



Foundation Investigation Report

VARIOUS CREEK CULVERT EXTENSIONS, HIGHWAY 3 WIDENING AND SAFETY ENHANCEMENTS 1.2 KM EAST OF ESSEX COUNTY ROAD 23 TO 1.1 KM EAST OF ESSEX COUNTY ROAD 34, TOWNSHIPS OF GOSFIELD NORTH / GOSFIELD SOUTH, DISTRICT OF CHATHAM, TOWN OF KINGSVILLE, ESSEX COUNTY, ONTARIO, MINISTRY OF TRANSPORTATION, ONTARIO, GWP 3021-18-00

**SITE NO.: 06X-0420/C0, 06X-0421/C0, 06X-0422/C0, 06X-0423/C0
06X-0426/C0, 06X-0427/C0, 06X-0429/C0, 06X-0432/C0**

Site NO.	Latitude	Longitude
06X-0420/C0	42.141773	-82.789997
06X-0421/C0	42.129369	-82.770415
06X-0422/C0	42.128920	-82.770742
06X-0423/C0	42.127865	-82.768205
06X-0426/C0	42.119725	-82.756535
06X-0427/C0	42.114946	-82.751028
06X-0429/C0	42.101778	-82.736576
06X-0432/C0	42.090308	-82.723864

13 January 2021

GEOCRES NO.: 40J2-147



→ **The Power of Commitment**

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1. Introduction

GHD Limited (GHD) was retained by the Ministry of Transportation, Ontario (MTO) to provide preliminary and design-build ready foundation engineering services for extension/replacement of eight culverts between Essex Road 23 and Essex Road 34 in the Town of Kingsville, County of Essex, Ontario. The location of the culverts is shown on the Key Plan on Drawing 1 The list of culverts with the corresponding site numbers, and the approximate culvert location and stationing are summarized in Table 1.

Table 1 List of Culvert Structures

Culvert No.	Approximate Station (m)	Road/Highway
06X-0420/C0	12+500	Concession Road 9
06X-0421/C0	14+625	Highway 3
06X-0422/C0	14+650	Concession Road 8
06X-0423/C0	14+870	Highway 3
06X-0426/C0	16+170	Highway 3
06X-0427/C0	16+900	Highway 3
06X-0429/C0	10+015	Highway 3
06X-0432/C0	11+661	Highway 3

Note: * Culvert No. 06X-0426/C0 will be relocated 25 m to the east, with a replacement length of 63.2 m.

The purpose of this investigation is to establish the subsurface soil and groundwater conditions at the proposed culvert extensions/replacement by borehole drilling and geotechnical and analytical laboratory testing on selected soil samples.

The Terms of Reference (TOR) and the scope of work for this project are identified within the agreement of services as amended between MTO and GHD for Consultant's Assignment Number 3017-E-0012. The work has been carried out in accordance with the requirements of *Guideline for Foundation Engineering Services, Version 2.0, October 2020*, prepared by the MTO.

2. Site Description

The culvert sites addressed in this report are located from about Concession Road 9 to about 1,200 m east of Essex Road 29 (Division Road) along either Highway 3 or intersecting Concession Roads 8 and 9, in the Township of Gosfield North, Ontario. Detailed below is a general description of the location of each culvert:

- Culvert No. 06X-0420/C0 is located on Concession Road 9, about 50 m south of the intersection with Highway 3.
- Culvert No. 06X-0421/C0 is located just west of the intersection between Highway 3 and Concession Road 8.
- Culvert No. 06X-0422/C0 is located on Concession Road 8, about 80 m south of the intersection between Highway 3 and Concession Road 8.
- Culvert No. 06X-0423/C0 is located approximately 220 m east of the intersection between Highway 3 and Concession Road 8.
- Culverts Nos. 06X-0426/C0, 06X-0427/C0 and 06X-0429/C0 are located between Essex Road 27 (Belle River Road) and Essex Road 29 (Division Road); and,

- Culvert No. 06X-0432/C0 is located about 600 m east of the intersection between Highway 3 and Essex Road 29 (Division Road).

The water in the culvert flows from north to south, with the exception of Culvert Nos. 06X-0427/C0 and 06X-0429/C0 where the water in the culvert flows to the west.

Highway 3 in the area serves as a regional corridor and major collector, connecting small rural and urban communities with Windsor and the United States. It is a two-lane road aligned mostly in the northwest-southeast direction. The culverts are situated in a rural-setting environment with generally a flat landscape. Land in the surroundings of the structures is used mainly for agricultural purposes and related farm facilities. There are few residential buildings immediately south of Culvert No. 06X-0429/C0 along Concession Road 6 and further north along Essex Road 29 (Division Road). A greenhouse structure and associated facilities also exist immediately south of the Culvert No. 06X-0432/C0.

The embankment slopes on culverts were covered by grass or other vegetation and observed to be stable, with no signs of erosion at most culvert locations. Signs of minor erosion at the toe of the embankment slopes was observed at the location of Culvert Nos. 06X-0422/C0 and 06X-0426/C0. General site and culvert conditions are shown in photographs (i.e., Photographs 1 to 16) presented in Appendix A.

3. Investigation Procedures

The geotechnical fieldwork for this investigation was carried out in two phases. Between April 27 and May 19, 2020 sixteen boreholes numbered as BH-20-01 to BH-16-20 (two boreholes at each structure), were advanced to depths between 9.8 m and 11.3 m below existing grade. The boreholes were advanced either, near or at the shoulder of the road and near the proposed south culvert extensions. The boreholes were advanced using a Diedrich D-50 track-mounted drill rig, equipped with continuous flight, solid stem augers supplied and operated by Altech Drilling and Investigative Services of Cambridge, Ontario.

Between October 4 and November 11, 2021, six boreholes (numbered BH-21-01 to BH-21-06, inclusive) were advanced at the location of Culvert Nos. 06X-0423/C0, 06X-0426/C0, 06X-0427/C0, 06X-0429/C0, 06X-0432/C0 to depths of between 11.3 m and 15.8 m below existing grade, near the end of the proposed north extensions. The boreholes were advanced using either a Diedrich D-50 track-mounted drill rig (for Boreholes BH-21-01, BH-21-03, and BH-21-06) or a truck-mounted drilling rig (for the remaining boreholes), equipped with hollow stem augers, supplied and operated by Direct Environmental Drilling Inc. of London, Ontario.

A summary of the field program including the borehole location, depth and termination elevation of the borehole is presented in Table 2. The location of the boreholes advanced at the culvert sites are shown on Drawings 2 to 9.

Table 2 Summary of the Borehole Program

Culvert Number	Borehole Number	Location	Location (MTM NAD 83, ZONE 11)		Borehole Depth (m)	Ground Surface Elevation (m)
			Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
06X-0420/C0	BH-20-01	NBL Shoulder of Concession Rd 9	4,666,959.4 (42.141783)	280,836.9 (-82.789905)	9.8	194.8
	BH-20-02	Near the east end of proposed culvert	4,666,946.7 (42.141670)	280,856.9 (-82.789663)	9.8	194.3
06X-0421/C0	BH-20-03	EBL Shoulder	4,665,573.4 (42.129352)	282,433.8 (-82.770533)	9.8	195.3

Culvert Number	Borehole Number	Location	Location (MTM NAD 83, ZONE 11)		Borehole Depth (m)	Ground Surface Elevation (m)
			Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
	BH-20-04	Near the south end of proposed culvert	4,665,539.7 (42.129048)	282,422.5 (-82.770669)	9.8	194.9
06X-0422/C0	BH-20-05	NBL Shoulder of Concession Rd 5	4,665,516.3 (42.128837)	282,413.7 (-82.770774)	9.8	194.5
	BH-20-06	Near the east end of proposed culvert	4,665,505.6 (42.128742)	282,445.9 (-82.770385)	9.8	194.4
06X-0423/C0	BH-20-07	EBL shoulder	4,665,404.5 (42.127837)	282,622.8 (-82.768241)	9.8	195.5
	BH-20-08	Near the south end of proposed culvert	4,665,399.6 (42.127792)	282,581.1 (-82.768745)	9.8	194.3
	BH- 21-01	Near the north end of proposed culvert	4,665,407.5 (42.127864)	282,642.3 (-82.768005)	13.6	194.9
06X-0426/C0	BH-20-09	EBL shoulder/original culvert location	4,664,521.8 (42.119915)	283,565.9 (-82.756802)	9.8	195.1
	BH-20-10	Near the south end of original culvert location	4,664,494.3 (42.119667)	283,549.3 (-82.757001)	11.3	193.3
	BH-21-02	Near the north end of proposed culvert	4,664,509.0 (42.119801)	283,607.0 (-82.756304)	15.8	195.7
06X-0427/C0	BH-20-11	EBL shoulder	4,663,965.9 (42.114922)	284,035.9 (-82.751097)	9.8	195.1
	BH-20-12	Near the south end of proposed culvert	4,663,975.9 (42.115011)	283,998.7 (-82.751668)	9.8	194.6
	BH-21-03	Near the north end of proposed culvert	4,663,959.4 (42.114864)	284,063.5 (-82.750763)	15.7	194.8
06X-0429/C0	BH-20-13	EBL shoulder	4,662,508.6 (42.101832)	285,219.3 (-82.736739)	9.8	195.3
	BH-20-14	Near the south end of proposed culvert	4,662,500.5 (42.101758)	285,185.7 (-82.737144)	11.3	194.7
	BH-21-04	Near the north end of proposed culvert	4,662,509.5 (42.101840)	285,243.3 (-82.736448)	15.8	195.0
	BH-21-05	Near the north end of proposed culvert	4,662,493.4 (42.101695)	285,254.3 (-82.736315)	15.8	195.3
06X-0432/C0	BH-20-15	EBL shoulder	4,661,218.0 (42.090237)	286,277.2 (-82.723907)	9.8	195.9
	BH-20-16	Near the south end of proposed culvert	4,661,205.3 (42.090123)	286,250.4 (-82.724231)	9.8	194.6
	BH-21-06	Near the north end of proposed culvert	4,661,226.8 (42.090317)	286,296.1 (-82.723679)	11.3	196.0

Prior to the start of the fieldwork, utility clearance procedures were implemented through Ontario One Call protocol, and fieldwork notification was sent to MTO West Region. Culvert No. 06X-0422/C0 is located on

Concession Road 8 and a road occupancy permit was obtained from the Town of Kingsville as the culvert is located beyond the limits of the MTO Right of Way (ROW). A project specific Health and Safety as well as Traffic Protection Plans were prepared before commencement of the fieldwork. In addition, the borehole locations were marked by GHD staff prior to drilling. All drilling activity, soil sampling and logging, and backfilling of boreholes were conducted under the full-time supervision of an experienced GHD geotechnical engineer.

Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer-diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures described in ASTM D1586¹. Where firm to stiff cohesive deposits were encountered, in-situ field vane shear tests were carried out using an MTO 'N'-size vane to assess the strength characteristics of these soils in accordance with ASTM D2573². In addition, relatively undisturbed samples were obtained using 76 mm outer diameter thin-walled Shelby tube (ASTM D1587)³. Soil samples obtained from the boreholes were inspected in the field immediately upon retrieval for type, texture, and color. All retrieved samples from the first phase of investigation were sealed in clean plastic bags and transported to the GHD laboratory in Whitby and Waterloo for further visual examination, and geotechnical laboratory tests.

Groundwater condition and water levels in the open boreholes were observed during drilling by visual examination of soil samples and drill rods as well as immediately following drill operations. Three monitoring wells were installed in Boreholes BH-21-01, BH-21-03 and BH-21-06 to permit monitoring of the groundwater level at the location of Culvert Nos. 06X-0423/C0, 06X-0427/C0, and 806X-0432/C0, respectively. The monitoring wells consist of 50 mm diameter PVC pipe with a slotted screen that was sealed above the screen. The borehole annulus surrounding the monitoring well was backfilled with sand and the remainder of the borehole was then backfilled with bentonite to or near the ground surface. Details of the monitoring well installation and water level readings are presented on the borehole records in Appendix B. The boreholes without monitoring wells were backfilled with bentonite and sealed at the top with compacted auger cuttings, in accordance with Ontario Regulation 903, (as amended).

Classification testing (i.e., water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. In addition, two one-dimensional consolidation (oedometer) tests were carried out in GHD Waterloo laboratory on selected samples of the cohesive deposit from the Shelby tube samples. All laboratory tests were conducted in accordance with MTO and/or American Society for Testing Materials (ASTM) standards, as appropriate.

In addition, one soil sample collected during the first phase of investigation from each culvert site and five samples from the second phase of investigation were submitted for analysis of a suite of parameters, including conductivity, resistivity, soluble chloride concentration, soluble sulphate concentration and pH. These samples were sent to Caduceon Environmental Laboratories (Caduceon) of Richmond Hill, Ontario for the first phase of investigation and to ALS Environmental Laboratory of Waterloo, Ontario for the second phase of investigation.

Surveying of the as-drilled borehole locations was conducted by Callon Dietz Inc. (Callon Dietz) of London, Ontario, subcontracted to GHD. Callon Dietz provided northing and easting in MTM NAD 83 (Zone 11) coordinates. The coordinates shown on borehole logs and any part of this report correspond to these northings and eastings. The ground surface elevations are referenced to Geodetic datum. The coordinates and ground surface elevation are presented in Table 2, on the borehole records and on Drawings 2 to 9.

¹ ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.

² ASTM D2573-15 Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils

³ ASTM D1587 - Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes

4. Physiography and Regional Geology

The culvert structures are located within the Essex Clay Plain region, which is a subdivision of the St. Clair Clay Plain, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)⁴. The plain is a broad area of low relief and poor natural drainage. It comprised of silt-clay soils and extends on both sides of the St. Clair/Detroit River system from Lake Huron to Lake Erie, and encompasses nearly all of Essex County. The Essex County area underwent at least four cycles of glaciations during the Quaternary Period, although only deposits of the most recent Wisconsinan age are recognized in Essex County (Chapman and Putnam, 1984). The surface geology is characterized by a clay plain with localized veneers of fine sand. This clay plain consists of a glaciolacustrine deposit made up of silty clay to clayey silt materials of less than 10 m in thickness. The glaciolacustrine deposits are underlain by a thicker glacial till. A thin layer of discontinuous sand and silt locally separates the glaciolacustrine deposit from the glacial till. Sand layers also occur sporadically within the till deposit. Throughout the Essex Clay Plain, the sand and clay soils together extend to a depth of 30 m to 60 m before encountering a bedrock (Chapman and Putnam, 1984).

The rock units in the area are sedimentary rocks consisting of limestone, dolostone and shale of the Michigan Basin sequence belonging to the Dundee Formation and Detroit River Group.

5. Subsurface Conditions

Details of the subsurface and groundwater conditions at each culvert location as encountered in the boreholes advanced during the investigation, the details of the monitoring well installations and the summary of the geotechnical laboratory testing are presented on the Records of Borehole provided in Appendix B. The *Notes on Borehole and Test Pit Reports* are also included in Appendix B to assist in the interpretation of the borehole records. The results of the geotechnical laboratory testing are contained in Appendix C. The results of in-situ field tests (i.e., SPT “N” values), as presented on the borehole records and in the sub-sections of Section 5 are uncorrected.

The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of the Standard Penetration Tests and in-situ vane shear tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole records governs any interpretation of the site conditions. It should be noted that the interpreted stratigraphy shown on Drawings 2 to 8 is a simplification of the subsurface conditions.

A more detailed description of the subsurface conditions encountered in the boreholes advanced near each culvert location is provided in the following subsections.

5.1 Culvert No. 06X-0420/C0

The fieldwork for the foundation investigation at Culvert No. 06X-0420/C0 consisted of Boreholes BH-20-01 and BH-20-02 advanced at the shoulder of Concession Road 9 and near the end of the proposed culvert extension, respectively (see Drawing 2).

⁴ Chapman, L.J. and Putman, D.F., 1984, *The Physiography of Southern Ontario*, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)

In summary, the subsurface conditions at borehole locations consist of a surficial layer of topsoil or fill material underlain by a cohesive till deposit extending to the maximum depth of investigation at 9.8 m below ground surface (Elevation 184.5 m).

5.1.1 Topsoil

A 0.3 m thick layer of topsoil was encountered in Borehole BH-20-02. The topsoil was dark brown to black in color, moist to wet, and was generally clayey silt in texture and contains traces of sand, gravel and rootlets.

5.1.2 Fill

A 0.7 m thick layer of granular fill consisting of sand and gravel, some silt was encountered in Borehole BH-20-01, immediately below the ground surface.

The Standard Penetration Test (SPT) “N” value recorded within the fill was 23 blows per 0.3 m of penetration, indicating a compact compactness condition.

The water content measured on a sample of the fill was 9 per cent.

5.1.3 Clayey Silt to Silty Clay (Till)

A cohesive till deposit consisting of an upper silty clay layer underlain by clayey silt, some sand and trace gravel, was encountered beneath the fill material in Borehole BH-20-01 and beneath the topsoil in Borehole BH-20-02 at depths of 0.3 m and 0.7 m below ground surface, respectively. Boreholes BH-20-01 and BH-20-02 terminated in the till deposit at a depth of 9.8 m below ground surface (Elevations 185.0 m and 184.5 m), respectively. Within samples of the cohesive till deposit discontinuous 0.1 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the cohesive till deposit range from 7 blows to 30 blows per 0.3 m of penetration, suggesting a firm to hard consistency.

Atterberg limits tests were carried out on five samples of cohesive till deposit and measured liquid limits between about 31 per cent and 46 per cent, plastic limits between about 16 per cent and 20 per cent, and plasticity indices between about 15 per cent and 26 per cent. The higher plasticity results were measured in the silty clay till deposit and the lower plasticity values were measured in the clayey silt till deposit. Based on these values, the upper portion of the till deposit may be classified as silty clay of medium to high plasticity and beneath the silty clay till deposit the till is classified as clayey silt with medium plasticity below depths of 1.5 m and 2.2 m below ground surface in Boreholes BH-20-2 and BH-20201, respectively. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C1-1 in Appendix C.

Grain size distribution testing was carried out on five samples of cohesive till and the results are shown on Figure C1-2 in Appendix C.

The water content measured on of samples of the cohesive till range between 15 per cent and 26 per cent.

5.2 Culvert No. 06X-0421/C0

The fieldwork at Culvert No. 06X-0421/C0 consisted of the completion of Boreholes BH-20-03 and BH-20-04 advanced at the shoulders of Highway 3 and Concession Road 8 (near to the end of the proposed culvert), respectively (see Drawing 3).

In summary, the subsurface conditions at borehole locations consist of a layer of fill material underlain by a cohesive till deposit extending to the maximum depth of investigation of 9.8 m below ground surface (Elevation 185.1 m).

5.2.1 Fill

At ground surface granular fill material consisting of sand and gravel with trace to some amounts of fines was encountered in Boreholes BH-20-03 and BH-20-04 and extended to depths of 1.4 m and 1.1 m below ground surface (Elevations 193.9 m and 193.8 m), respectively.

The SPT “N” values within the fill range from 8 blows to 16 blows per 0.3 m of penetration, indicating loose to compact compactness condition.

Grain size distribution test was carried out on a sample of the granular fill material and the results are shown on Figure C2-1 in Appendix C.

The water content measured on four samples of the granular fill range from 2 per cent to 4 per cent.

5.2.2 Clayey Silt to Silty Clay (Till)

Underlying the fill material, a cohesive till deposit consisting of silty clay underlain by clayey silt, some sand and trace gravel, was encountered in Boreholes BH-20-03 and BH-20-04 at depths of 1.4 m and 1.1 m below ground surface (Elevations 193.9 m and 193.8 m), respectively. Boreholes BH-20-03 and BH-20-04 terminated in the till deposit at a depth of 9.8 m below ground surface (Elevation 185.5 m and 185.1 m), respectively. Within samples of the cohesive till deposit discontinuous 0.1 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the cohesive till range from 8 blows to 28 blows per 0.3 m of penetration, suggesting a stiff to very stiff consistency.

Atterberg limits tests were carried out on four samples of cohesive till and measured liquid limits between about 34 per cent and 38 per cent, plastic limits between about 14 per cent and 19 per cent, and plasticity indices between about 18 per cent and 20 per cent. Based on these values, the upper portion of the till deposit may be classified as silty clay of medium to high plasticity and beneath the silty clay till deposit the till is classified as clayey silt with medium plasticity below depths of 2.8 m and 2.2 m below ground surface in Boreholes BH-20-03 and BH-20-04, respectively. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C2-2 in Appendix C.

Grain size distribution test was carried out on four samples of the cohesive till and the results are provided on Figure C2-3 in Appendix C.

The water content measured on of samples of the cohesive till range between 17 per cent and 25 per cent.

5.3 Culvert No. 06X-0422/C0

The fieldwork at Culvert No. 06X-0422/C0 consisted of Boreholes BH-20-05 and BH-20-06 advanced at the shoulders of Concession Road 8 and near the end of the proposed culvert, respectively (see Drawing 4).

In summary, the subsurface conditions at borehole locations consist of topsoil/fill material underlain by a cohesive and granular till deposit extending to the maximum depth of investigation of 9.8 m below ground surface (Elevation 184.6 m).

5.3.1 Topsoil

A 0.4 m thick layer of topsoil was encountered in Borehole BH-20-06 at ground surface. The topsoil consists of clayey silt, trace sand and gravel and rootlets.

5.3.2 Fill

At ground surface in Borehole BH-20-05 a 0.3 m thick granular fill layer consisting of sand and gravel with trace to some fines was encountered.

The SPT “N” value recorded within the granular fill material was 10 blows per 0.3 m of penetration, indicating a compact compactness condition.

The water content measured on a sample of the granular fill was 5 per cent.

5.3.3 Clayey Silt to Silty Clay (Till)

Underlying the fill material, a cohesive till deposit consisting of silty clay underlain by clayey silt, some sand and trace gravel, was encountered in Boreholes BH-20-05 and BH-20-06 at depths of 0.3 m and 0.4 m below ground surface (Elevations 194.2 m and 194.0 m), respectively. Boreholes BH-20-05 and BH-20-06 terminated in the till deposit at a depth of 9.8 m below ground surface (Elevation 184.7 m and 184.6 m), respectively. The till deposit in Borehole BH-20-06 between depths of 5.6 m and 7.2 m below ground surface (Elevation 188.8 m and 187.2 m) was described as silt and sand, trace to some clay. Within samples of the cohesive till deposit discontinuous 0.1 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the till deposit range from 5 blows to 18 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency.

Atterberg limits tests were carried out on four samples of cohesive till deposit and measured liquid limits between about 35 per cent and 51 per cent, plastic limits between about 18 per cent and 21 per cent, and plasticity indices between about 16 per cent and 30 per cent. Based on these values, the upper portion of the till deposit may be classified as silty clay of medium to high plasticity and beneath the silty clay till deposit the till is classified as clayey silt with medium plasticity below depths of 2.1 m and 2.9 m below ground surface in Boreholes BH-20-05 and BH-20-06, respectively. The results of the Atterberg limits tests are shown on the plasticity chart on Figure C3-1 in Appendix C.

Grain size distribution tests carried out on four samples of cohesive till deposit and the results are provided on Figure C3-2 in Appendix C. Grain size distribution tests carried out on one sample of silt and sand till deposit and the results are provided on Figure C3-3 in Appendix C.

The water content measured on samples of the cohesive till deposit range between about 17 per cent to 24 per cent and the water content measured on a sample of the silt and sand till deposit was about 23 per cent.

5.4 Culvert No. 06X-0423/C0

The fieldwork for the foundation investigation at Culvert No. 06X-0423/C0 consisted of Boreholes BH-20-07, BH-20-08 and BH-21-01 advanced at the shoulder of Highway 3, near the proposed south and north end of the culvert extension (see Drawing 5).

In summary, the subsurface conditions at borehole locations consist of topsoil/fill material underlain by a cohesive till deposit extending to depths of between 9.8 m and 13.6 m below ground surface (Elevation 185.7 m and 181.3 m).

5.4.1 Topsoil

A 0.3 m thick layer of topsoil was encountered in Borehole BH-20-08 at ground surface. The topsoil consisted of clayey silt, trace sand and gravel and rootlets.

5.4.2 Fill

At ground surface in Boreholes BH-20-07 and BH-21-01 fill material consisting of sand to sand and gravel, some fines was encountered and extended to depths of 1.1 and 0.8 m below ground surface (Elevations 194.4 m and 194.1 m), respectively. Underlying the granular fill material, a layer of cohesive fill consisting of silty clay with sand to silty clay was encountered in Boreholes BH-20-07 and BH-21-01 and extended to depths of 3.0 m and 2.3 m below ground surface (Elevations 192.5 m and 192.6 m), respectively.

The SPT “N” values recorded within the granular fill material were 5 blows and 9 blows per 0.3 m of penetration, indicating a loose compactness condition. The SPT “N” values within the silty clay fill material range from 3 blows to 8 blows, per 0.3 m of penetration., suggesting a soft to stiff consistency.

Atterberg limits test were carried out on a sample of cohesive fill material and measured a liquid limit of 45 per cent, a plastic limit of 19 per cent, and a plasticity index of 26 per cent, indicating a silty clay of medium plasticity. These results of the Atterberg limits test are shown on the plasticity chart on Figure C4-1 in Appendix C.

Grain size distribution tests carried out on one sample of granular fill material and one sample of the cohesive fill material are shown on Figures C4-2 and C4-3 in Appendix C, respectively.

The water content measured on samples of the granular fill material range between about 3 per cent to 15 per cent and the water content measured on samples of the cohesive fill material range between about 16 per cent and 24 per cent.

5.4.3 Clayey Silt (Till)

Underlying the fill material in Boreholes BH-20.07 and BH 21-01, and underlying the topsoil in Borehole BH 20-08, a cohesive till deposit consisting of clayey silt, some sand and trace gravel, was encountered at depths of between 0.3 m and 3.0 m below ground surface (between Elevations 194.0 m and 192.5 m). Boreholes BH-20-07, BH-20-08 and BH-21-01 terminated in the till deposit at depths of between 9.8 m and 13.6 m below ground surface (Elevation 185.7 m and 181.3 m). Within samples of the cohesive till deposit discontinuous 0.1 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the cohesive till deposit range from 4 blows to 31 blows per 0.3 m of penetration. The SPT “N” values generally decrease with depth within the till deposit. In-situ vane tests were carried out within this deposit measured undrained shear strengths ranging from about 80 kPa to greater than 100 kPa and the sensitivity ranges from about 1.7 to 2.3. The in-situ field vane test results together with the SPT “N” values indicate that the clayey silt till deposit predominately has a firm to hard consistency.

Atterberg limits tests were carried out on six samples of cohesive till deposit and measured liquid limits between about 31 per cent and 34 per cent, plastic limits between about 13 per cent and 18 per cent, and plasticity indices between about 13 per cent and 20 per cent. The results of the Atterberg limits tests shown on the plasticity chart on Figure C4-4 in Appendix C indicate that the cohesive deposit can be classified as clayey silt of low plasticity.

Grain size distribution tests carried out on three samples of cohesive till deposit and the results are provided on Figure C4-5 in Appendix C.

The water content measured on samples of the cohesive till deposit range between about 14 per cent to 24 per cent.

5.5 Culvert No. 06X-0426/C0

The fieldwork for the foundation investigation at Culvert No. 06X-0426/C0 consisted of Boreholes BH-20-09, BH-20-10 and BH-21-02, advanced at the shoulder of Highway 3, near the proposed south and north end of the culvert extension (see Drawing 6).

In summary, the subsurface conditions encountered at borehole locations consist of granular fill material underlain by cohesive till deposit extending to the maximum depth of investigation of 15.8 m (Elevation 179.8).

5.5.1 Fill

A 0.7 m to 1.5 m thick granular fill consisting of gravelly sand to sand and gravel, some silt was encountered in Boreholes BH-20-09 and BH-21-02, immediately below the ground surface.

The SPT “N” values recorded within the fill ranges between 11 blows and 53 blows per 0.3 m of penetration, indicating compact to very dense compactness condition.

The water content measured on samples of the granular fill ranged between 5 per cent and 9 per cent.

5.5.2 Clayey Silt to Silty Clay (Till)

A cohesive till deposit consisting of silty clay underlain by clayey silt, some sand and trace gravel, was encountered in Borehole BH-20-10 at ground surface and in Boreholes BH-20-09, and BH-21-02 underlying the fill material at depths of 0.7 m and 1.5 m below ground surface (Elevations 194.4 m and 194.2 m), respectively. Boreholes BH-20-09, BH-20-10 and BH-21-02 terminated in the till deposit at a depth of between 9.8 m and 15.8 m below ground surface (Elevation 185.3 m and 179.9 m), respectively. Within samples of the cohesive till deposit discontinuous 0.1 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the cohesive till ranged from 5 blows to 29 blows per 0.3 m of penetration. In-situ vane tests were carried out within this deposit measured undrained shear strengths ranging from about 82 kPa to greater than 100 kPa and the sensitivity ranges from about 1.6 to 1.8. The in-situ field vane test results together with the SPT “N” values indicate that the clayey silt till deposit predominately has a firm to very stiff consistency.

Atterberg limits tests were carried out on ten samples of cohesive till deposit and measured liquid limits between about 31 per cent and 46 per cent, plastic limits between about 15 per cent and 30 per cent, and plasticity indices between about 13 per cent and 23 per cent. The results of the Atterberg limits tests shown on the plasticity chart on Figure C5-1 in Appendix C indicate that the cohesive deposit consists of low plasticity clayey silt to medium plasticity silty clay.

Grain size distribution tests carried out on seven samples of cohesive till deposit and the results are provided on Figure C5-2 in Appendix C.

The water content measured on samples of the cohesive till deposit range between about 17 per cent to 28 per cent.

In addition, a consolidation test carried out on a sample of the clayey silt till from a Shelby tube obtained from Borehole BH-21-02, and the results are summarized in Table 6. The results of the consolidation test are presented on Figure C5-3 in Appendix C.

Table 3 Consolidation Parameters – Borehole BH-21-02

Borehole No. and Sample No.	Sample Depth / Elevation (m)	σ_{vo}'	σ_p'	Void Ratio (e_0)	Compression Indices		OCR	Average C_v
					Cr	Cc		
BH 21-02 TW-1	7.6 – 8.2 (188.1 – 187.5)	141.7	153	0.57	0.010	0.116	1.1	4.5

Where: σ_{vo}' is the in-situ vertical effective overburden stress in kPa
 σ_p' is the preconsolidation stress in kPa
OCR is the overconsolidation ratio
 e_0 is the initial void ratio
Cc is the compression index
Cr is the recompression index
 c_v is the coefficient of consolidation in $m^2/year$

5.6 Culvert No. 06X-0427/C0

The fieldwork for the foundation investigation at Culvert No. 06X-0427/C0 consisted of Boreholes BH-20-11, BH-20-12 and BH-21-03 advanced at the shoulder of Highway 3, near the proposed south and north end of the culvert extension (see Drawing 7).

In summary, the subsurface conditions at borehole locations consist of fill and topsoil underlain by a cohesive till extending to the maximum depth of investigation of 15.7 m (Elevation 179.1).

5.6.1 Topsoil

A 0.3 m thick layer of topsoil was encountered in Borehole BH-20-12 at ground surface. The topsoil consisted of clayey silt, trace of sand and gravel and rootlets.

5.6.2 Fill

At ground surface in Boreholes BH-20-11 and BH-21-03 fill material consisting of sand to sand and gravel, some fines was encountered and extended to depths of 1.4 and 0.8 m below ground surface (Elevations 193.7 m and 194.0 m), respectively. Underlying the granular fill material, a layer of cohesive fill consisting of silty clay trace to some sand was encountered in Boreholes BH-20-11 and BH-21-03 and extended to depths of 3.0 m and 2.3 m below ground surface (Elevations 192.15 m and 192.5 m), respectively.

The SPT “N” values recorded within the granular fill material ranged from 10 blows to 29 blows per 0.3 m of penetration, indicating a compact compactness condition. The SPT “N” values recorded within the cohesive fill material ranged from 3 blows to 9 blows per 0.3 m of penetration, suggesting a soft to stiff consistency.

Atterberg limits test were carried out on a sample of cohesive fill material and measured a liquid limit of 55 per cent, a plastic limit of 22 per cent, and a plasticity index of 33 per cent, indicating a silty clay of high plasticity. The results of the Atterberg limits test are shown on the plasticity chart on Figure C6-1 in Appendix C.

Grain size distribution tests carried out on one sample of granular fill material and one sample of the cohesive fill material are shown on Figures C6-2 and C6-3 in Appendix C, respectively.

The water content measured on samples of the granular fill material range between about 7 per cent to 24 per cent and the water content measured on samples of the cohesive fill material range between about 18 per cent and 30 per cent.

5.6.3 Clayey Silt to Silty Clay (Till)

A cohesive till deposit consisting of silty clay underlain by clayey silt, some sand and trace gravel, was encountered underlying the cohesive fill material in Boreholes BH-20-11 and BH-21-03 and underlying the topsoil in Borehole BH-20-12 at depths of 0.3 m and 3.0 m below ground surface (Elevations 194.3 m and 192.1 m). Boreholes BH-20-11, BH-20-12 and BH-21-03 terminated in the cohesive till deposit at depths of between 9.8 m and 15.7 m below ground surface (Elevation 185.3 m and 179.1 m). Within samples of the cohesive till deposit discontinuous 0.1 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the cohesive till deposit ranged from 2 blows to 32 blows per 0.3 m of penetration. In-situ vane tests were carried out within this deposit measured undrained shear strengths ranging from about 73 kPa to greater than 100 kPa and the sensitivity ranges from about 1.7 to 2.8. The in-situ field vane test results together with the SPT “N” values indicate that the cohesive till deposit predominately has a firm to hard consistency.

Atterberg limits tests were carried out on six samples of cohesive till deposit and measured liquid limits between about 25 per cent and 41 per cent, plastic limits between about 13 per cent and 20 per cent, and plasticity indices between about 12 per cent and 21 per cent. The results of the Atterberg limits tests shown on the plasticity chart on Figure C6-4 in Appendix C indicate that the cohesive deposit consists of low plasticity clayey silt to medium plasticity silty clay.

Grain size distribution tests carried out on five samples of cohesive till deposit and the results are provided on Figure C6-5 in Appendix C.

The water content measured on samples of the cohesive till deposit range between about 17 per cent to 27 per cent.

5.7 Culvert No. 06X-0429/C0

The fieldwork for the foundation investigation at Culvert No. 06X-0429/C0 consisted of Boreholes BH-20-13, BH-20-14, BH-21-04 and BH-21-05. These boreholes were advanced at the shoulder of Highway 3 (BH-20-13), near the end of the proposed south extension (BH-20-14), and near the end of proposed north extension (BH-21-04 and BH-21-05) (see Drawing 8).

In summary, the subsurface conditions at borehole locations consists of topsoil or fill underlain by a cohesive and granular till deposit extending to the maximum depth of investigation of 15.8 m (Elevation 179.2).

5.7.1 Topsoil

Topsoil was encountered in Boreholes BH-20-14 and BH-21-04 at ground surface and extended to a depth of 0.4 m and 0.2 m below ground surface. The topsoil consists of clayey silt, trace of sand and gravel and rootlets.

5.7.2 Fill

A 0.7 m thick layer of granular fill material consisting of sand and gravel, some clay, trace silt was encountered in Borehole BH-20-13 at ground surface. Underlying the topsoil in Borehole 21-04 and at ground surface in Borehole BH-21-05 a 0.7 m thick layer of silty clay fill material, some sand, trace to some gravel was encountered.

The SPT “N” values recorded within the granular fill material was 6 blows per 0.3 m of penetration, indicating a loose compactness condition. The SPT “N” recorded values within the silty clay fill material was 2 blows and 10 blows per 0.3 m of penetration, suggesting a soft to stiff consistency.

The water content measured on a sample of the granular fill material was about 10 per cent and the water content measured on samples of the cohesive fill material was about 22 per cent.

5.7.3 Clayey Silt and Sand to Silty Clay (Till)

Underlying the topsoil and/or fill material, a cohesive till deposit consisting of silty clay underlain by clayey silt, some sand and trace gravel to clayey silt and sand, was encountered at depths of 0.4 m and 0.8 m below ground surface (Elevations 194.6 m and 193.2 m). Within the till deposit in Borehole BH-21-05 the till consists of sand and gravel and was encountered at depths of between 6.1 m to 7.6 m below ground surface (between Elevation 189.2 m and 187.7 m). Granular till consisting of sandy silt to sand was encountered in Boreholes BH-21-04 and BH-21-05 at a depth of 13.7 m below ground surface (between Elevation 181.6 m and 181.3 m). Boreholes BH-21-04 and BH-21-05 terminated within this granular till deposit at a depth of 15.8 m below ground surface (between Elevations 179.5 m and 179.2 m). Boreholes BH-20-13 and BH-20-14 terminated in the cohesive till deposit at depths of between 9.8 m and 11.3 m below ground surface (Elevation 185.5 m and 183.4 m). Within samples of the cohesive till deposit discontinuous 0.15 m thick layers of fine sand and silt were observed.

The SPT “N” values recorded within the cohesive till deposit range from 4 blows to 58 blows per 0.3 m of penetration. In-situ vane tests were carried out within this deposit measured undrained shear strengths ranging from about 47 kPa to greater than 100 kPa and the sensitivity ranges from about 1.3 to 1.8. The in-situ field vane test results together with the SPT “N” values indicate that the cohesive till deposit predominately has a firm to hard consistency. The SPT “N” values recorded within the granular till deposit range from 7 blows to 80 blows per 0.3 m of penetration, suggesting a loose to very dense compactness condition.

The Atterberg Limit testing carried out on 13 samples of cohesive till gave liquid limit values ranging from 23% to 45%, plastic limit values ranging from 14% to 20%, resulting in plasticity index values ranging from 9% to 23%. Based on these values, the soil may be classified as clayey silt of low plasticity (CL) or silty clay of intermediate plasticity (CI) in the Unified Soil Classification System (USCS). The plasticity chart is provided on Figure C7-1 in Appendix C.

Atterberg limits tests were carried out on thirteen samples of cohesive till and measured liquid limits between about 23 per cent and 45 per cent, plastic limits between about 14 per cent and 20 per cent, and plasticity indices between about 9 per cent and 23 per cent. Based on these values, the upper portion of the till deposit may be classified as silty clay of medium plasticity and beneath the silty clay till deposit the till is classified as clayey silt with low plasticity. The results of the Atterberg limits tests are shown on the plasticity chart on Figures C7-1A and C7-1B in Appendix C.

Grain size distribution tests carried out on eight samples of cohesive till deposit and the results are provided on Figure C7-2 in Appendix C. Grain size distribution tests carried out on two samples of the granular till deposit and the results are provided on Figure C7-3 in Appendix C.

The water content measured on samples of the cohesive till deposit range between about 15 per cent to 37 per cent and the water content measured on samples of the silty sand to sand and gravel till deposit range between about 8 per cent to 26 per cent.

In addition, a consolidation test carried out on a clayey silt sample from Borehole BH-21-04, and the results are summarized in Table 10. The results of the consolidation test are presented on Figure C7-4 in Appendix C.

Table 4 Consolidation Test results - BH-21-04

Borehole No. and Sample No.	Sample Depth / Elevation (m)	σ_{vo}'	σ_p'	Void Ratio (e_0)	Compression Indices		OCR	Average C_v
					Cr	Cc		
BH-21-04 TW-2	6.1 – 6.7 188.9 – 188.4	125.5	145	0.64	0.010	0.116	1.16	3.7

Where: σ_{vo}' is the in-situ vertical effective overburden stress in kPa
 σ_p' is the preconsolidation stress in kPa
OCR is the overconsolidation ratio
 e_0 is the initial void ratio
Cc is the compression index
Cr is the recompression index
 c_v is the coefficient of consolidation in $m^2/year$

5.8 Culvert No. 06X-0432/C0

The fieldwork for the foundation investigation at Culvert No. 06X-0432/C0 consisted of Boreholes BH-20-15, BH-20-16 and BH-21-06. These boreholes were advanced at the shoulder of Highway 3 (BH-20-11), near the end of the proposed south extension (BH-20-12), and near the end of proposed north extension (BH-21-03) (see Drawing 9).

In summary, the subsurface conditions at borehole locations consists of topsoil or fill underlain by a cohesive and granular till deposit extending to the maximum depth of investigation of 11.3 m (Elevation 184.7).

5.8.1 Topsoil

A 0.2 m thick layer of topsoil was encountered in Borehole BH-20-16 at ground surface. The topsoil consists of clayey silt, trace of sand and gravel.

5.8.2 Fill

A 0.7 m to 0.8 m thick layer of granular fill consisting of gravelly sand to sand and gravel was encountered at ground surface in Boreholes BH-20-15 and BH-21-06. The granular fill material is underlain by a layer of silty clay with sand fill material that extends to depths of 2.2 m and 2.3 m below ground surface (Elevation 193.7 m).

The SPT “N” values recorded within the granular fill were 9 blows and 15 blows per 0.3 m of penetration, suggesting a loose to compact compactness condition. The SPT “N” values recorded within the cohesive fill range from 3 blows to 14 blows per 0.3 m of penetration, suggesting a soft to stiff consistency.

Atterberg limits test were carried out on two samples of cohesive fill material and measured liquid limits of 32 per cent and 39 per cent, plastic limits of 15 per cent and 18 per cent, and plasticity indices of 13 per cent and 18 per cent, indicating a silty clay of medium plasticity. The results of the Atterberg limits test are shown on the plasticity chart on Figure C8-1 in Appendix C.

Grain size distribution tests carried out on two samples of granular fill material are shown on Figure C8-2 in Appendix C.

The water content measured on samples of the granular fill material were about 10 per cent and 12 per cent and the water content measured on samples of the cohesive fill material range from 12 per cent to 28 per cent.

5.8.3 Clayey Silt to Silty Clay (Till)

Underlying the fill material in Boreholes BH-20-15 and BH-21-06 and underlying the topsoil in Borehole BH-20-16 a cohesive till deposit consisting of clayey silt with sand to clayey silt, some sand, trace gravel was encountered at depths of between 0.2 m and 2.3 m below ground surface (between Elevations 194.2 m and 193.7 m). The cohesive till deposit in Borehole BH-20-16 contains granular till layers consisting of silt and sand, trace clay to silty sand, trace gravel, trace clay between depths of 2.1 m to 5.6 m below ground surface (between Elevations 192.5 m and 189.0 m). In Borehole BH-21-06 a granular till consisting of silty sand, trace to some gravel was encountered underlying the cohesive till at a depth of 9.1 m below ground surface (Elevation 186.9 m). Borehole BH-21-06 terminated within the granular till deposit at a depth of 11.3 m below ground surface (Elevation 184.7 m). Boreholes BH-20-15 and BH-20-16 terminated within the cohesive till deposit at a depth of 9.8 m below ground surface (between Elevation 186.1 m and 184.8 m). Silty sand lenses with thicknesses of less than 0.1 m were also detected through the cohesive till layer.

The SPT “N” values recorded within the cohesive till deposit range from 10 blows to 33 blows per 0.3 m of penetration, suggesting a stiff to hard consistency. The SPT “N” values recorded within the granular till deposit ranged from 15 blows to 29 blows per 0.3 m of penetration, suggesting a compact compactness condition.

Atterberg limits tests were carried out on five samples of cohesive till deposit and measured liquid limits between about 25 per cent and 33 per cent, plastic limits between about 13 per cent and 18 per cent, and plasticity indices between about 10 per cent and 15 per cent. The results of the Atterberg limits tests shown on the plasticity chart on Figure C8-3 in Appendix C indicate that the cohesive deposit consists of low to medium plasticity clayey silt.

Grain size distribution tests carried out on three samples of cohesive till deposit and the results are provided on Figure C8-4 in Appendix C. Grain size distribution tests carried out on three samples of the granular till deposit and the results are provided on Figure C8-5 in Appendix C.

The water content measured on samples of the cohesive till deposit range between about 12 per cent to 27 per cent and the water content measured on samples of the granular till deposit range between about 10 per cent to 66 per cent.

5.9 Groundwater

Groundwater observations and measurements were obtained from the open boreholes during and upon completion of drilling each borehole. A monitoring well was installed in Boreholes BH-21-01, BH-21-03 and BH-21-06 to monitor the groundwater levels at the borehole locations. The water levels measured in the open boreholes and the monitoring wells are summarized in Table 3 below.

Table 5 Summary of Groundwater Level Measurements

Culvert Number	Borehole Number	Water Level Depth (m)	Water Level Elevation (m)	Date of Observation (Measurement)	Remark
06X-0420/C0	BH-20-01	Dry	--	April 27, 2020	Upon completion of drilling
	BH-20-02	Dry	--	April 27, 2020	
06X-0421/C0	BH-20-03	2.2	193.1	April 28, 2020	
	BH-20-04	Dry	--	April 28, 2020	
06X-0422/C0	BH-20-05	Dry	--	April 28, 2020	
	BH-20-06	6.1	188.3	April 28, 2020	
06X-0423/C0	BH-20-07	Dry	--	April 30, 2020	

Culvert Number	Borehole Number	Water Level Depth (m)	Water Level Elevation (m)	Date of Observation (Measurement)	Remark
	BH-20-08	Dry	--	April 30, 2020	
	BH-21-01	Dry	--	April 10, 2021	
			0.9	193.9	November 24, 2021
06X-0426/C0	BH-20-09	Dry	--	April 30, 2020	Upon completion of drilling
	BH-20-10	10.7	182.6	May 1, 2020	
	BH-21-02	Dry	--	November 10, 2021	
06X-0427/C0	BH-20-11	1.2	193.9	May 1, 2020	
	BH-20-12	4.9	189.7	May 1, 2020	
	BH-21-03	Dry	--	May 10, 2021	
		5.1	189.6	November 24, 2021	Monitoring well
06X-0429/C0	BH-20-13	0.8	194.5	May 4, 2020	Upon Completion of Drilling
	BH-20-14	6.1	188.6	May 4, 2020	
	BH-21-04	10.4	184.6	November 11, 2021	
	BH-21-05	11.5	183.8	November 10, 2021	
06X-0432/C0	BH-20-15	1.8	194.1	May 19, 2020	
	BH-20-16	2.4	192.2	May 19, 2020	
	BH-21-06	7.6	188.4	October 5, 2021	
8.4		187.6	November 24, 2021	Monitoring well	

It should be noted that the groundwater level at the site may be influenced by the water level in the culvert, and will fluctuate with seasonal changes, periods of precipitation, and temperature and should be expected to be higher during wet periods of the year.

5.10 Analytical Testing Results

Soil corrosivity chemical test consisting of pH, water soluble sulphate, sulphide, chloride and resistivity was conducted on a total of twelve samples. A summary of the test results is provided in Table 4. The test methods and test results are provided in Appendix D.

Table 6 Soil Corrosivity Test Results

Culvert Number	Borehole No.	Sample No.	Depth (Elevation) (m)	Sulphate (µg/g)	Sulphide (µg/g)	Chloride (µg/g)	pH	Resistivity (Ohm-cm)
06X-0420/C0	BH-20-02	SS-6	4.8 (189.5)	510	< 5	13	7.78	1870
06X-0421/C0	BH-20-03	SS-6	3.0 (191.3)	980	< 5	129	7.80	1240
06X-0422/C0	BH-20-05	SS-6	4.8 (189.7)	800	< 5	71	7.69	1410
06X-0423/C0	BH-20-08	SS-5	3.2 (192.3)	510	< 5	12	7.68	1880
	BH-21-01	SS-4	2.6 (192.3)	729	<0.2	80.3	7.48	1180
06X-0426/C0	BH-20-10	SS-6	4.9 (189.8)	580	< 5	16	7.70	1730
	BH-21-02	SS-5	3.3 (192.4)	166	0.23	133	7.89	2070
06X-0427/C0	BH-20-11	SS-5	3.3 (191.8)	130	< 5	230	7.75	2060

Culvert Number	Borehole No.	Sample No.	Depth (Elevation) (m)	Sulphate (µg/g)	Sulphide (µg/g)	Chloride (µg/g)	pH	Resistivity (Ohm-cm)
	BH-21-03	SS-4	2.6 (192.2)	840	<0.2	263	7.46	857
06X-0429/C0	BH-20-13	SS-5	3.3 (192.0)	30	< 5	171	7.71	2880
	BH-21-04	SS-5	3.5 (191.5)	84	<0.2	133	7.61	1600
06X-0432/C0	BH-20-16	SS-5	3.3 (191.3)	280	< 5	30	7.70	2420

6. Closure

The fieldwork was supervised by Mr. Moe Nasir, E.I.T. and Mr. Manvit Reddy Mettupalli, E.I.T. under the direction of Mr. Nirjar Vyas, M.Eng., P.Eng., and Ms. Sandra McGaghran M.Eng., P.Eng.

This report was prepared by Ms. Sahar Soleimani, Ph.D., P.Eng, a Senior Geotechnical Engineer with GHD. Ms. Sandra McGaghran, M.Eng., P.Eng., a Senior Geotechnical Engineer with GHD and MTO Foundations Designated Contact conducted an independent review of the report.

Sincerely,

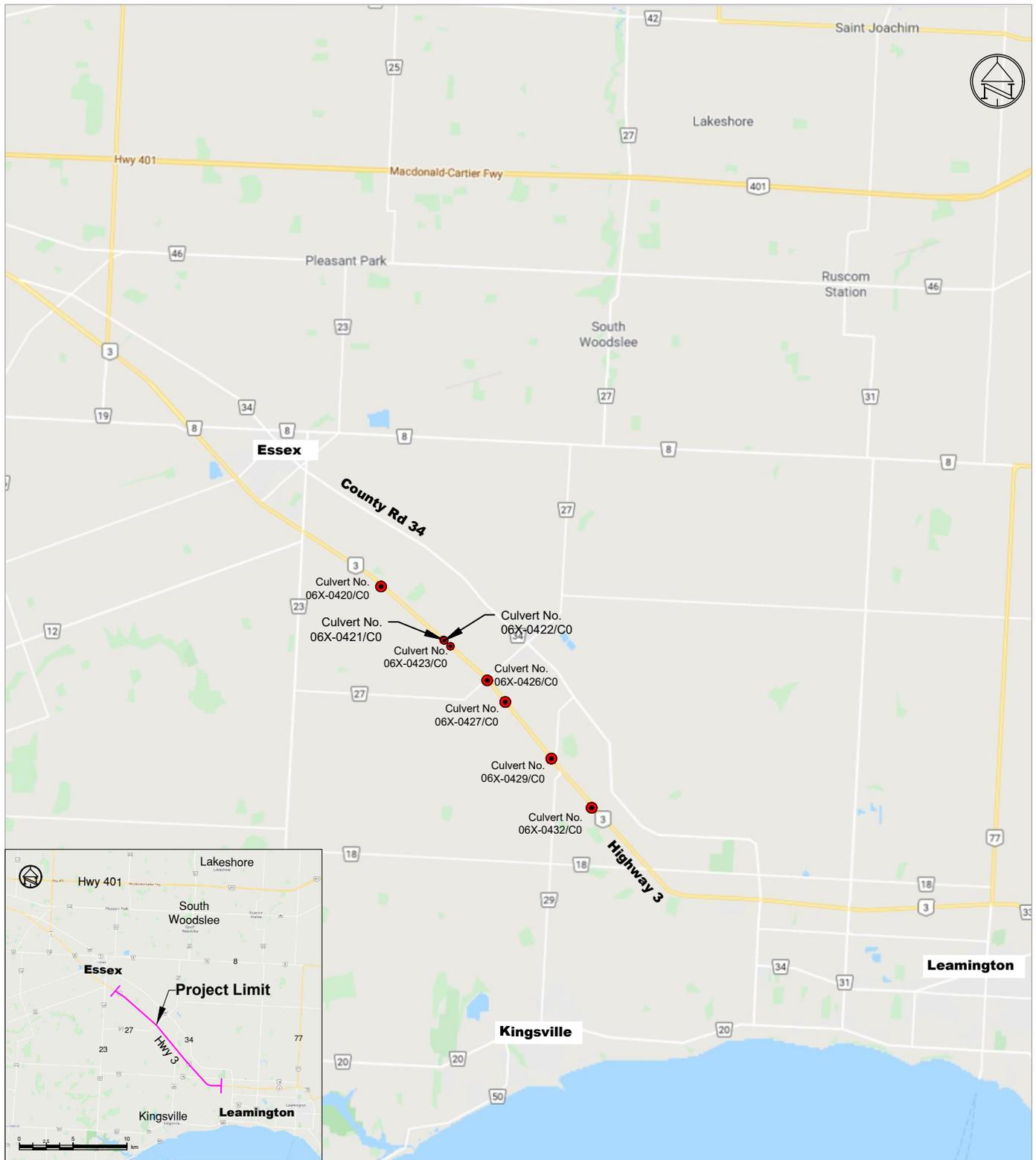
GHD Limited




Sahar Soleimani, Ph.D., P.Eng.
Senior Geotechnical Engineer



Sandra McGaghran, M.Eng., P.Eng.
MTO Foundations Designated Contact, Senior Geotechnical Engineer



LEGEND:  Culvert Location



REFERENCE: Google Map Data

Assignment No.:	3017-E-0012	Geocres No.:	40J2-147
GWP:	3021-18-00	Hwy No.:	3
Township:	Gosfield North and Gosfield South		
District:	Chatham		
Drawn:	AW	Project No.:	11202866
Checked:	SS	Date:	1.10.2022
Reviewed:	SS	Revision:	
Approved:	SMM	Drawing:	1



Key Plan

Foundation Investigation and Design

Hwy 3 Widening, Windsor to Leamington, Phase 3 - Contract 2

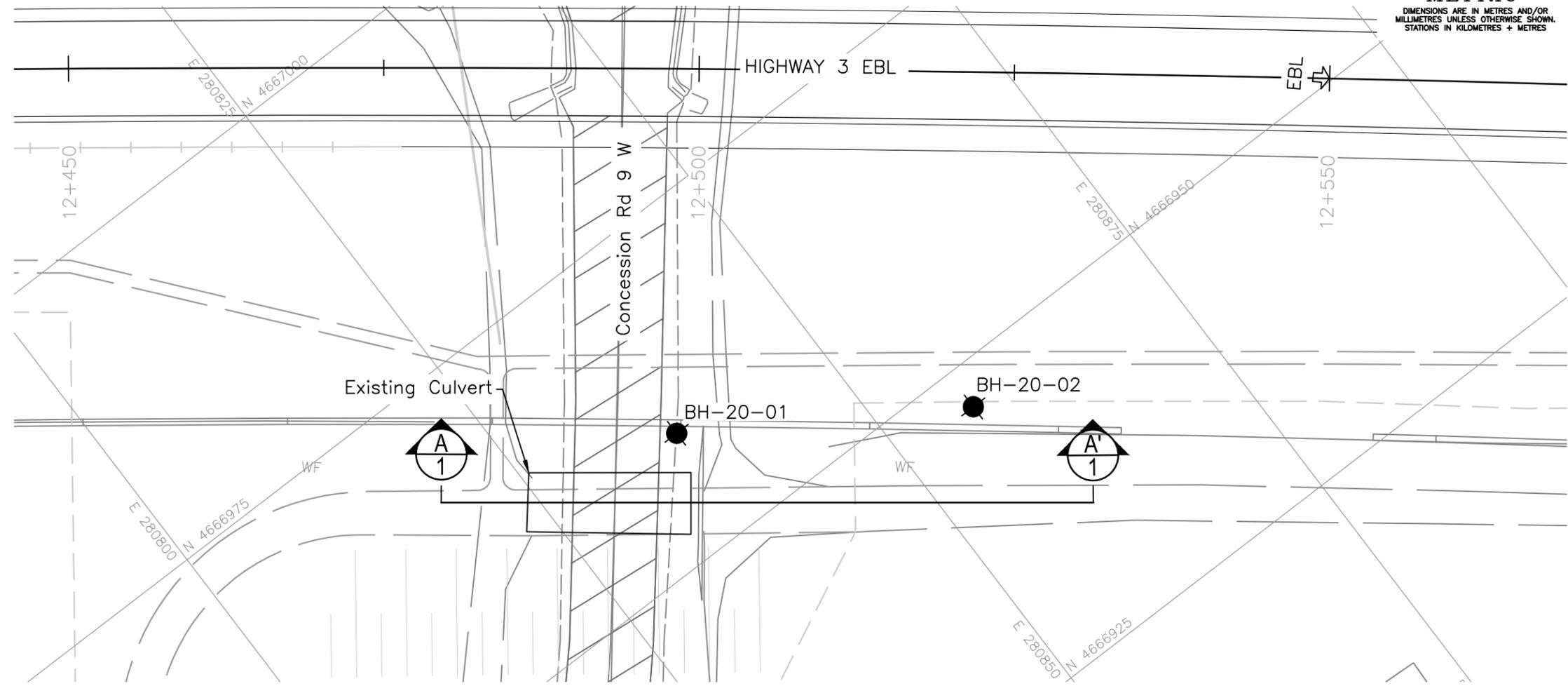
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No. GWP No. 3021-18-00



CULVERT No. 06X-0420/C0
HIGHWAY 3
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



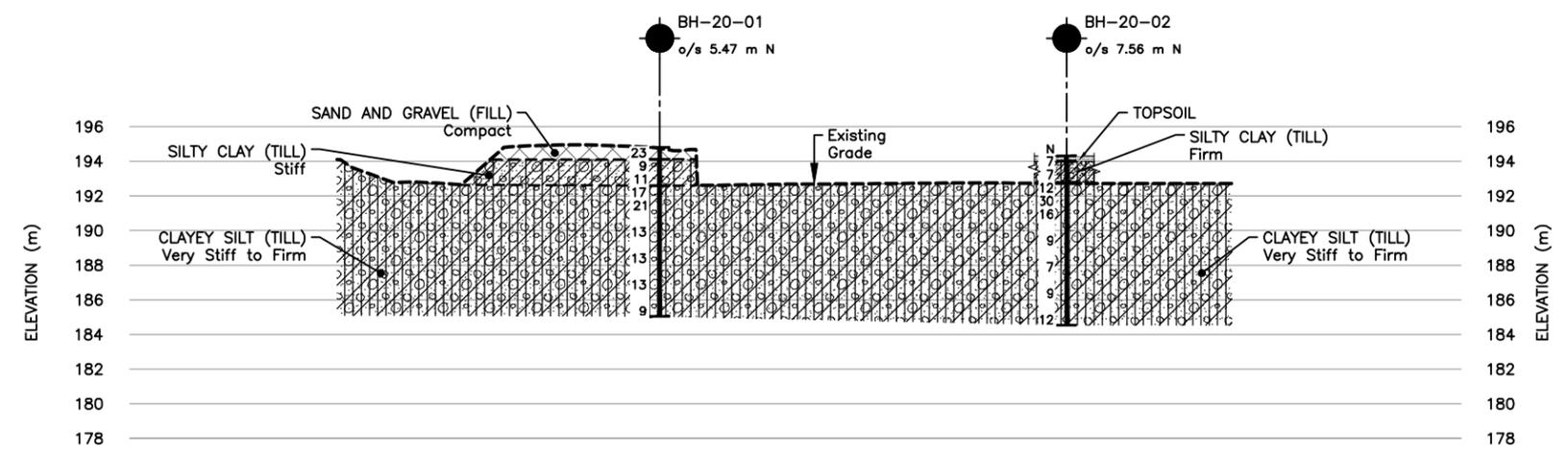
PLAN SCALE 0 2.5 5 10 m

LEGEND

- Borehole
- N Standard Penetration Test Value
- Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-01	194.8	4666959.4	280836.9
BH-20-02	194.3	4666946.7	280856.9



PROFILE A-A'

HORIZONTAL SCALE 0 2.5 5 10 m VERTICAL SCALE 0 2.5 5 10 m



NOTES

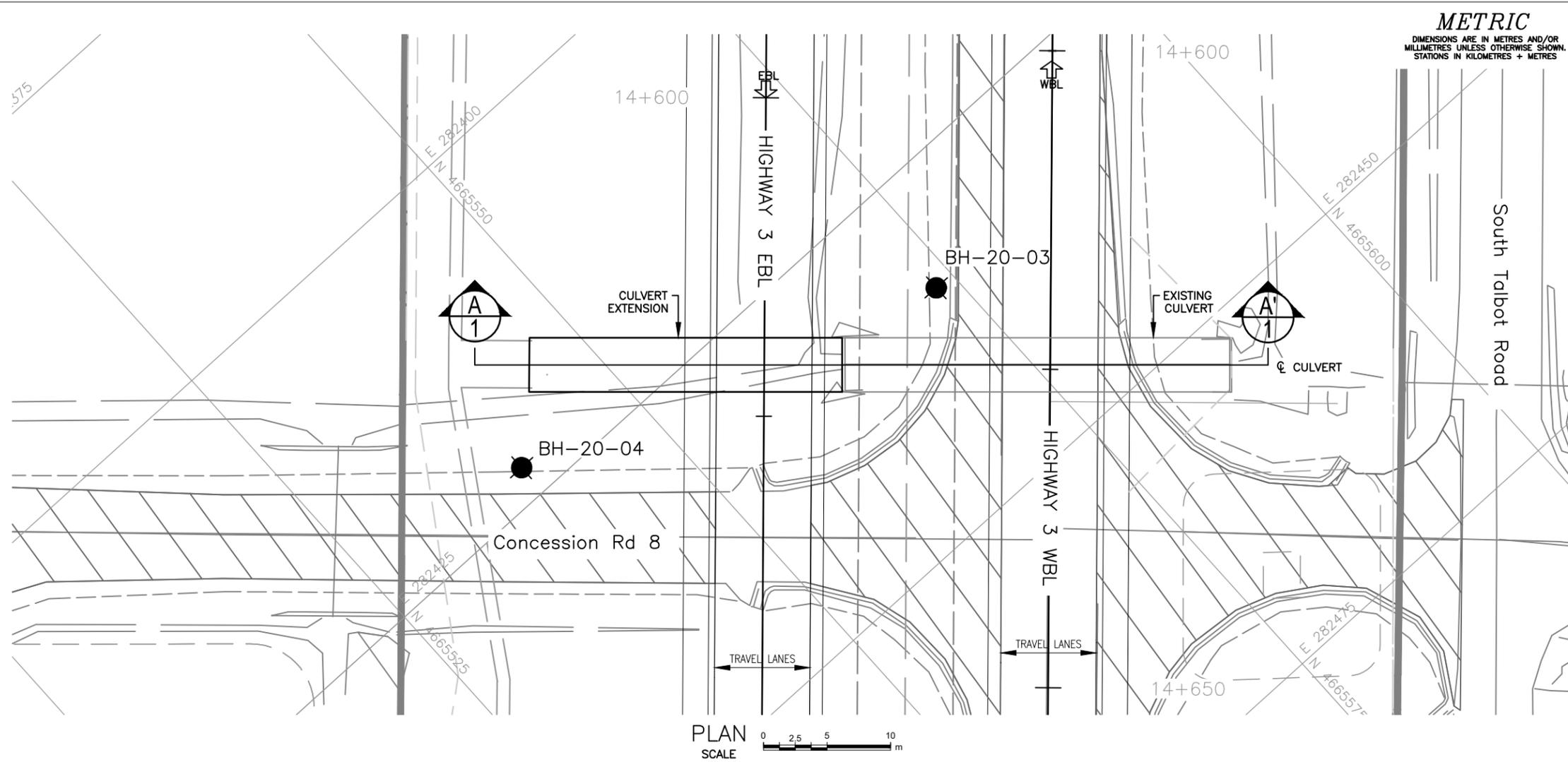
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

Base plans provide in digital format by Callon Dietz, drawing file: B-117-003-1 DB, B-116-003-1 DB, received March 5, 2021.

NO.	DATE	BY	REVISION

Geocres No.: 40J2-147		PROJECT NO. 11202886	DIST. CHATHAM
HWY. 3	CHKD. SS	DATE: 1.10.2022	SITE: 06X-0420/C0
SUBM'D. MN	CHKD. SS	APPD. SMM	DWG. 2



METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No. GWP No. 3021-18-00



CULVERT No. 06X-0421/C0
 HIGHWAY 3
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

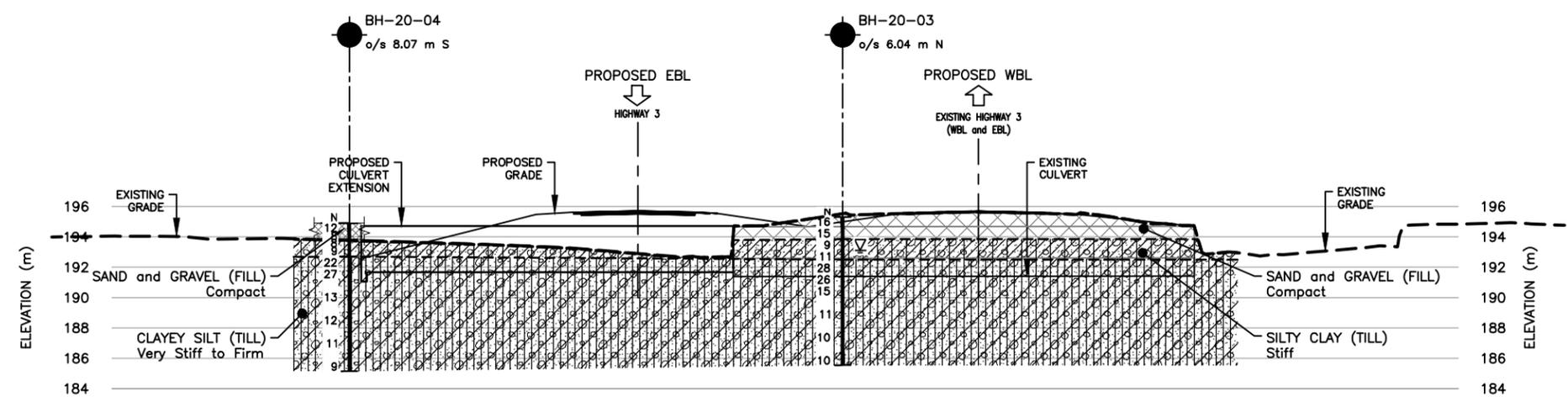


LEGEND

- Borehole
- N Standard Penetration Test Value
- Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)
- ▽ Water Level in open borehole upon completion of drilling

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-03	195.3	4665573.4	282433.8
BH-20-04	194.9	4665539.7	282422.5



NOTES

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REFERENCE

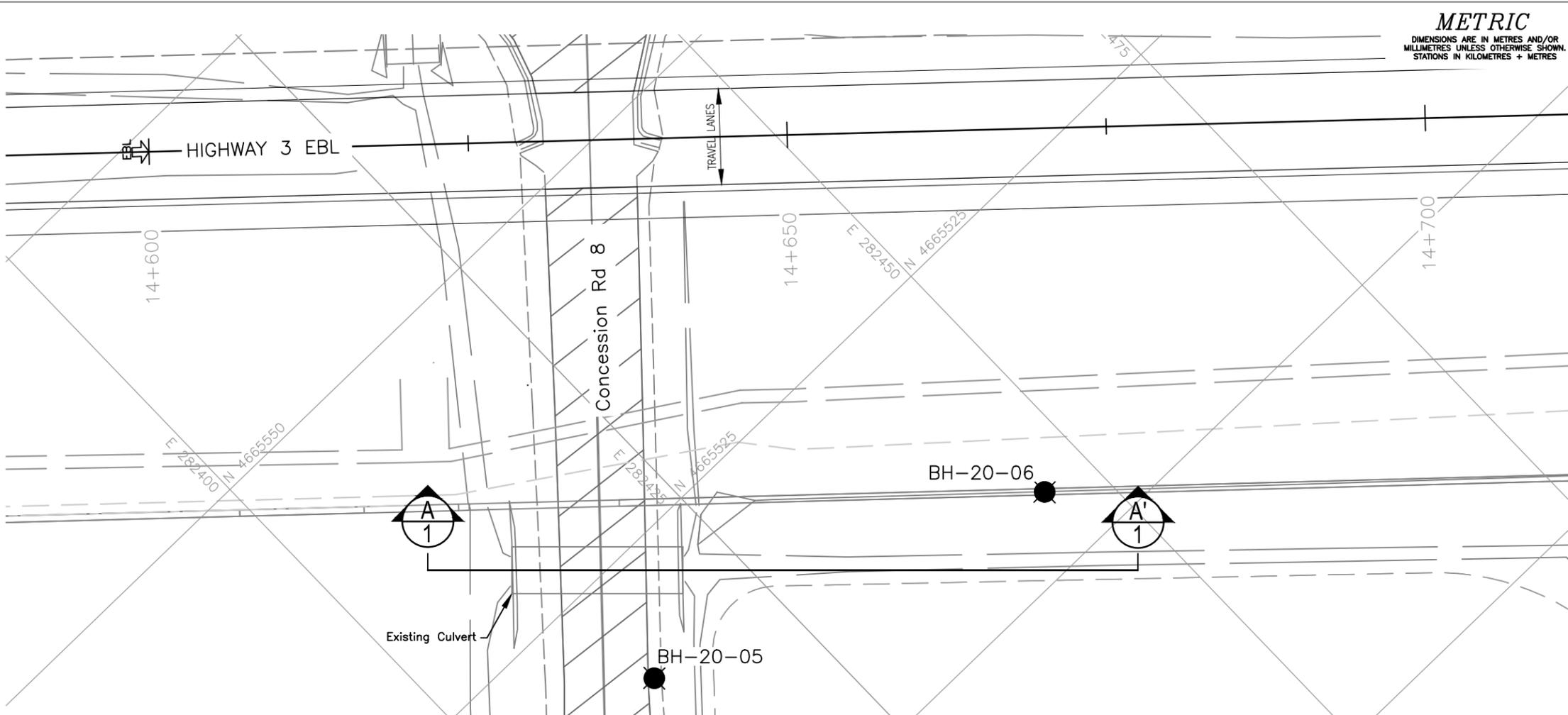
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NO.	DATE	BY	REVISION

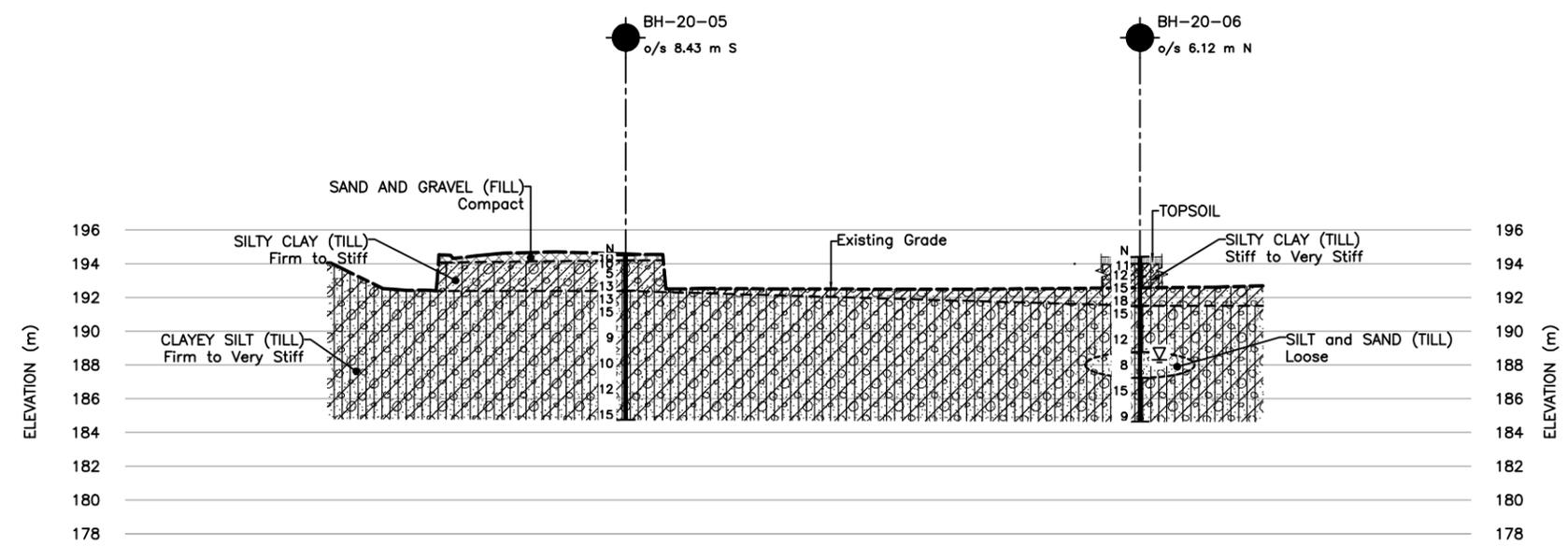
Geocres No.: 40J2-147

HWY. 3	PROJECT NO. 11202886	DIST. CHATHAM
SUBM'D. MN	CHKD. SS	DATE: 1.10.2022
DRAWN: AW	CHKD. SS	APPD. SMM
		SITE: 06X-0421/C0
		DWG. 3





PLAN SCALE 0 2.5 5 10 m

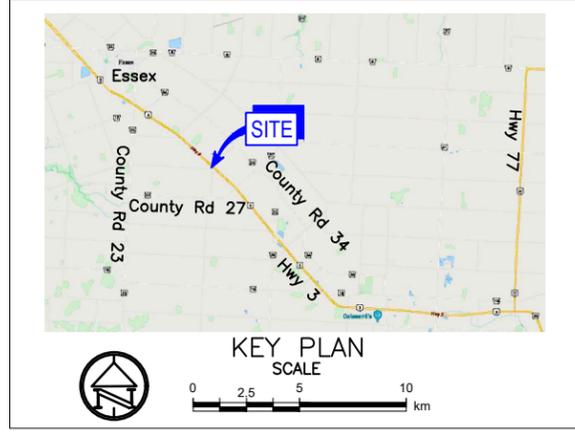


PROFILE A-A' SCALE HORIZONTAL 0 2.5 5 10 m VERTICAL 0 2.5 5 10 m

METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No. GWP No. 3021-18-00
 CULVERT No. 06X-0422/CO
 HIGHWAY 3
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

- Borehole
- N Standard Penetration Test Value
Blows/0.3m unless otherwise stated
(Std. Pen. Test. 475 j/blow)
- ▽ Water Level in open borehole upon completion of drilling

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-05	194.5	4665516.3	282413.7
BH-20-06	194.4	4665505.6	282445.9

NOTES

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REFERENCE

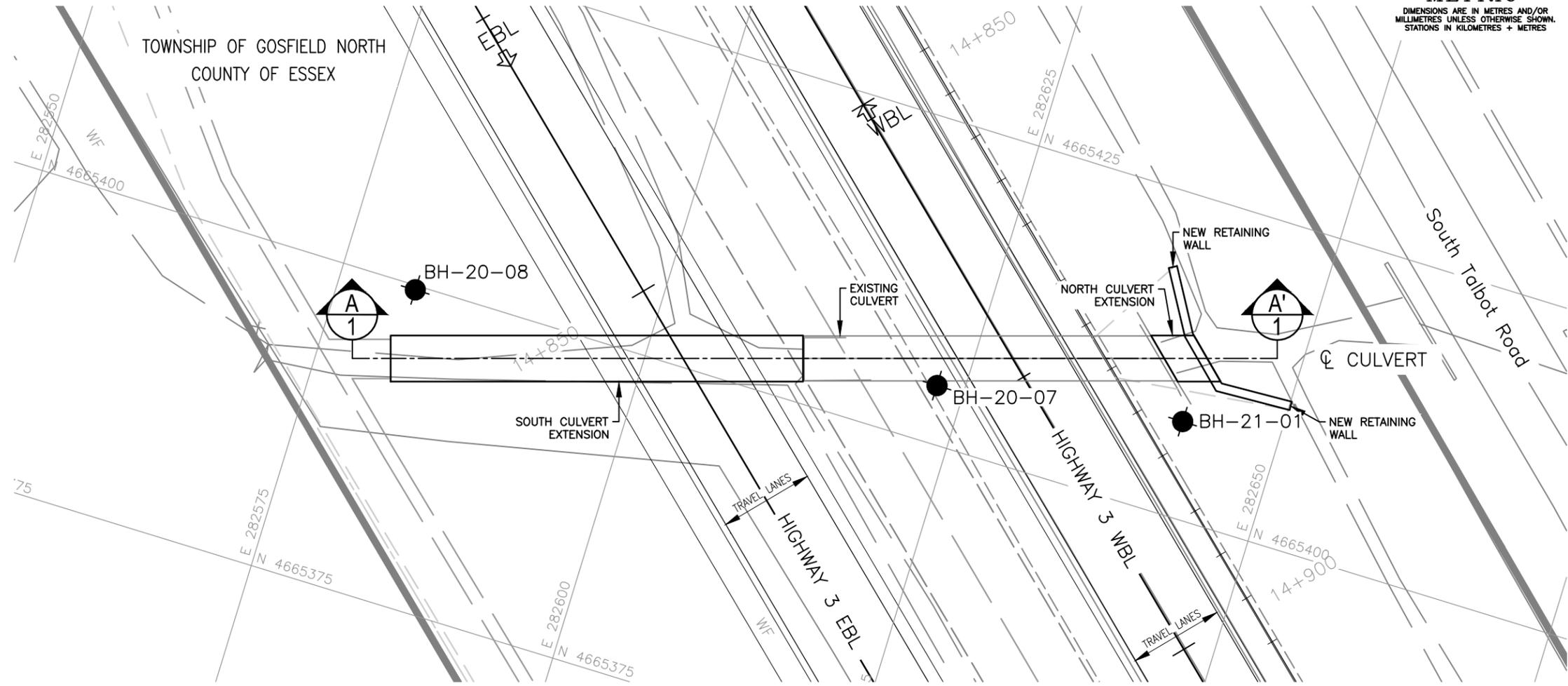
Base plans provide in digital format by Callon Dietz, drawing file: B-117-003-1 DB, B-116-003-1 DB, received March 5, 2021.

NO.	DATE	BY	REVISION

Geocres No.: 40J2-147

HWY. 3	PROJECT NO. 11202886	DIST. CHATHAM
SUBM'D. MN	CHKD. SS	DATE: 1.10.2022
DRAWN: AW	CHKD. SS	APPD. SMM
		SITE: 06X-0422/CO
		DWG. 4





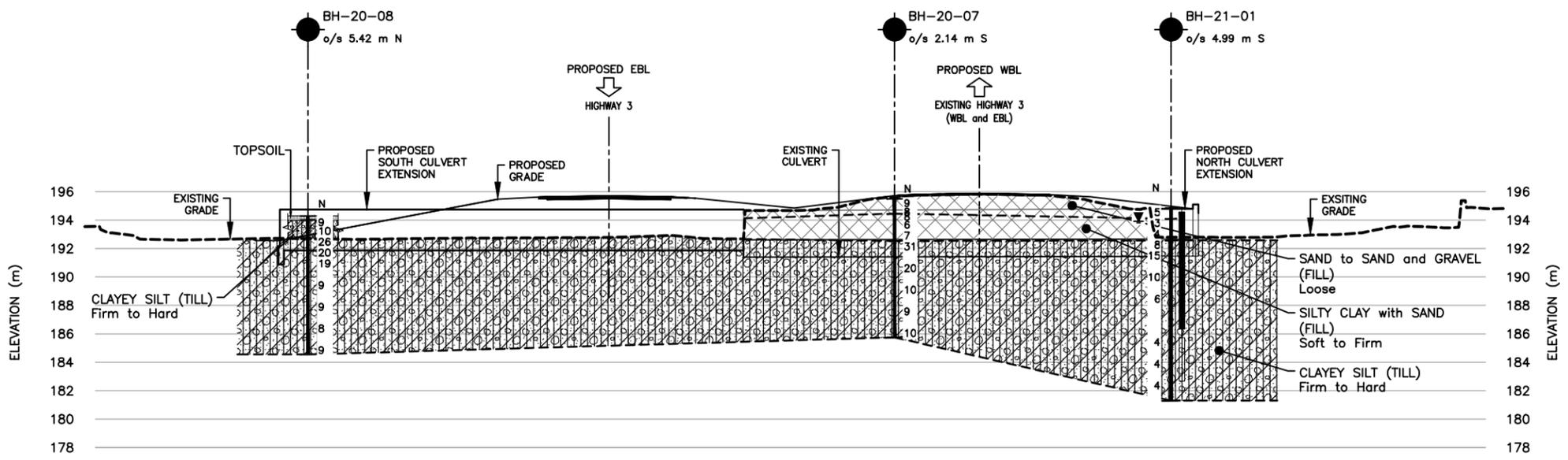
PLAN SCALE 0 2.5 5 10 m

LEGEND

- Borehole
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)
- Water Level in open borehole upon completion of drilling
- Water Level measured in piezometer (Nov. 24/2021)

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-07	195.5	4665404.5	282622.8
BH-20-08	194.3	4665399.6	282581.1
BH21-01	194.9	4665407.5	282642.3



PROFILE A-A'

HORIZONTAL SCALE 0 2.5 5 10 m VERTICAL SCALE 0 2.5 5 10 m

NOTES

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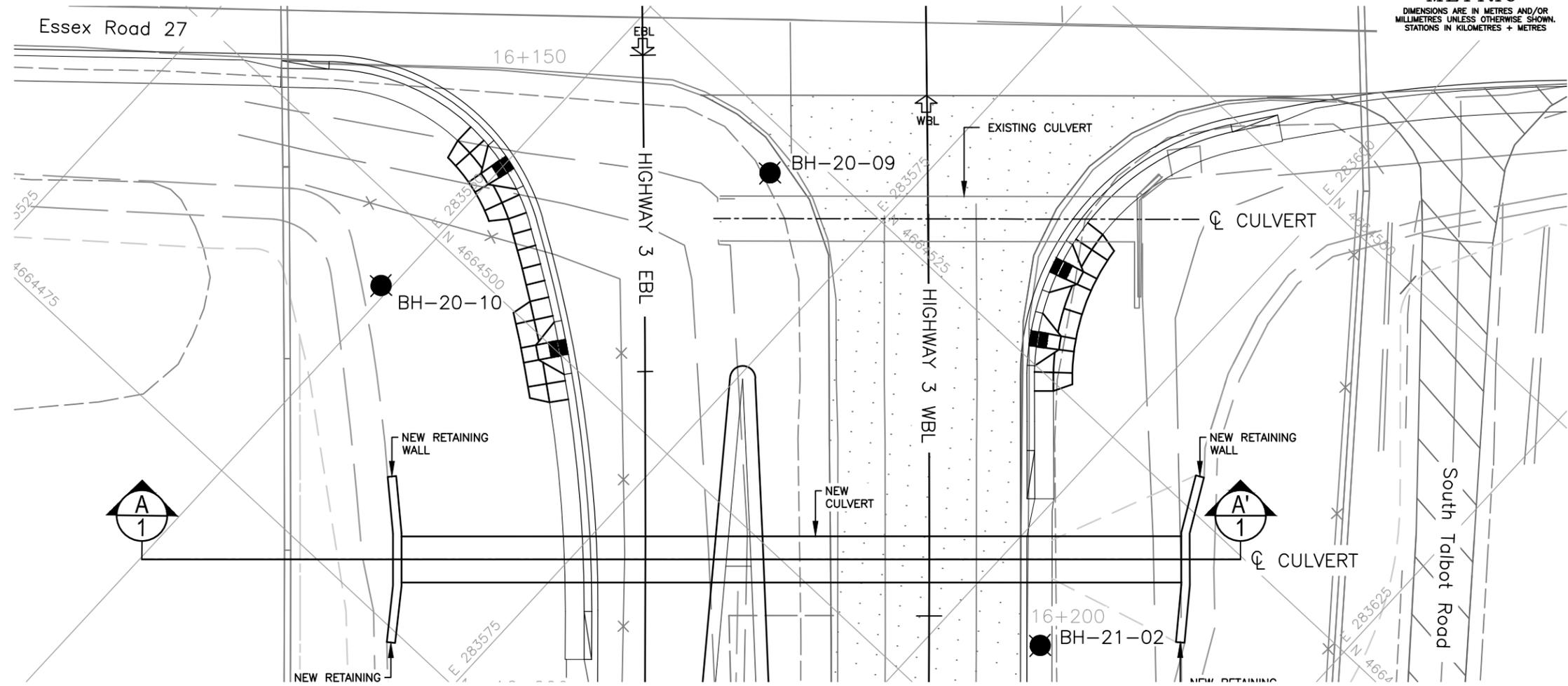
REFERENCE

Base plans provide in digital format by Callon Dietz, drawing file: B-117-003-1 DB, B-116-003-1 DB, received March 5, 2021.

NO.	DATE	BY	REVISION

Geocres No.: 40J2-147		PROJECT NO. 11202886	DIST. CHATHAM
HWY. 3	CHKD. SS	DATE: 1.10.2022	SITE: 06X-0423/C0
SUBM'D. MN/MRM	CHKD. SS	APPD. SMM	DWG. 5





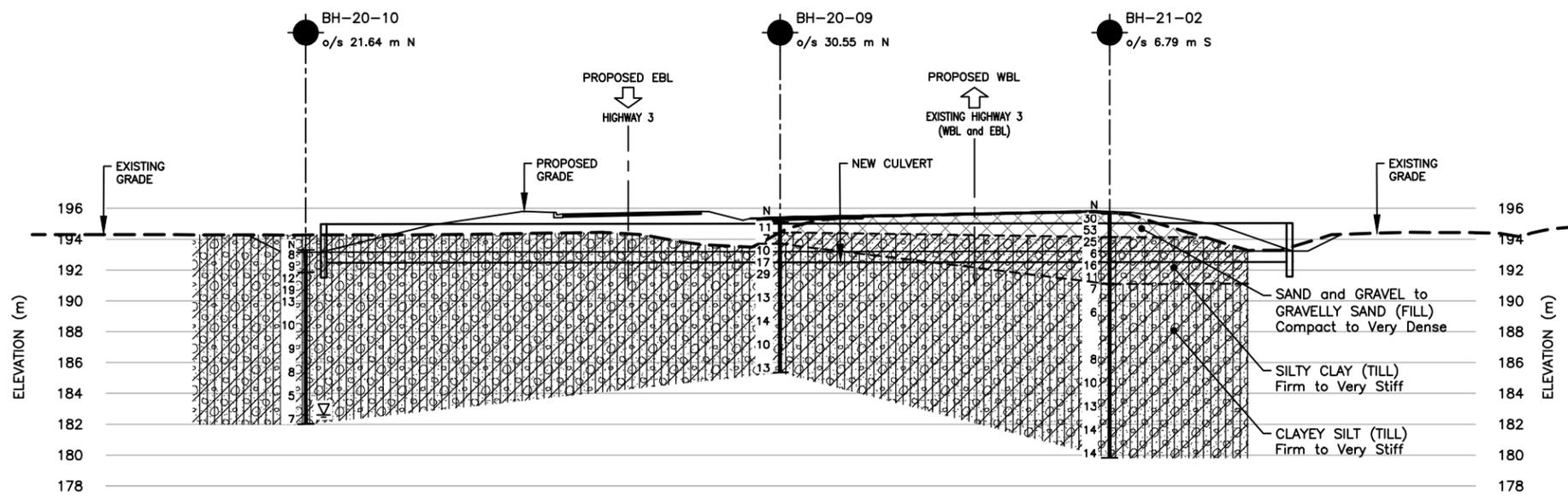
PLAN SCALE 0 2.5 5 10 m

LEGEND

- Borehole
- N Standard Penetration Test Value
- Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)
- ▽ Water Level in open borehole upon completion of drilling

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-09	195.1	4664521.8	283565.9
BH-20-10	193.3	4664494.3	283549.3
BH21-02	195.7	4664509.0	283607.0



PROFILE A-A'

HORIZONTAL SCALE 0 2.5 5 10 m VERTICAL SCALE 0 2.5 5 10 m

NOTES
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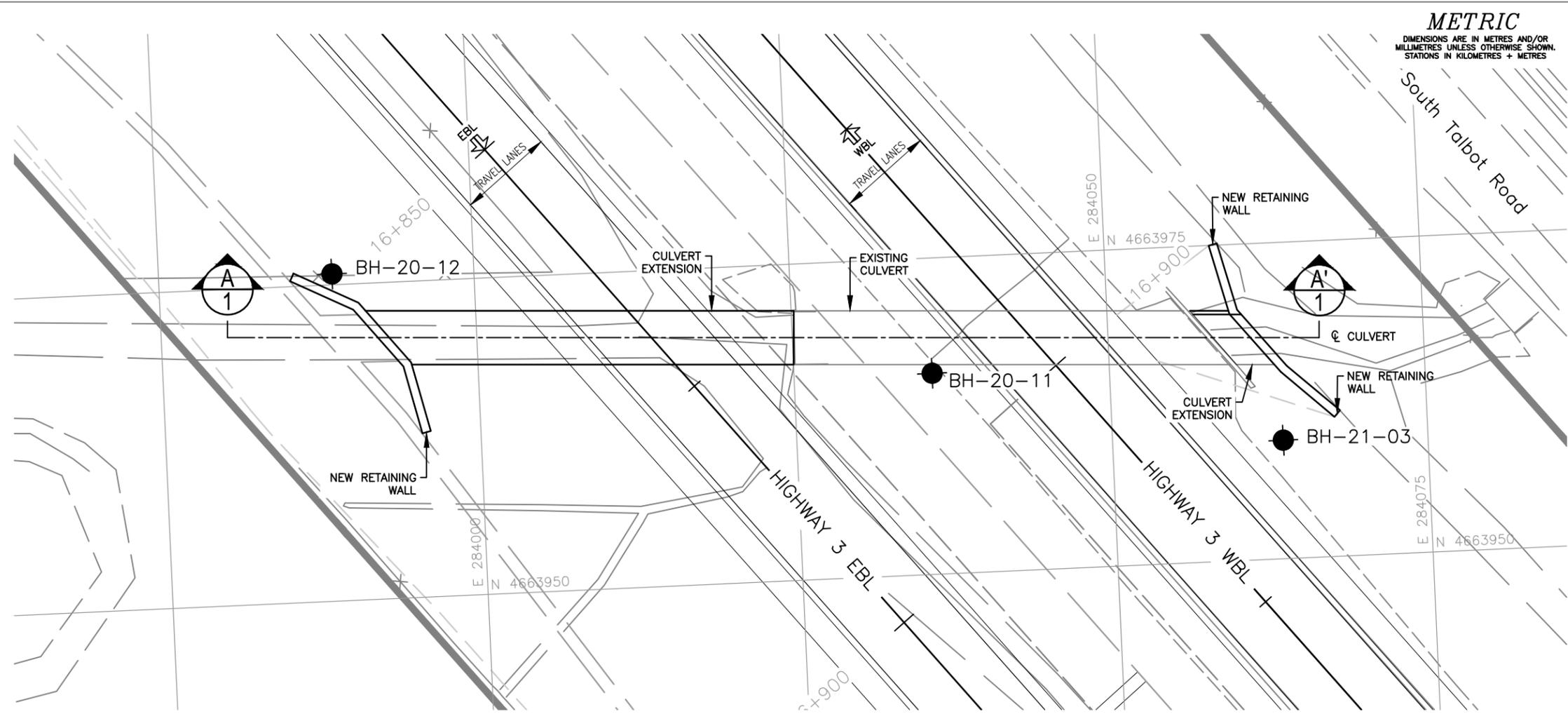
REFERENCE
Base plans provide in digital format by Callon Dietz, drawing file: B-117-003-1 DB, B-116-003-1 DB, received March 5, 2021.

NO.	DATE	BY	REVISION

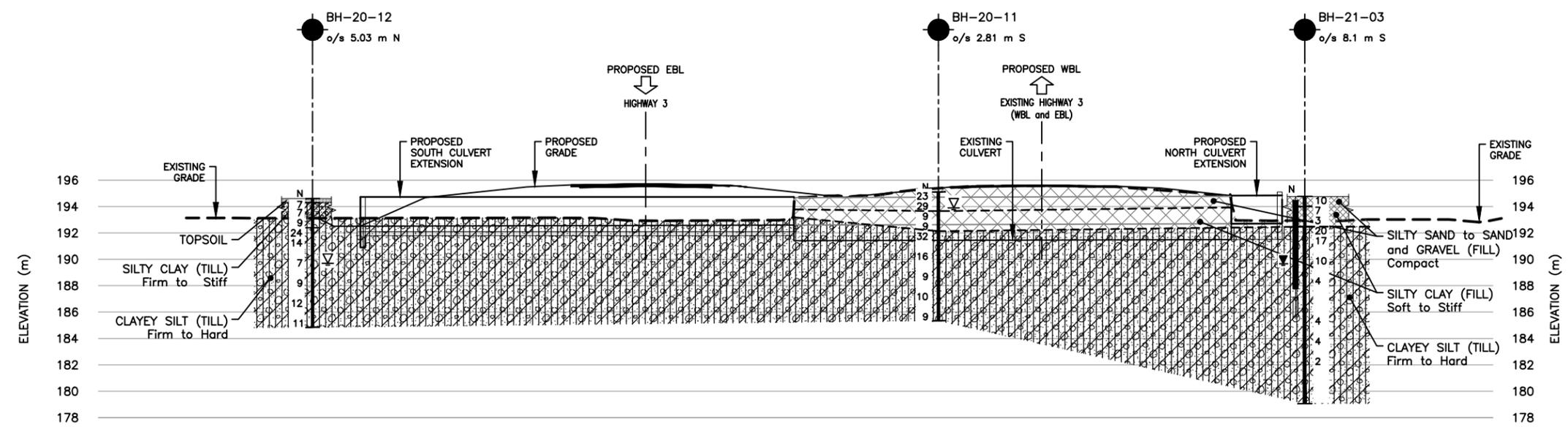
Geores No.: 40J2-147

HWY. 3	PROJECT NO. 11202886	DIST. CHATHAM
SUBM'D. MN/MRM	CHKD. SS	DATE: 1.10.2022
DRAWN: AW	CHKD. SS	APPD. SMM
		SITE: 06X-0426/C0
		DWG. 6





PLAN SCALE 0 2.5 5 10 m



PROFILE A-A'
 HORIZONTAL SCALE 0 2.5 5 10 m
 VERTICAL SCALE 0 2.5 5 10 m

METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No. GWP No. 3021-18-00



CULVERT No. 06X-0427/CO
 HIGHWAY 3
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



LEGEND

- Borehole
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)
- ∇ Water Level in open borehole upon completion of drilling
- ∇ Water Level measured in piezometer (Nov. 24/2021)

BOREHOLE CO-ORDINATES (MTM ZONE 11)			
NO	ELEVATION	NORTHING	EASTING
BH-20-11	195.1	4663965.9	284035.9
BH-20-12	194.6	4663975.9	283988.7
BH21-03	194.8	4663959.4	284063.5

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REFERENCE

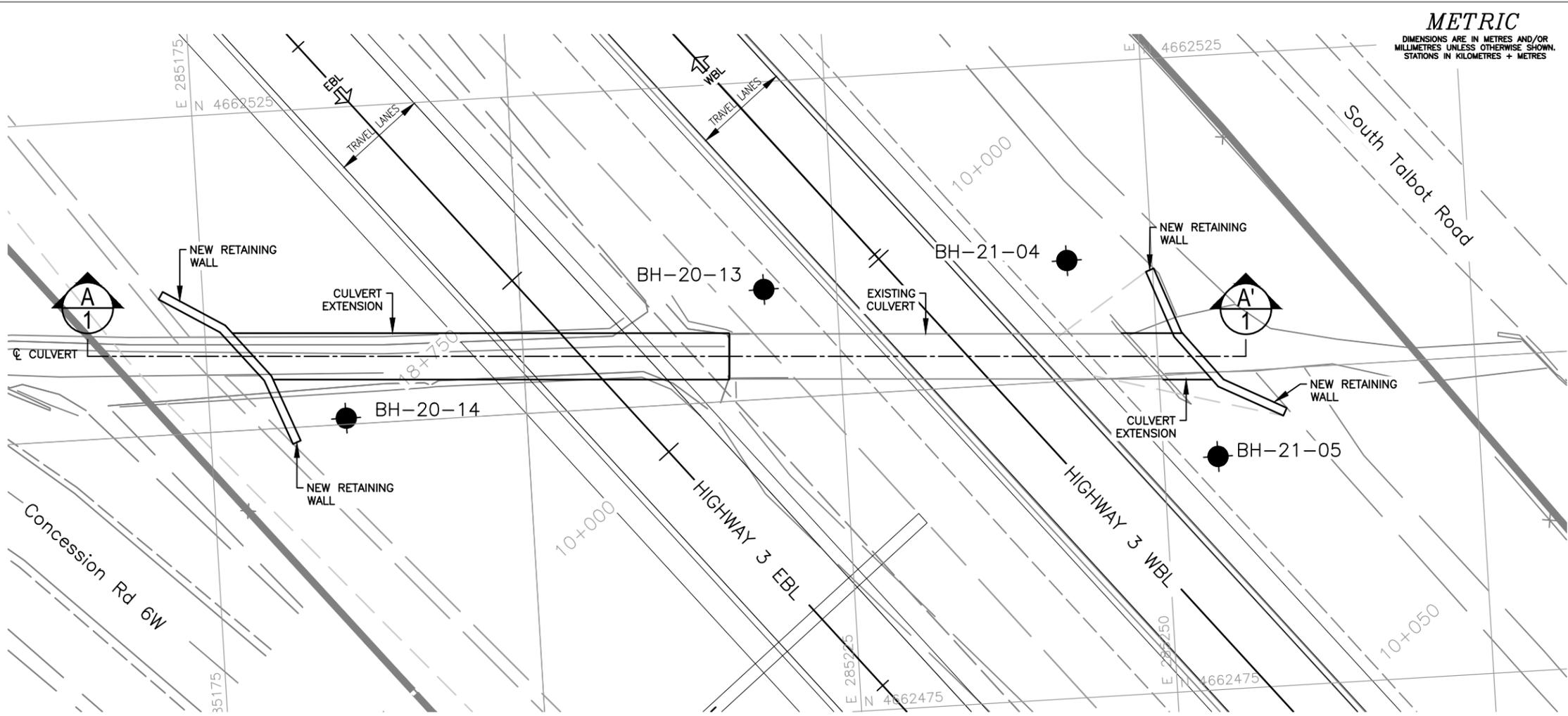
Base plans provide in digital format by Callon Dietz, drawing file: B-117-003-1 DB, B-116-003-1 DB, received March 5, 2021.

NO.	DATE	BY	REVISION

Geocres No.: 40J2-147

HWY. 3	PROJECT NO. 11202886	DIST. CHATHAM
SUBM'D. MN/MRM	CHKD. SS	DATE: 1.10.2022
DRAWN: AW	CHKD. SS	APPD. SMM
		SITE: 06X-0427/CO
		DWG. 7





METRIC
 DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No. GWP No. 3021-18-00



CULVERT No. 06X-0429/C0
 HIGHWAY 3
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

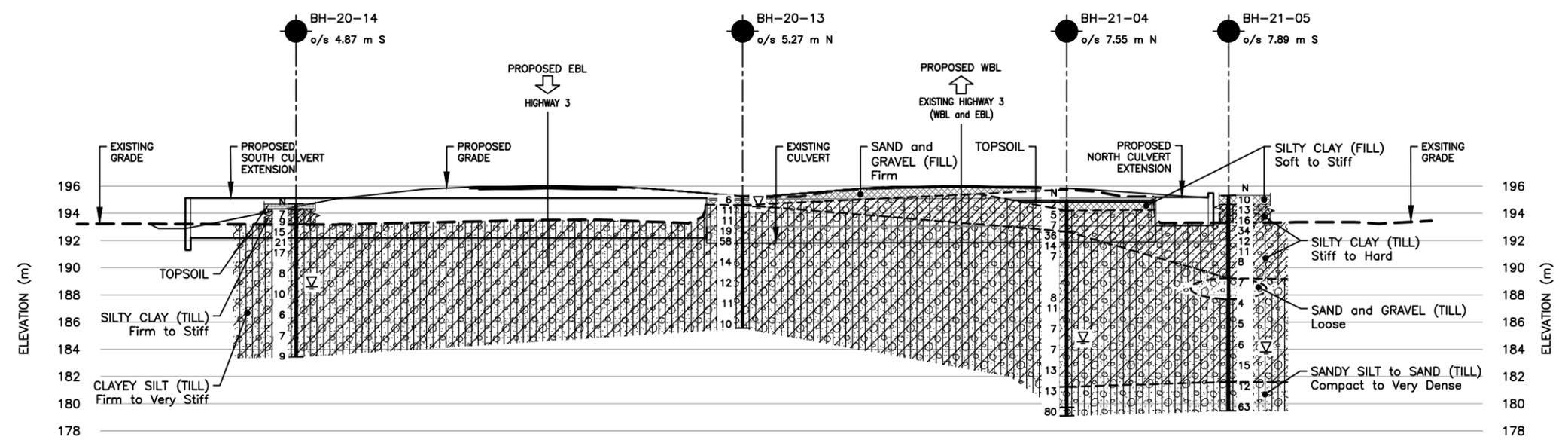


LEGEND

- Borehole
- N Standard Penetration Test Value
 Blows/0.3m unless otherwise stated
 (Std. Pen. Test. 475 j/blow)
- ▽ Water Level in open borehole upon completion of drilling

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-13	195.3	4662508.6	285219.3
BH-20-14	194.7	4662500.5	285185.7
BH21-04	195.0	4662509.5	285243.3
BH21-05	195.3	4662493.4	285254.3



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NO.	DATE	BY	REVISION

Geocres No.: 40J2-147

HWY. 3	PROJECT NO. 11202886	DIST. CHATHAM
SUBM'D. MN/MRM	CHKD. SS	DATE: 1.10.2022
DRAWN: AW	CHKD. SS	APPD. SMM
		SITE: 06X-0429/C0
		DWG. 8



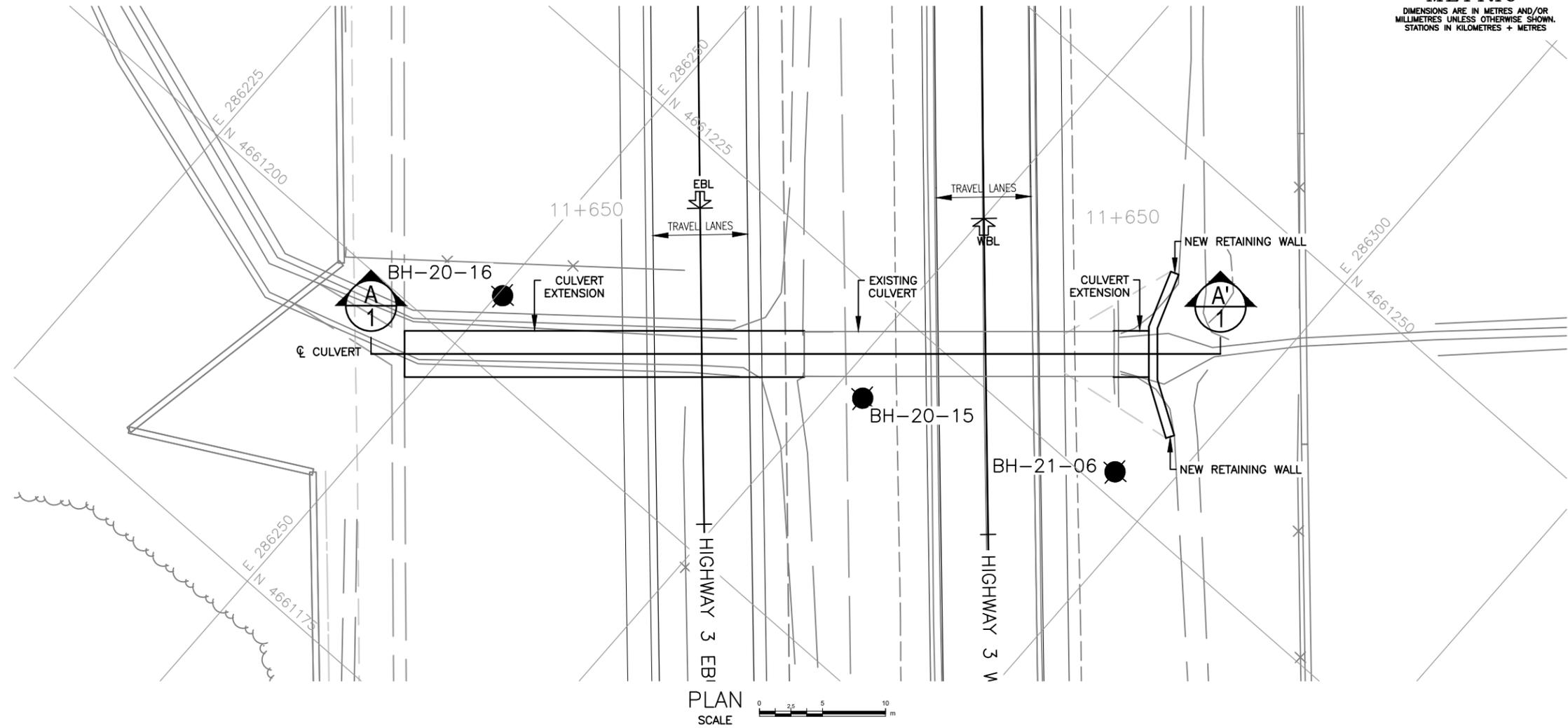
METRIC
 DIMENSIONS ARE IN METRES AND/OR
 MILLIMETRES UNLESS OTHERWISE SHOWN.
 STATIONS IN KILOMETRES + METRES

CONT No.
 GWP No. 3021-18-00



CULVERT No. 06X-0432/C0
 HIGHWAY 3
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

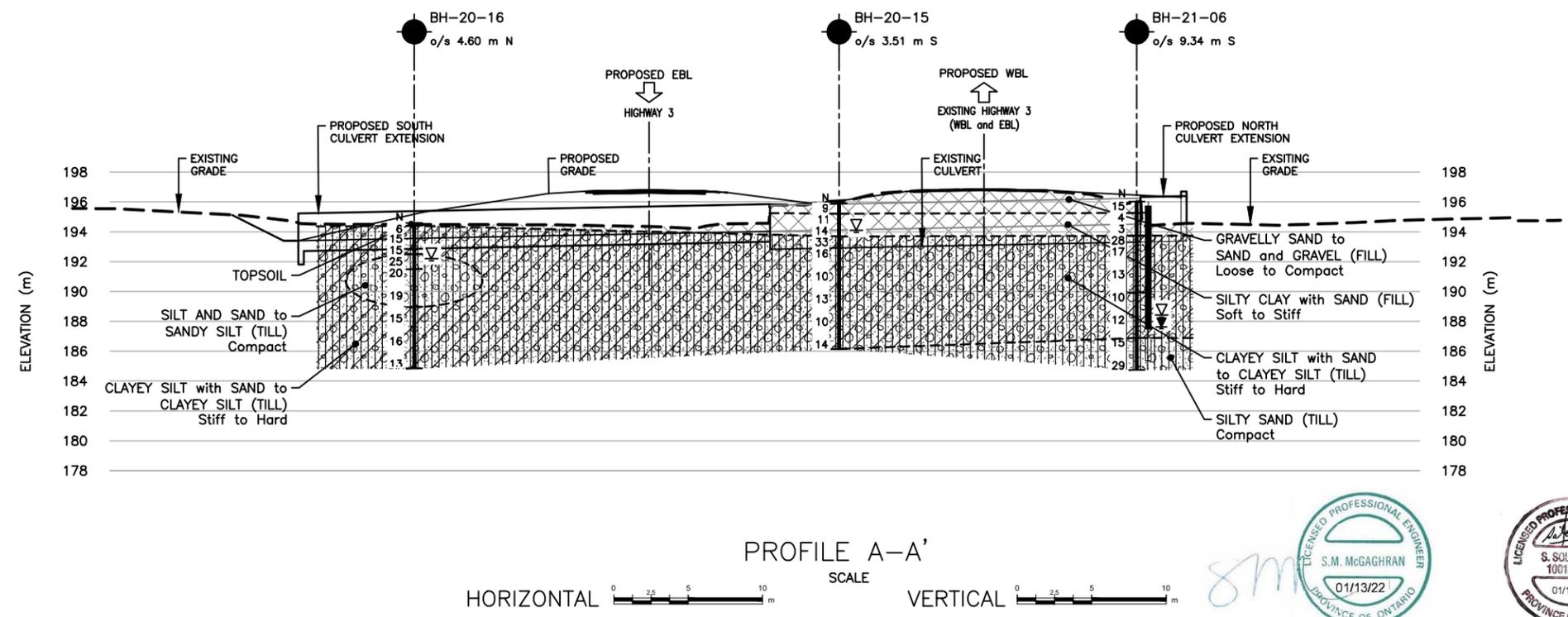


LEGEND

- Borehole
- Seal
- Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test. 475 j/blow)
- Water Level in open borehole upon completion of drilling
- Water Level measured in piezometer (Nov. 24/2021)

BOREHOLE CO-ORDINATES (MTM ZONE 11)

NO	ELEVATION	NORTHING	EASTING
BH-20-15	195.9	4661218.0	286277.2
BH-20-16	194.6	4661205.3	286250.4
BH21-06	196.0	4661226.8	286296.1



PROFILE A-A'

HORIZONTAL SCALE 0 2.5 5 10 m
 VERTICAL SCALE 0 2.5 5 10 m



NOTES

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REFERENCE

Base plans provide in digital format by Callon Dietz, drawing file: B-117-003-1 DB, B-116-003-1 DB, received March 5, 2021.

NO.	DATE	BY	REVISION

Geocres No.: 40J2-147

Hwy. 3	PROJECT NO. 11202886	DIST. CHATHAM
SUBM'D. MN/MRM	CHKD. SS	DATE: 1.10.2022
DRAWN: AW	CHKD. SS	APPD. SMM
		SITE: 06X-0432/C0
		DWG. 9

Appendices

Appendix A

Site Photographs



Photo 1 – Culvert No. 06X-420/C0 – Concession Road 9



Photo 2 – A Sample of Silty Clay at BH-20-02 – Culvert No. 06X-420/C0



Photo 3 – Culvert No. 06X-421/C0 – Intersection between Hwy 3 and Concession Road 8



Photo 4 – Drilling at BH-20-03 – Culvert No. 06X-421/C0



Photo 5 – Culvert No. 06X-422/C0 – Concession Road 8



Photo 6 – Drilling at BH-20-06 – Culvert No. 06X-422/C0



Photo 7 – Drilling at BH-20-07 – Culvert No. 06X-423/C0 – Hwy 3, 220 m East of Concession Road 8



Photo 8 – Drilling at BH-20-08 – Culvert No. 06X-423/C0, Hwy 3, 220 m East of Concession Road 8



Photo 9- Culvert No. 06X-423/C0, North Extension- Location of BH-21-01



Photo 10 – Culvert No. 06X-426/C0 – Intersection between Hwy 3 and County Road 27



Photo 11 – Drilling Set up at BH-20-10 – Culvert No. 06X-426/C0 – Hwy 3 between County Road 27



Photo 12 – Drilling at BH-21-02 – Culvert No. 06X-426/C0 North Extension– Hwy 3 Shoulder



Photo 13 – Drilling at BH-20-11 – Culvert No. 06X-427/C0 – Hwy 3, 700 m east of County Road 27



Photo 14 – Drilling at BH-20-12 – Culvert No. 06X-427/C0 – Hwy 3, 700 m east of County Road 27



Photo 15 – BH-21-03– Culvert No. 06X-427/C0 North Extension – Hwy 3



Photo 16 – Culvert No. 06X-429/C0 – Hwy 3, 460 m west of Division Road



Photo 17 – Drilling at BH-20-13 – Culvert No. 06X-429/C0 – Hwy 3, 460 m West of Division Road



Photo 18– Drilling at BH-21-04 – Culvert No. 06X-429/C0, North Extension – Hwy 3 Shoulder



Photo 19–BH-21-05 Location – Culvert No. 06X-429/C0, North Extension – Hwy 3 Shoulder



Photo 20 – Culvert No. 06X-432/C0 – Hwy 3, 600 m East of County Road 34



Photo 21– Drilling at BH-20-16 - Culvert No. 06X-432/C0 – Hwy 3, 600 m East of County Road 34



Photo 22– Location of BH-21-016 with respect to Culvert No. 06X-432/C0 , North Extension– Hwy 3

Appendix B

Borehole Records



Notes on Borehole and Test Pit Reports

Soil description :

Each subsurface stratum is described using the following terminology. The relative density of granular soils is determined by the Standard Penetration Index ("N" value), while the consistency of clayey soils is measured by the value of undrained shear strength (Su).

Classification (Unified system)			
Clay	< 0.002 mm		
Silt	0.002 to 0.075 mm		
Sand	0.075 to 4.75 mm	fine	0.075 to 4.25 mm
		medium	0.425 to 2.0 mm
		coarse	2.0 to 4.75 mm
Gravel	4.75 to 75 mm	fine	4.75 to 19 mm
		coarse	19 to 75 mm
Cobbles	75 to 300 mm		
Boulders	>300 mm		

Terminology	
"trace"	1-10%
"some"	10-20%
adjective (silty, sandy)	20-35%
"and"	35-50%

Relative density of granular soils	Standard penetration index "N" value (BLOWS/ft – 300 mm)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Consistency of cohesive soils	Undrained shear strength (Cu)	
	(P.S.F)	(kPa)
Very soft	<250	<12
Soft	250-500	12-25
Firm	500-1000	25-50
Stiff	1000-2000	50-100
Very stiff	2000-4000	100-200
Hard	>4000	>200

Rock quality designation	
"RQD" (%) Value	Quality
<25	Very poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

STRATIGRAPHIC LEGEND			
Sand	Gravel	Cobbles & boulders	Bedrock
Silt	Clay	Organic soil	Fill

Samples:

Type and Number

The type of sample recovered is shown on the log by the abbreviation listed hereafter. The numbering of samples is sequential for each type of sample.

SS: Split spoon	ST: Shelby tube	AG: Auger
SSE, GSE, AGE: Environmental sampling	PS: Piston sample (Osterberg)	RC: Rock core
	NR: No Recovery	GS: Grab sample

Recovery

The recovery, shown as a percentage, is the ratio of length of the sample obtained to the distance the sampler was driven/pushed into the soil

RQD

The "Rock Quality Designation" or "RQD" value, expressed as percentage, is the ratio of the total length of all core fragments of 4 inches (10 cm) or more to the total length of the run.

IN-SITU TESTS:

N: Standard penetration index	N _c : Dynamic cone penetration index	k: Permeability
R: Refusal to penetration	Su: Undrained Shear Strength	ABS: Absorption (Packer test)
	Pr: Pressuremeter	

LABORATORY TESTS:

I _p : Plasticity index	H: Hydrometer analysis	A: Atterberg limits	C: Consolidation	O.V.: Organic vapor
W _l : Liquid limit	GSA: Grain size analysis	w: Water content	CS: Swedish fall cone	
W _p : Plastic limit	NP: non-plastic	y: Unit weight	CHEM: Chemical analysis	

RECORD OF BOREHOLE No BH-21-01

1 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0423/C0 (Northing: 4665407.5, Easting: 282642.3, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.10.04 LATITUDE 42.127864 LONGITUDE -82.768005 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04\FIELDWORK\06\FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
194.9 0.0	FILL - SAND, trace clay Loose Brown Moist		1	SS	5	+							15	
194.1 0.8	FILL - SILTY CLAY, contains organics, trace sand, trace gravel Soft Brown to Grey Moist		2	SS	3	▼							24	
			3	SS	4								24	
192.6 2.3	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey Moist		4	SS	8								21	1 15 45 39 LL=34% PL=18% PI=16%
			5	SS	15								20	
			6	SS	10								18	
			7	SS	6								23	LL=33% PL=13% PI=20%
			8	TW	PH									

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-01

2 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0423/C0 (Northing: 4665407.5, Easting: 282642.3, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.10.04 LATITUDE 42.127864 LONGITUDE -82.768005 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04\FIELDWORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)		
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
181.3	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey Moist		9	SS	4									23					LL=33% PL=17% Pt=16%
			10	SS	4									24					
			11	SS	4									23					
182									1.7										
										>100 kPa									
13.6	END OF BOREHOLE Notes: 1. Borehole dry during and upon completion of drilling. 2. Groundwater level at a depth of 0.94 m (Elev. 193.96 m) on Nov 24, 2021.																		

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-02

1 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0426/C0 (Northing: 4664509.0, Easting: 283607.0, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Truck Mounted COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.11.10 LATITUDE 42.119801 LONGITUDE -82.756304 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)	
						20	40	60	80	100	20	40	60		GR	SA	SI	CL	
195.7 0.0	FILL - GRAVELLY SAND, some silt Dense to Very Dense Brown Moist		1	SS	30							5							
			2	SS	53							9							
194.2 1.5	SILTY CLAY, trace gravel, trace to some sand (TILL) Very Stiff to Firm Greyish Brown Moist		3	SS	25							23							LL=46% PL=30% Pt=16%
			4	SS	6							22							
			5	SS	16							19							
	becoming with SAND		6	SS	11							20							4 26 45 25 LL=40% PL=17% Pt=23%
191.1 4.6	CLAYEY SILT, some sand, trace gravel (TILL) Very Stiff to Stiff Brown to Grey Moist		7	SS	7							18							2 12 53 33 LL=35% PL=18% Pt=17%
			8	SS	6							20							LL=34% PL=15% Pt=19%
			1	TW	PH														C

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-03

2 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0427/C0 (Northing: 4663959.4, Easting: 284063.5, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.10.05 LATITUDE 42.114864 LONGITUDE -82.750763 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELD\WORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40	60	GR SA SI CL	
179.1	CLAYEY SILT, some sand (TILL) Very Stiff to Stiff Brown to Grey Moist	STRAT PLOT	9	SS	4	[Groundwater symbol]	186	[DCP Plot]	[Moisture Content]	[Liquid Limit]	[Unit Weight]	[Remarks]									
185													10	SS	4	184	[DCP Plot]	[Moisture Content]	[Liquid Limit]	[Unit Weight]	[Remarks]
183																					
181													179.1	END OF BOREHOLE	[DCP Plot]	[Moisture Content]	[Liquid Limit]	[Unit Weight]	[Remarks]		
180																				15.7	END OF BOREHOLE
179.1													15.7	END OF BOREHOLE	[DCP Plot]	[Moisture Content]	[Liquid Limit]	[Unit Weight]	[Remarks]		
15.7																				END OF BOREHOLE	[DCP Plot]
15.7	END OF BOREHOLE	[DCP Plot]	[Moisture Content]	[Liquid Limit]	[Unit Weight]	[Remarks]															

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-04

2 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0429/C0 (Northing: 4662509.5, Easting: 285243.3, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Truck Mounted COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.11.11 LATITUDE 42.101840 LONGITUDE -82.736448 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04\FIELD\WORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100 WATER CONTENT (%) 20 40 60											
186	CLAYEY SILT and SAND, trace gravel to CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Hard Dark Brown Wet		9	SS	7	▽											
185																	
184			10	SS	7												
183																	
182																	
181.3																	
181	SAND, some gravel, some fines (TILL) Compact Brown Wet		12	SS	13											12 75 (13)	
180																	
179.8																	
179.2																	
15.8	END OF BOREHOLE																
	Notes: 1. Groundwater level at a depth of 10.4 m below ground surface (Elev. 184.6 m) upon completion of drilling.																

+³ Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-05

1 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0429/C0 (Northing: 4662493.4, Easting: 285254.3, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Truck Mounted COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.11.10 LATITUDE 42.101695 LONGITUDE -82.736315 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)				
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
195.3 0.0	FILL - SILTY CLAY, some sand, trace gravel, contains rootlets Stiff Brown Moist		1	SS	10							22						
194.6 0.7	SILTY CLAY, some sand, trace gravel (TILL) Stiff to Hard Grey Moist		2	SS	13							22						
	becoming brown		3	SS	16							24						LL=36% PL=17% PI=19%
	0.15 m thick layer of sand and gravel		4	SS	34							22						
			5	SS	12							23						3 19 43 35 LL=45% PL=19% PI=26%
			6	SS	11							19						LL=39% PL=18% PI=21%
	0.1 m thick layer of sand		7	SS	8							19						
189.2 6.1	SAND and GRAVEL, some fines (TILL) Loose Brown Moist		8	SS	7							16						45 40 (15)
187.7 7.6	SILTY CLAY, trace sand, trace gravel, contains wood pieces at depths of 7.6 m to 8.2 m (TILL) Soft to Very Stiff Dark Brown to Grey Moist to Wet		9	SS	4							25						LL=37% PL=15% PI=22%

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-05

2 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0429/C0 (Northing: 4662493.4, Easting: 285254.3, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Truck Mounted COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.11.10 LATITUDE 42.101695 LONGITUDE -82.736315 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04\FIELD\WORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY_V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)	
						20	40	60	80	100	20	40	60		GR SA SI CL			
181.6	SILTY CLAY, trace sand, trace gravel, contains wood pieces at depths of 7.6 m to 8.2 m (TILL) Soft to Very Stiff Dark Brown to Grey Moist to Wet		1	TW														
186			10	SS	5								37					
185								1.3										
184											1.8							
183												>100 kPa						
182																		
181.6	SILTY SAND, some gravel, trace clay (TILL) Compact to Very Dense Brown to Grey Wet		13	SS	12							11						
181																		
180																		
179.5	END OF BOREHOLE Notes: 1. Groundwater level at a depth of 11.5 m below ground surface (Elev. 183.8 m) upon completion of drilling.		14	SS	63							8						
15.8																		

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-06

1 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0432/C0 (Northing: 4661226.8, Easting: 286296.1, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.10.05 LATITUDE 42.090317 LONGITUDE -82.723679 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
196.0 0.0	FILL - GRAVELLY SAND, trace silt, some organics (plants) Compact Brown Moist		1	SS	15								10	
195.2 0.8	FILL - SILTY CLAY with SAND, contains rootlets and organics Soft Brown to Grey Moist		2	SS	4								28	
			3	SS	3								27	0 29 37 34 LL=39% PL=21% PI=18%
193.7 2.3	CLAYEY SILT with SAND (TILL) Stiff to Very Stiff Brown to Grey Moist		4	SS	28								15	LL=25% PL=15% PI=10%
			5	SS	17								23	0 27 42 31 LL=26% PL=13% PI=13%
			6	SS	13								17	
189.9 6.1	CLAYEY SILT, some sand (TILL) Stiff Grey Moist to Wet		7	SS	10								16	LL=25% PL=14% PI=11%
			8	SS	12								21	

Continued Next Page

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-21-06

2 OF 2

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0432/C0 (Northing: 4661226.8, Easting: 286296.1, MTM Zone 11, NAD 83) ORIGINATED BY Manvit.M
 DIST Chatham HWY 3 BOREHOLE TYPE Hollow Stem Auger (4") DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2021.10.05 LATITUDE 42.090317 LONGITUDE -82.723679 CHECKED BY Sandra McGaghan

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2021 GINT LOGS_SCOPE CHANGE\11202886 HWY 3_SCOPE CHANGE BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
186.9	CLAYEY SILT, some sand (TILL) Stiff Grey Moist to Wet															
9.1	SILTY SAND, trace to some gravel (TILL) Compact Grey Wet		9	SS	15							10				
184.7	END OF BOREHOLE		10	SS	29							10			7	60 (33)
11.3	Notes: 1. Groundwater level at a depth of 7.6 m below ground surface (Elev. 188.4 m) upon completion of drilling. 2. Groundwater level at a depth of 8.4 m (Elev. 187.6 m) on Nov 24, 2021.															

+³ Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-01

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0420/C0 (Northing: 4666959.4, Easting: 280836.9, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.27 LATITUDE 42.141783 LONGITUDE -82.789905 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60
194.8 0.0	FILL - SAND and GRAVEL, some silt Compact Light Brown Moist		1	SS	23							9			
194.1 0.7	SILTY CLAY, some sand, trace gravel (TILL) Stiff Brown to Grey Moist to Wet		2	SS	9							21			
			3	SS	11							25			1 15 39 45 LL=52% PL=21% PI=31%
192.6 2.2	CLAYEY SILT, some sand, trace gravel (TILL) Very Stiff to Stiff Grey Moist		4	SS	17							18			
			5	SS	21							16			
			6	SS	13							19			2 14 41 43 LL=34% PL=16% PI=18%
			7	SS	13							20			
			8	SS	13							22			
			9	SS	9							22			
185.0 9.8	END OF BOREHOLE														
	Notes: 1. Borehole dry during and upon completion of drilling.														

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-02

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0420/C0 (Northing: 4666946.7, Easting: 280856.9, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.27 LATITUDE 42.141670 LONGITUDE -82.789663 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40
194.3	TOPSOIL - Clayey Silt, trace sand and gravel, containing rootlets		1	SS	7														
0.0 194.0	Firm Dark Brown Moist		2	SS	7														0 14 36 50 LL=46% PL=20% Pt=26%
0.3	SILTY CLAY, some sand, trace gravel (TILL)		3	SS	12														
192.8	Firm Light Brown to Grey Moist		4	SS	30														
1.5	CLAYEY SILT, some sand, trace gravel (TILL)		5	SS	16														0 12 41 47 LL=31% PL=18% Pt=13%
	Firm to Hard Grey Moist		6	SS	9														
			7	SS	7														0 14 41 45 LL=35% PL=18% Pt=17%
			8	SS	9														
			9	SS	12														
184.5	END OF BOREHOLE																		
9.8	Notes: 1. Borehole dry during and upon completion of drilling.																		

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-03

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0421/C0 (Northing: 4665573.4, Easting: 282433.8, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.28 LATITUDE 42.129352 LONGITUDE -82.770533 CHECKED BY Sahar Soleimani

File: N:\CAWATER\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40	60
195.3 0.0	FILL - SAND and GRAVEL, trace to some fines Compact Light Brown Moist		1	SS	16	▽	195						20							
			2	SS	15		194								20					46 45 (9)
193.9 1.4	SILTY CLAY, some sand, trace gravel (TILL) Stiff Brown to Grey Moist to Wet		3	SS	9		193							24						
			4	SS	11		193								25					2 14 36 48 LL=38% PL=16% Pt=20%
192.5 2.8	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey Moist		5	SS	28		192							20						
			6	SS	26		191								17					
			7	SS	15		190								20					2 13 39 46 LL=34% PL=16% Pt=18%
			8	SS	11		189								22					
			9	SS	10		187								23					
			10	SS	10		186								24					
185.5 9.8			END OF BOREHOLE																	
			Notes: 1. Groundwater level at a depth of 2.2 m below ground surface (Elev. 193.1 m) upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-04

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0421/C0 (Northing: 4665539.7, Easting: 282422.5, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.28 LATITUDE 42.129048 LONGITUDE -82.770669 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04\FIELD\WORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20	40	60
194.9	FILL - SAND and GRAVEL, some silt Loose to Compact Light Brown Moist		1	SS	12															
193.8			2A	SS	8															
1.1	SILTY CLAY, some sand, trace gravel (TILL) Stiff Grey Wet		2B																	
193			3	SS	9														1 15 45 39 LL=37% PL=19% Pt=18%	
192.7	CLAYEY SILT, some sand, trace gravel (TILL) Very Stiff to Stiff Grey Moist		4	SS	22															
192			5	SS	27															
191																				
190			6	SS	13															1 12 47 40 LL=34% PL=14% Pt=20%
189																				
188																				
187																				
186																				
185.1																				
9.8	END OF BOREHOLE																			
	Notes: 1. Borehole dry during and upon completion of drilling.																			

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-05

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0422/C0 (Northing: 4665516.3, Easting: 282413.7, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.28 LATITUDE 42.128837 LONGITUDE -82.770774 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)				
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
194.5	FILL - SAND and GRAVEL, trace to some fines		1A	SS	10													
194.2	Compact Brown Moist		1B															
0.3	SILTY CLAY, some sand, trace gravel (TILL) Firm to Stiff Grey Moist		2	SS	5													
			3	SS	13													
192.4	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey Moist		4	SS	13													
			5	SS	15													
			6	SS	9													
			7	SS	10													
			8	SS	12													
184.7	END OF BOREHOLE	9	SS	15														
9.8	Notes: 1. Borehole dry during and upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-06

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0422/C0 (Northing: 4665505.6, Easting: 282445.9, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.28 LATITUDE 42.128742 LONGITUDE -82.770385 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04\FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
194.4	TOPSOIL, Clayey Silt, trace sand, containing rootlets		1A															
194.0	Stiff Dark Brown to Black		1B	SS	11							23						
0.4	Moist SILTY CLAY, some sand, trace gravel, some organic (TILL) Stiff to Very Stiff Light Brown to Grey		2	SS	12							24						0 11 37 52 LL=51% PL=21% Pt=30%
	Moist		3	SS	15							20						
			4	SS	18							17						1 12 46 41 LL=37% PL=18% Pt=19%
191.5	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey		5	SS	15							19						
2.9	Moist		6	SS	12							22						
			7	SS	8							23						0 39 51 10
188.8	SILT and SAND, trace to some clay (TILL) Loose Grey Moist		8	SS	15							18						
5.6			9	SS	9							17						
187.2	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey Moist																	
7.2																		
184.6	END OF BOREHOLE																	
9.8	Notes: 1. Groundwater level at a depth of 6.1 m below ground surface (Elev. 188.3m) upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-07

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0423/C0 (Northing: 4665404.5, Easting: 282622.8, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.30 LATITUDE 42.127837 LONGITUDE -82.768241 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20
195.5 0.0	FILL - SAND and GRAVEL, some fines Loose Brown Moist		1	SS	9													38 49 (13)
194.4			2A															
194.4 1.1	FILL - SILTY CLAY with SAND, trace gravel Firm Grey Moist to Wet		2B	SS	8													
			3	SS	6													
			4	SS	7													4 26 33 37 LL=45% PL=19% Pt=26%
192.5 3.0	CLAYEY SILT, some sand, trace gravel (TILL) Hard to Stiff Grey Moist		5	SS	31													
			6	SS	20													
			7	SS	10													0 13 47 40 LL=34% PL=18% Pt=16%
			8	SS	9													
			9	SS	10													
185.7 9.8	END OF BOREHOLE																	
	Notes: 1. Borehole dry during and upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-08

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0423/C0 (Northing: 4665399.6, Easting: 282581.1, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.30 LATITUDE 42.127792 LONGITUDE -82.768745 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40
194.3 0.0 194.0 0.3	TOPSOIL, Clayey Silt, trace sand, trace gravel, containing rootlets Firm Dark Brown to Black Moist	1A												
	CLAYEY SILT, some sand, trace gravel (TILL) Very Stiff to Stiff Light Brown to Grey Moist	1B	SS	9					20					
		2	SS	10					18					
		3	SS	26					14				1 18 49 32 LL=32% PL=17% Pt=15%	
		4	SS	20					16					
		5	SS	19					18				0 12 46 42 LL=31% PL=18% Pt=13%	
		6	SS	9					22					
		7	SS	9					23					
		8	SS	8					24					
		9	SS	9					24					
184.5 9.8	END OF BOREHOLE													
	Notes: 1. Borehole dry during and upon completion of drilling.													

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-09

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0426/C0 (Northing: 4664521.8, Easting: 283565.9, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.04.30 LATITUDE 42.119915 LONGITUDE -82.756802 CHECKED BY Sahar Soleimani

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 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			20	40					
195.1 0.0	FILL - SAND and GRAVEL, trace silt Compact Light Brown Moist		1	SS	11		195			8				
194.4 0.7	SILTY CLAY, some sand, trace gravel (TILL) Firm Grey Moist		2	SS	7		194			21				4 17 40 39 LL=40% PL=21% Pt=19%
193.7 1.4	CLAYEY SILT, some sand, trace gravel (TILL) Very Stiff to Stiff Grey Moist		3	SS	10		193			20				
			4	SS	17		192			19				
			5	SS	29		192			17				0 12 49 39 LL=34% PL=18% Pt=16%
			6	SS	13		191			19				
			7	SS	14		189			22				1 12 48 39 LL=31% PL=18% Pt=13%
			8	SS	10		187			23				
			9	SS	13		186			23				
185.3 9.8	END OF BOREHOLE													

Notes:
 1. Borehole dry during and upon completion of drilling.

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-10

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0426/C0 (Northing: 4664494.3, Easting: 283549.3, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.05.01 LATITUDE 42.119667 LONGITUDE -82.757001 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
193.3	CLAYEY SILT, some sand, trace gravel, some organics (TILL) Firm to Very Stiff Light Brown to Grey Moist to Wet		1	SS	8							25							
			2	SS	9								19						
			3	SS	12								20						0 12 50 38 LL=33% PL=19% PI=14%
			4	SS	19								17						
			5	SS	13								18						0 12 51 37 LL=32% PL=18% PI=14%
			6	SS	10								20						
			7	SS	9								23						
			8	SS	8								23						
			9	SS	5								25						
			10	SS	7								27						
182.0	END OF BOREHOLE																		
11.3	Note: 1. Groundwater level at a depth of 10.7 m below ground surface (Elev. 182.6 m) upon completion of drilling.																		

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-11

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0427/C0 (Northing: 4663965.9, Easting: 284035.9, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.05.01 LATITUDE 42.114922 LONGITUDE -82.751097 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
195.1 0.0	FILL - SAND and GRAVEL, trace fines Compact Brown Moist		1	SS	23	▽	195													
			2	SS	29		194													35 57 (8)
193.7 1.4	FILL - SILTY CLAY, some sand, trace gravel, some organics Stiff Light Brown to Grey Moist to Wet		3	SS	9		193												1 19 36 44 LL=55% PL=22% P1=33%	
			4	SS	9		193													
192.1 3.0	CLAYEY SILT, some sand, trace gravel (TILL) Hard to Stiff Brown to Grey Moist		5	SS	32		192													
			6	SS	16		190													1 17 48 34 LL=29% PL=17% P1=12%
			7	SS	9		189													
			8	SS	10		187													
			9	SS	9		186													
185.3 9.8	END OF BOREHOLE																			
	Note: 1. Groundwater level at a depth of 1.2 m below ground surface (Elev. 193.9 m) upon completion of drilling.																			

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-12

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0427/C0 (Northing: 4663975.9, Easting: 283988.7, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.05.01 LATITUDE 42.115011 LONGITUDE -82.751668 CHECKED BY Sahar Soleimani

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 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
194.6	TOPSOIL, Clayey Silt, trace sand and gravel, containing rootlets		1A											
0.0 194.3	Firm Dark Brown to Black Moist		1B	SS	7						25			
0.3	SILTY CLAY, some sand, trace gravel, some organics (TILL) Firm to Stiff Light Brown to Grey Moist		2	SS	7						21			1 14 43 42 LL=41% PL=20% Pt=21%
			3	SS	9						18			
192.4	CLAYEY SILT, some sand, trace gravel (TILL) Firm to Very Stiff Brown to Grey Moist		4	SS	24						18			
2.2			5	SS	14						18			0 14 49 37 LL=31% PL=17% Pt=14%
			6	SS	7						20			
			7	SS	9						22			
			8	SS	12						24			
			9	SS	11						19			
184.8 9.8	END OF BOREHOLE													
	Note: 1. Groundwater level at a depth of 4.9 m below ground surface (Elev. 189.7 m) upon completion of drilling.													

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-13

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0429/C0 (Northing: 4662508.6, Easting: 285219.3, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.05.04 LATITUDE 42.101832 LONGITUDE -82.736739 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOOP\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80
195.3 0.0	FILL - SAND and GRAVEL, some clay, trace silt Loose Brown Moist CLAYEY SILT, some sand, trace gravel (TILL) Hard to Stiff Brown to Grey Moist		1	SS	6	▽	195									
194.6 0.7			2	SS	11		194									
			3	SS	11		193									
			4	SS	19		192									
			5	SS	58		191									
			6	SS	14		190									
			7	SS	12		189									
			8	SS	11		188									
			9	SS	10		187									
185.5 9.8	END OF BOREHOLE															
	Note: 1. Groundwater level at a depth of 0.8 m below ground surface (Elev. 194.5 m) upon completion of drilling.															

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-14 1 OF 1 METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0429/C0 (Northing: 4662500.5, Easting: 285185.7, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 2020.05.04 LATITUDE 42.101758 LONGITUDE -82.737144 CHECKED BY Sahar Soleimani

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 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20						40	60	80	100	20
194.7	TOPSOIL, Clayey Silt, trace sand, trace gravel, containing rootlets		1A															
194.3	Firm Dark Brown to Black Moist		1B	SS	7							26						
0.4			2	SS	9							21						0 12 43 45 LL=43% PL=20% P _t =23%
193.2	SILTY CLAY, some sand, some organic (TILL) Firm to Stiff Brown Moist		3	SS	15							18						
1.5			4	SS	21							18						0 14 46 40 LL=34% PL=18% P _t =16%
	CLAYEY SILT, some sand, trace gravel (TILL) Very Stiff to Firm Grey Moist		5	SS	17							19						
			6	SS	8							23						
			7	SS	10							26						0 11 48 41 LL=34% PL=19% P _t =15%
			8	SS	6							24						
			9	SS	7							26						
			10	SS	9							27						
183.4	END OF BOREHOLE																	
11.3	Note: 1. Groundwater level at a depth of 6.1m below ground surface (Elev. 188.6 m) upon completion of drilling.																	

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-15

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0432/C0 (Northing: 4661218.0, Easting: 286277.2, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 0202.05.19 LATITUDE 42.090237 LONGITUDE -82.723907 CHECKED BY Sahar Soleimani

File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELD\WORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60
195.9 0.0	FILL - SAND and GRAVEL, trace silt, trace clay Loose Brown Moist		1	SS	9	▽														
195.2 0.7			2	SS	11															
	FILL - CLAYEY SILT with SAND, trace to some gravel Stiff Grey Moist		3	SS	14														8 29 39 24 LL=32% PL=18% Pt=14%	
193.7 2.2			4	SS	33															0 19 49 32 LL=29% PL=16% Pt=13%
	CLAYEY SILT, some sand (TILL) Stiff to Hard Grey Moist		5	SS	16															
			6	SS	10															
			7	SS	13															
			8	SS	10															
			9	SS	14															
186.1 9.8	END OF BOREHOLE																			

Note:
 1. Groundwater level at a depth of 1.8 m below ground surface (Elev. 194.1 m) upon completion of drilling.

+ 3 Numbers refer to Sensitivity

RECORD OF BOREHOLE No BH-20-16

1 OF 1

METRIC

G.W.P. NO. 3021-18-00 LOCATION Culvert No. 06X-0432/C0 (Northing: 4661205.3, Easting: 286250.4, MTM Zone 11, NAD 83) ORIGINATED BY Moe Nasir
 DIST Chatham HWY 3 BOREHOLE TYPE Solid Stem Auger DRILLING RIG TYPE Diedrich D-50 Track COMPILED BY Anne Wang
 DATUM Geodetic DATE 0202.05.19 LATITUDE 42.090123 LONGITUDE -82.724231 CHECKED BY Sahar Soleimani

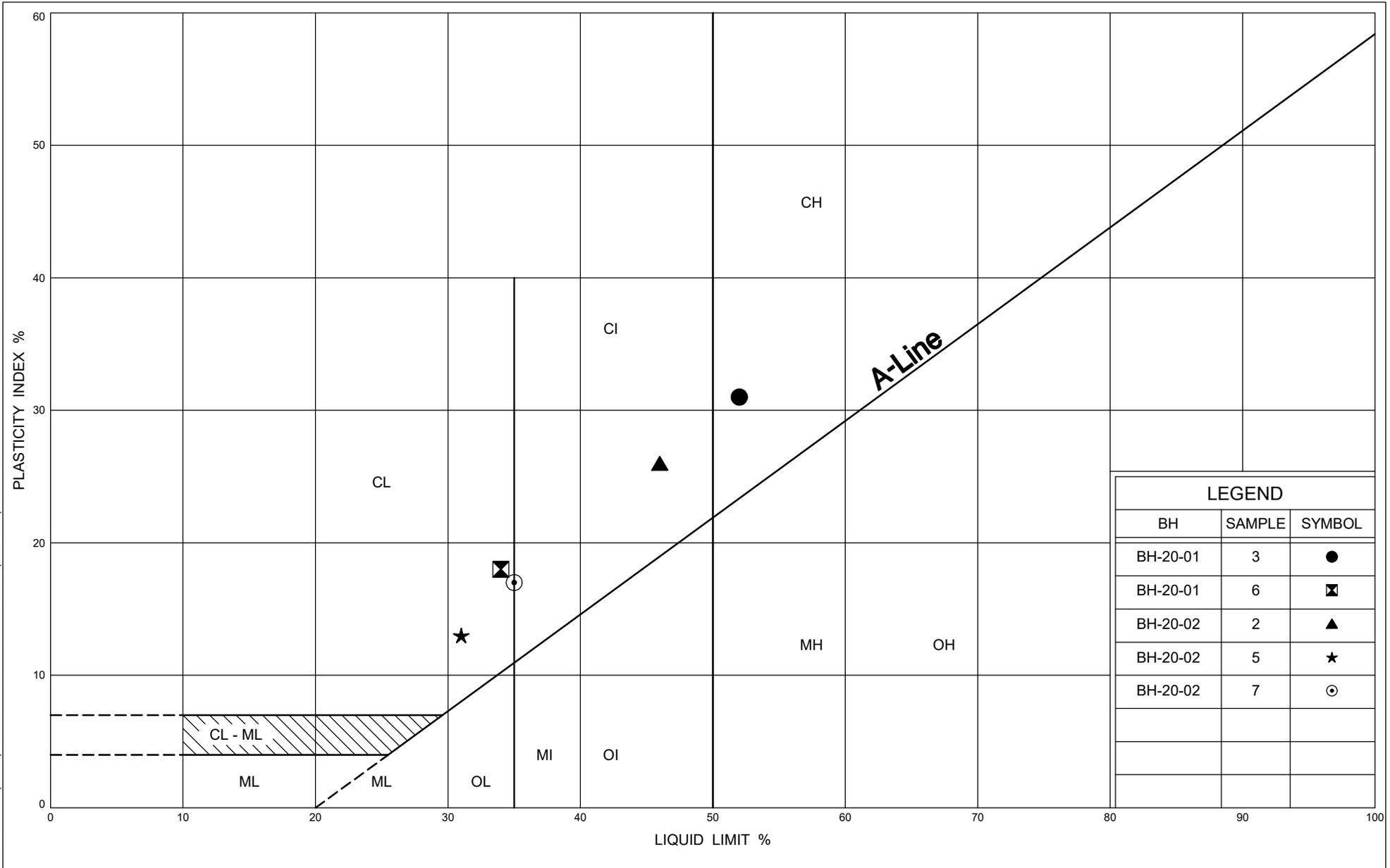
File: N:\CAWATERLOO\PROJECTS\662\11202886\TECH\12 FOUNDATIONS\04-FIELDWORK\06-FIELD NOTES AND LOGS\2020 GINT LOGS\11202886 HWY 3 WIDENING - WINDSOR TO LEAMINGTON BH LOGS V02.GPJ
 Library File: 11202886 MTD LIBRARY V01.GLB Report: 11202886 SCOPE CHANGE Date: 19/12/21

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	GR	SA
194.6	TOPSOIL, Clayey Silt, trace sand, trace gravel, containing rootlets Firm Dark Brown Moist		1A																			
192.2			1B	SS	6								26									
0.2			2	SS	15									21								
	CLAYEY SILT, some sand, trace gravel (TILL) Stiff Grey Moist		3	SS	15								17									
192.5			4	SS	25									13				7	57	29	7	
2.1			5	SS	20										16							
191.5	SILT and SAND, trace clay (TILL) Compact Grey Moist		6	SS	19									15				0	55	42	3	
			7	SS	15										24				3	16	47	34
5.6			8	SS	16										17							
189.0	CLAYEY SILT, some sand, trace gravel (TILL) Stiff to Very Stiff Grey Moist		9	SS	13									26								
184.8	END OF BOREHOLE																					
9.8	Note: 1. Groundwater level at a depth of 2.4 m below ground surface (Elev. 192.2 m) upon completion of drilling.																					

+ 3 Numbers refer to Sensitivity

Appendix C

Geotechnical Laboratory Test

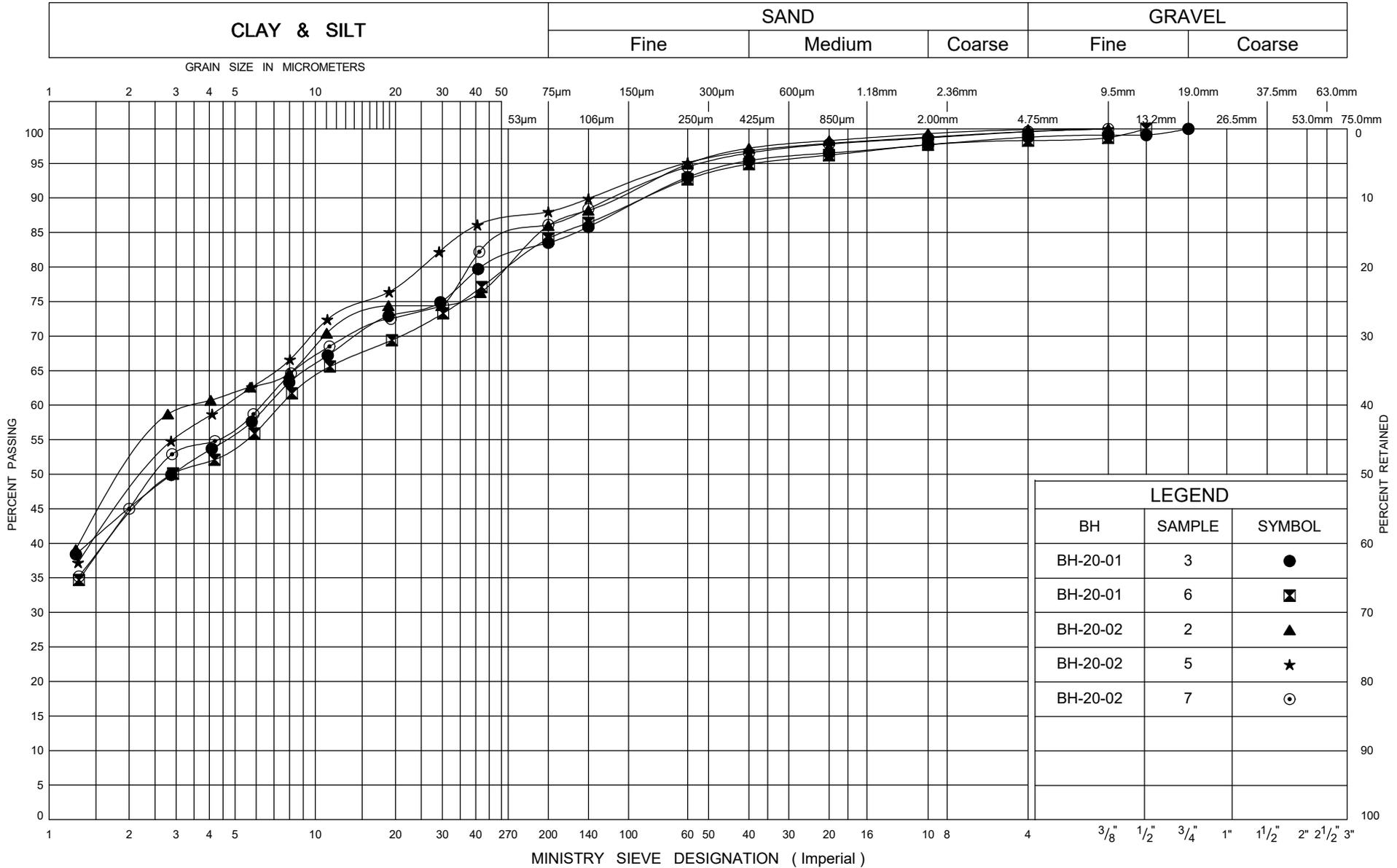


PLASTICITY CHART

Culvert No. 06X-0420/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C1-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



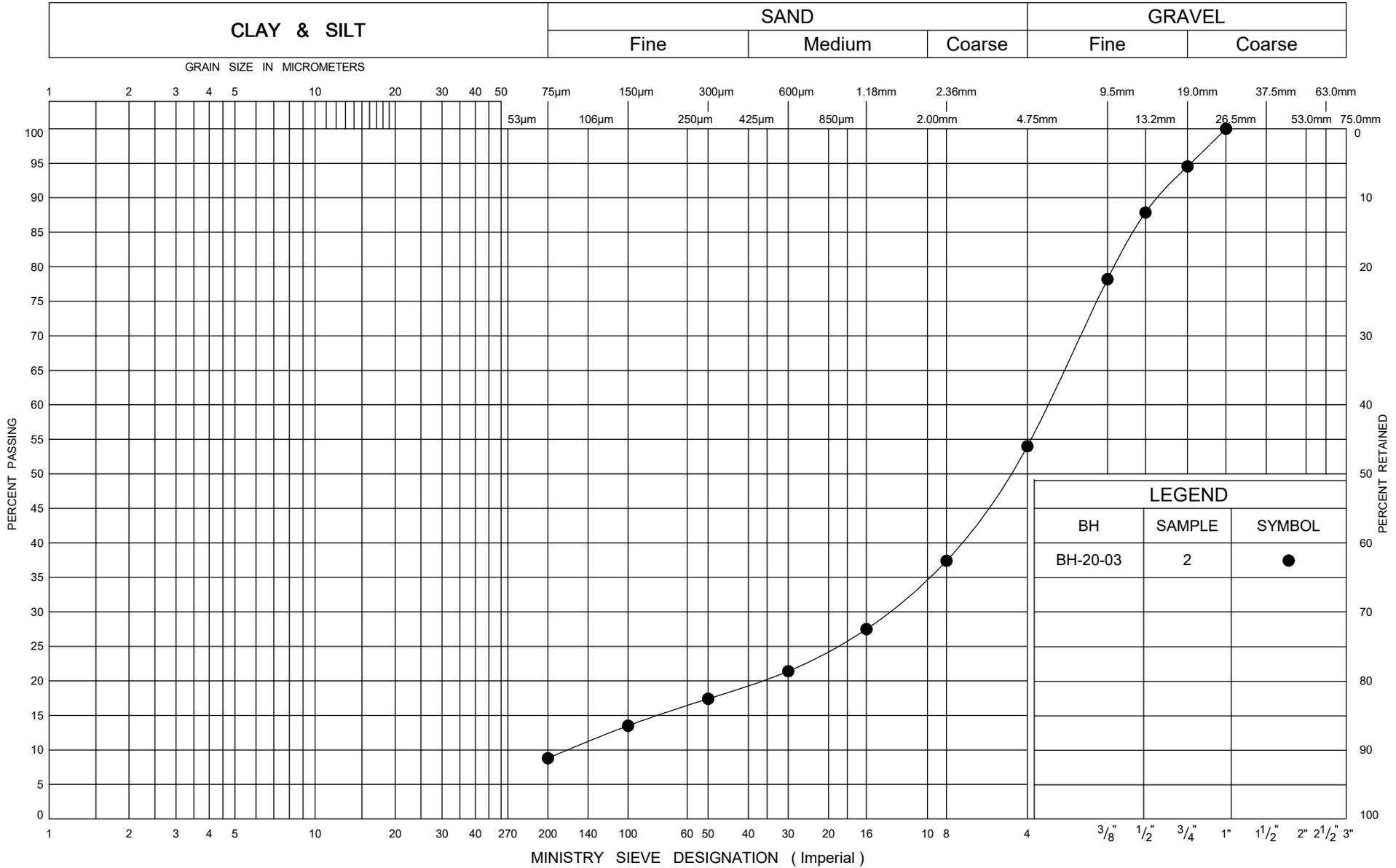
LEGEND		
BH	SAMPLE	SYMBOL
BH-20-01	3	●
BH-20-01	6	⊠
BH-20-02	2	▲
BH-20-02	5	★
BH-20-02	7	⊙



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0420/C0 - Clayey Silt to Silty Clay (Till)

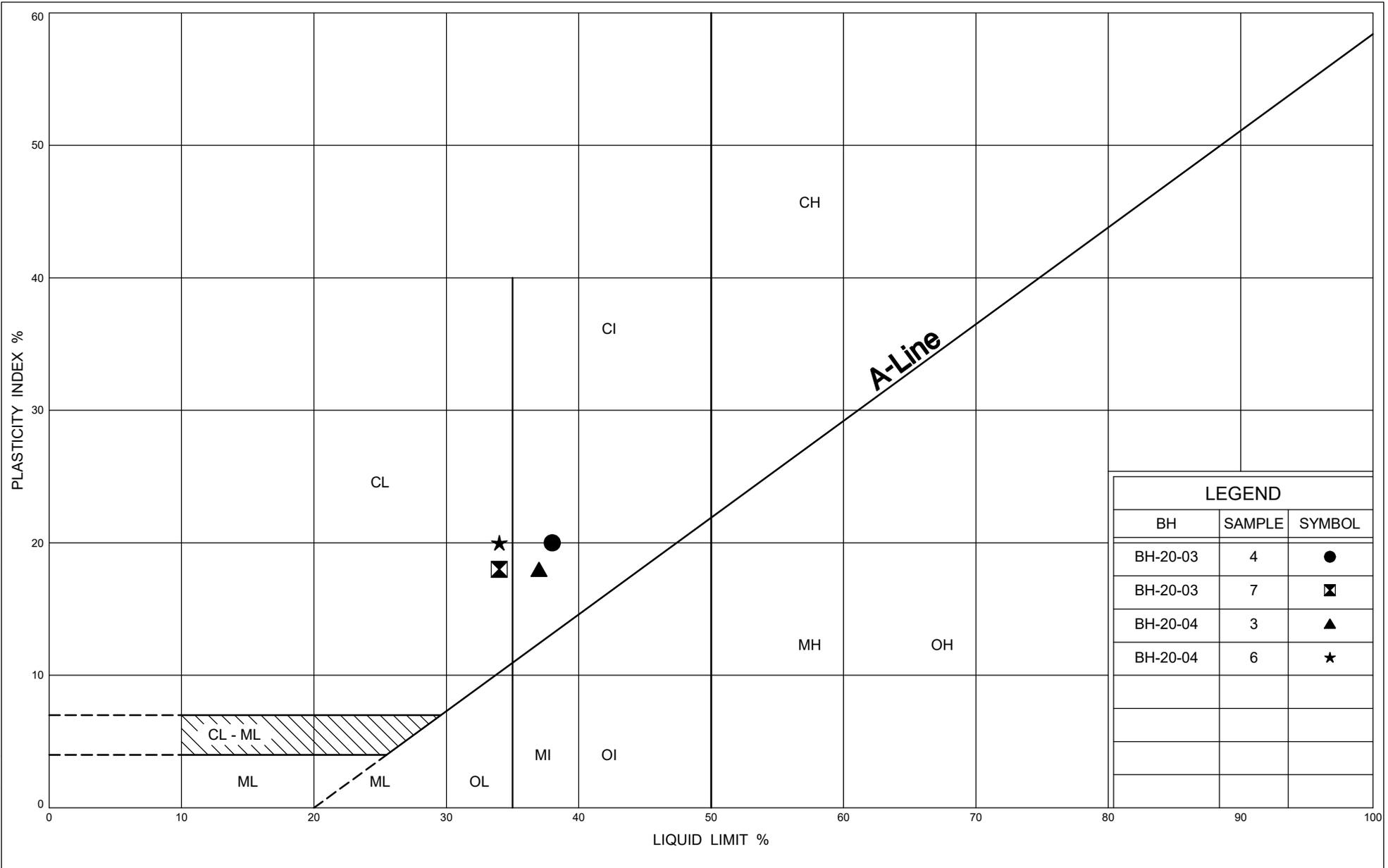
Figure:	C1-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0421/C0 - Fill - Sand and Gravel

Figure:	C2-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



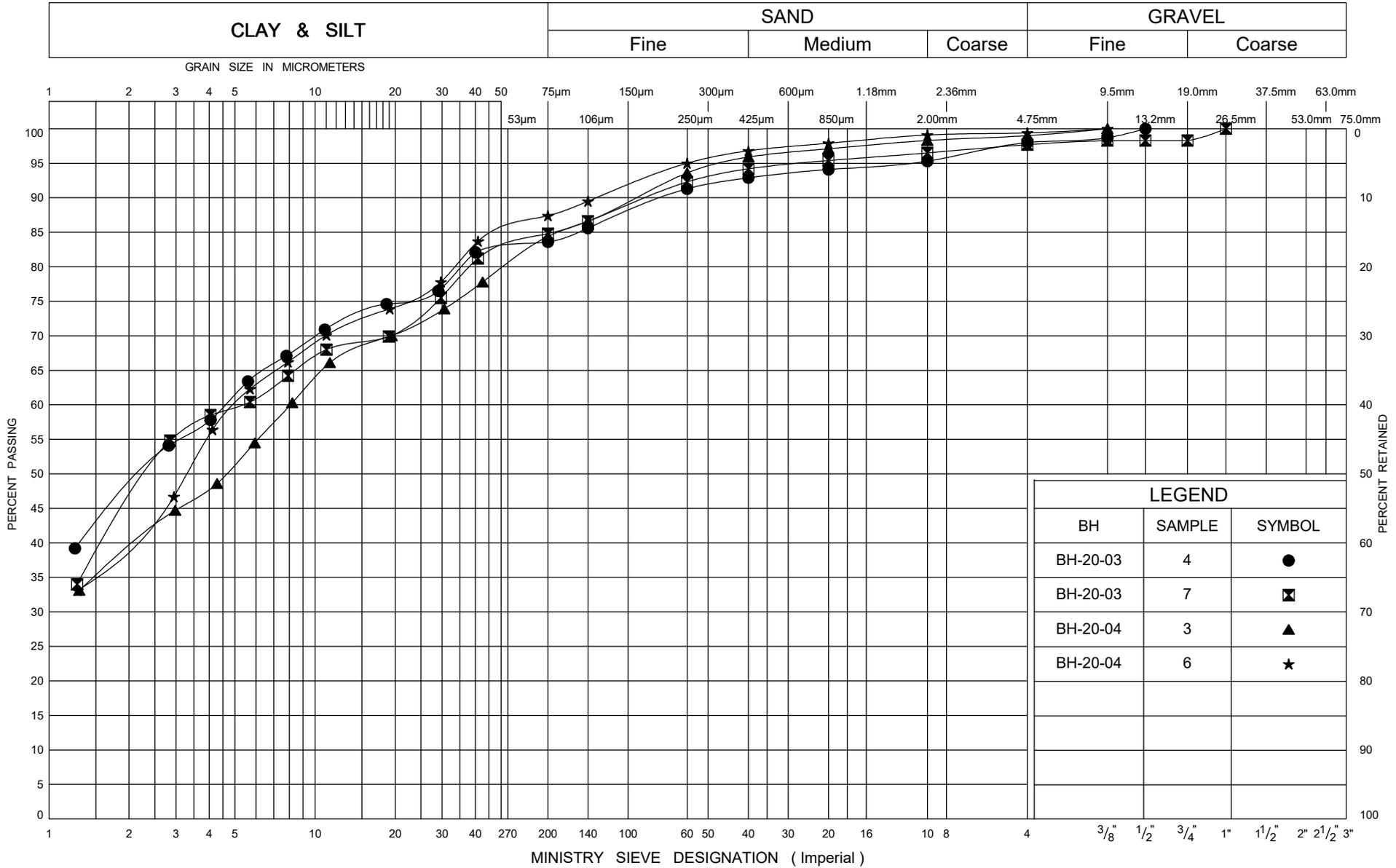
LEGEND		
BH	SAMPLE	SYMBOL
BH-20-03	4	●
BH-20-03	7	⊠
BH-20-04	3	▲
BH-20-04	6	★



PLASTICITY CHART
 Culvert No. 06X-0421/C0 - Clayey Silt to Silty Clay (Till)

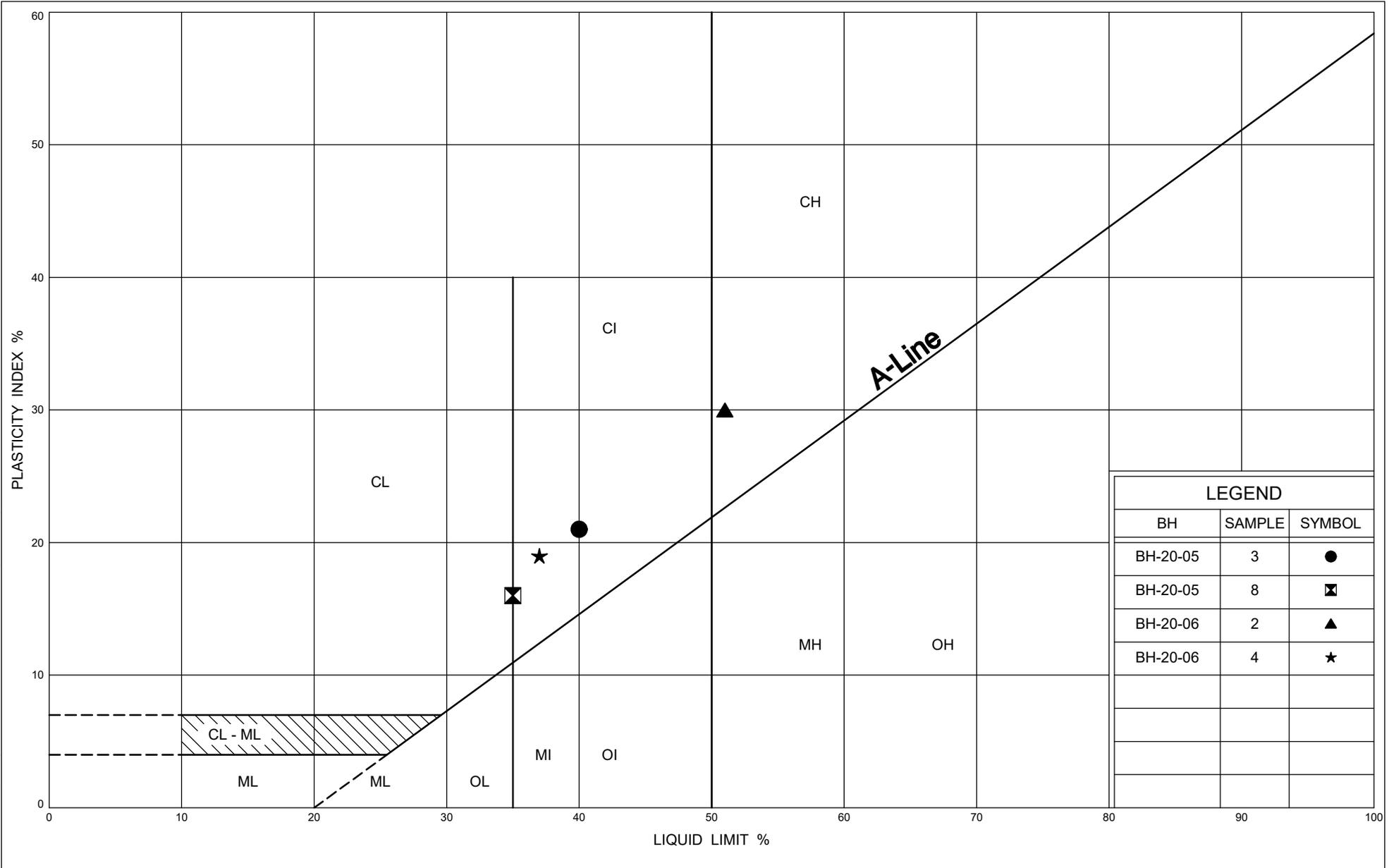
Figure:	C2-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0421/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C2-3
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



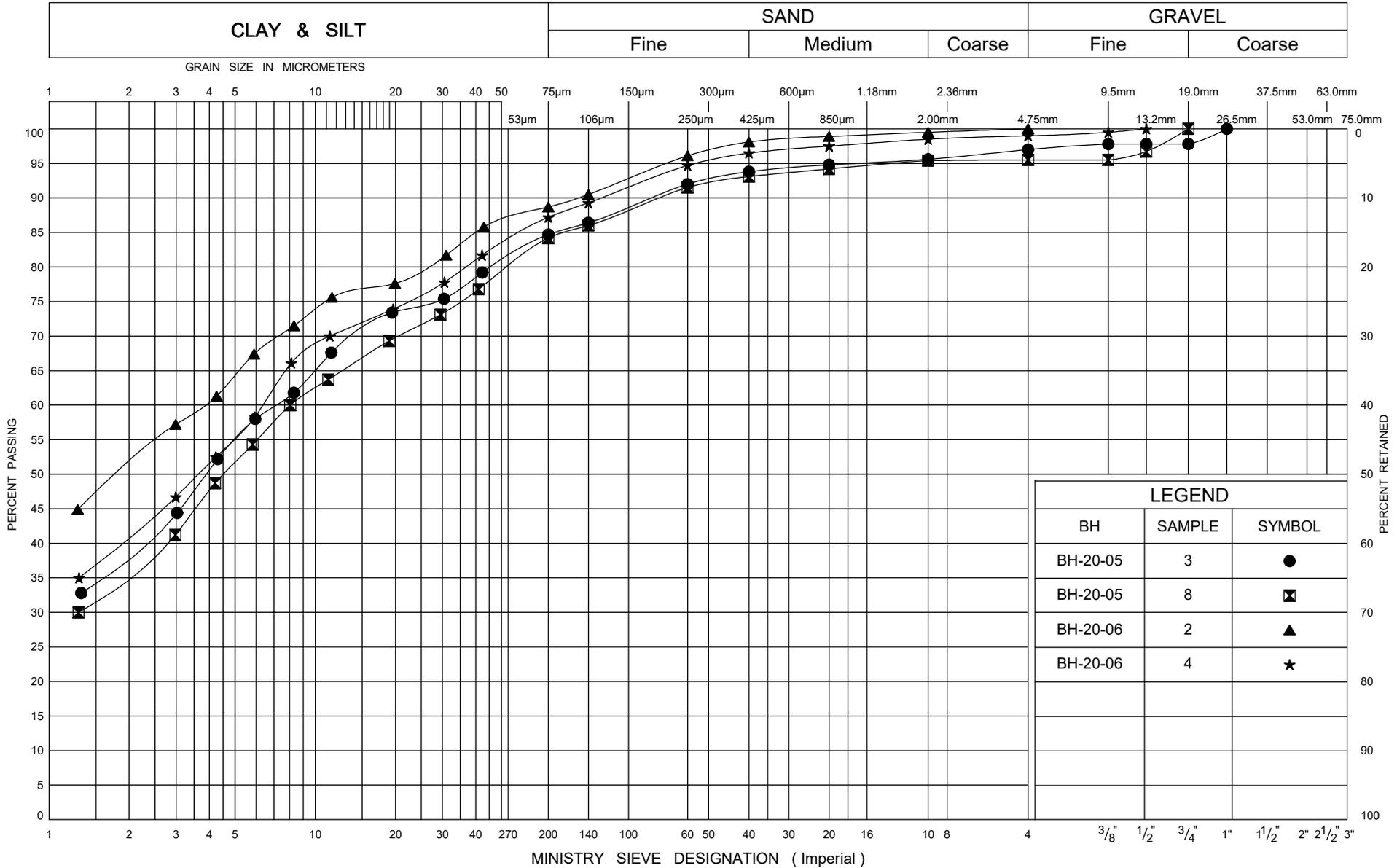
LEGEND		
BH	SAMPLE	SYMBOL
BH-20-05	3	●
BH-20-05	8	⊠
BH-20-06	2	▲
BH-20-06	4	★



PLASTICITY CHART
 Culvert No. 06X-0422/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C3-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

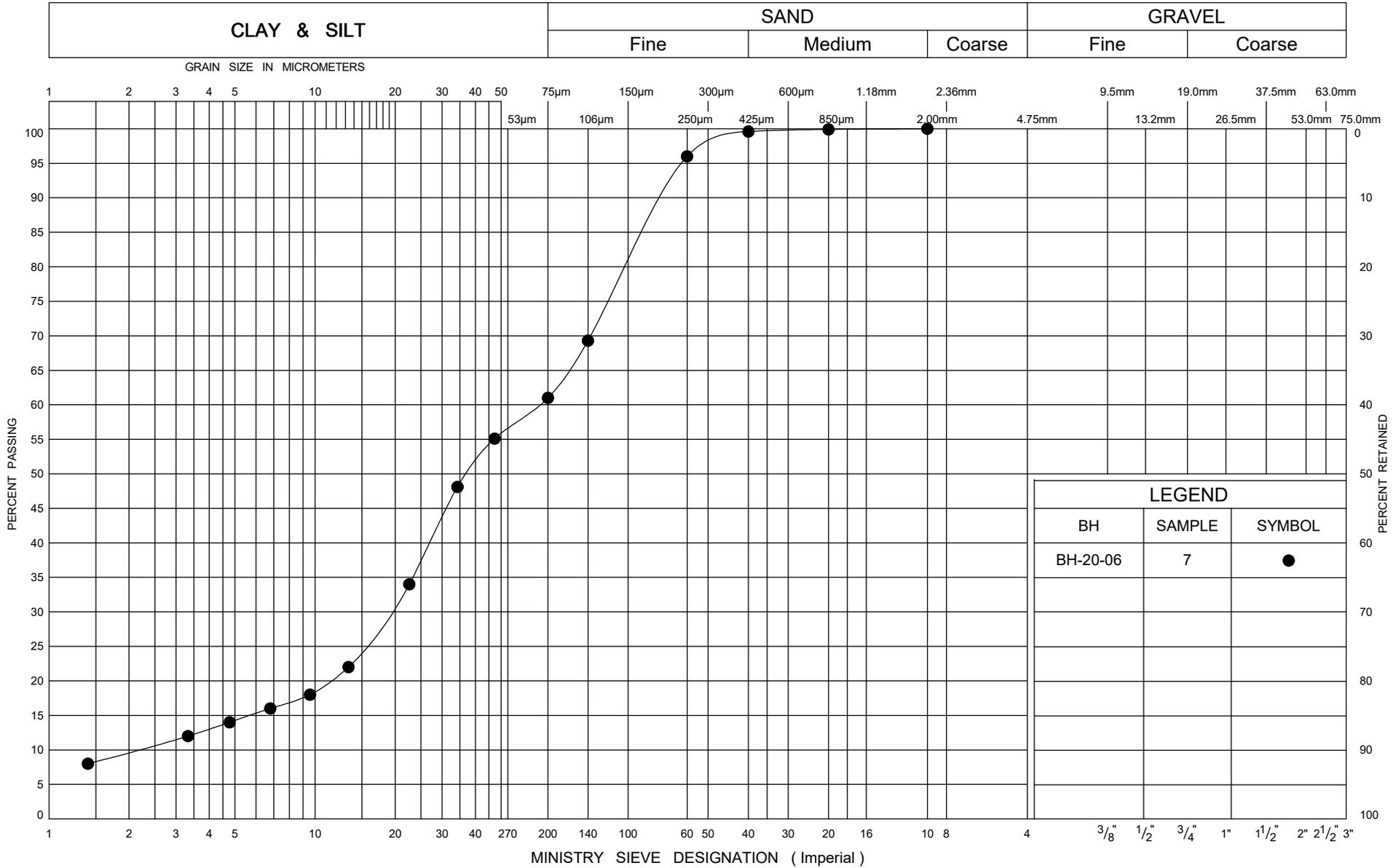
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0422/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C3-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

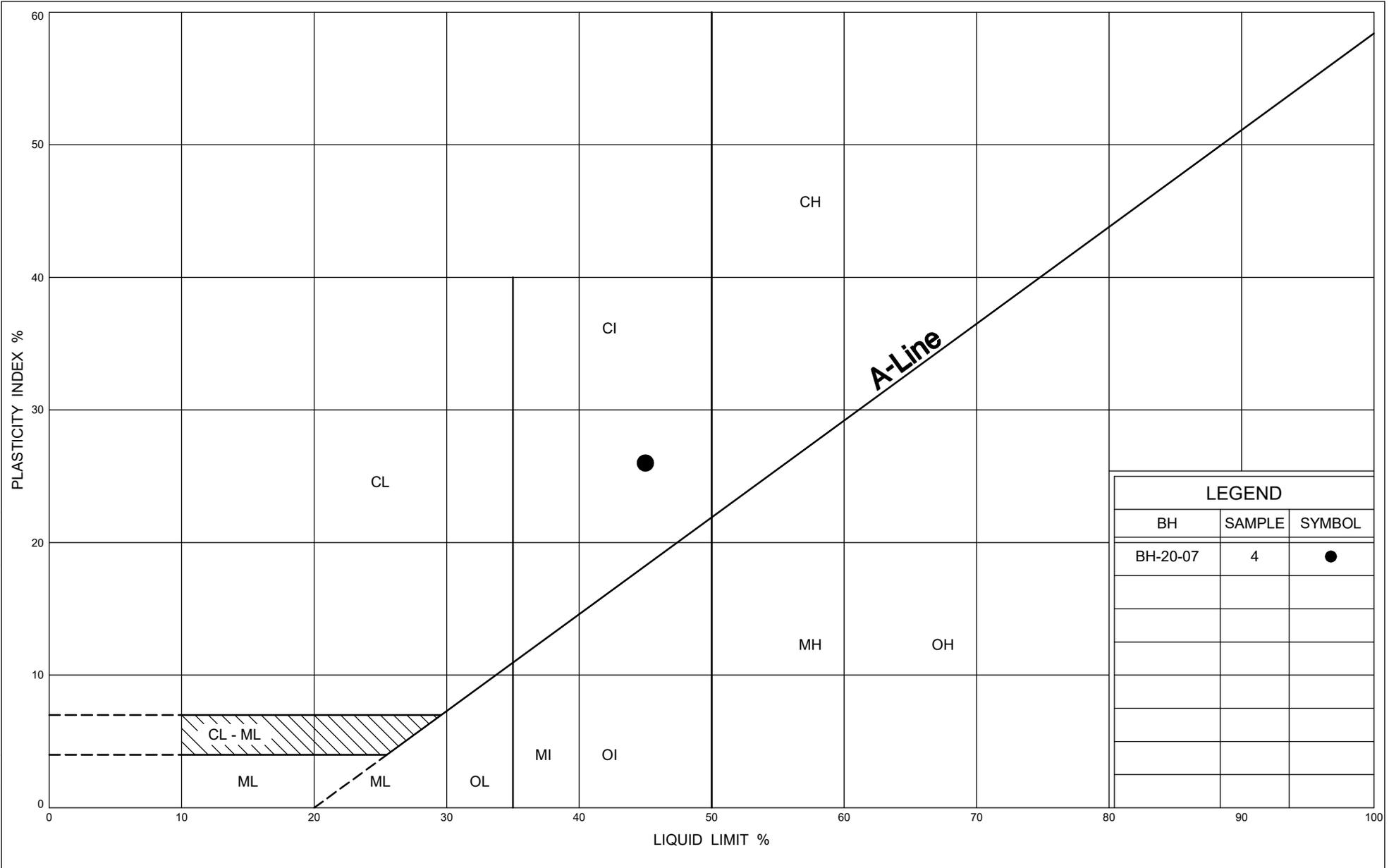
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Culvert No. 06X-0422/C0 - Silt and Sand (Till)

Figure:	C3-3
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



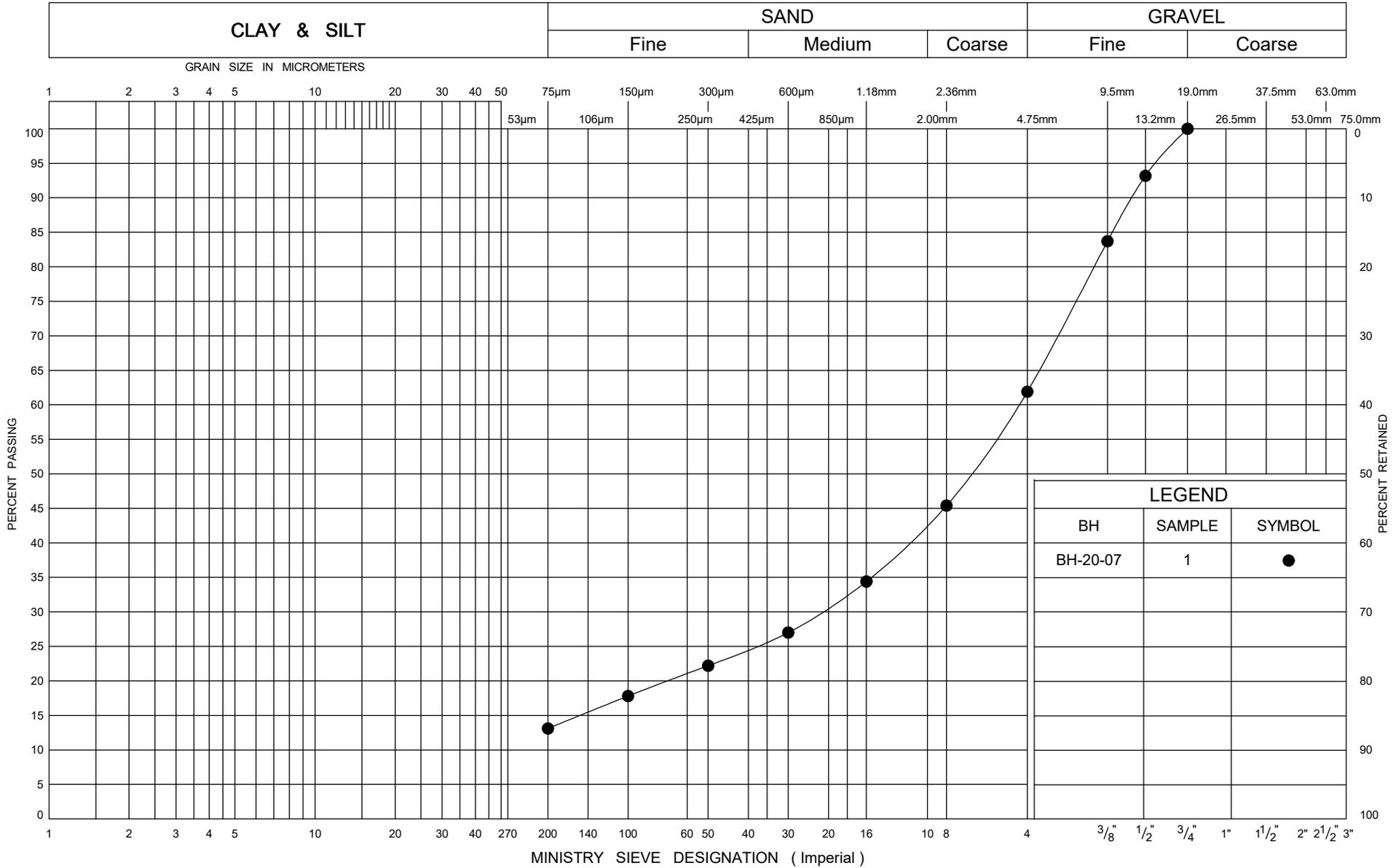
LEGEND		
BH	SAMPLE	SYMBOL
BH-20-07	4	●



PLASTICITY CHART
Culvert No. 06X-0423/C0 - Silty Clay Fill

Figure:	C4-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



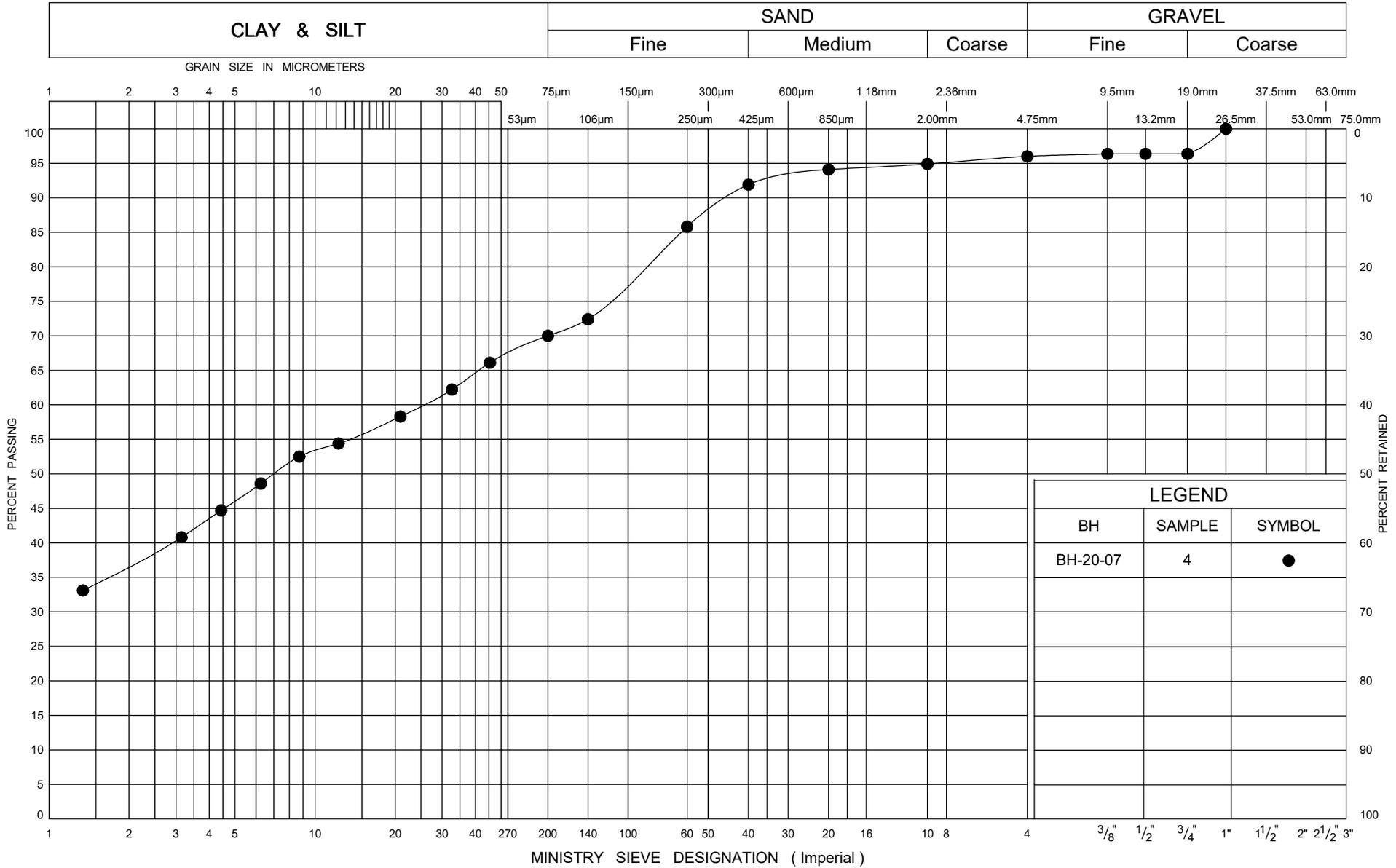
LEGEND		
BH	SAMPLE	SYMBOL
BH-20-07	1	●



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0423/C0 - Sand and Gravel Fill

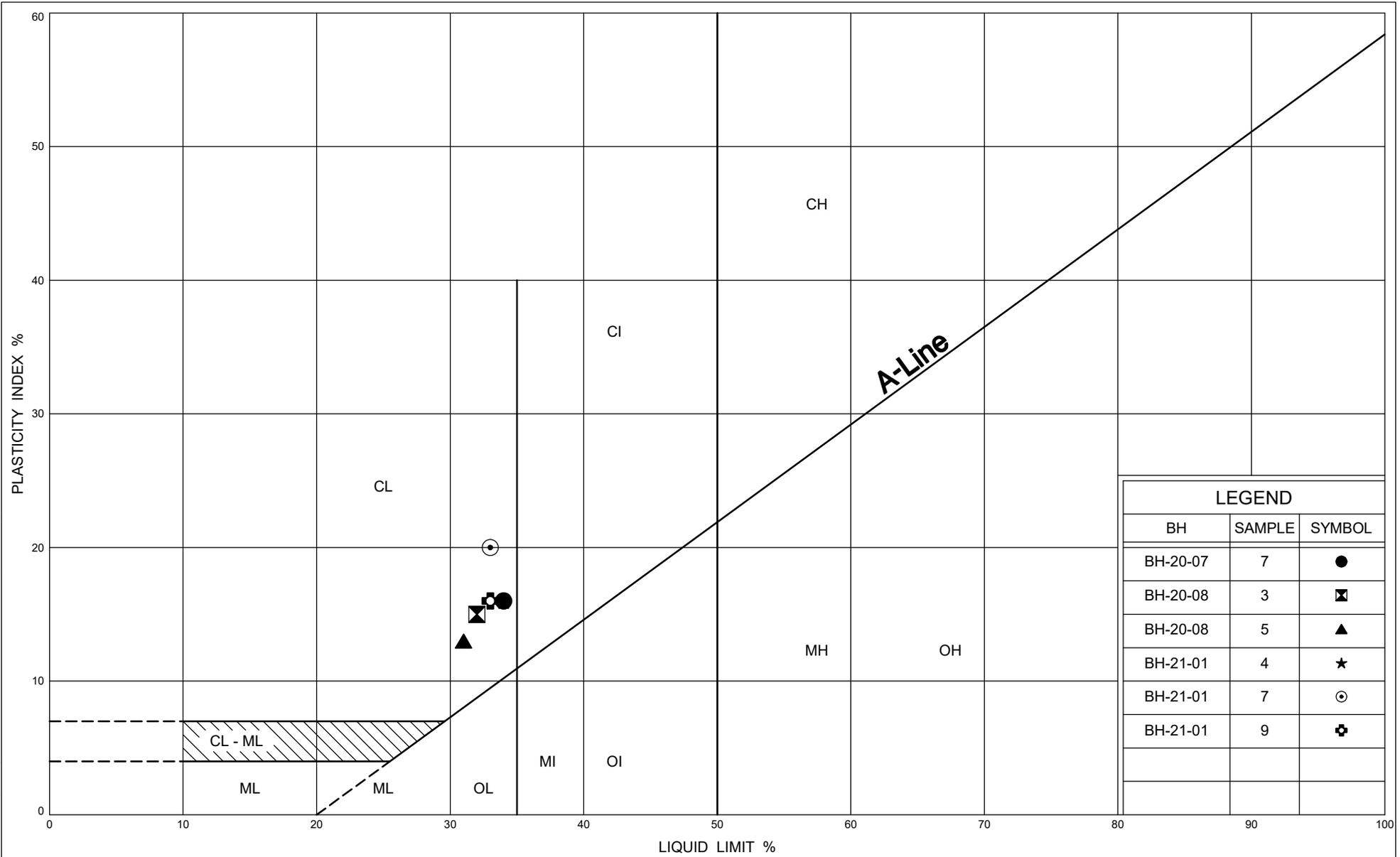
Figure:	C4-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0423/C0 - Silty Clay Fill

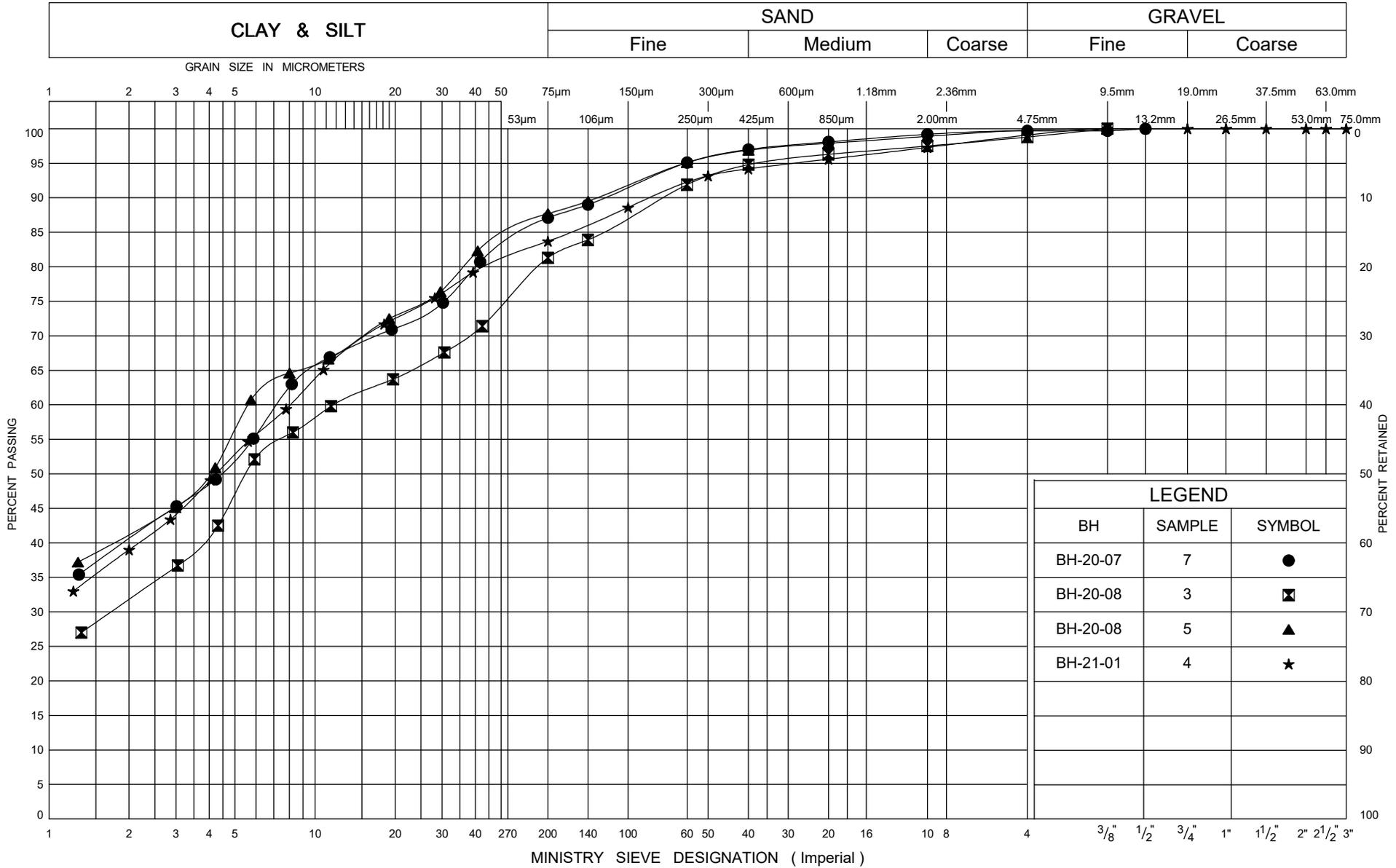
Figure:	C4-3
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



PLASTICITY CHART
 Culvert No. 06X-0423/C0 - Clayey Silt (Till)

Figure:	C4-4
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM

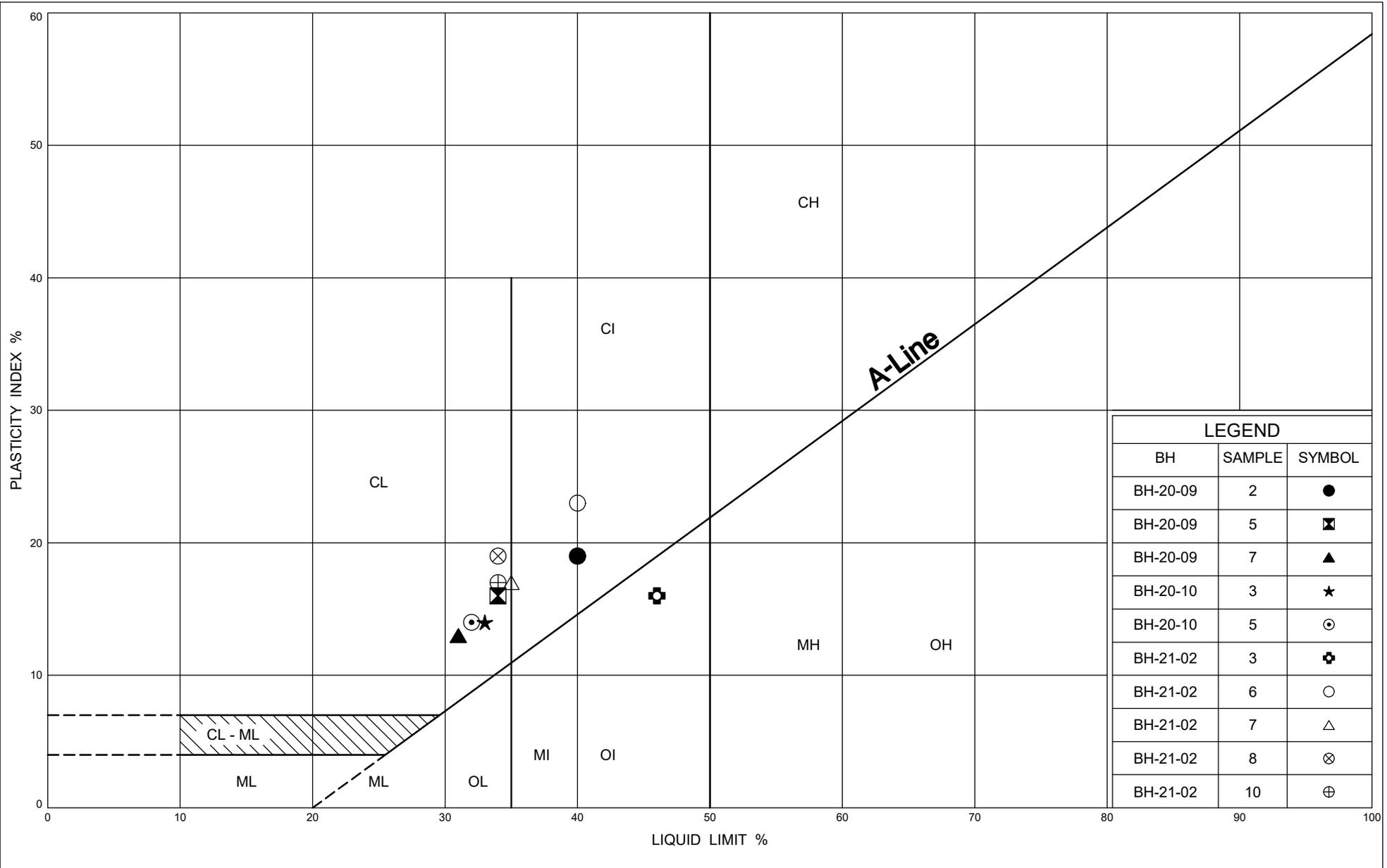


LEGEND		
BH	SAMPLE	SYMBOL
BH-20-07	7	●
BH-20-08	3	☒
BH-20-08	5	▲
BH-21-01	4	★



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0423/C0 - Clayey Silt (Till)

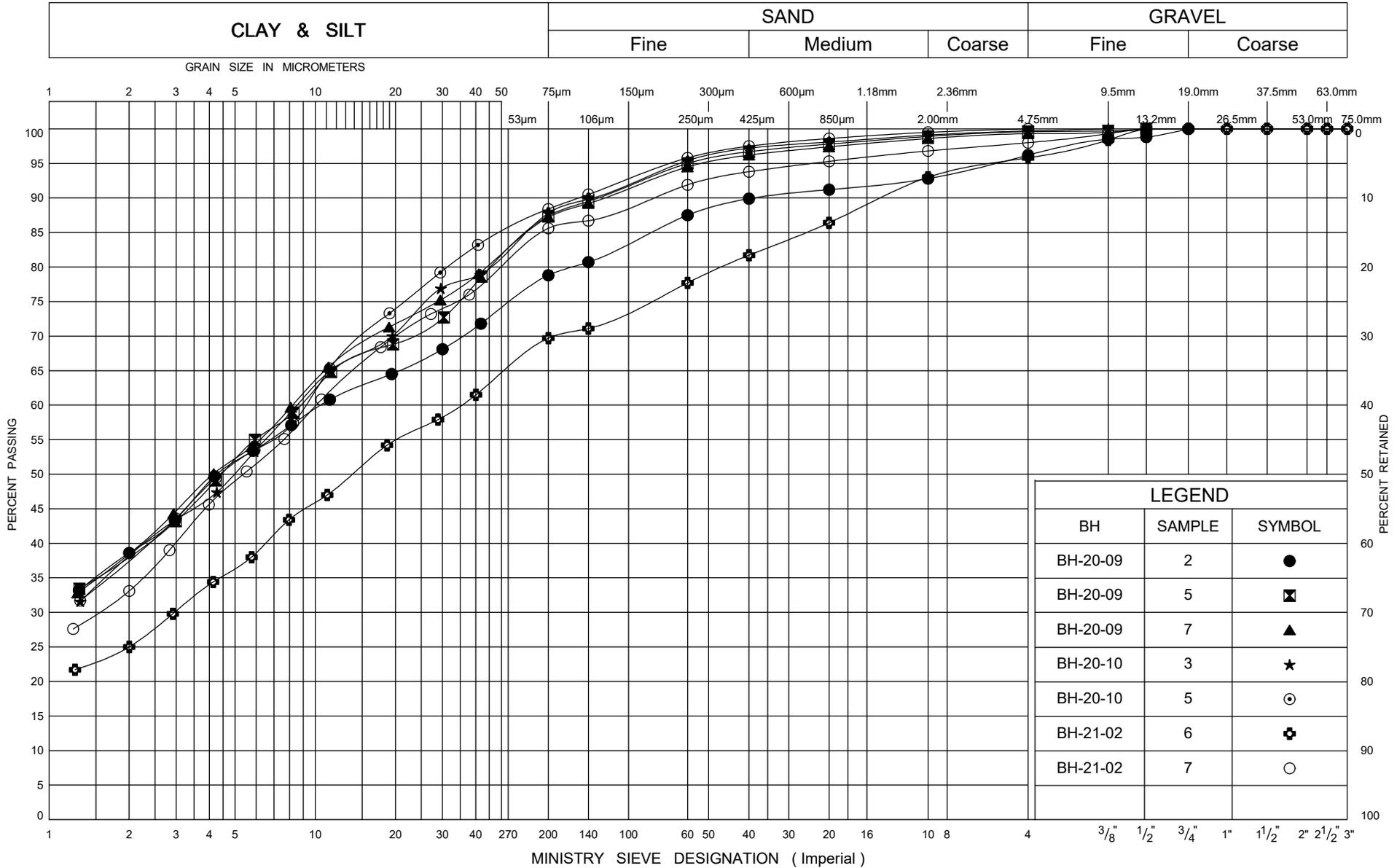
Figure:	C4-5
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



PLASTICITY CHART
 Culvert No. 06X-0426/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C5-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



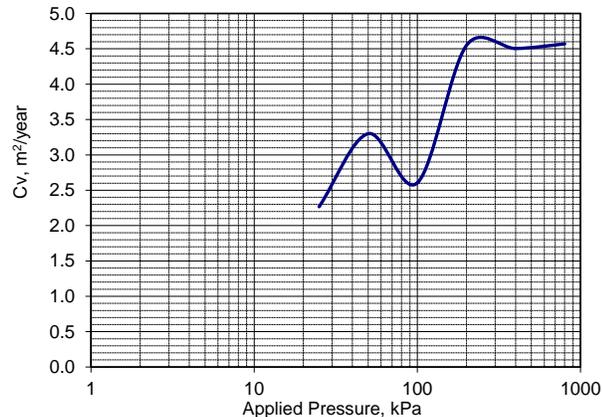
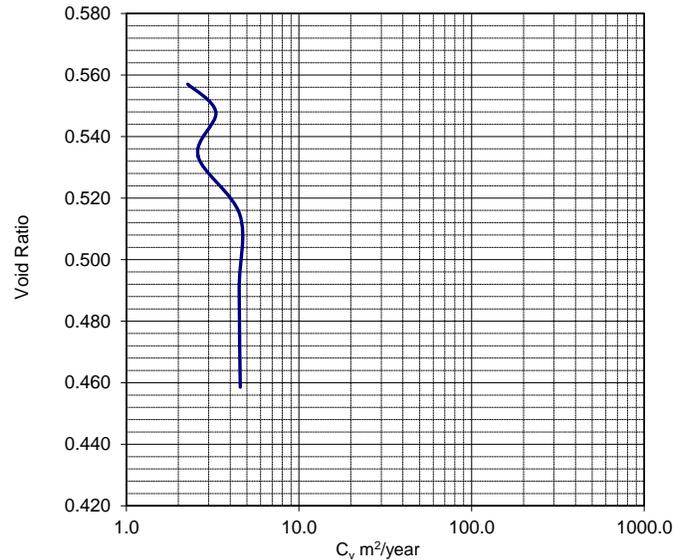
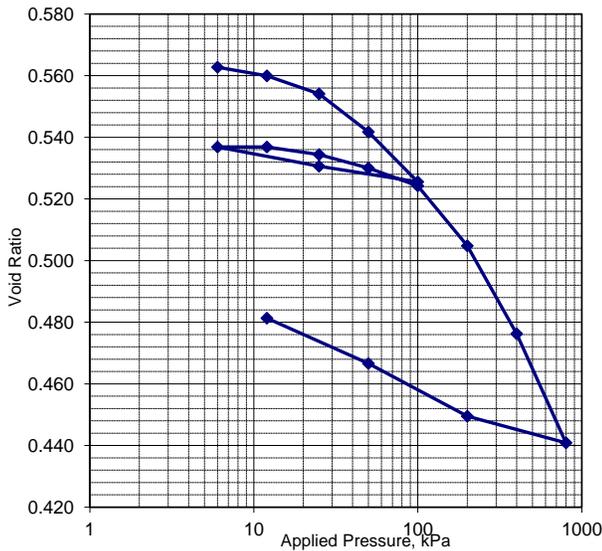
GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0426/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C5-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



Figure C5-3 Consolidation Test Results

CLIENT: Ministry of Transportation of Ontario **PROJECT No:** 11202886
PROJECT: GWP 3021-18.00 Highway 3 Widening, Windsor to Leamington, Phase 3, Contract 2 **LAB No:** WLT 710-1
BOREHOLE No: BH21-02 **SAMPLE No:** TW1 **DEPTH:** 7.6 - 8.2 m (25'0" - 27'0")
DESCRIPTION OF MATERIAL: Culvert No. 06X-0426/C0 - Clayey Silt (Till)



Axial Stress kPa	Specimen Height mm	Axial Strain %	Void Ratio e	c_v $m^2/year$
Initial	19.910	0.00	0.565	
6	19.887	0.12	0.563	
12	19.852	0.29	0.560	
25	19.777	0.67	0.554	2.3
50	19.619	1.46	0.542	3.3
100	19.414	2.49	0.526	2.6
25	19.478	2.17	0.531	
6	19.557	1.77	0.537	
12	19.557	1.77	0.537	
25	19.526	1.93	0.534	
50	19.471	2.21	0.530	
100	19.397	2.58	0.524	
200	19.149	3.82	0.505	4.5
400	18.786	5.64	0.476	4.5
800	18.336	7.91	0.441	4.6
200	18.446	7.36	0.449	
50	18.663	6.26	0.467	
12	18.851	5.32	0.481	

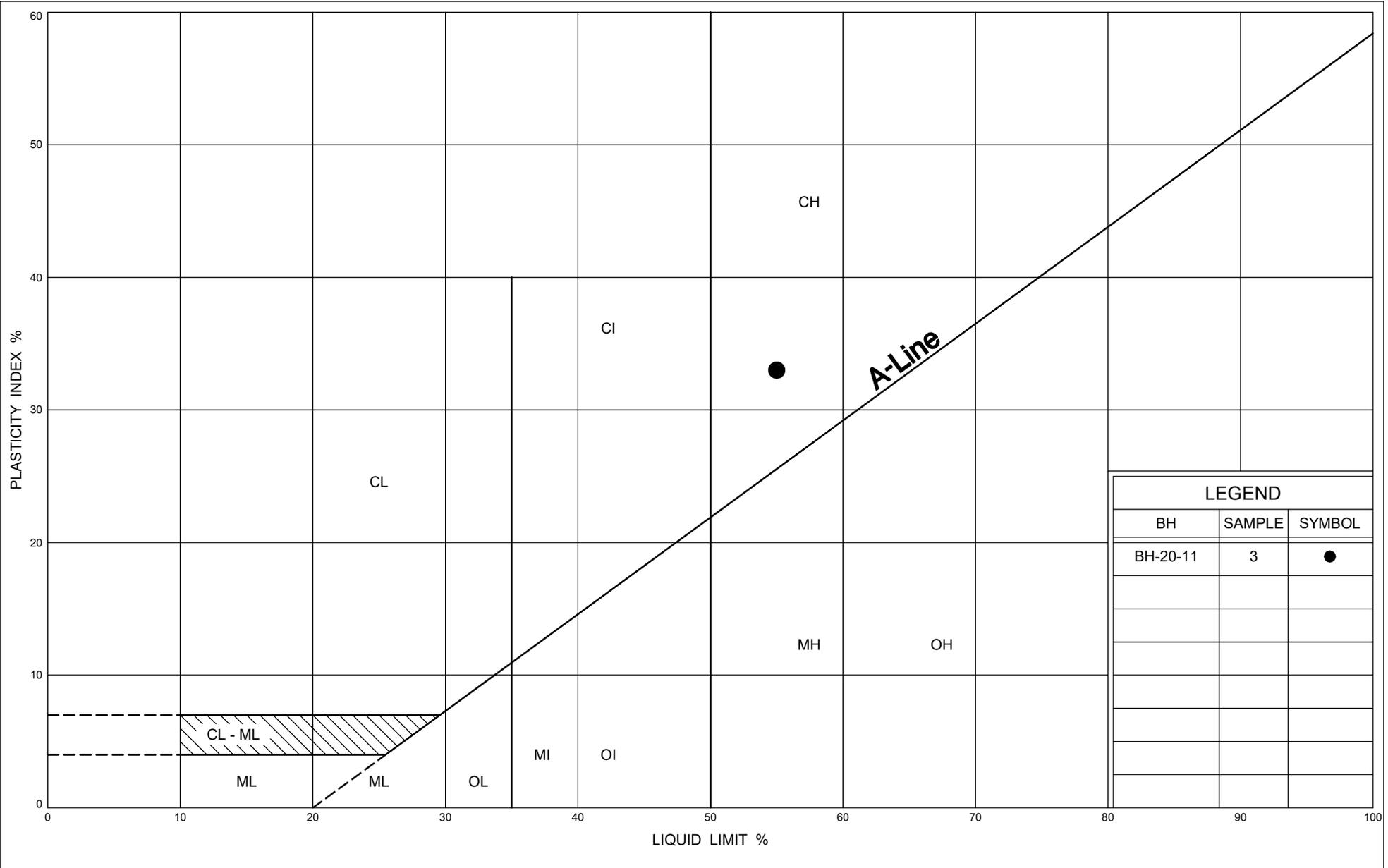
Test Summary

σ'_p Preconsolidation pressure, kPa	153.0	e_0 Initial Void Ratio	0.565
σ'_0 Effective vertical pressure, kPa	141.7	e_r Final Void Ratio	0.481
$\sigma'_p - \sigma'_0$ Overconsolidation, kPa	11.3	Initial Degree of Saturation	0.97
Overconsolidation ratio ("OCR")	1.1	Final Degree of Saturation	1.00
C_c Compression Index	0.116	C_R Recompression Index	0.010

Sample dry density, g/cm^3		Moisture content (W) %	
Initial state	1.757	Initial state	20.0
Final state	1.855	Final state	17.5

REMARKS:

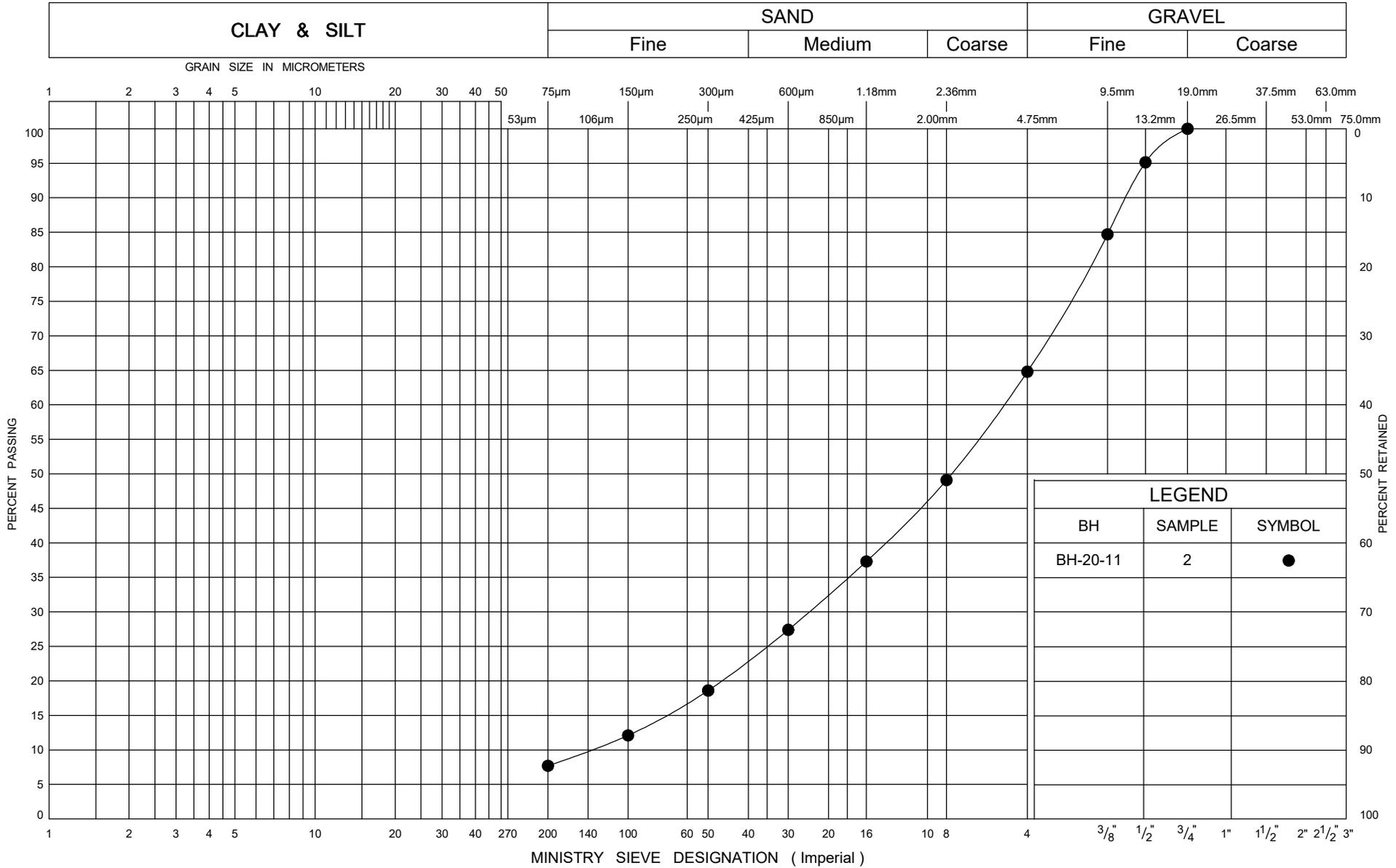
PERFORMED BY: Melanie Mitchell **DATE:** Nov 12 - Nov 28, 2021
VERIFIED BY: Michael Braverman **DATE:** November 30, 2021



PLASTICITY CHART
Culvert No. 06X-0427/C0 - Silty Clay Fill

Figure:	C6-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

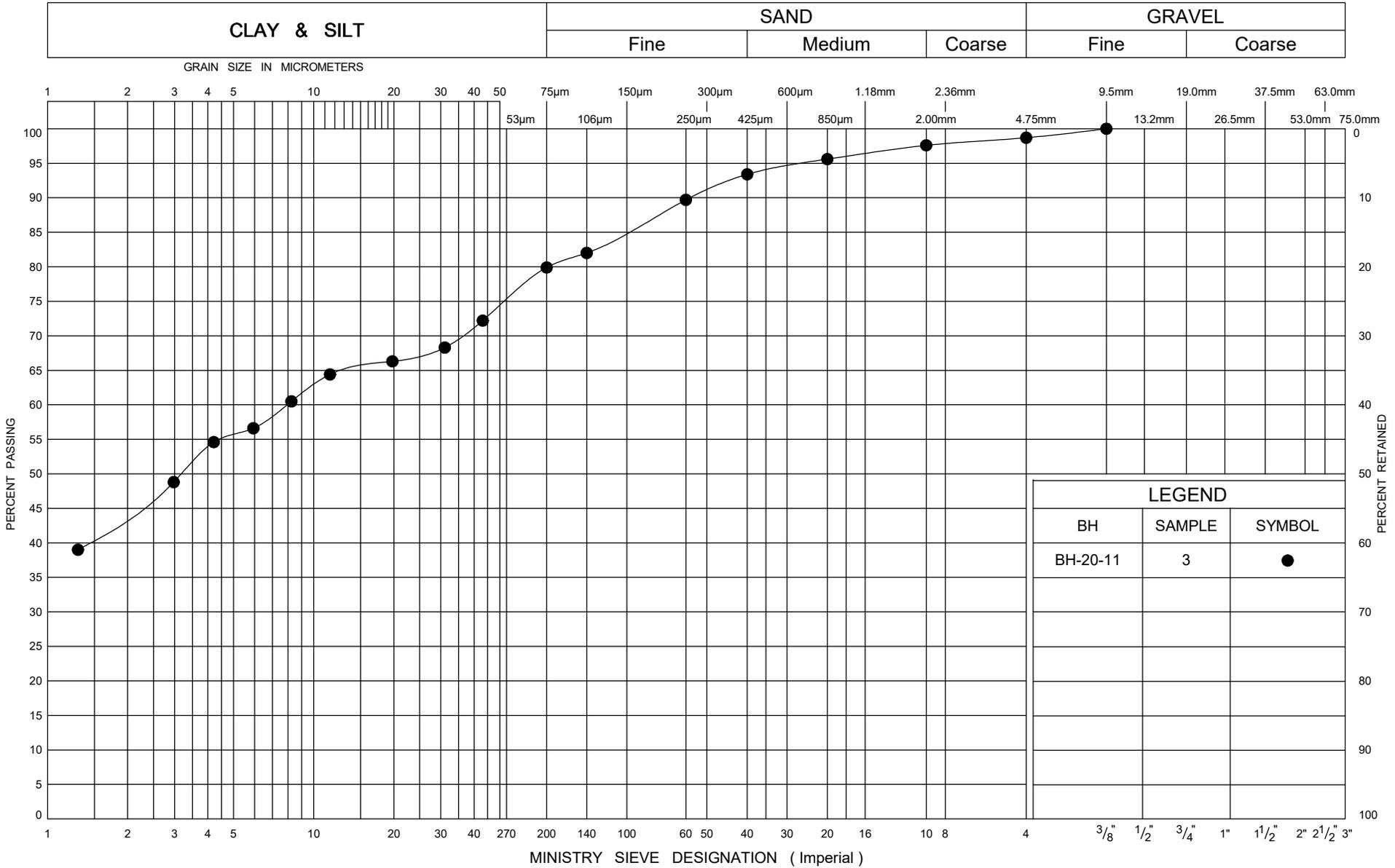
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0427/C0 - Sand and Gravel Fill

Figure:	C6-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

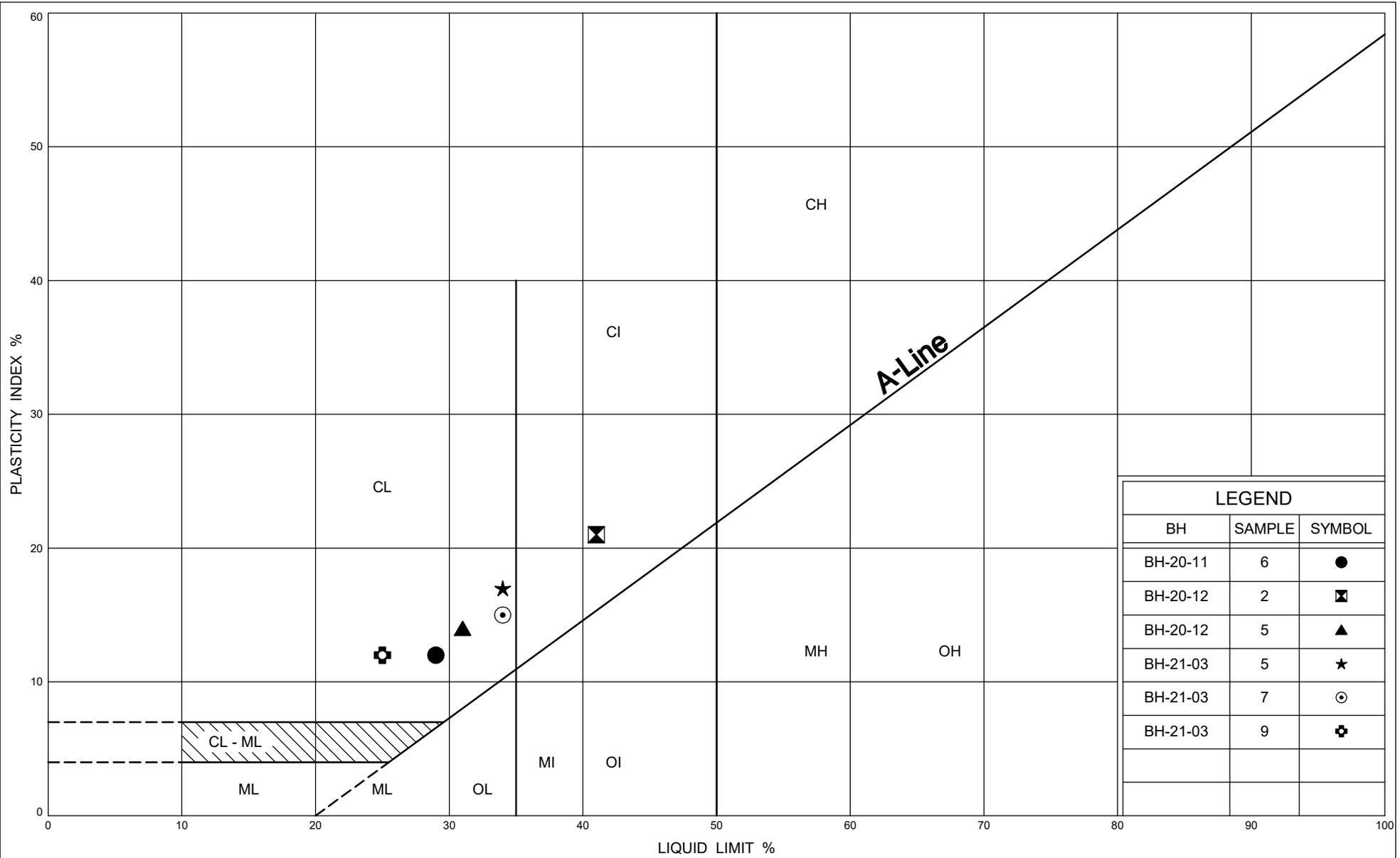
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Culvert No. 06X-0427/C0 - Silty Clay Fill

Figure:	C6-3
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

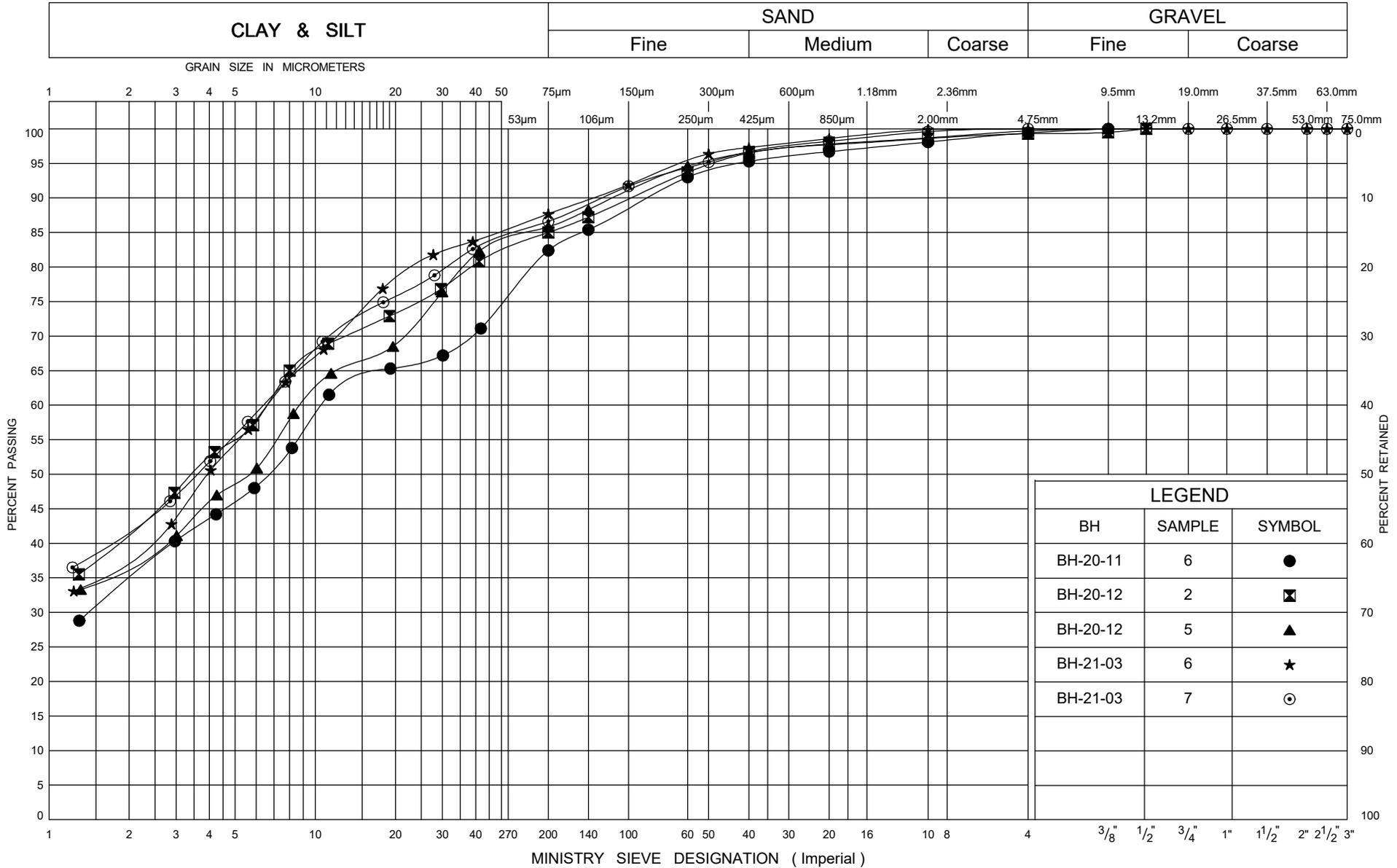


PLASTICITY CHART

Culvert No. 06X-0427/C0 - Clayey Silt to Silty Clay (Till)

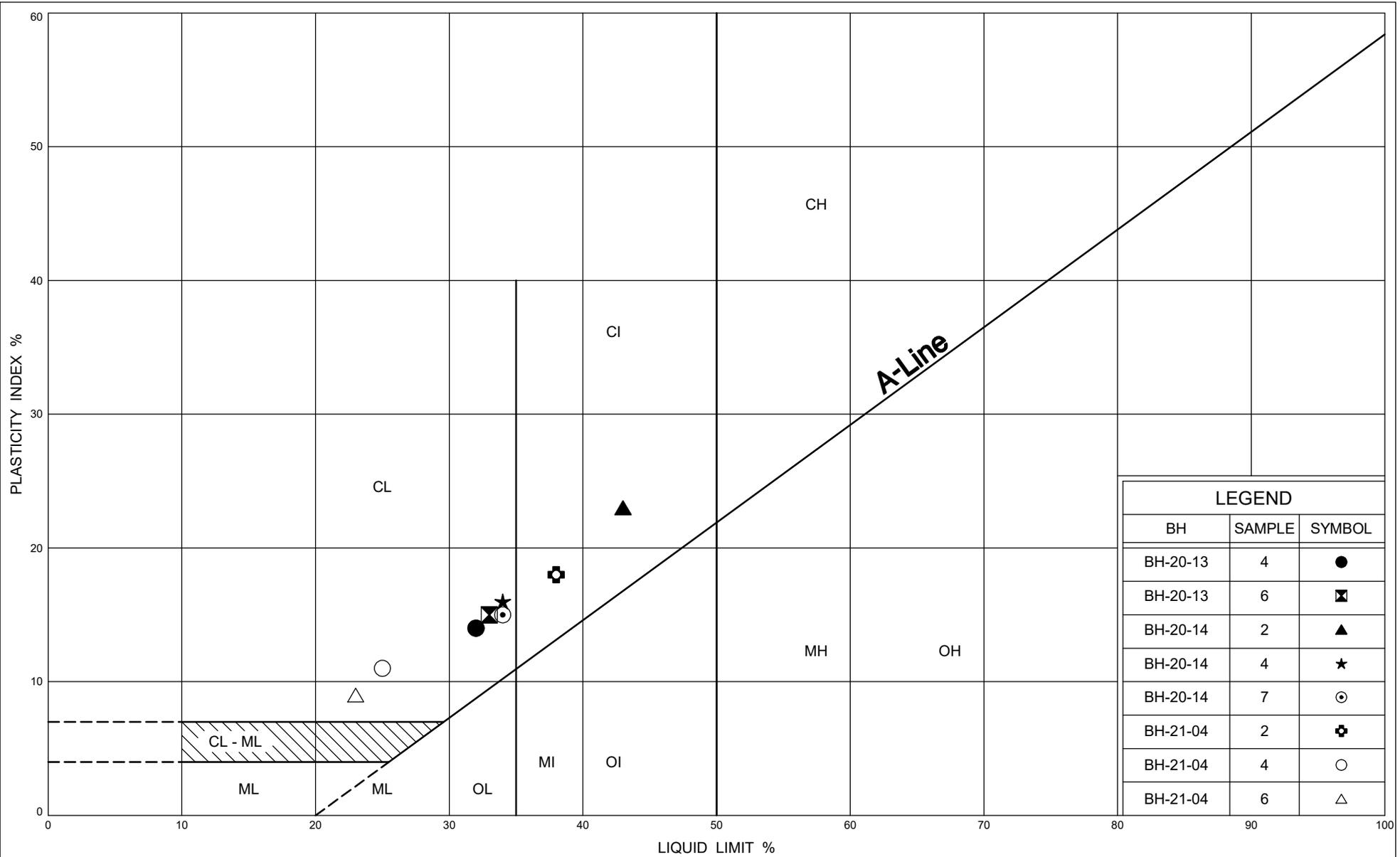
Figure:	C6-4
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0427/C0 - Clayey Silt to Silty Clay (Till)

Figure:	C6-5
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

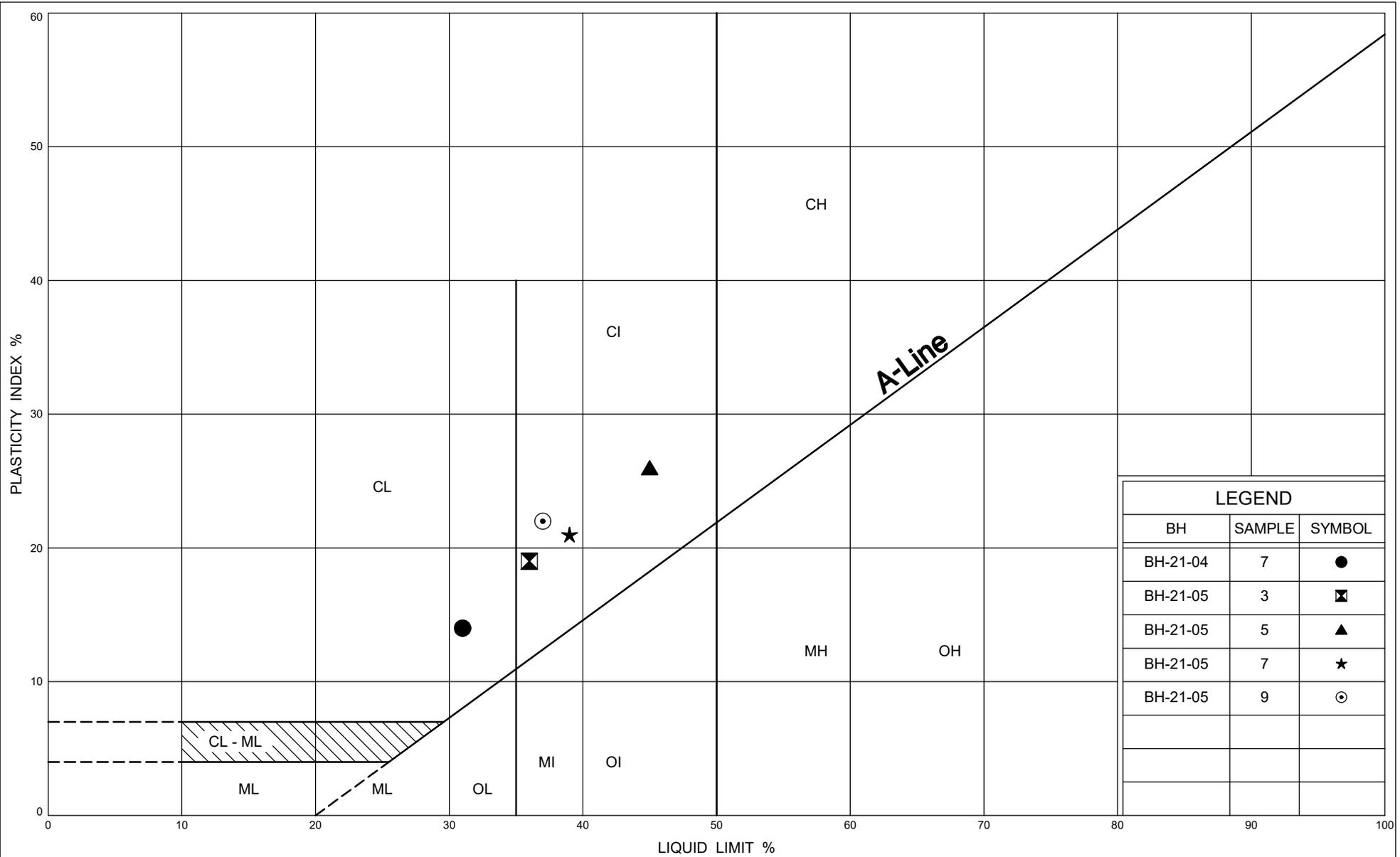


LEGEND		
BH	SAMPLE	SYMBOL
BH-20-13	4	●
BH-20-13	6	⊠
BH-20-14	2	▲
BH-20-14	4	★
BH-20-14	7	⊙
BH-21-04	2	⊕
BH-21-04	4	○
BH-21-04	6	△



PLASTICITY CHART
 Culvert No. 06X-0429/C0 - Clayey Silt and Sand to Silty Clay (Till)

Figure:	C7-1A
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



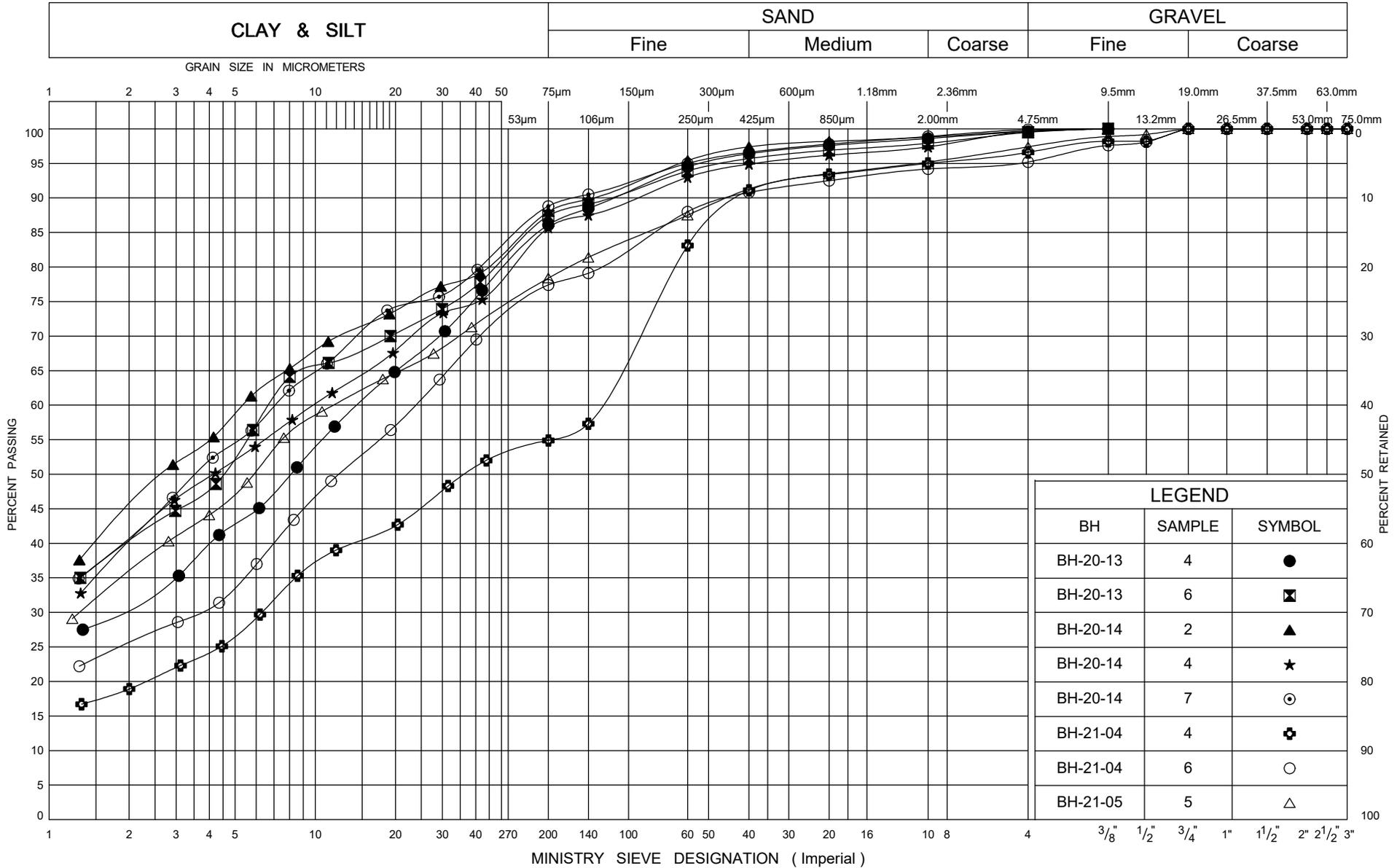
LEGEND		
BH	SAMPLE	SYMBOL
BH-21-04	7	●
BH-21-05	3	⊠
BH-21-05	5	▲
BH-21-05	7	★
BH-21-05	9	⊙



PLASTICITY CHART
 Culvert No. 06X-0429/C0 - Clayey Silt and Sand to Silty Clay (Till)

Figure:	C7-1B
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



ONTARIO MOT GRAIN SIZE (TITLE) 11202886 COMBINE FOR FIGURE(20211217)-1.GPJ_ONTARIO MOT.GDT_17/12/21

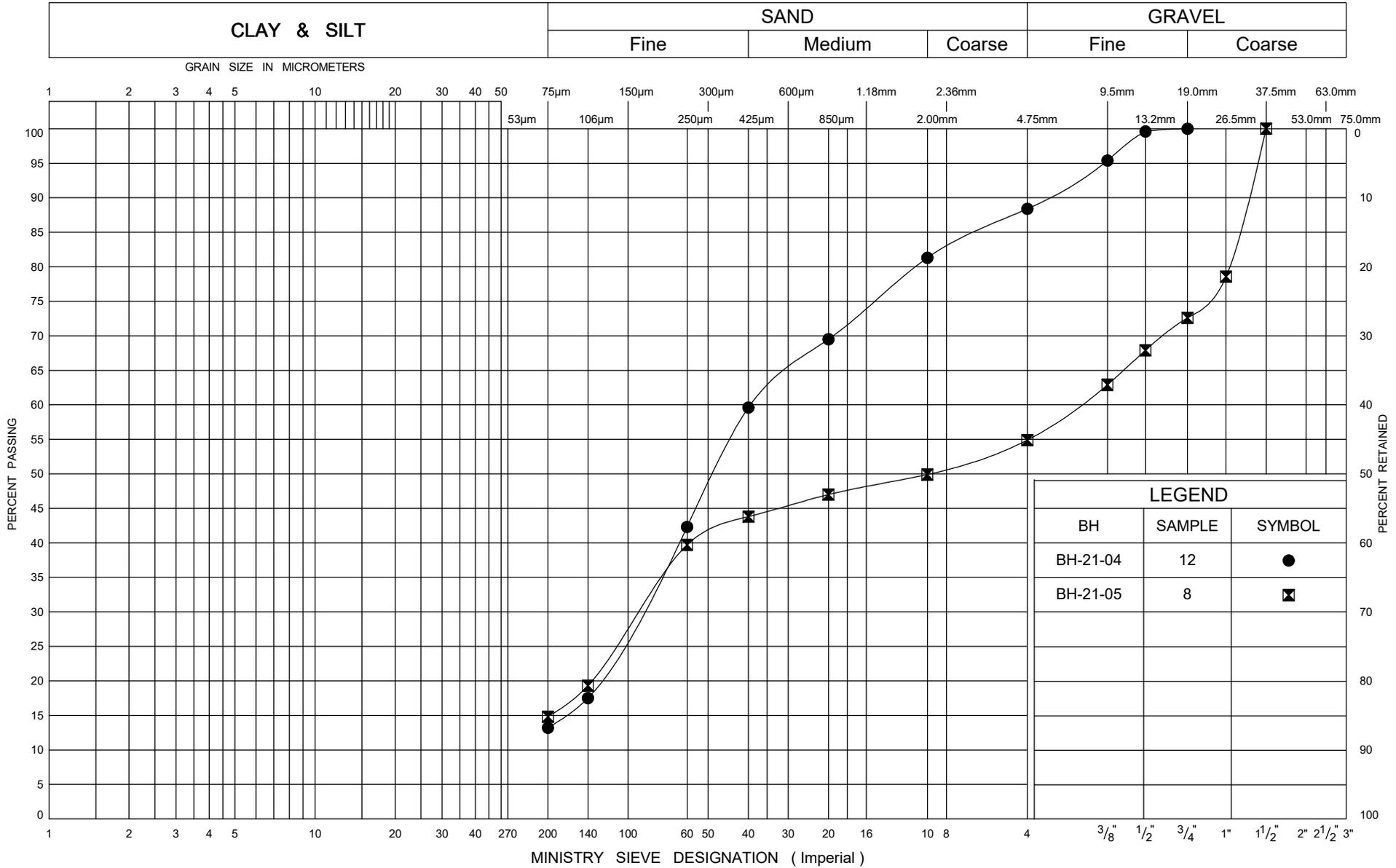


GRAIN SIZE DISTRIBUTION

Culvert No. 06X-0429/C0 - Clayey Silt and Sand to Silty Clay (Till)

Figure:	C7-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



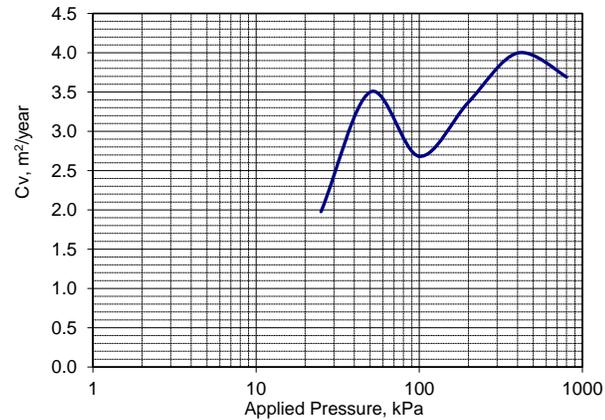
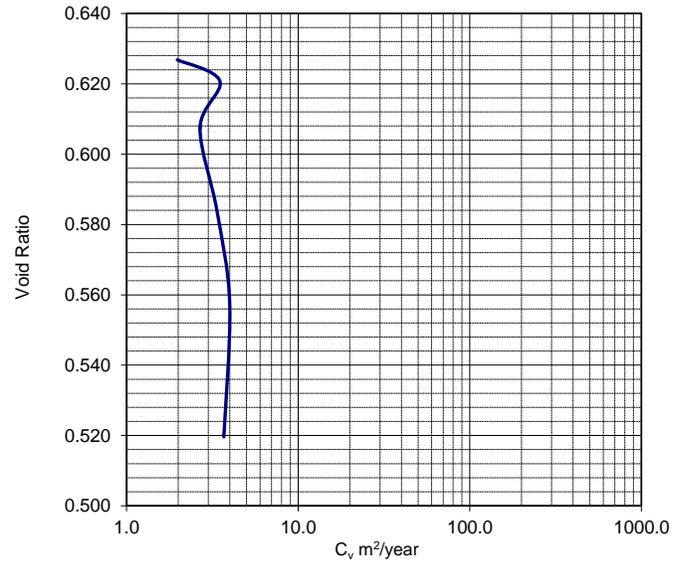
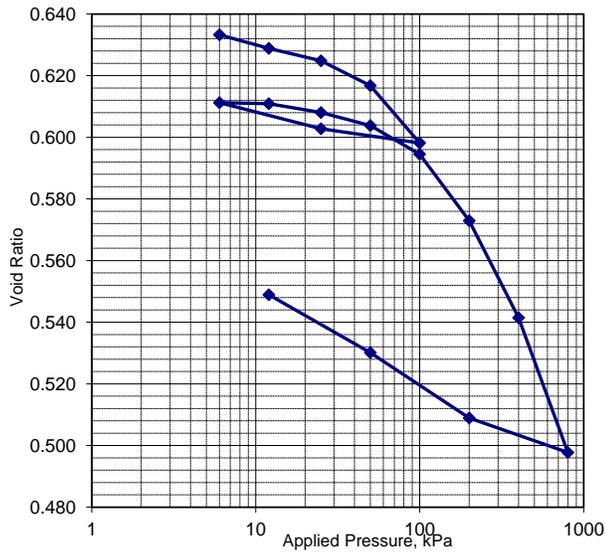
GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0429/C0 - Sand to Sand and Gravel (Till)

Figure:	C7-3
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



Figure C7-4 Consolidation Test Results

CLIENT: Ministry of Transportation of Ontario **PROJECT No:** 11202886
PROJECT: GWP 3021-18.00 Highway 3 Widening, Windsor to Leamington, Phase 3, Contract 2 **LAB No:** WLT 710-2
BOREHOLE No: BH21-04 **SAMPLE No:** TW2 **DEPTH:** 6.1 - 6.7 m (20'0" - 22'0")
DESCRIPTION OF MATERIAL: Culvert No. 06X-0429/C0 - Clayey Silt (Till)



Axial Stress kPa	Specimen Height mm	Axial Strain %	Void Ratio e	C_v $m^2/year$
Initial	19.590	0.00	0.636	
6	19.563	0.14	0.633	
12	19.510	0.41	0.629	
25	19.462	0.66	0.625	2.0
50	19.365	1.15	0.617	3.5
100	19.143	2.28	0.598	2.7
25	19.198	2.00	0.603	
6	19.299	1.49	0.611	
12	19.295	1.50	0.611	
25	19.261	1.68	0.608	
50	19.210	1.94	0.604	
100	19.099	2.51	0.595	
200	18.841	3.83	0.573	3.4
400	18.464	5.75	0.541	4.0
800	17.940	8.42	0.498	3.7
200	18.074	7.74	0.509	
50	18.328	6.44	0.530	
12	18.553	5.30	0.549	

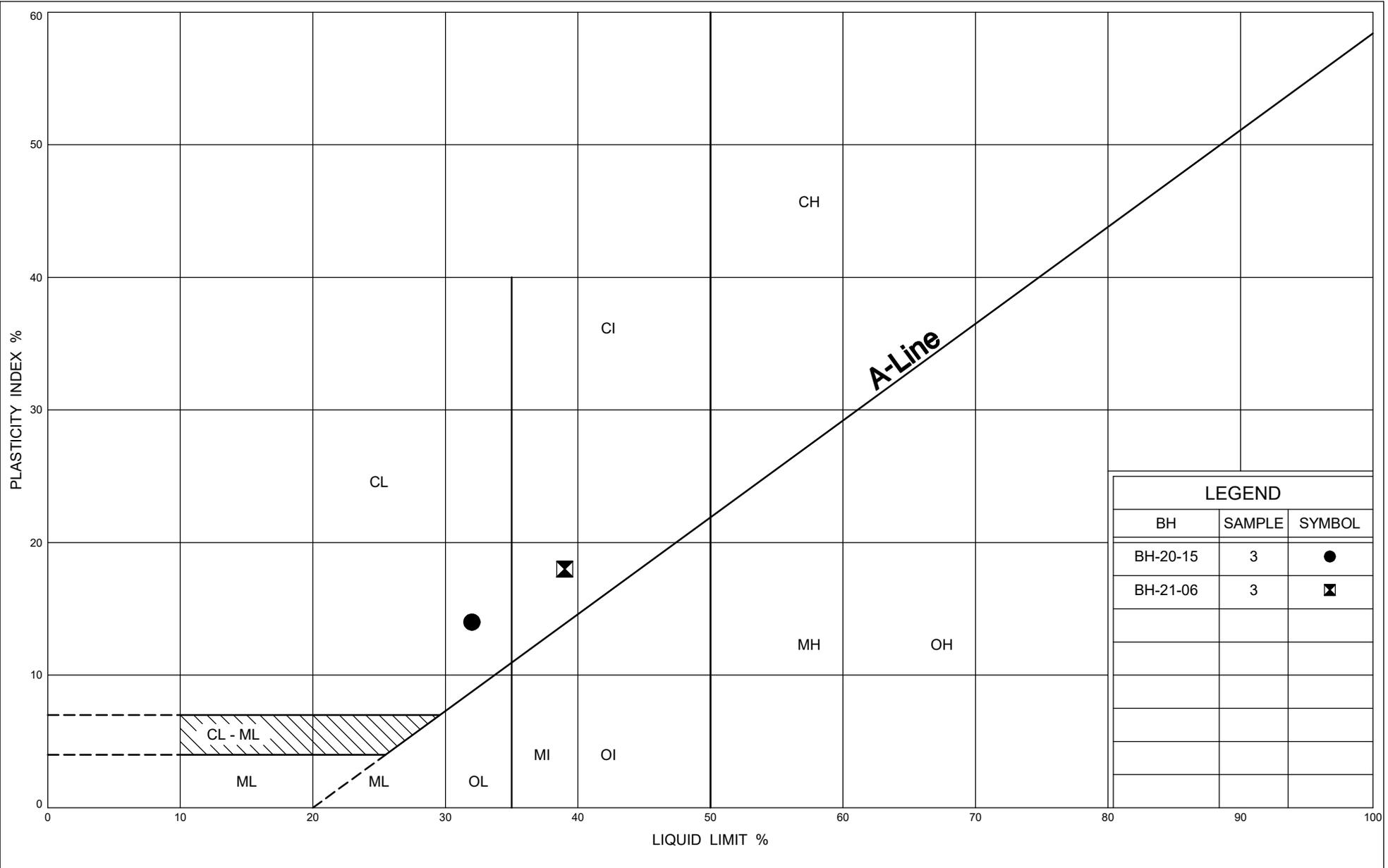
Test Summary

σ_p Preconsolidation pressure, kPa	145.0	e_0 Initial Void Ratio	0.636
σ'_0 Effective vertical pressure, kPa	125.5	e_f Final Void Ratio	0.549
$\sigma'_p - \sigma'_0$ Overconsolidation, kPa	19.5	Initial Degree of Saturation	0.97
Overconsolidation ratio ("OCR")	1.16	Final Degree of Saturation	1.00
C_c Compression Index	0.116	C_R Recompression Index	0.010

Sample dry density, g/cm^3		Moisture content (W) %	
Initial state	1.681	Initial state	22.3
Final state	1.775	Final state	19.9

REMARKS:

PERFORMED BY: Melanie Mitchell **DATE:** Nov 12 - Nov 28, 2021
VERIFIED BY: Michael Braverman **DATE:** November 30, 2021



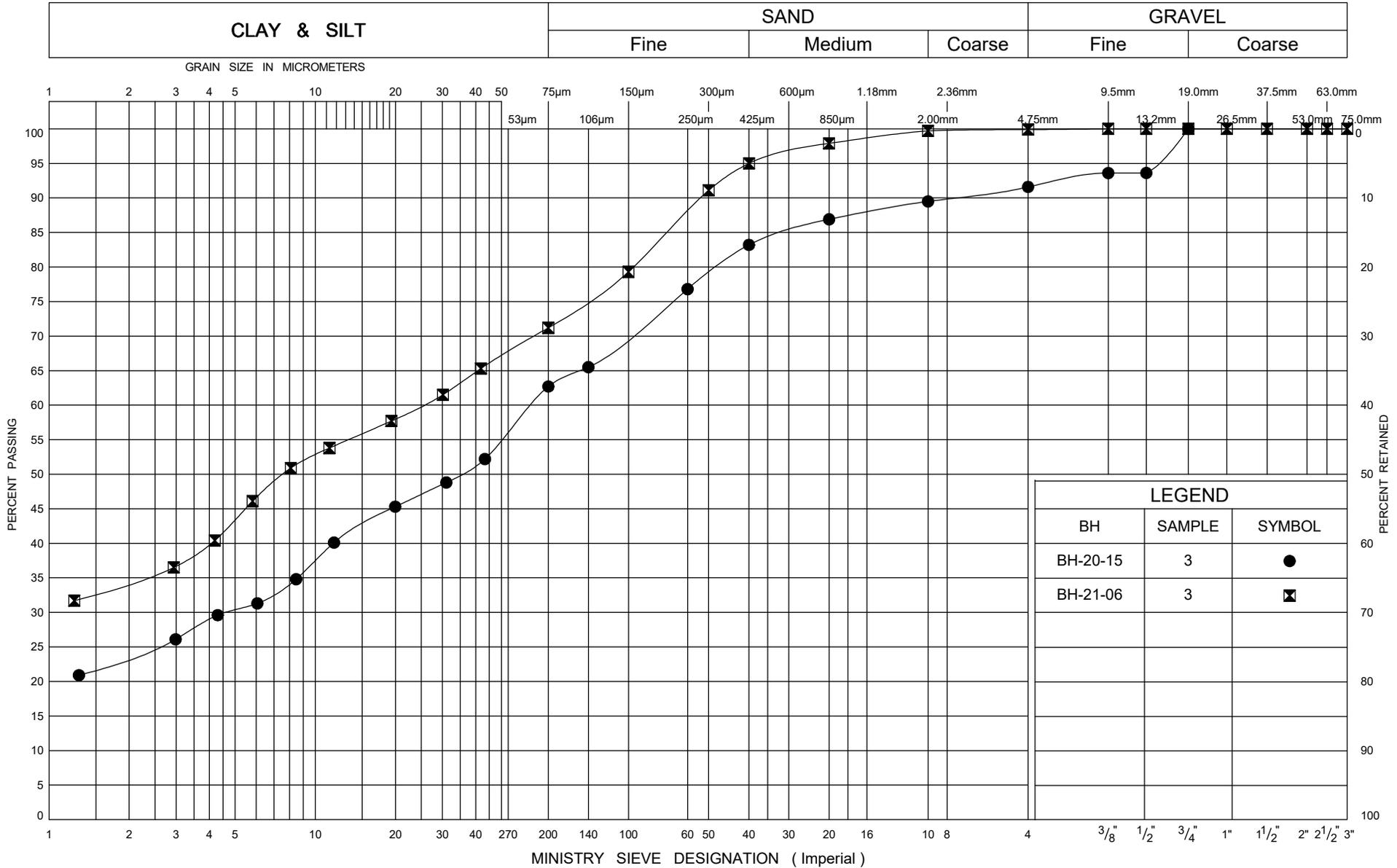
LEGEND		
BH	SAMPLE	SYMBOL
BH-20-15	3	●
BH-21-06	3	⊠



PLASTICITY CHART
 Culvert No. 06X-0432/C0 - Silty Clay with Sand Fill

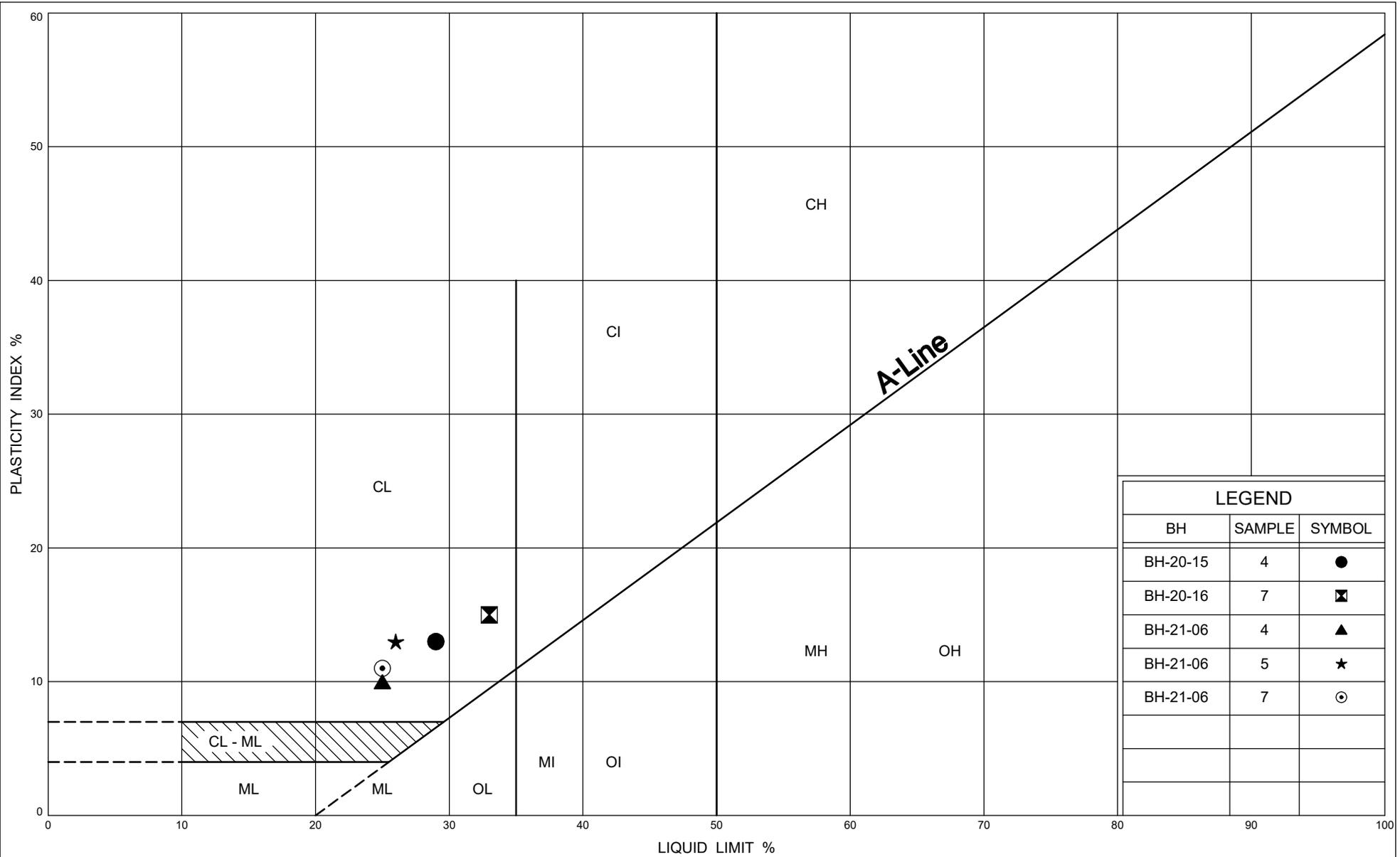
Figure:	C8-1
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0432/C0 - Silty Clay with Sand Fill

Figure:	C8-2
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886



LEGEND		
BH	SAMPLE	SYMBOL
BH-20-15	4	●
BH-20-16	7	⊠
BH-21-06	4	▲
BH-21-06	5	★
BH-21-06	7	⊙

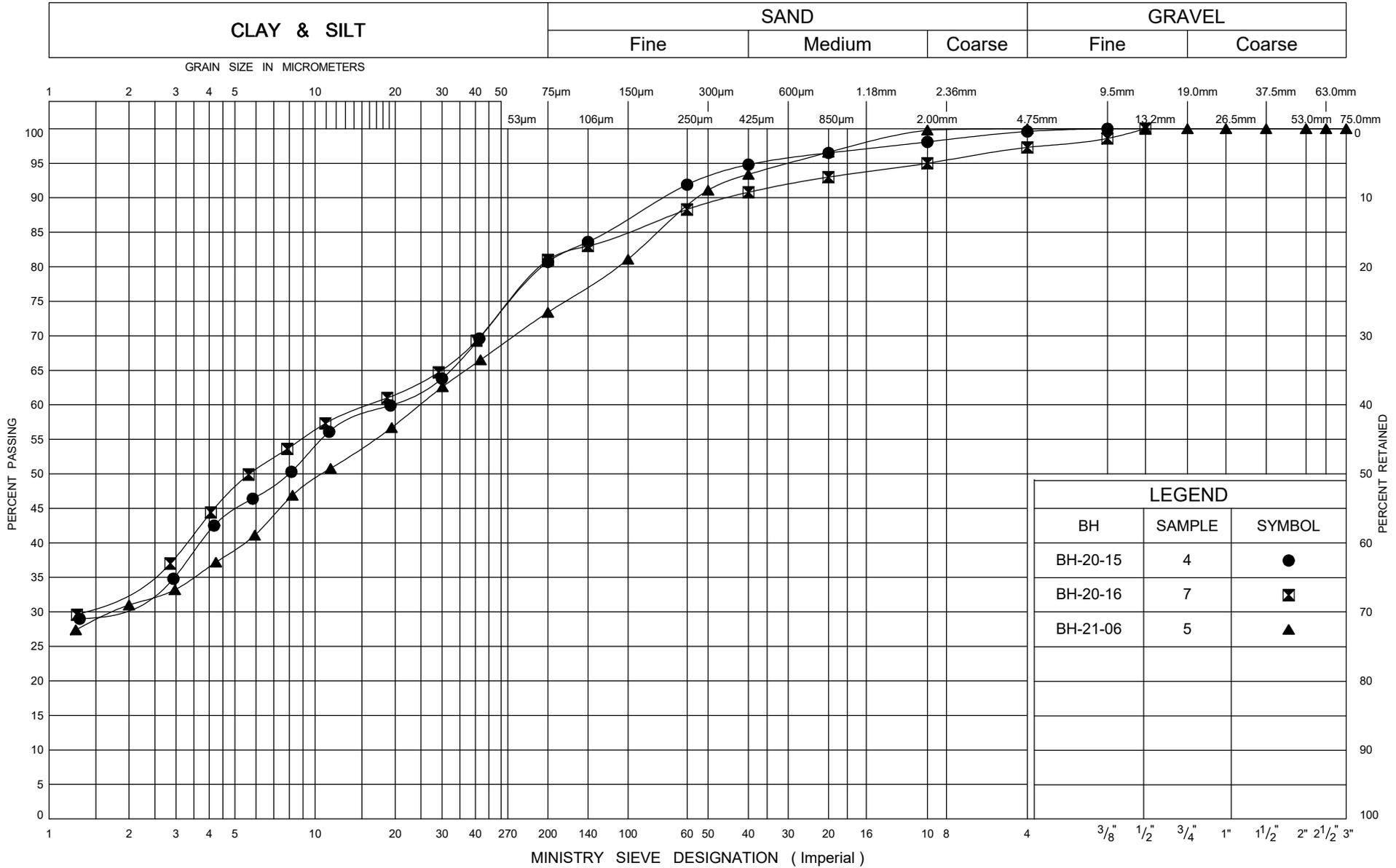


PLASTICITY CHART

Culvert No. 06X-0432/C0 - Clayey Silt with Sand (Till)

Figure:	C8-3
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM

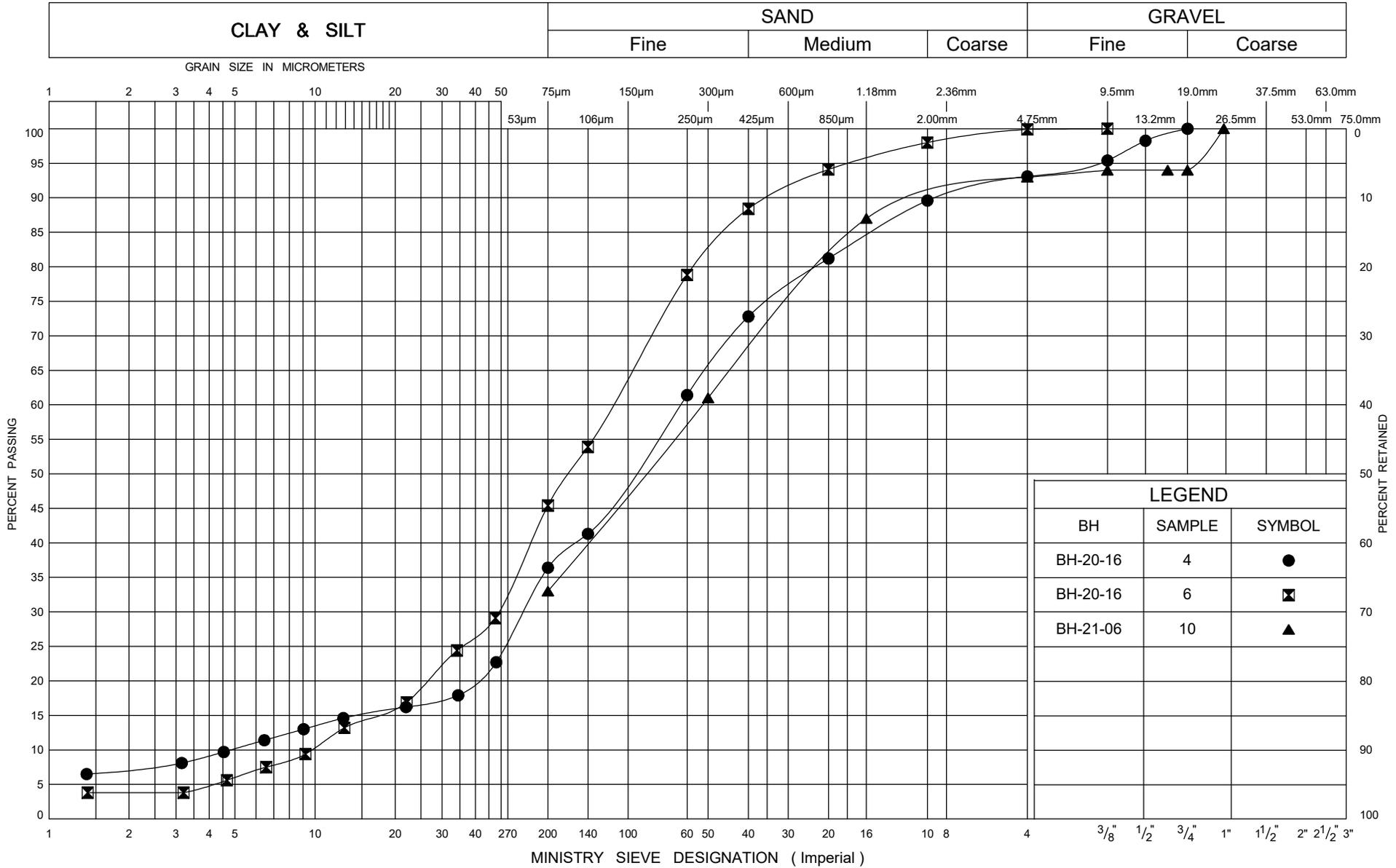


GRAIN SIZE DISTRIBUTION

Culvert No. 06X-0432/C0 - Clayey Silt (Till)

Figure:	C8-4
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 Culvert No. 06X-0432/C0 - Silt and Sand to Silty Sand (Till)

Figure:	C8-5
Assignment No.:	3017-E-0012
G.W.P. No.:	3021-18-00
GHD Project No.:	11202886

Appendix D

Analytical Test Results

C.O.C.: G93264

REPORT No. B20-13601

Report To:

GHD Limited
 455 Phillip Street,
 Waterloo Ontario N2L 3X2 Canada

Attention: Vincent Zappia

Caduceon Environmental Laboratories

110 West Beaver Creek Rd Unit 14
 Richmond Hill ON L4B 1J9

Tel: 289-475-5442

Fax: 289-562-1963

DATE RECEIVED: 20-May-20

JOB/PROJECT NO.: Hwy 3 Widening

DATE REPORTED: 27-May-20

P.O. NUMBER:

SAMPLE MATRIX: Soil

WATERWORKS NO.

Client I.D.	BH-20-02; SS-6	BH-20-03; SS-6	BH-20-05; SS-6	BH-20-08; SS-5
Sample I.D.	B20-13601-1	B20-13601-2	B20-13601-3	B20-13601-4
Date Collected	19-May-20	19-May-20	19-May-20	19-May-20

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
pH @25°C	pH Units		MOEE3530	21-May-20/R	7.78	7.80	7.69	7.68
Resistivity	ohms-cm		SM 2510B	26-May-20/O	1870	1240	1410	1880
REDOX potential	mV		In-House	22-May-20/R	161	189	173	172
Chloride	µg/g	5	SM4110C	26-May-20/O	13	129	71	12
Sulphate	µg/g	10	SM4110C	26-May-20/O	510	980	800	510
Sulfide	µg/g	5	In-House	26-May-20	< 5 ¹	< 5 ¹	< 5 ¹	< 5 ¹

¹ Subcontracted to Testmark Labs



Christine Burke
 Lab Manager

R.L. = Reporting Limit

Test methods may be modified from specified reference method unless indicated by an *

Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

C.O.C.: G93264

REPORT No. B20-13601

Report To:

GHD Limited
 455 Phillip Street,
 Waterloo Ontario N2L 3X2 Canada

Attention: Vincent Zappia

Caduceon Environmental Laboratories

110 West Beaver Creek Rd Unit 14
 Richmond Hill ON L4B 1J9

Tel: 289-475-5442

Fax: 289-562-1963

DATE RECEIVED: 20-May-20

JOB/PROJECT NO.: Hwy 3 Widening

DATE REPORTED: 27-May-20

P.O. NUMBER:

SAMPLE MATRIX: Soil

WATERWORKS NO.

Client I.D.	BH-20-10; SS-6	BH-20-11; SS-5	BH-20-13; SS-5A	BH-20-16; SS-5
Sample I.D.	B20-13601-5	B20-13601-6	B20-13601-7	B20-13601-8
Date Collected	19-May-20	19-May-20	19-May-20	19-May-20

Parameter	Units	R.L.	Reference Method	Date/Site Analyzed				
pH @25°C	pH Units		MOEE3530	21-May-20/R	7.70	7.75	7.71	7.70
Resistivity	ohms-cm		SM 2510B	26-May-20/O	1730	2060	2880	2420
REDOX potential	mV		In-House	22-May-20/R	163	208	222	167
Chloride	µg/g	5	SM4110C	26-May-20/O	16	230	171	30
Sulphate	µg/g	10	SM4110C	26-May-20/O	580	130	30	280
Sulfide	µg/g	5	In-House	26-May-20	< 5 ¹	< 5 ¹	< 5 ¹	< 5 ¹

¹ Subcontracted to Testmark Labs



Christine Burke
 Lab Manager

R.L. = Reporting Limit

Test methods may be modified from specified reference method unless indicated by an *

Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill,B-Barrie

The analytical results reported herein refer to the samples as received. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.



GHD Limited (Waterloo)
ATTN: JENNIFER BALKWILL
455 PHILLIP STREET
WATERLOO ON N2L 3X2

Date Received: 19-OCT-21
Report Date: 29-OCT-21 14:46 (MT)
Version: FINAL

Client Phone: 519-884-0510

Certificate of Analysis

Lab Work Order #: L2652975
Project P.O. #: 735-001026
Job Reference: 11202886
C of C Numbers:
Legal Site Desc:

Rick Hawthorne
Account Manager

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ADDRESS: 60 Northland Road, Unit 1, Waterloo, ON N2V 2B8 Canada | Phone: +1 519 886 6910 | Fax: +1 519 886 9047
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2652975-1 BH21-01-SS4 Sampled By: CLIENT on 18-OCT-21 @ 16:00 Matrix: WATER							
Physical Tests							
Conductivity	0.845		0.0040	mS/cm		29-OCT-21	R5632792
% Moisture	18.7		0.25	%	21-OCT-21	22-OCT-21	R5626550
pH	7.48		0.10	pH units		26-OCT-21	R5628935
Redox Potential	263		-1000	mV		22-OCT-21	R5627178
Resistivity	1180		1.0	ohm*cm		29-OCT-21	
Leachable Anions & Nutrients							
Chloride	80.3		5.0	ug/g	26-OCT-21	27-OCT-21	R5630777
Anions and Nutrients							
Sulphate	729		20	ug/g	26-OCT-21	27-OCT-21	R5630777
Inorganic Parameters							
Acid Volatile Sulphides	<0.20		0.20	mg/kg	26-OCT-21	26-OCT-21	R5629101
L2652975-2 BH21-03-SS4 Sampled By: CLIENT on 18-OCT-21 @ 16:00 Matrix: WATER							
Physical Tests							
Conductivity	1.17		0.0040	mS/cm		29-OCT-21	R5632792
% Moisture	15.1		0.25	%	21-OCT-21	22-OCT-21	R5626550
pH	7.46		0.10	pH units		26-OCT-21	R5628935
Redox Potential	297		-1000	mV		22-OCT-21	R5627178
Resistivity	857		1.0	ohm*cm		29-OCT-21	
Leachable Anions & Nutrients							
Chloride	263		5.0	ug/g	26-OCT-21	27-OCT-21	R5630777
Anions and Nutrients							
Sulphate	840		20	ug/g	26-OCT-21	27-OCT-21	R5630777
Inorganic Parameters							
Acid Volatile Sulphides	<0.20		0.20	mg/kg	26-OCT-21	26-OCT-21	R5629101

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid weight of sample

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L2652975

Report Date: 29-OCT-21

Page 1 of 3

Client: GHD Limited (Waterloo)
455 PHILLIP STREET
WATERLOO ON N2L 3X2

Contact: JENNIFER BALKWILL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT	Soil							
Batch	R5630777							
WG3645863-3	CRM	AN-CRM-WT						
Chloride			93.3		%		70-130	27-OCT-21
WG3645863-4	DUP	WG3645863-5						
Chloride		80.1	79.5		ug/g	0.7	30	27-OCT-21
WG3645863-2	LCS							
Chloride			99.9		%		80-120	27-OCT-21
WG3645863-1	MB							
Chloride			<5.0		ug/g		5	27-OCT-21
EC-WT	Soil							
Batch	R5632792							
WG3645937-6	DUP	WG3645937-3						
Conductivity		0.400	0.394		mS/cm	1.5	20	29-OCT-21
WG3645937-2	IRM	WT SAR4						
Conductivity			112.1		%		70-130	29-OCT-21
WG3648689-1	LCS							
Conductivity			96.8		%		90-110	29-OCT-21
WG3645937-1	MB							
Conductivity			<0.0040		mS/cm		0.004	29-OCT-21
MOISTURE-WT	Soil							
Batch	R5626550							
WG3642699-3	DUP	L2647897-28						
% Moisture		79.2	82.7		%	4.3	20	22-OCT-21
WG3642699-2	LCS							
% Moisture			99.5		%		90-110	22-OCT-21
WG3642699-1	MB							
% Moisture			<0.25		%		0.25	22-OCT-21
PH-WT	Soil							
Batch	R5628935							
WG3643896-1	DUP	L2653172-6						
pH		8.11	8.09	J	pH units	0.02	0.3	26-OCT-21
WG3646007-1	LCS							
pH			6.95		pH units		6.9-7.1	26-OCT-21
REDOX-POTENTIAL-WT	Soil							
Batch	R5627178							
WG3643513-1	CRM	WT-REDOX						
Redox Potential			99.4		%		80-120	22-OCT-21
WG3641736-1	DUP	L2651880-1						



Quality Control Report

Workorder: L2652975

Report Date: 29-OCT-21

Page 2 of 3

Client: GHD Limited (Waterloo)
 455 PHILLIP STREET
 WATERLOO ON N2L 3X2

Contact: JENNIFER BALKWILL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	Soil							
Batch	R5627178							
WG3641736-1	DUP	L2651880-1						
Redox Potential		277	252		mV	9.5	25	22-OCT-21
SO4-WT	Soil							
Batch	R5630777							
WG3645863-3	CRM	AN-CRM-WT						
Sulphate			101.3		%		60-140	27-OCT-21
WG3645863-4	DUP	WG3645863-5						
Sulphate		729	683		ug/g	6.5	25	27-OCT-21
WG3645863-2	LCS							
Sulphate			100.1		%		70-130	27-OCT-21
WG3645863-1	MB							
Sulphate			<20		ug/g		20	27-OCT-21
SULPHIDE-WT	Soil							
Batch	R5629101							
WG3646000-3	DUP	L2653158-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	26-OCT-21
WG3646000-2	LCS							
Acid Volatile Sulphides			71.9		%		70-130	26-OCT-21
WG3646000-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	26-OCT-21

Quality Control Report

Workorder: L2652975

Report Date: 29-OCT-21

Client: GHD Limited (Waterloo)
455 PHILLIP STREET
WATERLOO ON N2L 3X2
Contact: JENNIFER BALKWILL

Page 3 of 3

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



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Chain of Cust



L2652975-COFC

COC Number: 21 -

Page of

Report To Contact and company name below will appear on the final report		Reports / Recipients			Turnaround Time (TAT) Requested			AFFIX ALS BARCODE LABEL HERE (ALS use only)								
Company:	GHD LIMITED - ACCT# 13791	Select Report Format:	<input type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)	<input checked="" type="checkbox"/> Routine [R] if received by 3pm M-F - no surcharges apply												
Contact:	Jennifer Balkwill	Merge QC/QCI Reports with COA	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A	<input type="checkbox"/> 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum												
Phone:	519 884 0510	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked			<input type="checkbox"/> 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum											
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	<input type="checkbox"/> 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum												
Street:	111 Brunel Road Suite 200	Email 1 or Fax	Sandra.McGaghan@ghd.com	<input type="checkbox"/> 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum												
City/Province:	Mississauga/Ontario	Email 2	Nirjar.Vyas@ghd.com	<input type="checkbox"/> Same day [E2] if received by 10am M-S - 200% rush surcharge.												
Postal Code:	L4Z 1X3	Email 3	Puneet.Verma@ghd.com	Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.												
Invoice To	Same as Report To <input type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Recipients			Date and Time Required for all E&P TATs:											
Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		Select Invoice Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	For all tests with rush TATs requested, please contact your AM to confirm availability.												
Company:	GHD LIMITED	Select Invoice Distribution:			Analysis Request											
Contact:	Jennifer Balkwill	Email 1 or Fax				Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below										
Project Information		Oil and Gas Required Fields (client use)			NUMBER OF CONTAINERS								SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)	
ALS Account # / Quote #:	11202886	AFE/Cost Center:	PO#													
Job #:	11202886	Major/Minor Code:	Routing Code:													
PO / AFE:	735-001026	Requisitioner:														
LSD:		Location:														
ALS Lab Work Order # (ALS use only): L2652975		ALS Contact:			Sampler:		Satbir Guram									
ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type												
	BH21-01-SS4	18-Oct-21	4:00 PM	soil	R											
	BH21-03-SS4	18-Oct-21	4:00 PM	soil	R											
Drinking Water (DW) Samples¹ (client use)		Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)			SAMPLE RECEIPT DETAILS (ALS use only)											
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		Ontario Regulation 153/04 - April 15, 2011 Standards			Cooling Method: <input type="checkbox"/> NONE <input checked="" type="checkbox"/> ICE <input type="checkbox"/> ICE PACKS <input type="checkbox"/> FROZEN <input type="checkbox"/> COOLING INITIATED											
Are samples for human consumption/ use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO					Submission Comments identified on Sample Receipt Notification: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO											
					Cooler Custody Seals Intact: <input type="checkbox"/> YES <input type="checkbox"/> N/A Sample Custody Seals Intact: <input type="checkbox"/> YES <input type="checkbox"/> N/A											
					INITIAL COOLER TEMPERATURES °C: 1.3 FINAL COOLER TEMPERATURES °C: 2.0											
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)											
Released by: Satbir Guram	Date: Oct 18, 2021	Time: 6pm	Received by: Karan	Date: 10/18/2021	Time: 8:57	Received by: [Signature]	Date: 10/19/21	Time: [Signature]								

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

195 (KS)



GHD Limited (Waterloo)
ATTN: JENNIFER BALKWILL
455 PHILLIP STREET
WATERLOO ON N2L 3X2

Date Received: 15-NOV-21
Report Date: 23-NOV-21 11:12 (MT)
Version: FINAL

Client Phone: 519-884-0510

Certificate of Analysis

Lab Work Order #: L2662811
Project P.O. #: 735-001026
Job Reference: 11202886
C of C Numbers:
Legal Site Desc:

Rick Hawthorne
Account Manager

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ADDRESS: 60 Northland Road, Unit 1, Waterloo, ON N2V 2B8 Canada | Phone: +1 519 886 6910 | Fax: +1 519 886 9047
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2662811-1 11202886-BH-21-02, SS5 Sampled By: CLIENT on 10-NOV-21 @ 12:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.484		0.0040	mS/cm		22-NOV-21	R5655044
% Moisture	15.6		0.25	%	16-NOV-21	17-NOV-21	R5650566
pH	7.89		0.10	pH units		18-NOV-21	R5653879
Redox Potential	319		-1000	mV		17-NOV-21	R5652635
Resistivity	2070		1.0	ohm*cm		22-NOV-21	
Leachable Anions & Nutrients							
Chloride	133		5.0	ug/g	19-NOV-21	22-NOV-21	R5655790
Anions and Nutrients							
Sulphate	166		20	ug/g	19-NOV-21	22-NOV-21	R5655790
Inorganic Parameters							
Acid Volatile Sulphides	0.23		0.20	mg/kg	22-NOV-21	22-NOV-21	R5655518
L2662811-2 11202886-BH-21-04, SS5 Sampled By: CLIENT on 11-NOV-21 @ 12:00 Matrix: SOIL							
Physical Tests							
Conductivity	0.626		0.0040	mS/cm		22-NOV-21	R5655044
% Moisture	18.2		0.25	%	16-NOV-21	17-NOV-21	R5650566
pH	7.61		0.10	pH units		18-NOV-21	R5653879
Redox Potential	288		-1000	mV		17-NOV-21	R5652635
Resistivity	1600		1.0	ohm*cm		22-NOV-21	
Leachable Anions & Nutrients							
Chloride	133		5.0	ug/g	19-NOV-21	22-NOV-21	R5655790
Anions and Nutrients							
Sulphate	84		20	ug/g	19-NOV-21	22-NOV-21	R5655790
Inorganic Parameters							
Acid Volatile Sulphides	<0.20		0.20	mg/kg	22-NOV-21	22-NOV-21	R5655518

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0
<p>5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).</p>			
EC-WT	Soil	Conductivity (EC)	MOEE E3138
<p>A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A
<p>A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.</p> <p>Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).</p>			
REDOX-POTENTIAL-WT	Soil	Redox Potential	APHA 2580
<p>This analysis is carried out in accordance with the procedure described in the "APHA" method 2580 "Oxidation-Reduction Potential" 2012. Samples are extracted at a fixed ratio with DI water. Results are reported as observed oxidation-reduction potential of the platinum metal-reference electrode employed, in mV.</p>			
RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B
<p>"Soil Resistivity (calculated)" is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.</p>			
SO4-WT	Soil	Sulphate	EPA 300.0
<p>5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.</p>			
SULPHIDE-WT	Soil	Sulphide, Acid Volatile	APHA 4500S2J
<p>This analysis is carried out in accordance with the method described in APHA 4500 S2-J. Hydrochloric acid is added to sediment samples within a purge and trap system. The evolved hydrogen sulphide (H₂S) is carried into a basic solution by inert gas. The acid volatile sulfide is then determined colourimetrically.</p>			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid weight of sample

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L2662811

Report Date: 23-NOV-21

Page 1 of 3

Client: GHD Limited (Waterloo)
455 PHILLIP STREET
WATERLOO ON N2L 3X2

Contact: JENNIFER BALKWILL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-R511-WT		Soil						
Batch	R5655790							
WG3661697-7	CRM	AN-CRM-WT						
Chloride			104.4		%		70-130	22-NOV-21
WG3661697-8	DUP	WG3661697-9						
Chloride		6.0	5.8		ug/g	4.4	30	22-NOV-21
WG3661697-6	LCS							
Chloride			101.2		%		80-120	22-NOV-21
WG3661697-5	MB							
Chloride			<5.0		ug/g		5	22-NOV-21
EC-WT		Soil						
Batch	R5655044							
WG3661808-3	DUP	L2662751-4						
Conductivity		0.187	0.186		mS/cm	0.2	20	22-NOV-21
WG3661808-2	IRM	WT SAR4						
Conductivity			112.5		%		70-130	22-NOV-21
WG3662461-1	LCS							
Conductivity			98.3		%		90-110	22-NOV-21
WG3661808-1	MB							
Conductivity			<0.0040		mS/cm		0.004	22-NOV-21
MOISTURE-WT		Soil						
Batch	R5650566							
WG3659023-3	DUP	L2662161-1						
% Moisture		13.3	13.5		%	2.0	20	17-NOV-21
WG3659023-2	LCS							
% Moisture			101.3		%		90-110	17-NOV-21
WG3659023-1	MB							
% Moisture			<0.25		%		0.25	17-NOV-21
PH-WT		Soil						
Batch	R5653879							
WG3658893-1	DUP	L2662156-8						
pH		7.20	7.17	J	pH units	0.03	0.3	18-NOV-21
WG3660796-1	LCS							
pH			6.98		pH units		6.9-7.1	18-NOV-21
REDOX-POTENTIAL-WT		Soil						
Batch	R5652635							
WG3659997-1	CRM	WT-REDOX						
Redox Potential			100.4		%		80-120	17-NOV-21
WG3659748-1	DUP	L2663014-9						



Quality Control Report

Workorder: L2662811

Report Date: 23-NOV-21

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Client: GHD Limited (Waterloo)
455 PHILLIP STREET
WATERLOO ON N2L 3X2

Contact: JENNIFER BALKWILL

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
REDOX-POTENTIAL-WT	Soil							
Batch	R5652635							
WG3659748-1	DUP	L2663014-9						
Redox Potential		272	256		mV	6.1	25	17-NOV-21
SO4-WT	Soil							
Batch	R5655790							
WG3661697-7	CRM	AN-CRM-WT						
Sulphate			110.3		%		60-140	22-NOV-21
WG3661697-8	DUP	WG3661697-9						
Sulphate		<20	<20	RPD-NA	ug/g	N/A	25	22-NOV-21
WG3661697-6	LCS							
Sulphate			100.2		%		70-130	22-NOV-21
WG3661697-5	MB							
Sulphate			<20		ug/g		20	22-NOV-21
SULPHIDE-WT	Soil							
Batch	R5655518							
WG3662900-3	DUP	L2662794-1						
Acid Volatile Sulphides		<0.20	<0.20	RPD-NA	mg/kg	N/A	45	22-NOV-21
WG3662900-2	LCS							
Acid Volatile Sulphides			90.8		%		70-130	22-NOV-21
WG3662900-1	MB							
Acid Volatile Sulphides			<0.20		mg/kg		0.2	22-NOV-21

Quality Control Report

Workorder: L2662811

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Client: GHD Limited (Waterloo)
455 PHILLIP STREET
WATERLOO ON N2L 3X2
Contact: JENNIFER BALKWILL

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



L2662811-COFC

Handwritten signature

Report To Contact and company name below will appear on the final report		Select Report For		Turnaround Time (TAT) Requested		AFFIX ALS BARCODE LABEL HERE (ALS use only)																														
Company:	GHD LIMITED - ACCT# 13791	Merge QC/QCI R		<input type="checkbox"/> 4 day [P4] if received by 3pm M-F - no surcharges apply <input type="checkbox"/> 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum <input type="checkbox"/> 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum <input type="checkbox"/> 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum <input type="checkbox"/> Same day [E2] if received by 10am M-S - 200% rush surcharge.																																
Contact:	Jennifer Balkwill	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.																																
Phone:	519 884 0510	Email 1 or Fax Sandra.McGaghran@ghd.com Email 2 Nirjar.Vyas@ghd.com Email 3 Puneet.Verma@ghd.com		Date and Time Required for all E&P TATs:																																
Company address below will appear on the final report		Invoice Recipients		For all tests with rush TATs requested, please contact your AM to confirm availability.																																
Street:	111 Brunel Road Suite 200	Select Invoice Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		Analysis Request																																
City/Province:	Mississauga/Ontario	Email 1 or Fax		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																																
Postal Code:	L4Z 1X3	Email 2		<table border="1"> <tr> <td rowspan="2">NUMBER OF CONTAINERS</td> <td rowspan="2">Corrosivity package</td> <td colspan="12"></td> <td rowspan="2">SAMPLES ON HOLD</td> <td rowspan="2">EXTENDED STORAGE REQUIRED</td> <td rowspan="2">SUSPECTED HAZARD (see notes)</td> </tr> <tr> <td colspan="12"></td> </tr> </table>				NUMBER OF CONTAINERS	Corrosivity package													SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)												
NUMBER OF CONTAINERS	Corrosivity package													SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)																				
Invoice To		Project Information																																		
Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Copy of Invoice with Report <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO																																		
Company:	GHD LIMITED	ALS Account # / Quote #:																																		
Contact:	Jennifer Balkwill	Job #:																																		
		Major/Minor Code:																																		
		Requisitioner:																																		
		Location:																																		
		ALS Lab Work Order # (ALS use only):		ALS Contact:		Sampler:																														
		L2662811 JD																																		
ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type																																
	11202886 - BH-21-02, SS5	10-Nov-21	12:00	soil																																
	11202886 - BH-21-04, SS5	11-Nov-21	12:00	soil																																
Drinking Water (DW) Samples¹ (client use)		Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)		SAMPLE RECEIPT DETAILS (ALS use only)																																
Are samples taken from a Regulated DW System?		Ontario Regulation 153/04 - April 15, 2011 Standards		Cooling Method: <input type="checkbox"/> NONE <input checked="" type="checkbox"/> ICE <input type="checkbox"/> ICE PACKS <input type="checkbox"/> FROZEN <input type="checkbox"/> COOLING INITIATED																																
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				Submission Comments identified on Sample Receipt Notification: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO																																
Are samples for human consumption/ use?				Cooler Custody Seals Intact: <input type="checkbox"/> YES <input type="checkbox"/> N/A Sample Custody Seals Intact: <input type="checkbox"/> YES <input type="checkbox"/> N/A																																
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				INITIAL COOLER TEMPERATURES °C: 0.4 FINAL COOLER TEMPERATURES °C: 4.8																																
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (ALS use only)		FINAL SHIPMENT RECEPTION (ALS use only)																																
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:																													
<i>Patricia Guyard</i>	NOV 15, 21	1:00 PM	<i>H.K.</i>	11/15/21	12:30	<i>W</i>	11/15/21																													



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→ **The Power of Commitment**