511.20	1.94	1.427	-	0.423	5.0	400	100													
87-N07	Pass Oil, Western Emulsion	6/15/2000	5/8" @ 26	0.45	391.142	392.015	0.873	4609.44	2.56	1.534	-	0.521	5.0	192	150						950	300	350					
87-N08	AC15-5TR, Paramount	6/12/2000	5/8" @ 28	0.45	392.015	392.750	0.735	3880.80	1.45	1.427	-	0.430	4.5	144														
87-N09	Pass Oil, Western Emulsion	6/15/2000	5/8" @ 26	0.45	392.750	393.462	0.712	3759.36	3.11	1.534	-	0.458	5.0	470							500	700	350					
Total Sections					9																							

SR-87 Winslow Southbound (SB)																												
SR-87 Winslow Southbound (SB)									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
87-S12	Double Application Chip, ADOT	6/16/2000	1/2" @ 20	0.47	385.000	385.750	0.750	3960.00	1.75	1.534	-	0.468	4.0	214	80													
87-S11	Control, Do Nothing	orig	n/a	n/a	385.750	386.500	0.750	3960.00	1.11	1.105	-	0.504	4.5	500	116													
87-S10	Control, Do Nothing	orig	n/a	n/a	386.500	387.466	0.966	5100.48	1.26	0.890	-	0.459	4.5	440	78													
87-S09	AC15-5TR, Paramount	6/12/2000	5/8" @ 28	0.45	387.466	388.250	0.784	4139.52	1.34	1.534	-	0.445	4.0	160										250				
87-S08	Double Chip Seal, ADOT	6/15/2000	1/2" @ 26	0.50	388.250	389.000	0.750	3960.00	1.71	1.534	-	0.486	4.5	300	166						300	200	120					
87-S07	Double Chip Seal, ADOT	6/15/2000	1/2" @ 26	0.50	389.000	389.748	0.748	3949.44	1.74	1.319	-	0.496	5.0	209	130						600							
87-S06	CRS-2, Copperstate	6/14/2000	5/8" @ 26	0.50	389.748	390.477	0.729	3849.12	2.72	1.534	-	0.534	5.0	430	304						1000	350	300					
87-S05	Control, Do Nothing	orig	n/a	n/a	390.477	390.825	0.348	1837.44	1.48	1.400	-	0.483	5.0	500	334							40						
87-S04	Novachip, Koch	7/6/2000	1/2" @ 65	0.17	390.825	391.251	0.426	2249.28	1.78	1.400	-	0.461	5.0	500	168													
87-S03	CRS-2, Copperstate	6/14/2000	5/8" @ 26	0.50	391.251	391.990	0.739	3901.92	2.21	1.507	-	0.448	5.0	262	180						900	250	120					
87-S02	CRS-2P, Crown	6/14/2000	5/8" @ 26	0.48	391.990	392.739	0.749	3954.72	2.43	1.534	-	0.526	5.0	292	300						800	500	850					
87-S01	CRS-2P, Crown	6/14/2000	5/8" @ 26	0.48	392.739	393.463	0.724	3822.72	2.40	1.427	-	0.453	5.0	392							600	500	1000					
Total Sections					12																							

Table 97. Performance/Condition Data for SR 83 Wearing Course Sections.

SR-83 Northbound (NB) MP 32 to MP 43

SR-83 Northbound (NB) MP 32 to MP 43									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
83-001	Type III Slurry Seal, SW Slurry	7/14/2001	36	n/a	33.20	33.91	0.71	3748.80	0.54	0.970	51	0.206	2.5	790		600								1800				
83-002	Double Chip Seal, ADOT	n/a	n/a	n/a	33.91	34.52	0.61	3220.80	0.98	1.105	71	0.409	4.5	550	230	350										800		
83-003	AR-ACFC	n/a	n/a	n/a	34.52	35.14	0.62	3273.60	1.31	1.158	-	0.381	5.0	390	100						200					50		
83-004	AR-ACFC, ADOT	n/a	n/a	n/a	35.14	35.75	0.61	3220.80	1.43	1.212	63	0.332	4.5	340							600	250						
83-005	AR-ACFC (replaced CRS-2P)	n/a	n/a	n/a	35.75	36.36	0.61	3220.80	1.42	1.212	70	0.337	5.0	388	200						350	60				450		
83-006	AC15-5TR, Paramount	6/26/2001	37	0.51	36.36	36.97	0.61	3220.80	1.76	1.319	62	0.414	3.5	512		450					150			750				
83-007	CRS-2P, ADOT	7/25/2001	30	0.48	36.97	37.58	0.61	3220.80	0.58	0.568	63	0.271	3.0	750	250	500								1200		350		
83-008	Asphalt Rubber Chip, ISS	7/14/2001	n/a	n/a	37.58	38.20	0.62	3273.60	1.26	0.702	63	0.282	4.0	120		450	150							700	30			
83-009	P-ACFC, Paramount	n/a	n/a	n/a	38.20	40.64	2.44	12883.20	1.53	1.319	68	0.359	5.0	880	300						600					300		
83-010	Novachip, Koch	8/3/2001	n/a	0.20	40.64	41.26	0.62	3273.60	2.06	1.346	60	0.333	5.0	366							500							
83-011	CM-90, Koch	6/26/2001	27	0.53	41.26	41.87	0.61	3220.80	1.84	1.507	68	0.359	4.0	396		450					250			800				
83-012	CRS-2, ADOT	n/a	26	0.50	41.87	42.48	0.61	3220.80	1.65	1.239	-	0.368	4.0	320		250	75				300			800	60			
83-013	HF CRS-2P, Copperstate	7/24/2001	33	0.55	42.48	43.09	0.61	3220.80	2.73	1.400	-	0.365	4.5	372		200								250				
83-014	Pass CR, Western Emulsion	7/23/2001	n/a	0.45	43.09	43.50	0.41	2164.80	2.08	1.534	-	0.407	4.5	96		250								200				
Total Sections					14																							

SR-83 Southbound (SB) MP 32 to MP 43

SR-83 Southbound (SB) MP 32 to MP 43									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
83-015	AR-ACFC	n/a	n/a	n/a	33.20	33.91	0.71	3748.80	0.54	0.997	70	0.362	5.0	600	150						300					25		
83-016	CRS-2, ADOT	n/a	26	0.50	33.91	34.52	0.61	3220.80	1.48	1.185	65	0.392	3.5	400	220	100								900		500		
83-017	Asphalt Rubber Chip, ISS	7/14/2001	n/a	n/a	34.52	35.14	0.62	3273.60	1.84	1.427	-	0.395	3.5	216		150								900				
83-018	CM-90, Koch	7/23/2001	n/a	0.51	35.14	35.75	0.61	3220.80	1.65	1.427	65	0.360	4.0	192		50								400		12		
83-019	AR-ACFC, ADOT	n/a	n/a	n/a	35.75	36.36	0.61	3220.80	1.72	1.319	-	0.349	4.5	194							500	80						
83-020	CRS-2P, ADOT	7/25/2001	n/a	n/a	36.36	36.97	0.61	3220.80	1.16	1.427	-	0.414	4.0	240	80	600	150				400	100		250		60		
83-021	Type III Slurry Seal, SW Slurry	7/14/2001	30	n/a	36.97	37.58	0.61	3220.80	0.95	1.319	69	0.376	4.5	300	68	450	150									1500		
83-022	AC15-5TR, Paramount	6/26/2001	34	0.48	37.58	38.20	0.62	3273.60	2.04	1.427	71	0.354	4.5	36		300					700	180		100				
83-023	P-ACFC, Paramount	n/a	n/a	n/a	38.20	40.64	2.44	12883.20	2.23	1.534	-	0.450	5.0	560	250	100					700					550		
83-024	HF CRS-2P, Copperstate	n/a	n/a	n/a	40.64	41.26	0.62	3273.60	1.14	1.427	72	0.392	3.5	344		350								800				
83-025	Double Chip Seal, ADOT	7/25/2001	25	0.58	41.26	41.87	0.61	3220.80	0.52	0.970	-	0.217	3.5	172		300					150			1400	120			
83-026	CRS-2P, Crown	7/26/2001	30	0.55	41.87	42.48	0.61	3220.80	1.92	1.319	-	0.375	4.5	124		350					250	80		300				
83-027	Novachip, Koch	8/3/2001	n/a	n/a	42.48	43.09	0.61	3220.80	1.32	1.319	-	0.373	5.0	210							1300	180				50		
83-028	Pass CR, Western Emulsion	7/24/2001	n/a	n/a	43.09	43.50	0.41	2164.80	1.81	1.454	-	0.377	4.5	176		200								160				
Total Sections					14																							

Table 98. Performance/Condition Data for U.S. 191 Wearing Course Sections.

US-191 Northbound (NB) MP 181 to MP 185																												
US-191 Northbound (NB) MP 181 to MP 185									Inspection Data / Distresses (Severity)																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
191-001	ADOT CRS-2P	7/2/2001	5/8" @ 32	0.47	181.00	181.67	0.67	3537.60	1.30	1.400	-	0.404	5.0	86							550							
191-002	Control	orig	n/a	n/a	181.67	182.34	0.67	3537.60	2.19	1.507	-	0.423	5.0	40							400							
191-003	ADOT CRS-2P future	orig	n/a	n/a	182.34	183.01	0.67	3537.60	1.91	1.507	-	0.411	5.0	48							200							
191-004	ADOT CRS-2P	7/2/2001	5/8" @ 33	0.57	183.01	183.68	0.67	3537.60	1.60	1.454	-	0.357	3.5	480	50						100			400				
191-005	ADOT CRS-2P future	orig	n/a	n/a	183.68	184.35	0.67	3537.60	2.02	1.534	-	0.470	4.0	460							250	50	300					
191-006	Control	orig	n/a	n/a	184.35	185.00	0.65	3432.00	2.23	1.534	-	0.370	4.5	474		50					200	20	5					
Total Sections					6																							

US-191 Southbound (SB) MP 181 to MP 185																												
US-191 Southbound (SB) MP 181 to MP 185									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
191-007	ADOT CRS-2P	7/2/2001	5/8" @ 32	0.56	181.00	181.67	0.67	3537.60	1.62	1.480	-	0.386	5.0	256			150				300							
191-008	Control	orig	n/a	n/a	181.67	182.34	0.67	3537.60	2.09	1.507	-	0.414	4.5	182							2000	150						
191-009	ADOT CRS-2P future	orig	n/a	n/a	182.34	183.01	0.67	3537.60	2.10	1.534	-	0.400	4.5	72							250	30						
191-010	ADOT CRS-2P	7/2/2001	5/8" @ 30	0.54	183.01	183.68	0.67	3537.60	1.56	1.292	-	0.366	5.0	840	400	50	75				200							
191-011	ADOT CRS-2P future	orig	n/a	n/a	183.68	184.35	0.67	3537.60	2.16	1.427	-	0.453	4.0	566							600	30						
191-012	Control	orig	n/a	n/a	184.35	185.00	0.65	3432.00	2.24	1.480	-	0.415	5.0	551							220	25	15					
Total Sections					6																							

Table 98. Performance/Condition Data for U.S. 191 Wearing Course Sections (Continued).

US-191 Northbound (NB) MP 200.5 to MP 219.25																												
US-191 Northbound (NB) MP 200.5 to MP 219.25									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
191-013	AR-Chip, ISS	n/a	n/a	n/a	200.50	201.25	0.75	3960.00	0.89	1.346	-	0.341	3.5	500	128	100					200	15		550			10	
191-014	CRS-2 ADOT	6/27/2001	3/8" @ 27	0.48	201.25	202.00	0.75	3960.00	1.49	1.346	-	0.388	4.5	300	180						100			20				
191-015	CRS-2P, Crown	6/26/2001	5/8" @ 28	0.571	202.00	202.75	0.75	3960.00	1.74	1.212	-	0.331	3.5	500	70	50					100			450			8	
191-016	AC15-5TR, Paramount	6/21/2001	5/8" @ 30	0.522	202.75	203.50	0.75	3960.00	1.14	1.158	-	0.314	3.0	314							100			1100				
191-017	CM-90, Koch	n/a	n/a	n/a	203.50	204.25	0.75	3960.00	1.75	1.212	-	0.329	3.0	96		150					300			1800				
191-018	ADOT AR-ACFC	6/18/2001	n/a	n/a	204.25	205.00	0.75	3960.00	1.19	0.917	-	0.333	4.5	386							1000	200						
191-019	ADOT HF CRS-2P	6/25/2001	3/8" @ 27	0.462	205.00	205.75	0.75	3960.00	1.70	1.266	-	0.379	4.5	600	260						200			30		5		
191-020	P-ACFC, Paramount PG 64-28	6/15/2001	n/a	n/a	205.75	206.50	0.75	3960.00	1.39	1.105	-	0.396	4.5	340	128						900							40
191-021	ADOT Double Chip Seal	6/29/2001	5/8" @ 29 and 3/8" @ 23	0.548 & 0.501	206.50	207.25	0.75	3960.00	1.01	0.890	-	0.363	2.5	132							200			3000				
191-022	Novachip, Koch	6/21/2001	90.0	0.20	207.25	208.00	0.75	3960.00	1.80	1.480	-	0.341	5.0	540	200						1000							
191-023	Type III Slurry Seal, SW Slurry	6/27/2001	22.7	n/a	208.00	208.75	0.75	3960.00	1.78	1.158	-	0.475	5.0	450	268				0.2%	0.2%	350	100				25		30
191-024	HF CRS-2P, Copperstate	6/25/2001	5/8" @ 29	0.51	208.75	209.75	1.00	5280.00	1.58	1.319	-	0.337	4.5	800	304	50					400	180		60				
191-025	CRS-2P, Crown	6/26/2001	5/8" @ 29	0.547	210.25	211.00	0.75	3960.00	1.21	1.319	-	0.375	4.5	450	126						300			100				
191-026	AC15-5TR, Paramount	6/21/2001	5/8" @ 28	0.535	211.00	211.75	0.75	3960.00	0.76	1.292	-	0.402	4.0	300	56						300			800				
191-027	CRS-2 ADOT	6/27/2001	3/8" @ 27	0.475	211.75	212.50	0.75	3960.00	1.42	1.105	-	0.350	4.0	432		100					250			200				
191-028	CM-90, Koch	n/a	n/a	n/a	212.50	213.25	0.75	3960.00	1.43	0.890	-	0.350	3.0	690	36						350			2500				
191-029	AR-Chip, ISS	n/a	n/a	n/a	213.25	214.00	0.75	3960.00	0.94	1.212	-	0.355	4.0	940							300			120				
191-030	Type III Slurry Seal, SW Slurry	6/27/2001	32.2	n/a	214.00	214.75	0.75	3960.00	0.65	0.943	-	0.439	5.0	1400	420						260					340		
191-031	ADOT AR-ACFC	6/19/2001	n/a	n/a	214.75	215.50	0.75	3960.00	1.08	1.078	-	0.354	4.5	240							500							
191-032	Novachip, Koch	6/21/2001	90.0	0.20	215.50	216.25	0.75	3960.00	0.81	1.292	-	0.334	4.5	1220							650	100						
191-033	ADOT HF CRS-2P	6/25/2001	3/8" @ 27	0.475	216.25	217.00	0.75	3960.00	1.07	0.997	-	0.359	4.5	280	120						150		8	160				
191-034	P-ACFC, Paramount PG 64-28	6/15/2001	n/a	n/a	217.00	217.75	0.75	3960.00	1.71	1.266	-	0.325	4.5	1032							650							
191-035	HF CRS-2P, Copperstate	6/25/2001	5/8" @ 32	0.50	217.75	218.50	0.75	3960.00	2.10	1.534	-	0.356	4.5	650	350			0.2%			100			80				
191-036	ADOT Double Chip Seal	6/29/2001	5/8" @ 29 and 3/8" @ 22	0.569 & 0.495	218.50	219.25	0.75	3960.00	0.70	-0.372	-	0.259	2.5	280							100		10	1650				
Total Sections					24																							

US-191 Southbound (SB) MP 200.5 to MP 219.25																												
US-191 Southbound (SB) MP 200.5 to MP 219.25									Inspection Data / Distresses																			
Test Section ID	Material	Construction Date	Agg. Application (lb/sy)	Binder Application (gal/sy)	MP From	MP To	Length, mi	Distance, ft	Texture, MPD (mm)	Outflow, MTD (mm)	Skid	DF Test	Flushing	LTD (L)	LTD (M)	Rutting (L)	Rutting (M)	Patching (L)	Patching (M)	Patching (H)	Weath. (L)	Weath. (M)	Weath. (H)	Bleeding (L)	Bleeding (M)	Fatigue Crk. (M)	Swelling (L)	Edge Crk. (L)
191-037	AR-Chip, ISS	n/a	n/a	n/a	200.50	201.25	0.75	3960.00	1.79	1.427	-	0.329	4.0	394	60	150	225				200	10		100			6	
191-038	CRS-2 ADOT	6/27/2001	3/8" @ 27	0.444	201.25	202.00	0.75	3960.00	1.47	1.292	-	0.333	4.5	380	160						80			40				
191-039	CRS-2P, Crown	6/26/2001	5/8" @ 28	0.55	202.00	202.75	0.75	3960.00	1.46	1.266	-	0.357	3.5	260	50	200	75				120			280			12	
191-040	AC15-5TR, Paramount	6/21/2001	5/8" @ 29	0.52	202.75	203.50	0.75	3960.00	1.34	1.319	-	0.295	2.0	650	142	100					200	10		2500	300			
191-041	CM-90, Koch	n/a	n/a	n/a	203.50	204.25	0.75	3960.00	1.67	1.212	-	0.332	3.5	124		150					200			900			20	
191-042	ADOT AR-ACFC	6/18/2001	n/a	n/a	204.25	205.00	0.75	3960.00	1.83	1.292	-	0.503	4.5	716							900	30						
191-043	ADOT HF CRS-2P	6/25/2001	3/8" @ 27	0.441	205.00	205.75	0.75	3960.00	1.42	1.212	-	0.380	4.5	800	350						200	10		130		12		
191-044	P-ACFC, Paramount PG 64-28	6/15/2001	n/a	n/a	205.75	206.50	0.75	3960.00	1.32	1.105	-	0.347	4.5	532	120	50					800							35
191-045	ADOT Double Chip Seal	6/29/2001	5/8" @ 29 and 3/8" @ 23	0.567 & 0.529	206.50	207.25	0.75	3960.00	1.26	0.943	-	0.376	2.0	72							150			4200				
191-046	Novachip, Koch	6/21/2001	90.0	0.20	207.25	208.00	0.75	3960.00	1.18	1.373	-	0.362	5.0	540	128						1200							
191-047	Type III Slurry Seal, SW Slurry	6/27/2001	30.6	n/a	208.00	208.75	0.75	3960.00	1.58	1.212	-	0.486	5.0	420	366						300	20				25		12
191-048	HF CRS-2P, Copperstate	6/25/2001	5/8" @ 29	0.45	208.75	209.75	1.00	5280.00	2.19	1.427	-	0.360	4.5	650	256						300	60		100				
191-049	CRS-2P, Crown	6/26/2001	5/8" @ 28	0.506	210.25	211.00	0.75	3960.00	1.21	1.105	-	0.336	4.5	450	206						250			250		25		12
191-050	AC15-5TR, Paramount	6/21/2001	5/8" @ 28	0.496	211.00	211.75	0.75	3960.00	1.01	1.266	-	0.334	4.0	300	42						260			1300				
191-051	CRS-2 ADOT	6/27/2001	3/8" @ 27	0.446	211.75	212.50	0.75	3960.00	1.64	1.319	-	0.425	3.5	484		50					350		4	400				
191-052	CM-90, Koch	n/a	n/a	n/a	212.50	213.25	0.75	3960.00	1.36	1.400	-	0.341	3.0	740	24	150					300	200		2500				8
191-053	AR-Chip, ISS	n/a	n/a	n/a	213.25	214.00	0.75	3960.00	0.94	1.185	-	0.306	4.0	880		100					300			200				
191-054	Type III Slurry Seal, SW Slurry	6/27/2001	29.5	n/a	214.00	214.75	0.75	3960.00	1.85	1.534	-	0.443	5.0	1400	360						250					220		
191-055	ADOT AR-ACFC	6/19/2001	n/a	n/a	214.75	215.50	0.75	3960.00	1.23	1.292	-	0.371	4.5	960							800	30						
191-056	Novachip, Koch	6/21/2001	90.0	0.20	215.50	216.25	0.75	3960.00	0.97	0.890	-	0.324	4.5	738							400							
191-057	ADOT HF CRS-2P	6/25/2001	3/8" @ 27	0.469	216.25	217.00	0.75	3960.00	0.75	0.836	-	0.297	3.5	640		50					250		30	400			20	
191-058	P-ACFC, Paramount PG 64-28	6/15/2001	n/a	n/a	217.00	217.75	0.75	3960.00	1.34	1.078	-	0.393	4.5	420							550							
191-059	HF CRS-2P, Copperstate	6/25/2001	5/8" @ 29	0.49	217.75	218.50	0.75	3960.00	1.08	1.266	-	0.399	4.5	800	460	100					100		10	100				
191-060	ADOT Double Chip Seal	6/29/2001	5/8" @ 29	0.507	218.50	219.25	0.75	3960.00	1.41	1.292	-	0.351	4.0	562			75				150		4	300				
Total Sections					24																							

APPENDIX D
DEDUCT VALUE CALCULATION

This appendix describes the deduct value (DV) equations developed by the U.S. Army Corps of Engineers (ASTM 2011) to determine a roadway's Pavement Condition Index (PCI).

PCI data collected for a particular roadway consists of distress type, severity, and extent (quantity). The extent data is used to determine the percentage density value for the particular distress at low, medium, and high severity.

The percentage density is obtained using the following equation:

$$Percentage\ Density = \frac{Quantity\ of\ Distress\ (for\ particular\ severity)}{Sample\ Area} x100$$

The DV for each distress type and severity level combination is obtained using the percentage DVs. The DV curves are used to determine the DV. The value of percentage density, type of distress, and severity of distress are required to refer the particular curve for obtaining the DV. For example, for the given information, the DV is obtained using the curves as follows:

Type of distress = longitudinal and transverse cracking
Percentage density = 0.90
Severity of distress = Low

Referring to the DV curves for longitudinal and transverse cracking (see Figure 7), the DV is 4.8.

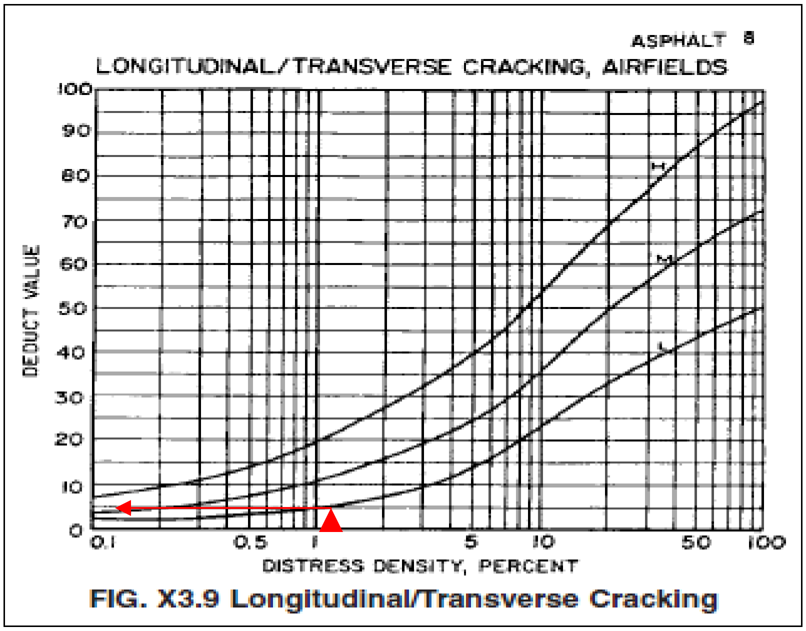

Figure 7. DV Curves for Longitudinal and Transverse Cracking (ASTM 2011).

The standard curves for distress type and severity level combination can be represented in the form of an equation. The DV can also be determined from these equations. The standard form of the polynomial equation can be represented as follows:

$$DV(i) = a_0*x + a_1*x^2 + a_2*x^3 + a_3*x^3 + a_4*x^4 + a_5*x^5 + a_6*x^6$$

where

DV(i)	=	DV for each distress type and severity level
x	=	Percentage distress
a_0, a_1,a_2,a_3, etc.	=	DV coefficient

The DV coefficients for the polynomial equation vary with respect to the type of distress and severity level. Tables 99, 100, and 101 provide the DV coefficients for the different distresses at low, medium, and high severity, respectively.

Table 99. DV Coefficients for Low Severity Distresses.

Distress Type	Dis-tress Code	a_0	a_1	a_2	a_3	a_4	a_5	a_6
Alligator cracking	1	11.57282	14.47294	5.323757	1.59328	-0.8304	0	0
Bleeding	2	0.226389	0.526314	0.808991	0.98469	0.47562	0	0
Block cracking	3	0.653826	2.442088	3.661845	1.55629	-0.3173	0	0
Bumps and sags	4	6.842161	13.21294	10.81703	6.6296	2.78335	0	0
Corrugation	5	1.719801	4.148407	5.883605	2.15801	-0.697	0	0
Depression	6	4.576458	1.56377	5.720728	7.57356	0.9556	-1.8667	0.01785
Edge cracking	7	2.678353	3.009038	4.088985	2.31193	-1.2464	0	0
Joint reflection cracking	8	2.368495	5.585601	4.304673	1.40666	0.31909	0	0
Lane/ shoulder drop-off	9	2.603195	2.571387	4.029737	2.46853	0.40699	0	0
Long and trans cracking	10	2.026879	6.764295	7.027913	1.52647	-0.764	0	0
patching	11	2.318707	5.967067	6.850561	2.08319	-1.119	0	0
Polished aggregate	12	0	- 0.141572	3.588791	-1.6819	1.21091	0	0
Potholes	13	58.0456	41.97506	2.918861	-2.7756	-0.3735	0	0
Railroad crossing	14	2	5.51293	-29.36848	76.942	-55.301	12.4976	0
Rutting	15	7.864241	13.94023	7.431795	-0.3771	-0.733	0	0
Shoving	16	3.968421	9.926723	7.064671	0.31435	-0.792	0	0
Slippage cracking	17	4.348589	11.43505	14.15354	0.39453	-4.8667	1.40584	0
Swell	18	2	5.846334	4.610276	-0.974	0.52452	0	0
Weather and raveling	19	1.518308	1.463035	1.225113	1.18395	-0.0964	0	0

Table 100. DV Coefficients for Medium Severity Distresses.

Distress Type	Dis-tress Code	a_0	a_1	a_2	a_3	a_4	a_5	a_6
Alligator cracking	1	21.06287	21.87252	5.430085	-2.25521	0.524358	0	0
Bleeding	2	3.103022	5.033304	3.347506	0.957058	0.339835	0	0
Block cracking	3	2.505961	6.738529	5.642363	1.13416	-0.27564	0	0
Bumps and sags	4	23.6662	24.87604	13.0282	11.5001	6.281742	0	0
Corrugation	5	15.52694	18.69575	6.45422	-1.36052	0.354079	0	0
Depression	6	9.18211	3.496649	11.12484	11.6605	-1.95889	-3.85509	0.954007
Edge cracking	7	8.118318	9.360312	7.534917	0.340772	-1.95215	0	0
Joint reflection cracking	8	6.622707	14.02556	14.48692	2.16426	-4.81981	0	0
Lane/ shoulder drop-off	9	4.506029	1.917193	4.716884	5.791711	2.48599	0	0
Long and trans cracking	10	8.428558	15.6896	6.70787	-0.447	0.106175	0	0
Patching	11	9.573035	12.04862	7.786538	1.894723	-0.41622	0	0
Polished aggregate	12	0	-0.1415721	3.588791	-1.68193	1.210908	0	0
Potholes	13	89.72291	61.35048	-0.8974963	-7.80229	-1.24064	0	0
Railroad crossing	14	6	0.0940975	74.13531	-52.6759	10.54689	0	0
Rutting	15	17.9108	20.09714	6.764661	0.335158	-0.60516	-0.362	0
Shoving	16	9.312978	14.62188	11.48379	1.394249	-1.18064	0	0
Slippage cracking	17	10.77733	20.24104	18.4704	-1.7614	-6.43406	1.934033	0
Swell	18	12	21.45781	-9.318042	14.77898	-4.38961	0	0
Weather and raveling	19	8.216442	4.187497	3.774271	3.050996	-0.75222	0	0

Table 101. DV Coefficients for High Severity Distresses.

Distress Type	Distress Code	a_0	a_1	a_2	a_3	a_4	a_5	a_6
Alligator cracking	1	30.35494	29.47183	5.773053	-5.02079	1.123057	0	0
Bleeding	2	5.174671	6.973435	7.552022	3.26362	-0.08964	0	0
Block cracking	3	5.698064	11.97259	10.52476	2.565825	-1.28441	0	0
Bumps and sags	4	52.43768	36.51803	5.190109	3.443652	2.333901	0	0
Corrugation	5	33.73598	22.8334	2.978519	2.716514	-1.16458	0	0
Depression	6	16.2489	6.837703	13.47965	15.15847	-3.98759	-6.20127	2.053938
Edge cracking	7	13.03806	15.51621	14.72085	0.336104	-4.50659	0	0
Joint reflection cracking	8	14.01349	18.83563	25.97381	22.76282	-14.5529	-12.5832	5.580756
Lane/ shoulder drop-off	9	7.040119	5.204559	9.724312	8.009115	2.449223	0	0
Long and trans cracking	10	18.19322	22.18564	14.63774	12.49489	-0.00014	-5.2497	0
Patching	11	18.65748	14.89525	9.107156	15.73892	-1.06098	-7.76801	2.162507
Polished aggregate	12	0	-0.1415721	3.588791	-1.68193	1.210908	0	0
Potholes	13	108.9686	58.37936	0.97282088	-3.59034	-0.26399	0	0
Railroad crossing	14	20	32.91058	-33.17019	138.5578	-122.88	31.40176	0
Rutting	15	27.35017	24.50075	5.838376	3.139074	-0.15555	-1.00682	0
Shoving	16	18.97428	15.49013	12.02632	13.36067	-3.0542	-6.69051	2.213889
Slippage cracking	17	18.90548	30.13452	25.77373	2.893255	-11.3648	-1.77798	1.935406
Swell	18	34	6.308562	9.44694	4.614884	-1.85515	0	0
Weather and raveling	19	15.03442	13.0601	12.93693	4.599652	-3.3116	0	0

APPENDIX E
PERFORMANCE COMPARISON TABLES: WEARING COURSE EXPERIMENT

Table 102. ADOT Wearing Course Performance Comparison: Skid Number.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Skid No.	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	68	64.8	1.8	64.4
I-10	99-07	ACFC	3/4	2.0	2.5	66			
I-10	99-14	ACFC	3/4	3.0	3.5	64			
I-10	99-16	ACFC	3/4	3.0	3.5	64			
I-10	99-21	ACFC	3/4	4.0	4.5	64			
I-10	99-26	ACFC	3/4	4.0	4.5	63			
I-10	Control	AR-ACFC	1/2	3.0	3.5	69	63.5	7.8	61.5
I-10	Control	AR-ACFC	1/2	3.0	3.5	58			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	68	62.0	3.9	61.0
I-10	99-06	AR-ACFC	3/4	2.0	2.5	65			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	61			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	61			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	60			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	57			
I-10	99-03	P-ACFC	3/4	2.0	2.5	71	68.0	2.2	67.4
I-10	99-09	P-ACFC	3/4	2.0	2.5	69			
I-10	99-12	P-ACFC	3/4	3.0	3.5	69			
I-10	99-20	P-ACFC	3/4	3.0	3.5	68			
I-10	99-24	P-ACFC	3/4	4.0	4.5	65			
I-10	99-30	P-ACFC	3/4	4.0	4.5	66			
I-10	99-04	PEM	1 1/4	2.0	2.5	59	56.5	2.3	55.9
I-10	99-08	PEM	1 1/4	2.0	2.5	58			
I-10	99-11	PEM	1 1/4	3.0	3.5	58			
I-10	99-19	PEM	1 1/4	3.0	3.5	56			
I-10	99-25	PEM	1 1/4	4.0	4.5	55			
I-10	99-27	PEM	1 1/4	4.0	4.5	53			
I-10	99-02	SMA	3/4	2.0	2.5	64	59.3	2.5	58.7
I-10	99-10	SMA	3/4	2.0	2.5	60			
I-10	99-15	SMA	3/4	3.0	3.5	58			
I-10	99-18	SMA	3/4	3.0	3.5	59			
I-10	99-23	SMA	3/4	4.0	4.5	58			
I-10	99-29	SMA	3/4	4.0	4.5	57			
I-8	99-35	ACFC	3/4	2.0	1.0	62	62.7	0.5	62.5
I-8	99-40	ACFC	3/4	2.0	2.0	63			
I-8	99-45	ACFC	3/4	2.0	3.0	63			
I-8	99-52	ACFC	3/4	2.0	1.0	63			
I-8	99-57	ACFC	3/4	2.0	2.0	63			
I-8	99-62	ACFC	3/4	2.0	3.0	62			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?	--	--	--
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	62	63.0	1.3	62.7
I-8	99-39	AR-ACFC	3/4	2.0	2.0	63			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	65			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	62			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	64			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	62			
I-8	99-36	P-ACFC	3/4	2.0	1.0	64	63.2	1.2	62.9
I-8	99-41	P-ACFC	3/4	2.0	2.0	63			
I-8	99-46	P-ACFC	3/4	2.0	3.0	65			
I-8	99-53	P-ACFC	3/4	2.0	1.0	62			
I-8	99-58	P-ACFC	3/4	2.0	2.0	62			
I-8	99-63	P-ACFC	3/4	2.0	3.0	63			
I-8	99-37	PEM	1 1/4	2.0	1.0	61	60.7	2.2	60.1
I-8	99-42	PEM	1 1/4	2.0	2.0	62			
I-8	99-47	PEM	1 1/4	2.0	3.0	64			
I-8	99-54	PEM	1 1/4	2.0	1.0	59			
I-8	99-59	PEM	1 1/4	2.0	2.0	60			
I-8	99-64	PEM	1 1/4	2.0	3.0	58			
I-8	99-38	SMA	3/4	2.0	1.0	64	61.5	1.8	61.1
I-8	99-43	SMA	3/4	2.0	2.0	62			
I-8	99-48	SMA	3/4	2.0	3.0	59			
I-8	99-55	SMA	3/4	2.0	1.0	62			
I-8	99-60	SMA	3/4	2.0	2.0	60			
I-8	99-65	SMA	3/4	2.0	3.0	62			

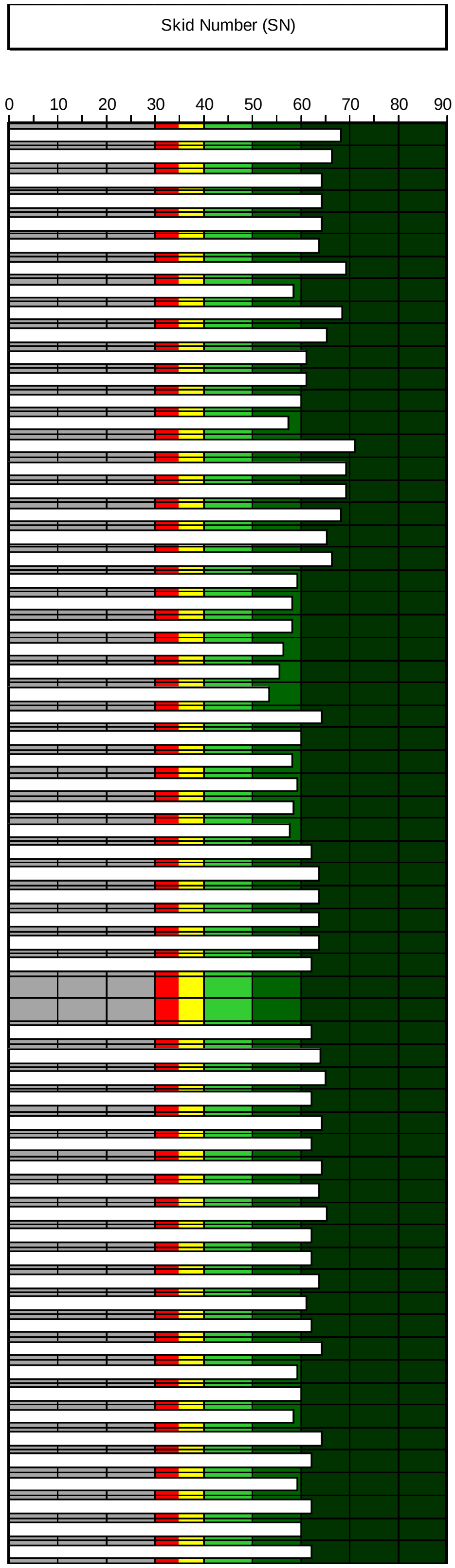

Table 102. ADOT Wearing Course Performance Comparison: Skid Number (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Skid No.	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	70			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	68			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	71			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	69	68.9	1.7	68.4
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	66			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	68			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	70			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	72			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	74			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	73	73.8	4.4	72.7
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	81			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	69			
SR 74	--	Paramount, PG 72-22 TR+	3/8	2.0	2.0	75			
SR 74	--	Paramount, PG 72-22 TR+	3/8	2.0	2.0	72			
SR 74	--	Paramount, PG 72-22 TR+	3/8	3.0	3.0	75	73.3	3.4	72.5
SR 74	--	Paramount, PG 72-22 TR+	3/8	3.0	3.0	75			
SR 74	--	Paramount, PG 72-22 TR+	3/8	0.0	0.0	76			
SR 74	--	Paramount, PG 72-22 TR+	3/8	0.0	0.0	67			

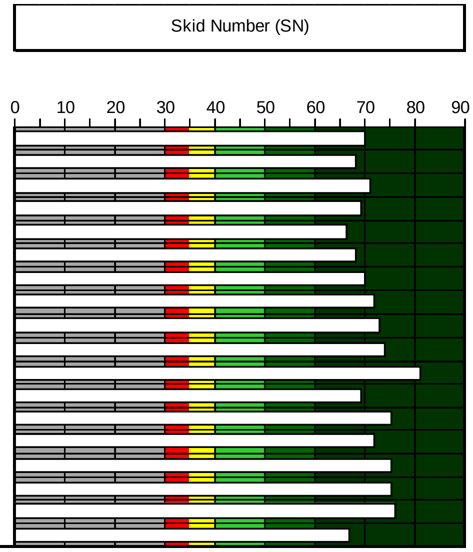

Table 103. ADOT Wearing Course Performance Comparison: Weathering.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	3	6.7	4.1	7.8
I-10	99-07	ACFC	3/4	2.0	2.5	9			
I-10	99-14	ACFC	3/4	3.0	3.5	0			
I-10	99-16	ACFC	3/4	3.0	3.5	9			
I-10	99-21	ACFC	3/4	4.0	4.5	10			
I-10	99-26	ACFC	3/4	4.0	4.5	9			
I-10	Control	AR-ACFC	1/2	3.0	3.5	0	0.0	0.0	0.0
I-10	Control	AR-ACFC	1/2	3.0	3.5	0			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-06	AR-ACFC	3/4	2.0	2.5	0			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-03	P-ACFC	3/4	2.0	2.5	2	13.0	7.2	14.8
I-10	99-09	P-ACFC	3/4	2.0	2.5	14			
I-10	99-12	P-ACFC	3/4	3.0	3.5	10			
I-10	99-20	P-ACFC	3/4	3.0	3.5	19			
I-10	99-24	P-ACFC	3/4	4.0	4.5	10			
I-10	99-30	P-ACFC	3/4	4.0	4.5	22			
I-10	99-04	PEM	1 1/4	2.0	2.5	0	2.2	2.8	2.9
I-10	99-08	PEM	1 1/4	2.0	2.5	0			
I-10	99-11	PEM	1 1/4	3.0	3.5	0			
I-10	99-19	PEM	1 1/4	3.0	3.5	7			
I-10	99-25	PEM	1 1/4	4.0	4.5	3			
I-10	99-27	PEM	1 1/4	4.0	4.5	3			
I-10	99-02	SMA	3/4	2.0	2.5	0	0.9	2.2	1.4
I-10	99-10	SMA	3/4	2.0	2.5	0			
I-10	99-15	SMA	3/4	3.0	3.5	0			
I-10	99-18	SMA	3/4	3.0	3.5	0			
I-10	99-23	SMA	3/4	4.0	4.5	0			
I-10	99-29	SMA	3/4	4.0	4.5	5			
I-8	99-35	ACFC	3/4	2.0	1.0	0	0.1	0.2	0.1
I-8	99-40	ACFC	3/4	2.0	2.0	0			
I-8	99-45	ACFC	3/4	2.0	3.0	0			
I-8	99-52	ACFC	3/4	2.0	1.0	0			
I-8	99-57	ACFC	3/4	2.0	2.0	0			
I-8	99-62	ACFC	3/4	2.0	3.0	0			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?	--	--	--
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	0	0.3	0.8	0.5
I-8	99-39	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	0			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	2			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-36	P-ACFC	3/4	2.0	1.0	3	2.1	1.8	2.6
I-8	99-41	P-ACFC	3/4	2.0	2.0	0			
I-8	99-46	P-ACFC	3/4	2.0	3.0	0			
I-8	99-53	P-ACFC	3/4	2.0	1.0	3			
I-8	99-58	P-ACFC	3/4	2.0	2.0	3			
I-8	99-63	P-ACFC	3/4	2.0	3.0	4			
I-8	99-37	PEM	1 1/4	2.0	1.0	0	0.2	0.4	0.3
I-8	99-42	PEM	1 1/4	2.0	2.0	0			
I-8	99-47	PEM	1 1/4	2.0	3.0	0			
I-8	99-54	PEM	1 1/4	2.0	1.0	1			
I-8	99-59	PEM	1 1/4	2.0	2.0	0			
I-8	99-64	PEM	1 1/4	2.0	3.0	0			
I-8	99-38	SMA	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-43	SMA	3/4	2.0	2.0	0			
I-8	99-48	SMA	3/4	2.0	3.0	0			
I-8	99-55	SMA	3/4	2.0	1.0	0			
I-8	99-60	SMA	3/4	2.0	2.0	0			
I-8	99-65	SMA	3/4	2.0	3.0	0			

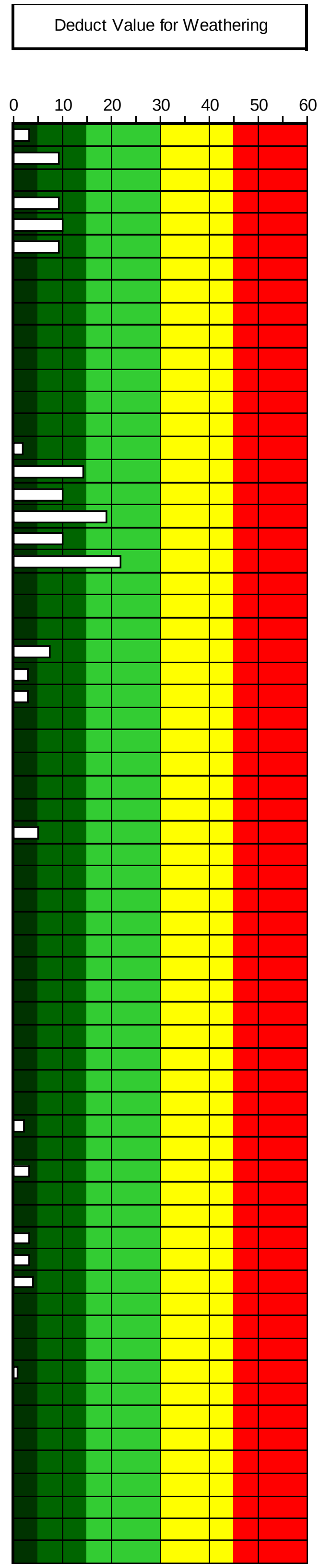

Table 103. ADOT Wearing Course Performance Comparison: Weathering (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	6	5.2	2.0	5.7
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	3			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	5			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	7			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	8			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	3			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	4			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	6	18.0	13.0	21.3
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	10			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	16			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	39			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	19			
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	17	24.7	11.9	27.7
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	15			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	23			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	29			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	47			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	18			

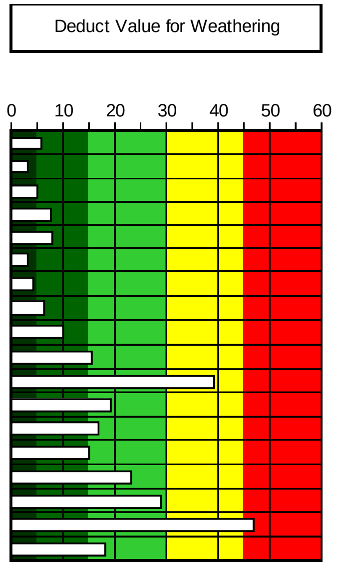

Table 104. ADOT Wearing Course Performance Comparison: Bleeding.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-07	ACFC	3/4	2.0	2.5	0			
I-10	99-14	ACFC	3/4	3.0	3.5	0			
I-10	99-16	ACFC	3/4	3.0	3.5	0			
I-10	99-21	ACFC	3/4	4.0	4.5	0			
I-10	99-26	ACFC	3/4	4.0	4.5	0			
I-10	Control	AR-ACFC	1/2	3.0	3.5	0	0.0	0.0	0.0
I-10	Control	AR-ACFC	1/2	3.0	3.5	0			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	0	1.5	3.7	2.5
I-10	99-06	AR-ACFC	3/4	2.0	2.5	0			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	9			
I-10	99-03	P-ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-09	P-ACFC	3/4	2.0	2.5	0			
I-10	99-12	P-ACFC	3/4	3.0	3.5	0			
I-10	99-20	P-ACFC	3/4	3.0	3.5	0			
I-10	99-24	P-ACFC	3/4	4.0	4.5	0			
I-10	99-30	P-ACFC	3/4	4.0	4.5	0			
I-10	99-04	PEM	1 1/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-08	PEM	1 1/4	2.0	2.5	0			
I-10	99-11	PEM	1 1/4	3.0	3.5	0			
I-10	99-19	PEM	1 1/4	3.0	3.5	0			
I-10	99-25	PEM	1 1/4	4.0	4.5	0			
I-10	99-27	PEM	1 1/4	4.0	4.5	0			
I-10	99-02	SMA	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-10	SMA	3/4	2.0	2.5	0			
I-10	99-15	SMA	3/4	3.0	3.5	0			
I-10	99-18	SMA	3/4	3.0	3.5	0			
I-10	99-23	SMA	3/4	4.0	4.5	0			
I-10	99-29	SMA	3/4	4.0	4.5	0			
I-8	99-35	ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-40	ACFC	3/4	2.0	2.0	0			
I-8	99-45	ACFC	3/4	2.0	3.0	0			
I-8	99-52	ACFC	3/4	2.0	1.0	0			
I-8	99-57	ACFC	3/4	2.0	2.0	0			
I-8	99-62	ACFC	3/4	2.0	3.0	0			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-39	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	0			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-36	P-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-41	P-ACFC	3/4	2.0	2.0	0			
I-8	99-46	P-ACFC	3/4	2.0	3.0	0			
I-8	99-53	P-ACFC	3/4	2.0	1.0	0			
I-8	99-58	P-ACFC	3/4	2.0	2.0	0			
I-8	99-63	P-ACFC	3/4	2.0	3.0	0			
I-8	99-37	PEM	1 1/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-42	PEM	1 1/4	2.0	2.0	0			
I-8	99-47	PEM	1 1/4	2.0	3.0	0			
I-8	99-54	PEM	1 1/4	2.0	1.0	0			
I-8	99-59	PEM	1 1/4	2.0	2.0	0			
I-8	99-64	PEM	1 1/4	2.0	3.0	0			
I-8	99-38	SMA	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-43	SMA	3/4	2.0	2.0	0			
I-8	99-48	SMA	3/4	2.0	3.0	0			
I-8	99-55	SMA	3/4	2.0	1.0	0			
I-8	99-60	SMA	3/4	2.0	2.0	0			
I-8	99-65	SMA	3/4	2.0	3.0	0			

Table 104. ADOT Wearing Course Performance Comparison: Bleeding (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0	0.0	0.0	0.0
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0	0.0	0.0	0.0
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0	0.0	0.0	0.0
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	0			

Table 105. ADOT Wearing Course Performance Comparison: Fatigue Cracking.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	3	12.1	22.3	17.8
I-10	99-07	ACFC	3/4	2.0	2.5	56			
I-10	99-14	ACFC	3/4	3.0	3.5	13			
I-10	99-16	ACFC	3/4	3.0	3.5	0			
I-10	99-21	ACFC	3/4	4.0	4.5	0			
I-10	99-26	ACFC	3/4	4.0	4.5	0			
I-10	Control	AR-ACFC	1/2	3.0	3.5	0	0.0	0.0	0.0
I-10	Control	AR-ACFC	1/2	3.0	3.5	0			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	0	19.3	22.8	25.1
I-10	99-06	AR-ACFC	3/4	2.0	2.5	31			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	31			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	54			
I-10	99-03	P-ACFC	3/4	2.0	2.5	0	11.0	19.1	15.9
I-10	99-09	P-ACFC	3/4	2.0	2.5	47			
I-10	99-12	P-ACFC	3/4	3.0	3.5	20			
I-10	99-20	P-ACFC	3/4	3.0	3.5	0			
I-10	99-24	P-ACFC	3/4	4.0	4.5	0			
I-10	99-30	P-ACFC	3/4	4.0	4.5	0			
I-10	99-04	PEM	1 1/4	2.0	2.5	0	6.9	10.4	9.5
I-10	99-08	PEM	1 1/4	2.0	2.5	27			
I-10	99-11	PEM	1 1/4	3.0	3.5	6			
I-10	99-19	PEM	1 1/4	3.0	3.5	9			
I-10	99-25	PEM	1 1/4	4.0	4.5	0			
I-10	99-27	PEM	1 1/4	4.0	4.5	0			
I-10	99-02	SMA	3/4	2.0	2.5	0	13.5	28.7	20.7
I-10	99-10	SMA	3/4	2.0	2.5	3			
I-10	99-15	SMA	3/4	3.0	3.5	0			
I-10	99-18	SMA	3/4	3.0	3.5	6			
I-10	99-23	SMA	3/4	4.0	4.5	0			
I-10	99-29	SMA	3/4	4.0	4.5	72			
I-8	99-35	ACFC	3/4	2.0	1.0	16	2.6	6.3	4.2
I-8	99-40	ACFC	3/4	2.0	2.0	0			
I-8	99-45	ACFC	3/4	2.0	3.0	0			
I-8	99-52	ACFC	3/4	2.0	1.0	0			
I-8	99-57	ACFC	3/4	2.0	2.0	0			
I-8	99-62	ACFC	3/4	2.0	3.0	0			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?	--	--	--
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	6	1.5	2.4	2.1
I-8	99-39	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	3			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-36	P-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-41	P-ACFC	3/4	2.0	2.0	0			
I-8	99-46	P-ACFC	3/4	2.0	3.0	0			
I-8	99-53	P-ACFC	3/4	2.0	1.0	0			
I-8	99-58	P-ACFC	3/4	2.0	2.0	0			
I-8	99-63	P-ACFC	3/4	2.0	3.0	0			
I-8	99-37	PEM	1 1/4	2.0	1.0	4	0.7	1.8	1.2
I-8	99-42	PEM	1 1/4	2.0	2.0	0			
I-8	99-47	PEM	1 1/4	2.0	3.0	0			
I-8	99-54	PEM	1 1/4	2.0	1.0	0			
I-8	99-59	PEM	1 1/4	2.0	2.0	0			
I-8	99-64	PEM	1 1/4	2.0	3.0	0			
I-8	99-38	SMA	3/4	2.0	1.0	0	0.5	1.2	0.8
I-8	99-43	SMA	3/4	2.0	2.0	0			
I-8	99-48	SMA	3/4	2.0	3.0	0			
I-8	99-55	SMA	3/4	2.0	1.0	3			
I-8	99-60	SMA	3/4	2.0	2.0	0			
I-8	99-65	SMA	3/4	2.0	3.0	0			

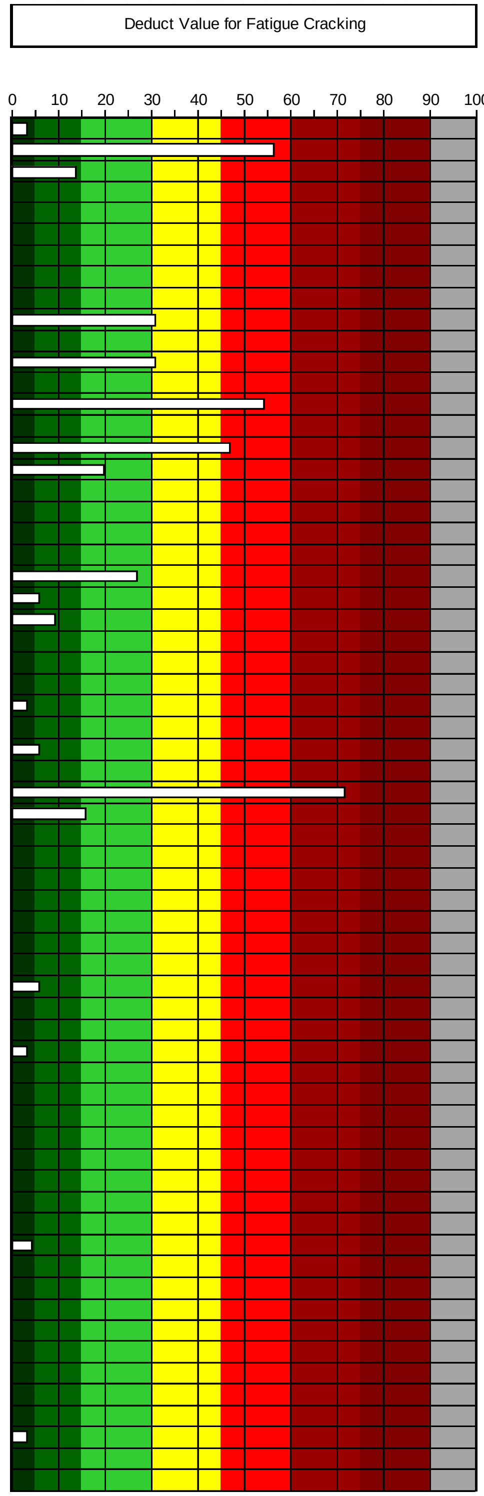

Table 105. ADOT Wearing Course Performance Comparison: Fatigue Cracking (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0	8.5	10.6	11.2
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	3			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	18			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	27			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	12			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	2	13.3	21.2	18.6
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	16			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	49			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	56	40.4	43.2	51.3
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	9			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	99			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	78			

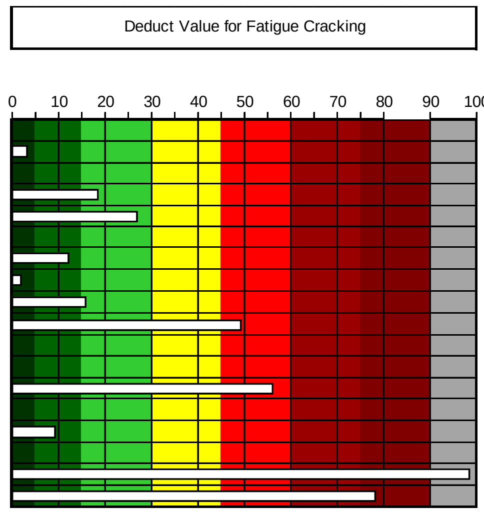

Table 106. ADOT Wearing Course Performance Comparison: Longitudinal, Transverse, and Diagonal Cracking.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	44	24.4	15.0	28.2
I-10	99-07	ACFC	3/4	2.0	2.5	41			
I-10	99-14	ACFC	3/4	3.0	3.5	18			
I-10	99-16	ACFC	3/4	3.0	3.5	24			
I-10	99-21	ACFC	3/4	4.0	4.5	12			
I-10	99-26	ACFC	3/4	4.0	4.5	8			
I-10	Control	AR-ACFC	1/2	3.0	3.5	20	16.0	5.8	17.5
I-10	Control	AR-ACFC	1/2	3.0	3.5	12			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	24	26.8	9.1	29.1
I-10	99-06	AR-ACFC	3/4	2.0	2.5	22			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	15			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	33			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	27			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	41			
I-10	99-03	P-ACFC	3/4	2.0	2.5	48	31.9	13.1	35.2
I-10	99-09	P-ACFC	3/4	2.0	2.5	42			
I-10	99-12	P-ACFC	3/4	3.0	3.5	19			
I-10	99-20	P-ACFC	3/4	3.0	3.5	40			
I-10	99-24	P-ACFC	3/4	4.0	4.5	17			
I-10	99-30	P-ACFC	3/4	4.0	4.5	26			
I-10	99-04	PEM	1 1/4	2.0	2.5	43	23.8	12.9	27.0
I-10	99-08	PEM	1 1/4	2.0	2.5	33			
I-10	99-11	PEM	1 1/4	3.0	3.5	23			
I-10	99-19	PEM	1 1/4	3.0	3.5	22			
I-10	99-25	PEM	1 1/4	4.0	4.5	12			
I-10	99-27	PEM	1 1/4	4.0	4.5	10			
I-10	99-02	SMA	3/4	2.0	2.5	25	27.3	14.6	31.0
I-10	99-10	SMA	3/4	2.0	2.5	17			
I-10	99-15	SMA	3/4	3.0	3.5	8			
I-10	99-18	SMA	3/4	3.0	3.5	30			
I-10	99-23	SMA	3/4	4.0	4.5	51			
I-10	99-29	SMA	3/4	4.0	4.5	32			
I-8	99-35	ACFC	3/4	2.0	1.0	21	14.6	7.0	16.4
I-8	99-40	ACFC	3/4	2.0	2.0	8			
I-8	99-45	ACFC	3/4	2.0	3.0	7			
I-8	99-52	ACFC	3/4	2.0	1.0	24			
I-8	99-57	ACFC	3/4	2.0	2.0	10			
I-8	99-62	ACFC	3/4	2.0	3.0	17			
I-8	Control	AR-ACFC	1/2	2.0	2.5	**?**			
I-8	Control	AR-ACFC	1/2	2.0	2.5	**?**			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	37	19.0	13.5	22.4
I-8	99-39	AR-ACFC	3/4	2.0	2.0	9			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	27			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	26			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	16			
I-8	99-36	P-ACFC	3/4	2.0	1.0	25	22.8	10.9	25.6
I-8	99-41	P-ACFC	3/4	2.0	2.0	15			
I-8	99-46	P-ACFC	3/4	2.0	3.0	18			
I-8	99-53	P-ACFC	3/4	2.0	1.0	43			
I-8	99-58	P-ACFC	3/4	2.0	2.0	14			
I-8	99-63	P-ACFC	3/4	2.0	3.0	22			
I-8	99-37	PEM	1 1/4	2.0	1.0	34	23.7	14.0	27.3
I-8	99-42	PEM	1 1/4	2.0	2.0	25			
I-8	99-47	PEM	1 1/4	2.0	3.0	7			
I-8	99-54	PEM	1 1/4	2.0	1.0	45			
I-8	99-59	PEM	1 1/4	2.0	2.0	18			
I-8	99-64	PEM	1 1/4	2.0	3.0	13			
I-8	99-38	SMA	3/4	2.0	1.0	41	25.6	9.8	28.0
I-8	99-43	SMA	3/4	2.0	2.0	19			
I-8	99-48	SMA	3/4	2.0	3.0	20			
I-8	99-55	SMA	3/4	2.0	1.0	32			
I-8	99-60	SMA	3/4	2.0	2.0	26			
I-8	99-65	SMA	3/4	2.0	3.0	15			

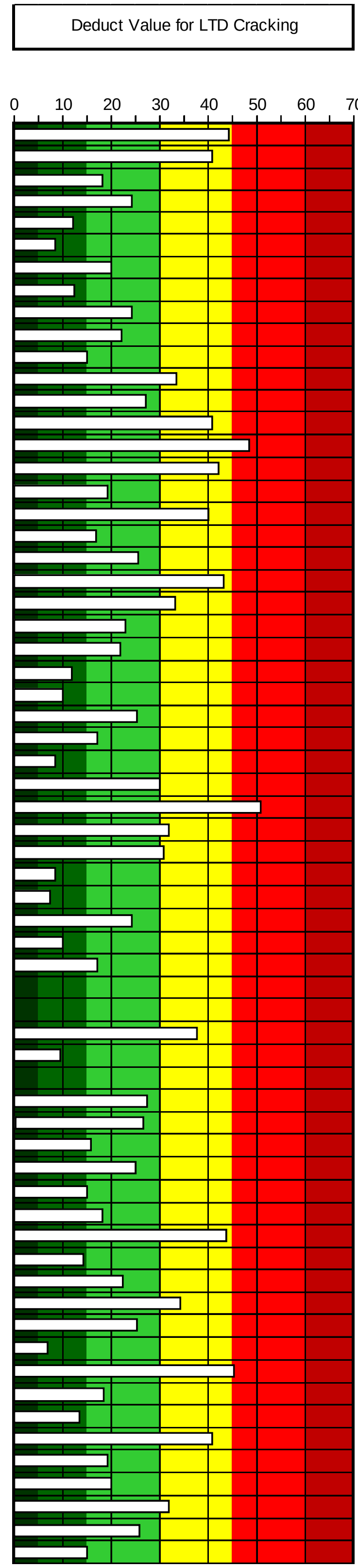

Table 106. ADOT Wearing Course Performance Comparison: Longitudinal, Transverse, and Diagonal Cracking (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	44	30.1	12.9	33.4
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	47			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	9			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	25			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	32			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	24			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	29			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	17	29.5	8.2	31.6
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	39			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	30			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	34			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	28			
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	37	33.3	20.0	38.3
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	15			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	11			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	25			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	61			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	51			

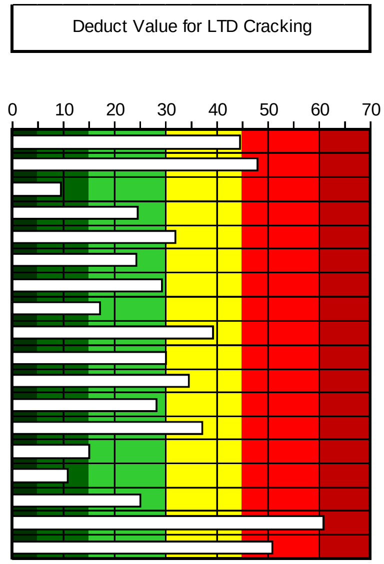

Table 107. ADOT Wearing Course Performance Comparison: Rutting.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-07	ACFC	3/4	2.0	2.5	0			
I-10	99-14	ACFC	3/4	3.0	3.5	0			
I-10	99-16	ACFC	3/4	3.0	3.5	0			
I-10	99-21	ACFC	3/4	4.0	4.5	0			
I-10	99-26	ACFC	3/4	4.0	4.5	0			
I-10	Control	AR-ACFC	1/2	3.0	3.5	0	0.0	0.0	0.0
I-10	Control	AR-ACFC	1/2	3.0	3.5	0			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-06	AR-ACFC	3/4	2.0	2.5	0			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-03	P-ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-09	P-ACFC	3/4	2.0	2.5	0			
I-10	99-12	P-ACFC	3/4	3.0	3.5	0			
I-10	99-20	P-ACFC	3/4	3.0	3.5	0			
I-10	99-24	P-ACFC	3/4	4.0	4.5	0			
I-10	99-30	P-ACFC	3/4	4.0	4.5	0			
I-10	99-04	PEM	1 1/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-08	PEM	1 1/4	2.0	2.5	0			
I-10	99-11	PEM	1 1/4	3.0	3.5	0			
I-10	99-19	PEM	1 1/4	3.0	3.5	0			
I-10	99-25	PEM	1 1/4	4.0	4.5	0			
I-10	99-27	PEM	1 1/4	4.0	4.5	0			
I-10	99-02	SMA	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-10	SMA	3/4	2.0	2.5	0			
I-10	99-15	SMA	3/4	3.0	3.5	0			
I-10	99-18	SMA	3/4	3.0	3.5	0			
I-10	99-23	SMA	3/4	4.0	4.5	0			
I-10	99-29	SMA	3/4	4.0	4.5	0			
I-8	99-35	ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-40	ACFC	3/4	2.0	2.0	0			
I-8	99-45	ACFC	3/4	2.0	3.0	0			
I-8	99-52	ACFC	3/4	2.0	1.0	0			
I-8	99-57	ACFC	3/4	2.0	2.0	0			
I-8	99-62	ACFC	3/4	2.0	3.0	0			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-39	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	0			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-36	P-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-41	P-ACFC	3/4	2.0	2.0	0			
I-8	99-46	P-ACFC	3/4	2.0	3.0	0			
I-8	99-53	P-ACFC	3/4	2.0	1.0	0			
I-8	99-58	P-ACFC	3/4	2.0	2.0	0			
I-8	99-63	P-ACFC	3/4	2.0	3.0	0			
I-8	99-37	PEM	1 1/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-42	PEM	1 1/4	2.0	2.0	0			
I-8	99-47	PEM	1 1/4	2.0	3.0	0			
I-8	99-54	PEM	1 1/4	2.0	1.0	0			
I-8	99-59	PEM	1 1/4	2.0	2.0	0			
I-8	99-64	PEM	1 1/4	2.0	3.0	0			
I-8	99-38	SMA	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-43	SMA	3/4	2.0	2.0	0			
I-8	99-48	SMA	3/4	2.0	3.0	0			
I-8	99-55	SMA	3/4	2.0	1.0	0			
I-8	99-60	SMA	3/4	2.0	2.0	0			
I-8	99-65	SMA	3/4	2.0	3.0	0			

Table 107. ADOT Wearing Course Performance Comparison: Rutting (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0	0.0	0.0	0.0
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0				
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0	0.0	0.0	0.0
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0	0.0	0.0	0.0
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	0			

Table 108. ADOT Wearing Course Performance Comparison: Patching.

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
I-10	99-05	ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-07	ACFC	3/4	2.0	2.5	0			
I-10	99-14	ACFC	3/4	3.0	3.5	0			
I-10	99-16	ACFC	3/4	3.0	3.5	0			
I-10	99-21	ACFC	3/4	4.0	4.5	0			
I-10	99-26	ACFC	3/4	4.0	4.5	0			
I-10	Control	AR-ACFC	1/2	3.0	3.5	0	0.0	0.0	0.0
I-10	Control	AR-ACFC	1/2	3.0	3.5	0			
I-10	99-01	AR-ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-06	AR-ACFC	3/4	2.0	2.5	0			
I-10	99-13	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-17	AR-ACFC	3/4	3.0	3.5	0			
I-10	99-22	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-28	AR-ACFC	3/4	4.0	4.5	0			
I-10	99-03	P-ACFC	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-09	P-ACFC	3/4	2.0	2.5	0			
I-10	99-12	P-ACFC	3/4	3.0	3.5	0			
I-10	99-20	P-ACFC	3/4	3.0	3.5	0			
I-10	99-24	P-ACFC	3/4	4.0	4.5	0			
I-10	99-30	P-ACFC	3/4	4.0	4.5	0			
I-10	99-04	PEM	1 1/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-08	PEM	1 1/4	2.0	2.5	0			
I-10	99-11	PEM	1 1/4	3.0	3.5	0			
I-10	99-19	PEM	1 1/4	3.0	3.5	0			
I-10	99-25	PEM	1 1/4	4.0	4.5	0			
I-10	99-27	PEM	1 1/4	4.0	4.5	0			
I-10	99-02	SMA	3/4	2.0	2.5	0	0.0	0.0	0.0
I-10	99-10	SMA	3/4	2.0	2.5	0			
I-10	99-15	SMA	3/4	3.0	3.5	0			
I-10	99-18	SMA	3/4	3.0	3.5	0			
I-10	99-23	SMA	3/4	4.0	4.5	0			
I-10	99-29	SMA	3/4	4.0	4.5	0			
I-8	99-35	ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-40	ACFC	3/4	2.0	2.0	0			
I-8	99-45	ACFC	3/4	2.0	3.0	0			
I-8	99-52	ACFC	3/4	2.0	1.0	0			
I-8	99-57	ACFC	3/4	2.0	2.0	0			
I-8	99-62	ACFC	3/4	2.0	3.0	0			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	Control	AR-ACFC	1/2	2.0	2.5	?			
I-8	99-34	AR-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-39	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-44	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-51	AR-ACFC	3/4	2.0	1.0	0			
I-8	99-56	AR-ACFC	3/4	2.0	2.0	0			
I-8	99-61	AR-ACFC	3/4	2.0	3.0	0			
I-8	99-36	P-ACFC	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-41	P-ACFC	3/4	2.0	2.0	0			
I-8	99-46	P-ACFC	3/4	2.0	3.0	0			
I-8	99-53	P-ACFC	3/4	2.0	1.0	0			
I-8	99-58	P-ACFC	3/4	2.0	2.0	0			
I-8	99-63	P-ACFC	3/4	2.0	3.0	0			
I-8	99-37	PEM	1 1/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-42	PEM	1 1/4	2.0	2.0	0			
I-8	99-47	PEM	1 1/4	2.0	3.0	0			
I-8	99-54	PEM	1 1/4	2.0	1.0	0			
I-8	99-59	PEM	1 1/4	2.0	2.0	0			
I-8	99-64	PEM	1 1/4	2.0	3.0	0			
I-8	99-38	SMA	3/4	2.0	1.0	0	0.0	0.0	0.0
I-8	99-43	SMA	3/4	2.0	2.0	0			
I-8	99-48	SMA	3/4	2.0	3.0	0			
I-8	99-55	SMA	3/4	2.0	1.0	0			
I-8	99-60	SMA	3/4	2.0	2.0	0			
I-8	99-65	SMA	3/4	2.0	3.0	0			

Table 108. ADOT Wearing Course Performance Comparison: Patching (Continued).

Route	Test Section Identifier (TPSS No.)	Treatment	Top Size Aggr. (in)	Overlay Thick-ness (in)	Mill Thick-ness (in)	Deduct Value	Mean	Std. Dev.	60th %ile
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0	0.0	0.0	0.0
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	2.0	2.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	3.0	3.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	AR-ACFC, PG 64-16, CRA-1	3/8	0.0	0.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0	0.0	0.0	0.0
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	2.0	2.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	P-ACFC, PG 76-22+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0	0.0	0.0	0.0
SR 74	--	Paramount, PG 76-22 TR+	3/8	2.0	2.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	3.0	3.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	0			
SR 74	--	Paramount, PG 76-22 TR+	3/8	0.0	0.0	0			

APPENDIX F
PERFORMANCE COMPARISON TABLES: PREVENTIVE MAINTENANCE EXPERIMENT

Table 109. ADOT Preventive Maintenance Treatment Performance Comparison: Weathering.

Hwy	Treatment	Producer	Section No.	DV	Mean	Std. Dev.	60th %ile
SR-66	AC15-5TR	Paramount	E03	0.0	0.0	0.0	0.0
SR-66	AC15-5TR	Paramount	W06	0.0			
SR-66	ACFC	ADOT	E13	0.0	0.0	0.0	0.0
SR-66	ACFC	ADOT	W10	0.0			
SR-66	AR-ACFC	ADOT	E05	0.0	1.0	1.4	1.4
SR-66	AR-ACFC	ADOT	W13	2.0			
SR-66	AR-Chip	ISS	E08	0.0	0.0	0.0	0.0
SR-66	AR-Chip	ISS	W08	0.0			
SR-66	CM-90	Navajo Western	E10	0.0	4.4	6.2	5.9
SR-66	CM-90	Navajo Western	W09	8.7			
SR-66	CRS-2	Copperstate	E04	7.9	12.4	6.3	13.9
SR-66	CRS-2	Copperstate	W04	16.8			
SR-66	CRS-2P	ADOT	E09	5.3	6.1	3.7	7.0
SR-66	CRS-2P	ADOT	W05	2.5			
SR-66	CRS-2P	ADOT	E14	5.3			
SR-66	CRS-2P	ADOT	W14	11.3			
SR-66	CRS-2P	Crown	E11	0.0	7.8	11.0	10.6
SR-66	CRS-2P	Crown	W03	15.6			
SR-66	DACS&B	ADOT	E01	2.0	1.8	0.4	1.8
SR-66	DACS&B	ADOT	W01	1.5			
SR-66	Dbl Applic	???	E02	0.0	2.7	3.7	3.6
SR-66	Dbl Applic	???	W02	5.3			
SR-66	Microsurfacing	Southwest Slurry	E07	0.0	0.0	0.0	0.0
SR-66	Microsurfacing	Southwest Slurry	W12	0.0			
SR-66	Novachip	Koch	E06	0.0	1.3	1.8	1.7
SR-66	Novachip	Koch	W11	2.5			
SR-66	Pass Oil	Western Emulsion	E12	0.0	0.0	0.0	0.0
SR-66	Pass Oil	Western Emulsion	W07	0.0			
SR-83	AC15-5TR	Paramount	N06	0.9	6.3	7.6	8.2
SR-83	AC15-5TR	Paramount	S22	11.6			
SR-83	AR-ACFC	?	N03	1.5	2.3	0.8	2.5
SR-83	AR-ACFC	?	S15	2.5			
SR-83	AR-ACFC	??	N05	3.0			
SR-83	AR-ACFC	ADOT	N04	13.3	9.4	5.5	10.8
SR-83	AR-ACFC	ADOT	S19	5.5			
SR-83	AR-Chip	ISS	N08	0.0	0.0	0.0	0.0
SR-83	AR-Chip	ISS	S17	0.0			
SR-83	CM-90	Koch	N11	2.0	1.0	1.4	1.4
SR-83	CM-90	Koch	S18	0.0			
SR-83	CRS-2	ADOT	N12	2.5	1.3	1.8	1.7
SR-83	CRS-2	ADOT	S16	0.0			
SR-83	CRS-2P	ADOT	N07	0.0	2.8	3.9	3.7
SR-83	CRS-2P	ADOT	S20	5.5			
SR-83	CRS-2P	Crown	S26	3.1	3.1	--	--
SR-83	Dbl Chip Seal	ADOT	N02	0.0	0.5	0.6	0.6
SR-83	Dbl Chip Seal	ADOT	S25	0.9			
SR-83	HF CRS-2P	Copperstate	N13	0.0	0.0	0.0	0.0
SR-83	HF CRS-2P	Copperstate	S24	0.0			
SR-83	Novachip	Koch	N10	4.4	10.4	8.4	12.5
SR-83	Novachip	Koch	S27	16.3			
SR-83	P-ACFC	Paramount	N09	5.3	5.8	0.6	5.9
SR-83	P-ACFC	Paramount	S23	6.2			
SR-83	Pass CR	Western Emulsion	N14	0.0	0.0	0.0	0.0
SR-83	Pass CR	Western Emulsion	S28	0.0			
SR-83	Slurry Seal	Southwest Slurry	N01	0.0	0.0	0.0	0.0
SR-83	Slurry Seal	Southwest Slurry	S21	0.0			

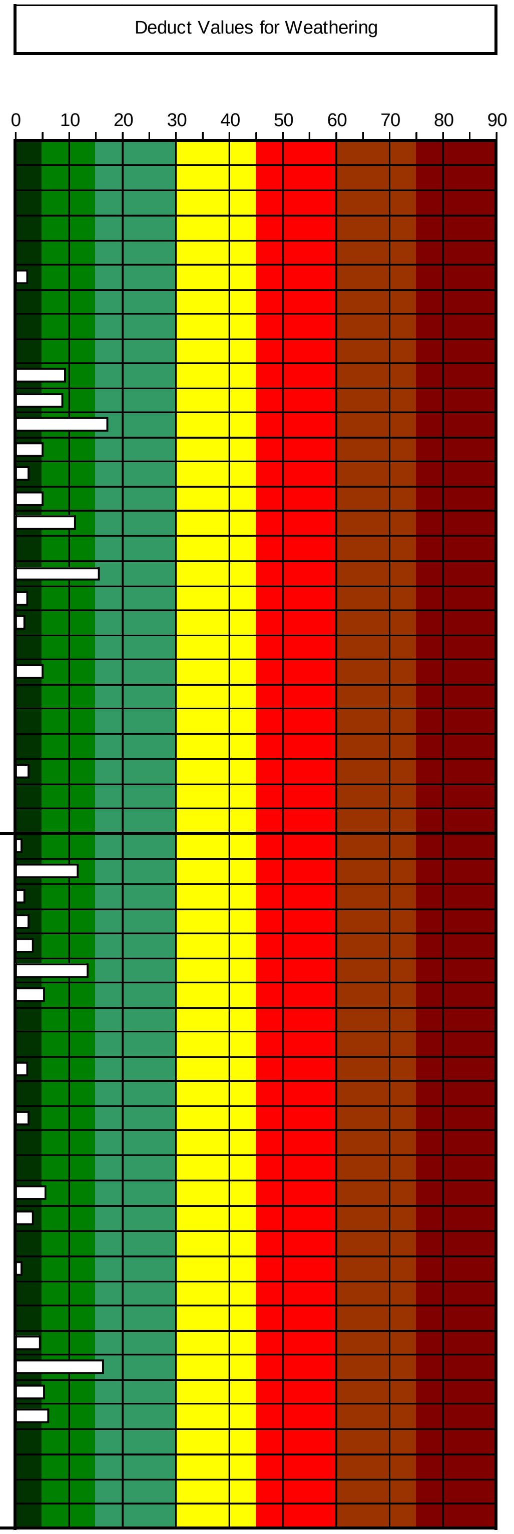

Table 109. ADOT Preventive Maintenance Treatment Performance Comparison: Weathering (Continued).

Hwy	Treatment	Producer	Section No.	DV	Mean	Std. Dev.	60th %ile
SR-87	AC15-5TR	Paramount	N08	0.0	0.0	0.0	0.0
SR-87	AC15-5TR	Paramount	S09	0.0			
SR-87	CM-90	Navajo Western	N02	22.8	30.9	11.4	33.7
SR-87	CM-90	Navajo Western	N03	38.9			
SR-87	Control	No treatment	S05	0.0	0.0	0.0	0.0
SR-87	Control	No treatment	S10	0.0			
SR-87	Control	No treatment	S11	0.0			
SR-87	CRS-2	Copperstate	S06	41.8	31.9	14.1	35.4
SR-87	CRS-2	Copperstate	S03	21.9			
SR-87	CRS-2P	Crown	S02	78.5	81.2	3.7	82.1
SR-87	CRS-2P	Crown	S01	83.8			
SR-87	DACS&B	ADOT	N01	0.0	0.0	0.0	0.0
SR-87	DACS&B	ADOT	S12	0.0			
SR-87	Dbl Chip Seal	ADOT	S07	5.3	12.8	10.4	15.4
SR-87	Dbl Chip Seal	ADOT	S08	14.7			
SR-87	Dbl Chip Seal	ADOT	N04	4.4			
SR-87	Dbl Chip Seal	ADOT	N05	26.8			
SR-87	Novachip	Koch	N06	0.0	0.0	0.0	0.0
SR-87	Novachip	Koch	S04	0.0			
SR-87	Pass Oil	Western Emulsion	N07	43.6	47.4	5.3	48.7
SR-87	Pass Oil	Western Emulsion	N09	51.1			
US-191	AC15-5TR	Paramount	016	0.4	1.6	0.9	1.9
US-191	AC15-5TR	Paramount	040	1.5			
US-191	AC15-5TR	Paramount	026	2.5			
US-191	AC15-5TR	Paramount	050	2.1			
US-191	AR-ACFC	ADOT	018	14.8	8.5	4.4	9.6
US-191	AR-ACFC	ADOT	042	7.9			
US-191	AR-ACFC	ADOT	031	4.4			
US-191	AR-ACFC	ADOT	055	7.0			
US-191	AR-Chip	ISS	013	1.5	2.0	0.6	2.1
US-191	AR-Chip	ISS	037	1.5			
US-191	AR-Chip	ISS	029	2.5			
US-191	AR-Chip	ISS	053	2.5			
US-191	CM-90	Koch	017	2.5	3.9	3.2	4.7
US-191	CM-90	Koch	041	1.5			
US-191	CM-90	Koch	028	3.0			
US-191	CM-90	Koch	052	8.6			
US-191	Control	No treatment	006	1.5	6.6	8.8	8.8
US-191	Control	No treatment	012	1.7			
US-191	Control	No treatment	002	3.4			
US-191	Control	No treatment	008	19.8			
US-191	CRS-2	ADOT	014	0.4	1.4	1.3	1.7
US-191	CRS-2	ADOT	038	0.2			
US-191	CRS-2	ADOT	027	2.0			
US-191	CRS-2	ADOT	051	3.0			
US-191	CRS-2P	ADOT	004	0.4	2.3	1.9	2.8
US-191	CRS-2P	ADOT	010	1.5			
US-191	CRS-2P	ADOT	001	4.8			
US-191	CRS-2P	ADOT	007	2.5			
US-191	CRS-2P	ADOT (FC)	005	23.8	8.2	10.6	10.8
US-191	CRS-2P	ADOT (FC)	011	5.3			
US-191	CRS-2P	ADOT (FC)	003	1.5			
US-191	CRS-2P	ADOT (FC)	009	2.0			
US-191	CRS-2P	Crown	015	0.4	1.4	1.0	1.6
US-191	CRS-2P	Crown	039	0.6			
US-191	CRS-2P	Crown	025	2.5			
US-191	CRS-2P	Crown	049	2.0			
US-191	Dbl Chip Seal	ADOT	021	1.5	0.9	0.5	1.0
US-191	Dbl Chip Seal	ADOT	045	0.9			
US-191	Dbl Chip Seal	ADOT	036	0.4			
US-191	Dbl Chip Seal	ADOT	060	0.9			
US-191	HF CRS-2P	ADOT	019	1.5	1.5	0.5	1.6
US-191	HF CRS-2P	ADOT	043	1.5			
US-191	HF CRS-2P	ADOT	033	0.9			
US-191	HF CRS-2P	ADOT	057	2.0			

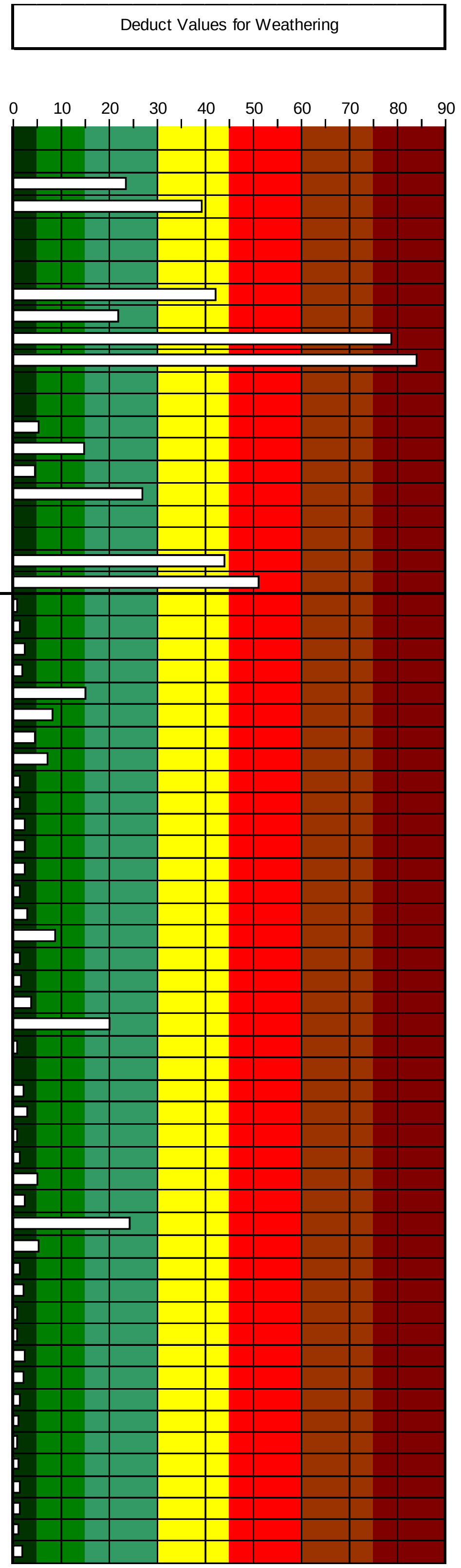

Table 110. ADOT Preventive Maintenance Treatment Performance Comparison: Flushing.

Hwy	Treatment	Producer	Section No.	Flush No.	Mean	Std. Dev.	60th %ile
SR-66	AC15-5TR	Paramount	E03	3.0	3.0	0.0	3.0
SR-66	AC15-5TR	Paramount	W06	3.0			
SR-66	ACFC	ADOT	E13	4.0	4.5	0.7	4.3
SR-66	ACFC	ADOT	W10	5.0			
SR-66	AR-ACFC	ADOT	E05	5.0	4.5	0.7	4.3
SR-66	AR-ACFC	ADOT	W13	4.0			
SR-66	AR-Chip	ISS	E08	4.5	4.3	0.4	4.2
SR-66	AR-Chip	ISS	W08	4.0			
SR-66	CM-90	Navajo Western	E10	2.5	2.8	0.4	2.7
SR-66	CM-90	Navajo Western	W09	3.0			
SR-66	CRS-2	Copperstate	E04	4.0	4.0	0.0	4.0
SR-66	CRS-2	Copperstate	W04	4.0			
SR-66	CRS-2P	ADOT	E09	3.5	3.8	0.5	3.6
SR-66	CRS-2P	ADOT	W05	4.5			
SR-66	CRS-2P	ADOT	E14	3.5			
SR-66	CRS-2P	ADOT	W14	3.5			
SR-66	CRS-2P	Crown	E11	3.0	3.0	0.0	3.0
SR-66	CRS-2P	Crown	W03	3.0			
SR-66	DACS&B	ADOT	E01	3.5	3.8	0.4	3.7
SR-66	DACS&B	ADOT	W01	4.0			
SR-66	Dbl Applic	???	E02	3.5	3.5	0.0	3.5
SR-66	Dbl Applic	???	W02	3.5			
SR-66	Microsurfacing	Southwest Slurry	E07	5.0	4.8	0.4	4.7
SR-66	Microsurfacing	Southwest Slurry	W12	4.5			
SR-66	Novachip	Koch	E06	5.0	5.0	0.0	5.0
SR-66	Novachip	Koch	W11	5.0			
SR-66	Pass Oil	Western Emulsion	E12	3.0	3.8	1.1	3.5
SR-66	Pass Oil	Western Emulsion	W07	4.5			
SR-83	AC15-5TR	Paramount	N06	3.5	4.0	0.7	3.8
SR-83	AC15-5TR	Paramount	S22	4.5			
SR-83	AR-ACFC	?	N03	5.0	5.0	0.0	5.0
SR-83	AR-ACFC	?	S15	5.0			
SR-83	AR-ACFC	??	N05	5.0			
SR-83	AR-ACFC	ADOT	N04	4.5	4.5	0.0	4.5
SR-83	AR-ACFC	ADOT	S19	4.5			
SR-83	AR-Chip	ISS	N08	4.0	3.8	0.4	3.7
SR-83	AR-Chip	ISS	S17	3.5			
SR-83	CM-90	Koch	N11	4.0	4.0	0.0	4.0
SR-83	CM-90	Koch	S18	4.0			
SR-83	CRS-2	ADOT	N12	4.0	3.8	0.4	3.7
SR-83	CRS-2	ADOT	S16	3.5			
SR-83	CRS-2P	ADOT	N07	3.0	3.5	0.7	3.3
SR-83	CRS-2P	ADOT	S20	4.0			
SR-83	CRS-2P	Crown	S26	4.5	4.5	--	--
SR-83	Dbl Chip Seal	ADOT	N02	4.5	4.0	0.7	3.8
SR-83	Dbl Chip Seal	ADOT	S25	3.5			
SR-83	HF CRS-2P	Copperstate	N13	4.5	4.0	0.7	3.8
SR-83	HF CRS-2P	Copperstate	S24	3.5			
SR-83	Novachip	Koch	N10	5.0	5.0	0.0	5.0
SR-83	Novachip	Koch	S27	5.0			
SR-83	P-ACFC	Paramount	N09	5.0	5.0	0.0	5.0
SR-83	P-ACFC	Paramount	S23	5.0			
SR-83	Pass CR	Western Emulsion	N14	4.5	4.5	0.0	4.5
SR-83	Pass CR	Western Emulsion	S28	4.5			
SR-83	Slurry Seal	Southwest Slurry	N01	2.5	3.5	1.4	3.1
SR-83	Slurry Seal	Southwest Slurry	S21	4.5			

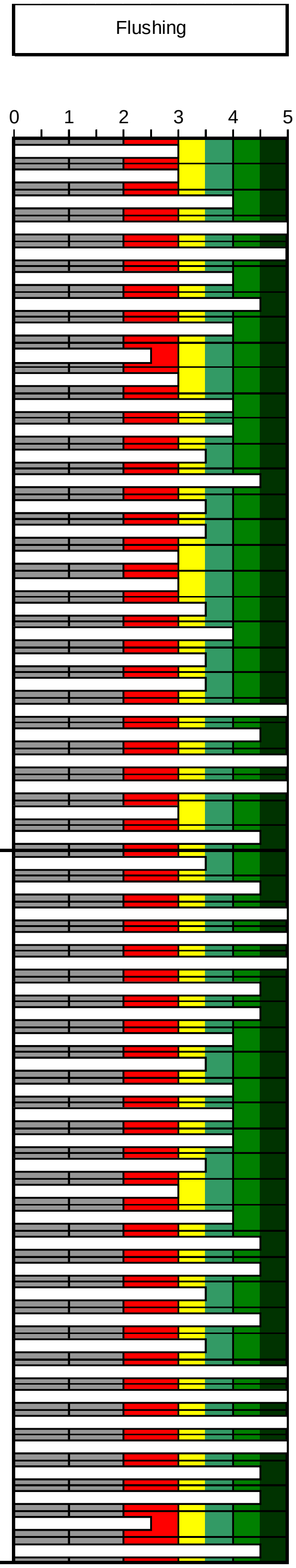

Table 110. ADOT Preventive Maintenance Treatment Performance Comparison: Flushing (Continued).

Hwy	Treatment	Producer	Section No.	Flush No.	Mean	Std. Dev.	60th %ile
SR-87	AC15-5TR	Paramount	N08	4.5	4.3	0.4	4.2
SR-87	AC15-5TR	Paramount	S09	4.0			
SR-87	CM-90	Navajo Western	N02	3.0	3.5	0.7	3.3
SR-87	CM-90	Navajo Western	N03	4.0			
SR-87	Control	No treatment	S05	5.0	4.7	0.3	4.6
SR-87	Control	No treatment	S10	4.5			
SR-87	Control	No treatment	S11	4.5			
SR-87	CRS-2	Copperstate	S06	5.0	5.0	0.0	5.0
SR-87	CRS-2	Copperstate	S03	5.0			
SR-87	CRS-2P	Crown	S02	5.0	5.0	0.0	5.0
SR-87	CRS-2P	Crown	S01	5.0			
SR-87	DACS&B	ADOT	N01	4.0	4.0	0.0	4.0
SR-87	DACS&B	ADOT	S12	4.0			
SR-87	Dbl Chip Seal	ADOT	S07	5.0	4.9	0.3	4.8
SR-87	Dbl Chip Seal	ADOT	S08	4.5			
SR-87	Dbl Chip Seal	ADOT	N04	5.0			
SR-87	Dbl Chip Seal	ADOT	N05	5.0			
SR-87	Novachip	Koch	N06	5.0	5.0	0.0	5.0
SR-87	Novachip	Koch	S04	5.0			
SR-87	Pass Oil	Western Emulsion	N07	5.0	5.0	0.0	5.0
SR-87	Pass Oil	Western Emulsion	N09	5.0			
US-191	AC15-5TR	Paramount	016	3.0	3.3	1.0	3.0
US-191	AC15-5TR	Paramount	040	2.0			
US-191	AC15-5TR	Paramount	026	4.0			
US-191	AC15-5TR	Paramount	050	4.0			
US-191	AR-ACFC	ADOT	018	4.5	4.5	0.0	4.5
US-191	AR-ACFC	ADOT	042	4.5			
US-191	AR-ACFC	ADOT	031	4.5			
US-191	AR-ACFC	ADOT	055	4.5			
US-191	AR-Chip	ISS	013	3.5	3.9	0.3	3.8
US-191	AR-Chip	ISS	037	4.0			
US-191	AR-Chip	ISS	029	4.0			
US-191	AR-Chip	ISS	053	4.0			
US-191	CM-90	Koch	017	3.0	3.1	0.3	3.1
US-191	CM-90	Koch	041	3.5			
US-191	CM-90	Koch	028	3.0			
US-191	CM-90	Koch	052	3.0			
US-191	Control	No treatment	006	4.5	4.8	0.3	4.7
US-191	Control	No treatment	012	5.0			
US-191	Control	No treatment	002	5.0			
US-191	Control	No treatment	008	4.5			
US-191	CRS-2	ADOT	014	4.5	4.1	0.5	4.0
US-191	CRS-2	ADOT	038	4.5			
US-191	CRS-2	ADOT	027	4.0			
US-191	CRS-2	ADOT	051	3.5			
US-191	CRS-2P	ADOT	004	3.5	4.6	0.8	4.4
US-191	CRS-2P	ADOT	010	5.0			
US-191	CRS-2P	ADOT	001	5.0			
US-191	CRS-2P	ADOT	007	5.0			
US-191	CRS-2P	ADOT (FC)	005	4.0	4.4	0.5	4.3
US-191	CRS-2P	ADOT (FC)	011	4.0			
US-191	CRS-2P	ADOT (FC)	003	5.0			
US-191	CRS-2P	ADOT (FC)	009	4.5			
US-191	CRS-2P	Crown	015	3.5	4.0	0.6	3.9
US-191	CRS-2P	Crown	039	3.5			
US-191	CRS-2P	Crown	025	4.5			
US-191	CRS-2P	Crown	049	4.5			
US-191	Dbl Chip Seal	ADOT	021	2.5	2.8	0.9	2.5
US-191	Dbl Chip Seal	ADOT	045	2.0			
US-191	Dbl Chip Seal	ADOT	036	2.5			
US-191	Dbl Chip Seal	ADOT	060	4.0			
US-191	HF CRS-2P	ADOT	019	4.5	4.3	0.5	4.1
US-191	HF CRS-2P	ADOT	043	4.5			
US-191	HF CRS-2P	ADOT	033	4.5			
US-191	HF CRS-2P	ADOT	057	3.5			

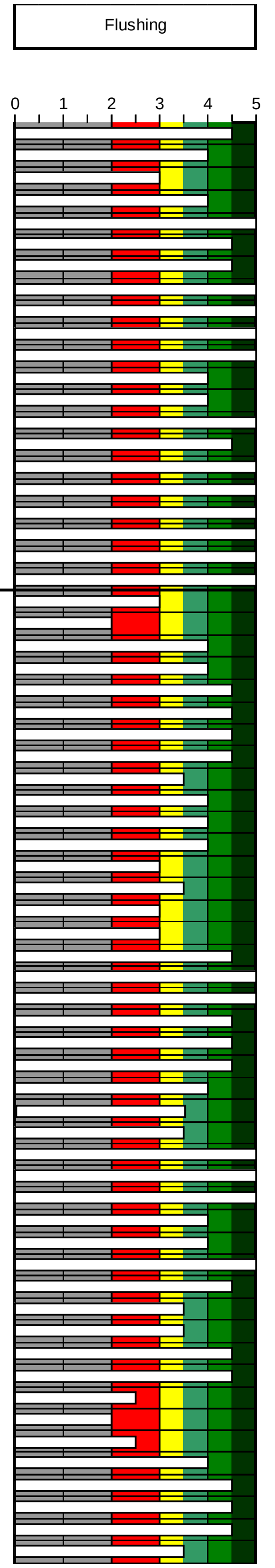

Table 111. ADOT Preventive Maintenance Treatment Performance Comparison: LTD Cracking.

Hwy	Treatment	Producer	Section No.	DV	Mean	Std. Dev.	60th %ile
SR-66	AC15-5TR	Paramount	E03	16.5	22.3	8.2	24.4
SR-66	AC15-5TR	Paramount	W06	28.1			
SR-66	ACFC	ADOT	E13	19.3	10.0	13.2	13.3
SR-66	ACFC	ADOT	W10	0.6			
SR-66	AR-ACFC	ADOT	E05	34.0	17.0	24.0	23.1
SR-66	AR-ACFC	ADOT	W13	0.0			
SR-66	AR-Chip	ISS	E08	19.0	17.2	2.6	17.8
SR-66	AR-Chip	ISS	W08	15.3			
SR-66	CM-90	Navajo Western	E10	3.3	8.1	6.8	9.8
SR-66	CM-90	Navajo Western	W09	12.9			
SR-66	CRS-2	Copperstate	E04	24.3	15.0	13.2	18.3
SR-66	CRS-2	Copperstate	W04	5.6			
SR-66	CRS-2P	ADOT	E09	0.3	5.5	10.9	8.3
SR-66	CRS-2P	ADOT	W05	21.8			
SR-66	CRS-2P	ADOT	E14	0.0			
SR-66	CRS-2P	ADOT	W14	0.0			
SR-66	CRS-2P	Crown	E11	4.0	3.6	0.6	3.7
SR-66	CRS-2P	Crown	W03	3.1			
SR-66	DACS&B	ADOT	E01	36.8	43.6	9.5	46.0
SR-66	DACS&B	ADOT	W01	50.3			
SR-66	Dbl Applic	???	E02	37.8	33.6	5.9	35.1
SR-66	Dbl Applic	???	W02	29.4			
SR-66	Microsurfacing	Southwest Slurry	E07	24.2	21.3	4.1	22.3
SR-66	Microsurfacing	Southwest Slurry	W12	18.4			
SR-66	Novachip	Koch	E06	17.0	8.5	12.0	11.5
SR-66	Novachip	Koch	W11	0.0			
SR-66	Pass Oil	Western Emulsion	E12	0.0	11.9	16.8	16.1
SR-66	Pass Oil	Western Emulsion	W07	23.7			
SR-83	AC15-5TR	Paramount	N06	14.0	7.0	9.9	9.5
SR-83	AC15-5TR	Paramount	S22	0.0			
SR-83	AR-ACFC	?	N03	13.0	18.6	5.0	19.8
SR-83	AR-ACFC	?	S15	22.8			
SR-83	AR-ACFC	??	N05	19.9			
SR-83	AR-ACFC	ADOT	N04	8.7	6.3	3.5	7.1
SR-83	AR-ACFC	ADOT	S19	3.8			
SR-83	AR-Chip	ISS	N08	1.4	3.0	2.2	3.5
SR-83	AR-Chip	ISS	S17	4.5			
SR-83	CM-90	Koch	N11	10.5	7.1	4.8	8.3
SR-83	CM-90	Koch	S18	3.7			
SR-83	CRS-2	ADOT	N12	8.0	14.8	9.5	17.2
SR-83	CRS-2	ADOT	S16	21.5			
SR-83	CRS-2P	ADOT	N07	33.4	13.9	17.1	18.2
SR-83	CRS-2P	ADOT	S20	6.7			
SR-83	CRS-2P	Crown	S26	1.5	1.5	--	--
SR-83	Dbl Chip Seal	ADOT	N02	26.7	14.9	16.7	19.1
SR-83	Dbl Chip Seal	ADOT	S25	3.1			
SR-83	HF CRS-2P	Copperstate	N13	9.7	9.3	0.6	9.4
SR-83	HF CRS-2P	Copperstate	S24	8.8			
SR-83	Novachip	Koch	N10	9.5	6.9	3.7	7.8
SR-83	Novachip	Koch	S27	4.3			
SR-83	P-ACFC	Paramount	N09	39.7	34.0	8.1	36.0
SR-83	P-ACFC	Paramount	S23	28.2			
SR-83	Pass CR	Western Emulsion	N14	0.8	2.0	1.7	2.4
SR-83	Pass CR	Western Emulsion	S28	3.2			
SR-83	Slurry Seal	Southwest Slurry	N01	21.7	14.8	9.8	17.3
SR-83	Slurry Seal	Southwest Slurry	S21	7.9			

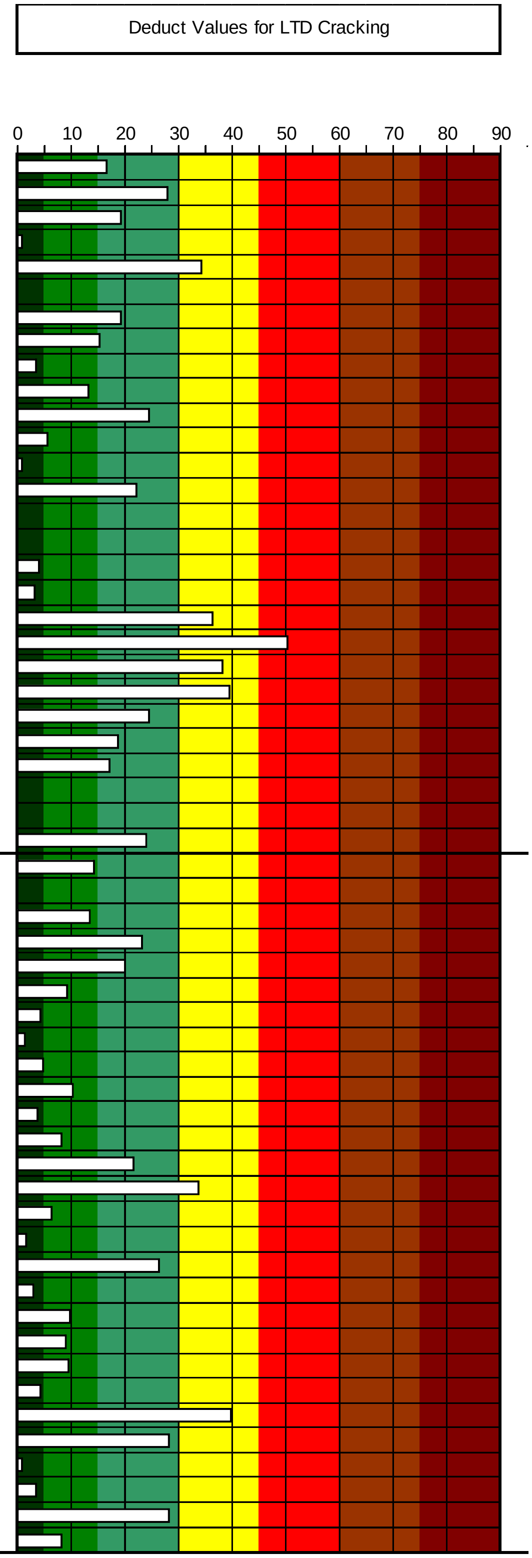

Table 111. ADOT Preventive Maintenance Treatment Performance Comparison: LTD Cracking (Continued).

Hwy	Treatment	Producer	Section No.	DV	Mean	Std. Dev.	60th %ile
SR-87	AC15-5TR	Paramount	N08	2.2	2.5	0.4	2.5
SR-87	AC15-5TR	Paramount	S09	2.7			
SR-87	CM-90	Navajo Western	N02	4.1	9.5	7.6	11.4
SR-87	CM-90	Navajo Western	N03	14.8			
SR-87	Control	No treatment	S05	31.4	20.6	9.6	23.1
SR-87	Control	No treatment	S10	13.0			
SR-87	Control	No treatment	S11	17.5			
SR-87	CRS-2	Copperstate	S06	27.5	21.0	9.3	23.3
SR-87	CRS-2	Copperstate	S03	14.4			
SR-87	CRS-2P	Crown	S02	22.9	16.7	8.8	18.9
SR-87	CRS-2P	Crown	S01	10.4			
SR-87	DACS&B	ADOT	N01	6.2	6.0	0.3	6.1
SR-87	DACS&B	ADOT	S12	5.8			
SR-87	Dbl Chip Seal	ADOT	S07	9.1	10.6	3.7	11.6
SR-87	Dbl Chip Seal	ADOT	S08	14.7			
SR-87	Dbl Chip Seal	ADOT	N04	6.3			
SR-87	Dbl Chip Seal	ADOT	N05	12.4			
SR-87	Novachip	Koch	N06	13.3	17.3	5.6	18.7
SR-87	Novachip	Koch	S04	21.2			
SR-87	Pass Oil	Western Emulsion	N07	10.0	11.4	2.0	11.9
SR-87	Pass Oil	Western Emulsion	N09	12.8			
US-191	AC15-5TR	Paramount	016	7.8	11.6	8.1	13.6
US-191	AC15-5TR	Paramount	040	23.7			
US-191	AC15-5TR	Paramount	026	7.4			
US-191	AC15-5TR	Paramount	050	7.4			
US-191	AR-ACFC	ADOT	018	10.2	15.3	9.2	17.6
US-191	AR-ACFC	ADOT	042	19.7			
US-191	AR-ACFC	ADOT	031	5.3			
US-191	AR-ACFC	ADOT	055	25.8			
US-191	AR-Chip	ISS	013	18.4	19.5	6.8	21.2
US-191	AR-Chip	ISS	037	10.4			
US-191	AR-Chip	ISS	029	25.3			
US-191	AR-Chip	ISS	053	23.9			
US-191	CM-90	Koch	017	0.8	10.5	10.8	13.2
US-191	CM-90	Koch	041	1.5			
US-191	CM-90	Koch	028	19.1			
US-191	CM-90	Koch	052	20.4			
US-191	Control	No treatment	006	12.9	7.9	7.3	9.7
US-191	Control	No treatment	012	15.2			
US-191	Control	No treatment	002	0.0			
US-191	Control	No treatment	008	3.4			
US-191	CRS-2	ADOT	014	15.7	14.4	2.4	15.0
US-191	CRS-2	ADOT	038	16.9			
US-191	CRS-2	ADOT	027	11.6			
US-191	CRS-2	ADOT	051	13.2			
US-191	CRS-2P	ADOT	004	13.1	15.9	19.5	20.8
US-191	CRS-2P	ADOT	010	44.1			
US-191	CRS-2P	ADOT	001	0.5			
US-191	CRS-2P	ADOT	007	5.9			
US-191	CRS-2P	ADOT (FC)	005	12.5	7.1	8.2	9.1
US-191	CRS-2P	ADOT (FC)	011	15.6			
US-191	CRS-2P	ADOT (FC)	003	0.0			
US-191	CRS-2P	ADOT (FC)	009	0.2			
US-191	CRS-2P	Crown	015	14.3	14.8	6.7	16.5
US-191	CRS-2P	Crown	039	6.0			
US-191	CRS-2P	Crown	025	16.7			
US-191	CRS-2P	Crown	049	22.2			
US-191	Dbl Chip Seal	ADOT	021	1.8	6.1	6.9	7.8
US-191	Dbl Chip Seal	ADOT	045	0.2			
US-191	Dbl Chip Seal	ADOT	036	6.7			
US-191	Dbl Chip Seal	ADOT	060	15.5			
US-191	HF CRS-2P	ADOT	019	30.0	24.8	13.2	28.1
US-191	HF CRS-2P	ADOT	043	40.5			
US-191	HF CRS-2P	ADOT	033	10.8