SURVEY OF HIGHWAY CONSTRUCTION MATERIALS

IN THE TOWN OF WESTMORE, ORLEANS 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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Acknowledgements

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

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

2. 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, Bureau of Public Roads.

History

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

on materials sources available beforehand. Prior 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 were designed with their intended use in mind. These maps and data sheets were devised to furnish information of particular use to the contractor or construction man. For maximum benefit, the maps, data sheets, and this report should be studied simultaneously.

Inclosures

Included in this folder are two surface-geology maps, one defining the location of tests conducted on bedrock sources, the other defining the location of tests conducted on granular materials. These maps are derived from 15-minute or 7½-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 types of the area. This information was obtained from numerous sources: Vermont Geological Survey Bulletins, Vermont State Geologist Reports, United States Geological Survey Bedrock Maps, and the Centennial Geological Map of Vermont, as well as other references.

The granular materials map depicts 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 had been mapping the glacial features of Vermont during the summer months since 1956. Further

information was obtained from the Soil Survey (Reconnaissance) of Vermont conducted by the Bureau of Chemistry and Soils of the United States Department of Agricultrue, and from Vermont Geological Survey Bulletins, United States Geological Survey Quadrangles, aerial photographs, the Surficial Geologic Map of Vermont, and other sources. On both maps the areas tested are represented by Identification Numbers. Several tests are usually conducted in each area represented by an Identification Number, the number of such tests being more or less arbitrarily determined either by the character of the material or by the topography.

Also included in this folder 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 other sources, and including an active card file compiled by the Highway Testing Laboratory. The latter information was gathered over a period of years by many persons and consequently lacks the organized approach and detail required for effective use. The information on the cards varied widely in completeness. Transfer of information from the cards to the data sheets was made without elaboration or verification. When possible, the locations of the deposits listed in the card files have also been plotted on the maps; however, some cards in the file were not used because the information on the location of the deposit was incomplete or unidentifiable. Caution should be exercised wherever this information appears incomplete. This Project does not assume responsibility for the information taken from the card files.

Work sheets contain more detailed information on each test and a detailed sketch of each identification Number Area. The work sheets and laboratory reports are on file in the office headquarters of this Project.

LOCATION

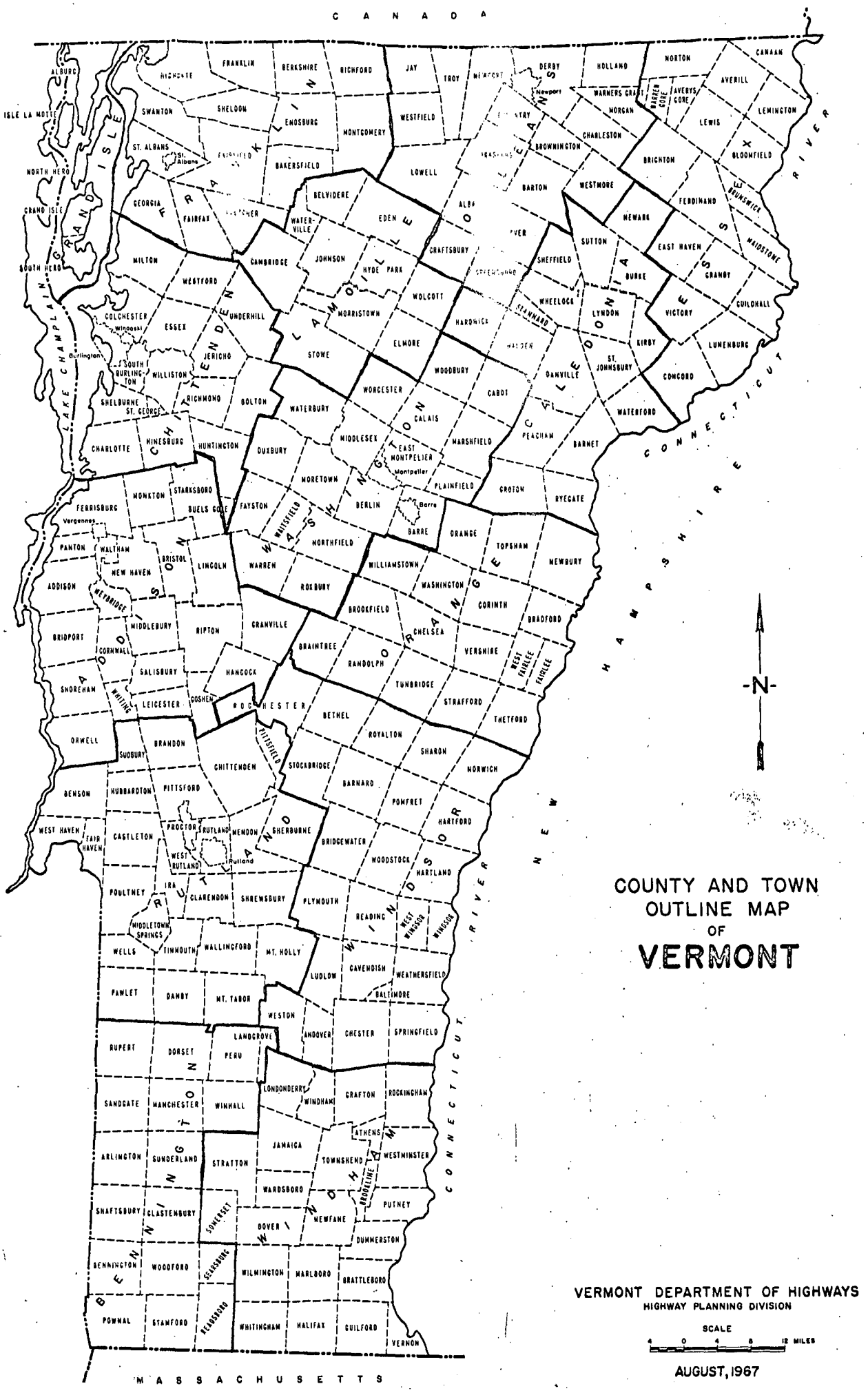
The town of Westmore is situated in the southeast part of Orleans County, and lies in the Memphremagog, Lyndonville, Island Pond, and Burke Quadrangles. It is bounded by the town of Sutton to the southwest, Newark to the southeast, Brighton to the east, Charleston to the north, Brownington to the northwest, and Barton to the west. (See County and Town Map of Vermont on the following page.)

Westmore lies entirely within the Vermont Piedmont Physiographic Region. The town is very hilly and, in places, mountainous. Many of the hills are heavily forested. Farms or houses occupy the few relatively flat areas in town.

Willoughby Gap is the chief physiographic feature in the town and may be the glacially scoured valley of a pre-glacial stream which cut its channel between Mount Hor and Mount Pisgah.

Mount Pisgah, 2,751', the most noted peak in town is lower than Jobs Mountain, 2,800', Goodwin Mountain, 2,935', and Bald Mountain, the town's highest elevation at 3,315'. The lowest point, 1,160', is the Barton Town Line on the Willoughby River as it drains northwestward from Lake Willoughby.

Many unnamed brooks rise on Goodwin Mountain and flow southwestward into Lake Willoughby. Mill Brook flows west from Bald Mountain. Arcadia Brook flows southeastward to join the West Branch of the Passumpsic River in Sutton. In the northeast part of town, drainage is to the north via Bald Mountain, Gray, and several unnamed brooks.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION

SCALE
4 0 4 8 12 MILES

AUGUST, 1967

SURVEY OF ROCK SOURCES

Procedure for Rock Survey

The routine 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 primarilty during the winter months and comprises the mapping and description of rock types as indicated in various reference sources. Many different sources of information are utilized, as indicated in the bibliography. These references differ considerably in dependability due to new developments and studies that have contributed to the obsolescense 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. In other words, as complete a correlation as possible is made of all the information available concerning the geology of the area under consideration.

The field investigation is begun by making a cursory preliminary survey of the entire area. The information obtained in the preliminary survey, together with the information assimilated in the office investigation, is employed to determine the areas where testing and 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. The samples are submitted to the Material Testing Laboratory for abrasion testing both by the Deval Method (AASHO T-3) and the Los Angeles Method (AASHO T-96). It should be kept in mind that the 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 material is uniform and acceptable abrasion tests result from the chip samples, the material source is included in this report as being satisfactory.

Discussion of Rock and Rock Sources

About two-thirds of Westmore is underlain by the granitic rocks of the New Hampshire Plutonic Series which have intruded the older rocks of the Eastern Vermont Stratigraphic Sequence according to the Centennial Geologic Map.

There is a large, somewhat circular body of granitic rock mapped in Westmore, but no samples were taken due to inaccessible outcrops and mantling by glacial deposits and dense vegetation. The granites, schists, and limestone of Willoughby Gap, including those close to Vermont Route 5-A, are too steep and inaccessible to develop as quarry sites. The oldest rocks in Westmore are the schists and limestones of the Waits River formation which nearly surround the granitic body. The greatest topographic relief occurs near the granitic contacts, and thus there should be good exposures of either granite or metamorphic rocks due to the greater relief. However, these sites would not be potential crushed rock sources for the reasons cited above. The schists and quartzites of the slightly younger Gile Mountain formation occur in the northwest corner of Westmore, and form many low rolling hills.

The only easily accessible source of rock suitable for Item 704.06, crushed stone for sub-base, is Wheeler Mountain located just over the town line in Sutton. It is accessible via Town Highway No. 24 in Westmore, and Town Highway No. 15 in Sutton.

There are a number of land owners who are interested in keeping the land as it is, and do not wish to develop any quarry operations at the present. This is especially true in the vicinity of Lake Willoughby.

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 possible potentially productive areas as indicated from various references. Of these references, the survey of glacial deposits mapped by Professor Stewart proves to be valuable, particularly when used in conjunction with other references such as soil-type maps, aerial photographs, and United States Geological Survey quadrangles. The last two are used in the recognition and location of physiographic features indicating glacial deposits and in the study of drainage patterns. In addition, the locations of existing pits are mapped when known. The locations in which samples were taken by other individuals are noted and mapped when possible.

The field investigation is begun by making a cursory preliminary survey of the entire town. All pits and other areas which show physiographic features that give evidence of glacial or fluvial deposition are noted. These locations are later investigated by obtaining samples of pit faces and other exposed materials. Tests pits, dug with a backhoe to a depth of approximately 11 feet, are also sampled. The samples are submitted to the Materials Testing Laboratory where they are tested for gradation and stone abrasion, the latter by the Deval Method (AASHO T-4).

Discussion of Sand and Gravel Deposits

The granular deposits in Westmore are limited, and occur either as sands and gravels of ice-contact origin deposited as kame terraces, kame moraine or kames; or sands deposited in the quiescent waters of post-glacial lakes. Some material may have been deposited as post-glacial fluvial gravel. It is possible that post-glacial Lake Willoughby overflowed to the southeast for a time and thus worked and deposited some fluvial gravels in the lower elevations southeast of the lake into both Westmore and Sutton. One area mapped as kame moraine by D.P. Stewart appears to be a very slightly water-worked till.

There were no areas which had gravel which met item specifications, but the town pit (former Huntoon Property) may yield material which could be modified and used as a gravel. Two of eight samples taken were misplaced. There were two other samples which met the grading requirements. One did not have enough stones for the wear test; the other barely failed on the wear test. There were some 6" and larger boulders which was the reason the town road commissioner was thinking of bringing in a crusher.

Only Map Identification Numbers 1, a pit, and 2, a pasture knoll, had sand which met specification requirements. There were other locations which had previously supplied material, but have since been built on. One example is a trailer court that occupies an old sand pit. There are lake sand deposits near the north shore of the lake, but these are occupied by cottages, camps, and permanent homes. The are two other sources which the owners did not want sampled because they were using the material themselves. Permission to sample properties of several out-of-state owners could not be obtained.

The material in Westmore was tested using the old specification requirements only. Where a sample met the new specification requirements, it was noted in the "Remarks" column on the granular data sheets. Its suitability for the new item was determined statistically from records of samples for which all screens were used.

SUMMARY OF ROCK FORMATIONS IN THE TOWN OF WESTMORE

Eastern Vermont Sequence

Gile Mountain Formation - Gray Quartz - Muscovite phyllite or schist, interbedded and intergradational with gray micaceous quartzite, calcareous mica schist, and locally quartzose and micaceous crystalline limestone like that of the Waits River Formation. The phyllite and schist commonly contains porphyroblasts of biotite, garnet, or staurolite, and locally, kyanite, andalusite, or sillimanite.

Waits River Formation - Gray quartzose and micaceous crystalline limestone weathered to distinctive brown earthy crust; interbedded and intergradational with gray quartz - muscovite phyllite or schist. Where more metamorphosed the limestone contain actinolite, hornblende, zoisite, diopside, wollastonite, and garnet; and the phyllite and schist, biotite, garnet, and locally andalusite, kyanite, or sillimanite.

New Hampshire Plutonic Series

Granitic Dikes - Gray granitic rock varying from fine- to coarse-grained. Width and extent of individual dikes not determined.

Granite - Undifferentiated granitic rock, light- to dark-gray, medium- to coarse-grained granodiorite to quartz monzonite.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Alluvial - Pertaining to material carried or deposited by running water.

Breccia - A rock consisting of consolidated angular rock fragments larger than sand grains. There may be fault, talus, and volcanic breccia.

Calcareous - Pertaining to or containing calcium carbonate.

Carbonate Rocks - Rocks composed of the molecule CO_3 combined with calcium, magnesium, etc. Includes limestones and dolomites.

Delta - A predominantly alluvial deposit built by a stream entering the sea or other body of water. Usually it has the form of the Greek letter delta.

Dolomite - A rock consisting predominantly of the mineral calcium magnesium carbonate (dolomite), containing carbon dioxide 47.7%, lime 30.4%, magnesia 21.9%.

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.

Fluvial - Of or pertaining to rivers or river action. Produced by river action.

Ice Contact - Refers to sediments which have accumulated in contact with stagnant or wasting glacial ice. They assume the varied topographic forms expressed by eskers, kames, and kame terraces.

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 - Stratified sands and gravels deposited by streams between a glacier and an adjacent valley wall.

Kame Moraine - An accumulation of material deposited directly from the frontal portion of the glacial ice and partially sorted by water action. The deposits may take the form of coalescent knolls, hummocks, and ridges.

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

Marble - A soft, white rock being the metamorphic form of limestone in which the calcium carbonate (calcite) is recrystallized and the calcite crystals are overgrown and interlocked with additional calcite. Commercially it is a trade name applied to any carbonate rock of good color and texture and hard enough to take a polish.

Metamorphic Rocks - Rocks that owe their distinctive characteristics to the transformation of preexisting rocks through intense heat or pressure or both.

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.

Physiographic - Pertaining to the physical divisions of the earth.

Quartzite - A compact metamorphic rock composed of quartz grains so firmly cemented that fracture takes place across the grains and the cementing material with equal ease.

Siliceous - Containing or pertaining to silica (silicon dioxide, SiO_2).

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

Till - An unsorted, unstratified, and unconsolidated heterogeneous mixture of clay, silt, sand, gravel, and boulders deposited directly by glacial ice.

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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 in April, 1964.

Item 105, Granular Borrow

"Article 105.02 - Materials. The granular borrow shall be obtained from approved sources and shall consist of satisfactorily graded, free-draining, hard durable stone and coarse sand practically free from loam, silt, clay, and organic matter.

"The sand portion (material passing the No. 4 screen) shall have not more than ten percent (10%) passing the No. 270 mesh sieve and shall show a color of not more than three and one-half (3½) as determined by the colorimetric test described in AASHO Method of Test, Designation T-21.

"When used in connection with fine grading or in fills where piling is to be driven, the granular material shall all pass the nine-inch (9") square-opening screen."

Item 201, Sub-base of Gravel

"Article 201.02 - Materials. The gravel shall consist of material reasonably free from silt, loam, clay or organic matter. It shall be obtained from approved sources and meet the following requirements.

"Not less than forty percent (40%) stone shall be retained on No. 4 sieve.

"The percent of wear shall be not more than twenty-five (25) when tested by laboratory methods using Method T-4 or more than forty (40) when tested by AASHO Method T-96.

"The stone portion of the gravel shall be uniformly graded from coarse to fine, and the maximum-size particles shall not exceed two-thirds (2/3) of the layer being spread.

"The sand portion, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Minimum Percent of Stone	Percent Passing Square Openings No. 100	Percent Passing Square Openings No. 270
40	0-15	0-3
50	0-15	0-4
60	0-15	0-5
70	0-15	0-6

"The sand shall show a color of not more than three and one-half (3½) as determined by the colorimetric test described in the AASHO Method of Test, Designation T-21."

Item 202, Sub-base of Sand

"Article 202.02 - Materials. The sand shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and meet the following requirements:

"The sand, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Square Openings	Percent Passing
1½"	95-100
5/8"	80-100
No. 4	70-100
No. 100	0-18
No. 270	0-5

"The sand shall show a color of not more than three and one-half (3½) as determined by the colorimetric test described in the AASHO Method of Test, Designation T-21."

Item 204, Sub-base of Crushed Rock

"Article 204.02 - Materials. The materials for sub-base, filler, and sand cushion shall be obtained from approved sources and meet the following requirements:

A - Crushed Rock. "The crushed rock shall be uniformly graded, crusher-run material and shall be free from dirt. The ledge from which this material is obtained shall be stripped and cleaned before blasting. Conical stockpiling, or any other method of stockpiling which causes segregation of aggregates, will not be permitted.

"The crushed rock, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Square Openings	Percent Passing
4"	95-100
1½"	25-50
No. 4	0-15

"The percent of wear shall not be more than eight (8) when tested by laboratory methods using Method AASHO T-3 or more than forty (40) when tested by AASHO Method T-96."

Item 205, Sub-base of Crushed Gravel

"Article 205.02 - Materials.

A - Crushed Gravel. "The crushed gravel shall consist of material reasonably free from silt, loam, clay, or organic matter. It shall be obtained from approved sources and produced by a crusher adjusted to deliver a product uniformly graded from coarse to fine.

"When tested by laboratory methods using Method AASHO T-27, it shall meet the grading requirements as set forth below:

		Square Openings	Percent Passing
Sub-base of Crushed Gravel	Coarse-Graded Item 205-A	4"	100
		No. 4	25-50
	Fine-Graded Item 205-B	1½"	95-100
		No. 4	30-60

"At least thirty percent (30%) by weight of the stone content of the crushed gravel, that is, the material retained on the No. 4 screen, shall have a minimum of one (1) fractured face as determined by actual count from the sample submitted to the laboratory.

"The percent of wear shall not be more that twenty (20) when tested by laboratory methods using Method AASHO T-4 or more than thirty-five when tested by AASHO Method T-96.

B - Sand. "The sand content of the crushed gravel, that is the material passing the No. 4 screen, when tested by laboratory methods using Method AASHO T-27, shall meet the grading requirements set up in the following table:

Square Openings	Percent Passing
No. 100	0-18
No. 270	0-8

"The sand shall show a color of not more than three and one-half (3½) as determined by the colorimetric test described in the AASHO Method of Test, Designation T-21."

Item 207, Sub-base of Dense Graded Crushed Rock

"Article 207.02 - materials. The crushed rock shall consist of granular fragments of hard, durable rock, of uniform quality throughout, reasonably free from thin or elongated pieces, soft or disintegrated rock, dirt or other objectionable matter."

"The rock shall meet the following requirements:

" The percent of wear shall be not more than eight (8) when tested by laboratory methods, using Method AASHO T-3, or more than forty (40), when tested by AASHO Method T-96."

"When tested by laboratory methods, using Method AASHO T-27, the material shall meet the requirements set up in the following table:

	Square Openings	Percent Passing
Grading	3"	100
	2"	80-100
	1½"	50-75
	No. 4	30-55
	No. 100	3-10
	No. 270	0-6

"The dense graded rock shall be homogeneous and shall be produced and manipulated in such a manner as to prevent segregation before material is spread on the prepared subgrade, or at other locations."

PARTIAL SPECIFICATIONS FOR HIGHWAY CONSTRUCTION MATERIALS

Listed below are partial specifications for Highway Construction Materials items that will supercede the items currently in effect on July 1, 1971. The new items are included as an appendix to this report since the suitability of materials for construction is referred to the new items in many instances.

DIVISION 700 - MATERIALS

Section 703, Soils and Borrow 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 - Gradation Requirements

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, and organic material.

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

Table 703.05A - Gradation Requirements

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.

Section 704, Aggregate

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 - Gradation Requirements

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 AASHO T 4, or more than 40 when tested in accordance with AASHO 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 - Gradation Requirements

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 AASHO T 3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHO T 96.

(d) Thin and Elongated Pieces
Not more than 30 percent, by weight, of thin and elongated peices 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 - Gradation Requirements

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves Total Sample
1"	100
3/4"	90-100
1/2"	50- 90
No. 4	30- 70
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 - Gradation Requirements

Grading	Sieve Designation	Percentage by Weight Passing Square Mesh Sieves Total Sample	Sand Portion
	4"	100	
Coarse	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 AASHO T 4, or the crushed gravel a percent of wear of not more than 35 when tested in accordance with AASHO 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 - Gradation Requirements

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 AASHO T 3, or the crushed stone a percent of wear of not more than 40 when tested in accordance with AASHO 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 - Gradation Requirements

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 - Gradation Requirements

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

WESTMORE GRANULAR DATA SHEET NO. 1

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing 1½"	5/8"	#4	#100	#270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
1	1A	1970	0-18	---	Yes	100	96.4	86.6	7.0	1.5 1.3*	1	---	Sand	Owner: Alfred Davis. Area is a pit and extension mapped as being in a kame terrace. The pit is on the west side of Vermont Route No. 16, just east of the Barton Town Line. The extension is a granular knoll in which the beds dip gently to the north (probably due to slumping of deposits after the supporting ice melted). Test #1A was a hand-shovel sample at the upper south face. Log of Test #1A: 0'-10', lenses of sand and pebbly sand; 10'-13', sand; 13'-18', lenses of sand and pebbly sand. A few 3" cobbles were noted.
	1B	1970	18-29	---	Yes	100	82.6	75.2	8.0	1.9 1.4*	1	---	Sand	Test #1B was a hand-shovel sample below Test #1A, and from 18'-29' was interbedded sand, pebbly sand, and gravelly sand. There were not enough stones to consider it a gravel. From 29'-38' was not sampled due to caving.
	2	1970	0-9	---	Yes	100	99.3	84.1	7.0	3.1 2.6*	1	---	Sand	Test #2 was dug in floor, 15' north of Test #1. Log of Test #2: 0'-2', sand; 2'-9', pebbly sand; test bottoms at 9' in clayey, pebbly till.
	3	1970	1-10	0-1	No	100	100	99.1	6.0	0.7 0.7*	1	---	Sand	Test #3 was dug on north slope of feature, 85' south of fence near Vermont Route No. 16, and 60' north of north face of

* Percentage of total sample

WESTMORE GRANULAR DATA SHEET NO. 2

Map Ident No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
														pit. Log of Test #3: 0'-1', overburden; 1'-2', reddish brown sand; 2'-10', tan-gray sand with an occasional pebble. Pretty clean looking and not very coarse.
	4	1970	2-9	0-2	Yes	100	99.4	93.0	4.0	1.3 1.2*	1	---	Sand	Test #4 was dug atop the south face, in an old diggings, 80' southwest of, and about the same height as top of south face. Log of Test #4: 0'-2', pebbly sand; test bottoms at 9' in clay.
	5	1970	1-5	0-1	No	100	100	96.4	12.0	3.2 3.1*	1½	---	Sand	Test #5 was dug near change of slope, 80' S.70°W. of Test #4. Log of Test #5: 0'-1', overburden; 1'-5', sand; test bottoms at 5' in clay. This hole is very near the edge of feature. The area north of road was low and looked rather heavy. Owner would not permit sampling in that area.
2	1	1970	2-6	0-2	No	100	100	100	6.0	2.4 2.4*	4½	---	---	Owner: Alfred Davis. Area is a granular, hilly pasture with small knolls, southeast and above Davis' house. Test #1 was dug near fence at top of hill. Log of Test #1: 0'-2', overburden; 2'-6', sand; test bottoms at 6' in clay with a few boulders. Material fails with a color of 4½ for Item 105, but it would pass for Item 703.03, sand borrow and cushion, and Item 703.05, granular borrow.

* Percentage of total sample

WESTMORE 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					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
	2	1970	2-10	0-2	No	100	97.9	97.9	17.0	2.2 2.2*	1	---	Sand	Test #2 was dug downslope and 150' N.40°E. of Test #1. Log of Test #2: 0'-2', overburden; 2'-5', brown sand; 5'-10', gray sand. The feature is mapped as a kame terrace and is mostly sand, underlain by a hardpan of clay, boulders and some pebbles.
3	1	1970	0-9	---	Yes	100	100	63.1	23.0	10.9	1	---	---	Owner: Millard Stevens. Area is a shallow diggings near the crest of a rocky, rolling pasture, west of Town Highway No. 21, and north of Town Highway No. 22. Test #1 was dug by backhoe in pit floor, 100' S.25° E. of apple tree at fence corner, and N.7°W. of Stevens' house. Log of Test #1: 0'-2', a till of angular rock fragments and pebbles mixed with clay. There was very little water sorting of material. From 2'-9' was mostly rock fragments and clay. Material meets requirements for granular borrow, Item 703.05, under the new specifications.
	2	1970	0-9	---	Yes	100	100	98.6	39.0	24.5	1	---	---	Test #2 was dug in shallow diggings, 340' N.40°E. of fence near Test #1. From 0'-9' was clay or silt-clay, with very few pebbles noted below the surface. The material was not as stony as that in Test #1.

* Percentage of total sample

WESTMORE GRANULAR DATA SHEET NO. 4

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
4	1	1970	3-11	0-3	Yes	48.8	41.0	31.2	17.0	7.5	2	25.1%	Gran. Borrow (Grav.)	Owner: Town of Westmore (Former Huntoon property). Area is a low, sprawling pit with water in several low places on the floor. It is mapped as being within a kame moraine area. Access is via a pit road which is 0.05 mile south of Vermont Route No. 5-A, 0.11 mile west of the Newark Town Line. There is a possible extension in the terrace to the south and southwest of the pit. Test #1 was a hand-shovel sample on the west face, near the north end of pit. There was 3' of strippings underlain by 8' of well-packed gravel which is a bit high on the fines. Test bottomed at floor level. Does not meet specifications for Item 704.05, gravel for sub-base.
	2	1970	0-0.5	---	Yes	100	91.7	79.0	23.0	7.0 5.5*	1	---	Gran. Borrow (Sand)	Test #2 was dug in floor, 30' N.20°E. of Test #1. Log of Test #2: 0'-0.5', pebbles; 0.5'-1.0', pebbles; water at 1'; 1'-5', sand; material seemed rather sticky and this may explain the high amount of fines. Some boulders were noted.
	3	1970	(T E S T R E S U L T S W E R E M I S P L A C E D)											Test #3 was dug in terrace atop pit face, 150' N.35°W. of Test #2. Log of Test #3: 0'-3.5', gravel; 3.5'-6', gravelly sand; 6'-10', bouldery gravel. Water flowed into hole at 10'.

* Percentage of total sample

WESTMORE GRANULAR DATA SHEET NO. 5

Map Ident No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing 1½"	5/8"	#4	#100	"270	Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
	4	1970	(T E S T R E S U L T S W E R E M I S P L A C E D)											Test #4 was dug in field, 130' S.7°W. of Test #3. Log of Test #4: 0'-1.5', overburden; 1.5'-3.5', gravel; 3.5'-4.5', sand; 4.5'-5.5', gravel; 5.5'-10.5', interbedded sand and gravel layers; water at 10'; fine gravel or gravelly sand below water at 10'; material looks pretty good. The beds are nearly horizontal.
	5	1970	2-8	0-2	No	100	77.1	64.3	19.0	6.4 4.1*	2	---	Gran. Borrow (Sand)	Test #5 was dug in field, 350' S.14°E. of Test #4, and just east of alder trees. Log of Test #5: 0'-2', overburden; 2'-8', sand and gravelly sand lenses; 8'-10', boulders, clay, sand and water. Material meets the requirements for Item 703.03, sand borrow and cushion.
	6	1970	1-11	0-1	No	100	100	71.8	50.0	17.3 12.3*	1½	---	---	Test #6 was dug atop a small knoll, 150' S.20°E. of, and 10' above Test #5. Log of Test #6: 0'-1', overburden; 1'-11', pebbly sand. The pebbles are angular to sub-angular.
	7	1970	1-7	0-1	No	72.9	67.1	55.5	7.0	3.5	3½	---	Gran. Borrow (Grav.)	Test #7 was dug in field, 225' S.85°W. of Test #3. Log of Test #7: 0'-1', overburden; 1'-3', gravelly sand; 3'-5', fine gravel; 5'-7', pebbly sand and fine gravel; test bottoms in water at 7'. Material meets the grading requirements for Item 704.05, gravel for sub-base.

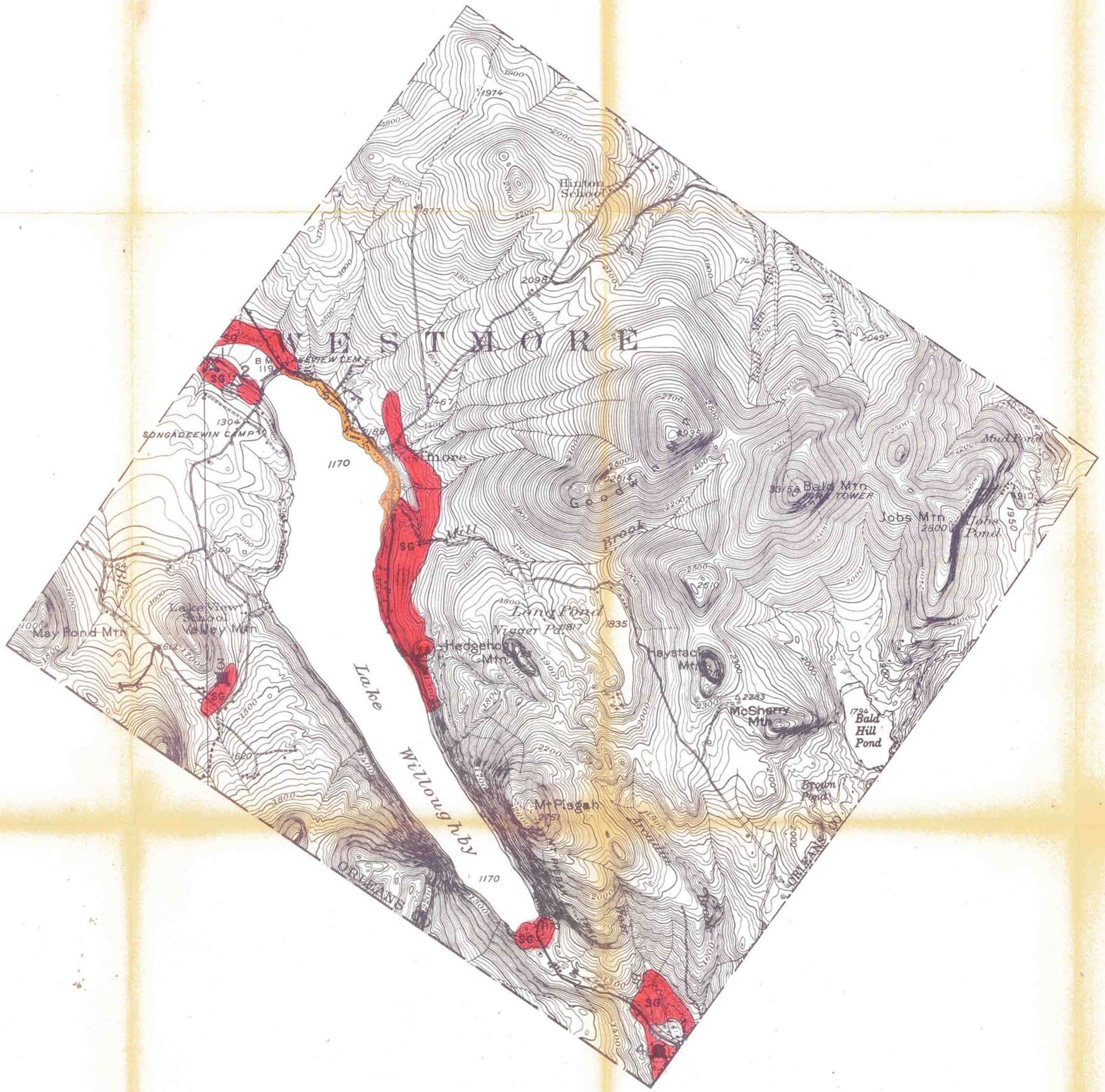
* Percentage of total sample

WESTMORE GRANULAR DATA SHEET NO. 6

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Existing Pit	Sieve Analysis % Passing					Color AASHO T-21	Abrasion AASHO T-4-35	Passes VHD Spec.	Remarks
						1½"	5/8"	#4	#100	#270				
	8	1970	1-10	0-1	No	100	100	82.5	16.5	5.5 4.5*	1½	—	Sand	Insufficient proper size stones were included for percentage of wear test. Test #8 was dug on slope of knoll, 390' due west of Test #7, and just east of trees. Log of Test #8: 0'-1', overburden, 1'-10', rotted rocks, boulders, and one thin lens of sand. The test results must be for some other sample since the material in Test #8 was definitely a glacial till.

* Percentage of total sample

Westmore Property Owners - Granular	Map Ident. No.
Davis, Alfred	1, 2
Stevens, Millard	3
Westmore, Town of	4



LEGEND

- ○ GRAVEL, ACCEPTABLE FOR ITEM 201 (sub-base of gravel)
- ◎ GRAVEL, DEPLETED OR NOT ACCEPTABLE FOR ITEM 201
- △ SAND, ACCEPTABLE FOR ITEM 202 (sub-base of sand)
- ▲ SAND, DEPLETED OR NOT ACCEPTABLE FOR ITEM 202
- □ GRANULAR BORROW, ITEM 105
- ▣ MATERIAL NOT ACCEPTABLE FOR ITEM 105
- EXISTING PIT
- SG SAND & GRAVEL DEPOSIT
- S SAND DEPOSIT
- 3 IDENTIFICATION NUMBER (refer to data sheets)

WESTMORE

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET
1971

GRANULAR MATERIALS MAP

BY
VERMONT DEPARTMENT OF HIGHWAYS
IN COOPERATION WITH
U.S. BUREAU OF PUBLIC ROADS

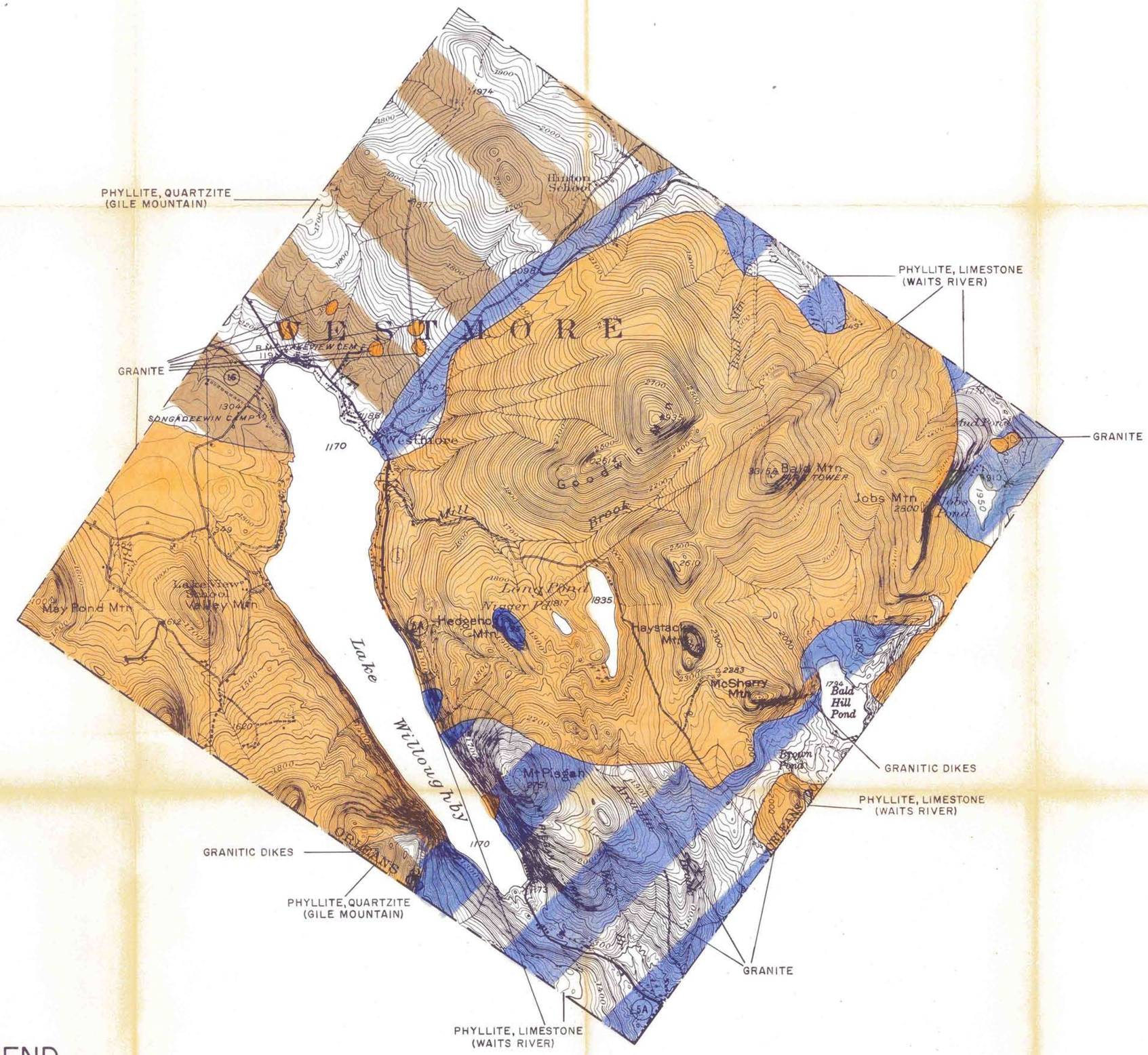
NOTE: BASED ON U.S.G.S. TOPOGRAPHIC MAPS

PLATE I GRANULAR

ORLEANS COUNTY VT. HWY. DISTRICT NO. 9

REVISIONS

DATE							
BY							



LEGEND

- ROCK, ACCEPTABLE FOR ITEM 704.06 (crushed stone for sub-base)
- ROCK, NOT ACCEPTABLE FOR ITEM 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)

WESTMORE

SCALE 1:31,250

0.5 0 1 MILE

CONTOUR INTERVAL 20 FEET

1971

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

ORLEANS COUNTY VT. HWY. DISTRICT NO. 9

REVISIONS

DATE							
BY							