SURVEY OF HIGHWAY CONSTRUCTION MATERIALS

IN THE TOWN OF RICHMOND, CHITTENDEN COUNTY, VERMONT

prepared by

Geologic Survey Section, Construction Division

Vermont Department of Highways

in cooperation with

United States Department of [illegible]

Bureau of Public [illegible]

Montpelier, Vt.

April, 19[illegible]

Survey of Highway Construction Materials in the Town of Richmond, Chittenden 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 Materials 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 material were conducted only as the immediate situation required. Thus, only limited areas were surveyed and no overall picture of material resources was available. Highway contractors or resident engineers are usually required to locate the materials for their respective projects and have samples tested by the Highway Testing Laboratory. The additional cost of exploration for construction materials 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 bed-rock sources, the other defining the location of tests conducted on granular materials. These maps are derived from 15 minute quadrangles of the United States Geological Survey enlarged to 1:31250 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 the 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 were 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 Road and Surficial 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 details 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 location of the deposit was incomplete or unidentifiable. This Project does not assume responsibility for the information taken from the card files.

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

Location:

The Town of Richmond is located on the Winooski River approximately ten miles east of its mouth at Burlington. It lies on the western slope of the Green Mountains and extends westward to the eastern edge of the Champlain Valley. The Winooski River is the dominant geographical feature, bisecting the town from east to west. The topography is characterized by rolling hills and broad valleys with the more rugged terrain contained in the eastern por-

tion of the town where elevations of two thousand feet above sea level are encountered. Drainage is westerly into Lake Champlain.

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 the 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 locations in which these samples were taken are mapped when possible. In other words, the complete a correlation as possible is made of all the information [illegible] 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 results 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 due to 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 in the town of Richmond is limited to the metamorphics, consisting generally of schists grading into gneiss with a north-south strike. Two outcrops were sampled as indicated by Identification Numbers 1 and 2. Although the material in these two outcrops is generally satisfactory, the results of the sampling show variable wears. In Identification Number it was necessary to resample three tests. The results of the resamples showed a wide variance from the original tests. This was particularly noticeable in Test Number 6 of this Identification Number where the original sample showed a wear of 15.4% while the resample showed a wear of 5.1%. Although extreme care is observed to include only fresh material in the samples, the reason for this wide variation in wears is debatable. Identification Number 1 is limited in extent, ending as a low bluff overlooking the Winooski Valley to the north and apparently grading into a schist to the south. It has a width of only 157'. Identification Number 2, although limited by the Winooski Valley to the south extends northward for an unknown distance and has a width of 250'.

Due to the wide variation in the quality of the rock over short lateral distances, caution should be observed in estimating the amount of satisfactory material available.

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 by 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-96-55). 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 these samples 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 town of Richmond lies along the eastern limit of the post-glacial Lake Champlain. Consequently, much of the surficial material is probably the result of lacustrine deposition. This is especially true of the sand and silt deposits in the western portion of the town as represented by Identification Numbers 13, 14, and 20. Identification Number 20 is an unusually fine source of sand, containing well graded material over a wide area to considerable depth and situated to facilitate excavation. The town contains much river gravel of good quality, as represented by Identification Numbers 4, 9, 15-18, and 30. The remainder of the Identification Numbers [illegible] town contain material resulting from glacial deposits, [illegible] kame terraces.

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.

Bibliography

1. United States Department of the Interior, Geological Survey, Burlington, Vermont quadrangle.

2. United States Department of the Interior, Geological Survey, Camels Hump, Vermont quadrangle.

3. "A Survey of the Glacial Geology of Vermont", by D. P. Stewart. Not published.

4. "Soil Survey (Reconnaisance) of Vermont", by W. J. Latimer. United States Department of Agriculture, Bureau of Chemistry and Soils. 1930

5. "Soil Exploration and Mapping", Highway Research Board, Bulletin 28, 1950.

6. "Glossary, Pedologic and Landform Terminology", Highway Research Board, Special Report 25, 1957.

7. "Survey of Highway Aggregate Materials in West Virginia", Engineering Experiment Station, West Virginia University, Morgantown, West Virginia. December, 1959.

8. Materials Inventory, Bangor Quadrangle, South Half, September, 1959.

9. "Glacial Geology and the Pleistocene Epoch", Richard F. Flint, John Wiley and Sons, 1947.

10. "Geology of the Green Mountains of Northern Vermont", E. C. Jacobs, Report of the State Geologist on the Geology of Vermont. Volume 21, 1937-1938.

11. Aerial Photographs.

12. "A Handbook of Rocks", James F. Kemp, D. Van Nostrand Company, Inc. June, 1946.

13. "Rocks and Rock Minerals", Louis V. Pirsson, John Wiley and Sons, Inc. June, 1949.

14. "Glossary of Selected Geologic Terms," by W. L. Stokes and D. J. Varnes, Colorado Scientific Society Proceedings, Vol. 16, 1955.

Ident. No.	Field Test No.	[illegible] Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Existing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
1	1	1959	1-8	-0-1	Yes	5,000	—	38.5	5	1.5	1½	19.6	Gravel	Owner: Glenn [illegible]. Pit in west end of long terrace sampled by F.J.C. This terrace appears to contain more borrow than gravel, but this is a possible source of Item 201 (sub-base of gravel).
2	1	1959	4-20	-0-4	Yes	5,000	—	40.8	9	1.75	1	9.2	Gravel	Owner: Louis Bombardier. Test No. [illegible] in a large gravel pit with lay[illegible] of sand and gravel. South end of pit is mostly sand and the thick overburden is sandy silt. Most of the remaining gravel is behind the east face of the pit. Sample taken in this [illegible] by F.J.C. [illegible]
	2	195[illegible]	[illegible]		Yes	[illegible]	—	[illegible]	[illegible]	—	—	—	[illegible]	[illegible] 2 [illegible] 600 [illegible] No. 1. [illegible] pebbly [illegible] sand bottom.

Ident. No.	Number Test No.	Year Field Tested	Depth of Sample or Test (ft.)	Over-Burden (ft.)	Existing Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
	3	1959	1-3	0-1	No	--	Not	Sampled		--	--	--	Borrow (Sand)	Test No. 3 was made in small knoll 200' north of Test No. 2. Material is fine sand to sandy silt.
3	1	1959	0-4	--	Yes	--	Not	Sampled		--	--	--	Borrow (Grav.)	Owner: Xenophon Wheeler. Old gravel pit with gravel in layers between fine sand and sandy silt. Test No. 1 was taken in south face silt and clay in bottom.
	2	1960	1.5-20	0-1.5	Yes	--	--	50.1	4.0	1.0	2	24.4	Gravel	Test #2--west face of pit. Sandy gravel, clay bottom. Acceptable for Item 201, sub-base of gravel
	3	1959	0-5	0	Yes	--	--	Not	Sampled		--	--	Borrow (Grav.)	Test No. 3--north face of pit. Material--a gravelly sand, not enough stone for gravel sub-base.
4	1	1959	0-4	0	No	--	--	42.[illegible]	1	0.5	3	11.8	Gravel	Owner: R. Du[illegible]. [illegible] island in the [illegible] River at Jon[illegible]. Good road [illegible] but must be [illegible] so much island. Test No. 1 on [illegible] (upstream). Water level at 6 inches, gravel bottom.

...ent. ...o.	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
							[illegible]	#4	#100	#270				
	2	1959	0-4	0	No	-	—	31.0	1	0.5	2	12.5	Gravel	Test No. 2 150 ft. downstream from No. 1. Water table at 6 inches, gravel bottom. Island is covered with scrub growth. This island is a possible source for sub-base of gravel - Item 201.
	1	1959	0-3	-	No	-	—	Not	Sampled	—	—	—	Borrow (Sand)	Owner: Whelan Bowen. Toe of slope tested where fine sand exposed. Material is silt & fine sand.
	2	1959	1-2	0-1	No	-	—	Not	Sampled	—	—	—	Borrow (Sand)	Test No. 2 - 200 ft. west of No. 1 across large gully on top of terrace. Material fine sand and silt.
	3	1959	2-11.5	0-2	No	-	—	40.4	5	2.0	1	23.4	Gravel	Test No. 3 150 ft. north of Test No. 2 on same terrace. Overburden varies up to 3 ft. of silt. Test to 15 ft. (1½' fine sand bottom). Gravel bed dips sharply.
	4	1959	2-7	0-2	No	-	—	Not	Sampled	—	—	—	Borrow (Sand)	Test No. 4 100' north of Test No. 3. [illegible] bedded sand and [illegible] silt.
	5	[illegible]	2-5	0-2	No	-	—	[illegible]	Sampled	—	—	—	Borrow (Sand)	Test No. 5 60' N. of No. 3. Beds of sand and silt.

Ident. No.	Field Test No.	[illegible] Field Tested	[illegible] of Sample or Test (ft.)	Over-[illegible] (ft.)	[illegible] Pit	Volume Estimate (cu. yds.)	Sieve Analysis % Passing 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
	6	1959	2-6	0-2	No	--	—	28.5	3	1.5	3	20.6	Gravel	Test No. 6 25' east of No. 3 at top of gully. Preliminary sample - sand bottom. Tests 3 and 6 show a possible small source of sub-base of gravel - Item 201.
6	1	1959	0-3	0	Yes	-	Not	Sampled		—	—	—	Borrow (Grav.)	Owner: Edward Vercher-eau. An old depleted pit, dirty coarse mate-rial, bedrock bottom.
7	1	1959	1.5-13.0	0-1.5	No	-	100	96.9	8.7	1.4	1	—	Sand	Owner: Ed Vercherau. A sand knoll south of Town Road. Test No. 1 in toe of eastern slope. This site is a limited source of Item 202 - sub-base of sand.
	2	1959	1-5	0-1	No	-	Not	Sampled		—	—	—	Borrow (Sand)	Test No. 2 in top of knoll is 100' west of No. 1. Material is a fine sand with silt.
	3	1959	1-3	0-1	No	-	[illegible]	Sampled		—	—	—	Borrow (Grav.)	Test No. 3 was taken in another knoll to the east of Test No. 1. Material: 2 ft. [illegible] of gravel. [illegible] was sandy-silt. [illegible] had bottom of silt and clay.

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
8	1	1959	1-8	0-1	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Owner: Ed Verd[illegible]. A sand knoll 0.5 mile west of Location No. 7. Test No. 1 silty over-burden sand and silt mixed, silt bottom.
	2	1959	1.5-9	0-1.5	No	-	100	100	4	1	2	—	Sand	Test No. 2 30 ft. north of Test No. 1. Sandy over-burden, silt and clay bottom. This is a limited source for Item 202 (sub-base of sand).
9	1	1958	0-2	0	No	15,000	-	37.9	2	0.75	2	12.2	Gravel	Owner: Ken. Wheeler This is a large river bar on north side of river, former Hazen property. This is an extensive source for Item 201 (sub-base of gravel).
10	1	1959	0-3	0	No	-	Not	Sampled		—	—	—	Borrow (Sand)	Owner: Tom O'[illegible]. Area north of [illegible] 2 and west of [illegible] Island Road. Test No. 1 in field just south of Wheeler [illegible]. Sandy silt.
	2	1959	0-5	0	No	-	[illegible]	[illegible]	[illegible]	—	—	—	Borrow (Sand)	Test No. 2 [illegible] overburden [illegible] under power [illegible] sion line, sandy silt.

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
	3	1959	0-12	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Test No. 3 100 ft. NE of Test No. 2-silt and clay.
	4	1959	0-7	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Test No. 4 at side of Snipe Island Road under the power transmission line. Sand exposed here in road cut. Fine sand.
	5	1959	0-7	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Test No. 5 downhill from No. 4-same material.
11	1	1959	0-5	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Owner: Tom O'[illegible]. Area on north side of US Route 2 and east of Snipe Island Road. Test No. 1-clay and silt.
	2	1959	1-4	0-1	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Test No. 2 thin band of stone and [illegible] with clay and silt.
12	1	1959	0-6	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Owner: Xenophon [illegible] Sand Bank west of Snipe Island Road, fine sand.
13	1	1959	0-2	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Owner: Tyler [illegible]. Test No. 1 is in [illegible] knoll west of [illegible] Richmond Town Road. This knoll has a [illegible] cap of pebbly sand on a base of fine sand.
	2	1959	0-2	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Test No. 2 same as No. 1. 50 ft. north of Test No. 1.

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 1½	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
	3	1959	1-3	0-1	No	-	100	93.3	6.8	1.0	1½	—	Sand	Test No. 3 in knoll on east side of Jericho-Richmond Road next to telephone pole. This area close to the centerline of the Interstate. Seems a good possibility for Item 202 (sub-base of sand).
	4	1959	0-3	0	No	-	Not	Sampled		-	—	—	Borrow (Sand)	Test No. 4 knoll with sand exposed to NE of Test No. 3. This sand too fine for sub-base.
14	1	1959	1-3	0-1	No	-	100	95.8	0.9	0.4	2	—	Sand	Owner: Frank Westall. This is a large wooded sand knoll some distance north of US Route 2 and just north of Interstate C/L. This is a possible source of sub-base of sand, Item 202.
15	1	1959	-	-	No	-	-	30.5	3	0.75	2½	9.0	Gravel	Owner: Con[illegible] gravel partially [illegible] but a possible source of [illegible] of gravel [illegible]
16	1	1959	-	-	No	-	-	[illegible]	9	2.0	3½	12.4	Gravel	Owner: [illegible] south of [illegible] House Bridge [illegible] large [illegible] 201 ([illegible] Adjacent [illegible] Interstate Right-of-Way.

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
17	1	1959	0-2	0	No	-	—	29.6	1	0.5	2½	9.4	Gravel	Owner: Francis Martell. Test #1 was in a river bar across from Howell property.
	2	1959	0-3	0	No	-	—	20.5	4	2.0	3½	10.2	Gravel	Test #2 a very large river bar upstream from Test #1. Both these areas are possible sources of sub-base of gravel, Item 201.
18	1	1959	0-3	0	No	-	—	25.3	1	2.5	2½	10.2	Gravel	Owner: Frank Westall. A large river bar just west of Richmond Village. Possible source of Item 201, sub-base of gravel.
19	1	1959	2-5	0-2	No		—	—	Not	Sampled		—	Borrow (Sand)	Owner: Francis Martell. Sand bank on old Town Road (abandoned). Test #1-silt overburden, sandy silt to [illegible].
	2	1959	2-6	0-2	No		—	—	Not	Sampled		—	Borrow (Grav.)	Test #2, silt overburden, narrow band of gravel, silt bottom.
20	1	1959	2-9	0-2	No	-	[illegible]	80.9	3.2	1.2	3	—	Borrow (Sand)	Owner: Frank [illegible]. Huge sand [illegible] Town Road [illegible] Interstate [illegible]. Test [illegible] undoubtedly [illegible] resampled. Overburden

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
														fine sand, bottom-coarse sand.
	2	1959	1.5-10	0-1.5	No	-	100	89.4	5.4	0.8	2	—	Sand	Test #2 160 ft. SW of No. 1. Same material - still no bottom to 10 feet.
	3	1959	4-9	0-4	No	-	100	90.0	0.9	0.1	2	—	Sand	Test #3 300 ft. south of No. 2. Overburden of fine sand. Probably could be mixed with rest and still pass for 202 (sand).
	4	1959	1-6	0-1	No	-	100	103	4.0	0.5	1½	—	Sand	Test #4 south of No. 3 under the pine grove, just north of Liwak house. West of Town Road.
	5	1959	0.5-10	0-0.5	No	-	100	86.9	0.8	0.4	2½	—	Sand	Test No. 5 in NE corner of field across road and NE of No. 4.
	6	1959	0.5-10	0-0.5	No	-	100	89.8	3.6	0.6	1½	—	Sand	Test No. 6 in NW corner of field with No. 5. This area covered in part by these 6 tests and overlooking the Interstate Route - is very good source of sub-base of sand, Item 202.
21	1	1959	0-3	0	Yes		—	—	Not	Sampled	—	—	—	Owner: Unknown. This material has flat soft stones with a silt-clay binder.
22	1	1959	0-4	0	No		—	—	Not	Sampled	—	—	—	Owner: Summer Farr. This material is glacial till (flat [illegible]

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				
	2	1959	0-3	0	No		-		Not	Sampled		-	-	with a silt-clay binder). Test No. 2 same as No. 1.
23	1	1959	0-3	0	Yes	-	100	88.8	1.7	0.4	1	-	Sand	Owner: Hart. The quantity of sand in this pit is too limited to be a good source for 202. Test No. 1 was taken in west face.
	2	1959	1-8	0-1	No	-	-	34.8	8	3.5	2	22.4	Gravel	Test No. 2 was taken in a knoll north of the pit. Quantity is so limited by clay bottom that this is a poor source of sub-base of gravel, Item 201.
24	1	1959	1-4	0-1	Yes		-		Not	Sampled		-	Borrow (Sand)	Owner: Sumner Farr. Old borrow pit SW of Fay's Corners. Fine sand with some [illegible]. Quantity limited by brook and [illegible]
25	1	1959	1-7	0-1	No	-	-	45.5	5	1	3½	23.0	Gravel	Owner: [illegible] back. Test [illegible] barn. Quantity of [illegible] 201 is limited.
	2	1959	1-5	0-1	[illegible]		-		Not	Sampled		-	Borrow (Sand)	Test No. 2 [illegible] east of Test No. 1.
	3	1959	1-8	0-1	No		-		Not	Sampled		-	Borrow (Grav.)	Test No. 3 [illegible] next to brook. [illegible] gravel and clay [illegible].
	4	1959	1.5-8	0-1.5	Yes	-	100	80.9	9.7	1.6	5	-	Borrow (Sand)	Test No. 4 near to old borrow pit on side hill

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
														This sand fails on color as well as gradation.
26	1	1959	1-6	0-1	No	-	-	59.2	3	1.25	3	-	Borrow (Grav.)	Owner: Sumner Farr. Not enough stone for wear test. Fine sand and silt bottom. Bank above Town Road south from Fay's Corners.
27	1	1959	1-6	0-1	No		-	-	Not	Sampled	-	-	Borrow (Grav.)	Owner: Raymond DuPont. Gravel bank south of Town Road west of DuPont barn. Dirty gravel.
	2	1959	1-8	0-1	Yes	-	-	67.8	3	1.25	3	-	Borrow (Grav.)	Test No. 2 SW of old gravel pit by barn. Sand and gravel mixed. Not enough stone to run Abrasion Test.
28	1	1959	2-9	0-2	No		-	-	Not	Sampled	-	-	Borrow (Grav.)	Owner: Barcelo. Test No. 1 on knoll NW of burned house. Sand and gravel mixed.
	2	1959	1-12	0-1	Yes		-	-	Not	Sampled	-	-	Borrow (Grav.)	Test No. 2 [illegible] pit south of [illegible]. Gravel [illegible] layers.
	3	1959	1-7.5	0-1	No	-	-	51.3	3	1.0	3½	22.2	Gravel	Test No. 3 [illegible] north of [illegible]. Fine sand [illegible] in a possible source [illegible] sub-base of gravel. Item 201.

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
	4	1959	2-5	0-2	No		-	-	Not	Sampled	-	-	Borrow (Grav.)	Test No. 4 in flat meadow by brook, north of house. Gravel and sand with silt.
	5	1959	1.5-9	0-1.5	No	-	-	57.4	5	1.5	3	23.4	Gravel	Test No. 5 on hillside SE of Barcelo barn. Gravel bottom. Possible source of Item 201 (sub-base of gravel).
	6	1959	2.5-8	0-2.5	No	-	-	49.8	6	1.8	3½	24.0	Gravel	Test No. 6 on hillside west of Test No. 5. Gravel bottom. Possible source of gravel, Item 201.
29	1	1959	1-9	0-1	No		-	-	Not	Sampled	-	-	Borrow (Grav.)	Owner: MacDonald. Test No. 1 on east of State Aid Road. Material - sand and gravel mixed.
	2	1959	1-6	0-1	No		-	-	Not	Sampled	-	-	Borrow (Sand)	Test No. 2 east of Test No. 1. Fine sand with silt.
	3	1959	1-8	0-1	No		-	-	Not	Sampled	-	-	Borrow (Grav.)	Owner: MacDonald. Test No. 3 east of bar barn. Material till.
	4	1959	1-11	0-1	No		-	-	Not	Sampled	-	-	Borrow (Sand)	Test No. 4 west of State Aid Hwy. across from house. Fine sand with some stone silt bottom.
	5	1959	1-3	0-1	No		-	-	Not	Sampled	-	-	Borrow (Grav.)	Test No. 5 SE of No. 4. Material till.
30	1	1959	2-9	0-2	No	-	-	34.0	3	1.0	2	14.4	Gravel	Owner: Henry Meltzroy. Test No. 1 east of State Aid Hwy. behind barn. This looks like

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
														old river terrace. Silt in bottom of hole.
	2	1959	1-9	0-1	No	-	-	30.6	5	1.3	3½	13.4	Gravel	Test No. 2 south of Test No. 1. Same material, clay bottom.
	3	1959	1-9	0-1	No	-	-	34.2	4	1.0	3	13.4	Gravel	Test No. 3 south east of No. 2. Same (river gravel) material. Clay bottom at 9 ft.
	4	1959	2-4	0-2	No	-	-	33.8	6	2.0	3	13.8	Gravel	Test No. 4 river gravel. West of State Aid Hwy. next to stream. Water level at 3'. Gravel bottom.
	5	1959	3-7	0-3	No	-	-	28.3	7	2.0	3	14.7	Gravel	Test No. 5 river gravel. South of No. 4. Water came in at 6.5 ft. Gravel bottom. This location is a good source of sub-base of gravel, Item 201.
31	1	1959	1-4	0-1	No		-	-	Not	Sampled		-	Borrow (Grav.)	Owner: Gedeon Hoel. Test No. 1 west of farm road from barn - till and boulders.
	2	1959	3-13	3-8	Yes	-	-	45	1	0.5	1	8.2	Gravel	Test No. 2 [illegible] in old [illegible] pit at edge of [illegible] Overburden [illegible] up to 8 ft. [illegible] Bottom was [illegible] gravel.
	3	1959	3-16	0-3	Yes	-	-	40.1	1	0.5	1	6.4	Gravel	Test No. 3 in south end of old pit. This is a possible source of sub-base of gravel, Item 201.

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 1½"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes V.H.D. Specs.	Remarks
	4	1959	0-3	0	Yes		-	-	Not	Sampled	—	-	Borrow (Grav.)	Test No. 4 down Town Rd. (west) from Neal house on northern hillside. Old pit of glacial till.
32	1	1959	0	0	No	12,000	100	99.8	3.0	1.0	1	-	Sand	Owner: Vermont Paving Co. (Bayer Mingolla). Stockpile at old plant site. Possible limited source of sub-base of sand, Item 202.

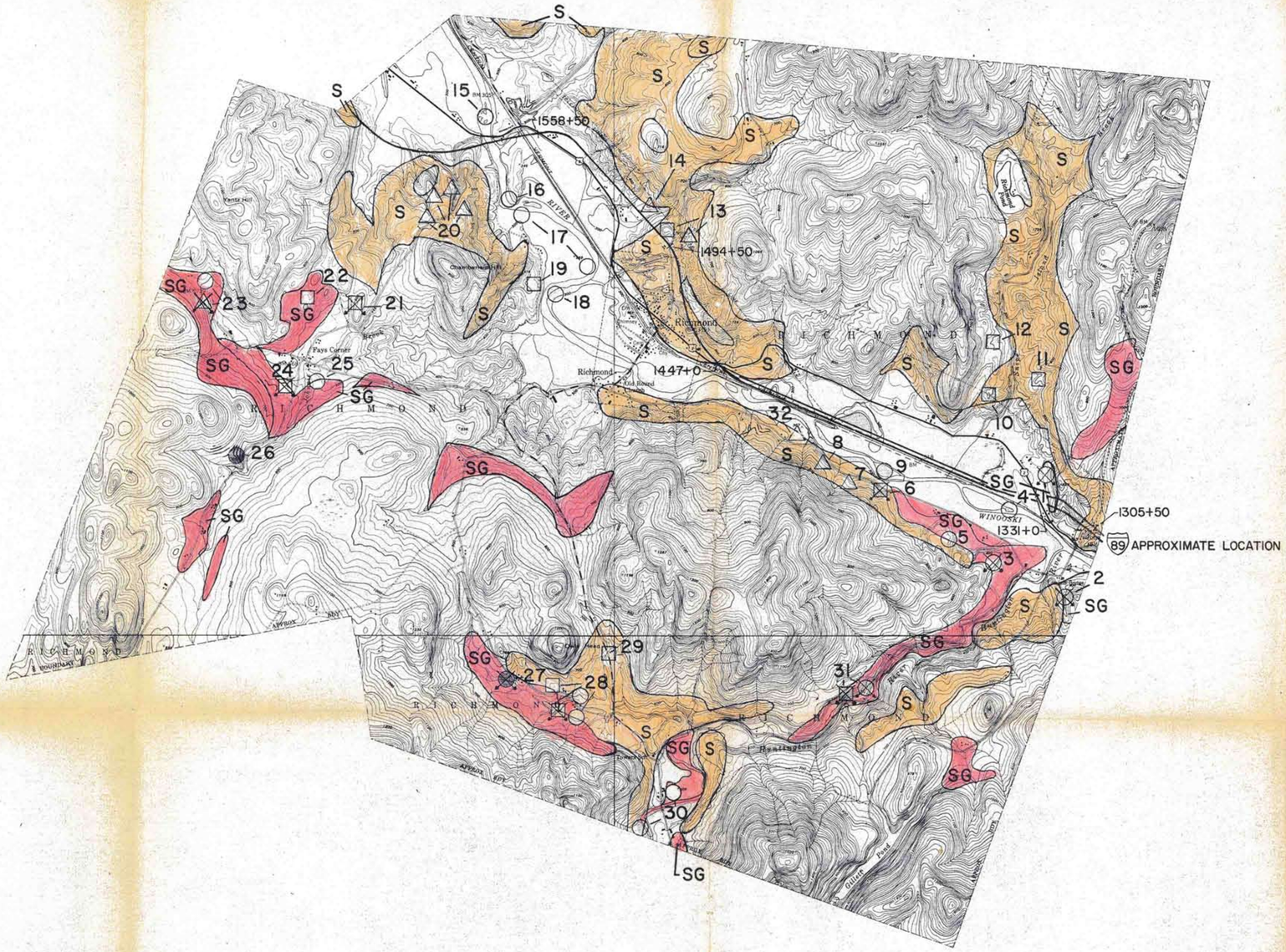
Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHO T - 3	Distance Between Samples (ft.)	Remarks
1	1	1959	Gneiss	No	Blasted	5.0	0	Owner: Louis Bombardier. Small bedrock outcrop in the Village of Jonesville, south of US Route 2 and the Winooski River. Samples taken represent 157 feet across strike. Rock is a granite gneiss grading locally to a quartz-sericite-biotite schist. The commercial value of this source is questionable due to the small size of the outcrop and the band of soft material shown by Test No. 3. Note: (R) indicates rock was resampled from the same blast hole.
	2	"	"	"	"	6.2	25	
	3	"	Schist	"	"	11.0-8.0 (R)	30	
	4	"	Gneiss	"	"	7.8	25	
	5	"	"	"	"	8.6-5.6 (R)	20	
	6	"	"	"	"	15.4-5.2 (R)	35	
	7	"	"	"	"	7.0	22	
2	1	1959	Gneiss	No	Blasted	6.4	0	Owner: Wheeler - Andrews. This bedrock outcrop lies on the Wheeler - Andrews property line adjacent to US Route 2. Samples taken represent 379' across strike; 160' (samples 1-7) on Wheeler property, and 219' (samples 8-15) on the Andrews property. The section sampled indicates approx. 80' of rock passing for 204 (sub-base of crushed rock) on Wheeler's property and approx. 180' on the Andrews' property. The rock is a fine grained gneiss grading to schist on the east and on the [illegible] to the nature of this rock it is entirely possible that softer bands may be present within the area tested so that additional extensive testing is recommended. The quality and quantity of the northern extension of this rock is unknown and further exploration in this direction might be profitable.
	2	"	"	"	"	7.2	25	
	3	"	"	"	"	9.2	35	
	4	"	"	"	"	5.6	33	
	5	"	"	"	"	6.4	25	
	6	"	"	"	"	7.6	21	
	7	"	"	"	"	7.6	21	
	8	"	"	"	"	6.8	20	
	9	"	"	"	"	6.4	15	
	10	"	"	"	"	6.2	35	
	11	"	"	"	"	6.4	19	
	12	"	"	"	"	7.2	23	
	13	"	"	"	"	6.8	52	
	14	"	"	"	"	9.0	30	
	15	"	"	"	"	9.[illegible]	25	

RICHMOND GRANULAR PROPERTY OWNERS

PROPERTY OWNERS	IDENT. NO.
Barcelo	28
Bennett	25
Bombardier, Louis	2
Bowen, Whelan	5
Bushey, R.	4
Conant-River	15
Dupont, Raymond	27
Farr, Sumner	22, 24, 26
Hart,	23
Howell-River bar	16
Livak, Frank	20
MacDonald	29
Martell, Francis	17, 19
Moultroup, Henry	30
Murray, Glenn	1
Noel, Gedeon	31
O'Neill, Tom	10, 11
Stevens, Tyler	13
Unknown	21
Verchereau, Edward	6, 7, 8
Vermont Paving Company (Bayer Mingolla)	32
Westall, Frank	14, 18
Wheeler, Xenophon	3, 9, 12

RICHMOND ROCK PROPERTY OWNERS

PROPERTY OWNERS	IDENT. NO.
Bombardier, Louis	1
Wheeler--Andrews	2



N

RICHMOND

SCALE 1:31,250

1 0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1960

LEGEND

- ○ GRAVEL, ACCEPTABLE FOR ITEM 201 (sub-base of gravel)
- ● GRAVEL, DEPLETED OR NOT ACCEPTABLE FOR ITEM 201
- △ SAND, ACCEPTABLE FOR ITEM 202 (sub-base of sand)
- ▲ SAND, DEPLETED OR NOT ACCEPTABLE FOR ITEM 202
- □ BORROW
- ⨯ EXISTING PIT
- SG SAND & GRAVEL DEPOSIT
- S SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheet)

GRANULAR MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

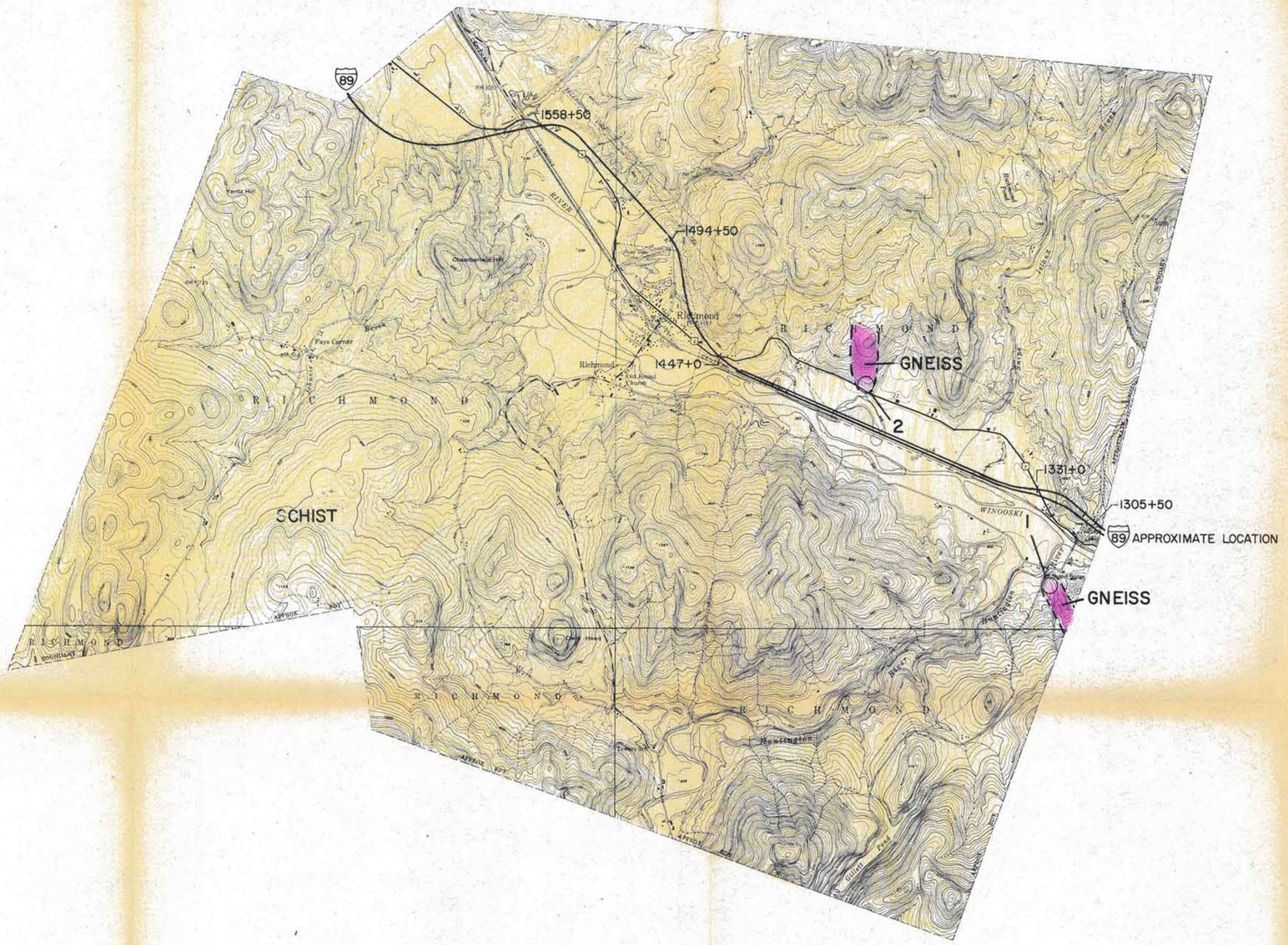
IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

PLATE I

GRANULAR



N

LEGEND

- ROCK , ACCEPTABLE FOR ITEM 204 (sub-base of crushed rock)
- ROCK , NOT ACCEPTABLE FOR ITEM 204
- EXISTING QUARRY
- GRANITE TO DIORITE (light to intermediate igneous rocks)
- AMPHIBOLITE , GABBRO , DIABASE , METADIABASE , GREENSTONE , TRAP DIKES (basic or dark igneous rocks)
- PERIDOTITE , PYROXENITE , SERPENTINITE (ultra-basic igneous rocks)
- GNEISS
- QUARTZITE
- DOLOMITE
- MARBLE , LIMESTONE
- SCHISTS , SLATES , PHYLLITES , CONGLOMERATES
- 3 IDENTIFICATION NUMBER (refer to text)

RICHMOND

SCALE 1:31,250

1 0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1960

ROCK MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

PLATE 2

ROCK