SURVEY OF HIGHWAY CONSTRUCTION MATERIALS

IN THE TOWN OF HARDWICK, CALEDONIA COUNTY, VERMONT

Prepared by

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

ENGINEERING GEOLOGY SUBDIVISION

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Acknowledgments

This project acknowledges the surficial geological information obtained from Professor D. P. Stewart of Miami University, Oxford, Ohio and the bedrock information from the Centennial Geologic Map of Vermont, C. G. Doll.

History

The Materials Survey Project was initiated in 1957 by the Vermont Department of Highways with the assistance of the Bureau of Public Roads to compile an inventory of highway construction materials in the State of Vermont. Previously, investigations for highway construction materials were conducted only as the immediate situation required and only limited areas were surveyed. Since no overall picture of material resources was available, highway contractors or resident engineers were required to locate the materials for their respective projects and the samples were tested by the Materials & Research Division. The additional expense of exploration for construction materials resulted in higher construction costs being paid by the State. The Materials Survey Project was formed to minimize this factor by enabling the State and the contractors to use available information on material resources and to project cost estimates. Knowledge of locations of suitable materials is an important factor in planning highways.

The sources of construction materials are located by this Project through ground reconnaissance, study of maps and aerial photographs, and geological and physiographic interpretation. Maps, data sheets and work sheets furnish information of particular use to contractors and construction personnel, and should be studied together for maximum benefit.

Enclosures

Included in this report are two surface-geology maps, one defining the location of tests on bedrock, the other defining the location of tests on

granular materials. These maps are based on 15-minute or 7-½-minute quadrangles of the United States Geological Survey enlarged or reduced to 1:31250 or 1" = 2604'. The various rock formations and types are delineated on the Bedrock Map of the township. This information is obtained from: Vermont Geological Survey Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, Centennial Geologic Map of Vermont, the Surficial Geologic Map of Vermont and other references.

The granular materials map shows areas of various types of glacial deposits (outwash, moraines, kames, kame terraces, eskers, etc.) which are potential sources of gravel and sand. This information was obtained primarily from a survey conducted by Professor D. P. Stewart of Miami University, Oxford, Ohio, who mapped the glacial features of the State of Vermont during the summer months from 1956 to 1966. Further information is obtained from the Soil Survey (Reconnaissance) of Vermont (conducted by the Bureau of Chemistry and Soils of the United States Department of Agriculture), available Soil Surveys of individual counties (by the Soil Conservation Service of the United States Department of Agriculture), Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs and other sources. The location of each test area is represented by a Map Identification Number.

This report contains data sheets with detailed information on each test taken in the Granular and Bedrock areas. Data is also used from an active card file compiled by the Materials & Research Division over a period of years. Some cards are not used because they are incomplete or have unusable information on the location of the deposit.

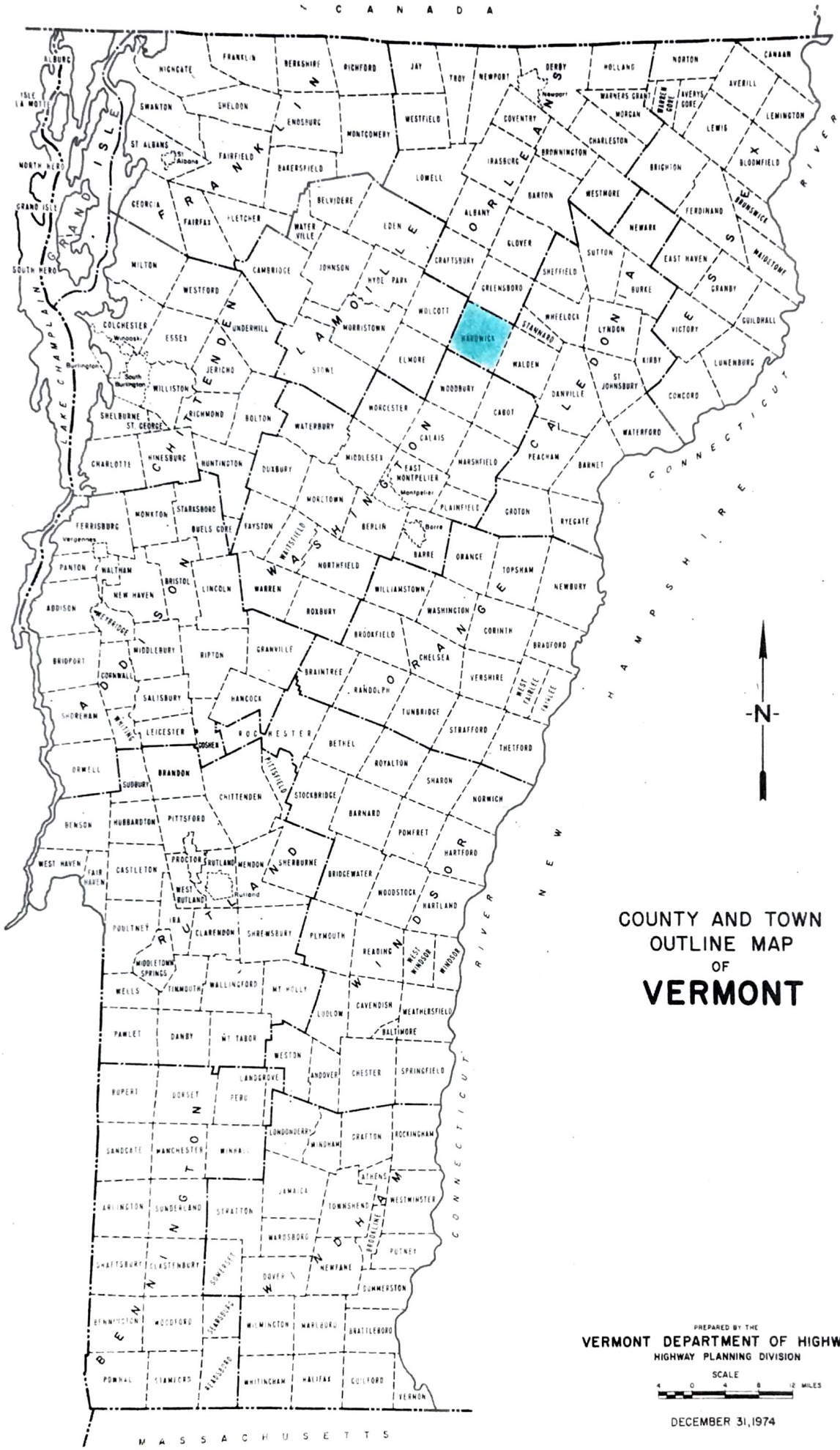
Work sheets containing more detailed information and a field sketch of the area, and laboratory test results are on file in the Materials & Research Division of the Agency of Transportation, State of Vermont.

LOCATION

The Town of Hardwick is in the westernmost part of Caledonia County in northern Vermont. It is bounded on the north by Greensboro, the east by Walden, the south by Woodbury, and the west by Wolcott. (See County and Town Outline Map of Vermont on the following page.)

Hardwick is within the Vermont Piedmont physiographic subdivision of the New England Upland. This subdivision is a stream-dissected plateau with undulating-to-rough topography. Elevations vary from 1,832 feet atop Jeudevine Mountain, near the northwest corner of town, to less than 780 feet where the Lamoille River crosses the Wolcott Town Line.

Hardwick is in the Lamoille River drainage basin. The Lamoille River flows westward from the east-northeast corner to the west-southwest corner of the town. Principal northern tributaries flowing south to the River are Alder, Bailey, Bunker, Greensboro, Millard, Porter, and Tucker Brooks. Southern tributaries are Cooper, Haynesville, Kate, Nichols, Stannard, and Stevens Brooks. The largest body of water is Hardwick Lake in the west-central part of the town.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

PREPARED BY THE
VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION

SCALE
4 0 4 8 12 MILES

DECEMBER 31, 1974

SURVEY OF ROCK SOURCES

Procedure for Rock Survey

The method employed by the project in a survey of possible sources of rock for highway construction is divided into two main stages: office and field investigations.

The office investigation is conducted during the winter months and comprises the mapping and description of rock types perused from many reference sources, as acknowledged in the bibliography. These references differ considerably in dependability due to subsequent developments and studies that have contributed to the obsolescence of a number of reports. The results of samples taken by other individuals are analyzed, and their location is mapped when possible. As complete a correlation as possible is made of the available geological information concerning the area under consideration.

The field investigation is begun by making a cursory survey of the entire town. The information obtained from the preliminary survey, and that from the office investigation, is used to determine where sampling will be concentrated. When a promising source has been determined by rock type, volume of material, accessibility, adequate exposure and relief, chip samples are taken with a hammer across the strike or trend of the rock, and are submitted to the Materials & Research Division for abrasion testing by the Deval Method (AASHTO T-3) and the Los Angeles Method (AASHTO T-96). Samples taken by the chip method are often within the weathered zone of the outcrop and thus may give a less satisfactory test result than fresh material from unweathered rock. When the rock is uniform, and the chip samples yield acceptable abrasion test results, the material source is listed in this report as being satisfactory.

Discussion of Rock and Rock Sources

It should be noted that information on the Rock Materials Map (Plate II) is somewhat simplified. (For a more detailed description of the respective rock formations, see the Summary of Rock Formations included in this report.)

Occasionally, rocks belonging to the same formation and exhibiting similar characteristics (i.e., color and texture) produce different abrasion test results owing to differing physical properties or chemical compositions. Therefore, in no case should satisfactory test results obtained in one area be construed to mean that the same formation, even in the same area, will not later produce unsatisfactory material; this is particularly true of metamorphic rocks.

Complex metamorphic rocks comprise most of the bedrock lithology in Hardwick with the exception of several igneous intrusives in the southern part of the town. Limestones of the Barton River member of the Waits River formation, which underlie the eastern two-thirds of Hardwick, are thinly bedded with much intraformational sericitic phyllite that tends to split into paper-thin fragments when quarried.

Cram Hill member rocks of the Missisquoi formation underlie most of the western third of Hardwick, and were sampled from Map Identification Nos. 1 and 2. Rock from both areas meet requirements for Dense Graded Crushed Stone for Sub-base, Item 704.09.

Map Identification Nos. 3, 4, 5, and 6 are granite quarries in separate New Hampshire plutonic igneous bodies southwest and southeast of Hardwick village, but only the material at Number 3 meets requirements for Dense Graded Crushed Stone for Sub-base, Item 704.09.

Material sampled in Hardwick was only tested in accordance with AASHTO T-96 procedures.

SURVEY OF SAND AND GRAVEL SOURCES

Procedure for Sand and Gravel Survey

The method used for conducting the survey of possible sources of sand and gravel for highway construction is divided into two main stages: office and field investigations.

The office investigation is conducted during the winter months and comprises the mapping of potentially productive areas from various references. Of these references, the survey of glacial deposits mapped by Professor Stewart is particularly helpful when used with soil-type maps, aerial photographs, and United States Geological Survey Quadrangles. The last two are used in the recognition and location of physiographic features indicating glacial deposits, and in the study of drainage patterns. The locations of existing pits are mapped, as are the locations in which samples were taken by other individuals.

The field investigation is begun by making a cursory survey of the entire town. All pits, and any areas that show evidence of glacial or fluvial deposition are noted, and later investigated by obtaining samples from pit faces and other exposed surfaces. Test holes in pit floors and extensions are later dug with a backhoe to a depth of approximately 11 feet to obtain material which is submitted to the Materials & Research Division for gradation, sieve analysis and AASHTO T-4 Method stone abrasion test.

Discussion of Sand and Gravel Deposits

Granular materials in the town of Hardwick are mainly below 1,300 feet in elevation and appear to be largely the result of continental glaciation at the close of the Pleistocene epoch. Two depositional processes were involved; glaciofluvial and glaciolacustrine.

Glaciolacustrine deposition took place in a shallow, high level lake that occupied the Lamoille River, Alder Brook, and Cooper Brook valleys. Materials at Map Identification Numbers 3, 5, 11, 15 and 16 probably are from lake sediments that are represented by the orange-colored areas on the Granular Materials Map (Plate I).

Glaciofluvial deposition took the forms of scattered kames, kame terraces, an esker and a beach gravel. The beach gravel is 0.3 mile southeast of East Hardwick village. The mile long esker between Vermont Route 14 and Hardwick Lake was sampled at Map Identification Numbers 6 and 7. The kamic features are the most promising sources of Gravel for Sub-base, Item 704.05, in Hardwick and are represented by the remainder of the red-colored areas on the Granular Materials Map. They were sampled at Map Identification Numbers 1, 2, 4, 9, 10 and 12.

The pits at Map Identification Numbers 1 and 9 have the best Gravel for Sub-base, Item 704.05, potential. The gravel source at Number 4 is nearly depleted.

Map Identification Numbers 3, 11 and 15 have the best Sand Borrow and Cushion, Item 703.03, potential.

SUMMARY OF ROCK FORMATIONS IN THE TOWN OF HARDWICK

Ayers Cliff member of the Waits River formation: Siliceous crystalline limestone containing thin beds of slate and phyllite north of the Lamoille River.

Barton River member of the Waits River formation: Interbedded siliceous crystalline limestone and sericite-quartz-chlorite phyllite in northern Vermont; diopsidic limestone and cordierite hornfels at contacts with granitic dikes and sills.

Cram Hill member of the Missisquoi formation: Pale greenish-gray to black phyllite grades locally into gray to black slate; felsic to mafic volcanic rocks.

Moretown member of the Missisquoi formation: Quartz and quartz-plagioclase granulite in layers 1/8" to several inches thick, separated by "pinstripe" partings that contain muscovite, chlorite, epidote, biotite, and locally garnet; also greenish quartz-sericite-chlorite phyllite and schist, and minor carbonaceous phyllite.

New Hampshire Plutonic series: Medium to coarse grained gray to pink granite, granodiorite, quartz-monzonite.

Northfield formation: Dark gray to black quartz-sericite slate or phyllite with fairly widely-spaced interbeds a few inches thick of siltstone and silty crystalline limestone like that of the Waits River formation; calcareous slate north of the Lamoille River.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Beach gravel: Gravel that has been thrown up and partially sorted by wave action at the margin of a body of water.

Bedrock: The more or less solid, undisturbed rock in place either at the surface or beneath superficial deposits of gravel, sand, or soil.

Biotite: A silicate mineral commonly known as black mica.

Calcareous: Consisting of, or containing calcium carbonate.

Carbonaceous: Relating to, containing, or composed of carbon.

Chlorite: A general designation for a group of hydrous silicates of magnesium and iron, with or without aluminum, so named because of their green color.

Contact: The surface, often irregular, which constitutes the junction of two bodies of rock different in kind, age, or origin.

Cordierite: A blue mineral consisting of a silicate of magnesium, aluminum, and iron.

Cross-bedding: A diagonal arrangement of bedding in sediments or rocks such that the layers are inclined at various angles to the more general planes of stratification or the formational contact. Sand-dune, river channel, and delta deposits commonly show cross-bedding on an extensive scale.

Diopside: Green to white pyroxene containing little or no aluminum.

Dip: The angle that a stratum makes with a horizontal plane.

Drainage: The manner in which the water of an area passes off by surface streams and rivers, or by subsurface channels.

Epidote: A mineral, calcium aluminum iron silicate that usually occurs in rocks as formless grains and masses. The color is usually some shade of green, pistachio-green or yellowish-green being the most characteristic.

Esker: A long, narrow winding ridge of mixed sand and gravel deposited by a stream of meltwater flowing in a tunnel or crevasse in stagnant glacial ice.

Felsic: A term derived from the names of the light-colored minerals: FE for feldspar, L for lenads or feldspathoids, and S for silica, and applied to these minerals and to rocks composed predominantly of one or more of them.

Garnet: An important group of silicate minerals having the general formula $R_3R_2(SiO_4)_3$, in which the radical R_3 is calcium, magnesium, ferrous iron, or manganese and R_2 is aluminum, ferric iron, or chromium. There are numerous varieties, of which pyrope, almandite, and andradite are the most important.

Glaciofluvial: Of, or pertaining to, formation by or relation to, streams within, upon or emerging from glacial ice.

Glaciolacustrine: Of, or pertaining to, formation by or deposition in quiescent waters of glacial lakes.

Granite: A granular, crystalline rock of predominantly interlocking texture, composed essentially of alkalic feldspars and quartz. Accessory minerals (chiefly micas, hornblende, or more rarely pyroxene) are commonly present.

Granodiorite: A type of deep-seated, crystalline igneous rock composed of plagioclase, a smaller amount of orthoclase or other alkalic feldspar, quartz, and usually one or more of the dark minerals, biotite, hornblende, or pyroxene.

Granulite: A banded or laminated whitish granular rock consisting of feldspar, quartz, and small red garnets and occurring with crystalline schists.

Greenstone: Any of numerous usually altered dark green compact rocks.

Hornfels: A general term for very dense, dark-colored, hard, sugary-grained rocks that have been recrystallized by the heat of an adjacent igneous intrusion.

Igneous rocks: Rocks formed by solidification of hot mobile rock material.

Intrusive: Igneous rock which has cooled before reaching the earth's surface contains small to large visible grains - opposed to extrusive - solidifying at the surface and containing small unrecognizable grains.

Kame: A conical hill of generally poorly stratified drift deposited in contact with glacial ice by 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.

Ledge: A shelf-like ridge or projection of rock, usually horizontal and much longer than high.

Limestone: A bedded sedimentary rock consisting chiefly of calcium carbonate. The most important and widely distributed of the carbonate rocks.

Limonite: A native hydrous ferric oxide of variable composition that is a major ore of iron.

Mafic: Dark igneous rocks consisting predominantly of iron-magnesium minerals such as hornblende.

Metamorphic rocks: Rocks that owe their distinctive characteristics to the transformation of pre-existing rocks by intense heat, pressure, or both.

Monzonite: An igneous rock of granular, interlocking texture composed mainly of plagioclase and orthoclase feldspars and one or more dark minerals. The two types of feldspar occur in approximately equal amounts and the monzonites may be regarded as forming connecting links between the diorites and syenites. Quartz is typically absent; when it is present the rock is called quartz-monzonite.

Muscovite: An important member of the mica group of minerals, known also as white mica, potash mica, or isinglass.

Outcrop: A part of a body of rock that appears, bare and exposed, at the surface of the ground. In a more general sense the term applies also to areas where the rock formation occurs next beneath the soil, even though it is not exposed.

Phyllite: A fine-grained, foliated metamorphic rock intermediate between the mica schists and slates into which it may grade. The foliation is made possible by the development of a large amount of potash mica, sericite, which also gives the rock a distinctive silvery appearance.

Piedmont: Lying or formed at the base of mountains.

Plagioclase: The group of common rock-forming feldspar minerals of the albite-anorthite isomorphous series.

Plateau: A tableland or flat-topped area of considerable extent elevated above surrounding country on at least one side. The surface may be fairly smooth but not necessarily so; generally, if a large part of the original surface has been destroyed by streams it is called a dissected plateau.

Pleistocene epoch: The first epoch of the Quaternary period, in general including the time and deposits of the last great glacial epoch.

Plutonic: Pertaining to the depths of the earth, generally applied to rocks and intrusions that have consolidated at great depths.

Quartz: Anhydrous crystalline silica, SiO_2. It is the most common of minerals. It has a hardness of 7, specific gravity of 2.65, color from colorless to white or variously colored depending on impurities, luster vitreous or greasy, fracture conchoidal, crystals hexagonal or amorphous. The word quartz is prefixed to the names of many rocks when quartz is not a normal necessary or essential constituent, as quartz monzonite.

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.

Seam: A thin layer or stratum between other distinctive layers.

Sediments: All kinds of deposits from the waters of streams, lakes, or seas, and in a more general sense deposits of wind and ice.

Sericite: A mineral very similar to muscovite mica. It occurs in small flakes and scales in metamorphic rocks such as schists and gneisses.

Siliceous: Of, relating to, or containing silica or a silicate.

Siltstone: A rock composed of somewhat indurated silt. If possessed of bedding cleavage approximately parallel to bedding it is a shale.

Slate: A very fine-grained homogeneous metamorphic rock which splits smoothly along parallel cleavage planes and yields roughly similar slabs.

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.

Water Table: Is the upper surface of a zone of saturation except where that surface is formed by an impermeable body.

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PARTIAL SPECIFICATIONS FOR HIGHWAY CONSTRUCTION MATERIALS

Listed below are partial specifications for Highway Construction Materials as they apply to this report at date of publication. For a complete list of specifications see Standard Specifications for Highway and Bridge Construction, approved and adopted by the Vermont Department of Highways, March, 1976.

DIVISION 700 - MATERIALS

703.03 SAND BORROW AND CUSHION. Sand borrow shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and shall meet the requirements of the following table:

TABLE 703.03A - SAND BORROW AND CUSHION

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
2"	100	
1½"	90-100	
½"	70-100	
No. 4	60-100	100
No. 100		0- 30
No. 200		0- 12

703.05 GRANULAR BORROW. Granular borrow shall be obtained from approved sources, consisting of satisfactorily graded, free draining, hard, durable stone and coarse sand reasonably free from loam, silt, clay, or organic material.

The Granular Borrow shall meet the requirements of the following table:

TABLE 703.05A - GRANULAR BORROW

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
No. 4	20-100	100
No. 200		0- 15

The maximum size stone particles of the Granular Borrow shall not exceed 2/3 of the thickness of the layer being spread.

704.05 GRAVEL FOR SUB-BASE. Gravel for Sub-base shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and shall meet the following requirements:

(a) Grading. The gravel shall meet the requirements of the following table:

TABLE 704.05A - GRAVEL FOR SUB-BASE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
No. 4	20-60	100
No. 100		0- 18
No. 200		0- 8

The stone portion of the gravel shall be uniformly graded from coarse to fine, and the maximum size stone particles shall not exceed 2/3 the thickness of the layer being placed.

(b) Percent of Wear. The percent of wear of the gravel shall be not more than 25 when tested in accordance with AASHTO T-4, or more than 40 when tested in accordance with AASHTO T-96.

704.06 CRUSHED STONE FOR SUB-BASE. Crushed stone for sub-base shall consist of clean, hard, crushed stone, uniformly graded, reasonably free from dirt, deleterious material, pieces which are structurally weak and shall meet the following requirements:

(a) Source. This material shall be obtained from approved sources and the area from which this material is obtained shall be stripped and cleaned before blasting.

(b) Grading. This material shall meet the requirements of the following table:

TABLE 704.06A - CRUSHED STONE FOR SUB-BASE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
4½"	100
4"	90-100
1½"	25- 50
No. 4	0- 15

(c) Percent of Wear. The percent of wear of the parent rock shall be not more than 8 when tested in accordance with AASHTO T-3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHTO T-96.

(d) Thin and Elongated Pieces. Not more than 30 percent, by weight, of thin and elongated pieces will be permitted.

Thin and elongated pieces will be determined on the material coarser than the No. 4 sieve.

(e) Filler. The filler shall be obtained from approved sources and shall meet the requirements as set up for Sand Cushion, Subsection 703.03.

(f) Leveling Material. The leveling material shall be obtained from approved sources and may be either crushed gravel or stone screening produced by the crushing process. The material shall consist of hard durable particles, reasonably free from silt, loam, clay or organic matter.

This material shall meet the requirements of the following table:

TABLE 704.06B - LEVELING MATERIAL

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
3/4"	100
1/2"	70-100
No. 4	50- 90
No. 100	0- 20
No. 200	0- 10

704.07 CRUSHED GRAVEL FOR SUB-BASE. Crushed gravel for sub-base shall consist of material reasonably free from silt, loam, clay or organic matter. It shall be obtained from approved sources and shall meet the following requirements:

(a) Grading. The crushed gravel shall be uniformly graded from coarse to fine and shall meet the requirements of the following table:

TABLE 704.07A - CRUSHED GRAVEL FOR SUB-BASE

GRADING	Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
COARSE	4"	100	
	No. 4	25- 50	100
	No. 100		0- 20
	No. 200		0- 12
FINE	2"	100	
	1½"	90-100	
	No. 4	30- 60	100
	No. 100		0- 20
	No. 200		0- 12

(d) Thin and Elongated Pieces. Not more than 30 percent, by weight, of thin and elongated pieces will be permitted.

Thin and elongated pieces will be determined on the material coarser than the No. 4 sieve.

(e) Filler. The filler shall be obtained from approved sources and shall meet the requirements as set up for Sand Cushion, Subsection 703.03.

(f) Leveling Material. The leveling material shall be obtained from approved sources and may be either crushed gravel or stone screening produced by the crushing process. The material shall consist of hard durable particles, reasonably free from silt, loam, clay or organic matter.

This material shall meet the requirements of the following table:

TABLE 704.06B - LEVELING MATERIAL

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
3/4"	100
1/2"	70-100
No. 4	50- 90
No. 100	0- 20
No. 200	0- 10

704.07 CRUSHED GRAVEL FOR SUB-BASE. Crushed gravel for sub-base shall consist of material reasonably free from silt, loam, clay or organic matter. It shall be obtained from approved sources and shall meet the following requirements:

(a) Grading. The crushed gravel shall be uniformly graded from coarse to fine and shall meet the requirements of the following table:

TABLE 704.07A - CRUSHED GRAVEL FOR SUB-BASE

GRADING	Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
COARSE	4"	100	
	No. 4	25- 50	100
	No. 100		0- 20
	No. 200		0- 12
FINE	2"	100	
	1½"	90-100	
	No. 4	30- 60	100
	No. 100		0- 20
	No. 200		0- 12

(b) Percent of Wear. The percent of wear of the parent gravel shall be not more than 20 when tested in accordance with AASHTO T-4, or the crushed gravel a percent of wear of not more than 35 when tested in accordance with AASHTO T-96.

(c) Fractured Faces. At least 30 percent, by weight, of the stone content shall have at least one fractured face.

Fractured faces will be determined on the material coarser than the No. 4 sieve.

704.09 DENSE GRADED CRUSHED STONE FOR SUB-BASE. Dense graded crushed stone for sub-base shall consist of clean, hard, crushed stone, uniformly graded, reasonably free from dirt, deleterious material and pieces which are structurally weak, and shall meet the following requirements:

(a) Source. This material shall be obtained from approved sources and the area from which this material is obtained shall be stripped and cleaned before blasting.

(b) Grading. This material shall meet the requirements of the following table:

TABLE 704.09A - DENSE GRADED CRUSHED STONE FOR SUB-BASE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE
3½"	100
3"	90–100
2"	75–100
1"	50– 80
½"	30– 60
No. 4	15– 40
No. 200	0– 10

(c) Percent of Wear. The percent of wear of the parent rock shall be not more than 8 when tested in accordance with AASHTO T-3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHTO T-96.

(d) Thin and Elongated Pieces. Not more than 30 percent, by weight, of thin or elongated pieces will be permitted.

Thin and elongated pieces will be determined on the material coarser than the No. 4 sieve.

704.10 GRAVEL BACKFILL FOR SLOPE STABILIZATION. Gravel backfill for slope stabilization shall be obtained from approved sources, consisting of satisfactorily graded, free draining, hard, durable stone and coarse sand reasonably free from loam,

silt, clay, and organic material.

The gravel backfill shall meet the requirements of the following table:

TABLE 704.10A - GRAVEL BACKFILL FOR SLOPE STABILIZATION

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
No. 4	20-50	100
No. 100		0- 20
No. 200		0- 10

The stone portion of the gravel backfill shall be uniformly graded from coarse to fine, and the maximum size stone particles shall not exceed 2/3 the thickness of the layer being placed.

704.11 GRANULAR BACKFILL FOR STRUCTURES. Granular backfill for structures shall be obtained from approved sources, consisting of satisfactorily graded, free draining granular material reasonably free from loam, silt, clay, and organic material.

The granular backfill shall meet the requirements of the following table:

TABLE 704.11A - GRANULAR BACKFILL FOR STRUCTURES

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE	SAND PORTION
3"	100	
2½"	90-100	
No. 4	50-100	100
No. 100		0- 18
No. 200		0- 8

IA 404 2C 12-78

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION - GEOLOGY SECTION

TABLE I

HARDWICK GRANULAR DATA SHEET NO. 1

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
1	1	1978	5.5-11.5	0-5.5	Yes	93	76	49	27	5	4	14.3%	Gravel	Owner: Leopold Leriche. Area is a gravel pit 0.14 mile north of Vermont Route 15, 0.16 mile east of Town Highway No. 39. Pit is 400' x 250' with a 12-foot high extension to the east. Inactive pit with much sloughing on the faces is in an uncut meadow. Field road access would need improvement for heavy equipment. Test No. 1 was in the middle of east face of pit. Material is: 0'-5.5', top of face possibly gravel but inaccessible; 5.5'-11.5', clean medium gravel.
	2	1978	0.5-6.5	0-0.5	Yes	90	88	62	31	6	4	16.4%	Gravel	Test No. 2 was in the northeast floor of pit. Material is: 0'-0.5', overburden; 0.5'-6.5', medium gravel; bottom, boulder or bedrock.
2	1	1978	1-17	0-1	Yes	100	100	97	91	3	1	-	Sand	Owner: Leopold Leriche. Area is a long pit complex that is north of and parallel to Vermont Route 15, 0.6 mile west of Town Highway No. 22. Pit is 875' x 320' with 26-foot high extension to the north. Inactive pit, with much sloughing on the faces, had overgrown gravel piles, standing water, and junked cars on the floor. Extension to the northwest was an uncut meadow crossed by power and telephone lines.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 2

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														Test No. 1 was near the north-west end of the pit, 58' S 20° E of a telephone pole. Material is: 0'-1', overburden; 1'-17', sand becoming stony with depth; bottom, cobbly gravel.
	2	1978	0-3	-	Yes	100	100	100	100	98	58	-	-	Test No. 2 was in floor, 27' south of Test No. 1. Material is: 0'-3', sandy silt; bottom, silt-clay.
	3	1978	12.5-15	-	Yes	100	100	100	86	7	4	-	Sand	Test No. 3 was in middle of 24-foot high east face, and 30' south of highest face. Material is: 0'-12.5', not accessible; 12.5'-15', loosely consolidated clean sand; bottom, cobbly gravel.
	4	1978	0-10	-	Yes	100	88	86	82	18	5	-	Gran. Borrow (Sand)	Test No. 4 was in floor near east end of pit. Material is: 0'-10', poorly sorted, loosely consolidated sand with stony layers that are westward dipping; bottom, silt.
	5	1978	0-9	-	Yes	100	88	64	47	12	8	20.6%	Gravel	Test No. 5 was in floor near center of pit, 390' N30°W of Test No. 4. Material is: 0'-9', medium, sandy gravel. Less than 2% of the stones are larger than 4" and not included in sample.
	6A	1978	0-5.5	-	Yes	100	100	100	91	31	25	-	-	Test No. 6A was in floor, 140' N25°W of Test No. 4, and 200' southeast of and 14' above Test No. 5. Material is: 0'-5.5', silty sand; bottom, gravel.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 3

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
	6B	1978	5.5-10	-	Yes	93	89	57	40	18	13	20.2%	Gran. Borrow (Grav.)	Test No. 6B was below Test No. 6A. Material is: 5.5'-10', sandy gravel; bottom, gravel.
	7	1978	0-3	-	Yes	100	78	53	45	7	4	-	Gran. Borrow (Grav. Grading)	Test No. 7 was in western floor, 135' S80°W of Test No. 2. Material is: 0'-3', medium gravel with a sand layer; bottom, sandy silt. Note: This material met the gradational requirements for Item 704.05.
	8	1978	3.5-7	0-3.5	Yes	100	96	78	66	6	4	-	Sand	Test No. 8 was in south-central floor, 115' N50°E, of field road entrance. Material is: 0'-3.5', overburden; 3.5'-7', stony sand.
3	1A	1978	2-5	0-2	Yes	100	100	94	82	8	4	-	Sand	Owner: Carl Harvey. Area is an inactive sand pit 0.06 mile north of Vermont Route 15, 0.19 mile west of Vermont Route 16. 140' x 40' pit has 19-foot high extension to the east-northeast. Pit is north of telephone and power line. Access is steep with an indistinct field road. Test No. 1A was in upper north-east face. Material is: 0'-2', overburden; 2'-5', sand and pebbly sand.
	1B	1978	6-14	5-6	Yes	100	100	100	97	5	2	-	Sand	Test No. 1B was below Test No. 1A. Material is: 5'-6', silt-clay seam (not sampled); 6'-9', silty fine sand; 9'-14', medium sand with pebbles; bottom, silt-clay.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 4

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
4	1	1978	3-17	0-3	Yes	95	74	53	34	12	8	20.0%	Gravel	Owners: Murphy, Sherman, and Urie (Walter). Area is a large very active, nearly depleted pit complex south of Vermont Route 15, 0.45 mile east of Vermont 14. Floor was clean with gravel stock-piles but faces were sloughing. Best extension appears to be 20-foot high south face. Test No. 1 was in north face in southwest end of pit. Material is: 0'-3', overburden; 3'-6', sandy gravel; 6'-7', sand; 7'-17', sandy gravel; bottom, sandy gravel. Note: This material was exploited later in 1978.
5	1	1978	2-10	0-2	Yes	RESULTS NOT AVAILABLE								Owner: Ed Gates. Area is a pit in junk yard west of Vermont Route 14, 0.3 mile north of gate, which is 0.13 mile north of Town Highway No. 20. 150' x 85' pit has 12-foot high extension. Floor was lettered with junked cars; faces were fairly clean. There was standing water on the floor and scattered brush on the 500-foot long extension. Test No. 1 was in north face of pit. Material is: 0'-2', overburden; 2'-5', cobbly gravel; 5'-7', sandy fine gravel; 7'-10', cobbly coarse gravel; bottom, stony silt-clay. Sampled material is poorly sorted, loosely consolidated and an esti-mated 5% is larger than 4" and not included in sample.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 5

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
6	1	1978	2-10	0-2	Yes	56	46	28	15	21	18	-	-	Owner: State of Vermont. Area is a pit east of Vermont Route 14, 1.06 miles north of Vermont Route 15. Three-level, 420' x 105' pit has 24-foot high north extension. Floor had boulders and a minor amount of rubbish; faces had much sloughing. Test No. 1 was in upper east-central face of pit. Material is: 0'-2', overburden; 2'-10', poorly sorted, silty coarse gravel; bottom, cobbles. Not much north or east extension.
7	1	1978	1-10	0-1	Yes	94	80	53	30	21	15	22.5%	Gran. Borrow (Grav.)	Owner: Mrs. Doris Chaplin. Area is a pit east of Vermont Route 14, 1.51 miles north of Vermont Route 15. 75'x50' pit has 22-foot high extension to northeast. Recently active pit had stones and firewood stockpiled on floor. Test No. 1 was in upper north face of pit. Material is: 0'-1', overburden; 1'-11', medium silty gravel. Less than 1% of stones are larger than 4" and not included with sample. Steep hillside extension was not accessible to backhoe.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 6

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
8	1	1978	0.5-3.5	0-0.5	Yes	100	100	100	94	26	13	-	Gran. Borrow (Sand)	Owners: Gordon Alston and Paul Carrier. Area is an inactive borrow pit, 25' north of Town Highway No. 64, 0.54 mile east of Vermont Route 14. 120' x 90' pit has 19-foot high extension in pasture to the east. There are boulders on the floor and much sloughing on the faces. Test No. 1 was in upper east face of pit. Material is: 0'-0.5', overburden; 0.5'-3.0', dirty sand; 3.0'-3.5', clean pebbly sand; bottom, silt-clay.
9	1A	1978	26-30	0-5	Yes	70	66	52	41	11	7	22.8%	Gravel	Owners: Eugene Brochu and Virginia Brochu. Area is an inactive pit 0.21 mile south of Town Highway No. 8, 0.53 mile west of Town Highway No. 10. 500' x 125' pit has 57-foot high northeast extension. There is much sloughing on the face, and the overgrown floor is littered with boulder and slough piles and junked cars. Field access road is in fair condition. Test No. 1A was in center of east face. Material is: 0-5', overburden; 5'-26', stony silt-clay (inaccessible); 26'-30', slightly cemented sandy gravel. Less than 3% of stones are larger than 4" and not included in sample.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 7

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
	1B	1978	30-33	-	Yes	100	100	100	90	7	5	-	Sand	Test No. 1B below Test No. 1A. Material is: 30'-33', medium sand becoming gravelly with depth.
	1C	1978	41-47	-	Yes	100	100	93	86	20	12	-	Sand	Test No. 1C was below Test No. 1B. Material is: 41'-47', medium sand with a few stones larger than 4".
10	1	1978	6-17	0-6	Yes	100	100	91	84	59	34	-	-	Owner: Hardwick Farmlands, Inc. Area is an inactive pit 0.09 mile south of Town Highway No. 28, 0.47 mile east of Town Highway No. 27. Pit surrounds a 17-foot high remnant of terrace that is site of utility pole. Floor is grassy and there is much sloughing on sides of remnant. Test No. 1 was in southeast corner of remnant, 40' east of utility pole. Material is: 0'-6', overburden; 6'-17', silt seams with sand and pebbly sand layers.
11	1	1978	1.5-7.5	0-1.5	Yes	79	76	60	50	14	9	-	Gran. Borrow (Gravel)	Owner: Maynard O. Douse. Area is an active pit 50' east of Vermont Route 16, 1.0 mile north of Vermont Route 15. 640' x 250' pit has three levels and 92-foot high extension to north-northeast. Floors were clean but there is much sloughing on the north face.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 8

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														Test No. 1 was on northeast face. Extension is stripped. Material is: 1.5'-7.5', coarse gravel with cobbles and sand. Less than 1% of stones are larger than 4" and not included in sample. Face from 7.5'to 57' is silt seams with minor sand and was not sampled.
	2A	1978	1.5-6.5	0-1.5	Yes	100	100	100	100	30	13	-	Gran. Borrow (Sand)	Test No. 2A was in east face above lowest level. Material is: 0'-1.5', overburden; 1.5'-6.5', silty fine sand coarsening with depth.
	2B	1978	6.5-9.5	-	Yes	100	100	100	100	18	8	-	Sand	Test No. 2B was below Test No. 2A. Material is: 6.5'-9.5', clean fine sand with a diagonal layer of coarse sand; bottom, silt-clay.
	3	1978	0-3	-	Yes		R E S U L T S N O T A V A I L A B L E							Test No. 3 was in highest floor below northeast face. Material is: 0'-3', stony silt-clay.
	4A	1978	2-10	0-2	Yes	100	93	80	69	10	6	-	Sand	Test No. 4A was in face of separate excavation near Vermont Route 16. Material is: 0'-2', overburden; 2'-10', interbedded sand and gravel.
	4B	1978	10-13	-	Yes	100	100	100	98	27	14	-	Grav. Borrow (Sand)	Test No. 4B was in floor below Test No. 4A. Material is: 10'-13', moist silty sand.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 9

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
12	1	1978	0.5-7.5	0-0.5	No	RESULTS NOT AVAILABLE								Owner: Maynard O. Douse. Area is a terrace west of Town Highway No. 30 with inactive excavation west of railroad through field. Test No. 1 was east of railroad tracks, 200' N65°W of owner's barn. Material is: 0'-0.5', overburden; 0.5'-7.5', coarse sandy gravel that dips 30° to southwest; bottom, same.
	2	1978	2-10	0-2	No	100	100	100	90	60	52	-	-	Test No. 2 was at the highest point in field east of railroad tracks 500' north-northeast of Test No. 1. Material is: 0'-2', overburden; 2'-10', silt-clay.
	3	1978	1-9	0-1	Yes	74	64	52	45	17	10	-	Gran. Borrow (Grav.)	Test No. 3 was in north face of pit at northwest end of field west of railroad tracks. Material is: 0'-1', overburden; 1'-9', poorly sorted lenses of gravels and sands. Less than 1% of stones are larger than 4" and not included in sample.
13	1	1978	2-12	0-2	Yes	100	100	80	60	15	10	-	Sand	Owner: John Campbell. (Former owner: Eastman Rogers). Area is a 40' x 35' inactive sand pit 0.3 mile southwest of Town Highway No. 55 with field road access 0.4 mile southeast of Town Highway No. 64. Pit has 12-foot high extension northeast into 500' x 400' field.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 10

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														Test No. 1 was in center of northeast face of pit. Material is: 0'-2', overburden; 2'-12', sandy gravel with a sand wedge; bottom, gravel.
	2	1978	1.5-10	0-1.5	No	93	83	65	50	36	25	28.4%	-	Test No. 2 was in field 170' N40°E of Test No. 1. Material is: 0'-1.5', overburden; 1.5'-10', bouldery sandy gravel, becoming finer with depth. An estimated 5% of stones were coarser than 4" and not included in sample. Water table was at 8.0'.
	3	1978	1.5-3.0	0-1.5	No	N O T	S A M P L E D							Test No. 3 was in field 270' N20°E of Test No. 2. Material is: 0'-1.5', overburden; 1.5'-3', stony silt, bottom, bouldery silt-clay.
14	1	1978	0-7.5	-	Yes	R E S U L T S	N O T	A V A I L A B L E						Owner: Wayne Dutton. Area is a large pit complex south of a land-fill west of Town Highway No. 45 0.2 mile southwest of Town Highway No. 55 junction. Pit complex is 1600' x 300', (not counting land-fill at the north end). Major ex-tension is 24-foot high east face with 500' wide cow pasture between it and Town Highway No. 45. There is much sloughing on pit faces, many areas of standing water and a few stockpiles on the floor. A small stream flowed through center of pit.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 11

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VRD Spec.	Remarks
														Test No. 1 was in the southern-most face. Material is: 0'-7.5', coarse-medium gravel with minor sand. Less than 1% of the stones are coarser than 4" and not included in the sample.
	2	1978	10-16	0-10	Yes	78	71	52	37	17	13	28.8%	Gran. Borrow (Grav.)	Test No. 2 was in central lower east face, 500' north of Test No. 1. Material is: 0'-10', not exposed and not accessible. 10'-16', coarse-medium gravel; bottom, sand and gravel.
	3	1978	3-9	0-3	Yes	97	88	67	52	33	25	27.0%	-	Test No. 3 was south of east access ramp 60' south-southeast of Test No. 2. Material is: 0'-3', overburden; 3'-9', coarse-medium silty gravel.
	4	1978	2-8	0-2	Yes	84	82	66	56	25	20	-	-	Test No. 4 was in extension, 40' north of Test No. 2. Material is: 0'-2', overburden; 2'-8', sandy coarse gravel, with less than 15% of stones larger than 4". The material becomes finer with depth; bottom, gravel.
	5	1978	3-7	0-3	Yes	85	85	68	55	44	34	-	-	Test No. 5 was in extension, 120' N70°E of, and 24' above Test No. 3. Material is: 0'-3', overburden; 3'-7', sandy coarse gravel; with less than 5% of stones larger than 4" and not included in sample.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 12

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
	6	1978	2-5	0-2	Yes		RESULTS NOT AVAILABLE							Test No. 6 was in the extension, 130' S20°E of Test No. 1. Material is: 0'-2', overburden; 2'-5', coarse-medium sandy gravel with less than 1% of stones larger than 4" and not included in sample; bottom, boulders.
15	1	1978	28-35	0-28	Yes	100	100	100	97	4	3	-	Sand	Owner: L. G. Bellavance and Sons. Area is a large active sand pit 0.07 mile west of Vermont Route 14, a little north of Town Highway No. 44. Pit is 550' x 215' with 38-foot high extension to the west. Clean floor of pit has stockpiles of sand. Some faces, except where being worked, are heavily sloughed and overgrown. Test No. 1 was in lower west-central face. Material is: 0'-28', overburden; 28'-35', slaty sand with a few subangular stones; bottom, slaty sand with a few subangular stones.
	2	1978	25-35	0-25	Yes	100	100	100	99	20	17	-	-	Test No. 2 was in lower northwest face of pit, 100' north of Test No. 1. Material is: 0'-25', overburden; 25'-35', silty sand; bottom, silty sand.
	3	1978	2-28	0-2	Yes	100	100	100	100	62	27	-	-	Test No. 3 was in upper middle central face, 65' northwest of Test No. 1, and 45' south of Test No. 2. Material is: 0'-2', overburden; 2'-28', sandy silt seams with very minor fine sand seamlets.

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TABLE I

HARDWICK GRANULAR DATA SHEET NO. 13

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														Material is grossly crossbedded.
16	1A	1978	1-10	0-1	Yes	100	100	100	100	94	43	-	-	Owner: Raymond Anair. Area is a 200' x 50' borrow pit south of owner's house, east of Vermont Route 14, 0.09 mile south of Town Highway No. 48. Lower face is heavily sloughed and floor is storage area for house trailer. 31-foot high extension is to the south. Test No. 1A was in upper south face. Material is: 0'-1', over-burden; 1'-10', very fine sand and silt.
	1B	1978	10-31	-	Yes	100	100	100	100	62	26	-	-	Test No. 1B was below Test No. 1A. Material is: 10'-31', silty, very fine sand.

TABLE I
SUPPLEMENT

HARDWICK PROPERTY OWNERS - GRANULAR — Map Identification No.

TABLE II

HARDWICK ROCK DATA SHEET NO. 1

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
1	1	1978	Greenstone	No	Chip	-	-	Owner: Ronald Villeneuve. Area tested is on steep wooded hillside west of little Eligo Pond and Vermont Route 14, 0.2 mile south of the Greensboro town line. There is a major volume of rock at this area. Water is available from Little Eligo Pond. Test No. 1 was taken west of and next to a parking area on Vermont Route 14. Access to ledges of greenstone rock is excellent. Unable to perform abrasion tests due to lack of sample material.
	2	1978	Greenstone	No	Chip	-	37.4%	Test No. 2 was taken 200' above and 1,000' west of Test No. 1. It is reached by a woods road that climbs 1,000' steeply southwestward from the parking area, then turns northward and follows a gulley for another thousand feet. Bedrock is similar to that at Test No. 1.
2	1	1978	Greenstone	No	Chip	-	38.8	Owner: Mrs. Alfred Putvain. Area is a pasture east of the Putvain homestead on Town Highway No. 22, 0.9 mile north of Vermont Route 15. Test No. 1 was taken in ledges of greenstone 300' south-southeast of house via a good field road. There is sufficient material in the north-south trending outcrops for future development.
	2	1978	Granulite	No	Chip	-	42.8	Test No. 2 was taken from outcrop in woods 350' north-northeast of Test No. 1.
3	1	1978	Granite	Yes	Chip	-	48.6	Owner: Paul R. Sullivan. Area is a 50' x 35' granite quarry in woodland 900' south of Town Highway No. 44 legal trail, 0.94 mile west of its junction with Vermont Route 14. Haul road is overgrown with small trees. A 900-foot long series of grout piles extends northeast from quarry to the legal trail. There is a major volume of material with good access but site would require tree-clearing. Test No. 1 was at north end of grout piles near legal trail.

TABLE II

HARDWICK ROCK DATA SHEET NO. 2

Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
4	1	1978	Granite	Yes	Chip	-	76.5	Owner: Rock-Of-Ages Corporation. Area is a 175' x 80' quarry in woodland 160' south of Town Highway No. 46, 0.6 mile east of its junction with Town Highway No. 48. Quarry extension is east-southeastward into ridge in a sparsely wooded cow pasture. Test No. 1 was of granitic material from a grout pile west of the quarry.
5	1	1978	Granite	Yes	Chip	-	60.6	Owner: E. Paul Menard. Area is a granite quarry 500' southwest of Town Highway No. 45, 0.38 mile southeast of its junction with Town Highway No. 51. Quarry is 100' x 60' southwest wall is 25' high. Water was in lowest floor and both ends are surrounded by deciduous trees. Largest grout pile is at the southeast end of the quarry. Test No. 1 was of grout from a smaller pile near north corner south of a derrick mast.
6	1	1978	Granite	Yes	Chip		68.7	Owner: George Smith. Area is a quarry southwest of Town Highway No. 51, 0.5 mile east of its junction with Town Highway No. 46. Quarry is 110' by 55' and southwest wall is 32' high. Area is thickly covered with trees. Test No. 1 was taken from grout on the floor of the quarry.

TABLE II
SUPPLEMENT

HARDWICK PROPERTY OWNERS - ROCK

	Identification No.
Menard, E. Paul	5
Putvain, Alfred (Mrs.)	2
Rock-Of-Ages Corporation	4
Smith, George	6
Sullivan, Paul R.	3
Villeneuve, Ronald	1

LEGEND

- GRAVEL, ACCEPTABLE FOR SEC. 704.05 (gravel for sub-base)
- GRAVEL, DEPLETED OR NOT ACCEPTABLE FOR SEC. 704.05
- SAND, ACCEPTABLE FOR SEC. 703.03 (sand borrow and cushion)
- SAND, DEPLETED OR NOT ACCEPTABLE FOR SEC. 703.03
- GRANULAR BORROW, SEC. 703.05
- MATERIAL NOT ACCEPTABLE FOR SEC. 703.05
- EXISTING PIT
- SG — SAND & GRAVEL DEPOSIT
- S — SAND DEPOSIT
- 3 — IDENTIFICATION NUMBER (refer to data sheets)

HARDWICK

SCALE 1:31,250

0.5 0 MILE

CONTOUR INTERVAL 20 FEET

1979

GRANULAR MATERIALS MAP

BY

VERMONT AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

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

CALEDONIA COUNTY VT. HWY. DISTRICT NO. 7

REVISIONS

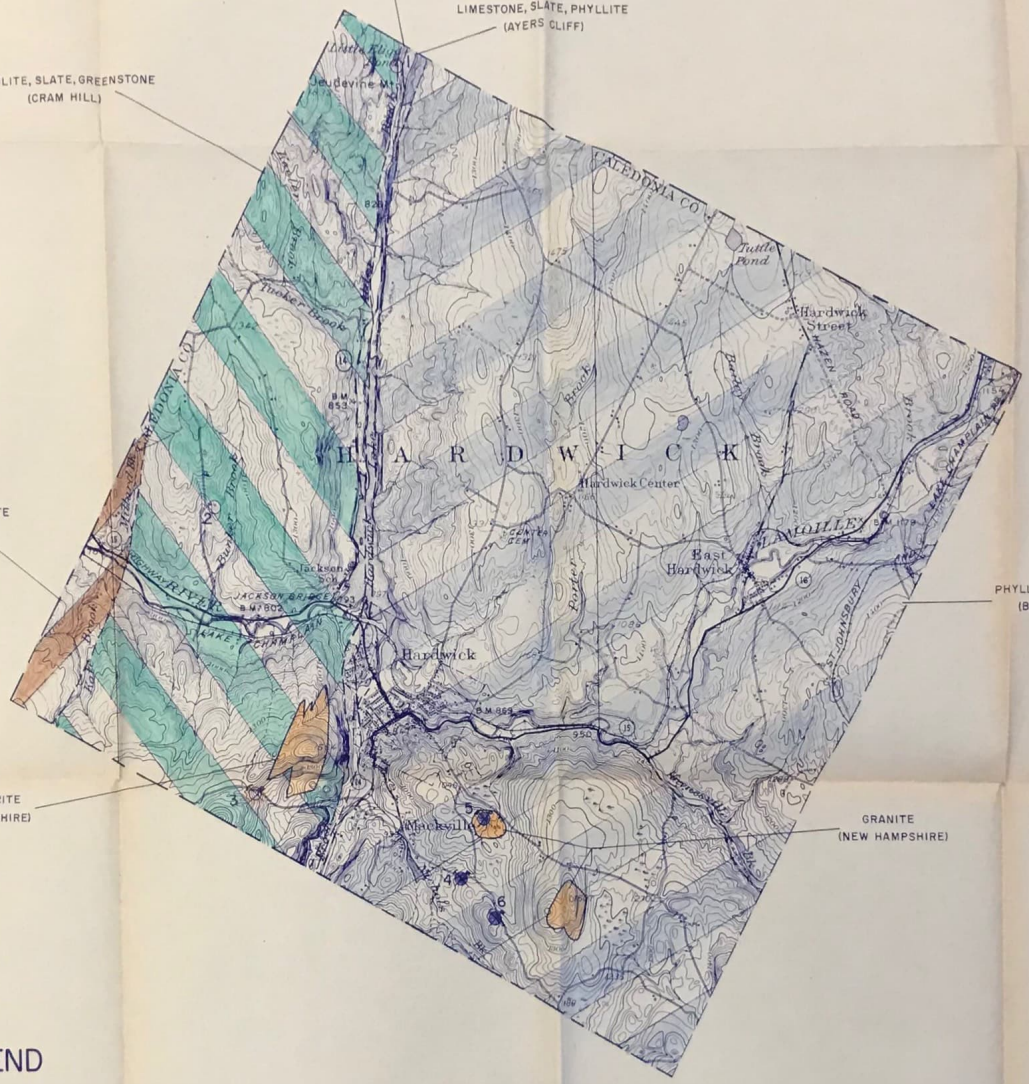
DATE						
BY						

PLATE 2

GRANULAR

HARDWICK

OFFICE



LEGEND

- ROCK, ACCEPTABLE FOR SEC. 704.06 (crushed stone for sub-base)
- ROCK, NOT ACCEPTABLE FOR SEC. 704.06
- 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, SHALES, CONGLOMERATES
- 3 IDENTIFICATION NUMBER (refer to data sheets)

HARDWICK

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1979

ROCK MATERIALS MAP

BY

VERMONT AGENCY OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

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

PLATE II

ROCK

CALEDONIA COUNTY VT. HWY. DISTRICT NO. 7

REVISIONS

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