VIRGINIA'S WET PAVEMENT ACCIDENT REDUCTION PROGRAM

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While a great deal of work on skid resistance has been conducted in Virginia over the past three decades, only within the past year has attention been given to the development of a systematic program for the identification and treatment of high or potentially high wet pavement accident sites. The purpose of this paper is to outline that program. The use of Virginia's automated accident and survey skid data files in the program is described. The site selection process utilizing these two data bases is explained as is the site review process, including the field review. The economic analysis used initially to rank sites for field review, and used again to rank sites for recommended treatments is also explained. In essence, this economic analysis involves the computation of a breakeven value considering the costs of possible site treatments versus projected savings from reductions in wet pavement accidents. As explained in the paper, in the Virginia program there is an emphasis on the use of accident data, with every effort being made to achieve the greatest total reduction in wet accidents with a given amount of funds for improvements.

For many years Virginia has conducted a very active research program in pavement skid resistance. The state's long series of publications on the subject was initiated with the paper entitled "Skid Resistance Measurements of Virginia Pavements", by T. E. Shelburne and R. L. Sheppe, which was published by the Highway Research Board in 1948 (1). The First International Skid Prevention Conference was held at the University of Virginia a decade later (2), with an accompanying correlation of skid test vehicles over various types of pavements throughout the state. A second correlation was made on Virginia highways in 1960; and a third was conducted on specially prepared pavements at Tappahannock, Virginia, in 1962 (3). The first British portable tester to be used in the United States was purchased for research in Virginia and was used in the 1960 correlation study.

Locally, the state has continuously tested pavements for skid resistance since Shelburne and Sheppe's early work; and nationally, Virginia has contributed much through participation in committee activities. In regard to the latter, it is noted that several Virginians played key roles in organizing ASTM Committee E-17 on Skid Resistance.

Early in its program for combatting pavement slipperiness, about 25 years ago, Virginia outlawed the use of certain polish susceptible aggregates in the surface mixes on primary and higher class roads; and since that time state engineers have conducted many field experiments in the development of economical means of providing skid resistant roads.

Perhaps the most important decision made by Virginia highway officials through the years was the adoption of the policy that calls for the resurfacing of pavements that have experienced wet weather accidents and which have a stopping distance number of less than 40 when tested at 64 kph (40 mph). Yet, presently there is not in operation any program for identifying wet pavement accident sites nor for systematically evaluating wet accident or low skid number sites. With the buildup of knowledge in the field of pavement skid resistance, it has become clear that a well conceived program is needed, and for this reason the authors have designed and are implementing the program described in the following pages.

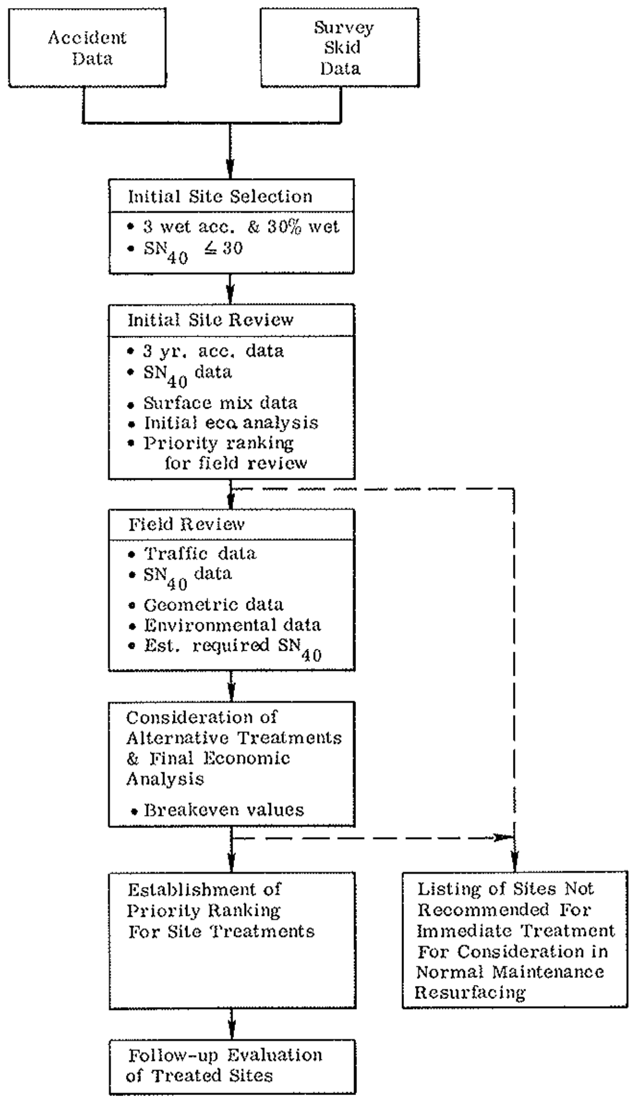
Program Outline

It should be noted that the program outlined pertains to the interstate, arterial, and primary roadway systems maintained by the Virginia Department of Highways and Transportation. Potential high wet pavement accident locations on the secondary road system are evaluated when brought to the attention of those responsible for the program; however, the procedures described herein for locating possible high wet pavement accident sites are not directly applicable to the secondary system.

A generalized flow diagram of the wet pavement accident reduction program is shown in Figure 1. This program is discussed in the following sections, but a brief glance at Figure 1 indicates the prime importance attached to the use of accident data. While it obviously is important to identify and consider improvements to potentially dangerous sites, i.e., sites having low skid resistance, it is more important to identify and correct sites already characterized by a high frequency and proportion of wet accidents.

In addition to accident data, the data collected in Virginia's survey skid program are an integral part of the system. These two data bases are discussed briefly in the following two sections, with the remainder of the paper being devoted to the use of the data in the wet pavement accident reduction program.

Figure 1. Wet pavement accident reduction program.



Accident Data Base

Accident data utilized in the program are obtained from the automated accident files maintained by the Department's Data Processing Division. Table 1 indicates the items of data contained on each accident record, and each item is discussed in detail in "Code for Analysis of Highway Motor Vehicle Accidents" (4). Data considered to be of primary importance for the purpose under discussion are locational data, placement data indicating direction of travel, surface condition (dry, wet, snowy, icy, etc.), number killed, number injured, and property damage. Other items are obviously of importance at times, but the above six items are always considered.

It is worth noting that some deficiencies do exist in the accident data collection procedure in terms of the use of the data in the wet pavement accident reduction program. Primarily these deficiencies relate to determining the direction of travel for the accident-involved vehicles, particularly on divided highways, and to determining the location of accidents occurring in interchange ramps. Clarification of these locational data would enhance the use of the accident data in the accident reduction program. In addition, quantitative data relating to tire tread depth for accident-involved vehicles are desirable information not now collected.

Annual detailed computer listings are furnished the authors for use in the wet accident reduction program. These detailed listings contain all the data items shown in Table 1 for each accident occurring during the preceding calendar year (Jan. 1 - Dec. 31). In addition, a summary listing indicating high wet pavement accident sites is provided annually. This listing and the criteria used for the selection of high wet accident sites are discussed in a later section.

Survey Skid Data Base

A survey skid testing program was initiated in Virginia in 1974. Thus far, the entire interstate system has been tested, with five SN_{40} values being obtained per lane mile. In addition, all of the arterial system and some of the primary system have been tested, with the number of tests per mile having been reduced to three and with testing having been restricted to the traffic lane only. It is anticipated that within several years every lane mile in the three systems will have been tested at least once. In the interim, the Research Council's skid trailer will be used to test identified wet pavement accident sites which have not been tested by the survey trailer, and to retest many sites tested by the survey trailer to verify the survey SN_{40} values. The data from the two trailers can be interchanged through a correlation program designed and conducted by Runkle (5).

Procedures for the collection and computer storage of survey skid data, as well as the utilization of the data considering variabilities present in testing, have been discussed in published reports (6, 7). Data items contained in each skid test record are shown in Table 2. In addition to the items shown in Table 2, the skid number corrected to a 64 kph (40 mph) test speed (SN_{40}) is contained on all skid data computer listings. Since the test speed is usually intended to be 64 kph (40 mph) the difference between the actual and corrected skid number (SN_{40}) is usually small. The correction is based on a skid number-speed gradient of 0.5 per 1.6 kph (1 mile). Also, shown on the skid data listings is the predicted stopping distance number at 64 kph (40 mph) ($PSDN_{40}$) as determined by a regression analysis (8).

Determining High Accident and/or Low SN_{40} Sites

Each year high wet accident sites are selected on the basis of accident data, and low SN_{40} sites are selected on the basis of survey skid data.

Accident Data. Potentially high wet accident sites are selected on the basis of a 0.8-km (0.5-mile) segments, incremented by 0.16-km (0.1-mile) lengths. For example, the initial segment on a route would be from milepoint 0 to milepoint 0.5, the second segment from 0.1 to 0.6, and the third from 0.2 to 0.7. A site is selected as a possible high wet pavement accident site when three or more wet accidents occur in the 0.8-km (0.5-mile) section, provided the wet accidents account for at least 30% of the combined total of wet and dry pavement accidents. (Accidents occurring under icy or snowy conditions are excluded.)

The site selection process just described is performed each year by an automated review of the latest year's detailed accident computer file. The output provided from this process is illustrated in Figure 2. Notice that for each site selected locational information, as well as the number of fatal, injury, and property damage accidents, the number of fatalities, number of injuries, and amount of property damage, is shown for

Table 1. Data items contained in each accident record.

Item	Item
Report Number	Light
Month	Weather
Date	Type of Collision
Year	Fixed Object
Hour	Skidding
District	Zone of Impact
County	Major Factor
Cities & Towns over 3,500	Severity
Towns Under 3,500	Number Killed
Route	Number Injured
Section Number	Number Vehicles Involved
Milepoint	Amount of Property Damage
Surface Type	Card Control
Surface Width	Type of Vehicle (per vehicle)
Kind of Highway	Speed (per vehicle)
Speed Limits	Residence of Driver (per vehicle)
Intersection Type	Vehicle Maneuver (per vehicle)
Intersection Route Number	Placement (per vehicle)
Accident Location	Driver and Pedestrian Action (per vehicle)
Alignment	Condition of Individual (per vehicle)
Surface Condition	Vehicle Condition (per vehicle)
Defective Road Conditions	Visibility Conditions
Traffic Control	

Table 2. Data items contained in each survey skid test record.

Item
District
Residency
County
Route Number
City/Town/County
Test Vehicle
Test Wheel
Calibration
Operators
Date of Test
Time of Test
Weather Condition
Air Temperature
Surface Temperature
Tread Depth
Direction
Lane
Data Type
Milepoint
Speed
Skid Number
Pavement Condition [a]
Time Since Last Rain [a]

[a] Required for test run on control loop only.

Figure 2. Example of computer output for selection of high wet pavement accident sites.

Listing of Wet Accident Sections for the Primary System for the Year 1975

DI	CO	CTY	ROUT	MILEPOINT FROM	TO	WET ACCIDENTS FAT. ACCD	NO. KILL	INJ. ACCD	NO. INJ	P/D ACCD	AMOUNT P/D	TOT ACCD	DRY ACCIDENTS FAT. ACCD	NO. KILL	INJ. ACCD	NO. INJ	P/D ACCD	AMOUNT P/D	TOT ACCD	PCT WET
5	01		0013	.1	.5					3	1100	3								100.00
5	01		0013	3.7	4.1					5	4300	5			1	1	1	700	2	71.43
5	01		0013	4.0	4.4					4	3600	4			1	1	2	4000	3	57.14
5	01		0013	7.5	7.9			3	4	9	14700	12					3	3500	3	80.00
5	01		0013	7.7	8.1			3	4	9	14700	12			1	1	2	1900	3	80.00
5	01		0013	7.8	8.2			2	2	5	8400	7			1	1	2	1900	3	70.00
5	01		0013	13.2	13.6			1	2	3	2400	4					1	100	1	80.00

both wet and dry pavement accidents. The percentage of wet accidents shown is computed by dividing the number of wet accidents by the total of dry and wet accidents.

Should overlaps occur, such as from milepoint 3.7 to milepoint 4.4 and 7.5 to 8.2, the sections are combined so that the entire length is considered as one section. Presently this combining process is done manually by reference to the detailed accident data, but ultimately it will be accomplished in the automated procedures.

Survey Skid Data. Annually, as survey skid testing is completed within a highway district the detailed skid output (Figure 3) is reviewed, and SN_{40} values below 30 brought to the attention of the district engineer and the authors. A copy of a cover letter submitted with the skid data is given in the Appendix and one paragraph is reproduced here: "Although the criteria for identifying high wet accident sites have not been finalized, for the present we intend to extract sites such as these from our regular inventory survey testing which record skid numbers that approach or fall below the SN_{40} value (trailer value) of 30 as recommended by the Virginia Highway and Transportation Research Council. These sites will be studied by Research Council personnel in light of the tentative criteria that have been established by them and recommendations will be made thereafter."

The SN_{40} value of 30 has been selected as a tentative minimum guideline value on the basis of the authors' report presented at the 1977 annual meeting of the Transportation Research Board (9). It is recognized that sites may exist which require an SN_{40} value greater or less than 30 because of geometric or traffic conditions, but 30 is regarded as a minimum value indicative of the need for a review of existing and potential wet accident experience.

Figure 3. Example of survey skid data output showing area with SN_{40} generally < 30.

COUNTY Wise
ROUTE 58

LANE	MILE POINT	DATE	TEST SPEED	ACTUAL SN	CORR SN_{40}	$PSDN_{40}$
WBL1	1.65	6-08-76	38.7	52	51	60
	1.94		40.5	52	52	60
	2.32		41.5	51	52	60
	2.97		38.9	57	56	64
	3.43		40.6	29	29	43
	3.67		40.7	24	24	39
	3.94		40.9	23	23	38
	4.22		40.6	47	47	57
	4.72		40.1	24	24	39
	4.96		39.6	29	29	42
	5.47		40.2	31	31	44
	5.91		40.4	28	28	42
	6.32		40.8	32	32	45
	6.67		40.2	30	30	43
	7.21		39.8	32	32	45
	7.97		39.8	23	23	38
	8.33		38.6	34	33	46
	9.47		42.4	25	26	40
	10.16		41.7	27	28	42
	10.60		39.9	28	28	42
	13.70		40.5	54	54	62
	13.95		40.3	55	55	63
	14.35		39.8	57	57	64
	14.89		40.1	58	58	65
	15.34		40.0	59	59	66

Site Review Process

Once a high or potentially high wet pavement accident site is selected, whether on the basis of accident data or skid data, the review process is essentially the same. The steps involved in the review process are best illustrated through an example, and one is presented for a site selected by the use of accident data.

Development of Accident Site Information. For all sites selected data are entered on an Accident Site Review Sheet (Figure 4), and an indication is made of whether the site was selected on the basis of accident data and/or survey skid data, or by some other process. In the example, the site was selected on the basis of 1975 accident data between milepoints 9.6 and 10.6. Data relative to the site selection process are the beginning and ending milepoints for the section (9.6 and 10.6), the number of wet and dry pavement accidents (8), the number of wet accidents (5), the percentage of wet accidents (62%), and fatalities, injuries, and property damage resulting from the wet accidents (0, 2, and $3,400, respectively). To complete the upper portion of the Accident Site Review Sheet the accident data for the preceding two years (1974 and 1973) are entered and survey skid data are entered if tests have been made. As shown, the accident data for the two previous years substantiate the relatively high proportion of wet pavement accidents for this site. Survey skid data were not available for this site at the time of selection, but subsequent tests on two dates with the Research Council's trailer yielded the skid data shown. It has been concluded that the SN_{40} value in the traffic lane probably is less than 35 for most of the year, since the June tests were run just after a heavy rain and no doubt represent the most favorable skid resistance situation with regard to both seasonal and weather conditions.

Were the site selected on the basis of survey skid data, the same procedure as above would be followed, with the site beginning and ending milepoints being determined on the basis of the skid data.

Development of Surface Mix Site Information. The second step in the site review process (middle of Figure 4) involves the determination of the surface mix section or sections the accident site falls within, and the compilation of the relevant accident data and skid data. Evaluation of the entire surface mix section (s) is considered essential because the surface mix type is obviously of prime importance in providing adequate skid resistance, and the presence of an accident site within a surface mix may be indicative of a problem for the entire mix. The determination of the surface mix section(s) is accomplished by reference to the annual surface mix listing, which indicates, among other things, the direction, beginning and ending milepoints, highway type (i.e., number of lanes), the surface mix type, and the date the mix was placed for all surface mixes along a highway. For the example under discussion, the surface mix type is S-1 (bituminous sand mix) placed in 1967, and includes both directions of a four-lane highway between milepoints 8.00 and 12.00. Were the surface mix information to indicate the mix to be different by directions, the accident information and skid data would be summarized by direction. Also, if the accident site were to overlap two or more surface mix sections, accident data and skid data would be summarized for each section. For these purposes, reference to the detailed accident data is required.

Initial Economic Analysis. The next step in the review process is to perform an initial economic analysis (middle of Figure 4). In this analysis, a breakeven figure is computed based on an estimated reduction in wet pavement accidents and corresponding savings from reductions in injuries and property damages divided by the probable cost of the improvement (usually resurfacing) necessary to bring about the reduction in wet accidents. Thus, the breakeven value represents the time in years required to achieve savings from reduced accidents equal to the cost of the selected improvement. While a more sophisticated analysis could be performed and a discounted rate of return computed for possible alternative actions, it is felt that the simple breakeven computation is sufficient, particularly considering the many variables present and the approximately equal annual savings that may result.

The estimated reduction in wet accidents is computed by assuming that after the reduction, wet pavement accidents should account for approximately 20% of the combined total of wet and dry accidents. Thus, in the example it was estimated that wet accidents could perhaps be reduced by 4 at the accident site and 7.5 for the surface mix section by some type of treatment. The 20% value for wet accidents was determined to be a reasonable general value in a previous study conducted by the authors (10). This value is substantiated by the data shown in Table 3, in which the percentages of wet accidents for the interstate, arterial and primary, and secondary systems for the years 1965 through 1974 are presented. In the future, in order to compensate for possible weather influences, the base value (now 20%) will probably be based on the year for the accident data under investigation. Furthermore, separate values may be utilized for each of the highway districts in the state.

The reduction in property damage is computed by determining the property damage per wet pavement accident based on the actual data and multiplying by the reduction in wet accidents. In the example, for the accident site the property damage per wet accident was computed to be about $680 ($3,400 5), and thus the savings in property damage were estimated to be $2,720 ($680 4). For the surface mix section, the property damage per wet accident was $1,215 ($15,800 13), and the property damage savings $9,112 ($1,215 7.5).

Injury savings are computed in a similar manner, with the dollar value being determined by multiplying the injury reduction by $4,000, which is the figure recommended by the National Safety Council (11). Thus, for the accident site the injuries per wet accident figure was 0.4 (2 5), yielding an estimated reduction in injuries of 1.6 (4 .4), or an estimated savings of $6,400 (1.6 $4000). For the surface mix site the injuries per accident value was 0.38 and the estimated savings $11,400. Currently, in computing savings, values are not placed on deaths, except to the extent that a death is included as an injury. However, the occurrence of a fatality at a site is considered in the final evaluation of that site.

To complete the initial economic analysis, estimated costs of possible improvements must be considered. Generally, various types of resurfacing are anticipated and the estimated unit costs are used to estimate total improvement costs. In this example, two possible improvements were considered:

1. Plant mix $25,000/mile/two lanes, and
2. Slurry seal $6,000/mile/two lanes.

Thus, the cost of improvement for the accident site was estimated to be $50,000 for plant mix and $12,000 for slurry seal, and for the surface mix site four times the above amounts, or $200,000 for plant mix and $48,000 for slurry seal.

As already indicated, breakeven values are computed by dividing the estimated total cost by the projected savings resulting from an improvement. Thus, for the plant mix improvement, the estimated breakeven values are 5.48 for the accident site ($50,000 $9,120) and 9.75 for the surface mix site ($200,000 $20,512). For the slurry seal improvement the breakeven values are estimated to be 1.32 for the accident site ($12,000 $9,120) and 2.34 for the surface mix site (48,000 $20,512).

Priority Ranking for Field Review. Based on the initial economic analysis, sites are assigned priorities for field review on the basis of the lowest to highest breakeven values. Because of the large amount of judgement used in the computation of the breakeven values, the priority for field review is also influenced by the following:

1. Sites or surface mix sections having five or more wet pavement accidents which account for 50% or more of the total wet and dry accidents.
2. Sites on which survey skid tests have not been performed.
3. Sites showing an increasing trend in wet pavement accident percentages.
4. Sites with an average SN_{40} value below 30 in the traffic or passing lanes.

In the example, the 1.32 breakeven figure for the accident site combined with the facts that the site had not been skid tested and had experienced 50% wet accidents considering three years' data indicated that a field review was desirable.

Field Review. During the field evaluation of a site, careful attention is given to geometrics, traffic turbulence, sight distance, roadside development, traffic control, posted speed limit, and general pavement surface condition. If SN_{40} data have not been obtained prior to the field review, they are obtained as part of the field review process. Field review data for the example site are shown in the lower portion of Figure 4.

With the accident and skid data analysis and the results of the field inspection in hand, the reviewers make a judgement evaluation as to the prime causative factor or factors in the wet pavement accidents. If in their judgement higher skid values would be of little value but one or more of the other variables such as traffic control or roadside congestion are the prime factors, they refer the location to the accident reduction team in the Department's Traffic and Planning Division. If on the other hand, the evidence indicates that improved skid resistance would be of value, a second cost/benefit

Figure 4. Accident site review sheet.

COUNTY ________________

ROUTE ________________

Site Selected by: ☐ Accident Data, ☐ Survey Skid Data, ☐ Other

Date Reviewed ____________

By ____________

SITE INFORMATION													
Accident Data									Skid Data				
Year	B.M.	E.M.	Wet & Dry Accidents	Wet Accidents	Percent Wet	F	I	PD	Lane	SN	MPH	SN_{40}	Date

SURFACE MIX SITE INFORMATION																	
Mix Information						Accident Information							Skid Data				
High. Type	Dir.	BM	EM	Type	Yr.	Yr.	Tot	Wet	Percent Wet	F	I	PD	Lane	SN	MPH	SN_{40}	Date

INITIAL ANALYSIS									
Area Analyzed	Length	Lanes	Date	Estimated Reduction Wet Accidents	Injury Savings	P.D. Savings	Total Savings	Break-even	Assumptions and Comments

RECOMMENDATIONS:

FIELD REVIEW DATA

GENERAL GEOMETRY:

POSTED SPEED LIMIT:

ENVIRONMENTAL DATA:

GENERAL COMMENTS:

FINAL ANALYSIS									
Area Analyzed	Length	Lanes	Date	Estimated Reduction Wet Accidents	Injury Savings	P.D. Savings	Total Savings	Break-even	Assumptions and Comments

RECOMMENDATIONS:

Table 3. Percentages of wet pavement accidents.

YEAR	INTERSTATE SYSTEM			ARTERIAL AND PRIMARY SYSTEM			SECONDARY SYSTEM		
	DRY ACCIDENTS	WET ACCIDENTS	PERCENT WET	DRY ACCIDENTS	WET ACCIDENTS	PERCENT WET	DRY ACCIDENTS	WET ACCIDENTS	PERCENT WET
1965	2,799	579	17	22,304	5,285	19	12,461	2,832	19
1966	2,798	753	21	21,281	5,896	22	12,064	3,223	21
1967	3,099	875	22	21,667	5,840	21	12,313	3,317	21
1968	3,773	1,101	23	23,592	5,781	20	13,786	3,589	21
1969	4,332	1,362	24	26,292	6,227	19	15,267	3,989	21
1970	4,689	1,462	24	26,795	6,720	20	15,535	4,103	21
1971	5,393	1,846	26	27,127	7,520	22	16,006	4,878	23
1972	5,821	2,667	31	28,749	9,993	26	12,629	5,085	29
1973	6,305	2,091	25	30,033	7,837	21	19,801	5,943	23
1974	4,747	1,228	21	26,729	7,029	21	19,613	5,972	23

analysis is conducted and modified as appropriate by the results of the field review.

For the site reviewed in Figure 4, items of particular interest determined from the field review and skid tests included:

1. The development in Oakwood between milepoints 9.4 and 10.7 where the speed limit is reduced to 72 kph (45 mph).
2. The indication that an SN_{40} of 40 may be necessary for the area between milepoints 9.4 and 10.7.
3. The fact that the S-1 mix is worn through in several places in the traffic lanes.
4. The difference in the SN_{40} values between the traffic and passing lanes of approximately 10 skid numbers, with the probability that the SN_{40} value in the traffic lanes was less than 35 for most of the year.
5. The generally adequate appearance of the pavement from a structural standpoint.

Note that in item number 2 above, it was estimated that an SN_{40} value of 40 or greater may be required for the area in question. While the estimated SN_{40} required is based largely on judgement at this time, it is anticipated that several levels of SN_{40} requirements for various types of sites will evolve as the program progresses.

Final Economic Analysis. On the basis of the accident data, skid test data, and field review data, a final economic analysis is made. In the example it was evident from the field review that the problem area was in the village of Oakwood between milepoints 9.4 and 10.7. Within these milepoints there was a reduced speed limit of 72 kph (45 mph) with moderate commercial development. Furthermore, the skid resistance was much less in the traffic lanes where the existing S-1 mix (thin sand mix) had worn through. For all these reasons, a slurry seal application in the traffic lanes seemed the appropriate treatment.

The final breakeven value of 0.8 is then computed as shown at the bottom of Figure 4 for the area between milepoints 9.4 and 10.7. Notice that the cost of the slurry seal is estimated as $6,000 per mile, since only the traffic lanes are to be treated.

Priority Ranking for Site Treatment

Sites are ranked for recommended treatment on the basis of the final breakeven value computed. Obviously some judgement is needed in deciding whether the breakeven time justifies corrective action. Some judgements are quite easy to make while others require much reflection. The evaluation is easy if the breakeven time is quite short and the estimated wet pavement accident reduction is high, or if the breakeven time is quite long and the estimated wet accident reduction is quite low. The in between or borderline cases are quite difficult ones. However, it must be kept in mind that the most important consideration is to do everything possible to see that the money available is spent at those locations where the greatest benefits can be derived. It should be indicated that sites not recommended for immediate action nevertheless will be brought to the attention of the Maintenance Division for consideration in establishing normal maintenance resurfacing schedules.

For the example section, it was recommended that the traffic lanes between milepoints 9.4 and 10.7 be resurfaced with slurry seal as shown in the Recommended Treatment Form (Figure 5) submitted to the District Engineer.

Follow-Up Evaluation

As was illustrated in Figure 1, an integral part of the wet pavement accident reduction program is the follow-up evaluation of treated sites. Thus far, all sites recommended for treatment—42.78 km (26.58 miles) on 5 routes in 4 counties—have been resurfaced. For this purpose, each site will be evaluated on the basis of both accident and skid data annually for three years after treatment. In addition, some sites that remain untreated, particularly those with SN_{40} values less than 30, will be monitored for the life of the program.

Hopefully, these evaluations will indicate that the treatments have been beneficial and also indicate to a greater extent than is presently known the levels of skid resistance required for various types of sites.

Figure 5. Accident site recommended treatment form.

RECOMMENDED TREATMENT FORM

Route 460 — Date 5/11/76

County Buchanan — By S. N. Runkle & D. C. Mahone

Mix Information: Type S-1 (wearing through in places) — Year Placed 1967

From 8.00 — To 12.00

Length 4.00 — AVD 10,825 (1974)

Highway Type 4 lane

Accident Data:

				Wet Accidents		
Year	Wet & Dry	Wet	Percent Wet	Fatalities	Injuries	Prop. Damage
1973	40	9	23	1	1	4,700
1974	30	13	43	0	6	5,500
1975	35	13	37	0	5	15,800
Totals:	105	35	33	1	12	$26,000

Comments: Twenty one of the 35 wet accidents occurred within the milepoints 9.4 and 10.7, while only 45 of the total 105 accidents were within these limits. Not considering this section, there were 60 wet and dry accidents, 14 of which were wet for a percentage wet of 23%. It is noteworthy that the area 9.5 to 10.7 includes the village of Oakwood which has a fairly congested traffic situation at relatively high speeds (posted @ 45 mph-probably higher).

Skid Data:

Lane	SN_{40}	Date Tested	Comments
Traffic	35	4/13/76	
Traffic	42	6/2/76	Ave. both directions
Passing	53	6/2/76	

Because the S-1 mix is wearing through in places, there may be several spots with a considerably lower SN_{40} value, but not reflected in the test results.

Recommended Action: Resurfacing is indicated for the section 9.4 to 10.7. It is estimated that for the geometric and traffic conditions at this site that an $SN_{40} \geqq 40$ is required, and thus, because of the relatively high traffic volume an S-5 non-polishing mix seems necessary, or possibly a slurry seal.

Economic Analysis: Based on the below listed assumptions, and with an estimated reduction of 5 wet accidents per year the breakeven for the site 9.4 to 10.7 is .8 year for slurry seal and 3.12 for plant mix. These breakeven values are computed based on surfacing just the traffic lanes. Obviously if all four lanes were resurfaced, the values would be doubled.

1. Reduction in injuries of 1/3/accident @ $4,000/injury
2. Reduction in property damage of $750/accident
3. Cost of slurry seal of $6,000/mile
4. Cost of plant mix of $25,000/mile

References

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APPENDIX

COMMONWEALTH *of* VIRGINIA

DEPARTMENT OF HIGHWAYS & TRANSPORTATION
1221 EAST BROAD STREET
RICHMOND, 23219

IN REPLY PLEASE REFER TO

July 6, 1976

Memorandum

To - Mr. J. F. Turner
Attention - Mr. J. L. Corley
Subject - Skid Tests Report

Skid tests have recently been conducted on all the arterial routes in the Bristol District as part of our regular state-wide skid testing inventory of the arterial system.

Attached are some of the results of these tests which we thought should be brought to your attention. The tests of concern have been marked on the attached sheets for your convenience. Notice that these tests have recorded skid numbers (SN_{40}) that are somewhat lower than those for adjacent sections and are below or approaching SN_{40}=30.

The results of tests presented here are for your information. It is suggested that these sites be kept under observation and that accident data, geometrics, etc. be correlated to determine if any corrective action is needed.

Although the criteria for identifying high wet accident sites have not been finalized, for the present we intend to extract sites such as these from our regular inventory survey testing, which record skid numbers that approach or fall below an SN_{40} value (trailer value) of 30 as recommended by the Virginia Highway and Transportation Research Council. These sites will be studied by Research Council personnel in light of the tentative criteria that have been established by them and recommendations will be made thereafter.

Presently, we feel that a high wet accident site is indicated when three or more wet pavement accidents occur within an 0.5-mile section, and the wet accidents represent at least 30% of the combined total of wet and dry pavement accidents. Once a site is selected in this manner, the procedure is to identify the limits of the surface mix section(s) in which the site is located and to determine the accident experience and SN_{40} data for the section(s). Surface mix sections having 30% wet pavement accidents and/or an SN_{40} value (trailer value) below 30 are selected for field evaluation. Depending on the findings from the field evaluation, a possible treatment to the surface mix section or accident site may be recommended, or further evaluation may be indicated. It should be mentioned that wet accident sites having five or more wet accidents which account for 50% or more of the combined wet and dry accidents will be reviewed in the field, regardless of the analysis for the surface mix section(s) provided, of course, a new surface has not been placed since the occurrence of the accidents.

If more information is necessary, please advise.

J. P. Bassett
Materials Engineer

GTP:slf
Attachment