DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M12-245

DIST. 6 REGION

W.P. No.

CONT. No.

W. O. No. 2000 - 11006

STR. SITE No.

HWY. No. Loc

LOCATION Storm Sewer Crossing
Hurontario St

No. of Pages -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

WO 2000-11006

GEOCRES No: 30M12-245

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

FINAL REPORT
TO

R. E. WINTER & ASSOCIATES LTD.

SUBSURFACE INVESTIGATION
UNDERGROUND UTILITIES AND PAVEMENTS
PROPOSED BRITANNIA
EAST INDUSTRIAL PARK, PHASE II

MISSISSAUGA ONTARIO

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November, 1980 801-1040-II

Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

November 11, 1980

R. E. Winter & Associates Ltd.
Consulting Engineers
77 City Centre Drive
MISSISSAUGA, Ontario
L5B 1M5

ATTENTION: Mr. J. M. Tomlinson, P. Eng.

RE: SUBSURFACE INVESTIGATION
UNDERGROUND UTILITIES AND PAVEMENTS
PROPOSED BRITANNIA EAST INDUSTRIAL PARK
PHASE II
MISSISSAUGA, ONTARIO

Dear Sirs:

This letter reports the results of a subsurface investigation carried out at the site of the proposed Britannia East Industrial Park in Mississauga, Ontario, (Figure 1). This letter deals with the Phase II area, in the northern portion of the overall site. A separate report has been provided for the Phase I area (Golder Associates report 801-1040, dated May 1, 1980). The purpose of the investigation was to assess the subsurface conditions at the site by means of a limited number of sampled borings and, based on the results of these borings, to provide geotechnical recommendations for the engineering design of the proposed underground utilities installation and road construction. Comments on specific aspects of construction of the proposed works are also included for the guidance of the design engineer.

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DESCRIPTION OF PROJECT

We understand that Phase II of the Britannia East Industrial Park project involves the installation of storm and sanitary sewers and watermains, and the construction of industrial pavements along portions of Britannia Road East, Wallace Street, Coopers Avenue, Brunel Road, Traders Boulevard, and Whittle Road, (Figure 2). We understand that industrial and office structures up to 6 storeys high may be constructed in the blocks bounded by Brunel Road, Whittle Road, Watline Avenue and Highway 10. An engineered fill program is currently being carried out in the west-central portion of the site. Details of the proposed services work have been supplied to us on your first submission Drawings G-1 to G-9 and 1 to 47 for R. E. Winter & Associates Ltd. project 1312X1, dated August, 1980.

SITE DESCRIPTION AND GEOLOGY

The natural topography at the site consists of gently rolling hills ranging in elevation from about 200 m, Geodetic datum, to about elevation 185 m. The western and southern portions of the overall site are lower than the northern and eastern areas. Within the limits of the Phase II project, the ground surface is generally within the "higher" area, except in the area immediately to the east of Highway 10 near Traders Boulevard where the engineered fill operation is being carried out. This low area was formerly a stream valley which dipped to the west. The Phase II area has generally been used as farm land.

The site is located in the physiographic region known as the 'Peel Plain', a drumlinized till plain characterized by deposits of clayey silt to silty sand glacial till, overlying shale bedrock of the Meaford-Dundas formation.

Relatively deep interglacial lacustrine sand and silt deposits occur in the western "lower" portion of the site.

PREVIOUS INVESTIGATIONS

Previous investigations (Golder Associates report Nos. 791-1234, 791-1292, 801-1025) have been carried out along Britannia Road and Kennedy Road. The locations of some of the borings put down during these investigations are shown on Figure 2. Recommendations were provided for the engineering design of the proposed underground services. In addition, a pavement design for the proposed reconstruction of Kennedy Road was provided.

INVESTIGATION PROCEDURE

The present investigation was carried out during March, 1980, when a total of 51 boreholes were put down at the locations shown on the attached Figure 2. The results of the 20 boreholes put down in the Phase I portion of the site, (Figure 1) have been previously reported (Golder Associates report 801-1040, dated May, 1980). The results of the boreholes in the Phase II portion of the site were reported in a factual report (Golder Associates report 801-1040-I, dated June, 1980.

The field work for the Phase II portion of the investigation was carried out between March 17 and 28, 1980. The borings were put down using a power auger supplied by a specialist drilling contractor. A total of 31 borings (Boreholes 201 to 220, Borehole 222, Boreholes 239 to 244, Boreholes 247 to 249, and Borehole 301) were put down at the locations shown on the attached Figure 2. The locations of the boreholes were selected and staked in the field by R. E. Winter & Associates Ltd. Each of the boreholes were put down to the depths specified by R. E. Winter & Associates Ltd. except that where bedrock was encountered prior to the proposed depth, the borehole was advanced to practical refusal, whereupon it was terminated. In addition, Borehole 247 was advanced to refusal, whereupon BXL core was recovered for a length of 1.4 m.

The field work was supervised throughout by a member of our engineering staff who located the borings in the field, directed the drilling and sampling operations and logged the borings. Following field identification and logging, all of the samples obtained during the investigation were sealed into air-tight containers and brought to our laboratory for detailed examination and testing. On March 27 and 28, 1980, water level readings were taken in all the piezometers installed during the investigation.

In the laboratory, a detailed examination of each soil sample was carried out and the water content, particle size distribution and plasticity of selected samples were determined. California Bearing Ratio and standard Proctor compaction tests were not carried out on any soil samples since the major subgrade types at the site have been tested previously, (Golder Associates report No. 801-1025, dated February, 1980 and Progress Report Nos. 1 and 2 for Project 801-1171, dated July 31 and August 18, 1980).

The borehole locations and the elevations of the ground surface at each boring were determined by R. E. Winter & Associates Ltd. and supplied to us on a print of your plan Nos. 1 and 2. It is understood that all of the ground surface elevations are referred to Geodetic datum.

SUBSURFACE CONDITIONS

The detailed stratigraphy encountered in each of the boreholes, together with the results of laboratory tests carried out on representative samples of the soil strata, are given on the attached Record of Borehole sheets and on Figures 3 to 5. It should be noted that the stratigraphic boundaries indicated on the borehole logs are inferred from non-continuous samples. These boundaries typically represent a transition from one soil type to another and do not necessarily indicate an exact plane of geologic change. Further, the subsurface conditions may vary between boreholes.

In general, the ground surface at the site is underlain by "topsoil" ranging in thickness from 0.5 m to 1.1 m, with an average thickness of 0.7 m. Generally, the upper 0.3 to 0.5 m of the topsoil is dark brown and more organic than the underlying soil material. In several areas of the site, the ground surface is underlain by fill ranging in thickness from 0.2 m to 1.4 m. In the eastern "higher" portion of the Phase II area, glacial till deposits directly overlie residual soil and bedrock of the Meaford-Dundas formation. In the western "lower" portion of the site, glacial till materials, overlying deposits of sand, silty fine sand and silt were encountered. These latter deposits are of glacio-lacustrine origin and were found to overlie a sandy silt to silty sand till which in turn is underlain by a clayey silt residual soil and/or shale bedrock.

The following is a detailed description of each of the major soil types encountered during the investigation.

Clayey Sandy Silt Till

In Boreholes 206, 207, 215, 217, 218, 220, 241 and 248, firm to hard clayey sandy silt till, containing a trace to some gravel (Figure 3), was encountered. The water content of this cohesive till material generally ranges from 10 to 14 per cent. Standard Proctor compaction tests have been carried out on samples of the clayey sandy silt till during the Phase I construction. The results of these tests indicate that the optimum water content (for maximum dry density) of the glacial till ranges between about 12 and 14 per cent.

Upper Silty Sand to Sandy Silt Till

In Boreholes 203, 205, 206, 208 to 212, 239, 240, 244 and 248, compact to very dense silty sand to sandy silt till or till-like material, containing a trace to some clay and gravel, was encountered. The water contents of samples of the silty sand to sandy silt till range from 9 to 14 per cent, but some values as high as 24 per cent were recorded. The results of standard Proctor compaction tests carried out on samples of the till material from the Phase I site, indicate that its optimum moisture content is generally about 10 per cent.

Fine to Medium Sand to Silty Sand

Very loose to very dense layered, fine to medium sand to silty sand, occasionally containing some sandy silt layers and/or a trace of gravel and clay, was encountered in Boreholes 204, 206, 207, 209, 222, 247, 249 and 301. The natural water content of these glacio-lacustrine strata range from about 11 to 20 per cent. Standard Proctor compaction tests carried out on samples of these materials indicate that the optimum water content of the sands is between about 10 to 12 per cent.

Sandy Silt to Silt

Extensive deposits of very loose to very dense sandy silt to silt, containing traces of fine sand and clay (Figure 4), were encountered in Boreholes 204, 209, 222, 247, 249 and 301 in the southwestern portion of the site. The sandy silt to silt was stratified and was generally inter-layered with sand and silty fine sand strata. In Borehole 249, thin strata of clayey silt were also included in this deposit. The natural water contents of samples of the silts generally range from 17 to 22 per cent. Standard Proctor compaction tests carried out on this material indicate that the optimum water content is about 12 to 14 per cent. It is considered that, in general, the in situ material is wet of its optimum moisture content.

Lower Silty Sand to Sand and Gravel Till

Underlying the glacio-lacustrine silt and sand deposits in Boreholes 206 and 249, a silty sand to sand and gravel till was encountered. The natural water content of samples of this glacial till, as measured in the laboratory, ranged from 9 to 14 per cent.

Clayey Silt Residual Soil

In Boreholes 201 to 203, 208, 216 and 217, very stiff to hard, greenish grey to reddish brown clayey silt residual soil, containing a trace to some sand and some gravel size shale fragments, was encountered, (Figure 5). The natural water content of samples of this stratum ranged from 7 to 16 per cent.

Shale and Limestone Bedrock

Boreholes 206, 214 and 215 were advanced 1.5 m, 0.9 m and 0.2 m, respectively, into highly to completely weathered reddish brown to greenish grey shale with occasional limestone beds, whereupon the borehole was terminated without practical refusal at elevations 183.4, 185.6 and 188.9, respectively. In Boreholes 217, 243 and 249, practical refusal to auger advance was encountered at elevations 184.1 m, 180.3 m, 180.1 m and 182.2 m, respectively. It is interpreted that this refusal was at the surface of moderately weathered shale bedrock or on the surface of a limestone bed. Based on our previous experience in the area of the site, the hard limestone beds may be up to 1 m thick.

Boreholes 201, 208, 213, 240, 241, 242, 243, 244 and 249 were advanced from 0.1 m to 6.5 m into highly to completely weathered reddish brown to greenish grey thinly bedded shale, whereupon the boreholes encountered practical refusal to advance of the CME 55 auger at elevations ranging from 178.8 to 188.8 m.

Borehole 247 was advanced to refusal at elevation 174.3, whereupon BXL sized core was extracted for a length of 1.4 m. The recovered core consisted of hard clayey silt till containing numerous shale fragments and boulders, overlying (at elevation 173.3) highly to completely weathered grey shale containing thin limestone bands.

Groundwater Conditions

Water level readings taken in the piezometers installed during the investigation on March 27 and 28, 1980, are given on the Record of Borehole sheets. In the northwestern portion of the Phase II site, the groundwater level at that time was at about elevation 190 to 192 m (see Boreholes 207, 208 and 209). In the southwestern portion, the groundwater was at between elevation 182 and 186 m (see Boreholes 222, 247 and 249). Most of the shallow borings put down in the central portion of the site were dry on completion. However, water levels of 189, 190 and 193 m were measured in Boreholes 201, 214 and 211, respectively. In the eastern portion of the Phase II site (along Cooper Avenue), the shallow borings were dry upon completion. During previous subsurface investigations along Kennedy Road, the groundwater level was found to vary from elevation 186 m at Borehole 9 (Golder Associates report 791-1234, dated December, 1979) to 183 m at Borehole 2 (Golder Associates report 791-1292, dated December, 1979). We recommend that current water level readings be taken at the site prior to calling for tenders for the work.

ENGINEERING RECOMMENDATIONS

Pipe Bedding

In general, the invert of the underground services proposed for the central and eastern portions of the site, is in dense or hard till materials, hard residual soil or shale bedrock. We consider that where the proposed services are placed on these competent native materials, only a minimum depth of pipe bedding conforming to City of Mississauga and Region of Peel standards is required for the support of the pipe. We suggest that the pipe bedding material be a well graded, free draining granular material such as MTC Granular 'A' or City of Mississauga "Granular Bedding" (Plan No. 2-1-32).

Where the trench invert is in the glacio-lacustrine sands and silts encountered in the western portion of the site, we suggest that the pipe be placed on a minimum depth of 300 mm of well graded granular material such as that described above. If clear stone is used to stabilize the trench bottom in wet areas, it is suggested that this material not be brought above the proposed trench invert level. Instead, the required amount of well graded granular material should be placed and compacted above the clear stone. If water is encountered in the trench during construction and proper groundwater control measures are not employed (i.e. lowering of the groundwater level to at least 0.5 m below the trench invert prior to excavation), some loosening of the silts and sands can be anticipated. This causes a reduction in strength and an increase in compressibility of the foundation materials and, therefore, the bedding thickness should be reviewed on field inspection of the foundation conditions. It may be necessary in some cases to carry out proper dewatering and to subexcavate loosened soils and replace them with suitable granular materials well compacted in place.

Pipe bedding materials should be placed in lifts not exceeding 150 mm and compacted to at least 95 per cent standard Proctor dry density of the material. The use of hand tamping or small compaction equipment at the haunches and sides of the pipe is particularly important for the support of the pipe.

A well graded granular material such as MTC Granular 'C' or City of Mississauga "Sand Cover" (Plan No. 2-1-33) should be used between springline of the pipe and 300 mm above the pipe. The granular material should be placed in lifts not exceeding 300 mm loose thickness and compacted to at least 95 per cent standard Proctor dry density.

It should be noted that the width of the trench should meet minimum standards and be chosen to allow proper use of compaction equipment beside the pipe.

Trench Backfill

It is understood that where possible, native soils will be used as trench backfill. It should be noted that any fill or native materials containing significant amounts of organic matter or shale are not suitable for use as trench backfill and should be disposed of in non-settlement sensitive areas of the development.

The trench backfill materials should be placed in lifts not exceeding 300 mm and compacted to at least 95 per cent standard Proctor dry density and in accordance with City of Mississauga specifications. It is understood that these specifications apply to services located in easements as well as along roadways.

Based on the results of this investigation, the native clayey tills and residual soils are suitable for use as trench backfill provided that cobbles, boulders and shale slabs larger than 150 mm are removed prior to placement. The water content of these materials is generally such that the specified 95 per cent standard Proctor dry density can be readily achieved.

Some portions of the sandy till and the glacio-lacustrine sand to silty sand material are at in situ water contents which are generally in excess of the optimum water content for compaction. In general, it is considered that the maximum densities which can be achieved at the in situ water contents is between about 90 and 95 per cent of the standard Proctor maximum dry density, provided that proper construction techniques are adopted. To achieve the required density (i.e. 95 percent of the standard Proctor dry density as specified by the City of Mississauga), it will be necessary to dry these materials or to mix them with drier native or imported soils of suitable gradation. Particular attention should be given to the compaction of backfill materials adjacent to manholes, and the like.

It is considered that thick layers of uniformly (poorly) graded fine sands and silts which occur in some areas of the site and are at an in situ water content well in excess of the optimum value for compaction, will be difficult to compact. It is likely that some of these materials will have to be wasted. Further, in the central and eastern portions of the site where the excavations will be taken into bedrock, the excavated shale is unsuitable for use as backfill unless it is in a completely to highly weathered condition and will behave as a clayey till during compaction operations. Considerable care and judgment is required in the proper selection and working of these materials. The less weathered shale and shale containing limestone beds will be unsuitable for use as trench backfill in settlement sensitive areas.

It is recommended that prior to commencement of construction, laboratory compaction tests and/or grain size analyses be carried out on samples of imported backfill materials which the contractor proposes to use. It is further recommended that selection of suitable backfill materials, together with trench base preparation, backfilling and compaction operations, be supervised by experienced geotechnical personnel.

Along Whittle Road and Traders Boulevard East, the watermain is proposed to be placed on fill materials placed as part of the Britannia East Engineered Fill Program at the site. It is recommended that special control of and additional testing of trench backfill conforming to Region of Peel requirements be carried out.

Pavement Design

It is recommended that, prior to pavement construction, any topsoil within the proposed roadway limits be stripped and removed from the site. The exposed subgrade materials should be inspected and proof-rolled. Any materials having a high organic content (based on field examination) or behaving in a soft/loose manner during proof-rolling, should be subexcavated and wasted.

Following removal of unsuitable materials and proof-rolling of the subgrade, cutting and filling of the existing materials to conform to the design subgrade profile can be carried out. Materials considered suitable for use as subgrade backfill are the same as those recommended for use as trench backfill (and subject to the same compaction criteria).

Provided that trench backfill materials are placed and compacted as given in the previous section, and that the subgrade is prepared as given above, we consider that the following pavement design for Phase II will be adequate:

			Kennedy Road Britannia Road	'Internal' Roads
Asphalt:	MTC H.L.3	-	40 mm	40 mm
	MTC H.L.6	-	100 mm	65 mm
Base:	MTC Granular 'A'	-	150 mm	150 mm
Subbase:	MTC Granular 'B'	-	300 mm	300 mm

Although curb and gutter construction is proposed, it is recommended that during the 1981 construction program only the binder course of asphalt be placed.

Storm Sewer Outfall West of Hurontario Street

Borehole 301 was put down at the western end of the proposed 2550 mm concrete storm sewer outfall to the west of Hurontario Street. At the location of Borehole 301, the invert of the storm sewer will be in dense silty fine sand to sandy silt below the water table. Provided that proper groundwater control is carried out, the dense sands and silts should provide adequate support of the pipe which is bedded and backfilled as above in cut and cover excavations. The comments given above in relation to pipe bedding and the suitability of the various native soils as trench backfill are also pertinent to this section of trench.

We understand that a 70 m long, 3.6 m inside diameter, tunnel will be constructed to convey the proposed storm outfall under Hurontario Street (Highway 10). Although no boreholes have been put down immediately at the tunnel location, the results of the adjacent Boreholes 301 and 222, indicate that the tunnel will be advanced through compact to dense stratified silty fine sand, sandy silt and silt. The groundwater level is high, at about elevation 18.3 m. The composition and density of the Highway 10 embankment fill and the actual in-situ density of the underlying native soils are not known.

Based on the above, we consider that construction of the 3.6 m "soft ground" tunnel must include provision for positive groundwater lowering and immediate installation of temporary support systems to minimize loss of ground into the tunnel and settlement at the ground surface or subsidence. The groundwater control system should be designed and installed such that the groundwater level is drawn down to at least 0.5 m below the tunnel invert prior to commencement of tunnelling. Grouting behind the temporary support system must be carried out as soon as possible. It should be appreciated that some settlement will be evident along the surface of the Highway 10 pavement. The settlement is a result of changes in the state of stress in the ground, together with corresponding strains and displacement, due to loss of ground at the tunnel face and the like. While subsidence cannot be eliminated, it can be minimized by the use of appropriate construction techniques. The surface settlements will be more or less symmetrical about the vertical axis of the tunnel system, forming a trough-like depression. Based on the limited information presently available, and assuming that good construction techniques are adopted, it is considered that the magnitude of the settlement will be within acceptable limits. It is recommended that the proposed construction/dewatering procedures be reviewed by a geotechnical engineer prior to construction.

COMMENTS ON CONSTRUCTION

The following comments on construction procedures are provided for the guidance of the design engineer. The contractor should make his own interpretation of the factual borehole information provided in this report as it affects his construction procedures and scheduling.

Excavation of trenches in both the glacial till materials and the glacio-lacustrine sands and silts may generally be cut in accordance with the applicable guidelines of the Occupational Health and Safety Act of Ontario (1979). Since the trench base at various locations of the site will be in cohesionless granular till or lacustrine materials below the water table, some groundwater seepage may be expected. Even if the water inflow is relatively small, instability and "loosening" of the sides and base of the excavation is to be expected in excavations taken into the sands and silts below the water table. The assured method to avoid difficulty with respect to excavation slope stability and to prevent loosening of the foundation subsoils is to lower the groundwater level to at least 0.5 m below the proposed invert depth, prior to construction. The proposed groundwater control system should be reviewed prior to construction and should be designed and installed by personnel experienced in this field. The alternative method (of rapid excavation and backfilling in short sections and controlling groundwater inflow using sumps) involves risk of instability and loosening of the foundation subsoils. The contractors bidding on this work should be made aware of the potential difficulties associated with excavation in the silts and sands below the groundwater level.

In the central and eastern portions of the site, refusal to advance of the power auger was encountered at elevations generally higher than the invert of the proposed services. Since coring of the bedrock was not carried out during this investigation, it is not possible to comment in detail on the thickness or state of weathering of the material to be excavated. It is considered that where the auger could be advanced, mechanical excavation should be possible provided that suitable equipment and procedures are used. However, some limestone beds were noted in the bedrock cored along Kennedy Road during a previous investigation (Golder Associates report 791-1292, dated December 1979) and also during construction of Matheson Blvd. sanitary sewer. Based on the above, together with the occurrence of refusal to the power auger above the invert level during drilling for this investigation, it should be anticipated that some pre-blasting of the bedrock will be necessary prior to excavation, depending on the type of construction equipment or procedures used. Such blasting operations must be properly planned and carried out by experienced personnel and should be closely monitored to ensure that no damage results to nearby existing structures.

We trust that the above information is sufficient for your present requirements. Should you have any questions regarding this report, please call us.

Yours truly,

GOLDER ASSOCIATES

REGISTERED PROFESSIONAL ENGINEER
D. W. HUBBLE
PROVINCE OF ONTARIO

D. W. Hubble, P. Eng.

J.H.A. Crooks, P. Eng.

DWH:JHAC:jm
801-1040-II

Att: Abbreviations and Symbols
Record of Borehole sheets
Figures 1 to 5

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS	auger sample
CS	chunk sample
DO	drive open
DS	Denison type sample
FS	foil sample
RC	rock core
ST	slotted tube
TO	thin-walled, open
TP	thin-walled, piston
WS	wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 63.5 kg hammer dropped 760 mm required to drive a 50 mm diameter, 60 degree cone 0.3 m, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 63.5 kg hammer dropped 760 mm required to drive a 50 mm drive open sampler 0.3 m.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*N, blows/* 0.3 m
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	c_u, kPa
Very soft	Less than 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	over 200

IV. SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	combined analysis, sieve and hydrometer[1]
Q	undrained triaxial[2]
R	consolidated undrained triaxial[2]
S	drained triaxial
U	unconfined compression
V	field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

Form...GA-R-1

LIST OF SYMBOLS

I. GENERAL

$\pi = 3.1416$

e = base of natural logarithms 2.7183

$\log_e a$ or $\ln a$, natural logarithm of a

$\log_{10} a$ or $\log a$, logarithm of a to base 10

t time

g acceleration due to gravity

V volume

W weight

M moment

F factor of safety

II. STRESS AND STRAIN

u pore pressure

σ normal stress

σ' normal effective stress ($\bar{\sigma}$ is also used)

τ shear stress

ϵ linear strain

ϵ_{xy} shear strain

ν Poisson's ratio (μ is also used)

E modulus of linear deformation (Young's modulus)

G modulus of shear deformation

K modulus of compressibility

η coefficient of viscosity

III. SOIL PROPERTIES

(a) *Unit weight*

γ unit weight of soil (bulk density)

γ_s unit weight of solid particles

γ_w unit weight of water

γ_d unit dry weight of soil (dry density)

γ' unit weight of submerged soil

G_s specific gravity of solid particles $G_s = \gamma_s/\gamma_w$

e void ratio

n porosity

w water content

S_r degree of saturation

(b) *Consistency*

w_L liquid limit

w_P plastic limit

I_P plasticity index

w_S shrinkage limit

I_L liquidity index $= (w - w_P)/I_P$

I_C consistency index $= (w_L - w)/I_P$

e_{max} void ratio in loosest state

e_{min} void ratio in densest state

D_r relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

h hydraulic head or potential

q rate of discharge

v velocity of flow

i hydraulic gradient

k coefficient of permeability

j seepage force per unit volume

(d) *Consolidation (one-dimensional)*

m_v coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$

C_c compression index $= -\Delta e/\Delta \log_{10} \sigma'$

c_v coefficient of consolidation

T_v time factor $= c_v t/d^2$ (d, drainage path)

U degree of consolidation

(e) *Shear strength*

τ_f shear strength

c' effective cohesion intercept; ϕ' effective angle of shearing resistance, or friction — in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$

c_u apparent cohesion*; ϕ_u apparent angle of shearing resistance, or friction — in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$

μ coefficient of friction

S_t sensitivity

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

Form G.A.-D-1. Project No. 801-1040

RECORD OF BOREHOLE 201

LOCATION See Figure 2 BORING DATE MARCH 19, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	ELEV'N. / DEPTH m	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ELEVATION SCALE
						192
						191
	190.5	GROUND SURFACE				
POWER AUGER BORING 114 mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		190
	189.9 / 0.6	HARD, REDDISH BROWN CLAYEY SILT, SOME SAND & SOME SHALE FRAGMENTS (RESIDUAL SOIL)	1	D.O.	61	
			2	AS	–	189
			3	D.O.	78	
	188.5 / 2.0	COMPLETELY TO HIGHLY WEATHERED REDDISH BROWN TO GREY, THINLY BEDDED SHALE	4	"	70/150mm	
			5	"	50/150mm	187
	186.1 / 4.4	END OF HOLE, REFUSAL TO AUGER				186
						185
						184

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k., CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

G.S.
GROUT
BACKFILL
BENTONITE SEAL
GRAVEL FILTER
PIEZOMETER
CAVED MATERIAL

W.L. IN PIEZOMETER @ ELEV. 188.6 MAR. 28, 1980

15 - 0 - 5 - 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW
CHECKED DWM

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 202 & 203

LOCATION See Figure 2 — BORING DATE MARCH 19, 1980 — DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm — PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD | SOIL PROFILE (ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ ; SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 ; WATER CONTENT, PERCENT Wp W Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

202

Boring Method	Elev'n. / Depth (m)	Description	Sample No.	Type	Blows/0.3m	Piezometer or Standpipe Installation
	193.7	GROUND SURFACE				
POWER AUGER, 114 mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		
	193.1 / 0.6	HARD DARK REDDISH BROWN CLAYEY SILT SOME SAND & SOME SHALE FRAGMENTS (RESIDUAL SOIL)	1	D.O.	45	BOREHOLE DRY ON COMPLETION OF DRILLING
			2	AS	–	
			3	D.O.	74	
	191.7 / 2.0	END OF HOLE				

203

Boring Method	Elev'n. / Depth (m)	Description	Sample No.	Type	Blows/0.3m	Piezometer or Standpipe Installation
	193.7	GROUND SURFACE				
POWER AUGER, 114 mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		
	193.1 / 0.6	COMPACT MOTTLED BROWN TO GREYISH BROWN SANDY SILT, SOME GRAVEL, TRACE ORGANIC MATTER (TILL)	1	D.O.	23	BOREHOLE DRY ON COMPLETION OF DRILLING
	192.2 / 1.5	HARD, GREENISH GREY TO REDDISH BROWN CLAYEY SILT, SOME SAND AND SOME SHALE FRAGMENTS (RESIDUAL SOIL)	2	AS	–	
			3	D.O.	85	
	191.7 / 2.0	END OF HOLE				

Elevation scale: 195, 194, 193, 192, 191 (202); 194, 193, 192, 191, 190 (203)

15 - ◆ - 5 Percent axial strain at failure 10

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW
CHECKED DWM

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 204 & 205

LOCATION See Figure 2 | BORING DATE MARCH 24, 1980 | DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm | PENETRATION TEST HAMMER WEIGHT — DROP —

Columns: BORING METHOD | SOIL PROFILE (ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ | SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ● U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 | WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

204

REDDISH BROWN SILTY SAND, SOME GRAVEL (FILL)

Boring Method	Elev'n / Depth (m)	Description	Number	Type	Blows/0.3m
	201.1	GROUND SURFACE			
POWER AUGER 114 mm DIA., UNCASED	0.0				
	0.2	COMPACT REDDISH BROWN SILTY SAND, TRACE ORGANIC MATTER		50 mm	
	200.2 / 0.9	LOOSE BROWN LAYERED SAND AND SANDY SILT	1	D.O.	13
			2	AS	—
	199.1		3	D.O.	9
	2.0	END OF HOLE			

Elevation scale: 202, 201, 200, 199, 198

BOREHOLE DRY ON COMPLETION OF DRILLING

205

Boring Method	Elev'n / Depth (m)	Description	Number	Type	Blows/0.3m
	195.9	GROUND SURFACE		50 mm	
POWER AUGER 114 mm DIA., UNCASED	0.0	DENSE DARK BROWN ORGANIC CLAYEY SILT (TOPSOIL & FILL)	1	D.O.	38
	195.1 / 0.8	DENSE MOTTLED GREY & BROWN TO BROWN SANDY SILT, SOME GRAVEL, TRACE TO SOME CLAY (TILL)	2	D.O.	41
			3	AS	—
	193.9		4	D.O.	45
	2.0	END OF HOLE			

Elevation scale: 196, 195, 194, 193, 192

BOREHOLE DRY ON COMPLETION OF DRILLING

15 -5 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DWA

Form G.A.-D-1. Project No. 801-1040

RECORD OF BOREHOLE 206

LOCATION See Figure 2 BORING DATE MARCH 24, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5kg. DROP 760mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH m	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m
	LOOSE BROWN GRAVELLY SAND, SOME SILT, TRACE BRICK FRAGMENTS (FILL) — 50 mm			
191.2 / 0.0	GROUND SURFACE			
0.2	VERY STIFF TO HARD MOTTLED BROWN AND GREY TO GREYISH BROWN, CLAYEY SANDY SILT, SOME GRAVEL (TILL)	1	D.O.	31
		2	"	23
		3	"	38
189.1 / 2.1	VERY DENSE, BROWN LAYERED SILTY FINE SAND	4	"	66
188.0 / 3.2	VERY DENSE, MOTTLED GREY TO REDDISH BROWN, SILTY SAND, SOME GRAVEL TO SAND & GRAVEL SOME SILT (TILL)	5	"	62/150mm
		6	"	50/140mm
		7	"	70/150mm
184.9 / 6.3	HIGHLY TO COMPLETELY WEATHERED REDDISH BROWN SHALE	8	"	50/140mm
183.4 / 7.8	END OF HOLE	9	"	50/75mm

ELEVATION SCALE: 191, 190, 189, 188, 187, 186, 185, 184, 183

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL: 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: G.S., GROUT, BACKFILL, BENTONITE SEAL, CAVED MATERIAL, PIEZOMETER

W.L. IN PIEZOMETER @ELEV. 190.4 MAR. 28, 80

15 5 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DWK

Form G.A.-D-1. Project No. 801-1040

RECORD OF BOREHOLE 207

LOCATION See Figure 2. BORING DATE MARCH 24, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5kg., DROP 760mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION (SOIL PROFILE)	STRAT. PLOT	NUMBER	TYPE	BLOWS/0.3m	ELEVATION SCALE
							192
	191.3	GROUND SURFACE			50 mm		
POWER AUGER 114mm DIA., UNCASED	0.0 / 190.8	DENSE GREYISH BROWN SILTY SAND AND GRAVEL (FILL)		1	D.O.	22	191
	0.5 / 189.8	VERY STIFF GREYISH BROWN CLAYEY SANDY SILT, SOME GRAVEL (TILL)		2	"	17	
				3	AS	—	190
	1.5 / 189.3	DENSE GREYISH BROWN TO BROWN SILTY FINE SAND		4	D.O.	31	
	2.0	END OF HOLE					189
							188

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

W.L. IN OPEN HOLE @ ELEV. 189.8 AT TIME OF DRILLING

15 5 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED OWA

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 208

LOCATION See Figure 2 BORING DATE MARCH 18, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg, DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH m	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3 m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
193.0	GROUND SURFACE					G.S.
0.0	VERY DENSE BROWN SILTY SAND, SOME CLAY & SOME GRAVEL (TILL)			50 mm		GROUT
		1	D.O.	50/75 mm	MH	
192.1 / 0.9						
191.7 / 1.3	HARD REDDISH BROWN, CLAYEY SILT, SOME SAND & SOME SHALY FRAGMENTS (RESIDUAL SOIL)	2	"	79		
		3	"	90		
	HIGHLY TO COMPLETELY WEATHERED REDDISH BROWN TO GREENISH GREY SHALE	4	"	50/100 mm		BACKFILL
		5	"	60/100 mm		
		6	"	90/100 mm		GRAVEL FILTER; PIEZOMETER; CAVED MATERIAL
185.2 / 7.8	END OF HOLE, REFUSAL TO AUGER					

ELEVATION SCALE: 194, 193, 192, 191, 190, 188, 187, 186, 185, 184

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3 m

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL — 10 20 30 40

W.L. IN PIEZOMETER @ELEV. 191.5 MAR. 28, 1980

15 — 5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DWM

Form G.A.-D-1. Project No. 801-1040

RECORD OF BOREHOLE 209 & 210

LOCATION See Figure 2 BORING DATE MARCH 17, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5kg, DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD | SOIL PROFILE: ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT | SAMPLES: NUMBER, TYPE, BLOWS/0.3m | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ ; SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 ; WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

209

Boring method: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m
189.9	GROUND SURFACE			
0.0	DARK BROWN TOPSOIL		50 mm	
189.3 / 0.6	DENSE TO VERY DENSE BROWN TO DARK BROWN, SILTY SAND, SOME GRAVEL, TRACE CLAY & TRACE ORGANICS IN UPPER ZONES (TILL)	1	D.O.	45
		2	AS	—
		3	D.O.	50
187.8 / 2.1	DENSE TO VERY DENSE BROWN SAND, SOME SILT INTERBEDDED WITH SANDY SILT	4	"	81
		5	"	49
		6	"	72
		7	"	57
184.9 / 5.0	END OF HOLE			

Elevation scale: 190, 189, 188, 187, 186, 185, 184

Piezometer or standpipe installation: G.S., GROUT, BACKFILL, STANDPIPE

W.L. IN STANDPIPE @ ELEV. 185.5 MARCH 27, 1980

210

Boring method: POWER AUGER, 114 mm DIA., UNCASED

ELEV'N. / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m
186.0	GROUND SURFACE			
0.0	DARK BROWN TOPSOIL		50 mm	
185.4 / 0.6	VERY DENSE, MOTTLED BROWN SANDY SILT TO SILTY SAND, SOME CLAY AND GRAVEL, TRACE OF ORGANIC MATTER TO ELEV. 185 (TILL)	1	D.O.	40
		2	AS	—
		3	D.O.	70/150mm
184.2 / 1.8	END OF HOLE			

Elevation scale: 186, 185, 184, 183

BOREHOLE DRY ON COMPLETION OF DRILLING

15 — 5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DW/G

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 211

LOCATION See Figure 2 BORING DATE MARCH 18, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

Boring method: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH m	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3 m	WATER CONTENT, PERCENT (approx.)
194.4	GROUND SURFACE				
0.0	DARK BROWN TOPSOIL		50 mm		
193.5 / 0.9	DENSE TO VERY DENSE BROWN SILTY SAND, TRACE TO SOME GRAVEL, TRACE CLAY (TILL)	1	D.O.	51	
		2	"	34	
		3	"	52	
		4	"	86	
		5	"	74/150 mm	
		6	"	80/150 mm	
187.8		7	"	75/150 mm	
6.6	END OF HOLE				

ELEVATION SCALE: 195, 194, 193, 192, 191, 190, 189, 188, 187

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL: 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: G.S., GROUT, BACKFILL, STANDPIPE, CAVED MATERIAL

W.L. IN STANDPIPE @ ELEV. 193.0 MAR. 28, 1980

15 5 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED [illegible]

Form G.A.-D-1.   Project No. 801-1040

RECORD OF BOREHOLE 212 & 213

LOCATION See Figure 2   BORING DATE MARCH 18, 1980   DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5kg., DROP 760mm   PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD | SOIL PROFILE (ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ ; SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 ; WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

212

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	ELEVATION SCALE	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	199.3	GROUND SURFACE						
POWER AUGER, 114mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		199		
	198.5 / 0.8	COMPACT TO DENSE BROWN TO DARK BROWN SILTY SAND SOME GRAVEL, TRACE ORGANICS (TILL)	1	D.O.	19	198		
			2	AS	–			
			3	D.O.	33			
	197.3 / 2.0	END OF HOLE				197		BOREHOLE DRY ON COMPLETION OF DRILLING

213

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	ELEVATION SCALE	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	194.3	GROUND SURFACE						
POWER AUGER BORING, 114 mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		194		
	193.7 / 0.6	HARD MOTTLED REDDISH BROWN TO GREENISH GREY, CLAYEY SANDY SILT, SOME GRAVEL AND SHALE FRAGMENTS (TILL)	1	D.O.	64	193		
			2	AS	–			
			3	D.O.	83			
			4	"	55/75mm	192	MH	
	191.6 / 2.7	HIGHLY TO COMPLETELY WEATHERED REDDISH BROWN SHALE	5	"	55/75mm			
			6	"	70/150mm	190		
	188.8 / 5.5	END OF HOLE, REFUSAL TO AUGER				189, 188		BOREHOLE DRY ON COMPLETION OF DRILLING

15 — 5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW
CHECKED DWH

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 214 & 215

LOCATION See Figure 2 BORING DATE MARCH 20 & 24, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION SCALE	PIEZOMETER OR STANDPIPE INSTALLATION
		214					
	190.3	GROUND SURFACE					G.S.
POWER AUGER BORING 114mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		190	GROUT
	189.8 / 0.5	VERY STIFF TO HARD MOTTLED GREY AND REDDISH BROWN CLAYEY SANDY SILT, SOME GRAVEL AND SHALE FRAGMENTS (TILL), 50 TO 100mm SAND LAYERS AT ELEV. 188.7 AND 186.9	1	D.O.	20		BACKFILL
			2	"	115	189	BENTONITE SEAL
			3	"	28	188	BACKFILL
			4	"	54	187	GRAVEL FILTER
	186.5 / 5.8	HIGHLY TO COMPLETELY WEATHERED REDDISH BROWN SHALE	5	"	50/75mm	186	STANDPIPE
	185.6 / 4.7	END OF HOLE				185	W.L. IN STANDPIPE @ ELEV. 189.6 MAR. 28, 1980
		215					
	190.7	GROUND SURFACE				191	
POWER AUGER 114mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		190	BOREHOLE DRY ON COMPLETION OF DRILLING
	189.9 / 0.8	HARD MOTTLED BROWN CLAYEY SANDY SILT, SOME GRAVEL (TILL)	1	D.O.	61		
			2	AS	—		
	189.1	COMPLETELY WEATHERED REDDISH BROWN SHALE	3	D.O.	100/150mm		
	188.9 / 1.8	END OF HOLE				188	

DYNAMIC PENETRATION RESISTANCE, BLOWS/

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ● U. - O

WATER CONTENT, PERCENT W_p W W_L 10 20 30 40

ADDITIONAL LAB. TESTING

STRAT. PLOT

15 5 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED [illegible]

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 216 & 217

LOCATION See Figure 2 BORING DATE MARCH 20 & 24, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD | SOIL PROFILE: ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT | SAMPLES: NUMBER, TYPE, BLOWS/0.3m | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ | SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ● U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 | WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

216

Boring Method	Elev'n. / Depth (m)	Description	Sample No.	Type	Blows/0.3m	Elevation Scale	Piezometer or Standpipe Installation
	186.9	GROUND SURFACE				187	
POWER AUGER 114mm DIA. UNCASED	0.0	DARK BROWN TOPSOIL		50 mm			
	186.1 / 0.8	VERY STIFF TO HARD REDDISH BROWN CLAYEY SILT, TRACE TO SOME SAND (RESIDUAL SOIL)	1	D.O.	24	186	
			2	AS	–		
	185.2		3	D.O.	50/150mm		
	1.7	END OF HOLE				185	BOREHOLE DRY ON COMPLETION OF DRILLING

217

Boring Method	Elev'n. / Depth (m)	Description	Sample No.	Type	Blows/0.3m	Elevation Scale	Piezometer or Standpipe Installation
	189.1	GROUND SURFACE				189	
POWER AUGER BORING 114 mm DIA., UNCASED	0.0	GREY TO BROWN SANDY GRAVEL TO SILTY SAND, TRACE TO SOME CLAY (FILL)		50 mm			
	188.3 / 0.8	VERY STIFF TO HARD BROWN TO MOTTLED GREY AND BROWN CLAYEY SANDY SILT SOME GRAVEL (TILL)	1	D.O.	106	188	
			2	"	28	187	
			3	"	28		
			4	"	31	186	
	185.3 / 3.8	HARD REDDISH BROWN CLAYEY SILT, SOME SAND AND SHALE FRAGMENTS (RESIDUAL SOIL)	5	"	54	185	
	184.1		6	"	91		
	5.0	END OF HOLE, REFUSAL TO AUGER				184	BOREHOLE DRY ON COMPETION OF DRILLING

15 -+- 5 Percent axial strain at failure (10)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DWA

Form G.A.-D-I.

Project No. 801-1040

RECORD OF BOREHOLE 218 & 219

LOCATION See Figure 2 | BORING DATE MARCH 20, 1980 | DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg. DROP 760 mm | PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD; SOIL PROFILE (ELEV'N. DEPTH m; DESCRIPTION; STRAT. PLOT); SAMPLES (NUMBER; TYPE; BLOWS/0.3m); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE, BLOWS/; SHEAR STRENGTH Cu. (NAT. V. - + Q. - ● REM.V. - ● U. - O); COEFFICIENT OF PERMEABILITY, k, CM./SEC. (1x10 1x10 1x10 1x10); WATER CONTENT, PERCENT (Wp W WL; 10 20 30 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

218

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	187.5	GROUND SURFACE				
POWER AUGER 114 mm DIA. UNCASED	0.0	HARD GREY CLAYEY SILT SOME SAND & GRAVEL (FILL)	1	DO.	50 mm 60/150 mm	BOREHOLE DRY ON COMPLETION OF DRILLING
			2	A.S.	—	
	186.1 / 1.4	VERY STIFF GREYISH BROWN TO BROWNISH GREY CLAYEY SANDY SILT TO SANDY SILT SOME GRAVEL (TILL)	3	DO.	23	
	185.5 / 2.0	END OF HOLE				

Elevation scale: 188, 187, 186, 185

219

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	186.9	GROUND SURFACE				
POWER AUGER 114 mm DIA. UNCASED	0.0	DENSE BROWN TO GREY SANDY SILT, TRACE TO SOME GRAVEL, TRACE CLAY & SMALL RED FRAGMENTS (FILL)	1	DO.	50 mm 75/150 mm	BOREHOLE DRY ON COMPLETION OF DRILLING
	185.7 / 1.2	COMPACT GREY SANDY SILT, SOME GRAVEL, TRACE CLAY (TILL)	2	AS	—	
			3	DO.	26	
	184.9 / 2.0	END OF HOLE				

Elevation scale: 187, 186, 185, 184, 183

15 — 5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DWH

Form G.A.-D-1. Project No. 801-1040

RECORD OF BOREHOLE 220

LOCATION See Figure 2 BORING DATE MARCH 17, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg. DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	ELEV'N. DEPTH m	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/0.3m	ELEVATION SCALE	WATER CONTENT, PERCENT	PIEZOMETER OR STANDPIPE INSTALLATION
	182.3	GROUND SURFACE							
POWER AUGER BORING 114 mm DIA., UNCASED	0.0	HARD GREY, CLAYEY SILT, SOME SAND AND GRAVEL TRACE ORGANIC MATTER (FILL)			50 mm		182		
	181.1			1	D.O.	73		o	
	1.2	VERY STIFF TO HARD GREYISH BROWN CLAYEY SANDY SILT, SOME GRAVEL, SOME ORGANIC MATTER TO ELEV. 180.5 (TILL)					181		BOREHOLE DRY ON COMPETION OF DRILLING
				2	"	29		o	
							180		
	179.6			3	"	34		o	
	2.7	END OF HOLE					179		

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT W_P — W — W_L : 10 20 30 40

ADDITIONAL LAB. TESTING

220

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED DW/[illegible]

Form G.A.-D-I.

Project No. 801-1040

RECORD OF BOREHOLE 222

LOCATION See Figure 2 — BORING DATE MARCH 17, 1980 — DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm — PENETRATION TEST HAMMER WEIGHT — DROP —

Columns: BORING METHOD | SOIL PROFILE (ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ ; SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 ; WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

Boring method: POWER AUGER BORING, 114 mm DIA., UNCASED

Elev'n / Depth (m)	Description	Sample No.	Type	Blows/0.3m	Water content (%) approx.	Additional lab testing
183.0	GROUND SURFACE					
182.2 / 0.8	GREY BROWN SILTY SAND SOME GRAVEL (FILL)		50 mm			
	COMPACT TO DENSE GREY TO GREYISH BROWN STRATIFIED SILTY FINE SAND, SANDY SILT, AND SILT	1	D.O.	19	~21	
		2	"	25	~20	
		3	"	20	~22	
		4	"	17	~19	MH
		5	"	26	~20	
		6	"	34	~20	
176.9 / 6.1	END OF HOLE	7	"	24	~21	

Elevation scale: 183, 182, 181, 180, 179, 178, 177, 176

Piezometer installation: G.S., GROUT, BACKFILL, PIEZOMETER, CAVED MATERIAL

W.L. IN PIEZOMETER @ ELEV. 183.0 MAR. 27, 1980

15 – 5 – 0 – 10 Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED [signature]

Form G.A.-D-I.

Project No. 801-1040

RECORD OF BOREHOLE 239, 240 & 241

LOCATION See Figure 2 BORING DATE MARCH 19, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760mm PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD | SOIL PROFILE: ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT | SAMPLES: NUMBER, TYPE, BLOWS/0.3m | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ ; SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ● U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 ; WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

239

Boring method	Elev'n. / Depth (m)	Description	Sample number	Type	Blows/0.3m	Elevation scale	Piezometer or standpipe installation
	186.0	GROUND SURFACE					
POWER AUGER, 114 mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		186	
	185.4 / 0.6	VERY DENSE BROWN, SANDY SILT, SOME CLAY & GRAVEL (TILL)	1	D.O.	62	185	BOREHOLE DRY ON COMPLETION OF DRILLING
			2	AS	-		
			3	D.O.	76		
	184.0 / 2.0	END OF HOLE				184	

240

Boring method	Elev'n. / Depth (m)	Description	Sample number	Type	Blows/0.3m	Elevation scale	Piezometer or standpipe installation
	183.9	GROUND SURFACE				184	
POWER AUGER BORING, 114 mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm			
	183.3 / 0.6	DENSE BROWN SANDY SILT, SOME CLAY & GRAVEL, OCCASIONAL BOULDER (TILL)	1	D.O.	34	183	BOREHOLE DRY ON COMPLETION OF DRILLING
						182	
	181.6 / 2.3	HIGHLY WEATHERED GREY SHALE	2	"	55/150mm		
	2.5	END OF HOLE, REFUSAL TO AUGER				181	

241

Boring method	Elev'n. / Depth (m)	Description	Sample number	Type	Blows/0.3m	Elevation scale	Piezometer or standpipe installation
	181.5	GROUND SURFACE					
POWER AUGER, 114 mm Ø, UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		181	BOREHOLE DRY ON COMPLETION OF DRILLING
	180.7 / 0.8	HARD MOTTLED BROWN CLAYEY SANDY SILT, TRACE SHALE FRAGMENTS (TILL)	1	D.O.	40/25mm		
	180.5	HIGHLY WEATHERED GREY SHALE					
	180.3 / 1.2	END OF HOLE. REFUSAL TO AUGER. (REFUSAL TO AUGER ALSO ENCOUNTERED AT ELEV. 180.3, 3m NORTH)				180	

15 - 5 Percent axial strain at failure (10 / 0)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW

CHECKED [signature]

Form G.A.-D-1. Project No. 801-1040

RECORD OF BOREHOLE 242, 243 & 244

LOCATION See Figure 2. BORING DATE MARCH 19, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5kg DROP 760mm PENETRATION TEST HAMMER WEIGHT — DROP —

Column headings: BORING METHOD | SOIL PROFILE (ELEV'N. DEPTH m, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS/0.3m) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ ; SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 ; WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

242

Boring Method	Elev'n / Depth (m)	Description	Number	Type	Blows/0.3m	Elevation Scale	Piezometer or Standpipe Installation
	183.3	GROUND SURFACE					
POWER AUGER 114mm DIA. UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		183	BOREHOLE DRY ON COMPLETION OF DRILLING
	182.5 / 0.8		1	D.O.	50/50mm		
	0.9	END OF HOLE, REFUSAL TO AUGER				182	

HIGHLY TO COMPLETELY WEATHERED, REDDISH BROWN SHALE

243

Boring Method	Elev'n / Depth (m)	Description	Number	Type	Blows/0.3m	Elevation Scale	Piezometer or Standpipe Installation
	180.9	GROUND SURFACE				181	
POWER AUGER 114mm DIA. UNCASED	0.0	DARK BROWN TOPSOIL					BOREHOLE DRY ON COMPLETION OF DRILLING
	180.1 / 0.8	END OF HOLE, REFUSAL TO AUGER (REFUSAL ALSO ENCOUNTERED AT ELEV. 180.1, 1m NORTH)				180	

244

Boring Method	Elev'n / Depth (m)	Description	Number	Type	Blows/0.3m	Elevation Scale	Piezometer or Standpipe Installation
						181	
	180.5	GROUND SURFACE					
POWER AUGER 114mm DIA., UNCASED	0.0	DARK BROWN TOPSOIL		50 mm		180	BORE HOLE DRY ON COMPLETION OF DRILLING
	179.9 / 0.6	COMPACT BROWN SANDY SILT, SOME CLAY, TRACE GRAVEL (TILL)	1	D.O.	28		
	179.0 / 1.5	HIGHLY WEATHERED SHALE				179	
	1.7	END OF HOLE, REFUSAL TO AUGER					

15 —5 Percent axial strain at failure (0, 10)

VERTICAL SCALE 1:50 (METRIC)

Golder Associates.

DRAWN MHW

CHECKED DWK

Form G.A.-D-I. Project No. 801-1040

RECORD OF BOREHOLE 247

LOCATION See Figure 2 BORING DATE MARCH 26 - 28, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760 mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD	ELEV'N. / DEPTH m	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m
	187.0	GROUND SURFACE			
POWER AUGER BORING 114 mm DIA., UNCASED	0.0	DENSE GREY SHALE FRAGMENTS (FILL)		50 mm	
	186.2 / 0.8	LOOSE BROWN SILTY SAND, TRACE CLAY, GRAVEL AND ORGANIC MATTER (FILL)	1	D.O.	9
	185.5 / 1.5	COMPACT TO VERY DENSE GREY, GREYISH BROWN STRATIFIED SILTY FINE SAND AND SANDY SILT TRACE TO SOME ORGANIC MATTER TO 184.9	2	"	21
			3	"	24
			4	"	39
			5	"	WH 14/ 50mm
			6	"	22
			7	"	61
			8	"	50
			9	"	21
	177.0 / 10.0	HARD, REDDISH BROWN, CLAYEY SILT, NUMEROUS SHALE FRAGMENTS AND BOULDERS, SOME SAND AND GRAVEL (TILL)	10	"	56/ 140mm
			11	"	50/ 75mm
ROTARY BX CA.			12	BXL RC	—
ROTARY BXL CORE	173.3		13	"	—
	13.7		14	"	—
	172.9	COMPLETELY TO HIGHLY WEATHERED GREY SHALE	15	"	—
	14.1	END OF HOLE			

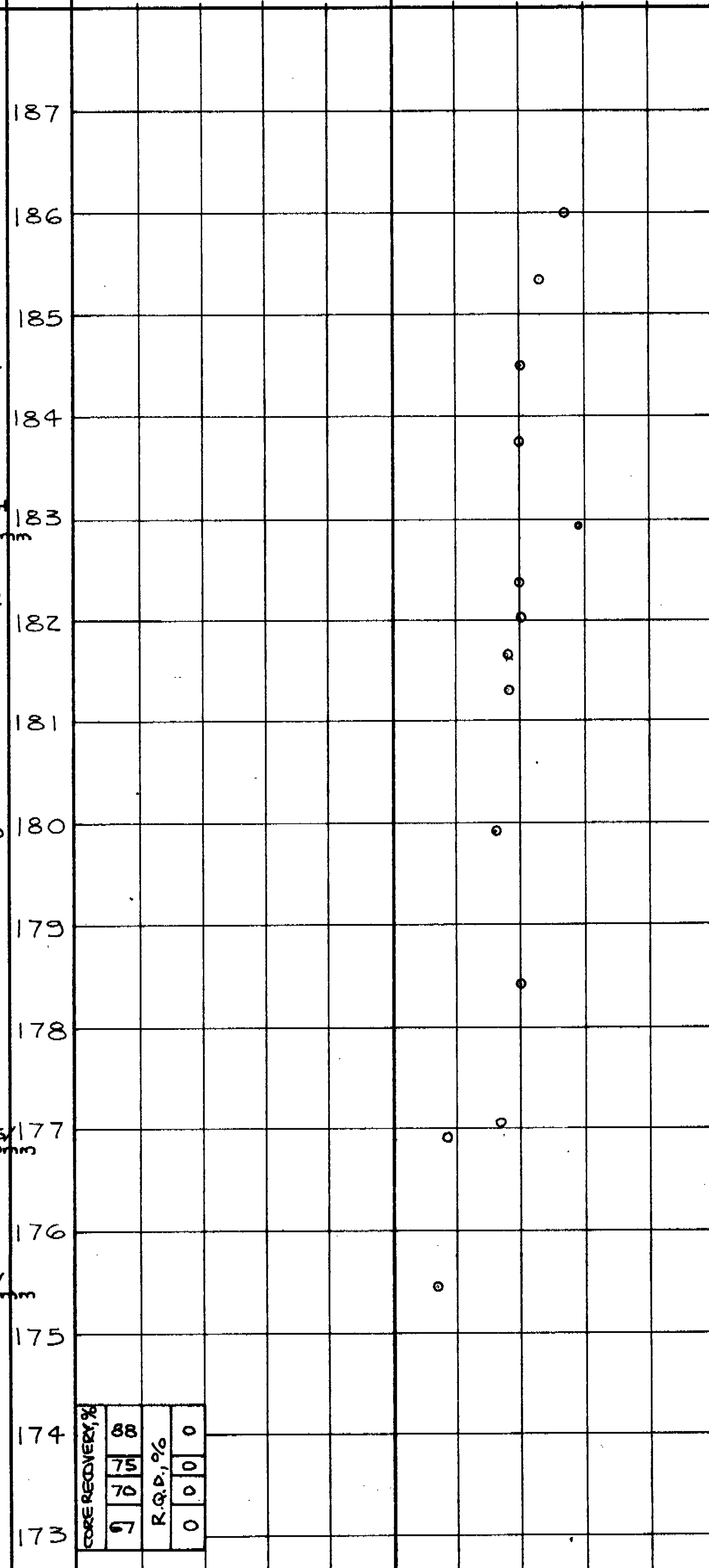
Sample	CORE RECOVERY, %	R.Q.D., %
12	88	0
13	75	0
14	70	0
15	67	0

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT W_P W W_L 10 20 30 40



15 –⊕– 5 Percent axial strain at failure (0 / 10)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

G.S.
GROUT
BACKFILL
BENTONITE SEAL
BACKFILL
GRAVEL FILTER
STANDPIPE
BACKFILL
BENTONITE SEAL
BACKFILL
GRAVEL FILTER
PIEZOMETER

W.L. IN STANDPIPE @ ELEV. 186.2
W.L. IN PIEZOMETER @ ELEV. 185.8
MAR. 28, 1980

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN MHW
CHECKED [signature]

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLES 248 & 249

LOCATION See Figure 2 BORING DATE MARCH 26, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg DROP 760 mm PENETRATION TEST HAMMER WEIGHT – DROP –

Column headings: BORING METHOD | SOIL PROFILE: ELEV'N. / DEPTH m, DESCRIPTION, STRAT. PLOT | SAMPLES: NUMBER, TYPE, BLOWS/0.3 m | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE, BLOWS/ | SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O | COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10 | WATER CONTENT, PERCENT Wp W WL 10 20 30 40 | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

248

Boring method: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3 m
186.0	GROUND SURFACE			
0.0 – 185.2	DENSE GREY SHALE FRAGMENTS (FILL)		50 mm	
0.8 – 184.7	VERY DENSE DARK BROWN SILTY SAND TRACE CLAY, GRAVEL (FILL)	1	D.O	54/150 mm
1.3 – 183.5	STIFF BROWN CLAYEY SANDY SILT, SOME GRAVEL (TILL)	2	"	10
2.1 – 182.5	VERY DENSE MOTTLED GREY + BROWN SANDY SILT, SOME GRAVEL TRACE TO SOME CLAY (TILL)	3	"	63
		4	"	57
3.5 – 182.2	COMPLETELY WEATHERED SHALE			
3.8	END OF HOLE, REFUSAL TO AUGER			

W.L. IN OPEN HOLE @ ELEV. 183.4 DURING DRILLING

249

Boring method: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS/0.3 m	ADDITIONAL LAB. TESTING
182.8	GROUND SURFACE				
0.0 – 182.0	COMPACT BROWN SILTY SAND SOME CLAY, GRAVEL AND SHALE FRAGMENTS (FILL)		50 mm		
0.8 – 180.8	COMPACT BROWN TO GREYISH BROWN SILTY SAND TRACE CLAY	1	D.O	13	
		2	"	28	
2.0 – 178.4	VERY LOOSE TO LOOSE GREY STRATIFIED SANDY SILT, SILTY FINE SAND & CLAYEY SILT	3	"	9	MH
		4	"	9	
		5	"	WH	
4.4 – 177.3	COMPACT GREY SILTY SAND SOME CLAY & GRAVEL (TILL)	6	"	14	
5.5	END OF HOLE REFUSAL TO AUGER				

Piezometer installation: G.S., GROUT, BACKFILL, BENTONITE SEAL, CAVED MATERIAL, PIEZOMETER

W.L. IN PIEZOMETER @ ELEV. 182.2 MAR. 28, 1980

15 – 5 (0, 10) Percent axial strain at failure

VERTICAL SCALE 1:50 (METRIC)

Golder Associates

DRAWN WP

CHECKED DWH

Form G.A.-D-1.

Project No. 801-1040

RECORD OF BOREHOLE 301

LOCATION See Figure 2 BORING DATE MARCH 25, 1980 DATUM GEODETIC

SAMPLER HAMMER WEIGHT 63.5 kg., DROP 760mm PENETRATION TEST HAMMER WEIGHT — DROP —

BORING METHOD: POWER AUGER BORING, 114 mm DIA., UNCASED

ELEV'N. / DEPTH (m)	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m
181.6	GROUND SURFACE			
0.0	DARK BROWN TOPSOIL			
181.0 / 0.6	COMPACT MOTTLED GREYISH BROWN TO REDDISH BROWN, SILTY FINE SAND TRACE ORGANIC MATTER	1	D.O. (50 mm)	13
		2	"	22
179.4 / 2.2	DENSE TO VERY DENSE GREY STRATIFIED SILTY FINE SAND AND SANDY SILT	3	"	40
		4	"	43
		5	"	49
		6	"	75
176.0		7	"	65/150mm
5.6	END OF HOLE			

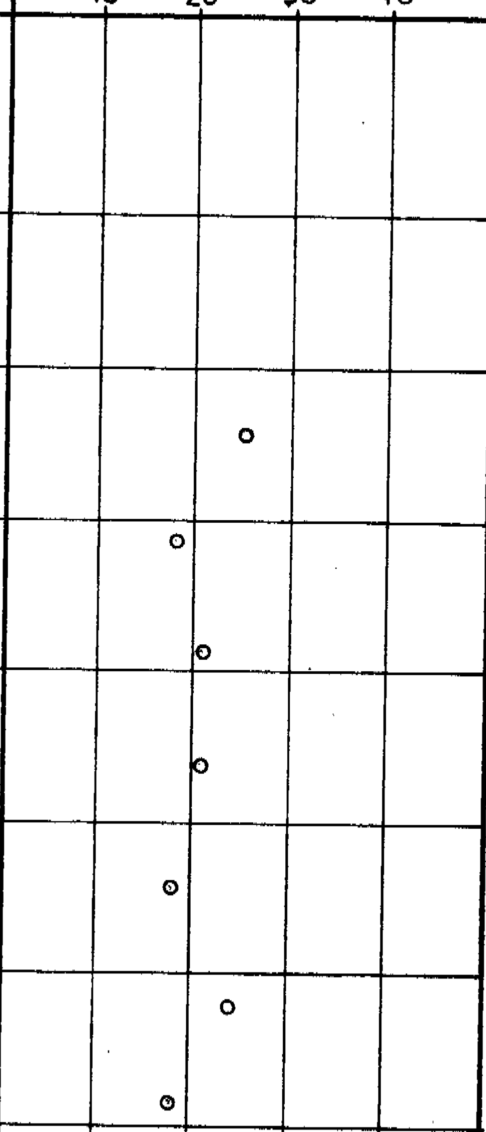
ELEVATION SCALE: 182, 181, 180, 179, 178, 177, 175, 174

DYNAMIC PENETRATION RESISTANCE, BLOWS/

SHEAR STRENGTH Cu. NAT. V. - + Q. - ● REM.V. - ⊕ U. - O

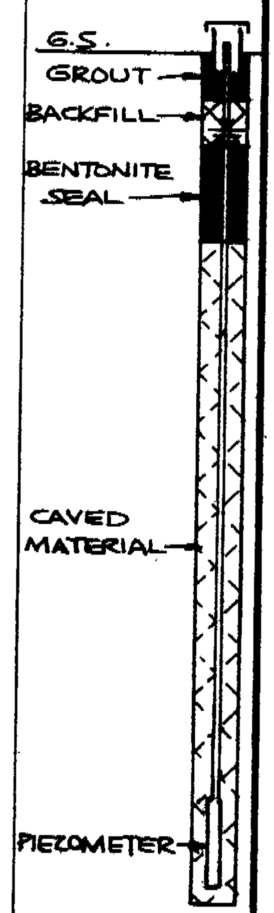
COEFFICIENT OF PERMEABILITY, k, CM./SEC. 1x10 1x10 1x10 1x10

WATER CONTENT, PERCENT Wp W WL — 10 20 30 40



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

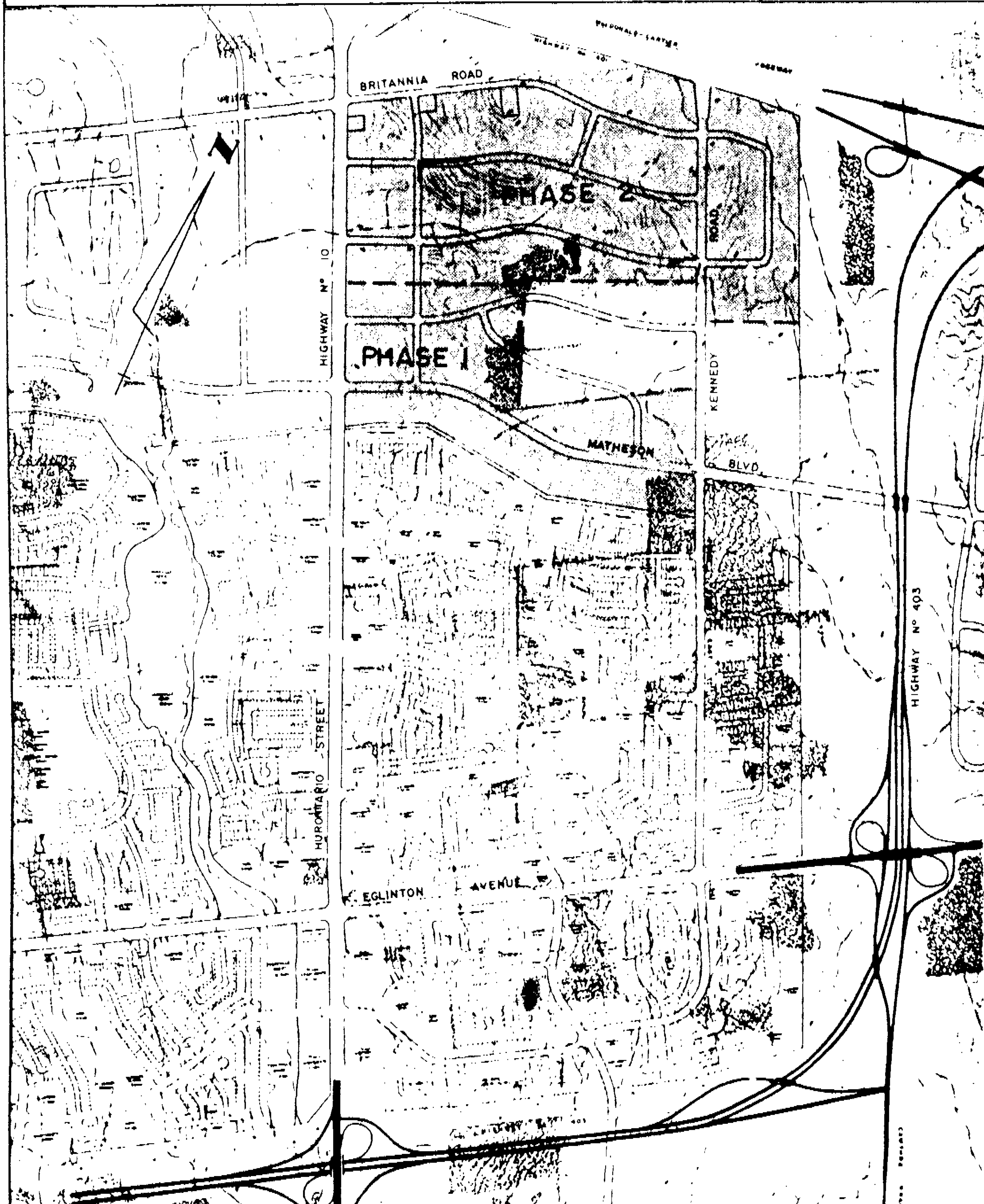


W.L. IN PIEZOMETER @ELEV. 181.1 MAR. 27, 1980

15 0 5 10 Percent axial strain at failure

VERTICAL SCALE		
1:50 (METRIC)	Golder Associates	DRAWN MHW CHECKED [signature]

SITE LOCATION PLAN	FIGURE 1



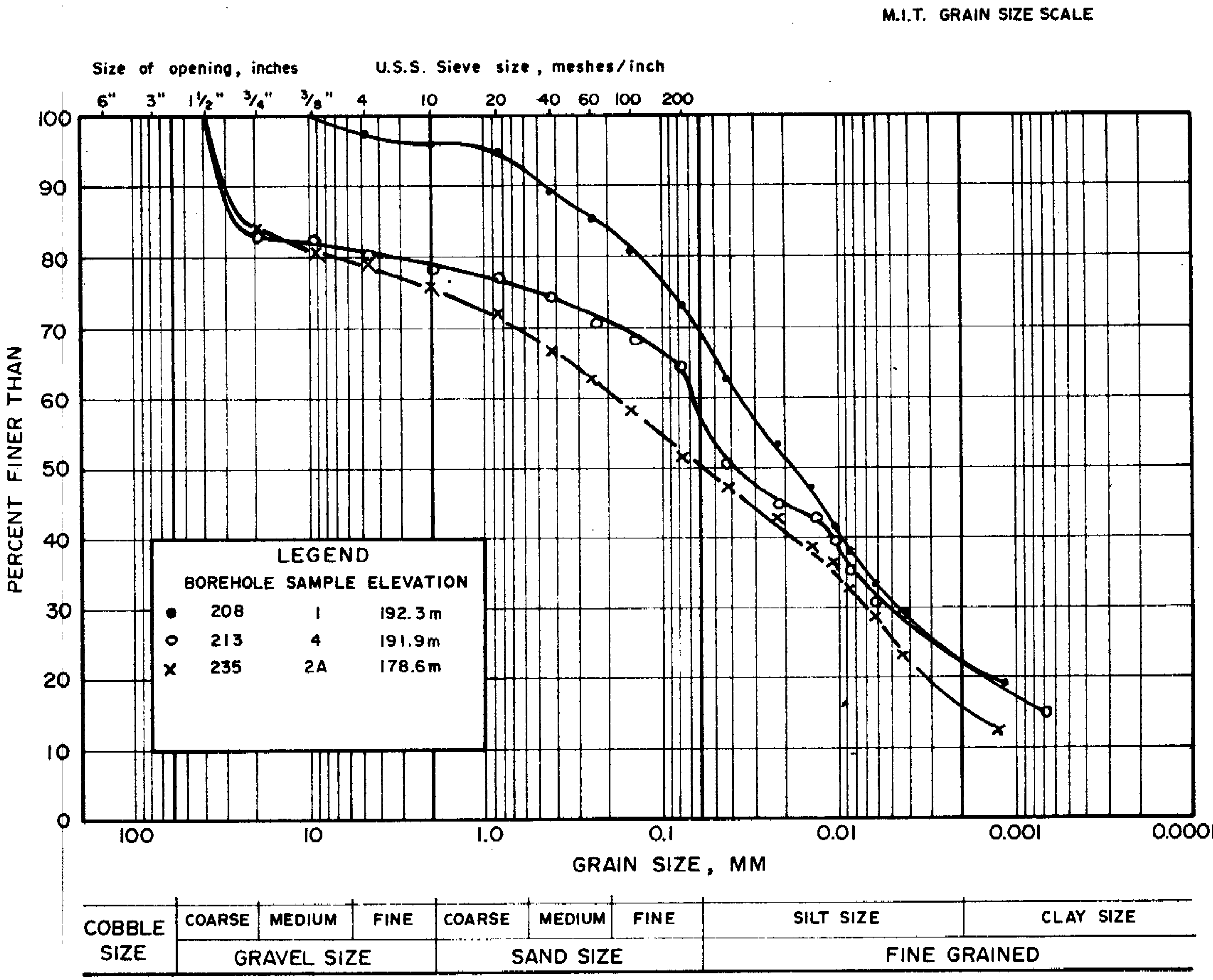
SCALE 1 : 20,000 APPROX.

Date APRIL 10, 1980
Project No 801-1040

Golder Associates

Drawn M.H.W.
Chkd DWH

Form G.A.-D.-6 [redacted]ROJE[redacted]o. [redacted]



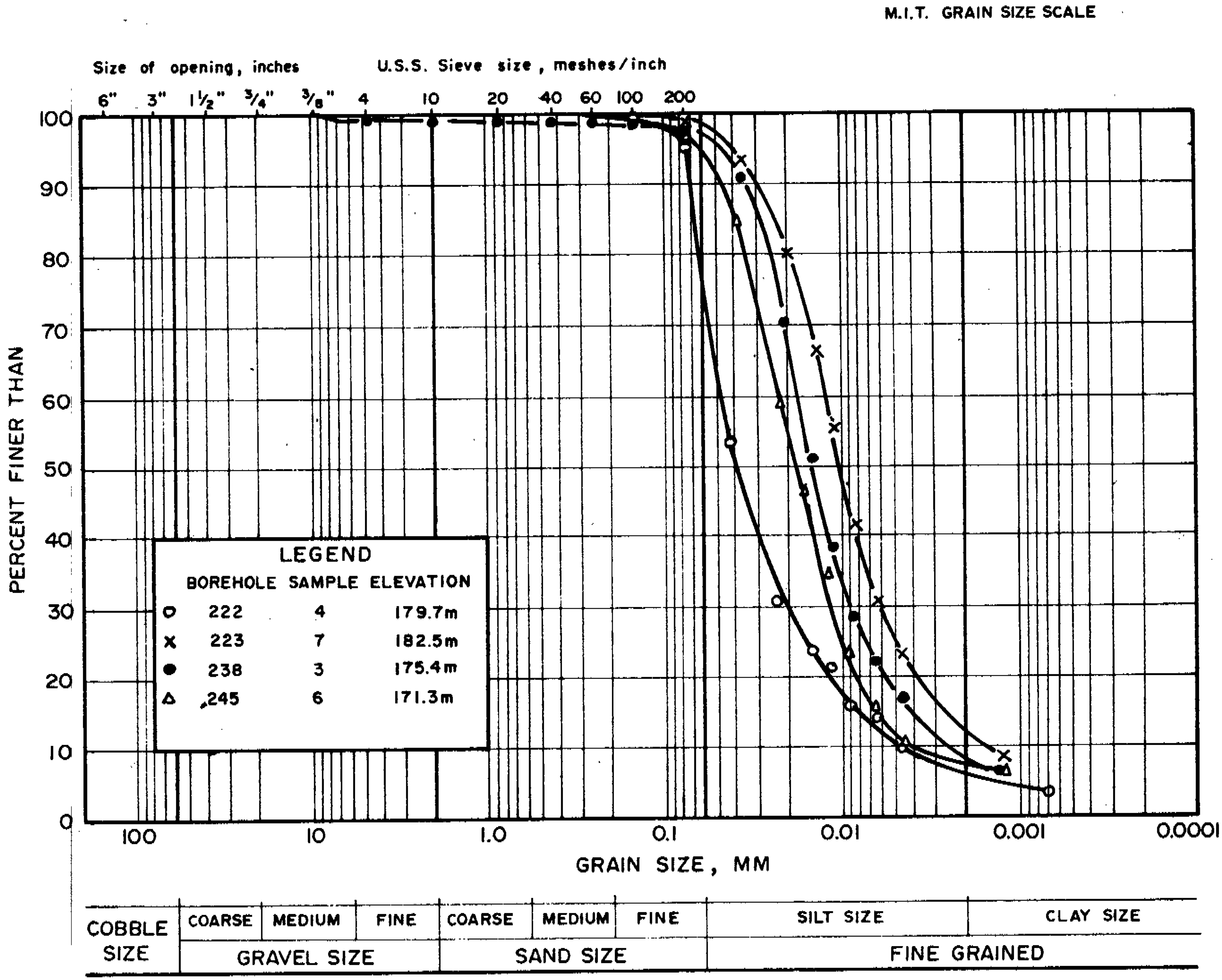
Golder Associates

GRAIN SIZE DISTRIBUTION
CLAYEY SANDY SILT (TILL)

FIGURE 3

Form GA-D.-6 [redacted]

Golder Associates



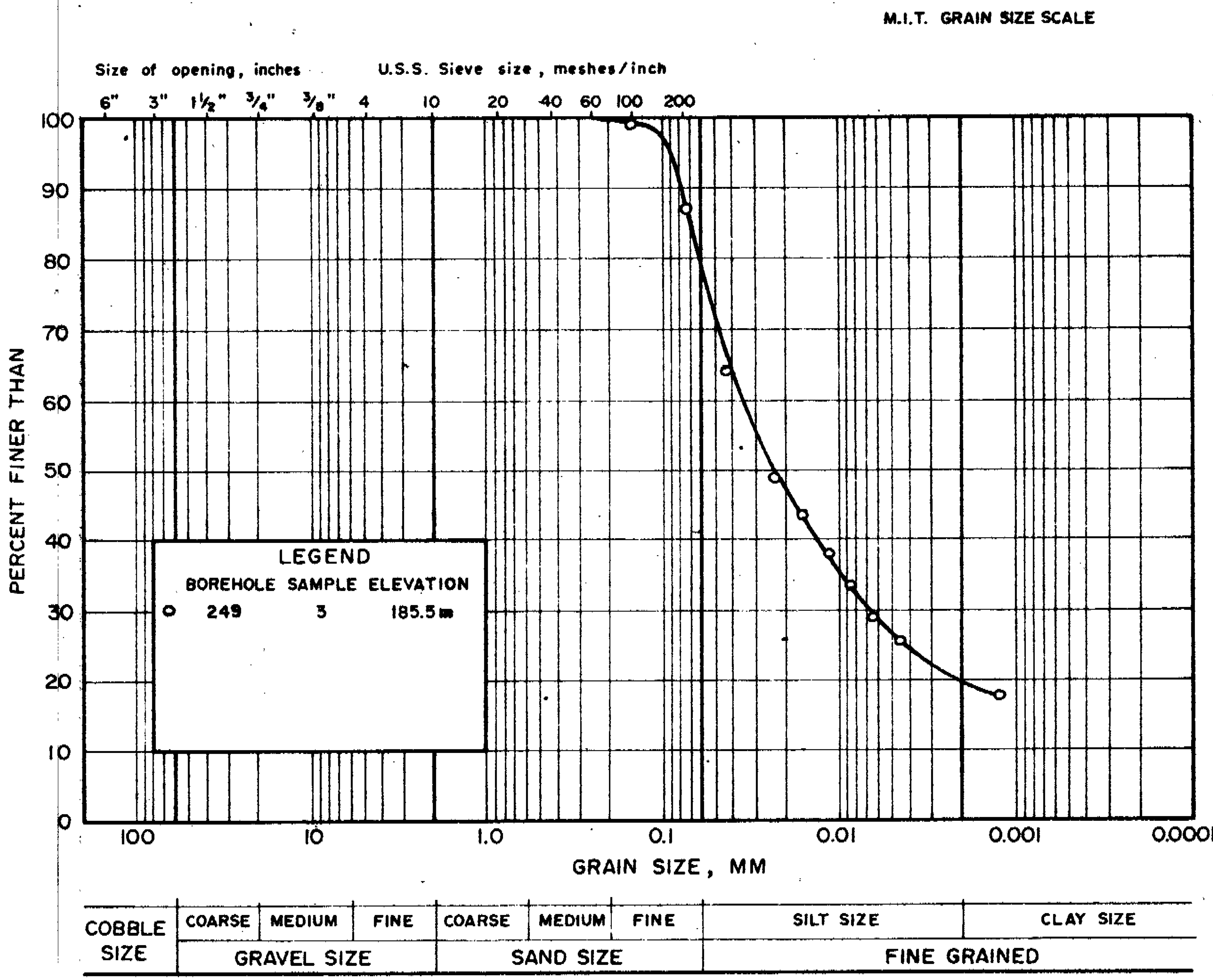
GRAIN SIZE DISTRIBUTION

SILT

FIGURE 4

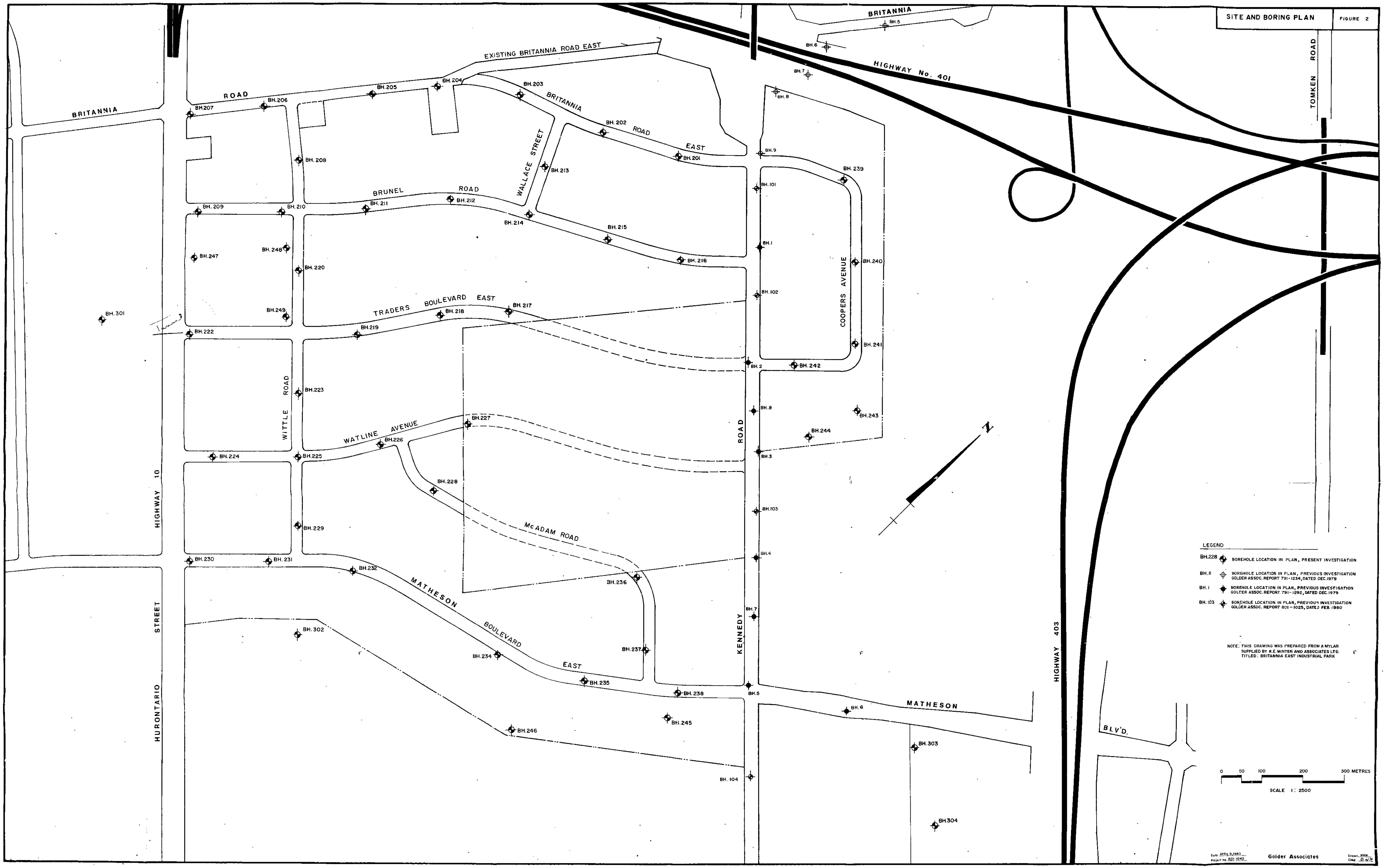
Form G.A.-D-6

GRAIN SIZE DISTRIBUTION
CLAYEY SILT



Golder Associates

FIGURE 5


SITE AND BORING PLAN
FIGURE 2
EXISTING BRITANNIA ROAD EAST
BRITANNIA ROAD
BRITANNIA ROAD EAST
HIGHWAY No. 401
TOMKEN ROAD
BRUNEL ROAD
WALLACE STREET
TRADERS BOULEVARD EAST
COOPERS AVENUE
WITTLE ROAD
WATLINE AVENUE
McADAM ROAD
MATHESON BOULEVARD EAST
MATHESON BLV'D.
KENNEDY ROAD
HIGHWAY 10
HURONTARIO STREET
HIGHWAY 403
N
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BH.202
BH.203
BH.204
BH.205
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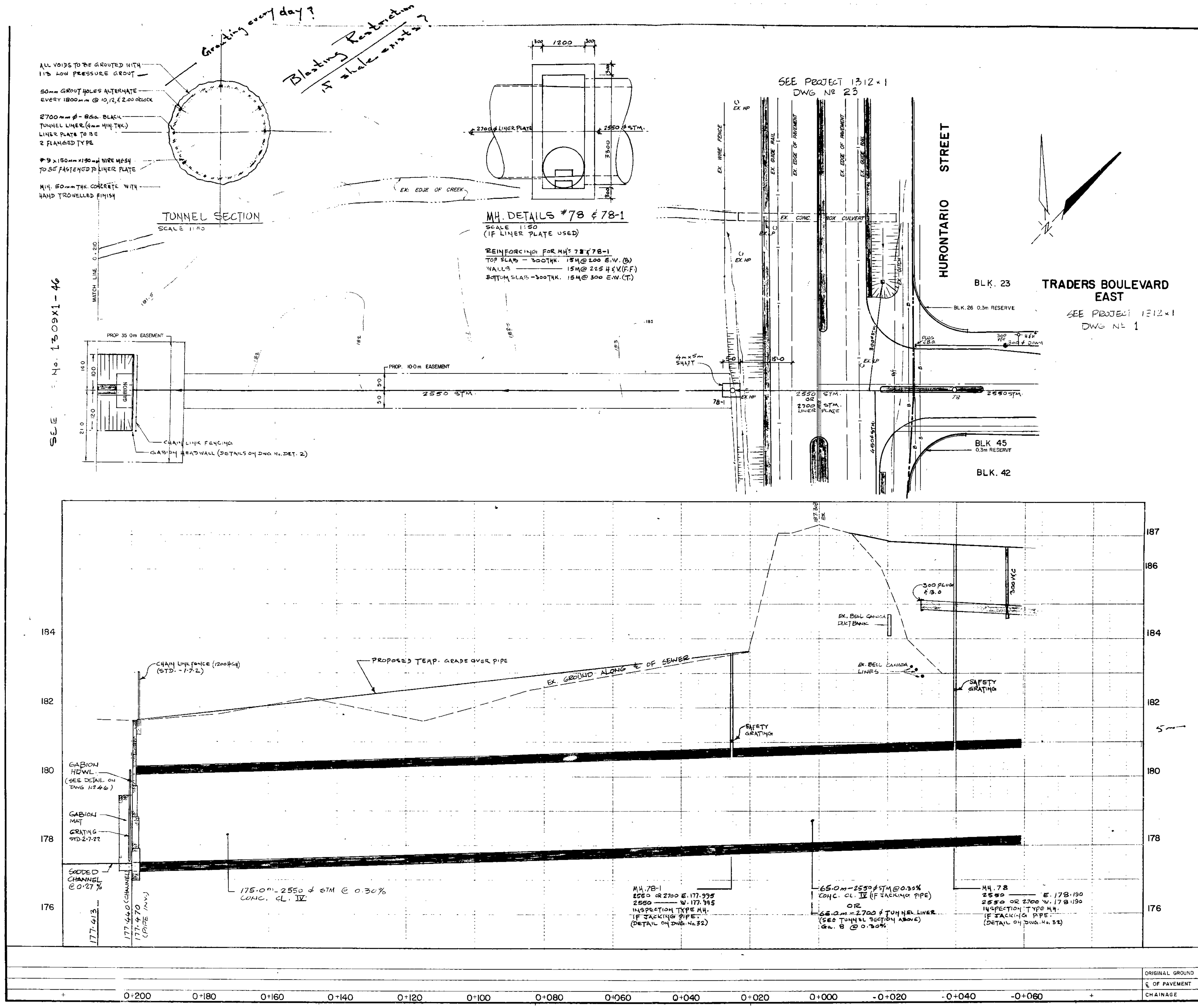
BH.3
BH.4
BH.5
BH.6
BH.7
BH.8
BH.9
BH.101
BH.102
BH.103
BH.104
LEGEND
BH.228 BOREHOLE LOCATION IN PLAN, PRESENT INVESTIGATION
BH.8 BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION GOLDER ASSOC. REPORT 791-1234, DATED DEC.1979
BH.1 BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION GOLDER ASSOC. REPORT 791-1292, DATED DEC.1979
BH.103 BOREHOLE LOCATION IN PLAN, PREVIOUS INVESTIGATION GOLDER ASSOC. REPORT 801-1025, DATED FEB.1980
NOTE: THIS DRAWING WAS PREPARED FROM A MYLAR SUPPLIED BY R.E. WINTER AND ASSOCIATES LTD. TITLED: BRITANNIA EAST INDUSTRIAL PARK
0 50 100 200 300 METRES
SCALE 1: 2500
Date APRIL 9,1980
Project No. 801-1040
Golder Associates
Drawn MHW
Chkd. DWH



REVISIONS

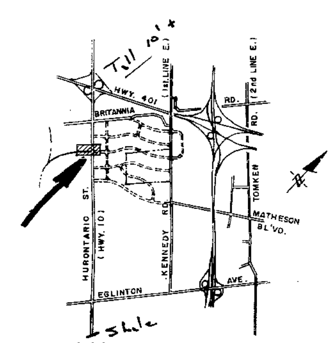
DATE	DETAILS	INIT.

GENERAL NOTES

1. CITY B.M. No. 220 ELEV. 192·696
2. TEMP. BENCH MARK ELEV.
   DESCRIPTION:

NOTES

1. ALL SEWERS TO HAVE CLASS 'B' BEDDING AS PER CITY STD. No. 2-1-31, EXCEPT AS NOTED.
2. CONTRACTOR IS RESPONSIBLE FOR SUPPLYING ADDITIONAL BEDDING AND/OR STRONGER PIPE IF ACTUAL TRENCH WIDTHS EXCEED THE DESIGN WIDTHS.
3. TRENCH WIDTH (SEPARATE TRENCH) AT TOP OF THE PIPE SHALL BE AS PER CITY STD. No. 2-1-31.
4. 400mm. TO 120 mm. WATERMAIN TO BE CONC. PRESSURE PIPE AW.W.A. C-301 CLASS SHOWN
5. W.S. TO HAVE 1200mm. MINIMUM HORIZONTAL CLEARANCE FROM ALL OTHER UTILITIES.
6. 150mm. TO 300mm. WATERMAIN TO BE DUCTILE IRON A.N.S.I. CLASS 52 CEMENT LINED WITH 'TYTON' JOINTS.
7. CURB AND GUTTER — 1 STAGE TO CITY STD. No. 1-5-4
8. ASPHALT PAVEMENT THICKNESS:-
   H.L. 3 ——— mm.
   H.L. 6 ——— mm.
   GRANULAR 'A' ——— mm.
   GRANULAR 'B' ——— mm.
9. ANY RELOCATION OF EXIST. UTILITIES, REQUIRED BY THE DEVELOPMENT OF THE SUBJECT LANDS, IS TO BE UNDERTAKEN AT THE DEVELOPER'S EXPENSE.
10. THE SUITABILITY AND COMPACTION OF ALL FILL MATERIALS ARE TO BE CONFIRMED BY A RECOGNIZED SOIL CONSULTANT TO THE CITY'S ENGINEER PRIOR TO THE INSTALLATION OF ANY ROAD BASE MATERIAL.



LOCATION PLAN

DWG No. 45

SUBMISSIONS 1st ___ 2nd ✓ PRE-SERV. ___
DATE OCT. '80 INTERIM ___ FINAL ___

REGISTERED PROFESSIONAL ENGINEER J. M. TOMLINSON PROVINCE OF ONTARIO

DESIGNED
CHK'D ___
APPROVED

R.E. WINTER & ASSOCIATES LTD.
CONSULTING ENGINEERS
77 CITY CENTRE DRIVE, MISSISSAUGA L5B 1M5. 270-0110

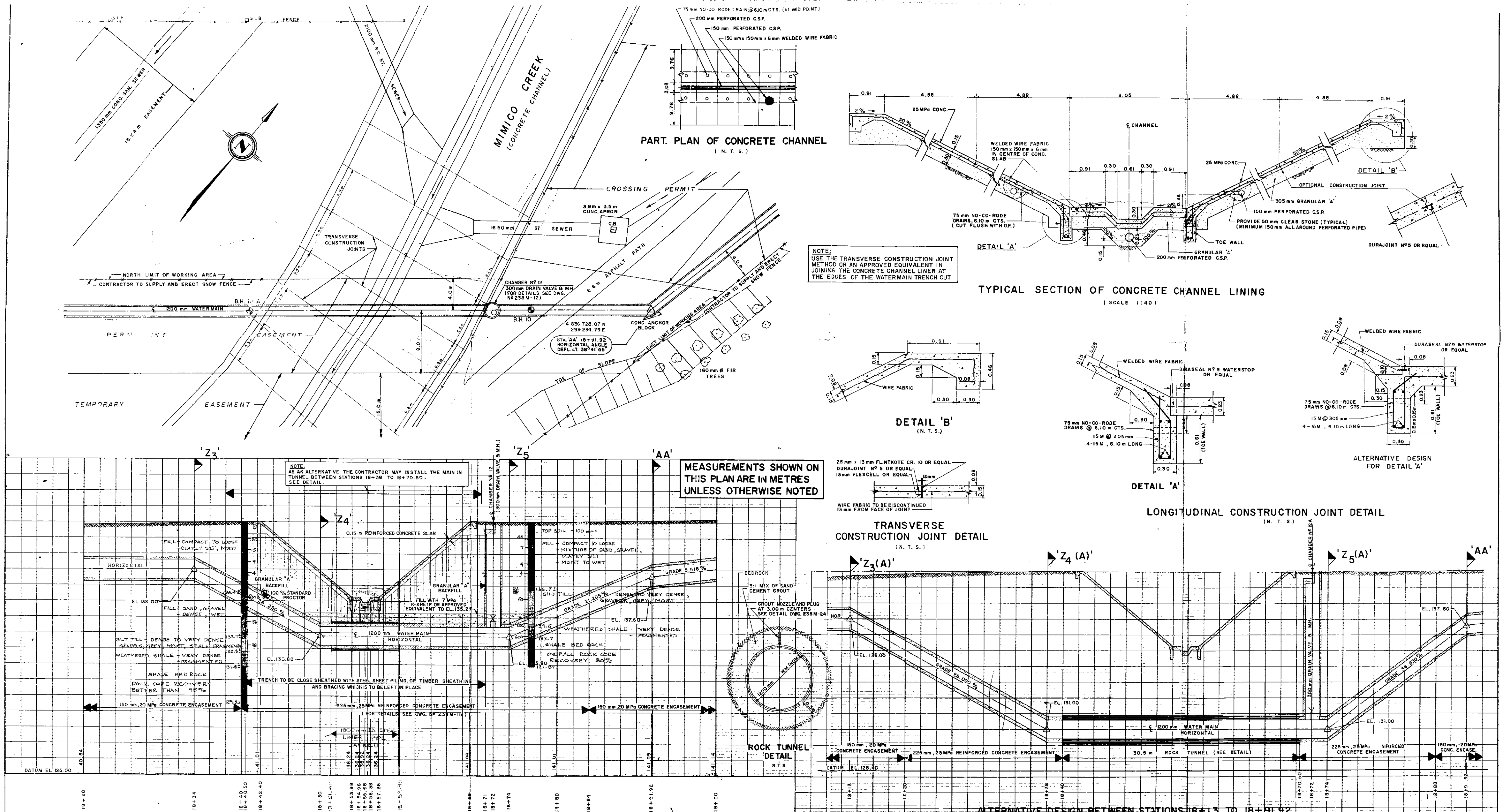
PHASE II
BRITANNIA EAST INDUSTRIAL PARK

TRADERS ASSOCIATES
M.O.H. No. T-77039 CITY FILE No. 16 III 80231

CITY OF MISSISSAUGA
REGIONAL MUNICIPALITY OF PEEL
ENGINEERING DEPARTMENT

PLAN & PROFILE OF
STORM SEWER EASEMENT
Sta. -0+060 To Sta. 0+210

METRIC SCALE HOR. 1:500 VERT. 1:50	AREA Z-36	R.E.W.A.L. 1309×1
DRAWN CFC	CHK'D	PLAN No.
DATE 80-01-22	SHEET 1 OF 3	



Nº	REVISIONS	DATE	DESIGNED BY D.F. / DRAWN BY P. Vink / CHECKED BY W. Winckelsophy	DIRECTOR OF ENGINEERING & PLANNING / DIRECTOR OF WATER SUPPLY	COMMISSIONER OF WORKS	

MUNICIPALITY OF METROPOLITAN TORONTO
DEPARTMENT OF WORKS
WATER SUPPLY DIVISION

1200 mm WATER MAIN
on THE EAST MALL, EGLINTON AVENUE WEST
and MARTINGROVE ROAD from ROBINGLADE DRIVE
to RICHVIEW RESERVOIR and PUMPING STATION

DETAIL OF MIMICO CREEK CROSSING

CONTRACT Nº W-10-80
DATE NOVEMBER 1980
SCALE: HORIZ. 1:200; VERT. 1:100 OR AS SHOWN

238M-9