INPLACE COLD RECYCLING

VT ROUTE 12 RANDOLPH

Initial Report 89-1
January 1989

REPORTING ON WORK PLAN 86-R-4

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

SUSAN C. CRAMPTON, SECRETARY OF TRANSPORTATION
DAVID KELLEY, P. E., CHIEF ENGINEER
Donald C. Brown, P. E., Acting MATERIALS & RESEARCH ENGINEER

Prepared By

Ronald I. Frascoia
Research & Development Supervisor

Reviewed By: D C Brown
Acting Materials & Research Engineer
Date: 1-18-89

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ACKNOWLEDGEMENT

This project was performed in cooperation with the U. S. Department of Transportation, Federal Highway Administration. The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. This report does not constitute a standard, specification or regulation.

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A B S T R A C T

The search for a low cost method of inplace cold recycling led to the specified use of a BOMAG MPH 100 recycler on a severly cracked portion of VT Route 12, in Randolph, in September, 1986. The rehabilitation contract included the placement of a standard bituminous overlay on a portion of the project for comparison purposes.

Observations made through August 19, 1988 disclosed some longitudinal cracking at the original travel lane/shoulder joint in the recycled section. The total equals 9% of the original crack footage. In comparison, the control section had 13% reflective cracking. Mays roughness values remained 20" ± lower on the recycled section.

Through two years of service, it appears the recycled section has performed somewhat better than the control section. However, to be cost effective, the recycled section must produce more than a doubling of service life.

INTRODUCTION

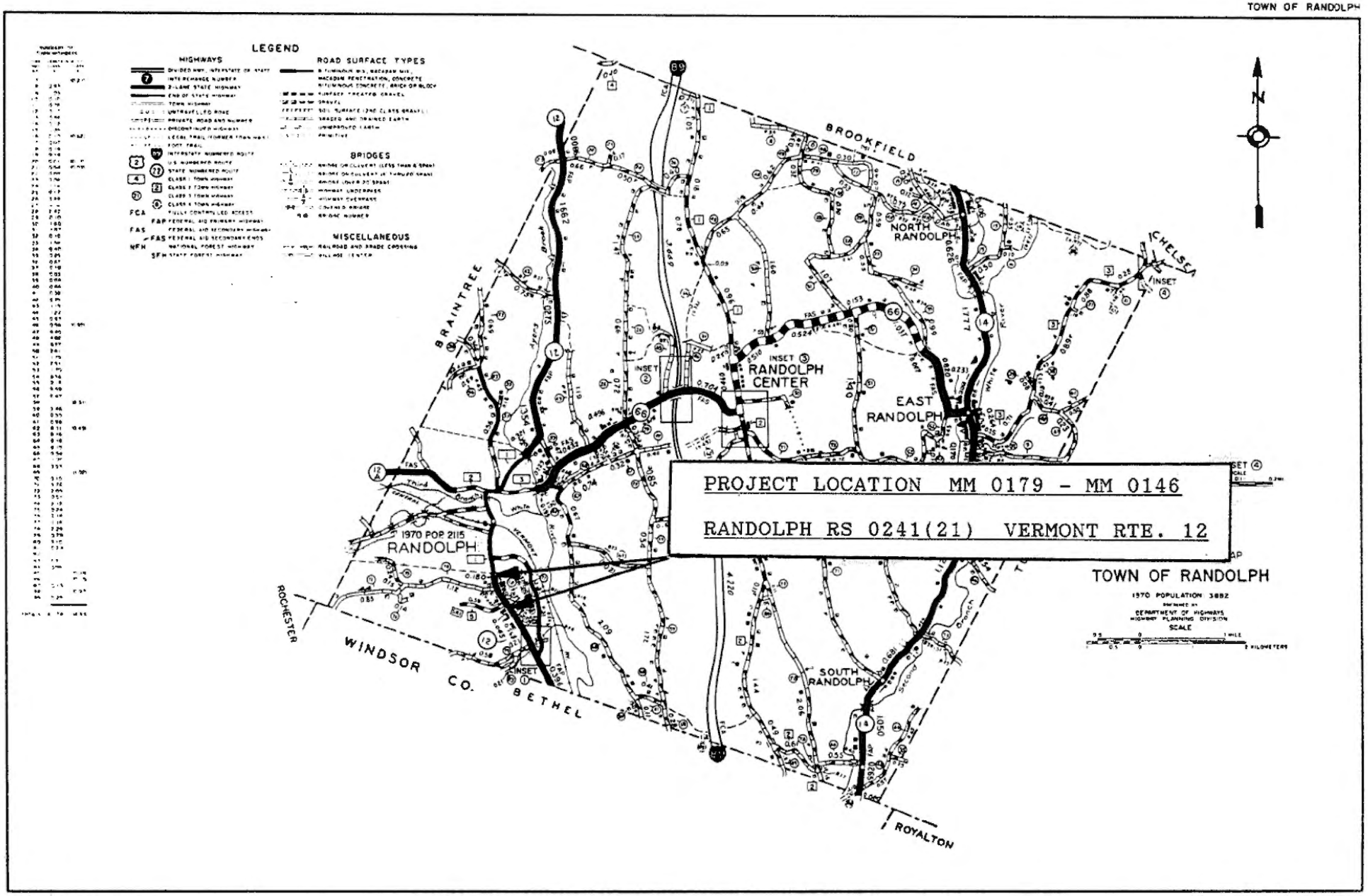
Vermont's standard pavement maintenance/rehabilitation procedure consists of placing a thin leveling course and overlaying with a 1" to 2" wearing course of new bituminous concrete pavement. Experience has shown that this procedure is not effective in preventing the cracks in the old pavement from reflecting up through the new overlay. In numerous instances, transverse thermal cracks were found to reflect through the new overlay during the first winter of exposure. Previous experience with cold recycling carried out in 1978 (report 79-1) and traveling hammermill operations in 1975 (report 75-1) and 1981 (report 81-7) had proven sucessful in preventing premature cracking of the new pavements although the cost of such projects had been relatively high.

Subsequent discussions with sales and technical personnel involved with cold recycling suggested that the use of a BOMAG MPH 100 RECYCLER could reduce the cost of inplace cold recycling to a range of $1.25 to $1.50 per square yard plus the cost of a stabilizing asphalt additive. In anticipation of such reasonable costs, a list of upcoming overlay projects was reviewed and the project described in this report was selected for in place cold recycling.

PROJECT DESCRIPTION AND ROADWAY CONDITION

The project consisted of a section of VT Route 12 beginning approximately 1.079 miles north of the Bethel-Randolph Town Line and extending northerly 0.46 miles to the Randolph town/village line. The existing roadway was reconstructed in 1967 featuring a 44' wide surface, 24" subbase, a 3" base course of penetration macadam and a 2-1/2" bituminous concrete wearing course. The roadway was overlaid in 1978 with a grit seal. The pavement thickness, determined from field core measurements, was 6" and the subbase, consisting of gravel varying from 23" to 27" thick was of good quality. A survey of the pavement condition made at two locations in March of 1985 revealed severe transverse longitudinal cracking throughout the project. Detailed pavement surveys completed in June 1986 revealed 1416 linear feet of cracks in the 100 linear feet of control section #1. Test section #2, located within the area to be recycled, contained 1402 linear feet of cracks in the 100 foot section. Fifty nine percent of the cracks in test section 1 were longitudinal, while 63% of the cracks in test section 2 were longitudinal. Because rutting was minimal, averaging 1/4", the severe cracking was believed due to failures in the bituminous materials rather than problems with the subbase materials or subsurface moisture.

Average daily traffic volume on this section of VT Route 12 was 3840 vehicles in 1986.


LEGEND
HIGHWAYS
ROAD SURFACE TYPES
BRIDGES
MISCELLANEOUS
PROJECT LOCATION MM 0179 - MM 0146
RANDOLPH RS 0241(21) VERMONT RTE. 12
TOWN OF RANDOLPH
1970 POPULATION 3882
BROOKFIELD
BRAINTREE
CHELSEA
ROCHESTER
WINDSOR CO.
BETHEL
ROYALTON
1970 POP 2115
RANDOLPH
NORTH RANDOLPH
INSET ③ RANDOLPH CENTER
EAST RANDOLPH
SOUTH RANDOLPH
INSET ①
INSET ②
INSET ④
N

PRELIMINARY INVESTIGATION

Preliminary testing of field recovered pavement cores was carried out in the Materials and Research laboratory; the results indicated the average asphalt content was 6.3% in the top 1-1/2" and 4.9% in the bottom 1-1/2". Average recovered penetrations were 23 top and 20 bottom. The absolute viscosities were too high to be measured with available equipment. Abson recovery test values indicate that the asphalt had lost much of it's "life" and had become quite brittle.

The subbase material was of fair quality with an average of 8% of the sand portion of the sample passing the #200 sieve, and a wear of 53% on the coarse aggregate.

CONSTRUCTION OPERATION

The project was advertised in April 1986 and the contract was awarded to the Cooley Asphalt Paving Corporation of Barre, Vermont who sublet the recycling work to the Frank W. Whitcomb Construction Corporation of Bellows Falls, Vermont.

The cold recycling operation was completed on September 26th and 29th, 1986 in a total of 11 working hours. The area treated was 850 feet in length by 41.5 feet in width for a total of 3828 square yards. The BOMAG MPH 100 pulverized the five to six inches of existing pavement in six foot wide passes traveling at an average rate of nine feet per minute. Compaction of the pulverized material was achieved with a vibratory roller following the addition of water. The asphalt emulsion specified for stabilizing the pulverized mix (a proprietary product developed by the Penelizer Corporation) was not available for use during the recycling operation. A plan to rework the material and add the emulsion at a later date was not carried out due to a later decision by the Agency to delete the use of the binding agent. On October 10th, 1986, a grader was used to rework the top four inches of pulverized material which was then recompacted and overlaid with two 1-1/2" courses of bituminous pavement two days later.

The rehabilitation of the control section, which consisted of the southernmost 0.3 mile section of the project, was completed at the same time that the test section was paved. The cracks were filled, as initially planned, then a thin leveling course and a 1-3/4" overlay were applied.

POST CONSTRUCTION OBSERVATIONS

Observations made in April of 1987, after one winter of exposure, indicated no significant difference in the performance of the control and recycled sections, however, by August of 1988, test section #1, in the overlay segment, had experienced 13% reflective cracking with 85% of the total consisting of transverse cracks. Longitudinal cracks totaling 121 feet in length, 9% of the original crack count, were recorded in the recycled test section. They consisted of nearly continuous cracks approximately 12 feet left and right of the roadway centerline. The location of such cracks suggest that the recycling process did not pulverize to the full depth of the old pavement at the original travel lane/shoulder joint and the new cracks are reflective in nature.

Shortly after construction, pavement riding quality was measured using a trailer mounted Mays meter. The values showed a 28" difference between the two treatments with the recycled area averaging 70"/mile and the standard overlay averaging 98"/mile. By 1988, the difference had decreased to 20" with the recycled area averaging 107"/mile and the overlay averaging 127"/mile.

COST ANALYSIS

Following is a breakdown of the project costs for the recycled and standard overlay sections:

Cost of Cold Recycling and Overlay

Bituminous base stabilization -	3828 sq.yd.	@	$3.90/sq.yd.	= $14929.20
Bituminous Concrete overlay -	692 sq.yd.	@	$33.75/ton.	= 23355.00
			Total cost	38284.20
Surface area treated - 3828 sq.yd.			Cost per sq.yd.	$10.00 sq.yd.

Cost of Standard Overlay Procedure

Bituminous Concrete Overlay	650 tons	@	$33.75/ton	= $21937.50
Bituminous crack filling	9794 l.f.	@	1.50/l.f.	= 14691.00
Surface area treated - 7822 sq.yd.			Cost per sq.yd.	$ 4.68 sq.yd.

There were two conditions relative to the project which had an effect on the unit cost of the treatments and thus could effect future cost effectiveness comparisons.

The area specified for recycling was relatively small, 4200 s.y., and it could be assumed that a somewhat lower price might have been received had the project quantity been larger. For comparison purposes the same model recycling unit was utilized a few weeks earlier on VT Route 30 in Jamaica. The bid price on that project was $3.25/s.y. with a design quantity of 21,600 s.y. involved.

Had the inplace recycling been bid at $3.25/s.y. on this project the cost would have been exactly twice that of the standard overlay.

The second point of interest involves the bituminous crack filling which was carried out on the standard overlay section. Crack filling has not been done on projects prior to paving for the past 6 ± years. If the process had not been specified on this project the cost of the standard overlay treatments would have been reduced to $2.80/s.y. thus making it approximately 3-1/2 times less costly than the recycle treatment.

As completed, the cost per square yard of the recycled section was more than twice that of the standard overlay treatment. This suggests that, while recycling may be an effective engineering solution to reflective cracking, it may not be an economical one. To be cost effective it on this project, the recycled section will have to provide more than a twofold increase in service life over the standard treatment.

SUMMARY

Specific items of interest documented on this experimental project include the following:

1) A BOMAG MPH 100 recycler was specified in hopes of obtaining a low bid price for the pulverization item. The contract bid price of $3.90/s.y. was more than double what had been suggested as reasonable by recycling representatives.

2) The section of VT Route 12 selected for recycling consisted of a grit seal over 2-1/2" of bituminous pavement over 3" of penetration macadam. Cracks in the pavement averaged 1400+ feet per 100 feet of roadway.

3) The BOMAG MPH 100 was able to pulverize the pavement full depth in a single pass averaging 9 feet per minute for an average of 348 square yards per hour.

4) Asphalt emulsion was not added to the pulverized material due to an initial lack of availability and a later decision to delete the use of the material.

5) Through two years of service there has been no indication that the deletion of the emulsion has had an adverse effect such as the development of wheel path rutting or other forms of pavement distress.

6) The standard overlay has experienced 13% reflective cracking in the control test section through August 1988.

7) The recycled section has experienced nearly continuous longitudinal cracking 12 feet left and right of the centerline. This location suggests that the old pavement was not pulverized full depth at the original travel lane/shoulder joint and the new cracks are reflective in nature.

8) Initial and follow up Mays meter ride values indicate the recycled section has remained 20+ inches smoother than the standard overlay section.

9) The cost of the treatment on the recycled section was more than two times ($10.00/s.y., vs $4.68/s.y.) that of the standard overlay. Therefore, the recycled section will have to provide more than a two fold increase in service life to be cost effective.

RECOMMENDATIONS

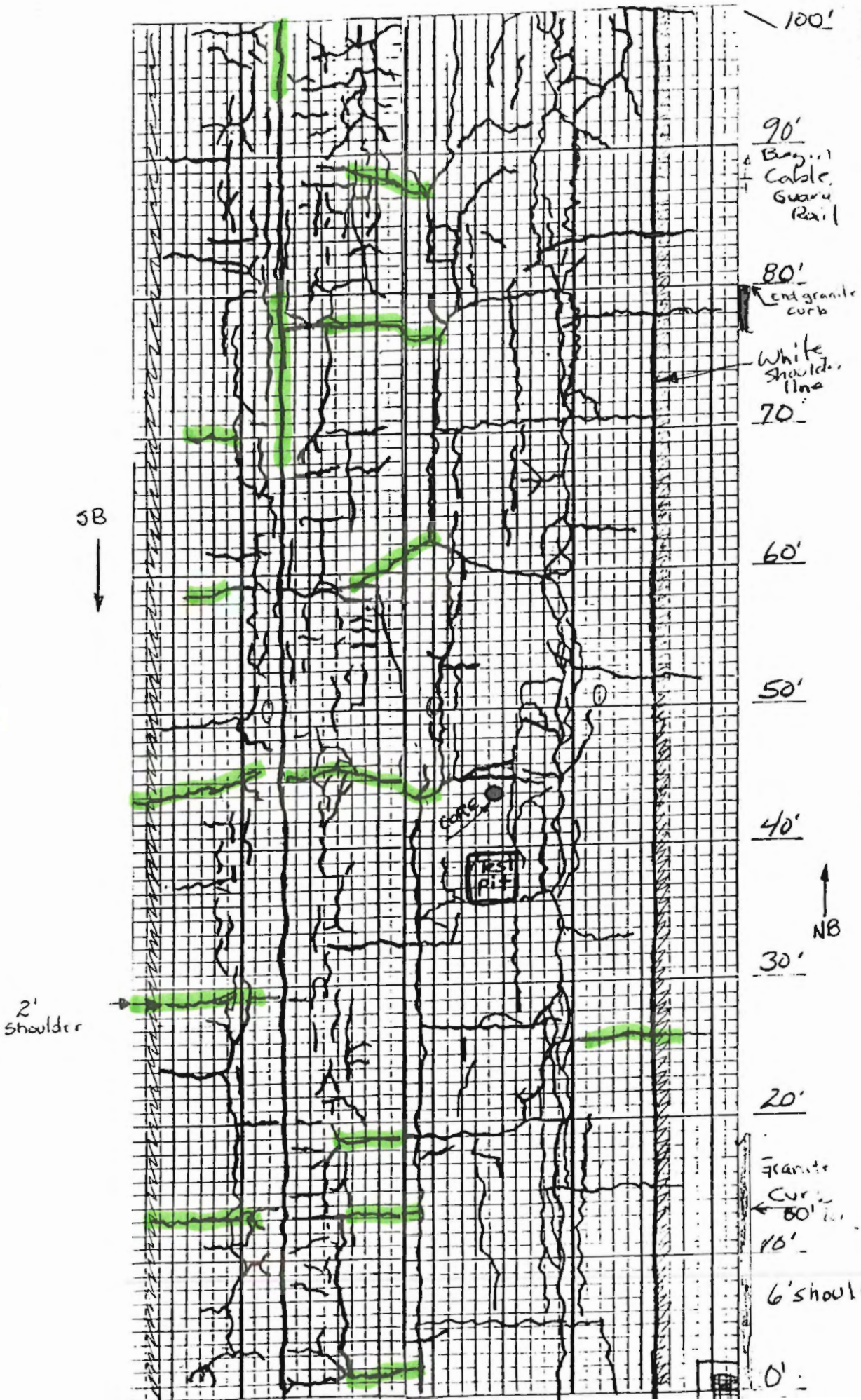
Consideration should be given to letting pavement rehabilitation projects, which include inplace recycling, in two stages. Such a process could result in significant savings in recycling costs by encouraging bidding by speciality contractors equipped to pulverize and stabilize the existing bituminous courses. The final stage would consist of the bituminous paving which would be bid by the paving contractors. The same result might be achieved by allowing alternate bids which would allow the selection of the most cost effective alternative.

FOLLOW UP

Yearly inspections will continue until conclusions can be drawn regarding the cost effectiveness of inplace recycling on this project.

APPENDIX A

PAVEMENT CONDITION SURVEY



PROJECT:
Randolph
Rte 12
RS 0241(21)

ORIG. SURV. BY:
ECH.

DATE: 6·3·86

CONTROL
T.S. # 1

100' LONG
44' WIDE
18' LANES

Test Section begins at ℄ of D.I. (see sketch on back of this sheet). Approx. MM.0114.

8-9-88
RW KPR

APPENDIX B

PAVEMENT CONDITION SURVEY

PROJECT:
Randolph
Rte 12
RS 0241(21)

ORIG. SURV. BY:
E.C.H.

DATE: 6/86
RECYCLE
T.S. #2.

100' LONG
44' WIDE
18' LANES

Test Section begins @ begining of guard rail (see sketch on back of this sheet).

8-4-88
PCW-KPR

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

WORK PLAN FOR CATEGORY II EXPERIMENTAL PROJECT INPLACE RECYCLING WITH A BOMAG RECYCLER

WORK PLAN 86-R-4

OBJECTIVE OF EXPERIMENT

To evaluate the long term performance of a section of highway recycled with a BOMAG Recycler.

PROJECT

Randolph RS 0241 (21)

PROJECT LOCATION

Beginning at a point on Vermont Route 12 approximately 1.079 miles westerly of the Bethel-Randolph Town Line and extending northerly approximately 0.464 miles to the Randolph Town Village Line.

EXPERIMENTAL WORK LOCATION

The northerly 0.16 mile (850 feet) portion of the project shall consist of inplace cold recycling with a 1½ inch bituminous concrete pavement.

EQUIPMENT TO BE USED

The experimental inplace recycling will be carried out utilizing a BOMAG recycler.

CONSTRUCTION PROCEDURE

The existing 3 inches of bituminous concrete pavement and 3 inches of bituminous penetration macadam will be pulverized inplace and the top 4 inches of the material will be stabilized with a standard emulsion at the rate of 2.1 gallons per square yard.

CONTROL SECTION AND TREATMENT

The remainder of the project will receive a bituminous concrete leveling course and a 1 3/4 inch bituminous concrete overlay.

COST

The estimated cost for the experimental test section is as follows:

Item 310.15 Bituminous Base Stabilization - $4.50/sy
Item 406.25 Bituminous Concrete Pavement (1½") - $2.90/sy

Total Cost = $7.40/sy

The estimated cost for the control section is as follows:

Item 406.25 Bituminous Concrete Pavement (2") - $3.90/sy

Total Cost = $3.90/sy

DATE OF CONSTRUCTION

Prior to November 1, 1986

DURATION OF STUDY

The experimental project will be monitored for the length of time required to obtain valid conclusions on the performance of the treatment.

SURVEILLANCE

The experimental and control areas shall be monitored during construction and at least once each year for the duration of the study. The evaluation shall include the following:

1) Document the condition of a portion of the existing pavement in the control section so that crack reflection data can be obtained.

2) Observe and record production information on the recycler.

3) Obtain Mays Meter ride values on the experimental and control sections, both prior to and following completion of construction.

4) Record the long term performance of both sections with emphasis on wheelpath rutting, crack development, retention of initial ride values and maintenance requirements.

REPORTS

Reports will be submitted to the Federal Highway Administration when conclusions can be drawn on the performance of the treatment.

Reviewed By:

R. F. Nicholson

Materials & Research Division
Agency of Transportation
March 12, 1986

R. F. Nicholson, P.E.
Materials & Research Engineer
Date: 03-13-86