TOTTEN SIMS HUBICKI ASSOCIATES

DRAFT FOUNDATION INVESTIGATION AND DESIGN REPORT

G.W.P. 66-99-00
HIGHWAY 62
CULVERT FAILURE AT STATION 24+320
TOWNSHIP OF TUDOR, ONTARIO

BANCROFT DISTRICT
MINISTRY OF TRANSPORTATION ONTARIO

31C-170

Jacques Whitford

PROJECT NO. ONO11686

DRAFT FOUNDATION INVESTIGATION AND DESIGN REPORT

TO

TOTTEN SIMS HUBICKI ASSOCIATES

ON

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TOWNSHIP OF TUDOR, ONTARIO

BANCROFT DISTRICT
MINISTRY OF TRANSPORTATION ONTARIO

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DRAFT FOUNDATION INVESTIGATION REPORT

For

Culvert Failure at Station 24+320
Township of Tudor, Ontario
G.W.P. 66-99-00
Highway 62
Bancroft District

1.0 INTRODUCTION

This report presents the results of a foundation investigation carried out in the vicinity of a failed culvert located along Highway 62 at Station 24+320, Township of Tudor, approximately 30 km south of Bancroft, Ontario. The purpose of the investigation was to identify the likely cause(s) of the culvert failure and to identify short term and long term remedial measures.

The work was carried out under Agreement No. 4005-A-000310 and in general accordance with our proposal dated October 6, 2004. Authorization to proceed was provided by Ms. Brenda Jamieson, P.Eng., of Totten Sims Hubicki Associates (TSH).

This report contains the factual information obtained from the field and laboratory investigation.

2.0 SITE DESCRIPTION AND GEOLOGY

The project site is located on Highway 62 approximately 30 km south of Bancroft. The centreline of the culvert is located at Station 24+320 Township of Tudor. The culvert connects swampy areas located on both sides of the highway. The site location is shown on the Key Plan portion of Drawing No. 11686-1 in Appendix B.

The project site is within an area identified by Chapman and Putnam as the Algonquin Highlands. The region is characterized by frequent outcrops of bare rock, generally shallow soil, frequent swamps and bogs, and rough relief. The thickness of soil over bedrock can vary greatly over short distances and the valleys are frequently floored with outwash sand and gravel.

The regional drainage pattern is not apparent. The area is relatively flat with swampy areas located on both sides of the highway. The water level in the swamp was above the top of the culvert on both sides and was just 850 mm below the top of pavement at the centreline at the time of the investigation.

Highway 62 has a two lane rural cross-section within the study limits. Soft granular shoulders were observed during a site visit by Jacques Whitford engineering staff. Historical MTO documents indicate that this section of Highway 62 was originally constructed within a swamp by displacement of organic matter with well-graded sand fill. Excessive settlement of the roadway embankment was experienced after the initial construction and an investigation was carried out in 1976. Boreholes drilled as part of that investigation indicated that up to 3 m of organic matter remained beneath the road embankment in the vicinity of the culvert and that the organic thickness in the adjacent swampy area was up to 10 m thick. A surcharge program was then carried out, followed by lowering of the profile grades.

Historical contract drawings indicate that the failed culvert consists of a 72" x 72' CSP (1829 mm x 23.1 m CSP). Due to the submerged conditions at both ends of the culvert, a visual inspection of the condition of the culvert was not possible. It is understood that an attempt by MTO staff to expose the culvert by excavating a test pit in the shoulder of the highway was abandoned when excessive water flow from the fill beneath the roadway was encountered at a depth approximately at the top of the culvert.

3.0 INVESTIGATION PROCEDURES

3.1 Field Program

The field work for this investigation was carried out in November 2004. The subsurface conditions were investigated through a borehole drilling program. A total of five (5) boreholes, numbered 04-1 through 04-5, were advanced at select locations.

Boreholes 04-1 and 04-2 were drilled within the swamp, approximately 3 m beyond the edge of the road embankment. These boreholes were drilled from a raft using portable drilling equipment including casing and a one-third weight hammer for carrying out standard penetration testing (SPT). The SPT N-values shown on the borehole records have been corrected to account for the one-third weight hammer by dividing the number of blows by three. Soil samples were generally retrieved at 0.61 m intervals by a split spoon sampler. Attempts were made to recover undisturbed samples of the peat using Shelby tubes, however, the sample recovery was very poor. Boreholes 04-1 and 04-2 fully penetrated the organic deposit and were terminated within an underlying layer of silt and sand, trace gravel.

What type of Sampler was used? Piston Sampler needed.

Boreholes 04-3 through 04-5 were drilled through the existing road embankment (driving lane and both shoulders) with a truck-mounted CME 55 power auger drill suitably equipped for soil sampling. Hollow stem auger equipment was used to advance the boreholes. Soil samples were generally retrieved at 0.61 m intervals by a split spoon sampler in accordance with the Standard Penetration Test (ASTM D1586). The SPT carried out with the drilling equipment was performed using a standard 64 kg hammer with a 760 mm drop. Undisturbed samples of the peat deposit were collected using Shelby tubes in Borehole 04-4. All three boreholes were terminated upon split spoon refusal (>100 blows/300 mm) or auger refusal on inferred bedrock.

A standpipe was installed in Borehole 04-1. Groundwater levels were recorded in the open boreholes throughout the duration of the investigation. Prior to completing the investigation, the boreholes within the shoulder of the roadway were backfilled with a cement/bentonite mixture. The boreholes within the swamp caved in as the casing was withdrawn.

The subsurface conditions are described in detail in the Borehole Records presented in Appendix A. All soil samples recovered were identified in the field, stored in moisture proof containers and were returned to our laboratory for detailed classification and testing.

Borehole locations were established in the field by Jacques Whitford personnel relative to stations and offsets from the centreline of the road. The ground surface elevations at the borehole locations were referenced to a benchmark located on a rock cut on the left side of Highway 62 at approximately Station 24+583. The benchmark was identified on the contract survey plans as a rock plug (HCP 114) and as having a geodetic elevation of 316.199 m.

A survey of the roadway cross-section at the culvert was carried out by MTO with reference to the pavement elevation at centerline.

3.2 Laboratory Testing

All samples returned to the laboratory were subjected to detailed visual classification by a geotechnical engineer. Selected samples were tested for moisture content, grain size distribution and organic content. Two undisturbed samples of the peat were delivered to the Golder Associates laboratory in Mississauga for consolidation testing. All soil and bedrock samples will be stored for a period of twelve months after issuance of the final report. Unless otherwise directed, the stored samples will be disposed of after this period.

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4.0 RESULTS

The results of the surveys carried out by MTO and Jacques Whitford indicate that the top of the culvert on the east and west sides of the roadway is at approximate El. 310.72 m and 311.39 m respectively. The MTO survey indicates that the 1829 mm diameter culvert has been filled with sediment to El. 310.24 m and 310.43 m at the east and west ends respectively.

The subsurface conditions observed in the boreholes are presented in detail on the Borehole Records provided in Appendix A. An explanation of the symbols and terms used to describe the Borehole Records is also provided. A borehole location plan is shown on Drawing 11686-1 along with a Stratigraphic Plot (Appendix B). A detailed description of the subsurface conditions encountered is given below.

4.1 Sand, some Gravel, trace Silt (Fill)

A thin layer of granular base consisting of sand and gravel, trace to some silt, was observed at the surface in the highway shoulders and directly beneath the asphalt in Borehole 04-5, located within the driving lane. The granular base layer was underlain by a thick deposit of granular fill consisting of sand, some gravel, trace silt. Within the roadway embankment, the thickness of this fill deposit ranged from 2.8 m to 4.9 m. The SPT N-values ranged from 2 to 33, with an average of 12, indicating generally compact conditions.

An 800 mm thick layer of sandy fill was identified between layers of peat in Borehole 04-2. Borehole 04-2 was located approximately 3 m beyond the interface of the water and the embankment slope. The presence of this fill between layers of peat may have been caused by lateral displacement of the sand into the adjacent peat during the initial road construction which was carried out by displacement of the peat with sand fill.

The natural moisture content of eight samples tested ranged from 10% to 18% with an average of 15%. Three limited grain-size distribution analyses carried out on representative samples of the fill indicated that it contained 11% to 17% gravel, 75% to 79% sand, and 8% to 10% silt and clay sized particles.

4.2 Peat

A deposit of peat was encountered in all five boreholes.

In Boreholes 04-1 and 04-2, located beyond the edges of the roadway embankment, the top of the peat was located beneath 1.1 m to 1.2 m of water and the thickness of the peat ranged from 3.0 m to 6.0 m. The peat was dark brown in colour. Near the surface, the peat was very loose and woody. The peat became less woody and more fibrous with increasing depth. The SPT N-values ranged from 1 to 3, after correction for the one-third weight hammer used in these boreholes. The natural moisture content of the eight samples tested ranged from 145% to 965% with an average of 571%. The organic content of four samples ranged from 31% to 78 % with an average of 53%.

In Boreholes 04-3 through 04-5, the peat was located beneath the embankment fill and appeared to be drier and more compact. The thickness of the peat deposit in these three boreholes ranged from 1.4 m to 3.0 m. The peat was dark brown in colour, was woody near the surface and became more fibrous near the base of the deposit. The SPT N-values ranged from 3 to 12, with an average of 6. The natural moisture content of the ten samples tested ranged from 107% to 358% with an average of 283%. The organic content of five samples ranged from 46% to 81 % with an average of 59%.

Consolidation tests were carried out on two samples of the peat collected from Borehole 04-4, located beneath the shoulder of the existing road. Three single increment loading tests were carried out on specimens from sample SH9. The in-situ effective stress at the sample depth was estimated to be approximately 35 kPa. The test loading was therefore carried out at approximately 35 kPa, 45 kPa and 55 kPa, in order to reflect the effective stress range associated with a profile grade raise of up to 1 m. Due to limited sample recovery in sample SH8, only a single test specimen could be tested. This specimen was subjected to an initial load increment of 45 kPa, followed by load increments to 55 kPa and 65 kPa. The coefficient of consolidation from these tests ranged from 0.00115 cm^2/s to 0.0796 cm^2/s. The specific gravity of samples SH8 and SH9 was 1.45 and 1.46, respectively. Copies of the test results are included in Appendix A.

It is noted that no undisturbed peat samples were obtained from the areas beyond the existing highway embankment and the consolidation test results presented above do not necessarily reflect the properties of the peat in this area.

4.3 Silt and Sand, Trace Gravel

A deposit of silt and sand trace gravel was encountered beneath the peat in all five boreholes. Boreholes 04-1 and 04-2 were terminated within the silt and sand, trace gravel deposit. The base of the silt and sand, trace gravel deposit was inferred to have been encountered based on split spoon and/or auger refusal in Boreholes 04-3 through 04-5. The thickness of this deposit, ranged from 0.5 m to 3.9 m at the boreholes locations.

Standard Penetration tests in the silt and sand, trace gravel yielded SPT N-values ranging from 2 to 7 (excluding tests where refusal on inferred bedrock was encountered) indicating very loose to loose conditions.

The natural moisture content of the six samples tested ranged from 10% to 17% with an average of 12%. The results of three grain-size distribution analyses carried out on representative samples of the silt and sand, trace gravel, indicated that it contained 7% to 10% gravel, 45% to 59% sand, and 31% to 48% silt and clay sized particles, see Figure 1, Appendix A.

4.4 Bedrock

Split spoon and/or auger refusal was encountered in Boreholes 04-3 through 04-5. Bedrock coring was beyond the scope of work for this assignment. The inferred bedrock surface elevations are presented in the table below.

Borehole	Bedrock Surface Elevation (m)
04-3	302.6
04-4	305.5
04-5	303.5

It is noted that rock cuts are present along the sides of Highway 62 approximately 425 m to the north and 125 m to the south of the culvert location.

4.5 Groundwater

The water level in the swamp was 311.6 m on both sides of Highway 62 at the time of the drilling investigation. Boreholes 04-1 and 04-2 were drilled in the swamp where water depths were 1.1 m and 1.2 m respectively. The water level in the boreholes drilled within the driving lane and shoulders was approximately equal to the water level in the adjacent swamp.

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

5.0 CLOSURE

A subsurface investigation is a limited sampling of a site. The subsurface conditions provided herein are based on information gathered at specific borehole locations and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions as well as the history of the site reflecting natural, construction and other activities. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

Yours very truly,

JACQUES WHITFORD LIMITED

Paul Carnaffan, M.Eng., P.Eng.

Fred J. Griffiths, Ph.D., P.Eng.
Designated Principal MTO Foundation Contact

6.0 DISCUSSION

6.1 PROPOSED DEVELOPMENT

The failed culvert is located within the contract limits of a section of Highway 62 that is currently undergoing preliminary design for rehabilitation and upgrading to current design standards. Due to the failure of the culvert in September 2004, the Ministry of Transportation (MTO) has identified the need for short-term and long-term remedial measures to address the failed culvert located at Station 24+320.

The existing culvert is an 1829 mm diameter CSP, 23.1 m in length. The survey data indicates that the culvert has 1.7 m of cover on the upstream side (east) and 1.0 m of cover on the downstream side. It is also noted that there is approximately 1.3 m and 0.9 m of sediment in the culvert at the upstream and downstream ends respectively.

The culvert failure occurred in the inside wheelpath of the Southbound lane. MTO maintenance staff indicated that the failure appeared as a sink hole at least 1.2 m deep and approximately 300 mm in diameter. It is understood that the hole was filled with cold-patch asphalt that needed to be topped up several times before stabilizing.

It is noted that as part of the preliminary design work, consideration is being given to raising the profile grade in the area of the culvert in order to help address drainage deficiencies. The potential impact of a grade raise with regards to settlement and stability of the road embankment is being investigated and addressed separately. Other options being considered include replacing the existing culvert with two 1000 mm culverts set 0.5 m higher than the existing culvert invert or three 700 mm culverts set 1.0 m higher than the existing culvert invert.

The location of the culvert is indicated on Drawing No. ONO11686-1 in Appendix B.

Design Objectives:

Design objectives have not been identified for the failed culvert since the current investigation is in response to a failure rather than a planning/design process. Based on discussions with TSH and MTO, it is understood that the short-term objective is to prevent further deterioration of the culvert and highway pavement structure. The long-term objective is to reinstate a culvert at this approximate location that functions as part of the overall drainage design for this section of Highway 62.

Due to the potential presence of fish within the swamp, it is anticipated that no in-water work can be carried out between the normal spawning period of April 1st to May 31st. Other environmental restrictions may also apply to the proposed work.

The site is within an area with a Mean Freezing Index of 1000 Degree Days (°C)(Canadian Foundation Engineering Manual). Using Figure 3.4 of the MTO Pavement Design Rehabilitation Manual, the Frost Penetration Depth for this area is 1.8 m.

6.2 ASSESSMENT OF CULVERT FAILURE

Site History

The original construction documents for Highway 62 in the study area are not available. It is likely that the original embankment was constructed by displacing the organic materials by granular and well graded sand fill. The top of road elevation was approximately 6 feet higher than original ground.

Historical documents provided by MTO (Appendix C) indicated that this section of Highway 62 was reconstructed under contracts 61-044 and 62-081. Re-surfacing occurred in 1972. It is understood that this section of Highway 62 underwent 100 mm to 200 mm of settlement between each maintenance operation from 1972 to 1976 and required patching/filling three times per year.

In 1976 the roadway was investigated and organic materials beneath the roadway were observed in the boreholes. A surcharge program was recommended and subsequently carried out under WP 103-63-04. The area was loaded with 2 feet of Granular C and a temporary base course and asphalt surface. This material was subsequently removed after a period of at least one year and the pavement structure reconstructed to a grade lower than the original.
In 1998, Highway 62 within the study area was rehabilitated. It is understood that the existing asphalt was pulverized and processed into the underlying granulars and that two lifts of hot mix were placed.

The construction date of the culvert is unknown. Survey data dated 8/70 indicates a 72", 72' CSP at the study location. The top of the culvert on the right side (upstream) is indicated to be 1022.9 (converts to 311.78 m). The top of the culvert on the left side (downstream) is indicated to be 1023.0 (converts to 311.81 m). The elevation at centerline is approximately 1026.6 (converts to 312.91 m).

Culvert Failure

It is noted that the culvert is likely over 30 years old and there are no records indicating any increase in load having been applied to the culvert in recent years. In addition, there are no records of any recent road cut activity or boreholes having been drilled at the culvert location in recent years.

The failed culvert section has yet to be exposed to allow for a detailed inspection of the damage. As such, a definitive assessment of the cause of the culvert failure cannot be made. However, based on the information available at this time, it is likely that the probably cause of the failure was differential settlement.

Normal practice would include grading the culvert to facilitate flow. The historical survey data (8/70) indicates a reverse grade of 30 mm over the length of the culvert. The 2004 survey indicates a reverse grade of 670 mm over the length of the culvert. This suggests that the culvert has undergone differential settlement of more than 600 mm. Historical MTO documents also indicate that this section of Highway 62 exhibited severe differential settlements and underwent 100 to 200 mm of settlement between each maintenance operation from 1972 to 1976 and required patching/filling three times per year.

Differential settlement of the roadway surface is not evident in the pavement at present however the 1998 rehabilitation of the area would have masked the settlement. The 2004 survey of the top of the culvert suggests that the east (upstream) end of the culvert had settled in excess of 600 mm more than the west end of the culvert.

The greatest increase in stress due to the roadway embankment and therefore the greatest magnitude of settlement would be expected to occur beneath the centreline of the embankment. The failure occurred within the inside wheelpath, very close to the centreline. It is possible that differential settlement of the embankment resulted in a kink in the culvert and that, with time, corrosion created a hole in the culvert at the kink, resulting in loss of roadway material from above.

6.3 FOUNDATION ASSESSMENT

The critical features of the site soil and water conditions include:

- Water levels above the top of the culvert.
- Loose to compact sand fill extending to beneath the invert of the culvert.
- A peat deposit beneath the sand fill within the road embankment.
- A peat deposit extending from surface to well below the invert elevation in the swampy areas beyond the ends of the culvert and adjacent to the road embankment.
- Soft granular shoulders.

Some of the critical design considerations for the proposed work include the following:

- Traffic Staging: requires one lane of traffic throughout duration of work. The soft shoulders and presence of peat make construction of detours very expensive and may raise environmental concerns. Signalized traffic control and roadway protection will likely be required.
- Construction Dewatering: construction will either need to be carried out in the wet or the site will need to be isolated from the swamp and culvert flow during construction prior to dewatering. Basal heave will need to be considered if shoring and dewatering is to be carried out.
- Settlement: settlement of the culvert will be a significant design issue if a profile grade raise is proposed.

6.4 Foundation Options

6.4.1 Short-Term Remedial Measures

Observations made during the site work and the elevation of the water on each side of the culvert suggest that there is virtually no flow through the culvert, therefore blocking the flow in the short-term is not considered to be a significant problem. Should this assumption be incorrect the culvert will need to be replaced as discussed in the Section on Long-Term Remedial Measures below.

Two options have been considered for short-term remedial measures:

1) Patch and monitor conditions. It is understood that MTO maintenance staff patched the hole above the culvert with a rigid object and cold patch after the failure was first noticed. It is understood that the hole was topped up several times before the fill material stabilized. It is not known whether or not the inside of the culvert is completely blocked or whether flow can still pass through the culvert. In the short term, monitoring and maintaining this patch is appropriate, provided flow through the culvert is not essential.

2) Backfill with concrete. If the current patch fails, or if a depression starts to form around the hole (indicating that roadway granulars are being lost into the damaged culvert), it is recommended that the hole be backfilled with concrete to within 300 mm of the top of pavement. The surface could then be patched with asphalt (cold patch or hot mix patch). Ideally, the concrete would completely fill the hole/break in the culvert in order to prevent further loss of material into the culvert. As such, it is likely that all flow through the culvert would be blocked if it isn't already.

6.4.2 Long-Term Remedial Measures

It is understood that several issues relating to the overall drainage of this portion of Highway 62 are being explored. These options may include raising the profile grade or other measures to lower the water level in the area of the culvert. In either case, it is anticipated that reinstatement of the failed culvert will be required. It is anticipated that a culvert of similar size and in approximately the same location will be required in order to satisfy environmental requirements.

The size of the culvert is such that it is not considered to be a "Structure" by MTO and can therefore be specified using standard design details such as those presented in the OPSD 800 series. It is the construction methodology (staging and dewatering) that will require careful consideration.

The following construction methodologies have been considered assuming that the replacement culvert is an 1800 mm diameter culvert with a design invert elevation of 309.2 and a cover depth of 1.4 m at centreline:

Construction Staging Options

Option	Advantages	Disadvantages	Relative Cost	Risk/Consequences
S1 Close highway during replacement	- minimal environmental effect - ease of culvert construction - culvert installed in single stage	- interruption to traffic	- low	- construction problems delay highway reopening
S2 Two lane detour through swamp on east side. Toe of detour embankment at least 6 m from toe of existing embankment. Place detour embankment on geogrid/filter fabric to allow subsequent removal	- ease of culvert construction - culvert installed in single stage	- length of detour alignment - detour must be constructed well in advance to allow settlement and regrading prior to traffic - temporary environmental effect - potential property issues	- high	- excessive settlement of detour requiring continuous maintenance - detour embankment failure with interruption of work and permanent environmental alteration
S3 Install centerline shoring. One lane of traffic on existing embankment footprint. Construct half of replacement culvert. Flip traffic over and construct second half of culvert	- minimal environmental effect	- some disruption to traffic. - will require temporary shoring as there is insufficient room to achieve safe side slopes and groundwater control - culvert installed in two stages	- medium	- insufficient depth to rock to allow shoring to act as a cantilever - would require rock anchors or bracing

Based on the above assessment it is recommended that Option S3 be selected. Option S2 is considered to be too costly and would result in an extended construction period. Option S1 has numerous advantages however is only feasible if the highway can be closed to traffic during construction which is not likely.

Agreed!

Excavation Options

It is noted that conventional dewatering by sump and pump methods is unlikely to succeed at this site due to the presence of the loose and permeable sand fill.

Option	Advantages	Disadvantages	Relative Cost	Risk/Consequences
E1 Open cut, construction in the wet. Place geotextile on subgrade, place clearstone bedding, install culvert, backfill with clearstone to 300 mm above high water line, cover clearstone with geotextile and reinstate pavement	- minimal dewatering	- very flat side slopes required (5H:1V) - difficult to connect culvert - no subgrade inspection - possible disturbance to swamp area to achieve sideslopes	- high	- instability of sideslopes leading to increased excavation volumes and possible impacts to traffic flow - difficulty of construction
E2 Open cut, well point system for dewatering of sand layer	- allows for subgrade inspection - steeper side slope permitted (1H:1V) - allows use of less expensive backfill	- specialized contractor required for well point system - large volumes of water expected from peat material - possible disturbance to swamp area to achieve side slopes	- low	- removal of water from peat leading to settlement - large volume of water may be generated from peat - removal of water from sand fill leading to settlement of underlying peat
E3 Shore all four sides of excavation, sump and pump dewatering	- minimizes excavation volume - minimal impact to swamp - boxed excavation allows for efficient bracing - allows for subgrade inspection - eliminates possible need for rock anchors for shoring - allows use of less expensive backfill		- moderate	- extraction of sheet piling may loosen backfill leading to minor localized settlements

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Based on the above assessment, Option E3 is recommended. Option E1 is the most expensive option due to the large volumes of materials required to achieve stable side slopes. Option E2 is both feasible and economic however there is a risk that settlement will be induced due to dewatering of the underlying peats. Option E3 presents little risk to the success of the culvert replacement and is of moderate cost.

7.0 RECOMMENDATIONS

7.1 Earth Pressure Design

Geotechnical design parameters for use in determining lateral earth pressures acting on shoring are provided in the table below. The unfactored earth pressure coefficients assume a horizontal backslope condition.

Computation of earth pressures should be in accordance with Section 6.9 of the CHBDC. For structures that are designed to allow rotation, active earth pressure may be used for design. For rigidly tied structures, the at-rest pressure should be used in design for inorganic soils, unless the wall can deflect enough (approximately 0.05% of the wall height) to establish the active pressure. Active earth pressures should be used in design for peat for both rigid and flexible structures.

Lateral earth pressures may be calculated using the following parameters:

Parameters	Native Silt and Sand, trace Gravel	Peat	Existing Embankment Fill
Total Unit Weight (kN/m^3)	20.0	14.3	19.0
Angle of Internal Friction, φ	30°	40°	28°
Coeff. of Active Earth Pressure, K_a	0.33	0.22	0.36
Coeff. of Passive Earth Pressure, K_p	3.00	0.0 (see note 1)	2.77
Coeff. of Earth Pressure at Rest, K_o	0.50	0.0 (see note 1)	0.53

Notes:

1. Very large deformations are required to mobilize K_o and K_p in peat materials. Driving forces in peat should be developed using K_a. Resisting forces from peat should be ignored.

7.2 Tie-Back Anchors

Tie-back anchors may be required to support shoring systems. A detailed investigation of the bedrock was not carried out as part of this investigation. Previous investigation presented in the historical documents (Appendix C) indicate the site is underlain by granite bedrock. Conservative design parameters for pre-stressed grouted rock anchors are provided below:

- A factored geotechnical resistance at ULS of 500 kPa for the bond between rock and grout assuming a non-shrink grout having a minimum compressive strength of 30 MPa. A resistance factor of 0.4 has been applied to generate this value.
- Minimal deformation of the rock and grout is anticipated. Thus the SLS value should be determined based on elastic deformation of the tendon. It is anticipated that there will be minimal movement if the anchors are prestressed, thus SLS will not likely apply.
- The minimum fixed anchor length should be no less than 3 m.
- The minimum anchor spacing should be 900 mm centre to centre.
- To ensure against the possibility of rock mass failure, the following design parameters should be used:
  - submerged unit weight for bedrock of 14 kN/m^3
  - a 60 degree apex angle failure cone in the bedrock with the apex located at the midpoint of the bonded length. Resistance from overburden should be calculated based on a truncated cone with a 20° angle from vertical. The interaction between cones must be included in the overall stability analysis.
- where cementitious grouts are used, the tendon area should not exceed 20% of the borehole area.

Construction of rock anchors should be carried out in accordance with OPSS 942.

7.3 Embankment Design

No signs of instability in the existing roadway embankment slopes were observed at the time of the field investigation work. At this time, it is anticipated that no new embankments will be constructed and that the proposed culvert replacement will include reinstatement of the existing embankment geometry. Therefore a detailed slope stability analysis was not carried out. No additional loading beyond current loads is anticipated at this site thus settlement will be limited to internal settlement of the fill (less than 10 mm) and secondary compression of the peat.

Based on the results of the consolidation testing carried out for this project, it is estimated that the coefficient of secondary compression is approximately 0.025. Given that the last load application was the surcharge which was removed in 1977, significant secondary compression has already occurred. It is estimated that secondary compression over the next 20 years will be between 35 mm and 50 mm provided the profile grade is not raised. Differential settlement will occur with the west end of the culvert settling very little, while the central and eastern portions are expected to settle the full 35 mm to 50 mm. Consideration should be given to constructing the culvert with a camber of 50 mm to allow for the differential settlement to occur without impacting culvert performance.

The option of raising the grades as part of the overall pavement rehabilitation and drainage design is being considered. The implications of this proposed change on the stability of the embankments will be addressed in a separate report. This report pertains strictly to embankment work required as part of the culvert replacement.

Reinstatement of the embankment above the new culvert structure should be constructed in accordance with OPSS 206 and 501.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Supported Excavations – Shoring

Shoring will be required to support the traffic lanes during excavation and construction of the adjacent stage of the new culvert structure. In order to minimize water movement into the work area, it is recommended that shoring consist of steel sheet piles driven to bedrock. Due to the presence of peat beneath the roadway embankment, it is anticipated that the shoring will need to be braced in order to achieve adequate lateral resistance.

Full penetration of the sheet piles down to bedrock will also provide resistance against base heave within dewatered work areas.

The lateral earth pressures provided in Section 7.1 may be used for the design of the shoring system. The surcharge load imposed by traffic should also be considered in the design.

8.2 Dewatering

Potential flow through the culvert will need to be blocked or diverted and dewatering of the work area will be required. It is anticipated that shoring will consist of sheetpiling and that dewatering will be carried out using sump pumps/pits within the work area. The volume of water inflow will be highly dependent on the rate of leakage through the sheet pile walls and the integrity of the seal between the bottom of the sheetpiles and the underlying bedrock.

It is anticipated that lowering of the water level to at least 600 mm below the bottom of the bedding material will be required in order to achieve adequate compaction of the new bedding material.

8.3 Erosion Control

Slope protection and drainage measures will be required to ensure the long-term stability of the embankment slopes near the ends of the culvert. Normal slope vegetation should be established as soon as possible after completion of the embankment in order to control surface erosion. Alternatively, protection in the form of rip-rap or gabion baskets should be provided.

The contractor should provide silt fences and erosion control blankets, as required, throughout the duration of the construction to prevent silt/sediment from running off the site.

8.4 Frost Treatments

Frost treatments in accordance with OPSD 803.030 or 803.031 will be required during the installation and backfilling of the new culvert(s). A frost depth of 1.8 m is suitable for this site.

8.5 Cement Type and Corrosion Potential

One soil sample collected during the investigation was submitted to Paracel Laboratories Limited in Ottawa, Ontario, for analysis of resistivity, pH, soluble sulphate and soluble chloride. The test results are summarized in the table below.

Borehole	Sample	Depth	Soluble Sulphate (µg/g)	Resistivity (Ohm-m)	pH	Soluble Chloride (µg/g)
04-3	SS3	2.1 m	30	14	8.85	420

The concentration of soluble sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the site. Soluble sulphate concentrations less than 1000 µg/g generally indicate that a low degree of sulphate attack is expected for concrete in contact with soil and groundwater. Type 10 Portland Cement should therefore be suitable for use in concrete at this site.

The pH, resistivity and chloride concentration provide an indication of the degree of corrosiveness of the sub-surface environment. The test results are provided in the above table for use in the selection of coatings for buried steel objects such as CSP culverts.

9.0 CLOSURE

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review our recommendations when the drawings and specifications are complete.

A foundation investigation is a limited sampling of a site. The conclusions given herein are based on information gathered at the specific borehole locations and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil and groundwater conditions, as well as the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information and its effects on the above recommendations.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

Yours very truly,

JACQUES WHITFORD LIMITED

Paul Carnaffan, M.Eng., P.Eng.

Fred J. Griffiths, Ph.D., P.Eng.
Designated Principal MTO Foundation Contact

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Jacques Whitford

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil	-	mixture of soil and humus capable of supporting good vegetative growth
Peat	-	fibrous aggregate of visible and invisible fragments of decayed organic matter
Till	-	unstratified glacial deposit which may range from clay to boulders
Fill	-	any materials below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	-	having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure
Varved	-	composed of regular alternating layers of silt and clay
Stratified	-	composed of alternating successions of different soil types, e.g. silt and sand
Layer	-	>75 mm
Seam	-	2 mm to 75 mm
Parting	-	< 2 mm
Well Graded	-	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Uniformly Graded	-	predominantly of one grain size

Terminology describing soils on the basis of grain size and plasticity is based on the Unified Soil Classification System (USCS) (ASTM D-2488). The classification excludes particles larger than 76 mm (3 inches). This system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%

The standard terminology to describe cohesionless soils includes the compactness (formerly "relative density"), as determined by laboratory test or by the Standard Penetration Test 'N' - value.

Relative Density	'N' Value	Compactness %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests, or occasionally by standard penetration tests.

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Consistency	Undrained Shear Strength		'N' Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25-0.5	12.5-25	2-4
Firm	0.5-1.0	25-50	4-8
Stiff	1.0-2.0	50-100	8-15
Very Stiff	2.0-4.0	100-200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Rock Quality Designation (RQD)

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from in situ fractures.

RQD	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

Terminology describing rock mass:

Spacing (mm)	Bedding, Laminations, Bands	Discontinuities
2000-6000	*Very Thick*	*Very Wide*
600-2000	*Thick*	*Wide*
200-600	*Medium*	*Moderate*
60-200	*Thin*	*Close*
20-60	*Very Thin*	*Very Close*
<20	*Laminated*	*Extremely Close*
<6	*Thinly Laminated*	

Strength Classification	Uniaxial Compressive Strength (MPa)
Very Low	1-25
Low	25-50
Medium	50-100
High	100-200
Very High	>200

Terminology describing weathering:

Slight - Weathering limited to the surface of major discontinuities. Typically iron stained.

Moderate - Weathering extends throughout rock mass. Rock is not friable.

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High - Weathering extends throughout rock mass. Rock is friable.

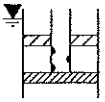
STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:

Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

WATER LEVEL MEASUREMENT

Borehole or Standpipe



Piezometer

SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond drilling bits.

N - VALUE

Numbers in this column are the results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and 'N' values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75).

OTHER TESTS

S	Sieve analysis
G_s	Specific gravity of soil particles
k	Permeability (cm/sec)
	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer
H	Hydrometer analysis
?	Unit weight
C	Consolidation
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct shear
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$; the index corrected to a reference diameter of 50 mm)

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RECORD OF BOREHOLE No 04-1 1 OF 1 METRIC

W.P. 66-99-00 LOCATION Hwy 62, 24+320, 12.3 m Lt C/L ORIGINATED BY DF

DIST 10 HWY 62 BOREHOLE TYPE Portable equipment; split spoons, casing COMPILED BY PC

DATUM Geodetic DATE 08.11.04 - 08.11.04 CHECKED BY FG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
310.6	water										
0.0	Peat, some silt, woody, dark brown		1	SS	1		310				
			2	SS	1						
			3	SS	1		309		438		
			4	SS	2				695		
307.5			5	SS	2		308		516		
3.0	Silt and sand, trace gravel, grey, compact		6	SS	10		307				
306.2			7	SS	13						10 59 (31)
4.4	End of Borehole Borehole located in swamp. Water level 1.1 m above surface.										

MTO 11686 HWY 62 CULVERT.GPJ ON_MOT.GDT 09/12/04

$^{3}_{\times}{}^{3}$ Numbers refer to Sensitivity 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 04-2 1 OF 1 METRIC

W.P. 66-99-00 LOCATION Hwy 62, 24+320, 11.0 m Rt C/L ORIGINATED BY DF

DIST 10 HWY 62 BOREHOLE TYPE Portable equipment; split spoons, casing COMPILED BY PC

DATUM Geodetic DATE 09.11.04 - 08.11.04 CHECKED BY FG.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL × FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.4	water										
0.0	Peat, some silt, dark brown to black		1	SS	1		310				
			2	SS	1						
308.9							309			52.8	
1.5	Sand, some silt, trace gravel, brown (FILL)		3	SS	3						
			4	SS	5					242.6	
308.1							308				
2.3	Peat, some silt, woody, dark brown		5	SS	1						
			6	SS	2					584	
			7	SS	3		307			689	
							306				
			8	SS	2					965	
			9	SS	7		305			438	
304.4											
6.0	Silt and sand, trace gravel, grey, loose		10	SS	7		304				
303.7											
6.7	End of Borehole Borehole located in swamp. Water level 1.2 m above surface.										

3 × 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 04-3 1 OF 1 METRIC

W.P. 66-99-00 LOCATION Hwy 62, 24+318, 5.3 m Rt C/L ORIGINATED BY DF

DIST 10 HWY 62 BOREHOLE TYPE HS Augers, split spoons COMPILED BY PC

DATUM Geodetic DATE 10.11.04 - 10.11.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL × FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
312.0											
311.8 / 0.2	Sand, with gravel, trace silt, brown (FILL)										
	Sand, some gravel, trace silt, brown (FILL)		1	SS	14	▼	311				
310.8 / 1.2	Sand, some gravel, some silt, occasional cobbles, brown (FILL)		2	SS	8						
			3	SS	2		310		○		
			4	SS	6						
			5	SS	33		309		○		
307.9			6	SS	9		308			35	
4.1	Peat, some silt, woody, dark brown		7	SS	5					356	
306.5			8	SS	5		307			145	
5.5	Silt and sand, trace gravel, grey, very loose to loose		9	SS	3		306				
			10	SS	5						
			11	SS	5		305				
			12	SS	2				○		8 52 (40)
			13	SS	4		304				
			14	SS	7				○		
302.6			15	SS	100/250mm		303				
9.4	End of Borehole Split Spoon Refusal on Inferred Bedrock Standpipe Installed										

3 × 3. Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 04-4 1 OF 1 METRIC

W.P. 66-99-00 LOCATION Hwy 62, 24+318, 6.3 m Lt C/L ORIGINATED BY DF

DIST 10 HWY 62 BOREHOLE TYPE HS Augers, split spoons, shelby tubes COMPILED BY PC

DATUM Geodetic DATE 10.11.04 - 10.11.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL × FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
312.0											
0.0 / 311.8	Sand and gravel, trace silt, brown (FILL)										
0.3	Sand some gravel, trace silt, occasional cobbles, brown (FILL)		1	SS	6		311				
			2	SS	4						
			3	SS	10		310		○		
			4	SS	100/75mm						
309.0							309				
3.1	Peat, some silt, woody, dark brown		5	SS	3					269	
			6	SH			308			194.8	
			7	SH						358.1	
			8	SH			307				
			9	SH							
305.9							306				
6.1 / 305.5	Silt and sand, trace gravel, grey		10	SH							
6.6	End of Borehole										
	Auger Refusal on Inferred Bedrock										

MTO 11686 HWY 62 CULVERT.GPJ ON_MOT.GDT 09/12/04

$_{+3}$ $_{\times 3}$ Numbers refer to Sensitivity 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 04-5

1 OF 1

METRIC

W.P. 66-99-00 LOCATION Hwy 62, 24+318, 1.6 m Lt C/L ORIGINATED BY DF

DIST 10 HWY 62 BOREHOLE TYPE HS Augers, split spoons COMPILED BY PC

DATUM Geodetic DATE 12.11.04 - 12.11.04 CHECKED BY FG

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL × FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
312.4											
312.0	Asphalt										
311.8	Sand, with gravel, trace silt, brown (FILL)										
312.0 / 0.4	Sand, some gravel, trace silt, brown (FILL)		1	SS	9		312				17 75 (9)
			2	SS	13		311				
			3	SS	13						16 76 (8)
			4	SS	19		310				
							309				
			5	SS	18						11 79 (10)
			6	SS	21		308				
307.1			7	SS	12						
5.3	Peat, some silt, woody, dark brown		8	SS	12		307			196	
			9	SS	8		306			235	
			10	SS	6					350	
			11	SS	5		305			265	
304.6											
7.8	Silt and sand, trace gravel, grey, loose		12	SS	3		304				7 45 (48)
303.5			13	SS	100/150mm						
8.9	End of Borehole										
	Split Spoon Refusal on Inferred Bedrock										

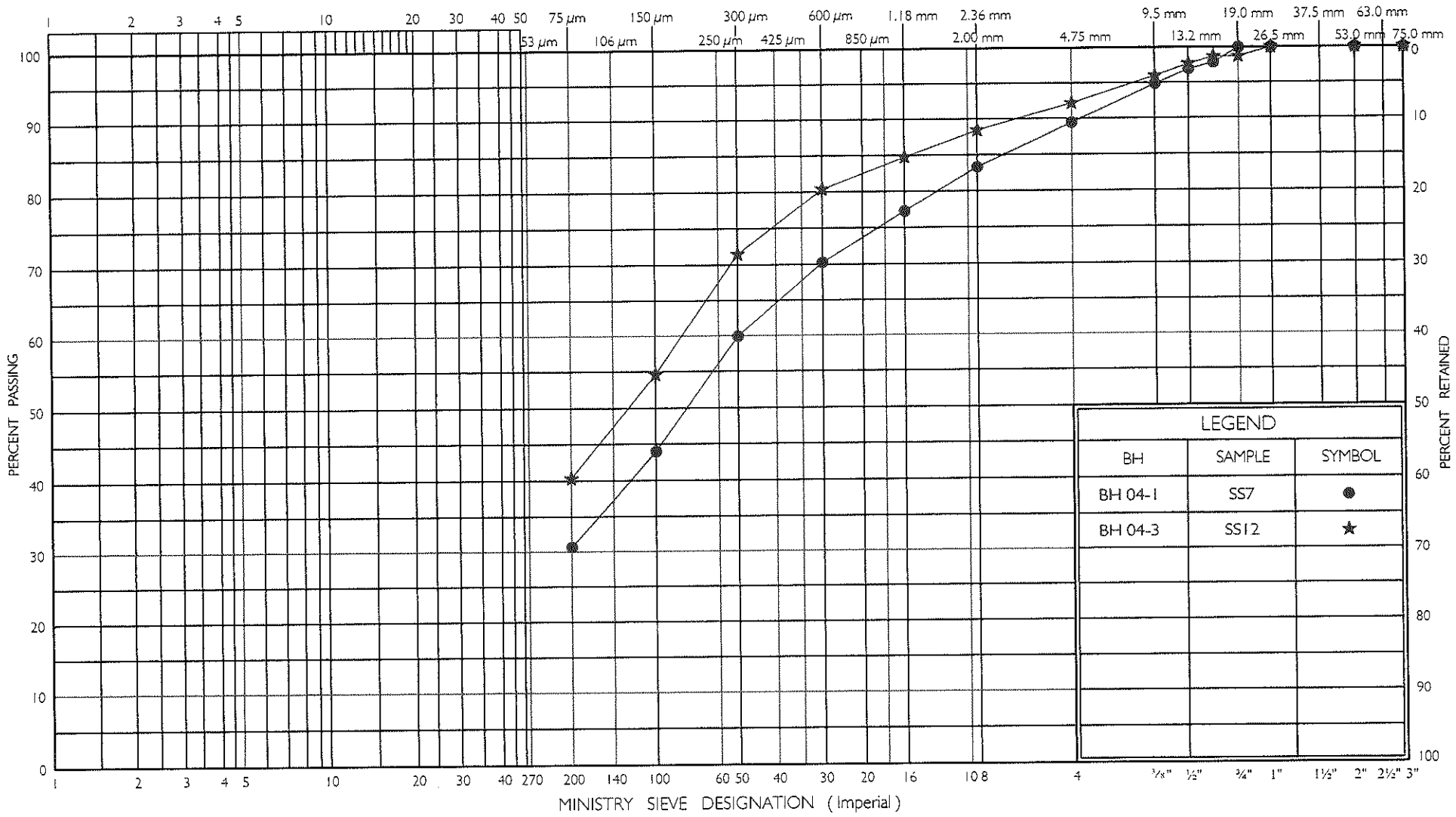
3 , × 3 : Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

FILENAME: 11686-F1.DWG

MTO-GSD NOV. 16, 2004

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SILT AND SAND, TRACE GRAVEL

FIG No 1

W P 66-99-00

7JM

Golder Associates Ltd.

2390 Argentia Road
Mississauga, Ontario, Canada L5N 5Z7
Telephone (905) 567-4444
Fax (905) 567-6561

December 10, 2004

04-1116-120

Jacques Whitford and Assocaites Ltd.
2781 Lancaster Road
Suite 200
Ottawa, Ontario
K1B 1A7

DEC 13 2004

Attention: Mr. Paul Carnaffan

RE: GEOTECHNICAL LABORATORY TESTING

Dear Sirs:

This letter reports the results of laboratory testing carried out on the samples received at our office in Mississauga. The results of the tests are summarized in the following figures.

We trust that the results are sufficient for your current requirements. If you have any questions, please do not hesitate to call us.

Yours very truly,

GOLDER ASSOCIATES LTD.

Marijana Manojlovic
Laboratory Manager

MM/JPD/lg

SPECIFIC GRAVITY TEST RESULTS

ASTM D 854-98 TEST METHOD A

PROJECT NUMBER	04-1116-120
PROJECT NAME	Jacques Whitford / Lab Testing / ONO11686
DATE TESTED	December, 2004

Borehole No.	Sample No.	Measured Specific Gravity
04-4	SH9	1.46
04-4	SH8	1.45

Note: Test carried out on soil particles <4.75mm using kerosene.

OEDOMETER CONSOLIDATION SUMMARY

SAMPLE IDENTIFICATION

Project Number	04-1116-120	Sample Number	SH9
Borehole Number	04-4	Sample Depth, m	5.5-6.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	11/29/2004		
Date Completed	11/30/2004		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m^3	10.10
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	1.77
Area, cm^2	31.67	Specific Gravity, assumed	1.46
Volume, cm^3	60.17	Solids Height, cm	0.235
Water Content, %	470.12	Volume of Solids, cm^3	7.45
Wet Mass, g	61.97	Volume of Voids, cm^3	52.73
Dry Mass, g	10.87	Degree of Saturation, %	96.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	1.900	7.082	1.900				
4.75	1.896	7.065	1.898	12	6.36E-02	4.43E-04	2.76E-06
9.54	1.890	7.039	1.893	16	4.75E-02	6.59E-04	3.07E-06
19.25	1.857	6.899	1.874	174	4.28E-03	1.79E-03	5.93E-07
35.02	1.769	6.525	1.813	416	1.68E-03	2.94E-03	4.82E-07

Notes:
k calculated using cv based on t_{90} values.
sample taken 20cm from the bottom of the shelby tube

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.77	Unit Weight, kN/m^3	10.97
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	1.90
Area, cm^2	31.67	Specific Gravity, assumed	1.46
Volume, cm^3	56.02	Solids Height, cm	0.235
Water Content, %	476.65	Volume of Solids, cm^3	7.45
Wet Mass, g	62.68	Volume of Voids, cm^3	48.58
Dry Mass, g	10.87		

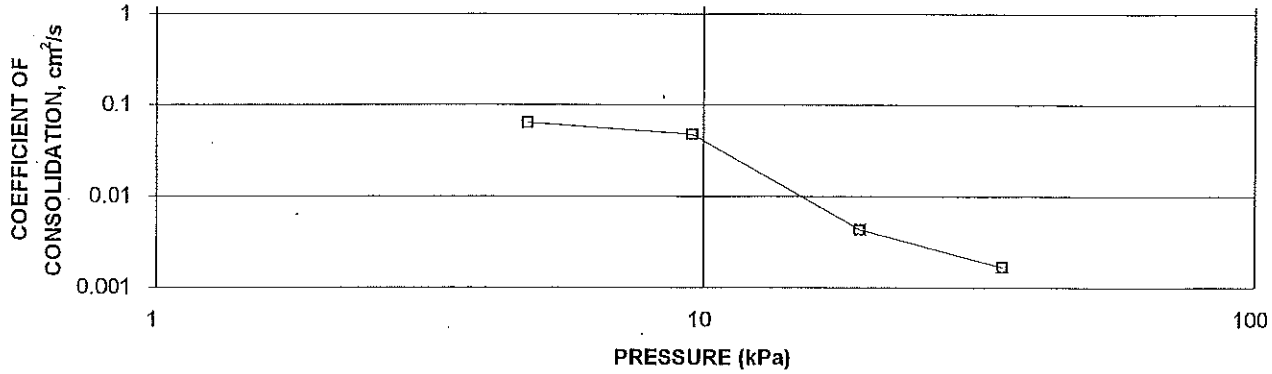
Prepared By: LFG

Golder Associates

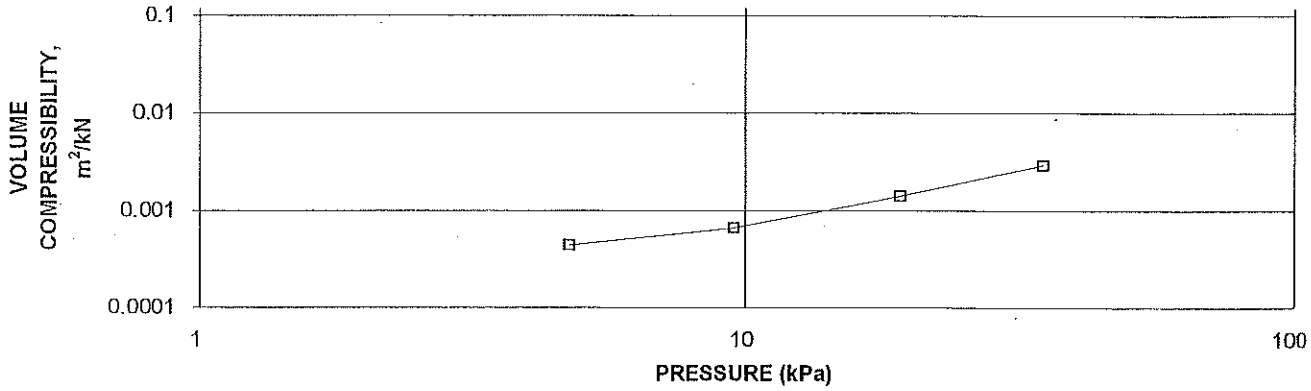
Checked By: MM

OEDOMETER CONSOLIDATION SUMMARY

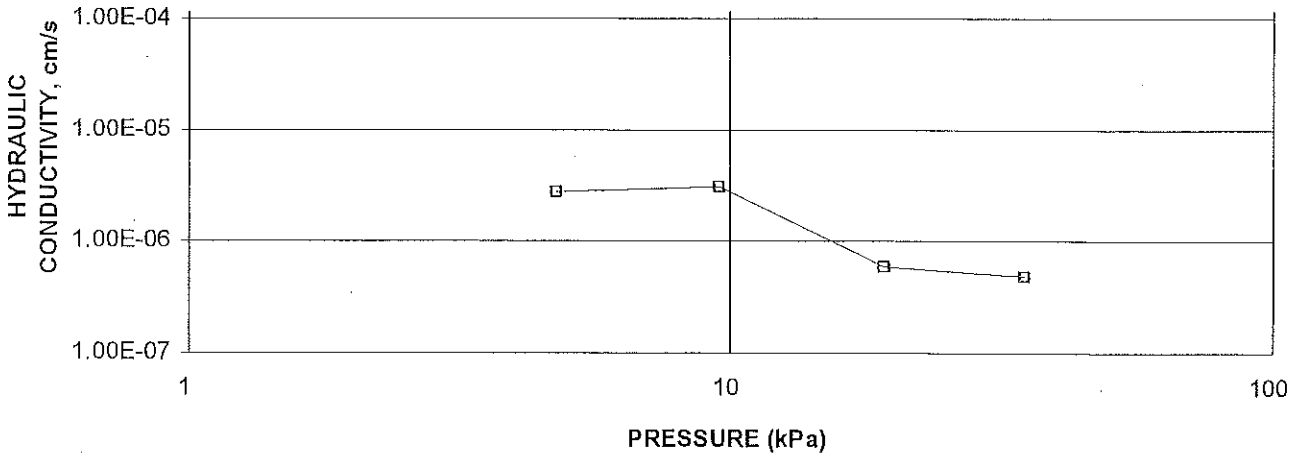
CONSOLIDATION TEST
CV cm^2/s VS PRESSURE (kPa)
BH 04-4 SH 9



CONSOLIDATION TEST
MV m^2/kN vs PRESSURE (kPa)
BH 04-4 SH 9



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs PRESSURE
BH 04-4 SH 9

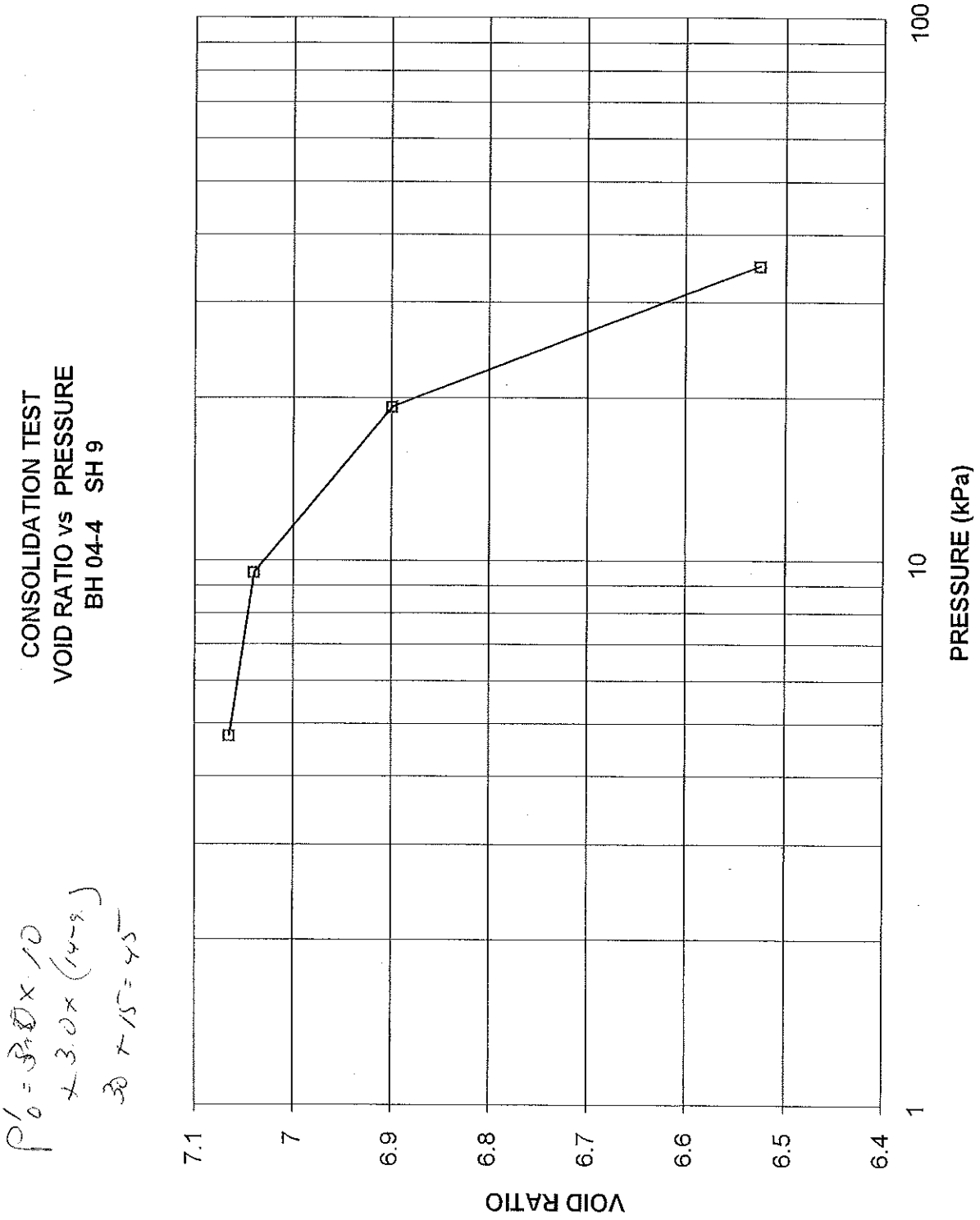


Project No. 04-1116-120
Prepared By: LFG

Golder Associates

Checkey By: MM

CONSOLIDATION TEST VOID RATIO VS. LOG PRESSURE	FIGURE



$P_o' = 32.0 \times 10 + 3.0 \times (14-8)$
$32 + 15 = 47$

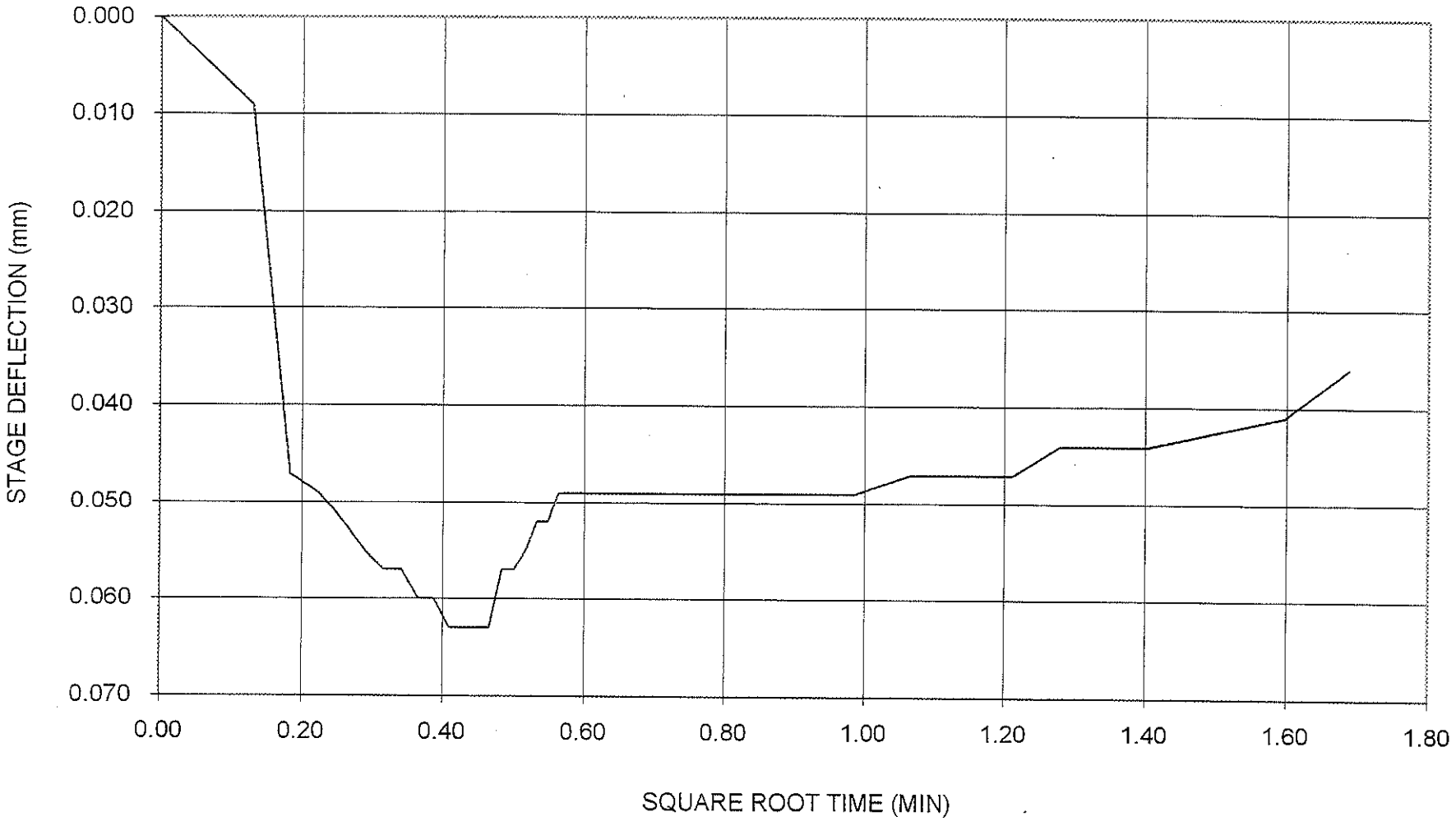
Project No. 04-1116-120
Prepared By: LFG

Golder Associates

Checked By: MM

BOREHOLE 04-4 SAMPLE NUMBER SH9

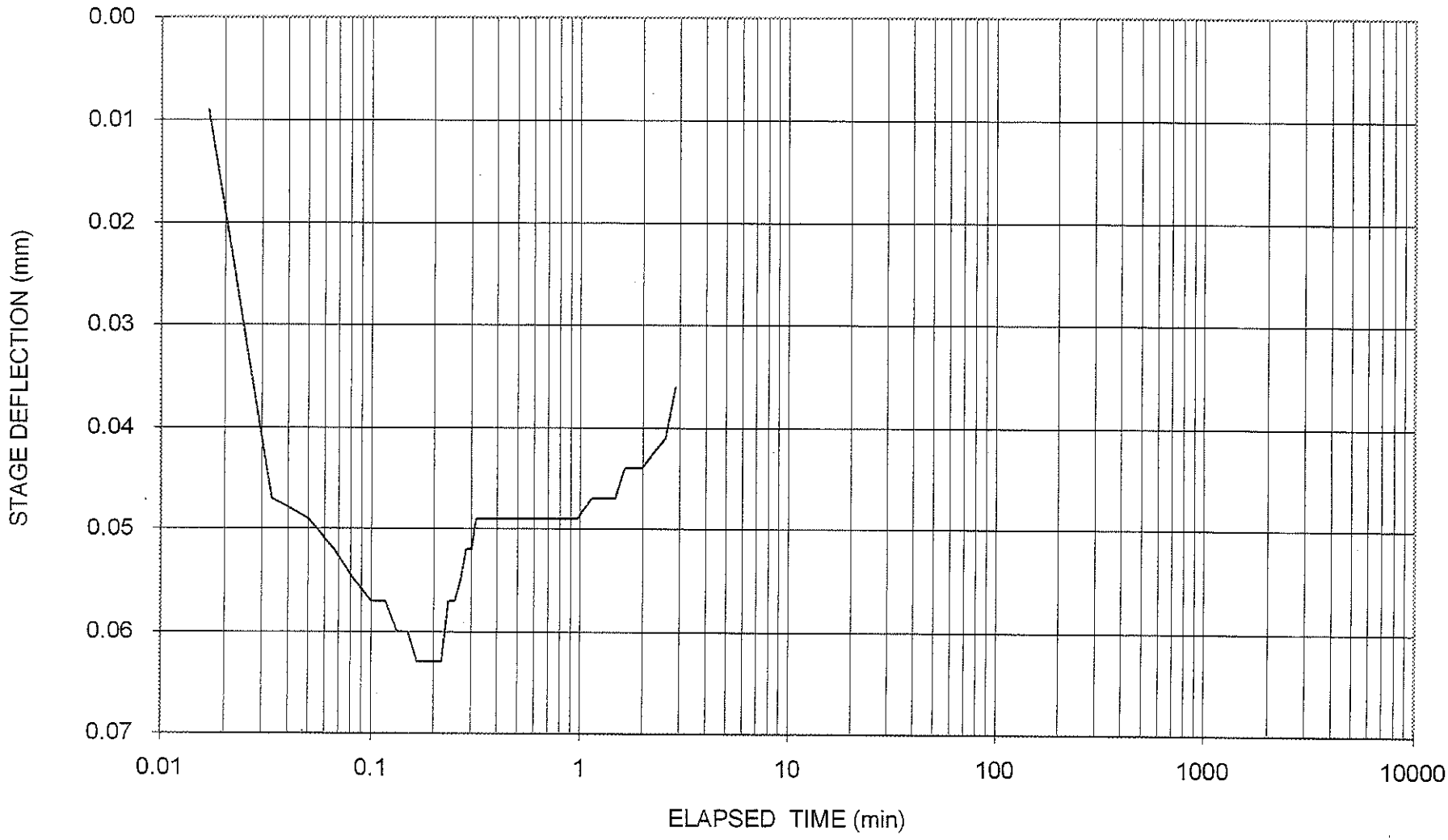
APPLIED PRESSURE = 4.75 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH9

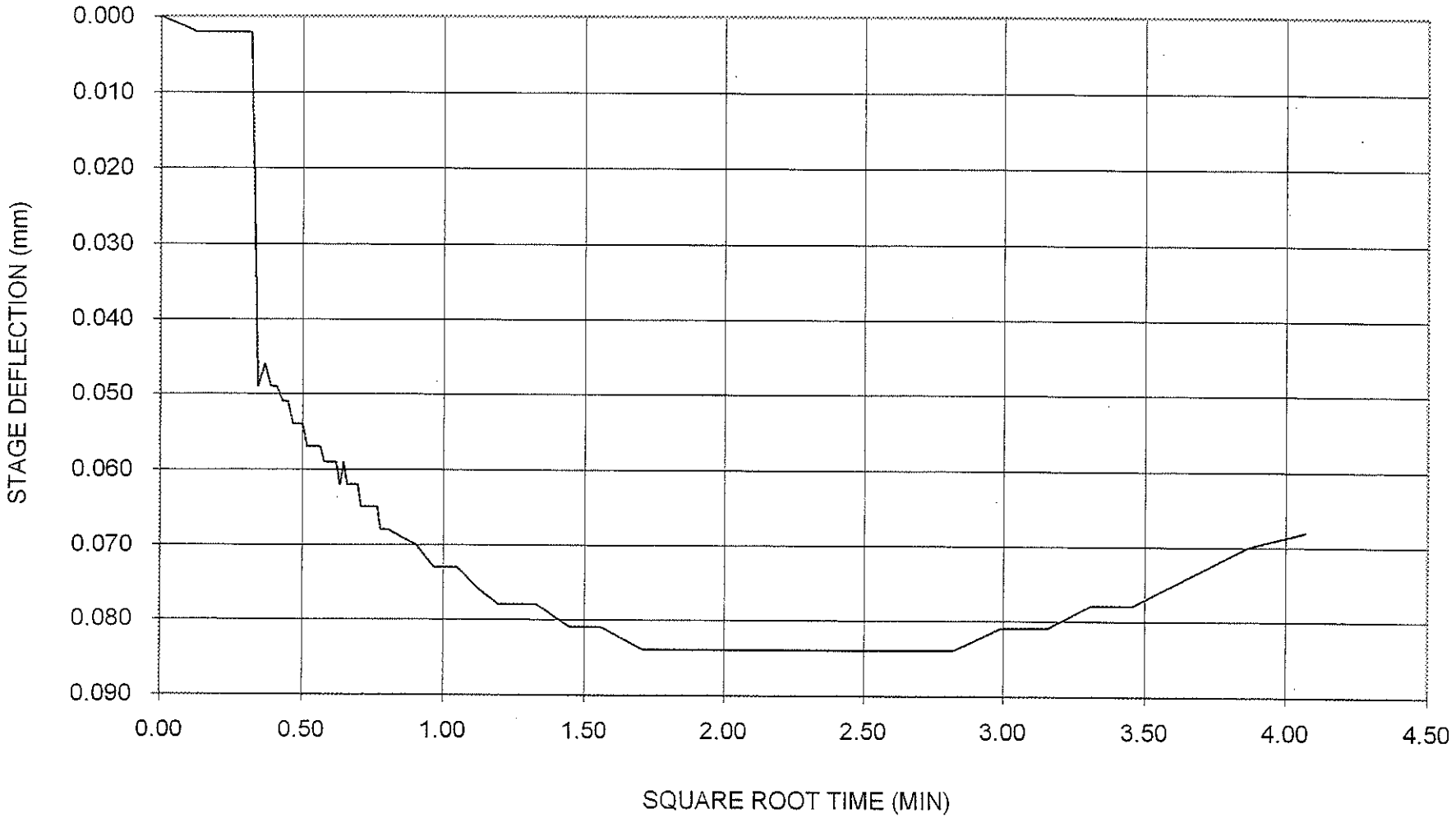
APPLIED PRESSURE = 4.75 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH9

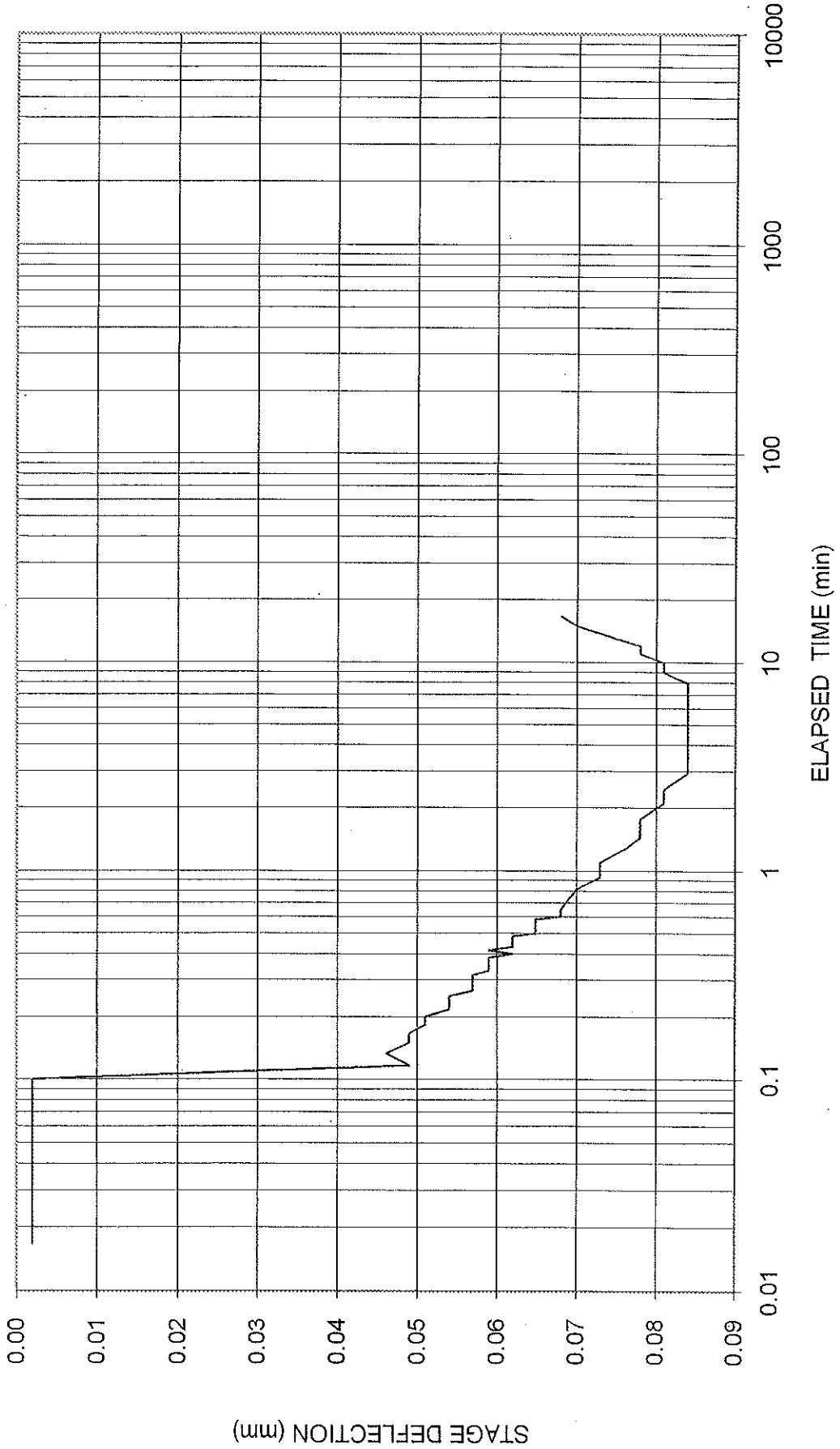
APPLIED PRESSURE = 9.54 kPa



Golder Associates

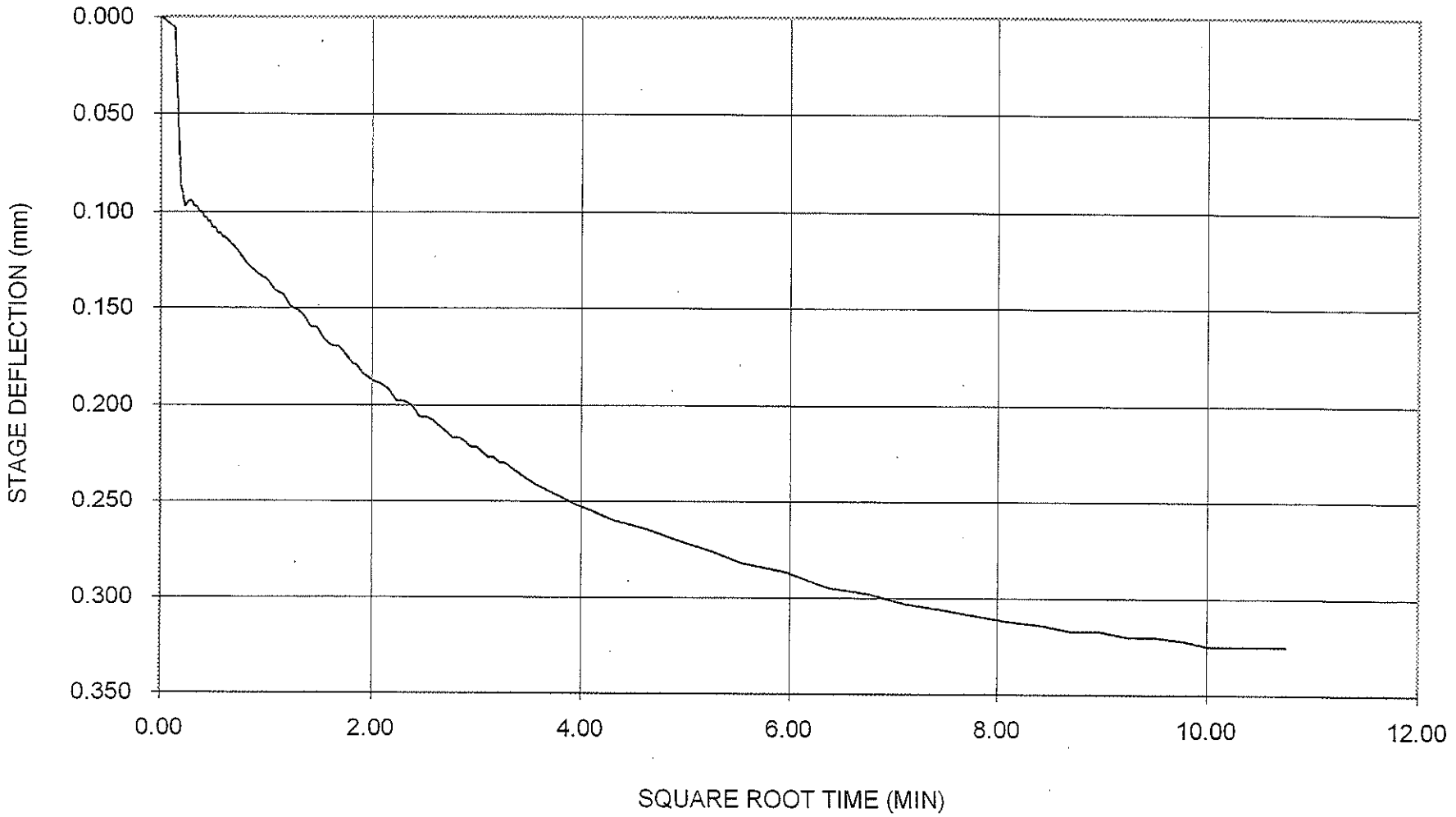
BOREHOLE 04-4 SAMPLE NUMBER SH9

APPLIED PRESSURE = 9.54 kPa



BOREHOLE 04-4 SAMPLE NUMBER SH9

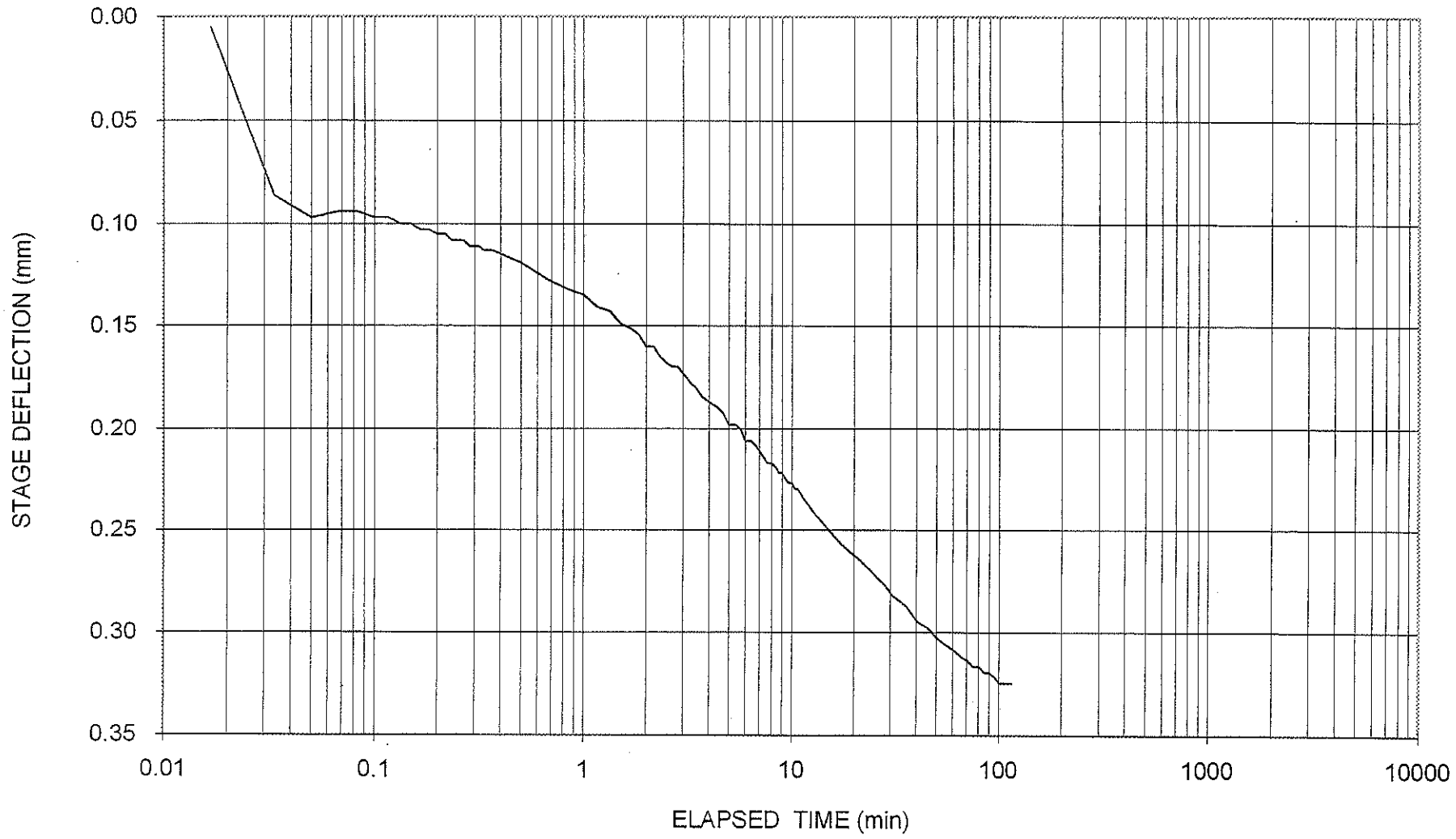
APPLIED PRESSURE = 19.25 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH9

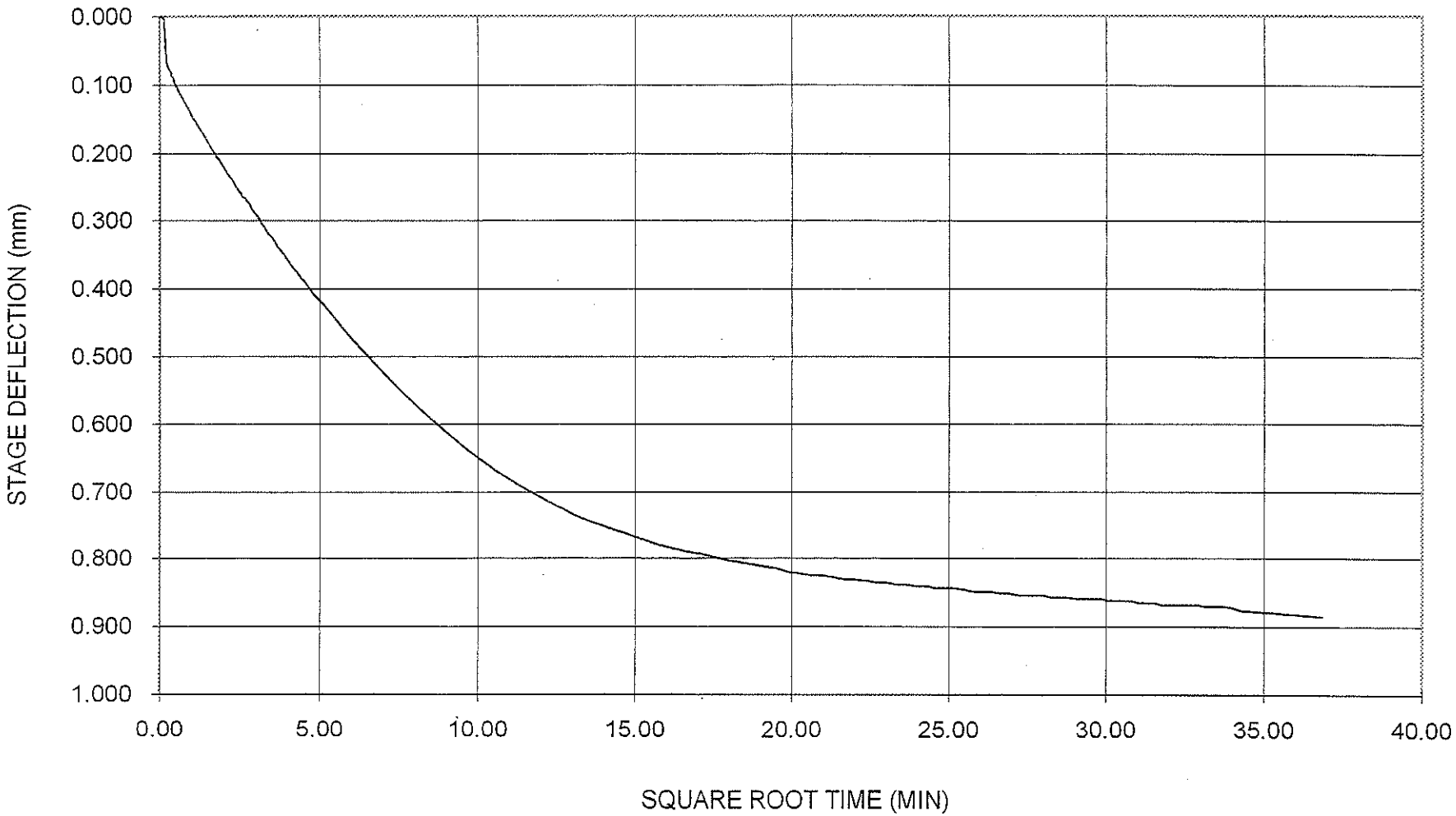
APPLIED PRESSURE = 19.25 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH9

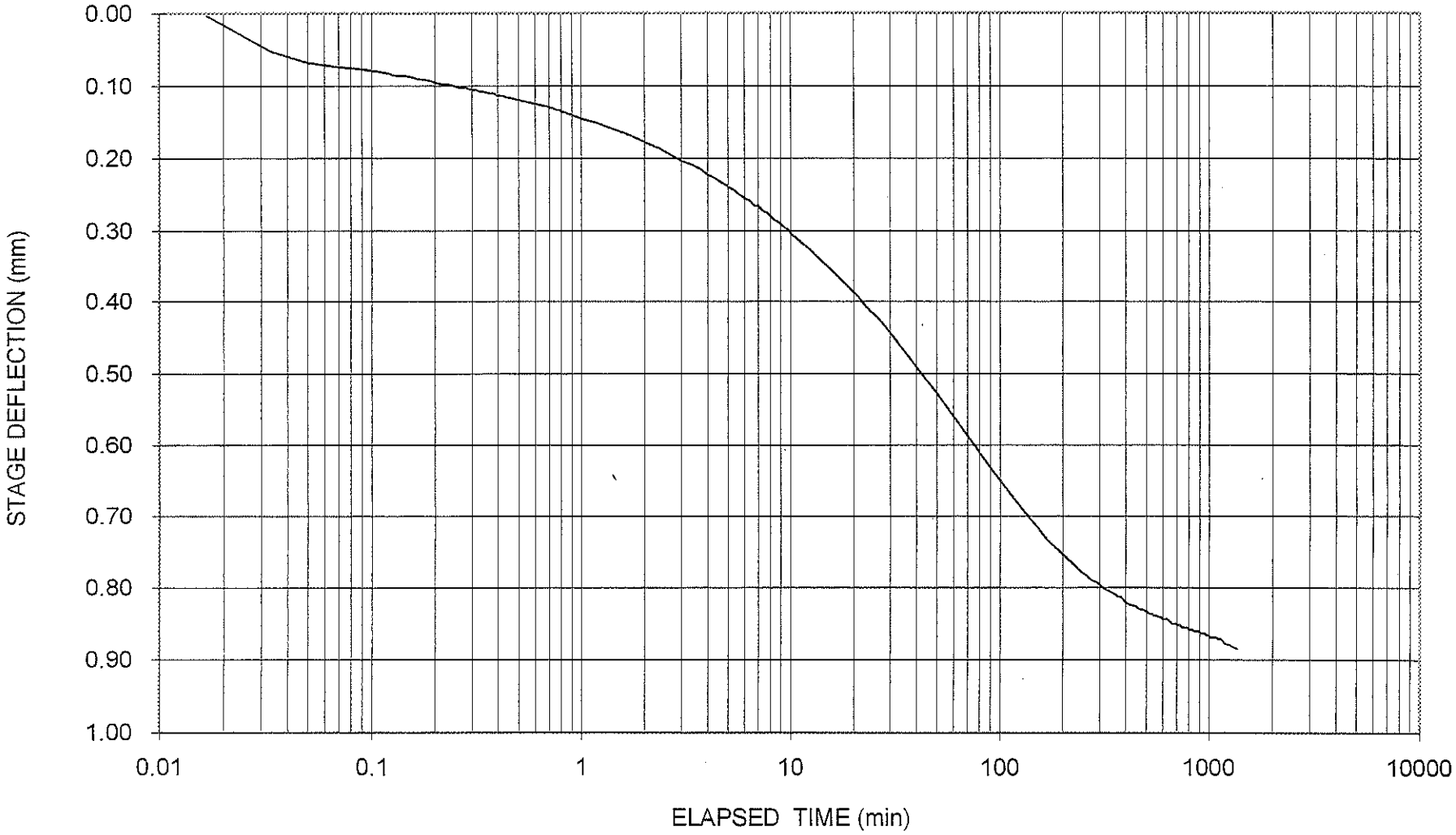
APPLIED PRESSURE = 35 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH9

APPLIED PRESSURE = 35 kPa



Golder Associates

OEDOMETER CONSOLIDATION SUMMARY

SAMPLE IDENTIFICATION

Project Number	04-1116-120	Sample Number	SH9
Borehole Number	04-4	Sample Depth, m	5.5-6.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	11/30/2004		
Date Completed	12/01/2004		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m^3	9.59
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	1.70
Area, cm^2	31.67	Specific Gravity, assumed	1.46
Volume, cm^3	60.17	Solids Height, cm	0.226
Water Content, %	464.45	Volume of Solids, cm^3	7.14
Wet Mass, g	58.87	Volume of Voids, cm^3	53.03
Dry Mass, g	10.43	Degree of Saturation, %	91.4

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	1.900	7.423	1.900				
44.99	1.567	5.947	1.734	8	7.96E-02	3.90E-03	3.04E-05

Notes:
k calculated using cv based on t_{90} values.
sample taken 25cm from the bottom of the shelby tube

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.57	Unit Weight, kN/m^3	11.36
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	2.06
Area, cm^2	31.67	Specific Gravity, assumed	1.46
Volume, cm^3	49.63	Solids Height, cm	0.226
Water Content, %	451.22	Volume of Solids, cm^3	7.14
Wet Mass, g	57.49	Volume of Voids, cm^3	42.48
Dry Mass, g	10.43		

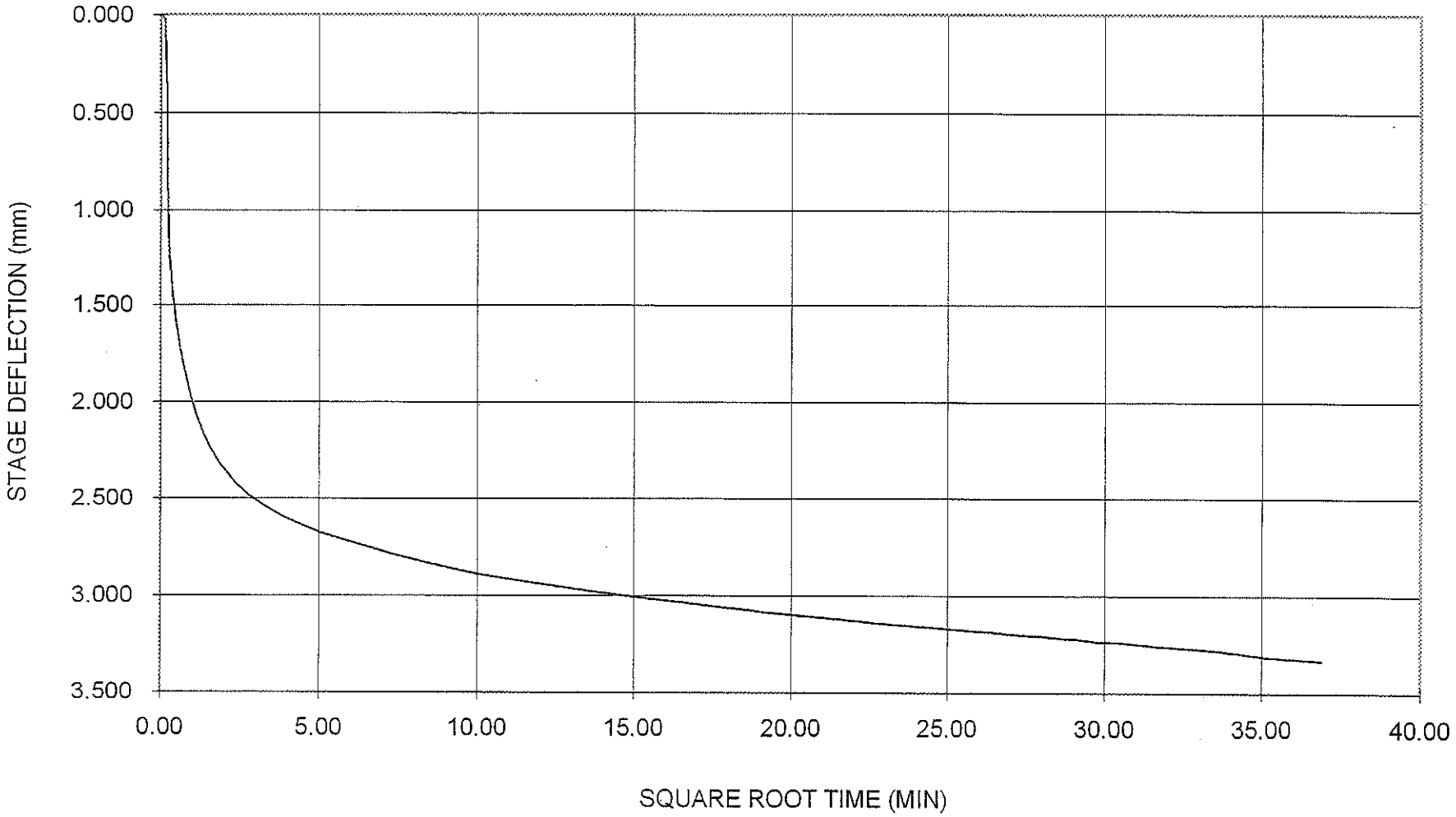
Prepared By: LFG

Golder Associates

Checked By: MM

BOREHOLE 04-4 SAMPLE.NUMBER SH9

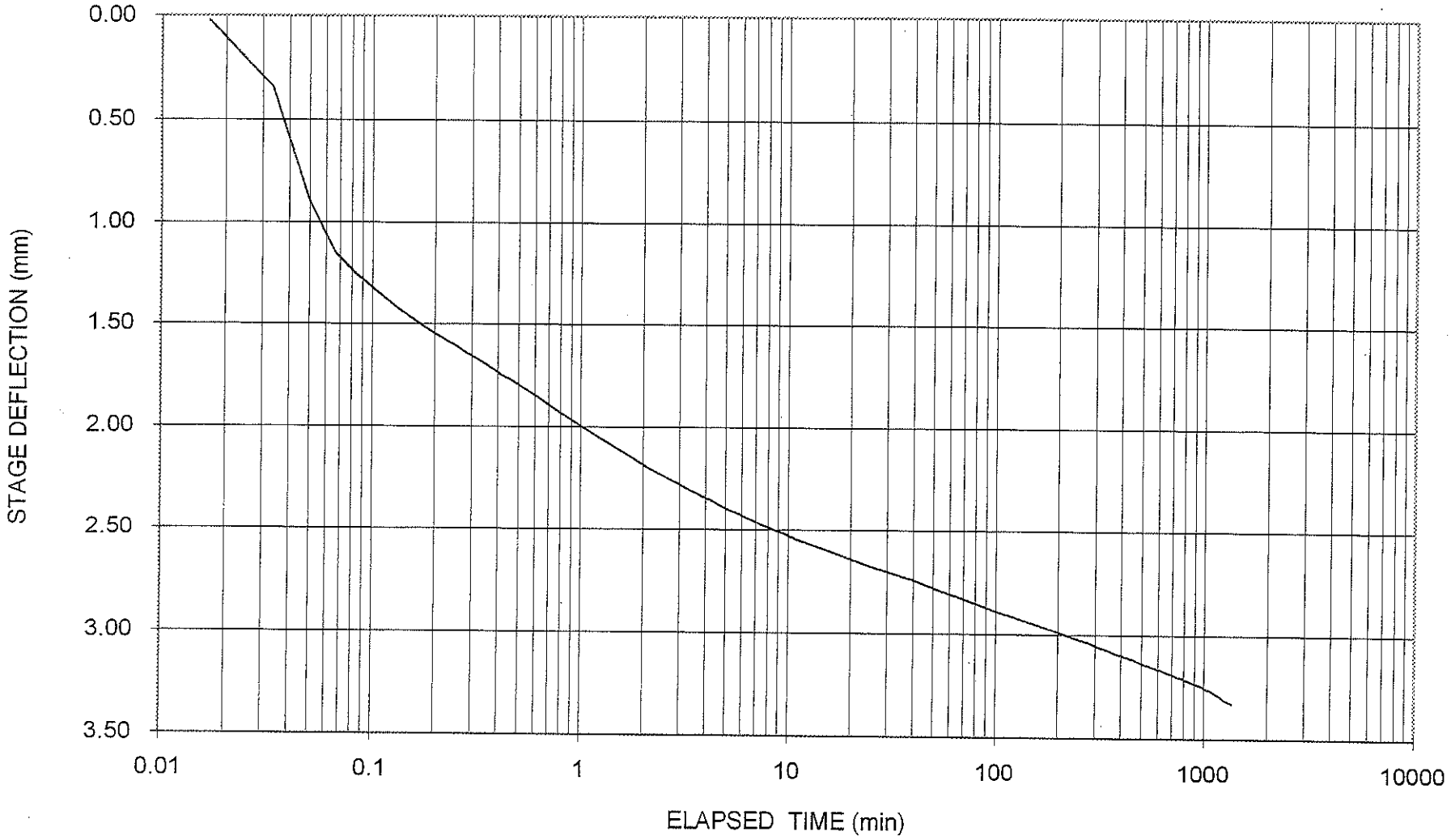
APPLIED PRESSURE = 44.99 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH9

APPLIED PRESSURE = 44.99 kPa



Golder Associates

OEDOMETER CONSOLIDATION SUMMARY

SAMPLE IDENTIFICATION

Project Number	04-1116-120	Sample Number	SH9
Borehole Number	04-4	Sample Depth, m	5.5-6.1

TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	6		
Date Started	12/01/2004		
Date Completed	12/02/2004		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.90	Unit Weight, kN/m^3	9.31
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	1.72
Area, cm^2	31.67	Specific Gravity, assumed	1.46
Volume, cm^3	60.17	Solids Height, cm	0.228
Water Content, %	441.35	Volume of Solids, cm^3	7.23
Wet Mass, g	57.11	Volume of Voids, cm^3	52.95
Dry Mass, g	10.55	Degree of Saturation, %	87.9

TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t_{90} sec	cv. cm^2/s	mv m^2/kN	k cm/s
0.00	1.900	7.327	1.900				
55.01	1.553	5.806	1.727	17	3.72E-02	3.32E-03	1.21E-05

Notes:
k calculated using cv based on t_{90} values.
sample taken 30cm from the bottom of the shelby tube

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.55	Unit Weight, kN/m^3	10.95
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m^3	2.10
Area, cm^2	31.67	Specific Gravity, assumed	1.46
Volume, cm^3	49.18	Solids Height, cm	0.228
Water Content, %	420.68	Volume of Solids, cm^3	7.23
Wet Mass, g	54.93	Volume of Voids, cm^3	41.96
Dry Mass, g	10.55		

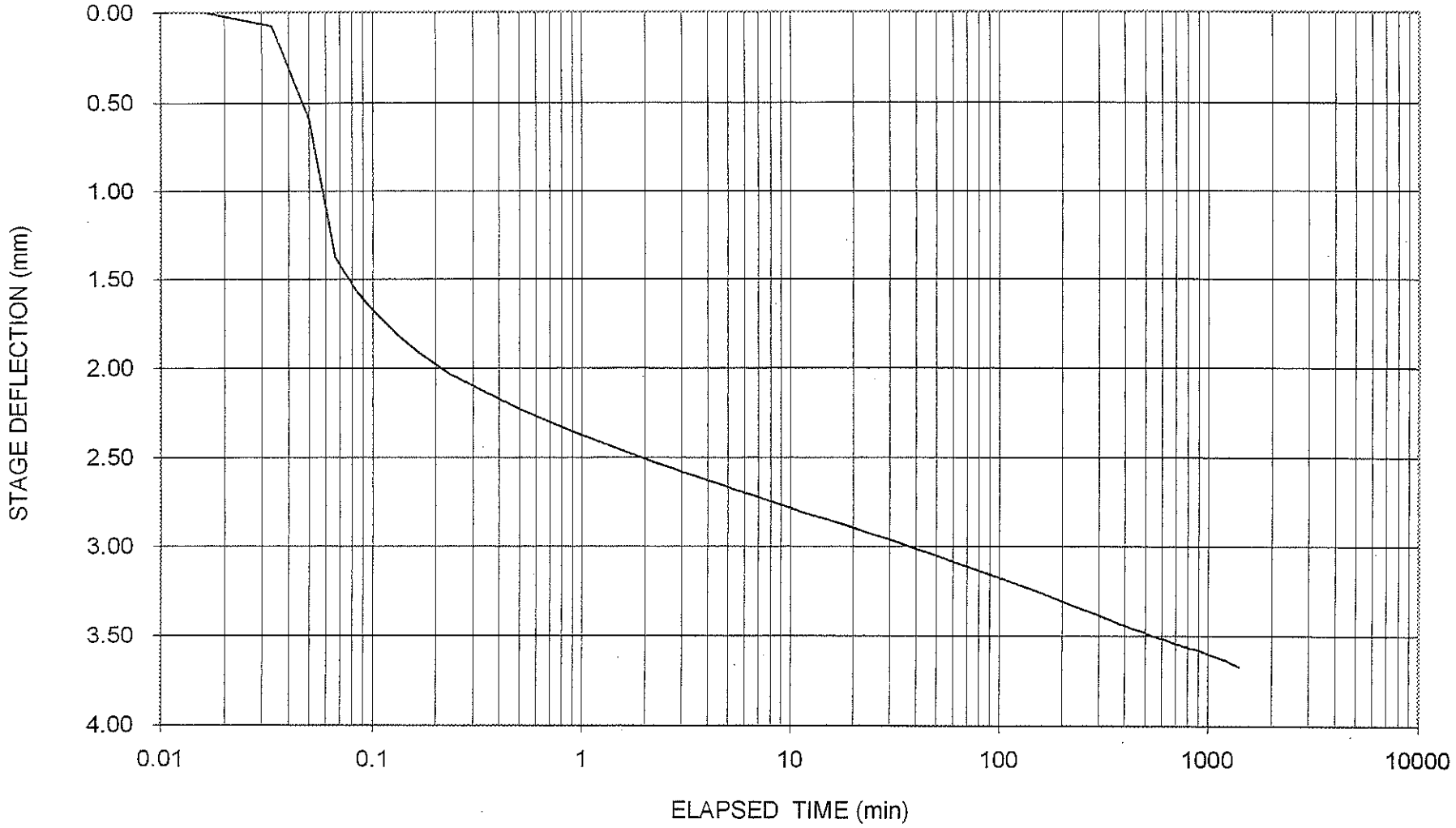
Prepared By: LFG

Golder Associates

Checked By: MM

BOREHOLE 04-4 SAMPLE NUMBER SH9

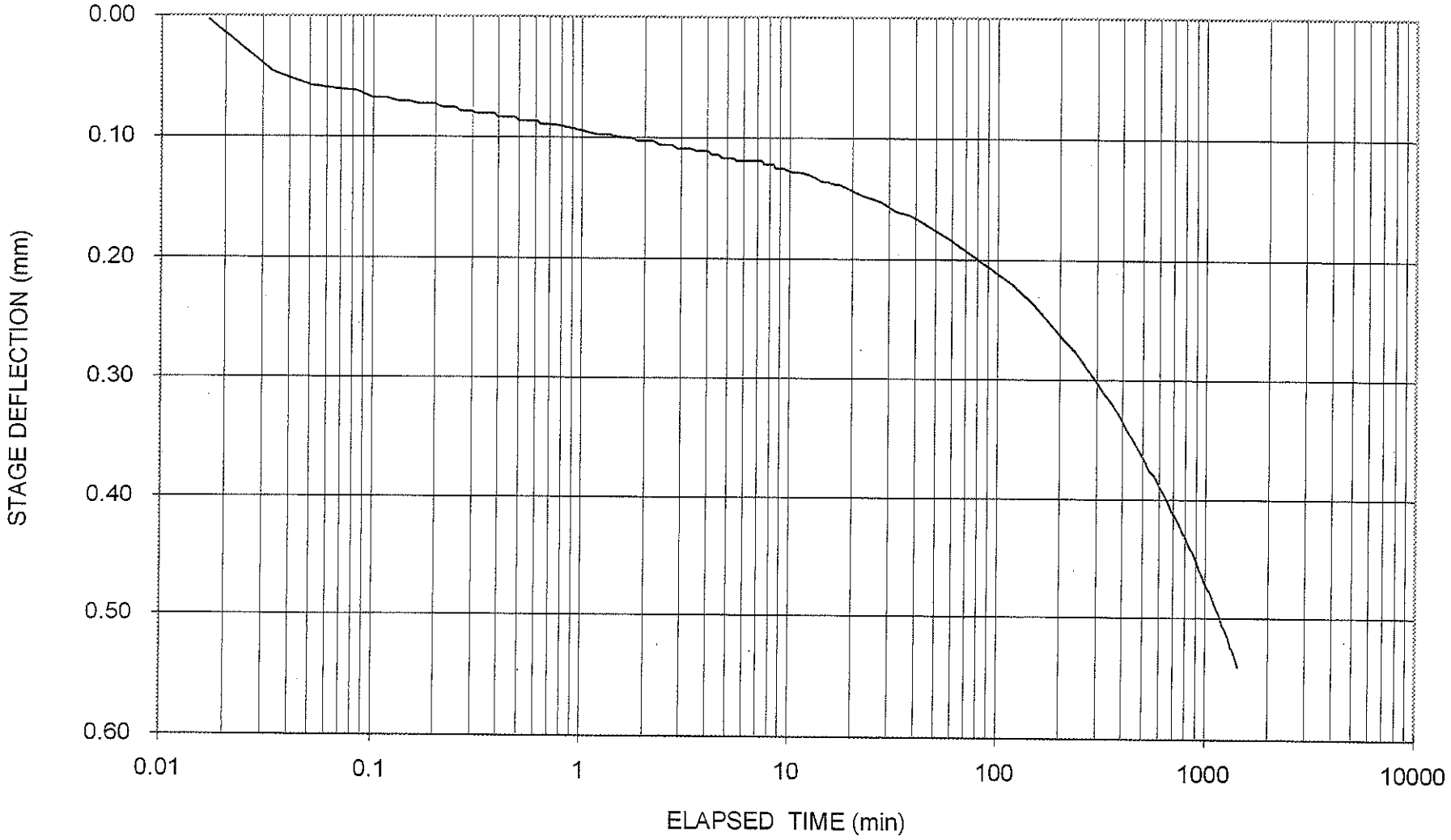
APPLIED PRESSURE = 55.01 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH8

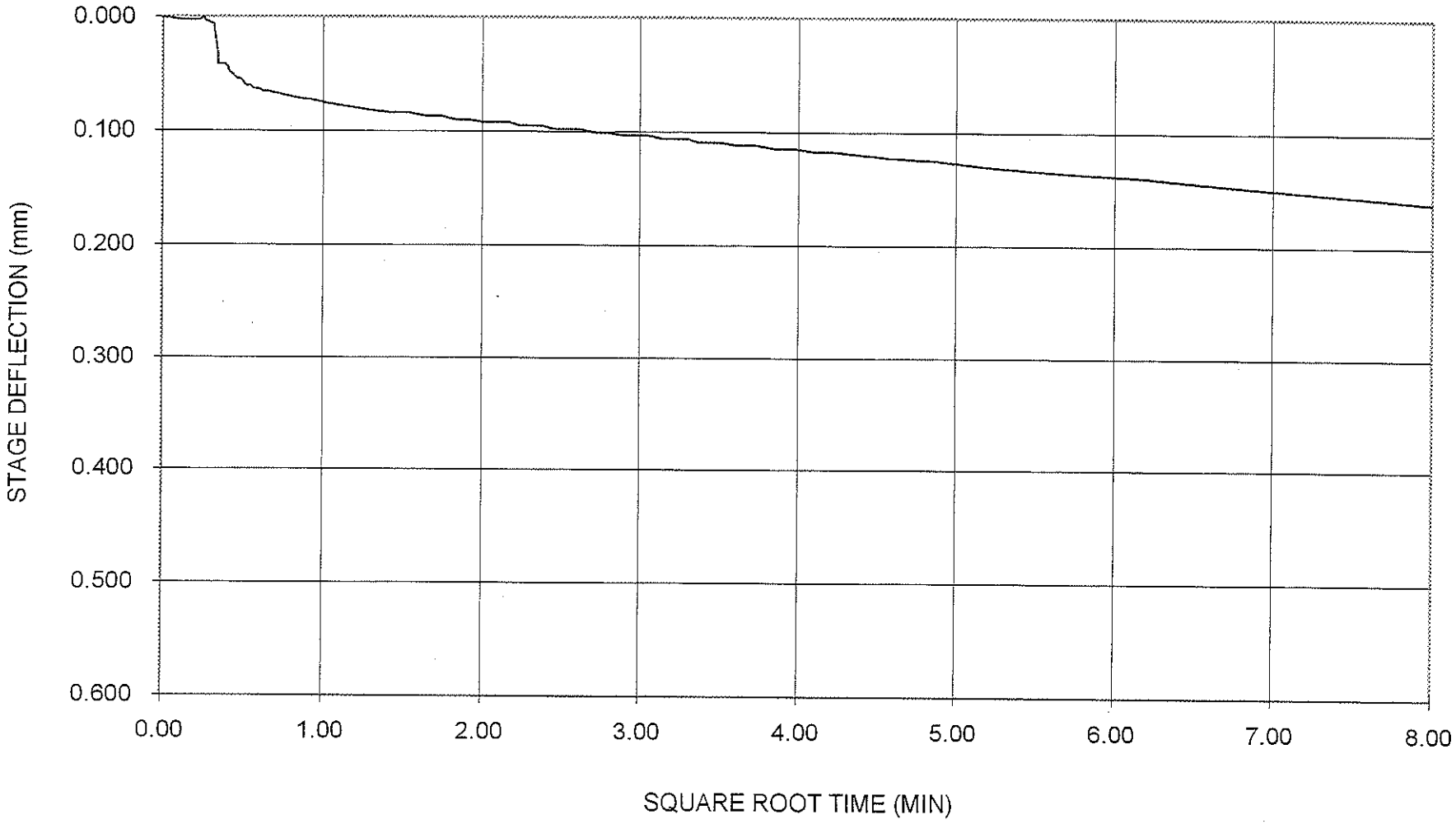
APPLIED PRESSURE = 55.0 kPa



Golder Associates

BOREHOLE 04-4 SAMPLE NUMBER SH8

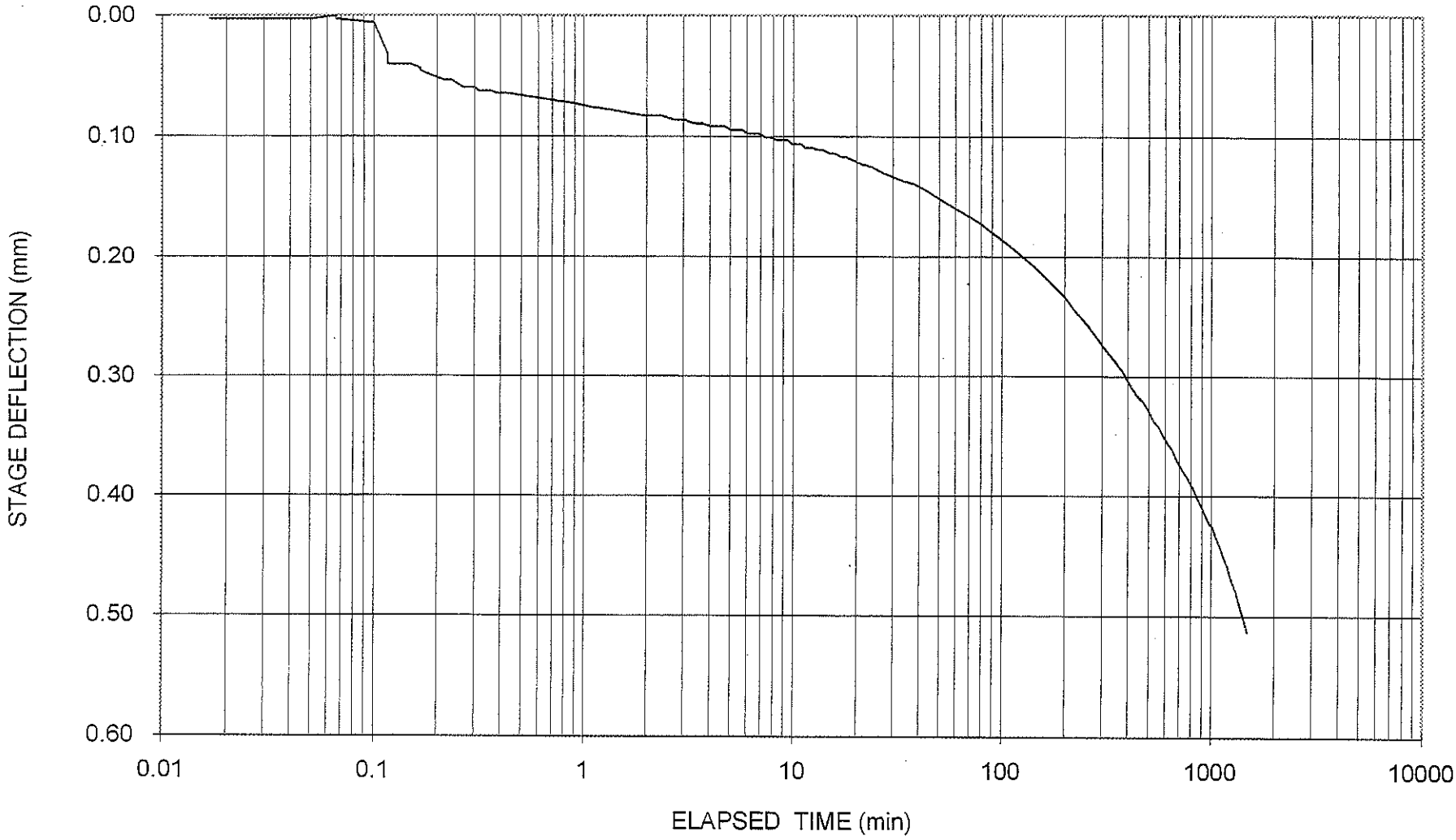
APPLIED PRESSURE = 65.0 kPa



Golder Associates

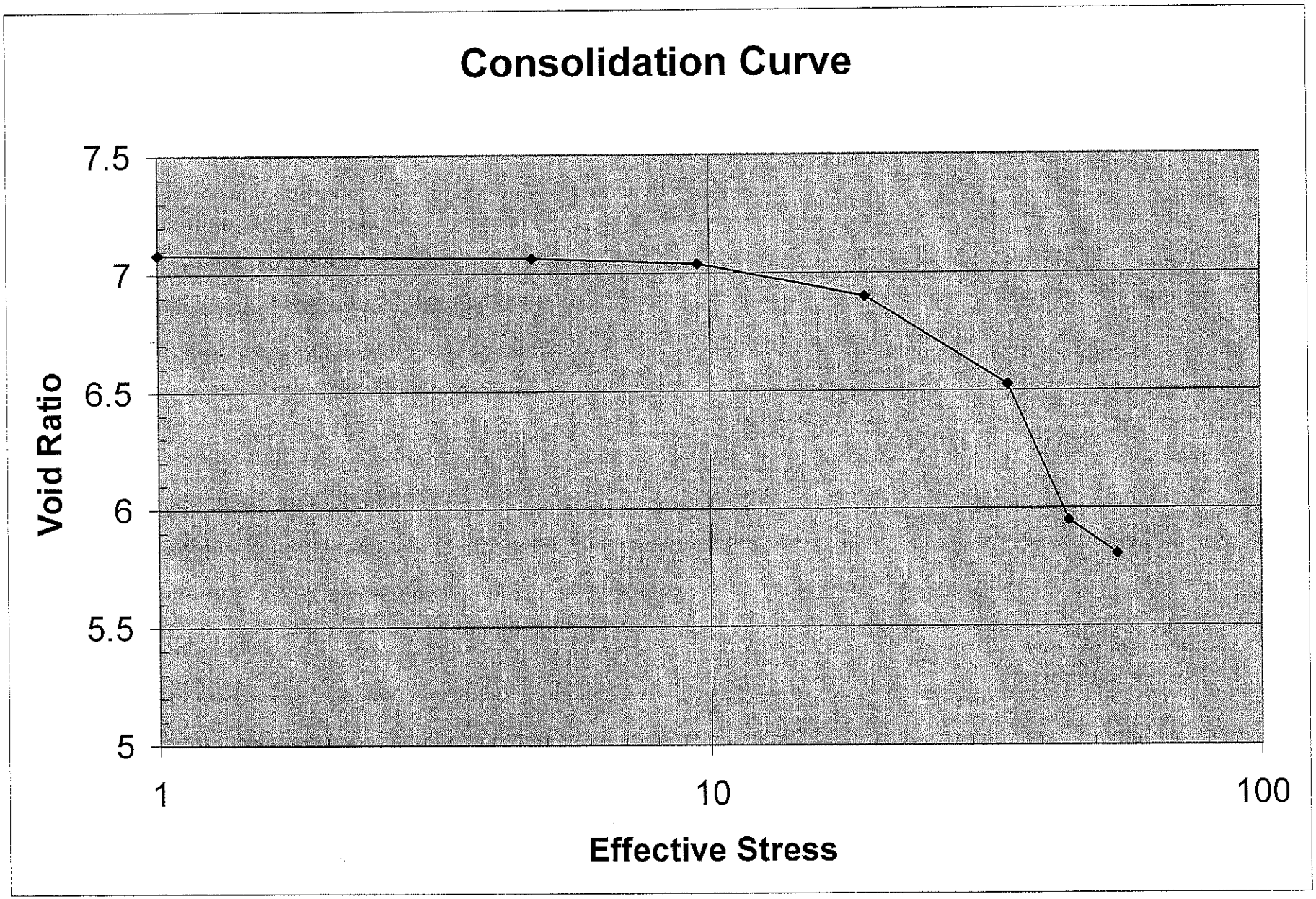
BOREHOLE 04-4 SAMPLE NUMBER SH8

APPLIED PRESSURE = 65.0 kPa



Golder Associates

Project ono11686
WP 66-99-00



Highway 62 Culvert
Figure 1
Borehole 04-4, SH-9

22/12/04

consol.04-12-22

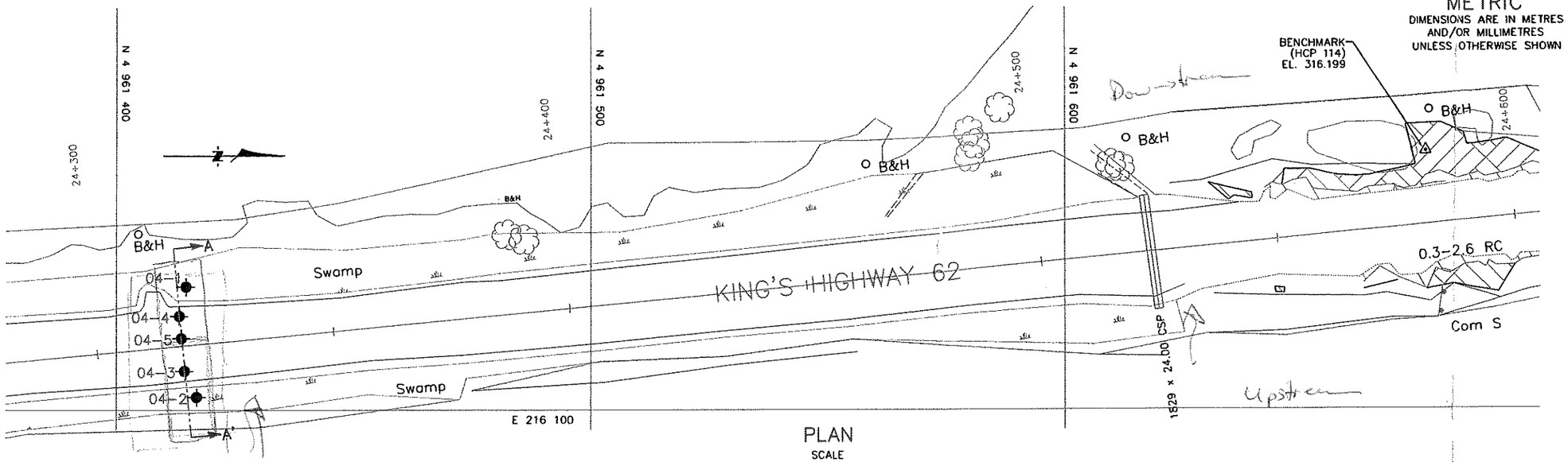
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No 66-99-00

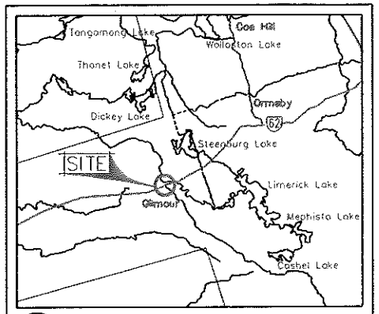
HIGHWAY 62
STATION 24+318 TO 24+320
BORE HOLE LOCATIONS & SOIL STRATA

SHEET
—

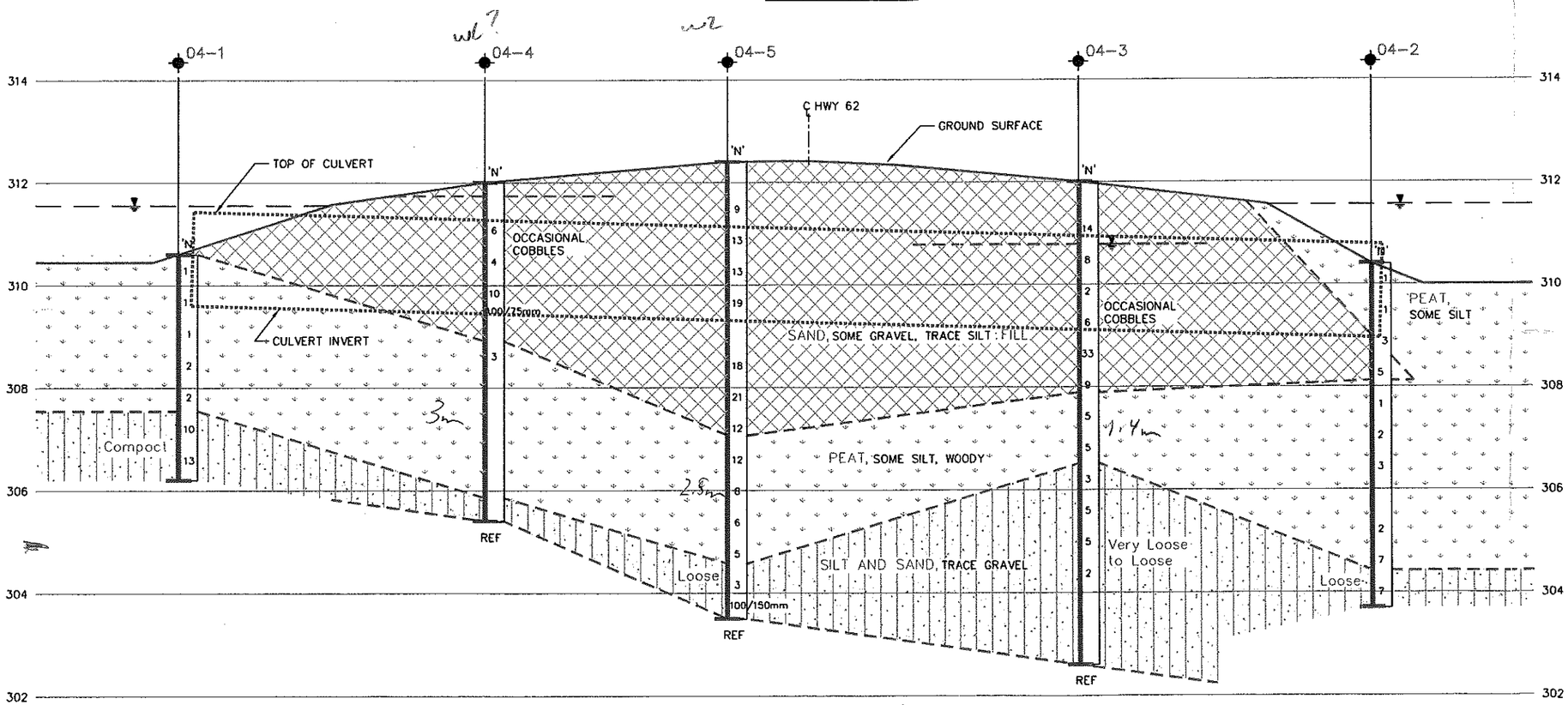
Jacques Whitford



PLAN
SCALE
10 m 0 10 20m



KEY PLAN
NOT TO SCALE



CROSS-SECTION A-A'
SCALE
1m 0 1 2m

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at Time of Investigation Nov 2004
- WL in Piezometer
- Piezometer
- REF Refusal on Inferred Bedrock

No	ELEVATION	COORDINATES NORTH	EAST
04-1	310.6	4 961 414.8	216 074.1
04-2	310.4	4 961 417.1	216 097.3
04-3	312.0	4 961 414.5	216 091.8
04-4	312.0	4 961 413.4	216 080.2
04-5	312.4	4 961 413.9	216 084.9

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REVISIONS	DATE	BY	DESCRIPTION
	—	—	

GEOCRES No

HWY No 62			DIST 10
SUBM'D PC	CHECKED	DATE 200-12-22	SITE
DRAWN GBB	CHECKED	APPROVED	DWG ON011686-1

BOARDR[redacted]S E-1 and E-2
DOWNSV[redacted] M3M 1J8, Ontario

DATE: January 21, 1977

W.P. 103-63-02 CONTRACT 76-127 HIGHWAY 62 & 620

TYPE OF WORK Grading, Drainage, Granular Base & Hot Mix Paving

LOCATION Highway 62 From 0.2 Mile South of Highway 620 Northerly 9.2 Miles
Highway 620 Coe Hill Built-up Area 1.0 Mile

DISTRICT 10 ADVERTISING DATE February 23, 1977

ATTENDANCE

J. B. Wilkes
R. S. Pillar
J. R. Wear
E. J. Willis
J. Brown
J. E. Callaghan
R. A. Verscheure
G. Wrong
W. Bennett
J. Crannie
B. Giroux
W. Katarynczuk
J. Davidson
M. Devata
M. Guyett

POINTS OF DISCUSSION

Preloading of Swamp - M. Devata opined preloading would not achieve absolute solution but as no alternative presented, project to remain as designed. Mr. Devata said effect would be monitered for a year or two so no funds to be set up for earth removal under this contract.

E. J. Willis
Supervisor
Contract Review Section

EJW/ls
cc: S. J. Radbone
E. R. Saint
R. S. Chapman
H. B. McKay
J. Heffernan
G. Wrong
C. Mirza
B. Giroux
J. Crannie
E. J. Willis
W. R. Bennett
R. S. Pillar
P. McWatt

m devata
m m
FILES

Ministry of Transportation and Communications

Ontario

Memorandum

To: Mr. R. S. Chapman
District Engineer
Bancroft, Ontario

From: Planning and Design Office
Kingston, Ontario

Attention:

Date: December 14, 1976

Our File Ref.

In Reply to

Subject:

RE: W. P. 103-63-02, Highway #62, From 0.2 Miles South of Secondary Highway #620, Northerly 9.2 Miles, District #10 - Bancroft

Contract Drawings and Documents of the projects grouped under the above were issued June 14th, 1976, at which time, it was proposed to call a Regional Pre-Contract Review for August 1976.

Since that time, various changes have been made and additional modifications from Materials and Testing and the Traffic Office are pending.

In order to retain these projects in the 1976-77 Program Year, it will be necessary to forward the drawings and documents to Head Office no later than January 12th, 1977. This further necessitates the holding of a Regional Pre-Contract Review in the near future and arrangements are now being made to that effect.

Forwarded herewith are copies of the revised drawings and documents as they presently exist and these will be reviewed at 10:30 a.m., Wednesday, December 22nd, 1976, in Boardroom #1 of the Regional Offices.

J. F. Brown
Project Manager

JFB/ll
Att'd.

c.c. P. D. Billings, E. R. Saint, H. B. McKay, J. S. Trew, T. C. Kingsland, R. S. Pillar, J. Wear, H. W. Miller, R. J. Forrest, B. Giroux, C. Mirza, A. E. McKim

PMD.

WP 103-63-04

1 File

Design Synopsis Report

(A) W.P. 103-63-02, Resurfacing of Hwy. 62, From 0.2 miles South of Sec. Hwy. 620 Northerly 9.2 miles

(B) W.P. 103-63-04, Frost Heave Treatment and H. M. Paving of Hwy. 62, From 1.9 miles North of Bannockburn Northerly 13.4 miles to 1.1 miles North of St. Ola Road, Various Locations

(C) W.P. 213-66-00, Sec. Hwy. 620, G.D. C.B. and Paving of Coe Hill Built-Up Area Incl. 0.5 miles of Resurfacing

(D) W.P. 95-76-01, Resurfacing of Hwy. 62, From Hwy. 500 Northerly 0.9 miles Incl. 0.1 miles on Station St. from Hwy. 62 Westerly and a Frost Heave Treatment on Hwy. 28 0.8 miles South of Hwy. 62 - Connecting Link

(E) W.P. 95-76-02, Resurfacing of Hwy. 500, From Hwy. 62 Easterly 0.6 miles Connecting Link

(F) W.P. 21-76-01, Stockpile 15,000 tons of 5/8" Crushed Gravel 'A' in the Ormsby Patrol Yard at the Junction of Hwy. 62 and Sec. Hwy. 620

(G) W.P. 22-76-01, Stockpile 10,000 tons of 5/8" Crushed Gravel 'A' in the Hwy. 28 Patrol Yard at Apsley

District-10-Bancroft

The above noted projects are grouped together under Project (A) W.P. 103-63-02.

This section of Highway 62 was reconstructed under Contract 67-138 with follow-up Base Course Paving under Contract 69-061.

It is the purpose of the current project to provide a top course of 1½" H.L. 4. Included with this will be the following:

(I) 4 Frost Heave Treatments involving excavation and/or ditch improvements.

(II) 5 Hot Mix Padding Areas

(III) Superelevation Correction to 3 Curves

(IV) Updating of tapers at the Junction of Sec. Hwy. 620, to present day standards

(V) Paving of open throats at 3 sideroads

(VI) Shoulder Protection Treatment at 1 sideroad intersection.

(V11) Paving of 1 C. S. Entrance.

(V111) Adjustment of Guide Rail.

(B) This section of Highway 62 was reconstructed under Contracts 61-044 and 62-081. The northern half was last paved in 1967 and the south half in 1972.

Due to severe longitudinal and random cracking severe dishing in wheel tracks, frost heaves and settlement in muskeg areas, the following work is proposed:

(1) 2 frost heave treatments involving excavation and ditching.

(2) 16 1½" - 2" Hot Mix Patching Areas.

Situated within the limits of this project is a one mile section, signed as "Rough Road" where muskeg deposits have adversely affected the condition and ridability of the pavement. Apart from becoming a continued maintenance problem, the distortion, settlement, cracking and wheel track rutting has made driving difficult and hazardous.

W.P 103-63-74 Hwy # 62

A 1976 investigation of this area indicated various degrees of displacement of organic material underneath the roadway fill thereby indicating the need of a grade change along this section. To effect this change, the Materials and Testing Office recommend the following treatment:

(a) Preload the distressed areas with a 2 foot surcharge of Granular 'C' in an attempt to(completely displace) or at least consolidate the underlying trapped organic material.

(b) Place a base course and a 20 foot wide pavement on top of the surcharge to maintain traffic.

(c) Remove the surcharge after one year has elapsed and excavate old road bed to allow pavement and granular courses to be placed at a lower grade.

The following work is proposed under this project:

(1) Reconstruct a 0.5 mile portion in Coe Hill to an urban cross-section identical to that provided by adjacent Contract 62-315, i.e. 22' pavement, mountable 'D' type curb and gutter and 6' paved reverse shoulder parking lanes.

(11) Resurface pavement constructed under Contract 62-315

(111) Waterproof deck and update steel beam guide rail at the Deer Creek Bridge.

(1V) Update and extend storm water sewer system.

(V) Reconstruct sidewalk where necessary.

(Vl) Slight improvement to horizontal alignment.

(Vll) Vertical alignment to be improved where possible.

(D) & (E) The work under this connecting link project involves:

(1) Frost Heave Treatments
Hastings Street - Hwy. 62 North 2 locations
Bridge Street - Hwy. 500 East 1 location
Hwy. 28 South 1 location

(11) Resurfacing
Hastings St. (Hwy. 62) from Bridge St. (Hwy. 500)
Northerly 0.87 miles
Bridge St. (Hwy. 500) from Hastings St. (Hwy. 62)
Easterly 0.6 miles
Station St. from Hastings St. (Hwy. 62)
Westerly 0.1 miles
Highway 28, from 0.83 miles from South
Juction of Hwy. 62 Westerly 0.01 miles

(111) Manhole and Catch Basin adjustments where necessary.

The reconstruction proposals at Coe Hill and the resurfacing at Bancroft have received the approval of the Municipal Councils concerned.

An Environmental Status Statement for the reconstruction at Coe Hill has been forwarded to the Ministry of the Environment.

Disposal — ?
Overloading — yes ? no restrictions ?
Burning — yes ? " ?
Specials — None Requiring committee Review.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. E.V. Saint
Head Geotechnical Section
Kingston, Ont.

FROM: Engineering Materials Office
Soil Mechanics Section

ATTENTION: D.G. Guibord

DATE: December 9, 1976

OUR FILE REF.

IN REPLY TO

SUBJECT:

Treatment of Settled Areas Over Muskeg Deposits
From 8.9 Miles North of Bannockburn 100.3 Miles North of St. Ola Rd.
W.P. 103-63-04, Highway #62
District #10 - Bancroft

We have completed our testing of the samples your Regional Soils Office obtained to determine the subsoil conditions of the above sections of Hwy. 62. Shown on the Record of Boreholes, attached, are the moisture content, the organic content and the grain size distribution as determined by our testing. Also please find attached Appendix 1 showing factual data of the locations, details of distress of roadway, existing elevation of embankment, average original ground elevation and a description of subsoil conditions.

In conversation with the Region we were informed that the original method of construction of the roadway embankment was displacement of the organics by granular and a well-graded sand fill. The Bancroft District Maintenance branch have kept records of maintenance operations on the above sections of highway since 1972. From these records the following information was obtained.

A) Cold mix applications twice per year
Hot mix applications once per year

B) 120 tons of cold mix every year
120 tons of hot mix every year

C) Settlements of about 4" to 8" (sometimes more) from one maintenance operation to the other

The Details of Distress of Roadway as described in Appendix 1 are explained as follows:

REASONS FOR DISTRESS

1. Since the organics are not removed or displaced completely, settlements (total as well as differential settlements) will occur in the future if present grades are maintained.

2. Since the organics are not of uniform thickness underneath roadway, the settlements will not be uniform.

3. We expect that there is a shear deformation of the organics due to low bearing capacity.

4. The general relief is very poor in this area. Fluctuations in water level due to seasonal variations will induce additional volume changes in the area adjacent to the roadway.

Our suggestions regarding treatment are as follows:

REMEDIAL MEASURES

1. If traffic conditions permit, then preloading the distress areas with additional fill and constructing adequate lengths of berms to ensure stability would be the best possible remedial measure. However, it is understood that detouring may not be economical. If it is feasible this section will provide the necessary recommendations pertaining to this aspect.

2. In our opinion the alternative would be to reduce the induced stresses in the underlying organic material by unloading the existing fills as much as possible, preferably three feet. The removed material should be used to flatten the side slopes and also to construct as berms on the sides. In addition areas lying in undated adjacent to the roadway should be filled. The new section should satisfy the following requirements.

A) Drainage of the area without flooding the roadway during spring thaw or heavy rain storms.

B) Frost protection requirements of the roadways.

C) A smooth transition in the profile grade should be provided between the treated and untreated areas.

Although settlements and maintenance costs will be significantly reduced by unloading the existing fill, settlements will continue indefinately due to the extreme compressibility of the organics.

If you have any further questions please do not hesitate to contact us.

Malcolm Maclean

M. MacLean
Project Engineer

For: M. Devata
Supervising Engineer

MM/bp

cc: G.A. Wrong
Files
Record Services

APPENDIX 1 FACTUAL DATA

Location Station to Station	Existing Elev. of Embankment	Average Original Ground Elev.	Details of Distress of Roadway	Subsurface Conditions	Remarks
561+00 to 563+50	1026±	1022±	Severe meander cracking Severe differential settlement on diagonal crossing centreline	Sta. 562+50 - Subsoil consists of 13 ft. of sand fill (roadway embankment) underlain by 8 ft. of organics which is followed by sand - The thickness of the roadway fill and that of the underlying organic material is more or less uniform at this location - The granular fill material above the water line is not susceptible to frost. The fill material below the water line is borderline susceptible to frost - Water line is at elev. 1020	Subsurface data at this location is based on borings and testing completed by the Regional Soils
569+00 to 576+00	1027±	1021±	Very severe distortion Very slight midlane cracks Mulch patch in poor condition Moderate to severe loss of coarse and fine aggregate Severe differential settlements Very severe wheel track rutting Worst settlement Sta. 572+50 to 573+50	Sta. 571+50 - B.H. 5-15' lt. of centreline Top of B.H. Elev. = 1026.3 Subsoil consists of 17 ft. of sand fill underlain by 10 ft. of organics underlain by bedrock - B.H. 1-15' rt. of centreline Top of B.H. Elev. = 1026.3 Subsoil consists of 25 ft. of sand fill underlain by 12 ft. of sand and gravel which is followed by bedrock - B.H. 2-72' rt. of centreline Top of B.H. at elev. 1022.0 Subsoil consists of 30 ft. of organics underlain by silty sand - The thickness of the roadway	Sta. 571+50 15' lt. B.H. 5 Moisture content of organics under roadway fill: at elev. 1005 = 355% at elev. 1000 = 441% Sta. 571+50 72' rt. B.H.2 Moisture content of organics outside of roadway fill at elev. 1018 = 683%

Location Station to Station	Existing Elev. of Embankment	Average Original Ground Elev.	Details of Distress of Roadway	Subsurface Conditions	Remarks
569+00 to 576+00 continued				fill and that of the organics is variable at this location - The granular fill material at this location is not susceptible to frost - Water line is at elev. 1020 Sta. 573+50 - B.H. 4 15' lt. of centreline Top of B.H. elev. = 1026.2 Subsoil consists of 17 ft. of sandy fill underlain by 5 ft. of organics underlain by sand - B.H. 6 15' rt. of centreline Top of B.H. elev. = 1026.2 Subsoil consists of 18 ft. of sandy fill underlain by silty sand - The thickness of the roadway fill and that of the organics is variable at this location - Granular fill at this location is not susceptible to frost - Water line is at elev. 1020	Sta. 573+50 15' lt. Moisture content of organics at elev. 1005 122%
589+00 to 591+00	1026±	1021±	Moderate differential settlement and distortion Severe loss of coarse aggregate	Sta. 590+50 - Subsoil consists of 13 ft. of sand fill roadway embankment underlain by 3 ft. of organics underlain by bedrock - Since only one borehole was done at this location the variation of thickness of the roadway fill and that of the organics is not known	Subsurface data at this location is based on borings and testing completed by the Regional Soils

Location Station to Station	Existing Elev. of Embankment	Average Original Ground Elev.	Details of Distress of Roadway	Subsurface Conditions	Remarks
				- Granular fill at this location above elev. 1015 is not frost susceptible - Water line is at elev. 1020	
594+00 to 598+00	1027±	1021±	Severe differential settlement Moderate to severe loss of fine aggregate Moderate midlane cracking with severe to very severe distortion	Sta. 596+00 - B.H. 8 14' lt. of centreline Top of B.H. Elev. 1025.6 Subsoil consists of 31 ft. of sand fill underlain by 3 ft. of organic followed by bedrock - B.H. 7 14' rt. of centreline Top of B.H. Elev. 1025.6 Subsoil consists of 21 ft. of sand fill underlain by 10 ft. of organics followed by bedrock - The thickness of the roadway fill and that of the organics under the roadway embankment is variable - Water line is at elev. 1020	Sta. 596+00 14' lt. Moisture content of organics at elev. 995 205% Sta. 596+00 14' rt. Moisture content of organics at elev. 1001 = 321%

Location Station to Station	Existing Elev. of Embankment	Average Original Ground Elev.	Details of Distress of Roadway	Subsurface Conditions	Remarks
615+00 to 618+00	P.G. at Sta. 615+00 1032.3 P.G. at Sta. 616+00 1033.0 P.G. at Sta. 617+00 1034.7 P.G. at Sta. 618+00 1038.0	(at Sta. 616+00) 1025±	Very severe differential settlement at Sta. 616+ Slight meandering cracks Severe distortion Severe loss of coarse aggregate	Sta. 615+00 - B.H. 10 14' lt. Top of B.H. Elev. 1032.6 Subsoil consists of 20 ft. of sand fill underlain by 10 ft. of organics underlain by bedrock - B.H. 9 15' rt. Top of B.H. Elev. 1032.6 Subsoil consists of 29 ft. of sand fill underlain by 4 ft. of organics followed by bedrock - The thickness of roadway fill and organics under the roadway embankment is variable - The granular fill material at this location is not susceptible to frost - Water line is at elev. 1025	At B.H. 10 14' lt. Moisture content of organics under roadway fill at elev. 1008 = 152% At B.H. 9 15' rt. Moisture content of organics under roadway fill at elev. 1003 = 158%

Ministry of Transportation and Communications

Ontario

Memorandum

To: Mr. M. Devata, Supervising Engineer, Soils Mechanics Office, W. Building, Downsview, Ontario.

From: Materials and Testing Office, Kingston, Ontario.

Attention:

Date: 13 October 76.

Our File Ref.

In Reply to

Subject:

W. P. 103-63-04, Highway #62 - Treatment of Settled Areas Over Muskeg Deposits, From 8.9 Miles North of Bannockburn to 0.3 Miles North of St. Ola Road

On October 5, 1976 two borings were obtained for one additional muskeg location. These were taken to bedrock with a truck-mounted flight auger. A third boring was done at yet another location to attempt to penetrate through the bouldery material. However, penetration was limited to a depth of 16' (4.8m). I am forwarding a copy of these field notes for your information. The two samples collected are being analyzed for gradation and moisture content at our Regional Soils Lab.

D. G. Guibord

D. G. Guibord,
Project Soils Engineer.

/sgr

c.c. G. A. Wrong

Encl.

TELETYPE

SEP 8 9 59 AM '76

TCI746 09080950
KIN283
DNA
MR. MURTI DEVATA, SOILS MECHANICS SECTION

RE: W.P. 103-63-04, HWY 62, TREATMENT OF
SETTLED AREAS OVER MUSKEG DEPOSITS.

AS PER YOUR REQUEST FOR FURTHER CLARIFICATION ON THE 600 FEET OF DRILLING, WE SUBMIT THE FOLLOWING. THIS IS THE TOTAL DISTANCE OF DRILLING, WHICH INCLUDES 400 FEET THROUGH MUSKEG APPROXIMATELY.

D.G. GUIBORD, M AND T
VF

TELETYPE

Ministry of Transportation and Communications
Ontario

Memorandum

To: Mr. M. Devata
Supervising Engineer
Soil Mechanics Office, West Building,
Attention: Downsview

From: Materials & Testing Office
Eastern Region, Kingston

Date: 1 September 1976

Our File Ref.

In Reply to

Subject: W.P. 103-63-04, Hwy #62
Treatment of Settled Areas over Muskeg Deposits and
HM Paving, From 1.9 Mi. N. Bannockburn N'ly to 1.1 Mi.N.of St.Ola.

As discussed with you on August 31, 1976, we would appreciate it if you could assist us with sub-surface investigation and development of design alternatives for treatment of the problem areas on the above noted project.

We are interested in carrying out the field investigation in the Region, but would like your advice on the investigation program and your assistance on the analysis of the field data and on the development of the possible design alternatives.

It would therefore be appreciated if you would arrange for a Diamond Drill and a drilling machine with hollow stem augers to arrive on the site either on Sept. 13,14 or 20, 1976. Denis Guibord, Project Soils Engineer, will supervise the site investigation work. When final arrangements have been made, please notify Mr.Guibord or the undersigned.

Investigation will involve establishment of 4 bore holes (2 through existing roadbed fill and 2 at offsets) at 5 locations along the settled areas. The swamp depths are approximately 25' to 30', therefore approximately 600' of drilling is required.

It would be appreciated if we could meet with you or your representative on the site to assess the drilling program in its early stage.

You mentioned that you will forward your office stationery for recording the field investigation data. Also, could you bring some Shelby Tubes when you visit the site.

We will pay the Drilling Contractor for the work from this office, in accordance with the Ministry's Agreement and Denis will record equipment time sheets etc.

Should you require additional information, please do not hesitate to contact us.

A.M.Batten
Senior Soils Supervisor

RECEIVED
GEOTECHNICAL OFFICE
SEP 07 1976
SOIL MECHANICS
MINISTRY OF TRANSPORTATION & COMMUNICATIONS

c.c.
G.Gauthier
G.A.Wrong

/jeb

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

Soils Field Summary

Hwy. 62 W.P. 103-63-04

Location: 8.9 MI. N. OF BANNOCKBURN N'LY TO 0.3 MI. N. OF ST. OLA RD.

Type of Proposed Contract: MISC. Length: VAR.

Soils Profile	Line	Chainage	Township	County
NOTE: THESE NOTES WERE EXTRACTED FROM THE SOILS PROFILE ~~(K-62-A-2)~~				
K-62-A-2	-	557+50 - 617+00	TUDOR	HASTINGS

GENERAL DATA

Type of Survey: Pedological Sketch (Logs of Borings)

Method of Investigation: Power Auger Peat Sampler Hand Auger Vanes

Line On: Existing Road New Location

Type of Surface: H.M. & MULCH PATCH Width of: Surface 22' Shoulders 6'

Condition of Surface at time of Survey: POOR AT SWAMP LOCATIONS, WHERE DRILLING WAS MADE.

NOTE: BOREHOLES WITH ASTERISK WERE OBTAINED IN 1976, WITH PRESENT ℄ DATUM, OTHER OFFSETS OBTAINED IN 1960.

General Description of Existing Gradeline and Alignment:

BOTH SATISFACTORY RE. GEOMETRICS.

SOILS DATA

Physiography (Topography and Land Form):

Describe General Soil Types and Conditions:

What type of Earth Borrow is available if required?

Are any Foundation problems anticipated with fills greater than 10'? YES.

Does this Survey include a Granular Survey? NO.

Party Chief: Date:

~~Sample Results~~ Transferred by: D. C. Cuthbert Date: 28 Sept 76

Ministry of Transportation and Communications
Ontario

SUBGRADE CHECK FIELD SHEET

PAGE NO. 1

TWP. _____ DATE _____ 19__

557+50 40' Rt (-8')

0-5' MUCK
5' NFP SOLID SA BOTTOM

557+50 40' Lt (-8')

0-5' MUCK
5' NFP SOLID SA BOTTOM.

559+00 40' Rt (-5')

0-5' BR-BLK MUCK
5'-6' VF SA & SI
6' NFP BLDS

559+00 40' Lt (-5')

0-5' BR-BLK MUCK
5' NFP B.R.

561+50 50' Rt (-4')

0-22' BR-BLK MUCK (LOGS) SAT SLY FIB & SLY (SOFT) WDY
22'-24' VF SA & SI FIRM @ 24'

HWY. NO. 62 LOCATION W.P. 103-63-04 ENGINEER _____

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Ontario

SUBGRADE CHECK FIELD SHEET

PAGE NO. 2

TWP. [redacted] DATE 19

561+50 50' Lt (-4')

0 - 8' BR-BLK MUCK (LOGS) SAT. SLY FIB & SLY WDY (SOFT)
8' NFP LOGS

562+20 14' Rt

0 - 8" BR CR GR
8" - 96" BR F GR
96" - 13' GRY FSA LO TILL (SI SEAMS) (TR ORG)
13' - 15.5' BR ORG DRY (VERY WDY)
15.5' NFP (VERY COMP.)

563+50 45' Rt (-4')

0 - 22' BR-BLK MUCK SLY FIB & WDY SOFT.
22' - 24' VF SA & SI FIRM @ 24'

563+50 45' Lt (-4')

0 - 17' BR-BLK MUCK SAT. SLY FIB & SLY WDY SOFT.
17' - 20' VF SA & SI FIRM @ 20'

568+50 50' Rt (-5')

0 - 18' BR-BLK MUCK (LOGS) SLY FIB & SLY WDY - SOFT.
18' - 19' GRY M. SA.

HWY. NO. LOCATION ENGINEER

QB-MT-161 6-74

Ministry of Transportation and Communications
Ontario

SUBGRADE CHECK FIELD SHEET

PAGE NO. 3

TWP. _____ DATE _____ 19____

568 +50 40' Lt (-5')

0-6' BR-BLK MUCK SLY FIB & SLY WDY
6'-7' GRY M. SA SAT.
7'+ NFP

570 +00 60' Rt (-6')

0-18' BR-BLK MUCK (LOGS) SAT. SLY FIB & SLY WDY (SOFT)
18' SOLID SA BOTTOM

570+00 35' Lt (-6')

0-24" WATER
24"-12.5' BR-BLK MUCK (LOGS) SAT. SLY FIB. & SLY WDY SOFT
12.5' SOLID SA BOTTOM.

571+00 40' Rt (-6')

0-23' BR-BLK MUCK (LOGS) (SAT) SLY FIB & SLY WDY SOFT
23'-26' GRY VFSA & SI WET.
26' NFP POSS B.R.

572+00 50' Lt (-5')

0-23' BR-BLK MUCK SAT SLY FIB & SLY WDY - SOFT.
23'-25' GRY VFSA & SI WET F. FIRM TO FIRM.

HWY. NO. _____ LOCATION _____ ENGINEER _____

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 4

TWP. _____ DATE _____ 19____

572+50 12' Rt.

0-14" BR CR GR
14"-15.5' BR F GR (SAT. 10'+)

573+00 12' Lt

0-7" BR CR GR
7"-40" BR F GR
40"-45" ASPH
45"-15' BR F GR (SAT 10'+)

573+00 50' Rt (-6')

0-7' BR-BLK MUCK (LOGS) SAT. SLY FIB & SLY WDY-SOFT.
7'+ NFP LOGS.

573+50 12' Lt.

0-8" BR CR GR
8"-12' BR F GR
12'-15' BR F SA LO TILL
15' NFP RK FILL

SURFACE VEGETATION - CLASS 'A'	
VANE TESTS - UNDIST/REMOLD (PSF)	
STA. 573+35' Rt (-6')	STA. 573+42' Lt (-6')
@3' - 200/120	@3' - 480/160
@7' - 380/140	@6' - 360/120
@9' - 480/240	@8' - 400/120
@11' - 640/380	@11' - 400/200
@13' - 880/600	@14' - 640/340
	@16' - 760/440

574+00 50' Lt (-6')

0-21' BR-BLK MUCK SAT. SLY FIB & SLY WDY - SOFT.
21'-23' GRY VF SA & SI WET SOFT TO FIRM @ 23'.

HWY. NO. _____ LOCATION _____ ENGINEER _____

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 5

TWP. _____ DATE _____ 19____

575+00 50' Rt (-6')

0-25' BR-BLK MUCK LOGS SAT SLY FIB & SLY WDY-SOFT
25'+ NFP B.R.

589+00 45' Lt. (-4')

0-7' - BR-BLK MUCK SAT. FIB.
7'+ NFP BLDS.

590+00 13' Rt. ℄

0-8" BR CR GR
8"-10' BR F GR
10' NFP BLDS

590+00 45' Rt. (-4')

0-12' BR-BLK MUCK SAT. FIB.
12'-14' F SA BLDY √

591+00 50' Rt. (-4')

0-11' BLK-BR MUCK SAT. FIB.
11'+ NFP BLDS

HWY. NO. _____ LOCATION _____ ENGINEER _____

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 6

TWP. _____ DATE _____ 19____

594 + 10 34' Lt. (-5')

0-15' BLK MUCK SAT. FIB.

595 + 45 12' Rt.

0-7" BR CR GR
7"-38" BR F GR
38"-44" ASPH
44"-96" BR F GR
96"-13' GRY F SA LO TILL (TR ORG)
13'-15.5' BR ORG WDY (VERY COMP)
15.5' NFP

595 + 50 55' Rt. (-5')

0-18' BLK-BR MUCK SAT FIB
18'-19' V F SA & SI WET FIRM (BLDS)

596 + 00 14' Lt.

0-9" BR CR GR
9"-96" BR F GR
96"-9.5' GRY F SA LO (TR ORG 8'-9')
9.5'-15' BR F SA LO TILL

HWY. NO. _____ LOCATION _____ ENGINEER _____

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 7

TWP. _____ DATE _____ 19____

596+00 55' Lt. (-5')

0-28' BLK MUCK SAT SOFT FIB
28'-32' BR-BLK ORG. SI. WET. F FIRM
32'+ NFP.

597+50 45' Rt (-6')

0-18' BLK-BR MUCK SAT. FIB. PART. DECOMP.
18'-19' VF SA & SI WET FIRM

598+00 50' Lt (-6')

0-11' BLK MUCK SAT SOFT
11' NFP BLDS

613+00 45' Lt (-6')

0-7' MUCK SAT BLK SOFT.
7'+ NFP B.R.

614+00 40' Rt. (-6')

0-5' MUCK SAT BLK SOFT.
5'+ NFP SA & BLDS

HWY. NO. _____ LOCATION _____ ENGINEER _____

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 8

TWP. _____ DATE _____ 19____

615+00 45' Lt (-6')

0-20' MUCK SAT. BLK SOFT
20'+ NFP BLDS & SA.

616+00 50' Rt. (-7')

0-29' MUCK SAT FIB SOFT.
29'-30' VF SA & SI WET.
30' NFP

616+00 55' Lt (-7')

0-16' MUCK SAT BLK-BR FIB SOFT
16'+ NFP SA & BLDS.

616+25 14' Rt.

0-18" BR CR GR
18"-96" BR F GR (SAT 7'+)
96"-16' BR F SA

617+00 15' Lt.

0-8" BR CR GR
8"-12' BR F GR (DIRTY 3'+)(SAT. 8'+)
12'-16' GRY F SA LO TILL

HWY. NO. _____ LOCATION _____ ENGINEER _____

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 9

TWP. _____ DATE _____ 19____

617 +18 40' Rt (-10')

0-19' MUCK SAT FIB SOFT
19'-20' VF SA & SI WET F. SOFT.
20' NFP PROB BLDS.

617 +18 40' Lt (-10')

0-15" WATER
15"-20' MUCK SAT SOFT (TR SA)
20'-26' F SA WET.
26' NFP

HWY. NO. _____ LOCATION _____ ENGINEER _____

08-MT-161 6-74

Ministry of Transportation and Communications
Ontario

FIELD BORING LOG

SOIL MECHANICS SECTION

SHEET 1 OF 10

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 1
DRILLER MIKE REVEKIO GROUND ELEV. JOB No. W.P. 103-43-04
ENGINEER W.D. FOX CASING SIZE NX DATE 21 SEPT 76
SITE LOCATION 8.9 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD. (HWY 62)
HOLE LOCATION STA. 571+50 15'RT (CO. HASTINGS, TWP. TUDOR)
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	10'	12-23-19-12-10-9-8-14-22-26		
10'	20'	25-15-13-5-3-4-3-4-5-9		
20'	27'	9-9-14-21-49-100-130		
		WASHING & SAMPLING		
0'	5'0"	DROVE NX CASING		
5'0"	6'6"	ATTEMPT SAMPLE RECOVERY — UNSUCCESSFUL		
		BLOWS: 4-4-4		
		WATER LEVEL @ 6'1"		
5'0"	10'0"	DROVE NX CASING		
10'0"	11'6"	BLOWS: 8-8-9		
		SAMPLES: 10'0"-11'0" — SA LO TILL	S.S. #1	
		11'0"-11'6" — GRY SALOTILL	S.S. #2	
10'0"	15'0"	DROVE NX CASING		
15'0"	16'6"	BLOWS: 5-5-1 F GR.	S.S. #3	
15'0"	20'0"	DROVE NX CASING (WASHED STARTING @ 16'6")		
20'0"	21'6"	BLOWS: 6-3-3 SA LO TILL	S.S. #4	
20'0"	25'0"	DROVE NX CASING & WASH		
25'0"	26'6"	BLOWS: 26-20-83 F-MED SA	S.S. #5	
25'0"	30'0"	DROVE NX CASING & WASH		
30'0"	31'6"	BLOWS: 37-14-10 CO. SA. & WOOD	S.S. #6	
30'0"	35'0"	DROVE NX CASING & WASH		
35'0"	36'8"	F SA LO TILL & CO SA (OVER B.R.) TRACE ORG		6-17 for 5"
		at 35'0". WATER GUSHED FOR HOLE @ 35'.		
36'8"	40'0"	CORED GRANITE ROCK (DIAMOND BIT 984921)		

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FIELD BORING LOG

SOIL MECHANICS SECTION

SHEET 2 OF 10

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 2
DRILLER STAN SUKUNDA GROUND ELEV. JOB No. W.P. 103-63-04
ENGINEER W.D. FOX CASING SIZE NX DATE 21 SEP 76
SITE LOCATION 8.9 MI. N. OF RANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD. (HWY 62)
HOLE LOCATION STA. 571+50 72' RT. (-6')
REMARKS BOMBARDIER MOUNTED HOLLOW STEM AUGER

DEPTH FEET FROM	TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	3'	1 BLOW FOR 3'		
3'	10'	1-1-1-1-2-2-3		
10'	20'	4-2-3-2-2-3-2-2-5-4		
20'	30'	7-5-4-6-4-5-5-6-8-8		
30'	31'	100		
31'0"	31'6"	100		
		WASHING & SAMPLING		
0'	3'0"	DROVE HOLLOW STEM AUGER — TOPSOIL & ORG. WOOD		
3'0"	6'0"	DROVE AUGER — BLK ORG WDY (WATER @ 1'2")	S.S. #1	1-1-1
6'0"	8'6"	BLK ORG WDY (WATER @ 2'0")	S.S. #2	1 for 1', 1 for 1'6"
10'0"	14'0"	BLK ORG WDY (WATER @ 3'0")	S.S. #3	1-1
15'0"	19'0"	BLK ORG WDY	S.S. #4	1 FOR 4'0"
20'0"	27'0"	BLK ORG WDY & PEAT	S.S. #5	1 FOR 7'0"
27'0"	28'0"	BLK ORG WDY		
30'0"	32'0"	F SI SA & FGR	S.S. #6	1-2-47-28
0'	2'	TRS & ORG WOOD		
→	28'	ORGANIC MATERIAL		

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Ministry of Transportation and Communications
Ontario

FIELD BORING LOG

SOIL MECHANICS SECTION

DRILLING CO. ATCOST. (TORONTO) DATUM ELEV. GEODETIC B.H. No. 3
DRILLER STAN SUKUNDA GROUND ELEV. JOB No. 103-63-04
ENGINEER W.P. FOX CASING SIZE NX DATE 22 SEP 76
SITE LOCATION HWY 62 - 8.9 MI. N OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD.
HOLE LOCATION STA. 573+50 70' RT. (-5')
REMARKS BOMBARDIER MOUNTED HOLLOW STEM AUGER

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	10'	1 (FOR 3') - 1 - 1 - 1 - 1 - 2 - 5 - 2		
10'	20'	3 - 3 - 3 - 3 - 3 - 4 - 4 - 4 - 4 - 4		
20'0"	29'6"	7 - 4 - 6 - 4 - 6 - 5 - 6 - 8 - 9 - 16 FOR 6"		
		REFUSAL AT 29'6"		
		SAMPLING		
0'0"	2'0"	AUGERED HOLE - TPS & ORG, PEAT, WOOD (WATER @ 1'4")		
2'0"	5'0"	AUGERED HOLE		
3'0"	5'0"	BLK ORG WDY SOFT	S.S. #1	1 FOR 1'6" 1 FOR 6"
5'0"	8'0"	AUGERED HOLE		
		BLK ORG WDY SOFT	S.S. #2	1 FOR 2' 1 FOR 6", 1 FOR 6"
8'0"	14'0"	AUGERED HOLE		
10'0"	14'0"	BLK ORG WDY SOFT	S.S. #3	1 FOR 2', 1 FOR 2'
14'0"	18'0"	AUGERED HOLE		
15'0"	18'0"	BLK ORG WDY	S.S. #4	1 FOR 3'
18'0"	28'0"	AUGERED HOLE		
20'0"	27'0"	BLK ORG WDY (PEAT)	S.S. #5 (2 bags)	?
27'0"	27'3"	GRY CL SI		1 - 1 - 2
28'0"	30'6"	AUGERED HOLE		
27'3"	29'0"	F SI SA WITH FCL SI LAYERS WET		
29'0"	30'6"	MED SA & CO. SA WET	S.S. #6	1 - 2 - 3 -
		REFUSAL - HOLE ENDS AT 30'6"		(50 FOR 0")

Ministry of Transportation and Communications
Ontario

FIELD BORING LOG

SOIL MECHANICS SECTION

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 4
DRILLER STAN SUKUNDA GROUND ELEV. JOB No. 10.3-63-04
ENGINEER W. D. FOX CASING SIZE NX DATE 23 SEP 76
SITE LOCATION 8.9 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD. (HWY 62)
HOLE LOCATION 573+50 15' LT.
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST.		
0'	10'	5-17-23-12-9-9-8-12-20-13		
10'	20'	8-5-3-5-6-7-10-11-14-25		
20'	26'	27-26-25-26-25-55		
26'0"	26'3"	16 FOR 3" THEN 100 FOR 0"		
		(REFUSAL AT 26'3" WITH POINT)		
		SAMPLING		
0'0"	2'6"	DROVE NX CASING		
2'6"	4'0"	S, SA & FGR	S.S.#1	8-10-12
2'6"	6'0"	DROVE NX CASING		
6'0"	7'6"	BR SA & FGR WET FROM 5'0" TO 6'9"	S.S.#2	4-7-8
6'0"	9'0"	DROVE NX CASING		
9'0"	11'0"	BR SA & FGR - CHANGE AT 10'0" TO	S.S.#3	7-6-5-5
		GRY CO SA & FGR WET		
9'0"	12'0"	DROVE NX CASING		
12'0"	14'0"	F SI SA WET.	S.S.#4	1-1-1-3
12'0"	15'0"	DROVE NX CASING		
15'0"	16'6"	CO SA SOME ORG AT 16'3" TO 16'6"	S.S.#5	4-3-1
15'0"	20'0"	DROVE NX CASING		
20'0"	21'6"	ORG. PEAT - REFUSAL AT 21'6" WITH	S.S.#6	1-2-2
		CASING & S.S.		
20'6"	23'0"	F SA USED AUGER		
23'0"	24'6"	MED SA - REFUSAL AT 24'6"		

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Ontario

FIELD BORING LOG

SOIL MECHANICS SECTION

SHEET 5 OF 10

DRILLING CO. ATCOST. (TORONTO) DATUM ELEV. GEODETIC B.H. No. 5
DRILLER MIKE REVEKIO GROUND ELEV. JOB No. 103-63-04
ENGINEER W.D. FOX CASING SIZE NX DATE 23 SEP 76
SITE LOCATION HWY 62 - 8.9 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD.
HOLE LOCATION STA 571+50 15' LT.
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'0"	10'0"	16-40-39-30-17-14-22-28-38-45		
10'0"	17'0"	40-30-15-7-7-15-18		
17'0"	17'6"	100 for 6" REFUSAL		
		SAMPLING & WASHING		
0'0"	3'0"	DROVE NX CASING		
3'0"	4'6"	FGR	S.S. # 1	15-13-12
3'0"	6'0"	DROVE NX CASING & WASHED		
6'0"	7'6"	FGR	SS. # 2	7-11-14
6'0"	9'0"	DROVE NX CASING & WASHED		
9'0"	10'6"	SILSA TILL	S.S. # 3	17-20-24
9'0"	12'0"	DROVE NX CASING & WASHED		
12'0"	13'6"	SILSA TILL	S.S. # 4	7-2-2
12'0"	15'0"	DROVE NX CASING & WASHED		
15'0"	16'6"	SILSA TILL	S.S. # 5	4-5-12
15'0"	20'0"	DROVE NX CASING & WASHED		
20'0"	21'6"	BLK ORG WDY	S.S. # 6	4-4-5
20'0"	25'0"	DROVE NX CASING & WASHED		
25'0"	26'6"	BLK ORG WDY	S.S. # 7	5-4-7
26'6"	28'5"	DROVE NX CASING & WASHED		
		REFUSAL @ 28'5" WITH CASING		

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Ministry of Transportation and Communications
Ontario

FIELD BORING LOG

SOIL MECHANICS SECTION

SHEET 6 OF 10

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 6
DRILLER STAN SUKUNDA GROUND ELEV. JOB No. 105-63-04
ENGINEER W.D. FOX CASING SIZE NX DATE 23 SEP 76
SITE LOCATION HWY 62 - 8.9 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD.
HOLE LOCATION STA. 573+50 15' RT.
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST.		
0'	10'	3 - 8 - 11 - 7 - 5 - 4 - 9 - 13 - 24 - 30		
10'	20'	19 - 8 - 6 - 3 - 16 - 26 - 28 - 28 - 23 - 35		
20'	30'	37 - 37 - 27 - 26 - 30 - 51 - 87 - 73 - 100 - 110		
30'	33'	100 - 85 - 110		
33'0"	33'3"	100 FOR 3"		
		SAMPLING		
0'0"	5'0"	AUGERED HOLE (HOLLOW STEM)		
3'0"	5'0"	CO SA & FGR V. MOIST AT 4'9"	S.S. #1	2-3-4-2
5'0"	7'6"	AUGERED HOLE		
6'0"	7'6"	BR SA SI & CO SA & FGR WET (ROADWAY FILL)	S.S. #2	5-5-11
7'6"	10'0"	AUGERED HOLE		
9'0"	11'0"	BR SA & FGR	S.S. #3	10-12-8-6
		CHANGE AT 10'0" TO GRY CO SA		
		& AT 10'6" TO F SI SA WET		
10'0"	17'6"	AUGERED HOLE		
12'0"	14'0"	F SA & SI ——— FILL	S.S. #4	1-1-6-7
16'0'	18'0"	F SA & SI	S.S. #5	8-14-8-6
		CHANGE AT 17'6" TO FSISA & ORG MIXED WET		
17'6"	20'0"	AUGERED HOLE		
		F SA & SI WITH ORG MIXED WET		
		REFUSAL AT 20'0" WITH AUGER.		

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FIELD BORING LOG

SOIL MECHANICS SECTION

DRILLING CO. AJCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 7
DRILLER STAN SUKUNDA GROUND ELEV. JOB No. 103-63-04
ENGINEER W. D. FOX CASING SIZE NX DATE 24 SEP 76
SITE LOCATION HWY 62 - 8.9 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD.
HOLE LOCATION STA 596+00 14' RT
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	10'	3-12-13-6-6-11-15-16-18-21		
10'	20'	10-5-2-1-5-2-5-5-5-11		
20'	31'	17-13-13-13-16-19-30-31-30-30-42		
31'0"	31'4"	41 FOR 4" THEN 100 FOR 0"		
		SAMPLING & WASHING		
0'0"	3'0"	DROVE NX CASING & WASHED		
3'0"	4'6"	BR SISA & FGR (ROADWAY FILL)	S.S. #1	5-5-7
3'0"	6'0"	DROVE NX CASING & WASHED		
6'0"	7'6"	SISA & COSA & SOME ORG WET (FILL)	S.S #2	6-8-8
6'0"	9'0"	DROVE NX CASING & WASHED		
9'0"	11'0"	AS PREVIOUS BUT CHANGE AT 10'6" TO GRY & WET	S.S. #3	16-12-8-7
9'0"	12'0"	DROVE NX CASING & WASHED		
12'0"	13'6"	GRY SISA WET SOFT	S.S. #4	2 FOR 6" 1 FOR 1'
12'0"	15'0"	DROVE NX CASING & WASHED		
15'0"	17'0"	F SISA SOME ORG WET (ROADWAY FILL)	S.S. #5	1-1-2
15'0"	20'0"	DROVE NX CASING & WASHED		
20'0"	22'0"	GRY SI & MED SA WET (FILL) MOIST	S.S. #6	5-3-4-5
		CHANGE AT 20'6" TO BLK ORG PEAT	(2 bags)	
		(ORIGINAL SOIL) NO WATER IN PEAT		
20'0"	25'0"	DROVE NX CASING & WASHED		
25'0"	27'0"	PEAT - WOOD - BLK ORG WDY	S.S. #7	5-3-3-4
25'0"	30'3"	DROVE NX CASING & WASHED		
30'3"	30'8"	GRY SI CL - SAMPLED FROM AUGER	SAMPLE #8	16 FOR 5"
		REFUSAL AT 30'8".		

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FIELD BORING LOG

SOIL MECHANICS SECTION

SHEET 8 OF 10

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 8
DRILLER MIKE REVEKIO GROUND ELEV. JOB No. 103-63-04
ENGINEER W. D. FOX CASING SIZE NX DATE 24 SEP 76
SITE LOCATION HWY 62 - 89 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD.
HOLE LOCATION STA 596+00 14' LT
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	10'	11-21-22-19-13-7-8-9-22-20		
10'	20'	24-14-8-4-5-8-10-8-6-10		
20'	30'	16-18-11-17-11-12-15-18-13-13		
30'0"	33'0"	13-12-15		
33'0"	33'4"	5 FOR 4" THEN 100 FOR 0"		
		REFUSAL AT 33'4" (BEDROCK)		
		SAMPLING & WASHING		
0'0"	1'6"	DROVE NX CASING		
3'0"	4'6"	FGR	S.S. #1	11-10-7
4'6"	7'6"	DROVE NX CASING		
6'0"	7'6"	FGR	S.S. #2	9-17-7
7'6"	13'0"	DROVE NX CASING & WASHED (SI SA TILL)		
		REFUSAL WITH S.S. AT 9', CASING DRIVEN		
		& HOLE WASHED TO 9', SAMPLED 9'-10'6"		(13-7-4)
		BUT NO RECOVERY		
13'6"	15'0"	SI SA TILL	S.S. #3	2-1-1
15'0"	21'6"	DROVE NX CASING		
20'0"	21'6"	SI SA TILL	S.S. #4	1-2-1
21'6"	26'6"	DROVE NX CASING		
25'0"	26'6"	SI SA TILL & FSA	S.S. #5	7-5-5
26'6"	31'6"	TILL TO 30'6", SAMPLED FROM 30'6"-31'6" BLK ORG WDY	S.S. #6	(30'0" → 31'6") 4-7-5
30'6"	33'0"	BLK ORG WDY		
		REFUSAL AT 33'0" WITH CASING.		
		(WATER IN HOLE AT 5')		

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FIELD BORING LOG

SOIL MECHANICS SECTION

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 9
DRILLER STAN SUKUNDA GROUND ELEV: JOB No. 105-63-04
ENGINEER W. D. FOX CASING SIZE NX DATE 21 & 27 SEP 76
SITE LOCATION HWY 62 - 8.9 MI. N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD.
HOLE LOCATION STA. 615+00 14' RT
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	10'	2-9-3-2-10 (5' TO 6' EMPTY SPACE), 16-9-6-14		
10'	20'	27-52-31-25-30-16-11-8-10-14		
20'	30'	15-15-15-19-18-20-20-23-27-28		
30'0"	33'8"	30-42-40-50 FOR 8"		
		REFUSAL AT 33'8" (100 FOR 0")		
		SAMPLING (USED AUGER-HOLLOW STEM)		
0'0"	5'0"	AUGERED HOLE		
3'0"	5'0"	FGR	S.S. #1	1-1-1-2
5'0"	8'6"	AUGERED HOLE		
6'0"	8'0"	FGR	S.S. #2	2-1-1 for 1"
8'6"	10'6"	AUGERED HOLE		
9'0"	10'6"	FGR	S.S. #3	1-3-7
10'6"	13'6"	AUGERED HOLE		
12'0"	13'6"	SISA TILL TR. ORG	S.S. #4	7-7-7
13'6"	17'0"	AUGERED HOLE		
15'0"	17'0"	SISA TILL	S.S. #5	5-3-3-3
17'0"	22'0"	AUGERED HOLE		
20'0"	22'0"	SISA TILL	S.S. #6	2-4-9-6
22'0"	27'0"	AUGERED HOLE		
25'0"	27'0"	SISA TILL	S.S. #7	3-2-2-4
27'0"	32'0"	AUGERED HOLE		
30'0"	32'0"	BLK ORG WDY & MARL	S.S. #8	2-2-4-4
32'0"	33'6"	AUGERED HOLE		
32'0"	33'0"	BLK ORG & SICL MIXED - REFUSAL AT 33'6" (B.R.)	S.S. #9	?
		WATER IN HOLE @ 6'7"		
		CAVED IN @ 7'6"		

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FIELD BORING LOG

SOIL MECHANICS SECTION

SHEET 10 OF 10

DRILLING CO. ATCOST (TORONTO) DATUM ELEV. GEODETIC B.H. No. 10
DRILLER STAN SUKUNDA GROUND ELEV. JOB No. 103-63-04
ENGINEER W.D. FOX CASING SIZE NX DATE 24,27SEP 76
SITE LOCATION 8.9 MI N. OF BANNOCKBURN TO 0.3 MI. N. OF ST. OLA RD. (HWY. 62)
HOLE LOCATION STA. 615+00 14' LT.
REMARKS

DEPTH FEET FROM	DEPTH FEET TO	DESCRIPTION	SAMPLE TYPE, No. & RECOVERY	METHOD OR BLOWS & DISTANCE
		DYNAMIC CONE PENETRATION TEST		
0'	10'	6-20-10-4-2-1-4-6-7-19		
10'	20'	11-5-5-4-2-3-4-4-4-4		
20'	29'	7-8-12-10-9-15-17-27-29		
29'0"	29'1"	15 FOR 1" THEN 100 FOR 0" (REFUSAL)		
		SAMPLING		
0'0"	4'6"	AUGERED HOLE		
3'0"	4'6"	F GR	S.S. #1	13-13-10
4'6"	8'0"	AUGERED HOLE		
6'0"	8'0"	F GR	S.S. #2	5-3-3-2
8'0"	10'6"	AUGERED HOLE		
9'0"	10'6"	SISA TILL	S.S. #3	4-5-5
10'6"	13'6"	AUGERED HOLE		
12'0"	13'6"	SI SA TILL	S.S. #4	2 FOR 6" 3 FOR 9", 1 FOR 6"
13'6"	17'0"	AUGERED HOLE		
15'0"	17'0"	SI SA TILL TR ORG.	S.S. #5	2-1-1-1
17'0"	23'0"	AUGERED HOLE		
18'0"	20'0"	F SA & SI SA TILL	S.S. #6	2-2-3-3
23'0"	28'0"	AUGERED HOLE		
25'0"	27'0"	BLK ORG WDY	S.S #7	6-7-10-9
28'0"	29'6"	AUGERED HOLE		
		GRY SI CL		
		REFUSAL AT 29'6" (BEDROCK)		

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SUBGRADE CHECK FIELD SHEET

PAGE NO. 1

TWP. _____ DATE Sept 27 19 76

B.H. #1 571+50 15' RT

0 – 8' F GRAVEL
8 – 15' BLK SA LO TILL
15 – 21'6" F GRAVEL
21'6" 26'5" F - MED SAND
26'5" – 35' Co SAND (PIECES OF WOOD @ 31')
35' – 36.8' F SA LO TILL & Co SAND (TR of ORG AT 35')
36.8' – 40' CORED B.R.

B.H. # 2 571+50 72' RT (-6')

0 – 28' BLK ORG WOODY
28 – 31'6" F SAND & SILT
31'6" NFP B.R.

B.H. # 3 573+50 70' RT

0 – 27' BLK ORG WOODY
27 – 29' GREY LT - MED CLAY
29 – 30'6" MED SAND
30'6" NFP B.R.

B.H. # 4 573+50 15' LT

0 – 10' F GRAVEL
10 – 11' GREY Co SAND – F GRAVEL
11 – 14' F SA LOOSE WET
14 – 16'3" Co SAND
16'3" – 22'6" BLK ORG WOODY
22'6" – 23' F SAND
23 – 24'6" M SAND
24'6" NFP B.R.

HWY. NO. 62 LOCATION BANNOCK BRAN N'LY ENGINEER W D Fox

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Ontario

SUBGRADE CHECK FIELD SHEET

PAGE NO. 2

TWP. _____ DATE SEPT 27 19 76

B.H. # 5 571+50 15' LT

0 – 7'6" F GRAVEL
7'6" – 16'6" BR SA Lo TILL
16'6" – 28'5" BLK ORG WOODY
28'5" NFP B.R.

B.H. # 6 573+50 15' RT

0 – 10' F SA & F GRAVEL
10 – 17'6" F SAND & SILT
17'6" – 20' F SAND & SILT ORGANIC MIXTURE
20' REFUSAL WITH AUGER (POINT DRIVEN TO 33'3")

B.H. # 7 596+00 14' RT

0 – 10' F GRAVEL
10 – 17' SA Lo TILL
17 – 20'6" MED SAND
20'6" – 27' BLK ORG WOODY
27 – 30'8" GREY M CL
30'8" NFP B.R.

B.H. # 8 596+00 14' LT

0 – 7'6" F GRAVEL
7'6" – 30'6" SA Lo TILL
30'6" – 33' BLK ORG WOODY
33' NFP B.R.

HWY. NO. 62 LOCATION BANNOCK BURN N'LY ENGINEER W D FOX

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Ontario

SUBGRADE CHECK FIELD SHEET

PAGE NO. 3

TWP. _____ DATE SEPT 27 19 76

B.H. # 9

0 – 10'6"	F GRAVEL
10'6" – 13'6"	SA LO TILL (TR OF ORG)
13'6" – 27'	SA LO TILL
27 – 32'	BLK ORG WOODY & MARL MIXTURE
32 – 33'6"	GREY M CL
33'6"	NFD B.R.

B.H. # 10

0 – 8'	F GRAVEL
8 – 13'6"	SA LO TILL
13'6" – 17'	SA LO TILL (TR OF ORG)
17 – 23'	F SAND & SA LO TILL
23 – 28'	BLK ORG WOODY
28 – 29'6"	GREY M CL
29'6"	NFD B.R.

HWY. NO. 62 LOCATION BANNOCK BURN N'LY ENGINEER W D FOX

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FORM OB-MT-161 DEPARTMENT OF HIGHWAYS ONTARIO

PAGE NO. 1

TWP. TUDOR DATE Oct 5, 1976

W.P. 103-63-04

562+50 12' Rt.

0-36"	Br F Gr
36"-13'	Br F Sa Lo Till (Sat 72"+)
13'-20'	Blk Org (Firm, Woody)
20'-25'	Gry Si Cl Lo Sat 76-LL-239 M
25'	N.F.P. B.R.

562+60 12' Lt.

0-36"	Br F Gr
36"-14'	Br F Sa Lo Till (Sat 84"+) 76-LL-240M
14'-22'	Blk Org (Firm, Woody)
22'-26'	Gry Si Cl Lo Sat.
26'	NFP B.R.

590+50 12' Rt.

0-36"	Br F Gr
36"-13'	Br F Sa Lo Till (Stny) Sat 10'+
13'-16'	Blk Org (Firm)
16'	NFP Blds.

HWY. NO. 62 LOCATION 8.9 mi. N of Renfrew to 0.3 mi. N of St. No. 63 ENGINEER D. McCoy

sta 561 to sta 563.50

1026.5 to 1025.5

sta 569 to sta. 576

1027 to 1028

sta. 589 to sta 591

1026

sta. 594 to sta. 598

1026 to 1028

sta 615 to sta 618

1032 to 1038.

Sta. 561+00 to Sta 563+50

$$q_u = cC\left(1+0.2\frac{D_f}{B}\right) \qquad C \doteq 200$$
$$\doteq 1000 \text{ psf}.$$

$$q = 15 \times 125 - 8 \times 85 \doteq 1200 \text{ psf}.$$

$\therefore \quad q_u \doteq q$

Sol'n. 1. reduce q.
2. provide berm, or flatten the slope.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE Nº 1

FOUNDATIONS OFFICE

WP 103 63 04 LOCATION STA. 571+50 15' RT ORIGINATED BY W.F.

DIST ____ HWY 62 BORING DATE 21 SEPT 76 COMPILED BY M.M

DATUM GEODETIC BOREHOLE TYPE WASH BORING, NX CASING AND CONE CHECKED BY ____

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV
1026.3 0.0				SS	8	▽
	WELL GRADED SANDS, SOME GRAVEL AND FINES		1	SS	17	
			2	SS	17	
	LOOSE TO COMPACT		3	SS	6	
			4	SS	6	
1021.3 5.0	SANDY GRAVEL, SOME FINES, VERY DENSE		5	SS	103	
998.3 28.0	WELL GRADED SANDS, SOME GRAVEL AND FINES		6	SS	24	
	COMPACT		7	SS	25	
989.6 36.7	GRANITE		8	RC		
	END OF BOREHOLE					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE

LIQUID LIMIT ——W_L PLASTIC LIMIT ——W_P WATER CONTENT ——W

W_P W W_L

WATER CONTENT % 10 20 30

BULK DENSITY γ

REMARKS

GR. SA. SI. CL.

17 61 └22┘

45 43 └12┘

22 49 24 5

E REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 2

WP 103 63 04 LOCATION STA. 571+50 72' RT. ORIGINATED BY W.F.

DIST _____ HWY 62 BORING DATE 21 SEPT 76 COMPILED BY M.M

DATUM GEODETIC BOREHOLE TYPE HOLLOW STEM AUGER AND CONE CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. DEPTH (~~322.~~)	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES	ELEV	SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	W_P W W_L WATER CONTENT % 10 20 30	γ	GR. SA. SI. CL.
0.0 (1020.0)	TOP SOIL					▽				
2.0			1	SS	2					ORG. = 88 % W = 683 %
			2	SS	1					
	BLACK ORGANIC SOILS		3	SS	1					
	VERY SOFT		4	SS	1/4"					ORG. = 92 %
			5	SS	1/7"					ORG. 80 %
30.0 (992.0)	SILTY SAND VERY DENSE		6	SS	95		100/6"			9 50 36 5
	END OF BOREHOLE									

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 3

WP 103-63-04 — LOCATION STA 573+50 70' RT. — ORIGINATED BY W. F.

DIST ____ HWY 62 — BORING DATE 22 SEPT 76 — COMPILED BY M. M

DATUM GEODETIC — BOREHOLE TYPE HOLLOW STEM AUGER AND CONE — CHECKED BY ____

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES	ELEV	SHEAR STRENGTH: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	WATER CONTENT % (10 20 30)	γ	GR. SA. SI. CL.
1021.8 / 0.0	TOPSOIL					▽				
1012.8 / 9.0	BLACK ORGANIC SOILS VERY SOFT		1	SS	2					W = 488 % ORG = 74 %
			2	SS	2					
			3	SS	1/2"					W = 789 % ORG = 71 %
			4	SS	1/3"					
			5	SS						
994.8 / 27.0	UNIFORM MEDIUM SAND TRACE FINES LOOSE		6	SS	5		REFUSAL			0 89 11
992.8 / 30.0	AUGER REFUSAL BEDROCK ASSUMED									

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 4

WP 103-63-04 LOCATION STA 573+50 15' LT. ORIGINATED BY W.F.

DIST ____ HWY 62 BORING DATE 23 SEPT 76 COMPILED BY M.M

DATUM GEODETIC BOREHOLE TYPE WASH BORING, NX CASING AND CONE CHECKED BY ____

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w (w_P — w — w_L) WATER CONTENT % (10 20 30)	BULK DENSITY γ	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES	ELEV				GR. SA. SI. CL.
1026.2 / 0.0										
	WELL GRADED SANDS SOME GRAVEL AND FINES VERY LOOSE TO COMPACT		1	SS	22					16 65 15 4
			2	SS	15					
			3	SS	10					
			4	SS	4					
1009.2 / 17.0			5	SS	4					
	BLACK ORGANIC SOIL SOFT UNIFORM MEDIUM GRAIN TRACE FINES LOOSE.		6	S	4					W = 122% ORG. = 17 %
1008.2 / 21.5										
1001.7 / 24.5	AUGER REFUSAL BEDROCK ASSUMED						100/6"			

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 5

WP 103 - 63 - 04 — LOCATION STR 571+50 15' LT. — ORIGINATED BY W.F.

DIST ____ HWY 62 — BORING DATE 23 SEPT. 76 — COMPILED BY M.M.

DATUM GEODETIC — BOREHOLE TYPE WASH BORING, NX CASING, AND CONE — CHECKED BY ____

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV
1026.3						
	WELL GRADED SANDS SOME GRAVEL AND FINES LOOSE TO DENSE		1	SS	25	
			2	SS	25	
			3	SS	44	
1012.3			4	SS	4	
14.0	GRAVELLY SANDS SOME FINES COMPACT		5	SS	17	
1008.3						
18.0	BLACK ORGANIC SOIL		6	SS	9	
			7	SS	11	
997.8						
28.5	AUGER REFUSAL BEDROCK ASSUMED					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100)

SHEAR STRENGTH: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

10 1/2"

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W — W_P W W_L

WATER CONTENT % (10 20 30)

BULK DENSITY γ

REMARKS	GR. SA. SI. CL.
	23 60 17
	6 60 34
	41 44 15
W = 356 % ORG = 83 %	
W = 441 % ORG = 89 %	

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DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 6

WP 103 63 04 LOCATION STA. 573+50 15' RT. ORIGINATED BY W.P.

DIST ____ HWY 62 BORING DATE 23 SEPT. 72 COMPILED BY M.M.

DATUM GEODETIC BOREHOLE TYPE HOLLOW STEM AUGER AND CONE CHECKED BY ____

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES	ELEV	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W_P W W_L WATER CONTENT % 10 20 30	γ	GR. SA. SI. CL.
1026.2 0.0	WELL GRADED SANDS SOME GRAVEL AND FINES COMPACT		1	SS	6					
			2	SS	16					
			3	SS	14					16 74 10
			4	SS	13					
1008.7 17.5 1008.2	FINE SILTY SAND SOME ORGANICS		5	SS	14					17 61 22
20.0	AUGER REFUSAL						100/3"			

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DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 7

WP 103-63-04 — LOCATION STA 596+00 14' RT. — ORIGINATED BY W.F.

DIST ____ HWY 62 — BORING DATE 24 SEPT. 76 — COMPILED BY M.M

DATUM GEODETIC — BOREHOLE TYPE WASH BORING, NX CASING, AND CONE — CHECKED BY ____

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV
1025.6 / 0.0	WELL GRADED SANDS SOME GRAVEL AND FINES		1	SS	12	
			2	SS	16	
	VERY LOOSE TO COMPACT		3	SS	15	
			4	SS	4	
			5	SS	3	
1007.6 / 18.0	SILTY SAND LOOSE		6	SS	9	
1005.1 / 20.5	BLACK ORGANIC SOILS FIRM CLAYEY SILTS		7	SS	7	
994.9 / 30.7	AUGER REFUSAL BEDROCK ASSUMED		8	SS	16/5"	

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100)

SHEAR STRENGTH: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W — W_P W W_L

WATER CONTENT % (10 20 30)

BULK DENSITY γ

REMARKS	GR. SA. SI. CL.
	16 71 13
	17 62 21
W = 32.1%	

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DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 8

WP 103-63-04 LOCATION STA 596+00 14' LT ORIGINATED BY W. F.

DIST ____ HWY 62 BORING DATE 24 SEPT, 76 COMPILED BY M M

DATUM GEODETIC BOREHOLE TYPE WASH BORING, NX CASING, AND CONE CHECKED BY ____

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) / WATER CONTENT % (10 20 30)	BULK DENSITY γ	REMARKS / GR. SA. SI. CL.
1025.6 / 0.0										
	WELL GRADED SANDS SOME GRAVEL AND FINES		1	SS	17	▽				14 67 19
			2	SS	24					
				SS	11					
	VERY LOOSE TO COMPACT		3	SS	2					
			4	SS	3					16 72 12
			5	SS	10					
995.1 / 30.5	BLACK ORGANIC SOILS FIRM		6	SS	12					W = 205% ORG = 37%
992.6 / 33.0	AUGER REFUSAL BEDROCK ASSUMED						100/0"			

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 9

WP 103-63-04 LOCATION STA 615+00 14' RT. ORIGINATED BY W.F.

DIST ____ HWY 62 BORING DATE 24 & 27 SEPT 76 COMPILED BY M.M.

DATUM GEODETIC BOREHOLE TYPE HOLLOW STEM AUGER AND CONE CHECKED BY ____

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER ELEV	BULK DENSITY γ	REMARKS / GR. SA. SI. CL.
1032.6								
0.0								
	WELL GRADED SAND SOME GRAVEL AND FINES		1	SS	3			
			2	SS	1			
			3	SS	10			36 56 7 / 1
	VERY LOOSE TO COMPACT		4	SS	14			
			5	SS	6			23 56 21 /
			6	SS	15			
			7	SS	6			
1004.1 28.5	BLACK ORGANIC SOILS FIRM		8	SS	8			w = 158 % eeq = 37 % w = 47 % eRG = 5 %
1000.6 32.0	SILT TRACE OF ORGANICS		9	SS				
999.1 33.5	AUGER REFUSAL BEDROCK ASSUMED							

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

SHEAR STRENGTH: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

100/0"

LIQUID LIMIT —— w_L PLASTIC LIMIT —— w_P WATER CONTENT —— w

w_P w w_L

WATER CONTENT % 10 20 30

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DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 10

WP 103-63-04 LOCATION STA. 615+00 14' LT. ORIGINATED BY W. F.

DIST ____ HWY 62 BORING DATE 24 & 27 SEPT 76 COMPILED BY M.M.

DATUM GEODETIC BOREHOLE TYPE WASH BORING, NX CASING AND CONE CHECKED BY ____

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES	ELEV	SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	W_P W W_L WATER CONTENT % 10 20 30	γ	GR. SA. SI. CL.
1032.6	WELL GRADED SANDS SOME GRAVEL AND FINES - VERY LOOSE TO COMPACT		1	SS	23					18 70 12
			2	SS	5					
			3	SS	10					
			4	SS	4					21 65 14
			5	SS	2					
1012.6 20.0			6	SS	6					
	BLACK ORGANIC SOILS VERY STIFF		7	SS	19					W = 152.5% ORG = 37%
1003.1 29.5	AUGER REFUSAL BEDROCK ASSUMED						100/0"			

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PROJECT 103-63-04 SITE BOREHOLE NO. 1 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	10'-11'6"	5/8"	SUB ANG	15	75	10	SLIGHT	NIL	QUICK	NIL	EARTHY	BROWN	STRONG	-	GRAVELLY SAND - TRACE OF FINES	SW
2	11-11'6"	1"	S.A.	25	70	5	NIL	"	"	"	"	GREY	"	-	" " " " "	"
3	15-16.5	1/2	"	5	90	5	"	"	"	"	"	BROWN	"	—	" " " " "	"
4	20-21.5	1"	"	30	50	20	SLIGHT	"	"	"	SLIGHTLY ORG.	DARK BROWN	"	—	" " - SOME FINES	SP
6	30-31.5	1/2	"	5	90	5	NIL	"	"	"	EARTHY	CHARCOAL GREY	"		" " - TRACE OF FINES	SW

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE

PROJECT 103-63-05 SITE BOREHOLE NO. 1 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION						SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE			DRY STRENGTH									
				GRAVEL	SAND	SILT AND CLAY										
5	25-26.5	1½	SA	60	35	5	NIL	NIL	QUICK	NIL	EARTHY	BROWN	STRONG	–	SANDY GRAVEL – TRACE OF FINES	GW

NOTE:– VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:–

M.T.–3

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PROJECT 103-63-02 SITE _____ BOREHOLE NO. 1 GROUND ELEVATION _____

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
7	35'-36'	3/4	SR	20	30	50	SLIGHT	DULL	SLOW-QUICK	NIL	EARTHY	GREY	STRONG	—	GRAVELLY SAND - WITH EXCESS OF FINES (SILT)	SF

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE

PROJECT 103-63-04 SITE BOREHOLE NO. 2 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE GRAVEL	SAND	SILT AND CLAY										
1	3'-6'														MUSKEG (PEAT)	Pt
2	6'-8'6"														" "	"
3	10'-14'														" "	"
4	15'-19'														" "	"
5	26'-27'														" "	"
6	30'-32'	3/8"	SA	5	55	40	Low	Nil	QU.	NIL	EARTHY	GREY	STRONG		SILTY FINE SAND - TRACE OF GRAVEL	SF

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE

PROJECT 103-63-04 SITE BOREHOLE NO. 3 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	3'-5'														MUSKEG (PEAT) - (WOOD CHIPS)	Pt.
2	5-8														"	"
3	10-14														"	"
4	15-18														"	"
5	20-28														"	"
5	20-28	1/2	ANG.	5	55	40	LOW	NIL	QU.	NIL	EARTHY	GREY	STRONG		SILTY FINE SAND - TRACE OF GRAVEL	SF
6	29-30	#60	—	—	95	5	NIL	"	"	"	"	"	"		UNIFORM FINE SAND - TRACE OF SILT	SU

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.
REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE.

PROJECT 10 3-G 3-0K SITE BOREHOLE NO. 4 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	2'6"-4'	1/2	SA	5	90	5	NIL	NIL	QU	NIL	EARTHY	BROWN	STRONG		GRAVELLY FINE SAND - TRACE OF FINES	SU
2	6'-7'6"	3/4	SR	10	85	5	"	"	"	"	"	"	"		" " " "	"
3	9'-11'	1	Ang.	20	75	5	"	"	"	"	"	"	"		" " " "	SP
4	12'-14'	1/8"	—	—	90	10	"	"	"	"	"	GREY - BROWN	"		UNIFORM FINE SAND	SU
5	15'-16'6"	1	Ang.	30	<5	5	"	"	"	"	"	BROWN	"		GRAVELLY SAND - TRACE OF FINES	SP
6	20'-21'6"														PEAT	PT

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.
REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE

PROJECT 103-63-04 SITE BOREHOLE NO. 5 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	3'-4'6"	1	Ang.	20	75	5	NIL	NIL	QU.	NIL	EARTHY	BROWN	STRONG		GRAVELY FINE SAND - TRACE OF FINES	SP
2	6'-7'6"	1	S. Ang.	10	85	5	"	"	"	"	"	"	"		" " " — "	"
3	9'-10'6"	1	"	35	45	20	"	"	"	"	"	GREY BROWN	"		" " " — SOME FINES	GF
4	12'-13'6"	5/8	"	5	35	60	"	"	"	"	"	"	"		SANDY SILT - TRACE OF GRAVEL	ML
5	15-16'6"	1½	Ang	50	30	20	"	"	"	"	"	DARK BROWN	"		SANDY GRAVEL - SOME SILT	GF
6	20-21'6"														Peat	Pt
7	25-26'6"														"	"

NOTE:— VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.
REMARKS:—

M.T.—3

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SOILS MECHANICS OFFICE

PROJECT 103-63-04 SITE BOREHOLE NO. 6 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION						DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE													
				GRAVEL	SAND	SILT AND CLAY											
1	3'-5'	3/4	S.Ang.	10	85	5	NIL	NIL	QU.	NIL	EARTHY	BROWN	STRONG	-		GRAVELY FINE SAND - TRACE OF FINES	SP
2	6'-7½"	1	"	5	80	15	"	"	"	"	"	"	"			" " " - SOME FINES	SP
3	9'-11'	1⅛	"	10	85	5	"	"	"	"	"	GREY BROWN	"			" " " - TRACE OF FINES	SP
4	12'-14'	3/4	"	5	90	5	"	"	"	"	"	"	"			" " " - "	"
5	16'-18'	1	"	10	60	30	"	"	"	"	"	"	"			GRAVELY SAND - WITH FINES	SF

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.
REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE

PROJECT 103-63-04 SITE BOREHOLE NO. 7 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	3'-4'6"	1/2	S.Ang	10	85	5	NIL	NIL	QU.	NIL	EARTHY	BROWN	STRONG		GRAVELY FINE SAND - TRACE OF FINES	SU
2	6'-7'6"	1/4	"	15	60	25	"	"	"	"	"	"	"		" " " — SOME FINES	SF
3	9'-11'	3/4	S.Round	5	85	10	"	"	"	"	"	"	"		" " " — TRACE OF FINES	SP
4	12'-13'6"	1	S.Ang.	30	60	10	"	"	"	"	"	"	"		" " " — "	SU
5	15'-17'	1	"	15	65	20	"	"	"	"	"	"	"		" " " — SOME FINES	SU
6	20'-22'			-	60	40	SLIGHT	"	SLOW TO QUICK	"	SLIGHTLY ORG.	GREY BROWN	MILD		SILTY SAND	SF
6	20'-22'														PEAT	~~Pt~~
7	25'-27'														PEAT	Pt
8	30'3"-30'8"				5	95	MED.	DULL	SLOW	MED	EARTHY	GREY	MILD		CLAY SILT	CL

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

M.T.-3

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PROJECT 103-63-04 SITE BOREHOLE NO. 8 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	3'-4'6"	3/4	S. Ang.	10	85	5	NIL	NIL	QO.	NIL	EARTHY	BROWN	STRONG		GRAVELY FINE SAND - TRACE OF FINES	SU
2	6'-7'6"	5/8	"	15	75	10	"	"	"	"	"	"	"		" " " "	SU
3	13'6"-15'	1/2	"	20	65	15	"	"	"	"	"	"	"		" " " - SOME FINES	SP
4	20'-21'6"	5/8	"	10	80	10	"	"	"	"	"	GREY BROWN	"		" " " - TRACE OF FINES	SU
5	25'-26'6"	1	S. Round	10	85	5	"	"	"	"	"	"	"		" " " - "	SU
6	30'6"-31'6"														Peat	Pt

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

M.T.-3

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PROJECT 103-63-04 SITE BOREHOLE NO. 9 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	3'-5'	3/4	S. Ang.	20	75	5	NIL	NIL	Q.U.	NIL	EARTHY	BROWN	STRONG		GRAVELLY FINE SAND - TRACE OF FINES	SP
2	6'-8½'	3/4	"	25	70	5	"	"	"	"	"	"	"		" " " "	"
3	9'-10'6"	1¼	S. Round	30	65	5	"	"	"	"	"	"	"		" " " "	"
4	12'-13'6"	½	S. Ang.	5	55	40	"	"	"	"	"	"	"		" " " - WITH FINES & TRACE OF ORG.	SA
5	15'-17'	1	"	20	50	30	"	"	"	"	"	GREY BROWN	"		" " " - WITH FINES	SF
6	20'-22'	1	"	10	85	5	"	"	"	"	"	"	"		" " " - TRACE OF FINES	SP
7	25'-27'	¼	"	5	90	5	"	"	"	"	"	"	"		" " " "	SU
8	30'-32'														PEAT & MARL	Pt
9	32'-33'				5	95	MED.	DULL	SLOW	LOW	ORGANIC	GREY	NIL		ORGANIC SILT	ML OH

NOTE:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.
REMARKS:-

M.T.-3

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SOILS MECHANICS OFFICE

PROJECT 103-63-04 SITE BOREHOLE NO. 10 GROUND ELEVATION

SAMPLE NO.	DEPTH	GRAIN SIZE DISTRIBUTION: LARGEST GRAIN SIZE	SHAPE	PERCENTAGE: GRAVEL	SAND	SILT AND CLAY	DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
1	3'-5'	1	S. Ang.	15	80	5	NIL	NIL	QU.	NIL	EARTHY	BROWN	STRONG		GRAVELLY FINE SAND - TRACE OF FINES	SU
2	6'-8'	3/8	"	25	70	5	"	"	"	"	"	"	"		" " " "	SP
3	9'-10'6"	5/8	"	20	70	10	"	"	"	"	"	"	"		" " " "	SP
4	12'-13'6"	5/8	Ang.	20	65	15	"	"	"	"	"	"	"		" " " - SOME FINES	SP
5	15'-17'	5/8	S. Ang.	20	70	10	"	"	"	"	"	GREY BROWN	"		" " " - TRACE OF FINES	SP
6	18'-20'	1"	Ang.	25	70	5	"	"	"	"	"	"	"		" " " "	SP
7	25'-27'														PEAT	Pt

NOTE:— VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

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