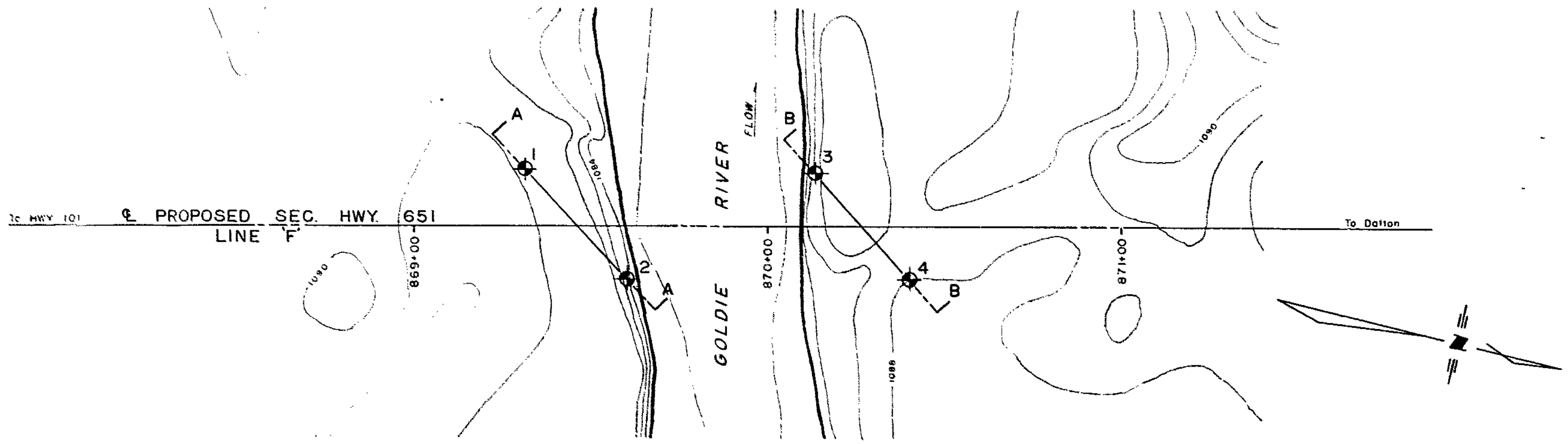
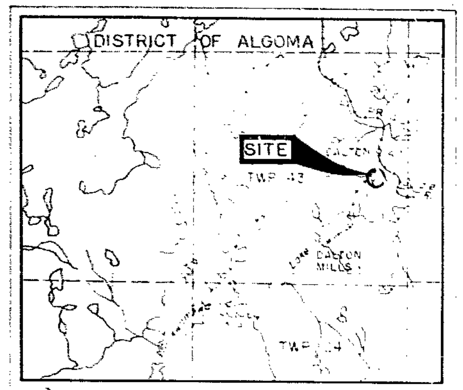
#66-F-215-C
W.P. #412-65
HWY. #651 &
PROPOSED
GOLDIE RIVER
BRIDGE



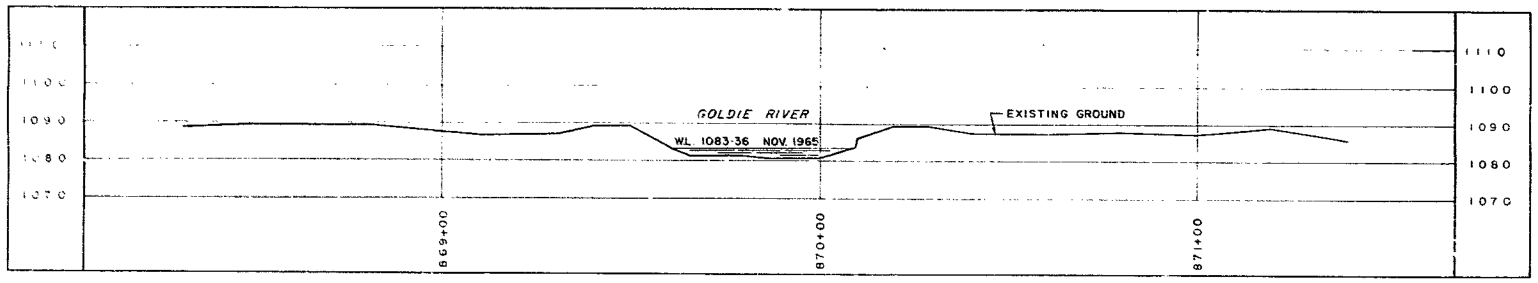
PLAN

SCALE

20 10 0 20 40 FT.



KEY PLAN



℄ PROFILE LINE 'F'

SCALE

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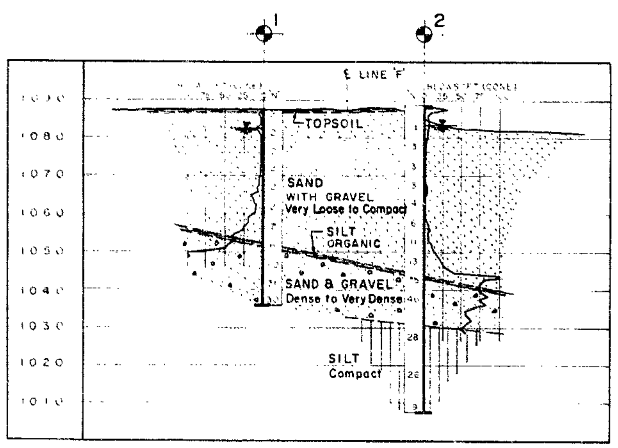
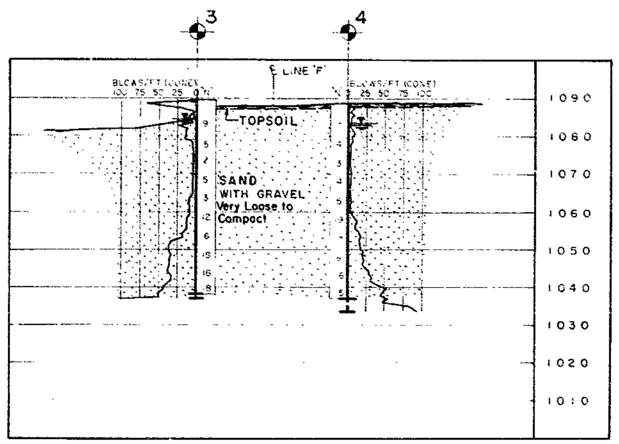


A – A



B – B

SECTIONS

SCALE

20 10 0 20 40 FT.

LEGEND

Bore Hole

Cone Penetration Hole

Bore & Cone Penetration Hole

Water Levels established at time of field investigation. (Mar 1966)

NO.	ELEVATION	STATION	OFFSET
1	1087·6	869+31	16' LT.
2	1088·8	869+60	15' RT
3	1089·8	870+13	15' LT
4	1088·6	870+40	15' RT

B.M. 1092.53 GEODETIC DATUM
N. & A. in top O.4 Balsam Stp
82' Rt. of Sta. 871+36

– NOTE –

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
DATE	BY	DESCRIPTION

GEOCON LTD

DEPARTMENT OF HIGHWAYS – ONTARIO
MATERIALS & TESTING DIVISION – FOUNDATION SECTION

GOLDIE RIVER

KING'S HIGHWAY NO. 651 DIST. NO. 18
DISTRICT OF ALGOMA
TWP. 43 LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. H.L.M.	CHECKED D.B.O.	W.P. NO. 412-65	DRAWING NO. T7856-1
DRAWN A.E.L.	CHECKED J.N.B.	JOB NO.	
DATE APRIL 7, 1966		SITE NO.	BRIDGE DRAWING NO.
APPROVED D.B. Oalis		CONT NO.	

REF. NO. E-4544-1

PRINT RECORD		
NO.	FOR	DATE

CC: Foundations Office (Rm. 110)
Extra copy

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

Attentimn: Mr. S. McCombie

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

DATE: April 22, 1966

OUR FILE REF.

IN REPLY TO APR 22 1966

SUBJECT: FOUNDATION INVESTIGATION REPORT BY:
Geocon, Limited, Consulting Engineers -
Proposed Goldie River Bridge, Sec. Hwy. 651,
Line "F", Dalton, Ont. - District No. 18 -
W.P. 412-65

Attached, please find the above mentioned report prepared and submitted by the consultant, Geocon, Ltd. We have reviewed the report and have found the factual information well presented.

In the report the consultant draws attention to the dewatering that would have to be undertaken if work is to be carried out below ground water table. Two dewatering procedures are outlined and discussed. In view of the necessity for dewatering, we would suggest that piles that could be used as piers, be given serious consideration. Such a solution would eliminate the need of dewatering and could, therefore, provide a more economical design. For such an alternative, we would suggest the use of steel tube piles whose length can be easily and readily adjusted.

Yet another type of pile that would be very suitable for this type of material is the cast-in-place "Franki type" pile. A much greater capacity per pile could be achieved and combined with the afore mentioned proposal, could also provide a very economical solution.

We trust that you will have sufficient information to proceed with and complete your design work. However, should you have any queries, please feel free to contact this Office.

AGS/MdeF
Attach.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
H. W. Hurrell
J. A. Knowles
E. R. Saint
F. De Visser
A. Watt

Foundations Office
Gen. Files

GEOCON LTD

HEAD OFFICE

420 MICHEL JASMIN, DORVAL, QUEBEC
TELEPHONE 631-9827

DISTRICT OFFICES

14 HAAS ROAD
REXDALE, TORONTO, ONT.
TEL. 244-6476

295 EAST 11TH AVENUE
VANCOUVER 10, B.C.
TEL. 879-2620

Rexdale, Ontario,
April 6, 1966.

Department of Highways, Ontario,
Downsview, Ontario.

Attention: Mr. A. G. Stermac, P. Eng.,
Principal Foundation Engineer.

Re: Soil Conditions and Foundations
Proposed Goldie River Bridge
Sec. Highway 651, Line "F"
Dalton, Ontario.

412-65

Dear Sirs:

This letter accompanies our detailed report on the above investigation.

We find that the overburden consists of at least 80 feet of very loose to very dense sand or sand and gravel and silt. In general, the upper 30 to 35 feet of the deposit is very loose to loose. The soil conditions encountered are described in detail in the report.

In view of the generally very loose to loose nature of the upper 30 to 35 feet of the overburden, spread footings are not considered a practical foundation solution for the proposed bridge. The most suitable foundation is believed to be the use of piles as discussed in the report. Recommendations covering pile design and foundation and embankment construction and scour protection are given in the report.

....2

We believe that this report presents all the information required from this investigation. Should you have any questions or if we can be of further assistance otherwise, please do not hesitate to call us.

Yours very truly,

GEOCON LTD.,

D.B. Oates

D. B. Oates, P. Eng.
District Engineer.

DBO/a

T.7856

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED GOLDIE RIVER BRIDGE

SEC. HIGHWAY 651 - LINE "F"

DALTON ONTARIO

Distribution:

12 copies - Department of Highways, Ontario
Downsview, Ontario

3 copies - Geocon Ltd.,
Rexdale, Ontario

GEOCON

I N D E X

INTRODUCTION

Geocon Ltd. has been retained by the Department of Highways, Ontario by letter dated February 23, 1966, Local Purchase Order No. J. 34805 to carry out a foundation investigation for the proposed crossing at Goldie River, approximately one mile south of Dalton, Ontario

The purpose of the investigation was to determine the soil conditions at the site of the proposed crossing as required for the design of foundations for the proposed structure.

SUMMARIZED SOIL CONDITIONS

The site is underlain by deposits of granular material having a thickness in excess of 80 feet. The deposits consist of strata of sand with gravel and sand and gravel becoming silt below about 58 feet depth. The upper 30 to 35 feet of the sand with gravel has a very loose to loose relative density. The relative density of the sand with gravel to sand and gravel below 30 to 35 feet ranges generally from compact on the north side of the river, to dense to very dense with depth on the south side of the river.

At the time of the investigation, the water level in the river was at about elevation 1083. The water level as encountered at the boreholes during the investigation was between elevations 1082 and

1084, that is at river level.

DISCUSSION

General

It is understood that it is proposed to construct a bridge over the Goldie River at the site investigated. As presently planned the bridge will consist of three spans with piers and abutments located as shown on the attached Drawing No. T. 7856-1. It is further understood that the proposed elevation of the grade at the structure will be 1109. Other design details with respect to the proposed bridge are not available to us at time of this writing.

Foundations

The soil conditions at the site consist of a deep granular deposit composed of sand with gravel, becoming sand and gravel with depth. The sand and gravel is underlain by silt. The relative density of the deposits range generally from very loose to compact for the sand with gravel, dense to very dense where the sand and gravel was encountered on the south side of the river, and compact in the silt. The upper 30 to 35 feet of soil are generally very loose to loose.

Foundations (continued)

Because of the very loose to loose relative density of the surface strata and the fact that the soil is scour susceptible, the site is not considered suitable for the practical use of spread footings for the foundations of the proposed structure. The most suitable foundation solution appears therefore to be the use of piles.

In view of the increase in relative density of the sand with gravel or sand and gravel strata at about elevation 1040, as observed from the standard and dynamic cone penetration tests, the most suitable pile type would be a displacement type which derives its support partly by side friction and partly by point resistance within the granular overburden. Suitable displacement pile types would be treated timber piles, steel pipe piles driven closed end or pre-cast concrete piles. Irrespective of the pile type chosen, it is recommended that pile tests be performed on a representative pile to verify the pile design working load. Further, all pile caps, subject to frost action, should be provided with a minimum of 6 feet of protective earth cover.

Foundations (continued)

Preliminary calculations show that for a pile 12 inches in diameter and 40 feet long the pile capacity will be about 20 tons. This value incorporates a factor of safety of 2.5. A factor of safety of 2.0 may be used in conjunction with pile load tests. However in no case should the working load of the pile exceed the safe load as determined from the structural properties of the pile material. In view of the above preliminary pile capacity a timber pile would appear to be most suitable because 20 tons represents a practical working load for a timber pile.

All the overburden at the site is susceptible to scour and therefore, measures should be taken to protect bridge foundations from undermining due to this effect. This could be done by such means as provision of rip-rap protection, or carrying foundations a safe distance beyond maximum scour depth. The extent of scour in both lateral and vertical direction depends on the maximum flood level of the river, the hydraulics of the river channel in the vicinity of the bridge, the orientation of the piers relative to the direction of flow and the like. The hydraulic considerations involved are beyond the scope of this report. In this regard it is under-

Foundations (continued)

stood that a dam is to be constructed at the south west end of Lake Shikwamkwa. It is understood by extrapolation that this will cause a resultant rise in the river level of about 15 feet which will necessitate an increase in the extent of rip-rap protection along the embankment sections. Published data (Terzaghi and Peck, "Soil Mechanics in Engineering Practice.") indicates that the depth of scour below the low water channel may be in the order of four times the greatest known rise of river level. Therefore, if no suitable rip-rap protection is provided to the piers, it should be assumed that scouring to at least the depth indicated may occur. The computed pile capacities may be effected by the amount or effectiveness of the rip-rap provided.

Approach Embankments

It is recommended that the surface organic material be stripped from beneath approach embankments. With a proposed grade at 1109, the overall height of embankment relative to adjacent ground level will be about 22 feet. In view of the granular nature of the subsoil, it is considered that the stability of the approach embankments with side slopes of 1 vertical to 2 horizontal, assuming that the embankment fill is granular, will be adequate.

Approach Embankments (continued)

The approach embankment as planned will experience settlement caused by consolidation of the underlying very loose to loose sand with gravel stratum. In view of the granular nature of the overburden, most of the settlement should take place during construction of the embankment. However, it is recommended that the embankment be constructed in advance of pile driving to avoid negative skin friction effects on the piles. In addition, it is recommended that additional surcharge be provided by temporarily increasing the embankment height during the construction phase.

It is recommended that rip-rap be provided where necessary to above maximum high river level, that is, 15 feet above present river level to prevent scour.

It is recommended that the backfill to abutments consist of well compacted, free drain , non-frost susceptible, clean granular material. With this provision, a coefficient of lateral earth pressure of 0.5 is recommended for the case of pile supported abutments.

Construction

Should excavations be required below water level at the pier or abutment locations, they will involve excavation within the very

Construction (continued)

loose sand with gravel and, therefore, some means will be required to control water inflow. For this purpose a "sanded-in" well point system could be used or, alternatively, the excavation could be sheeted and dewatered by pumping from filter equipped sumps maintained ahead of excavation. Where excavations are required within the river, berms built to above river level would be required if well points only are used. Similar berms might also facilitate construction if sheeting was used. Sheeting, if used, should be carried down below excavation level a distance at least equal to the maximum head differential likely to be encountered. Irrespective of the method used, construction should be carried out in sections to minimize constriction of the river flow.

CONCLUSIONS AND RECOMMENDATIONS

1) The site is covered by a deposit of sand with gravel and sand and gravel underlain by silt. The maximum depth of overburden as encountered was 80 feet. The relative density of the sand with gravel and sand and gravel ranged generally from very loose to compact on the north side of the river and very loose to very dense on the south side of the river.

2) At the time of investigation the water level in the river and

the adjacent river bank was at about elevation 1083.

3) The low relative density and scour susceptibility of the surficial soil strata at the site preclude the practical use of shallow spread footings. The most suitable foundation solution, therefore, is considered to be the use of friction piles as indicated in the report.

4) Construction of piers and pile caps will probably require excavation below water level. Recommendations are given on possible measures to handle unwatering of such excavations.

PERSONNEL

The field work for this investigation was carried out under the supervision of Mr. B. Coleman. This report was written by Mr. J. N. Beckett, checked by Mr. D. B. Oates, P. Eng., and reviewed by Mr. M. A. J. Matich, P. Eng.

JNB/md

J. N. Beckett

APPENDIX 1

PROCEDURE

SITE AND GEOLOGY

SOIL CONDITIONS

WATER CONDITIONS

OFFICE REPORTS ON SOIL EXPLORATION

PROCEDURE

The field work was carried out between March 25th, 1966 and April 1st, 1966. A total of 4 boreholes in BX size each with an accompanying dynamic uncased cone penetration test were put down. One hole extended to 80 feet depth. The remaining three holes were taken to 50 feet depth. For the work, a skid mounted diamond drill rig was used.

The soil strata were sampled at intervals of 5 feet in the upper 50 feet and at 10 feet intervals between 50 and 80 feet depth. Two inch split spoon samples, adapted with a foot valve to facilitate recovery, were taken in the overburden. Because of the generally loose relative density of the strata recovery was not always achieved with the split spoon. As a result, slotted tube samples were generally obtained after the first attempt at recovery with the split spoon.

Detailed logs of the 4 boreholes and accompanying dynamic uncased cone penetration tests are presented on the Office Reports on Soil Exploration in this Appendix. The locations of the boreholes and dynamic cone penetration tests, together with the inferred stratigraphy are shown on Drawing No. 7856-1 at the rear of this report.

The laboratory testing of selected soil samples was carried out in the Soil Mechanics Laboratory of Geocon Ltd. in Toronto. The results are plotted on the Figures in Appendix 11. The soil samples remaining after testing will be stored until April 1967 at which time you will be contacted for instructions regarding their disposal.

All elevations given in this report are referred to Geodetic datum. The bench mark referred to is a nail and washer in the top of a 4 inch diameter Balsam stump. The stump is located 82 feet east of station 871+36, along proposed Secondary Highway No. 651, Line "L". The Geodetic elevation of the bench mark is given as 1092.53.

SITE AND GEOLOGY

The proposed D.H.O. bridge site is to be located on the proposed Secondary Highway No. 651, Line "L" over the Goldie River, approximately 1 mile south of Dalton, Ontario. The site is located in Township No. 43, District of Algoma, Ontario. At the time of the investigation the Goldie River, which flows in an easterly direction, was about 45 feet wide and about 2 feet deep at its deepest point; indications are that at high water level the depth of water is about 7 feet. Ground level at the site varies between elevations 1083 and 1090, with the maximum variation occurring close to the edge of the creek. The site area is covered by dark brown peat and other related organic soils to a maximum observed depth of about 1 foot.

From available geological information and previous work in the area, it is known that the overburden cover is composed of sands and silts of post glacial fluvial origin. The bedrock types in the area include granite, syenite and gabbro.

SOIL CONDITIONS

The principal soil strata encountered in the boreholes are described below. Because of the difficulty of obtaining relatively undisturbed samples of the overburden and also its variable composition, the boundaries and descriptions of the various strata are probably idealized. Because of the method of deposition, a more detailed definition of continuous layers was not possible and in any event would probably not be realistic. It is believed, however, that the inferred strata described below and on Drawing T7856-1 are for all practical purposes representative of the stratigraphy.

Dark Brown Sandy Organic Topsoil

The surficial stratum across the site is a dark brown sandy organic topsoil containing roots and other decayed organics. The ground surface elevation at the borehole locations across the site, which corresponds to the surface elevation of this stratum, varies from elevation 1088 to 1090. The thickness of the topsoil is about 0.7 feet.

Very Loose to Compact Brown to Grey Sand with Gravel.

Directly underlying the topsoil at the borehole locations is a stratum of brown to grey sand which contains in places a small percentage of gravel and some silt traces. The surface elevation of the stratum ranged from 1087 to 1089. The thickness of the stratum, where penetrated fully, was found to range from 34 feet in borehole 1 to 44 feet in borehole 2. In boreholes 3 and 4 the stratum was not fully penetrated and was found to be at least 51 feet in thickness. The colour change from brown to grey was noted at a depth of about 25 feet in the boreholes. However grey and brown zones occur above or below this depth. The material consists mainly of fine to coarse sand with some silt and a small percentage of subrounded gravel; both the silt and gravel content is present only at localized areas within the stratum. Some wood fragments are present within the stratum.

Mechanical analysis tests were carried out on four typical samples from this stratum and the results are shown as grain size distribution curves on Figure 1 of Appendix 11. The grain size curves indicate that the samples contained up to 4 per cent silt sizes, 88 to 96 per cent sand sizes and up to 12 per cent gravel sizes.

Standard penetration tests were carried out in this stratum and gave "N" values ranging from 2 to 19 blows per foot. The standard

Very Loose to Compact Brown to Grey Sand with Gravel (cont'd)

penetration resistances indicate that the relative density of the stratum is generally very loose to loose but becomes compact with depth particularly on the north side of the river.

For design purposes the following parameters may be used, where appropriate:

Wet unit weight,	115 pounds per cubic foot
Angle of shearing resistance,	32 degrees

Dark Brown Organic Silt

The sand with gravel is underlain in boreholes 1 and 2 by a thin stratum of organic silt. The thickness of this stratum was found to be 1.1 to 0.8 feet in boreholes 1 and 2 respectively. The elevation of the surface of this stratum is 1052.6 and 1043.8 in boreholes 1 and 2 respectively. The silt is horizontally stratified and its dark brown colour is imparted by its organic content. It is estimated that the relative density of this stratum is compact.

Dense to Very Dense Grey Sand and Gravel

The dark brown organic silt in boreholes 1 and 2 is underlain by a stratum of sand and gravel. The surface of this stratum was encountered at elevations 1051.5 and 1043.0 in boreholes 1 and 2

Dense to Very Dense Grey Sand and Gravel (continued)

respectively. The stratum was fully penetrated in borehole 2 only where it was found to be 12.2 feet in thickness. The sand and gravel is generally grey in colour although some brown sections were noted. The stratum is essentially similar in composition to the overlying sand with gravel. However it is being described separately in view of its slightly higher gravel and, in places, silt content and high relative density.

Mechanical analyses were carried out on 2 typical samples from this stratum and the results are shown on Figure 2 in Appendix 11. The results indicate that the stratum contains up to 25 per cent silt, about 53 per cent sand and between 23 and 46 per cent gravel sized particles.

Standard penetration tests carried out in the stratum gave "N" values ranging from 30 to 75 blows per foot with an average value of 50 blows per foot. The relative density is estimated to range from dense to very dense.

For design purposes the following parameters may be used where appropriate:

Wet unit weight	130 pounds per cubic foot
Angle of shearing resistance	40 degrees

Compact Grey Silt with Some Sand

Underlying the sand and gravel stratum as encountered at elevation 1030.8 in borehole 2 only is a stratum of grey silt which contains sand sizes. This stratum was not fully penetrated. The investigated thickness was about 23 feet. The silt is horizontally stratified and contains some silty sand layers.

A mechanical analysis was carried out on a typical sample from this stratum and the results plotted on Figure 3 in Appendix 11. The results indicate that the stratum contains 30 per cent fine sand sizes and 70 per cent silt sizes.

Standard penetration tests carried out in the stratum gave "N" values ranging from 19 to 28 blows per foot with an average value of 24 blows per foot. The relative density is therefore generally compact.

For design purposes the following parameters may be used where appropriate:

Wet Unit weight	125 pounds per cubic foot
Angle of shearing resistance	35 degrees

WATER CONDITIONS

At the time of the investigation the water level in the Goldie River was at about elevation 1083. Observations of the ground water level in boreholes 1 and 4 confirm this elevation.

Local information indicates that the maximum river level is at about elevation 1088 during spring runoff. In this regard it is understood that a conservation dam is to be constructed at the south west end of Lake Shikwamkwa. By extrapolation it is believed that there will be a rise in water level at the bridge site to about elevation 1097.

EXPLANATION OF THE FORM "OFFICE REPORT ON SOIL EXPLORATION"

The object of this form is to enable a comprehensive study of the soil to be made by combining on one sheet all of the information obtained from the boring. An explanation of the various columns of the report follows.

ELEVATION AND DEPTH

This column gives the elevation and depth of boundaries between the various soil strata. The elevation is referred to the datum shown in the general heading.

WATER CONDITIONS

In this column the water level in the casing at the time of boring or the water table in the ground, determined by a series of observations in a piezometer or standpipe, is indicated to scale by a horizontal line with the symbol W.L. or W.T. above the line. A notation of any complicated groundwater conditions will be made in this column.

DESCRIPTION

A description of the soil, using standard terminology, is contained in this column. The consistency of cohesive soils and the relative density of non-cohesive soils are described by the following terms:

Consistency	U-Strength Tons/sq. ft.
Very soft	0.03 to 0.25
Soft	0.25 to 0.5
Firm	0.5 to 1.0
Stiff	1.0 to 2.0
Very stiff	2.0 to 4.0
Hard	over 4.0

Relative Density	Standard Penetration Resistance. Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

STRATIGRAPHIC PLOT

The stratigraphic plot follows the standard symbols of the National Research Council, Canada.

ELEVATION SCALE

The information in all columns is plotted to a true elevation scale which is shown in this column.

GRAPHS

The main body of the report forms a graph which is used to plot to correct elevation the important soil properties which are obtained through field and laboratory tests. The scales and symbols for the plotting are shown at the head of the column.

OTHER TESTS

In this column are shown, by symbol, the other field or laboratory tests which have been performed on the soil and for which the results have not been plotted on the above graph.

SAMPLES

The first three columns describe the condition, type and number of each sample obtained from the boring. The location and extent of each sample is plotted to scale.

In the last column is shown the penetration resistance in blows of 4200 inch-pounds required to drive one foot of the sampler into the ground. When a 2 inch Drive Sampler is used the result obtained is termed the "Standard Penetration Resistance".

APPENDIX I

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT T7856 BORING # 1 DATUM GEODETIC CASING BX
BORING DATE MAR. 28-29/66 REPORT DATE APR. 5, 1966 COMPILED BY A E L CHECKED BY L.B.
SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

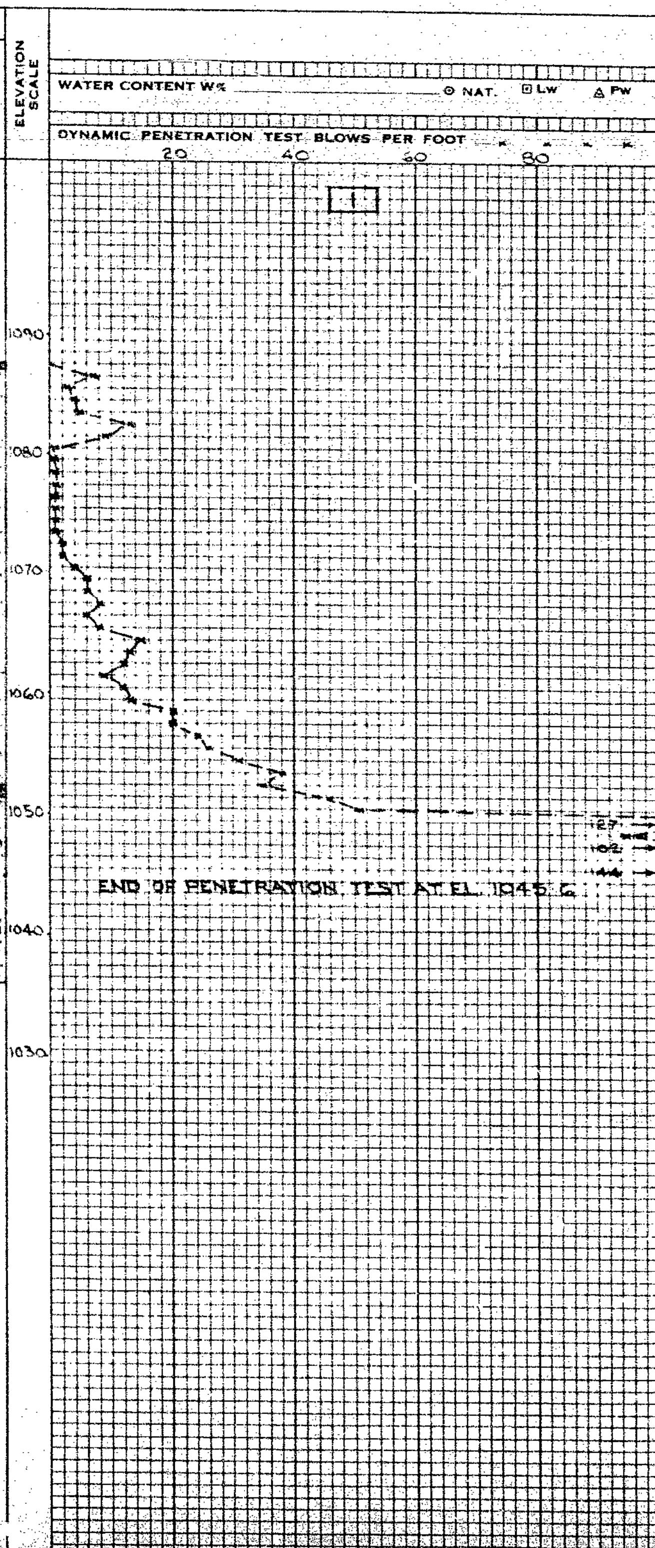
SAMPLE CONDITION
- DISTURBED
- FAIR
- GOOD
- LOST

SAMPLE TYPES
- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F... - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS
- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- Qc - TRIAXIAL CONSOLIDATED UNDRAINED
- Q - TRIAXIAL UNDRAINED
- S - TRIAXIAL DRAINED
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEVN. / DEPTH	WATER CONDITIONS	DESCRIPTION
1087.6 / 0.0		GROUND LEVEL 8" TOPSOIL
	WL @ EL 1082.3 MAR 29, 1966	VERY LOOSE TO LOOSE BROWN TO GREY SAND WITH GRAVEL
1052.6 / 35.0 / 36.1		DARK BROWN ORGANIC SILT
		DENSE TO VERY DENSE GREY SAND & GRAVEL
1036.1 / 51.5		END OF HOLE



SAMPLES

OTHER TESTS	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
	Disturbed	2" DO	1	2
	Disturbed	" DO	2	2
	Disturbed	" DF	3	2
	Disturbed	" DF	4	2
	Lost / Disturbed	" DF " ST	5	2 / 1
M	Lost / Disturbed	" DF " ST	6	2 / 1
	Lost / Disturbed	" DF " ST	7	7
	Disturbed	" DF	8	6
	Disturbed	" DF	9	60
	Lost / Disturbed	" DF " ST	10	31
M	Disturbed	" DF	11	30

APPENDIX I

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT T7856 BORING # 2 DATUM GEODETIC CASING BX.
BORING DATE MAR. 26-28/66 REPORT DATE APR. 5, 1966 COMPILED BY A.E.L. CHECKED BY J.B.
SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SAMPLE TYPES

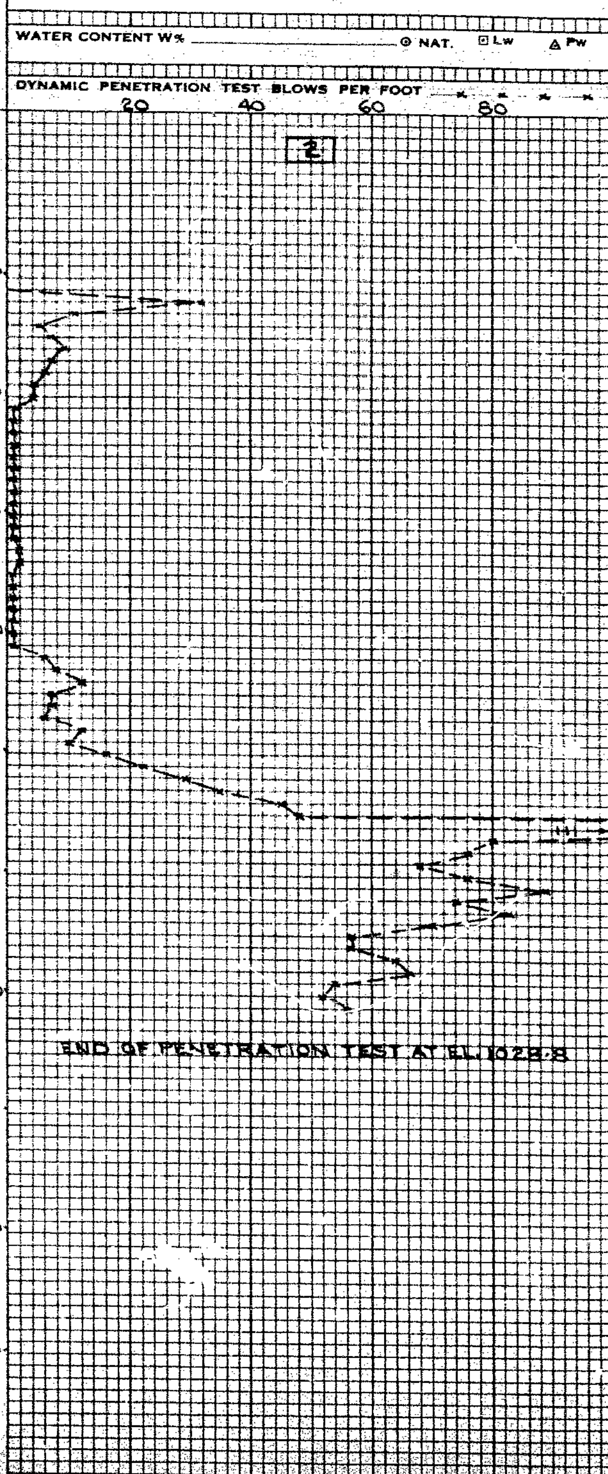
- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F.S. - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS

- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- Qc - TRIAXIAL CONSOLIDATED UNDRAINED
- Q - TRIAXIAL UNDRAINED
- S - TRIAXIAL DRAINED
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEVN. / DEPTH	WATER CONDITIONS	DESCRIPTION
1088.8 / 0.0		GROUND LEVEL; 8" TOPSOIL
	WL. @ EL. 1083.6 MAR. 28, 1966	VERY LOOSE TO COMPACT BROWN TO GREY SAND WITH GRAVEL; 45.0 - 45.8 ft. DARK BROWN ORGANIC SILT
1043.8 / 45.0		DENSE TO VERY DENSE GREY SAND & GRAVEL
1030.8 / 58.0		COMPACT GREY SILT
1007.3 / 81.5		END OF HOLE



Elevation scale: 1090, 1080, 1070, 1060, 1050, 1040, 1030, 1020, 1010, 1000

SAMPLES

OTHER TESTS	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
	DISTURBED	2"DO	1	14
	DISTURBED	DO	2	3
M	DISTURBED	DF	3	3
	LOST / DISTURBED	DF, ST	4	3
	DISTURBED	DF	5	4
	LOST / DISTURBED	DF, ST	6	6
	LOST	DF	7	11
	LOST / DISTURBED	DF, ST	8	13
	DISTURBED	DF	9	75
M	DISTURBED	DF	10	46
	DISTURBED	DF	11	28
M	DISTURBED	DF	12	26
	DISTURBED	DF	13	19

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT T7856 BORING # 3 DATUM GEODETIC CASING BX

BORING DATE MAR. 30-31/66 REPORT DATE APR. 5, 1966 COMPILED BY A.E.L. CHECKED BY J.B.

SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

- DISTURBED
- FAIR
- GOOD
- LOST

SAMPLE TYPES

- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F.S. - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS

- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- Qc - TRIAXIAL CONSOLIDATED UNDRAINED
- Q - TRIAXIAL UNDRAINED
- S - TRIAXIAL DRAINED
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

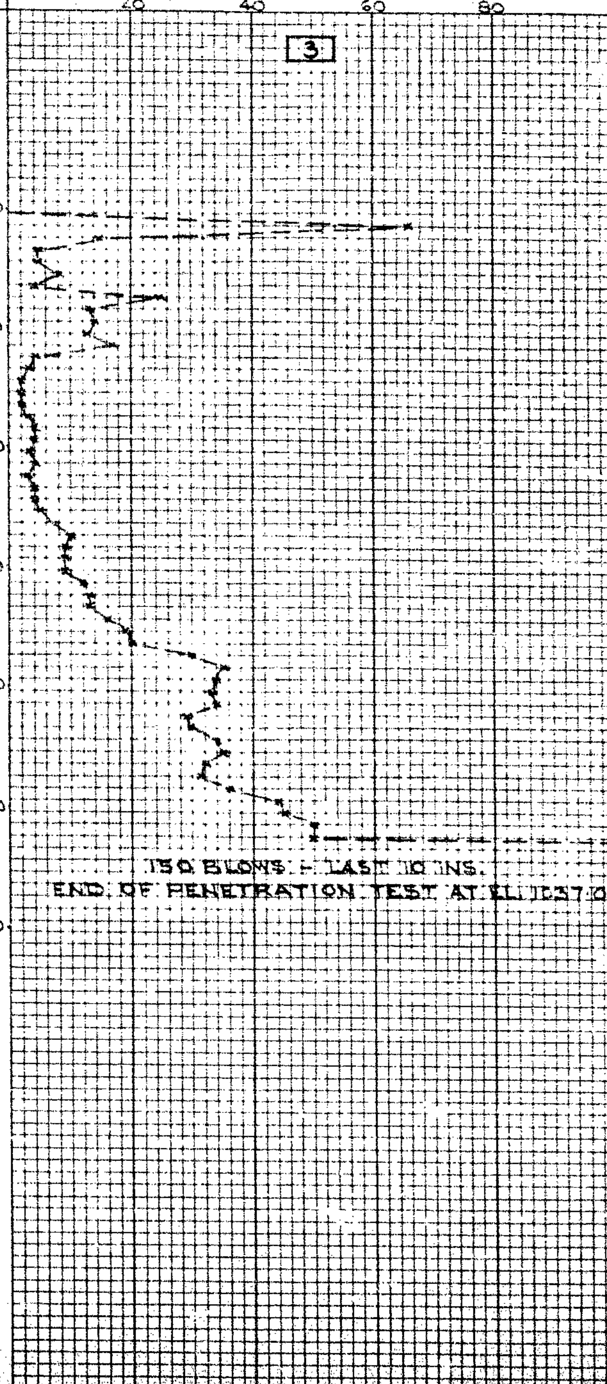
SOIL PROFILE

ELEVN. / DEPTH	WATER CONDITIONS	DESCRIPTION
1089.8 / 0.0		GROUND LEVEL
		? TOPSOIL
	WL. @ EL. 1084.3 MAR. 31, 1966	VERY LOOSE TO COMPACT BROWN TO GREY SAND WITH GRAVEL
1038.3 / 51.5		END OF HOLE

ELEVATION SCALE: 1090, 1080, 1070, 1060, 1050, 1040, 1030

WATER CONTENT W% ⊙ NAT. ⊡ Lw △ Pw

DYNAMIC PENETRATION TEST BLOWS PER FOOT 20 40 60 80



OTHER TESTS: M (at sample 3)

SAMPLES

CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
Disturbed	DO	1	9
Disturbed	DO	2	5
Disturbed	DF	3	2
Lost / Disturbed	DF / ST	4	5
Lost / Disturbed	DF / ST	5	3
Lost / Disturbed	DF / ST	6	12
Lost / Disturbed	DF / ST	7	6
Lost / Disturbed	DF / ST	8	18
Lost / Disturbed	DF / ST	9	16
Disturbed	DF	10	18

APPENDIX I

GEOCON

OFFICE REPORT ON SOIL EXPLORATION

CONTRACT T7856 BORING # 4 DATUM GEODETIC CASING BX
BORING DATE APRIL 1/66 REPORT DATE APR. 5, 1966 COMPILED BY AEL CHECKED BY J.G.
SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

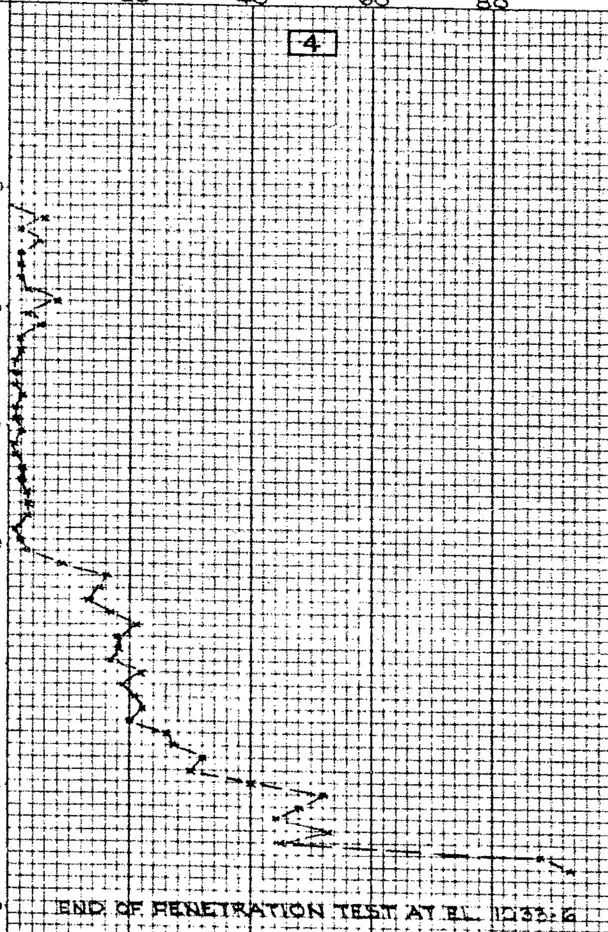
SAMPLE CONDITION
- DISTURBED
- FAIR
- GOOD
- LOST

SAMPLE TYPES
- A.S. - AUGER SAMPLE
- S.T. - SLOTTED TUBE
- W.S. - WASHED SAMPLE
- D.O. - DRIVE-OPEN
- D.F. - DRIVE-FOOT VALVE
- C.S. - CHUNK SAMPLE
- F.S. - FOIL SAMPLE
- S.O. - SLEEVE-OPEN
- S.F. - SLEEVE-FOOT VALVE
- T.O. - THIN WALLED OPEN
- R.C. - ROCK CORE

ABBREVIATIONS
- V - IN-SITU VANE TEST
- M - MECHANICAL ANALYSIS
- U - UNCONFINED COMPRESSION
- Qc - TRIAXIAL CONSOLIDATED UNDRAINED
- Q - TRIAXIAL UNDRAINED
- S - TRIAXIAL DRAINED
- γ - WET UNIT WEIGHT
- K - PERMEABILITY
- C - CONSOLIDATION
- WL - WATER LEVEL IN CASING
- WT - WATER TABLE IN SOIL

SOIL PROFILE

ELEVN. DEPTH	WATER CONDITIONS	DESCRIPTION
1088.6 / 0.0		GROUND LEVEL; 8" TOPSOIL
	WL. @ EL. 1083.4 APR. 1, 1966	VERY LOOSE TO COMPACT BROWN TO GREY SAND WITH GRAVEL
1037.1 / 51.5		END OF HOLE
1033.6 / 55.0		END OF PEN. TEST



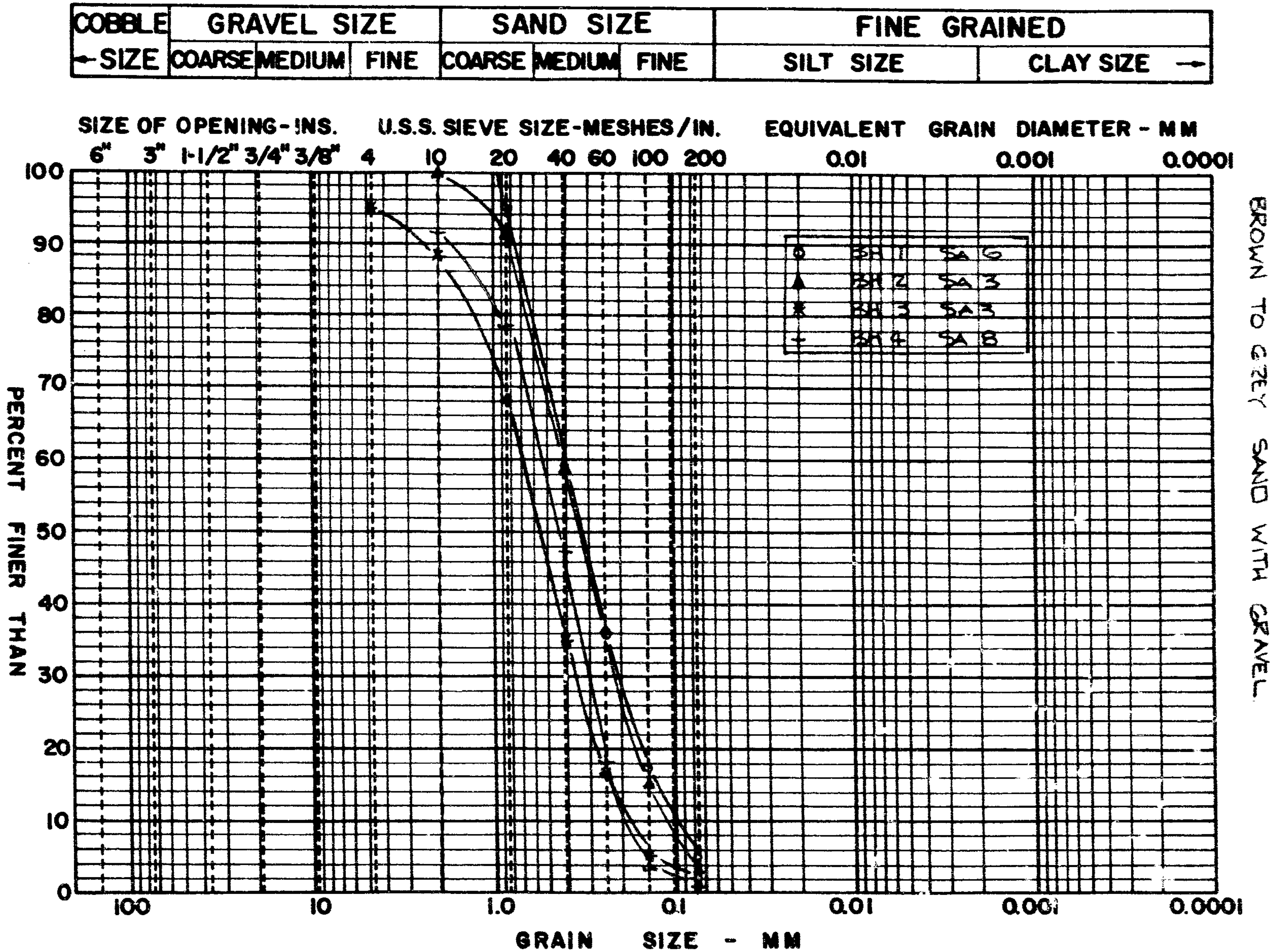
SAMPLES

OTHER TESTS	CONDITION	TYPE	NUMBER	PENETRATION RESISTANCE BLOWS/FT.
		2" DF	1	7
		" DF	2	4
		" DF ST	3	3
		" DF	4	4
		" DF	5	5
		" DF	6	19
		" DF	7	17
M		" DF	8	8
		" DF	9	16
		" DF	10	15

APPENDIX II

FIGURES - LABORATORY TESTING

GEOCON

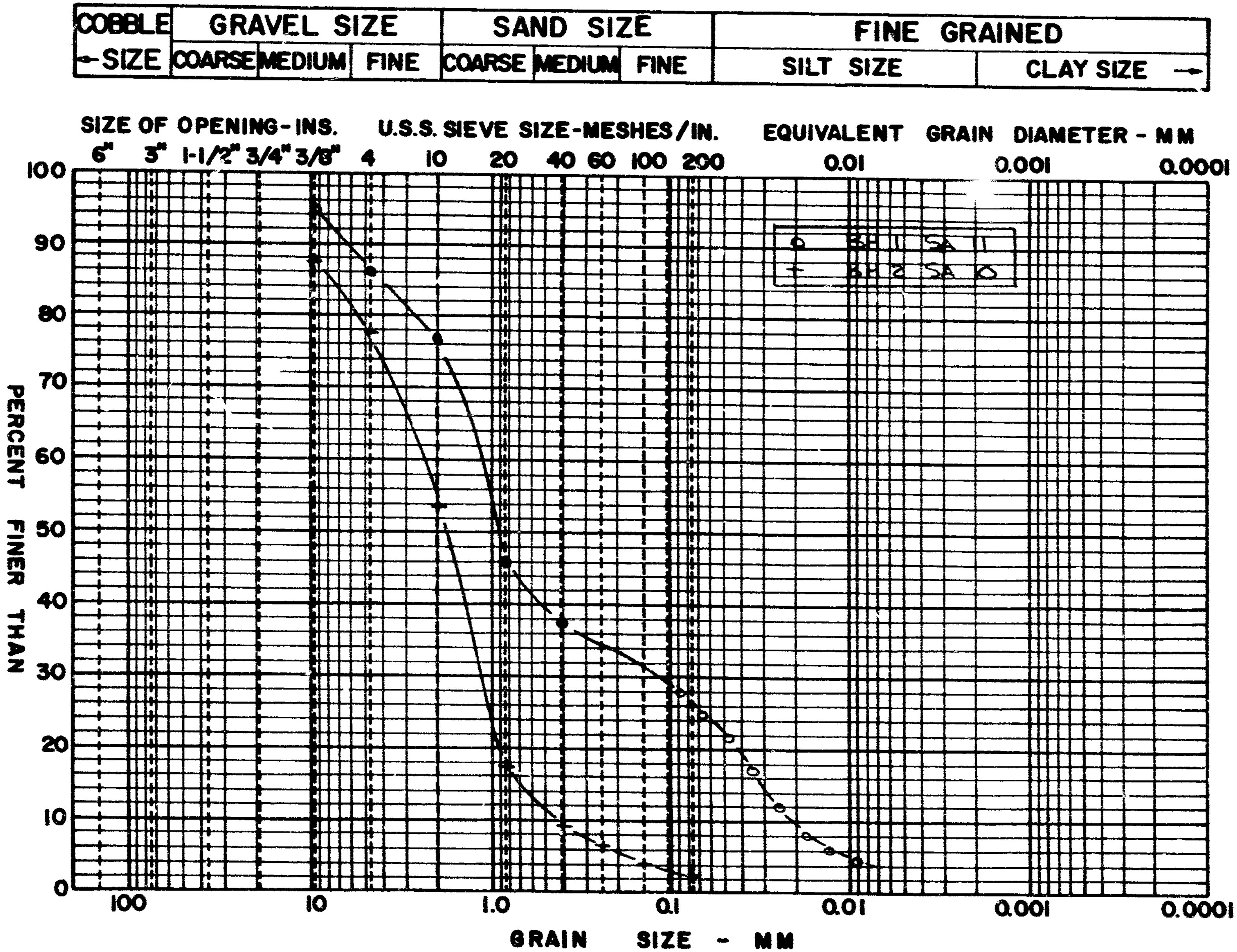


M.I.T. GRAIN SIZE SCALE

GRAIN SIZE DISTRIBUTION

APPENDIX II
FIGURE 1
PROJECT T 7856

GEOCON



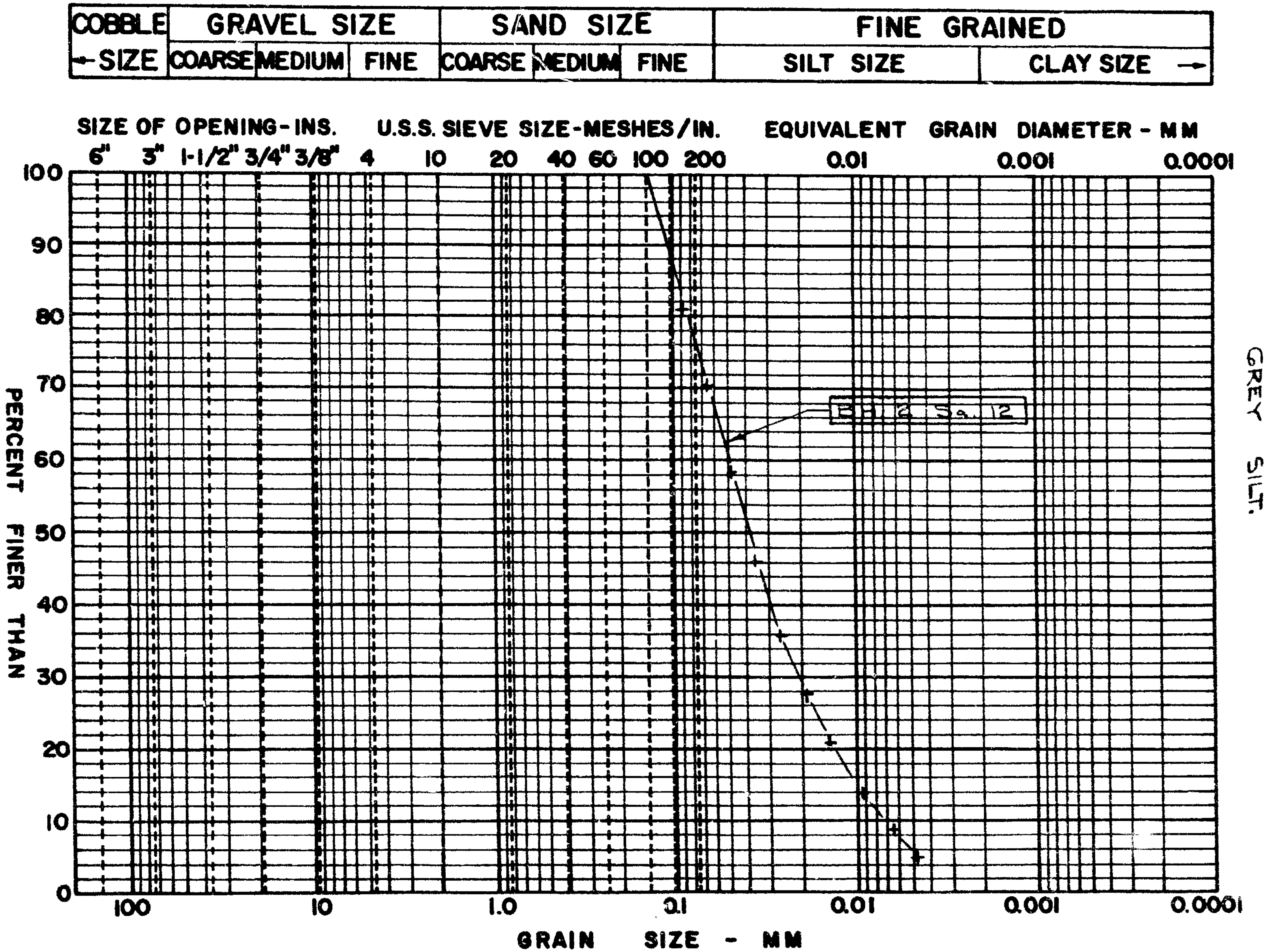
M.I.T. GRAIN SIZE SCALE

GREY SAND AND GRAVEL

GRAIN SIZE DISTRIBUTION

APPENDIX II
FIGURE 2
PROJECT T.7856

GEOCON



M.I.T. GRAIN SIZE SCALE

GRAIN SIZE DISTRIBUTION

APPENDIX II
FIGURE 3
PROJECT T.7856