

GEOCRES No. 31E-99DIST. 11 REGION W.P. No. CONT. No. W. O. No. 2000-11018STR. SITE No. HWY. No. LOCATION Huntsville - SEWAGE
Treatment System - SNO -- PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

T10303A

REPORT TO
HIDDEN VALLEY INN LIMITED
ON
STABILITY OF WEST RETAINING DYKE
CELL 4, HIDDEN VALLEY
SEWAGE TREATMENT SYSTEM
HUNTSVILLE ONTARIO

DISTRIBUTION:

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Rexdale, Ontario

October 23, 1979

GEOCON

Geo. No. 31E-99

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1.0 INTRODUCTION

Geocon (1975) Ltd. has been retained by Hidden Valley Inn Limited under the terms of our letter dated August 21, 1979 to carry out a geotechnical investigation for the west dyke of Cell No. 4 of the Hidden Valley Holiday Inn sewage treatment system in Huntsville, Ontario. The purpose of the investigation was to obtain information on the configuration of the dyke and subsurface conditions, and evaluate the overall stability of the dyke. The results of a previous site reconnaissance of all of the Cells in the sewage treatment system are given in our Report T10303 dated August 21, 1979 and in a letter to Seagram Real Estate dated August 27, 1979.

2.0 SUMMARIZED SOIL CONDITIONS

Based on the results of the investigation, the west dyke of Cell 4 consists of loose to compact dark brown silty sand till fill containing a trace to some gravel, and occasional cobbles and boulders. The height of the dyke at the section investigated is about 26 feet. The maximum height is estimated to be about 36 feet. The thickness of the fill at Borehole 1 is in the order of 28 feet. The fill is directly underlain by a dense deposit of grey silty sand and gravel till. The thickness of the till in the area investigated is about 7 feet. It is underlain by bedrock.

The results of water level measurements taken in piezometers installed in Boreholes 1 and 2 indicate a water level in the dyke at a depth of about 18 to 19 feet below the crest, and below a depth of 10 feet at about mid-height of the slope. It should be noted, however, that the pond level at the time that water levels were recorded, was some 8 feet below normal high water level.

3.0 DISCUSSION

A reconnaissance of the retaining dykes for each of the Cells in the Hidden Valley sewage system was carried out by us on August 9, 1979. The results were given in our Report T10303 dated August 21, 1979.

3.0 DISCUSSION (continued)

In this previous report, it was concluded that, based on available information and observed site conditions, the retaining dykes for each of Cells 1, 2, and 3 are adequately stable. With respect to the west retaining dyke of Cell 4, preliminary computations indicated that the existing dyke may not have an adequate degree of safety to satisfy Ministry of Environment standards. Consequently, a detailed study of this dyke in particular has been carried out, and the results are reported herein. Preliminary consideration is given also to infiltration - exfiltration at Cell 3.

Based on available documentation, discussions with personnel familiar with the site and on visual site reconnaissance, the following information is known to us about Cell 4.

- a) Cell 4 was constructed as a "Holding Pond" in late 1971 and early 1972.
- b) All the dykes for Cell 4 were constructed of glacial till borrowed from the surrounding area. Compaction of the fill was only by the bulldozers used for placing the till fill, and other construction traffic.
- c) In February 1973, overtopping of both the east and west dykes of Cell 4 occurred resulting in a breach at the top of the west dyke which was subsequently repaired by infilling with silty sand till fill.
- d) No evidence of downstream instability of the west retaining dyke is visible. Surficial vegetation on the slope is well established and mature tree growth is evident along the length of the dyke at the toe of the slope.
- e) The normal high water level in the pond is approximately 2.5 to 3 feet below the crest of the west retaining dyke. During pumping periods from Cell 4 a drawdown rate of 16

3.0 DISCUSSION (continued)

e) (continued)

inches in 24 hours occurs. This is considered to be rapid drawdown. Under the proposed system, it is understood that such drawdown would occur twice each year.

3.1 Seepage Conditions

As noted above, the results of our site reconnaissance indicate that there is no evidence that seepage through the west retaining dyke emerges above the toe of the dyke. Vegetation on the downstream face of the slope is well established over the full height and width of the dyke. The alders and swamp growth immediately downstream and at the toe of the dyke infer a groundwater level close to ground surface.

The surficial runoff from the area surrounding the retention dykes is channeled around the west retaining dyke and down to the lowlands west of the Cells. The surficial drainage is part of the normal westward watershed that existed prior to construction of the dykes.

The groundwater levels recorded on September 27, 1979 in the piezometers installed in the west retaining dyke, indicate that the water level is some 18 to 19 feet below the crest level and that, at about mid-height of the downstream slope, the water level is in excess of 10 feet below the slope surface. These water levels were recorded at a time when the water retained in Cell 4 was some 8 feet below the normal water level in the pond. Stability analyses were based on high water level in the pond, and an internal water level about 11 feet below the dyke crest. Seepage through the dyke was assumed to emerge some 4 feet above the toe. Based on observed site conditions, these assumed seepage conditions are probably on the conservative side.

3.0 DISCUSSION (continued)

3.2 Stability Analyses

Evaluation of the west retaining dyke of Cell 4 has been carried out with respect to deep seated and shallow stability of the downstream face, and in terms of rapid drawdown conditions on the upstream face. Based on the results of laboratory drained direct shear tests, the internal effective angle of shearing resistance ϕ' used in analyses is 36 degrees for the till fill, for which a unit weight of 120 pounds per cubic foot was considered applicable. The position of the steady state phreatic surface has been described above. As previously noted, the surveyed profile was obtained at a location where the dyke was not at its maximum height. The stability analyses therefore were carried out on a section some 10 feet higher than that surveyed in the field, viz. for the dyke at maximum height.

The stability analyses were carried out using the Bishop's Simplified Circular Analysis method and the computer program 'LEASE' which is part of the ICES package for engineering analyses. The results of the computer analyses were verified by hand computations, for the critical circles.

It is understood that the computed Factor of Safety considered acceptable by the Ministry is 1.5. The results of the stability analyses carried out by ourselves, indicate that the Factor of Safety for the downstream portion of the dyke in its present state, both in terms of shallow and deepseated stability, is less than the acceptable value of 1.5. In addition, computations of stability of the internal face of the dyke indicate that there is not a sufficient margin of safety with respect to the rapid drawdown case.

With respect to seismicity, Huntsville is located in the seismic zone* designated as '1'. No special evaluation of seismic effects on the dykes was therefore considered necessary.

*National Building Code 1975

4.0 REMEDIAL MEASURES

Alternative methods for remedial works on the west containment dyke of Cell 4 have been considered assuming the following conditions:

- 1) That the toe of the dyke can be moved to the west.
- 2) That extension of the dyke to the west is not involved.

Irrespective of the method selected for remedial work on the downstream slope, provision for ensuring an adequate Factor of Safety under rapid drawdown conditions on the upstream (east) face of the west containment dyke of Cell 4 is also required. For both Cases 1 and 2, discussed below, the east face of the west containment dyke should be flattened to 3 horizontal to 1 vertical (3H:1V) under engineering control, by infilling with select till fill. For Case 3, involving placement of an artificial liner, the east face should also be flattened although in this case to accommodate the lining rather than for rapid drawdown. Tentatively, the slope should be 2:5H:1V and selected finally to suit the lining used.

4.1 Case 1; Construction of Toe Berm

Construction of a toe berm over the existing downstream toe of the dyke would involve extension of the dyke onto the adjacent property. One configuration of the toe berm is shown on Drawing T10303A-2 together with associated computed Factors of Safety. The toe berm would consist of gravel, filter-graded with respect to the till fill. Prior to placement, the surficial topsoil and vegetation on the face of the dyke, at least to the full height of the berm, would have to be removed. The remainder of the downstream slope could be left as is.

4.2 Case 2; Construction of Counterfort Toe Drains

Construction of counterfort toe drains would involve excavation into the existing dyke at regular intervals and backfilling with filter gravel to form a toe drainage system as shown on Drawing T10303A-2. In addition, trimming of the upper portion of the downstream face of the dyke to form a 2 horizontal to 1 vertical overall slope is

4.0 REMEDIAL MEASURES (continued)

4.2 Case 2; Construction of Counterfort Toe Drains (continued)

recommended, with accompanying filling on the upstream side. The drains would occupy about one-half the toe length. In the event that access to the toe of the dyke cannot be effected through the adjacent property, consideration could be given to building the counterfort drains using dragline or backhoe equipment operating from the top of the dyke. The width of the counterfort drains could be selected to suit the construction equipment used. To avoid sloughing due to seepage into the drain areas during excavation, the excavations should preferably be carried out with the pond level in Cell 4 as low as possible, or pumped out completely. Alternatively, special dewatering measures could be used to control the level of seepage during construction.

Based on the results of stability calculations for the configuration shown on Drawing T10303A-2, the computed Factor of Safety is within acceptable limits.

4.3 Case 3; Lining of West Dyke of Cell 4

In the event that extension of the dyke toe towards the west is not feasible, and as an alternative to construction of the counterfort drains noted above, consideration could be given to placing an artificial impervious liner on the upstream face of the west dyke of Cell 4. This would maintain the phreatic surface in the dyke low at periods of high water in the Cell. The lining would have to extend across the full length of the west containment dyke i.e. about 370 feet, and be placed on an approximately 2.5H:1V slope formed by filling on the upstream side along the lines given for Case 2 above. It would also have to be carried a short distance around the north and south dykes of Cell 4. The details are a matter of design and we would be pleased to provide necessary specifics, should the alternative be pursued further.

4.0 REMEDIAL MEASURES (continued)

4.2 Case 3; Lining of West Dyke of Cell 4 (continued)

In addition to the liner, the downstream face of the dyke should be trimmed back to an overall slope of 2 horizontal to 1 vertical as shown for Case 2 on Drawing T10303A-2, and the slope subsequently revegetated.

5.0 CELL 3

In respect to infiltration into Cell 3, it is understood that it is planned to pump out this Cell in the immediate future. It is recommended that as a first step in the study of this item, the infiltration into the Cell during the empty stage, be measured, following which recommendations would be made covering such further work as may be deemed necessary.

6.0 SUMMARY AND CONCLUSIONS

Based on the results of this study it has been determined that the existing west retaining dyke of Cell 4 has a computed Factor of Safety below that acceptable to the Ministry of the Environment. Three alternative measures are presented for remedial works from a geotechnical standpoint only. Each of the alternatives in the detailed design configuration will result in an adequate computed Factor of Safety. Selection of the most suitable form of remedial measures will depend on a number of factors such as the feasibility of extending the toe of the dyke to the west, time schedule for construction, comparative costs, and other pertinent factors. It is not within our terms of reference to select the remedial works. However, we would be pleased to assist you in making the final selection, (to the extent that this is influenced by geotechnical considerations), and in final design. Whichever solution is selected, it is recommended that a detailed topographic survey of the dyke configuration be carried out, as soon as possible, so that details for construction can be firmed up.

With respect to timing of construction of the remedial works, it is considered that from a purely technical standpoint, the work could be

6.0 SUMMARY AND CONCLUSIONS (continued)

deferred until the spring or early summer of 1980, to avoid the difficulties associated with construction of earthworks in winter.

7.0 CLOSURE

We trust that this report which was reviewed by Mr. M. A. J. Matich, P. Eng., is sufficient for your present requirements. Should you have any questions regarding this report, or if we can be of further service to you on this project, please call us.

Yours very truly,
GEOCON (1975) LTD.

PAG:sjp
T10303A

Paul A. Graham, P. Eng.
Senior Geotechnical Engineer

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APPENDIX I

1.0 PROCEDURE

2.0 SITE AND GEOLOGY

3.0 SOIL CONDITIONS

3.1 Loose to Compact Dark
Brown Silty Sand (Till Fill)

3.2 Dense Grey Silty Sand and
Gravel Till

3.3 Bedrock

4.0 WATER CONDITIONS

1.0 PROCEDURE

The field work for this investigation was carried out on September 14 and 17, 1979. On these dates two boreholes (numbered 1 and 2) were put down at the locations shown on Drawing T10303A-1. Borehole 1 was put down to a depth of 43 feet below ground surface using a bombardier mounted CME 45 power auger, and samples of the overburden were obtained at 5 foot intervals of depth using standard split spoon sampling equipment. Standard Penetration Tests were carried out in the overburden in conjunction with the split spoon sampling. Bedrock was proven for a depth of 7.5 feet in Borehole 1 using rotary coring techniques in BXL size. The samples of the overburden obtained were placed in air tight glass jars and the rock core samples were logged and stored sequentially in conventional core boxes. All of the samples obtained were brought to our Toronto Soil Mechanics Laboratory for detailed examination and testing. Following completion of drilling and sampling in Borehole 1 a piezometer was installed in the hole for continuation of water level readings.

In Borehole 2 no sampling was carried out. A drive type Casagrande piezometer was installed at this location to a depth of 10 feet below ground surface.

Details of drilling, sampling, piezometer installations and interpreted stratigraphy together with laboratory test results are given in summary form on the Office Reports on Soil Exploration in Appendix I following this text.

The field work for this investigation was supervised throughout by a member of our engineering staff. We also established the topographic section through the Dam as shown on Drawing T10303A-1. Elevations are referenced to a local benchmark consisting of ground surface at the Borehole 1 location. The elevation of the bench mark was taken as 100.00 feet.

2.0 SITE AND GEOLOGY

Cells 3 and 4 of the Hidden Valley Sewage System are located on Lot 32 of Concession 2 in Huntsville, Ontario. The cells are located in a valley between two high points of land to the north and south of the

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2.0 SITE AND GEOLOGY (continued)

retention area. It is understood that prior to construction of the Cells, runoff was shed both to the east and west through the valley from a high point located at about the current location of the separating dyke between Cells 3 and 4. Cell 3 was formerly a swamp covered area and local information indicates that there was a spring in the south east corner of the swamp. Swamp areas exist to the immediate west of the subject site and to the north. Topographic information indicates that the flow from the northern swamp and the swamp in the former area of Cell 3 emptied into a common drainage channel to the east.

Currently Cells 3 and 4 are surrounded by drainage ditches which channel surficial flows from the surrounding area towards both the east and west, around the retention dykes located at the west end of Cell 4 and the east end of Cell 3. Immediately north of Cell 4, bedrock exposures are evident which are the result of excavation of the natural overlying glacial till material as a borrow source for construction of the dykes. Surficial ponding of water is evident in this area and flow through a local depression north of the west retaining dyke for Cell 4 has been observed.

Reconnaissance of the highlands surrounding Cells 3 and 4 indicate that the subsoil in this area consists of glacial till generally described as grey silty sand and gravel. Reportedly, all of the dykes for Cells 3 and 4 were constructed using the surrounding till slopes for borrow material.

With respect specifically to the west retaining dyke of Cell 4, the configuration of the slope as determined by survey in the field by Geocon staff is shown on Drawing T10303A-1. The survey section is located approximately 100 feet south of the northern leg of Cell 4. However, the maximum height of the dyke occurs about 100 feet further south, and is estimated to be about 10 feet higher than that shown on the above-noted section. Vegetation at the toe and immediately west of the west retaining dyke of Cell 4 consists of well-established tree growth and alders. The upper part of the downstream slope of the dyke is covered

2.0 SITE AND GEOLOGY (continued)

with grass. Further to the west, the ground is predominantly swamp.

Examination of the lower portion of the dyke downstream slope revealed no obvious signs of erosion from either seepage or surface runoff.

Based on available geological data, it is known that this area is underlain by glacial till deposits overlying either Precambrian Granitic bedrock or Metasedimentary rock consisting of paragneiss, gneiss or quartzite.

3.0 SOIL CONDITIONS

3.1 Loose to Compact Dark Brown Silty Sand (Till Fill)

Based on the results of Borehole 1, the west retaining dyke of Cell No. 4 consists of dark brown silty sand till fill containing a trace to some gravel and occasional cobbles and boulders. Occasional traces of organics were obtained in samples which probably resulted from stripping operations in the adjacent borrow areas. The thickness of the till fill at the Borehole 1 location is about 28 feet. The results of gradation analyses carried out on samples of the fill obtained in the borehole are shown on Figure 1 of Appendix II of this report. Natural water contents in the fill range between 9 and 29 percent and are generally about 20 percent.

The results of Standard Penetration Tests in the fill gave "N" values ranging between 6 and 21 suggesting a loose to compact state. The higher values may have been influenced by cobble or boulder sizes. A laboratory drained direct shear test was carried out on a recompacted sample of the portion of the fill passing the No. 4 sieve and a resultant effective angle of shearing resistance ϕ' of 35 degrees was obtained. The unit weight of the recompacted sample was 112 pounds per cubic foot. The results of the direct shear tests are given on Figures 3 and 4 of the attached Appendix II.

3.0 SOIL CONDITIONS (continued)

3.2 Dense Grey Silty Sand and Gravel Till

Underlying the fill at the Borehole 1 location is a deposit of grey silty sand and gravel till. The thickness of the till deposit at this location is about 7 feet. A gradation analysis was carried out on a sample of the till and the results are shown on Figure 2 of Appendix II. The natural water content of the till based on one laboratory determination is about 9 per cent.

The results of a Standard Penetration Test carried out in the till deposit gave an "N" value of 42 suggesting a dense state.

3.3 Bedrock

Boulders were encountered immediately above bedrock. The bedrock itself consists of a fresh dark grey banded micaceous gneiss. Core recovery in the rock was 72 percent in the upper approximately 2 feet increasing to 100 per cent below this depth. The RQD* of the rock increased from 0 per cent in the upper 2 feet to 50 to 80 per cent with depth.

4.0 WATER CONDITIONS

Water level observations were made during drilling operations and in the piezometers installed in the boreholes subsequent to completion of the field work. The piezometer was installed in Borehole 1 by first backfilling the drilled hole up to 24.5 ft. depth with sand and gravel, and then lowering the piezometer to the 24.5 ft. level whereupon backfilling with sand and gravel continued up to a depth of 3 feet below ground surface. A bentonite seal was placed in the borehole between a depth of 3.0 feet and 1.0 feet and the remaining portion of the hole was filled with sand and gravel. The piezometer in Borehole 2 was installed by manual drive methods.

*RQD = Rock Quality Designation = the cumulative length of 4 inch long or greater pieces of rock core in a run, divided by the total length of the run.

4.0 WATER CONDITIONS (continued)

The piezometer is a drive type Casagrande piezometer equipped with a metal point and attached to metal rods which form part of the permanent installation.

The results of water level observations taken in the piezometers on September 27, 1979 indicate that the water level in Borehole 1 is about 19 feet below ground surface while in Borehole 2 the piezometer remained dry indicating a depth to water level of greater than 10 feet at this location. It should be noted, however, that the pond level in Cell 4 on this date was some 8 feet below normal high water level.

In addition to the water levels in the piezometers, ponded water was observed in the bedrock outcrop area immediately north of Cell 4. Further, surficial runoff flow was noted in the drainage ditches to the north and south of Cells 3 and 4. This flow was channeled around the west containment dyke of Cell 4 and the east containment dyke of Cell 3.

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:

<u>Consistency</u>	<u>U-Strength Tons/sq. ft.</u>	<u>Relative Density</u>	<u>Standard Penetration Resistance. Blows/ft.</u>
Very soft	0.03 to 0.25	Very loose	0 to 4
Soft	0.25 to 0.5	Loose	4 to 10
Firm	0.5 to 1.0	Compact	10 to 30
Stiff	1.0 to 2.0	Dense	30 to 50
Very stiff	2.0 to 4.0	Very dense	over 50
Hard	over 4.0		

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".

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OFFICE REPORT ON SOIL EXPLORATION

CONTRACT T10303A BORING # 2 DATUM LOCAL
 BORING DATE SEPT. 17/79 REPORT DATE OCT. 17, 1979 COMPILED BY MCZ CHECKED BY RB
 SAMPLER HAMMER WT 140 LBS POINT 30 INCHES PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN LBS ENERGY

SAMPLE CONDITION

☒ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

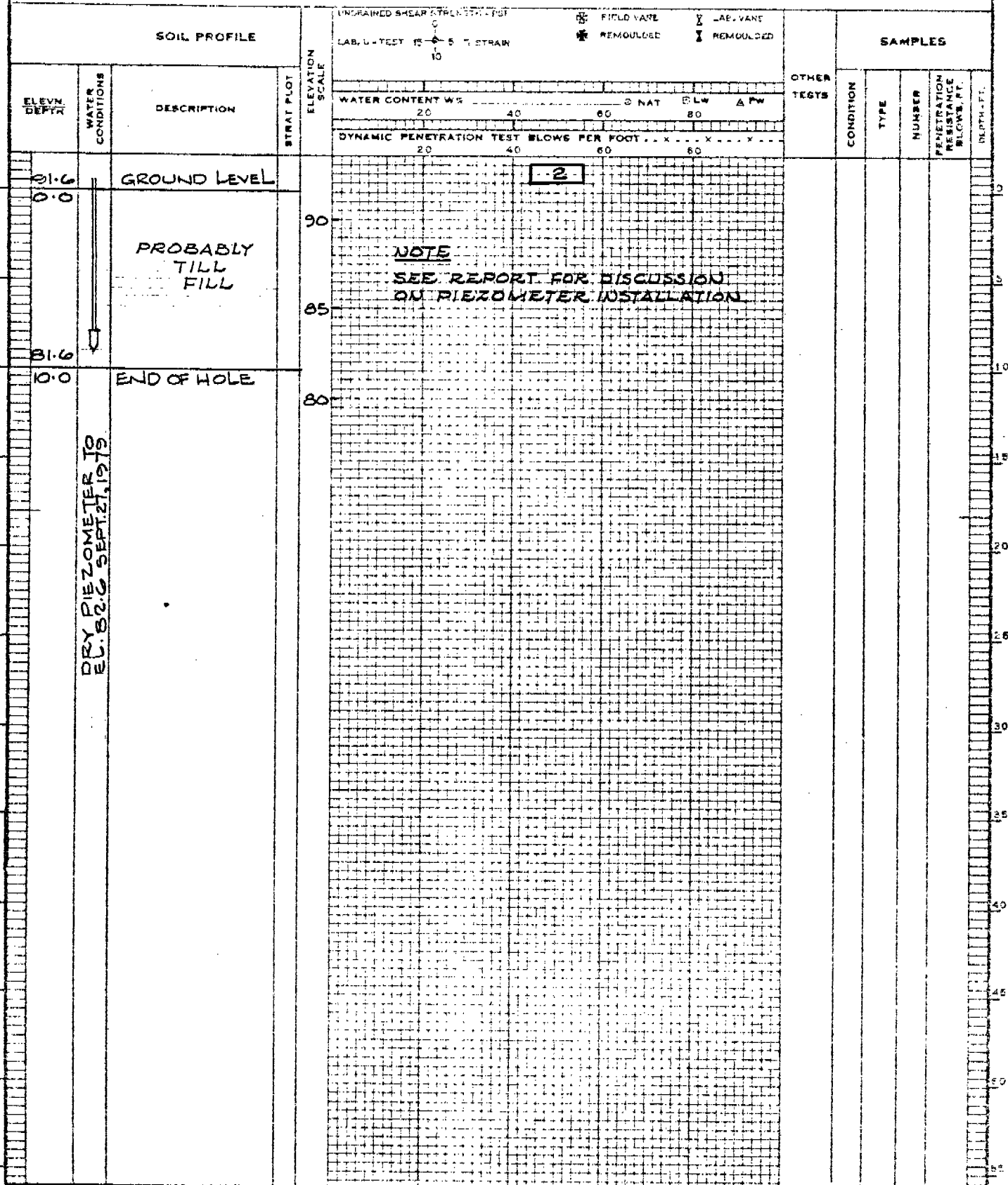
SAMPLE TYPES

AS AUGER SAMPLE
 ST SLOTTED TUBE
 WS WASHED SAMPLE
 DO DRIVE OPEN
 DF DRIVE FOOT VALVE
 CS CHUNK SAMPLE

FS SOIL SAMPLE
 SO SILENT OPEN
 SF SILENT FOOT VALVE
 TO THIN WALLED OPEN
 RC 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



APPENDIX II

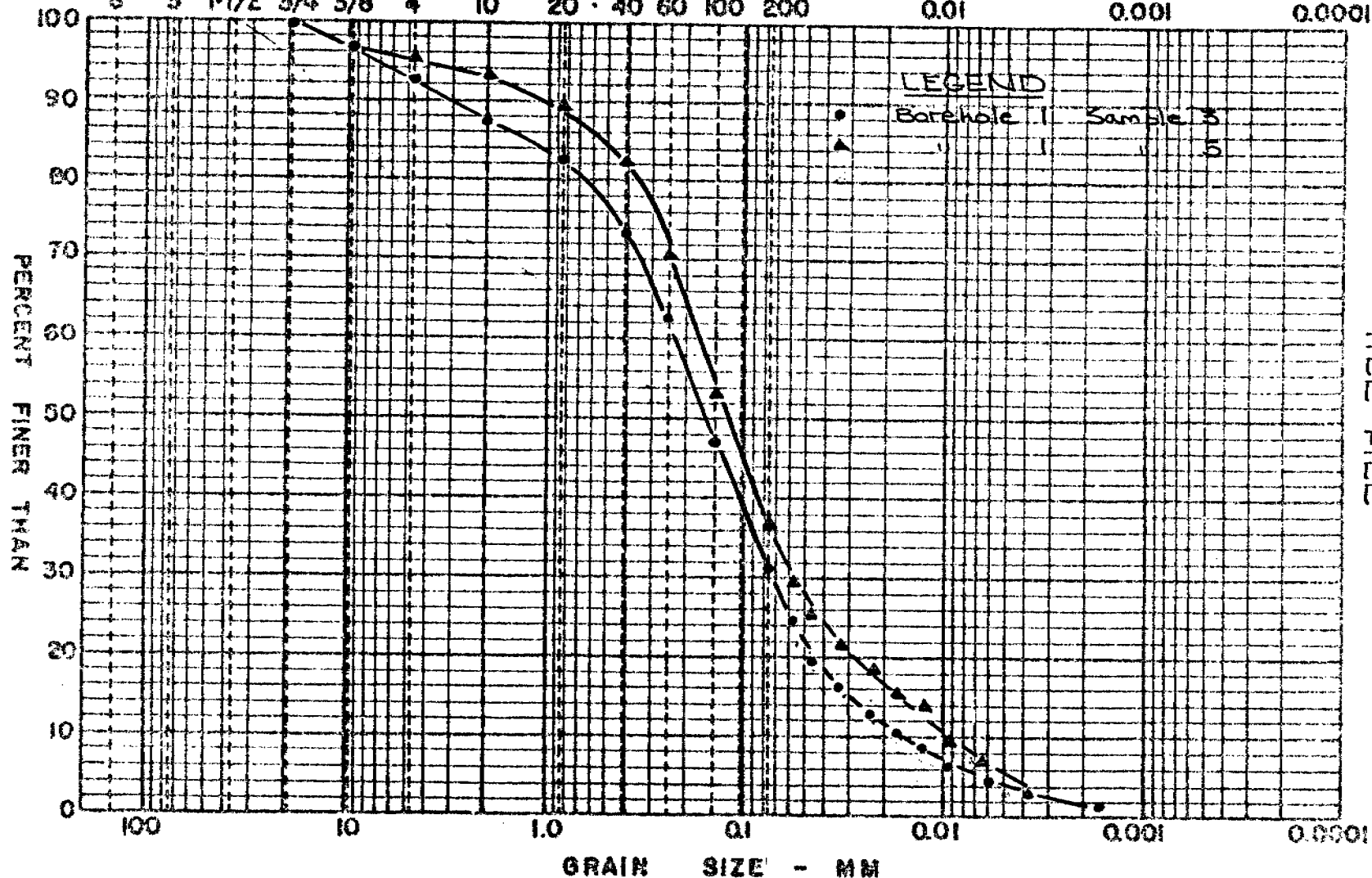
FIGURES - LABORATORY TESTING

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COBBLE	GRAVEL SIZE			SAND SIZE			FINE GRAINED	
← SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE →

SIZE OF OPENING-INS. U.S.S. SIEVE SIZE-MESHES/IN. EQUIVALENT GRAIN DIAMETER - MM

6" 3" 1-1/2" 3/4" 3/8" 4 10 20 40 60 100 200 0.01 0.001 0.0001



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M.I.T. GRAIN SIZE SCALE

GRAIN SIZE DISTRIBUTION

APPENDIX II

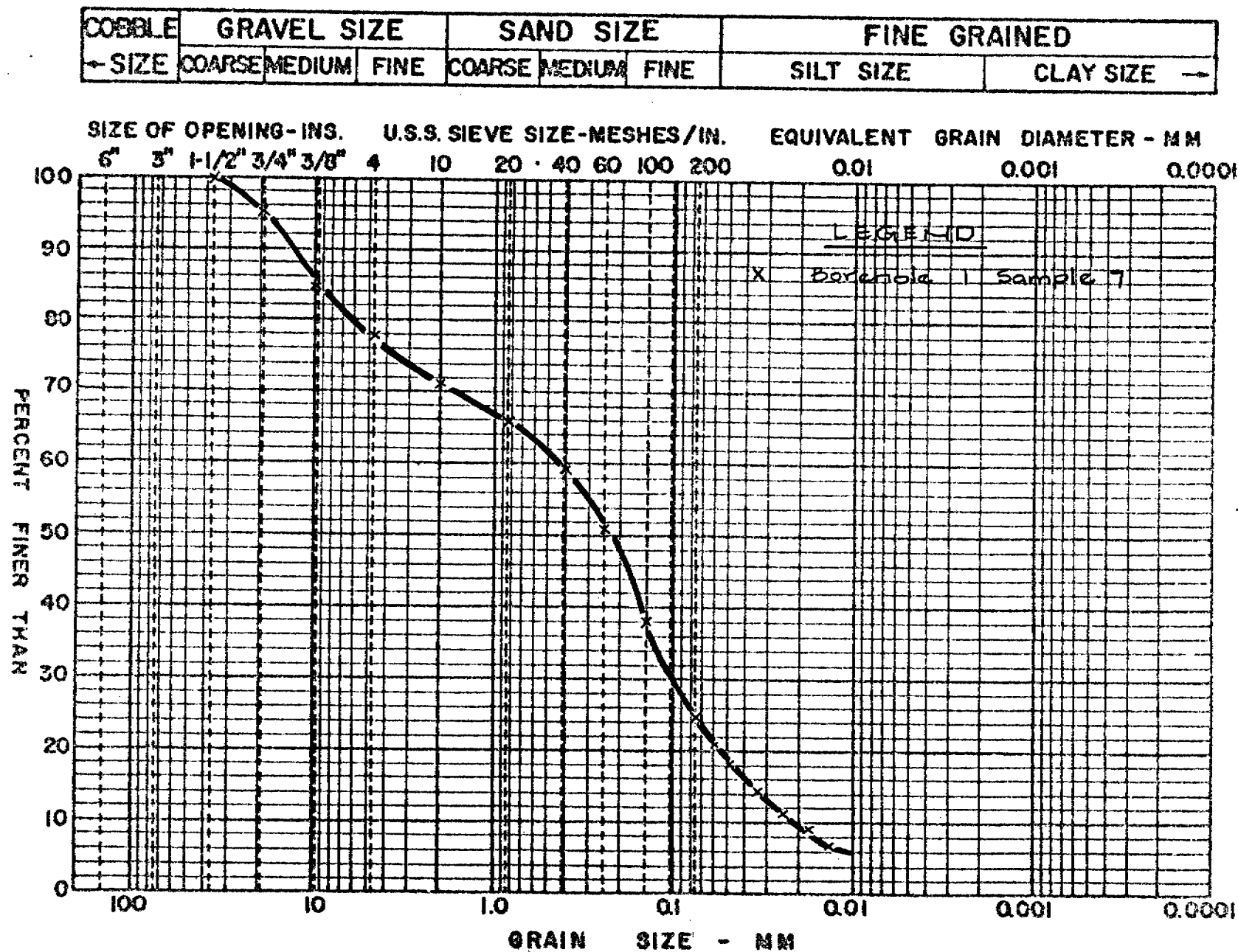
FIGURE 1

PROJECT T10303A

APPENDIX III

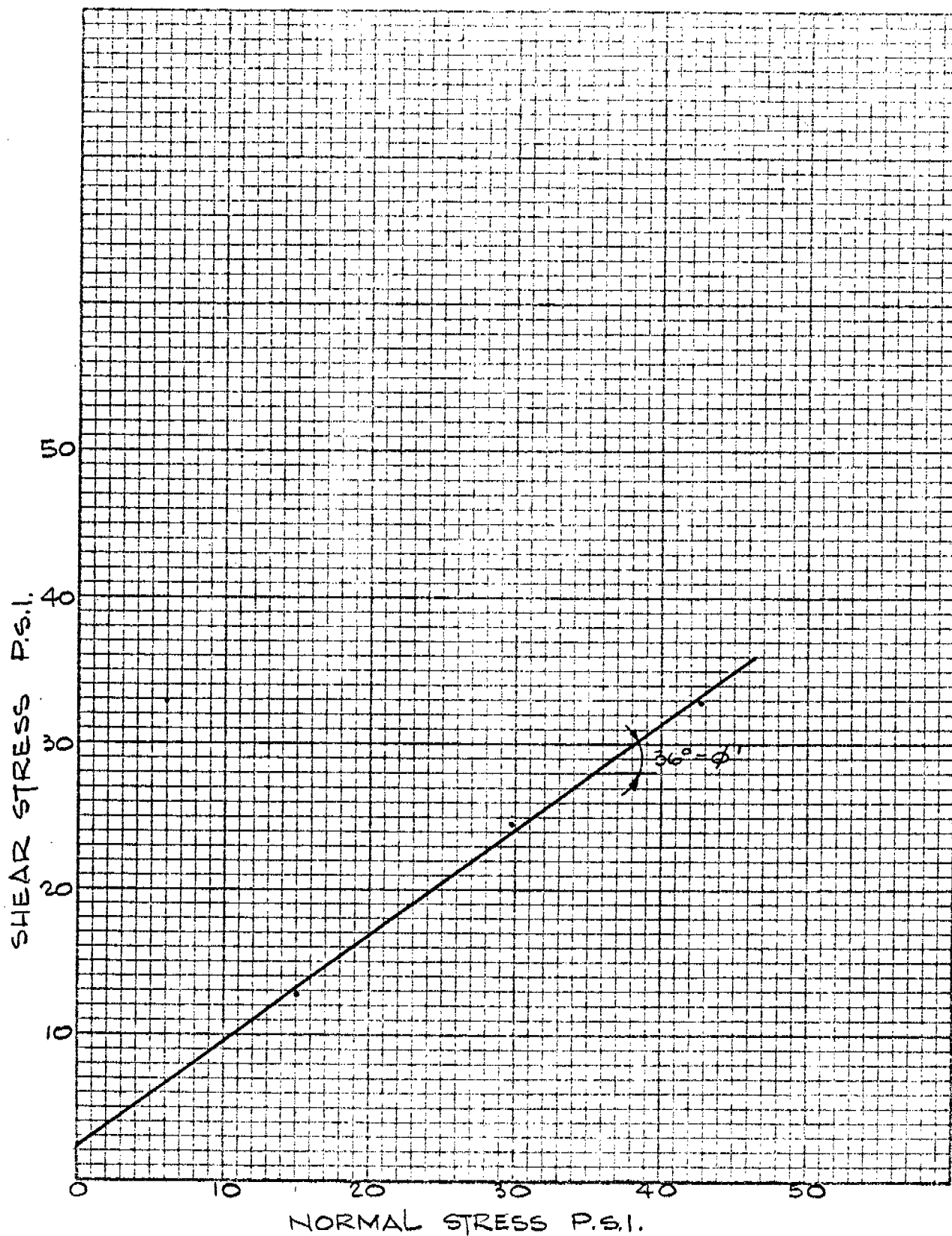
PROJECT T10303A

SILTY SAND & GRAVEL TILL



DRAINED
DIRECT SHEAR TEST
BOREHOLE 1 - SAMPLE 5

APPENDIX II
FIGURE 3
PROJECT T10303A

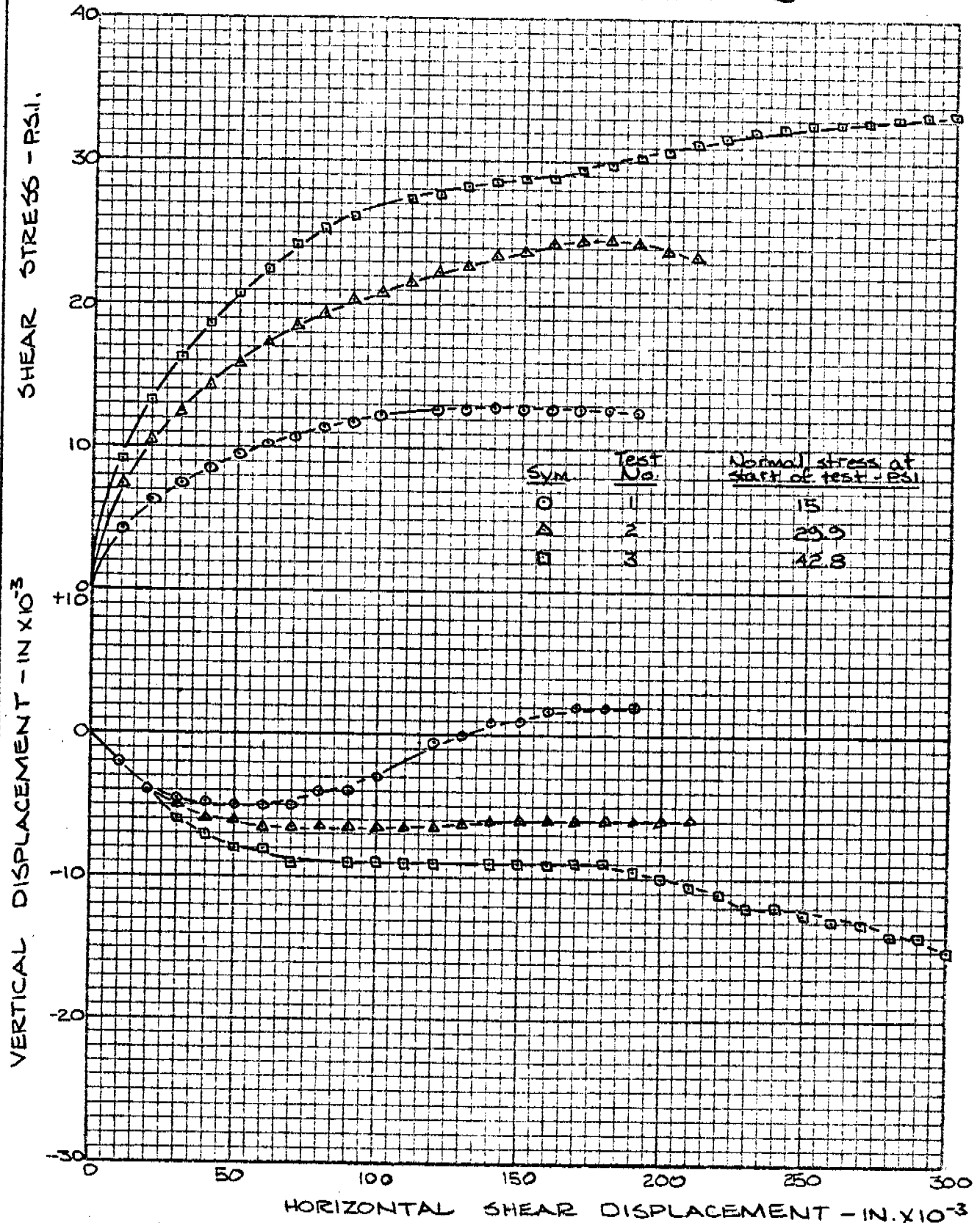


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DRAINED DIRECT SHEAR TESTS STRESS DEFORMATION CURVES

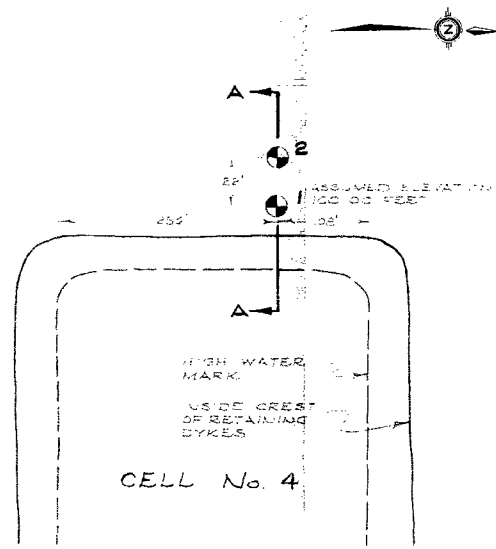
APPENDIX II
FIGURE 4
PROJECT T10303A

BOREHOLE 1 - SAMPLE 5

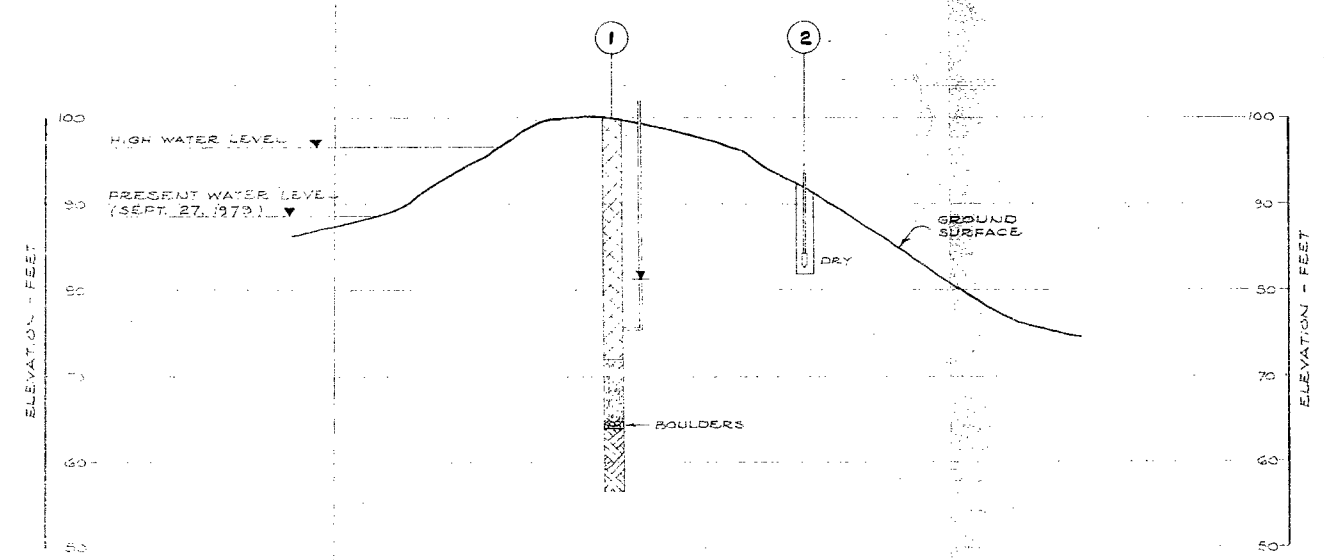


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OVERSIZE DRAWING(S)



BOREHOLE PLAN
(NOT TO SCALE)



SECTION A-A
SCALE: 1" = 10'

LEGEND

- BOREHOLE IN PLAN
- BOREHOLE IN SECTION
- WATER LEVEL (SEPT. 27, 1979)

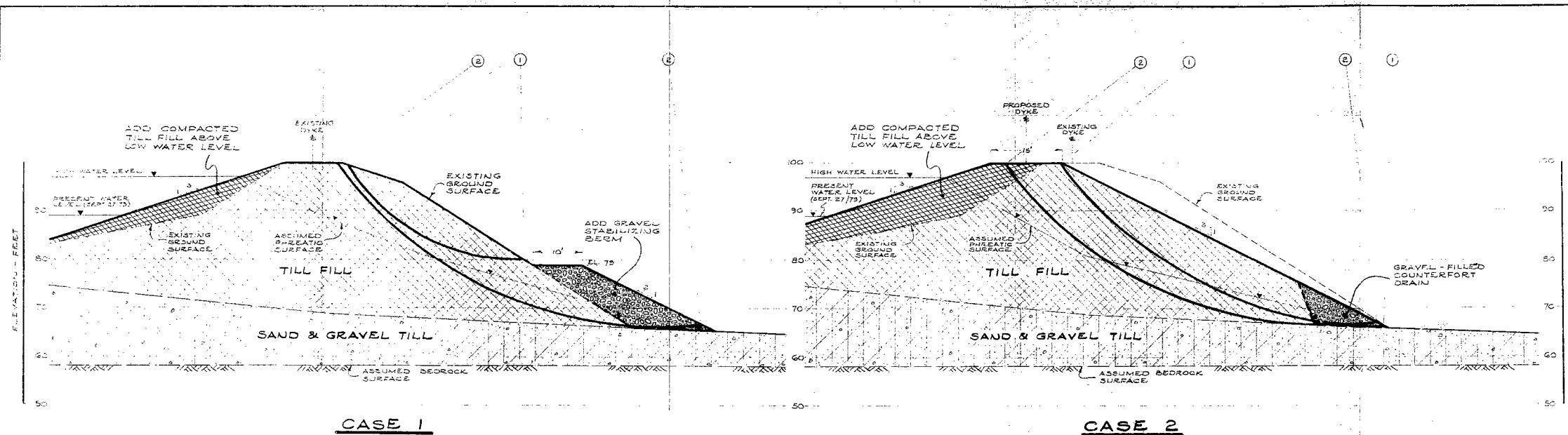
STRATIGRAPHY

- LOOSE TO COMPACT BROWN SILTY SAND
SOME GRAVEL (TILL FILL)
- DENSE GREY SILTY SAND
AND GRAVEL TILL
- BEDROCK

NOTES

- 1 GROUND SURFACE OBTAINED FROM SURVEY ON SEPT. 27, 1979 BY GEOCON (1979) LTD.
- 2 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING REPORT.

REFERENCE		HIDDEN VALLEY INN LIMITED HUNTSVILLE, ONTARIO WEST RETAINING DYKE-CELL No. 4 HUNTSVILLE, ONTARIO BORING PLAN & SOIL STRATIGRAPHY	GEOCON (1975) LTD. DATE: OCT. 1979 SCALE: AS SHOWN NO. T10503A-1
DWG. NO.	DESCRIPTION		



SUMMARY OF SOIL PARAMETERS			
SOIL STRATA	EFFECTIVE ANGLE OF INTERNAL FRICTION ϕ (DEGREES)	EFFECTIVE COHESION C (PSF)	TOTAL WEIGHT (KIP)
TILL FILL	36	0	10.5
SAND & GRAVEL TILL	40	0	2.0

SUMMARY OF COMPUTED FACTOR OF SAFETY		
CASE 1	CIRCLE	COMPUTED FACTOR OF SAFETY
	①	1.51
	②	1.21
CASE 2	CIRCLE	COMPUTED FACTOR OF SAFETY
	①	1.53
	②	1.65

REFERENCE		HIDDEN VALLEY INN LIMITED HUNTSVILLE, ONTARIO WEST RETAINING DYKE-CELL No. 4 HUNTSVILLE, ONTARIO PROPOSED REMEDIAL MEASURES	GEOCON (1975) LTD. DATE: 10/10/77 SCALE: 1" = 10' JOB NO. 10103024-B
DWG. NO.	DESCRIPTION		