#67-F-269M

WEST MALL

ROADWAY

EXTENSION

STATION 20+00-

80+00

ETOBICOKE

SITE 37-869

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

REPORT

TO

WYLLIE & UFNAL LIMITED

ON

SUBSURFACE INVESTIGATION

FOR

PROPOSED WEST MALL ROADWAY EXTENSION

STATION 20+00 TO STATION 80+00

ETOBICOKE ONTARIO

67-F-26714

Distribution:

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ABSTRACT

The results of an investigation to determine the subsoil and groundwater conditions along the route of the proposed West Mall roadway extension in Etobicoke, Ontario, are reported. Recommendations are made for the foundation design of the proposed underpass structure and the construction of the roadway extension.

It was found that along about one half its length the proposed route is underlain by fill. Two sections of the fill are comprised of some 25 to 30 feet of garbage material which extends down to a thin recent alluvial deposit above shale bedrock. In the vicinity of the proposed underpass structure some 5 to 10 feet of essentially inorganic or earth fill overlies a stratum of clayey silt till up to 7 feet thick which in turn overlies shale bedrock. The upper 5 foot zone of the shale bedrock was found to be weathered. In the northern half of the proposed route a surficial sand deposit overlies glacial till.

It is recommended that the proposed underpass structure be founded on footings placed within the shale bedrock using an allowable bearing pressure of up to 10 tons/sq.ft. in the sound rock or 5 tons/sq.ft. in the weathered shale bedrock.

A construction procedure for carrying the proposed roadway over the deep garbage fill deposit is presented. It is suggested that a 4 to 5 foot depth of garbage fill along the proposed route in the disposal areas be removed and replaced by a sand cushion which should then be surcharged by some 10 feet of fill. A three month surcharge period should be sufficient to minimize differential settlement of the finished roadway pavement. It is however recommended that settlement plates be installed below the surcharge fill to monitor the expected settlements and to aid in the assessment of the required duration of the surcharge load.

Recommendations are made for the design and construction of the proposed temporary roadway detour which is to be built adjacent to the southern section of the proposed roadway extension.

Recommendations are also made for pavement design of the proposed roadway.

INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by the Borough of Etobicoke on the recommendation of Wyllie & Ufnal Limited, Consulting Engineers, to carry out a soil investigation along the route of the proposed West Mall roadway extension in Etobicoke, Ontario. The purpose of this investigation was to determine the subsoil conditions along the route of the proposed roadway and at the site of a proposed underpass structure where the roadway would pass beneath the Canadian Pacific Railway tracks. Based on the subsurface information obtained, recommendations for the foundation design of the proposed roadway and underpass structure were also to be made.

PROCEDURE

The field work for this investigation was carried out in three phases:

(i) Eight borings (numbered 1 to 8) were put down to depths ranging from about 15 to 37 feet below existing ground surface along the route of the proposed roadway extension and at the site of the proposed underpass structure using a trailer-mounted power auger. This phase of the field work was carried out between January 4 and January 9, 1967.

(ii) An additional five borings (numbered 9 to 13) were put down to depths ranging from about 9 to 29 feet below existing ground surface at the location of two garbage fill areas to delineate more fully the horizontal extent of this poor quality fill. These borings were put down using a trailer-mounted power auger on January 12, 1967.

(iii) Two of the original eight borings (numbered 3 and 4) which were put down at the site of the proposed underpass structure were advanced to refusal using a power auger. To establish the character of the bedrock and to prove the existence of a competent bearing stratum for the support of the underpass structure, boreholes 3 and 4 were each advanced a further 10 feet using diamond drilling techniques on January 18 and 19, 1967.

The power auger and machine drillrig along with all the necessary drilling equipment were supplied and operated by the F.E. Johnston Drilling Co. Ltd. A standpipe or piezometer was installed in each of boreholes 1 to 8, inclusive. The field work was supervised throughout by a member of our engineering staff.

The locations of the borings are shown on Figure 1 and the inferred soil stratigraphy along the route of the proposed roadway extension is given on Figure 2. A detailed log of each boring is given on the Record of Borehole sheets following the text of this report.

The samples obtained during the investigation were brought to our laboratory for detailed examination and testing. The results of the testing are shown on the Records of Boreholes and on Figures 3 to 5, inclusive.

The elevation at each borehole location was either determined by Wyllie & Ufnal Limited or by us from local bench marks established at various station locations along the route of the proposed roadway extension. It is understood that these elevations are referred to the Borough of Etobicoke datum.

SITE AND GEOLOGY

The section of the route of the proposed West Mall extension under investigation is some 6,000 feet long with ground surface rising gradually towards the north. The southern portion of the route, between station 20+00 and station 35+00, will run in a north-westerly direction alongside Etobicoke Creek and will pass under an existing Canadian Pacific Railway line at about station 32+50. From here the roadway will turn towards the north following a meander in Etobicoke Creek to about station 47+50 where it joins the existing Cocker Avenue. The route then follows Cocker Avenue to station 80+00 at the northern limit of this investigation.

The route of the proposed roadway extension will pass over two fill deposits both of which are known to have been used as recently as 1966 for garbage disposal areas. The first of these two areas, between about station 22+50 and station 32+50, adjacent to Etobicoke Creek, has been covered with a layer of earth fill within the past year or so. The second area, between about station 35+50 and station 50+00, also adjacent to Etobicoke Creek, has more recently been used as a dumping area for leaves.

Geologically the general site area is situated below the old shoreline of glacial Lake Iroquois. Grey shale bedrock of the Dundas formation overlain by till, and often also by Lake Iroquois sand, is found in cliff faces along the Credit River, Etobicoke Creek, and other streams which cross the till plain from the north-west. From previous experience with the Dundas shale formation in this area it has been found that the upper several feet of the bedrock is generally badly weathered.

SOIL CONDITIONS

The detailed stratigraphy encountered in the borings put down along the route is given on the Records of Boreholes. The major deposits encountered in the borings are summarized below.

Fill

Between about station 20+00 and station 50+00 two relatively large fill or refuse disposal areas (referred to as the northerly and southerly areas) were encountered. At the location of boreholes 1 and 2 (southerly area) the fill was found to be some 26 to 31 feet deep, with the deposit decreasing in depth to about 12 feet (borehole 12) to the north and to about 3 feet (borehole 13) to the west. In the vicinity of boreholes 5, 6 and 9 at the northerly fill area, the deposit was found to be between about 25 and 28 feet deep with its vertical extent decreasing towards the north (borehole 7) and south (borehole 10). The approximate lateral limits of these refuse fill deposits may be seen on Figure 2.

In general the upper 4 to 12 feet of fill in the southerly refuse area is relatively free of organic matter and consists essentially of silty clay to silty sand with varying amounts of gravel together with brick fragments and occasional rubbish inclusions dispersed throughout. This better quality fill (earth material) has been dumped over the underlying heterogeneous rubbish fill in the recent past. A similar cover or blanket of better quality fill does not generally exist over the northerly fill area in the vicinity of boreholes 5, 6 and 9.

Surficial deposits of silty clay to silty sand fill were encountered overlying a natural glacial till stratum in the vicinity of the underpass structure for depths of about 4 and 8 feet below existing ground surface. Grain size distribution curves for three samples of this inorganic fill are given on Figure 3.

The major portion of the rubbish or garbage fill in the two disposal areas referred to above consists of a heterogeneous mixture of paper, tin cans, wire, glass, organic matter, bricks, rags and wood pieces with inclusions of silty sand and clayey silt dispersed throughout. This garbage fill is in a state of partial decomposition and is considered to be in an "active" state, that is, subject to further breakdown or deterioration. It is understood that both garbage fill areas have been used until recently with the northerly disposal area being used originally as a private dumping area by a construction firm. Standard penetration tests carried out in sampling the garbage fill deposit gave "N" values varying from 6 blows/ft. to several values in excess of

100 blows/ft. The high blow count is not considered representative of the density of the fill as the sampler met obstructions within the fill. Due to the heterogeneous nature of the fill a wide variation in "N" values was recorded between samples taken only a few feet apart. It is therefore considered that the garbage fill is in a generally loose state of packing with the upper blanket of earth fill between station 20+00 and station 32+50 (southerly area) being loose to compact.

Sand and Recent Alluvium

At the northern limit of the proposed roadway extension (borehole 8) a surficial deposit of compact brown fine to medium sand, some 8 to 9 feet thick, was encountered. This material is probably part of the old Lake Iroquois shoreline. Grain size distribution curves from laboratory tests carried out on two samples of this natural sand deposit are given on Figure 4.

Underlying the fill deposits in boreholes 1, 2 and 3 at a depth of about 24 to 30 feet below existing ground surface, recent alluvial deposits from Etobicoke Creek were encountered. It is considered that these deposits which consist of silty sand to clayey silt with a trace of gravel and wood pieces formed part of the flood plain adjacent to the creek before being covered with garbage fill.

Clayey Silt Till

During the advance of the most recent glacier in this region a clayey silt till with a trace to some sand and gravel dispersed throughout was laid down over an extensive area. Since this time Etobicoke Creek has eroded a channel down through the till and at the location of boreholes 1, 2, 5, 6 and 9 had exposed shale bedrock.

Between about station 30+00 and station 37+00 in the vicinity of the proposed underpass a veneer of clayey silt till as much as 7 feet thick was encountered below a surficial cover of fill. In borehole 7 beneath a surficial deposit of fill and in borehole 8 below the sand, clayey silt till was sampled to a depth of 16 and 15 feet below existing ground surface, respectively. Gradation curves for typical samples of the till, obtained using 1½ inch I.D. sampling equipment, are given on Figure 5.

Atterberg limit tests carried out on samples of the till gave liquid limits of 18 and 27 with corresponding placticity indices of 6 and 11, respectively, which indicates a soil of low plasticity. The in situ water content of these samples was several percent lower than the plastic limit indicating an insensitive soil of low compressibility. Based on the "N" values obtained in sampling, the clayey silt till is essentially hard.

BEDROCK CONDITIONS

During the first and second phases of the field work for this investigation where the power auger was being used, refusal to augering was met in boreholes 1, 2, 5, 6 and 9 at about a depth of 26 to 34 feet below existing ground surface. In boreholes 3, 4 and 10 near the existing railway line refusal to augering was met at about a depth of 10 to 13 feet below existing ground surface. In all these locations refusal was met on weathered grey shale bedrock. The weathered shale bedrock was found to contain softer clayey layers and harder limestone bands throughout.

In boreholes 3 and 4 where the underpass structure is to be located, bedrock was proved in the third phase of the investigation by core drilling in BXL size for a depth of about 10 feet in each hole. The elevation of the top of weathered shale bedrock was found to be at about 363, with sound shale bedrock containing occasional bands of interbedded limestone occurring below about elevation 358.

GROUNDWATER CONDITIONS

In order to determine the elevation of the groundwater level along the route of the proposed roadway extension and underpass structure, a sealed piezometer or standpipe was installed in eight of the boreholes put down at this site. The details of these installations are shown on the Record of Borehole sheets following the text of this report.

During the period of the field investigation and on January 13 and 25, 1967, water level readings were taken in the standpipe and piezometer installations along the route of the proposed roadway extension. The piezometric water level in the garbage fill areas was found to be at a depth of 20 feet or more below existing ground surface. In borehole 4, near the proposed underpass structure, the piezometric groundwater level was found to be just above the weathered shale. On the other side of the existing C.P.R. tracks, at borehole 3, the water level was at ground surface on January 25, 1967. It is considered, however, that this does not represent the true groundwater level but rather is the result of surface water inflow during a period of thawing. The piezometric groundwater level in borehole 3 is probably at about the same elevation as in borehole 4. The water level readings taken in the two boreholes (numbers 7 and 8) put down along Cocker Avenue indicate that the groundwater level is some 4 to 10 feet below existing ground surface.

DISCUSSION

It is understood that Cocker Avenue in Etobicoke, Ontario, is to be extended some 3,000 feet to connect with the proposed extension of the Queensway as shown on Figure 1. An underpass may be constructed to carry Cocker Avenue below the existing C.P.R. tracks at about station 32+50. In the vicinity of station 42+50 the roadway will pass quite close to the top of the existing Etobicoke Creek bank. Beyond about station 50+00 to the end of the proposed roadway section, at station 80+00, Cocker Avenue will be widened from the existing two lane roadway to a four lane road.

Reconstruction Section (Station 50+00 to Station 80+00)

Between about station 50+00 and station 80+00 the proposed roadway extension will involve the reconstruction of the existing two lane road to form a four lane road and the possible provision of curbs and gutters and a storm sewer beneath about the roadway centreline. The borings put down along this section of the proposed route show that the upper 3 to 8 feet of soil consists of a silty sand to fine to medium sand with a trace of gravel dispersed throughout. Below this surficial granular deposit there is a clayey silt till which may rise to ground surface between the borehole locations.

All topsoil and foreign material should be removed from within the proposed construction limits. The surficial granular deposits and the clayey silt till are suitable for use as earth borrow material up to roadway subgrade level along the route.

It is understood that the expected traffic density of the West Mall extension with possible future expansion could be of the order of 10,000 vehicles per day. It is also understood that the existing pavement along Cocker Avenue consists of 5½ inches of asphalt on 14 inches of granular base material. Since the existing pavement is to be incorporated in the final 4 lane roadway, it is suggested that its strength be checked by taking Benkelman beam readings during the spring thaw period. The results from these readings would provide a basis for design of the additional traffic lanes and also indicate whether an additional layer of asphalt wearing surface would be necessary over the existing pavement in order for it to perform satisfactorily under the expected increased traffic density. For preliminary design, however, the thickness of the granular base material forming the new pavement may be taken as 15 inches. This could consist of 9 inches of sand cushion sub-base below 6 inches of granular "A" base course topped by 5 inches of asphalt.

Prior to the placement of the sand cushion the subgrade surface should be proof rolled with a heavy roller. It is further recommended that the sand cushion and base course be compacted to 100 percent Proctor density using a vibratory steel wheel roller prior to placement of the asphalt wearing surface.

Underpass Structure and Approach Cuts

At about station 32+50 it will be necessary to provide a grade separation in order to carry the proposed roadway beneath the existing C.P.R. lines.

The borings put down at the location of the proposed underpass structure (boreholes 3 and 4) indicate that the subsoil consists of a 4 to 8 foot thick deposit of silty sand to clayey silt fill overlying a 5 to 6 foot thick stratum of hard clayey silt till which in turn overlies weathered shale bedrock. The elevation of the surface of the weathered shale is at about 363 with the weathered zone being some 6 to 7 feet thick as encountered in the borings.

It is understood that the proposed roadway grade will be as shown on the section on Figure 2. The grade line, at its lowest point beneath the C.P.R. tracks, will pass through sound shale bedrock. The construction of the roadway approach cuts to the underpass structure will require excavation of both earth and garbage fill, hard clayey silt till and shale bedrock.

The sound shale bedrock at or below about elevation 358 is a competent bearing stratum for the foundation support of the proposed underpass structure. For footings taken down into the sound shale bedrock an allowable bearing pressure of up to 10 tons/sq.ft. may be used in design.

Where footings are placed within the weathered shale bedrock below about elevation 362, an allowable bearing pressure of 5 tons/sq.ft. may be used in design.

The underpass structure will be supported by abutment walls which will also act as retaining walls. It is recommended that the backfill behind the abutment walls, for a minimum horizontal distance of 4 feet, be a free-draining and non-frost-susceptible granular material, well compacted during placing in lifts. For a rigid structure the abutment retaining walls should be designed using an at rest lateral earth pressure coefficient, Ko, of 0.5. With the provision of positive drainage from the granular backfill, no allowance for hydrostatic pressures behind the walls need be made. In the computation of sliding resistance of the abutment footings resting on shale bedrock, a coefficient of friction of 0.4, which is a limiting value, may be used.

Due to the relatively impermeable nature of the bedrock and the subsoil below the surficial cover of fill at the location of the proposed underpass structure, no groundwater problems are anticipated in excavating down to final foundation grade. Provision should however be made to have sump pumps available to take care of any local seepage and surface water runoff during inclement weather. Shale, on exposure to the elements, tends to soften very rapidly and therefore should be protected immediately after final footing level is reached by pouring a lean concrete skin coat over its surface.

The provision of approach cuts for the underpass structure will necessitate considerable excavation between about station 26+00 and station 39+00. The major portion of the material to be excavated will consist of earth fill, clayey silt till and some bedrock. In the vicinity of boreholes 9, 10 and 11 (station 34+00 to station 39+00) some garbage fill will have to be excavated. Trafficability for equipment in this area could become extremely difficult, particularly during inclement weather.

For the design of retaining wall foundations beyond the structure abutments an allowable bearing pressure equal to that given for the abutment footings in the weathered or sound bedrock may be used. To provide drainage from behind the retaining walls and to prevent formation of ice lenses behind the walls, it is recommended that a 4 foot thick zone of compacted clean granular fill be placed between the walls and the soil to be retained. Positive drainage should be provided to the granular backfill behind the retaining structure. If slight movements of the top of the retaining walls can be tolerated, an active lateral earth pressure coefficient, Ka, of 0.3 may be used in the design of these walls. With the use of a free-draining granular fill behind the retaining walls in conjunction with a positive drainage system no allowance need be made for hydrostatic pressures against the walls.

It is understood that a portion of the roadway approaches beyond the retaining walls will be in a permanent cut. In order to prevent surficial instability over the long term it is recommended that the side slopes of the permanent cut be made no steeper than 2 horizontal to 1 vertical. To minimize surficial gullying and erosion it is also recommended that the slopes be sodded and staked or that a fast developing growth be promoted following final sloping operations.

Roadway Construction Over Garbage Fill Sections

As discussed previously two relatively extensive deposits of garbage fill were encountered during the subsurface investigation for this project. The first of these garbage areas extends from about station 20+00 at the southern limit of the proposed

Cocker Avenue extension route to about station 31+00 near the proposed underpass structure. In the vicinity of boreholes 1 and 2 the garbage fill deposit was found to be some 26 to 31 feet deep with the upper several feet being a better quality earth fill. The second garbage fill area found along the route of the proposed roadway extension extends from about station 34+00 to station 50+00 with the fill in the vicinity of boreholes 5, 6 and 9 being some 24 to 28 feet deep. It is understood that these locations have been used for refuse and leaf disposal areas within the past year. The material in these disposal areas is heterogeneous and includes varying amounts of organic and other matter which may decompose with time.

In order to provide a roadway over these fill areas which would perform satisfactorily over a normal design period without continuing repairs and maintenance it would be necessary to sub-excavate the garbage fill down to a competent stratum and replace it with better quality compacted fill prior to the placement of the pavement. In this case, this would involve excavation and subsequent backfilling of some 25 feet of material below existing ground surface, which would probably not be economically practical for this roadway.

Provided that periodic repairs and some maintenace of the roadway in the years following its completion can be tolerated, the roadway may be constructed by using partial excavation and preloading techniques. In order to provide a roadway over the garbage fill areas which will perform satisfactorily without resorting to the expensive method of replacing the existing garbage fill, the following construction procedure is recommended between about stations 20+00 and 28+00 and between stations 37+00 and 50+00:

(i) Sub-excavate some 4 to 5 feet of the garbage fill material below existing ground surface or proposed final grade where the roadway is in cut. Where pockets of extremely poor quality garbage fill are visually evident at sub-excavation level these should be removed to a greater depth.

(ii) Place a 2 to 3 foot sand cushion layer along the length of the excavated garbage fill areas.

(iii) In order to locate any concentrations of very poor quality garbage fill within the subgrade which are not visually evident, proof-rolling over the sand cushion should be carried out using a pneumatic roller weighing about 15 to 20 tons. About 10 passes should be sufficient to locate any weak zones which should then be sub-excavated and backfilled with clean fill.

(iv) A further 2 feet of sand cushion compacted in place should then be added to bring the roadway up to the proposed subgrade level.

(v) The surcharging of the roadway should be accomplished by the use of an additional 8 to 10 feet of soil. This soil, which will provide a surcharge for the roadway subgrade, should be left in place for about 3 months. The roadway should be instrumented to check the amount and rate of the settlement under the surcharge. Settlement plates installed on the sand cushion surface prior to the placement of the surcharge loading would monitor the compression of the underlying garbage fill. Elevation readings of the settlement plates taken at regular intervals, would be used to determine if further surcharge time than indicated above is necessary prior to final construction of the roadway.

Once the surcharge material is no longer required it would then be removed from above the sand cushion and could be placed over the creek banks, near stations 25+00 and 42+50 where some slope treatment may be required.

Following the removal of the surcharge loading a 6 inch layer of base course consisting of granular "A" material should be laid down and well compacted in place prior to the placement of the asphalt wearing surface. With the use of this partial excavation and surcharge loading technique, differential settlement of the roadway should be minimized but continuing maintenance will be required and possibly a re-surfacing program will be necessary with time.

Since the soil conditions along the route of the proposed West Mall extension are quite variable and the two major garbage disposal areas are comprised of heterogeneous fill, it is considered that a rigid pavement would not be suitable for this site. Differential and local settlements due to the continued deterioration and compression of pockets of the fill could result in breaking of concrete slabs. Flexible pavements, on the other hand, lend themselves more readily to repair.

Slope Treatment

At two locations along the route of the proposed West Mall extension the roadway alignment passes immediately adjacent to or encroaches on the existing banks of Etobicoke Creek.

Between about station 22+50 and station 26+00 an embankment will be necessary to carry the proposed roadway over the existing Etobicoke Creek flood plain at this location. The required fill material may be obtained from the excavation for the underpass structure, particularly in the vicinity of boreholes 3 and 13. The water content of the clayey till is well below its plastic limit and is probably at about its optimum compaction water content. The till would be an acceptable material for use as general embankment fill, provided any lumpy structure is broken down. The fill should be placed and compacted to at least 95 percent standard Proctor density in layers not exceeding 1 foot in thickness to provide a suitable subgrade for the proposed roadway. Further, the slope of this fill section which encroaches on the Etobicoke Creek flood plain should be no steeper than 2 horizontal to 1 vertical. Provision should be made to rip-rap the lower portion of the slope in this area for protection against scour and undermining erosion during high water level periods. The upper section of the slope should be sodded and staked to prevent gullying erosion due to surface water runoff during inclement weather.

In the vicinity of borehole 5 the roadway alignment passes within about 20 feet of the crest of the existing Etobicoke Creek bank. From visual examination on January 25 during a period of unseasonably high temperatures it was apparent that the high water creek flow was actively eroding the toe of the existing slope in this area. A cross section of the creek bank in the vicinity of borehole 5 would show an almost vertical face at the toe of the slope which generally results from active erosion. To protect the proposed roadway embankment from progressive scour erosion during periods of high water it is recommended that the embankment side slope be made no steeper than 2 horizontal to 1 vertical with the toe of the slope being protected by rip-rap or rubble to a point several feet above the estimated high water mark. The surcharge material from the garbage fill sections of the proposed roadway could be used to form the embankment slope in this area.

Roadway and Railroad Detours

It is understood that a temporary paved by-pass road, which will be in service for at least 18 months, will be provided between about stations 20+00 and 50+00 before the finished West Mall extension is opened. This by-pass will follow and be immediately adjacent to the proposed roadway extension. In the area of the underpass section where the route is underlain by a suitable subgrade material, the temporary pavement could consist of a 6 inch sand cushion layer, followed by a 6 inch layer of granular "A" base course topped by a 2 inch thick asphalt wearing surface.

In the garbage fill area, settlement and possible break-up of the detour roadway due to compression of the garbage fill will be a problem. In order to minimize this settlement, it is recommended that no embankment fill be placed and to this end the roadway grade in the garbage areas should be kept at or below existing ground surface. In the fill area south of the underpass, where a considerable thickness of earth fill covers the garbage, the 6 inch granular "A" base course layer should be underlain by 18 inches of sand cushion material. North of the underpass structure where the garbage is near ground surface, the sand cushion layer should be increased to at least 24 inches.

It is further understood that a by-pass for railroad traffic will be required to expedite construction of the proposed underpass structure. This by-pass would be constructed to the west of the existing C.P.R. tracks near station 32+50. It is recommended that several shallow auger holes be put down along the proposed railway by-pass alignment to determine whether any poor quality fill exists along this detour route. All such poor quality garbage fill should be removed and replaced with suitable earth fill prior to laying of the tracks.

R. H. Amaral, P.Eng.

J. L. Seychuk, P.Eng.

RHA:hdg
67002
February 3, 1967.

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 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, 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 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

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/ft.*
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*, lb./sq. ft.*
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

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 $\bar{R}$.

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.

PROJECT No. 67002

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE 1

LOCATION See Figure 1 BORING DATE JAN 4-5, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN TEST HAMMER WEIGHT — LB DROP — INCHES

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	BLOWS / FT	ELEVATION SCALE	ADDITIONAL LAB. TESTING
					370	
365.5	GROUND LEVEL					
0.0	STIFF BROWN-GREY SILTY CLAY SOME SAND, GRAVEL AND BOULDERS **(FILL)**				365	
360.5 / 5.0	LOOSE BROWN SILTY SAND, OCCASIONAL CLAYEY TILL LUMPS OR INCLUSIONS **(FILL)**	1	D.O.	8	360	MH
		2	"	8	355	MH
353.5 / 12.0	LOOSE GREY SILTY SAND TO CLAYEY SILT SOME SAND GRAVEL RAGS WIRE, BRICK ETC. **(GARBAGE FILL)**	3	"	43	350	
		4	"	>100	345	
		5	"	38	340	
		6	"	20	335	
334.5 / 31.0	STIFF GREY CLAYEY SILT, SOME SAND, WOOD, TIMBERS **(RECENT ALLUVIUM)**					
331.5 / 34.0	BADLY WEATHERED BROWN-GREY **SHALE BEDROCK**	7	"	>100	330	
329.0 / 36.5	END OF HOLE				325	

DYNAMIC PENETRATION RESISTANCE BLOWS/FT.

SHEAR STRENGTH C_u, LB/SQ FT

COEFFICIENT OF PERMEABILITY k, CM./SEC

WATER CONTENT, PERCENT W_p W W_L

15-O-5 Percent axial strain at failure (10 below)

PIEZOMETER OR STANDPIPE INSTALLATION:

- GROUND LEVEL
- SURFACE SEAL
- SAND FILTER
- PERFORATED STANDPIPE
- W.L. IN STANDPIPE AT ELEV. 343.7 ON JAN 13, 1967

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.

CHECKED RHA

RECORD OF BOREHOLE 2

LOCATION See Figure 1 BORING DATE JAN 4, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB DROP 30 INCHES PEN TEST HAMMER WEIGHT – LB DROP — INCHES

ELEVN. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	BLOWS / FT
357.2	GROUND LEVEL			
0.0	GENERALLY COMPACT BROWN GREY SILTY SAND SOME GRAVEL TRACE WIRE, GLASS, CLAY ETC. **(FILL)**	1	2" OD	77
351.2 6.0	LOOSE BROWN - GREY SILTY SAND SOME GRAVEL CARD-BOARD, PAPER, GLASS BRICKS RAGS ETC **(GARBAGE FILL)**	2	"	>100
		3	"	26
		4	"	64
		5	"	14
231.0 26.2	COMPACT GREY SILTY SAND TO SANDY SILT TRACE GRAVEL AND CLAY (RECENT ALLUVIUM)			
329.2 28.0	WEATHERED GREY SHALE BEDROCK	6	"	>100
327.1 30.1	END OF HOLE			

ELEVATION SCALE: 360, 355, 350, 345, 340, 335, 330, 325

DYNAMIC PENETRATION RESISTANCE BLOWS / FT

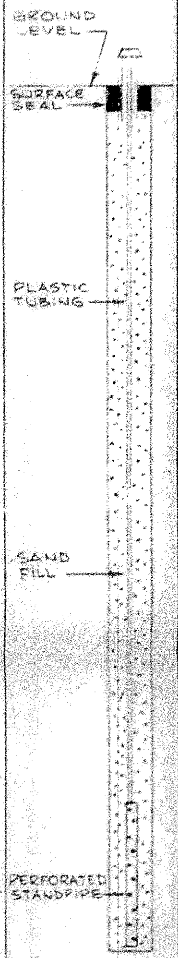
SHEAR STRENGTH C_u, LB / SQ FT

COEFFICIENT OF PERMEABILITY k, CM / SEC

WATER CONTENT, PERCENT W_P — W — W_L

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



STANDPIPE DRY TO ELEV 327.1 ON JAN. 13 1967

15 S 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.

CHECKED RHA

RECORD OF BOREHOLE 3

LOCATION See Figure 1 BORING DATE JAN. 5 & 1?, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER & WASHBORING BOREHOLE DIAMETER 4.5" & BX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB DROP — INCHES

ELEVN. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT	WATER CONTENT	PERCENT CORE RECOVERY
373.5 / 0.0	GROUND LEVEL					
	COMPACT BROWN SILTY SAND SOME GRAVEL (FILL)					
370.0 / 3.5	VERY HARD MOTTLED GREY AND BROWN CLAYEY SILT TRACE TO SOME SAND AND GRAVEL (CLAYEY SILT TILL)	1	2" D.O.	66	○	
363.5 / 10.0	WEATHERED BROWN-GREY SHALE BEDROCK, OCCASIONAL SOUND SHALE AND LIMESTONE LAYERS	2	"	>100		
		3	"	>100		
358.1 / 15.4	SOUND GREY SHALE BEDROCK, OCCASIONAL INTERBEDDED LIMESTONE BANDS.	4	"	>100		
		5	BXL RC	-		75
		6	"	-		85
348.5 / 25.0	END OF HOLE					

Elevation scale: 375, 370, 365, 360, 355, 350, 345, 340

DYNAMIC PENETRATION RESISTANCE BLOWS/FT

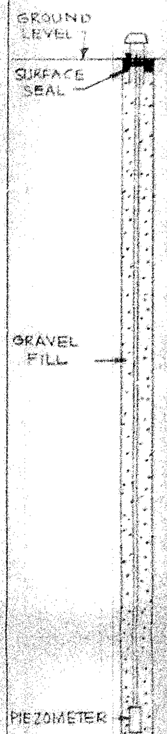
SHEAR STRENGTH C_u, LB/SQ FT

COEFFICIENT OF PERMEABILITY k, CM./SEC

WATER CONTENT, PERCENT W_p — W — W_L 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



W.L. IN PIEZOMETER AT GROUND LEVEL JAN. 25, 1967.

15 ○ 5 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.
CHECKED RHA

CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE 4

LOCATION See Figure 1 BORING DATE JAN 5 & 1[illegible] 19[illegible] DATUM GEODETIC

BOREHOLE TYPE POWER AUGER & WASH BORING BOREHOLE DIAMETER 4.5" & BX CASING

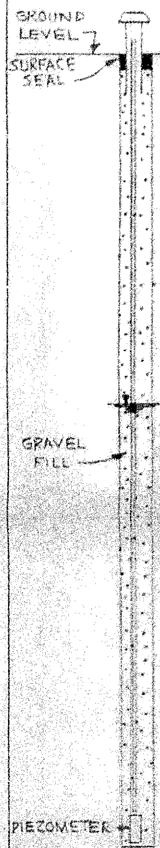
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB DROP — INCHES

ELEVN. DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT	WATER CONTENT / PERCENT CORE RECOVERY	ADDITIONAL LAB TESTING
377.1	GROUND LEVEL					
0.0	GENERALLY LOOSE TO COMPACT BLACK CINDERS IN CLAYEY SILT MATRIX SOME GRAVEL AND WOOD **(FILL)**	1	2" DO	36		MH
369.1 / 8.0	HARD MOTTLED GREY TO BROWN CLAYEY SILT TRACE TO SOME SAND AND GRAVEL **(CLAYEY SILT TILL)**	2	"	89	W ≈ 13, W_P–W_L ≈ 17–25	MH
363.2 / 13.9	BADLY **WEATHERED** GREY **SHALE BEDROCK** OCCASIONAL THIN LAYERS OF HARD SHALE	3	"	>100		
358.1		4	"	>100		
19.0	**SOUND** GREY **SHALE BEDROCK**, OCCASIONAL INTERBEDDED LIMESTONE BANDS	5	BXL RC	—	[illegible]	
		6	"	—	[illegible]	
347.7 / 29.4	END OF HOLE					

Column headings: SOIL PROFILE (ELEVN./DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, BLOWS/FT); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FT; SHEAR STRENGTH C_u, LB/SQ FT; COEFFICIENT OF PERMEABILITY k, CM./SEC; WATER CONTENT, PERCENT W_P W W_L 10 20 30 40; ADDITIONAL LAB TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Elevation scale: 380, 375, 370, 365, 360, 355, 350, 345

PERCENT CORE RECOVERY



W.L. IN PIEZOMETER AT ELEV. 364.2 JAN. 25, 1967.

15 ○ 5 / 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.
CHECKED RHA

CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE 5

LOCATION See Figure 1 BORING DATE [illegible] DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER [illegible]

SAMPLER HAMMER WEIGHT [illegible] LB. DROP [illegible] INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT	ELEVATION SCALE
					375
370.8	GROUND LEVEL				
0.0	COMPACT BROWN SILTY SAND AND GRAVEL (FILL)				370
		1	2" DO	13	
366.8 / 4.0	LOOSE GREY - BROWN SILTY SAND SOME GRAVEL, WOOD, WIRE, GLASS, TIN (GARBAGE FILL)				
		2	"	17	365
		3	"	64	
		4	"	11	360
		5	"	>100	
		6	"	0	355
		7	"	9	350
346.8 / 24.0	LOOSE TO COMPACT DARK GREY SILTY SAND AND GRAVEL (RECENT ALLUVIUM)				
		8	"	24	345
342.8	WEATHERED GREY SHALE BEDROCK				
341.5 / 29.3	END OF HOLE				340

DYNAMIC PENETRATION RESISTANCE BLOWS/FT

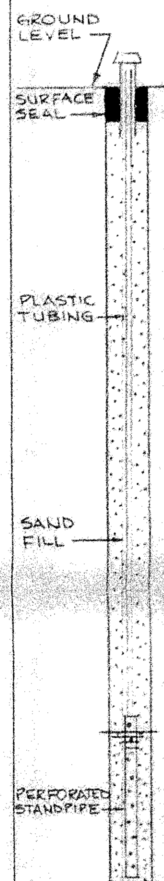
SHEAR STRENGTH C_u, LB/SQ FT

COEFFICIENT OF PERMEABILITY k, CM./SEC

WATER CONTENT, PERCENT W_P W W_L

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



W.L. IN STANDPIPE AT ELEV. 347.0 ON JAN-25,1967

15 ◇ 5 Percent axial strain at failure
10

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.
CHECKED RHA

CONDITION OF ORIGINAL DOCUMENT

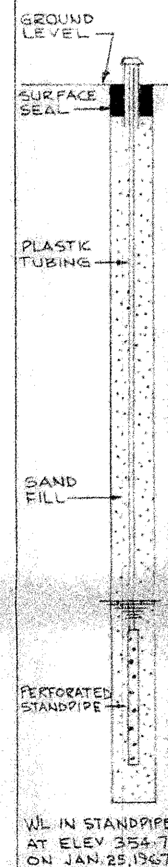
RECORD OF BOREHOLE 6

LOCATION See Figure 1 BORING DATE JAN 6, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FT / SHEAR STRENGTH C_u, LB/SQ.FT	COEFFICIENT OF PERMEABILITY k, CM/SEC / WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
ELEVN. / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS/FT.					
						375				
373.7 / 0.0	GROUND LEVEL									
	LOOSE HETEROGENEOUS MIXTURE OF WOOD WIRE RAGS TIN CANS WITH SOME SILTY SAND (GARBAGE FILL)		1	2" DO	6	370				
			2	"	11					
			3	"	8	365				
			4	"	21					
						360				
			5	"	13					
						355				
			6	"	10					
						350				
348.7 / 25.0	WEATHERED GREY SHALE BEDROCK		7	"	>100					
347.2 / 26.5	END OF HOLE									
						345				
						340				



15-ϕ-5 / 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.
CHECKED D.H.A.

RECORD OF BOREHOLE 7 & 8

LOCATION See Figure 1 BORING DATE JAN. [illegible] 1967 DATUM GEODETIC

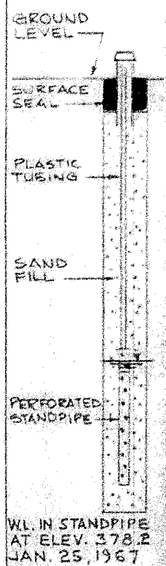
BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

Column headings: SOIL PROFILE (ELEVN. / DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, BLOWS / FT); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS / FT; SHEAR STRENGTH C_u, LB / SQ FT; COEFFICIENT OF PERMEABILITY k, CM. / SEC; WATER CONTENT, PERCENT W_P — W — W_L (10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

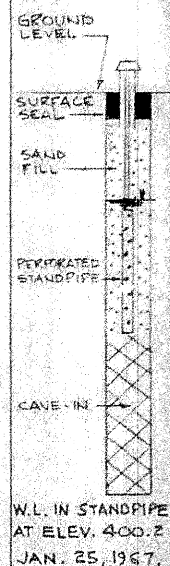
7

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT	ADDITIONAL LAB. TESTING
388.8	GROUND LEVEL				
0.0	COMPACT DARK BROWN SILTY SAND AND GRAVEL (FILL)				
385.8 / 3.0	HARD BROWN TO GREY CLAYEY SILT, SOME SAND, TRACE GRAVEL (CLAYEY SILT TILL)	1	2" D.O.	46	H
		2	"	64	
		3	"	70	
		4	"	>100	
		5	"	>100	
372.8 / 16.0	END OF HOLE				



8

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT	ADDITIONAL LAB. TESTING
404.2	GROUND LEVEL				
0.0	COMPACT BROWN FINE TO MEDIUM SAND, TRACE TO SOME SILT AND GRAVEL	1	2" D.O.	28	M
		2	"	24	M
		3	"	26	
395.7 / 8.5	HARD GREY CLAYEY SILT, TRACE SAND AND GRAVEL (CLAYEY SILT TILL)	4	"	41	MH
389.2 / 15.0	END OF HOLE				



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

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.
CHECKED RHA

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE 9

LOCATION See Figure 1 BORING DATE JAN 12, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

SOIL PROFILE			SAMPLES								
ELEVN. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT	ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FT / SHEAR STRENGTH C_u, LB / SQ FT	COEFFICIENT OF PERMEABILITY k, CM. / SEC. / WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
						370				
369.1 0.0	GROUND LEVEL									
	LOOSE GREY-BLACK CLAYEY SILT, SOME PAPER, GLASS, WOOD PIECES AND SHAVINGS (GARBAGE FILL)		1	2" D.O.	6	365				
			2	"	30	360				
			3	"	7	355				
			4	"	31	350				
			5	"	14	345				
341.6 27.5	WEATHERED SHALE BEDROCK		6	"	61	340				
340.1 29.0	END OF HOLE									

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

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.

CHECKED RHA

PROJECT NO. ....

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

RECORD OF BOREHOLE 10 & 11

LOCATION See Figure 1 BORING DATE JAN 10, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB DROP — INCHES

Borehole 10

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
375.7	GROUND LEVEL			
0.0	LOOSE GREY-BLACK CLAYEY SILT, SOME WOOD, RAGS AND WIRE (GARBAGE FILL)	1	2" D.O.	7
		2	"	>100
367.2 / 8.8	END OF HOLE			
	WEATHERED SHALE BEDROCK.			

Elevation scale: 375, 370, 365

Borehole 11

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
376.6	GROUND LEVEL			
0.0	LOOSE GREY-BLACK CLAYEY SILT SOME WOOD CHIPS, RAGS, PAPER, AND TIN CANS (GARBAGE FILL)	1	2" D.O.	>100
368.6 / 8.0	HARD BROWN CLAYEY SILT, SOME SAND (CLAYEY SILT TILL)	2	"	39
		3	"	>100
365.9 / 10.7	END OF HOLE			

Elevation scale: 380, 375, 370, 365

Column headings: SOIL PROFILE (ELEVN. DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, BLOWS / FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS / FT; SHEAR STRENGTH C_u, LB / SQ FT; COEFFICIENT OF PERMEABILITY k, CM./SEC; WATER CONTENT, PERCENT W_P W W_L; ADDITIONAL LAB TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

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

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN A.H.T.

CHECKED R.H.A.

DEFECTS IN NEGATIVE DUE TO ~~CONDITION OF ORIGINAL DOCUMENT~~

RECORD OF BOREHOLE 12 & 13

LOCATION See Figure 1 BORING DATE JAN 12, 1967 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT — LB DROP — INCHES

Columns: SOIL PROFILE (ELEVN. / DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, BLOWS/FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FT; SHEAR STRENGTH C_u, LB./SQ FT; COEFFICIENT OF PERMEABILITY k, CM./SEC; WATER CONTENT, PERCENT W_p W W_L; ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

Borehole 12

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.
364.5	GROUND LEVEL			
0.0 – 360.5 / 4.0	LOOSE BROWN CLAYEY SILT TRACE SAND, GRAVEL AND BRICK (FILL)	1	2" D.O.	>100
352.0 / 12.5	LOOSE GREY - BLACK CLAYEY SILT SOME PAPER, WOOD, RUBBER AND WIRE (GARBAGE FILL)	2	"	40
	HARD BROWN CLAYEY SILT TRACE SAND AND GRAVEL (CLAYEY SILT TILL)	3	"	40
		4	"	50
341.7		5	"	>100
22.8	END OF HOLE			

Elevation scale: 365, 360, 355, 350, 345, 340

Borehole 13

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FT.
371.7	GROUND LEVEL			
0.0 – 367.2 / 4.5	LOOSE BROWN CLAYEY SILT SOME BRICK PIECES (FILL)	1	2" D.O.	12
362.7	HARD BROWN CLAYEY SILT, TRACE SAND AND GRAVEL (CLAYEY SILT TILL)	2	"	>100
9.0	END OF HOLE			

Elevation scale: 375, 370, 365, 360

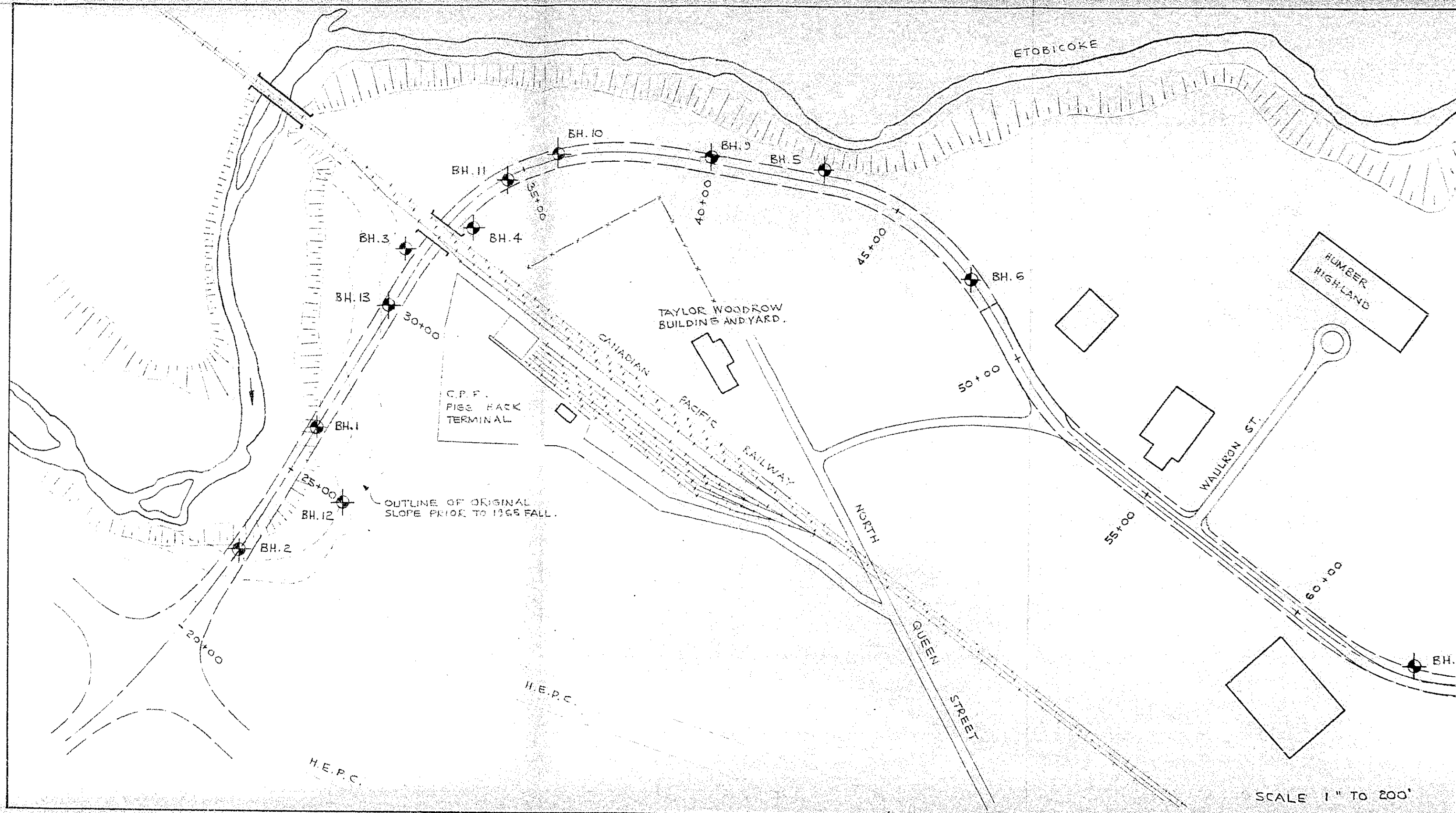
15 ◇ 5 / 10 Percent axial strain at failure

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

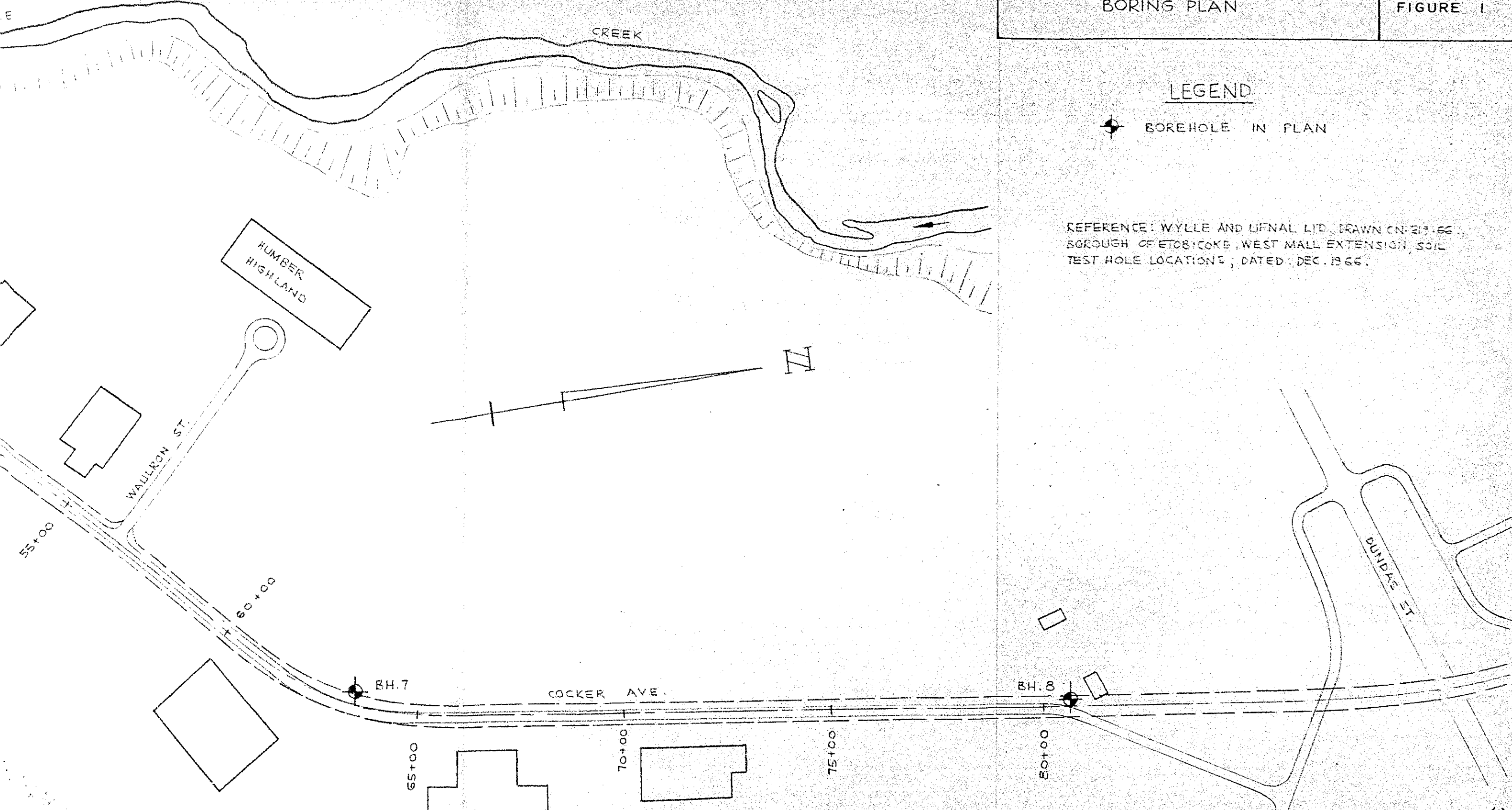
DRAWN A.H.T.

CHECKED RHA


ETOBICOKE
BH. 10
BH. 9
BH. 5
BH. 11
35+00
40+00
45+00
BH. 3
BH. 4
BH. 6
BH. 13
30+00
TAYLOR WOODROW
BUILDING AND YARD.
HUMBER
HIGHLAND
CANADIAN
PACIFIC
RAILWAY
C.P.R.
PIGG BACK
TERMINAL
50+00
BH. 1
WALDRON ST.
NORTH
QUEEN
STREET
25+00
BH. 12
OUTLINE OF ORIGINAL
SLOPE PRIOR TO 1965 FALL.
BH. 2
55+00
60+00
20+00
H.E.P.C.
H.E.P.C.
SCALE 1" TO 200'

BORING PLAN

FIGURE 1



LEGEND

BOREHOLE IN PLAN

REFERENCE: WYLLE AND UFNAL LTD. DRAWN CN-213-66., BOROUGH OF ETOBICOKE, WEST MALL EXTENSION, SOIL TEST HOLE LOCATIONS; DATED: DEC. 1966.

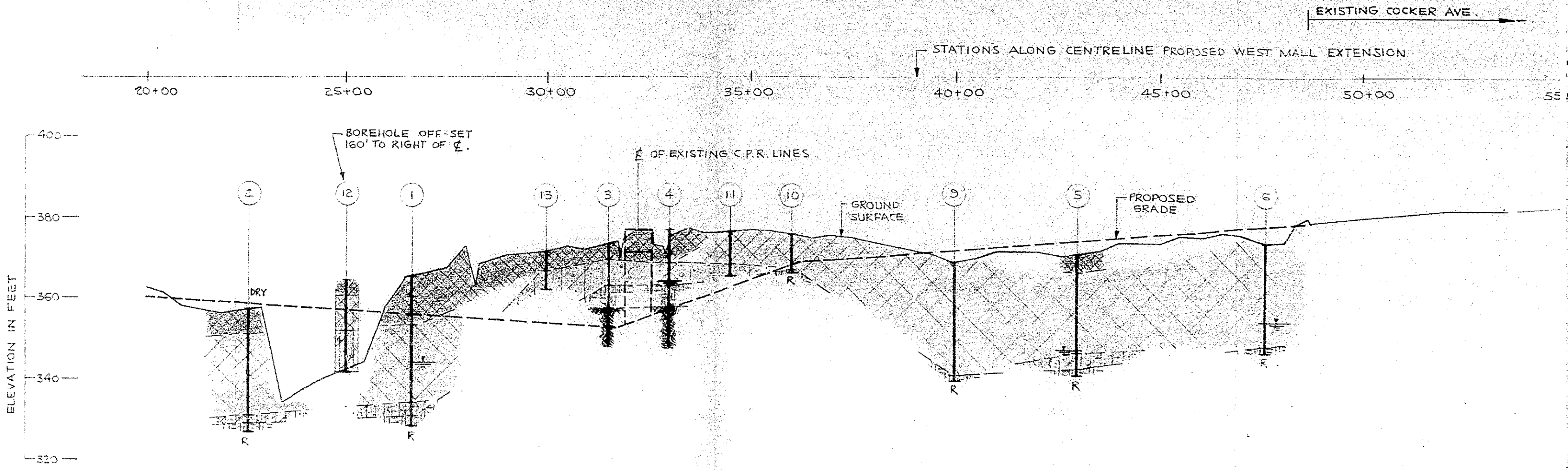
SCALE 1" TO 200'

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

Drawn, JAN. 16, 1967

GOLDER & ASSOCIATES

Made
Chkd.



SCHEMATIC SECTION ALONG PROPOSED WEST MALL EXTENSION

HORIZONTAL SCALE 1" TO 200' VERTICAL SCALE 1" TO 20'

LEGEND

(1) BOREHOLE IN ELEVATION

WATER LEVEL IN BORINGS, JAN 13 & 25, 1967.

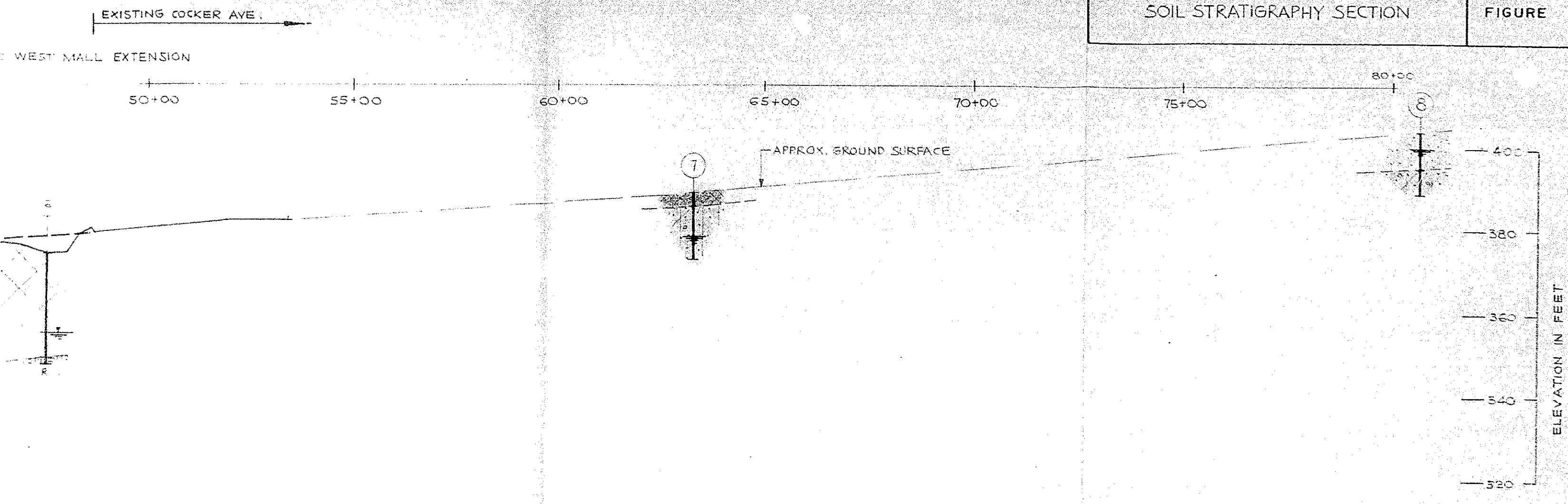
SPECIAL NOTE: DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND MAY VARY FROM THAT SHOWN.

REFERENCE: WYLLIE & ...
WEST MALL GRADE SEPA...
LAYOUT. BOROUGH OF ET...
REC'D. JAN. 15, 1967.

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ...

SOIL STRATIGRAPHY SECTION

FIGURE 2



EST MALL EXTENSION
VERTICAL SCALE 1" TO 20'

STRATIGRAPHY

- LOOSE TO COMPACT BROWN SILTY SAND, TRACE TO SOME GRAVEL, OCCASIONAL CLAYEY SILT INCLUSIONS (FILL)
- LOOSE BROWN TO GREY SILTY SAND TO CLAYEY SILT, SOME WOOD PIECES, PAPER, TIN CANS, RAGS, WIRE, BRICKETC (GARBAGE FILL)
- COMPACT BROWN FINE TO MEDIUM SAND, TRACE TO SOME SILT AND GRAVEL.
- COMPACT GREY SILTY SAND TO STIFF CLAYEY SILT, TRACE GRAVEL AND WOOD PIECES (RECENT ALLUVIUM)
- HARD BROWN TO GREY CLAYEY SILT, TRACE TO SOME SAND AND GRAVEL (CLAYEY SILT TILL)
- WEATHERED GREY SHALE BEDROCK
- SOUND GREY SHALE BEDROCK, OCCASIONAL INTERBEDDED LIMESTONE BANDS.
- R – REFUSAL TO AUGERING (PROBABLY WEATHERED SHALE)

REFERENCE: WYLLIE & UFNAL DRAWING No 2, WEST MALL GRADE SEPARATION, GENERAL LAYOUT BOROUGH OF ETOBICOKE, REC'D JAN. 18, 1967.

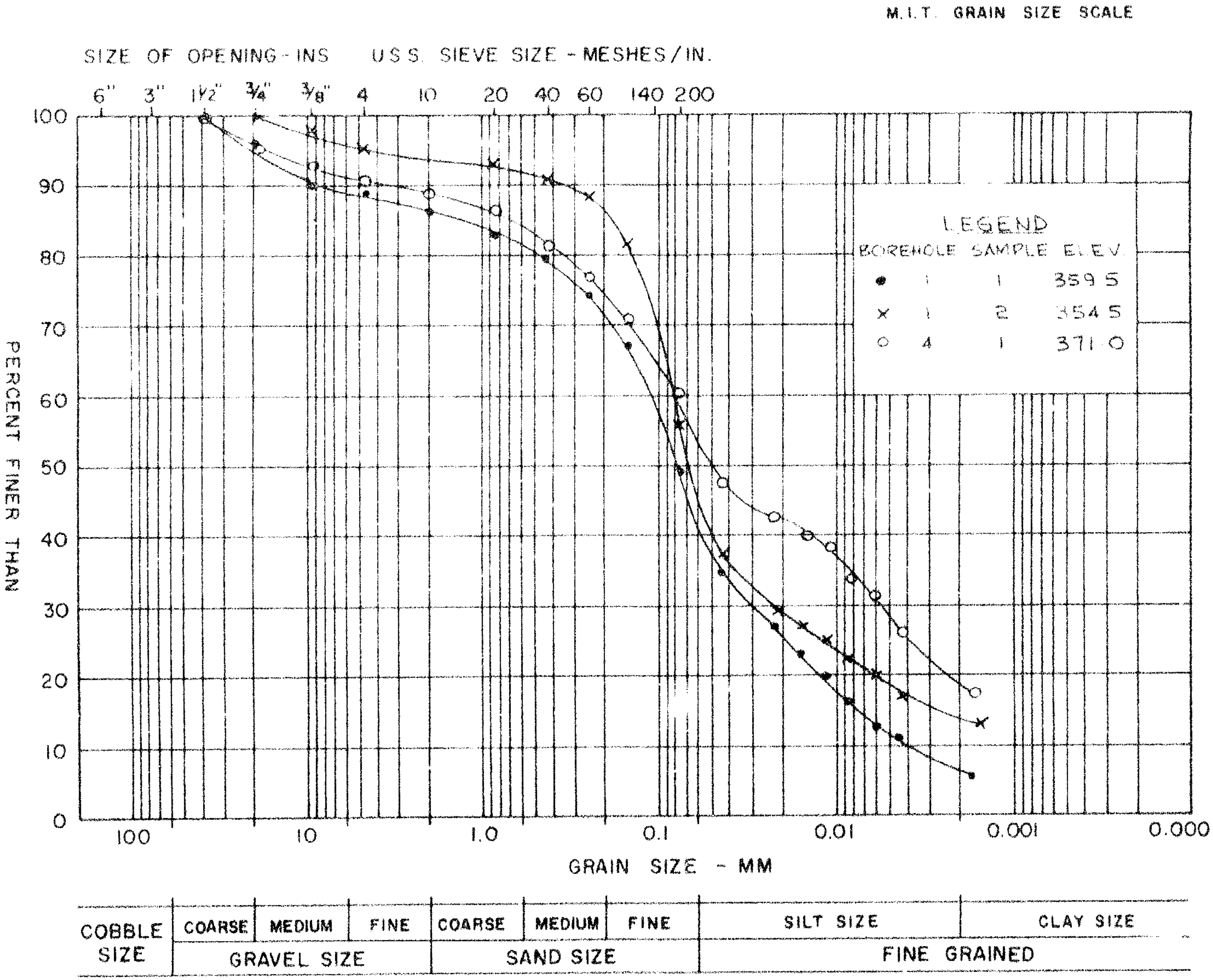
Drawn, JAN. 16, 1967

GOLDER & ASSOCIATES

Made
Chkd.

PROJECT No.

GOLDER & ASSOCIATES



GRAIN SIZE DISTRIBUTION

(FILL)

FIGURE 3

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GRAIN SIZE DISTRIBUTION

FINE TO MEDIUM SAND

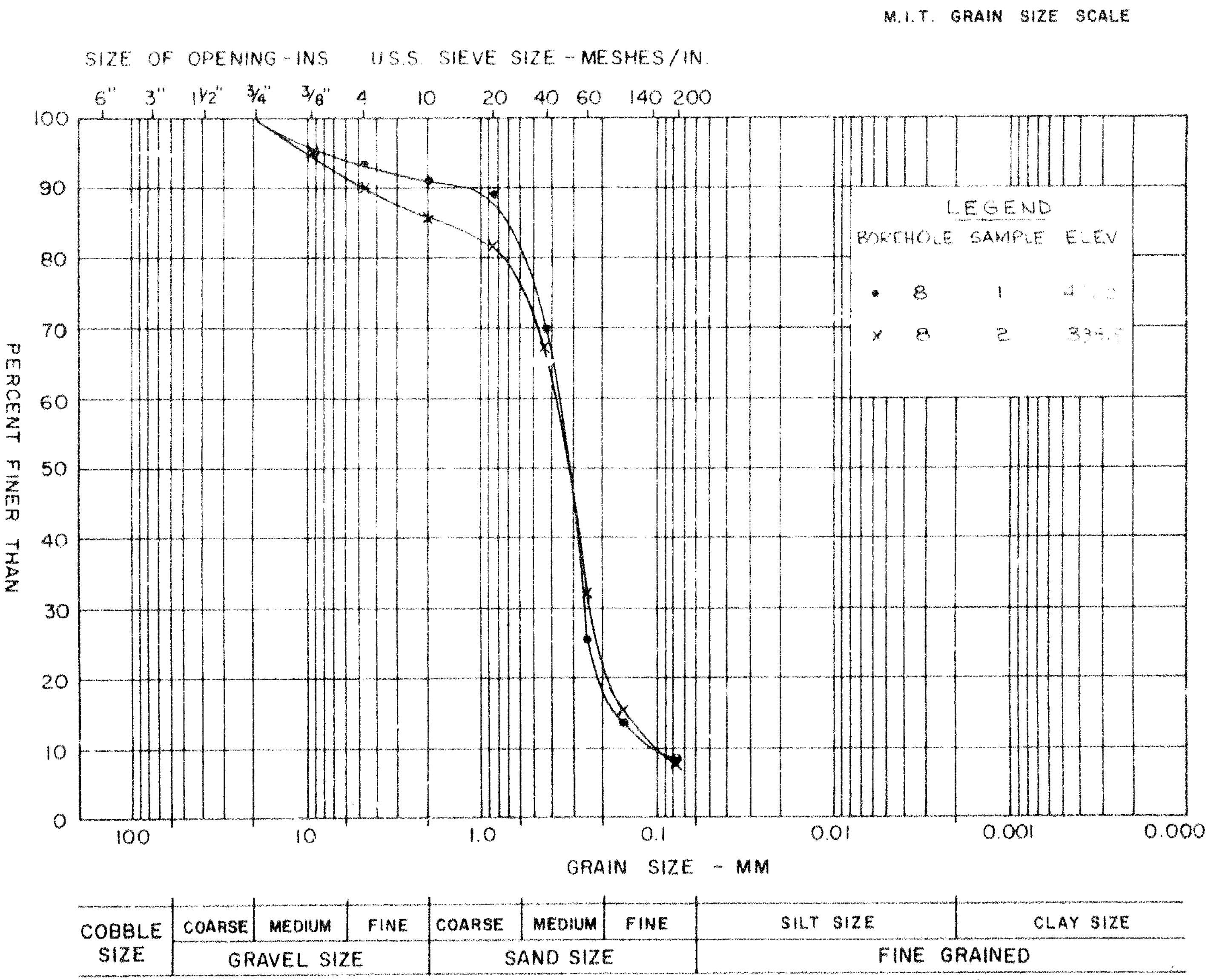
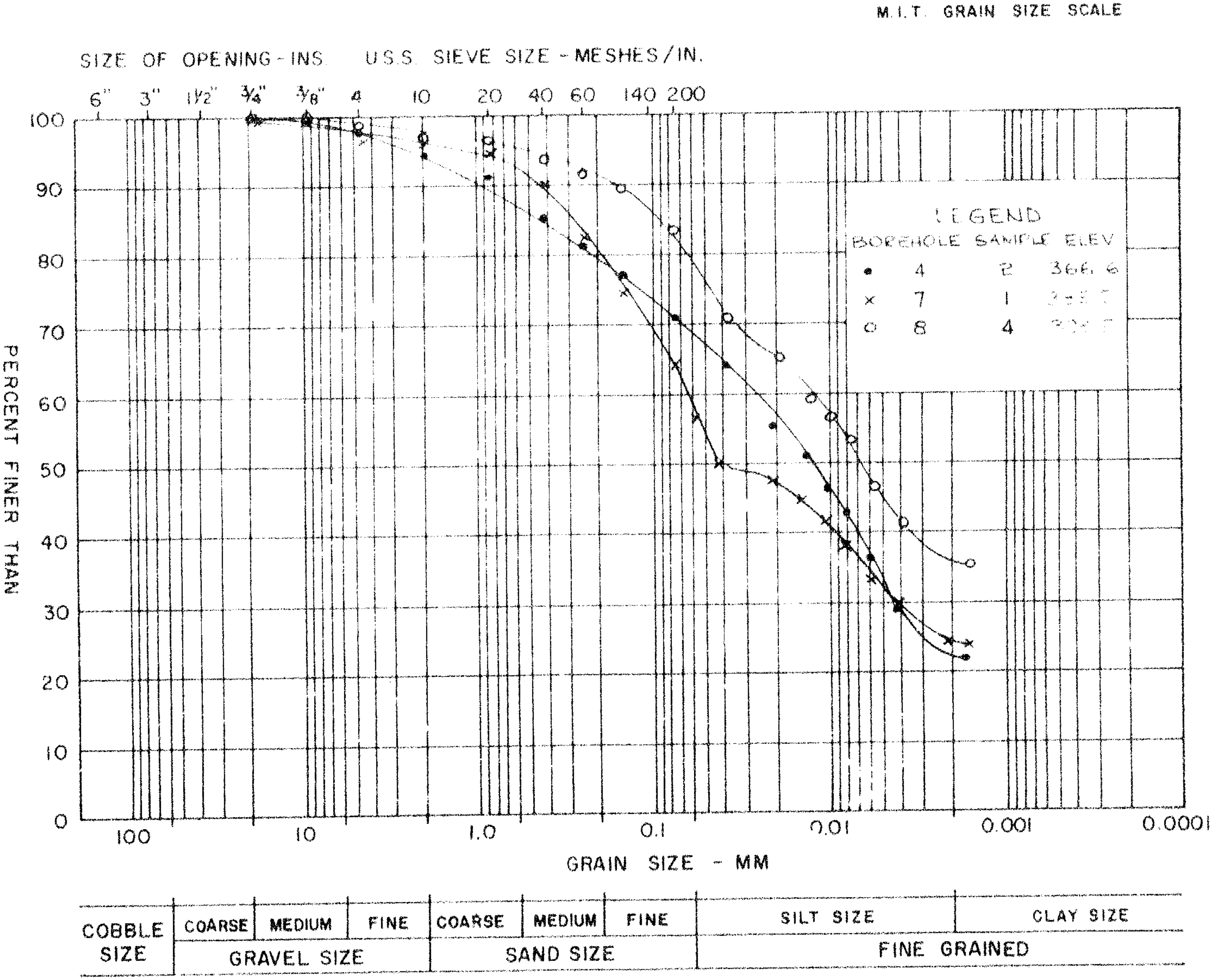


FIGURE 4

PROJECT No.



GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION (CLAYEY SILT TILL)

FIGURE 5