Installation and One-Year Evaluation of No. 8 Aggregate Slurry Seal and Precoated Chip Seal

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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ABSTRACT

This report describes the placement and early performance of experimental test sections on which No. 8 modified slurry seal and precoated No. 8 chip seal surface treatments were placed. From observations made during the installation and the performance after one year, it is concluded that the No. 8 modified slurry seal treatment has good potential but that use of the No. 8 chip seal treatment is not feasible.

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INTRODUCTION

Because of the increased cost of maintaining Virginia's roadway system, there is a continuing effort to lessen the expense and improve the effectiveness of the methods being employed. As part of this effort, for the past several years the Staunton District has been experimenting with slurry seal treatments using No. 8 stone and chip seals using precoated No. 8 stone. In view of the success achieved by the district with test installations placed on driveways and parking areas, it was decided to place some test sections of these materials on a lightly trafficked, rural, 4-lane divided highway. As mentioned in the original working plan for the experiments by Mahone, the test sections were to be monitored for 3 years after placement.(1)

PURPOSE AND SCOPE

While the general purpose of the project was to determine the feasibility of using the seal treatments in the repair of bituminous pavements, some of the specific objectives were to --

1. increase the crack-sealing capabilities of a slurry seal with the more fluid mixture of No. 8 stone and emulsified asphalt as compared to the finer type B slurry seal,

2. improve the skid resistance of a slurry seal with the coarse texture provided by the No. 8 slurry seal,

3. reduce the potential for dust and flying stone that are characteristic of conventional seal treatments, and

4. provide an alternate surface treatment that could be employed both for surface treating and patching over a longer season than is possible with conventional chip seal treatments, which have a tendency to lose aggregate in cold weather.

PRELIMINARY INVESTIGATION

Pavement Structure

The site selected for the study was a 4.12-mile (8.19-km) portion on Route 11 in Rockbridge County that was built in 1952. In the original pavement, the subbase was 4 to 6 in. (10 to 15 cm) of select local borrow, the base 5 in. (12.5 cm) of waterbound macadam plus 3 in. (7.5 cm) of bituminous penetration, and the surface 1 to 3 in. (2.5 cm to 7.5 cm) of H-2 bituminous concrete. The drainage is good. The mixes placed in this section since 1952 are shown in Appendix A. The surfaces immediately below the experimental seals are noted in Table 1.

To determine the structure of the pavement prior to and after placement of the experimental test sections, the Research Council's dynaflect tester was used. These results will be shown and discussed later in the report.

Table 1

Mix Types of Pavement Surface Prior to Placement of Test Sections

Lane	Milepost	Mix Type	Year of Placement
NB/SB	6.10- 6.20	S-5	1979
NB	6.20-10.90	Slurry B	1974
SB	6.20- 9.38	Slurry B	1973
NB	10.90-11.04	Slurry B	1973
SB	9.39-10.83	Slurry B	1974
NB	11.04-11.22	I-2 NP	1977
SB	10.83-11.22	Slurry B	1973

Pavement Condition

The existing surface mixes were an S-5, a slurry-B, and an I-2 non-polishing mix that had outlived their service lives and were badly deteriorated. Much of the surface texture was worn off and there were considerable cracks in both the S-5 and slurry seal, as can be seen in Figures 1, 2, and 3.

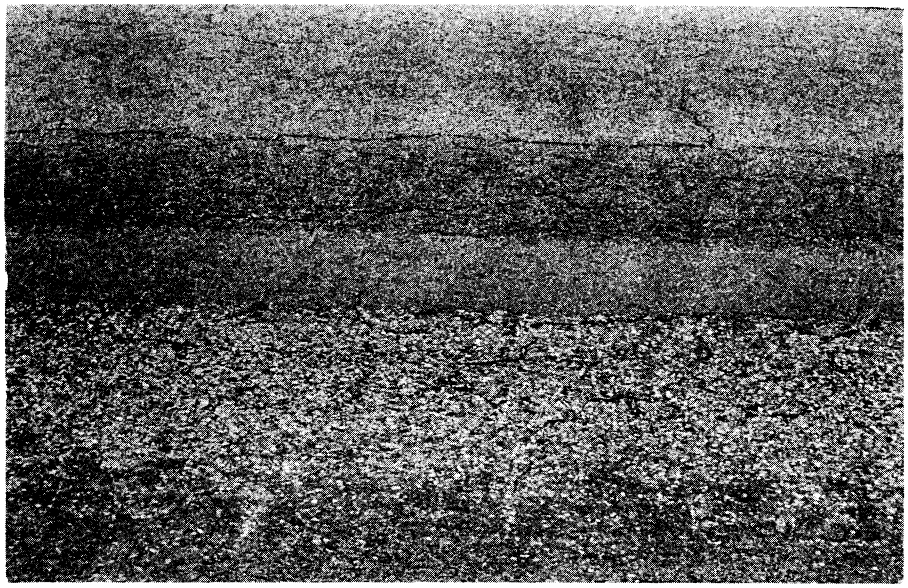

Figure 1. S-5 mix.

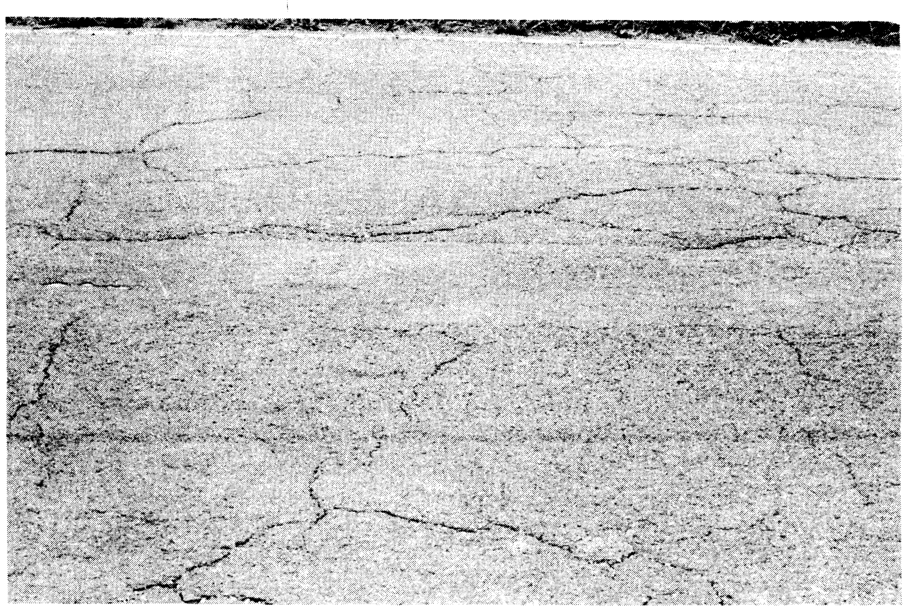

Figure 2. Slurry seal.

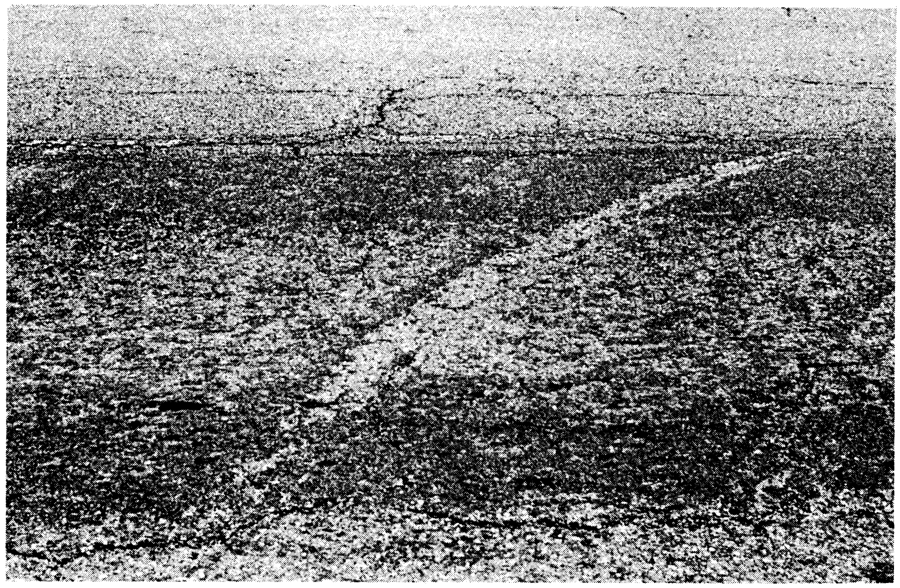

Figure 3. I-2 non-polishing mix.

Site Geometrics

The portion of Route 11 selected for the experimental sections extends from milepost 6.10 (south end of Fairfield) to milepost 11.22 (south of I-81 interchange) and traverses slight curves and grades. The sketches in Appendix B show the tangent and curve sections as well as positive and negative grades.

Traffic Volumes

The average daily traffic volumes obtained from the Department for 1982, the year the test sections were placed, and the 2 prior years showed no increases, as can be seen in Table 2.(2)

Table 2

Daily Traffic Volumes

Year	Cars	Single Unit Trucks	Buses	ADT	Change
1980	1,425	630	15	2,070	0
1981	1,400	565	15	1,980	-4%
1982	1,475	580	15	2,070	0

Wet Weather Accidents

To determine if the section of pavement between mileposts 6.10 and 11.22 was prone to wet weather accidents, the accident reports covering a 3-year period were reviewed and revealed that only 3 of the total of 26 reported accidents had occurred while the pavement was wet (see Table 3).

Table 3

Wet Weather Accident Data

Year	Milepost	Total Accidents	Wet Accidents	% Wet
1980	6.8-11.4	10	2	20
1981	6.2-10.4	5	0	0
1982	6.0-11.3	11	1	9
	Total	26	3	12

Climatologic Data

Monthly rainfall and temperature data for the period 1980-1982 were obtained from Lexington, the closest weather station, and are shown in Appendix C. Data for the days that the test site were placed will be shown later in the report.

TEST SECTIONS

Materials

During the summer and fall of 1982, precoated No. 8 surface treatment and No. 8 slurry seal test sections were placed on all four lanes of Route 11 between mileposts 6.10 and 11.22. The surface treatment was a chip seal consisting of a CRS-2H (SBL) and CRS-2 (NBL) and No. 8 non-polishing river gravel with approximately 1.4% to 1.7% AC20 asphalt. The modified slurry seal consisted of a blend of CRS-2H and CSS-1H (cationic emulsions) and No. 8 polish-resistant quartz instead of the fine slurry seal aggregate gradation. Table 4 shows the amount of residue and viscosity of the emulsions used in the No. 8 slurry mix.

Table 4

Asphalt Emulsions

Type of Emulsion	Residue, %	Viscosity
CRS-2H	69.0	200
CSS-1H	66.0	35

Solvents and quick setting emulsifying agents were used in the CRS-2H, and mixing agents were used in the CSS-1H.

The non-polishing No. 8 river gravel used for the precoated chip seal and the non-polishing quartzite used in the No. 8 slurry mix both came from Lone Jack Quarry. The gradations are shown in Table 5.

Table 5

Sieve Analysis in Percent Passing Indicated Sieves

Test Section	3/8	No. 4	No. 8	-8	No. 200
Precoated No. 8	94.3	24.1	6.3	--	1.1
No. 8 Slurry Mix	92.3	17.7	4.2	--	---

For comparative purposes, two sections of the state's conventional slurry seal B and a chip seal consisting of CRS-2H asphalt and polish-resistant aggregate from the Lone Jack Quarry were placed. Figure 4 shows a layout of all the test sections and dates of placement.

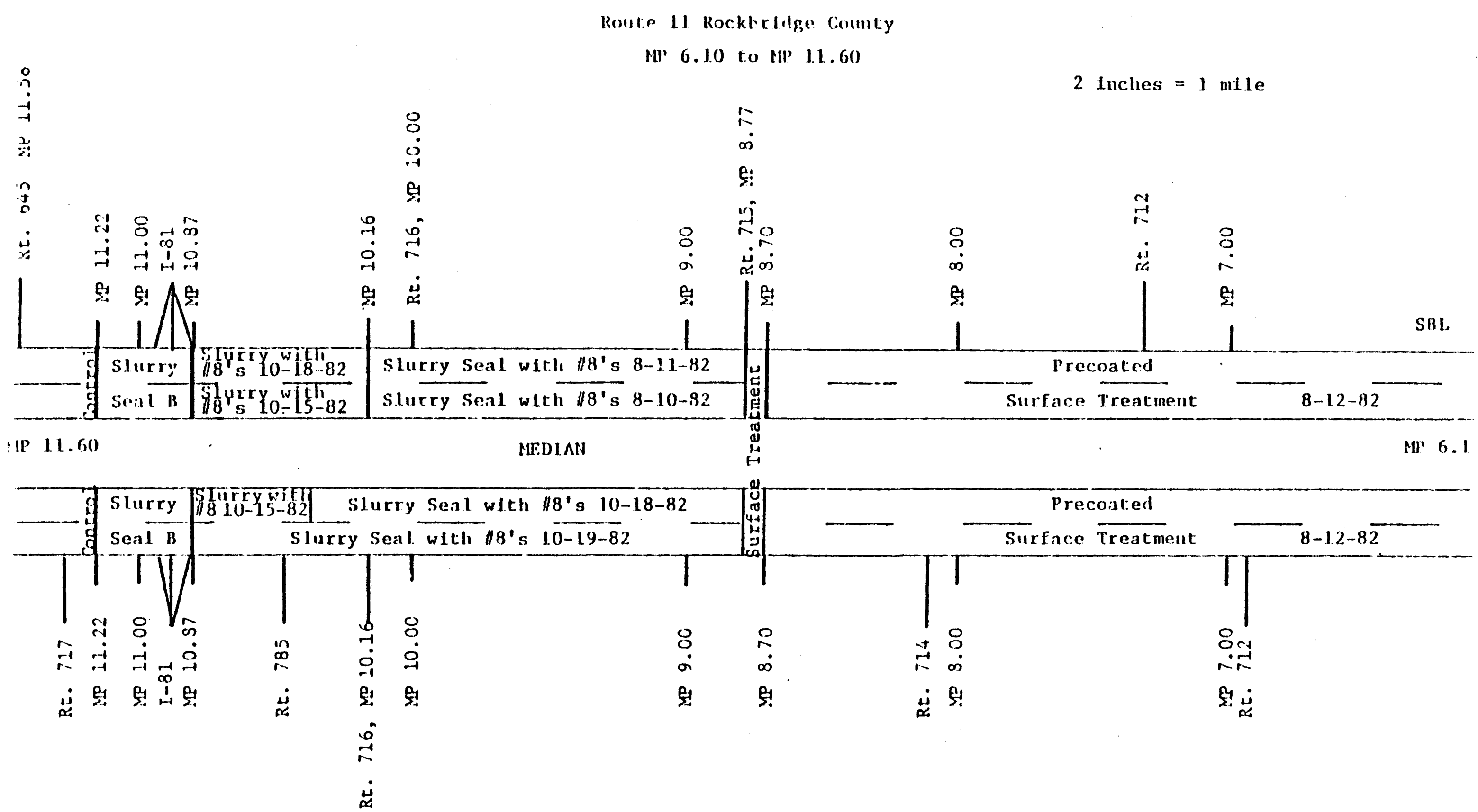

Figure 4. Locations of test sections.

Installation

The precoated and conventional chip seals were put down with state forces and equipment, except that a self-propelled chip spreader was rented from John Hall Construction Company in Roanoke. The equipment consisted of a tanker distributor calibrated prior to use, a tractor with a front-mounted broom, a rubber-tired roller, and the necessary trucks, signs, and barricades for the operation.

Slurry Pavers, Inc. of Richmond placed the No. 8 modified and conventional slurry seals. The No. 8 slurry was placed in August using a standard slurry paver but because of the size of the stone, the second application, placed in October, was put down with a box specially designed for use with a Midland Cold-mix paver (see Figures 5 and 6). The rear of the cold-mix machine was modified to use high pressure pumps to ensure mixing of the asphalt and stone. Also, the spreader box had been modified to eliminate spillage of the material. Originally, the spreader box had an auger in both the front and rear to evenly distribute the material; however, the rear auger was removed to eliminate spillage of material onto slurry already placed on the pavement.

The pavement was 24 ft. (720 cm) wide in each direction, which posed no problem for the slurry machine or cold-mix paver in placing the modified No. 8 slurry, since they both would spread to a 12 ft. (360 cm) width. However, when placing the precoated chip seal, three passes with the 8 ft. (240 cm) chip spreader were necessary.

The application rates for the treatments are shown in Tables 6 and 7, and the daily air and surface temperatures for the days of placement in Table 8.

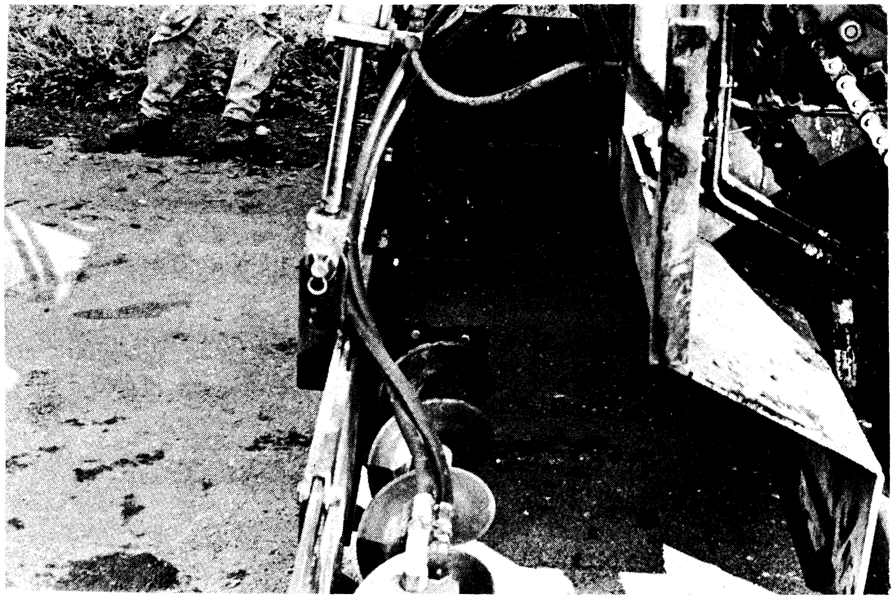

Figure 5. Spreader box on Midland paver.

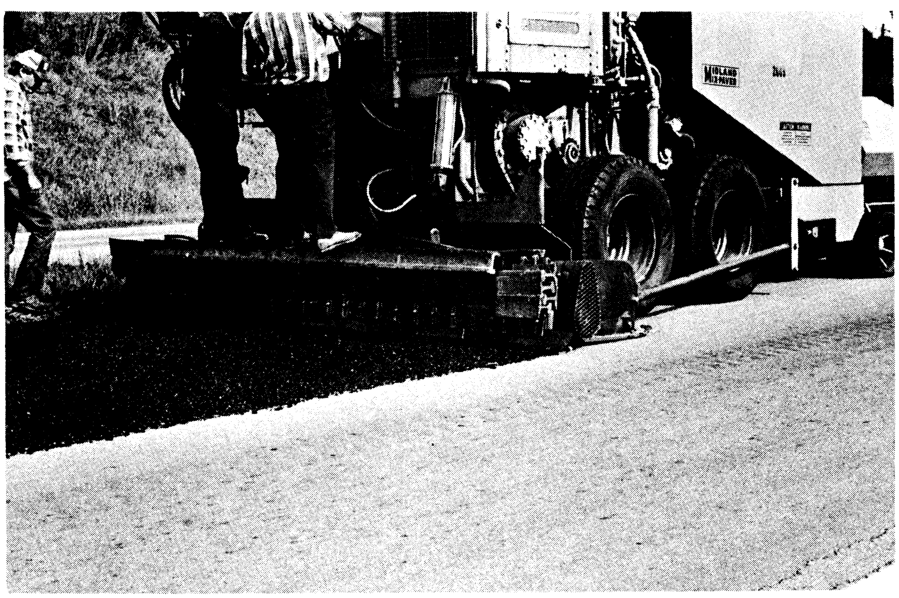

Figure 6. Placing No. 8 slurry with Midland paver.

Table 6

Application Rates for No. 8 Slurry Seal

Date	Milepost	Lane	Lb.yd.^{2}
8-10-82	8.77-10.16	SBPL	29
10-15-82	10.16-10.87	SBPL	34
8-11-82	8.77-10.16	SBTL	26
10-18-82	10.16-10.87	SBTL	32
10-15-82	10.87-10.52	NBPL	31
10-18-82	10.52- 8.77	NBPL	28
10-19-82	10.87- 8.77	NBTL	30

Note: 1 lb./yd.^{2} = 0.54 kg./m^2.

Table 7

Application Rates for Precoated Chip Seal

Date	Milepost	Lane	8' Section	Gal./Yd.^{2}	Lb./Yd.^{2}
8-11-82	8.70-6.10	NBTL	Outside	0.20	17
8-12-82	8.70-6.10	NBPL	Inside	.25	17
8-11-82	8.70-6.10	NBTL-PL	Middle	.25	17
8-11-82	6.10-8.70	SBTL	Outside	.20	17
8-12-82	6.10-8.70	SBPL	Inside	.25	17
8-12-82	6.10-8.70	SBTL-PL	Middle	0.25	17

NOTE: 1 gal./yd.^{2} = 4.53 l/m.^{2}; 1 lb./yd.^{2} = 0.54 kg./m.^{2}

Table 8

Temperature Data, Degrees F.

Date	Time	Air	Surface
8-10-82	8:30 a.m.	76	77
	9:30 a.m.	78	91
	10:30 a.m.	81	93
	11:30 a.m.	85	106
	12:30 p.m.	86	108
	1:30 p.m.	87	108
	2:50 p.m.	91	116
	3:45 p.m.	90	108
	5:00 p.m.	88	105
8-11-82	8:50 a.m.	69	73
	10:00 a.m.	80	92
	11:10 a.m.	78	100
	11:50 a.m.	81	108
	12:50 p.m.	82	101
	1:50 p.m.	85	114
	2:50 p.m.	87	122
	3:30 p.m.	88	106
8-12-82	10:00 a.m.	68	80
	11:00 a.m.	71	89
	12:35 p.m.	79	98
	1:30 p.m.	80	102
	2:30 p.m.	89	112
	3:30 p.m.	83	106
10-15-82	8:55 a.m.	56	52
	11:35 a.m.	76	64
10-18-82	11:05 a.m.	49	50
	12:00 m	56	60
	1:00 p.m.	65	56
	1:45 p.m.	60	80
	2:50 p.m.	72	82
	3:42 p.m.	68	86
10-19-82	9:25 a.m.	56	56
	10:20 a.m.	64	79
	10:52 a.m.	67	80
	11:43 a.m.	71	78
	1:20 p.m.	70	92
	2:20 p.m.	72	92

NOTE: 5/9 (Deg.F -32) = Deg. C.

Skid Tests

Skid tests were run prior to and after placement of the experimental surfaces, and will be made yearly for the 3-year evaluation period. Appendix D shows the mean skid data from tests with both bald and treaded tires on the old slurry seal and new surfaces. The skid numbers for the precoated chip seal and No. 8 slurry range from the 40's to the 60's, which is quite satisfactory.

Ride Quality

To determine if there was any significant improvement in the ride quality, tests were conducted with the Mays meter prior to and after placement of the test sections. Based on the Mays meter rating scale given in a report by McGhee(3), and shown in Table 9, the new surfaces did not produce any significant improvement in ride quality. The roughness data can be seen in Table 10.

Table 9

Mays Meter Rating Scale
(After McGhee[3])

Ride Quality	Mays Roughness, In./Mi.
Very Rough	170
Rough	130
Slightly Rough	95
Average	70
Smooth	70

NOTE: 1 in./mi. = 1.37 cm./km.

Table 10

Mays Meter Roughness Data, In./Mi.

Site	Lane	Milepost	Before 6-24-82	After 11-17-82	After 10-20-83
Precoated Chip Seal	NBTL	6.10- 8.70	77.4	81.1	87.8
Precoated Chip Seal	NBPL	6.10- 8.70	86.7	85.2	108.7
Precoated Chip Seal	SBTL	6.10- 8.70	106.8	106.2	107.6
Precoated Chip Seal	SBPL	6.10- 8.70	116.7	112.3	108.3
Conventional Chip Seal	NBTL	8.70- 8.77	70.7	83.6	87.8
Conventional Chip Seal	NBPL	8.70- 8.77	99.6	93.3	108.7
Conventional Chip Seal	SBTL	8.70- 8.77	94.5	78.5	87.8
Conventional Chip Seal	SBPL	8.70- 8.77	136.3	66.9	76.7
No. 8 Modified Slurry	NBTL	8.77-11.22	84.5	87.8	74.2
No. 8 Modified Slurry	NBPL	8.77-11.22	90.0	79.5	79.4
No. 8 Modified Slurry	SBTL	8.77-11.22	112.3	118.0	104.4
No. 8 Modified Slurry	SBPL	8.77-11.22	105.7	120.0	114.8

NOTE: 1 in./mi. = 1.37 cm./km.

Pavement Structure

The structural evaluation of the pavement was carried out with the Council's dynaflect tester. Based on Figure 7 in Vaswani's report entitled "Design Guide for Secondary Road Pavements in Virginia,"(4) the thickness index for the amount of traffic the roadway carried should be 8.8. This is shown in Figure 7 by the broken lines. The soil support value is found in Vaswani's report "Recommended Design Method for Flexible Pavements in Virginia,"(5) and the daily traffic in 18-kip equivalents is calculated as

$$N_{18} = 0.88\ N_{TT} + 0.28\ N_{\substack{3A\\6-10}} + 0.20 N_{\substack{2A\\6T}} + 0.22\ N_B, \text{ or}$$

$$N_{18} = 0.88(35) + 0.28(10) + 0.20(80) + 0.22(15) = 53.1.$$

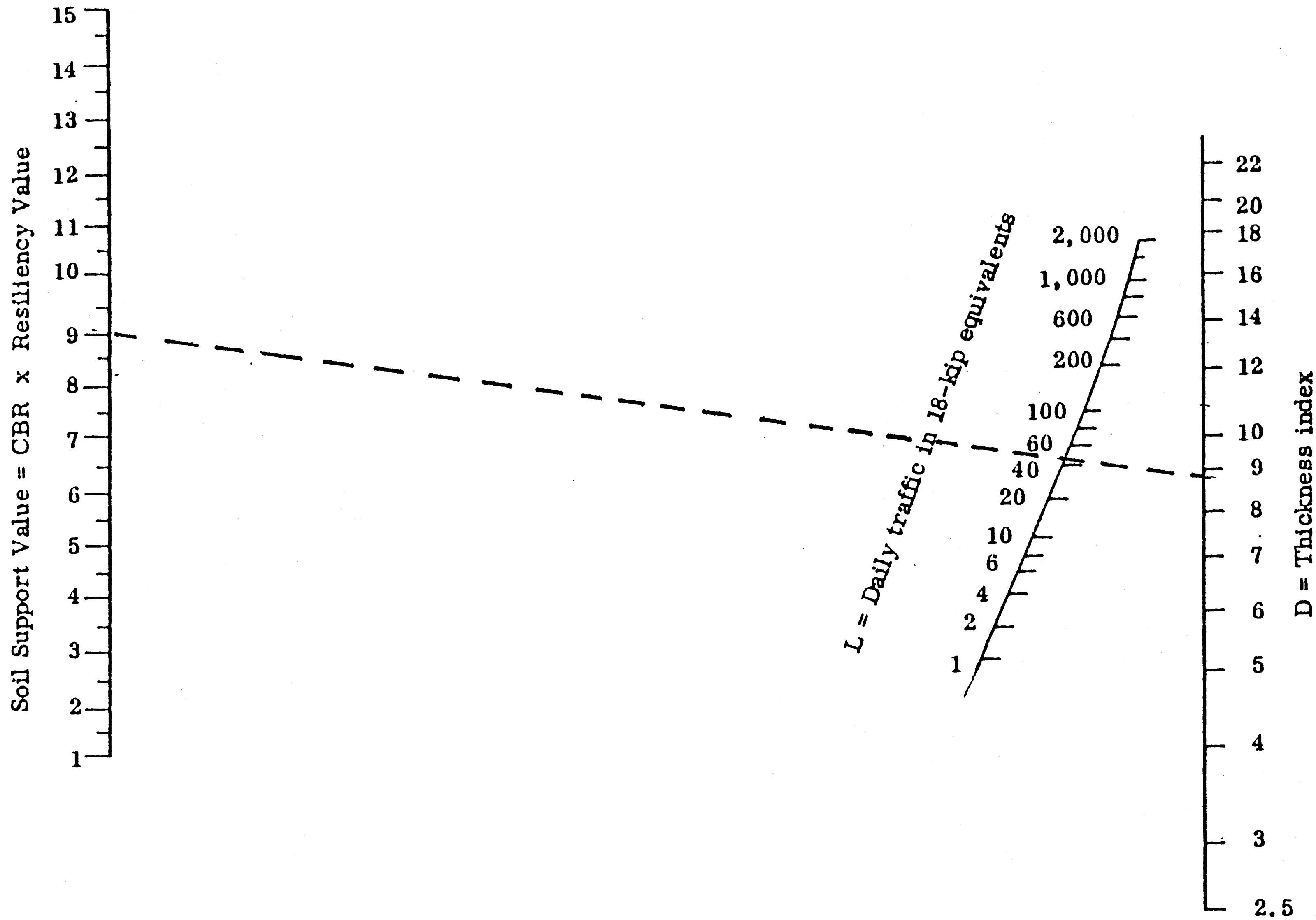

Figure 7. Nomograph correlating soil support value, traffic and thickness equivalencies (based on AASHO equation).

From Table 11 it can be seen that the structure of the pavement was not adequate for the traffic it carried, since the thickness index should read 8.8 or above and none of the readings before placement of the test sections exceeded 6.5. Also it is noted in this table that in some places thickness indices were worse after the installation than before. This is probably attributable to subgrade moisture, which would suggest that the chip seals did a poorer job of sealing the pavement than did the No. 8 slurry seal.

OBSERVATIONS AND CONDITIONS

Because the goal of this evaluation was to assess the performance of the No. 8 slurry seal and precoated No. 8 chip seal, this report is basically an installation report against which subsequent performance can be judged. Some of the observations and conclusions during construction are listed below.

1. The operations of both the state forces and Richmond Slurry Pavers were efficient. Traffic was controlled to allow the test sections ample curing time.

2. The application rates for both seal treatments were kept close to the desired rates. However, it can be noted back in Table 6 that the No. 8 slurry was applied at an average of 30 lb./yd.^{2} (13.5 kg/m^2).

3. Even though the above observations suggest a good job, the performance of both treatments has been poor. Although the most recently laid test sections were closed to traffic to allow them to cure for a sufficient time, neither performed well when opened to traffic. While the precoated stone and asphalt adhered well to each other, the materials picked up very badly under traffic. Flying stone broke the windshields on a number of cars. Loose stone had to be swept from the pavement several times, but after a couple of days the stone began to adhere and the treatment looked good. One of the problems with the slurry seal was poor lap joints. Too much material was left at the joint where one shot ended and another started, as well as at the center joint. The problem at these points was that the material overlapped and created a double thickness that resulted in a rough riding surface and left excess material to be bladed off by snowplows, which created raveling problems. Another problem during installation was poor application of the fines by the rotary type sand spreader. The fines were not dry, did not produce uniform coverage, and packed down to produce a poor riding surface when rolled. The pavement was swept several times, but some of the material remained until it was washed off. As the remaining material broke up and came off it pulled off some of the slurry with it.

Table 11

Dynaflect Test Results

Site	Date	Milepost	Lane	Deflections	Spreadability	Thickness Index
Precoated Chip Seal	6-29-82	6.10- 8.70	SBTL	0.022	52	6.4
Precoated Chip Seal	11-09-82	6.10- 8.70	SBTL	0.033	49	4.8
Precoated Chip Seal	6-29-82	6.10- 8.70	SBPL	0.028	50	5.3
Precoated Chip Seal	11-09-82	6.10- 8.70	SBPL	0.041	42	3.0
Conventional Chip Seal	6-29-82	8.70- 8.77	SBTL	0.021	49	6.0
Conventional Chip Seal	11-09-82	8.70- 8.77	SBTL	0.028	52	5.6
Conventional Chip Seal	6-29-82	8.70- 8.77	SBPL	0.026	48	5.7
Conventional Chip Seal	11-09-82	8.70- 8.77	SBPL	0.028	50	5.4
No. 8 Slurry Seal	6-29-82	8.77-10.87	SBTL	0.023	53	6.5
No. 8 Slurry Seal	11-09-82	8.77-10.87	SBTL	0.020	55	7.3
No. 8 Slurry Seal	6-29-82	8.77-10.87	SBPL	0.025	51	5.9
No. 8 Slurry Seal	11-09-82	8.77-10.87	SBPL	0.028	57	7.2

4. The test sections were observed in the spring of 1983 and neither was performing well. Some of the stone was stripping off the chip seal section and much of the material was raveling off the slurry seal.

Recommendations for Further Study

The investigation has shown that further work with the No. 8 modified slurry is essential. It is believed that this type of seal treatment has the potential of adequately preserving Virginia's roadways and can produce a durable surface if problems encountered in the experiments to date can be solved. In 1983, the No. 8 modified slurry was placed on three roads in the Staunton District with good success, and at the end of the year were performing well. A report on the 1983 test sections will be made later.

In regard to the precoated No. 8 chip seal, in light of the poor performance of applications that have been placed in parking lots and roadways and the number of problems that have been encountered, it is not feasible to continue use of this type of treatment.

SUMMARY

Experiments were conducted with the No. 8 slurry seal and precoated No. 8 chip seal to determine their performance. The major conclusions from the experiments are (1) that use of the No. 8 slurry seal treatment is feasible, but modifications must be made and more test sections must be placed; and (2) the use of the No. 8 chip seal is not warranted due to the problems encountered and the cost involved.

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3. McGhee, K. H., "Design of Overlays Based on Pavement Condition, Roughness, and Deflections," Virginia Highway and Transportation Research Council Report 82-R31, 1982.

4. Vaswani, N. K., "Design Guide for Secondary Road Pavements in Virginia," Virginia Highway Research Council Report 73-R18, October 1973.

5. _______, "Recommended Design Method for Flexible Pavements in Virginia," Virginia Highway Research Council Report 71-R26, March 1972.

APPENDIX A

HISTORY OF PAVEMENT BETWEEN MILEPOSTS 6.10 AND 11.22

Northbound Lanes

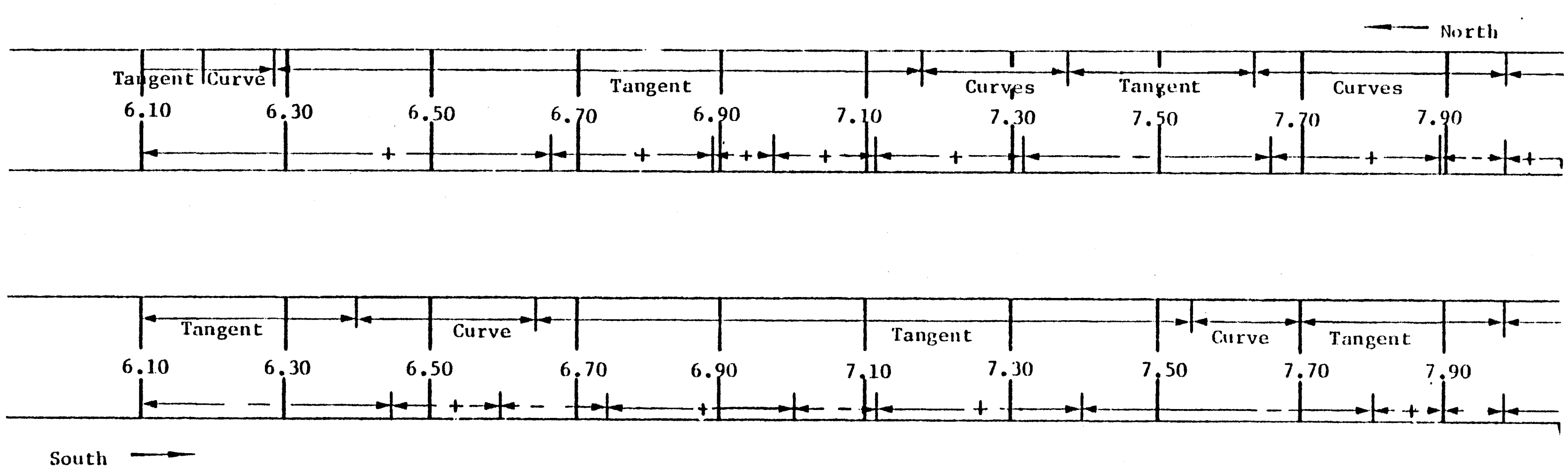
Milepost	Type	Placed
6.10- 6.20	H-2	1952
6.20- 7.90	I-3	1955
7.90- 8.50	I-3	1957
8.50- 8.80	I-3	1955
8.80- 9.40	I-3	1957
9.40-10.10	I-3	1955
10.10-10.60	I-3	1954
10.60-10.70	I-3	1957
10.70-11.22	I-3	1955
5.60- 6.20	I-3 NP	1964
6.20-11.22	S-5	1966
5.60- 6.20	Slurry B	1973
6.20-10.90	Slurry B	1974
10.90-11.22	Slurry B	1974
5.70- 6.20	S-5	1979
6.20-10.90	Slurry B	1974
10.90-11.04	Slurry B	1973
11.04-11.22	I-2 NP	1977

Southbound Lanes

Milepost	Type	Placed
5.70- 6.20	I-3	1954
6.20- 9.10	H-2	1952
9.10-9.30	I-3	1954
9.30- 9.50	I-3	1957
9.50-10.80	H-2	1953
10.80-11.22	I-3	19.54
5.60- 6.20	I-3 NP	1973
5.60- 6.20	S-5	1979
6.20- 9.38	Slurry B	1973
9.39-10.83	Slurry B	1974
10.83-11.22	Slurry B	1973

APPENDIX B

LAYOUT OF ROUTE 11, ROCKBRIDGE COUNTY, BETWEEN MILEPOSTS 6.10 AND 11.37



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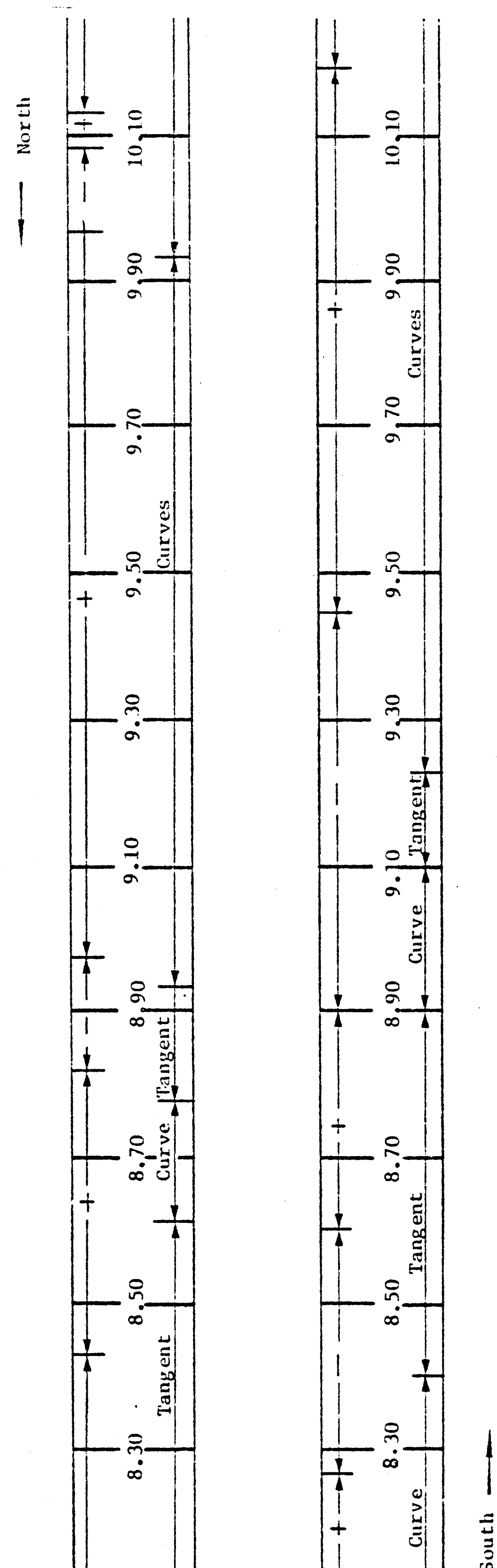

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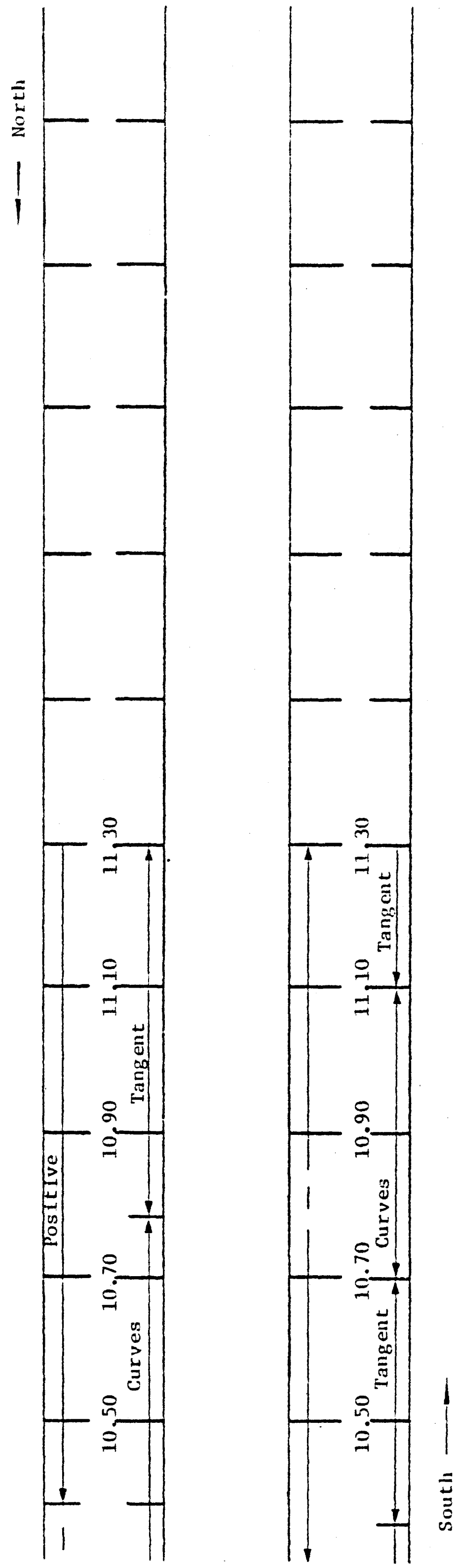

APPENDIX C

CLIMATOLOGICAL DATA

	Rainfall, in.			Temperatures, Deg. F.					
				1980		1981		1982	
Month	1980	1981	1982	High	Low	High	Low	High	Low
January	4.41	0.28	2.65	42	23	60	2	61	-8
February	0.86	3.00	4.16	46	22	74	7	76	16
March	5.65	1.53	3.15	56	31	83	17	80	13
April	4.97	1.56	2.87	70	42	90	25	75	15
May	2.19	3.98	3.69	79	51	89	30	90	36
June	1.41	2.45	7.14	84	57	95	48	88	51
July	3.94	3.70	4.53	91	65	94	51	93	52
August	1.80	1.42	2.11	90	64	95	47	91	48
September	2.49	2.85	2.91	85	59	90	36	91	40
October	2.15	4.06	2.31	70	43	88	23	85	30
November	2.45	0.74	4.01	57	32	75	15	84	19
December	0.46	2.84	2.63	50	26	60	6	77	5
Total	32.78	28.41	42.16						
	Average --			68	43	83	26	85	26

NOTE: 1 in. = 2.54 cm; 5/9 (Deg. F. - 32) = Deg. C.

APPENDIX D

SKID DATA

Date	Milepost	Lane	Treaded	Bald	Mix Type
6-21-82	6.20- 8.60	NBTL	53	36	Old Slurry Seal
6-21-82	6.20- 8.60	NBPL	56	46	Old Slurry Seal
6-21-82	6.20- 8.60	SBTL	52	42	Old Slurry Seal
6-21-82	6.20- 8.60	SBPL	60	49	Old Slurry Seal
11-09-82	6.10- 8.70	NBTL	54	57	Precoated S.T.
11-09-82	6.10- 8.70	NBPL	62	64	Precoated S.T.
11-09-82	6.10- 8.70	SBTL	51	55	Precoated S.T.
11-09-82	6.10- 8.70	SBPL	65	64	Precoated S.T.
11-09-82	8.70- 8.77	NBTL	45	49	Conventional S.T.
11-09-82	8.70- 8.77	NBPL	54	59	Conventional S.T.
11-09-82	8.70- 8.77	SBTL	46	48	Conventional S.T.
11-09-82	8.70- 8.77	SBPL	58	60	Conventional S.T.
11-09-82	8.77-10.87	NBTL	43	43	Slurry Plus No. 8
11-09-82	8.77-10.87	NBPL	48	54	Slurry Plus No. 8
11-09-82	8.77-10.87	SBTL	49	50	Slurry Plus No. 8
11-09-82	8.77-10.87	SBPL	59	58	Slurry Plus No. 8
11-09-82	10.87-11.22	NBTL	48	42	Slurry B
11-09-82	10.87-11.22	NBPL	49	42	Slurry B
11-09-82	10.87-11.22	SBTL	43	36	Slurry B
11-09-82	10.87-11.22	SBPL	45	46	Slurry B
11-09-82	11.22-11.58	NBTL	40	28	Control Site
11-09-82	11.22-11.58	NBPL	56	45	Control Site
11-09-82	11.22-11.58	SBTL	44	24	Control Site
11-09-82	11.22-11.58	SBPL	53	44	Control Site
7-21-83	6.10- 8.70	NBTL	55	54	Precoated S.T.
7-21-83	6.10- 8.70	NBPL	60	58	Precoated S.T.
7-21-83	6.10- 8.70	SBTL	53	52	Precoated S.T.
7-21-83	6.10- 8.70	SBPL	61	57	Precoated S.T.
7-21-83	8.70- 8.77	NBTL	46	37	Conventional S.T.
7-21-83	8.70- 8.77	NBPL	53	52	Conventional S.T.
7-21-83	8.70- 8.77	SBTL	40	40	Conventional S.T.
7-21-83	8.70- 8.77	SBPL	55	51	Conventional S.T.

Appendix D (continued)

Date	Milepost	Lane	Treaded	Bald	Mix Type
7-21-83	8.77-10.87	NBTL	49	46	Slurry Plus No. 8
7-21-83	8.77-10.87	NBPL	56	54	Slurry Plus No. 8
7-21-83	8.77-10.87	SBTL	47	48	Slurry Plus No. 8
7-21-83	8.77-10.87	SBPL	54	53	Slurry Plus No. 8
7-21-83	10.87-11.22	NBTL	46	34	Slurry B
7-21-83	10.87-11.22	NBPL	47	35	Slurry B
7-21-83	20.87-11.22	SBTL	39	26	Slurry B
7-21-83	10.87-11.22	SBPL	46	31	Slurry B
7-21-83	11.22-11.58	NBTL	49	38	Control Site
7-21-83	11.22-11.58	NBPL	58	47	Control Site
7-21-83	11.22-11.58	SBTL	44	25	Control Site
7-21-83	11.22-11.58	SBPL	52	42	Control Site