EVALUATION OF AN EMULSIFIED ASPHALT SURFACE TREATMENT

INITIAL REPORT 81-1
MARCH 1981

Reporting on
Work Plan 80-R-5

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

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16. Abstract

This report discusses the application of an emulsified asphalt single surface treatment on Vermont Route 31 by State Maintenance Forces. A CRS-2 emulsion was spray applied at an average rate of 0.33 gallons per square yard and 3/8" crushed gravel was readily placed over the emulsion at an average rate of 18 to 19 pounds per square yard. The treatment was compacted with pneumatic and steel wheeled rollers.

The treatment was placed over a period of two days at a completed cost of 44.4¢ per square yard. Energy consumption was 3,705 Btu per square yard or a total of 215,639,769 Btu.

Use of an MC-3000 cutback asphalt in place of the emulsion for the identical treatment would cost 9% more, use 241% more energy and produce considerable hydrocarbon air pollution.

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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. Anyone, other than the Agency using this report, does so with awareness that the Agency does not guarantee the opinions, findings, or conclusions contained therein.

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INTRODUCTION

Large quantities of cutback asphalts have been used nationwide in highway construction and maintenance for many years. Concern about our environment and the wasteful use of our resources has caused highway personnel to take a new look at the potential uses of emulsified asphalts in place of cutbacks. The cutbacks are asphalts liquefied by the addition of petroleum distillates, distillates which could be used as productive energy instead of a liquefying agent which evaporates into the atmosphere as environmentally harmful hydrocarbons. Emulsions, on the other hand, use water as the liquefying agent resulting in no air pollution or waste of a petroleum product.

Vermont has used both emulsions and cutback asphalts for a variety of treatments such as: tack coats, prime coats, slurry seals, sand seals, and single and multiple seal coats. This report describes the application of an emulsified asphalt single surface treatment by State of Vermont maintenance forces. The objective was to collect information on the design, construction and performance of the treatment, plus evaluate the cost, energy usage and environmental effects as compared to the use of a cutback asphalt.

BACKGROUND AND PRECONSTRUCTION CONDITION

The experimental surface treatment was applied to 4.96 miles of Vermont Route 31 in the towns of Wells and Poultney, Vermont. (See Appendix A). Initial construction of Vt. Route 31 as a surface treated gravel roadway occurred in two stages. The portion within the town of Poultney was constructed in 1939 and 1940. The remaining portion, to the New York - Vermont state line, within the town of Wells was constructed in 1953. Retreatments to the entire roadway were as follows: blade mix bituminous surface treatment in 1960, single chip seal surface treatment in 1964, blade mix bituminous surface treatment in 1965, single chip seal surface treatment in 1966 & 1969, and two inches of asphalt emulsion open graded cold mix in September, 1979.

Average daily traffic for the twenty-one foot wide, two lane roadway is 600 vehicles per day, of which 4.5 percent are trucks. Over the past decade, there has been a zero percent growth in traffic flow. The posted speed limit for the route is 50 miles per hour.

Prior to application of the chip seal, seven pre-determined 200 to 300 foot test sections of the existing one year old cold mix surface were examined for texture, rutting, raveling, and cracking. See appendix B for layout of test area locations.

Texture of the cold mix over the entire project appeared rough and slightly porous, indicating a higher than average absorption characteristic. Friction values on the surface prior to application of treatment averaged 45.0. The readings ranged from a low of 43 to a high of 47.

Cold Mix Surface Texture Prior to Application of Surface Treatment.

At all seven test sections, the amount of rutting in the wheel paths was measured. Out of 88 measurements at 22 locations across the entire width of the road, 57% indicated no rutting, 30% showed rutting of 1/16", 8% had rutting of 2/16", 3% had rutting of 3/16", and 2% had rutting of 7/16". The 7/16" readings were two isolated areas within a 100 linear foot area of roadway in one test section.

Raveling in pot hole configuration was noted over approximately 0.3% of the total roadway. Depth of the raveled areas varied from a minimum of 1/8" to a maximum of 5/8". Raveled areas often occurred in clusters and at different offsets. Very little raveling was noted along roadway edges.

Cracking within the test sections averaged 25 linear feet per one hundred linear feet of road. The worst cracking found was in one section containing 135 linear feet of cracks for 100 linear feet of road. All cracks were of longitudinal nature and at different offsets. (see following pictures)

Pavement Condition Prior to Treatment

Climatological data for the area of the project indicates a yearly freezing index of 963 and approximately 96 freeze-thaw cycles. Average annual temperature for the area is 46°F and of this 130 to 145 days average below freezing temperatures. The yearly average precipitation is 33".

ASPHALT DISTRIBUTOR

Gorman Brothers of Albany, New York supplied a truck mounted asphalt distributor. The truck was equipped with a baffled, insulated, shelled tank having a capacity of 2700 gal. of material. For monitoring quantity and temperature of material, there was a float type gauge and thermometer within the tank.

Heating of the emulsion was done by means of two oil fired burners on the distributor. Each burner throws a flame down a separate heating flue of the tank which in turn transfers heat to the emulsion.

A gear type engine-driven pump not only sprays material for application, but also circulates material in the tank, loads or unloads material from distributor, and transfers material from one storage area to another.

The 11' truck mounted spray bar had 45° nozzles mounted four inches apart at angle settings of approximately 10°. Height of the bar with the truck loaded was 8". There was no means of correcting the height as the truck unloaded or for irregularity in the roadway.

Flow of the emulsion was governed by three controlling systems within the cab of the truck. Systems consisted of valves for control of flow of material, a pump pressure gauge for measuring pump output, and a bitumeter for indicating number of feet per minute and total distance traveled.

STONE SPREADER

Stone was applied by means of a 10' wide Goodroads mechanical spreader. The spreader was readily attachable to the rear of a dump truck, accommodating speedy change from emptied to loaded truck. An auger within the receiving hopper of the spreader insured stone distribution for the full width of the box. Below this, a roughened spread roll generated a positive feed of aggregate onto the roadway. Both the auger and spread roll were driven by the four supportive wheels of the spreader. In addition, numerous adjustable fans on the outlet of the spreader allowed for regulation of application rate and consistancy of stone application across the width of the spreader.

AGGREGATE (Vermont A.O.T. Specification 704.14)

The grit cover stone for the project was produced by F.W. Whitcomb Construction Company in Wallingford, Vermont. Whitcomb was also responsible for transporting the cover stone to the Poultney Town Garage where it was stockpiled for future loading onto State vehicles for delivery to the project.

The washed, uniformly graded, crushed gravel cover stone primarily consisted of siliceous quartzite material. Samples of the aggregate were taken prior to and during application of the surface treatment. The samples taken during application were tested for moisture content, while previously sampled

aggregate was tested in laboratory facilities for gradation, percent of wear, fractured face, and thin and elongated pieces.

Cover Stone

Moisture content of the aggregate during application of the surface treatment averaged 1.5%. Results of various tests and the sampling locations are shown in Table I. Other test results were as follows: 28 percent wear by Los Angeles Abrasion Test; 88 percent fractured faces and 1 percent classified as thin and elongated. For the gradation results, see Table II.

Table I

Moisture Content of Cover Stone

Date Sampled	Sampled From	Milemarker Location	% Moisture
Aug. 18 - 80	Stockpile	Poultney Garage	1.6
Aug. 18 - 80	Spreader Box	MM 01.28	1.4
Aug. 18 - 80	Spreader Box	MM 00.77	1.8
Aug. 18 - 80	Spreader Box	MM 01.40	1.0
Aug. 18 - 80	Spreader Box	MM 01.70	1.3
Aug. 18 - 80	Spreader Box	MM 02.88	1.6

Table II

Gradation of Cover Stone

Sieve Size	Range of Test Results	Averaged Results
3/8"	98-100	100
No. 4	39-40	40
No. 8	6-7	7
No. 16	2-3	3
No. 30	2-2.5	2
No. 50	2	2
No. 200	1-1.5	1
Pan	0	0

EMULSIFIED ASPHALT

A cationic rapid setting emulsion (CRS-2) manufactured by Chevron USA of Troy, New York was used for the surface treatment. Base asphalt for the emulsion was a Chevron blend of Venezuelan Boscan and Heavy Arabian asphalts. Prior to emulsifying, the base asphalt had a penetration value of 148. Design criteria of the emulsion indicated an acidic emulsifier used at a rate of 0.3% based on total weight of asphalt and water, and a solvent content of 0.01% caused by oils in the base petroleum product.

Preliminary samples of the emulsion were tested in conjunction with the cover stone for coating ability and water resistance in accordance with AASHTO Standard Method of Test T-59, Testing Emulsified Asphalt. Test results indicated CRS-2 emulsion had good coating ability and water resistance in conjunction with the chosen aggregate.

The emulsion was transported from Chevron to the Poultney Town Garage by Merrill Transport Company. The project required three tankers of approximately 6200 gallons each.

Averages of test results for samples of each tanker were as follows: penetration of residue at 77^{o} F of 155; percent residue by distillation of 68; and a Saybolt-Furol viscosity at 122^{o} F of 268. For a breakdown of each sample's results see Table III.

TABLE III

TEST RESULTS OF EMULSION SAMPLES

Tanker #	Penetration of Residue @ 77°F	Percent Residue By Distillation	Saybolt-Furol Viscosity @ 122°F
1	155	68	272
2	156	67	276
3	153	69	256
AVERAGE	155	68	268

CHIP SEAL SURFACE TREATMENT

Application of the chip seal began on August 18, 1980 and took two days to complete. Ambient temperatures ranged from 72°F in the morning to 85°F in the afternoon on the first day, and 66°F to 80°F on the second day. Humidity varied from a low of 30% to a high of 57%. No precipitation was experienced during the application but total cloud cover was present for the majority of the time.

Prior to application of surface treatment no repairs were made to the roadway nor was any of the surface cleaned. Very little of the surface would have required either.

Traffic regulation consisted of closing down one travel lane for the approximate distance required for distributing an entire load of emulsion, 7000 feet on the average. Flagmen on each end of the closed lane stopped traffic and allowed a lead vehicle, which traveled back and forth on the open lane, to shuttle groups of cars. This system provided excellent control of traffic speed within work area and on freshly surfaced lanes.

The surface treatment train was comprised of the asphalt distributor truck, the stone spreader attached to a truck load of stone, five to six

additional dump trucks loaded with stone, a rubber tired roller and a steel wheeled roller.

Surface Treatment Application Train

Application of material began on the New York - Vermont state line in the southbound lane. The surface treatment was placed 10' wide, one lane at a time, opposite the direction of normal traffic flow.

Application rates of both the emulsion and the cover stone were established prior to construction by the maintenance personnel based on experience gained from previous surface treatment work. The design rate for placing the emulsion was 0.35 gallons per square yard. Throughout the entire project emulsion application was randomly checked. The test consisted of placing a pan of known area and weight on the roadway, allowing it to be sprayed by the passing distributor, retrieving before stone application and immediately weighing. Results of the testing indicated rates of application as high as 0.43 gallons per square yard and as low as 0.29 gallons per square yard. Average of all test results was 0.33 gallons per square yard which correlated with the 0.33 gallons per square yard computed from total gallons used versus square yards treated.

As application of emulsion began, spreading of cover stone immediately followed. A backing truck with the stone spreader attached dropped stone

onto the emulsion without disturbing the emulsion. One distributor load of emulsion would treat approximately 7,415 square yards and go 7 to 8 times further than a load of cover stone. Average cover stone application was 18.0 pounds per square yard, ranging between 15.7 and 20.1 pounds per square yard.

As a load of stone was used up, the truck with the spreader would pull ahead 20 to 30 feet on the just treated surface, unhook the spreader, pull away and allow one of the following loaded trucks to immediately hook up and continue applying stone. Change over of the spreader from an empty to a loaded truck was conducted smoothly and took approximately one to one and a half minutes. The distributor continued spraying the emulsion non stop until empty, and since the spreader had to be changed from truck to truck, application of stone frequently fell a significant distance behind. Average distances between emulsion and stone application were 200 to 300 feet with some as high as 800 to 900 feet. On occasions with the higher ambient temperatures, there were noticable signs of the emulsion breaking prior to receiving stone. Possible solutions to this problem would have been to have the driver of the distributor truck operate at a slower rate of speed, stop occasionally to allow the chip spreader to catch up, or use a self-propelled aggregate spreader.

Once empty, the distributor truck returned to the Poultney Town Garage to reload from the tanker. Upon return of the distributor truck to the project from reloading and heating, which took about 45 minutes, traffic was changed over to the lane just completed and treatment was applied to adjacent lane. This process was repeated throughout the entire project.

On the first pass along a section of roadway, the stone application extended all the way to the centerline edge of the emulsion application, leaving no overlap edge. Often stone was also dispersed on the adjacent untreated lane. As treatment was applied to the adjacent lane an 18" to 24" overlap of both emulsion and cover stone occurred at the centerline.

Overlap of Treatment at Centerline

Embedment of the cover stone into the asphalt film was enhanced by rolling, first with a pneumatic-tired roller and then with a steel-wheeled roller. The rubber tired roller averaged 0.2 to 0.3 mile behind the stone application while the steel-wheeled roller was an additional 0.1 to 0.2 miles behind. There was noticeable crushing of the larger aggregate by the rolling of the steel-wheeled roller. Use of two pneumatic-tired rollers working together in place of the steel-wheeled roller could have sped up the rolling operation.

~~At the end of the first day, 37,077 square yards, or 3.16 miles of road-~~ way were completed. The distributor loaded five times and logged approximately 136 minutes of actual spraying time, which calculates to an average rate of speed for spraying of 245 feet per minute. The remaining 21,120 square yards, or 1.8 mile of roadway was completed in half of the second day. Approximately three and one-third distributor loads of emulsion were required and were applied at an average rate of 268 feet per minute or 71 minutes of spraying time.

Throughout the entire project stone application seemed heavier between the wheel paths. This may have been due to wear to the rough roller or the need for adjustment of the fan guides on the spreader.

Overall the completed project had a good appearance. Extra cover stone was not excessive and adhesion and stability of the stone was good. There was no control of traffic or its speed once a section of roadway was completed and some cover stone was dislodged by fast moving vehicles on freshly treated areas.

Friction tests were taken two days after completion of the surface treatment. The readings ranged from 52.1 to 55.6 with an average of 53.7 or 8.7 points higher than the readings on the old surface.

COST (August, 1980)

Costs incurred during application of the emulsion surface treatment were as follows: delivery and application of emulsion - $17,023 @ 90.5¢ per gallon; purchase and delivery of cover stone - $2,582; truck expenses for stone spreading and traffic control - $1,610; rental and expenses for rollers - $2,360; labor - $2,263. The asphalt distributor and driver were supplied as part of the purchase price for the emulsion. Total cost for the emulsion surface treatment, as applied, was $25,838 or 44.4¢ per square yard.

Substituting the emulsion with an MC-3000 cutback asphalt at $1.03 per gallon, and considering all other cost to be the same, would have resulted in a total cost of $28,190 or 48.4¢ per square yard.

Cutback asphalt would have been 14% more costly to buy and would have increased the total cost of the treatment by $2,352, or 9%.

ENERGY CONSUMPTION

Energy consumption for manufacturing and placing the emulsion surface treatment was compared to that required to manufacture and place the same type of treatment using a cutback asphalt. Application rates of asphalt and cover stone were considered to be equal for both types of treatment. Consumption for

each treatment was the total sum of energy required to manufacture the asphalt and stone, haul to the project, heat the asphalt, and place the material.

Placing of the emulsion surface treatment resulted in an energy use of 215,639,796 Btu or 3705 Btu per square yard, whereas use of cutback asphalt would have resulted in the use of 735,566,144 Btu or 12,639 Btu per square yard. For a detailed breakdown of energy requirements, see appendix B and C. Cutback asphalt would require 241% more energy in the form of approximately 3760 gallons of petroleum distillates, and a small quantity of diesel required to heat cutback asphalt to a higher temperature. It should be noted that the emulsion requires slightly more energy (2%) for hauling than does cutback due to the fact that, in equal quantities, emulsion weighs more than the cutback.

Environmental Consideration

Vermont presently does not have any environmental regulations for the use of asphalt emulsions. The hydrocarbon emissions statewide are not of high enough levels to justify regulation. For this reason and the fact that the State does not equip its monitoring stations with instruments for measurements of hydrocarbons, no emission figures were available.

Even though there was no monitoring, it is easy to realize that the emulsion is dramatically beneficial environmentally.

SUMMARY

An emulsion single surface treatment was placed by State maintenance forces as a seal over a cold mix pavement on Vt. Route 31 in the towns of Wells and Poultney. The 4.97 mile, 20' wide treatment consisted of a CRS-2 emulsion applied at an average rate of 0.33 gallons per square yard and covered with a 3/8" graded crushed gravel at a rate of 18 to 19 pounds per square yard.

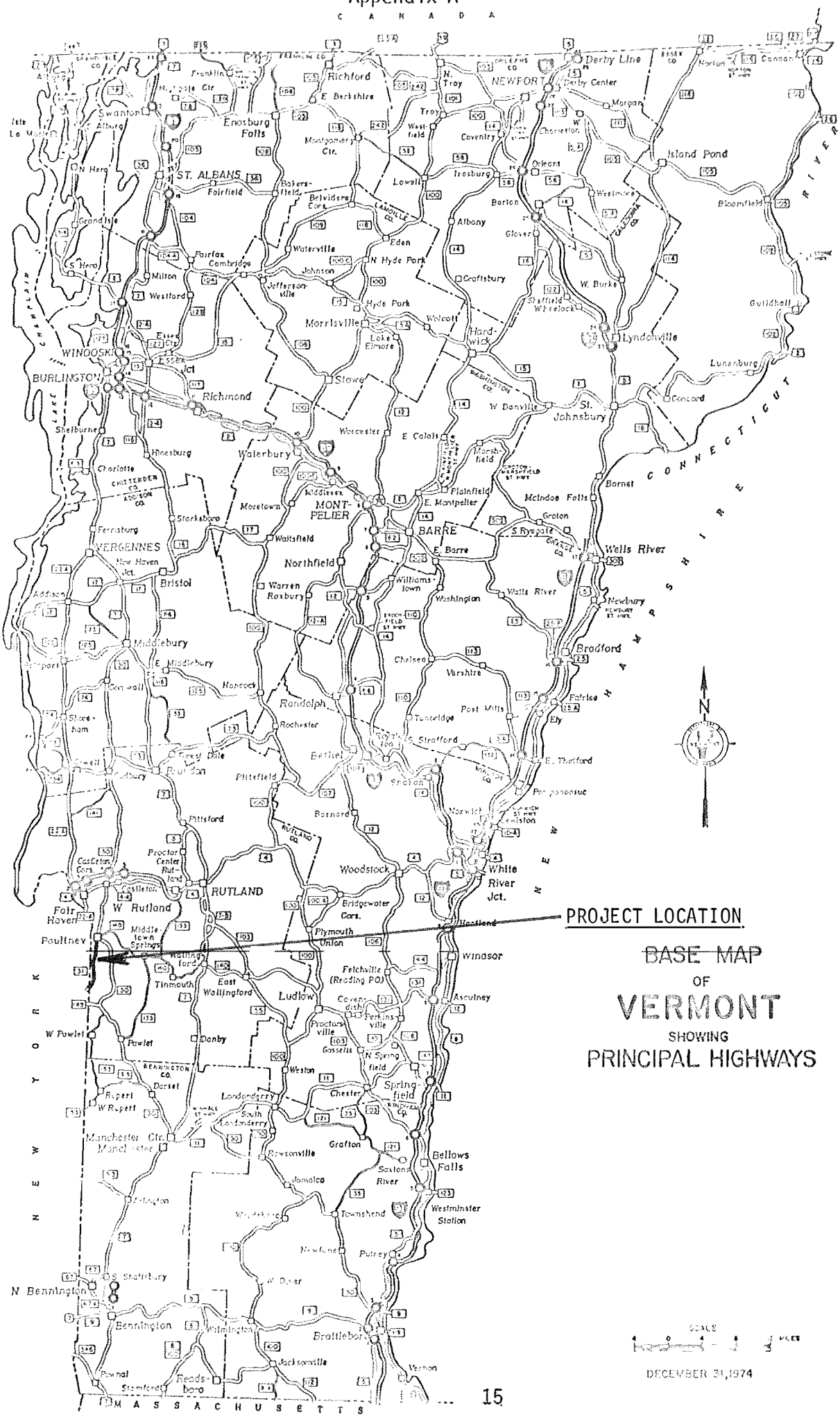
The surface treatment was applied in 10' widths one lane at a time. One segment of road was entirely treated before moving onto the next section.

An 18"-24" overlap of treatment occurred at the centerline of the roadway as a result of spreading stone to the edge of the first application of emulsion. Application and rolling of the cover stone was a noticeable distance behind the asphalt distributor, but stone adhesion and stability seemed good over the entire project. Some crushing of cover stone was noted from the use of the steel wheeled roller.

The seal was placed over a period of two days at a completed cost of 44.4¢ per square yard. Weather conditions during and after the application were favorable. Energy consumption was calculated to be 3,705 Btu per square yard or a total of 215,639,769 Btu.

The use of an MC-3000 cutback asphalt in place of the emulsion for the identical treatment would have cost 9% more overall, used 241% more energy, and knowingly produced considerable hydrocarbon air pollution.

Friction values were improved from an average of 45.0 for the cold mix surface prior to treatment to an average of 53.7 obtained 2 days after application of emulsified asphalt surface treatment.


CANADA
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NEW HAMPSHIRE
CONNECTICUT RIVER
LAKE CHAMPLAIN
Derby Line
NEWPORT
Island Pond
Richford
Enosburg Falls
ST. ALBANS
Swanton
Grand Isle
S. Hero
Milton
Fairfax
Westford
Fairfield
Waterville
Eden
Lowell
Troy
Orleans
Albany
Glover
Craftsbury
Hyde Park
Johnson
Jeffersonville
Morrisville
Stowe
Lake Elmore
Hardwick
W. Burke
Lyndonville
Guildhall
Lunenburg
WINOOSKI
BURLINGTON
Essex Jct
Richmond
Shelburne
Hinesburg
Charlotte
Waterbury
Worcester
E. Calais
Marshfield
Plainfield
E. Montpelier
MONTPELIER
BARRE
E. Barre
Northfield
Williamstown
Washington
Wells River
Barnet
Mcindoe Falls
Groton
S. Ryegate
St. Johnsbury
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Concord
Lunenburg
VERGENNES
New Haven Jct.
Bristol
Addison
Middlebury
E. Middlebury
Cornwall
Shoreham
Orwell
Whiting
Brandon
Pittsford
Proctor
Center Rutland
Castleton Corn.
RUTLAND
W. Rutland
Fair Haven
Poultney
Middletown Springs
Wallingford
Tinmouth
East Wallingford
Ludlow
Fletchville (Reading P.O.)
Cavendish
Perkinsville
Proctorsville
Gassetts
N. Springfield
Springfield
Chester
Weston
Londonderry
South Londonderry
Manchester Ctr.
Manchester
Rawsonville
Grafton
Saxtons River
Bellows Falls
Jamaica
Townshend
Westminster Station
Newfane
Putney
Brattleboro
Vernon
Jacksonville
Wilmington
Woodstock
Bridgewater Corn.
Plymouth Union
Hartland
White River Jct.
Windsor
Ascutney
Barnard
Sharon
Royalton
Randolph
Rochester
Bethel
Tunbridge
Post Mills
Chelsea
Vershire
Strafford
E. Thetford
Fairlee
Ely
Bradford
Newbury
Wells River
Williamstown
Warren
Roxbury
Waitsfield
Middlesex
Moretown
Starksboro
Ferrisburg
Charlotte
Hinesburg
Shelburne
Orwell
Whiting
Brandon
Pittsford
Proctor
Center Rutland
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Chester
Weston
Londonderry
South Londonderry
Manchester Ctr.
Manchester
Rawsonville
Grafton
Saxtons River
Bellows Falls
Jamaica
Townshend
Westminster Station
Newfane
Putney
Brattleboro
Vernon
Jacksonville
Wilmington
Woodstock
Bridgewater Corn.
Plymouth Union
Hartland
White River Jct.
Windsor
Ascutney
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Sharon
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Randolph
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Post Mills
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Fairlee
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Warren
Roxbury
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Middlesex
Moretown
Starksboro
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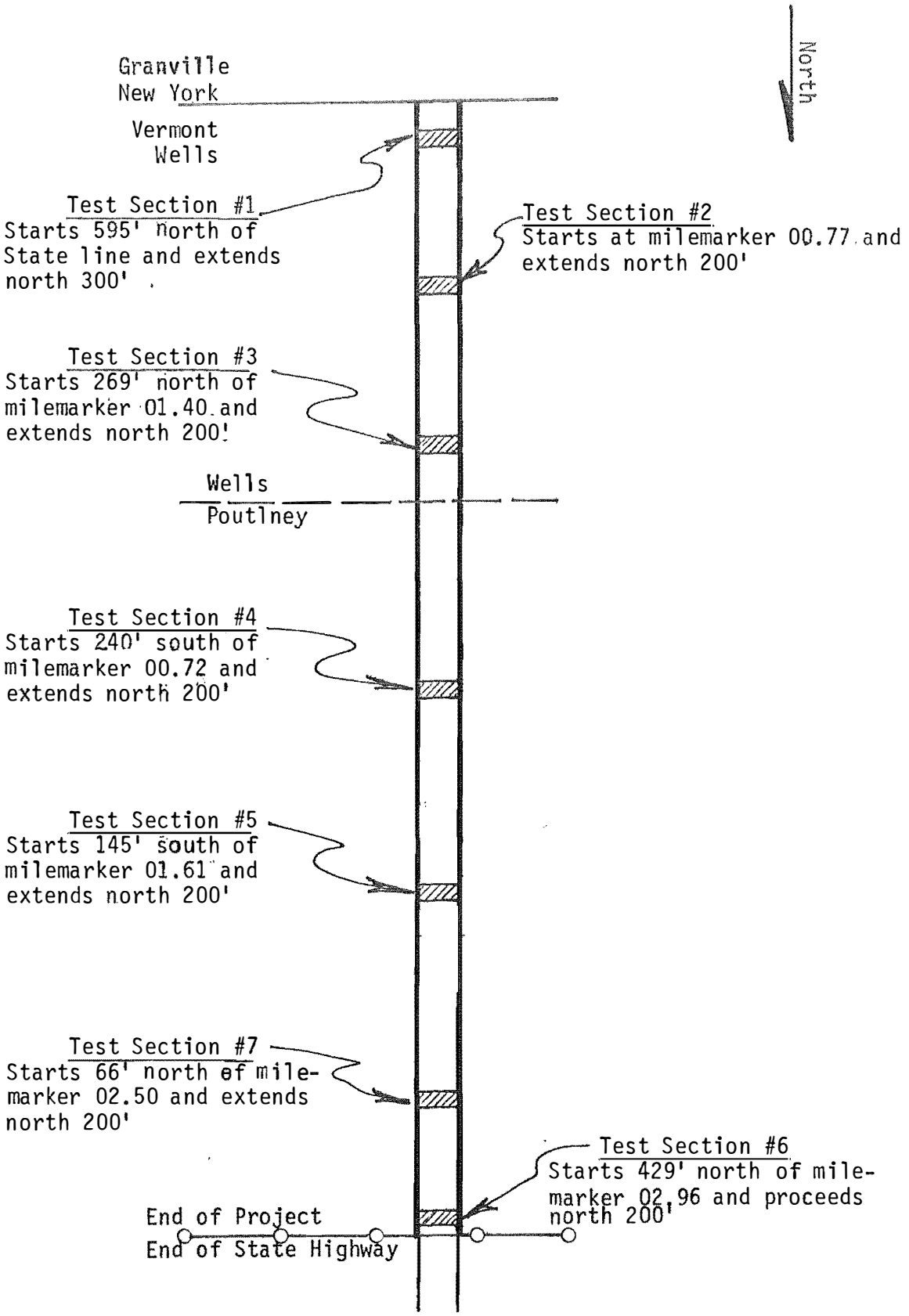
Westminster Station
Newfane
Putney
Brattleboro
Vernon
Jacksonville
Wilmington
N Bennington
Bennington
Pownal
Stamford
Readsboro
PROJECT LOCATION
BASE MAP
OF
VERMONT
SHOWING
PRINCIPAL HIGHWAYS
N
SCALE
DECEMBER 31, 1974

Test Section Location
Vt. Route 31



Appendix C

Surface Treatment Using Emulsified Asphalt

Materials

Produce CRS-2 Emulsified Asphalt @ 2100 Btu/gal. x 18,810 gal. used	=	39,501,000 Btu
Haul 88 Miles x 2 x 79.9 tons @ 3270 Btu/tm	=	45,984,048 Btu
Crushed Gravel @ 40,000 Btu/ton x 528 tons	=	21,120,000 Btu
Haul 20 Miles x 2 x 528 tons @ 3800 Btu/tm	=	80,256,000 Btu

Haul and Place

Haul Stone - 2.9 mile x 2 x 528 tons @ 3800 Btu/tm	=	11,637,120 Btu
Asphalt Distributor 18,810 gal x 144 Btu/gal	=	2,708,640 Btu
Haul Asphalt in Distributor ~~79.9 tons x 2 x 2.9 miles @~~ 4270 Btu/tm	=	1,978,803 Btu
Rolling - 2 Rollers 58,197 s.y. x 107 Btu/s.y.	=	12,454,158 Btu
Total Energy Used	=	215,639,769 Btu
Energy Use per Square Yard	=	3705 Btu

Appendix D

Surface Treatment Using Cutback Asphalt
(Same Application Rates)

Material

Produce MC-3000 - Application Rate of 0.32 gal/sy 18,810 gal @ 29,500 Btu/gal	=	554,895,000 Btu
Haul 88 Miles x 2 x 18,810 gal ÷ 241 Gal/ton @ 3270 Btu/tm	=	44,919,215 Btu
Crushed Gravel @ 40,000 Btu/ton x 528 Tons	=	21,120,000 Btu
Haul 20 Miles x 2 x 528 tons @ 3800 Btu/tm	=	80,256,000 Btu

Haul and Place

Haul Stone 2.9 Miles x 2 x 528 Tons @ 3800 Btu/tm	=	11,637,120 Btu
Haul Asphalt in Distributor 18,810 Gal - 241 Gal/ton x 2 x 2.9 miles @ 4270 Btu/tm	=	1,932,981 Btu
Asphalt distributor - Application 18,810 gal @ 444 Btu/gal	=	8,351,640 Btu
Rolling - 2 Rollers 58,197 s.y. x 107 Btu/s.y. x 2	=	12,454,158 Btu
Total Energy Used	=	735,566,114 Btu
Energy Use Per Square Yard	=	12,639 Btu

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

WORK PLAN FOR CATEGORY III EXPERIMENTAL PROJECT

ASPHALT EMULSION SURFACE TREATMENT (REGION 15 - DEMONSTRATION PROJECT NO. 55)

WORK PLAN 80-R-5

OBJECTIVE OF EXPERIMENT

To evaluate the cost, energy consumption, and performance of an asphalt emulsion surface treatment placed as a seal over a cold mix (emulsion) pavement.

PROJECT

Vermont Rte. 31, the former Wells-Poultney RS 0145 (8) construction contract completed in September, 1979.

PROJECT LOCATION

On Vt. Rte. 31 beginning at the New York-Vermont State line and extending northerly 4.957 miles to the Poultney Village line.

EXPERIMENTAL WORK LOCATION

The emulsion surface treatment shall be placed over the full length of the 4.957 mile project covering an area of approximately 60,000 square yards.

INVESTIGATION PROCEDURE

The investigation will include obtaining and documenting the following information:

1) Obtain initial design, construction and maintenance records on the existing roadway.

2) Note traffic data, roadway geometrics, and climatic conditions at the test site.

3) Record condition of base, subbase and surface pavement (distress, texture, friction numbers, absorption characteristics)

4) Design, test and analyze emulsions and aggregates to insure the quality and compatibility of the materials.

5) Type and extent of any repairs to the existing pavement.

6) Observe the application process and document information on climatic conditions during construction; variations in emulsion and aggregate properties such as asphalt content, moisture and gradation; asphalt spraying and aggregate spreading and rolling information; equipment used and production rates; problems which occur and related information.

7) Document field and lab tests taken during the application.

8) Determine total energy consumption for the seal application and compare it to an estimate of the energy which would have been expended had cutback asphalt been used.

9) Determine if the use of an emulsion provides significant environmental benefits.

CONTROL SECTION

There will be no control section.

COST

Estimated cost of the emulsion surface treatment is $0.50 per square yard or $30,000 for the 60,000 square yard project.

DATE OF CONSTRUCTION

The experimental treatment shall be completed prior to October 1, 1980.

DURATION OF STUDY

The experimental project will be evaluated for a minimum of three years following completion of construction.

SURVEILLANCE

The experimental treatment shall be inspected at least twice yearly for the duration of the study.

REPORTS

An initial report covering the basic data collected, construction experiences, test results and initial observations shall be forwarded to the F.H.W.A. Contract Manager within 90 days after project completion. Interim reports shall be made on an annual basis. A final report shall include recommendations for use in developing future surface treatment projects.

Agency of Transportation
Materials & Research Division
July 17, 1980

Reviewed By: R. F. Nicholson

R. F. Nicholson, P.E., Mat. & Res. Eng.

Date: July 18, 1980