SURVEY OF HIGHWAY CONSTRUCTION MATERIALS
IN THE TOWN OF WALDEN, CALEDONIA 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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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.

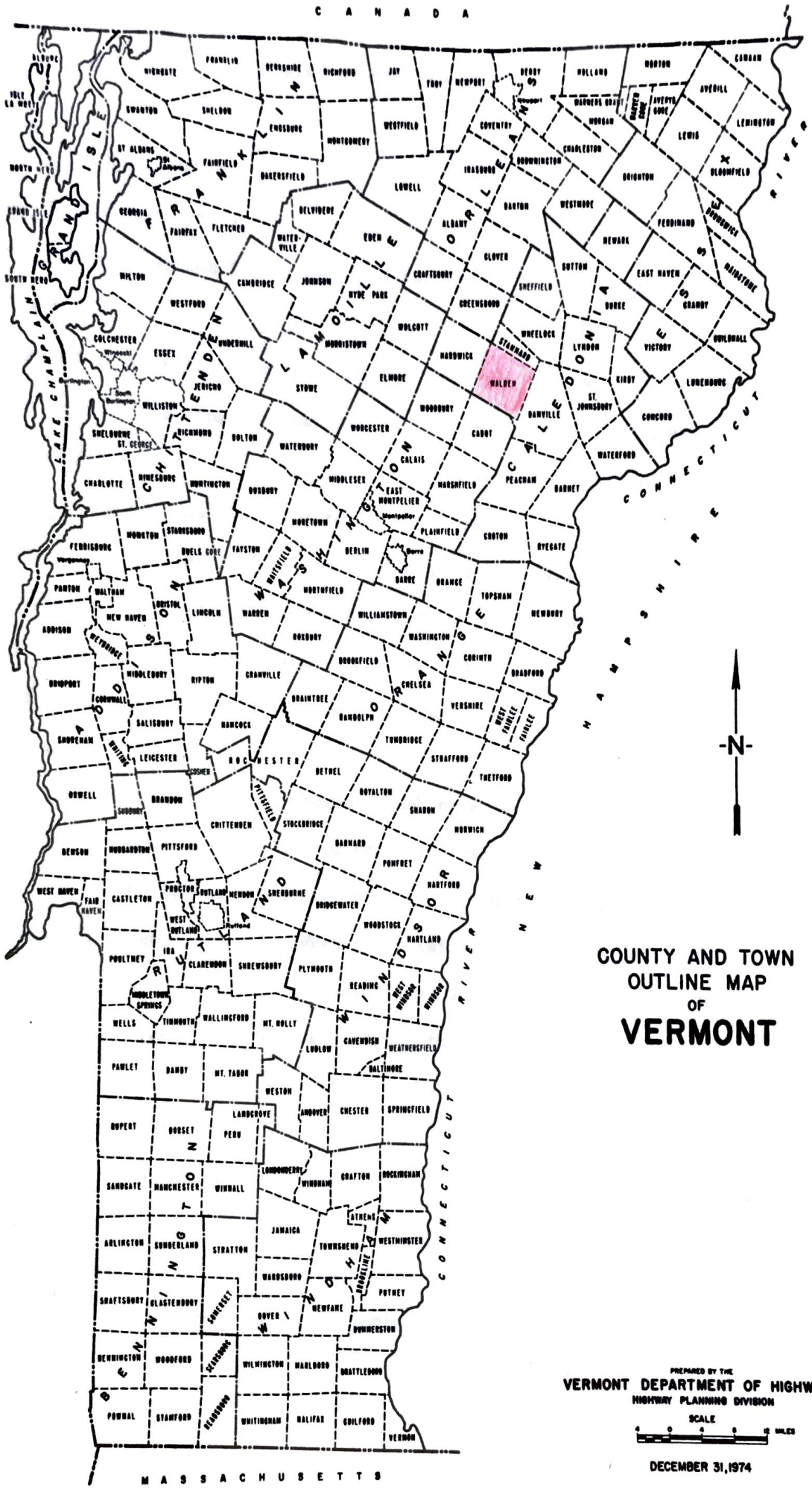
Work sheets, containing more detailed information and a field sketch of the area represented by the Identification Number, and laboratory reports are on file in the Materials Division of the Vermont Department of Highways.

LOCATION

The town of Walden is situated in western Caledonia County in northeastern Vermont. It is bounded on the north by Stannard, on the east by Danville, on the south by Cabot and on the west by Hardwick. (See County and Town Outline Map of Vermont on the following page.)

Walden is within the Vermont Piedmont subdivision of the New England Upland. This subdivision is a plateau dissected by streams and subdued by glaciation; numerous steep-sided valleys produce an undulating-to-rough topography. Elevations vary from more than 2,560 feet on the summit ridge of Stannard Mountain north of Coles Pond, to less than 1,060 feet where Haynesville Brook crosses the Hardwick Town Line.

The eastern half of Walden is in the Passumpsic River drainage basin with Bog Brook draining northward, and Joes Brook and Stream Mill Brook southward. The western half of the town is in the Lamoille River drainage basin with Stevens, Turner, Morrill and Meadow Brooks draining westward.



COUNTY AND TOWN OUTLINE MAP OF VERMONT

PREPARED BY THE
VERMONT DEPARTMENT OF HIGHWAYS
HIGHWAY PLANNING DIVISION

SCALE
4 0 4 8 12 MILES

DECEMBER 31, 1974

SURVEY OF ROCK SOURCES

Procedure for Rock Survey

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

The office investigation is conducted 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

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

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

Complex metamorphic rocks comprise most of the bedrock lithology in Walden with the exception of one isolated igneous intrusive, granodiorite, near the south corner of the town. Limestones of the Barton River member of the Waits River formation, which underlie the west half of Walden, are known to be thinly bedded with much intraformational sericitic phyllite that tends to split into paper-thin fragments when quarried. No other Waits River formation rock was found outcropping near a highway.

Gile Mountain formation rocks have been sources of crushed stone in other Vermont towns. This formation, which underlies most of the east half of Walden, is largely mantled with glacial till. Exposures a few feet in extent occur at two places along Town Highway No. 13 east of Coles Pond. An extensive exposure one mile west of Coles Pond on the south side of Town Highway No. 13 yielded rock suitable for Crushed Stone for Subbase at Map Identification No. 1.

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

Granular materials in the town of Walden mainly occur adjacent to valleys and below 1,600 feet in elevation; however, several sources are higher, with one above 1,900 feet.

Paul MacClintock noted several kames along Vermont Route 15 in addition to a large kamic feature southwest of Dows Crossing when field mapping for the Surficial Geologic Map of Vermont. An extensive pit in this feature at Map Identification No. 5 has been a major materials source, but permission to sample was denied by the present owner. Material from the other kames has excessive fines or fails to meet abrasion requirements for Gravel for Subbase. The pit at Map Identification No. 19 truncates a high ridge of probable deltaic origin.

Walden has ample amounts of Sand Borrow and Cushion. Sources within kamic areas include pits at Map Identification Nos. 4, 5, and 11. Pits at Nos. 2, 7, 11, 12, 16 and 17 are not in kamic features.

During a recessional phase of the recent continental glaciation, Joes Brook Valley, between Noyesville and Goslants Mill, may have been the site of a shoaling body of water that would account for lake sediments at Map Identification No. 16.

In the opinion of the survey, the place in Walden with the best potential for Gravel for Subbase is the kamic feature containing Map Identification Nos. 4, 5 and 6; the ridge at Map Identification No. 19 is the second best place. Map Identification No. 16 is the largest source of Sand Borrow and Cushion.

Summary of Rock Formations in the Town of Walden

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

Gile Mountain formation: Gray quartz-muscovite phyllite or schist, interbedded and intergradational with gray micaceous quartzite, calcareous mica schist, and local 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.

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 limestones contain actinolite, hornblende, zoisite, diopside, wallastonite, and garnet, and the phyllite and schist, biotite, garnet, and locally andalusite, kyanite or sillimanite.

GLOSSARY OF SELECTED GEOLOGIC TERMS

Amphibolite: A metamorphic rock composed chiefly of an amphibole mineral (i.e., tremolite, actinolite, hornblende or arfwedsonite). Color varies from green to black.

Cleavage: A tendency to split or cleave along definite, smooth, parallel, closely spaced planes. As applied to rocks, cleavage is the property of splitting into thin parallel sheets. Cleavage is a secondary feature and should not be confused with bedding.

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

Deltaic: Relating to predominantly alluvial deposition built out by a stream into the sea or other body of water. The deposit usually is formed like the Greek letter delta.

Drainage Basin: A part of the surface of the lithosphere that is occupied by a drainage system or contributes surface water to that system.

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

"Hardpan": A term loosely applied to any subsurface soil layer that offers great resistance to digging or drilling.

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

Intraformational: Within a formation; as, intraformational phyllite. The contrasting term is INTERFORMATIONAL: Between formations.

Intrusive: Igneous rock which has cooled before reaching the earth's surface.

Joint: A fracture or parting plane along which there has been little, if any, movement parallel to the walls.

Joint System: A group of two or more intersecting sets of joints constitutes a system.

Kame: A conical hill of generally poorly stratified drift deposited in contact with glacial ice by streams flowing in or on the ice.

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

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

Outcrop: A part of a body of rock that appears, bare and exposed, at the surface of the ground.

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 gives the rock a distinctive silvery appearance.

Piedmont: Lying or formed at the foot of mountains.

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.

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.

Seam: A comparatively thin stratum; a bed, as of coal.

Sediments: The word is applied to all kinds of deposits from the waters of streams, lakes, or seas, and in a broader sense, to deposits of wind and ice.

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

Water Table: The upper limit of the portion of the ground wholly saturated with water.

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 703.03A - SAND BORROW AND CUSHION

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

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

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

TABLE 703.05A - GRANULAR BORROW

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

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

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

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

TABLE 704.05A - GRAVEL FOR SUB-BASE

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

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

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

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

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

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

TABLE 704.06A - CRUSHED STONE FOR SUB-BASE

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

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

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

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

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

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

This material shall meet the requirements of the following table:

TABLE 704.06B - LEVELING MATERIAL

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

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

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

TABLE 704.07A - CRUSHED GRAVEL FOR SUB-BASE

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

(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

TABLE I

WALDEN GRANULAR DATA SHEET NO. 1

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
1	1	1976	2-9	0-2	Yes	100	100	84	74	61	48	----	----	Owner: William Henchon. Area is a borrow pit in a pasture, 475' north of Town Highway No. 9 with field road access 1/4 mile east of Town Highway No. 5 junction. Double lobed pit was 90' x 60' with standing water on both floors. Faces are gullied and have numerous 6" - 12" stones. Extension is northeast of the east lobe. Test No. 1 was in upper and middle 14-foot high north-east face. Log of test: 2'-9', sandy silt with a few stones and small boulders. Material is compact and an estimated 5% of the stones were coarser than 4" and not included in sample.
2	1	1976	1-8	0-1	Yes	100	100	100	87	25	11	----	Sand	Owner: John Hancock. Area is a borrow pit in a meadow 370' west of Town Highway No. 5 with field road access 0.4 mile north of State Aid Highway No. 2 junction. Pit was 230' x 100' and had a little standing water in the lowest parts. The south extension has been stripped and the north face

TABLE I

WALDEN GRANULAR DATA SHEET NO. 2

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														truncates a north-north-east trending feature. Test No. 1 was in 8-foot high northeast face. Log of test: 1'-2', fine gravel; 2'-3.5', silty sand; 3.5'-5', sandy gravel; 5'-6', silty sand; 6'-8', fine gravel. Material is loosely consolidated.
	2	1976	1-10	0-1	No	100	100	100	99	15	6	----	Sand	Test No. 2 was in feature 250' N 40° E of and 18' above Test No. 1. Log of test: 1'-10', clean sand; bottom, same. Cross-bedding was noted.
	3	1976	1-6	0-1	Yes	100	100	100	86	62	50	----	----	Test No. 3 was in floor 45' S 75° W of Test No. 1. Log of test: 1'-6', silt and stones with a little sand.
3	1	1976	1-5	0-1	No	100	100	100	74	35	21	----	----	Owner: Edgar Strong. Area is in a cow pasture west of Town Highway No. 12. A 120-foot long bank 8' high parallels the highway. The southeast facing bank was sampled at a point 20' west of highway and 0.11 mile south of junction with Town Highway No. 23. Test No. 1 was in bank of poor looking material. Log of test: 1'-5', compact sandy

TABLE I

WALDEN 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
														silt with much black phyllitic weathered material and stones; bottom, same. More than 5% of the stones were coarser than 4" and were not included in sample.
4	1	1976	0.5-9	0-0.5	Yes	100	87	72	60	15	8	26.7%	Granular Borrow (Gravel)	Owner: Edgar Strong. Former Owner: Dudley. Area is north portion of long, N - S oriented gravel pit and field to its east. The 500-foot long access road is south of Town Highway No.25, 0.08 mile west of its junction with Town Highway No. 12. Property line fence to south trends northwestward across field and pit, 250' south of its north end. Pit is 125' wide. Floor was wet, and had brush. The northeast face was the only one not overgrown. Test No. 1 was in the 10-foot high northeast face. Log of test: 0.5'-2', poorly sorted, compact sand with stones; 2'-9', sandy coarse gravel with many rotten, subangular phyllite stones; bottom, same. 5% of the stones were coarser than 4" and not included with sample.
	2	1976	2-10	0-2	Yes	100	95	81	67	22	15	32.9%	Granular Borrow (Sand)	Test No. 2 was in face 75' south of Test No. 1. Log of test: 2'-3', sand; 3'-10', sandy gravel; bottom, same.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 4

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
	3	1976		0-2	Yes	---------NOT SAMPLED---------						----	----	Test No. 3 was in floor 95' N 65° W of Test No. 1 and overlooked brook to north-west. Log of test: 0'-2', silty, stony sand not in place; 2'-4', stony silt-clay.
	4	1976	2-11	0-2	No	89	85	76	62	22	14	25.9%	Granular Borrow (Gravel)	Test No. 4 was at west edge of field 180' N 80° E of pit and 8' east of fence. Field is capped by 2' of sod and silt. Log of test: 2'-11', poorly sorted, loosely consolidated dark brown, gravelly sand.
	5	1976	2-10	0-2	No	100	100	85	73	18	12	----	Sand	Test No. 5 was at edge of field 240' east of Test No. 4. Log of test: 2'-10', poorly sorted, loosely consolidated, sandy brown gravel with water seep at 8.5'; bottom, boulders. Approximately 5% stones were coarser than 4" and not included with sample.
	6	1976	1.5-6	0-1.5	No	100	100	94	82	10	6	----	Sand	Test No. 6 was near south-east corner of field, 500' S 10° W of Test No. 5 and 435' southeast of pit. Log of test: 1.5'-6', dirty sand with stones; bottom, silt-clay with stones.
5	1	1967	3-25	0-3	Yes	80	74.5	58	44	4	1.8	24.4%	Gravel	Owner: Wayne Farr. Former Owner: Lester Fuller.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 5

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														Area is an active, large, high-faced pit west of cemetery on Town Highway No. 12, 1 mile north of its intersection with Vermont Route 15. Materials representing a northward extension of this pit were sampled in 1967. Test No. 1 was on high part of 30'-35' face in center. Material was gravelly sand with a few thin sand layers and one or two fine gravel beds underlain at 20' by a 2-foot thick cobble gravel.
	2	1967	3-20	0-3	Yes	100	96.8	95	86.9	18	3.5	----	Sand	Test No. 2 was at northeast corner of face. Present owner refused permission for additional sampling and stated that he has no intention of selling materials.
6					Yes	----------		NOT	SAMPLED		----------			Owner: Everett Goddard. Area is an inactive, small sand pit west of Town Highway No. 12 and south of Map Identification No. 5. Access is via a private road continuation of Town Highway No. 27. Pit is inactive. Owner has no intention of further exploitation and permission to sample was refused.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 6

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
7	1	1976	1-18	0-1	Yes	100	100	100	91	10	4	----	Sand	Owner: Maurice Eddy. Area is an inactive sand pit east of Town Highway No. 12, 0.53 mile north of its junction with Vermont Route 15. Pit had brush covered faces and a wet floor. Owner allowed hand sampling only; his material is not available. Test No. 1 was in upper and middle parts of 24-foot high northeast face. Log of test: 1'-18', pebbly sand; bottom, silty sand with stones.
8	1	1976	1-6	0-1	Yes	87	84	71	60	30	18	28.0%	----	Owner: Reginald Allen. Former Owner: Gendron. Area is a pitted terrace north of Meadow Brook. Pits can be seen from Vermont Route 15, 0.6 mile west of South Walden 4-Corners. Access is 0.45 mile west of the 4-Corners and crosses a plank bridge to pits. Material is not available, but owner allowed hand sampling. Test No. 1 was in upper northeast face of higher, northwest pit. Extension is north of 12-foot face. Log of test: 1-'6', poorly sorted, loosely consolidated coarse gravel; bottom, silt-clay. NOTE: Gravel is exposed in cut banks of brook east of barn.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 7

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
9	1	1976	1-5	0-1	Yes	100	84	84	73	19	9	-----	Granular Borrow (Sand)	Owner: Wilfred Cochrane. Former Owner: Goodenough. Area is an overgrown, 275' x 50' pit northwest of State Aid Highway No. 1, 0.08 mile south of its junction with Vermont Route 15. Lumber and old wagons are in the pit. Fallen trees block its entrance. Test No. 1 was in floor, 100' east of west face. Log of test: 1'-5', moist clean pebbly sand with stones; bottom, same.
	2	1976	1-5	0-1	No	100	100	100	100	57	38	----	----	Test No. 2 was in a field 250' S 70° W of west end of pit, and 130' west of State Aid Highway No. 1. Log of test: 1'-5', fine sand; bottom, silt-clay.
	3	1976		0-7	Yes	----------	----------	NOT	SAMPLED	----------	----------	----------	----------	Test No. 3 was in field near southeast corner of pit. Log of test: 1.5'-2', stones; 2'-7', silt and minor sand; 7'-10', compact silty sand; bottom, same.
10	1	1976	0.5-5	0-0.5	Yes	100	100	100	96	24	13	----	Granular Borrow (Sand)	Owner: Arthur Olney. Area is a 120' x 50' sand pit in a knoll north of Town Highway No. 42, 0.2 mile east of its junction with State Aid Highway No. 1. Limited extension is north-

TABLE I

WALDEN GRANULAR DATA SHEET NO. 8

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														ward because knoll slopes steeply down to forest. Test No. 1 was in east-central north face. Log of test: 0.5'-3.5', loosely consolidated dark brown sand; 3.5'-5', light gray sand; bottom, same.
11	1	1976	2-17	0-2	Yes	100	100	100	86	21	9	----	Sand	Owner: Gerald Greaves, Jr. Area is a 120' x 45' pit 0.09 mile south of Vermont Route 15. Access road is 0.12 mile west of Town Highway No. 78 junction with Route 15. Pit is in mixed forest. Material is not available, and only hand sampling was allowed. Lower faces of pit are heavily sloughed and overgrown. Test No. 1 was in 30' high northeast face of pit. Log of test: 2'-3', sandy gravel; 3'-4', fine sand; 4'-7', sandy gravel; 7'-14', fine sand; 14'-17', gravelly sand.
12	1	1976	1-4	0-1	Yes	100	100	100	96	11	4	----	Sand	Owner: Thomas O'Brien. Former Owner: Bob White. Area is a heavily overgrown pit in deciduous forest 550' north of Vermont Route 15, 0.11 mile east of Town Highway No. 78 junction.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 9

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
														Material is not available and backhoe testing was not allowed. Test No. 1 was in south face of pit. Log of test: 1'-4', clean medium sand with a few stones.
13	1	1976	1-12	0-1	Yes	100	100	100	96	44	31	----	----	Owner: Eugene Podhurst. Former Owner: Wood. Area is a pit with two levels, 150' north of Town Highway No. 18. The access road is 0.5 mile east of Town Highway No. 19 junction. Material in face above lower floor was stripped from northeast extension for a loading area for exploitation of 14-foot high upper face. Pit and extension are on steep, wooded hillside. Test No. 1 was in upper north face. Log of test: 1'-2.5', pebbly sand; 2.5'-12', fine to medium, northward dipping sand beds; bottom, same.
	2	1976	0-5	--	Yes	100	100	100	92	20	14	----	Granular Borrow (Sand)	Test No. 2 was in lower floor near west end of pit. Log of test: 0'-5', sand; bottom, same. Water table was at 2'.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 10

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
14	1	1976	1-4	0-1	No	100	100	100	80	65	47	----	----	Owner: Francis Clifford. Random sample of sand and stones was excavated from a spring hole in field 50' northeast of State Aid Highway No. 2, 0.3 mile northwest of its junction with Town Highway No. 18. Material is not available. Log of test: 1'-4', stony sand; water table at 2'.
15	1	1976	2-10	0-2	Yes	100	100	100	86	45	32	----	----	Owner: E. L. Loura. Area is a pasture with two pits north of Town Highway No. 32, 250' west of State Aid Highway No. 2. The lower pit was 120' x 35'. Test No. 1 was in 12-foot high northwest face of lower pit. Log of test: 2'-4', silty gravel; 4'-10', compact silt and stones with a 1" sand layer; bottom, silt.
	2	1976	1.5-4.5	0-1.5	Yes	82	82	73	65	8	5	----	Granular Borrow (Sand)	Test No. 2 was in low north-east face of small upper pit, 750' north of Test No. 1. Log of test: 1.5'-2.5', sandy gravel; 2.5'-3.5', sand; 3.5'-4.5', gravel. Many phyllite boulders occur on the floor and in the north-west extension of pit.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 11

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
16	1A	1976	0.5-8	0-0.5	Yes	100	100	100	91	12	5	----	Sand	Owner: Roy Watson. Area is a 200' x 50' sand pit 475' north of Town Highway No. 34. Access was 0.08 mile east of State Aid Highway No. 2. Test No. 1A was in 16-foot high south-central face. Log of test: 0.5'-4', sandy gravel; 4'-8', loosely consolidated sand.
	1B	1976	8-13	---	Yes	100	100	100	88	9	5	----	Sand	Test No. 1B was below Test No. 1A. Log of test: 8'-13', loosely consolidated sand with a trace of gravel; bottom, silt seam.
	2	1976		0-1	Yes	----------	----------	NOT SAMPLED	----------	----------	----------	----------	----------	Test No. 2 was in floor of upper level of pit, 50' north of Test No. 1B. Log of test: 1'-2.5', silt-clay.
	3	1976	6-10	0-6	No	100	100	100	97	27	12	----	Sand	Test No. 3 was at edge of field, 75' S 40° W of, and 6' above Test No. 1A. Log of test: 6'-10', clean sand; bottom, same.
	4	1976	1-6	0-1	No	100	100	100	100	65	31	----	----	Test No. 4 was at edge of field, 15' north of highway, 350' S 20° E of Test No. 3. Log of test: 1'-6', sand and silt with a few clay blobs (water seep at 4'); bottom, boulders.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 12

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
17	1	1976	1-5	0-1	Yes	100	100	100	84	17	12	----	Sand	Owner: Milton Cochrane. Area is a 90' x 55' pit south of Town Highway No. 34, 0.2 mile west of intersection with Town Highway No. 35. Water from spring flowed over floor. There is a 40' stripped extension to the east. Test No. 1 was in the 10-foot high southeast face. Log of test: 1'-5', loosely consolidated, dirty, coarse sand; bottom, compact silt and stone. Water seeped from face after sampling.
	2	1976		0-1	No	NOT SAMPLED								Test No. 2 was in meadow 65' S 70° E of Test No. 1. Log of test: 1'-5', compact, poorly sorted stony silt-clay; bottom, same. Water seeped in at 3'. This test was not in a granular feature.
18		1976			Yes	NOT SAMPLED								Owner: Ivanowsky. Area is an inactive pit southwest of Town Highway No. 37, 0.18 mile southeast of Town Highway No. 21 junction. Materials are not available and permission to sample was refused.

TABLE I

WALDEN GRANULAR DATA SHEET NO. 13

Map Ident. No.	Field Test No.	Year Field Tested	Depth of Sample (Ft)	Over-burden (Ft)	Exist-ing Pit	Sieve Analysis % Passing 2"	1-1/2"	1/2"	#4	#100	#200	Abrasion AASHTO T-4-35	Passes VHD Spec.	Remarks
19	1A	1976	9-17	0-1	Yes	95	79	59	42	11	8	19.0%	Gravel	Owner: George O. Davidson. Area is an active 150' x 50' gravel pit recently opened by the town, 0.2 mile north of the east end of Town Highway No. 48. Pit truncates a steep-sided hill, densely covered with conifers. An extension 150' wide was cleared east of pit. This extension was inaccessible to a back-hoe. Upper 9' of 26-foot high northeast face was not accessible. Test No. 1A was in middle of northeast face. Upper 9 feet of face was inaccessible silty sand. Material from 9'-17' was poorly sorted, loosely consolidated sand and medium to coarse gravel.
	1B	1976	17-20	---	Yes	100	100	100	96	7	3	----	Sand	Test No. 1B was below Test No. 1A. Log of test: 17'-18.5', clean medium sand; 18.5'-20', silty sand.
	1C	1976	20-23	---	Yes	94	82	65	51	11	8	19.4%	Gravel	Test No. 1C was 6' north-west of, and below Test No. 1B. Log of test: 20'-20.5', medium to coarse gravel; 20.5'-23', sandy gravel; bottom, same.

TABLE I

SUPPLEMENT

WALDEN PROPERTY OWNERS - GRANULAR

	Map Identification No.
Allen, Reginald	8
Clifford, Francis	14
Cochrane, Milton	17
Cochrane, Wilfred	9
Davidson, George	19
Eddy, Maurice	7
Farr, Wayne	5
Goddard, Everett	6
Greaves, Gerald, Jr.	11
Hancock, John	2
Henchon, William	1
Ivanowsky	18
Loura, E. L.	15
O'Brien, Thomas	12
Olney, Arthur	10
Podhurst, Eugene	13
Strong, Edgar	3, 4
Watson, Roy	16

TABLE II

ROCK DATA SHEET NO. 1

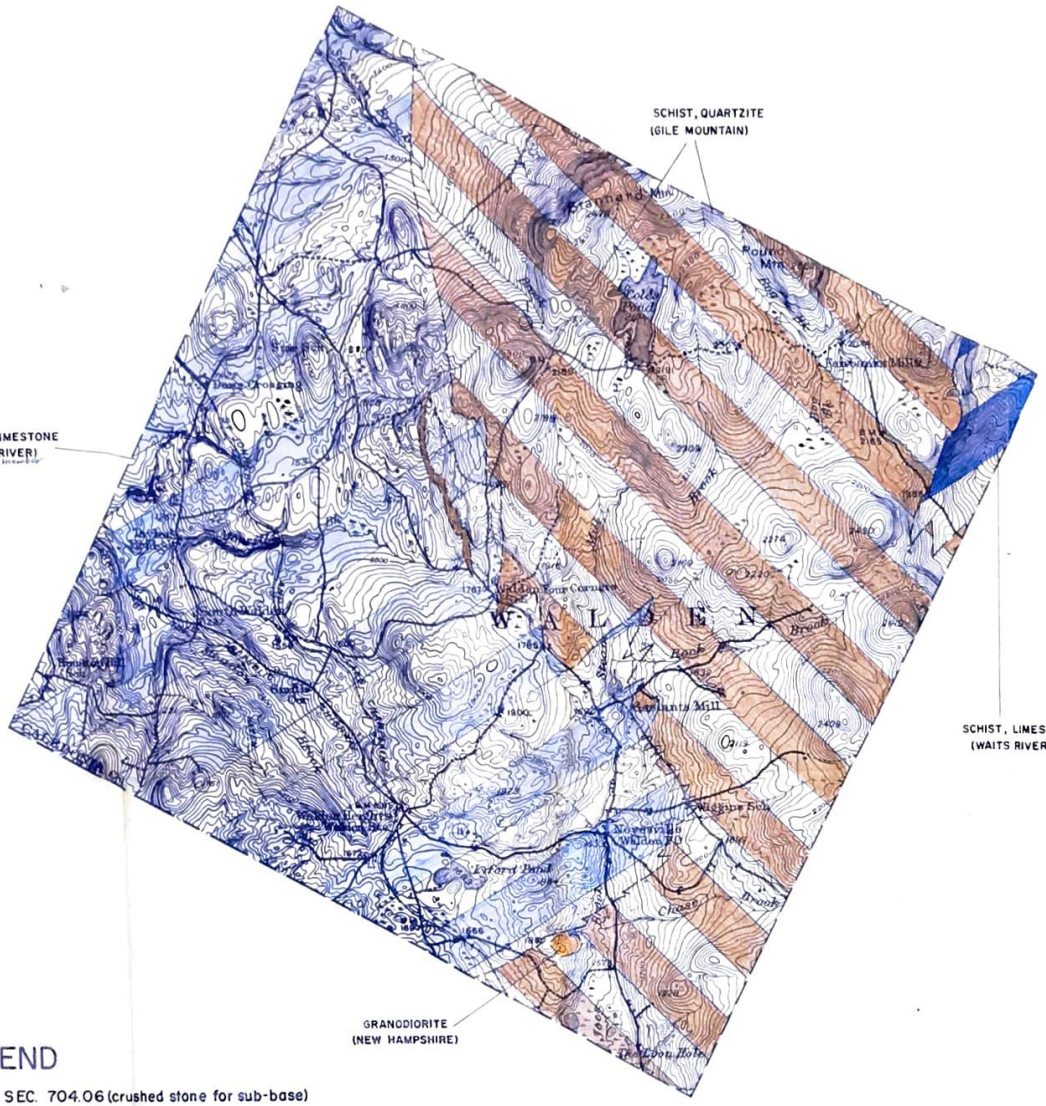
Ident. No.	Field Test No.	Year Field Tested	Rock Type	Existing Quarry	Method of Sampling	Abrasion AASHTO T-3	Abrasion AASHTO T-96	Remarks
1	1	1976	Phyllite	No	Chip	5.6%	26.3%	Owner: Peter Watson. Area is a 260' long bedrock exposure south of Town Highway No. 13 just west of its junction with Town Highway No. 52. Quartz-muscovite phyllite with interbedded amphibolite parallels Town Highway No. 13. Phyllite cleavage dips steeply west-northwest with a major joint system parallel to the cleavage, and a minor joint set oriented east-west. Ledges of this rock slope upward into a heavily wooded hillside to the south-southwest. Area is bounded on the east by a northward-flowing tributary of Stevens Brook. Test No. 1 extended from a utility pole at the east end of the area, westward for 130 feet to the midpoint of the outcrop.
	2	1976	Phyllite, Amphibolite	No	Chip	4.2%	38.3%	Test No. 2 continued 130' westward from the midpoint to the west end of the outcrop. Possible access for development is at the east end where the stream has gullied the hillside. Development would require clearing second-growth mixed woods; however, the owner was not eager to open a quarry.

TABLE II

SUPPLEMENT

WALDEN PROPERTY OWNERS - ROCK

	Map Identification No.
Watson, Peter	1



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)

WALDEN

SCALE 1:31,250

CONTOUR INTERVAL 20 FEET

1977

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

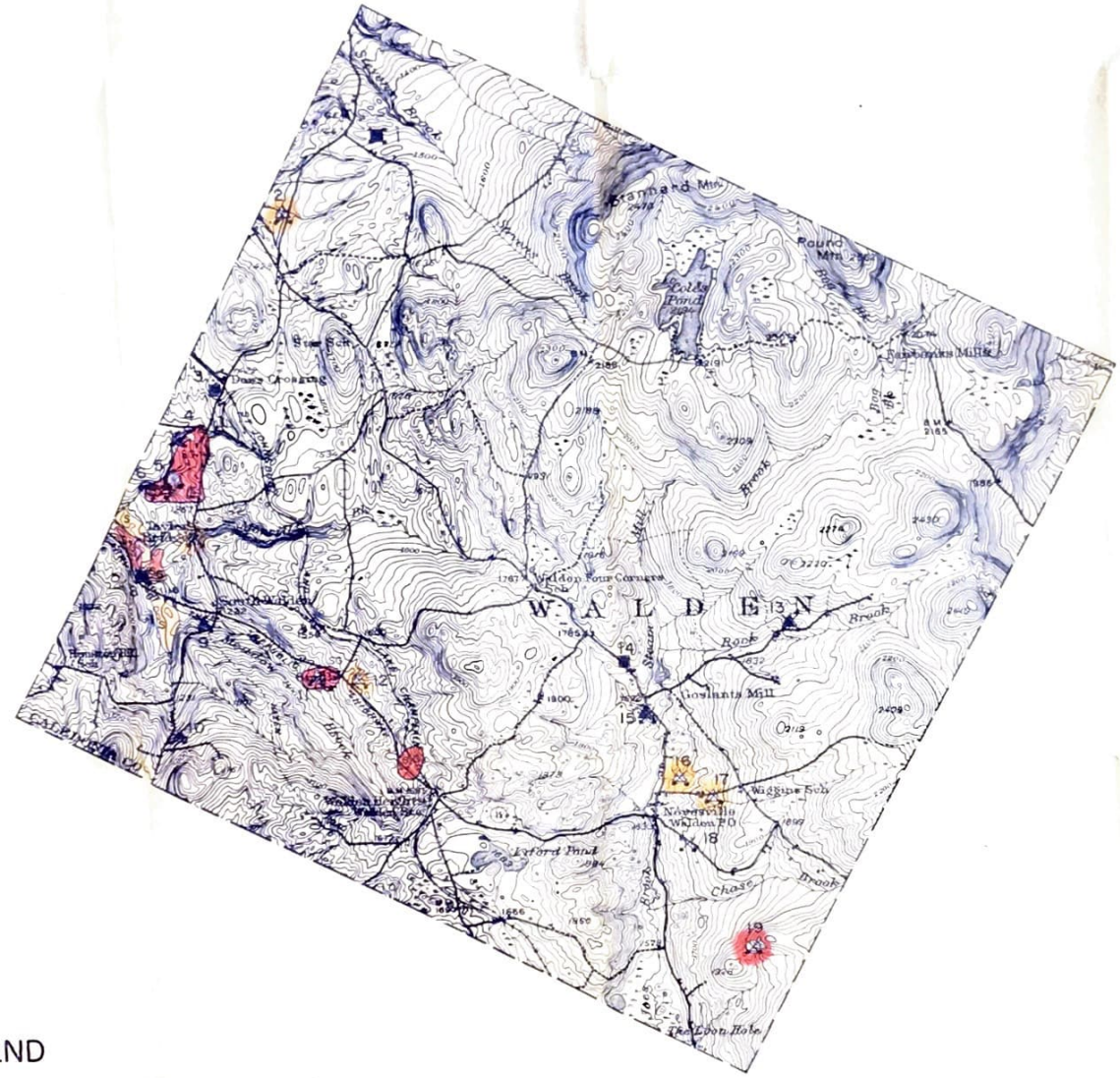
PLATE II

ROCK

CALEDONIA COUNTY VT. HWY. DISTRICT NO. 7

REVISIONS

DATE						
BY						



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)

WALDEN

SCALE 1:31,250

CONTOUR INTERVAL 20 FEET

1977

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 1

GRANULAR

CALEDONIA COUNTY VT. HWY. DISTRICT NO. 7

REVISIONS

DATE						
BY						