March 29, 1979
W.O. #A18769
ALEH #2

Southwest Region Schools
P.O. Box 196
Dillingham, Alaska 99576

Attention: Mr. Gary Smith
Facilities Coordinator

Subject; Soils Investigation
Proposed School Addition
Ekwok, Alaska

Gentlemen:

We present in this report the results of our soils investigation for the proposed addition to the Ekwok School. Ekwok is located approximately 40 miles northeast of Dillingham on the Nushagak River, as shown on the Vicinity Map, Figure 1. It is our understanding that the building will be a one-story, wood-frame classroom and multipurpose building and will not have a basement. Light foundation loads are expected.

R & M Consultants conducted a preliminary subsurface investigation at the site in August, 1978. Their investigation consisted of drilling three shallow borings at the approximate locations shown on Figure 2 and a reconnaissance of the site and borrow pit location. Their report was issued in August, 1978 and was entitled "Preliminary Subsurface Soil Investigation and Site Reconnaissance for the Proposed Addition to Ekwok School".

The purpose of our investigation was to determine subsurface conditions underlying the proposed addition, to develop design criteria for the recommended foundation types, and to determine design criteria for a new on-site waste water disposal system. To accomplish this purpose we have completed a program of field explorations, laboratory testing, and engineering analysis. The details and results of our field exploration and lab testing are presented in the text following the conclusions and recommendations. Our conclusions and recommendations, based on site observations and engineering analyses, are presented in the following sections of this report.

CONCLUSIONS

1. It is unlikely that permafrost or perennially frozen soils will be encountered, at least to depths of 15 ft., the maximum depth of our test holes.

2. The building may be supported on conventional spread footings and/or post and pad footings.

3. On-site soils are frost susceptible; therefore, precautions should be taken to minimize the possibility of frost heave. Recommendations to minimize frost heaving are included in this report.

4. On-site soils will be difficult to work if they become saturated. Saturation could occur from thawing of seasonally frozen soils, run-off into excavated areas, or precipitation.

5. The site is acceptable for an on-site waste-water system if such a system is properly designed and constructed.

6. A ground water table was not encountered within the 15 ft. maximum depth of our borings. Some seepage in the near surface soils was noted.

RECOMMENDATIONS

SITE GRADING AND DRAINAGE

Because the surficial soils become unstable when wet, adequate drainage must be maintained during construction. Grading must be such that no surface water can run into any excavated area. Slope the bottom of any excavations to drain to a sump outside the building limits. This is to control water that enters the building excavation either by seepage, precipitation or thawing of frozen soils. Excavation with a backhoe, rather than a Cat, to reduce disturbance of the soils could be advantageous.

Excavation for the foundations and crawl spaces should remove all predominantly silty and organic soils designated as Group A soils in this report. Underlying this group is a silty sand layer at a depth of 3 to 7 feet. The excavation should then be backfilled to footing level with compacted non-frost-susceptible soil as described in the foundation recommendations.

Final grading of the site should be such that drainage away from the building is assured. This grade should be at least 3 percent for 10 feet away from the structure and 1 1/2 percent elsewhere. "At grade" entrances to the building should be avoided if possible. Where such entrances are necessary, the exterior slab should be depressed 1 to 2 inches below finish floor.

FOUNDATIONS

The structure can be supported on continuous spread footings, and perimeter foundation walls. Interior support may be provided by post and pad footings. An allowable footing bearing capacity of 2,000 pounds per square foot may be used for dead and normally applied live loads. This capacity may be increased by one-third for wind or earthquake forces.

The minimum width for perimeter, continuous footings should be at least 16 inches. They should be placed at a depth of not less than four feet to the bottom of footing below final exterior grade. Interior pad footings should be at least 24 inches square and should be placed at a depth of 12 inches below final grade.

All footings should bear on a pad of non-frost-susceptible gravel having a minimum thickness of two feet. The gravel bearing pad should be at least twice the width of the footing and all fill underneath the footings must be compacted to at least 95 percent of the maximum density as obtained by the AASHTO T-80 (Modified Proctor) test or the Providence Field Standard. Natural soils underlying the gravel pad should be relatively undisturbed. If excessive disturbance occurs due to the excavation process, or water flowing into the excavation, the disturbed soils should be removed and additional gravel added. It would be prudent to have all excavations inspected for conformance to this requirement immediately prior to backfilling the excavation.

For additional protection from frost, place at least two inches of rigid non-water-absorbing, gas filled, polystyrene insulation to the outside of the footing wall from the top of the footing to the surface. In addition, a 2-foot wide, horizontal layer of insulation should be placed near the bottom of the exterior footings. The exterior side of the footing and foundation walls should be backfilled with non-frost-susceptible granular soils. Interior footings and the interior side of the footing walls may be backfilled, if required, with approved on-site or fill material. Since gravel is available, we recommend that all fill and backfill be granular soils. Figure 3 shows a sketch of the recommended foundation and footing configuration.

The foundations should be constructed in an expeditious manner. Excavations for the foundations should not proceed unless the contractor is prepared to immediately backfill them with compacted fill, pour the footings, construct the perimeter and post and pad foundations, and backfill around the footings.

All the above recommendations assume that the crawl space beneath the building will be heated throughout the life of the structure, including the construction period. If the crawl space is not heated, alternate foundation systems will have to be considered.

GRAVEL PAD AND SELECT BACK-FILL MATERIAL

As reported by R & M Consultants, Inc., there is a borrow pit approximately one mile from the school. This pit is located on the west side of the airfield. The pit contains a large amount of sandy gravel. It appears from the R & M report that this material will be adequate for backfill.

UNHEATED FOUNDATIONS

All unheated foundations, such as porch slabs, should not be connected structurally with the building. Any connections between unheated foundations and the building should be free to move or rotate so that significant uplift loads will not be applied to the building frame or footings.

ON-SITE SEWAGE SYSTEM

The percolation test gave a value of 7 1/2 minutes/inch. Using this rate as a basis, the U.S. Deparment of Health, Education, and Welfare's "Manual of Septic Tank Practice" (1969), gives a value of 1.9 sq. ft. per gallon per day for the seepage area. The system should be designed using the criteria as outlined in the above reference.

INSPECTION

We recommend the fill from the borrow pit be analyzed by Alaska Testlab for grain size distribution prior to construction to assure proper quality.

Earthwork and foundation construction activities should be observed by a qualified geotechnical engineer, or an engineering technician working under his direction. The inspection is to assure that: the footing and gravel pad beneath the footing is placed on undisturbed natural soils; the footings are constructed in accordance with the recommendations of this report, and the insulation is placed as recommended.

SITE CONDITIONS

SURFACE CONDITIONS

The school property sits on about 5 acres of relatively flat-lying ground in the approximate center of the village. An east-west running stream bed having a 20 to 25 ft. bank, borders the school property and village. The school property is covered with surface vegetation and scattered spruce with the exception of the northern 1/3 of the property. Here lies a cleared area with a gravel pad that ranges from 1 to 1 1/2 ft. thick. The school complex consists of the existing school building, shop and generator building, oil storage tank, and basketball court. The school currently has an enrollment of 25 children.

SUBSURFACE CONDITIONS

The subsurface exploration was conducted from the 15th to 17th of March. The program consisted of drilling 5 test holes at the locations shown on the site plan, Figure 2. The borings were drilled with a portable Minuteman drill rig, owned and operated by Denali Drilling, Inc. Drilling was supervised by Mr. Oz Hatch, Alaska Testlab Geologist/Field Engineer. He classified the soil encountered and the drilling process, maintained a continuous log of each boring, and obtained disturbed soil samples for further visual examination and laboratory testing. Samples were obtained by the use of a standard penetration sampler driven was with a 60 pound weight falling a distance of 30 inches. Samples were then placed in plastic bags and transported to the laboratory. In the laboratory, the moisture content and dry strength of each sample was determined.

For easy reference, samples of similar color, texture, and particle size distribution were given arbitrary group designations. Grain size analysis was then performed on the arbitrary groups. The logs of the test borings are presented in Table A, and the grain size distributions are shown on Sheets 4 and 5.

Group A - is a brown sandy non-plastic Silt. This soil type underlies a cover of sandy gravel and silts. It is found at a depth of from 1 to 3 ft. and is 1 1/4 to

5 1/2 ft. thick. The soil's Unified Classification is ML. It is highly frost-susceptible with a frost classification of F-4. See grain size distribution curve, Sheet 4.

Group B - is a brown silty fine to coarse Sand. It underlies Group A and varies from 5 1/2 to 10 1/2 ft. in thickness. Its Unified Classification is SM. This soil type is moderately frost susceptible having a frost classification of F-2. See grain size distribution curve, Sheet 5.

Group C - is a brown fine to medium Sand with a trace of silt. This soil type is found only in test hole 3 from 5 1/2 to 7 ft, sandwiched between Group A and B. Its Unified Classification is SP. It is moderately frost-susceptible, giving it a frost classification of NFS to F-2.

Group D - is a brown silty fine to coarse sandy Gravel. It underlies Group B. The amount of silt varies from test hole to test hole, but it is not a major constituent in any. Its Unified Classification is GP. This group is moderately frost susceptible, giving it a frost classification of F-1 to F-2.

A percolation test was performed in Boring 6. The test was conducted to determine whether the soils in the area would be adequate for an on-site waste-water disposal system. The test procedure involved filling the test hole with water and letting it sit overnight. The next day the test hole was again filled with water. After filling, the rate of fall over 60 minutes was recorded. From the recorded data, a percolation rate of 7.5 minutes per inch was calculated.

A ground water table was not encountered while drilling although some seepage was encountered in the near surface soils.

The following supplementary material is included for your use:

Vicinity Map	Figure 1
Site Plan	Figure 2
Footing Detail Sketch	Figure 3
Log of Borings	Table A
Standard Explanatory Information	Sheets 1-3
Grain Size Distribution Curves	Sheets 4-5

We trust this will give you the information and recommendations you need. If we can be of any further assistance to you, please let us know.

Sincerely,

ALASKA TESTLAB

James R. Finley, Jr.

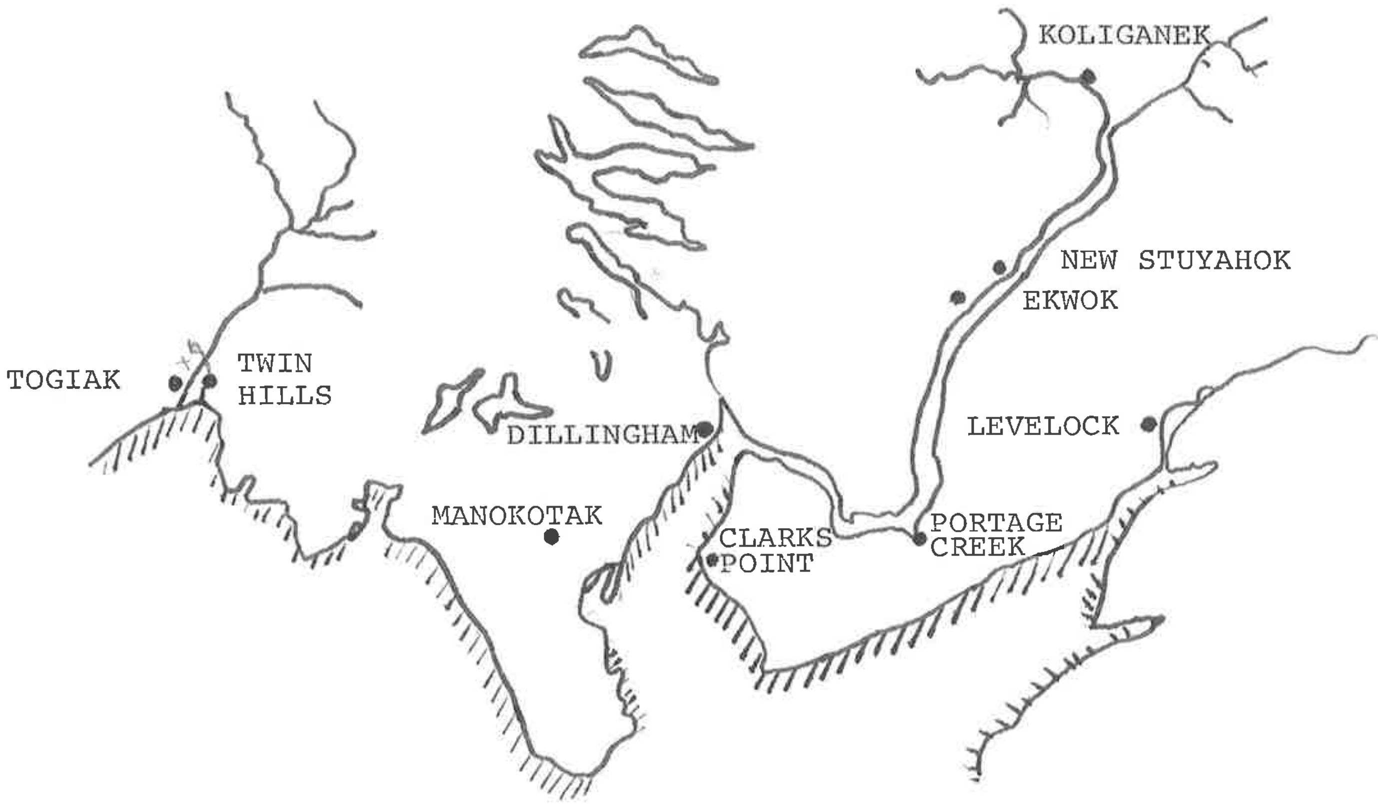
James R. Finley

APPROVED:

M. R. Nichols

Melvin R. Nichols, PE

JRF:gla:mm
Attachments



VICINITY MAP

Figure 1

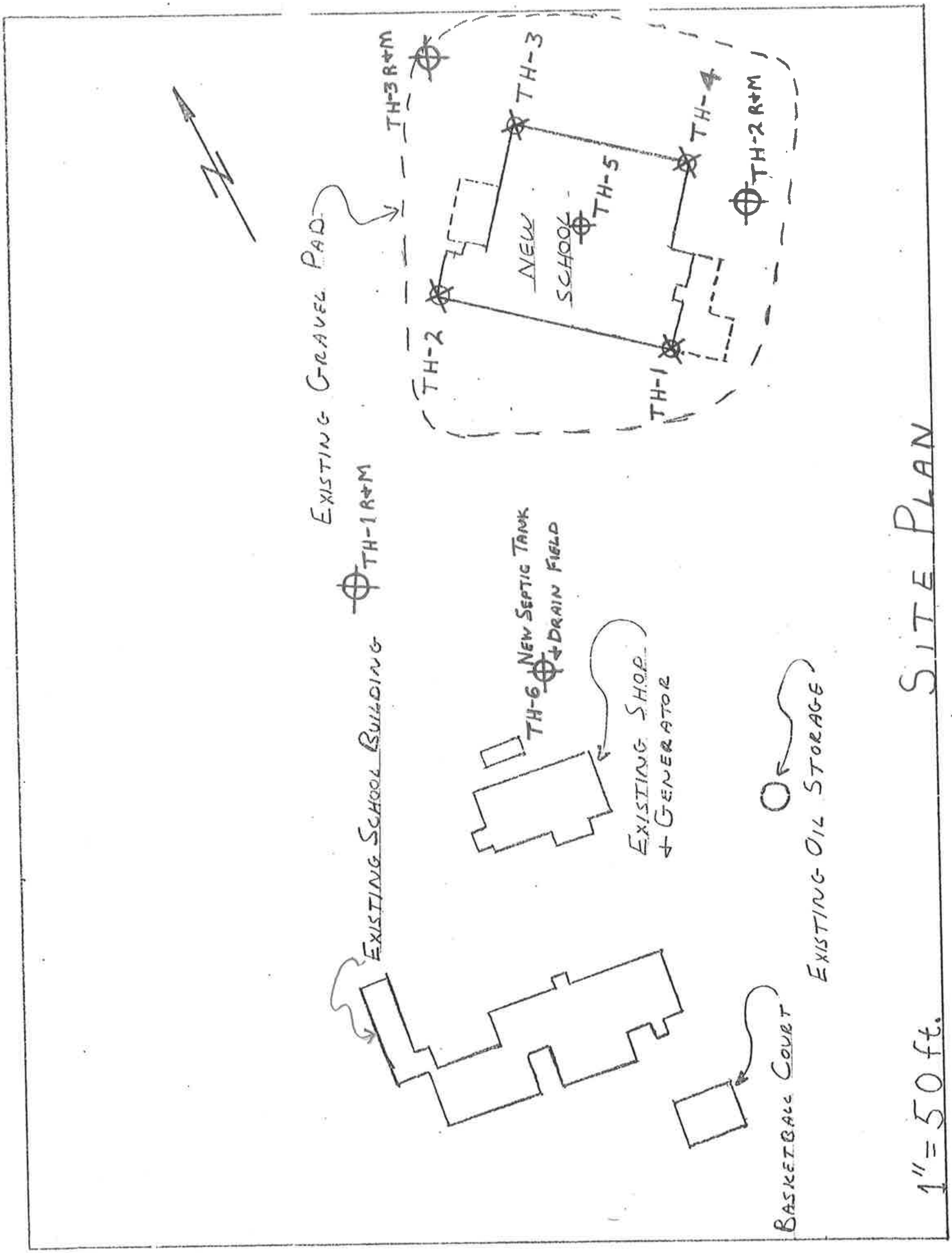
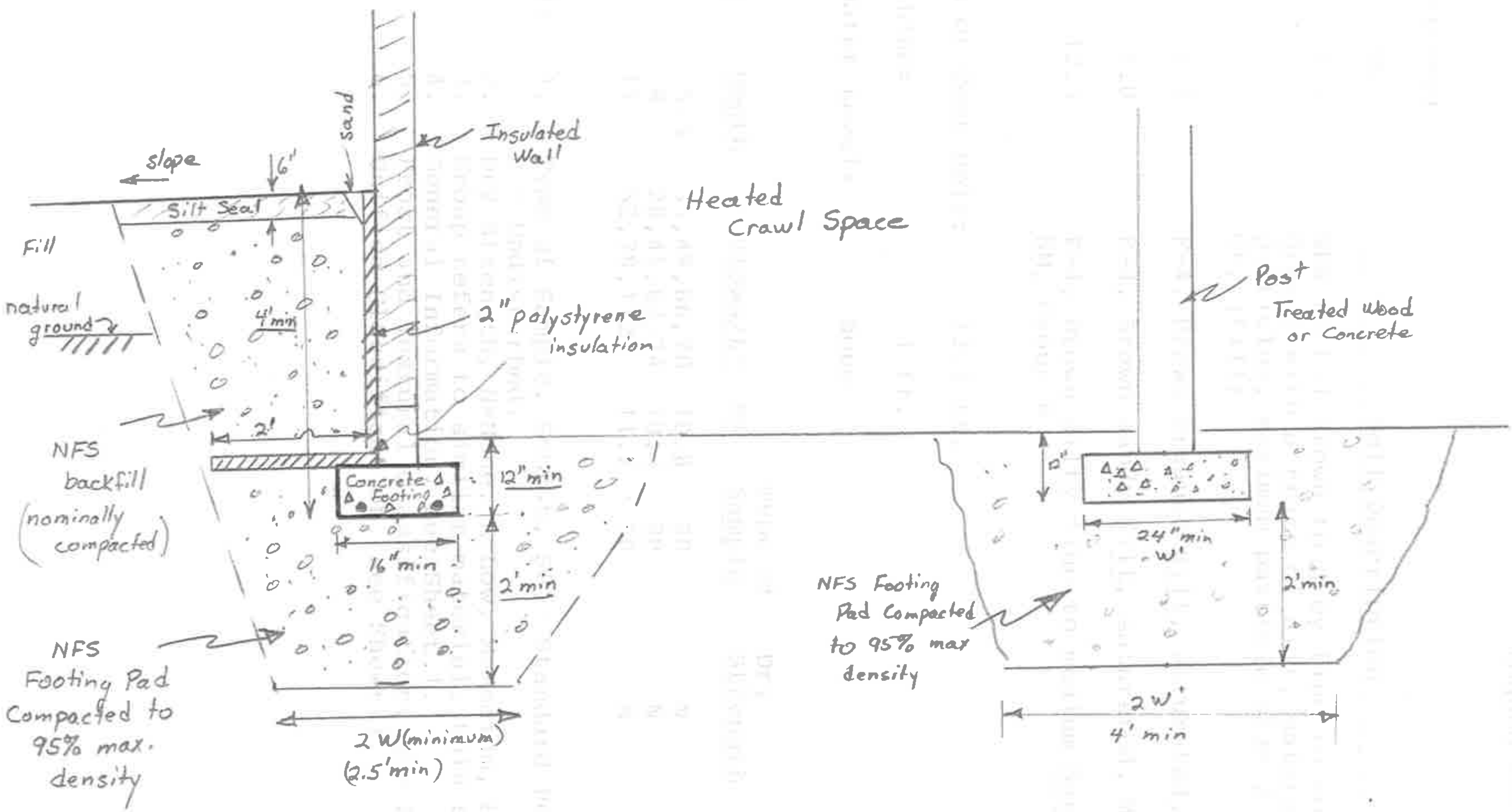

SITE PLAN
1" = 50 ft.
EXISTING GRAVEL PAD
TH-3 R+M
TH-3
TH-4
TH-2 R+M
TH-5
NEW
SCHOOL
TH-2
TH-1
TH-1 R+M
NEW SEPTIC TANK
+ DRAIN FIELD
TH-6
EXISTING SCHOOL BUILDING
EXISTING SHOP
+ GENERATOR
EXISTING OIL STORAGE
BASKETBALL COURT

FIGURE 2

JRT 3/30/79



FOOTING DETAIL SKETCH

Figure 3

Test Hole #1 TABLE A WO #A18769
Date: 3/17/79
Logged by: O.M. Hatch

Depth in Feet From	To	Soil Description
0	1.5	NFS to F-1 Brown to grey fine to coarse sandy Gravel with a trace of silt, saturated, round particles, maximum particle size 2 inches, GP, (Fill)
1.5	2.5	F-4, Brown organic Silt, saturated, OL
2.5	7.0	F-4, Brown sandy Silt, saturated, ML, Group A
7.0	12.5	F-4, Brown silty fine to medium Sand, damp, SM, Group B

Bottom of Test Hole: 12.5 ft.

Frost Line: 4 ft.

Free Water Level: None

Sample	Depth	Blows/6"	M%	Type of Sample	Dry Strength	Group	Unified	Temp. °F
1	5.5	35,48,66,70	10.8	SP	N	A	ML	37
2	8	28,45,62,74	10.3	SP	N	B	SM	27
3	11	52,78,112	11.2	SP	N	B	SM	37

Remarks
1. Type of Sample, G=Grab, SP = Standard Penetration, U = Undisturbed.
2. Dry Strength, N=None, L=Low, M=Medium, H=High.
3. Group refers to similar material, this study only.
4. General Information, see Sheet 1.
5. Frost and Textural Classification, see Sheet 2.
6. Unified Classification, see Sheet 3.

Test Hole #2 TABLE A WO #A18769

Date: 3/17/79

Logged by: O.M. Hatch

Depth in Feet		
From	**To**	**Soil Description**
0	.5	NFS to F-1, Brown to grey fine to coarse sandy Gravel, saturated, round particles, 2 inch maximum particle size, GP, (Fill)
.5	2.0	F-4, Brown organic Silt, saturated, OL
2.0	3.25	F-2, Brown silty fine to medium Sand, dry, acted like thaw, SM
3.25	4.0	F-4, Brown sandy Silt, damp stiff, non-plastic, ML, Group A
4.0	14.5	F-2, Brown silty fine to medium Sand, damp, dense SM, Group B

Bottom of Test Hole: 14.5 ft.

Frost Line: 3.5 ft.

Free Water Level: None

Sample	Depth	Blows/6"	M%	Type of Sample	Dry Strength	Group	Unified	Temp. °F
1	3	25, 250 for 1/4'	8.4	SP	N	A	ML	31
2	5	50,65,62,64	9.0	SP	N	B	SM	31
3	8	65,107 --	10.4	SP	N	B	SM	37
4	11	60,80,120--	8.9	SP	N	B	SM	38
5	14	58,140 for 1/10'		SP	N	B	SM	39

Remarks:

1. Type of Sample, G=Grab, SP = Standard Penetration, U = Undisturbed.
2. Dry Strength, N=None, L=Low, M=Medium, H=High.
3. Group refers to similar material, this study only.
4. General Information, see Sheet 1.
5. Frost and Textural Classification, see Sheet 2.
6. Unified Classification, see Sheet 3.

Test Hole #3 TABLE A WO #A18769

Date: 3/17/79

Logged by: O.M. Hatch

Depth in Feet From	To	Soil Description
0	1	NFS to F-1, Brown to grey fine to coarse sandy Gravel with a trace of silty, saturated, rounded particles, maximum particle size 2 inches, GP, (Fill)
1	2	F-4, Brown organic Silt, saturated, OL
2	5.5	F-4, Brown sandy Silt, damp to saturated, dense, ML, Group A
5.5	7	NFS to F-2, Brown fine to medium Sand with a trace of silt, dry to damp, dense, SP, Group C
7	13	F-2, Brown silty fine Sand, damp dense, SM, Group B
13	15	NFS to F-1 Brown fine to coarse sandy Gravel, with a trace of silt, damp dense, rounded particles, maximum particle size 2 inches, GP, Group D

Bottom of Test Hole: 15 ft.

Frost Line: 3.5 ft.

Free Water Level: None

Sample	Depth	Blows/6"	M%	Type of Sample	Dry Strength	Group	Unified	Temp. °F
1	2	75,95 to 1/4'	12.8	SP	N	A	ML	31
2	5.5	37,70,128 --	11.7	SP	N	C	SP	37
3	8	23,28,45 ---	6.3	SP	N	B	SM	37
4	11	71,163 ---	9.8	SP	N	B	SM	27
5	14	163,95 for 1/16'	3.1	SP	N	D	GP	38

Remarks:
1. Type of Sample, G=Grab, SP = Standard Penetration, U = Undisturbed.
2. Dry Strength, N=None, L=Low, M=Medium, H=High.
3. Group refers to similar material, this study only.
4. General Information, see Sheet 1.
5. Frost and Textural Classification, see Sheet 2.
6. Unified Classification, see Sheet 3.

Test Hole #4 TABLE A WO #A18769
Date: 3/16/79
Logged by: O.M. Hatch

Depth in Feet From	To	Soil Description
0	1	NFS, Brown to grey fine to coarse sandy Gravel, with a trace of silty, saturated, rounded particles, maximum particle size 2 inches, GP, (Fill)
1	1.5	F-4, Brown organic Silt, saturated, OL
1.5	7.0	F-4, Brown fine sandy Silt, damp to saturated, dense, ML, Group A
7.0	12.5	F-2, Brown silty fine Sand, damp dense, silt content increases with depth, SM, Group B
12.5	14.5	F-1, Brown slightly silty fine to coarse Sandy Gravel, damp, dense, rounded particles, maximum particle size 2 inches, GP, Group D

Bottom of Test Hole: 14 4/10 ft.

Frost Line: 3 ft.

Free Water Level: None

Sample	Depth	Blows/6"	M%	Type of Sample	Dry Strength	Group	Unified	Temp. °F
1	4.5	35,70,87	9.3	SP	N	A	ML	37
2	8.0	32,43,48,65	5.4	SP	VL	B	SM	37
3	11.0	31,92,	5.6	SP	N	B	SM	37
4	14.0	150 for 4/10'	2.1	SP	N	D	GP	35.4

Remarks:
1. Type of Sample, G=Grab, SP = Standard Penetration, U = Undisturbed.
2. Dry Strength, N=None, L=Low, M=Medium, H=High.
3. Group refers to similar material, this study only.
4. General Information, see Sheet 1.
5. Frost and Textural Classification, see Sheet 2.
6. Unified Classification, see Sheet 3.

Test Hole #5 TABLE A WO #A18769

Date: 3/15/79

Logged by: O.M. Hatch

Depth in Feet From	To	Soil Description
0	1	NFS to F-1, Brown to grey fine to coarse sandy Gravel, with a trace of silt, saturated, rounded particles, maximum particle size 2 inches, GP, (Fill)
1	6	F-4, Brown fine sandy Silt, saturated, ML, Group A
6	12	F-2, Brown silty fine Sand, dry to damp, dense, SM, Group B
12	13 3/4	F-1 to F-2, Brown silty fine to coarse sandy Gravel, damp, dense, rounded particles, maximum particle size 2 inches, GP, Group D

Bottom of Test Hole: 13 3/4 ft.

Frost Line: 3 1/2 ft.

Free Water Level: None

Sample	Depth	Blows/6"	M%	Type of Sample	Dry Strength	Group	Unified	Temp. °F
1	5	98,87 for 1/4'	10.1	SP	N	A	ML	36
2	8	50,88,108	6.8	SP	N	B	SM	--
3	11	65,109, --	8.9	SP	N	B	SM	--
4	13	58,200 for 1/4'	3.2	SP	N	P	GP	34.8

Remarks:
1. Type of Sample, G=Grab, SP = Standard Penetration, U = Undisturbed.
2. Dry Strength, N=None, L=Low, M=Medium, H=High.
3. Group refers to similar material, this study only.
4. General Information, see Sheet 1.
5. Frost and Textural Classification, see Sheet 2.
6. Unified Classification, see Sheet 3.

Test Hole #6 TABLE A WO #A18769

Date: 3/15/79

Logged by: O.M. Hatch

Depth in Feet		
From	To	Soil Description
0	1	F-4, Brown organic Silt, OL
1	3	F-4, Brown sandy Silt, damp to saturated, stiff, non-plastic, ML, Group A
3	12	F-2, Brown silty fine to medium Sand, damp, SM, Group B

Bottom of Test Hole: 12 ft.

Frost Line: 2 1/2 ft.

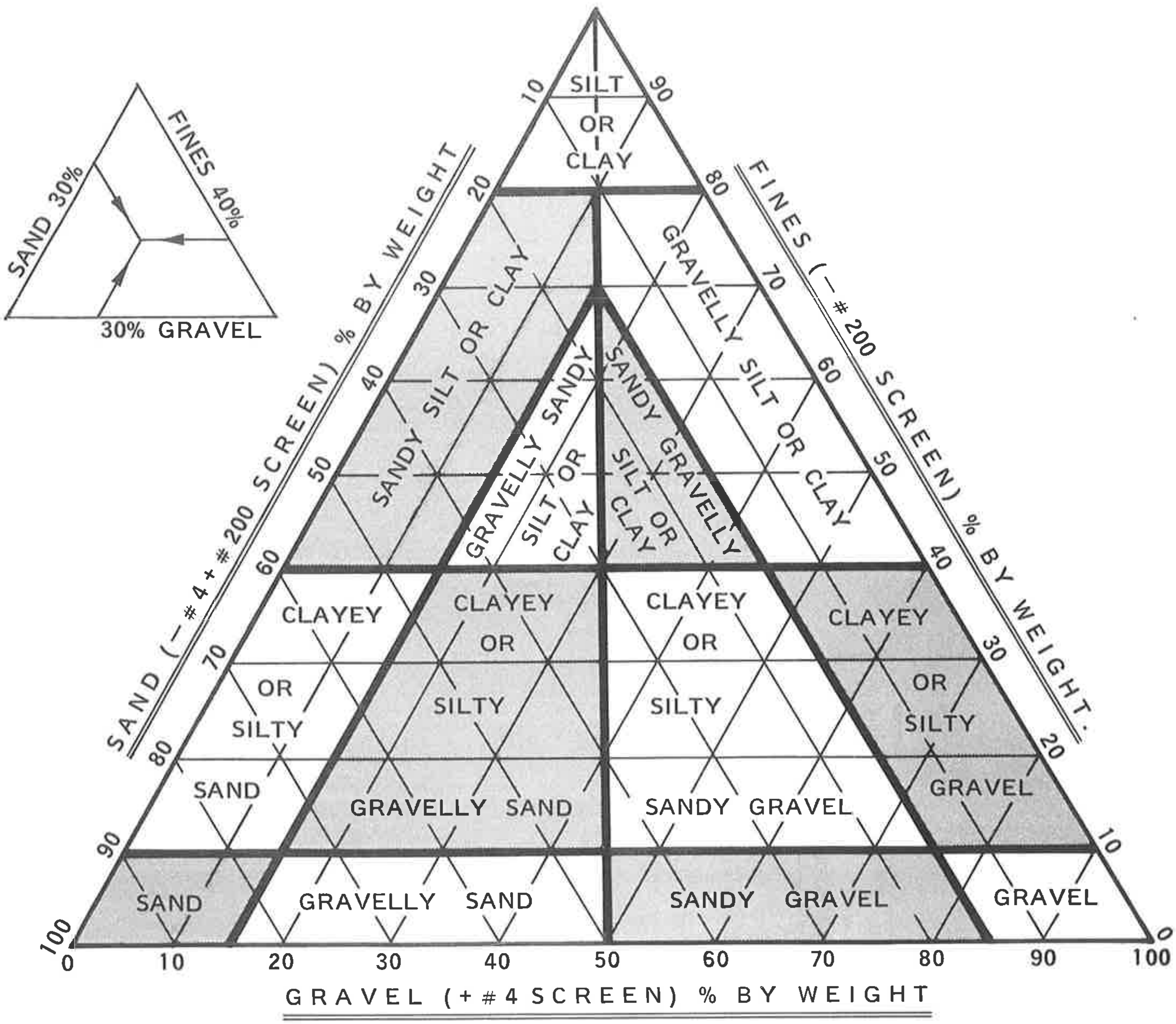
Free Water Level: None

Sample	Depth	Blows/6"	M%	Type of Sample	Dry Strength	Group	Unified	Temp. °F
1	10		11.2	G	VL	B	SM	

Remarks:

1. Type of Sample, G=Grab, SP = Standard Penetration, U = Undisturbed.
2. Dry Strength, N=None, L=Low, M=Medium, H=High.
3. Group refers to similar material, this study only.
4. General Information, see Sheet 1.
5. Frost and Textural Classification, see Sheet 2.
6. Unified Classification, see Sheet 3.

SOIL CLASSIFICATION CHART



NONFROST SUSCEPTIBLE SOILS ARE INORGANIC SOILS CONTAINING LESS THAN 3% FINER THAN 0.02 mm.
GROUPS OF FROST-SUSCEPTIBLE SOILS:

- F1 GRAVELLY SOILS CONTAINING BETWEEN 3 AND 20% FINER THAN 0.02 mm.
- F2 SANDY SOILS CONTAINING BETWEEN 3 AND 15% FINER THAN 0.02 mm.
- F3 a. GRAVELLY SOILS CONTAINING MORE THAN 20% FINER THAN 0.02 mm. AND SANDY SOILS (EXCEPT FINE SILTY, SANDS) CONTAINING MORE THAN 15% FINER THAN 0.02 mm.
  - b. CLAYS WITH PLASTICITY INDEXES OF MORE THAN 12. EXCEPT VARVED CLAYS.
- F4 a. ALL SILTS INCLUDING SANDY SILTS.
  - b. FINE SILTY SANDS CONTAINING MORE THAN 15% FINER THAN 0.02 mm.
  - c. LEAN CLAYS WITH PLASTICITY INDEXES OF LESS THAN 12.
  - d. VARVED CLAYS.

Test Hole Log — Description Guide

The soil descriptions shown on the logs are the best estimate of the soil's characteristics at the time of field examination and as such do not achieve the precision of a laboratory testing procedure. If the log includes soils samples, those samples receive an independent textural classification in the laboratory to verify the field examination.

The logs often include the following items:

Depth Interval — usually shown to 0.1 foot, within that zone no significant change in soil type was observed through drill action, direct observation or sampling.

Frost Classification — NFS, F1, F2, F3, F4, see "Soil Classification Chart"

Texture of Soil — An engineering classification of the soils by particle size and proportion, see "Soil Classification Chart", note the proportions are approximate and modifications to the soil group due to stratification, inclusions and changes in properties are included.

Moisture Content — this is a qualitative measure:
- dry, no or little apparent surface moisture,
- damp, moisture forms portion of color, less than plastic limit,
- wet, no free water, often soft, if cohesive soil,
- saturated, free water may be squeezed out, if a free draining soil; dilatent at natural moisture content, if a non-plastic silt or fine sand. (The moisture content is further defined by reference to Pl, Lw, NP, M% or dilatency.)

Density — refers to more-or-less non-cohesive soils, such as sand gravel mixtures with or without a fine fraction, derived from drilling action and/or sample data; usually described as: very loose, loose, medium dense, very dense. General intent is to portray earthwork characteristics.

Stiffness — refers to more-or-less cohesive soils and fine grained silts of the clay-silt groups. Derived from drill action and/or sample data. Very soft, soft, stiff, very stiff and hard are commonly used terms.

Particle size — The largest particle recovered by the split spoon is 1-3/8", Shelby tube 3", auger flights (minute-man) 2", Auger flights (B-50 hollow stem) 6"-8". Larger particles are described indirectly by action of the drilling and are referred to as cobbles, 3" to 8", or boulders 8"+. Therefore when reviewing the gradation sheets, if any, the description on the hole log must be considered for an indication of larger particles.

Unified Soil Classification — This is a two letter code. See Unified Classification sheet for further definition. In some cases AASHO and/or FAA soil classifications may be shown as well as the unified.

Atterberg Limits — useful for fine grained and other plastic soils.

Pl; natural moisture content believed to be less than plastic limit

Pl+; natural moisture content believed to be between plastic and liquid limits

Lw+; natural moisture content believed to be greater than liquid limit

NP; non-plastic, useful as a modifying description of some silty materials.

Dilatency — is the ability of water to migrate to the surface of a saturated or nearly saturated soil sample when vibrated or jolted — used as an aid to determine if a fine grained soil is a slightly or non-plastic silt or a volcanic ash.

Rock flour — finely ground soil that is not plastic but otherwise appears similar to a clayey silt.

Organic Content — usually described as Peat, PT, sometimes includes discrete particles such as wood, coal, etc. as a modifier to an inorganic soil. Quantity described as; trace, or an estimate of volume, or, in case of all organic, — as Peat. This may include tundra, muskeg and bog material.

Muck — a modifier used to describe very soft, semi-organic deposits usually occuring below a peat deposit.

Amorphus peat — organic particles nearly or fully disintegrated.

Fibrous Peat — organic particles more-or-less intact.

Bottom of Testhole — includes last sample interval.

Frost Line — seasonal frost depth as described by drilling action and/or samples at the time of drilling.

Frozen Ground — other than frost line, described by samples, usually includes description of ice content, often will include modified Unified Classification for frozen soils — this is a special case related to permafrost studies.

Free Water Level — The free water level noted during drilling. This is not necessarily the static water table at the time of drilling or at other seasons. Static water table determination in other than very permeable soils requires observation wells or piezometer installations, used only in special cases.

Blow/6" — The number of blows of a 140 weight free falling 30" to advance a 2" split spoon 6"; the number of blows for a 12" advance is, by definition, the standard penetration.

M% -- natural moisture content of the soil sample, usually not performed on clean sands or gravels below the water table.

Type of Sample —
- SP, refers to 2" split spoon driven into the soil by 140 pound weight, a disturbed sample,
- S, thin wall tube, "Shelby" used to obtain undisturbed samples of fine grained soil,
- G, "grab" disturbed sample from auger flights or wall of trench,
- C, cut sample, undisturbed sample from wall of trench.

Dry Strength — a useful indicator of a soil's clayey fraction, N=None, L=Low, M=Medium, H=High

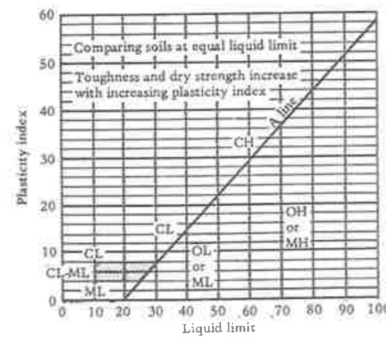
Group — The samples are placed into apparently similar groups based on color and texture and are arbitrarily assigned a group letter. Further disturbed tests including Atterberg Limits, grain size, moisture-density relationship, etc. may be performed on the group and are assumed to reflect the general distrubed characteristics of the soils assigned to the group. This is an important phase of the soil analysis and is used to standardize the various qualitative determinations and to reduce the number of quantitative tests necessary to describe the soil mass.

UNIFIED SOIL CLASSIFICATION SYSTEM

Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)				Group Symbols a	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils: More than half of material is larger than No. 200 sieve size b (The No. 200 sieve size is about the smallest particle visible to naked eye)	Gravels: More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size)	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the course grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see ML below)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits below "A" line, or PI less than 4 — Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			Plastic fines (for identification procedures, see CL below)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with PI greater than 7
	Sands: More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	SW	Well graded sands, gravelly sands, little or no fines	Example: Silty sand, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM)	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see ML below)	SM	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or PI less than 5 — Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
			Plastic fines (for identification procedures, see CL below)	SC	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with PI greater than 7

Laboratory classification criteria for coarse-grained soils: Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols

Fine-grained soils: More than half of material is smaller than No. 200 sieve size	Identification Procedures on Fraction Smaller than No. 40 Sieve Size: Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols a	Typical Names	Information Required for Describing Soils
Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
	Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
	High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays	Example: Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)
	Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity	
Highly Organic Soils	Readily identified by colour, odour, spongy feel and frequently by fibrous texture			Pt	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

From Wagner, 1957.
a Boundary classifications. Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW – GC, well graded gravel-sand mixture with clay binder.
b All Sieve sizes on this chart are U. S. standard

Field Identification Procedure for Fine Grained Soils or Fractions

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking):

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.

Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics):

After removing particles larger than No. 40 sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit):

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eight inch in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

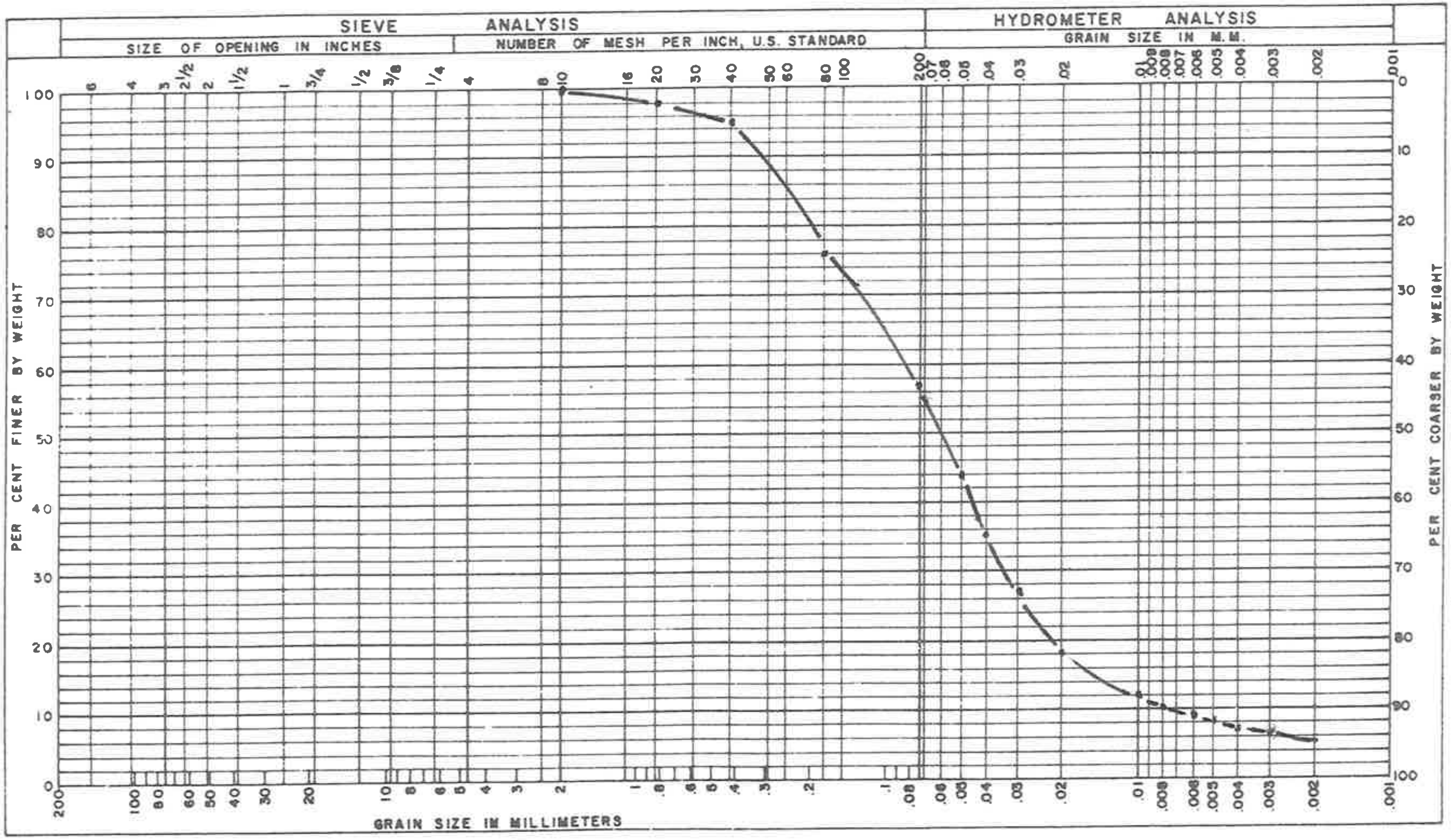
ALASKA TESTLAB

4040 B STREET
ANCHORAGE ALASKA 99503

Sheet 4 of 5
W. O. No. A18769
Date 3-19-79
Technician TB

Textural Class Sandy Silt
Frost Class F-4 Unified Class ML
Plastic Properties
Date Received

Client Southwest Region School
Project 3 Rural School Site Studies (Ekwok)
Sample Number Group A
Location
Sample Taken By ATL (OMH)



U.S. STD. SIEVE	CUM. % PASS
2	
1 1/2	
1	
3/4	
1/2	
3/8	
4	
10	100
20	98
40	95
80	76
100	--
200	57
0.02 MM	18

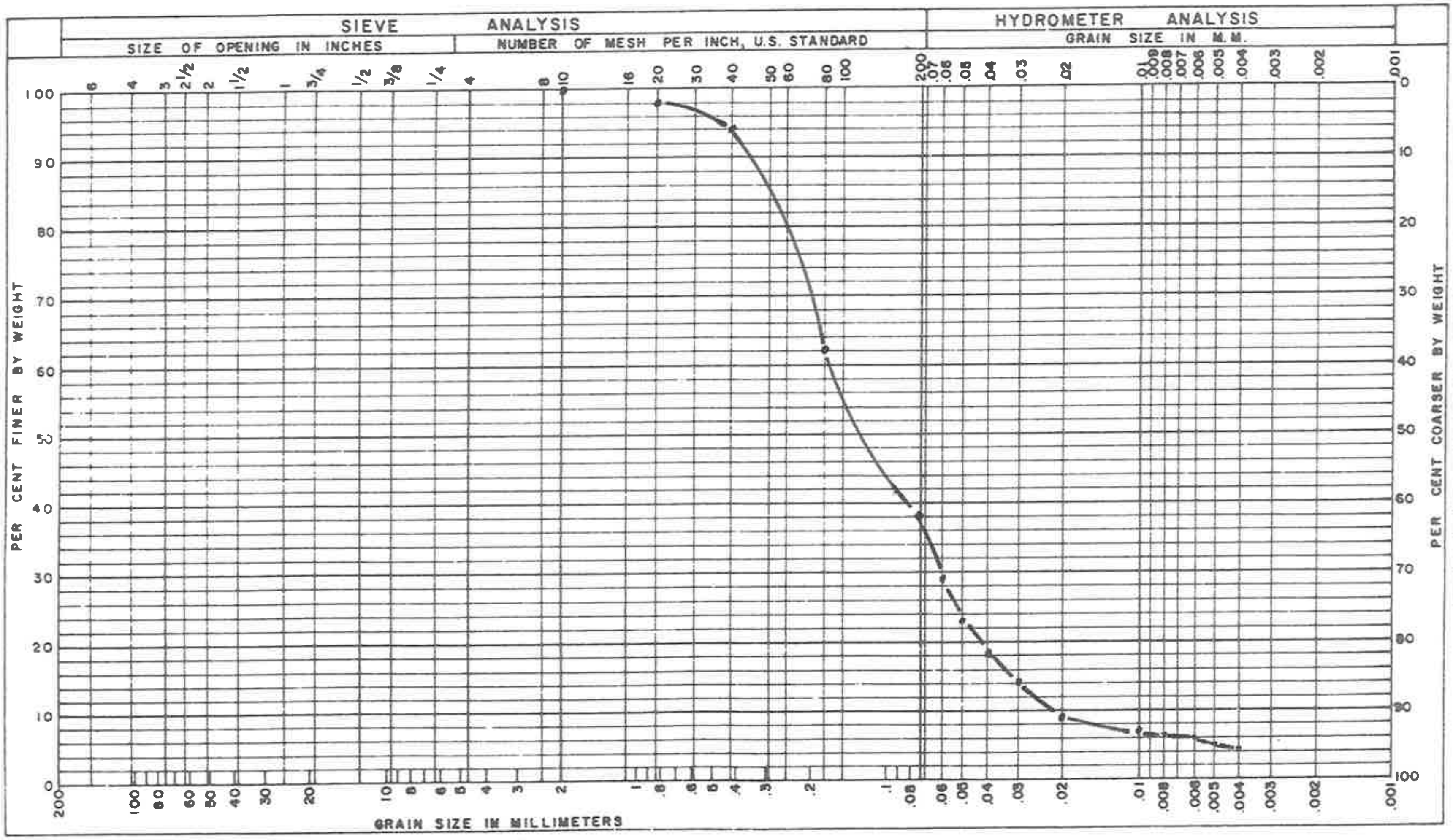
ALASKA TESTLAB

4040 B STREET
ANCHORAGE ALASKA 99503

Sheet 5 of 5
W. O. No. A18769
Date 3-19-79
Technician TB

Textural Class Silty Sand
Frost Class F-2 Unified Class SM
Plastic Properties
Date Received 3-19-79

Client Southwest Region School
Project 3 Rural School Site Studies (Ekwok)
Sample Number Group B
Location
Sample Taken By ATL (OMH)



U.S. STD. SIEVE	CUM. % PASS
2	
1 1/2	
1	
3/4	
1/2	
3/8	
4	
10	100
20	98
40	94
80	62
100	--
200	38
0.02 MM	8.8