SURVEY OF HIGHWAY CONSTRUCTION MATERIALS

IN WARREN GORE, ESSEX COUNTY, VERMONT

Prepared by

Engineering Geology Section, Materials Division
Vermont Department of Highways

in cooperation with

United States Department of Transportation
Federal Highway Administration

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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.


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

Warren Gore is in the northwest corner of Essex County in northeastern Vermont. It is bounded on the north by Norton, on the east by Avery's Gore, on the southeast by Brighton, on the southwest by Morgan, and on the west by Warner's Grant. (See County and Town Outline Map of Vermont of following page). The western two-thirds of Warren Gore lies within the Vermont Piedmont (a region of broad valleys and rounded hills). The eastern third of Warren Gore is in the Northeastern Highlands physiographic sub-division of the New England Upland, which is characterized by rugged, steep-sided mountainous terrain. Elevations range from 2,780 feet atop an unnamed peak on the eastern boundary, to 1,320 feet on the southern border where the Pherrins River crosses the Morgan Town Line.

Southeast drainage into Norton Pond is via Hurricane and Coaticook Brooks; Sucker Brook flows westward into Norton Pond. Pine Brook flows westward into Pherrins River which flows south into Morgan. Norton Pond is the only large body of water in Warren Gore. Significant drainage occurs via many unnamed brooks and rivulets.

Heavy woods nearly cover Warren Gore, and support large-scale logging operations of the Brown Co.
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 (Plate II) 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 igneous rock of the undifferentiated granites of the New Hampshire Plutonic Series comprises the lithology of the northern four-fifths of Warren Gore, and complex metamorphic rocks comprise the southern fifth. There were no samples taken because dense woods and much glacial drift cover any exposures. The most promising areas for future rock exploration would be in wooded plots on the slopes east of Vermont Route 114. Some bedrock control was noted in stream beds of a logging area southwest of Norton Pond; however, the high number of brooks and low relief might cause problems in developing a quarry.

There was a small mapped zone of the Gile Mountain Formation phyllite or schist in the south part of Warren Gore, but it was not located.
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 granular materials suitable for highway and related construction purposes were deposited in Warren Gore: along the western shore of Norton Pond in a mapped kame terrace; around the western lobe of Norton Pond in an area of kame moraines and eskers; and flanking the Pherrins River in an area mapped as being kame moraine and esker. These deposits were formed by glaciofluvial and glaciolacustrine processes at elevations between 1,340 and 1,400 feet.

The area along the western shore of Norton Pond was inaccessible, but may contain a considerable amount of material. Most of the areas were along logging or access roads leading from the Hurricane Brook Wildlife Preserve access road west of Vermont Route 114.

There was a widespread skim of coarse material over finer material (usually gravel over sand), which indicates a shoal origin of deposition.

The most promising sources for Gravel for Sub-base, Item 704.05 are pits at Map Identification Numbers 12, 13 and 16.

The most promising sources for Sand Borrow and Cushion, Item 703.03 are pits at Map Identification Numbers 14, 11, and 12.

The pit at Map Identification Number 4 yielded material which was not acceptable for Granular Borrow.

Brown Co. owns all the pits except those at Map Identification Numbers 4 and 9.
Summary of Rock Formations in Avery's Core

Gile Mountain Formation: Gray quartz-muscovite phyllite or schist, interbedded and intergradational with gray micaceous quartzite (graywacke northeast of Nulhegan River), calcareous mica schist, and, locally quartzose and micaceous crystalline limestone like that of the Waits River Formation. The phyllite and schist commonly contain porphyroblasts of biotite, garnet, staurolite, and locally kyanite, andalusite, or sillimanite.

Undifferentiated Granitic Rocks of the New Hampshire Plutonic Series: Mostly granitic bodies emplaced during or slightly after the regional metamorphism. Sillimanite and locally cordierite occur near many contacts in northern part of state in small dikes and sills too narrow to show on map.
Glossary of Selected Geologic Terms

**Andalusite**: A variously colored orthorhombic aluminum silicate, \( \text{Al}_2\text{SiO}_5 \), found in schistose rocks.

**Bedrock**: Solid, undisturbed rock in place at the surface or just beneath surficial deposits.

**Bedrock Control**: Land Features which show bedrock on, or close to, the surface. It is used to describe part of the topography.

**Biotite**: A platy silicate commonly known as black mica.

**Calcareous**: Pertaining to, or containing from 10- to 50- percent calcium carbonate (Ca CO\(_3\)).

**Cordierite**: A blue silicate of magnesium, aluminum, and iron.

**Fissure**: A sheet-like igneous rock that fills a fissure in older rocks while still in a molten state. It varies from less than an inch wide and a few yards long, to thousands of feet in width and many miles in length. May radiate in groups from a center, or occur singly and isolated from other igneous bodies.

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

**Drift**: A deposit of earth, sand, gravel and boulders, carried by glaciers (glacial drift), or by water flowing from glaciers (fluvioglacial drift). Large areas of North America and Europe are drift-covered in higher latitudes.

**Esker**: Long, narrow, winding ridges of sand and gravel deposited by meltwater streams flowing through crevasses and tunnels in stagnant ice sheets.

**Graywacke**: Dark-colored, hard sandstone consisting of angular grains of quartz, feldspar, and rock fragments embedded in a fine, compact matrix of micas, clay minerals, and chlorite.

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

**Kame Moraine**: Stratified sands and gravels deposited by water flowing beneath a glacier.

**Kame Terrace**: Stratified sands and gravels deposited by water flowing between a glacier and an adjacent valley wall.

**Kyanite**: A blue aluminum silicate occurring in thin-bladed crystals, or crystalline aggregates.

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

**Outcrop**: A part of a body of rock that appears, bare and exposed, at, or just below the surface.
Phyllite: A fine-grained, foliated metamorphic rock intermediate and
gradational between the mica schists and slates. The foliation is
caused by large amounts of potash mica (Sericite) which gives the
rock its distinctive silvery appearance.

Porphyrroblasts: Large crystals which have grown in place within the fine-
grained groundmass of a metamorphic rock. They have been formed by
heat, pressure, and infiltrating solutions occurring later than the
rocks in which they form.

Rock Flour: Glacially ground, angular, unweathered, silt and clay size rock
material which does not possess the cohesion characteristic of clay
minerals.

Schist: A crystalline metamorphic 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.

Sediments: All material deposited from water (streams, lakes or seas), wind,
or ice.

Shoal: A sandbar or gravel bar that forms in shallow water; specifically, an
elevation which is not rocky and on which there is a depth of water
of six fathoms (36 feet) or less.

Sill: A tabular body of igneous rock which has been injected while molten
between layers or foliations of rock. Sills have relatively great
lateral extent as compared to thickness.

Sillimanite: A brown, grayish or pale green aluminum silicate, Al₂ SiO₅,
forming in long, slender, and often fibrous crystals.

Staurolite: A brown to black, iron aluminum silicate, HFe₃Al₂Si₂O₁₃, occurring
in prismatic crystals, often twinned in the form of a cross.

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

Weathered: Showing the effects of exposure to the atmosphere.
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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, 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>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL SAMPLE</td>
</tr>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1½&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td>1²&quot;</td>
<td>70-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>60-100</td>
</tr>
<tr>
<td>No. 100</td>
<td>0-30</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-12</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL SAMPLE</td>
</tr>
<tr>
<td>No. 4</td>
<td>20-100</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-15</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE</th>
<th>SAND PORTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>20-60</td>
<td>100</td>
</tr>
<tr>
<td>No. 100</td>
<td>0-18</td>
<td>0-8</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-18</td>
<td>0-8</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4(\frac{1}{2})&quot;</td>
<td>100</td>
</tr>
<tr>
<td>4&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td>1(\frac{1}{2})&quot;</td>
<td>25-50</td>
</tr>
<tr>
<td>No. 4</td>
<td>0-15</td>
</tr>
</tbody>
</table>

(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>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL SAMPLE</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>70-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>50- 90</td>
</tr>
<tr>
<td>No. 100</td>
<td>0- 20</td>
</tr>
<tr>
<td>No. 200</td>
<td>0- 10</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>GRADING</th>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL SAMPLE</td>
<td>SAND PORTION</td>
</tr>
<tr>
<td>COARSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4&quot;</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>No. 4</td>
<td>25- 50</td>
</tr>
<tr>
<td></td>
<td>No. 100</td>
<td>0- 20</td>
</tr>
<tr>
<td></td>
<td>No. 200</td>
<td>0- 12</td>
</tr>
<tr>
<td>FINE</td>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>1½&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td></td>
<td>No. 4</td>
<td>30- 60</td>
</tr>
<tr>
<td></td>
<td>No. 100</td>
<td>0- 20</td>
</tr>
<tr>
<td></td>
<td>No. 200</td>
<td>0- 12</td>
</tr>
</tbody>
</table>
(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>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves TOTAL SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3(\frac{1}{2})&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td>2&quot;</td>
<td>75-100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>50-80</td>
</tr>
<tr>
<td>(\frac{1}{2})&quot;</td>
<td>30-60</td>
</tr>
<tr>
<td>No. 4</td>
<td>15-40</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

(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**

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL SAMPLE</td>
</tr>
<tr>
<td>No. 4</td>
<td>20–50</td>
</tr>
<tr>
<td>No. 100</td>
<td>0–20</td>
</tr>
<tr>
<td>No. 200</td>
<td>0–10</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Percentage by Weight Passing Square Mesh Sieves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TOTAL SAMPLE</td>
</tr>
<tr>
<td>3/4</td>
<td>100</td>
</tr>
<tr>
<td>2 1/2</td>
<td>90–100</td>
</tr>
<tr>
<td>No. 4</td>
<td>50–100</td>
</tr>
<tr>
<td>No. 100</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td></td>
</tr>
<tr>
<td>Varnen Gore Granular Data Sheet No. 1</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Map</strong></td>
<td><strong>Field</strong></td>
</tr>
<tr>
<td>No.</td>
<td>Test No.</td>
</tr>
<tr>
<td>1</td>
<td>1-A</td>
</tr>
<tr>
<td>1-B</td>
<td>1975</td>
</tr>
<tr>
<td>2</td>
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<td>2</td>
<td>1975</td>
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### WARREN GORE GRANULAR DATA SHEET NO. 4

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<th>Map Ident. Test No.</th>
<th>Field Test Year</th>
<th>Depth of Sample (Ft)</th>
<th>Overburden (Ft)</th>
<th>Existing Pit</th>
<th>Sieve Analysis % Passing</th>
<th>Abrasion AASHTO T-4-35 Passes VHD Spec.</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>6 1</td>
<td>1975</td>
<td>0-22</td>
<td>----</td>
<td>Yes</td>
<td>81 72 59 52 18 10</td>
<td>Gran. Borrow (Gravel)</td>
<td>bottoms on sloughed material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Owner: Brown Co. Area is pit on southwest end of wooded, lobate, 200' x 100' knoll northeast of Hurricane Brook access road, 0.56 mile northwest of its junction with Vermont Route 114. Test No. 1 was on north-northeast face of pit. Material was: 0'-1', gravel; 1'-2', silty fine sand; 2'-4', sand; 4'-22', gravel and random boulders with some layers of silty fine sand; bottoms in boulders and sloughed material. This test represents material in pit extension.</td>
<td></td>
</tr>
<tr>
<td>7 1</td>
<td>1975</td>
<td>2-12</td>
<td>0-2</td>
<td>Yes</td>
<td>94 85 67 57 19 7 19.9%</td>
<td>Gran. Borrow (Gravel)</td>
<td>Owner: Brown Co. Area is pit adjacent to north side of logging road near old sheds, 0.53 mile northwest of the junction of the Hurricane Brook access road with Vermont Route 114. Pit is on the southeast edge of a wooded, gently sloping ridge which rises to the west, and may be a tributary to the main esker nearby. Test No. 1 was on face adjacent to logging road. Material was: 2'-12', gravel with random boulders; bottoms on boulders and sloughed material.</td>
</tr>
<tr>
<td>Map Ident. No.</td>
<td>Field Test No.</td>
<td>Year</td>
<td>Depth of Sample (Ft)</td>
<td>Overburden (Ft)</td>
<td>Existing Pit</td>
<td>Sieve Analysis % Passing</td>
<td>Abrasion AASHO T-4-35 Spec.</td>
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<td>8</td>
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<td>1975</td>
<td>1-11</td>
<td>0-1</td>
<td>Yes</td>
<td>90 83 68 58 13 9</td>
<td>Gran. Borrow (Gravel)</td>
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<td>9</td>
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<td>1975</td>
<td>1-11</td>
<td>0-1</td>
<td>Yes</td>
<td>93 87 80 75 9 4</td>
<td>Gran. Borrow (Gravel)</td>
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<td>1975</td>
<td>1-10</td>
<td>0-1</td>
<td>Yes</td>
<td>85 85 85 81 14 7</td>
<td>Gran. Borrow (Sand)</td>
<td>Test No. 2 was on southeast face of pit, 65 feet southeast of Test No. 1.</td>
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<td>Map Ident. No.</td>
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<td>Year Field Tested</td>
<td>Depth of Sample (Ft)</td>
<td>Overburden (Ft)</td>
<td>Existing Pit</td>
<td>Sieve Analysis 2&quot; 1-1/2&quot; 1/2&quot; #4 #100 #200 T-4-35 Spec.</td>
<td>Abrasion AASHTO VHD Passes Spec.</td>
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<tr>
<td>10</td>
<td>1-A</td>
<td>1975</td>
<td>0-22</td>
<td>----</td>
<td>Yes</td>
<td>86 78 61 50 15 10 21.0%</td>
<td>Gran. Borrow (Gravel)</td>
</tr>
<tr>
<td>1-B</td>
<td>1975</td>
<td>22-37</td>
<td>----</td>
<td>Yes</td>
<td>91 85 68 56 14 9 23.8%</td>
<td>Gran. Borrow (Gravel)</td>
<td>Owner: Brown Co. Area is a pit on east side of a long wooded ridge (which is probably an esker), on west side of the Hurricane Brook access road, 0.28 mile northwest of its junction with Vermont Route 114. Test No. 1-A was on south face of pit. Material was: 0'-22', coarse gravel in bouldery gravel; very hard digging; bottoms on bouldery gravel.</td>
</tr>
<tr>
<td>2-A</td>
<td>1975</td>
<td>2-13</td>
<td>0-2</td>
<td>Yes</td>
<td>75 75 61 49 15 10 25.6%</td>
<td>Gran. Borrow (Gravel)</td>
<td>Test No. 1-B was below Test No. 1-A. Material was: 22'-37', coarse gravel and bouldery gravel; bottoms on piles of sloughed boulders.</td>
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<td>Overburden (Ft)</td>
<td>Existing Pit</td>
<td>Sieve Analysis % Passing</td>
<td>Abrasion</td>
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<tr>
<td>No.</td>
<td>Test No.</td>
<td>1975</td>
<td>13-35</td>
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<td>Yes</td>
<td>89 89 69 56 14 9</td>
<td>21.8%</td>
</tr>
<tr>
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<td>3</td>
<td>1975</td>
<td>1-12</td>
<td>0-1</td>
<td>Yes</td>
<td>94 84 66 54 14 9</td>
<td>Gran. Borrow (Gravel)</td>
</tr>
<tr>
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<td>4</td>
<td>1975</td>
<td>0-25</td>
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<td>Yes</td>
<td>81 76 62 55 15 9</td>
<td>21.6%</td>
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<tr>
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<td>11</td>
<td>1-A</td>
<td>0.5-14</td>
<td>0-0.5</td>
<td>Yes</td>
<td>85 80 69 60 14 7</td>
<td>Gravel (Grading only)</td>
</tr>
<tr>
<td>Map Ident. Test No.</td>
<td>Field No.</td>
<td>Year</td>
<td>Depth of Sample (Ft)</td>
<td>Overburden (Ft)</td>
<td>Existing Pit</td>
<td>Sieve Analysis % Passing</td>
<td>Abrasion AASHTO T-4-35</td>
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</tr>
<tr>
<td>1-B</td>
<td>1975</td>
<td>14-20</td>
<td>----</td>
<td>Yes</td>
<td>100 100</td>
<td>82 75 9 3</td>
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<td>2-A</td>
<td>1975</td>
<td>0.5-12</td>
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<td>Yes</td>
<td>72 72</td>
<td>67 60 6 4</td>
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<td>2-B</td>
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<td>12-21</td>
<td>----</td>
<td>Yes</td>
<td>100 100</td>
<td>87 83 5 4</td>
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</table>

Test No. 1-B was below Test No. 1-A. Material was: 14'-20', interbedded sand and pebbly sand with boulders; bottoms on sloughed material.

Test No. 2-A was on north face of south pit, 500 feet southwest of Test No. 1. Material was: 0.5'-1', sand; 1'-3', pebbly sand; 3'-3.5', silt-clay seam; 4'-4', coarse sand; 8'-10', layers of pebbles and coarse sand; 10'-10.5', fine gravel with a few scattered cobbles; 10.5'-11.5', sand; 11.5'-12', pebbly fine gravel. Some gravel is present, but overall the material is sand or granular borrow.

Test No. 2-B was below Test No. 2-A. Material was: 12'-21', interbedded fine sand and pebbly fine sand; bottoms in sloughed material. Floor was wet in places.
### WARREN GORE GRANULAR DATA SHEET NO. 9

<table>
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<tr>
<th>Map Ident. No.</th>
<th>Field Test No.</th>
<th>Year Field Tested</th>
<th>Depth of Sample (Ft)</th>
<th>Overburden (Ft)</th>
<th>Existing Pit</th>
<th>Sieve Analysis % Passing</th>
<th>Abrasion AASHTO T-4-35 Spec.</th>
<th>Passes VIID Spec.</th>
<th>Remarks</th>
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<td>12</td>
<td>1-A</td>
<td>1975</td>
<td>3-18</td>
<td>0-3</td>
<td>Yes</td>
<td>94 85 66 55 14 10</td>
<td>24.2%</td>
<td>Gravel</td>
<td>Owner: Brown Co. Area is a high face on east slope of wooded esker, 0.17 mile west of Vermont Route 114. The esker is west of marshes at the first sharp curve in the Hurricane Brook access road, and trends nearly north-south. It ranges up to 75 feet above the road; its summit is flat-topped and 20 feet to 40 feet wide by over 600 feet long. Test No. 1-A was on upper part of face. Material was: 3'-5', gravel; 5'-18', interbedded gravel and pebbly fine gravel seams and some large boulders; there was much vegetation and some sloughed material on upper face. The gravel was well-nested and hard to dig.</td>
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<tr>
<td>1-B</td>
<td>1975</td>
<td>18-40</td>
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<td>Yes</td>
<td>100 100 88 76 12 9</td>
<td>Sand</td>
<td>Test No. 1-B was below Test No. 1-A. Material was: 18'-40', sand and pebbly sand with some boulders; there was much sloughed material; uncertain if material was in place. The 0'-3' interval of overburden was boulders which could be used (or crushed).</td>
<td></td>
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<tr>
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<td>1</td>
<td>1975</td>
<td>3-9</td>
<td>0-3</td>
<td>Yes</td>
<td>71 66 61 55 14 8</td>
<td>Gravel (grading only)</td>
<td>Owner: Brown Co. Area is a wooded ridge with a pit on both sides of small logging road, 0.65</td>
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### WARREN CORE GRANULAR DATA SHEET NO. 10

#### TABLE I

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<th>Map Ident. No.</th>
<th>Test Field No.</th>
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<th>Abrasion Spec.</th>
<th>Passes VIID Spec.</th>
<th>Remarks</th>
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<td>1-1/2&quot;</td>
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<td>Yes</td>
<td>92</td>
<td>87</td>
<td>69</td>
<td>57</td>
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**Remarks**

- Mile south of main access road, and 1.17 miles west of the junction of the Hurricane Brook access road and Vermont Route 114. The ridge is broad and fairly flat-topped, and slopes down from northwest to southeast.
- Test No. 1 was on south face of small pit on southeast side of haul road.
- Material was: 3'-4', dusty, cemented gravel; 4'-6.5', fine gravel and pebbly gravel beds; 6.5'-9', sand and pebbly sand; bottoms on sloughed material. The 0'-3', interval was boulders.

Test No. 2 was face of small pit, 75 feet northwest across logging road from Test No. 1.
- Material was: 0'-7', well-nested, coarse gravel with some cementation; there were many plus 4" stones, but none were included in sample; bottoms on sloughed material and boulders. The material at this site was coarser than that at Test No. 1.

Test No. 3 was on north face of bull-dozed trench on wooded hillside northwest across haul road from Test No. 1.
- Material was: 3'-9', coarse gravel; 9'-11', pebbly sand; bottoms in silt-clay and sloughed material. The 0'-3'
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<th>Year Field Tested</th>
<th>Depth of Sample (Ft)</th>
<th>Overburden (Ft)</th>
<th>Existing Pit</th>
<th>Sieve Analysis</th>
<th>Abrasion</th>
<th>Passes</th>
<th>Remarks</th>
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<td>2&quot; 1-1/2&quot; 1/2&quot; #4 #100 #200 T-4-35 Spec.</td>
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<td>14</td>
<td>1</td>
<td>1975</td>
<td>1-15</td>
<td>0-1</td>
<td>Yes</td>
<td>100 94 88 81 4 2</td>
<td>Sand</td>
<td></td>
<td>interval was boulders. The test was offset, but represents a vertical distance.</td>
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<td>1975</td>
<td>2-8</td>
<td>0-2</td>
<td>Yes</td>
<td>83 80 69 59 24 14</td>
<td>Gran. Borrow (Gravel)</td>
<td>Owner: Brown Co. Area is a small pit on curve in logging road, 0.2 mile east of main logging road, and 0.86 mile south of the Hurricane Brook access road. Area is 1.6 miles from junction of Hurricane Brook access road and Vermont Route 114. The pit is on the east edge of a wooded, low, nearly flat-topped ridge which rises gently to the west. Test No. 1 was on face of pit. Material was: 1'-6', dusty gravel over fine gravel; 6'-15', inter-bedded sand, pebbly sand, and fine gravel layers.</td>
<td></td>
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<tr>
<td>Map Ident. No.</td>
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<td>Depth of Sample (Ft)</td>
<td>Overburden (Ft)</td>
<td>Existing Pit</td>
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<td>Abrasion VHD Spec.</td>
<td>Passes</td>
<td>Remarks</td>
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<tr>
<td>16</td>
<td>1</td>
<td>1975</td>
<td>1-6</td>
<td>0-1</td>
<td>Yes</td>
<td>86 75 58 46 20 12</td>
<td>20.3%</td>
<td></td>
<td>Owner: Brown Co. Area is a pit on logging road near the summit of Bluff Mountain in the southeast corner of town. Area is being used to make logging roads. The key to a locked cable across the access road near Vermont Route 114 can be obtained from Roland Devost in Norton, who cuts by contract for Brown Co. The pit is 2.47 miles east of Vermont Route 114, and 0.97 mile north of the Morgan town line. The irregular-shaped pit is 250' long and 150' wide; its faces slope up to the north. Test No. 1 was on west face of east trench in pit. Material was: 1&quot;-3.5', fine gravel; 3.5'-4.5', silt-clay and angular rock fragments; 4.5'-6', sandy gravel; the material was hard-packed, and contained mostly granitic stones.</td>
</tr>
<tr>
<td>2</td>
<td>1975</td>
<td>2-11</td>
<td>0-2</td>
<td>Yes</td>
<td>100 81 63 50 14 7</td>
<td>20.3%</td>
<td>Gravel</td>
<td></td>
<td>Test No. 2 was on west face of west trench. Material was: 2'-4', fine gravel; 4'-6', gravelly sand; 6'-9', nearly white sand with scattered small cobbles; 9'-11', silt-clay and angular rock fragments.</td>
</tr>
</tbody>
</table>
Table I
Supplement

WARREN GORE PROPERTY OWNERS – GRANULAR

Brown Co.

Vermont, State of

Map Identification No.

1, 2, 3, 5, 6, 7, 8,
10, 11, 12, 13, 14, 15, 16
4, 9