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Ponderosa Road and Highway 50 Interchange

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Quint, Mike; Howell, R.B.; Shirley, E.C.; Skog, J.B.

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16. ABSTRACT
This study demonstrated the use of fiberglass roving (loosely coiled fiberglass strands) for ditch and slope erosion control. Four ditches and one slope area at the Ponderosa Road Interchange on Highway 50 near Cameron Park were treated using various application rates of fiberglass roving and asphalt tack.

The five treated areas were monitored with photographs, field observations and precipitation measurements during the period October 19, 1973 to April 3, 1974. About 31 inches of rain was recorded during this period.

The fiberglass roving was effective in reducing erosion at all five locations. Grasses planted just prior to the application of the treatment emerged through the "cobweb" type lining with little or no difficulty. The treatment was applied for about 50 cents/ S.Y. including grass seed and fertilizer.

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HIGHWAY STUDY REPORT

FIBERGLASS ROVING FOR EROSION CONTROL

PONDEROSA ROAD AND HIGHWAY 50 INTERCHANGE

FINAL REPORT

74-19
DND

STATE OF CALIFORNIA

BUSINESS AND TRANSPORTATION AGENCY

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

TRANSPORTATION LABORATORY

RESEARCH REPORT

CA-DOT-TL-7158-1-74-19

19-954130

Prepared in Cooperation with the U.S. Department of Transportation, Federal Highway Administration June, 1974

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DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
TRANSPORTATION LABORATORY
5900 FOLSOM BLVD., SACRAMENTO 95819

Final Report
Translab
657158
19-954130

June 1974

Mr. Robert J. Datel
State Highway Engineer

Dear Sir:

Submitted herewith is a report titled:

"FIBERGLASS ROVING FOR EROSION CONTROL"

(Ponderosa Road and Highway 50 Interchange)

Study Made By
Environmental Improvement Section

Under General Direction Of
John Skog and Earl Shirley

Supervised By
Richard Howell

Report By
Mike Quint

Field Work By
Mike Quint and Martin Nolan

Very truly yours,

JOHN L. BEATON
Chief Engineer, Transportation Laboratory

ACKNOWLEDGEMENTS

This study was conducted by the Transportation Laboratory of the Department of Transportation in cooperation with the Federal Highway Administration, the District 03 Maintenance Branch, Headquarters Maintenance Branch and Project Development Branch. The assistance of Messrs. Gene Stager, Dennis Richards and Jeff Brooks of the FHWA is appreciated. Mr. Gene Steinwert and Mr. Dave Donaldson of District 03 provided assistance in locating the test sites and conducting the demonstration. Project coordination by Richard Wasser of TransLab is appreciated.

The assistance of Mr. George Edmunson of the U. S. Soil Conservation Service, Lockeford Plant Materials Center, in providing the seed, in planting and evaluating the vegetation,is greatly appreciated.

TABLE OF CONTENTS

INTRODUCTION

The appearance and safety of many miles of state highways are impaired by badly eroded roadside drainage ditches and slopes. Maintenance efforts expended to reverse the erosion process are costly and must be repeated often for the same area.

In September 1972, the Federal Highway Administration (FHWA) inquired as to whether the California Division of Highways would participate in a demonstration project involving the use of fiberglass roving for corrective ditch erosion control.

Fiberglass roving is a material formed from molten glass. It is manufactured for a variety of products that utilize fiberglass and commonly is produced in a coiled package (see Plate 1).

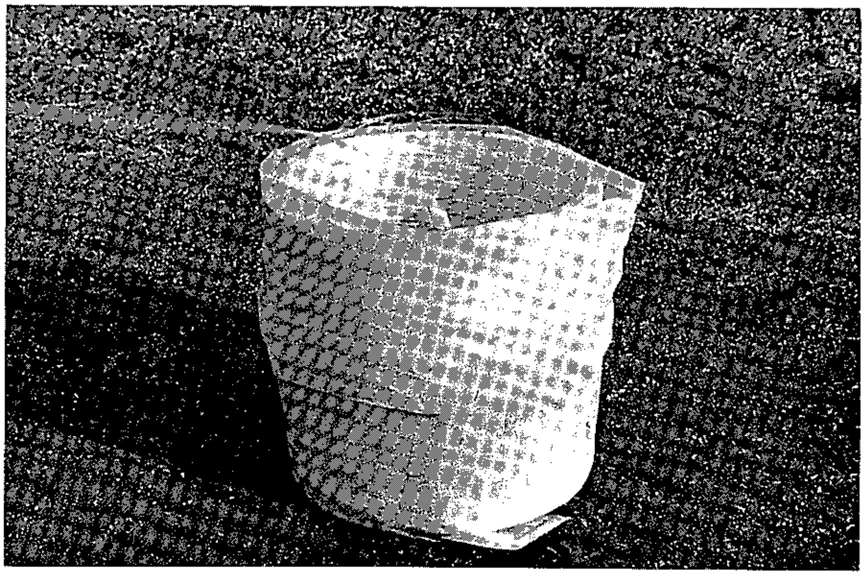


Plate 1. Coiled Fiberglass Roving Package

The roving is fed through a special nozzle connected to an air compressor and the compressed air propels and separates the strands of glass fibers, spreading them evenly over the area. A tack coat of asphalt is applied over the roving to bind the strands together and to insure adhesion to the soil. The Louisiana Department of Highways[1] and several other states have conducted demonstration projects which have revealed that severely eroded ditches can be successfully repaired with fiberglass roving[1,2].

The Transportation Laboratory indicated in October 1972 that the Environmental Improvement Section was interested in participating in a project using this material. Subsequently, in November 1972, the Division of Highways responded to the FHWA that the Transportation Laboratory would participate in "Demonstration Project No. 26, on the Use of Fiberglass Roving for Corrective Ditch Erosion Control". Region 15 presented a slide-talk of the proposed demonstration project in April 1973. It was indicated that the Fall season would be the best time for attempting to get grass germination because of the long hot summers that are typical of the Central Valley in California.

In October 1973, the Transportation Laboratory selected five sites for the demonstration project in conjunction with District 03 Maintenance Branch, Headquarters Maintenance Branch, Project Development Branch, and the FHWA. The sites were located at the Ponderosa Road Interchange on Highway 50 near Cameron Park (see Location Maps in Appendix A).

Representatives of Maintenance Branch, Construction Branch, Design Branch and the Erosion Control Committee were notified of the proposed demonstration project. On October 18 and 19, 1973, the sites were prepared and the fiberglass roving was applied under the supervision of Region 15 FHWA personnel with assistance from Maintenance Branch and Transportation Laboratory personnel. Representatives from various agencies including two visiting engineers from the Venezuela Highway Department attended the demonstration (see Attendance List in Appendix D).

Prior to applying the fiberglass roving on this project, various combinations of grasses were seeded on the soil, under the direction of the U. S. Soil Conservation Service (SCS). A subsequent evaluation of the effects of the roving treatment on the vegetal growth was conducted by the SCS and is incorporated into this report.

The Transportation Laboratory monitored the five sites with photographs, field observations and precipitation measurements during the period October 19, 1973 to April 3, 1974.

This report presents the results of the field application demonstration work, the monitoring program, and an evaluation of the effectiveness of fiberglass roving for erosion control.

OBJECTIVE

Demonstrate and evaluate the use of fiberglass roving for erosion control under procedures developed by Federal Highway Administration, Region 15, Demonstration Projects Program.

CONCLUSIONS AND RECOMMENDATIONS

Fiberglass roving was effective in controlling both ditch and slope erosion on this project during the period from October 1973 to April 1974. Grasses can grow through the "cobweb" type treatment with little or no difficulty. The treatment was applied for about 50¢ per S.Y. including grass and fertilizer.

The field construction procedures involved in the application of the fiberglass roving are amazingly simple, and the end result is impressive. This type of treatment has a strong potential for providing an alternative to lined ditches in new highway construction, as well as correcting existing erosion problems. The ultimate advantage of this type of ditch treatment is that it will not be visible to the travelling public after the emergence of grass and should help to beautify our highways. Also, the permeability and "roughness" of the roving should help to increase infiltration and reduce velocities of runoff water.

In the preparation of sites prior to the application of fiberglass roving, it is recommended that lateral trenches for the burial of the sides of the mat should not be constructed. However, the upper and lower end of the mat should be buried in a one-foot deep trench to prevent undermining at these locations. It is recommended that asphalt be applied at a rate of 0.25 to 0.35 gals./square yard.

IMPLEMENTATION

Implementation of this treatment will be handled through the Foundation Section of the Transportation Laboratory on a project by project basis for both highway construction and maintenance operations. A more comprehensive evaluation of the effectiveness of the treatment at various locations and under different soil, climatological, and hydraulic conditions throughout the State will provide information for the development of Standard Specifications and guidelines in California. Preliminary guide specifications provided by FHWA are included in Appendix C.

DISCUSSION

Site Location

The test sites are located at the Ponderosa Road Interchange on Highway 50, about 30 miles east of Sacramento (see Location Maps in Appendix A). The soils in the area are generally comprised of silty clays and the topography is gentle rolling hills. The underlying geologic formation is Jurassic-Triassic metavolcanic rock. The typical vegetative mantle consists of a moderate cover of valley oak, manzanita, and grass growth. The climate is relatively moderate with an annual temperature range of about 21°F to 104°F and average yearly precipitation of about 40 inches. Rainfall occurs in the period of November to May. The elevation of the test site is about 1500 feet above M.S.L.

Five locations were selected for experimentation at the test site. Locations 1, 2, 3 and 4 were selected to demonstrate the use of fiberglass roving for corrective ditch erosion control and consisted of highly erosive silty clays. Location 5 was selected to demonstrate the use of roving for slope erosion control and consisted of an extremely erosive highly weathered decomposed granite. Maintenance has experienced problems with erosion at these five locations since the highway was originally constructed in 1969.

Erosion at this location has been a problem since construction of the road. Plate 2 illustrates the safety hazard caused by erosion undermining the frontage road at Location 1. Plates 3 and 4 illustrate the severe and hazardous erosion adjacent to an on-ramp at Location 2. Plate 5 indicates the deterioration of an A.C. lined ditch at Location 3. Plates 6 and 7 illustrate moderate

Plate 2
Frontage Road Undermined by Erosion at Location 1

Plate 3
Hazardous Condition at Location 2

Plate 4
Hazardous Condition
At Location 2

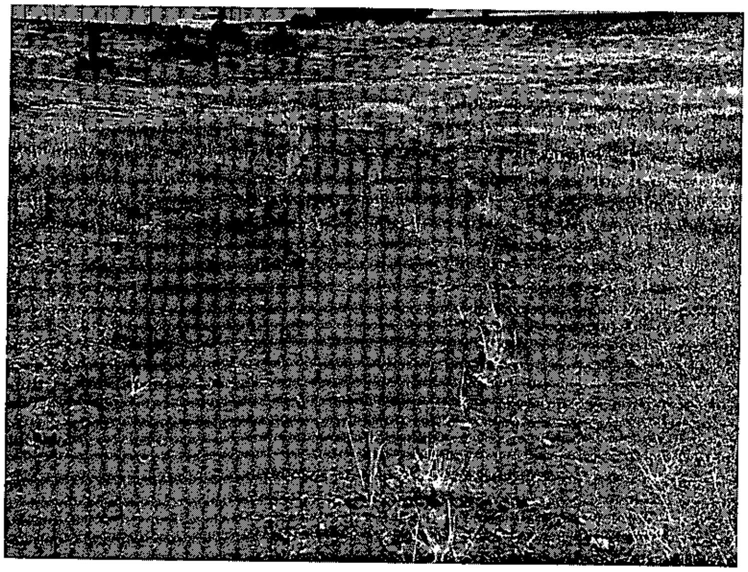


Plate 5
Deterioration of an
Asphalt Concrete Ditch
At Location 3

erosion at Location 4 while Plates 8 and 9 illustrate the severe erosion adjacent to the test plot at Location 5.

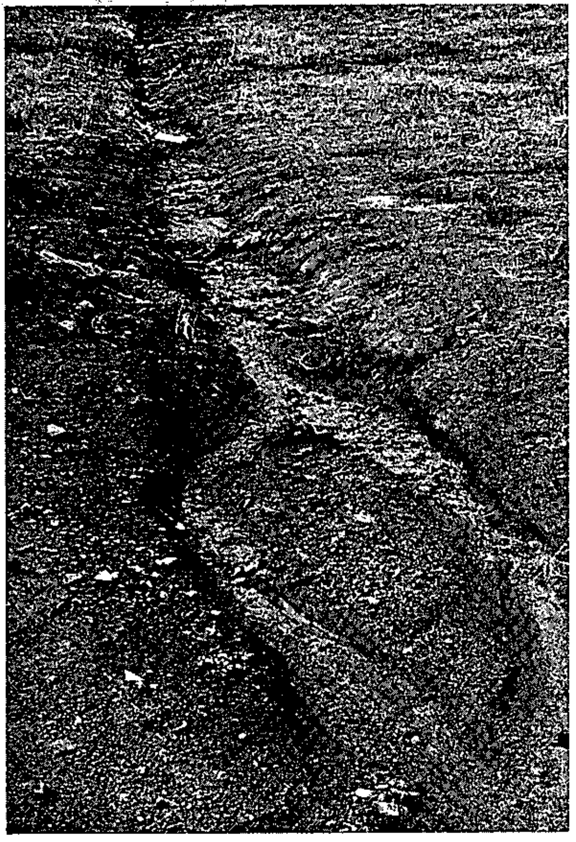


Plate 6
Moderate Erosion
At Location 4

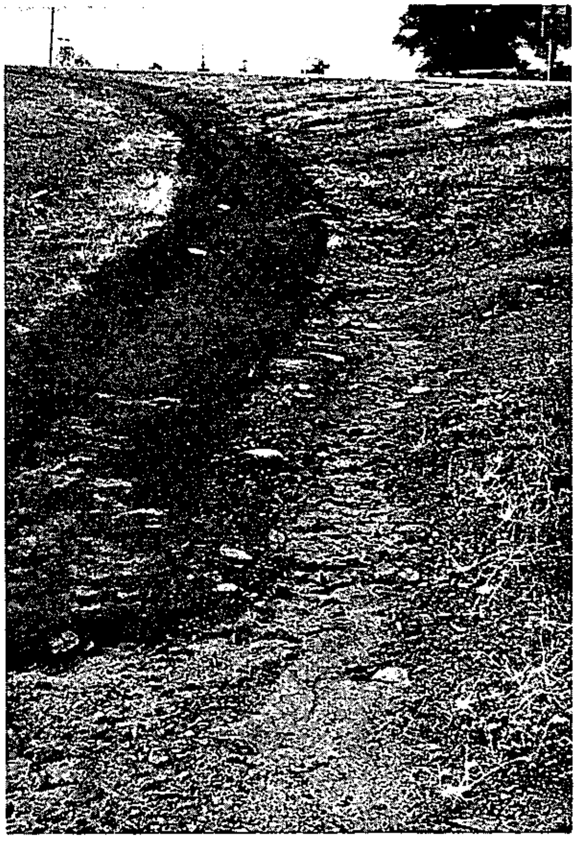


Plate 7
Moderate Erosion
At Location 4

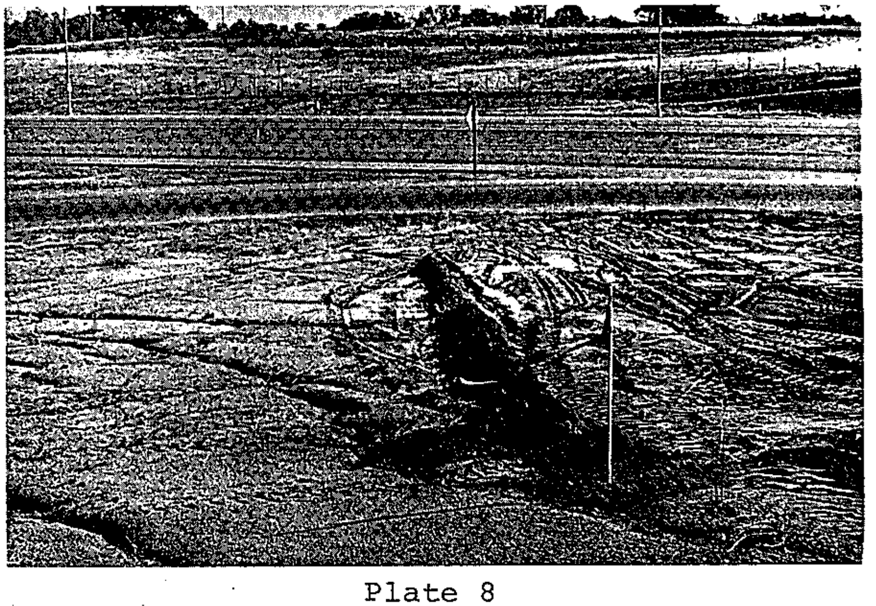


Plate 8
Severe Erosion at Location 5

Plate 9
Severe Erosion at Location 5

Locations 1, 2, 3 and 4 were selected to demonstrate the use of fiberglass roving for corrective ditch erosion control while Location 5 was selected to demonstrate its use for slope erosion control.

Preparatory Work

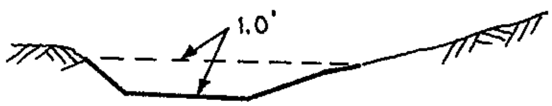
Preparatory work at Locations 1, 2, 3 and 4 consisted of regrading the eroded ditches and reshaping the ditch into flat bottomed sections with flat slopes. (See typical sections on page 10) A rectangular section of slope at Location 5 was regraded to a smooth section. One-half foot deep lateral trenches were constructed at Locations 3, 4 and 5 to allow for burial of the fiberglass mat to eliminate undermining by lateral inflow. A one-foot deep trench was cut along the upgrade end at all five locations to allow for burial of the mat and to prevent undermining.

A maintenance crew consisting of a motor grader and a laborer performed the preparatory work in two days. The lateral and upgrade trenches were later backfilled and compacted (by wheel rolling) by the same crew after the fiberglass roving had been applied.

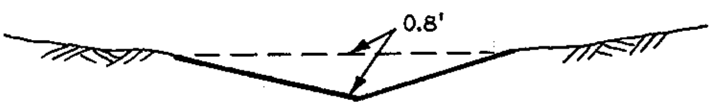
Plate 10
Regrading Ditch at Location 4

Typical cross sections and sizes of the treated areas are illustrated below:

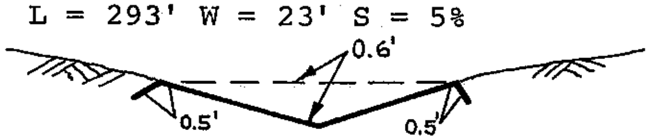
<u>Location 1</u>   Length (L) = 570' Width (W) = 16' F.L. Grade (S) = 7%



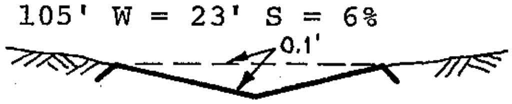
<u>Location 2</u>   L = 200' W = 19' S = 8%



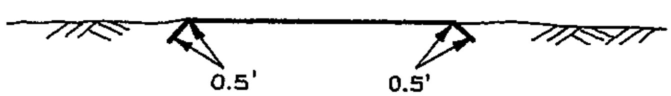
<u>Location 3</u>   L = 293' W = 23' S = 5%



<u>Location 4</u>   L = 105' W = 23' S = 6%



<u>Location 5</u>   L = 100' W = 52' S = 11%



Planting Work

A representative of the U. S. Soil Conservation Service Lockeford Plant Materials Center selected various combinations of grasses for each location. The selections were based on previous experience in the area. The seeding and application of fertilizer was performed by the SCS with the assistance of Transportation Laboratory personnel on October 18, 1973. The seed was hand cast on the ground within 24 hours prior to placing the fiberglass roving treatment.

The application rates and composition of the grass seeds and fertilizer are tabulated below:

Seeding and Fertilizer Record

Seeding Rate 50 lb/acre

Fertilizer Rate 500 lb/acre (16-20-0, ammonium phosphate)

Location 1

Wimmera 62 rye-grass	35%
Lana vetch	35
Blando brome	10
Barley (Briggs)	10
Other (Annual sweetclover, trefoil, etc.)	10

Locations 2, 3 and 4

Luna pubescent wheatgrass	20%
Palestine orchardgrass	20
Blando brome	35
Rose clover	15
Crimson clover	10

Location 5

Luna pubescent wheatgrass	25
Palestine orchardgrass	20
Foxtail fescue	20
Red brome	15
Rose clover	10
Crimson clover	10

Fiberglass Roving Application

Fiberglass roving is applied with the aid of a special nozzle driven by a 100 CFM air compressor. The material is fed into the nozzle from the center of the cylindrical package. Compressed air propels the fiberglass through the nozzle and separates the strands into individual fibers.

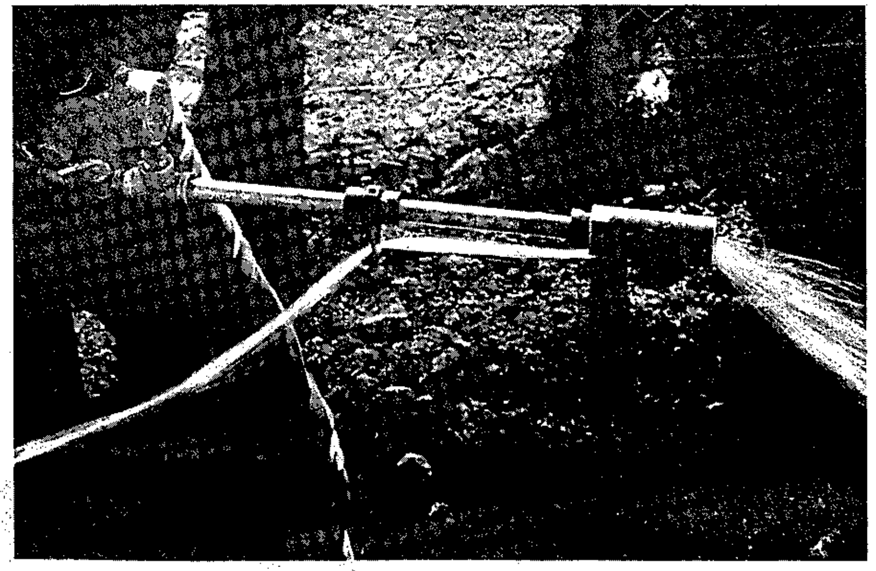


Plate 11
Nozzle Used to Apply Fiberglass Roving

The fibers are spread over the ditch section to form a random mat of continuous fibers. The fiberglass then has the appearance of "angel hair".

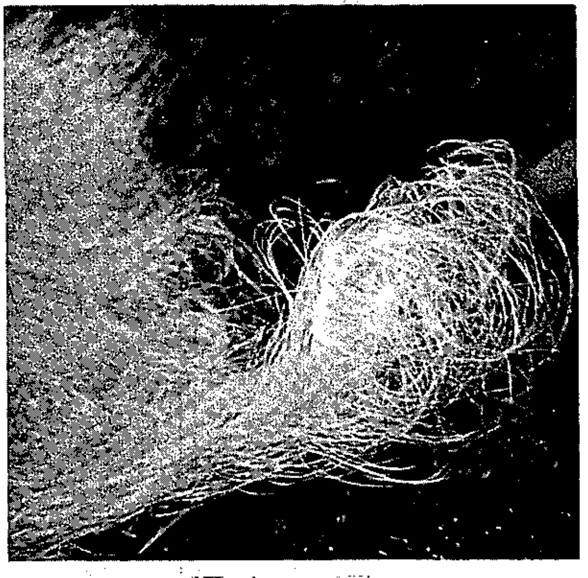


Plate 12
"Angel Hair" Appearance of Roving
Immediately After Application

To insure proper adhesion of the fibers to one another and to the soil, a tack coat of Asphaltic Emulsion (SS-1) is applied uniformly over the fiberglass.

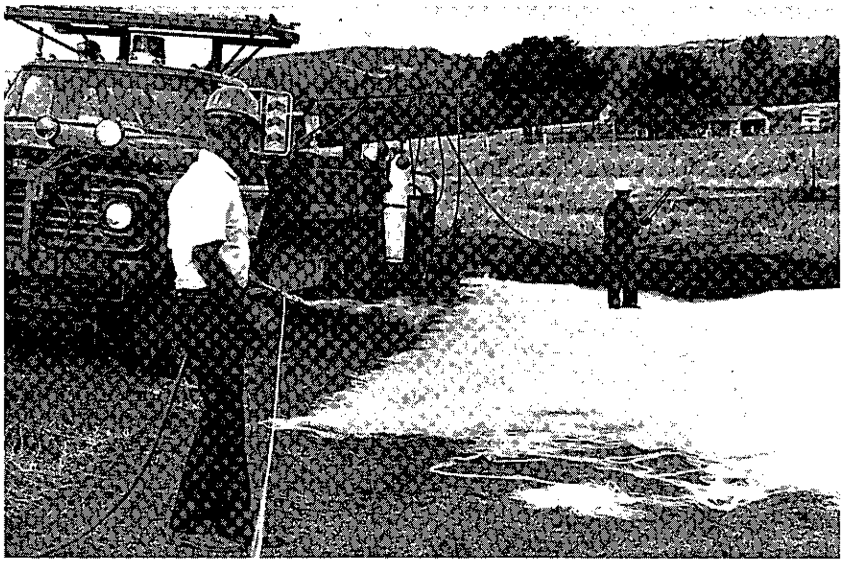


Plate 13
Man in Foreground Applies Roving While Man in Background Applies Asphalt Tack

The final result, after the application of the asphalt tack coat is a cobweb effect as illustrated in the photograph below.

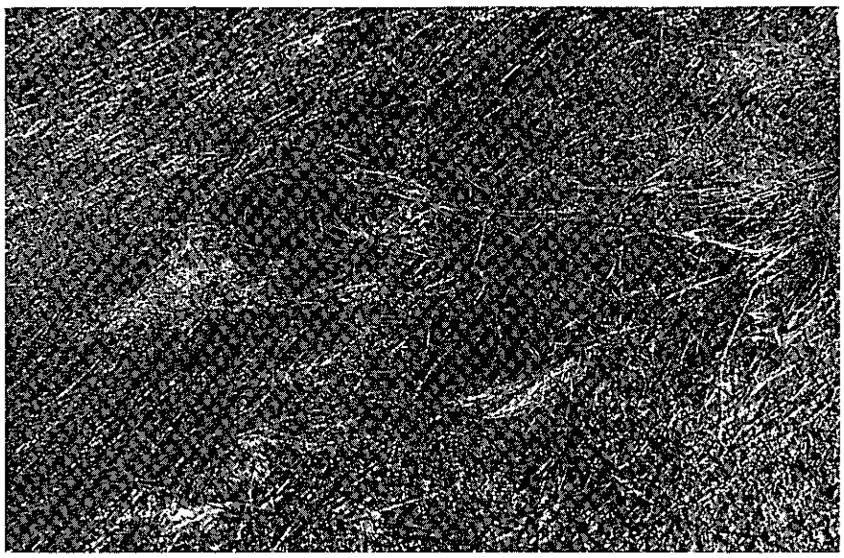


Plate 14
The End Result is a Cobweb Effect

The contrasting black color imparted by the asphalt tack coat presents a temporary negative visual impact until the grass seed germinates and covers the mat, obscuring it from view.

For this demonstration project the fiberglass roving treatment was applied by personnel from the FHWA and District 03 Maintenance Branch on October 18 and 19, 1973. The fiberglass roving, application nozzle and personnel experienced in applying fiberglass roving were supplied by the FHWA while the asphalt emulsion material (SS-1), asphalt tank and distributor, air compressor, trucks and support personnel were supplied by the District 03 Maintenance Branch.

The fiberglass roving and asphalt tack coat were applied at various rates to demonstrate the relative effectiveness of different application rates. The application rates for this project are tabulated below.

Location	Fiberglass Roving lb/S.Y.	Asphalt Emulsion Gal/S.Y.
1	0.55 Heavier rate on a section between 140' and 240' from upper end of the ditch.	0.28
2	0.52	0.17
3	0.40	0.10 on upper half 0.22 on lower half
4	0.50	0.24
5	0.45 on upper half 0.25 on lower half	0.17

Precipitation

A fence post rain gage was installed on a sign post at the southwest quadrangle of the Ponderosa Road Interchange. Precipitation was recorded intermittently and after each major storm. The total rainfall during the period 10-19-73 to 4-3-74 was 30.58 inches and is tabulated below. Compared to precipitation records for Placerville, located 10 miles east, the rainfall at this site appears to be below normal.

There was considerable lateral inflow at Location 2 as illustrated by Plates 17 and 18. However, the sides of the treated area were not undermined in spite of the omission of lateral trenches. This indicates that the use of lateral trenches to bury the sides of the mat is not necessary for conditions experienced during the test period.

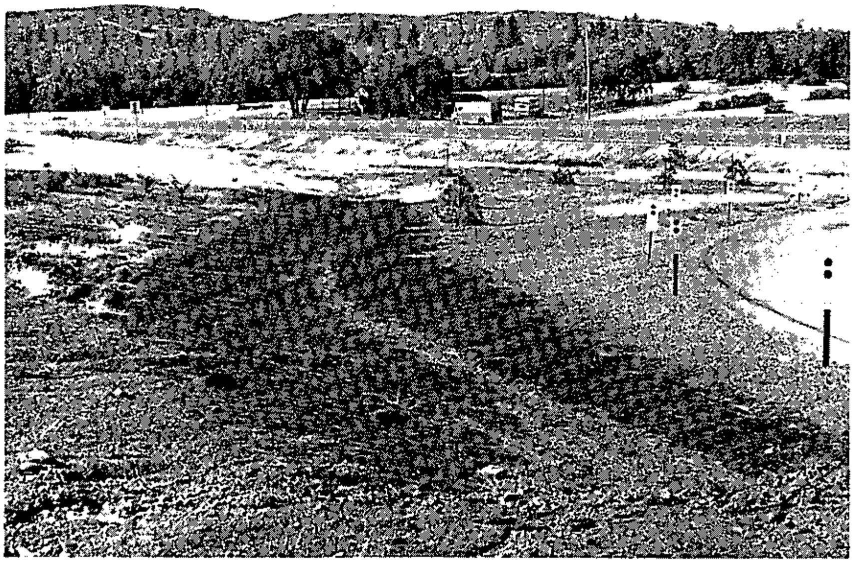


Plate 17
Lateral Inflow at Location 2

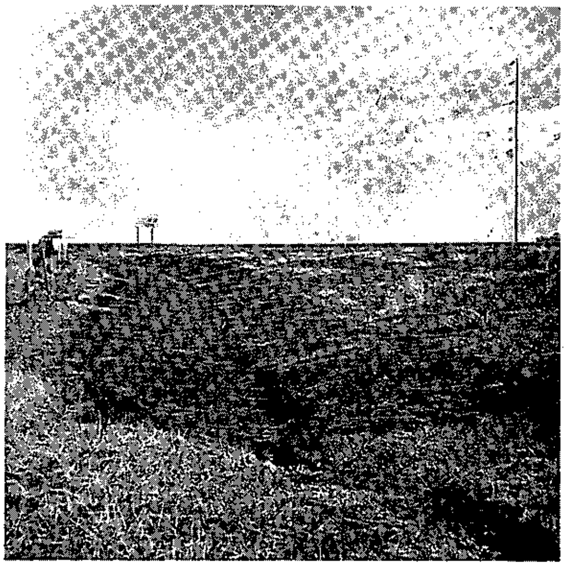


Plate 18
Lateral Inflow at Location 2

The integrity of the mat at the upper half of Location 3 was poor in several areas. This was probably due to the low asphalt application rate (0.10 gal/S.Y.).

Plates 19 and 20 illustrate the progressive severity of the erosion along the sides of the mat at Location 5. This concentrated

Plate 19
Progressive Erosion at Untreated Adjacent Areas

Plate 20
Progressive Erosion at Untreated Adjacent Areas

erosion was caused by the lateral trenches which were constructed to bury the sides of the mat and indicates that installing the trenches may have created an adverse effect.

The burial of the mat at the upgrade end of all the treated areas was effective in preventing undermining of the mat. However, at Locations 1, 2, 3 and 4 undermining was evident at the downgrade end of the mat. This indicates that the mat should be buried and possibly backfilled with small rocks at the downgrade end to eliminate undermining.

In general the grasses emerged through the fiberglass roving with little or no difficulty. Variations in the fiberglass and asphalt application rates had no visible effect on the vegetal growth.

An analysis of the emergence of the seedlings through the fiberglass roving was conducted on November 16, 1973. The average number of plants per square foot at the various locations is summarized below:

		No./Sq.Ft.	
Location 1	There were more plants in the bottom of the ditch than on the west side.	Grass	73
		Barley	3.5
		Vetch	3.5
Location 2		Grass	54
		Clover	1
Location 3	There was a large amount of rose clover already in this area which may account for the higher clover count.	Grass	78
		Clover	5
Location 4	The grass population was not as uniform as it should have been.	Grass	92
		Clover	2
Location 5		Grass	103
		Clover	2
		Calif. Poppy	1

There were a few small spots at Locations 3, 4 and 5 where over-application of asphalt sealed the mat and appeared to hinder vegetal growth. However, most of the grasses managed to emerge through the asphalt. The rather poor grass growth at the south half of Location 4 (see Plates 21 and 22) was possibly due to a lack of or low application of fertilizer.

Plate 21

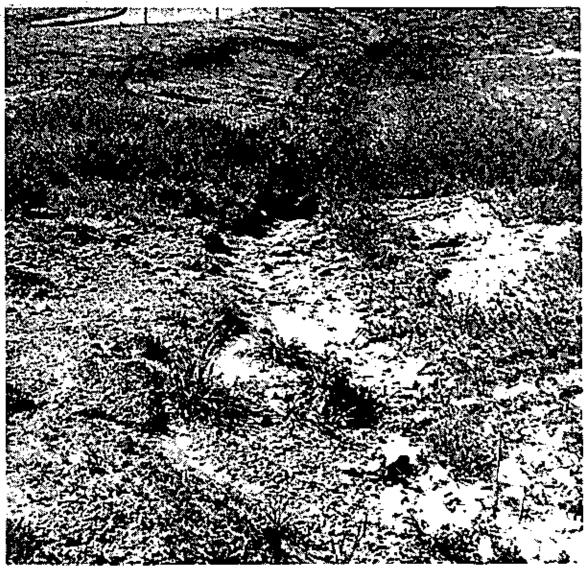


Plate 22

Lower Rate of Grass
Growth at Location 4

Economics

Fiberglass roving has been used on a contract basis in Iowa, Georgia, and Louisiana, where bid prices varied between 40¢ to 55¢ per S.Y. including seed and fertilizer. The fiberglass roving can be purchased from Owens Corning or Pittsburg Glass for about 35¢ per pound while the special nozzle required to apply the material can be purchased from Pittsburg Glass for about $100. The asphalt emulsion tack coat costs about 50¢ per gallon. All other equipment required to perform the work is standard and readily available for any contractor or maintenance crew.

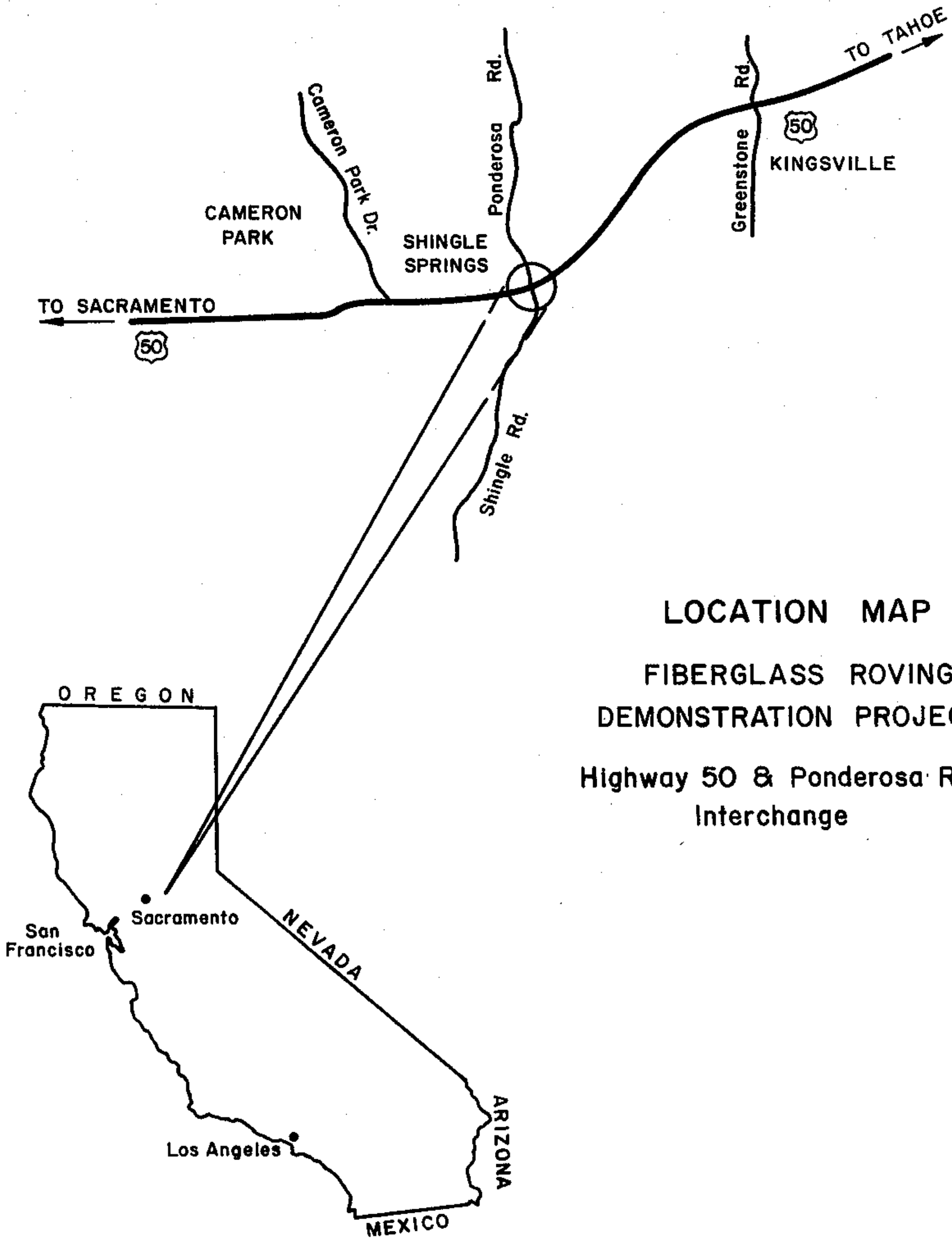
REFERENCES

1. "Environmental Quality Assurance Through Demonstration Projects", L. M. Darby, Public Roads, September 1972, Vol. 37, No. 2, Page 58.

2. "Project Prospectus No. 26, Demonstration of the Use of Fiberglass Roving for Corrective Ditch Erosion Control", U.S.D.O.T., Federal Highway Administration, Region 15.

APPENDIX A

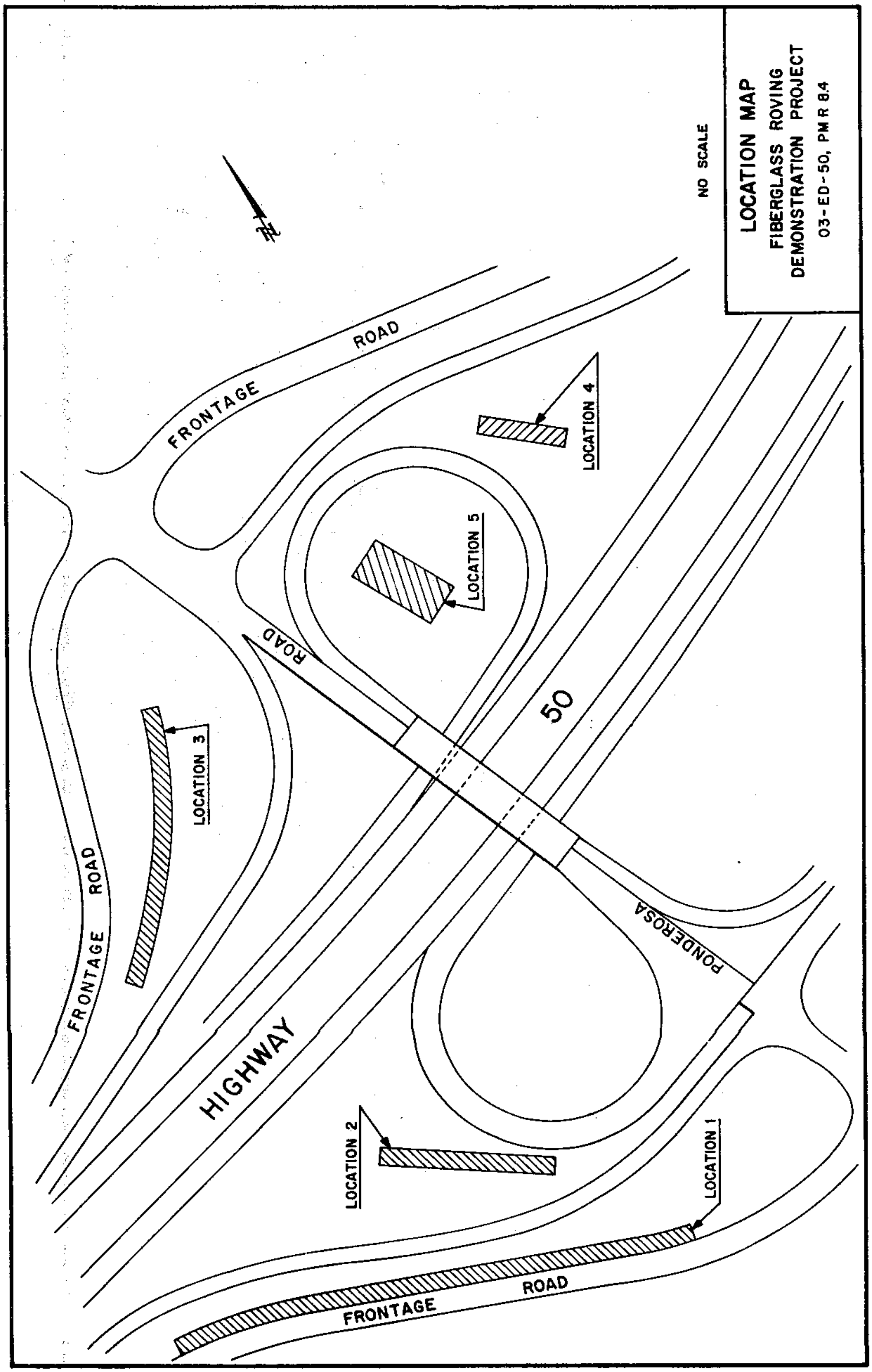
Location Maps



LOCATION MAP

FIBERGLASS ROVING DEMONSTRATION PROJECT

Highway 50 & Ponderosa Road Interchange


LOCATION MAP
FIBERGLASS ROVING
DEMONSTRATION PROJECT
03-ED-50, PM R 8.4
NO SCALE
N
FRONTAGE ROAD
FRONTAGE ROAD
FRONTAGE ROAD
LOCATION 1
LOCATION 2
LOCATION 3
LOCATION 4
LOCATION 5
PONDEROSA ROAD
HIGHWAY 50

APPENDIX B

Photographic Log
(Locations 1-5)

Plate 23 Before (October 10, 1973)

Plate 24 Before (October 10, 1973)

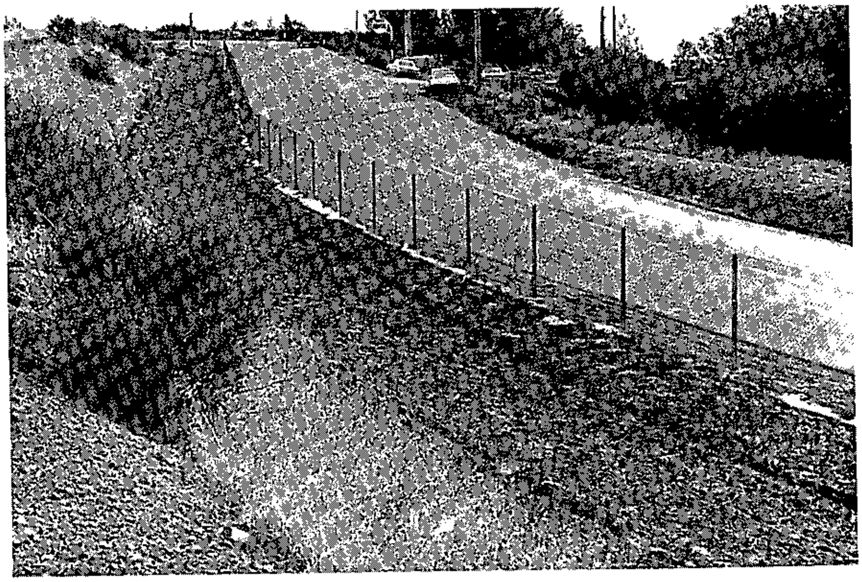


Plate 25 After Treatment (October 19, 1973)

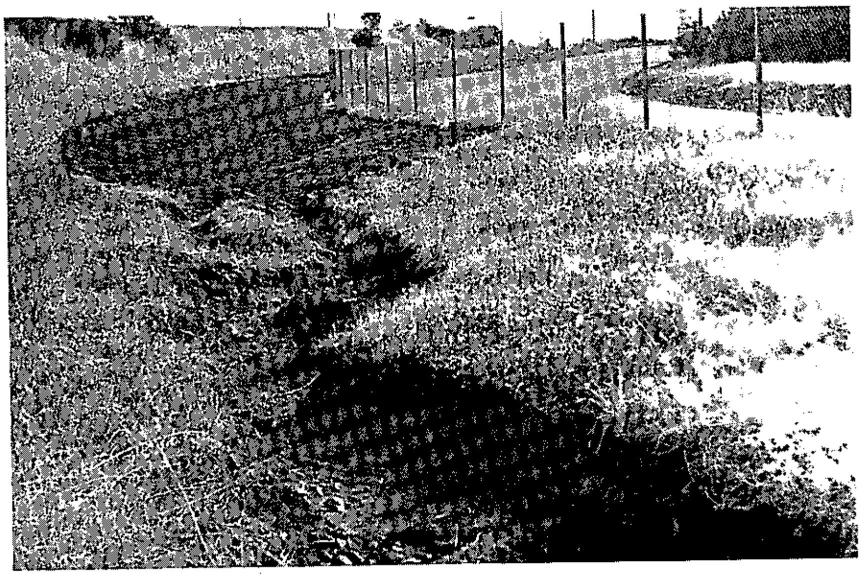


Plate 26 After Treatment (October 19, 1973)

Plate 27 After (April 3, 1974)

Plate 28 After (April 3, 1974)

LOCATION 2

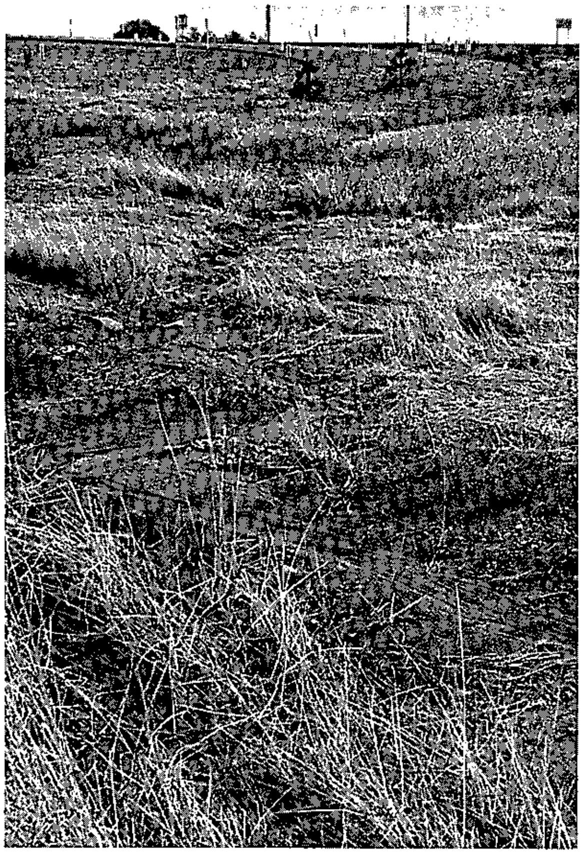


Plate 29 Before (October 10, 1973)

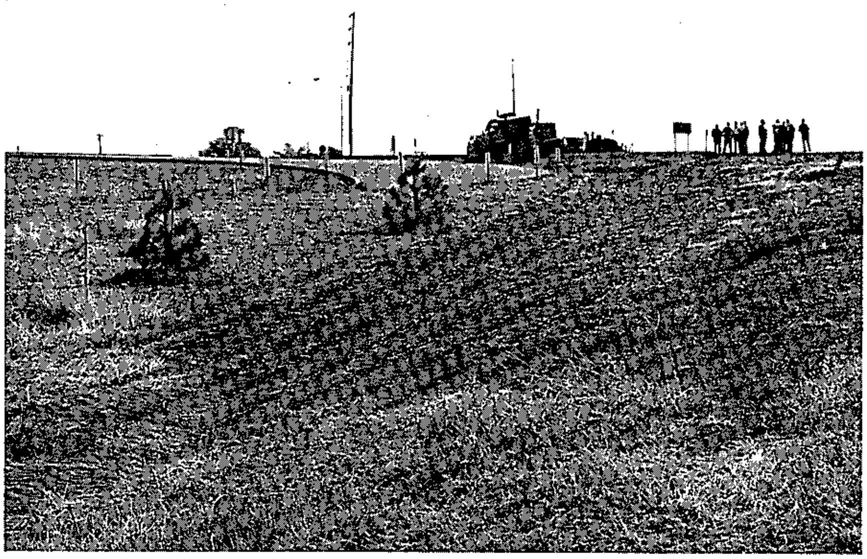


Plate 30 After Treatment (October 19, 1973)

Plate 31 After (April 3, 1974)

LOCATION 3

Plate 32 Before (October 10, 1973)

Plate 33 After Treatment (October 19, 1973)

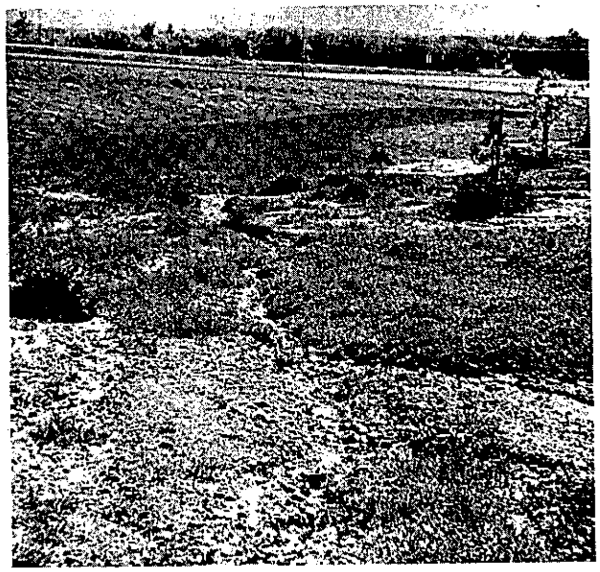


Plate 34 After (October 3, 1973)

LOCATION 4

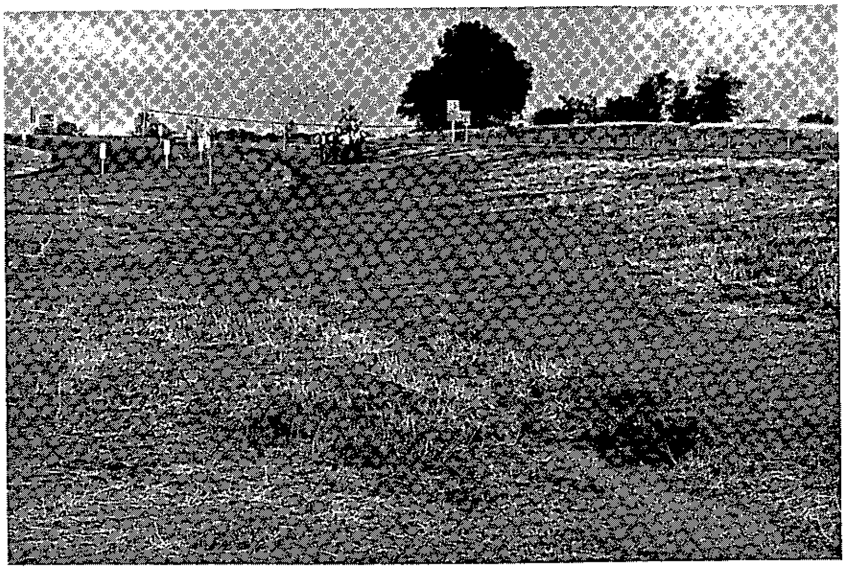


Plate 35 Before (October 18, 1973)

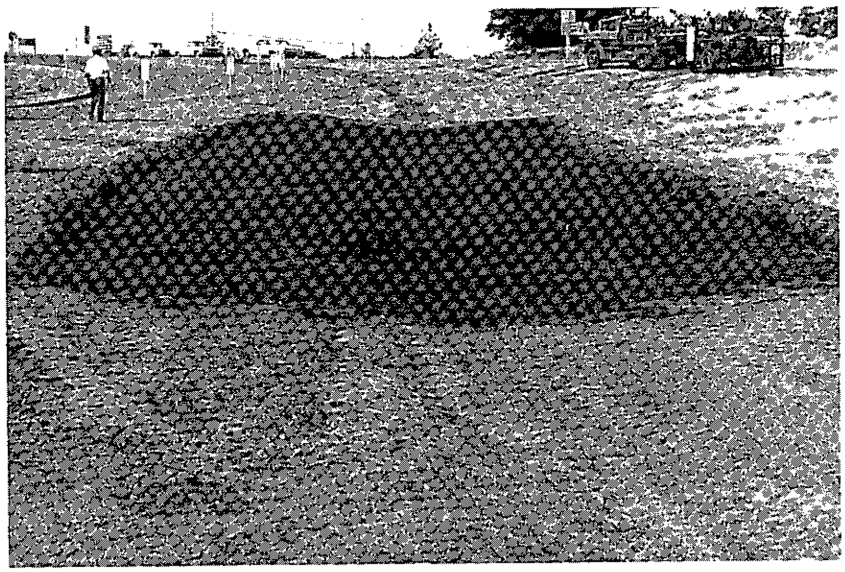


Plate 36 After Treatment (October 19, 1973)

Plate 37 After (November 2, 1973)

LOCATION 5

Plate 38 Before (October 18, 1973)

Plate 39 After Treatment (November 2, 1973)

Plate 40 After (April 3, 1974)

APPENDIX C

Tentative Guide Specifications

Tentative

GUIDE SPECIFICATIONS (Provided by FHWA)

FIBER GLASS ROVING

Description

This work shall consist of furnishing and installing fiber glass roving and asphalt for stabilization of soils on slopes and in ditches where shown on the plans or as directed by the engineer.

Materials

Fiber Glass Roving: The material shall be formed from continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound, collected into strands and lightly bound together into roving without the use of clay, starch or like deleterious substances. The roving shall be wound into a cylindrical package approximately 1 foot high in such a manner that the roving can be continuously fed from the center of the package through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

The fiber glass roving shall conform to these detailed requirements:

Property	Limits	Test Method
Strands/Rove	56-64	End Count
Fibers/Strand	184-234	
Fiber Diameter, in. (Trade Designation-G)	0.00035-0.0004	ASTM D 578
Yards/lb. of Strand	13,000-14,000	ASTM D 578
Yards/lb. of Rove	210-230	ASTM D 578
Organic Content, percent max.	0.75	ASTM D 578
Package Weight, lbs.	30-35	ASTM D 578
*Asphalt Emulsion	SS-1	Calif. Std. Spec. Sec. 94

Construction Requirements

Fiber glass roving shall be applied over the designated area within 24 hours after normal seeding operations have been completed. Fiber glass roving shall be spread uniformly over the designated area to form a random mat of continuous glass fibers at the rate of 0.25 to 0.35 pounds per square yard. This rate may be varied as directed by the engineer.

*Recommendation of California Transportation Laboratory

Fiber glass roving shall be anchored to the ground with asphaltic material applied uniformly over the glass fibers at the rate of 0.25 to 0.35 gallons per square yard. This rate may be varied as directed by the engineer.

The upgrade end of the lining shall be buried to a depth of 1 foot to prevent undermining. The above instructions for slope and ditch protection may be varied by the engineer to fit field conditions.

Maintenance and Repair

Lining shall be repaired immediately, if damaged due to the contractor's operations. Soil in damaged areas shall be restored to original grade, refertilized and reseeded if originally specified, all at no additional cost.

Equipment

Equipment shall include:

1. Pneumatic ejector capable of applying fiber glass roving at the rate of 2 pounds per minute (approximately 8 square yards per minute).

2. Air compressor capable of supplying 40 cfm at 80 to 100 psi. Acceptable air hoses necessary for supplying air to areas not accessible to the compressor.

3. Approved asphaltic material distributor with necessary hoses and hand spray bar for working on slopes and other areas not accessible to the distributor.

Measurement

Fiber glass roving will be measured by the pound, complete in place and accepted. The number of pounds will be determined as the product of the number of spools or packages of fiber glass roving actually used and the average weight of the spools or packages. The average weight will be determined by weighing and averaging random samples of not less than 3% of the total number of spools or packages required. In no case shall the samples selected be less than 3.

Asphalt cement or emulsified asphalt will be measured by the gallon, complete in place and accepted.

Payment

The accepted quantities of fiber glass roving and asphalt material will be paid for at the respective contract unit prices.

ITEM	UNIT
Fiber Glass Roving	Pound
Asphaltic Material	Gallon

APPENDIX D

Demonstration Attendance List

The following is a list of people who observed the demonstration project:

Mike Quint	Transportation Laboratory
Eric Torguson	"
Tom Hoover	"
John Adams	"
Marty Nolan	"
Lou Green	"
Dick Wasser	"
Joe Egan	"
Earl Shirley	"
Dick Howell	"
George Edmunson	U. S. Soil Conservation Service
Gene Stager	FHWA
Dennis Richards	"
Jeff Brooks	"
Buck Bolt	"
Mr. Schmidt	"
Dave Donaldson & crew	District 03 Maintenance
John Rime	" "
Don Frohreich	" "
Gene Kreb	" Design
Marty Van Zandt	" Hydraulics
Ed Jeffers	" "
Russ Hill	" Design
Erv Fuller	" Materials
Don Foster	" Environmental
Walt Whitnack	Headquarters Project Development
W. Romero	Venezuela Highway Department
M. Silva	" " "