SURVEY OF HIGHWAY CONSTRUCTION MATERIALS
IN THE TOWN OF PUTNEY, WINDHAM COUNTY, VERMONT

prepared by

Geologic Survey Section, Construction Division,
Vermont Department of Highways

in cooperation with

United States Department of Commerce
Bureau of Public Roads

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A Survey of Highway Construction Material in the Town of Putney, Windham County, Vermont

Acknowledgments:

The work of this project was greatly implemented by the cooperation and assistance of many groups and individuals. The following were particularly helpful in carrying out the project's objectives:

1. Various departments and individuals of the Vermont State Department of Highways, notably the Planning and Mapping Division and the Highway Testing Laboratory.

2. Prof. D. P. Stewart of Miami University, Oxford, Ohio.

3. Prof. Charles G. Doll, Vermont State Geologist, University of Vermont, Burlington, Vermont.

4. The United States Department of Commerce, Bureau of Public Roads.

History:

The Material Survey Project was formed in 1957 by the Vermont State Department of Highways with the assistance of the United States Bureau of Public Roads. Its prime object was to compile an inventory of highway construction materials in the State of Vermont. Prior to the efforts of the personnel of this survey as described in this and other reports, searches for highway construction materials were conducted only as the immediate situation required. Thus, only limited areas were surveyed and no over-all picture of material resources was available. Highway contractors or resident engineers are usually required to locate the material for their respective projects and have samples tested by the Highway Testing Laboratory. The additional cost of exploration for construction material is passed on to the State in the form of higher construction costs. The Materials Survey Project

was established to minimize or eliminate this factor by enabling the State and its contractors to proceed with information on material sources available beforehand. Prior knowledge of locations of suitable material is an important factor in planning future highways.

The sources of construction material were located by this project through ground reconnaisance, study of maps and aerial photographs, and geological and physiographic interpretation. Maps, data sheets, and work sheets for reporting the findings of the Project were designed, keeping in mind their intended use. These maps and data sheets were devised to furnish information of particular use to the contractor or construction man. For maximum benefit the maps, data sheets and this report should be studied simultaneously.

Inclosures:

Included in this folder are two surface-geology maps; one defining the location of tests conducted on bedrock sources, the other defining the location of tests conducted on granular material. These maps are derived from 15 minute quadrangles of the United States Geological Survey enlarged to 1:3125 or 1" = 2604'. Delineated on the Bedrock Map are the various rock types of the area. This information was obtained from numerous sources; i.e. Vermont Geological Society Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, as well as other references.

The Granular Materials Map depicts areas covered by various types of glacial deposits (outwash, moraines, kames, kame terraces, etc.) by which potential sources of gravel and sand may be recognized. This information was obtained primarily from a survey being conducted by Prof. D. P. Stewart of Miami University, Oxford, Ohio who, since 1956, has been mapping the glacial features of the State of Vermont during the summer months. Further information was obtained from the Soil Survey (Reconnaisance) of Vermont, conducted by the Bureau of Chemistry and Soils of the United States Department

of Agriculture; and from Vermont Geological Society Bulletins, United States Geological Survey quadrangles, aerial photographs and other sources.

On both maps the areas tested are represented by Identification Numbers. Several tests are usually conducted in each area represented by an Identification Number, the number of such tests being more or less arbitrarily determined either by the character of the material tested or by topography.

Also included in this folder are Data Sheets for both the Bedrock and Granular Material Survey which contain detailed information for each test conducted by the Project as well as information obtained from other sources, including an active card file compiled by the Highway Testing Laboratory. It was readily apparent that the latter information was gathered over a period of years by many persons and consequently lacks the organized approach and detail required for effective use. The information on the cards varied widely in completeness. Transfer of information from the cards to the Data Sheets was made without elaboration or verification. The location of the deposits listed in the card files have also been plotted on the maps. However, caution should be exercised wherever the information appears incomplete. Some cards in the file were not used because the information on the locations of the deposits was incomplete or unidentifiable. This Project does not assume responsibility for the information taken from the card files.

Work Sheets containing more detailed information of each test including a detailed sketch of each Identification Number area are on file in the office headquarters of the Project, together with the respective laboratory reports.

Location:

The Town of Putney is located in Windham County in the southeastern section of the State on the Connecticut River approximately 18 miles north of the Massachusetts border. According to the "Soil Survey of Vermont" of the

Bureau of Chemistry and Soils the town is in the "Eastern Hill Region", a relatively low plateau in an advanced stage of erosion with fairly smooth hills and generally unprecipitous valley walls. The stream valleys are fairly wide with large flood plains principally in the Connecticut River valley. The Connecticut Valley is the dominant geographic feature from which there is a gradual increase in elevation as one travels westward to the highest point of approximately 1600' in the southwest corner. Drainage is easterly into the Connecticut River.

Procedure for Rock Survey:

The routine employed by the project in the survey of possible sources of rock for highway construction is divided into two main stages; the office investigation and field investigation. The first is conducted primarily during the winter months and comprises the mapping of rock types as indicated in various reference sources. Since, at present, the mapping of bedrock geology in the State of Vermont is incomplete, many different sources of information were utilized, as indicated in the Bibliography. These references differ considerably in dependability due to new developments and studies contributing to the obsolescence of a number of reports. In addition, the results of samples taken by other individuals are analyzed and the location in which these samples were taken is mapped when possible. In other words, as complete a correlation as possible is made of all the information available concerning the geology of the area under consideration.

The second stage of the investigation is begun in the field by making a cursory preliminary survey over the entire area. The information obtained in this survey, together with the information assimilated in the first stage of the investigation is employed to determine the areas in which the testing and sampling will be concentrated. When a promising source is encountered as determined not only by rock types but also by volume and the existence of a good

working face, chip samples are taken with a hammer and submitted to the Highway Testing Laboratory for testing by the Deval Method (AASHO, T-3). It is kept in mind that samples taken by the chip method are often in the weathered zone of the outcrop and consequently may show a less satisfactory test result than the fresh material deeper in the body of the rock structure. Should the result of this test prove satisfactory, further samples are taken by drilling to a depth of 3 feet and blasting at intervals across the strike or trend of the outcrop. Occasionally, because of the uniformity of the material and a satisfactory test result from the chip sample, no further drilling, blasting or sampling is done and the material source is included as being satisfactory.

Discussion of Rock and Rock Sources:

The rock type in the Town of Putney consists generally of schist. A long, narrow body of amphibolite occurs in the southeast portion of the town of which Identification Number 1 is representative. This structure is only approximately 90' wide, the trend is to the east-northeast and the sampling was conducted almost directly along the strike for a distance of approximately 180', as represented on the Data Sheet. Test Number 6 of this Identification Number represents the schist on the northwest edge of the amphibolite and indicates that this material is unsatisfactory. It can be assumed that the schist to the southeast of the amphibolite is of similar quality. It is apparent that the width of this outcrop is restricted. Although Identification Number 1 shows a good relief, a large portion of the structure is covered with fluvial sediments. However, the results of the sampling of the amphibolite indicated wears ranging from 3.2%-7.2%, meeting the requirements for Item 204, sub-base of Crushed Rock. Another very small body of amphibolite occurs just across the town road north of the western tip of the first structure. This was considered too small to warrant further investigation. A third long, narrow amphibolite

band occurs north of the second. Again, its lack of width discouraged further investigation.

Procedure for Sand and Gravel Survey:

The method employed by the project in the survey of possible sources of sand and gravel for highway construction is divided into two main stages; office investigation and field investigation. The office investigation is conducted primarily during the winter months and comprises the mapping of possible potentially productive areas as indicated from various references. Of these references, the survey of glacial deposits mapped by Prof. Stewart proves to be valuable, particularly when used in conjunction with other references such as soil type maps, aerial photographs and United States Geological Survey quadrangles. The last two are used in recognizing and locating physiographic features indicating glacial deposits and in studying drainage patterns. In addition, the locations of existing pits, when known, are mapped. The locations in which samples were taken by other individuals are noted and mapped, when possible.

The second stage of the investigation is begun in the field by making a cursory preliminary survey over the entire area noting areas which show physiographic features giving evidence of glacial or fluvial deposits. At this time preliminary sampling is made with the aid of a hand shovel. The samples which indicate satisfactory material when examined megascopically are submitted to the Highway Testing Laboratory where they are tested for gradation and stone wear, the latter by the Deval Method (AASHO, T-4-35). Since the laboratory is somewhat limited in the number of samples which can be processed during the construction season, only samples which are apparently satisfactory are submitted. Should the results of these tests prove satisfactory, the locations from which they were taken are further examined by digging test pits with

a backhoe to a depth of approximately 12 feet and again sampling the material.

Discussion of Gravel and Sand Deposits:

The granular materials of this area are found primarily in glacial deposits, restricted almost entirely to kame terraces, indicating fairly well stratified deposits of gravel, sand, silt, and clay in the features. The majority of the kame terraces are confined to the lower elevations in the eastern half of the town along Sacketts Brook and East Putney Brook. The southern end of a very large kame terrace extends into the northeast corner of the town. The terrace along Sacketts Brook is represented by Identification Numbers 1-5. Identification Numbers 2-4 indicate a sand area containing material of good quality. Identification Number 5 is a shallow pit containing a mixture of sand and gravel with clay bottom, and thus proved unsatisfactory. Identification Number 6 is an old abandoned gravel pit with slumped faces and consequently should not be considered representative of the material in the kame terrace along East Putney Brook. Further investigation of this terrace might prove valuable. Identification Numbers 7-9 represent the large kame terrace extending north into Westminster and contain suitable sand and gravel.

Glossary of Selected Geologic Terms

Drift--Rock material of any sort deposited in one place after having been moved from another; as river drift. Specif., a deposit of earth, sand, gravel, and boulders, transported by glaciers (glacial drift) or by running water emanating from glaciers (fluvio-glacial drift) and distributed chiefly over large portions of North America and Europe, esp. in the higher latitudes.

Fluvial--Pertaining to streams.

Gneiss--A term originally applied to a more or less banded metamorphic rock with the mineral composition of granite. As now employed it designates a foliated metamorphic rock with no specific composition implied, but having layers that are mineralogically unlike and consisting of interlocking mineral particles that are mostly large enough to be visible to the eye. Usually gneiss displays an alteration of granular minerals and tabular or schistose minerals with the rock, tending to split along the planes where tabular or schistose minerals predominate.

Kame--A conical hill of stratified drift, deposited at a glacial terminus by glacial streams flowing in or on the ice.

Kame Terrace--An accumulation of stratified drift laid down chiefly by streams between a glacier and an adjacent valley wall.

Lacustrine--Pertaining to lakes.

Megascopic--Characters of a material that can be perceived by the unaided eye.

Metamorphic Rocks--Rocks that owe their distinctive characters to the transformation of pre-existing rocks, either through intense heat or pressure or both.

Moraine--An accumulation of drift with an initial topographic expression of its own built within a glaciated region chiefly by the direct action of glacier ice.

Outwash--Stratified drift that is stream built beyond the glacier; laid down by meltwater streams issuing from the face of the glacier ice.

Quartzite--A firm, compact rock composed of grains of quartz so firmly united that fracture takes place across the grains instead of around them. A metamorphosed sandstone.

Schist--A crystalline rock with a secondary foliation or lamination based on parallelism of platy or needle-like grains. The name refers to the tendency to split along the foliation.

Schistosity--The property of a foliated rock by which it can be split into thin layers or flakes. The property of splitting may be due to alternating layers of differing mineral composition or to preferred orientation and parallelism of cleavage planes of the mineral.

Strike--The direction of a line formed by the intersection of a stratum with a horizontal plane.

Surface-geology map--A map showing areas of outcrop of geologic formations, both consolidated rocks and the unconsolidated sediments. Its scale is large enough that pits and quarries can be accurately shown and indexed.

Terrace--A plain, natural or artificial, from which the surface descends on one side and ascends on the other. Terraces are commonly long and narrow, and they border seas, lakes, or interior valleys. A terrace may be built by deposition of sediment from water, it may be cut by the breaking of waves on a shore or the sweeping of currents, or it may be formed by the dislocation of rocks in crustal movements. The descent from river terraces toward the river may be very abrupt, especially in arid regions, the ascent on the other side may be only that of an extensive alluvial slope.

Till--Unsorted drift, or the mixture of rock fragments and fine materials left by melting glaciers.

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Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Exist-ing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing				Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
							1½"	#4	#100	#270				
1	1	1958	0-8	0	Yes	10,000	-	39.0	7	1.75	3½	23.0	Gravel	Owner: Mr. Hamilton. This is a granular deposit east of the Hamilton house. There are two levels or terraces. The upper one is gravel, the lower fine sand. Test No. 1 was taken at the upper level in the upper pit at the west end of the south face. The limited volume of material remaining is to the south. This is a possible source of sub-base of gravel, Item 201.
	2	1958	0-3	0	Yes	-	—	Not	Sampled	—	—	—	Borrow (Sand)	Test No. 2 on the lower level was taken in the north end of the floor of the lower pit. Material here is a fine sand with silt.
2	1	1958	0-12	0	Yes	30,000	100	89.0	2.0	0.5	3½	—	Sand	Owner: The Putney School. This granular deposit has several shallow test pits around the main pit. This pit was tested by hand shovel in the east face which is 12 to 15 ft. high and partially stripped. Material: scattered, thin beds of gravel

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Existing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing				Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
							1½"	#4	#100	#270				
														in a sand matrix. Remaining material to the east and north. This pit needs further testing, but is a possible source of sub-base of sand, Item 202.
3	1	1958	1-4	0-1	Yes	5,000	100	92.2	5.0	0.5	1	———	Sand	Owner: Mrs. Speno. This granular deposit has an old slumped in sand pit which was sampled on the west face by hand shovel. This is the same deposit which extends under the road to the Community Center Ball Field. Material is a fine sand. With cleaning and stripping this pit could be an acceptable source of sub-base of sand, Item 202.
4	1	1958	1-5	0-1	No	30,000	100	94.3	7.0	0.75	3	———	Sand	Owner: Putney Community Center. This granular deposit extends under the ball field and is exposed in the road cut where it was sampled with hand shovel. Material is fine sand. Volume is for area 150 x 200 ft. to a depth of 30 ft. (approx.). This is a

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Exist-ing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing				Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
							1½"	#4	#100	#270				
														possible source for sub-base of sand, Item 202.
5	1	1958	1-6	0-1	Yes	-	-	-	Not	Sampled	-	-	Borrow (Grav.)	Owner: Mr. Miller. This is a large shallow pit with a clay bottom. Material is sand and gravel mixed. Pit seems to be depleted except for a possible extension to the NE for sand.
6	1	1958	0-3	0	Yes	-	-	-	Not	Sampled	-	-	Borrow (Grav.)	Owner: Mr. Stockwell. This is a large old abandoned gravel pit. Slumped in faces are about 20 ft. high. Material: a dirty gravel with soft disintegrated stones.
7	1	1958	0-10	0	Yes	-	-	41.9	2.0	0.25	2	15.5	Gravel	Owner: Mr. Wood. This is a medium size pit with an average gravel thickness of approx. 10 ft. The bottom of the pit is clay with water standing in spots. The area is partially stripped to the south. All 3 tests were taken from the south face of pit. Test No. 1 in
	2	1958	0-10	0	Yes	-	43	48.1	8.0	1.25	3	16.8	Gravel	
	3	1958	0-10	0	Yes	-	-	44.8	7.0	1.50	2.5	16.0	Gravel	

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Existing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing				Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
							1½"	#4	#100	#270				
														the west corner. Test No. 2 in the central portion and Test No. 3 in the east corner of the south face. This pit can be extended to the south for additional quantities. This area may be considered a source of gravel, Item 201.
8	1	1959	0.5-8	0-0.5	No	-	100	83.8	1.0	0.5	1	0	Borrow (Sand)	Owner: Gardner Hubbard This area is located in a large kame terrace that extends into the town of Westminster. Test No. 1 was taken in the east edge of the terrace and failed to meet requirements for Item 202 (sand) due to a slight excess retained on the #4 screen. Test No. 2 was taken 150 ft. north and 50 ft. west of Test No. 1. No sample was taken as the material encountered was a silty sand. Test No. 3 was taken 86 ft. west of Test No. 1. Sand which met the requirements for Item 202 was encountered at a depth of 5 ft. Test No. 4
	2	1959	0-8	0-0.5	No	-	-	Not	Sampled		-	——	Borrow (Sand)	
	3	1959	5-8.5	0-5	No	-	100	91.5	1.0	0.5	1	——	Sand	
	4	1959	5-10	0-5	No	-	100	99.4	6.0	1.25	1	——	Sand	
	5	1959	0-10	0-8	No	-	-	Not	Sampled		-	——	Borrow (Sand)	

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Existing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing				Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
							1½"	#4	#100	#270				
														was taken 280 ft. south and 120 ft. west of Test No. 3. Sand which met the requirements for Item 202 was found at a depth of 5 ft. Test No. 5 was taken 208 ft. west of Test No. 2. The upper 8 ft. of the hole was very fine sand, the remaining 2 ft. was a coarser sand. No sample was taken from this hole. This area may be considered a source for sand, Item 202.
9	1	1959	2.5-6.5	0-2.5	No	-	-	36.0	6.0	2.5	3	13.0	Gravel	Owner: Gardner Hubbard. This area is located in the same kame terrace as Location 7 and 8. The area tested is approx. 2000 ft. west of Location 8 and 1300 ft. north of Location 7. The test hole revealed a 4 ft. bed of gravel with a clay bottom. The gravel in this area appears to be thinbedded. Additional backhoe or borings should be made to determine variations, if any, in the thickness and the

Ident. No.	Field Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Existing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing				Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
							1½"	#4	#100	#270				
														areal extent of the gravel strata above the clay bottom. This area may be considered a source for Item 201, sub-base of gravel.

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T-3	Distance Between Samples (ft.)	Remarks
1	1	1959	Amphib-olite	No	Chip	3.8	0	Owner: Roy Hallock. This outcrop of amphibolite rock is located on the river road south of Putney Station, near the Interstate line. This outcrop was sample along rather than across strike, so the distance shown does not represent the width of the amphibolite band. This rock is part of a band of interbedded amphib-olite and light-colored quartz-feldspar-biotite volcanics. Test No. 1 is 72 ft. east of the SE cor-ner of the new building. Tests 2-5 are east of Test No. 1 along the edge of the road. Test No. 6 was taken at a point 90 ft. from Test No. 5 on a bearing of N 5° E. The rock at Test No. 6 (a mica schist) was obviously not the same as at Tests 1-5. This change is shown clearly by the abrasion test results. Bedrock mapping of this area shows this is a narrow band striking NE-SW which Test No. 6 helps to illustrate, thus this site does not appear to be an econ-omical source of sub-base of crushed rock, Item 204.
	2	"	"	"	"	3.2	32	
	3	"	"	"	"	3.4	52	
	4	"	"	"	"	3.5	46	
	5	"	"	"	"	7.2	50	
	6	"	Schist	"	"	16.5	90	