A Summary of the Illinois Skid-Accident Reduction Program 1989-1994

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16. Abstract

This report summarizes the activities of the Illinois Skid-Accident Reduction Program during the years 1989-1994. A historical perspective outlines the development of the Illinois Skid-Accident Reduction Program. The field testing program is described and each bituminous surface mixture and portland cement concrete pavement were evaluated. All surfaces are performing within the specified guidelines. Blended surface mixtures and special mixtures were evaluated due to the reduction in high frictional aggregates. The effectiveness of TRA-16 was evaluated. The most effective skid-proofing countermeasures were identified.

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A SUMMARY OF THE ILLINOIS SKID-ACCIDENT REDUCTION PROGRAM 1989-1994

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August, 1995

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DISCLAIMER

The contents of this report reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Illinois Department of Transportation nor the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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PURPOSE

This report summarizes the activities of the Illinois Skid-Accident Reduction Program during the years 1989-1994.

HISTORICAL PERSPECTIVE

In 1964 the Illinois Department of Transportation (IDOT) recognized a potential to reduce the number of skidding accidents on wetted pavements through upgrading the frictional characteristics of the pavement. The initial step taken by Illinois in creating a program to improve pavement friction was the development of a research project conducted in cooperation with the Federal Highway Administration (FHWA). Research project IHR-86 titled "Skid Resistance of Pavement Surfaces" consisted of the following five phases.

1. Development and calibration of skid-testing equipment.
2. Evaluation of skid resistance of existing pavement surfaces.
3. Determination of polishing characteristics of aggregates.
4. Development of procedures for improving skid resistance of existing pavements.
5. Establishment of criteria for the skid resistance of pavements.

On September 9, 1966, Congress approved the Highway Safety Act of 1966. All of the Federal directives and advisories cited herein are a result of this Act.

On June 27, 1967, the FHWA issued their first directive Highway Safety Program Standard 12 (HSPS No. 12) titled "Highway Design, Construction, and Maintenance." The general objectives of this directive were to ensure: "That existing streets and highways are maintained in a condition that promotes safety, and that capital improvements either to modernize existing roads or to provide new facilities meet approved safety standards..."

It was further required that each state develop special provisions for high skid-resistant qualities in pavement design and construction and for correction of locations with low skid resistance by providing improved surface characteristics.

Illinois chose to develop a test trailer as the friction tester. Through the test criteria set by ASTM and competitive bidding, IDOT purchased a friction tester in 1968 which became fully operational in 1969.

From 1969-1971, IDOT performed an initial pavement inventory. Section selection included every type of pavement surface. Four hundred sites were tested. A total of more than 8300 friction tests were conducted.

It was found that most PCC pavements in central and southern Illinois and most Class I bituminous concrete surfaces in northern and central Illinois, where gravel and dolomite sources prevail, can provide adequate skid resistance throughout most of the pavement design life.

The following changes were made for Class I and B bituminous surfaces. The types of coarse aggregates were limited dependent on the ADT and lane number. This was to eliminate soft calcareous limestones from high ADT pavements, due to their polishing characteristics. The top size was increased to 1/2 inch to improve the macrotexture. The nominal thickness of the surface course was reduced to 1 1/4 inches to compensate for increased costs due to these recommendations.

Recommendations were also made for skid improvement for new surfaces and were as follows:

- Adopt better methods for texturing PCC pavements.
- Continue research and experimental construction of open-graded plant-mix asphalt friction courses.
- Establish a program of experimental construction using the sprinkle treatment with precoated aggregates.
- Continue the search for both natural and synthetic aggregates that will improve the skid resistance of bituminous mixtures.
- Continue the search for laboratory tests or other methods that can be used to satisfactorily quantify and rate the skid resistant characteristics of aggregates produced from various sources used in Illinois.

On July 19, 1973, the FHWA issued a second directive, FHWA Instructional Memorandum 21-2-73 titled "Skid-Accident Reduction." This document changed the federal emphasis from establishing skid-accident reduction programs to evaluating existing programs. The memorandum required every state program to include an evaluation of current pavement design, construction, and maintenance practices to ensure that skid-resistance properties are suitable for the needs of traffic. It also required a systematic procedure to identify and correct hazardous skid-prone locations.

On May 5, 1975, IDOT Design Memorandum No. 75-9 was issued. The memorandum was a result of the recommendations from the initial pavement inventory. It provided improved frictional properties for Class I bituminous surface course mixtures. This memorandum further identified three types of surface mixture classifications: C, D, and E. The policy governs the use of these mixtures with respect to ADT and lane number, while prorating the use of limestone. Overall, this special provision intended to improve the microtexture and macrotexture in the bituminous surface while reducing the number of skidding accidents.

On December 10, 1975, the FHWA issued The Federal-Aid Highway Program Manual 6-2-4-7. The directive, titled "Skid Measurement Guidelines for the Skid-Accident Reduction Program", suggested that each state's program consist of three basic activities.

1. The evaluation of pavement design, construction, and maintenance to ensure that only pavements with good skid resistance characteristics are used in construction and resurfacing,

2. The detection of locations with a high incidence of wet-pavement accidents by utilizing the state accident record system and local accident record system where applicable, and the development of priorities for correction of the locations,

3. The analysis of skid resistance for all roads with a speed limit of 40 mph or greater, so that skid resistance can be given consideration in development of priorities for resurfacing and maintenance programs

On March 1, 1976, IDOT issued a special provision for texturing portland cement concrete pavement. This special provision replaced the practice of the double-burlap drag method with a final finish obtained from the use of an artificial turf drag immediately followed by a mechanically operated metal-comb transverse grooving device. This special provision added positive macrotexture not previously obtained by earlier practices.

In 1978, IDOT acquired a second friction tester.

As of March 1980, IDOT had no single document outlining its skid-accident reduction program. The program consisted of two major activities: One, identifying and correcting wet-weather high accident sites, governed by the Highway Safety Construction Program. Second, to ensure that newly constructed pavements possess adequate friction qualities, controlled by the special provision for Skid-Resistant Bituminous Surfaces issued May 5, 1975.

Unfortunately, this program was better at identifying than correcting wet weather accident sites. The problem was not with the Highway Safety Construction Program. It was effectively responding to the most critical accident locations in the state by applying the available funds where they would do the most good. The problem was with the Department's attempt to use this program as the only means of correcting wet weather high accident sites.

On December 23, 1980, the FHWA issued Technical Advisory T 5040.17 titled "Skid-Accident Reduction Program." This advisory was a comprehensive guide for state and local highway agencies in conducting skid-accident reduction programs. No other guidelines have been issued since T 5040.17.

The purpose of the Skid-Accident Reduction Program was to minimize wet weather skidding accidents through:

- Identifying and correcting sections of roadway with a high or potentially high incidence of skid-accidents.
- Ensuring that the new surfaces have adequate and durable skid resistance properties.
- Utilizing resources available for accident reduction in a cost effective manner.

Between 1980 and 1984 IDOT developed two traffic safety programs in accordance with the guidelines established in FHWA's technical advisory T 5040.17. On March 29, 1983,IDOT issued departmental policy TRA-15, "Safety Improvement Construction Program" (formerly The Highway Safety Construction Program). One year later on March 15, 1984, issued departmental policy TRA-16, "Skid-Accident Reduction Program".

Policy TRA-15, "Safety Improvement Construction Program", states that the department shall have a program of identifying high accident locations and conducting a safety construction program addressing those and other potentially hazardous locations on a priority basis. The purpose of the policy is to describe the procedures for utilizing high accident location information to develop, implement, and evaluate an annual safety program of cost-effective improvements. The policy eliminated the Highway Safety Construction Committee and replaced it with a district multi-discipline team as the group who recommends projects for improvement within each district.

Policy TRA-16, "Skid-Accident Reduction Program," states that the department shall establish a program designed to minimize wet-pavement skidding accidents. This program shall ensure that new roadway surfaces have adequate, durable skid resistance properties, and identify and improve sections of roadway with high or potentially high skid-accident incidence.

This policy has three primary activities as required by FHWA T 5040.17.

The first activity involves incorporating adequate, durable skid-resistant roadway surfaces during construction and rehabilitation of highway pavement segments. Both portland cement concrete and bituminous concrete surfaces are addressed.

Final finishing produces friction characteristics for PCC. On pavements with posted speed limits greater than 40 mph, a Type A final finish shall be used. A Type A final finish as specified in the standard specifications requires a longitudinal turf drag to be immediately followed by a mechanically operated tine machine. The tining machine shall produce an uniform pattern of grooves perpendicular to the pavement centerline spaced at approximately 3/4 inch centers, 1/8 to 3/16 inch deep and 0.100 to 0.125 inch wide. On all other pavements a single longitudinal turf drag may be used as specified for a type B final finish or a type A finish may be used.

New bituminous surface courses shall have as a minimum, friction qualities equivalent to or greater than those provided by the following guidelines.

For bituminous concrete surfaces having a design ADT less than 2000, mixture C shall be used. Mixture C can contain any of the following approved aggregates: Crushed gravel, Crushed stone (limestone and dolomite), Crushed sandstone, Crushed slag, Chats, Crushed steel slag, or Novaculite gravel.

For bituminous concrete surfaces having a 2 lane pavement with a design ADT greater than 2000, a 4 lane pavement with a design ADT less than or equal to 25,000, or a 6 lane or greater pavement with a design ADT less than or equal to 60,000, mixture D shall be used. All approved aggregates can be used except limestone. Limestone can be used if it is blended 50/50 by volume with crushed slag, crushed steel slag or crushed sandstone.

For bituminous concrete surfaces having a 4 lane pavement with a design ADT greater than 25,000 or a 6 lane or greater pavement with a design ADT greater than 60,000, mixture E shall be used. Mixture E only allows either slag or crushed sandstone alone. No limestone can be used. All other approved aggregates can be used if they are blended 50/50 by volume with crushed slag, crushed steel slag or crushed sandstone.

The second activity of TRA-16 involves identifying, analyzing, and improving two categories of wet-pavement accident locations.

The first category of wet-pavement accident locations are sites that have an over represented rate of wet-pavement accidents. These sites are called high accident wet-pavement locations. The data used to determine these sites is obtained solely from the State Police accident reports. The Safety Improvement Construction Program, TRA-15, provides for immediate response to these most critical wet-weather locations.

The second category of wet-pavement accident locations are sites within rehabilitation/resurfacing projects that have been identified as potential wet-pavement accident locations. These sites are called cluster sites. These cluster sites are evaluated by using the "Procedures for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects." The procedures are a part of the "Illinois Safety Improvement Process" manual.

The basic approach for carrying out the procedure involves three steps.

1. Identify wet-pavement accident locations (cluster sites). The cluster sites that are identified have either a higher than critical wet pavement accident rate, frequency or severity.

2. Analyze the identified locations. Each cluster site should be analyzed individually. It must be determined whether the presence of the cluster site is due to an operational problem or difficult geometrics. If neither of these are the problem, it may be beneficial to look at the frictional characteristics of the pavement.

3. Select appropriate countermeasures. If an adequate analysis was made of the cluster site, it should be fairly easy to determine the appropriate countermeasure. When this decision is being made it should be kept in mind that it is better to plan improvements that lessen the dependence on high frictional resistance rather than merely provide a high-frictional mixture, although in some cases it may be appropriate to do both.

The third activity of TRA-16 involves evaluating and reporting on the effectiveness of the program.

The Bureau of Materials and Physical Research is responsible for the evaluation of current practices to ensure adequate skid resistance, all friction testing, analysis of a friction test data base, and the evaluation of experimental projects concerning friction characteristics.

The Division of Traffic Safety, in cooperation with the Bureau of Traffic and the Districts, are responsible for the evaluation of the effectiveness of selected countermeasures in reducing wet-pavement accidents.

Finally, the Bureau of Materials and Physical Research (BMPR), in cooperation with the Bureaus of Traffic and Local Roads and Streets and the Division of Traffic Safety, prepares an annual report summarizing the activities of the Illinois Skid-Accident Reduction Program.

FIELD TESTING PROGRAM

Background

As stated in TRA-16, the Bureau of Materials and Physical Research is responsible for all friction testing.

A friction number, abbreviated FN, represents the frictional properties of the pavement. These numbers are used to evaluate the skid resistance of the pavement with time.

A friction tester is a device designed to obtain a standard measurement of the friction properties of pavement surfaces under wetted conditions. A standard test is one that is made at 40 mph in the left wheel path with a treaded tire. The test takes about 3 seconds. Torque on the trailer axle is measured for a 1 second interval. The test can be run at different speeds and/or with a smooth tire in the right wheel path. Tests are made with alternate wheels as the trailer is towed along the roadway. Data is collected and stored on a personal computer.

The test consists of towing a two-wheeled trailer along the highway at a predetermined test speed and then locking one wheel on the trailer by braking. During braking, a measured amount of water is sprayed on the pavement in front of the tire as it slides along the wetted surface. Friction is generated between the tire and surface which causes a torque to be developed on the trailer axle. Friction numbers are calculated from the torque measured on the axle and can range between 1 and 100.

The treaded tire makes a measurement of the microtexture of the pavement. Microtexture is that quality of aggregates that makes them feel rough or smooth to the touch. The rough surfaces penetrate the water film permitting contact between the tire and the roadway. The smooth tire makes a measurement of the macrotexture of the pavement. Macrotexture is the frictional characteristics that provides the drainage escape paths between the tire and the pavement. Both macrotexture and microtexture are needed to make a frictionally adequate pavement. Treaded tire numbers are referred to as FN_t and smooth tire numbers as FN_s

The Bureau of Materials and Physical Research carries out testing programs based on federal guidelines and TRA-15 & 16. The database used to track friction testing is actually a management system, custom designed to meet BMPR's testing, reporting, and pavement monitoring commitments for pavement friction.

There are four categories of friction testing.

1. **HA** are wet weather accident locations. 100% of these sites are tested in accordance with TRA-15 and TRA-16.

2. **NC** are new construction and pavement rehabilitation sites. BMPR tests 50 % of all new pavement surfaces completed within a year. BMPR also chooses some projects as research projects based on materials and construction methods used.

3. **RR** are reruns of the new construction category. BMPR retests all sites tested as new construction locations for a maximum of 5 years or unless otherwise requested. This testing procedure began in 1982 and has continued through the current date.

4. **MS** are miscellaneous test requests. The miscellaneous category is assigned to a section when the construction contract number is not known.

In 1986 a set of tentative guidelines were established in evaluating high wet-pavement accident sites. The categorical guidelines are as follows.

Range of Friction Numbers	Tentative Guidelines
1. $FN_t \leq 30$ OR FN_s 1 - 15	Friction may be a factor contributing to wet weather accidents.
2. $FN_t > 30$ AND FN_s 16 - 25 OR FN_t 31 - 35 AND $FN_s > 25$	Uncertain if friction is a factor contributing to wet weather accidents.
3. $FN_t > 35$ AND $FN_s > 25$	Friction may not be a factor contributing to wet weather accidents.

The level of friction needed at each site is dependent upon the traffic demands and geometrics at that site. Each site should be evaluated independently.

Friction measurements can be used to:

- Evaluate pavement mix designs.
- Continue evaluation of experimental projects.
- Evaluate pavement friction of high accident wet-pavement locations.
- Determine pavement friction characteristics prior to restoration.
- Target sites for possible rehabilitation.

Evaluation

Friction testing consists of testing mixes C, D and E, and PCC pavement. Friction data for each mix and PCC pavement were evaluated and graphed. A linear regression line was plotted on each graph for reference. Since there is no actual correlation between the friction numbers and the cumulative axle loads, the regression lines do not represent the true trend of the data and should be used only as a reference.

Cumulative axle loads are the number of axles which pass over a designated area for a given period of time. To calculate the cumulative axle loads the ADT must be separated into passenger vehicles, single units and multiple units. Each type of traffic is multiplied by their respective axle loading. The given period of time is referred to as the time span between the construction date and the testing date. A traffic growth rate averages to approximately 3.5% per year. The formula to calculate cumulative axle loads is:

$$((PV * (2) + SU * (2.1) + MU * (4.8)) * (365)) * (1 / ((1 + GR)^N)) * (1 + GR) * (((1 + GR)^N - 1) / GR)$$

Where:
PV = Passenger Vehicles
SU = Single Units
MU = Multiple Units
GR = Growth Rate = 0.035
N = Testing Date Minus Construction Date, in Years

There are several factors that can contribute to inconsistent and/or unrealistic data.

1. Number of observations is small.
2. Not enough test sections were tested on a long term basis.
3. Overlaid test sections may not have been reported.
4. Required mixes may have been upgraded and not reported as such.

Each mix was evaluated with respect to departmental policy TRA-16. The design ADT per lane was projected to a 20-year cumulative axles. Based on a 20-year pavement life, the frictional properties of the pavement should maintain a minimum 30 treaded friction number.

Mixture C

Mixture C is used when the design ADT is less than 2000. 12.5 million cumulative axle loads are obtained from projecting the ADT per lane to a 20-year cumulative axles. Less than four percent of the test sections had a treaded friction number below 30. As seen in Figure 1, mixture C is performing beyond the guidelines established in TRA-16.

Mixture D

1. Overall

Mixture D is used when the design ADT is greater than 2000 on a 2-lane pavement, less than 25,000 on a 4-lane pavement, or less than or equal to 60,000 on a 6 lane or greater pavement. A range of 77-116.5 million cumulative axle loads is projected for a 20 year period.

Figure 2 illustrates the performance of mixture D. Mixture D performs within the established guidelines while almost leveling out at 151.6 million axle loads. Approximately 5.5 percent of the test sections were below 30.

2. Blends

A. Air cooled slag-Limestone(AS-LS)
This mixture provided the lowest values of all the mixture D blends. However, in Figure 3, this blend did perform within guidelines.

B. Limestone-Crushed gravel (LS-GG)
High treaded friction numbers were obtained from this blend as represented in Figure 4. However there were only 62 observations of this blend. Therefore testing will continue for reassurance of the promising results of the LS-GG blend.

C. Limestone-Novaculite gravel (LS-NV)
Figure 5 illustrates that the LS-NV blend also performed well. Again, only 100 observations were made and testing will also continue on this blend.

D. Limestone-Sandstone (LS-ST)
LS-ST blend performed beyond the guidelines as shown in Figure 6. Due to the small number of observations, testing will continue to allow for a truer representation of this blend.

So far, the results of the mixture D blends are promising. Further evaluation of these blends will be made.

Mixture E

1. Overall

Mixture E is used when the design ADT is greater than 25,000 on a 4 lane pavement or greater than 60,000 on a 6 lane or greater pavement. A minimum of 120 million cumulative axle loads should be experienced by a mixture E at 20 years. The AADT at capacity for a 4 and 6 lane pavement was calculated. This AADT per lane was projected to a 20 year cumulative axles. 201 million cumulative axles was obtained for a maximum cumulative axle loads.

Fewer than three percent of the tests performed below 30. Mixture E performed far and above the guidelines set by TRA-16, Figure 7.

2. Blends

A. Air cooled slag-Dolomite (AS-DO)
Figure 8 illustrates that the AS-DO blend performed well. The microtexture was extremely good while the macrotexture was marginal. Only 58 observations were made. Testing should continue on this blend.

B. Dolomite-Steel slag (DO-SS)
The DO-SS blend also performed well, Figure 8. There were a small number of observations, 43. Testing should also continue for the DO-SS blend.

Other mixture E blends were tested with some having as few as four observations. Due to the good performance of the mixture E blends, testing should continue.

3. Slag Vs. Sandstone

A. Air cooled slag (AS)
Air cooled slag provided good results as illustrated in Figure 9.

B. Steel slag (SS)
Steel slag also performed very well, Figure 9. SS provided the best macrotexture of three aggregates.

C. Sandstone (ST)
Figure 9 illustrates that the sandstone performance is well beyond the guidelines. ST provided the best macrotexture. To this point, sandstone has proven to perform as well as the slags. Long term testing will need to continue for further evaluation of this mix.

Special Mixtures

The following special mixtures were evaluated with the same parameters set for the mixture E.

1. Open graded friction courses (OGFC)
2. Stone matrix asphalt (SMA)
3. Rubber mixes

In the early seventies a more skid resistant surface was being sought. Open graded friction courses were introduced to Illinois. OGFC consisted of high frictional aggregates with a high asphalt content and high air-void content. The high asphalt content provides for a more durable mix. The high air-void content supplies drainage escape paths for the water which reduces hydroplaning and increases friction. The mixture was placed in a 3/4 inch lift. The thin application made it more economical than resurfacing. During construction of these mixes, problems occurred and most districts quit using OGFC.

One of the problems was adhesion of the asphalt to the aggregate. Due to the open nature of the mix, the asphalt would drain down in the trucks causing flushed spots. Therefore SMA mixes are being evaluated for frictional properties. A SMA is a mix which contains a higher aggregate content than conventional mixes. The mix provides aggregate to aggregate contact to reduce rutting. A thick film of asphalt is used to increase the durability of the mix. The open nature of the mix promotes a reduction in tire noise. SMA mixes are used in Europe for their abrasion-resistance and noise reduction. If SMA can compare to OGFC, thin applications of SMA may be used in high accident locations with better constructability.

At this time, SMA appears to be competitive frictionally with OGFC. Since there are only 14 observations, it is difficult to get a true view of the mixture trend. Therefore a better assessment can be made when more data is gathered. Rubber mixes were also evaluated to see how the rubber affects the frictional characteristics of the mixture. Rubber mixtures had poor microtexture, but very good macrotexture. Figure 10 illustrates the treaded friction number versus cumulative axle loads. Due to the low cumulative axle loads and minimal observations, these mixes need further testing and evaluation.

PCC Pavement

PCC pavement was also evaluated with the same parameters set for mixture E.

PCC pavement provided excellent microtexture and macrotexture. It performed well beyond the guidelines. The performance of PCC pavement is illustrated in Figure 11.

EVALUATION OF THE EFFECTIVENESS OF TRA-16

The Division of Traffic Safety evaluates the effectiveness of the chosen countermeasures dictated by TRA-16. This section provides a summary of the evaluation done by the Division of Traffic Safety. This summary includes projects that were awarded between May 1985 and August 1991. 195 projects have accident data for two years before and after the completion of the project (2 and 2 projects). 49 projects have accident data for two years before and one year after the completion of the project (2 and 1 projects).

The following table shows the different types of countermeasures used on the projects and the number of occurrences of each countermeasure.

TREATMENT	NUMBER OF PROJECTS	TREATMENT	NUMBER OF PROJECTS
Mix C	2	Mix D & PCC Pavement	3
Mix D	133	Incidental Bituminous Surface	2
Mix E	74	Grooving	1
Mix C & D	1	PCC Pavement	7
Mix C & E	2	Open Graded	1
Mix D & E	14	Grinding	1
Mix E & Cold Milling	1	Cold Mill	2

The evaluation of the projects were divided into categories with the following parameters.

1. Type of Countermeasure
2. Accident Experience for Total and Wet-Pavement Accidents
3. Change in Wet-Pavement Accidents in Reference to Actual Wet-Pavement Days
4. Number of Lanes
5. Rural or Urban
6. Average Daily Traffic
7. Benefit/Cost

Skid-proofing countermeasures used were effective in reducing the number of wet-pavement accidents. Tables 1 and 2 display the overall reduction in wet-pavement accidents for both the 2 and 2 projects and the 2 and 1 projects. Mix D & PCC Pavement was the most effective countermeasure on the 2 and 2 projects. However, Mix D & PCC Pavement was only used on three projects. PCC Pavement also performed well with an overall reduction of 73.2%. Since PCC Pavement only constitutes 3% of the projects it is not a true representation of the overall effectiveness. Mix E had an overall reduction of 61.6% and constituted 35% of the total projects. Therefore Mix E provides a truer example of the most effective countermeasure. Mix E & Cold Milling provided the highest reduction in wet-pavement accidents for the 2 and 1 projects.

A more detailed analysis, completed by the Division of Traffic Safety, is in Appendix A.

SUMMARY

Departmental policy TRA-16 outlines each type of surface and what determines its use. Each type of surface was evaluated with respect to the policy. It was found that the policy is suitable. Each type of surface has the ability to maintain appropriate frictional characteristics for the 20 year projected traffic.

At this time mixture D and E blends provide promising results. Therefore to conserve high friction aggregates, evaluation of mixture D and E blends should continue.

Fourteen types of skid-proofing countermeasures were used. Most countermeasures did realize a reduction in the number of wet-pavement accidents. Overall the skid-proofing countermeasures used were effective in reducing the number of wet-pavement accidents.

RECOMMENDATIONS AND CONTINUING WORK

Monitoring and evaluation of overall performance of pavements will continue in accordance with TRA-15 and TRA-16.

To continue the search for alternate aggregates and aggregate combinations, a study of recycled concrete chips as a frictional coarse aggregate should be considered.

Open graded friction courses using polymer modified asphalts or thin SMA overlays should be considered for use as a frictional repair.

For frictional repair on low volume roads, seal coats using polymers for aggregate retention could be researched.

Due to a shortage of high frictional aggregates, the laboratory testing system constructed in 1979 resumed in June 1994. The system consists of two machines. The first one is the wear and polishing machine. The machine consists of a small wheel circular track that accelerates the wear and polishing of aggregates on paved surfaces. The device was developed at North Carolina State University and follows applicable provisions of ASTM E 660. The second machine is the variable speed friction tester (VST). The VST is a pendulum type tester with a locked-wheel smooth-tire at its lower end. The friction is the measurement of the energy loss in the pendulum and is called the variable-speed tester number (VSN). A correlation between the VSN and FN is being attempted. The Bureau of Materials and Physical Research intends to use the data from these two devices to rank aggregates individually rather than on a geological basis.

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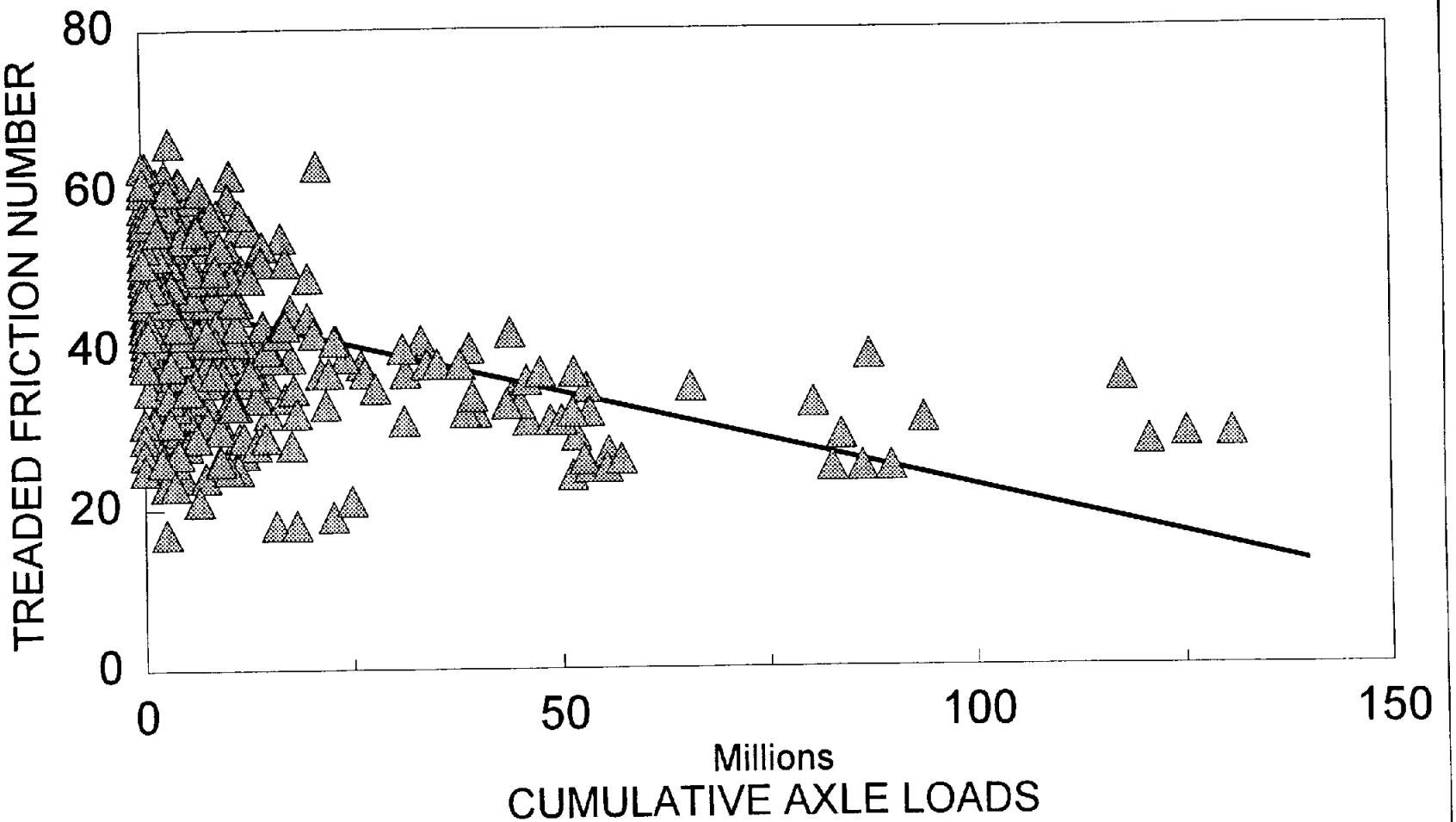
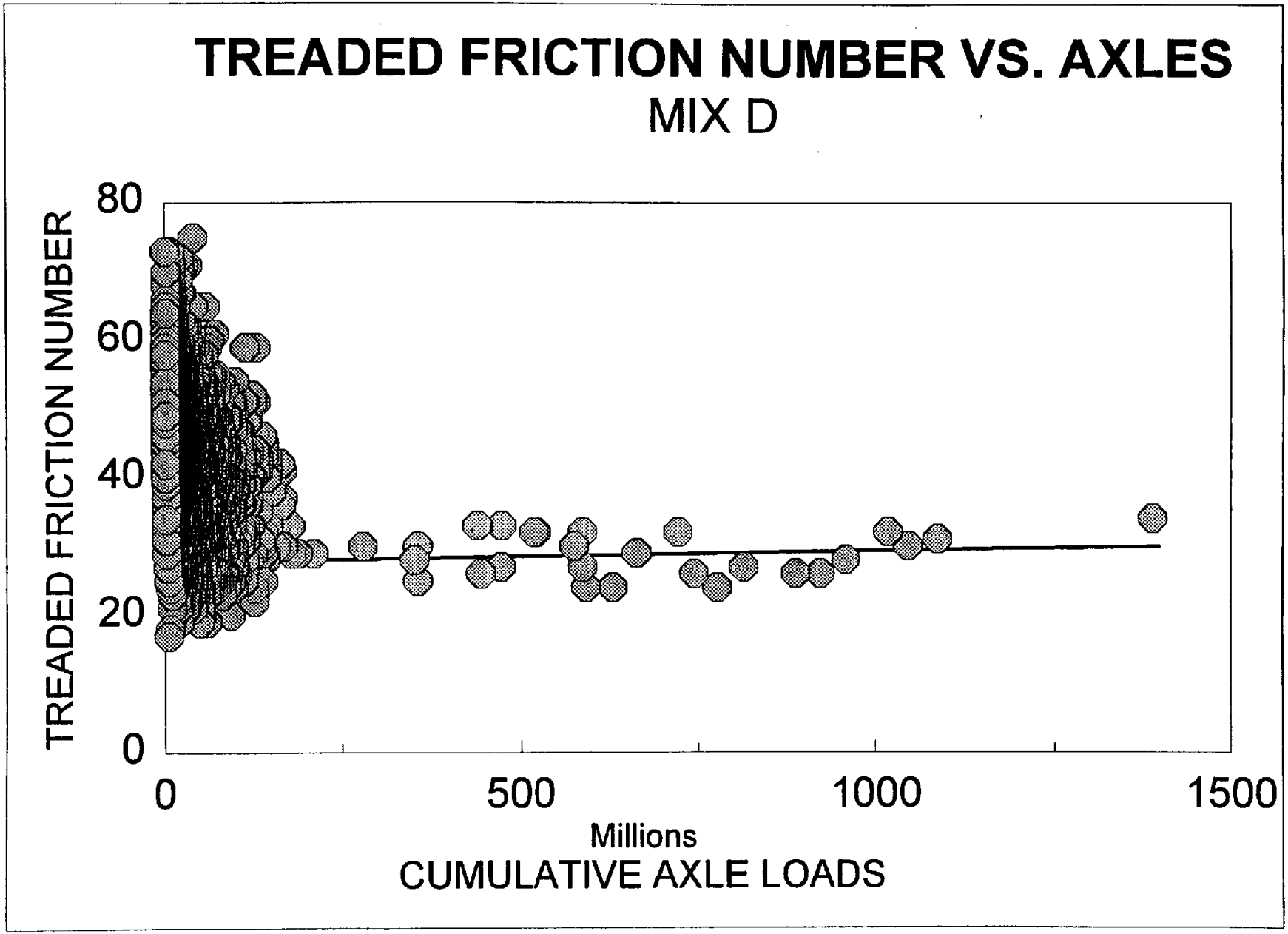
TREADED FRICTION NUMBER VS. AXLES

MIX C




TREADED FRICTION NUMBER VS. AXLES
MIX D
TREADED FRICTION NUMBER
80
60
40
20
0
0
500
1000
1500
Millions
CUMULATIVE AXLE LOADS

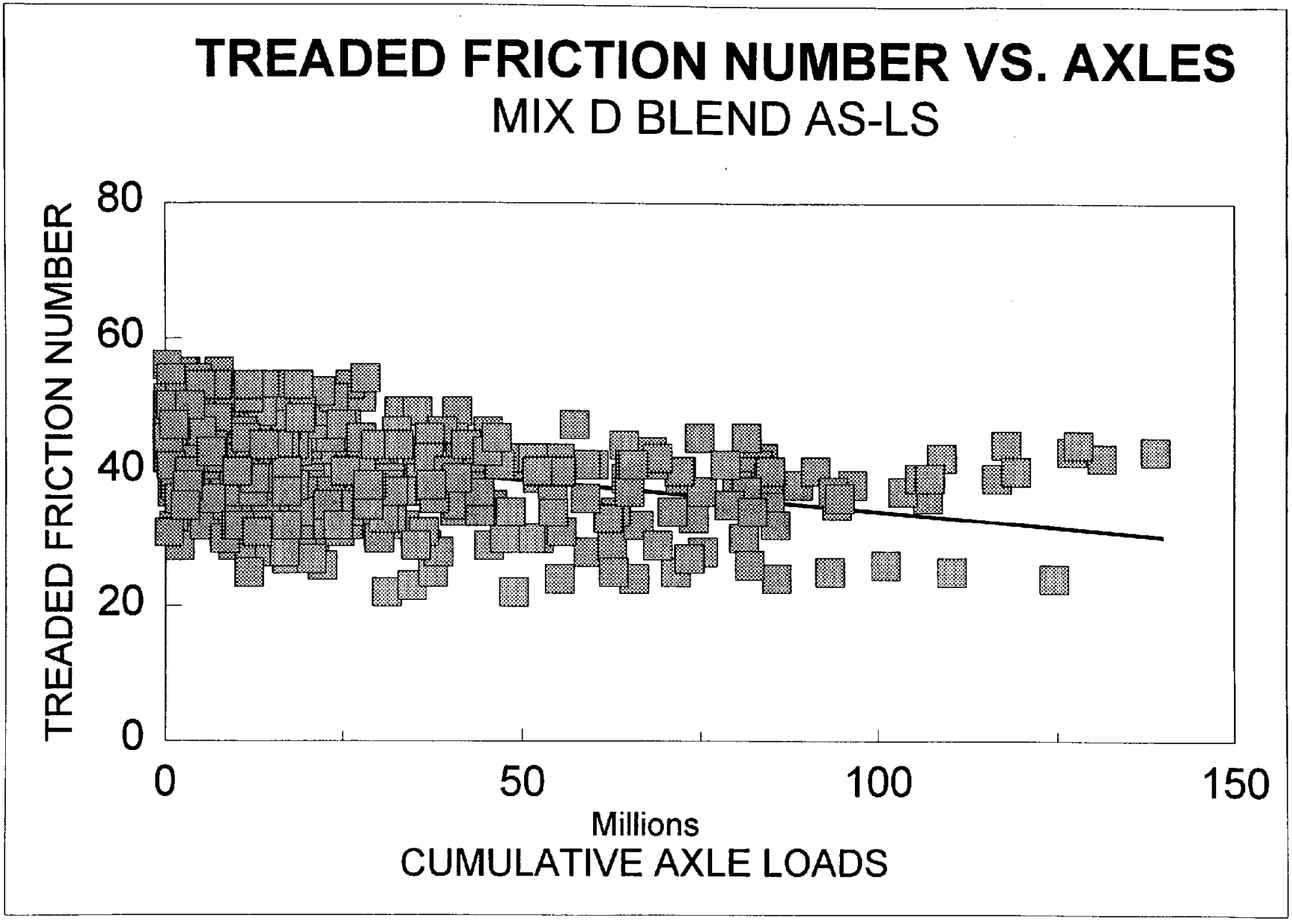
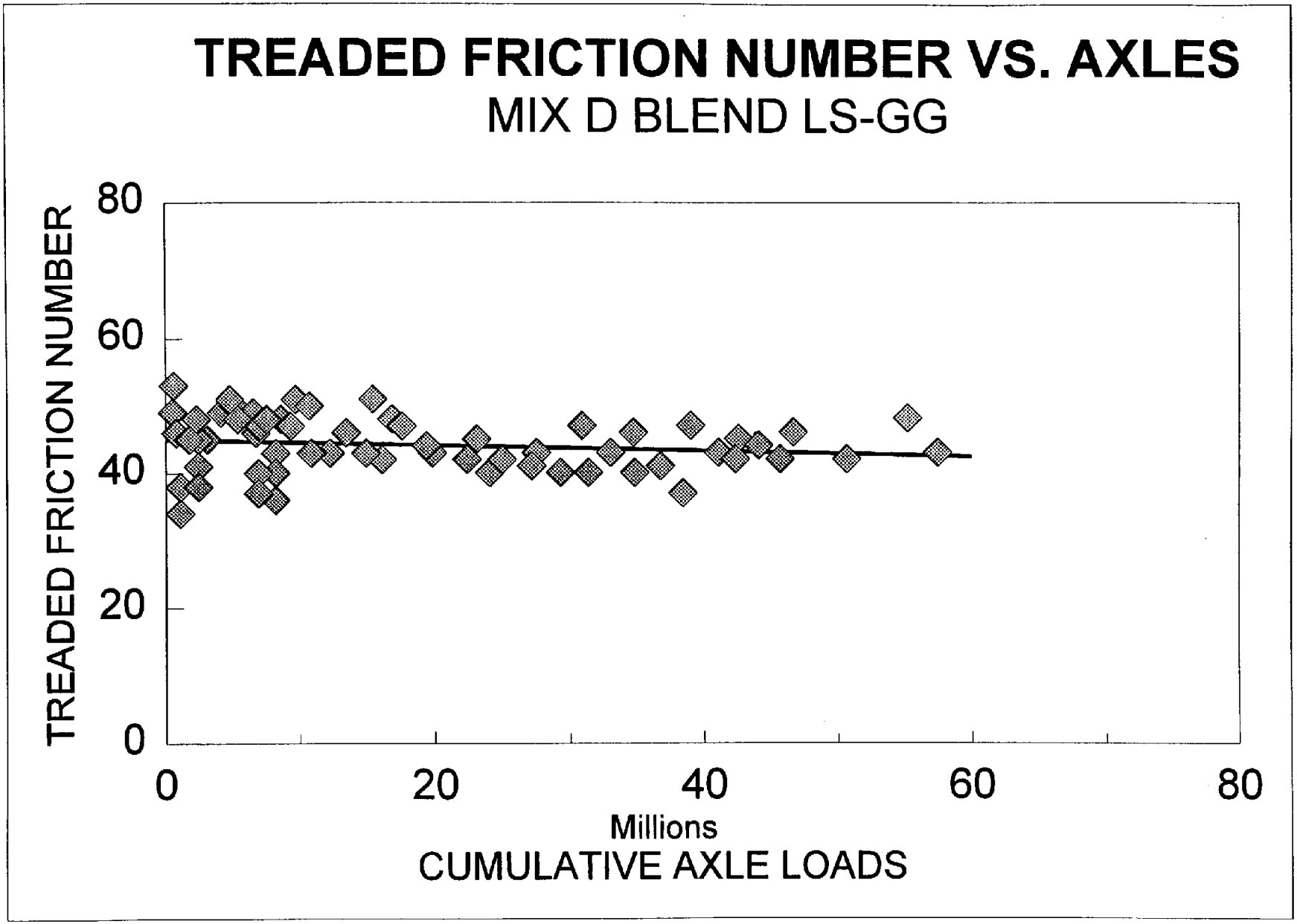

TREADED FRICTION NUMBER VS. AXLES
MIX D BLEND AS-LS
TREADED FRICTION NUMBER
80
60
40
20
0
0
50
100
150
Millions
CUMULATIVE AXLE LOADS

FIGURE 3


TREADED FRICTION NUMBER VS. AXLES
MIX D BLEND LS-GG
TREADED FRICTION NUMBER
80
60
40
20
0
0
20
40
60
80
Millions
CUMULATIVE AXLE LOADS

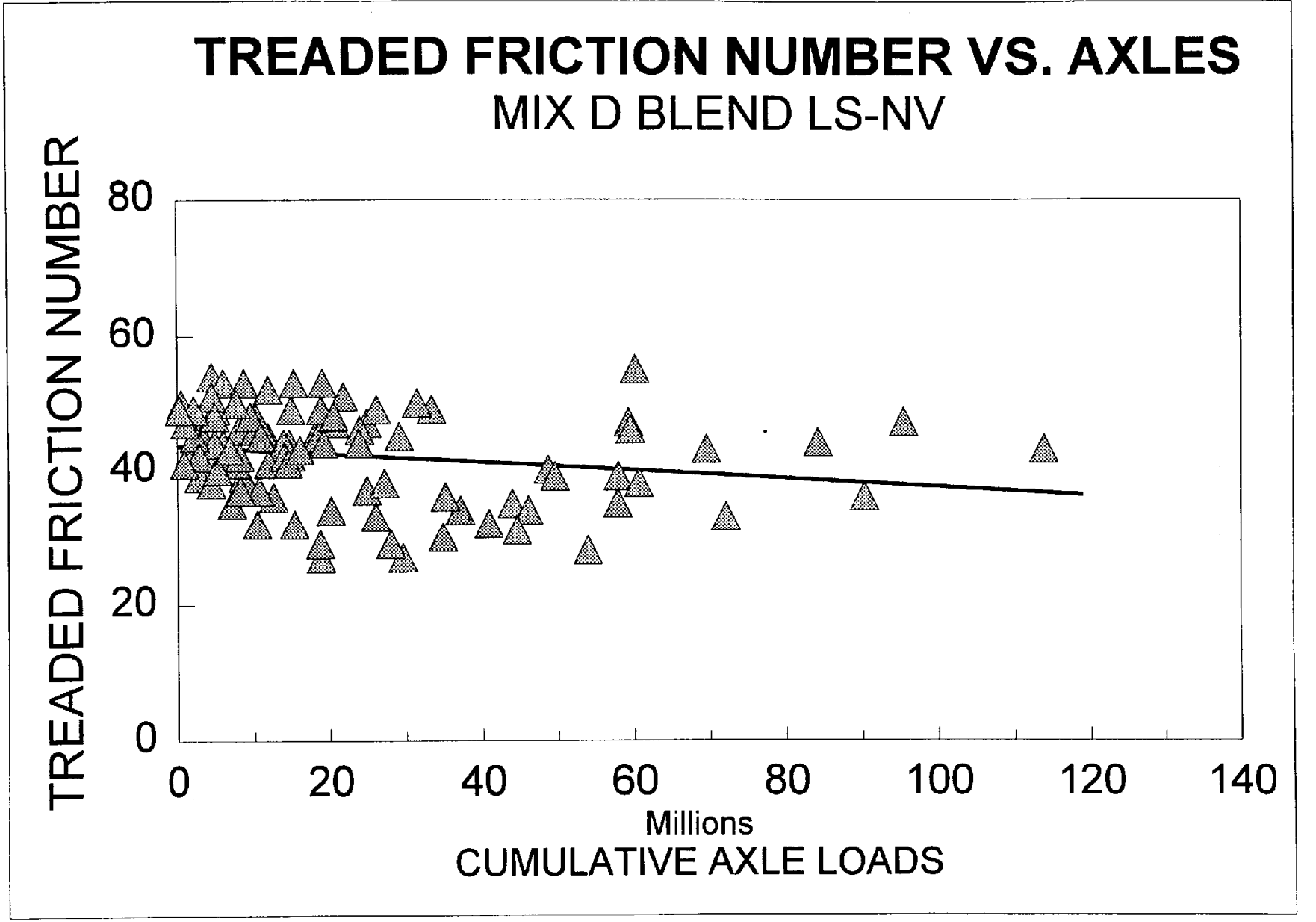

TREADED FRICTION NUMBER VS. AXLES
MIX D BLEND LS-NV
TREADED FRICTION NUMBER
80
60
40
20
0
0
20
40
60
80
100
120
140
Millions
CUMULATIVE AXLE LOADS

FIGURE 5

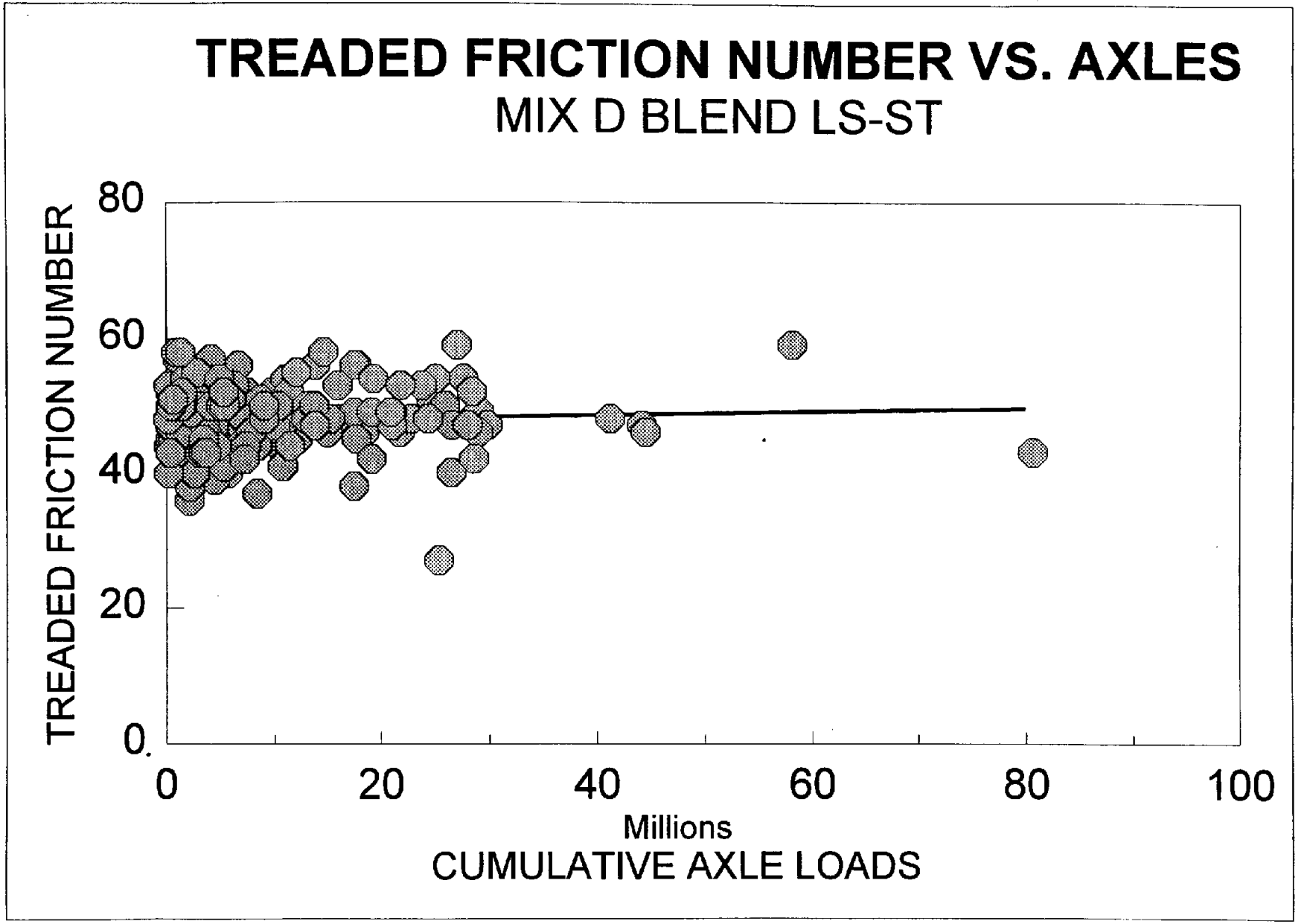
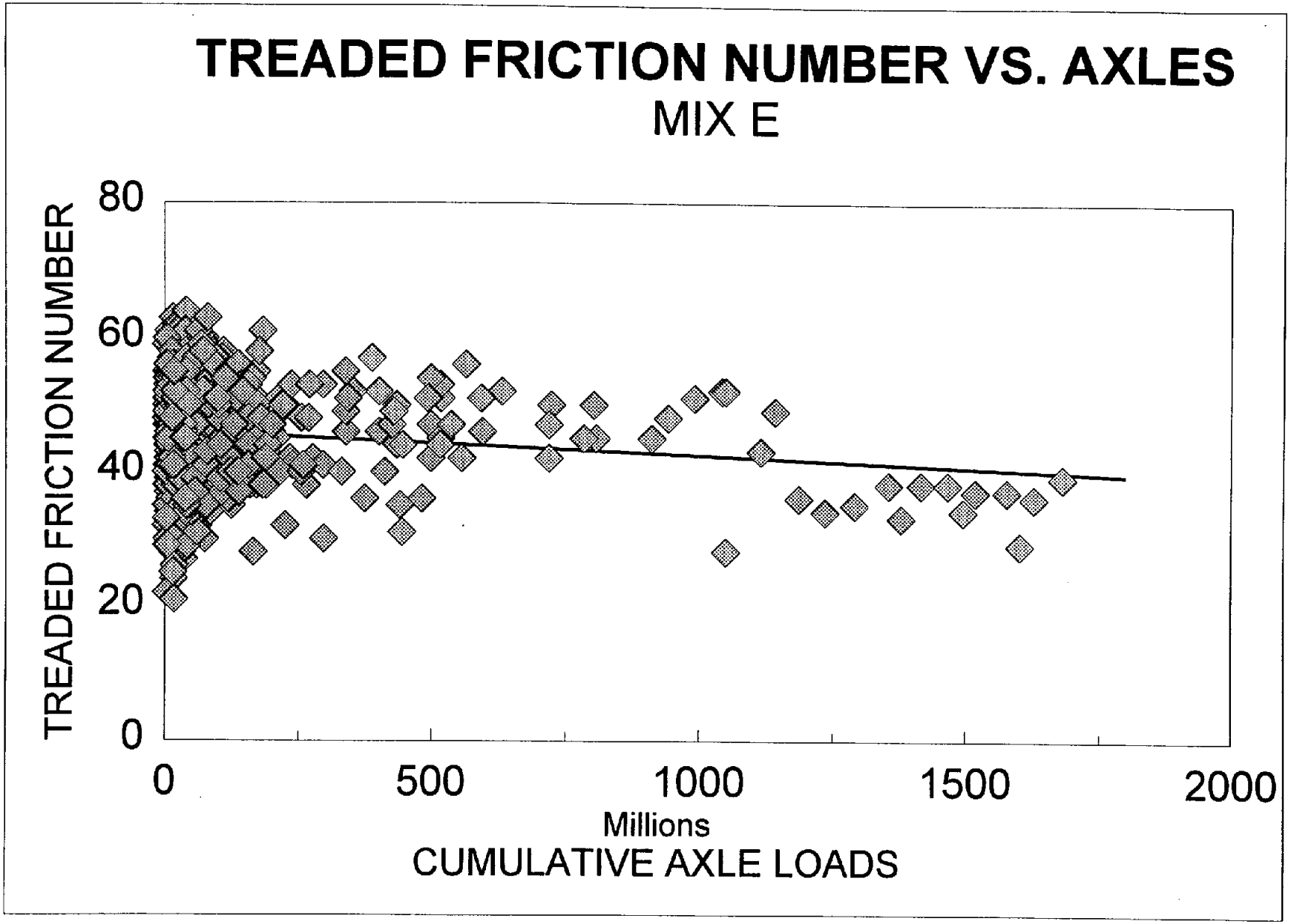
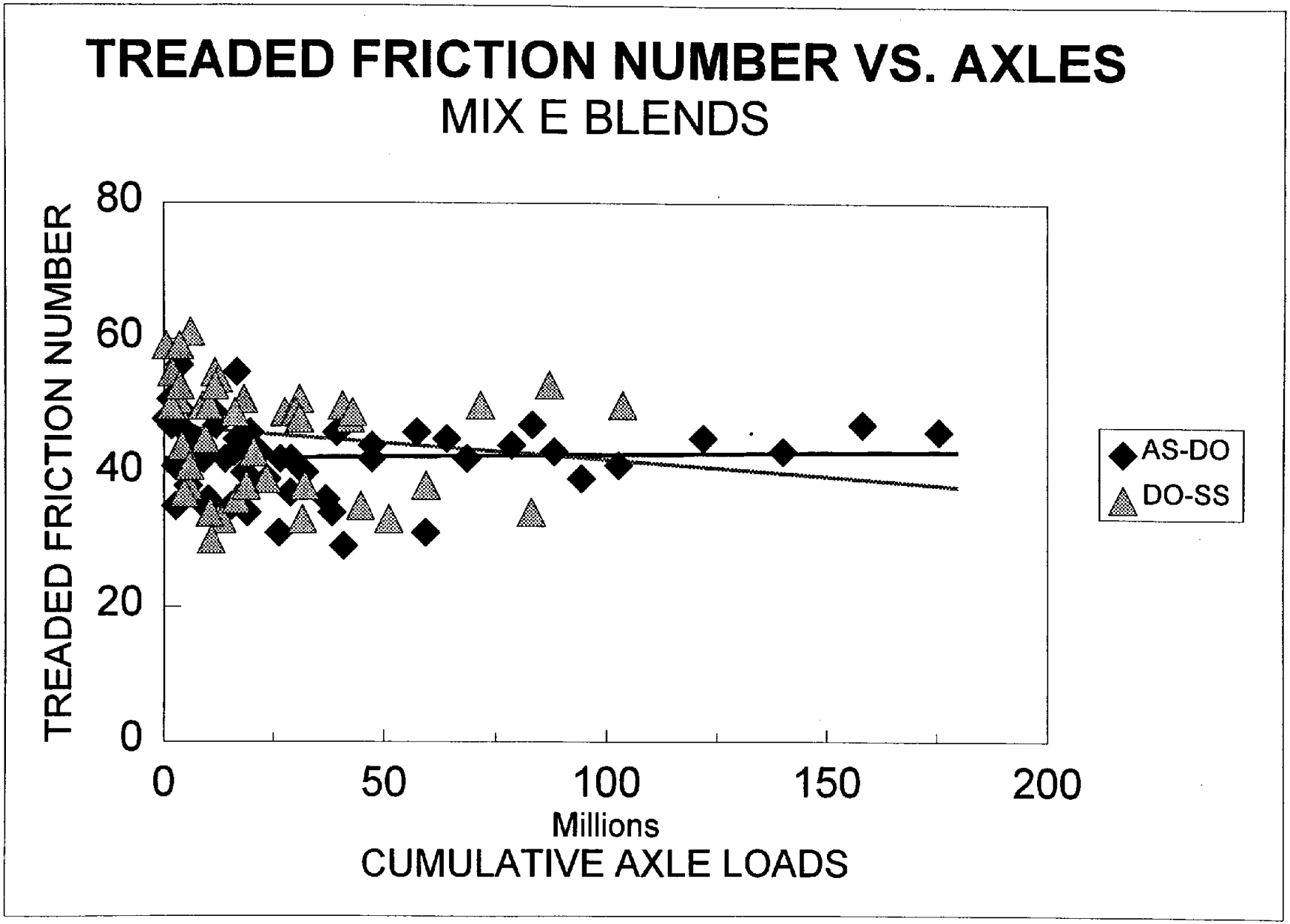

TREADED FRICTION NUMBER VS. AXLES
MIX D BLEND LS-ST
TREADED FRICTION NUMBER
80
60
40
20
0
0
20
40
60
80
100
Millions
CUMULATIVE AXLE LOADS

FIGURE 6


TREADED FRICTION NUMBER VS. AXLES
MIX E
TREADED FRICTION NUMBER
80
60
40
20
0
0
500
1000
1500
2000
Millions
CUMULATIVE AXLE LOADS


TREADED FRICTION NUMBER VS. AXLES
MIX E BLENDS
TREADED FRICTION NUMBER
80
60
40
20
0
0
50
100
150
200
Millions
CUMULATIVE AXLE LOADS
AS-DO
DO-SS

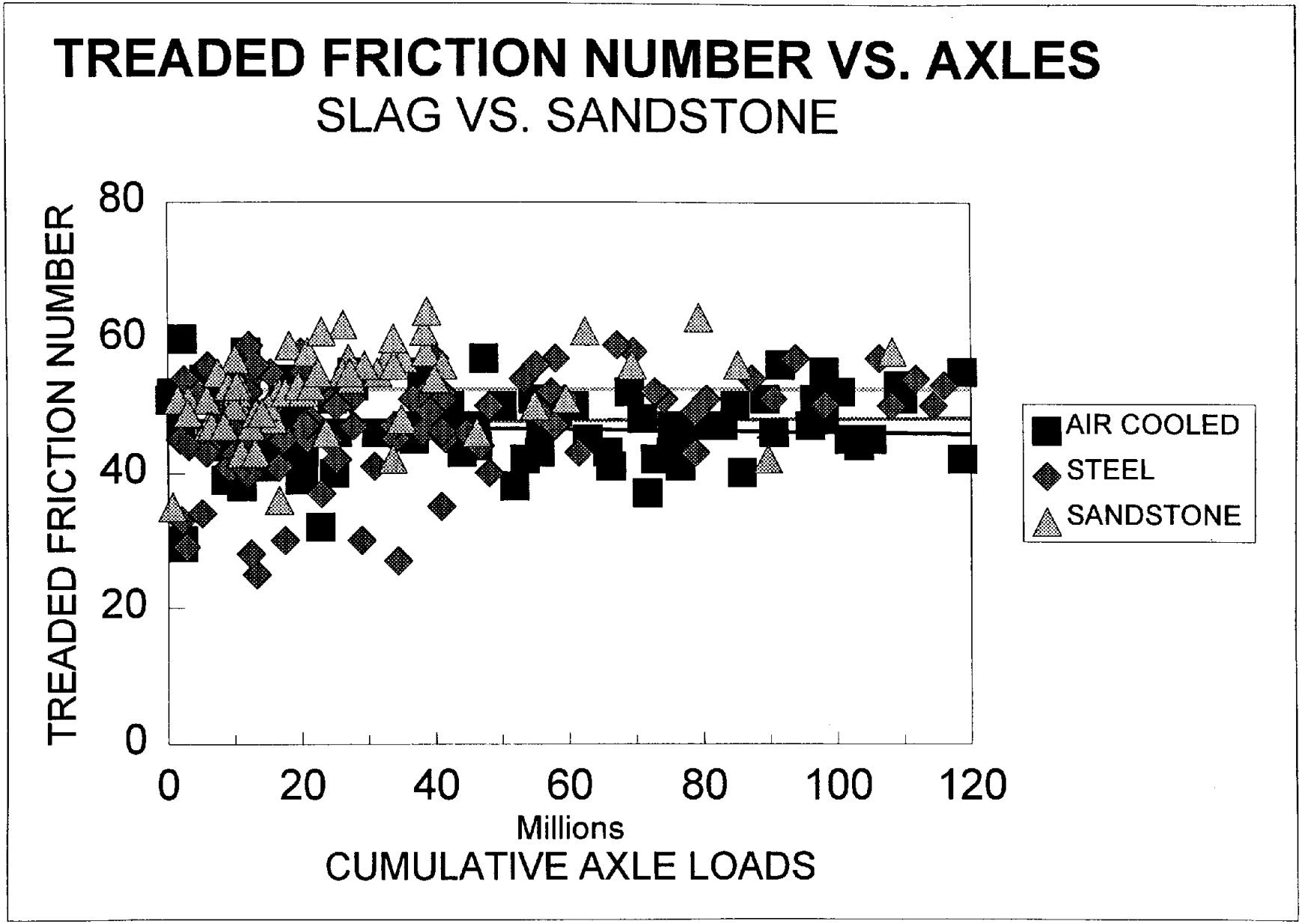

TREADED FRICTION NUMBER VS. AXLES
SLAG VS. SANDSTONE
TREADED FRICTION NUMBER
80
60
40
20
0
0
20
40
60
80
100
120
Millions
CUMULATIVE AXLE LOADS
AIR COOLED
STEEL
SANDSTONE

FIGURE 9

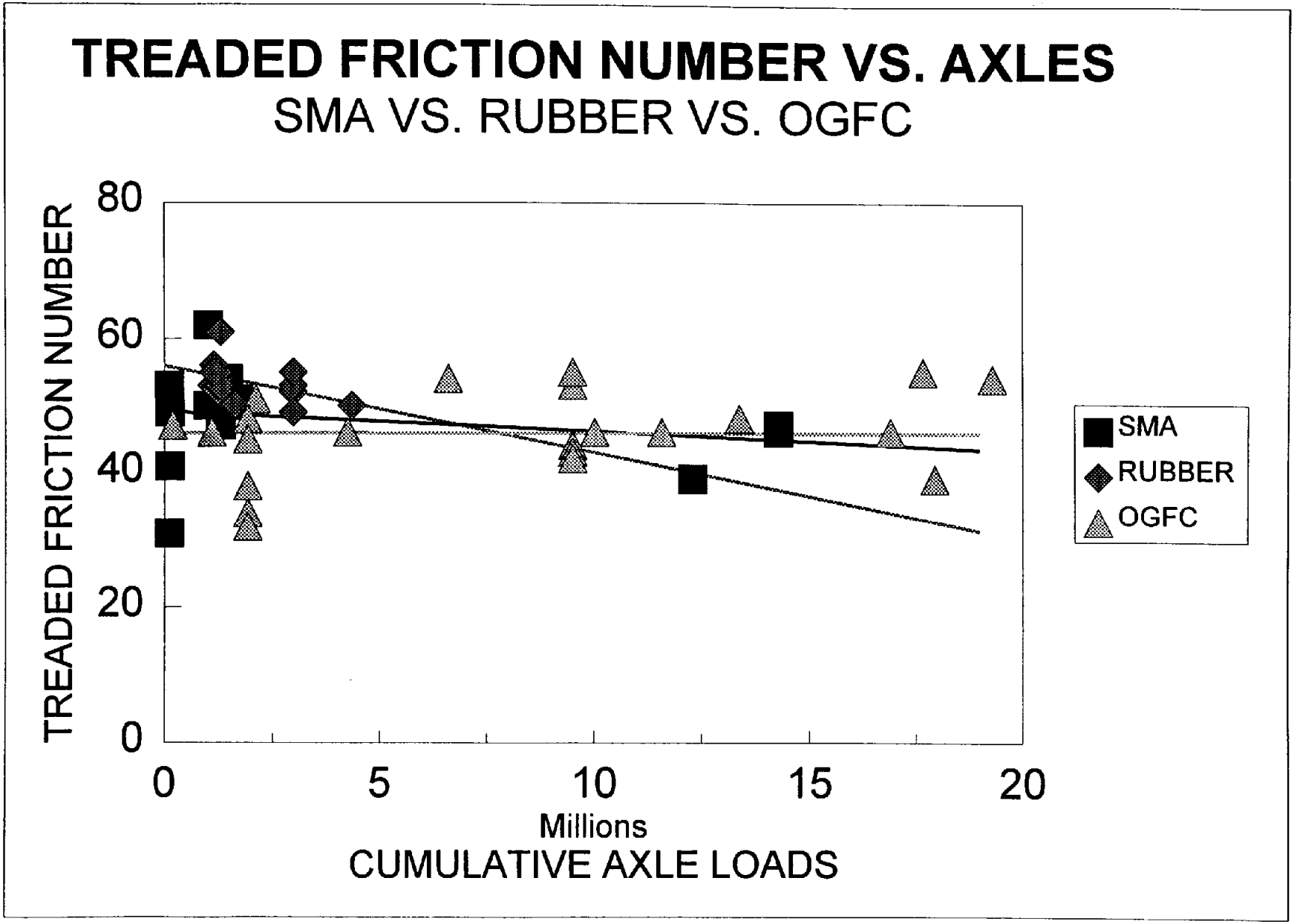

TREADED FRICTION NUMBER VS. AXLES
SMA VS. RUBBER VS. OGFC
TREADED FRICTION NUMBER
80
60
40
20
0
0
5
10
15
20
Millions
CUMULATIVE AXLE LOADS
SMA
RUBBER
OGFC

FIGURE 10

TREADED FRICTION NUMBER VS. AXLES

PCC PAVEMENT

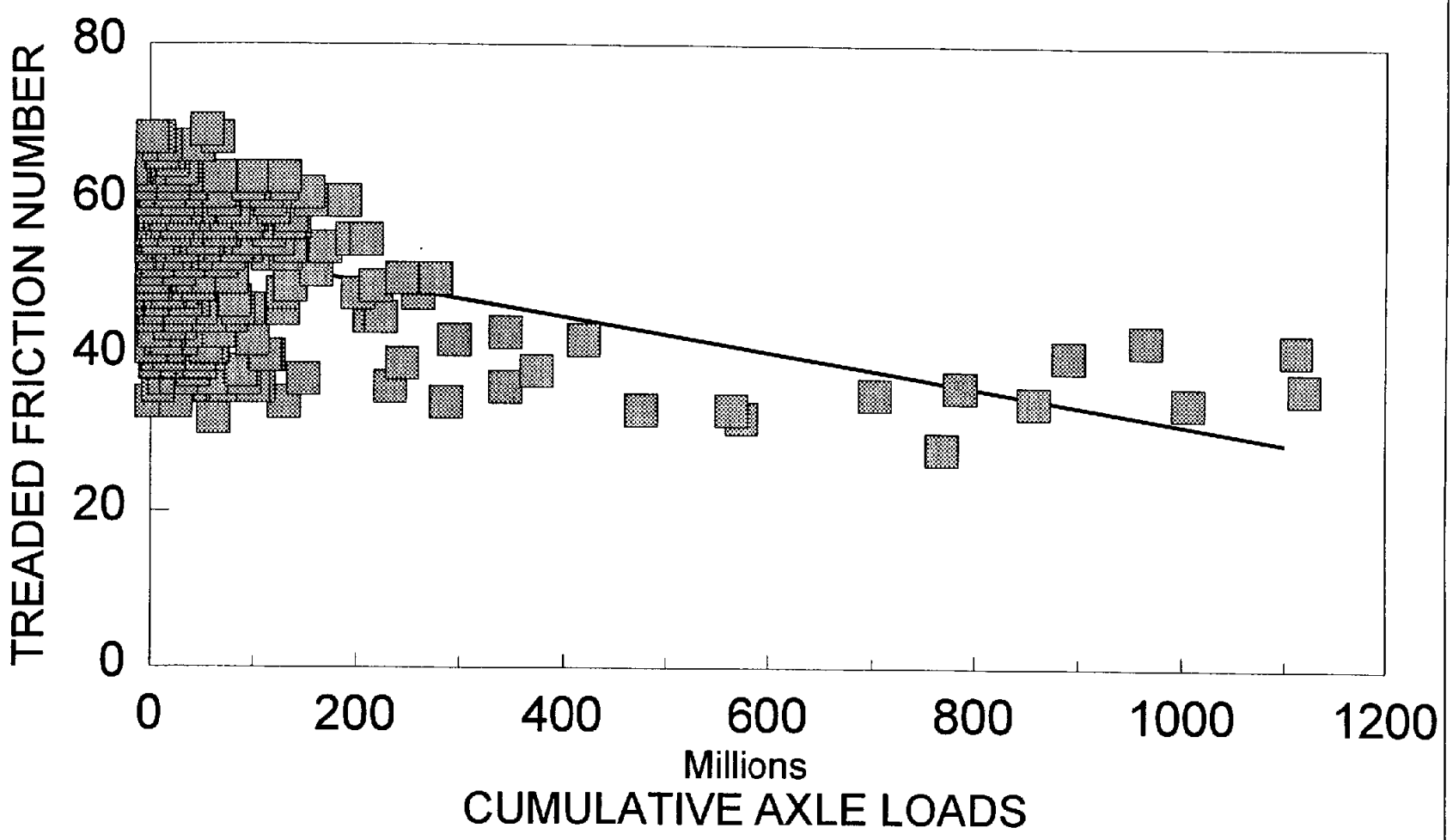


TABLE 1
Wet-Pavement Accidents Before and After Improvement
2 and 2 Projects

	Number of Projects	Number of Wet-Pavement Accidents Before Improvement	Number of Wet-Pavement Accidents After Improvement	(%) Overall Reduction
Mix C	2	6	6	0
Mix D	100	1118	601	46.2
Mix E	68	1909	733	61.6
Mix C & E	2	36	21	41.7
Mix D & E	9	188	193	-2.7
Mix D & PCC	3	150	34	77.3
Incidental Bituminous Surface	2	34	37	-8.8
Grooving	1	7	3	57.1
PCC	6	142	38	73.2
Open Graded	1	10	4	60.0
Grinding	1	18	24	-33.3

TABLE 2
Wet-Pavement Accidents Before and After Improvement
2 and 1 Projects

	Number of Projects	Number of Wet-Pavement Accidents Before Improvement	Number of Wet-Pavement Accidents After Improvement	(%) Overall Reduction
Mix D	33	93.5	49.0	47.6
Mix E	6	114	52	54.4
Mix C & D	1	1.5	1.0	33.3
Mix D & E	5	38.5	34.0	11.7
Mix E & Cold Milling	1	32	4	87.5
PCC	1	2	4	-100.0
Cold Milling	2	3	6	-100.0

APPENDIX A

THE ILLINOIS SKID-ACCIDENT REDUCTION PROGRAM
(TRA-16)
ACCIDENT ANALYSIS PORTION

Purpose and Scope

The purpose of this section is to assess the effectiveness of the various countermeasures used, as part of the rehabilitation/resurfacing projects, to reduce the number of wet-pavement accidents in Illinois. This assessment includes 96 projects for which contracts were award between May 1985 and August 1988. According to reports issued by the Bureau of Construction (BOC), 50 of the projects included in this report had a completion date prior to 1988. Therefore, accident data are available for each of these projects for two calendar years after completion. The remaining 46 projects had a completion date prior to 1989 and accident data are available for only one year after the completion of each project.

Each of the 96 projects had at least one type of engineering countermeasure applied in an attempt to reduce skidding related accidents on wet pavement surfaces. The projects were categorized according to the type of treatment used. In all, there were 7 treatment categories. They are shown in the following table.

Treatment	No. Of Projects	Treatment	No. Of Projects
Mix C	2	Grooving	1
Mix D	49	PCC Pvmt.	4
Mix E	37	Open Graded	1
I.B.S.*	2		

*Incidental Bituminous Surface

Background

On March 15, 1984 IDOT issued Department Policy TRA-16, Skid-Accident Reduction Program (Appendix A). The policy was in direct response to the Federal Highway Administration's (FHWA) Technical Advisory T5040.17. The Federal advisory outlined three basic activities required for a Skid-Accident Reduction Program. The TRA-16 policy describes and outlines the procedures to be followed in the implementation of a cost-effective skid-accident reduction program. This policy applies to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects. TRA-16 includes the following guidelines for implementation of the Skid-Accident Reduction Program.

1. The incorporation of adequate, durable skid resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2. The identification, analysis, and subsequent improvement of two categories of wet-pavement accident locations.

    a) One category is high-accident locations with over-represented wet pavement accidents that are improved as part of the Safety Improvement Construction Program.

    b) The other category is wet pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction programs.

3. Field testing and accident analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

This section is a part of the third guideline. Its focus is primarily to determine whether selected countermeasures or rehabilitation/resurfacing projects have been effective in reducing wet-pavement accidents. Since its inception in 1984, there have been approximately 279 contracts awarded under the guidelines of the program. This analysis examines the 96 projects that have accident data available for at least one year after completion and have not been previously reported.

Evaluation Approach

The Evaluation Design to be followed to determine the effectiveness of the TRA-16 program makes use of accident data for the two calendar years before the starting year of each project and compares that to accident data for one calendar year after the completion year for projects completed in 1988. Data for two calendar years before and after the completion year were used to evaluate projects completed before 1988. Projects with one year of after accident data available are referred to as "2 and 1" projects, and projects with two years of after accident data are referred to as "2 and 2" projects. In the case of "2 and 1" projects, the accident data is presented as a one year average in order to reflect an equal comparison between the "before" and "after" periods.

The 96 projects were grouped for evaluation purposes in a number of different ways. They were divided into categories according to the type of countermeasure that was used on each of them. The accident experience for each project was analyzed using before and after accident data for total and wet-pavement accidents. The change (increase or decrease) in the number of wet-pavement accidents was then compared to the change in the number of days that the pavement was actually wet. The projects were also evaluated according to the number of lanes of roadway, whether the roadway was rural or urban, and average daily traffic (ADT) range. Finally, a benefit/cost analysis was done for each treatment used. For evaluation purposes, the major focus will be on the 50 "2 and 2" projects. This is because actual accident data are available for each of the two years before and two years after and there is no need to present the data in the form of a yearly average which is the case with the "2 and 1" projects.

Results

On roadway segments included in the "2 and 2" analysis, there were 50 projects completed at a total cost of $7,421,428. At these 50 locations there were 2,613 property damage, 1,223 personal injury, and 12 fatal accidents in the before period. This is a total of 3,848 accidents. In the after period, at these same locations, there were 2,514 property damage, 952 personal injury, and 15 fatal accidents, for a total of 3,481 accidents (Table 1). This equates to reductions of 10 percent for total accidents and 22 percent for severe (personal injury, and fatal) accidents.

The wet pavement accidents at these locations were reduced substantially more than the total accidents. They dropped from 784 property damage, 396 personal injury, and 3 fatal accidents during the before period to 335 property damage, 132 personal injury, and 2 fatal accidents in the after period. This is a decline from 1,183 accidents before the treatment application to 469 accidents after the treatment for a reduction of 60% in total accidents and 66% in severe accidents (Table 2). The countermeasure which was most successful in decreasing wet-pavement accidents was Mix E. This countermeasure was used on 20 locations and reduced total accidents by 69% and accident severity by 76%. At a total cost of $2,442,009 the average cost per accident reduced is $1,673. The Grooving and Open Graded countermeasures each had a high percent reduction in total wet-pavement accidents with 57% and 60% respectively. However, each of these countermeasures was used on only one project and these results may not be truly representative of the wet-pavement accident reducing capabilities of these countermeasures.

The reduction in wet-pavement accidents does appear to be remarkable, but one last variable must be taken into consideration. That variable is the number of days on which the pavement was actually wet. More precisely, the number of days on which there was at least .01 inch of precipitation. According to data from the National Weather Service, and shown on Table 3, the average number of wet-pavement days per year in the before period was 228. The number of wet-pavement days in the after period was 163. This is a reduction of 28.5%. When this is applied to the overall change in wet-pavement accidents we obtain a clearer picture of the actual effectiveness of the skid-proofing countermeasures.

Had there been no skid proofing countermeasures applied at these 50 locations one would expect the number of wet-pavement accidents to change by the same percentage as wet pavement days. In this case 28.5%. However, Table 3 shows that by applying skid-proofing countermeasures, wet-pavement accidents were reduced by 60.3% overall for a net reduction of 31.8% (60.3 - 28.5). The most effective countermeasure, Mix E had a net reduction of 40.2%, while Mix D, which was used on 24 projects, reduced wet-pavement accidents by 15.7%.

Type of Roadway

As shown on Tables 4 and 5, 35 (70%) of the 50 "2 and 2" projects were on urban roadways and 15 (30%) were on rural. Of the 35 urban projects, 20 were on 4 lane roads, and 12 were on 2 lane roads. Total accidents on urban roads decreased from 3,441 to 3,116 (9.4%). Wet-pavement accidents decreased from 1,061 to 428 (59.7%). The remaining three projects were on either 3 or 5 lane roadways. On rural roadways, 11 of 15 were on 2 lane roads. The remaining four projects were on 3 and 4 lane roadways. Total accidents for all 15 locations declined from 407 to 365 (10.3%). Wet-pavement accidents declined from 122 to 42 (65.6%).

Average Daily Traffic

Each of the 50 "2 and 2" projects was placed into one of three categories according to the average daily traffic (ADT) of that project. Each category covers a range of ADT. The ADT ranges were 0-10,000, 10,000-20,000; and 20,000-40,000. Of the 50 projects, 17 fell into the ADT range of 0-10,000; 24 into 10,000-20,000; and 9 projects into 20,000-40,000 (Table 6).

In the 0-10,000 range, total accidents declined from an average of 46.0 to 42.0 accidents per project (8.7%). Wet-pavement accidents went down from an average of 10.2 to 6.2 (39.2%).

In the 10,000-20,000 range, total accidents per project decreased from an average of 52.6 to 45.0 (14.4%), and wet-pavement accidents decreased from an average of 17.1 to 6.5 (62.0%). In the 20,000-40,000 range, total accidents decreased from an average of 200.3 to 187.4 (6.4%), and wet-pavement accidents declined sharply, from an average of 63.9 to 23.1 (63.8%).

Benefit/Cost

Tables 7 and 8 show Benefit/Cost data for the 50 "2 and 2" projects. Table 7 shows the total number of property damage accidents as well as the number of people killed and injured in all accidents at each of the 50 locations. Table 8 shows similar data as Table 7, but Table 8 deals only with wet-pavement accidents. Mix E, which was used on 20 projects, showed a Benefit/Cost ratio of $9.53 per accident reduced per service life of the countermeasure. Mix D, used on 24 projects, showed a ratio of $2.23. The Open Graded countermeasure showed a ratio of $11.42, but again, this countermeasure was used on only one project and the results may not be exemplary of the true effectiveness of the countermeasure.

2 and 1 Preliminary Projects

There were a total of 46 "2 and 1" projects eligible for this report. A brief preliminary evaluation has been done on these 46 projects in preparation for a more detailed final evaluation which will be conducted in next year's report. There were a total of three countermeasures which were used at the 46 "2 and 1" locations. They are Mix D, Mix E, and PCC Pavement. The accident data is presented as a one year average in order to allow an equal comparison between the "before" and "after" periods. Table 9 shows the total accident data for the "2 and 1" projects. In the before period there was a one year average of 1,635.0 accidents at the 46 locations. Accidents were reduced in the after period to 1,332.0. This is a reduction of 19%. Accidents involving injuries or fatalities were reduced from 541 total (534.0 personal injury and 7.0 fatal) accidents to 381 total (378.0 personal injury and 3.0 fatal) accidents for a reduction of 30%. Table 10 shows similar wet-pavement accident history for the same 46 locations. As is the case with the "2 and 2" projects, wet pavement accidents were reduced substantially in relation to total accidents. In the before period, there was a one year average of 515.0 wet-pavement accidents and in the after period there were 217.0. This is a reduction of 58%. Accidents involving injuries or fatalities were reduced from 192 total (190.5 personal injury and 1.5 fatal) accidents to 69 total (69.0 personal injury and 0 fatal) accidents. This is a reduction of 64%. The countermeasure which appears to be the most successful in reducing wet-pavement accidents is PCC pavement which reduced total accidents by 73% and accident severity by 76%. However, PCC pavement was used on only 4 projects. Mix D, used on 25 projects, and Mix E, used on 17 projects, each

had similar reduction percentages. Mix D reduced total accidents 56% and accidents involving injury or fatalities 61%, while Mix E reduced total accidents 55% and accidents involving injuries or fatalities by 64%. When these figures are compared to the wet-weather data on Table 11 it appears that each countermeasure has been extremely successful in reducing wet-pavement accidents. PCC Pavement had the greatest net reduction of 51.4%.

Conclusion

Upon examination of the results it appears that the skid-proofing countermeasures used were effective in reducing the occurrance of wet-pavement accidents. Even with the decline in the number of wet-weather days, wet-pavement accidents decreased at a higher rate. Of the countermeasures used on "2 and 2" projects, Mix E was the most effective at reducing wet-pavement accidents. At "2 and 1" locations, PCC Pavement proved to provide the best reduction of wet-pavement accidents. It should be interesting to see if this trend in "2 and 1" s continues in next year's report.

TABLE 1

TOTAL ACCIDENTS BY COUNTERMEASURE TYPE
FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF ACCIDENTS TWO YEARS BEFORE IMPROVEMENT				NUMBER OF ACCIDENTS TWO YEARS AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX C	2	$254,988	47	32	15	0	49	34	14	1	-4	0	-$50,982
MIX D	24	$4,658,532	1263	647	410	6	973	647	317	9	8	22	$28,785
MIX E	28	$2,442,889	2483	1755	722	6	2158	1608	545	5	13	24	$3,886
I.B.S.	2	$31,348	152	123	29	0	245	197	58	0	-35	2	-$199
GROOVING	1	$17,838	28	23	5	0	12	9	4	0	57	28	$426
OPEN GRADED	1	$17,681	45	33	12	0	44	38	14	0	2	-17	$7,840
TOTAL	58	$7,421,428	3848	2613	1223	12	3481	2514	952	15	10	22	$8,089

TABLE 2

TOTAL WET-PAVEMENT ACCIDENTS BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF ACCIDENTS TWO YEARS BEFORE IMPROVEMENT				NUMBER OF ACCIDENTS TWO YEARS AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX C	2	$254,908	6	5	1	0	6	5	1	0	0	0	$0
MIX D	24	$4,658,532	276	171	103	2	153	101	51	1	45	50	$15,150
MIX E	20	$2,442,809	550	574	275	1	266	199	66	1	69	76	$1,673
I.B.S.	2	$31,340	34	23	11	0	37	27	10	0	-9	9	-$4,175
GROOVING	1	$17,838	7	4	3	0	3	0	3	0	57	0	$1,784
OPEN GRADED	1	$17,681	10	7	3	0	4	3	1	0	60	67	$1,173
TOTAL	50	$7,421,428	1183	784	396	3	469	335	132	2	60	66	$4,158

CHANGE IN WET-PAVEMENT ACCIDENTS COMPARED TO CHANGE IN WET-WEATHER DAYS * TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET-PAVEMENT ACCIDENTS BEFORE IMPROVEMENT	NUMBER OF WET-PAVEMENT ACCIDENTS AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET-PAVEMENT ACCIDENTS
MIX C	2	6	6	0.0% / -38.5%
MIX D	24	276	154	44.2% / 15.7%
MIX E	20	850	266	68.7% / 40.2%
I.B.S.	2	34	37	-8.8% / -37.3%
GROOVING	1	7	3	57.1% / 28.6%
OPEN GRADED	1	10	4	60.0% / 31.5%
TOTAL	50	1183	470	60.3% / 31.8%

YEARLY AVERAGE NUMBER OF WET-WEATHER DAYS

AVERAGE NUMBER OF WET-WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET-WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET-WEATHER DAYS
228	163	28.5%

TABLE 4

TOTAL ACCIDENTS BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
URBAN

		ALL ACCIDENTS		WET-PAVEMENT ACCIDENTS	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	12	684	571	189	90
3	2	141	124	33	18
4	20	2506	2333	818	307
5	1	110	88	21	13
TOTAL	35	3441	3116	1061	428

TABLE 5

TOTAL ACCIDENTS BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
RURAL

		ALL ACCIDENTS		WET-PAVEMENT ACCIDENTS	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	11	289	258	63	31
3	1	46	28	21	3
4	3	72	79	38	8
5	0	0	0	0	0
TOTAL	15	407	365	122	42

TABLE 6

AVERAGE ACCIDENTS PER PROJECT BY ADT RANGE
TWO YEARS BEFORE AND TWO YEARS AFTER

ADT	NUMBER OF PROJECTS	ALL ACCIDENTS		WET-PAVEMENT ACCIDENTS	
		2 YEARS BEFORE	2 YEARS AFTER	2 YEARS BEFORE	2 YEARS AFTER
0-10,000	17	46.0	42.0	10.2	6.2
10,000-20,000	24	52.6	45.0	17.1	6.5
20,000-40,000	9	200.3	187.4	33.9	23.1
TOTAL	50				

TABLE 7

BENEFIT/COST DATA FOR COMPLETED PROJECTS
TWO YEARS BEFORE AND TWO YEARS AFTER
ALL ACCIDENTS

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX C	2	0 / 1	26 / 21	32 / 34	-4.42	5
MIX D	24	6 / 9	656 / 493	647 / 647	1.53	5
MIX E	20	6 / 9	1107 / 792	1755 / 1608	8.22	5
I.B.S.	2	0 / 0	87 / 90	123 / 187	-37.38	5
GROOVING	1	0 / 0	7 / 6	23 / 8	17.34	5
OPEN GRADED	1	0 / 0	15 / 18	33 / 30	-9.46	5
TOTAL	50	12 / 19	1898 / 1420	2613 / 2514	3.37	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE ACCIDENTS

TABLE 8

BENEFIT/COST DATA FOR COMPLETED PROJECTS
TWO YEARS BEFORE AND TWO YEARS AFTER
WET-PAVEMENT ACCIDENTS

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX C	2	0 / 0	2 / 1	5 / 5	0.55	5
MIX D	24	3 / 1	174 / 93	171 / 101	2.23	5
MIX S	20	1 / 2	368 / 97	574 / 199	9.53	5
I.S.S.	2	0 / 0	15 / 18	23 / 27	-8.66	5
GROOVING	1	0 / 0	5 / 4	4 / 0	7.66	5
OPEN GRADED	1	0 / 0	4 / 2	7 / 3	11.42	5
TOTAL	50	4 / 3	569 / 205	784 / 335	4.56	5

F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE ACCIDENTS

TABLE 9

TOTAL ACCIDENTS BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	AVERAGE NUMBER OF ACCIDENTS IN THE BEFORE PERIOD				AVERAGE NUMBER OF ACCIDENTS IN THE AFTER PERIOD				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	25	$14,816,985	737.0	474.0	258.0	5.0	594.0	401.0	188.0	5.0	21	30	$38,737.22
MIX E	17	$2,677,582	637.5	421.0	216.0	2.5	551.0	412.0	137.0	2.0	14	36	$12,381.68
FED PVT.	4	$6,775,838	263.5	199.0	68.0	1.5	197.0	138.0	59.0	3.0	24	4	$42,662.39
TOTAL	46	$24,272,397	1638.0	1094.0	534.0	9.0	1332.0	951.0	375.0	7.0	19	30	$32,848.13

TABLE 10

TOTAL WET-PAVEMENT ACCIDENTS BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	AVERAGE NUMBER OF ACCIDENTS IN THE BEFORE PERIOD				AVERAGE NUMBER OF ACCIDENTS IN THE AFTER PERIOD				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	23	$14,816,585	234.3	143.5	89.5	1.3	132.3	67.3	35.3	3.0	56	61	$44,899.95
MIX E	17	$2,677,562	211.5	138.5	81.3	3.3	96.3	67.3	29.3	0.0	55	64	$9,273.31
PCC SVT.	4	$6,775,833	69.5	49.3	20.3	2.5	16.3	14.3	5.3	3.3	77	76	$53,669.64
TOTAL	44	$24,272,397	515.3	323.3	190.5	1.5	217.3	148.3	69.3	0.3	58	64	$32,577.71

TABLE 11

CHANGE IN WET-PAVEMENT ACCIDENTS COMPARED TO CHANGE IN WET-WEATHER DAYS * TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET-PAVEMENT ACCIDENTS BEFORE IMPROVEMENT	NUMBER OF WET-PAVEMENT ACCIDENTS AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET-PAVEMENT ACCIDENTS
MIX D	25	234.0	102.0	56.4% / 35.1%
MIX E	17	211.5	96.0	54.6% / 33.3%
PCC PVT.	4	69.5	19.0	72.7% / 51.4%
TOTAL	46	515.0	217.0	57.9% / 36.6%

YEARLY AVERAGE NUMBER OF WET-WEATHER DAYS	AVERAGE NUMBER OF WET-WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET-WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET-WEATHER DAYS
	218.2	180	21.3%

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42270 0002	Franklin	Resurfacing on Il 154 between Il 148 in Sesser and Rend Lake	10/22/87	4,250	C	2
42002 0052	McLean	Resurfacing on US 136 between the McLean-Logan County Line and FAI 55 at McLean	05/22/87	3,125	C	2
42021 0009	Lee	Right turn lane on NB Il 26 (Galena Ave.) at the intersection with Boyd St. in Dixon	11/14/87	23,100	D	4
42001 0001	Boone	On Bus US 20 from Shaw Rd. east to Belvidere	06/07/88	7,100	D	2
40006 0307	Crawford	Main St. from west of Dorsey Dr. to Park Forest Ave. in Robinson	05/00/87	12,000	D	3
38090 0191	Kankakee	Widening of the dual bridges carrying I-57 over the Kankakee River in Kankakee	10/16/87	17,000	D	4
38003 0337	St.Clair	On Il 163/157 from the Goose Lake Canal Bridge in Cahokia to Il 3 in Centreville	01/21/87	16,500	D	2
42776 0009	Lee	Channelize the intersection of US 30 and Il 251 north of Compton	10/24/87	2,375	D	2
38023 0323	Peoria	Il 88 between Pioneer Pkwy and Timber Ln. in Peoria	07/01/87	13,700	D	4
42012 0031	Lee Lasalle	Resurfacing and reconstruction of the intersection of Il 251 and Spur Rd. between West Brooklyn and Mendota	12/00/87	1,350	D	2
42517 0102	Madison	Resurfacing on Il 159 between Pine Lake Rd. and Dana Dr. in Collinsville	11/20/87	21,900	D	5
42000 0006	DuPage	Channelization and traffic signals at the intersection of Il 59 (Heltner Blvd.) and Forest Ave. in West Chicago	06/10/87	17,300	D	4
42053 0306	Tazewell	Resurface and widen the structure at Spring Creek and waterproof the structure at Ten Mile Creek on Il 116 between I-74 & Ten Mile Creek in East Peoria	12/26/87	18,000	D	4
44017 0007	Kendall	Resurfacing and installation of traffic signals on US 34 at the intersection of Douglas Rd. .5 mile east of Oswego	11/07/86	1,400 1,400	D	2
42665 0008	Saline	Cold milling and resurfacing on US 45 from .25 mile west of the intersection of Il 142 east to west of Jefferson St in Eldorado	00/00/86	9,000	D	2
42997 0047	Lee	Removal of IC RR structure on US 52 at Henkel Rd. 3.5 miles southeast of Sublette	09/29/88	2,500	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42849 8278	Rock Island	Resurfacing on Il 5 between 7th St. and FAI 74, and rehablitate the structure carrying Il 5 over 27th St. all in Moline	09/22/88	21,800	D	4
40912 8273	Marshall	Resurfacing on Il 17 & 89 from Lacon east and north to north of Varna	09/30/87	1,700	D	2
42793 8882	Boone	Resurfacing on New Belvidere Bypass from Bus US 20 at Appleton St. to Il 76 at the northwest edge of Belvidere	07/31/88	4,300 4,800	D	4
40914 8158	McDonough	Resurfacing and traffic signal modernization on US 67/136 between the US 67/136 intersection and Prairie St. in and west of Macomb	02/00/88	5,500	D	2
44048 8852	Stephenson	Remove and replace superstructure carrying Il 26 over the SCWRTC Rk and Richland Creek northwest of Orangeville	11/00/88	2,000	D	2
38098 8184	DuPage	Left turn lane on northbound Il 59 at Ferry Rd. and resurfacing on Il 59 at Il 5 south ramps in Naperville	07/27/88	24,825 49,500	D	4
42834 8238	Adams	Resurfacing, RC box culvert, and bridge repairs all on Il 104 from 1.4 miles east of Il 336 to Burton Rd. east of Quincy	05/12/88	5,500	D	4
40931 8946	Madison	Resurfacing on Il 143 between FAI 55 and FAI 70 near Marine	07/22/87	2,200	D	2
40972 8839	LaSalle	Resurfacing on Il 71 Between FAI 80 and US 52 northeast of Ottawa	08/27/87	3,700	D	2
40823 8833	Kankakee	Resurfacing on Il 17 from 2 miles west of Ponfield Rd., east to the west limits of Kankakee	08/20/87	6,300	D	2
42183 8842	Kane	Resurfacing, bridge widening, and deck repairs at eastbound Bus. US 20 over westbound US 20 and at US 20 over McLean Blvd. in Elgin	09/03/88	19,600 19,600	D	4
40768 8873	Peoria	Resurfacing and traffic signals on US 150 (War Memorial Dr.) from west of Frostwood Pkwy., southeast to West Northland Ave. in Peoria	12/20/86	21,800	D	4
42266 8811	Tazewell	Resurfacing on Il 29 between Wesley Rd. and Ruscne-Highway Ave in Creve Coeur	11/24/87	20,950	D	4
40695 8859	Adams	Resurfacing on Il 104 between Il 336 and TR 158 1 mile east of Quincy	07/00/86	6,700	D	4
42342 8813	Lake	Resurfacing and traffic signal modernization at the intersection of Il 83 and Rollings Rd. in Round Lake Beach	12/02/87	16,650	D	2
40856 8981	Saline	Raleigh Rd. from Il 34 at the west edge of Eldorado	11/17/87	3,150	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42418 0093	Kendall	Resurfacing on US 34 from west of Cannonball Trail to west of Il 47 and reconstruction of the structure carrying US 34 over Blackberry Creek in Yorkville	11/09/88	7,850	D	2
42273 0099	Rock Island	Resurfacing and triple RC box culvert on Andalusia Rd. at Ridge-wood Rd. in Milan	07/08/88	8,000	D	2
40693 0126	Peoria	Resurfacing on I-74 between University Ave. and the M. Baker Bridge, and on decks of 9 structures on I-74 between Sterl-ing Ave. and Adams St. in Peoria	07/09/87	29,075	D	4
42359 0017	LaSalle	Resurfacing on Il 71, between Covel Creek, southwest of Ottawa and Il 23 in Ottawa	10/14/88	2,850 2,850	D	2
42557 0016	Lawrence	Resurfacing, waterproofing and deck repairs to 3 structures all on US 50 from .18 mile east to 4.23 mile east of Il 1 north and east of Lawrenceville	06/17/88	3,000	D	4
40692 0125	Madison	Resurfacing on Il 160 between Chestnut St. and Lemon St. in Highland	05/28/87	2,400	D	2
42377 0061	Cook	Channelize, resurface and traffic signals at the intersection of Il 62 and Lexington Dr. in South Barrington and Hoffman Estates	11/07/88	17,300	D	4
42516 0163	Winnebago	Resurfacing on Il 251 from north of Glendale Rd. south to near Cottage Ave. in Loves Park	12/12/87	37,400	D	4
42669 0006	Iroquois	Shoulder reconstruction on I-57 south of the Il 54 interchange, south of Onarga	10/16/87	11,400	D	4
40659 0077	Fulton	Resurfacing on Il 9 between Canton and Banner	12/03/87	2,650	D	2
42288 0002	Cass	Resurfacing on Il 78 from 2.2 miles north of Virginia to Virginia	09/24/87	1,450	D	2
42181 0017	Winnebago	Resurfacing, traffic signal modernization, and bridge deck re-pairs on Il 2 from south of Aquamarine Dr. north to Morgan St. in Rockford	10/07/87	9,200	D	4
40959 0145	Kane	Resurfacing on Il 72 at the intersection with Rock Road Dr. in East Dundee	05/07/87	11,300	D	2
40775 0023	St.Clair	Resurfacing on Carlyle Rd. between McClintock Rd. and Il 161 in Belleville	07/30/87	11,900	D	4
42841 0066	Madison	Resurfacing on Il 159 between Railroad St. and Wilson St. in Collinsville	11/19/88	16,900	D	2
38942 0118	Perry	On Il 154 from a mile east of Pinckneyville to US 51	10/22/87	3,600	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42975 0050	Jersey Madison	Deck repairs on Il 267 from US 67 north of Godfrey north to Delhi	12/10/88	5,900 6,500	D	2
00969 0070	DuPage	Channelize the intersection of Rohlwing Rd. and Nordic Rd. in Itasca	11/22/88	12,000	D	4
42963 0069	St.Clair	Resurfacing on Il 15 from the entrance of Our Lady of Snows Shrine to Il 13 west of Belleville	10/28/88	18,400	D	4
42950 0010	Ogle	Resurfacing on Il 72 from the west limits of Stillman Valley, east to US 51 at Davis Junction	09/12/88	2,150 2,150	D	2
42844 0067	Madison	Resurfacing for left turn lanes on Il 159 at the intersection with Glen Crossing Rd. in Glen Carbon	06/21/88	11,900	D	2
42906 0008	Henry	Resurfacing on US 34 from the west edge Galva east to Il 91	11/07/88	2,700	D	2
42322 0012	Jackson	Resurfacing on Il 149 between 6th St. and 22nd St. in Murphysboro	08/26/87	13,000	E	2
42663 0035	Peoria	Reconstruction of the intersection of US 150 (War Memorial Dr.) and Prospect Rd. in Peoria	12/12/88	29,350	E	4
42636 0101	Perry	Resurfacing, cold-milling and new S&G on US 51 at the intersection of Il 152 in Duquoin	07/17/88	9,200	E	2
00077 0006	Cook	Resurfacing at the intersection of Il 19 and Des Plaines River Rd. in Schiller Park	08/11/88	26,700 26,700	E	4
13249 0060	Cook	Resurfacing and traffic signal modernization on Dempster St. from Lincoln Ave. east to Parkside Ave. in Morton Grove	11/25/87	32,900 32,000	E	4
42271 0168	Marion	Resurfacing on SB US 51 from Ellis St. in Central City south to Calumet St. in Centralia	05/21/88	9,100	E	2
96059 0017	Madison	Resurfacing on US 67 at Tolle Ln. in Godfrey, Il 100 at Clifton Terrace Rd. northwest of Alton and on Il 3 at Il 143 in Wood River	11/19/88	12,300 11,000	E	4
40647 0152	Cook	Resurfacing at the intersection of Governor's Highway with 216th St. in Matteson	05/22/87	19,450	E	4
42262 0004	Jackson	Cold milling and resurfacing on Il 13 between Poplar St. and Lewis Ln. in Carbondale	07/09/87	18,400	E	3
42003 0002	DuPage	Resurfacing and traffic signals on Il 59 between the Batavia-Warrenville Rd. and Butterfield Rd. in Warrenville	05/14/88	19,500	E	4

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
96858 2188	Randolph	Resurfacing on Il 150 at the "Z" curve near the north limits of Chester	10/26/88	6,000	E	2
94815 0096	Marion	Resurfacing at the intersection of Il 161 and Country Club Rd. in Centralia	10/25/88	9,000	E	2
90097 9287	Cook	Resurfacing at the intersection of 159th St. at Torrence Ave. in Calumet City	08/22/88	20,000	E	4
90092 0015	Cook	Resurfacing on IL 64 at the intersection with Railroad Ave. in North Lake	06/24/88	22,000 22,000	E	6
44102 0021	Kankakee	Channelization, resurfacing on Il 17 from I-57 east to 360' east of Eastringe Dr. also traffic signals at the intersection of IL 17 and I-57 northbound ramp	12/10/88	14,500	E	4
40866 0170	Will	Improvement of the intersection of US 6 with Draper Ave./ Walnut St. in Joliet	07/21/87	11,600	E	2
90975 0131	Champaign	Resurfacing on FAI 57 from 1.4 miles south of FAI 72 to FAI 74 at the northwest edge of Champaign	09/16/87	19,400	E	4
44012 0003	Champaign	Resurfacing on the approaches to Anthony Dr. on US 45 near the north limits of Urbana	09/15/88	11,200	E	2
42548 0002	Alexander	Resurfacing and C&G at the intersection of US 51, 60 and 62 in Cairo	09/10/87	6,025	E	4
40923 0212	Cook	Resurfacing on Oak Park Ave. at the intersection with 151st St. in Oak Forest	07/08/87	18,025	E	4
40784 0222	St.Clair	Resurfacing on Il 4 between Union St. and St. Clair Ave. in Lebanon	12/03/87	5,600	E	3
90081 0053	Union Williamson	Resurfacing at Il 146 and IL 3 at Ware in Union Co. and on IL 3 in Johnson City in Williamson Co. and Il 148 in Herrin and IL 37 south of Marion	08/04/88	6,150	E	2
42016 0001	Champaign	Resurfacing on US 150, between Springfield Ave. and FAI 74, in Champaign	10/27/88	16,500	E	4
40419 0139	Jackson	Widening and resurfacing on US 51 from north of Pleasant Hill Rd. to Heritage Hills Rd. south of Carbondale	07/09/87	13,600	E	2
42042 0299	Livingston	Resurfacing and traffic signals on Il 116 between Ladd St. and Pearl St. in Livingston County	11/13/87	6,600	E	2
42056 0387	Kankakee	Resurfacing and channelization on Il 17 from 300 ft. west Fairmont Ave.to 300 ft. east of Eastridge Dr. in Kankakee	12/04/87	14,600	E	4

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42433 0079	Warren	Resurface and traffic control improvements at the intersection of US 34 and US 67 in Monmouth	07/15/88	11,000	E	2
40958 0017	Lake	Channelization and traffic signals at the intersection of Il 120 and 134 in Hainesville	10/05/87	14,650	E	2
42186 0016	Williamson	Resurfacing on westbound Il 13 from .50 miles east of the Jackson-Williamson County line east to Carterville	07/15/87	17,300	E	4
42269 0003	Cook	Channelization and traffic signals at the intersection of Il 59 and Il 68 in Barrington Hills	11/25/87	14,550	E	2
60037 0012	Will	Reconstruction of the intersection of US 52 and Il 7 in Joliet	06/29/88	50,000	E	4
42199 0043	Kane Cook	Resurfacing and repairs to 6 structures on US 20 between the Fox River and Lovell St. in Elgin	12/02/88	20,000 20,000	E	4
40188 0031	Cook	On Milwaukee Ave. between Kedzie St. and Evanston-Elgin Rd. in Niles	07/08/87	29,900	E	4
40136 0056	St.Clair	On Il 3 between Monica Dr. and Monsanto Ave. in Cahokia and Sauget	07/30/87	26,100	E	4
42066 0044	Lee	Resurfacing on Il 2 from Peoria Ave. to Galena Ave. and on Il 26 from the IC6 RR to the Rock River in Dixon	06/00/87	10,400	I.R.S	4
42178 0006	Henry	Resurfacing on Il 78 from 10th St. to the RN RR and from Central Blvd. to Garfield St. in Kewanee	07/27/87	10,650	I.R.S.	4
42224 0073	Whiteside	Pavement grinding on East Third St. from 19th Ave. to Kroger entrance and on East Fourth St. from Second Ave. to Fourth Ave. in Sterling	10/07/87	11,350	GROOVING	2
40789 0119	Cook	Widen 8 structures, all on I-190 over I-294 ramps, Des Plaines River Rd., and Des Plaines River between Mannheim Rd. and East River Rd. in Rosemont & Chicago	02/11/88	107,000 107,000	PCC PVT.	8
42072 0173	Adams	CR PCC pavement, resurfacing and double RC box culvert at Burton Creek on Il 104 3.6 miles, east of Il 336 east 1.8 miles, all east of Quincy	05/13/88	4,200 4,200	PCC PVT.	2
42185 0057	Macon	Remove and replace bridge carrying West Main St. over Stevens Creek in Decatur	11/26/88	2,100 2,100	PCC PVT.	2
42294 0016	Macon	PCC pavement on West Main St. from Wycoles Rd. east to Victoria Ave. in Decatur	10/10/88	2,100	PCC PVT.	2
40683 0103	Peoria	Resurfacing and traffic signal modernization on Il 88 between Illinois Ave. and Armstrong Ave. in Peoria	10/29/87	28,700	OPEN GRADED	4

TRA-16
December 01, 1988

SKID-ACCIDENT REDUCTION PROGRAM

1. Policy

The Department shall establish a program designed to minimize wet-pavement skidding accidents. This shall be accomplished by ensuring that new roadway surfaces have adequate, durable skid resistance properties, and by identifying and improving sections of roadway with high or potentially high skid-accident incidence.

2. Purpose

The purpose of this policy is to describe and outline the procedures that will provide a cost-effective skid-accident reduction program. This policy will apply to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects.

3. Guidelines for Implementation

a. Primary Activities

1) The first activity (3b) consists of incorporating adequate, durable skid-resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2) The second activity (3c) involves identifying, analyzing, and improving two categories of wet-pavement accidents locations.

a) One category is high-accident locations with overrepresented wet-pavement accidents that are improved as part of the safety improvement construction program.

b) The other category is wet-pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction program.

3) The third activity (3d) concerns feedback from field testing and analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

b. Incorporation of Skid-Resistant Surfaces During Construction and Rehabilitation

1) Portland Cement Concrete

a) Final finishing on highways with posted speed limits in excess of 40 mph shall be obtained by the use of a longitudinal artificial turf drag followed immediately by a mechanically operated metal tine transverse grooving device as specified for Type A final finish in the Standard Specifications.

b) Final finishing on highways with posted speed limits not exceeding 40 mph may be obtained by the use of a single longitudinal artificial turf drag as specified for Type B final finish in the Standard Specifications or by a combination of longitudinal artificial turf drag and transverse tining as specified for Type A final finish.

2) Bituminous Concrete

New surface courses shall have, as a minimum, friction qualities equivalent to or greater than those provided by the following guidelines.

a) Mixture C should be used as the surface course on roads and streets having a design ADT of 2000 or less.

b) Mixture D should be used as the surface course on all two-lane roads and streets having a design ADT greater than 2000, on four-lane highways having a design ADT of 25,000 or less, and on six-lane (or greater) highways having a design ADT of 60,000 or less.

c) Mixture E should be used as the surface course on four-lane highways having a design ADT greater than 25,000 and on six-lane (or greater) highways having a design ADT greater than 60,000.

The Special Provision for Skid-Resistant Bituminous Surface describes Mixtures C, D, and E.

c. Identifying, Analyzing, and Improving Wet-Pavement Accident Locations

1) High Accident Wet-Pavement Locations

The procedures for identifying, analyzing, and improving high-accident locations that have an overrepresented rate of wet-pavement accidents are included in the "Illinois Safety Improvement Processes" and Departmental Policy TRA-15 which cover the Safety Improvement Construction Program.

2) Wet-Pavement Accident Locations (Cluster Sites)

a) Identification of Cluster Sites

When a route is selected for rehabilitation/resurfacing, the wet-pavement accident records, furnished by the Division of Traffic Safety/local agency, shall be analyzed for the entire project. The identification of cluster sites shall be as outlined in Section I of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects", which is included in the "Illinois Safety Improvement Processes."

b) Analysis of Cluster Sites

Each cluster site that is identified must be analyzed by District/local agency personnel. The analysis shall comply with Section II of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/ Resurfacing Projects."

c) Corrective Treatment for Cluster Sites

After analyzing each cluster site, the District/local agency shall select the appropriate corrective treatment in accordance with Section III of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects."

d) Documentation of Process

The identification, analysis, and improvement of each cluster site must be documented and become part of the location study report for State projects and project development report for local agency projects.

d. Evaluating and Reporting on Effectiveness of the Program

1) The Bureau of Materials and Physical Research will continue to evaluate current pavement design practices to ensure that skid resistance properties are durable and suitable for the needs of traffic.

2) The Bureau of Materials and Physical Research will develop a friction-test data base for retrieval and for subsequent data analysis.

3) The Bureau of Materials and Physical Research will continue evaluation of experimental projects which provide a broad body of knowledge concerning frictional characteristics applicable to Illinois surfaces.

4) The Division of Traffic Safety, in cooperation with the Bureau of Traffic and the Districts, will determine whether selected countermeasures on rehabilitation/resurfacing projects have been effective in reducing wet-pavement accidents. The results of the evaluation will be furnished to the Bureau of Materials and Physical Research for inclusion in their annual report.

5) The Bureau of Materials and Physical Research, in cooperation with the Bureaus of Traffic and Local Roads and Streets and the Division of Traffic Safety, will prepare an annual report summarizing activities of Illinois' Skid Accident Reduction Program on both the State and local highway systems.

6) The Bureau of Traffic will include in their annual "Evaluation and Report of the Highway Safety Construction Program" data on wet-pavement accident locations improved under the Safety Improvement Program.

4. Responsibilities

a. The Directors of Highways and Traffic Safety are responsible for assuring that their Divisions comply with the procedures set forth in this Policy.

b. The Bureau of Traffic is responsible for the maintenance, updating and dissemination of this Policy.

5. Accessibility

Copies of this policy may be obtained from the Bureau of Traffic, Room 104, Administration Building.

CLOSING NOTICE

Supersedes: Departmental Policy, SKID ACCIDENT REDUCTION PROGRAM, Effective March 15, 1984

Approval:

H W Monroney — Director of Highways — 1/1/89 — Date

Melvin H Smith — Director of Traffic Safety — 1/1/89 — Date

THE ILLINOIS SKID-ACCIDENT REDUCTION PROGRAM
(TRA-16)
ACCIDENT ANALYSIS PORTION

Purpose and Scope

The purpose of this section is to assess the effectiveness of the various countermeasures used, as part of the rehabilitation/resurfacing projects, to reduce the number of wet-pavement accidents in Illinois. This assessment includes 85 projects for which contracts were awarded between May 1986 and September 1989. According to reports issued by the Bureau of Construction (BOC), 46 of the projects included in this report had a completion date prior to 1989. Therefore, accident data are available for each of these projects for two calendar years after completion. The remaining 39 projects had a completion date between 1989 and 1990 and accident data are available for only one year after the completion of each project.

Each of the 85 projects had at least one type of engineering countermeasure applied in an attempt to reduce skidding related accidents on wet pavement surfaces. The projects were categorized according to the type of treatment used. In all, there were 6 treatment categories. They are shown in the following table.

Treatment	No. Of Projects	Treatment	No. Of Projects
Mix D	39	Mix D & PCC PVT	3
Mix E	31	PCC Pvmt.	5
Mix D & E	6	Grinding	1

Background

On March 15, 1984 IDOT issued Department Policy TRA-16, Skid-Accident Reduction Program (Appendix A). The policy was in direct response to the Federal Highway Administration's (FHWA) Technical Advisory T5040.17. The Federal advisory outlined three basic activities required for a Skid-Accident Reduction Program. The TRA-16 policy describes and outlines the procedures to be followed in the implementation of a cost-effective skid-accident reduction program. This policy applies to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects. TRA-16 includes the following guidelines for implementation of the Skid-Accident Reduction Program.

1. The incorporation of adequate, durable skid resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2. The identification, analysis, and subsequent improvement of two categories of wet-pavement accident locations.

   a) One category is high-accident locations with over-represented wet pavement accidents that are improved as part of the Safety Improvement Construction Program.

   b) The other category is wet pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction programs.

3. Field testing and accident analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

This section is a part of the third guideline. Its focus is primarily to determine whether selected countermeasures or rehabilitation/resurfacing projects have been effective in reducing wet-pavement accidents. Since its inception in 1984, there have been approximately 320 contracts awarded under the guidelines of the program. This analysis examines the projects that have accident data available for at least one year after completion and have not been previously reported.

Evaluation Approach

The Evaluation Design to be followed to determine the effectiveness of the TRA-16 program makes use of accident data for the two calendar years before the starting year of each project and compares that to accident data for one calendar year after the completion year for projects completed in 1989. Data for two calendar years before and after the completion year were used to evaluate projects completed before 1989. Projects with one year of accident data available after completion are referred to as "2 and 1" projects, and projects with two years of accident data available after completion are referred to as "2 and 2" projects. In the case of "2 and 1" projects, the accident data are presented as a one year average in order to reflect an equal comparison between the "before" and "after" periods.

The 85 projects were grouped for evaluation purposes in a number of different ways. They were divided into categories according to the type of countermeasure that was applied to each of them. The accident experience for each project was analyzed using before and after accident data for total and wet-pavement accidents. The change (increase or decrease) in the number of wet-pavement accidents was then compared to the change in the number of days that the pavement was actually wet. The projects were also evaluated according to the number of lanes of roadway, whether the roadway was rural or urban, and average daily traffic (ADT) range. Finally, a benefit/cost analysis was done for each treatment used. For evaluation purposes, the major focus will be on the 46 "2 and 2" projects. This is because actual accident data are available for each of the two years before and two years after and there is no need to present the data in the form of a yearly average which is the case with the "2 and 1" projects.

Results

On roadway segments included in the "2 and 2" analysis, there were 46 projects completed at a total cost of $24,270,397. At these 46 locations there were 2,188 property damage, 1,068 personal injury, and 14 fatal accidents in the before period. This is a total of 3,270 accidents. In the after period, at these same locations, there were 1,768 property damage, 708 personal injury, and 5 fatal accidents, for a total of 2,481 accidents (Table 1). This equates to reductions of 24 percent for total accidents and 34 percent for severe (personal injury, and fatal) accidents.

The wet pavement accidents at these locations were reduced substantially more than total accidents. They dropped from 646 property damage, 381 personal injury, and 3 fatal accidents during the before period to 320 property damage, 131 personal injury, and 0 fatal accidents in the after period. This is a decline from 1,030 accidents before the treatment application to 451 accidents after the treatment for a reduction of 56 percent in total accidents and 66 percent in severe accidents (Table 2). The countermeasure which was most successful in decreasing wet-pavement accidents was PCC Pavement. This countermeasure was used on 4 locations and reduced total accidents by 73 percent and accident severity by 80 percent. At a total cost of $6,775,830 the average cost per accident reduced is $26,571.88.

The reduction in wet-pavement accidents does appear to be remarkable, but one last variable must be taken into consideration. That variable is the number of days on which the pavement was actually wet. More precisely, the number of days on which there was at least .01 inch of precipitation. According to data from the National Weather Service, and shown on Table 3, the average number of wet-pavement days per year in the before period was 218.2. The number of wet-pavement days in the after period was 213. This is a reduction of 2.4 percent. When this is applied to the overall change in wet-pavement accidents a clearer picture of the actual effectiveness of the skid-proofing countermeasures can be obtained.

Had there been no skid proofing countermeasures applied at these 46 locations one would expect the number of wet-pavement accidents to change by the same percentage as wet pavement days. In this case 2.4 percent. However, Table 3 shows that by applying skid-proofing countermeasures, wet-pavement accidents were reduced by 56.2 percent overall for a net reduction of 53.8 percent (56.2 - 2.4). The most effective countermeasure, PCC Pavement which was used on 4 projects, had a net reduction of 71.0 percent. Mix D, which was used on 25 projects, reduced wet-pavement accidents by 50.0 percent. Mix E, used on 17 projects reduced wet-pavement accidents by 52.4 percent.

Type of Roadway

As shown on Tables 4 and 5, 33 (72%) of the 46 "2 and 2" projects were on urban roadways and 13 (28%) were on rural roadways. Of the 33 urban projects, 17 were on 4 lane roads, and 14 were on 2 lane roads. Total accidents on urban roads decreased from 2,865 to 2,143 (25.2%) and wet-pavement accidents decreased from 926 to 392 (57.7%). The remaining two projects were on either 6 or 8 lane roadways. On rural roadways, 10 of 13 were on 2 lane roads. The remaining three projects were on 4 lane roadways. Total accidents for all 13 locations declined from 405 to 338 (16.5%) and wet-pavement accidents declined from 104 to 59 (43.3%).

Average Daily Traffic

Each of the 46 "2 and 2" projects was placed into one of four categories according to the average daily traffic (ADT) of that project. Each category covers a range of ADT. The ADT ranges were 0-10,000; 10,000-20,000; 20,000-40,000; and over 40,000. Of the 46 projects, 24 were in the ADT range of 0-10,000; 12 in 10,000-20,000; 8 in 20,000-40,000; and 2 projects in the over 40,000 range (Table 6).

In the 0-10,000 range, total accidents declined from an average of 34.8 to 30.9 accidents per project (11.2%). Wet-pavement accidents went down from an average of 8.8 to 5.4 (38.6%).

In the 10,000-20,000 range, total accidents per project decreased from an average of 74.9 to 56.7 (24.3%), and wet-pavement accidents decreased from an average of 24.6 to 11.1 (54.9%). In the 20,000-40,000 range, total accidents decreased from an average of 118.0 to 85.8 (27.3%), and wet-pavement accidents declined sharply, from an average of 44.9 to 18.6 (44.5%). In the over 40,000 range, total accidents decreased from an average of 295.5 to 187.0 (36.7%) and wet-pavement accidents decreased from an average of 82.0 to 20.0 (76.5%).

Benefit/Cost

Tables 7 and 8 show Benefit/Cost data for the 46 "2 and 2" projects. Table 7 shows the total number of property damage accidents as well as the number of people killed and injured in all accidents at each of the 46 locations. Table 8 shows similar data as Table 7, but Table 8 deals only with wet-pavement accidents. Mix D, which was used on 25 projects, showed a Benefit/Cost ratio of $1.59 per accident reduced per service life of the countermeasure. Mix E, used on 17 projects, showed a ratio of $6.45. The PCC Pavement countermeasure showed a ratio of $1.08.

2 and 1 Preliminary Projects

There were a total of 39 "2 and 1" projects eligible for this report. A brief preliminary evaluation has been done on these 39 projects in preparation for a more detailed final evaluation which will be conducted in next year's report. There were a total of six countermeasures which were used at the 39 "2 and 1" locations. They are Mix D, Mix D & E, Mix E & PCC PVT., Mix E, PCC PVT., and Grinding. The accident data are presented as a one year average in order to allow an equal comparison between the "before" and "after" periods. Table 9 shows the total accident data for the "2 and 1" projects. In the before period there was a one year average of 1,219.5 total accidents at the 39 locations. Total accidents were reduced in the after period to 1,067.0. This is a reduction of 13 percent. Accidents involving injuries or fatalities were reduced from 403.5 (397.0 personal injury and 6.5 fatal) accidents to 284.0 (275.0 personal injury and 9.0 fatal) accidents for a reduction of 30 percent. Table 10 shows similar wet-pavement accident history for the same 39 locations. As is the case with the "2 and 2" projects, wet pavement accidents were reduced substantially in relation to total accidents.

In the before period, there was a one year average of 344.0 total wet-pavement accidents and in the after period there were 222.0. This is a reduction of 35 percent. Accidents involving injuries or fatalities were reduced from 116.5 (115.5 personal injury and 1.0 fatal) accidents to 73.0 (72.0 personal injury and 1.0 fatal) accidents. This is a reduction of 37 percent. The countermeasure which appears to be the most successful in reducing wet-pavement accidents is Mix E, which was used on 14 projects and reduced total wet-pavement accidents by 63 percent and accidents involving injuries or fatalities by 71 percent. PCC pavement, which reduced total accidents by 100

percent as well as accident severity by 100 percent was used on only one project.

When these figures are compared to the wet-weather data on Table 11 it appears that each countermeasure, with the exception of Mix D & E, has been extremely successful in reducing wet-pavement accidents. PCC Pavement had the greatest net reduction of 127.5%.

Conclusion

Upon examination of the results it appears that the skid-proofing countermeasures used were effective in reducing the occurrance of wet-pavement accidents. Even when compared to the change in the number of wet-weather days, wet-pavement accidents decreased at a higher rate. Of the countermeasures used on "2 and 2" projects, PCC Pavement was the most effective at reducing wet-pavement accidents. However, PCC Pavement was used on only four projects and it is difficult to gain a true representation of its effectiveness with so little data available. Mix E, which had a net reduction of 52.4 percent was used on 17 projects and shows a better example of the effectiveness of the countermeasure. The same is true in the case of the "2 and 1" projects. PCC Pavement showed the greatest percent reduction but was used on only one project. The countermeasure which was used on the greatest number of projects and had the highest percent reduction was, again, Mix E.

TABLE 1

TOTAL ACCIDENTS BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	AVERAGE NUMBER OF ACCIDENTS IN THE BEFORE PERIOD				AVERAGE NUMBER OF ACCIDENTS IN THE AFTER PERIOD				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	25	$14,816,985	1474	948	516	10	1153	807	341	5	22	34	$18,463.53
MIX E	17	$2,677,582	1275	842	432	1	1014	735	279	0	20	36	$4,103.57
PCC PVT.	4	$6,775,830	521	398	120	3	314	226	88	0	40	28	$13,093.39
TOTAL	46	$24,270,397	3270	2188	1068	14	2481	1768	708	5	24	34	$12,304.38

TABLE 2

TOTAL WET-PAVEMENT ACCIDENTS BY COUNTERMEASURE TYPE
FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	AVERAGE NUMBER OF ACCIDENTS IN THE BEFORE PERIOD				AVERAGE NUMBER OF ACCIDENTS IN THE AFTER PERIOD				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	25	$14,816,985	468	287	179	2	223	162	61	0	52	66	$24,191.00
MIX E	17	$2,677,582	423	261	162	0	191	129	62	0	55	62	$4,616.52
PCC PVT.	4	$6,775,830	139	98	40	1	37	29	8	0	73	80	$26,571.88
TOTAL	46	$24,270,397	1030	646	381	3	451	320	131	0	56	66	$16,767.11

TABLE 3

CHANGE IN WET-PAVEMENT ACCIDENTS COMPARED
TO CHANGE IN WET-WEATHER DAYS *
TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET-PAVEMENT ACCIDENTS BEFORE IMPROVEMENT	NUMBER OF WET-PAVEMENT ACCIDENTS AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET-PAVEMENT ACCIDENTS
MIX D	25	468	223	52.4% / 50.0%
MIX E	17	423	191	54.8% / 52.4%
PCC PVT.	4	139	37	73.4% / 71.0%
TOTAL	46	1030	451	56.2% / 53.8%

	AVERAGE NUMBER OF WET-WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET-WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET-WEATHER DAYS
YEARLY AVERAGE NUMBER OF WET-WEATHER DAYS	218.25	213	2.4%

* ANY DAY IN WHICH THERE WAS AT LEAST 0.01 INCH OF PRECIPITATION

TABLE 4

TOTAL ACCIDENTS BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
URBAN

		ALL ACCIDENTS		WET-PAVEMENT ACCIDENTS	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	14	651	600	157	108
4	17	1657	1215	617	245
6	1	59	40	18	8
8	1	498	288	134	31
TOTAL	33	2865	2143	926	392

TABLE 5

TOTAL ACCIDENTS BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
RURAL

		ALL ACCIDENTS		WET-PAVEMENT ACCIDENTS	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	10	343	287	93	55
4	3	62	51	11	4
TOTAL	13	405	338	104	59

TABLE 6

AVERAGE ACCIDENTS PER PROJECT BY ADT RANGE
TWO YEARS BEFORE AND TWO YEARS AFTER

ADT	NUMBER OF PROJECTS	ALL ACCIDENTS		WET-PAVEMENT ACCIDENTS	
		2 YEARS BEFORE	2 YEARS AFTER	2 YEARS BEFORE	2 YEARS AFTER
0–10,000	24	34.8	30.9	8.8	5.4
10,000–20,000	12	74.9	56.7	24.6	11.1
20,000–40,000	8	118.0	85.8	44.9	18.6
OVER 40,000	2	295.5	187.0	82.0	20.0
TOTAL	46				

TABLE 7

BENEFIT/COST DATA FOR COMPLETED PROJECTS
TWO YEARS BEFORE AND TWO YEARS AFTER
ALL ACCIDENTS

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX D	25	11 / 6	822 / 579	948 / 807	2.29	5
MIX E	17	1 / 0	696 / 445	842 / 735	9.62	5
PCC PVT.	4	4 / 0	181 / 141	398 / 226	2.17	5
TOTAL	46	16 / 6	1699 / 1165	2188 / 1768	3.06	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE ACCIDENTS

Note: The Benefit/Cost ratio is the monetary accident savings realized through a reduction in the number of accidents at a location divided by the improvement costs as applied over the service life of the improvement. Using this method, costs and benefits may be expressed as either an equivalent annual or present worth value of the project. Any project with a benefit-to-cost (B/C) ratio greater than 1.0 is considered economically successful and the project with the highest ratio is considered most desirable. The B/C technique is probably the most commonly used of the economic analysis techniques.

TABLE 8

BENEFIT/COST DATA FOR COMPLETED PROJECTS TWO YEARS BEFORE AND TWO YEARS AFTER WET-PAVEMENT ACCIDENTS

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX D	25	2 / 0	311 / 113	287 / 162	1.59	5
MIX E	17	0 / 0	267 / 95	261 / 129	6.45	5
PCC PVT.	4	1 / 0	56 / 9	98 / 29	1.08	5
TOTAL	46	3 / 0	634 / 217	646 / 320	1.98	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE ACCIDENTS

Note: The Benefit/Cost ratio is the monetary accident savings realized through a reduction in the number of accidents at a location divided by the improvement costs as applied over the service life of the improvement. Using this method, costs and benefits may be expressed as either an equivalent annual or present worth value of the project. Any project with a benefit-to-cost (B/C) ratio greater than 1.0 is considered economically successful and the project with the highest ratio is considered most desirable. The B/C technique is probably the most commonly used of the economic analysis techniques.

TABLE 9

TOTAL ACCIDENTS BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF ACCIDENTS TWO YEARS BEFORE IMPROVEMENT				NUMBER OF ACCIDENTS ONE YEAR AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	14	$12,657,513	237.5	159.0	76.0	2.5	208.0	138.0	69.0	1.0	12	11	$171,627
MIX D & E	6	$11,390,956	257.5	159.5	94.5	3.5	438.0	303.0	129.0	6.0	-70	-38	$25,243
MIX D & PCC. PVT	3	$9,191,190	171.0	121.5	49.0	0.5	129.0	88.0	40.0	1.0	25	17	$87,535
MIX E	14	$1,385,594	496.5	338.5	158.0	0.0	224.0	210.0	13.0	1.0	55	91	$2,034
PCC. PVT	1	$13,964	3.5	3.0	0.5	0.0	1.0	1.0	0.0	0.0	71	100	$2,234
GRINDING	1	$226,757	53.5	34.5	19.0	0.0	67.0	43.0	24.0	0.0	-25	-26	$6,719
TOTAL	39	$34,865,974	1219.5	816.0	397.0	6.5	1067.0	783.0	275.0	9.0	13	30	$91,452

TABLE 10

TOTAL WET-PAVEMENT ACCIDENTS BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF ACCIDENTS TWO YEARS BEFORE IMPROVEMENT				NUMBER OF ACCIDENTS ONE YEAR AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	14	$12,657,513	50.5	37.0	13.0	0.5	44.0	28.0	16.0	0.0	13	-19	$778,924
MIX D & E	6	$11,390,956	35.5	20.5	15.0	0.0	76.0	50.0	26.0	0.0	-114	-73	$112,503
MIX D & PCC. PVT	3	$9,191,190	75.0	49.0	25.5	0.5	30.0	22.0	7.0	1.0	60	69	$81,699
MIX E	14	$1,385,594	173.5	115.0	58.5	0.0	64.0	47.0	17.0	0.0	63	71	$5,062
PCC. PVT	1	$13,964	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	100	100	$11,171
GRINDING	1	$226,757	9.0	5.5	3.5	0.0	8.0	2.0	6.0	0.0	11	-71	$90,703
TOTAL	39	$34,865,974	344.0	227.5	115.5	1.0	222.0	149.0	72.0	1.0	35	37	$114,315

TABLE 11

CHANGE IN WET-PAVEMENT ACCIDENTS COMPARED TO CHANGE IN WET-WEATHER DAYS *
TWO YEARS BEFORE AND ONE YEAR AFTER
(ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET-PAVEMENT ACCIDENTS BEFORE IMPROVEMENT	NUMBER OF WET-PAVEMENT ACCIDENTS AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET-PAVEMENT ACCIDENTS
MIX D	14	50.5	44.0	12.9% / 40.4%
MIX D & E	6	35.5	76.0	-114.1% / -86.6%
MIX D & PCC. PVT.	3	75.0	30.0	60.0% / 87.5%
MIX E	14	173.5	64.0	63.1% / 90.6%
PCC. PVT.	1	0.5	0.0	100.0% / 127.5%
GRINDING	1	9.0	8.0	11.1% / 38.6%
TOTAL	39	344.0	222.0	35.5% / 63.0%

	AVERAGE NUMBER OF WET-WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET-WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET-WEATHER DAYS
YEARLY AVERAGE NUMBER OF WET-WEATHER DAYS	193	246	-27.5

* ANY DAY IN WHICH THERE WAS AT LEAST 0.01 INCH OF PRECIPITATION

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
40914 0150	McDonough	Resurfacing and traffic signal modernization on US 67/136 between the US 67/136 intersection and Prairie St. in and west of Macomb	02/08/88	5,500	D	2
40760 0073	Peoria	Resurfacing and traffic signals on US 150 (War Memorial Dr.) from west of Frostwood Pkwy., southeast to West Northland Ave. in Peoria	12/20/88	21,800	D	4
40695 0059	Adams	Resurfacing on Il 104 between Il 336 and TR 150 1 mile east of Quincy	07/08/88	6,900	D	4
80119 0076	Lake	Resurfacing on US 45 at the intersection with Inverrary Ln. at the southwest edge of Riverwoods	08/20/89	27,500	D	4
80069 0070	DuPage	Channelize the intersection of Rohlwing Rd. and Nordic Rd. in Itasca	11/22/88	12,000	D	4
42975 0050	Jersey Madison	Deck repairs on Il 267 from US 67 north of Godfrey north to Delhi	12/10/88	5,900 6,500	D	2
42950 0010	Ogle	Resurfacing on Il 72 from the west limits of Stillman Valley, east to US 51 at Davis Junction	09/12/88	2,150 2,150	D	2
42906 0008	Henry	Resurfacing on US 34 from the west edge of Galva east to Il 91	11/07/88	2,700	D	2
42875 0082	Carroll	Resurfacing on Il 84 between Pike Rd. and Il 64 in Savanna	11/11/89	10,500 10,500	D	2
42860 0074	Stephenson	Resurfacing on Il 26 over Yellow Creek (remove existing structure)	06/24/89	6,600 6,600	D	2
42863 0069	St.Clair	Resurfacing on Il 15 from the entrance of Our Lady of Snows Shrine to Il 13 west of Belleville	10/28/88	10,400	D	4
42844 0067	Madison	Resurfacing for left turn lanes on Il 159 at the intersection with Glen Crossing Rd. in Glen Carbon	06/21/88	11,900	D	2
42841 0066	Madison	Resurfacing on Il 159 between Railroad St. and Wilson St. in Collinsville	11/19/88	16,000	D	2
88022 0095	Peoria	Resurfacing on Il 88 between Northmoor Rd. and Prospect Rd. in Peoria	07/27/89	30,200 30,200	D	4
42183 0042	Kane	Resurfacing, bridge widening, and deck repairs at eastbound Bus. US 20 over westbound US 20 and at US 20 over McLean Blvd. in Elgin	09/03/88	19,600 19,600	D	4
42793 0002	Boone	Resurfacing on New Belvidere Bypass from Bus US 20 at Appleton St. to Il 76 at the northwest edge of Belvidere	07/31/88	4,800 4,800	D	4

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
80126 0025	DuPage	Reconstruction, resurfacing and traffic signals at the intersection of Il 64 and Prince Crossing Rd. at the northeast edge of West Chicago	11/22/89	23,725	D	4
94050 0286	Effingham	Resurfacing on Il 33 5.5 miles east of Effingham to the Effingham Jasper County line	11/09/89	4,000	D	2
84061 0186	Winnebago	Remove existing structure and replace with RC box culvert carrying Il 2 over drainage ditches .9 and .7 mile respectively north of Latham Rd.	09/02/89	5,300 5,300	D	2
84065 0075	Rock Island	Remove and replace existing structure with concrete I-beam bridge carrying Hillsdale Rd. over Canoe Creek 3 miles west of Hillsdale	09/23/89	850	D	2
42801 0001	Boone	On Bus US 20 from Shaw Rd. east to Belvidere	06/07/88	7,100	D	2
80209 0212	Will	Resurfacing, cold milling and patching on southbound I-55 from Il 126 south to south of Braidwood	10/30/89	28,000	D	4
80018 0178	Lake	PCC pavement and bridge deck repairs to the structure carrying Il 60 over the Tri-State Tollway in Mettawa	07/10/89	14,650	D	4
44017 0007	Kendall	Resurfacing and installation of traffic signals on US 34 at the intersection of Douglas Rd. .5 mile east of Oswego DROPPED FROM HES	11/07/88	1,400 1,400	D	2
42665 0008	Saline	Cold milling and resurfacing on US 45 from .25 mile west of the intersection of Il 142 east to west of Jefferson St. in Eldorado	08/08/88	9,000	D	2
42997 0047	Lee	Removal of IC RR structure on US 52 at Henkel Rd. 3.5 miles southeast of Sublette	09/29/88	2,500	D	2
42034 0238	Adams	Resurfacing, RC box culvert, and bridge repairs all on Il 104 from 1.4 miles east of Il 336 to Burton Rd. east of Quincy	05/12/88	5,500	D	4
80016 0090	Lake	Resurfacing and replace structure (over Des Plaines River) on Il 60 between Il 21 and Tri-State Tollway in Mettawa	05/20/89	23,250 23,250	D	4
42377 0061	Cook	Channelize, resurface and traffic signals at the intersection of Il 62 and Lexington Dr. in South Barrington and Hoffman Estates	11/07/88	17,300	D	4
42557 0018	Lawrence	Resurfacing, waterproofing and deck repairs to 3 structures all on US 50 from .18 mile east to 4.23 mile east of Il 1 north and east of Lawrenceville	06/17/88	3,000	D	4
42359 0017	LaSalle	Resurfacing on Il 71, between Covel Creek, southwest of Ottawa and Il 23 in Ottawa	10/14/88	2,850 2,850	D	2
44064 0023	Kendall	Resurfacing on US 34 between Little Rock Rd. and Rock River in Plano	07/09/89	10,000	D	2

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
44056 0036	Rock Island	Resurfacing on Il 5 (John Deere Rd.), 7th St. and relocated Blackhawk Rd. and traffic signals at 7th and John Deere Rd. all in Moline COMBINED WITH 44073	11/11/89	18,300 18,300	D	4
44040 0052	Stephenson	Remove and replace superstructure carrying Il 26 over the SCWRTC RR and Richland Creek northwest of Orangeville	11/08/88	2,800	D	2
44073 0079	Rock Island	Roadway reconstruction and modernize traffic signals on IL 5 (Blackhawk Rd.) from west of 38th St. in Rock Island east to 3rd St.in Moline COMBINED WITH 44056	12/12/89	17,200 17,200	D	4
80090 0104	DuPage	Left turn lane on northbound IL 59 at Ferry Rd. and resurfacing on Il 59 at Il 5 south ramps in Naperville	07/27/88	24,825 49,500	D	4
88014 0110	Knox	Remove and replace structure carrying IL 17 over Fitch Creek 2 miles west of Lafayette	11/13/89	650	D	2
80000 0158	Cook	Resurfacing on Kedzie Ave. between 103rd St. and 87th St. in Evergreen Park	07/01/89	22,000	D	4
96017 0126	Madison Bond	Resurfacing on IL 140 between Il 160 east of Alhambra and IL 127 in Greenville	06/03/89	1,400 1,400	D	2
42049 0278	Rock Island	Resurfacing on Il 5 between 7th St. and FAI 74, and rehabi-ilitate the structure carrying Il 5 over 27th St. all in Moline	09/22/88	21,000	D	4
42273 0099	Rock Island	Resurfacing and triple RC box culvert on Andalusia Rd. at Ridge-wood Rd. in Milan	07/08/88	8,000	D	2
42418 0093	Kendall	Resurfacing on US 34 from west of Cannonball Trail to west of Il 47 and reconstruction of the structure carrying US 34 over Blackberry Creek in Yorkville	11/09/88	7,850	D	2
84034 0062	JoDaviess	Widen, resurface, PCC pavement and bridge deck repairs on US 20 from Apple River to 1.75 miles northwest of Il 84, north of Hanover	11/25/89	3,600	D	2
40973 0274	McDonough	Resurfacing, construct two new bridges, and widen one bridge all on US 67 between Good Hope and Macomb	01/20/89	5,300	D	4
84050 0089	Bureau	Remove truss span and replace with CSP pipe culverts carrying US 6-34 over the Hennepin Canal and Towpath and resurfacing 1.2 miles west of Wayne	10/15/89	1,500	D	2
84046 0049	Carroll	Remove and replace 2 bridges carrying Il 78 over Sand Creek and resurfacing on Rel. Argo Fay Rd. all at the Il 78, Argo Fay Rd. intersection S of Mt. Carroll	11/18/89	1,675	D	2
84049 0021	Carroll	Remove structure and replace with PPC I-beam bridge carrying Il 73 over Straddle Creek	09/23/89	3,500	D	2
84052 0063	Rock Island	Resurfacing on Port Byron-Hillsdale Rd. extending east from Il 84, also relocate the intersection of Il 84 and Port Byron-Hillsdale Rd. at Port Byron	11/11/89	1,225 6,750	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
96058 0100	Randolph	Resurfacing on Il 150 at the "Z" curve near the north limits of Chester	10/26/88	6,000	E	2
94015 0096	Marion	Resurfacing at the intersection of Il 161 and Country Club Rd. in Centralia	10/25/88	9,000	E	2
84027 0026	Rock Island	Patching and joint repair on Il 92 (17th St.), from west of 12th St., east to 19th St., in east Moline	05/27/89	16,500	E	4
96059 0017	Madison	Resurfacing on US 67 at Tolle Ln. in Godfrey, Il 100 at Clifton Terrace Rd. northwest of Alton and on Il 3 at Il 143 in Wood River	11/19/88	12,300 11,000	E	4
44102 0021	Kankakee	Channelization, resurfacing on Il 17 from I-57 east to 360' east of Eastridge Dr. also traffic signals at the intersection of IL 17 and I-57 northbound ramp	12/10/88	14,500	E	4
42271 0168	Marion	Resurfacing on SB US 51 from Ellis St. in Central City south to Calumet St. in Centralia	05/21/88	9,100	E	2
80092 0015	Cook	Resurfacing on IL 64 at the intersection with Railroad Ave. in North Lake	06/24/88	22,000 22,000	E	6
80097 0207	Cook	Resurfacing at the intersection of 159th St. at Torrence Ave. in Calumet City	08/22/88	20,000	E	4
80068 0009	Cook	Reconstruction of the intersection of US 12 at IL 83 and Kensington Rd. with resurfacing and traffic signals in Mt. Prospect	08/03/89	45,260 45,260	E	4
44012 0003	Champaign	Resurfacing on the approaches to Anthony Dr. on US 45 near the north limits of Urbana	09/15/88	11,200	E	2
42696 0101	Perry	Resurfacing, cold-milling and new C&G on US 51 at the intersection of Il 152 in DuQuoin	07/19/88	9,200	E	2
98001 0053	Union Williamson	Resurfacing at Il 146 and IL 3 at Ware in Union Co. and on IL 37 in Johnson City in Williamson Co. and Il 148 in Herrin and IL 37 south of Marion	08/04/88	6,150	E	2
90090 0003	Champaign	Resurfacing on US 45/150 between Gregory Ave. and Broadway St. in Urbana	10/16/89	21,000	E	4
80188 0014	DuPage	Resurfacing on Il 59 north and south of the intersection of Batavia Rd. in Warrenville	06/14/89	19,050	E	4
96090 0036	St. Clair	Left turn lanes at the intersection of Il 158 and 59th St southwest of Belleville	09/28/89	4,800	E	2
42816 0001	Champaign	Resurfacing on US 150, between Springfield Ave. and FAI 74, in Champaign	10/27/88	16,500	E	4

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
80037 0012	Will	Reconstruction of the intersection of US 52 and Il 7 in Joliet	06/29/88	50,000	E	4
42663 0035	Peoria	Reconstruction of the intersection of US 150 (War Memorial Dr.) and Prospect Rd. in Peoria	12/12/88	29,350	E	4
42433 0079	Warren	Resurface and traffic control improvements at the intersection of US 34 and US 67 in Monmouth	07/15/88	11,000	E	2
84088 0042	Winnebago	Reconstruct the intersection of US 20 and Old Mill Rd at the north edge of Cherry Valley	11/11/89	17,025	E	4
80281 0047	Will	Reconstruction of the intersection of US 6 and Briggs Rd. in Joliet	11/04/89	4,950 4,950	E	2
80270 0009	Cook	Resurfacing on all four legs of US 45 (96th Ave) at the intersection of 95th St just west of Hickory Hills	06/20/89	36,150	E	4
80264 0005	Cook	Resurface the intersection of US 12/45 and Touhy Ave in Des Plaines	07/10/89	45,000	E	4
80198 0006	Cook	Resurface the intersection of Il 83 and Ridgeland Ave in Palos Heights	07/05/89	31,900	E	2
80190 0019	Lake	Resurface the intersection of US 45 and Il 120 east of Grayslake	07/05/89	27,200	E	2
80189 0020	Lake	Channelize, resurface and install traffic signals at the intersection of Il 131 and Brookside Ave. in Waukegan	08/19/89	23,400	E	4
80161 0006	Cook	Resurfacing on Des Plaines Ave. between Yuba and Harvard St. in Forest Park	06/06/89	16,300	E	4
80117 0011	Cook	Reconstruct the intersection, remove the median and install traffic signals at IL 43 and Il 68 in Northbrook	07/19/89	57,500	E	4
80077 0006	Cook	Resurfacing at the intersection of Il 19 and Des Plaines River Rd. in Schiller Park	08/11/88	26,700 26,700	E	4
42083 0002	DuPage	Resurfacing and traffic signals on Il 59 between the Batavia-Warrenville Rd. and Butterfield Rd. in Warrenville	05/14/88	19,500	E	4
42199 0043	Kane Cook	Resurfacing and repairs to 6 structures on US 20 between the Fox River and Lovell St. in Elgin	12/02/88	20,800 20,000	E	4
94026 0066	White	Installation of traffic signals at the intersection of Il 1/14 and Staley St. in Carmi	12/13/89	8,400	PCC PVT	2

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42294 0016	Macon	PCC pavement on West Main St. from Wychles Rd. east to Victoria Ave. in Decatur	10/18/88	2,100	PCC PVT.	2
42672 0173	Adams	CR PCC pavement, resurfacing and double RC box culvert at Burton Creek on Il 104 3.8 miles, east of Il 336 east 1.8 miles, all east of Quincy	05/13/88	4,200 4,200	PCC PVT.	2
40789 0119	Cook	Widen 8 structures, all on I-190 over I-294 ramps, Des Plaines River Rd., and Des Plaines River between Mannheim Rd. and East River Rd. in Rosemont & Chicago	02/11/88	107,800 107,800	PCC PVT.	8
42185 0057	Macon	Remove and replace bridge carrying West Main St. over Stevens Creek in Decatur	11/26/88	2,100 2,100	PCC PVT.	2
98012 0034	Williamson Jackson	Patching on I-57 from the Franklin County line south to Johnston City interchange and on IL 13 (Walnut St.) from Wall St. east to Lewis Ln. in Carbondale	07/15/89	16,200 19,800	GRINDING	4

TRA-16
December 01, 1988

SKID-ACCIDENT REDUCTION PROGRAM

1. Policy

The Department shall establish a program designed to minimize wet-pavement skidding accidents. This shall be accomplished by ensuring that new roadway surfaces have adequate, durable skid resistance properties, and by identifying and improving sections of roadway with high or potentially high skid-accident incidence.

2. Purpose

The purpose of this policy is to describe and outline the procedures that will provide a cost-effective skid-accident reduction program. This policy will apply to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects.

3. Guidelines for Implementation

a. Primary Activities

1) The first activity (3b) consists of incorporating adequate, durable skid-resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2) The second activity (3c) involves identifying, analyzing, and improving two categories of wet-pavement accidents locations.

a) One category is high-accident locations with overrepresented wet-pavement accidents that are improved as part of the safety improvement construction program.

b) The other category is wet-pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction program.

3) The third activity (3d) concerns feedback from field testing and analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

b. Incorporation of Skid-Resistant Surfaces During Construction and Rehabilitation

1) Portland Cement Concrete

a) Final finishing on highways with posted speed limits in excess of 40 mph shall be obtained by the use of a longitudinal artificial turf drag followed immediately by a mechanically operated metal tine transverse grooving device as specified for Type A final finish in the Standard Specifications.

b) Final finishing on highways with posted speed limits not exceeding 40 mph may be obtained by the use of a single longitudinal artificial turf drag as specified for Type B final finish in the Standard Specifications or by a combination of longitudinal artificial turf drag and transverse tining as specified for Type A final finish.

2) Bituminous Concrete

New surface courses shall have, as a minimum, friction qualities equivalent to or greater than those provided by the following guidelines.

a) Mixture C should be used as the surface course on roads and streets having a design ADT of 2000 or less.

b) Mixture D should be used as the surface course on all two-lane roads and streets having a design ADT greater than 2000, on four-lane highways having a design ADT of 25,000 or less, and on six-lane (or greater) highways having a design ADT of 60,000 or less.

c) Mixture E should be used as the surface course on four-lane highways having a design ADT greater than 25,000 and on six-lane (or greater) highways having a design ADT greater than 60,000.

The Special Provision for Skid-Resistant Bituminous Surface describes Mixtures C, D, and E.

c. Identifying, Analyzing, and Improving Wet-Pavement Accident Locations

1) High Accident Wet-Pavement Locations

The procedures for identifying, analyzing, and improving high-accident locations that have an overrepresented rate of wet-pavement accidents are included in the "Illinois Safety Improvement Processes" and Departmental Policy TRA-15 which cover the Safety Improvement Construction Program.

2) Wet-Pavement Accident Locations (Cluster Sites)

a) Identification of Cluster Sites

When a route is selected for rehabilitation/resurfacing, the wet-pavement accident records, furnished by the Division of Traffic Safety/local agency, shall be analyzed for the entire project. The identification of cluster sites shall be as outlined in Section I of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects", which is included in the "Illinois Safety Improvement Processes."

b) Analysis of Cluster Sites

Each cluster site that is identified must be analyzed by District/local agency personnel. The analysis shall comply with Section II of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/ Resurfacing Projects."

c) Corrective Treatment for Cluster Sites

After analyzing each cluster site, the District/local agency shall select the appropriate corrective treatment in accordance with Section III of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects."

d) Documentation of Process

The identification, analysis, and improvement of each cluster site must be documented and become part of the location study report for State projects and project development report for local agency projects.

d. Evaluating and Reporting on Effectiveness of the Program

1) The Bureau of Materials and Physical Research will continue to evaluate current pavement design practices to ensure that skid resistance properties are durable and suitable for the needs of traffic.

2) The Bureau of Materials and Physical Research will develop a friction-test data base for retrieval and for subsequent data analysis.

3) The Bureau of Materials and Physical Research will continue evaluation of experimental projects which provide a broad body of knowledge concerning frictional characteristics applicable to Illinois surfaces.

4) The Division of Traffic Safety, in cooperation with the Bureau of Traffic and the Districts, will determine whether selected countermeasures on rehabilitation/resurfacing projects have been effective in reducing wet-pavement accidents. The results of the evaluation will be furnished to the Bureau of Materials and Physical Research for inclusion in their annual report.

5) The Bureau of Materials and Physical Research, in cooperation with the Bureaus of Traffic and Local Roads and Streets and the Division of Traffic Safety, will prepare an annual report summarizing activities of Illinois' Skid Accident Reduction Program on both the State and local highway systems.

6) The Bureau of Traffic will include in their annual "Evaluation and Report of the Highway Safety Construction Program" data on wet-pavement accident locations improved under the Safety Improvement Program.

4. Responsibilities

a. The Directors of Highways and Traffic Safety are responsible for assuring that their Divisions comply with the procedures set forth in this Policy.

b. The Bureau of Traffic is responsible for the maintenance, updating and dissemination of this Policy.

5. Accessibility

Copies of this policy may be obtained from the Bureau of Traffic, Room 104, Administration Building.

CLOSING NOTICE

Supersedes: Departmental Policy, SKID ACCIDENT REDUCTION PROGRAM, Effective March 15, 1984

Approval:

H W Mooney — Director of Highways — 1/1/89 — Date

Melvin H Smith — Director of Traffic Safety — 1/1/89 — Date

THE ILLINOIS SKID-ACCIDENT REDUCTION PROGRAM
(TRA-16)
ACCIDENT ANALYSIS PORTION

Purpose and Scope

The purpose of this section is to assess the effectiveness of the various countermeasures used, as part of the rehabilitation/resurfacing projects, to reduce the number of wet-pavement crashes in Illinois. This assessment includes 99 projects for which contracts were awarded between July 1986 and August 1990. According to reports issued by the Bureau of Construction (BOC), 38 of the projects included in this report had a completion date prior to 1990. Therefore, crash data are available for each of these projects for two calendar years after completion. The remaining 61 projects were completed in 1990 and crash data are available for only one year after the completion of each project.

Each of the 99 projects had at least one type of engineering countermeasure applied in an attempt to reduce skidding related crashes on wet pavement surfaces. The projects were categorized according to the type of treatment used. In all, there were seven treatment categories. They are shown in the following table.

Treatment	No. Of Projects	Treatment	No. Of Projects
Mix D	51	Mix D & PCC Pavement	3
Mix E	31	PCC Pavement	2
Mix D & E	9	Grinding	1
Mix C & E	2		

Background

On March 15, 1984, IDOT issued Department Policy TRA-16, Skid-Accident Reduction Program (Appendix A). The policy was in direct response to the Federal Highway Administration's (FHWA) Technical Advisory T5040.17. The Federal advisory outlined three basic activities required for a Skid-Accident Reduction Program. The TRA-16 policy describes and outlines the procedures to be followed in the implementation of a cost-effective skid-accident reduction program. This policy applies to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects. TRA-16 includes the following guidelines for implementation of the Skid-Accident Reduction Program.

1. The incorporation of adequate, durable skid resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2. The identification, analysis, and subsequent improvement of two categories of wet-pavement accident locations.

   a) One category is high-accident locations with over-represented wet pavement accidents that are improved as part of the Safety Improvement Construction Program.

   b) The other category is wet pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction programs.

3. Field testing and accident analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

This section is a part of the third guideline. Its focus is primarily to determine whether selected countermeasures or rehabilitation/resurfacing projects have been effective in reducing wet-pavement crashes. Since its inception in 1984, there have been approximately 420 contracts awarded under the guidelines of the program. This analysis examines the projects that have crash data available for at least one year after completion and have not been previously reported.

Evaluation Approach

The Evaluation Design to be followed to determine the effectiveness of the TRA-16 program makes use of crash data for the two calendar years before the starting year of each project and compares that to crash data for one calendar year after the completion year for projects completed in 1990. Data for two calendar years before and after the completion year were used to evaluate projects completed in 1989. Projects with one year of crash data available after completion are referred to as "2 and 1" projects, and projects with two years of crash data available after completion are referred to as "2 and 2" projects. In the case of "2 and 1" projects, the crash data are presented as a one-year average in order to reflect an equal comparison between the "before" and "after" periods.

The 99 projects were grouped for evaluation purposes in a number of different ways. They were divided into categories according to the type of countermeasure that was applied to each of them. The crash experience for each project was analyzed using before and after crash data for total and wet-pavement crashes. The change (increase or decrease) in the number of wet-pavement crashes was then compared to the change in the number of days that the pavement was actually wet. The projects were also evaluated according to the number of lanes of roadway, whether the roadway was rural or urban, and average daily traffic (ADT) range. Finally, a benefit/cost analysis was done for each treatment used. For evaluation purposes, the major focus will be on the 38 "2 and 2" projects. This is because actual crash data are available for each of the two years before and two years after and there is no need to present the data in the form of a yearly average, which is the case with the "2 and 1" projects.

Results

On roadway segments included in the "2 and 2" analysis, there were 38 projects completed at a total cost of $33,978,749. At these 38 locations there were 1,408 property damage, 697 personal injury, and 11 fatal crashes in the before period. This is a total of 2,116 crashes. In the after period, at these same locations, there were 1,151 property damage, 543 personal injury, and 14 fatal crashes, for a total of 1,708 crashes (Table 1). This equates to reductions of 19 percent for total crashes and 21 percent for severe (personal injury, and fatal) crashes.

The wet pavement crashes at these locations were reduced substantially more than total crashes. They dropped from 404 property damage, 214 personal injury, and one fatal crashes during the before period to 208 property damage, 105 personal injury, and two fatal crashes in the after period. This is a decline from 619 crashes before the treatment application to 315 crashes after the treatment for a reduction of 49 percent in total crashes and 50 percent in severe crashes (Table 2). The countermeasure which was most successful in decreasing wet-pavement crashes was PCC Pavement, which showed a 100 percent reduction in crashes, however, it was used on only one project and the data that is available is not enough to draw a clear conclusion on the actual effectiveness of the countermeasure. Mix E, which was used on 14 projects, reduced total crashes 63 percent and crash severity by 61 percent. At a total cost of $1,385,594 the average cost per crash reduced is $2,519. Mix D & PCC Pavement was used on three projects and reduced total crashes 77 percent and crash severity 85 percent. With a total cost of $9,191,190, it showed an average cost per crash reduced of $31,694. Mix D, used on 13 projects, reduced total crashes and crash severity by 50 percent and 56 percent, respectively. Its total cost of $11,770,288 equates to an average cost per crash reduced of $294,257. Mix D and E, used on six projects, and grinding, used on one project, were not successful in reducing wet-pavement crashes. Each countermeasure showed an increase in both total crashes and crash severity.

The reduction in wet-pavement crashes does appear to be remarkable, but one last variable must be taken into consideration. That variable is the number

of days on which the pavement was actually wet: more precisely, the number of days on which there was at least .01 inch of precipitation. According to data from the National Weather Service, and shown on Table 3, the average number of wet-pavement days per year in the before period was 171. The number of wet-pavement days in the after period was 220. This is an increase of 28.6 percent. When this is applied to the overall change in wet-pavement crashes, a clearer picture of the actual effectiveness of the skid-proofing countermeasures can be obtained.

Had there been no skid proofing countermeasures applied at these 38 locations, one would expect the number of wet-pavement crashes to change by the same percentage as wet pavement days -- in this case an increase of 28.6 percent. However, Table 3 shows that by applying skid-proofing countermeasures, wet-pavement crashes were reduced by 49.1 percent overall, for a net reduction of 77.7 percent (49.1 + 28.6). The most effective countermeasure, Mix D and PCC Pavement, was used on three projects and showed a net reduction of 105.9 percent. Mix E, which was used on 14 projects, had a net reduction of 92.0 percent. Mix D, which was used on 13 projects, reduced wet-pavement crashes by 78.6 percent. PCC Pavement, used as a countermeasure in only one project, was not included in this comparison, since the occurrence of crashes was relatively rare.

Type of Roadway

As shown on Tables 4 and 5, 25 (66 percent) of the 38 "2 and 2" projects were on urban roadways and 13 (34 percent) were on rural roadways. Of the 25 urban projects, 19 were on 4-lane roads, and six were on 2-lane roads. Total crashes on urban roads decreased from 1,885 to 1,467 (22.2 percent) and wet-pavement crashes decreased from 580 to 272 (53.1 percent). On rural roadways, 11 of 13 were on 2-lane roads. The remaining two projects were on 4-lane roadways. Total crashes for all 13 locations increased from 231 to 241 (4.3 percent) and wet-pavement crashes increased from 39 to 43 (10.3 percent).

Average Daily Traffic

Each of the 38 "2 and 2" projects was placed into one of four categories according to the average daily traffic (ADT) of that project. Each category covers a range of ADT. The ADT ranges were 0-10,000; 10,001-20,000; 20,001-40,000; and over 40,000. Of the 38 projects, 14 were in the ADT range of 0-10,000; 10 in 10,001-20,000; 11 in 20,001-40,000; and three projects in the over 40,000 range (Table 6)

In the 0-10,000 range, total crashes declined from an average of 6.6 to 4.9 crashes per project (25.8 percent). Wet-pavement crashes went down from an average of 1.0 to 0.9 (10.0 percent).

In the 10,001-20,000 range, total crashes per project decreased from an average of 53.1 to 36.0 (32.2 percent), and wet-pavement crashes decreased

from an average of 17.4 to 6.7 (61.5 percent). In the 20,001-40,000 range, total crashes decreased from an average of 106.5 to 99.7 (6.4 percent), and wet-pavement crashes declined from an average of 26.8 to 18.3 (31.7 percent). In the over 40,000 range, total crashes decreased from an average of 106.6 to 60.7 (43.1 percent) and wet-pavement crashes decreased from an average of 45.3 to 11.7 (74.2 percent).

Benefit/Cost

Tables 7 and 8 show Benefit/Cost data for the 38 "2 and 2" projects. Table 7 shows the total number of property damage crashes as well as the number of people killed and injured in all crashes at each of the 38 locations. Table 8 shows similar data as Table 7, but Table 8 deals only with wet-pavement crashes. Mix E, which was used on 14 projects, showed a Benefit/Cost ratio of 11.60 per crash reduced per service life of the countermeasure. Mix D & PCC Pavement, used on three projects, showed a ratio of 1.16, and Mix D, used on 13 projects, showed a ratio of 0.66. For wet-pavement crashes, Mix E showed a ratio of 10.90, Mix D & PCC Pavement showed a ratio of 0.94, and Mix D showed a ratio of 0.04.

2 and 1 Preliminary Projects

There were a total of 61 "2 and 1" projects eligible for this report. A brief preliminary evaluation has been done on these 61 projects in preparation for a more detailed final evaluation which will be conducted in next year's report. There were a total of five countermeasures which were used at the 61 "2 and 1" locations. They are Mix D, Mix D & E, Mix E, PCC Pavement, and Mix C & E.

The crash data are presented as a one-year average in order to allow an equal comparison between the "before" and "after" periods. Table 9 shows the total crash data for the "2 and 1" projects. In the before period there was a one-year average of 1,721.5 total crashes at the 61 locations. Total crashes were reduced in the after period to 1,328.0. This is a reduction of 23 percent. Crashes involving injuries or fatalities were reduced from 539.5 (536.0 personal injury and 3.5 fatal) crashes to 388.0 (383.0 personal injury and 5.0 fatal) crashes for a reduction of 28 percent. Table 10 shows similar wet-pavement crash history for the same 61 locations. As in the case with the "2 and 2" projects, wet pavement crashes were reduced substantially in relation to total accidents.

In the before period there was a one-year average of 377.5 total wet-pavement crashes, and in the after period there were 213.0. This is a reduction of 44 percent. Crashes involving injuries or fatalities were reduced from 130.5 (130.0 personal injury and 0.5 fatal) crashes to 63.0 (62.0 personal injury and 1.0 fatal) crashes. This is a reduction of 52 percent. The countermeasure which appears to be the most successful overall in reducing wet-pavement crashes is Mix E, which was used on 17 projects and reduced total wet-pavement crashes by 52 percent and crashes involving injuries or fatalities by 58 percent.

When these figures are compared to the wet-weather data on Table 11, it appears that each countermeasure, with the exception of PCC Pavement, has been extremely successful in reducing wet-pavement crashes. Mix E had the greatest net reduction of 70.5 percent.

Conclusion

Upon examination of the results it appears that the skid-proofing countermeasures used were effective in reducing the occurrence of wet-pavement crashes. Even when compared to the change in the number of wet-weather days, wet-pavement crashes decreased at a higher rate. Of the countermeasures used on "2 and 2" projects, PCC Pavement was the most effective at reducing wet-pavement crashes. However, PCC Pavement was used on only one project and it is difficult to gain a true representation of its effectiveness with so little data available. Mix E, which had a net reduction of 92.0 percent, was used on 14 projects and shows a better example of the effectiveness of the countermeasure. Mix D & PCC Pavement was used on three projects and also showed a very high net reduction of 105.9 percent. In the case of the "2 and 1" projects, the countermeasure which showed the highest percent reduction was Mix E.

TABLE 1

TOTAL CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES TWO YEARS BEFORE IMPROVEMENT				NUMBER OF CRASHES ONE YEAR AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER CRASHES REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	13	$11,770,288	152	94	55	3	83	56	26	1	45	53	$68,234
MIX D & E	6	$11,390,956	515	319	189	7	736	511	217	8	-43	-15	$20,617
MIX D & PCC. PVT	3	$9,191,190	342	243	98	1	158	111	46	1	54	53	$19,981
MIX E	14	$1,385,594	993	677	316	0	606	388	215	3	39	31	$1,432
PCC. PVT	1	$13,964	7	6	1	0	3	1	2	0	57	-100	$1,396
GRINDING	1	$226,757	107	69	38	0	122	84	37	1	-14	0	$6,047
TOTAL	38	$33,978,749	2116	1408	697	11	1708	1151	543	14	19	21	$33,312

TABLE 2

TOTAL WET–PAVEMENT CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES TWO YEARS BEFORE IMPROVEMENT				NUMBER OF CRASHES ONE YEAR AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX D	13	$11,770,288	32	23	9	0	16	12	4	0	50	56	$294,257
MIX D & E	6	$11,390,956	71	41	30	0	114	75	39	0	−61	−30	$105,962
MIX D & PCC. PVT	3	$9,191,190	150	98	51	1	34	26	7	1	77	85	$31,694
MIX E	14	$1,385,594	347	230	117	0	127	81	46	0	63	61	$2,519
PCC. PVT	1	$13,964	1	1	0	0	0	0	0	0	100	100	$5,586
GRINDING	1	$226,757	18	11	7	0	24	14	9	1	−33	−43	$15,117
TOTAL	38	$33,978,749	619	404	214	1	315	208	105	2	49	50	$44,709

TABLE 3

CHANGE IN WET–PAVEMENT CRASHES COMPARED TO CHANGE IN WET–WEATHER DAYS * TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER–MEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET–PAVEMENT CRASHES BEFORE IMPROVEMENT	NUMBER OF WET–PAVEMENT CRASHES AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET–PAVEMENT CRASHES
MIX D	13	32	16	50.0% / 78.6%
MIX D & E	6	71	114	–60.6% / –32.0%
MIX D & PCC. PVT.	3	150	34	77.3% / 105.9%
MIX E	14	347	127	63.4% / 92.0%
PCC. PVT.	1	1	0	100.0% / 128.6%
GRINDING	1	18	24	–33.3% / –4.7%
TOTAL	38	619	315	49.1% / 77.7%

	AVERAGE NUMBER OF WET–WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET–WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET–WEATHER DAYS
ANNUAL AVERAGE NUMBER OF WET–WEATHER DAYS	171	220	–28.6

* ANY DAY IN WHICH THERE WAS AT LEAST 0.01 INCH OF PRECIPITATION

TABLE 4

TOTAL CRASHES BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
URBAN

		ALL CRASHES		WET–PAVEMENT CRASHES	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	6	195	132	63	40
4	19	1690	1335	517	232
TOTAL	25	1885	1467	580	272

TABLE 5

TOTAL CRASHES BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
RURAL

		ALL CRASHES		WET-PAVEMENT CRASHES	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	11	115	112	20	19
4	2	116	129	19	24
TOTAL	13	231	241	39	43

TABLE 6

AVERAGE CRASHES PER PROJECT BY ADT RANGE
TWO YEARS BEFORE AND TWO YEARS AFTER

ADT	NUMBER OF PROJECTS	ALL CRASHES		WET-PAVEMENT CRASHES	
		2 YEARS BEFORE	2 YEARS AFTER	2 YEARS BEFORE	2 YEARS AFTER
0-10,000	14	6.6	4.9	1.0	0.9
10,001-20,000	10	53.1	36.0	17.4	6.7
20,001-40,000	11	106.5	99.7	26.8	18.3
OVER 40,000	3	106.6	60.7	45.3	11.7
TOTAL	38				

TABLE 7

BENEFIT/COST DATA FOR COMPLETED PROJECTS TWO YEARS BEFORE AND TWO YEARS AFTER ALL CRASHES

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX D	13	3 / 2	87 / 40	94 / 56	0.66	5
MIX D & E	6	9 / 8	312 / 358	319 / 511	−0.57	5
MIX D & PCC PVT.	3	1 / 1	149 / 71	243 / 111	1.16	5
MIX E	14	0 / 3	513 / 348	677 / 388	11.60	5
PCC PVT.	1	0 / 0	2 / 2	6 / 1	7.52	5
GRINDING	1	0 / 2	55 / 78	69 / 84	−31.53	5
TOTAL	38	13 / 16	1118 / 897	1408 / 1151	0.62	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE CRASHES

Note: The Benefit/Cost ratio is the monetary accident savings realized through a reduction in the number of crashes at a location divided by the improvement costs as applied over the service life of the improvement. Using this method, costs and benefits may be expressed as either an equivalent annual or present worth value of the project. Any project with a benefit−to−cost (B/C) ratio greater than 1.0 is considered economically successful and the project with the highest ratio is considered most desirable. The B/C technique is probably the most commonly used of the economic analysis techniques.

TABLE 8

BENEFIT/COST DATA FOR COMPLETED PROJECTS TWO YEARS BEFORE AND TWO YEARS AFTER WET–PAVEMENT CRASHES

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX D	13	0 / 0	9 / 7	23 / 12	0.04	5
MIX D & E	6	0 / 0	50 / 56	41 / 75	−0.12	5
MIX D & PCC PVT.	3	1 / 1	79 / 9	98 / 26	0.94	5
MIX E	14	0 / 0	196 / 78	230 / 81	10.90	5
PCC PVT.	1	0 / 0	0 / 0	1 / 0	1.50	5
GRINDING	1	0 / 2	10 / 17	11 / 14	−23.26	5
TOTAL	38	1 / 3	344 / 167	404 / 208	0.52	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE CRASHES

Note: The Benefit/Cost ratio is the monetary accident savings realized through a reduction in the number of crashes at a location divided by the improvement costs as applied over the service life of the improvement. Using this method, costs and benefits may be expressed as either an equivalent annual or present worth value of the project. Any project with a benefit–to–cost (B/C) ratio greater than 1.0 is considered economically successful and the project with the highest ratio is considered most desirable. The B/C technique is probably the most commonly used of the economic analysis techniques.

TABLE 9

TOTAL CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES IN THE BEFORE PERIOD				NUMBER OF CRASHES IN THE AFTER PERIOD				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX C & E	2	$257,972	106.5	74.5	31.0	1.0	82.0	61.0	21.0	0.0	23	34	$2,105.89
MIX D	38	$26,537,236	869.0	585.0	282.0	2.0	679.0	499.0	178.0	2.0	22	37	$27,933.93
MIX D & E	3	$1,038,659	234.0	156.0	76.5	1.5	222.0	147.0	74.0	1.0	5	4	$17,310.98
MIX E	17	$8,485,040	615.0	438.0	177.0	0.0	424.0	294.0	128.0	2.0	31	27	$8,864.86
PCC PVT.	1	$680,429	3.5	3.0	0.5	0.0	3.0	0.0	3.0	0.0	14	-500	$272,171.60
TOTAL	61	$36,999,336	1721.5	1182.0	536.0	3.5	1328.0	940.0	383.0	5.0	23	28	$18,805.25

TABLE 10

TOTAL WET–PAVEMENT CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES IN THE BEFORE PERIOD				NUMBER OF CRASHES IN THE AFTER PERIOD				PERCENT REDUCTION		AVERAGE COST PER ACCIDENT REDUCED
			TA	PD	PI	FA	TA	PD	PI	FA	TA	PI+FA	
MIX C & E	2	$257,972	18.0	12.5	5.5	0.0	10.0	9.0	1.0	0.0	44	82	$6,449.30
MIX D	38	$26,537,236	173.5	113.0	60.5	0.0	106.0	76.0	29.0	1.0	39	50	$78,628.85
MIX D & E	3	$1,038,659	58.5	34.0	24.0	0.5	36.0	23.0	13.0	0.0	38	47	$9,232.52
MIX E	17	$8,485,040	144.5	99.0	45.5	0.0	70.0	51.0	19.0	0.0	52	58	$22,778.63
PCC PVT.	1	$680,429	1.0	1.0	0.0	0.0	1.0	0.0	1.0	0.0	0	0	NA
TOTAL	61	$36,999,336	377.5	247.0	130.0	0.5	213.0	150.0	62.0	1.0	44	52	$44,984.00

TABLE 11

CHANGE IN WET–PAVEMENT CRASHES COMPARED TO CHANGE IN WET–WEATHER DAYS * TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET-PAVEMENT CRASHES BEFORE IMPROVEMENT	NUMBER OF WET-PAVEMENT CRASHES AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET-PAVEMENT CRASHES
MIX C & E	2	18.0	10.0	44.4% / 63.3%
MIX D	38	173.5	106.0	38.9% / 57.8%
MIX D & E	3	58.5	36.0	38.5% / 57.4%
MIX E	17	144.5	70.0	51.6% / 70.5%
PCC PVT.	1	1.0	1.0	0.0% / 18.9%
TOTAL	61	377.5	213.0	43.6% / 62.5%

ANNUAL AVERAGE NUMBER OF WET–WEATHER DAYS	AVERAGE NUMBER OF WET–WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET–WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET–WEATHER DAYS
	196	233	–18.9%

* ANY DAY IN WHICH THERE WAS AT LEAST 0.01 INCH OF PRECIPITATION

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
98025 0082	Franklin	Resurface Il 14 between Christopher and West City	12/04/90	6,000	C E	2
94091 0082	Wayne	2.47 miles of resurfacing on Main St. between Airport Rd. and E. 9th St. and on Delaware Blvd. between W. 7th St. and E. 7th St. in Fairfield	08/14/90	9,000	C E	2
80119 0076	Lake	Resurfacing on US 45 at the intersection with Inverrary Ln. at the southwest edge of Riverwoods	08/20/89	27,500	D	4
94096 0157	Effingham	3.97 miles of resurfacing on Il 33 from 0.7 to 4.7 miles east of Effingham	10/29/90	4,600	D	2
80126 0025	DuPage	Reconstruction, resurfacing and traffic signals at the intersection of Il 64 and Prince Crossing Rd. at the northeast edge of West Chicago	11/22/89	23,725	D	4
94039 0032	Jefferson	Relocate Il 148 and improve Veteran's Memorial Dr. from Triangle St. to the intersection of Il 37 in Mt. Vernon	11/24/90	8,000	D	2
86072 0056	McLean	Resurfacing on Bus loop I-55 between I-74 and I-55 in Bloomington and Normal	08/24/90	20,000	D	4
84242 0097	Henry	Remove and replace existing RC box culvert carrying US 6 over a drainage ditch 0.9 miles west of Orion Rd. north of Coal City	11/07/90	3,800	D	2
94037 0274	Clay	Bituminous concrete pavement and a double 10'x10' RC box culvert on US 50 from approximately 1.2 miles west of Xenia, east to north of Xenia	12/07/90	2,100	D	2
94050 0286	Effingham	Resurfacing on Il 33 5.5 miles east of Effingham to the Effingham Jasper County line	11/09/89	4,000	D	2
84105 0294	Winnebago	1.26 miles of resurfacing and 2, 3-span PPC I-beam bridges on Il 251, over Kilbuck Cr. and resurface the intersection of Baxter Rd. and Beltline Rd. 2 miles south of Rockford	09/29/90	3,700	D	4
96217 0056	Randolph	Reconstruction of the intersection of Il 4 (Jackson St.) and St. Louis St. in Sparta	10/16/90	5,200	D	2
80290 0102	Cook	Remove and replace the existing concrete deck on 2 structures both over FAI 94 (Michigan City Rd.)	11/17/90	81,650	D	6
84061 0186	Winnebago	Remove existing structure and replace with RC box culvert carrying Il 2 over drainage ditches .9 and .7 mile respectively north of Latham Rd.	09/02/89	5,300	D	2
84056 0072	Ogle	Reconstruction of the intersection of Il 2 and Il 72, and bridge carrying IL 2 over Mill Creek all northeast of Byron	06/19/90	6,525	D	2
84065 0075	Rock Island	Remove and replace existing structure with concrete I-beam bridge carrying Hillsdale Rd. over Canoe Creek 3 miles west of Hillsdale	09/23/89	850	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
42818 0088	Kankakee	Rehabilitate 3 sets of twin bridges all on I-57, over Soldier Creek, Grinnell Rd. and over Conrail RR north of Il 17 at the east edge of Kankakee	12/10/90	18,000	D	4
84083 0114	Ogle	Remove structure and replace with a PPC I-beam bridge carrying Il 72 over Kilbuck Creek	03/25/90	2,800	D	2
84078 0118	Whiteside	Remove structure and replace with a 3-span W-beam bridge carrying US 30 over Hennepin Feeder Canal	10/26/90	7,400	D	2
86039 0165	Bureau Putnam	Remove and replace the existing concrete deck on the bridge carrying Il 89 over the Illinois River	06/06/90	4,200	D	2
84104 0166	Whiteside	Remove and replace concrete deck on the structure carrying US 30 over the CNW RR and resurface approaches 3 miles northwest of Morrison	10/12/90	5,100	D	2
84221 0094	Whiteside	Remove and replace existing structure carrying Garden Plain Rd. over Cattail Creek 5 miles west of Morrison	10/06/90	900	D	2
94094 0014	Lawrence	Resurfacing, shoulders and patching on US 50 from 3 miles east of Lawrenceville to the Indiana state line	11/16/90	4,700	D	4
84154 0028	Rock Island	Widening and resurfacing on Hillsdale Rd. between 256th St. and Moline Rd. all west of Hillsdale	11/30/90	850	D	2
84234 0091	Ogle	Remove and replace existing structure carrying US 52 over Buffalo Creek 1 mile northwest of Polo	10/06/90	800	D	2
80437 0075	Lake	.38 miles of resurfacing and traffic signal modernization on Il 173 (Sheridan Rd.) from 7th St. to 9th St. in Winthrop Harbor	10/06/90	12,000	D	4
86160 0114	Marshall	Box culvert on Il 17 at Judd Creek 4 miles west of US 51 south of Wenona	12/03/90	1,200	D	2
80292 0231	Cook	Widening of 3 structures on I-94: over Michigan Central RR, over B&OCT RR, and over Dolton Ave. in Dolton and Calumet City	10/31/90	75,000	D	6
88014 0110	Knox	Remove and replace structure carrying IL 17 over Fitch Creek 2 miles west of Lafayette	11/13/89	650	D	2
84034 0062	JoDaviess	Widen, resurface, PCC pavement and bridge deck repairs on US 20 from Apple River to 1.75 miles northwest of Il 84, north of Hanover	11/25/89	3,600	D	2
84046 0049	Carroll	Remove and replace 2 bridges carrying Il 78 over Sand Creek and resurfacing on Rel. Argo Fay Rd. all at the Il 78, Argo Fay Rd. intersection S of Mt. Carroll	11/18/89	1,675	D	2
44279 0092	Macon	Resurface and widen the bridge carrying Il 105 over Spring Creek and traffic signals on Il 48 from US 51 to Il 105 then east on Il 105 to Bus US 51	11/24/90	12,600	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84049 0021	Carroll	Remove structure and replace with PPC I-beam bridge carrying Il 73 over Straddle Creek	09/23/89	3,500	D	2
84052 0063	Rock Island	Resurfacing on Port Byron-Hillsdale Rd. extending east from Il 84, also relocate the intersection of Il 84 and Port Byron-Hillsdale Rd. at Port Byron	11/11/89	1,225	D	2
84050 0089	Bureau	Remove truss span and replace with CSP pipe culverts carrying US 6-34 over the Hennepin Canal and Towpath and resurfacing 1.2 miles west of Waynet	10/15/89	1,500	D	2
84054 0109	Winnebago Boone	1.82 miles of PCC pavement and 2 double box culverts on Bus US 20, between the Northeast Tollway and Olsen Rd. east of Rockford	10/17/90	11,900	D	4
86163 0134	McLean	1.78 miles of resurfacing on southbound US 51 (Center St.) from Hovey St. south to Oakland Ave. in Bloomington, Normal	12/05/90	17,400	D	2
84175 0043	Whiteside	Remove and replace existing structure and resurface approaches carrying US 30 over the C&NW RR west of Sterling	12/15/90	4,000	D	2
84235 0033	Dekalb	Remove and replace existing structure carrying Il 72 over a drainage ditch and resurface approaches 3 miles west of Kirkland	11/10/90	950	D	2
42860 0074	Stephenson	Resurfacing on Il 26 over Yellow Creek (remove existing structure)	06/24/89	6,600	D	2
42875 0082	Carroll	Resurfacing on Il 84 between Pike Rd. and Il 64 in Savanna	11/11/89	10,500	D	2
84197 0023	Boone	Remove and replace bridge carrying Il 76 over Beaver Creek 1.5 miles southwest of Poplar Grove	12/08/90	2,600	D	2
84193 0024	Carroll	Remove and replace bridge carrying Il 78 over a tributary of the East Fork of Plum Creek 4 miles north of Mt. Carroll	07/12/90	700	D	2
84172 0032	Whiteside	Remove and replace bridge carrying US 30 over the Rock River 2 miles west of Rock Falls	12/15/90	4,500	D	2
80501 0088	Will	Widen existing bridge carrying US 6 over the I&M canal, and resurfacing on US 6 and Brandon Dr. near the east limits of Rockdale	10/31/90	60,800	D	4
86112 0104	Marshall	Remove and replace the bridge carrying Il 17 over the Illinois River at Lacon	12/22/90	5,900	D	2
86119 0010	Grundy	.64 miles resurfacing on Il 113 from Mary Ave. to Lincoln St. in Coal City	05/18/90	8,400	D	2
96194 0033	St.Clair	0.33 miles of resurfacing on US 50 at the intersection with Shiloh Rd. in O'Fallon	12/07/90	13,000	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84178 0087	Ogle	RC box culvert and resurface the approaches carrying Il 72 over a drainage ditch 250 ft. west of the Mt. Vernon Rd. intersection north of Forreston	08/21/90	1,700	D	2
96190 0146	Randolph	1.02 miles of resurfacing on Il 3 from 0.15 miles south of Kaskaskia Dr. to Market St. in Red Bud	08/05/90	8,600	D	2
86121 0178	Iroquois	4.04 miles of resurfacing on I-57 from 1 mile north of Gilman, south to near Onarga	08/31/90	13,300	D	4
84173 0180	Winnebago	1.30 miles of resurfacing and traffic signal modernization on eastbound Bus US 20 from West State St. to East State St. in Rockford	11/10/90	6,500	D	2
84176 0182	Bureau	Remove and replace structure carrying Il 92 over Bureau Creek and resurface approaches 1.6 miles west of US 34 north of Lamoille	01/26/90	800	D	2
40973 0274	McDonough	Resurfacing, construct two new bridges, and widen one bridge all on US 67 between Good Hope and Macomb	01/20/89	5,300	D E	4
80018 0178	Lake	PCC pavement and bridge deck repairs to the structure carrying Il 60 over the Tri-State Tollway in Mettawa	07/10/89	14,650	D E	4
80016 0090	Lake	Resurfacing and replace structure (over Des Plaines River) on Il 60 between Il 21 and Tri-State Tollway in Mettawa	05/20/89	23,250	D E	4
44064 0023	Kendall	Resurfacing on US 34 between Little Rock Rd. and Rock River in Plano	07/09/89	10,000	D E	2
96156 0033	St. Clair	Resurfacing on Il 158/177 from just east of Greenmount Com. Rd. in Belleville east to west of Il 4 in Mascoutah	11/24/90	6,700	D E	4
80209 0212	Will	Resurfacing, cold milling and patching on southbound I-55 from Il 126 south to south of Braidwood	10/30/89	28,000	D E	4
96169 0027	St. Clair	Resurfacing and traffic signals on Il 161 between Sherman St. and Green Mount Rd. in and east of Belleville	10/27/90	22,700	D E	4
96131 0236	St. Clair Madison	Bituminous concrete resurfacing on I-70 between the B&O RR and Canteen Creek north and east of East St. Louis	11/29/90	38,900	D E	6
88022 0095	Peoria	Resurfacing on Il 88 between Northmoor Rd. and Prospect Rd. in Peoria	07/27/89	30,200	D E	4
80000 0158	Cook	Resurfacing on Kedzie Ave. between 103rd St. and 87th St. in Evergreen Park	07/01/89	22,000	D PCC PVT	4
44073 0079	Rock Island	Roadway reconstruction and modernize traffic signals on IL 5 (Blackhawk Rd.) from west of 38th St. in Rock Island east to 3rd St.in Moline COMBINED WITH 44056	12/12/89	17,200	D PCC PVT	4

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
44056 0036	Rock Island	Resurfacing on Il 5 (John Deere Rd.), 7th St. and relocated Blackhawk Rd. and traffic signals at 7th and John Deere Rd. all in Moline COMBINED WITH 44073	11/11/89	18,300	D PCC PVT	4
80117 0011	Cook	Reconstruct the intersection, remove the median and install traffic signals at IL 43 and Il 68 in Northbrook	07/19/89	57,500	E	4
80161 0006	Cook	Resurfacing on Des Plaines Ave. between Yuba and Harvard St. in Forest Park	06/06/89	16,300	E	4
80189 0020	Lake	Channelize, resurface and install traffic signals at the intersection of Il 131 and Brookside Ave. in Waukegan	08/19/89	23,400	E	4
80190 0019	Lake	Resurface the intersection of US 45 and Il 120 east of Grayslake	07/05/89	27,200	E	2
80198 0006	Cook	Resurface the intersection of Il 83 and Ridgeland Ave in Palos Heights	07/05/89	31,900	E	2
80264 0005	Cook	Resurface the intersection of US 12/45 and Touhy Ave in Des Plaines	07/10/89	45,000	E	4
80270 0009	Cook	Resurfacing on all four legs of US 45 (96th Ave) at the intersection of 95th St just west of Hickory Hills	06/20/89	36,150	E	4
80281 0047	Will	Reconstruction of the intersection of US 6 and Briggs Rd. in Joliet	11/04/89	4,950	E	2
84088 0042	Winnebago	Reconstruct the intersection of US 20 and Old Mill Rd at the north edge of Cherry Valley	11/11/89	17,025	E	4
96090 0036	St. Clair	Left turn lanes at the intersection of Il 158 and 59th St southwest of Belleville	09/28/89	4,800	E	2
80175 0284	DuPage	Channelize and resurface the intersection of Irving Park Rd. and Roselle Rd. in Roselle	11/28/90	34,950	E	2
88081 0307	Peoria	Reconstruct, resurface and modernize traffic signals at the intersections on Il 88 at Lake Ave. and McClure Ave. in Peoria	12/11/90	35,000	E	4
80288 0101	Cook	Remove and replace bridge superstructure, resurface at the I-94 (Calumet Expressway) and Sibley Blvd. interchange in Dolton	11/17/90	100,800	E	6
80188 0014	DuPage	Resurfacing on Il 59 north and south of the intersection of Batavia Rd. in Warrenville	06/14/89	19,050	E	4
90090 0003	Champaign	Resurfacing on US 45/150 between Gregory Ave. and Broadway St. in Urbana	10/16/89	21,000	E	4

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84157 0038	Whiteside	Resurfacing and C&G at the intersection of Il 2 and M Ave. in Sterling	12/03/90	12,100	E	3
96165 0098	Madison	Resurfacing and detector loop replacement on Il 111 at Washington Ave. in Alton and along Il 3 at Levis Ln. northwest of Alton	05/24/90	19,800	E	4
80068 0009	Cook	Reconstruction of the intersection of US 12 at IL 83 and Kensington Rd. with resurfacing and traffic signals in Mt. Prospect	08/03/89	45,260	E	4
84027 0026	Rock Island	Patching and joint repair on Il 92 (17th St.), from west of 12th St., east to 19th St., in east Moline	05/27/89	16,500	E	4
84006 0108	Whiteside	1.08 miles of resurfacing and PCC pavement on Il 88 from 2nd St. south to 16th St. in Rock Falls	11/03/90	8,000	E	4
80249 0012	Cook	0.34 miles of resurfacing on Il 171 at the intersection with Bell Rd. east Lemont	07/02/90	18,950	E	2
80304 0018	Kane	Reconstruction of the intersection of Il 25 and Army Trail Rd.	09/29/90	7,500	E	2
80215 0054	McHenry	Traffic signals, replace existing structure, and resurface the approaches on the bridge carrying Il 31/120 over Boone Creek in McHenry	12/10/90	14,200	E	4
94095 0137	Effingham	Reconstruct northern ramps, frontage road, and new bridge deck on southbound lanes, and resurface northbound lanes on I-70 bridge over Il 32/33	12/15/90	33,000	E	4
80309 0008	Kane DuPage	.19 miles resurfacing on Il 31 at the intersection of Kimball St.-Lawrence Ave. in Elgin and .29 miles resurfacing on Il 56 at Il 59 in Warrenville	09/17/90	17,000	E	4
80342 0013	Lake Cook	.37 miles of resurfacing on Il 43 at the intersections of Deerfield Rd. and Lake-Cook Rd. in Deerfield	08/27/90	61,650	E	4
88170 0080	Tazewell	.23 miles of resurfacing, median removal and traffic signal modernization on Court St. from Audubon St. to Cottage Grove Ave. in Pekin	08/12/90	25,000	E	4
94092 0042	Marion	2.95 miles of resurfacing on US 51 (Broadway St.) from Ellis St. in Central City, south to the south city limit of Centralia	11/03/90	9,100	E	2
80575 0170	Will	.26 miles of resurfacing at the intersection of US 52 and Il 7 in Joliet	10/25/90	54,800	E	4
84183 0260	Henry	.36 miles of resurfacing on Il 78 (Main St.) from the BN RR south to Central Blvd. in Kewanee	11/03/90	10,000	E	2
96340 0046	St.Clair	.22 miles of resurfacing on Old US 50 at 5th St. in O'Fallon	12/01/90	16,000	E	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
94026 0066	White	Installation of traffic signals at the intersection of Il 1/14 and Staley St. in Carmi	12/13/89	8,400	PCC PVT	2
84186 0028	Winnebago	1.29 miles of pavement patching on Bus US 20 and US 20 (Bypass) between Falconer Rd. and Weldon Rd. West of Rockford	07/09/90	5,000	PCC PVT.	4
98012 0034	Williamson Jackson	Patching on I-57 from the Franklin County line south to Johnston City interchange and on IL 13 (Walnut St.) from Wall St. east to Lewis Ln. in Carbondale	07/15/89	16,200	GRINDING	4

SKID-ACCIDENT REDUCTION PROGRAM

1. Policy

The Department shall establish a program designed to minimize wet-pavement skidding accidents. This shall be accomplished by ensuring that new roadway surfaces have adequate, durable skid resistance properties, and by identifying and improving sections of roadway with high or potentially high skid-accident incidence.

2. Purpose

The purpose of this policy is to describe and outline the procedures that will provide a cost-effective skid-accident reduction program. This policy will apply to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects.

3. Guidelines for Implementation

a. Primary Activities

1) The first activity (3b) consists of incorporating adequate, durable skid-resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2) The second activity (3c) involves identifying, analyzing, and improving two categories of wet-pavement accidents locations.

a) One category is high-accident locations with overrepresented wet-pavement accidents that are improved as part of the safety improvement construction program.

b) The other category is wet-pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction program.

3) The third activity (3d) concerns feedback from field testing and analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

b. Incorporation of Skid-Resistant Surfaces During Construction and Rehabilitation

1) Portland Cement Concrete

a) Final finishing on highways with posted speed limits in excess of 40 mph shall be obtained by the use of a longitudinal artificial turf drag followed immediately by a mechanically operated metal tine transverse grooving device as specified for Type A final finish in the Standard Specifications.

b) Final finishing on highways with posted speed limits not exceeding 40 mph may be obtained by the use of a single longitudinal artificial turf drag as specified for Type B final finish in the Standard Specifications or by a combination of longitudinal artificial turf drag and transverse tining as specified for Type A final finish.

2) Bituminous Concrete

New surface courses shall have, as a minimum, friction qualities equivalent to or greater than those provided by the following guidelines.

a) Mixture C should be used as the surface course on roads and streets having a design ADT of 2000 or less.

b) Mixture D should be used as the surface course on all two-lane roads and streets having a design ADT greater than 2000, on four-lane highways having a design ADT of 25,000 or less, and on six-lane (or greater) highways having a design ADT of 60,000 or less.

c) Mixture E should be used as the surface course on four-lane highways having a design ADT greater than 25,000 and on six-lane (or greater) highways having a design ADT greater than 60,000.

The Special Provision for Skid-Resistant Bituminous Surface describes Mixtures C, D, and E.

Identifying, Analyzing, and Improving Wet-Pavement Accident Locations

1) High Accident Wet-Pavement Locations

The procedures for identifying, analyzing, and improving high-accident locations that have an overrepresented rate of wet-pavement accidents are included in the "Illinois Safety Improvement Processes" and Departmental Policy TRA-15 which cover the Safety Improvement Construction Program.

2) Wet-Pavement Accident Locations (Cluster Sites)

a) Identification of Cluster Sites

When a route is selected for rehabilitation/resurfacing, the wet-pavement accident records, furnished by the Division of Traffic Safety/local agency, shall be analyzed for the entire project. The identification of cluster sites shall be as outlined in Section I of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects", which is included in the "Illinois Safety Improvement Processes."

b) Analysis of Cluster Sites

Each cluster site that is identified must be analyzed by District/local agency personnel. The analysis shall comply with Section II of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects."

c) Corrective Treatment for Cluster Sites

After analyzing each cluster site, the District/local agency shall select the appropriate corrective treatment in accordance with Section III of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects."

d) Documentation of Process

The identification, analysis, and improvement of each cluster site must be documented and become part of the location study report for State projects and project development report for local agency projects.

Evaluating and Reporting on Effectiveness of the Program

1) The Bureau of Materials and Physical Research will continue to evaluate current pavement design practices to ensure that skid resistance properties are durable and suitable for the needs of traffic.

2) The Bureau of Materials and Physical Research will develop a friction-test data base for retrieval and for subsequent data analysis.

3) The Bureau of Materials and Physical Research will continue evaluation of experimental projects which provide a broad body of knowledge concerning frictional characteristics applicable to Illinois surfaces.

4) The Division of Traffic Safety, in cooperation with the Bureau of Traffic and the Districts, will determine whether selected countermeasures on rehabilitation/resurfacing projects have been effective in reducing wet-pavement accidents. The results of the evaluation will be furnished to the Bureau of Materials and Physical Research for inclusion in their annual report.

5) The Bureau of Materials and Physical Research, in cooperation with the Bureaus of Traffic and Local Roads and Streets and the Division of Traffic Safety, will prepare an annual report summarizing activities of Illinois' Skid Accident Reduction Program on both the State and local highway systems.

6) The Bureau of Traffic will include in their annual "Evaluation and Report of the Highway Safety Construction Program" data on wet-pavement accident locations improved under the Safety Improvement Program.

4. Responsibilities

a. The Directors of Highways and Traffic Safety are responsible for assuring that their Divisions comply with the procedures set forth in this Policy.

b. The Bureau of Traffic is responsible for the maintenance, updating and dissemination of this Policy.

5. Accessibility

Copies of this policy may be obtained from the Bureau of Traffic, Room 104, Administration Building.

CLOSING NOTICE

Supersedes: Departmental Policy, SKID ACCIDENT REDUCTION PROGRAM, Effective March 15, 1984

Approval:

H W Monroney — Director of Highways — 1/1/89 — Date

Melvin H Smith — Director of Traffic Safety — 1/1/89 — Date

THE ILLINOIS SKID-ACCIDENT REDUCTION PROGRAM
(TRA-16)
CRASH ANALYSIS PORTION

Purpose and Scope

The purpose of this section is to assess the effectiveness of the various countermeasures used, as part of the rehabilitation/resurfacing projects, to reduce the number of wet-pavement crashes in Illinois. This assessment includes 110 projects for which contracts were awarded between October 1988 and August 1991 and were completed prior to or during 1991 (Appendix A). According to reports issued by the Bureau of Construction, 61 of the projects included in this report had a completion date prior to 1991. Therefore, crash data are available for each of these projects for two calendar years after completion. The remaining 49 projects were completed in 1991 and crash data are available for only one year after the completion of these projects.

Each of the 110 projects had at least one type of engineering countermeasure applied in an attempt to reduce skidding-related crashes on wet pavement surfaces. The projects were categorized according to the type of treatment used. In all, there were eight treatment categories. They are shown in the following table.

Treatment	No. Of Projects	Treatment	No. Of Projects
Mix C & D	1	Mix E	23
Mix C & E	2	Mix E & Cold Milling	1
Mix D	71	Cold Milling	2
Mix D & E	8	PCC Pavement	2

Background

On March 15, 1984, IDOT issued Department Policy TRA-16, Skid-Accident Reduction Program (revised December 1, 1988 - Appendix A). The policy was in direct response to the Federal Highway Administration's (FHWA) Technical Advisory T5040.17. The Federal advisory outlined three basic activities required for a Skid-Accident Reduction Program. The TRA-16 policy describes and outlines the procedures to be followed in the implementation of a cost-effective skid-accident reduction program. This policy applies to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects. TRA-16 includes the following guidelines for implementation of the Skid-Accident Reduction Program.

1. The incorporation of adequate, durable skid resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2. The identification, analysis, and subsequent improvement of two categories of wet-pavement accident locations.

   a) One category is high-accident locations with over-represented wet pavement accidents that are improved as part of the Safety Improvement Construction Program.

   b) The other category is wet pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction programs.

3. Field testing and accident analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

This section is a part of the third guideline. Its focus is primarily to determine whether selected countermeasures or rehabilitation/resurfacing projects have been effective in reducing wet-pavement crashes. Since its inception in 1984, there have been approximately 530 contracts awarded under the guidelines of the program. This analysis examines the projects that have crash data available for at least one year after completion and have not been previously reported.

Evaluation Approach

The Evaluation Design to be followed to determine the effectiveness of the TRA-16 program makes use of crash data for the two calendar years before the starting year of each project and compares that to crash data for one calendar year after the completion year for projects completed in 1991. Data for two calendar years before and after the completion year were used to evaluate projects completed in 1990. Projects with one year of crash data available after completion are referred to as "2 and 1" projects, and projects with two years of crash data available after completion are referred to as "2 and 2" projects. In the case of "2 and 1" projects, the crash data are presented as a one-year average in order to reflect an equal comparison between the "before" and "after" periods.

The 110 projects were grouped for evaluation purposes in a number of different ways. They were divided into categories according to the type of countermeasure that was applied to each of them. The crash experience for each project was analyzed using before and after crash data for total and wet-pavement crashes. The change (increase or decrease) in the number of wet-pavement crashes was then compared to the change in the number of days that the pavement was actually wet. The projects were also evaluated according to the number of lanes of roadway, whether the roadway was rural or urban, and average daily traffic (ADT) range. Finally, a benefit/cost analysis was done for each treatment used. For evaluation purposes, the major focus will be on the 61 "2 and 2" projects. This is because actual crash data are available for each of the two years before and two years after and there is no need to present the data in the form of a yearly average, which is the case with the "2 and 1" projects.

Results

On roadway segments included in the "2 and 2" analysis, there were 61 projects completed at a total cost of $36,999,336. At these 61 locations there were 2,425 property damage, 1,100 personal injury, and six fatal crashes in the before period. This is a total of 3,531 crashes. In the after period, at these same locations, there were 1,843 property damage, 777 personal injury, and seven fatal crashes, for a total of 2,627 crashes (Table 1). This equates to reductions of 26 percent for total crashes and 29 percent for severe (personal injury and fatal) crashes.

The wet pavement crashes at these locations were reduced substantially more than total crashes. They dropped from 515 property damage, 270 personal injury, and one fatal crash during the before period to 323 property damage, 134 personal injury, and one fatal crash in the after period. This is a decline from 786 crashes before the treatment application to 458 crashes after the treatment for a reduction of 42 percent in total crashes and 50 percent in severe crashes (Table 2). The countermeasure which was most successful in decreasing wet-pavement crashes was PCC Pavement, which showed a 50 percent reduction in crashes; however, it was used on only one project and the data that is available is not enough to draw a clear conclusion on the actual effectiveness of the countermeasure. Mix E, which was used on 17 projects, reduced total crashes 48 percent and crash severity by 52 percent. At a total cost of $8,485,040, the average cost per crash reduced is $24,243. Mix C & E was used on two projects and reduced total crashes 42 percent and crash severity 64 percent. With a total cost of $257,972, it showed an average cost per crash reduced of $6,879. Mix D, used on 38 projects, reduced total crashes and crash severity by 39 percent and 53 percent, respectively. Its total cost of $26,537,236 equates to an average cost per crash reduced of $79,216. Mix D & E, used on three projects, also showed a reduction in crashes, 32 percent in total and 40 percent in severe crashes.

The reduction in wet-pavement crashes does appear to be remarkable, but one last variable must be taken into consideration. That variable is the number

of days on which the pavement was actually wet: more precisely, the number of days on which there was at least .01 inch of precipitation. According to data from the National Weather Service, and shown in Table 3, the average number of wet-pavement days per year in the before period was 94. The number of wet-pavement days in the after period was 120. This is an increase of 27.7 percent. When this is applied to the overall change in wet-pavement crashes, a clearer picture of the actual effectiveness of the skid-proofing countermeasures can be obtained.

Had there been no skid proofing countermeasures applied at these 61 locations, one would expect the number of wet-pavement crashes to change by the same percentage as wet pavement days -- in this case an increase of 27.7 percent. However, Table 3 shows that by applying skid-proofing countermeasures, wet-pavement crashes were reduced by 41.7 percent overall, for a net reduction of 69.4 percent (41.7 + 27.7). The most effective countermeasure, PCC Pavement, was used on one project and showed a net reduction of 77.7 percent. Mix E, which was used on 17 projects, had a net reduction of 76.1 percent. Mix C & E, which was used on two projects, reduced wet-pavement crashes by 69.4 percent. Mix D & E, used on three projects, reduced wet pavement crashes 60.2 percent. Mix D, which was used on 38 projects, reduced wet pavement crashes 66.9 percent.

Type of Roadway

As shown in Tables 4 and 5, 31 (51 percent) of the 61 "2 and 2" projects were on urban roadways and 30 (49 percent) were on rural roadways. Of the 31 urban projects, 14 were on 2-lane, one was on 3-lane, 13 were on 4-lane, and three were on 6-lane roadways. Total crashes on urban roads decreased from 2,809 to 2,018 (28.2 percent) and wet-pavement crashes decreased from 644 to 348 (46.0 percent). On rural roadways, 22 of 30 were on 2-lane, seven were on 4-lane, and one was on a 6-lane roadway. Total crashes for all 30 locations decreased from 722 to 609 (15.7 percent) and wet-pavement crashes decreased from 142 to 110 (22.5 percent).

Average Daily Traffic

Each of the 61 "2 and 2" projects was placed into one of four categories according to the average daily traffic (ADT) of that project. Each category covers a range of ADT. The ADT ranges were 0-10,000; 10,001-20,000; 20,001-40,000; and over 40,000. Of the 61 projects, 35 were in the ADT range of 0-10,000; 14 in 10,001-20,000; six in 20,001-40,000; and six projects in the over 40,000 range (Table 6).

In the 0-10,000 range, total crashes declined from an average of 37.6 to 27.3 crashes per project (27.4 percent). Wet-pavement crashes went down from an average of 7.3 to 4.3 (41.1 percent).

In the 10,001-20,000 range, total crashes per project decreased from an average of 100.6 to 71.4 (29.0 percent), and wet-pavement crashes decreased

from an average of 25.1 to 13.0 (48.2 percent). In the 20,001-40,000 range, total crashes decreased from an average of 86.2 to 74.7 (13.3 percent), and wet-pavement crashes declined from an average of 21.2 to 13.3 (37.3 percent). In the over 40,000 range, total crashes decreased from an average of 48.5 to 37.2 (23.3 percent) and wet-pavement crashes decreased from an average of 8.8 to 7.5 (14.8 percent).

Benefit/Cost

Tables 7 and 8 show Benefit/Cost data for the 61 "2 and 2" projects. Table 7 shows the total number of property damage crashes as well as the number of people killed and injured in all crashes at each of the 61 locations. Table 8 shows similar data as Table 7, but Table 8 deals only with wet-pavement crashes. Mix E, which was used on 17 projects, showed a Benefit/Cost ratio of 1.36 per crash reduced per service life of the countermeasure. Mix C & E, used on two projects, showed a ratio of 6.50; Mix D & E, used on three projects, showed a ratio of 1.25; and Mix D, used on 38 projects, showed a ratio of 0.78. For wet-pavement crashes, Mix E showed a ratio of 0.56; Mix C & E showed a ratio of 2.69; Mix D showed a ratio of 0.19; and Mix D & E showed a ratio of 2.68.

2 and 1 Preliminary Projects

There were a total of 49 "2 and 1" projects eligible for this report. A brief preliminary evaluation has been done on these 49 projects in preparation for a more detailed final evaluation, which will be conducted in next year's report. There were a total of seven countermeasures which were used at the 49 "2 and 1" locations. They are Mix C & D, Mix D, Mix D & E, Cold Milling, Mix E, Mix E & Cold Milling, and PCC Pavement.

The crash data are presented as a one-year average in order to allow an equal comparison between the "before" and "after" periods. Table 9 shows the total crash data for the "2 and 1" projects. In the before period there was a one-year average of 1,246.0 total crashes at the 49 locations. Total crashes were reduced in the after period to 846.0. This is a reduction of 32 percent. Crashes involving injuries or fatalities were reduced from 356.0 (351.0 personal injury and 5.0 fatal) crashes to 245.0 (237.0 personal injury and 8.0 fatal) crashes, for a reduction of 31 percent. Table 10 shows similar wet-pavement crash history for the same 49 locations. As is the case with the "2 and 2" projects, wet pavement crashes were reduced substantially in relation to total crashes.

In the before period there was a one-year average of 284.5 total wet-pavement crashes, and in the after period there were 150.0. This is a reduction of 47 percent. Crashes involving injuries or fatalities were reduced from 81.5 (80.0 personal injury and 1.5 fatal) crashes to 36.0 (36.0 personal injury and 0 fatal) crashes. This is a reduction of 56 percent. The countermeasure which appears to be the most successful overall in reducing wet-pavement crashes is Mix E & Cold Milling, which was used on one project and reduced total wet-pavement crashes by 88 percent and crashes involving injuries or fatalities by 100 percent.

When these figures are compared to the wet-weather data in Table 11, it appears that each countermeasure, with the exception of Cold Milling, and PCC Pavement, has been extremely successful in reducing wet-pavement crashes. Mix E & Cold Milling had the greatest net reduction of 111.5 percent.

Conclusion

Upon examination of the results, it appears that the skid-proofing countermeasures used were effective in reducing the occurrence of wet-pavement crashes. When compared to the change in the number of wet-weather days, wet-pavement crashes decreased at an even higher rate. Of the countermeasures used on "2 and 2" projects, PCC Pavement was the most effective at reducing wet-pavement crashes. However, PCC Pavement was used on only one project, and it is difficult to gain a true representation of its effectiveness with so little data available. Mix E, which had a net reduction of 76.1 percent, was used on 17 projects and thereby shows a better example of the effectiveness of the countermeasure. Mix D, used on 38 projects, also showed a high net reduction of 66.9 percent. In the case of the "2 and 1" projects, the countermeasure which showed the highest percent reduction was Mix E & Cold Milling.

TABLE 1

TOTAL CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES TWO YEARS BEFORE IMPROVEMENT				NUMBER OF CRASHES TWO YEARS AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER CRASH REDUCED
			TOT	PD	PI	FA	TOT	PD	PI	FA	TOT	PI+FA	
MIX C & E	2	$257,972	213	149	62	2	175	123	51	1	18	19	–
MIX D	38	$26,537,236	1613	1082	530	1	1172	850	320	2	27	39	$24,070
MIX D & E	3	$1,038,659	468	312	153	3	425	282	141	2	9	6	$9,662
MIX E	17	$8,485,040	1230	876	354	0	849	586	261	2	31	26	$8,908
PCC PVT.	1	$680,429	7	6	1	0	6	2	4	0	14	−300	$272,172
TOTAL	61	$36,999,336	3531	2425	1100	6	2627	1843	777	7	26	29	$16,371

TABLE 2

TOTAL WET–PAVEMENT CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER–MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES TWO YEARS BEFORE IMPROVEMENT				NUMBER OF CRASHES TWO YEARS AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER CRASH REDUCED
			TOT	PD	PI	FA	TOT	PD	PI	FA	TOT	PI+FA	
MIX C & E	2	$357,972	38	25	11	0	21	17	4	0	42	64	$6,879
MIX D	38	$26,537,236	342	222	120	0	206	151	56	1	39	53	$79,216
MIX D & E	3	$1,038,659	117	68	48	1	79	50	29	0	32	40	$11,079
MIX E	17	$8,485,040	289	198	91	0	149	105	44	0	48	52	$24,243
PCC PVT.	1	$680,429	2	2	0	0	1	0	1	0	50	0	$272,172
TOTAL	61	$36,999,336	786	515	270	1	456	323	134	1	42	50	$45,190

TABLE 3

CHANGE IN WET–PAVEMENT CRASHES COMPARED TO CHANGE IN WET–WEATHER DAYS * TWO YEARS BEFORE AND TWO YEARS AFTER

COUNTER–MEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET–PAVEMENT CRASHES BEFORE IMPROVEMENT	NUMBER OF WET–PAVEMENT CRASHES AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET–PAVEMENT CRASHES
MIX C & E	2	36	21	41.7% / 69.4%
MIX D	38	342	208	39.2% / 66.9%
MIX D & E	3	117	79	32.5% / 60.2%
MIX E	17	289	149	48.4% / 76.1%
PCC PVT.	1	2	1	50.0% / 77.7%
TOTAL	61	786	458	41.7% / 69.4%

ANNUAL AVERAGE NUMBER OF WET–WEATHER DAYS	AVERAGE NUMBER OF WET–WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET–WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET–WEATHER DAYS
	94	120	–27.7%

* ANY DAY IN WHICH THERE WAS AT LEAST 0.01 INCH OF PRECIPITATION

TABLE 4

TOTAL CRASHES BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
URBAN

		ALL CRASHES		WET–PAVEMENT CRASHES	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	14	1118	737	199	122
3	1	2	2	0	0
4	13	1544	1162	400	211
6	3	145	117	45	15
TOTAL	31	2809	2018	644	348

TABLE 5

TOTAL CRASHES BY LANES OF ROADWAY
TWO YEARS BEFORE AND TWO YEARS AFTER
RURAL

		ALL CRASHES		WET–PAVEMENT CRASHES	
NUMBER OF LANES	NUMBER OF PROJECTS	TWO YEARS BEFORE	TWO YEARS AFTER	TWO YEARS BEFORE	TWO YEARS AFTER
2	22	182	140	25	17
4	7	536	467	117	92
6	1	4	2	0	1
TOTAL	30	722	609	142	110

TABLE 6

AVERAGE CRASHES PER PROJECT BY ADT RANGE
TWO YEARS BEFORE AND TWO YEARS AFTER

ADT	NUMBER OF PROJECTS	ALL CRASHES		WET–PAVEMENT CRASHES	
		2 YEARS BEFORE	2 YEARS AFTER	2 YEARS BEFORE	2 YEARS AFTER
0–10,000	35	37.6	27.3	7.3	4.3
10,001–20,000	14	100.6	71.4	25.1	13.0
20,001–40,000	6	86.2	74.7	21.2	13.3
OVER 40,000	6	48.5	37.2	8.8	7.5
TOTAL	61				

TABLE 7

BENEFIT/COST DATA FOR COMPLETED PROJECTS
TWO YEARS BEFORE AND TWO YEARS AFTER
ALL CRASHES

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX C & E	2	3 / 1	86 / 82	49 / 123	6.50	5
MIX D	38	2 / 2	875 / 515	1082 / 850	0.78	5
MIX D & E	3	4 / 2	211 / 236	312 / 282	1.25	5
MIX E	17	0 / 1	556 / 367	876 / 586	1.36	5
PCC PVT.	1	0 / 0	1 / 10	6 / 2	−0.61	5
TOTAL	61	9 / 6	1729 / 1210	2325 / 1843	0.94	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE CRASHES

Note: The Benefit/Cost ratio is the monetary crash savings realized through a reduction in the number of crashes at a location divided by the improvement costs as applied over the service life of the improvement. Using this method, costs and benefits may be expressed as either an equivalent annual or present worth value of the project. Any project with a benefit−to−cost (B/C) ratio greater than 1.0 is considered economically successful and the project with the highest ratio is considered most desirable. The B/C technique is probably the most commonly used of the economic analysis techniques.

TABLE 8

BENEFIT/COST DATA FOR COMPLETED PROJECTS TWO YEARS BEFORE AND TWO YEARS AFTER WET–PAVEMENT CRASHES

COUNTERMEASURE TYPE	NUMBER OF PROJECTS	BEFORE F/ AFTER F	BEFORE PI/ AFTER PI	BEFORE PD/ AFTER PD	BENEFIT / COST	SERVICE LIFE (YEARS)
MIX C & E	2	0 / 0	17 / 5	25 / 17	2.69	5
MIX D	38	0 / 1	194 / 85	222 / 151	0.19	5
MIX D & E	3	1 / 0	74 / 45	68 / 50	2.68	5
MIX E	17	0 / 0	142 / 67	198 / 105	0.56	5
PCC PVT.	1	0 / 0	0 / 3	2 / 0	–0.19	5
TOTAL	61	1 / 1	427 / 205	515 / 323	0.36	5

LEGEND: F = NUMBER OF PERSONS KILLED
PI = NUMBER OF PERSONS INJURED
PD = NUMBER OF PROPERTY DAMAGE CRASHES

Note: The Benefit/Cost ratio is the monetary crash savings realized through a reduction in the number of crashes at a location divided by the improvement costs as applied over the service life of the improvement. Using this method, costs and benefits may be expressed as either an equivalent annual or present worth value of the project. Any project with a benefit–to–cost (B/C) ratio greater than 1.0 is considered economically successful and the project with the highest ratio is considered most desirable. The B/C technique is probably the most commonly used of the economic analysis techniques.

TABLE 9

TOTAL CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES TWO YEARS BEFORE IMPROVEMENT				NUMBER OF CRASHES ONE YEAR AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER CRASH REDUCED
			TOT	PD	PI	FA	TOT	PD	PI	FA	TC	PI+FA	
MIX C & D	1	$445,302	20.5	13.0	7.5	0.0	23.0	15.0	7.0	1.0	-12	-7	-
MIX D	33	$10,119,481	389.0	257.5	118.5	3.0	245.0	167.0	77.0	1.0	37	36	$14,055
MIX D & E	5	$2,962,203	237.5	157.0	79.0	1.5	204.0	136.0	62.0	6.0	14	16	$17,804
COLD MILLING	2	$186,052	10.0	5.5	4.5	0.0	19.0	11.0	8.0	0.0	-90	-78	-
MIX E	6	$964,494	511.0	383.5	127.0	0.5	312.0	232.0	80.0	0.0	39	37	$969
MIX E & COLD MILLING	1	$20,393	52.0	43.0	9.0	0.0	34.0	32.0	2.0	0.0	35	78	$227
PCC PVT.	1	$26,600	26.0	20.5	5.5	0.0	9.0	8.0	1.0	0.0	65	82	$313
TOTAL	49	$14,744,525	1246.0	890.0	351.0	5.0	846.0	601.0	237.0	8.0	32	31	$7,372

TABLE 10

TOTAL WET–PAVEMENT CRASHES BY COUNTERMEASURE TYPE FOR TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER-MEASURE TYPE	NUMBER OF PROJECTS	TOTAL COST	NUMBER OF CRASHES TWO YEARS BEFORE IMPROVEMENT				NUMBER OF CRASHES ONE YEAR AFTER IMPROVEMENT				PERCENT REDUCTION		AVERAGE COST PER CRASH REDUCED
			TOT	PD	PI	FA	TOT	PD	PI	FA	TC	PI+FA	
MIX C & D	1	$445,302	1.5	0.5	1.0	0.0	1.0	0.0	1.0	0.0	33	0	$178,121
MIX D	33	$10,119,481	93.5	60.5	31.5	1.5	49.0	35.0	14.0	0.0	48	58	$45,481
MIX D & E	5	$2,962,203	38.5	24.5	14.0	0.0	34.0	24.0	10.0	0.0	12	29	$132,542
COLD MILLING	2	$166,052	3.0	1.5	1.5	0.0	6.0	4.0	2.0	0.0	−100	−33	–
MIX E	6	$964,494	114.0	89.0	25.0	0.0	52.0	44.0	8.0	0.0	54	100	$3,111
MIX E & COLD MILLING	1	$20,393	32.0	25.5	6.5	0.0	4.0	4.0	0.0	0.0	88	100	$146
PCC PVT.	1	$26,600	2.0	1.5	0.5	0.0	4.0	3.0	1.0	0.0	−100	−100	–
TOTAL	49	$14,744,525	284.5	203.0	80.0	1.5	150.0	114.0	36.0	0.0	47	56	$21,925

TABLE 11

CHANGE IN WET–PAVEMENT CRASHES COMPARED TO CHANGE IN WET–WEATHER DAYS * TWO YEARS BEFORE AND ONE YEAR AFTER (ONE YEAR AVERAGE)

COUNTER–MEASURE TYPE	NUMBER OF PROJECTS	NUMBER OF WET–PAVEMENT CRASHES BEFORE IMPROVEMENT	NUMBER OF WET–PAVEMENT CRASHES AFTER IMPROVEMENT	OVERALL / NET REDUCTION IN WET–PAVEMENT CRASHES
MIX C & D	1	1.5	1.0	33.3% / 57.3%
MIX D	33	93.5	49.0	47.6% / 71.6%
MIX D & E	5	38.5	34.0	11.7% / 35.7%
COLD MILLING	2	3.0	6.0	–100.0% / –76.0%
MIX E	6	114.0	52.0	54.4% / 78.4%
MIX E & COLD MILLING	1	32.0	4.0	87.5% / 111.5%
PCC. PVT.	1	2.0	4.0	–100.0% / –76.0%
TOTAL	49	284.5	150.0	47.3% / 71.3%

	AVERAGE NUMBER OF WET–WEATHER DAYS BEFORE IMPROVEMENT	AVERAGE NUMBER OF WET–WEATHER DAYS AFTER IMPROVEMENT	PERCENT REDUCTION IN WET–WEATHER DAYS
ANNUAL AVERAGE NUMBER OF WET–WEATHER DAYS	100	124	–24.0

* ANY DAY IN WHICH THERE WAS AT LEAST 0.01 INCH OF PRECIPITATION

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
86203 0009	Kankakee	3.01 miles of resurfacing on I-57 from .34 miles north of the Kankakee river bridge in Kankakee to the intersection of US 45/52 south of Kankakee	11/08/91	16,200	C D	4
94091 0082	Wayne	2.47 miles of resurfacing on Main St. between Airport Rd. and E. 9th St. and on Delaware Blvd. between W. 7th St. and E. 7th St. in Fairfield	08/14/90	9,000	C E	2
98025 0082	Franklin	Resurface Il 14 between Christopher and West City	12/04/90	6,000	C E	2
94039 0032	Jefferson	Relocate Il 148 and improve Veteran's Memorial Dr. from Triangle St. to the intersection of Il 37 in Mt. Vernon	11/24/90	8,000	D	2
86072 0056	McLean	Resurfacing on Bus. loop I-55 between I-74 and I-55 in Bloomington and Normal	08/24/90	20,000	D	4
94037 0274	Clay	Bituminous concrete pavement and a double 10'x 10' RC box culvert on US 50 from approximately 1.2 miles west of Xenia, east to north of Xenia	12/07/90	2,100	D	2
84105 0294	Winnebago	1.26 miles of resurfacing and 2, 3-span PPC I-beam bridges on Il 251, over Kilbuck Cr. and resurface the intersection of Baxter Rd. and Beltline Rd. 2 miles south of Rockford	09/29/90	3,700	D	4
90021 0064	Vermilion	Widening and traffic signal modernization at 5 intersections on US 136/Il 1 (Gilbert St.) in Danville	12/21/91	19,300	D	4
80290 0102	Cook	Remove and replace the existing concrete deck on 2 structures both over FAI 94 (Michigan City Rd.)	11/17/90	81,650	D	6
84156 0104	Ogle	Remove and replace 3 structures all carrying Il 2 over Gale Creek	10/05/91	4,200	D	2
84056 0072	Ogle	Reconstruction of the intersection of Il 2 and Il 72, and bridge carrying IL 2 over Mill Creek all northeast of Byron	06/19/90	6,525	D	2
42818 0088	Kankakee	Rehabilitate 3 sets of twin bridges all on I-57, over Soldier Creek, Grinnell Rd. and over Conrail RR north of Il 17 at the east edge of Kankakee	12/10/90	18,000	D	4
84072 0092	Ogle	Remove and replace the superstructure on the bridge carrying Il 72 over the Rock River also realign the intersection of Il 72, German Church Rd., and River Rd.	05/26/91	5,100	D	2
84083 0114	Ogle	Remove structure and replace with a PPC I-beam bridge carrying Il 72 over Kilbuck Creek	03/25/90	2,800	D	2
84078 0118	Whiteside	Remove structure and replace with a 3-span W-beam bridge carrying US 30 over Hennepin Feeder Canal	10/26/90	7,400	D	2
86039 0165	Bureau Putnam	Remove and replace the existing concrete deck on the bridge carrying Il 89 over the Illinois River	06/06/90	4,200	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84104 0166	Whiteside	Remove and replace concrete deck on the structure carrying US 30 over the CNW RR and resurface approaches 3 miles northwest of Morrison	10/12/90	5,100	D	2
94094 0014	Lawrence	Resurfacing, shoulders and patching on US 50 from 3 miles east of Lawrenceville to the Indiana state line	11/16/90	4,700	D	4
84154 0028	Rock Island	Widening and resurfacing on Hillsdale Rd. between 256th St. and Moline Rd. all west of Hillsdale	11/30/90	850	D	2
80095 0117	Cook	PCC pvmt. on Wolf Rd. between US 12 and Euclid Ave. in Des Plaines and Mt. Prospect	08/22/91	15,600	D	4
44279 0092	Macon	Resurface and widen the bridge carrying Il 105 over Spring Creek and traffic signals on Il 48 from US 51 to Il 105 then east on Il 105 to Bus US 51	11/24/90	12,600	D	2
84054 0109	Winnebago Boone	1.82 miles of PCC pavement and 2 double box culverts on Bus US 20, between the Northeast Toll Way and Olsen Rd. east of Rockford	10/17/90	11,900	D	4
84197 0023	Boone	Remove and replace bridge carrying Il 76 over Beaver Creek 1.5 miles southwest of Poplar Grove	12/08/90	2,600	D	2
84193 0024	Carroll	Remove and replace bridge carrying Il 78 over a tributary of the East Fork of Plum Creek 4 miles north of Mt. Carroll	07/12/90	700	D	2
84172 0032	Whiteside	Remove and replace bridge carrying US 30 over the Rock River 2 miles west of Rock Falls	12/15/90	4,500	D	2
80501 0088	Will	Widen existing bridge carrying US 6 over the I&M canal, and resurfacing on US 6 and Brandon Dr. near the east limits of Rockdale	10/31/90	60,800	D	4
86112 0104	Marshall	Remove and replace the bridge carrying Il 17 over the Illinois River at Lacon	12/22/90	5,900	D	2
96194 0033	St. Clair	0.33 mile of resurfacing on US 50 at the intersection with Shiloh Rd. in O'Fallon	12/07/90	13,000	D	2
84177 0065	Stephenson	Remove and replace existing structure and resurface the approaches on the bridge carrying Il 73 over Cedar Creek in Winslow	07/11/91	650	D	2
84178 0087	Ogle	RC box culvert and resurface the approaches carrying Il 72 over a drainage ditch 250 ft. west of the Mt. Vernon Rd. intersection north of Forreston	08/21/90	1,700	D	2
84153 0111	Ogle	1.67 miles of resurfacing on Il 38 from Il 251 in Rochelle east to .5 mile east of Caron Rd., east of Rochelle	08/10/91	7,200	D	2
96190 0146	Randolph	1.02 miles of resurfacing on Il 3 from 0.15 mile south of Kaskaskia Dr. to Market St. in Red Bud	08/05/90	8,600	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84195 0162	Winnebago	Remove and replace existing structure carrying Il 75 over Pecatonica River and resurface approaches at Harrison, west of Rockton	12/14/91	1,800	D	2
86121 0178	Iroquois	4.04 miles of resurfacing on I-57 from 1 mile north of Gilman, south to near Onarga	08/31/90	13,300	D	4
84173 0180	Winnebago	1.3 miles of resurfacing and traffic signal modernization on eastbound Bus US 20 from West State St. to East State St. in Rockford	11/10/90	6,500	D	2
84176 0182	Bureau	Remove and replace structure carrying Il 92 over Bureau Creek and resurface approaches 1.6 miles west of US 34 north of Lamoille	01/26/90	800	D	2
86119 0010	Grundy	.64 mile resurfacing on Il 113 from Mary Ave. to Lincoln St. in Coal City	05/18/90	8,400	D	2
84235 0033	DeKalb	Remove and replace existing structure carrying Il 72 over a drainage ditch and resurface approaches 3 miles west of Kirkland	11/10/90	950	D	2
84236 0034	DeKalb	Remove and replace existing structure carrying Il 72 over a drainage ditch 0.3 mile west of Kirkland	05/11/91	2,050	D	2
84175 0043	Whiteside	Remove and replace existing structure and resurface approaches carrying US 30 over the C&NW RR west of Sterling	12/15/90	4,000	D	2
80437 0075	Lake	.38 mile of resurfacing and traffic signal modernization on Il 173 (Sheridan Rd.) from 7th St. to 9th St. in Winthrop Harbor	10/06/90	12,000	D	4
84207 0079	Stephenson	1.26 miles of resurfacing on US 20 between Smokey Hollow Rd. and Springfield Rd. 2 miles east of Freeport	10/22/91	4,400	D	4
84234 0091	Ogle	Remove and replace existing structure carrying US 52 over Buffalo Creek 1 mile northwest of Polo	10/06/90	800	D	2
84179 0092	Ogle	Remove and replace existing structure and resurface approaches carrying Il 2 over a stream 4 miles north of Grand Detour	06/01/91	3,200	D	2
84221 0094	Whiteside	Remove and replace existing structure carrying Garden Plain Rd. over Cattail Creek 5 miles west of Morrison	10/06/90	900	D	2
96217 0056	Randolph	Reconstruction of the intersection of Il 4 (Jackson St.) and St. Louis St. in Sparta	10/16/90	5,200	D	2
96200 0066	St. Clair	.66 mile of resurfacing on Old US 50 from Smiley St. to Timber Creek Dr. in O'Fallon	12/14/91	18,200	D	2
84242 0097	Henry	Remove and replace existing RC box culvert carrying US 6 over a drainage ditch 0.9 mile west of Orion Rd. north of Coal City	11/07/90	3,800	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
94096 0157	Effingham	3.97 miles of resurfacing on Il 33 from 0.7 to 4.7 miles east of Effingham	10/29/90	4,600	D	2
94141 0158	Jefferson	1.39 miles of resurfacing on Il 37 between Bethel Rd. and Il 142/148 in and south of Mt. Vernon	10/11/91	3,700	D	2
96216 0164	Madison	Channelization, resurfacing, and traffic signals at the intersection of Collinsville Beltline Rd. and Johnson Hill Rd. in Collinsville	06/05/91	13,100	D	4
86163 0134	McLean	1.78 miles of resurfacing on southbound US 51 (Center St.) from Hovey St. south to Oakland Ave. in Bloomington, Normal	12/05/90	17,400	D	2
84167 0155	Stephenson	1.75 miles of resurfacing and two new bridges on Il 26 from south of Brush Creek, north to the east branch of Richland Creek, south of Orangeville	10/23/91	3,400	D	2
86178 0222	Kankakee	4.67 miles of resurfacing on US 45/52 from a mile south of Kankakee to the Iroquois County Line	09/30/91	3,970	D	2
80292 0231	Cook	Widening of 3 structures on I-94: over Michigan Central RR, over B&OCT RR, and over Dolton Ave. in Dolton and Calumet City	10/31/90	75,000	D	6
84190 0274	Winnebago	3.50 miles of resurfacing on I-39 from Alpine Rd. northeast to the Northwest Tollway in Rockford	09/26/91	18,000	D	4
94110 0012	Effingham	Traffic signals and improve turning radii at the intersection of US 4 (3rd. St.) and Temple Ave. in Effingham	09/21/91	13,175	D	2
94123 0106	Jasper	11.02 miles of resurfacing on Il 33 from the Effingham Co. line to Newton	12/14/91	3,975	D	2
86160 0114	Marshall	Box culvert on Il 17 at Judd Creek 4 miles west of US 51 south of Wenona	12/03/90	1,200	D	2
80111 0010	Lake	1.28 miles of resurfacing at the intersection of US 45 and Winchester Rd. in Libertyville	10/04/91	15,500	D	2
84295 0025	Bureau	Remove and replace structure carrying US 6/34 over Big Bureau Creek 2 miles west of Princeton	08/05/91	3,200	D	2
84296 0037	Bureau	Remove and replace bridge carrying Il 92 over a branch of Masters Cr. 0.7 mile west of Van Orin Rd., west of Mendota	10/16/91	600	D	2
84262 0028	DeKalb	Remove and replace structure with RC box culvert on Il 23 over a branch of Somonauk Creek one mile east of Waterman	07/13/91	1,400	D	2
84263 0029	DeKalb	Remove and replace structure with RC box culvert on Il 23 at Little Indian Creek 5 miles south of US 30 south of Waterman	11/16/91	1,350	D	2

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84308 0075	Ogle	Remove and replace structure carrying Il 251 over a drainage ditch at the east edge of Davis Junction	09/21/91	3,450	D	2
84309 0100	Ogle	Remove and replace structure carrying Il 251 over a stream 2 miles north of the Il 64 intersection, and replace R.C. box culvert 7.2 miles north of Rochelle	09/21/91	6,950	D	2
80620 0001	Cook	Patching shoulder reconstruction on two ramps at Il 171 and Joliet Rd. in McCook	10/31/91	19,900	D	4
84294 0007	DeKalb	Modernize traffic signals and channelize the intersection of Il 23 and Oakland Pl. near the north limits of DeKalb	08/30/91	19,500	D	4
84291 0038	Carroll	Remove and replace the superstructure on a bridge carrying Il 84 over Rush Creek 3.80 miles north of Savanna	12/07/91	3,800	D	2
80740 0011	Cook	Intersection improvement at 143rd St. and Bachelor Grove Rd. in Bremen and on 127th St. and Irving Rd. in Blue Island 127TH ST. NOT STATE MAINTAINED	11/01/91	10,000	D	2
94133 0025	Richland	3.05 miles of resurfacing on US 50 from 1 mile east of Olney, east to 1.2 miles west of Claremont Rd.	07/17/91	4,350	D	2
84303 0055	Winnebago	Remove and replace box culvert carrying US 70 (Trask Bridge Rd.) over a drainage ditch .25 mile east of Meridian Rd near the NW limits of Rockford	07/27/91	3,200	D	2
94164 0087	Clay	6.37 miles of resurfacing on US 50 from the intersection of US 45 west of Flora, east to 1.6 miles west of Clay City	10/23/91	4,440	D	2
84314 0124	Bureau	Remove and replace bridge carrying Il 29 over a ditch west of Negro Creek at the east limits of DePue	08/22/91	1,850	D	2
96131 0236	St. Clair Madison	Bituminous concrete resurfacing on I-70 between the B&O RR and Canteen Creek north and east of East St. Louis	11/29/90	38,900	D E	6
96169 0027	St. Clair	Resurfacing and traffic signals on Il 161 between Sherman St. and Green Mount Rd. in and east of Belleville	10/27/90	22,700	D E	4
96156 0033	St. Clair	Resurfacing on Il 158/177 from just east of Greenmount Com. Rd. in Belleville east to west of Il 4 in Mascoutah	11/24/90	6,700	D E	4
90046 0126	Champaign	Remove PCC deck and resurface on the structure carrying Lincoln Ave. over I-74 in Urbana	12/07/91	14,200	D E	4
90049 0099	Champaign	Resurfacing on I-74 from 0.6 mile west of Prospect Ave. to 0.3 mile east of Prospect Ave. and on Prospect Ave. ramps and side roads in Champaign	12/07/91	35,100	D E	4
80208 0114	Will	19.04 miles of resurfacing on NB I-55 between the Will-Grundy County Line and US 52 west and south of Joliet	08/27/91	23,050	D E	4

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
84200 0103	Jo Daviess	1.70 miles of resurfacing on US 20 from Elizabeth, east to Becker Rd.	11/27/91	3,700	D E	2
94177 0089	White	1.21 miles of resurfacing on Il 14 between 3rd St. and Commerce St. in Carmi	12/14/91	5,300	D E	2
80175 0284	DuPage	Channelize and resurface the intersection of Irving Park Rd. and Roselle Rd. in Roselle	11/28/90	34,950	E	2
88081 0307	Peoria	Reconstruct, resurface and modernize traffic signals at the intersections on Il 88 at Lake Ave. and McClure Ave. in Peoria	12/11/90	35,000	E	4
80288 0101	Cook	Remove and replace bridge superstructure, resurface at the I-94 (Calumet Expressway) and Sibley Blvd. interchange in Dolton	11/17/90	100,800	E	6
84157 0038	Whiteside	Resurfacing and C&G at the intersection of Il 2 and M Ave. in Sterling	12/03/90	12,100	E	3
96165 0098	Madison	Resurfacing and detector loop replacement on Il 111 at Washington Ave. in Alton and along Il 3 at Levis Ln. northwest of Alton	05/24/90	19,800	E	4
84006 0108	Whiteside	1.08 miles of resurfacing and PCC pavement on Il 88 from 2nd St. south to 16th St. in Rock Falls	11/03/90	8,000	E	4
80257 0011	Cook	Resurfacing on North Ave. at Roy Ave. in Northlake, and on Arlington Heights Rd. at Palatine Rd. in Arlington Heights NORTH AVE. NOT STATE MAINTAINED	04/29/91	54,450	E	4
80249 0012	Cook	0.34 miles of resurfacing on Il 171 at the intersection with Bell Rd. east of Lemont	07/02/90	18,950	E	2
80304 0018	Kane	Reconstruction of the intersection of Il 25 and Army Trail Rd.	09/29/90	7,500	E	2
80215 0054	McHenry	Traffic signals, replace existing structure, and resurface the approaches on the bridge carrying Il 31/120 over Boone Creek in McHenry	12/10/90	14,200	E	4
90023 0133	Champaign	0.72 mile resurfacing and remove and replace decks on 2 structures over Market St. and over the IC RR, all on I-74 between Neil St. and Lincoln Ave.	01/01/91	35,100	E	4
94095 0137	Effingham	Reconstruct northern ramps, frontage road, and new bridge deck on southbound lanes, and resurface northbound lanes on I-70 bridge over Il 32/33	12/15/90	33,000	E	4
80309	Kane	.19 mile resurfacing on Il 31 at the intersection of	09/17/90	17,000	E	4

TRA-16 PROJECTS

Contract Number	County	Project Limits	Completion Date	ADT	Counter-Measure	No. of Lanes
88170 0080	Tazewell	.23 mile of resurfacing, median removal and traffic signal modernization on Court St. from Audubon St. to Cottage Grove Ave. in Pekin	08/12/90	25,000	E	4
94092 0042	Marion	2.95 miles of resurfacing on US 51 (Broadway St.) from Ellis St. in Central City, south to the south city limit of Centralia	11/03/90	9,100	E	2
80575 0170	Will	.26 mile of resurfacing at the intersection of US 52 and Il 7 in Joliet	10/25/90	54,800	E	4
84183 0260	Henry	.36 mile of resurfacing on Il 78 (Main St.) from the BN RR south to Central Blvd. in Kewanee	11/03/90	10,000	E	2
96340 0046	St. Clair	.22 mile of resurfacing on Old US 50 at 5th St. in O'Fallon	12/01/90	16,000	E	2
96212 0149	Madison	.90 mile of resurfacing on Il 203 from Madison Ave. north to Pontoon Rd. in Granite City	12/09/91	26,733	E	4
90174 0004	Coles	Channelization, resurfacing, and traffic signals at the intersection of Il 130 (Madison Ave.) and 5th St. in Charleston	11/27/91	7,100	E	2
80719 0068	Cook	.881 mile of resurfacing on US 41 (Lake Shore Dr.) from north of LaSalle Dr. north to north of Fullerton Ave. in Chicago	08/12/91	95,200	E	8
84395 0040	Winnebago	.51 mile of resurfacing on Bus US 20 between Alpine Rd. and Rockford College entrance in Rockford	11/23/91	26,700	E	4
80785 0004	Cook	.06 mile of resurfacing at the intersection of US 14 (Ridge Ave.) and Hollywood Ave. in Chicago	09/09/91	18,800	E Cold Mill.	2
84186 0028	Winnebago	1.29 miles of pavement patching on Bus US 20 and US 20 (Bypass) between Falconer Rd. and Weldon Rd. west of Rockford	07/09/90	5,000	PCC PVT.	4
84274 0040	Rock Island	Right turn lane and traffic signal modernization at the intersection of US 6 and I-74 extension in Moline	06/01/91	21,400	PCC PVT.	4
86232 0210	Livingston	1.28 miles of resurfacing on US 24 (Oak St.) from west of Calhoun St. to east of 10th St. in Fairbury	10/23/91	4,250	Cold Mill.	2
94180 0019	Marion	2.10 miles of resurfacing on Il 37 from Kinmundy to 2 miles northeast of Kinmundy	07/29/91	1,100	Cold Mill.	2

SKID-ACCIDENT REDUCTION PROGRAM

1. Policy

The Department shall establish a program designed to minimize wet-pavement skidding accidents. This shall be accomplished by ensuring that new roadway surfaces have adequate, durable skid resistance properties, and by identifying and improving sections of roadway with high or potentially high skid-accident incidence.

2. Purpose

The purpose of this policy is to describe and outline the procedures that will provide a cost-effective skid-accident reduction program. This policy will apply to all federal and state funded projects on the interstate, primary, federal-aid secondary, and federal-aid urban systems, except maintenance and intermittent resurfacing projects.

3. Guidelines for Implementation

a. Primary Activities

1) The first activity (3b) consists of incorporating adequate, durable skid-resistant roadway surfaces during construction and rehabilitation of highway pavement segments.

2) The second activity (3c) involves identifying, analyzing, and improving two categories of wet-pavement accidents locations.

a) One category is high-accident locations with overrepresented wet-pavement accidents that are improved as part of the safety improvement construction program.

b) The other category is wet-pavement accident locations (cluster sites) within rehabilitation/resurfacing projects improved as part of the regular construction program.

3) The third activity (3d) concerns feedback from field testing and analysis to evaluate the effectiveness of previous skid-accident reduction efforts.

b. Incorporation of Skid-Resistant Surfaces During Construction and Rehabilitation

1) Portland Cement Concrete

a) Final finishing on highways with posted speed limits in excess of 40 mph shall be obtained by the use of a longitudinal artificial turf drag followed immediately by a mechanically operated metal tine transverse grooving device as specified for Type A final finish in the Standard Specifications.

b) Final finishing on highways with posted speed limits not exceeding 40 mph may be obtained by the use of a single longitudinal artificial turf drag as specified for Type B final finish in the Standard Specifications or by a combination of longitudinal artificial turf drag and transverse tining as specified for Type A final finish.

2) Bituminous Concrete

New surface courses shall have, as a minimum, friction qualities equivalent to or greater than those provided by the following guidelines.

a) Mixture C should be used as the surface course on roads and streets having a design ADT of 2000 or less.

b) Mixture D should be used as the surface course on all two-lane roads and streets having a design ADT greater than 2000, on four-lane highways having a design ADT of 25,000 or less, and on six-lane (or greater) highways having a design ADT of 60,000 or less.

c) Mixture E should be used as the surface course on four-lane highways having a design ADT greater than 25,000 and on six-lane (or greater) highways having a design ADT greater than 60,000.

The Special Provision for Skid-Resistant Bituminous Surface describes Mixtures C, D, and E.

c. Identifying, Analyzing, and Improving Wet-Pavement Accident Locations

1) High Accident Wet-Pavement Locations

The procedures for identifying, analyzing, and improving high-accident locations that have an overrepresented rate of wet-pavement accidents are included in the "Illinois Safety Improvement Processes" and Departmental Policy TRA-15 which cover the Safety Improvement Construction Program.

2) Wet-Pavement Accident Locations (Cluster Sites)

a) Identification of Cluster Sites

When a route is selected for rehabilitation/resurfacing, the wet-pavement accident records, furnished by the Division of Traffic Safety/local agency, shall be analyzed for the entire project. The identification of cluster sites shall be as outlined in Section I of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects", which is included in the "Illinois Safety Improvement Processes."

b) Analysis of Cluster Sites

Each cluster site that is identified must be analyzed by District/local agency personnel. The analysis shall comply with Section II of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/ Resurfacing Projects."

c) Corrective Treatment for Cluster Sites

After analyzing each cluster site, the District/local agency shall select the appropriate corrective treatment in accordance with Section III of "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Accident Locations Within Rehabilitation/Resurfacing Projects."

d) Documentation of Process

The identification, analysis, and improvement of each cluster site must be documented and become part of the location study report for State projects and project development report for local agency projects.

d. Evaluating and Reporting on Effectiveness of the Program

1) The Bureau of Materials and Physical Research will continue to evaluate current pavement design practices to ensure that skid resistance properties are durable and suitable for the needs of traffic.

2) The Bureau of Materials and Physical Research will develop a friction-test data base for retrieval and for subsequent data analysis.

3) The Bureau of Materials and Physical Research will continue evaluation of experimental projects which provide a broad body of knowledge concerning frictional characteristics applicable to Illinois surfaces.

4) The Division of Traffic Safety, in cooperation with the Bureau of Traffic and the Districts, will determine whether selected countermeasures on rehabilitation/resurfacing projects have been effective in reducing wet-pavement accidents. The results of the evaluation will be furnished to the Bureau of Materials and Physical Research for inclusion in their annual report.

5) The Bureau of Materials and Physical Research, in cooperation with the Bureaus of Traffic and Local Roads and Streets and the Division of Traffic Safety, will prepare an annual report summarizing activities of Illinois' Skid Accident Reduction Program on both the State and local highway systems.

6) The Bureau of Traffic will include in their annual "Evaluation and Report of the Highway Safety Construction Program" data on wet-pavement accident locations improved under the Safety Improvement Program.

Responsibilities

a. The Directors of Highways and Traffic Safety are responsible for assuring that their Divisions comply with the procedures set forth in this Policy.

b. The Bureau of Traffic is responsible for the maintenance, updating and dissemination of this Policy.

Accessibility

Copies of this policy may be obtained from the Bureau of Traffic, Room 104, Administration Building.

CLOSING NOTICE

Supersedes: Departmental Policy, SKID ACCIDENT REDUCTION PROGRAM, Effective March 15, 1984

Approval:

H W Monroney — Director of Highways — 1/1/89 — Date

Melvin H Smith — Director of Traffic Safety — 1/1/89 — Date