SURVEY OF HIGHWAY CONSTRUCTION MATERIALS
IN THE TOWN OF SOUTH HERO, GRAND ISLE COUNTY, VERMONT

Prepared by

Engineering Geology Section, Materials Division
Vermont Department of Highways

in cooperation with

United States Department of Transportation
Federal Highway Administration

Montpelier, Vermont
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Acknowledgments

The work of this Project was implemented with 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 Division and Mapping Section and the Materials Division.

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

3. Professor C. G. Doll, Vermont State Geologist, University of Vermont, Burlington, Vermont.

4. United States Department of Commerce, Federal Highways Administration.

History

The Materials Survey Project was formed in 1957 by the Vermont Department of Highways with the assistance of the Federal Highway Administration. Its prime objective was to compile an inventory of highway construction materials in the State of Vermont. Originally, investigations for highway construction materials were conducted only as the immediate situation required and only limited areas were surveyed; thus, no over-all picture of material resources was available. Highway contractors or resident engineers were required to locate the materials for their respective projects and samples were tested by the Materials Division. The additional cost of exploration for construction materials was passed on to the State bringing about higher construction costs. The Materials Survey Project was established to eliminate or minimize this factor by enabling the State and the contractors to proceed with information on available material resources and to project cost estimates. Knowledge of locations of suitable material is an important factor in planning future 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 for reporting the findings of the Project are used 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 together.

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 7-1/2-minute quadrangles of the United States Geological Survey enlarged or reduced to 1:31250 or 1" = 2604'. Delineated on the Bedrock Map are the various rock formations and types in the township. This information was obtained from: Vermont Geological Survey Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, Centennial Geological Map of Vermont, the Surficial Geologic Map of Vermont and other references.

The granular materials map shows areas covered by various types of glacial deposits (outwash, moraines, kames, kame terraces, eskers, etc.) by which potential sources of gravel and sand may be recognized. 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), Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs and other sources. On both maps, the areas tested are represented by Identification Numbers. The number and location of tests taken in each area represented by an Identification

Number is determined by the nature of the material or its topographic feature.

Also included in this report are data sheets for both the Bedrock and Granular Materials Survey, which contain detailed information for each test conducted by the Project as well as information obtained from an active card file compiled and updated by the Engineering Geology Section of the Materials Division over a period of years. Transfer of information from the cards to the data sheets was made and the location of the deposits was plotted on the maps. However, some cards in the file were not used because of incomplete or unidentifiable information on the location of the deposit. Caution should be exercised wherever this information appears incomplete.

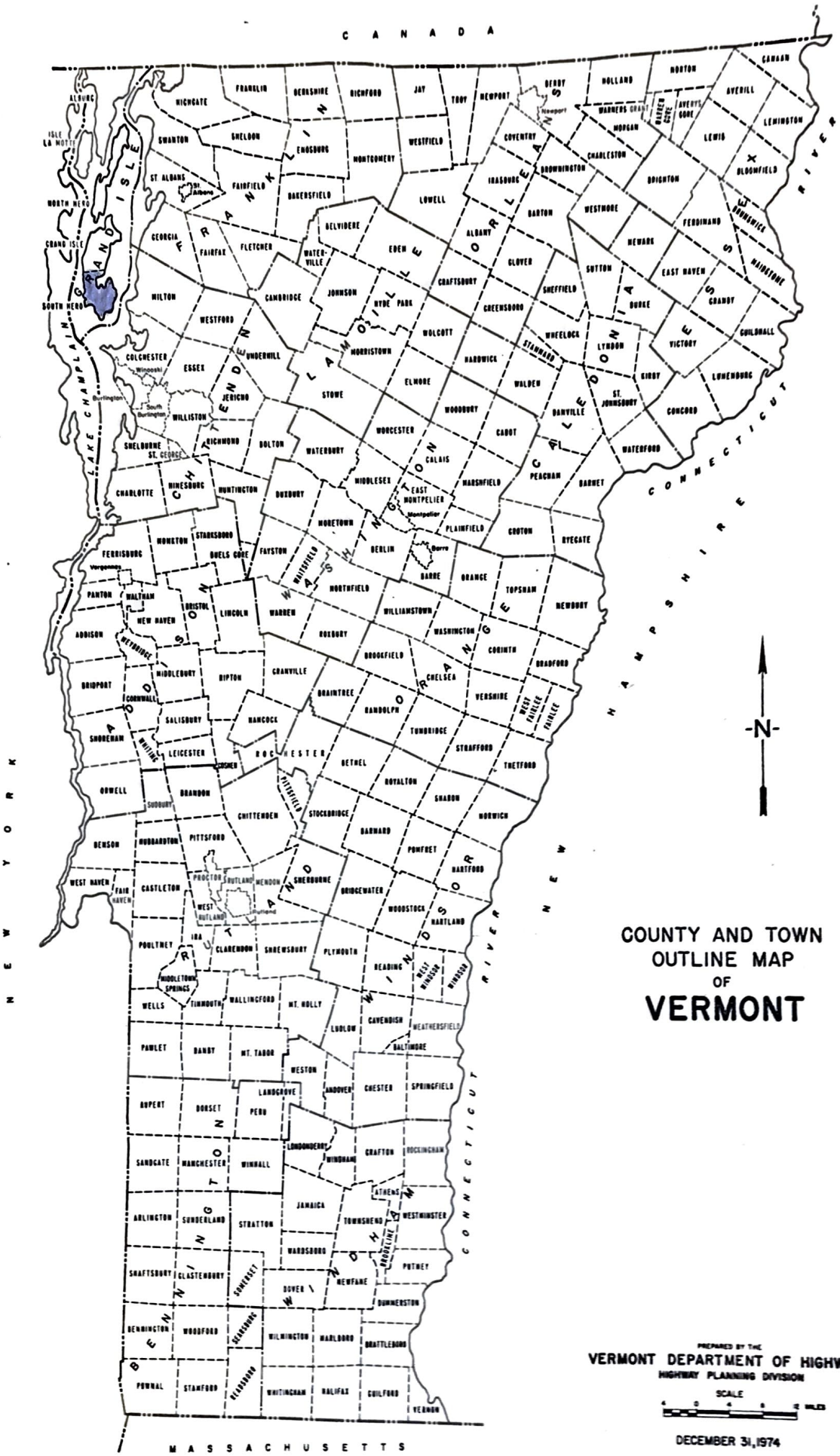
Work sheets, containing more detailed information and a field sketch of the area represented by the Identification Number, and laboratory reports are on file in the Materials Division of the Vermont Department of Highways.

LOCATION

The town of South Hero is located in the southern end of Grand Isle County in the northwest corner of the state. It is comprised of the south half of South Hero Island as well as Providence, Stave, Fish Bladder, Cedar, Kellogg and Sawyer Islands. South Hero Town is surrounded by Lake Champlain except for its north boundary with the town of Grand Isle. On the south, it is connected by bridge with the town of Milton. (See County and Town Outline Map of Vermont on the following page.)

South Hero is in the Champlain Lowland Physiographic Region. The surface of South Hero island is generally low and flat, broken occasionally by a low elongate ridge or dome-like hill. The town's highest elevation, 279 feet is located on a rounded hill top about 1.8 miles southwest of South Hero Village. Lake Champlain has an approximate mean elevation of 95 feet.

Numerous unnamed small streams drain the island; however, where poor drainage occurs, several marshes have formed.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

PREPARED BY THE
VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION

SCALE

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 primarily during the winter months and comprises the mapping and description of rock types as indicated in the many reference sources, as indicated in the bibliography. These references differ considerably in dependability due to new developments and studies that have contributed to the obsolescence of a number of reports. In addition, the results of samples taken by other individuals are analyzed, and the location at which these samples were taken, is mapped when possible. As complete a correlation as possible is made of all the available information concerning the geology of the area under consideration.

The field investigation is begun by making a cursory survey of the entire town. The information obtained from this preliminary survey, as well as that assimilated in the office investigation, is used to determine the areas where sampling will be concentrated. When a promising source has been determined by rock type, volume of material, accessibility, and 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 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 consequently may give a less satisfactory test result than fresh material deeper in the rock structure. When the rock is uniform, and the chip samples yield acceptable abrasion test results, the material source is included in this report as being satisfactory.

Discussion of Rock and Rock Sources

The information on the Rock Materials Map is simplified. (For a more detailed description of the respective rock formations, see the summary included in this report.) In the summary, it is apparent that calcareous shales and shaly limestones (sedimentary rocks) comprise the entire lithology within the town of South Hero.

The formation mapped as having the greatest extent in the town of South Hero is the Stony Point Formation which is a black calcareous shale or argillaceous limestone and covers three-quarters of the town. It yielded satisfactory abrasion test results for sub-base material by the Los Angeles Method (AASHTO T-96) and the only failing results in town by the Deval Method (AASHTO T-3) at Map Identification Number 6.

The Glens Falls Formation, underlying about one-eighth of the town, was sampled at Map Identification Numbers 2, 3, and 4 as either the Shoreham or Larrabee Members (either thin-bedded shaly limestone, or dark blue-gray granular limestone interbedded with shale).

The Chazy Formation was sampled at Map Identification Number 1, as either the Valcour Member or the Crown Point Member; and at Map Identification Number 5, as the Crown Point Member. All rock areas yielded satisfactory abrasion test results for sub-base material except at Map Identification Number 6.

Other formations mapped in town are the: Iberville, a non-calcareous black shale; Cumberland Head, a black shale and dark gray fine-grained limestone; Isle LaMotte smooth, fine-grained limestone; Day Point Member of Chazy Formation, a calcarenite; and the Providence Island Dolomite.

The survey noted that the rock formations became more favorable for highway construction material progressing from North Hero to Grand Isle to South Hero.

The two most favorable rock areas in the town of South Hero are the quarries at Map Identification Numbers 6 and 1; (Number 1 would require de-watering).

SURVEY OF SAND AND GRAVEL SOURCES

Procedure for Sand and Gravel Survey

The method employed by the project in a 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 primarily 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 proves to be particularly helpful 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 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 of materials from pit faces and other exposed surfaces. Test holes in pit floors and extensions are dug with a backhoe to a depth of approximately 11 feet to obtain samples which are submitted to the Materials Division where they are tested for stone abrasion by the AASHTO T-4 Method, and sieved for gradation.

Discussion of Sand and Gravel Deposits

Results of this survey showed that the granular material situation in the town of South Hero is very limited. Material from Map Identification Number 1 fails for Granular Borrow because of excessive fines. Material from Map Identification Number 2 fails for Sand Borrow and Cushion but was acceptable for Granular Borrow. Acceptable material for Sand Borrow and Cushion was found at Map Identification Number 3, but owner will not sell and there are private homes nearby; and Map Identification Number 4, but water was encountered one-foot below the floor. Tests at Map Identification Numbers 5 and 6 were in the banks of gulleys and both areas yielded A-4 Silts (Soil Classification).

The feature mapped as beach gravel on the Vermont Surficial Geologic Map was checked by the field survey, but was not confirmed because of very wet fields.

SUMMARY OF ROCK FORMATIONS IN THE TOWN OF SOUTH HERO

Iberville Formation: Non-calcareous black shale interbedded with occasional dolomite beds, and in the lower part with calcareous shale.

Stony Point Formation: Predominantly calcareous black shale that grades upward into argillaceous limestone and rare dolomite beds in northwestern Vermont.

Cumberland Head Formation: Interbedded calcareous black shale and fine-grained homogeneous dark gray limestone; shown only in Grand Isle County where it is thick enough and well enough exposed to map.

Shoreham Member of the Glens Falls Formation: Interbedded dark blue-gray, rather coarsely granular limestone and shale.

Larrabee Member of the Glens Falls Formation: Thin-bedded shaley limestone.

Isle LaMotte Limestone: Smooth-ledged, sublithographic and lithographic, dove gray weathered limestone commonly cut by veins of white calcite; beds filled with fossil shell fragments are characteristic.

Valcour Member of the Chazy Formation: Dark gray calcarenite succeeded by medium to light gray, buff-weathered, silty, partly coquinal limestone.

Crown Point Member of the Chazy Formation: Massive, dark blue-gray, somewhat nodular and granular limestone characterized by abundant fossils *Maclurites Magnus*.

Day Point Member of the Chazy Formation: Calcareous quartz sandstone and calcarenite.

Providence Island Dolomite: Buff to brown weathered, sharply defined and laterally persistent beds chiefly of medium bedded to massive scored dolomite, variously designated Bridport Formation in southwestern Vermont.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Argillaceous: Containing or consisting of clay. Commonly combined with rock names to indicate the presence of clay; as argillaceous sandstone.

Bedding: The arrangement of rock or granular materials in layers.

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

Bedrock Control: Land features which show bedrock on, or close to the surface; also used in the description of part of the topography.

Calcareous: Containing Calcium Carbonate ($Ca\ CO_3$).

Dip: The angle which a stratum, sheet, vein, fissure or similar geological feature makes with a horizontal plane, as measured in a plane normal to the strike.

Dolomite: Pertaining to a rock consisting of the mineral dolomite (calcium magnesium carbonate), containing carbon dioxide, 47.7%; lime, 30.4%; and magnesia, 21.9%. Dolomite is harder than limestone and is preferred for highway construction material.

Drainage: The manner by which water moves on the surface, in streams, rivers and brooks; or under the surface, in channels.

Interbedded: Occurring between beds, or lying adjacent and parallel to other beds of a different nature.

Limestone: A bedded sedimentary deposit consisting of calcium carbonate, ($CaCO_3$). It is the most important and widely distributed of the carbonate rocks. Calcium carbonate content varies from 40 percent to more than 98 percent. Some common impurities are clay and sand.

Matrix: The natural rock or earthy material in which pebbles, fossils, minerals or gems are imbedded.

Outcrop: A part of a body of rock that appears bare and exposed at the surface of the ground. Often, the term applies to areas where the rock formation occurs just below the surface, even though it is not actually exposed.

Physiographic: Pertaining to the physical divisions (or land-form regions) of the earth.

Plunge: The angle between any inclined line and a horizontal plane. the angle is always measured in a vertical plane containing the line.

Relief: The term used to designate the difference in elevation between the summits and the lowlands of a particular region.

Sediments: All kinds of material deposited from either waters of streams, lakes or seas, or wind or ice.

Shale: A general term for lithified muds, clays and silts that tend to split or cleave into thin sheets along the bedding planes. Shale differs from mudstone, claystone and siltstone by having the pronounced tendency to cleave, known as fissility.

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

BIBLIOGRAPHY

A survey of the glacial geology of Vermont being conducted by D. P. Stewart, the partial results of which are published in Vermont Geological Survey Bulletin No. 19; 1961.

The Surficial Geology and Pleistocene History of Vermont, David P. Stewart and Paul Mac Clintock; 1969; Vermont Geological Survey Bulletin No. 31.

Soil Survey (Reconnaissance) of Vermont, W. J. Latimer; 1930; Bureau of Chemistry and Soils, United States Department of Agriculture.

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

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

Materials Inventory Bangor Quadrangle, South Half; September, 1959; University of Maine.

Glacial Geology and the Pleistocene Epoch, R. F. Flint; 1947; John Wiley and Sons, Inc.

A Handbook of Rocks, J. F. Kemp; June, 1946; D. Van Nostrand Company, Inc.

Rock and Rock Minerals, L. V. Pirsson; June, 1949; John Wiley and Sons, Inc.

Glossary of Selected Geologic Terms, J. L. Stokes and D. J. Varnes; 1955; Colorado Scientific Proceedings, Vol. 16.

Centennial Geologic Map of Vermont, C. G. Doll; 1961.

Surficial Geologic Map of Vermont, C. G. Doll; 1970.

The Geology of the Limestone of Isle LaMotte and South Hero Island, Vermont, Robert B. Irwin; 1957; Vermont Geological Survey Bulletin No. 9.

Colchester Point, Vermont-New York Quadrangle; 1966; Geological Survey, United States Department of the Interior.

Georgia Plains, Vermont Quadrangle; 1948; Geological Survey, United States Department of the Interior.

Keeseville, New York-Vermont Quadrangle; 1966; Geological Survey, United States Department of the Interior.

Milton, Vermont Quadrangle; 1948; Geological Survey, United States Department of the Interior.

Plattsburgh, Vermont-New York 15 Minute Series Quadrangle; 1956; Geological Survey, United States Department of the Interior.

Plattsburgh, New York-Vermont 7-1/2 Minute Series Quadrangle; 1966; Geological Survey, United States Department of the Interior.

South Hero, Vermont-New York Quadrangle; 1966; Geological Survey, United States Department of the Interior.

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, January, 1972.

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
	2"	100	
	1½"	90-100	
FINE	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

SOUTH HERO GRANULAR DATA SHEET NO. 1

TABLE I

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	1975	1-8	0-1	Yes	91	91	68	52	19	16	18.0%	---	Owner: Bruce Hyde. Area is a small diggings 0.12 mile south of Vermont Route 314, and 0.48 mile northwest of its junction with U.S. Route 2. Pit is overgrown, wet and appears close to depletion. Test No. 1 was dug on northwest pit face. Material was: 0'-1', overburden; 1'-3', dirty sand, with small tabular stone fragments; 3' - 8', gravel (with mostly tabular, but some sub-round stones). Some post-glacial clam shells were noted in the gravel layers.
	2	1975	0.5-2.5	0-0.5	No	100	100	100	89	23	21	---	---	Test No. 2 was dug in field 400 feet southwest of Test No. 1. Material was: 0' - 0.5', overburden; 0.5' - 2', very hard-packed, silty fine sand with random small pebbles (not very good looking material); 2' - 2.5', slightly better looking, and a bit more sandy than the 0.5' - 2' interval; material is moist and not as hard-packed as above. Possibly, this material could be called fine gravel, but would be quite high in fines content. Overall, the material appears to be fragments closely overlying bedrock.

SOUTH HERO GRANULAR DATA SHEET NO. 2

TABLE I

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
2	1	1974	1-5	0-1	Yes	100	100	84	65	15	13	---	Granular Borrow (Sand)	Owner: Bernard Goulet. Area is a rubbish-strewn pit, 0.6 mile west of U.S. Route 2 at a point 0.41 mile north of Town Highway No. 8. Test No. 1 was in southwest face of inactive, depleted pit. Material was: 0' - 1', overburden; 1' - 3', silt, or silty fine sand; 3' - 4', layer of shells; 4' - 5', pebbly sand; bottoms in water on floor at five foot level. Pit is just about depleted. Note: Granular Materials Map (Plate I) shows a pit symbol about 0.15 mile northeast of Map Identification Number 2; however, a field check revealed the site to be smoothed and grassed-over.
3	1	1975	0 - 2.5	---	No	100	100	100	100	5	3	---	Sand	Owner: Alex Colodny. Area is a small clearing in pine grove west of private road number 15. Test No. 1 was a hand-shovel sample dug 40 feet west of private road. Material was: 0' - 2.5', clean sand; 2.5' - 3.5', moist silt-clay with

TABLE I

SOUTH HERO 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
														angular rock fragments; did not include anything below the 2.5'-level in the sample. Material is absolutely not available. The previous owner, Fred Reus, said he found bedrock at 4 or 5 feet.
4	1	1975	0.5-4	0-0.5	Yes	100	100	100	100	3	1	---	Sand	Owner: Alex Colodny. Area is a small shallow pit east of the south end of private road number 15. There are new houses in the immediate vicinity of the pit limiting the extensions and owner is keeping it for his own use. The material in the pit is good clean sand but water is one foot beneath the surface. Manure had been spread on surface to start grass to act as a sand anchor. There is a 70-acre wooded area that extends up to the road, and some sandy patches show, but according to a neighbor, the surface is very close (4 or 5 feet) to bedrock. Material is absolutely not available. Test No. 1 was in north face of pit. Material was: 0' -

SOUTH HERO GRANULAR DATA SHEET NO. 4

TABLE I

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
														0.5', overburden; 0.5' - 4', fine sand; encountered water one foot below 4-foot floor level. The wind constantly blows sand inland from the beach, and the Neighborhood Association is planting a cover to hold it.
5	1	1975	1-8	0-1	No	100	100	100	100	93.6	75.7	---	---	Owner: Alan K. Kinney. Area is a gullied field north of Town Highway No. 16 and west of small brook, 0.4 mile west of junction of Town Highways No. 16 and 17. Area was sampled because it is suggestive of a terrace with a stream-cut gulley. The sample was dug on the slope of the gulley just west of brook, and 150 feet north of the road. Test No. 1: Material was: 0' - 1', overburden; 1' - 3', fine silty sand; 3' - 4', silt-clay; 4' - 5', silty sand, 5' - 8', silt-clay. Material was run for Soil Classification only. Results: A-4-Silt. Bedrock control noted in the area.

SOUTH HERO GRANULAR DATA SHEET NO. 5

TABLE I

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	1975	0.5-3	0-0.5	No	100	100	100	96.7	72.4	63.7	---	---	Owner: Jasper Santor Area is an overgrown, rolling field sloping down to the west. It is south of Town Highway No. 16, 0.3 mile west of its junction with Town Highway No. 17. The area may be the remnant of a minor local beach (there is a skim of fine sand over silt-clay which amounts to 2 or 3 feet, at the most). No material will be made available by the owner. Test No. 1 was in field 75 feet southwest of a cellar hole just south of Town Highway No. 16. Material was: 0' - 0.5', overburden; 0.5' - 3', unsorted, moist, hard-packed silty material which balled up quite readily; 3', bedrock. Material was run for Soil Classification; results: A-4-Silt.
	2	1975	1-5	0-1	No	100	100	100	100	88.6	74.0	---	---	Test No. 2 was hand-shovel dug at edge of a bank, 350 feet west of Test No. 1. Material was: 0' - 1', overburden; 1' - 3', silty fine sand; 3' - 4', moist silt; 4' - 5', silty fine sand; 5', moist silt-clay. Material was run for Soil Classification; results: A-4-Silt.

TABLE I

SUPPLEMENT

SOUTH HERO PROPERTY OWNERS - GRANULAR

	Map Identification Number
Colodny, Alex	3, 4
Goulet, Bernard	2
Hyde, Bruce	1
Kinney, Alan K.	5
Santor, Jasper	6

SOUTH HERO ROCK DATA SHEET NO. 1

Table II

Map 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-A	1975	Limestone	Yes	Chip	4.6%	23.5%	Owner: State of Vermont (Formerly: E. Lombard) Survey was told the town of South Hero would buy the property in August, 1975. Area is a water-filled quarry northeast of the State Highway Department salt shed just east of U.S. Route 2, 0.9 mile north of its junction with Vermont Route 314. Estimated reserves: 100,000 cubic yards. The rock varies from a blue-gray to nearly black, dense limestone which breaks from blocky to sub-angular. The rock is the Crown Point Member of the Chazy Formation, and is exposed as low-lying nearly horizontal beds. The samples taken were <u>not across</u> the strike, except for the height of the quarry walls (10 to 20 feet). An excess number of joints appears to be due to blasting. The extension is wooded to the east, and there is a property line fence in the woods 75 feet north of the north end of the quarry. 100 feet south of the quarry there is a cornfield owned by Munson Earth Moving Co., Inc. (Formerly: E. Lombard and Baker.) Development would be easy but would be mostly down below the water level, or horizontal. The availability of material would depend on any objections by the Environmental Commission or local residents. Test No. 1-A was along quarry wall in the southeast corner.
	1-B	1975	Limestone	Yes	Chip	2.6%	22.8%	Test No. 1-B was along wall at north end of quarry. Note: On 5/7/75, the town clerk said the town of South Hero had the option to buy property from the State in August, 1975, after the lease runs out.

SOUTH HERO ROCK DATA SHEET NO. 2

Table II

Map Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
2	1	1975	Limestone	No	Chip	3.7%	20.9%	Owner: Bruce Hyde. Area is a small rock diggings of very low relief (not a quarry). The rock varies from the more massive, dark-gray granular limestone of the Shoreham Member, to the thin-bedded, shaley limestone of the Larrabee Member (both are part of the Glens Falls Formation). Only one sample was taken because of lack of outcrop exposure. The area is 0.08 mile south of Vermont Route 314 at a point 0.48 mile northwest of its junction with U.S. Route 2. The diggings are on the northwest base of a 20-foot high, wooded, bedrock control knoll which has a power line right-of-way running south from Vermont Route 314 to Hyde's house. The field survey believes that this outcrop is at, or very close to, the contact between the Larrabee Member (to the east) and the Shoreham Member (to the west). Estimated volume is 20,000 to 50,000 cubic yards, unless site is developed downward. Test No. 1 was taken along low east rise of diggings.
3	1-A	1974	Shaly Limestone	Yes	Chip	5.8%	23.5%	Owner: Frank Lessor. Area is a recently active quarry on the west side of a hill, 0.14 mile south of Town Highway No. 8; access gate is 0.63 mile west of the junction of U.S. Route 2 and Town Highway No. 8. The rock is in the Larrabee Member of the Glens Falls Formation (thin-bedded shaly limestone). Test No. 1-A was along the north and northeast walls of the quarry.
	1-B	1974	Shaly Limestone	Yes	Chip	5.0%	25.8%	Test No. 1-B was along the south and southeast walls of the quarry.

SOUTH HERO ROCK DATA SHEET NO. 3

Table II

Map Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
								The rock beds were horizontal and quite thin (maximum thickness 4"). The rock is a gray, shaly limestone, with zones of fossils. Some displacement seems to have occurred; probably the upper beds moved west relative to the lower beds. Some bending or gentle folding was noted as well as a possible very slight plunge. The beds strike east-west and dip((questionably) 10° to the north. There are three systems of joints or fractures; one strikes 60°east, one 60° west, and the third is nearly horizontal. Although the rock seems hard, it broke parallel to the joint systems and yielded fragments which varied from mostly sharp and angular, to sub-angular. Because the rocks are nearly horizontal only 30 feet or so of the bedding was sampled across the strike. Continued operation of this quarry would be easy. Access is good, and reserves continue eastward for the remainder of the hill. There is a power line right-of-way running N.30°W. to N.40°W. across the property which would have to be considered in any plans for quarry development to the east. Overall, this seems like a good source of rock on the island.
4	1	1974	Shaly Limestone	Tiny Diggings	Chip	---	34.8%	Owner: Leo LaMott. Area is a tiny, depleted diggings adjacent to the south side of Town Highway No. 8, and 0.3 mile west of its junction with U.S. Route 2. Any possible development is limited by property lines. Test No. 1 was taken along south edge of a low exposure of bedrock. There were no pieces large enough for the AASHTO T-4 (Deval Method) of abrasion testing. The rock was highly broken and shattered. The north "face" was not sampled because it borders Town Highway No. 8. The local people call this

SOUTH HERO ROCK DATA SHEET NO. 4

Table II

Map Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
								diggings a gravel pit, but it is bedrock which has been intensively shattered (possibly caused by the weight and motion of glacial ice, extreme frost action, or all three). Tabular, sharp pieces are tightly keyed (fitted together) with smaller fragments, and this may suggest a primitive pseudo-gravel; however, it is not a gravel. The rock is the thin-bedded, shaly limestone of the Larrabee Member of the Glens Falls Formation.
5	1-A	1975	Limestone	Yes	Chip	4.0%	24.4%	Owner: Alex Colodny. Area is an old quarry wall in dense cedar woods, southeast of Private Road No. 17 on Phelps Point in the southwest corner of town. Rock is absolutely not available. Quarry was used a long time ago as the source of ballast for the railroad roadbed. The access is difficult and would need a haul road to the working face; also, right-of-way would have to be arranged. The rock was fairly hard, but broke easily. The field survey could fine no trace of any haul road into the quarry; it may now be covered by lake-front cottages. Although the rock is the same formation as that at Map Identification Number 1, it is much more shaly and thin-bedded (Crown Point Member of the Chazy Formation). There is a small pond near the northeast end of the quarry which would have to be considered in any development plans. The vertical quarry walls vary from 10 to 25 feet. Test No. 1-A was taken along southwest wall of the quarry.

SOUTH HERO ROCK DATA SHEET NO. 5

Table II

Map 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-B	1975	Limestone	Yes	Chip	4.2%	27.0%	Test No. 1-B was taken along wall of quarry, northeast of Test No. 1-A.
6	1-A	1974	Calcareous Shale	Yes	Chip	8.8%	28.8%	Owner: As of 3/1975 it is Tom Curley; at the time of sampling it was owned by Champlain Island Campgrounds and Marina, Inc. and leased to Munson Earth Moving Co., Inc. Area is a quarry on the southwest side of U.S. Route 2, near the motel at the north end of the bridge to Milton. The quarry would be easy to reactivate. Rock from here was used for a U.S. Route 2 job, some years ago. A central bound of rock in the quarry was being given to the town (for moving the rock), because the owner plans to develop ponds, camp sites and parking lot. Access is very good. Property was previously owned by Leon Bora. As of 5/14/75, material was available for sale. The rock is the Stony Point Formation dark gray calcareous shale. Test No. 1-A was taken on the northwest wall of the southwest lobe of the quarry. This sample represents extension to the north and northwest. The rock broke between blocky and angular, and seemed fairly hard.
	1-B	1974	Calcareous Shale	Yes	Chip	8.8%	20.7%	Test No. 1-B was taken along southwest wall of southwest lobe of quarry, and represents extension to west and southwest.
	2-A	1974	Calcareous Shale	Yes	Chip	6.8%	28.2%	Test No. 2-A was taken along north half of west wall in northwest lobe of quarry.
	2-B	1974	Calcareous Shale	Yes	Chip	8.5%	23.7%	Test No. 2-B was taken along south half of west wall in northwest lobe of quarry.

SOUTH HERO ROCK DATA SHEET NO. 6

Table II

Map Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
	3-A	1974	Calcareous Shale	Yes	Chip	6.9%	26.3%	Test No. 3-A was taken along the northeast part of southwest wall of quarry. This sample represents the side of the quarry with the least amount of reserves.
	3-B	1974	Calcareous	Yes	Chip	9.5%	30.8%	Test No. 3-B was along the southwest part of the southeast wall of the quarry. With some care, a lot of rock could be taken from the quarry site without adverse effects to the neighborhood (i.e., the motel, etc.).

TABLE II

SUPPLEMENT

SOUTH HERO PROPERTY OWNERS - ROCK

	Map Identification Number
Colodny, Alex	5
Curley, Thomas	6
Hyde, Bruce	2
LaMott, Leo	4
Lessor, Frank	3
Vermont, State of	1

N

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
- SAND & GRAVEL DEPOSIT
- SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheets)

SOUTH HERO

SCALE 1:9,250

CONTOUR INTERVAL 10 FEET

1975

GRANULAR MATERIALS MAP

BY

VERMONT DEPARTMENT OF HIGHWAYS

IN COOPERATION WITH

U.S. BUREAU OF PUBLIC ROADS

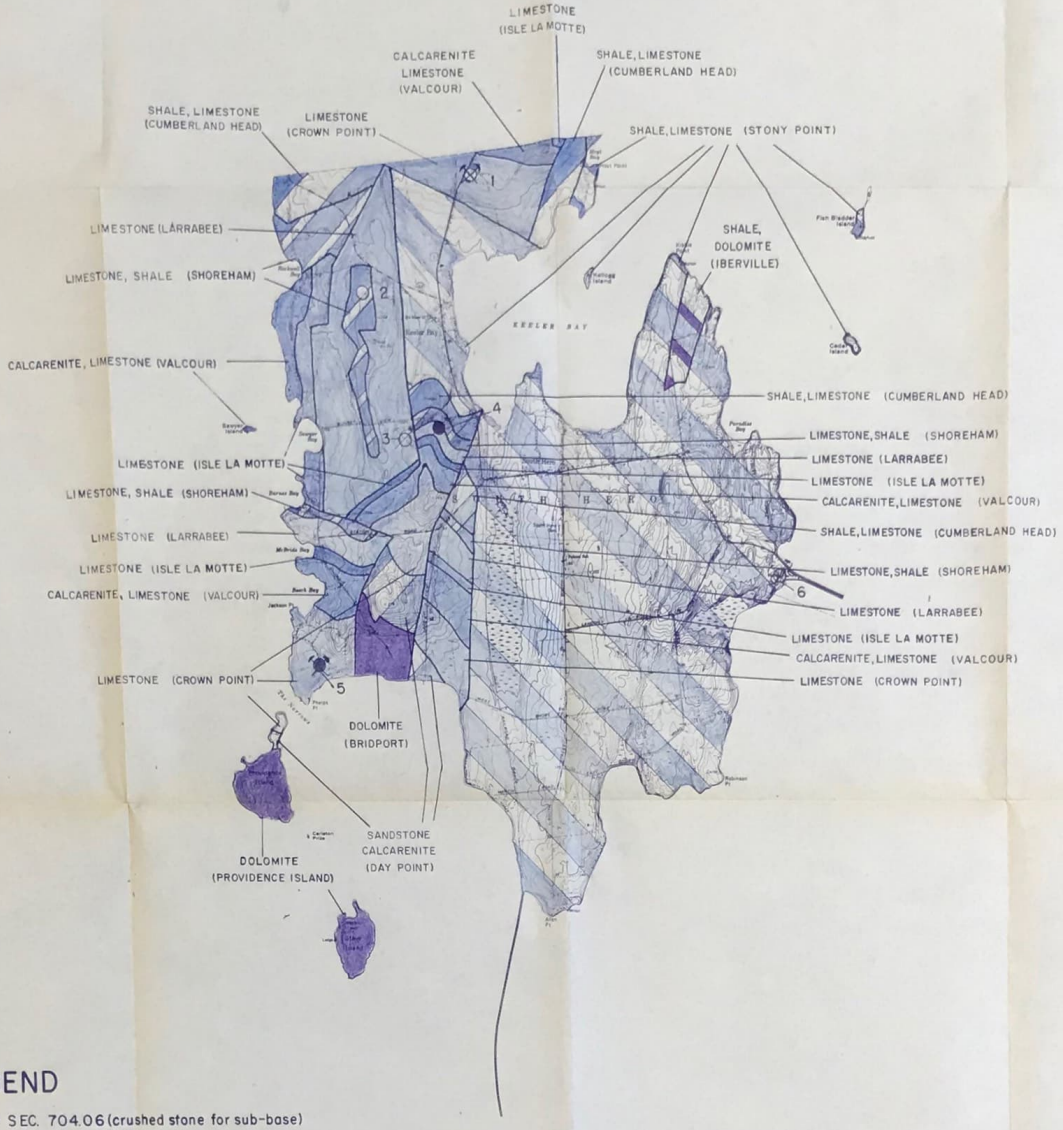
NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

GRANULAR

GRAND ISLE COUNTY VT. HWY. DISTRICT NO. 8

REVISIONS

DATE						
BY						



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)

SOUTH HERO

SCALE 1:31,250

CONTOUR INTERVAL 10 FEET

1975

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 II

ROCK

GRAND ISLE COUNTY VT. HWY. DISTRICT NO. 8

REVISIONS

DATE						
BY						