MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

FINAL
FOUNDATION INVESTIGATION AND DESIGN REPORT

Englehart River Bridge - Site No. 47-002
GWP 412-91-00
Highway 66, From 10.6 km East of Highway 65, Easterly 12.3 km

MEL Ref. No.: 08/07/08094 December 16, 2009

Submitted to:

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1.0 INTRODUCTION

Merlex Engineering Ltd. (MEL) has been retained by D.F. Elliott Consulting Engineers Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at the east and west abutments of the existing bridge, Site No 47-002, located on Highway 66, where it crosses the Englehart River. The limits identified in the TPMA for GWP 412-91-00 on Highway 66 are from 10.6 km east of the junction at Highway 65, easterly a distance of 12.7 km. In December 2008, MTO revised the east limit of the project, reducing the project length to 12.3 km (see Figure No. 1, Key Plan, in Appendix A). This foundation project involves the reconstruction of the east and west abutments (conversion to semi-integral abutments) and construction of a false Retained Soils System (RSS), behind the existing abutments, to reduce the lateral load on the abutment piles and construction of temporary roadway protection.

The foundation investigation location was specified by the MTO, Pavements and Foundations Section, in their correspondence dated July 21, 2009. The terms of reference for the scope of work are outlined in MEL's proposal 08/07/08094-R2 dated August 17, 2009. The purpose of the investigation was to determine the subsurface conditions behind the east and west abutments. MEL investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The bridge over the Englehart River is located on Highway 66 some 19 km west of the intersection with Highway 11. The topography at the site is generally of moderate relief and the direction of flow in the river is from north to south. The existing bridge supports two undivided lanes, running in an east west direction. The existing three span bridge is elevated some 9 m above the river and is 36.6 m in length.

2.1 Site Physiography and Surficial Geology

This Highway 66 project falls within the limits of the geomorphic sub-province known as the Eastern Sandy Uplands. The topography at the site is generally rolling. There is exposed bedrock ridges present at a few locations on the main project however, there are no outcrops in the vicinity of the bridge. In most areas, significant layers of earth overlay the bedrock. Within the project area overburden conditions consist primarily of sand and gravel containing varying amounts of silt. Organic (peat) deposits were also encountered.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period of August 23 to September 3, 2009 and consisted of a total of six (6) sampled boreholes.

The field investigation was carried out using a Bombardier mounted CME 45B and a CME 55 high torque drilling rig equipped with hollow stem augers, standard augers, and routine geotechnical sampling equipment. To penetrate the asphalt surface and underlying concrete approach slabs an electric core drill was used to advance 200 mm diameter core holes. The boreholes were advanced using 165 mm O.D. continuous flight hollow stem augers. Soil samples were obtained at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced, using an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedures at all borehole locations. A Dynamic Cone Penetration Test (DCPT) was advanced from grade, or from the bottom of the sampled borehole, to establish a general continuous indication of resistance characteristics of the overburden at the boring locations. In-situ field vane testing, using an MTO “N” size vane, was carried out where appropriate and possible.

Groundwater conditions in the open boreholes were observed during and immediately following completion of the individual boreholes. No artesian groundwater pressures were encountered during advance of the boreholes. All open boreholes were backfilled upon completion with compacted auger cuttings, in the general order they were removed, mixed with bentonite chips and where necessary, additional granular backfill was added to the boreholes to bring the soil level up to grade. The upper portion of the hole was capped with a cold mix patch was used to seal the existing asphalt surface.

The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figures L-1 to L-6).

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. The borehole location data was converted to MTM northerly and easterly as shown on the Record of Boreholes and the Borehole Location Plan, Figure 2. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. 2 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT and DCPT plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location.

4.1 Approaches to the Englehart River Bridge

A plan and profile showing the borehole locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. During the course of the exploration program, six (6) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced from the surface of the existing highway embankment at a distance of some 15 m up and down chainage from the east and west abutments respectively. Borehole Nos. 4 and 5, plus Borehole Nos. 3 and 6, were advanced through the existing approach slabs at the east and west abutments respectively.

Borehole Nos. 1 and 2, advanced through the embankment, indicated a pavement structure of 110 mm of asphalt underlain by 190 to 200 mm of crushed gravel, underlain by granular fill. The upper portion of this fill contained coarse gravel/fine rock fill which was not trapped in the conventional 37 mm I.D. split spoon sampler, however came up on the auger flights (see Photo 5 for example of material). At Borehole No. 2, refusal was met on the DCPT in this material at a depth of 1.4 m below grade. Based on the SPT test values, which ranged from 58 to 68 blows

per 300 mm penetration, the compactness of this portion of the fill was described as very dense, however this resistance value was influenced by the coarseness of the material. A typical gradation curve of the portion of this embankment fill which was retained in the 37 mm inside diameter of the spilt spoon sampler are found on Figure L-1 and indicate 34% gravel size particles, 61% sand size particles and 5% silt and clay size particles. Granular fill extended to depths of 3.4 and 4.4 m, at Borehole Nos. 1 and 2 respectively and the lower portion of this fill was described as a fine sand trace to some silt. Typical gradation curves of the portion of embankment fill which was retained in the 37 mm inside diameter of the spilt spoon sampler are found on Figure L-1 and indicate 0 to 1% gravel size particles, 63 to 89% sand size particles and 11 to 36% silt and clay size particles.

At the remaining Boreholes Nos. 3, 4, 5, and 6, which were advanced through the existing approach slab in close vicinity to the abutments, an asphalt layer, varying from100 to 130 mm in thickness was underlain by a concrete approach slab which varied from 250 to 280 mm in thickness. The concrete slab was supported on a layer of crushed gravel which ranged from 310 to 530 mm in thickness. The above road structure was underlain by a granular fill which was sampled to depths of some 4.1 to 5.1 m below grade. Typical gradation curves of the portion of embankment fill which was retained in the 37 mm inside diameter of the spilt spoon sampler are found on Figure L-2 and indicate 34 to 70% gravel size particles, 29 to 62% sand size particles, and 1 to 4% silt and clay size particles. Based on the SPT values, which ranged from 4 to greater than 100 blows per 300 mm penetration, the compactness of the embankment fill was described as loose to very dense, generally compact.

Underlying the embankment fill a native deposit of sands, generally fine and containing varying quantities of silt and occasional to frequent silt layers was penetrated. Typical gradation curves of the portion of native sands are found on Figures L-3, L-4, and L-5 and indicate 0 to 5% gravel

size particles, 20 to 91% sand size particles, and less than 8% silt and clay size particles to 78% silt. The high silt content was due to a silt layer in the sample. Based on the SPT values, which ranged from 0 (sampler sank under weight of hammer) to 30 blows per 300 mm penetration, the compactness of the native sands was described as very loose to compact, generally loose. These native sands were sampled to depths ranging between 15.7 m (elevation 251.3 m) to 11.5 m (elevation 256.0 m), were they were underlain by a silt deposit.

The silt contained a trace of fine sand and clay. Typical gradation curves of the silt stratum are found on Figure L-6 and indicate 0 % gravel size particles, 2 to13% fine sand size particles, 81 to 91% silt size particles and 6 to 10 % clay size particles. Based on the SPT values, which ranged from 5 to 17 blows per 300 mm penetration, the compactness of the native sands was described as loose to compact, generally loose.

4.2 Groundwater Conditions

Groundwater and cave-in levels in the open boreholes were taken upon completion of the individual borings. These levels were recorded on the individual Record of Borehole Log Sheets (Appendix B). At Borehole Nos. 1, 3, and 6 the water level was measured between elevations 258.9 and 260.1 m. The water level was measured in the Englehart River, at the bridge site, at elevation 259.4 m. These groundwater levels will fluctuate seasonally.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
Principal

J. R. Berghamer, P. Eng.
Project Engineer

5.0 DESIGN COMMENTS AND RECOMMENDATIONS

5.1 General

The existing 3 span bridge on Highway 66, which crosses the Englehart River, is scheduled for a major rehabilitation. A Detailed Condition Survey Report, conducted by Coffey Geotechnics Inc., concludes that some of the bridge elements are in poor condition. A Structural Design Report, prepared by URS, recommends that as part of the rehabilitation of the abutments (conversion to semi-integral abutments) the existing backfill pressure against the abutment be reduced. The evaluation conducted on the abutment piles indicated that the factored lateral loads marginally reached the lateral capacity for the current loading and, as a corrective measure, a false Retained Soil System (RSS) be constructed behind the abutment to reduce the lateral load on the piles. This foundation Investigation has been carried out to determine the soil conditions behind the abutments to facilitate the design of the RSS and Roadway Protection required during construction.

5.2 Existing Conditions

The existing 3 span bridge is supported on a deep foundation consisting of concrete filled pipe piles, presumably driven to a set based on the Hiley formula, that we understand have performed satisfactorily. The original construction drawings, dated 1967, indicated that at the abutments 325 mm diameter pipe piles were driven at a 1 on 18 batter, to the rear, and the piles were located either side of the bridge centerline. These drawings further indicate that the top of the concrete pile caps/footings were established at elevations 263.0 m and 263.5 m at the east and west abutments respectively.

5.3 Retaining Walls

5.3.1 Foundation Considerations

A false Retained Soil System (RSS) wall is to be constructed, below the approach slabs, to relieve the unbalanced lateral soil pressure imposed by the backfill on the existing piled foundation system. It is understood that this false RSS wall will be founded at elevations 263.6 and 264.0 m at the east and west abutments respectively.

To effectively reduce the lateral earth pressure, imposed upon the existing abutment/pile system, it will be necessary to transfer the vertical, and resulting lateral load, to the rear of the existing pile cap. As such, the false RSS wall will have to be founded directly on top of the pile caps, which are at elevation 263.0 and 263.5 m, east and west abutment respectively. Based on the original contract drawings, this will require excavations to a depth of approximately 4 m, to the rear of both the east and west abutments. The RSS wall will be constructed up to the "trim line", as shown on the current Contract Sheet 41, which will require a RSS wall some 2.1 m in height.

Considering the above noted excavation depths and subsurface conditions revealed during this foundation investigation, the false RSS wall will be founded on the existing pile cap and abutment backfill. At these elevations, the founding soils consist of gravel and sands to fine sands some gravel in a loose to very dense, generally compact, state of compactness based on the SPT values. Below the backfill material the native soils consist of fine sands, generally in a loose state of compactness. The groundwater level was measured at a depth of some 3.5 m below the founding subgrade level at the time of investigation.

Based on the above noted subgrade conditions, the presence of the existing approach backfill and noted founding elevation, as well as the underlying native soil conditions, we have determined a factored bearing resistance value at ULS of 400 kPa. A SLS bearing resistance of 120 kPa reflects settlement considerations of the preloaded zone of soil below the existing abutment backfill, a limiting settlement estimate of 10 mm, and the condition that the subgrade will not be excessively disturbed during excavation/construction and will be proof rolled with a minimum of 6 passes with a heavy hand directed vibratory compactor, prior to construction of the wall.

The false RSS wall is intended to eliminate the lateral earth pressure on the abutment/supporting pile foundation. A false RSS wall with a high performance level limits the horizontal movement to 1 in 500 relative to the vertical height of the wall. Considering the height of the wall, which will be in the order of 2100 mm, it is our opinion that consideration should be given to a performance level of medium, from a cost point of view, which limits horizontal movement to 1 in 250. This will allow consideration of a RSS wall/slope on DSM 9.70.56, which satisfies the angle requirement of 90^{o}, along with other environmental, appearance, height restrictions, etc. associated with the intended use. In addition, a compressible material should be installed between the face of the RSS wall and the back of the existing abutment, to accommodate any minor lateral movement of the wall face. The design, supply and construction of the RSS wall should be in conformance with SP 599S22 and SP 599S23. These proprietary systems should be designed by the supplier and should consider the method of rehabilitating the abutment approaches.

The supplier of the false RSS is to be responsible for the backfill material employed in construction, and must take into consideration the engineering properties of their proprietary

product, the design life of the bridge, drainage characteristics of the site, and freeze-thaw conditions which will develop below the approach slabs.

5.3.2 Lateral Earth Pressure

The RSS wall must be designed to resist the unbalanced lateral earth pressure imposed by the backfill and the surcharge load associated with live and dead load of the approach slab and compaction of the overlying backfill. Considering the limited wall height, as indicated on the construction drawings, and depressed level of the groundwater table, the lateral earth pressure could be computed using the equivalent fluid pressure, as outlined in section 6.9.2.3 of the CHBDC or employing the following equation, which assumes a triangular pressure distribution:

Where $p = K(\gamma h + q) + Cp + Cs$
- K = coefficient of lateral earth pressure (dimensionless)
- γ = unit weight of free draining granular material, kN/m^3
- h = depth below top of wall, m
- q = surcharge load, kPa
- Cp = compaction pressure, kPa (refer to clause 6.9.3 of CHBDC)
- Cs = earth pressure induced by seismic events, kPa

The seismic site coefficient for the conditions at this site is 1.0 (soil profile Type I, CHBDC Clause 4.4.6)

Free draining granular material conforming to OPSS gradation requirements, should be used as backfill behind the walls. The following parameters are recommended for design:

Parameter	Granular A or Granular B Type II	Granular B Type I
Angle of Internal Friction, degrees (ϕ)	35	32
Unit weight, kN/m^3 (γ)	22.8	19.5
Coefficient of Active Earth Pressure, K_a	0.27	0.31
Coefficient of Earth Pressure At Rest, K_o	0.43	0.47
Coefficient Passive Earth Pressure, K_p	3.70	3.23

The coefficient of earth pressure at rest should be used for design to limit wall movement.

5.3.3 Sliding Resistance

The RSS wall system should be checked for sliding resistance using the following geotechnical parameters for the cohesionless soils encountered at the approaches and the cast in place concrete pile cap:

Parameter	Granular A or Granular B Type II	Fine Sands and Silty Fine Sands
Friction Angle, degrees	35	32
Cohesion, kPa	0	0
Unit Weight, kN/m^3	22.8	20.0

5.4 Roadway Protection

A temporary roadway protection system (i.e. sheet piling, soldier piles and lagging, etc.) will be required to support the approach soils during staged construction. An excavation will be required at the approaches, to a depth of some 4 m, to allow installation of the RSS wall and rehabilitation of the abutments and approach slabs. At these locations the foundation investigation indicated fill materials, consisting of up to 130 mm of asphalt, over a concrete approach slab (250 to 280 mm thick) underlain by gravel and sand backfill, which extended to about elevation 263.0 and 264.0 m, at the west and east abutments respectively. Occasional layers/seams of coarse gravel or fine rock fill was encountered in the backfill, however auger advance was not severely restricted by this coarser backfill, and as such, its presence in the approach fill should not adversely affect the driving operations provided a sufficiently robust sheet pile section is used. To address this issue of cobbles/obstructions in the approach fill, we have included a NSSP in Appendix D for inclusion in the contract package. These fill materials were underlain by native fine sands generally in a loose state of compactness. At the time of this investigation, the groundwater level was recorded at a depth of some 4 m below the anticipated required depth of excavation.

Depending on the section properties of the support system, walers with rakers or bracing or a tieback system may be required. The contractor may consider using the existing approach slab to supplement this tieback system. If tiebacks are required, the resistance (R) for grouted anchors, located outside the active failure wedge, in cohesionless soils can be estimated from the following equation as supplied in the Canadian Foundation Manual (4th Edition):

$\mathbf{R = \sigma_z' A_s L_s \alpha_g}$ Where: $\mathbf{\sigma_z'}$ = effective vertical stress at the midpoint of the load carrying length

$\mathbf{A_s}$ = effective unit surface area of the anchor

$\mathbf{L_s}$ = effective embedment length of the anchor

α_g = anchorage coefficient
use 1.0 for granular backfill
use 0.6 for native fine sands

Unless the pull-out resistance (capacity) of the anchor is proven with a load test program the allowable anchor load, as suggested by the Canadian Foundation Engineering Manual (4th Edition), is commonly obtained by dividing the computed capacity of the anchor by a factor of safety of 3. Alternatively, proprietary anchor systems can be used.

The temporary roadway protection system should be designed and constructed in accordance with SP 105S19. In consideration of the location of the roadway protection, relative to the existing structure, a performance level 2 is considered appropriate. However, a detailed monitoring system must be implemented by the contractor in order to guarantee the serviceability of the half of the structure which is carrying traffic, specifically during critical stages of construction. The monitoring system shall include scaled survey targets attached to the roadway protection shoring, surveyed by a registered land surveyor or professional engineer as identified in SP 105S19, to ensure that the horizontal displacement and angular distortion do not exceed the limits as outlined in 539.04.02.01.

5.5 Excavation

Based on the Occupational Health and Safety Act Regulations for Construction Projects, the abutment backfill soil, down to the top of existing pile cap, can be classified as a Type 3 soil. All excavations greater than 1.2 m in depth must be sloped or shored in accordance with the Occupational Health and Safety Act Regulations for Construction Projects. Temporary open excavations will be stable, above the groundwater table, at an angle of 1H:1V. Below the prevailing groundwater table, the slopes of open excavations will have to be flattened to 2H:1V or possibly shallower depending upon the method of dewatering employed. As noted previously in Section 5.4, excavations greater than some 4 m are not anticipated for construction of the RSS wall. The groundwater table in the abutment area was identified in the boreholes varying between elevation 258.9 and 260.1 m, which is 8.0 to 7.4 m below grade, and as such, it is not anticipated that the groundwater table will be encountered during the excavations at the abutments.

6.0 CLOSURE

Information provided in this report is valid only at the locations described above. Any assumptions of continuity of soil stratigraphy between boreholes, as shown on the enclosed cross-sections, is intended as an aid for design purposes only and does not constitute a statement of existing conditions for contractual or construction purposes. Field investigation was carried out using a CME 45B and CME 55 drill rigs owned by a sister company of Merlex Engineering Ltd, and an independent drilling contractor, Landcore Drilling, respectively. The report was prepared by Mr. J.R. Berghamer, P. Eng and reviewed by the firm's principal and MTO designate Mr. M. A. Merleau, P. Eng.

Details of the investigation, the material analysis and recommendation in this report are considered to be complete. However, should any questions arise, please do not hesitate to contact the undersigned.

MERLEX ENGINEERING LTD.

M. A. Merleau, P. Eng.
Principal

J. R. Berghamer, P. Eng.

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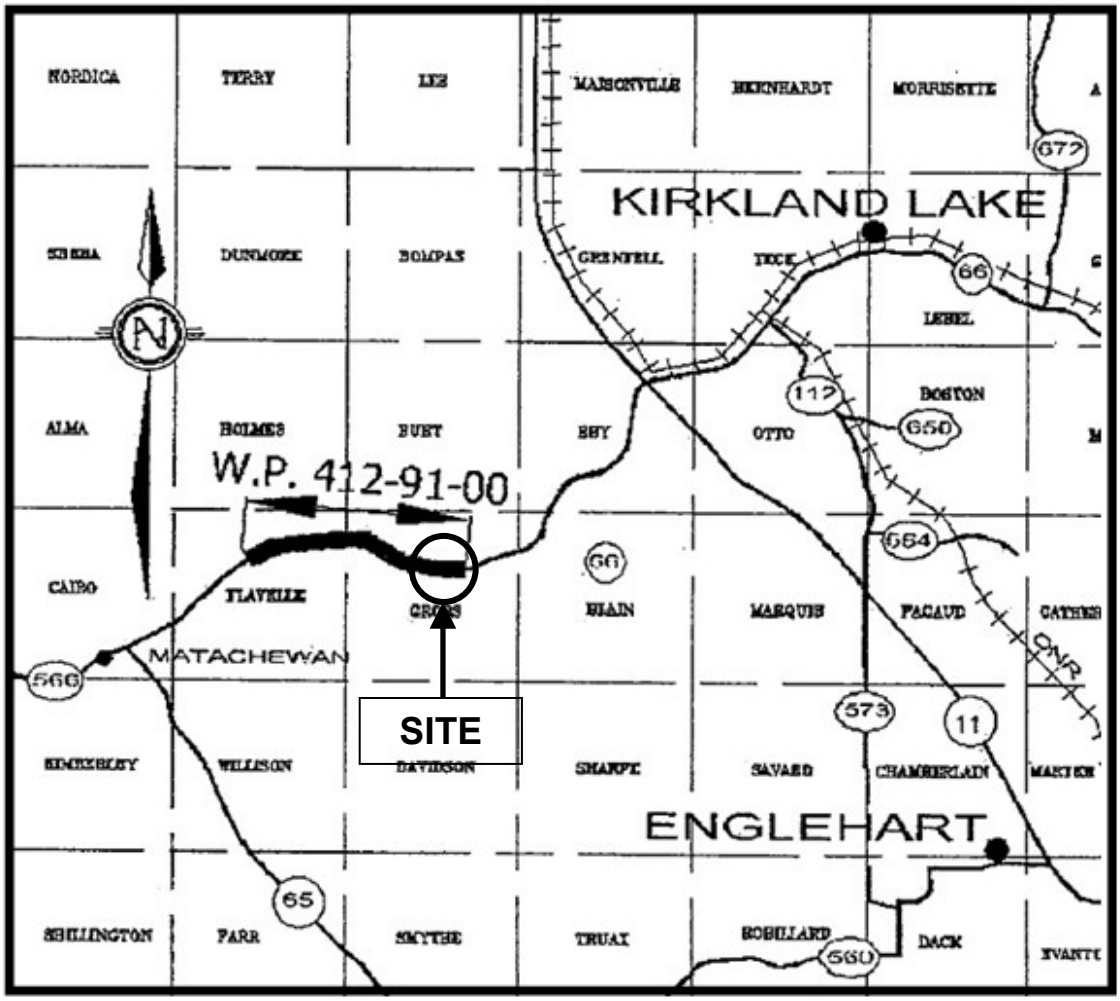
APPENDIX A

Figure No. 1 Key Plan

KEY PLAN

NOT TO SCALE



FINAL
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Highway 66
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MEL Ref. No.: 08/07/08094 December 2009

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APPENDIX B

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 7	Record of Borehole Sheets

LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS Auger Sample
CS Chunk Sample
DS Denison type sample
FS Foil Sample
HB Hammer Bouncing
NFP No Further Progress
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
RC Rock core with size & percentage of recovery
SS Split Spoon
ST Slotted Tube
TO Thin-walled, open
TP Thin-walled, piston
WH Sampler Advanced by static weight (weight of hammer and/or rods)
WS Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 90° point cone driven by a 63 kg hammer falling 760 mm.

Plotted as 

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*Relative Density*
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	*Consistency*
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole. The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

¨ - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P Standard Proctor Test
A Atterberg Limit Test
GS Grain Size Analysis
H Hydrometer Analysis
C Consolidation

SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.

2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.

3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.

4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

ENCLOSURE NO.: 2 (Pg. 1 of 3)

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 08094 DATUM Geodetic LOCATION N 5317625.058 E 353048.178 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 August 24 TIME 5:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 August 24

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
266.9	Asphalt Road Surface										
0.0 / 266.6	±110 mm Asphalt ±200 mm Crushed Gravel										
0.3 / 266.0	FILL - fine rock fill with sands		1	AS							
0.9	SANDS - brown fine sands, some silt trace gravel (probably fill)		2	SS	58		266				34 61 (5)
	(compact/dense)		3	SS	13		265				0 84 (16)
			4	SS	35						1 63 (36)
263.5	layer of gravel/ small cobbles		5	SS	20/1"		264				
3.4	SAND - brown fine sands and silt, occasional to frequent silt layers trace of clay										
	(compact)		6	SS	30		263				0 20 78 2
			7	SS	16		262				0 50 46 4
							261				
	(loose)		8	SS	3		260				0 23 72 5
	Continued Next Page		9	SS	PM	▼	259				0 63 34 3

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, × 3 : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 09/8/24 5:40:00 PM	8 ▼	8.9 ▼
2)	- ▼	-
3)	- ▼	-

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 2 (Pg. 2 of 3)

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 08094 DATUM Geodetic LOCATION N 5317625.058 E 353048.178 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 August 24 TIME 5:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 August 24

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page										
	SANDS - fine sands some silt										
	(loose)						258				
			10	SS	3				o		
							257				
			11	SS	9		256		o		0 70 25 5
	occasional wood pieces										
							255				
			12	SS	2				o		0 90 (10)
							254				
253.0											
13.9	SILT - grey silt trace fine sand and clay		13	SS	14		253		o o		1 89 (10) 0 5 86 9
							252				
251.2			14	SS	17				o		0 13 81 6
15.7	End of Sampling Commencement of DCPT						251				
	Continued Next Page										

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ENCLOSURE NO.: 2 (Pg. 3 of 3)

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 08094 DATUM Geodetic LOCATION N 5317625.058 E 353048.178 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 August 24 TIME 5:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 August 24

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	w_P w w_L	γ	
	Continued from Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60	kN/m³	GR SA (SI CL)
	Probably fine sands with varying silt content						250 249 248 247 246 245				
244.4 22.5	DCPT Refusal End of Borehole										

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 3 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 2

REFERENCE 08094 DATUM Geodetic LOCATION N 5317647.273 E 352985.445 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 3 TIME 5:40:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 3

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
267.6	Asphalt Road Surface						
0.0	±110 mm Asphalt ±190 mm Crushed Gravel						
267.3							
0.3	FILL - coarse gravel, fine rock fill		1	AS			
			2	SS	68		
266.2							
1.4	DCPT Refusal						
	FILL - fine sand trace to some silt		3	SS	59		
	(compact/dense)						
			4	SS	50/5"		
			5	SS	17		
	asphalt pieces		6	SS	44		
263.2							
4.4	SANDS - brown fine sands, some silt						
	(compact)		7	SS	20		
			8	SS	10		
	brown / grey						
	(loose) increase in silt content		9	SS	WH		
	Continued Next Page						

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa 20 40 60 80 100
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	(SI	CL)
5	0	89		(11)
7	0	73		(27)
9	0	34	60	6

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 09/9/3 5:40:00 PM	DRY	6.5
2)	-	-
3)	-	-

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 3 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. 2

REFERENCE 08094 DATUM Geodetic LOCATION N 5317647.273 E 352985.445 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 3 TIME 5:40:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 3

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page										
	SANDS - grey fine sands with silt						259				
	(loose)		10	SS	5		258		○		
	some bark/twigs		11	SS	7		257		○		0 66 (34)
	small shells present below ±12m depth		12	SS	5		256		○		
254.0							255				
13.6	SILT - grey silt trace fine sand trace shells		13	SS	5		254		○		
			14	SS	5		253		H ○		0 4 86 10
251.9							252				
15.7	End of Borehole										

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ENCLOSURE NO.: 4 (Pg. 1 of 3)

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 08094 DATUM Geodetic LOCATION N 5317644.688 E 352998.947 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 August 26 TIME CHECKED BY MAM

DATE (Completed) 2009 August 27

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
267.5	Asphalt Road Surface										
0.0	±100 mm Asphalt ±250 mm Concrete ±450 mm Crushed Gravel		1	AS			267				
	FILL - crushed gravel with sands to sands and gravel		2	SS	24						68 31 (1)
	(compact/loose)						266				
			3	SS	5						56 42 (2)
			4	SS	10		265				38 59 (3)
	occasional cobble/fine rock fill										
			5	SS	4		264				70 29 (1)
			6	SS	15						40 58 (2)
263.0							263				
4.5	SANDS - fine sands trace to some silt		7	SS	5						1 91 (8)
	(loose/very loose)						262				
			8	SS	4		261				0 84 (16)
	brown --- grey		9	SS	WH		260				1 68 (31)
	Continued Next Page										

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 09/8/27 3:45:00 PM	8	9.3
2)	-	-
3)	-	-

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 4 (Pg. 2 of 3)

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 08094 DATUM Geodetic LOCATION N 5317644.688 E 352998.947 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 August 26 TIME CHECKED BY MAM

DATE (Completed) 2009 August 27

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page										
	SANDS - grey fine sands some silt						259				
	(compact/very loose)		10	SS	10		258				5 75 (20)
	trace wood pieces		11	SS	PM		257				3 81 (16)
256.0											
11.5	SILT - grey silt, trace some sand, occasional shells						256				
	trace of wood pieces		12	SS	6		255				0 6 86 8
	(loose)		13	SS	8		254				0 2 91 7
							253				
			14	SS	6		252				0 4 87 9
251.8											
15.7	End of Sampling Commencment of DCPT						251				
	Continued Next Page										

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ENCLOSURE NO.: 4 (Pg. 3 of 3)

METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 08094 DATUM Geodetic LOCATION N 5317644.688 E 352998.947 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 August 26 TIME CHECKED BY MAM

DATE (Completed) 2009 August 27

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page						250, 249, 248, 247, 246, 245, 244	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100	20 40 60		
243.3 / 24.2	DCPT Refusal End of Borehole										

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 5 (Pg. 1 of 3)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 08094 DATUM Geodetic LOCATION N 5317630.245 E 353036.789 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 2 TIME 12:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 2

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
267.0	Asphalt Road Surface										
0.0	±110 mm Asphalt ±280 mm Concrete ±310 mm Crushed Gravel										
	FILL - gravel and sands to sandy gravel		1	SS	11		266				57 40 (3)
	(compact/dense)		2	SS	13		265				
	some gravel/cobbles		3	SS	17		264				
	some gravel/cobbles		4	SS	93						58 38 (4)
			5	SS	50		263				
262.0			6	SS	29		262				
5.0	SAND - fine sands some silt										
	brown grey		7	SS	3		261				0 26 68 6
	Silt layer in sample										
	(loose/very loose)						260				
	Continued Next Page		8	SS	PM						

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, × 3 : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 09/9/2 12:30:00 PM	DRY	6.6
2)	-	-
3)	-	-

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 5 (Pg. 2 of 3)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 08094 DATUM Geodetic LOCATION N 5317630.245 E 353036.789 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 2 TIME 12:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 2

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page										
	SANDS - fine sands some silt										
	wood pieces		9	SS	2		258		○		0 65 30 5
	(very loose/loose)						257				
			10	SS	2		256		○		
	wood pieces		11	SS	5		255		○		
	(loose)		12	SS	5		254		○		
251.3			13	SS	9		253		○		
15.7	End of Sampling Commencement of DCPT						252				
	Continued Next Page						251				

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ENCLOSURE NO.: 5 (Pg. 3 of 3)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 08094 DATUM Geodetic LOCATION N 5317630.245 E 353036.789 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 2 TIME 12:30:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
	Continued from Previous Page						250				
							249				
							248				
							247				
							246				
							245				
							244				
							243				
242.1											
24.9	DCPT Refusal End of Borehole										

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 6 (Pg. 1 of 3)

METRIC

RECORD OF BOREHOLE NO. 5

REFERENCE 08094 DATUM Geodetic LOCATION N 5317627.549 E 353033.023 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 2 TIME 6:40:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 2

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
267.1	Asphalt Road Surface										
0.0	±110 mm Asphalt ±270 mm Concrete ±370 mm Crushed Gravel						267				
	FILL - gravel and sand sill		1	SS							
	(compact/dense)		2	SS	16		266				
			3	SS	20						
							265				
	decrease in gravel size, occasional cobbles		4	SS	32						34 62 (4)
			5	SS	67		264				55 41 (4)
	occasional cobbles										
	occasional cobbles		6	SS	50/3"		263				
			7	SS	25						
262.0											
5.1	SANDS - fine sands trace to with silt						262				
	(looose/very loose)										
	Silt layer in sample		8	SS	4		261				0 24 69 7
							260				
	Continued Next Page		9	SS	PM						

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 09/9/2 6:40:00 PM	DRY	8
2)	-	-
3)	-	-

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METRIC

RECORD OF BOREHOLE NO. 5

REFERENCE 08094 DATUM Geodetic LOCATION N 5317627.549 E 353033.023 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 2 TIME 6:40:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 2

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page						259				
	SANDS - fine sands, some silt (very loose/loose)										
			10	SS	2		258				0 78 18 4
							257				
	trace wood pieces		11	SS	3						
							256				
			12	SS	5		255				
							254				
			13	SS	9						
252.6							253				
14.5	SILT - grey silt trace fine sand trace shells										
			14	SS	13		252				
251.4											
15.7	End of Sampling Commencement of DCPT						251				
	Continued Next Page										

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ENCLOSURE NO.: 6 (Pg. 3 of 3)

METRIC

RECORD OF BOREHOLE NO. 5

REFERENCE 08094 DATUM Geodetic LOCATION N 5317627.549 E 353033.023 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 2 TIME 6:40:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 2

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
	Continued from Previous Page						250				
							249				
							248				
							247				
							246				
							245				
							244				
							243				
242.2											
24.9	DCPT Refusal End of Borehole										

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

MERLEX ENGINEERING LTD.

120 Progress Court, North Bay P1B 8G4 Phone: (705) 476-2550 Fax: (705) 476-8882 Email: merlex@merlex.ca

ENCLOSURE NO.: 7 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 6

REFERENCE 08094 DATUM Geodetic LOCATION N 5317643.290 E 352994.084 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 3 TIME 1:05:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 3

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
267.5	Asphalt Road Surface										
0.0	±130 mm Asphalt ±250 mm Concrete ±530 mm Crushed Gravel		1	SS			267				
	FILL - gravel and sands		2	SS	29						
	(compact/very dense)						266				
	occasional cobbles/fine rock fill		3	SS	74						
			4	SS	45		265				42 54 (4)
	occasional cobbles/fine rock fill		5	SS	38						
263.4			6	SS	10		264				0 90 (10)
4.1	SANDS - fine sands, trace silt										
	(loose/very loose)		7	SS	7		263				
							262				
			8	SS	6						
	brown / grey		9	SS	WH	▼	261				
	Continued Next Page						260				

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+³, ×³ : Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (yy/mm/dd)/Time	Water Depth (m)	Cave In (m)
1) 09/9/3 1:05:00 PM	7.4	8.2
2)	-	-
3)	-	-

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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ENCLOSURE NO.: 7 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. 6

REFERENCE 08094 DATUM Geodetic LOCATION N 5317643.290 E 352994.084 ORIGINATED BY JL

PROJECT Englehart River Bridge - Site No. 47-002 - GWP 412-91-00 BOREHOLE TYPE CME 55 - Hollow Stem Augers COMPILED BY RG

CLIENT DF Elliot DATE (Started) 2009 September 3 TIME 1:05:00 PM CHECKED BY MAM

DATE (Completed) 2009 September 3

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
	Continued from Previous Page										
	SANDS - grey fine sands some silt						259				
			10	SS	4		258		NMC= 91		
	(loose)										
	trace wood pieces		11	SS	9		257				
							256				
	trace of shells		12	SS	5		255				
	trace of shells		13	SS	6		254				
253.2											
14.3	SILT - grey silt trace wood pieces						253				
	(loose)										
			14	SS	6		252				
251.8											
15.7	End of Borehole										

MEL-GEO 08094 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 09/12/17

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APPENDIX C

Figure No. 2	Borehole Locations & Soil Strata
Figures L-1 to L-6	Summary Grain Size Analysis Graph

CONT No

WP No 412-91-00

N

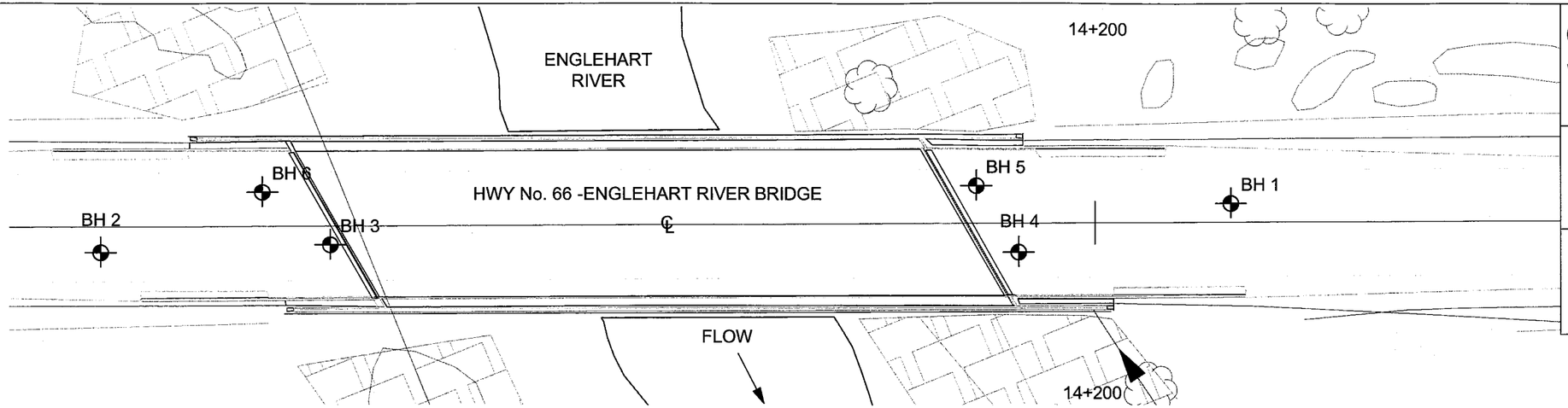
HWY 66 - Englehart River Bridge Rehabilitation

Site No. 47-002

BOREHOLE LOCATIONS & SOIL STRATA

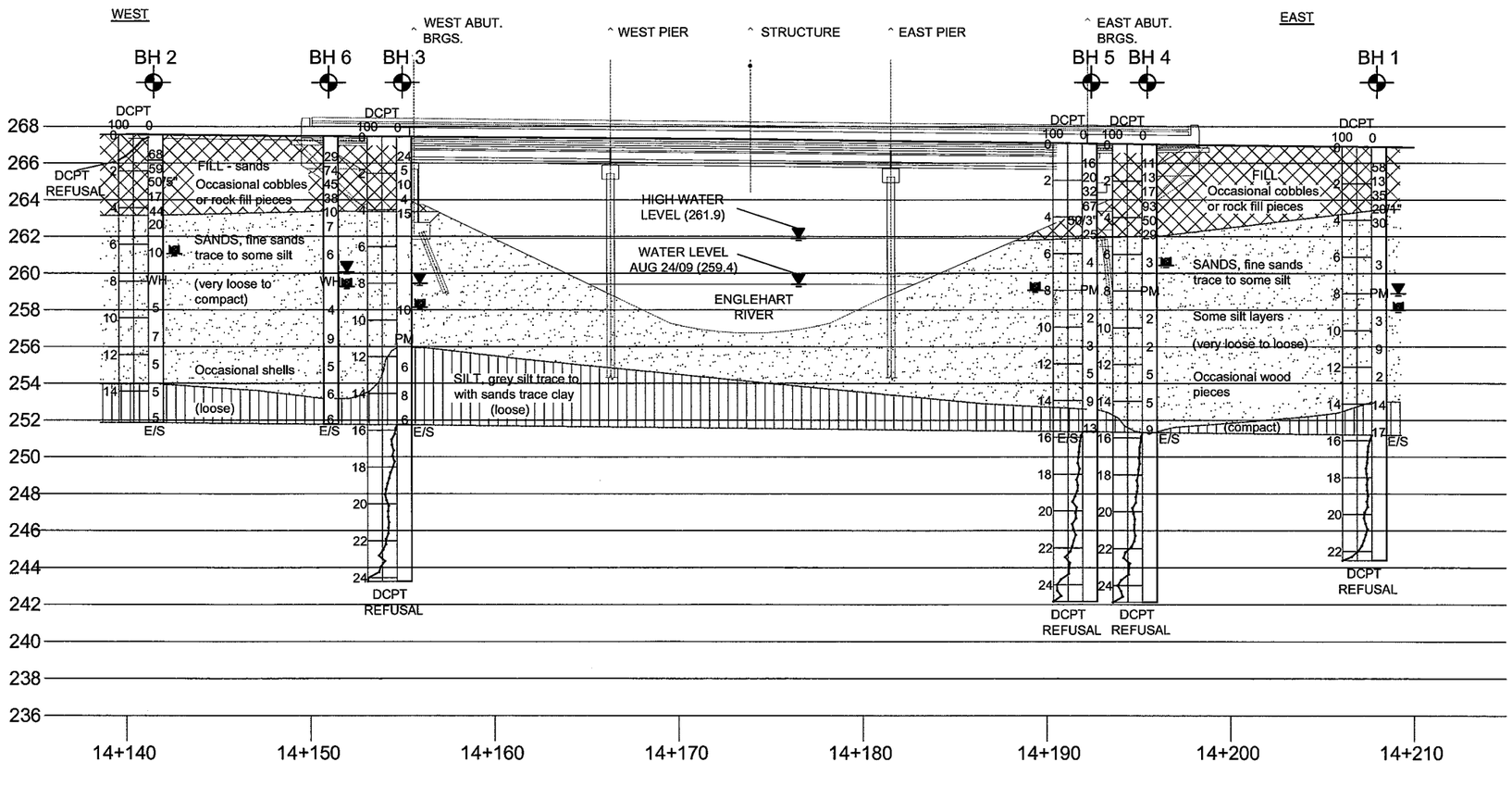
Figure 2

MERLEX ENGINEERING LTD.
Consulting Geotechnical Engineers



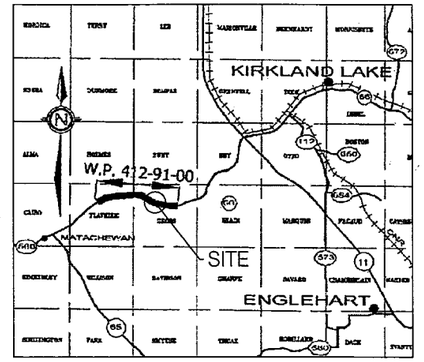
PLAN

HORT 1:300 5m 0 10m



PROFILE

HORT 1:300 5m 0 10m
VERT 1:300



KEY PLAN - NOT TO SCALE

LEGEND

- Borehole
- N Blows/0.3 m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R Auger Refusal at Elevation
- E/S End of Sampling

STRATIGRAPHY LEGEND

- FILL, sands, occasional cobbles/rock fill
- SANDS, fine sands trace to with silt, some silt layers
- SILT, trace to with fine sand

Borehole No.	Co-ordinates Northerly	Co-ordinates Easterly	Elev.
Borehole No. 1	N5317625.058	E353048.178	266.9
Borehole No. 2	N5317647.273	E352985.445	267.6
Borehole No. 3	N5317644.688	E352998.947	267.5
Borehole No. 4	N5317630.245	E353036.789	267.0
Borehole No. 5	N5317627.549	E353033.023	267.1
Borehole No. 6	N5317643.290	E352994.084	267.5

NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries between boreholes are assumed based on borehole data and may vary and are intended for design only.

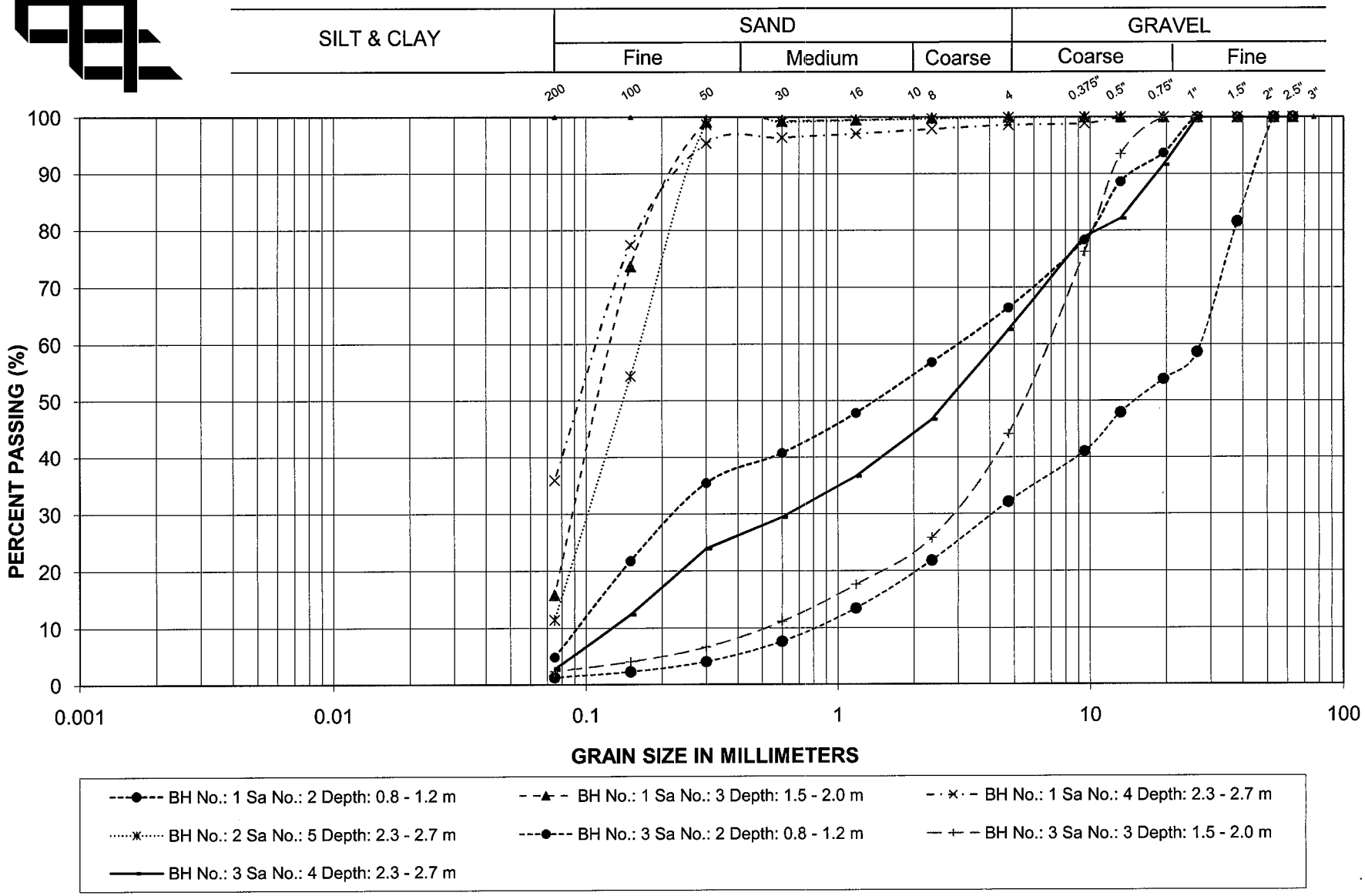
REVISIONS

DATE	BY	DESCRIPTION
09/09/25	RG	Expanded Stratigraphy, added descriptions and N'lys
		E'lys.

Hwy No. 66 – Englehart River Bridge Rehabilitation			DIST
SUBM'D		DATE 00/00/00	SITE No. 47-002
DRAWN RG	CHK MAM	DATE 09/09/25	FIG 1

Reference No.: 08094
Date: October 2009

GRAIN SIZE ANALYSIS



PROJECT: Site No. 47-002 - Englehart River Bridge
LOCATION: Highway No. 66

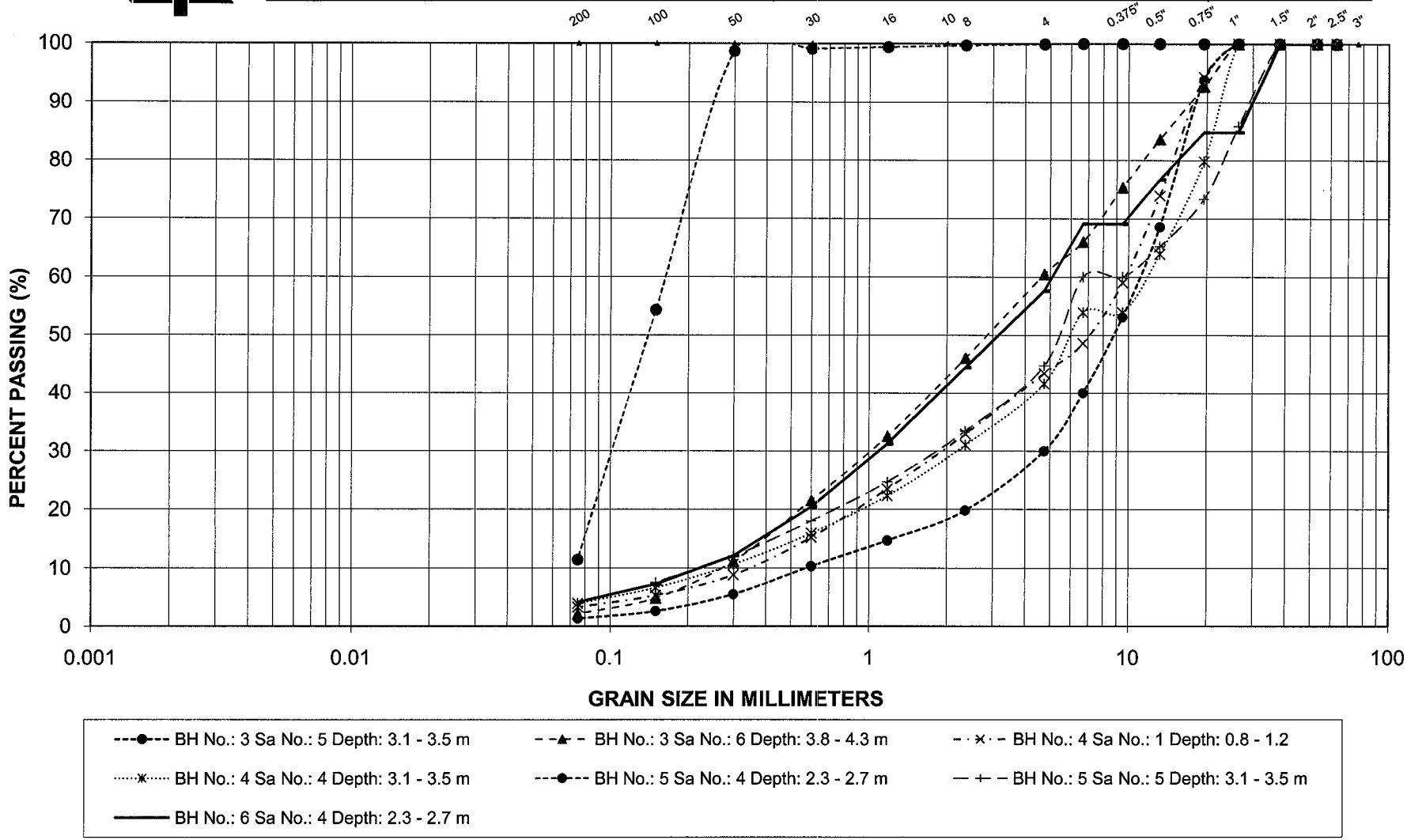
FILL

MERLEX ENGINEERING LTD.

FIGURE L-1

Reference No.: 08094
Date: October 2009

GRAIN SIZE ANALYSIS



PROJECT: Site No. 47-002 - Englehart River Bridge
LOCATION: Highway No. 66

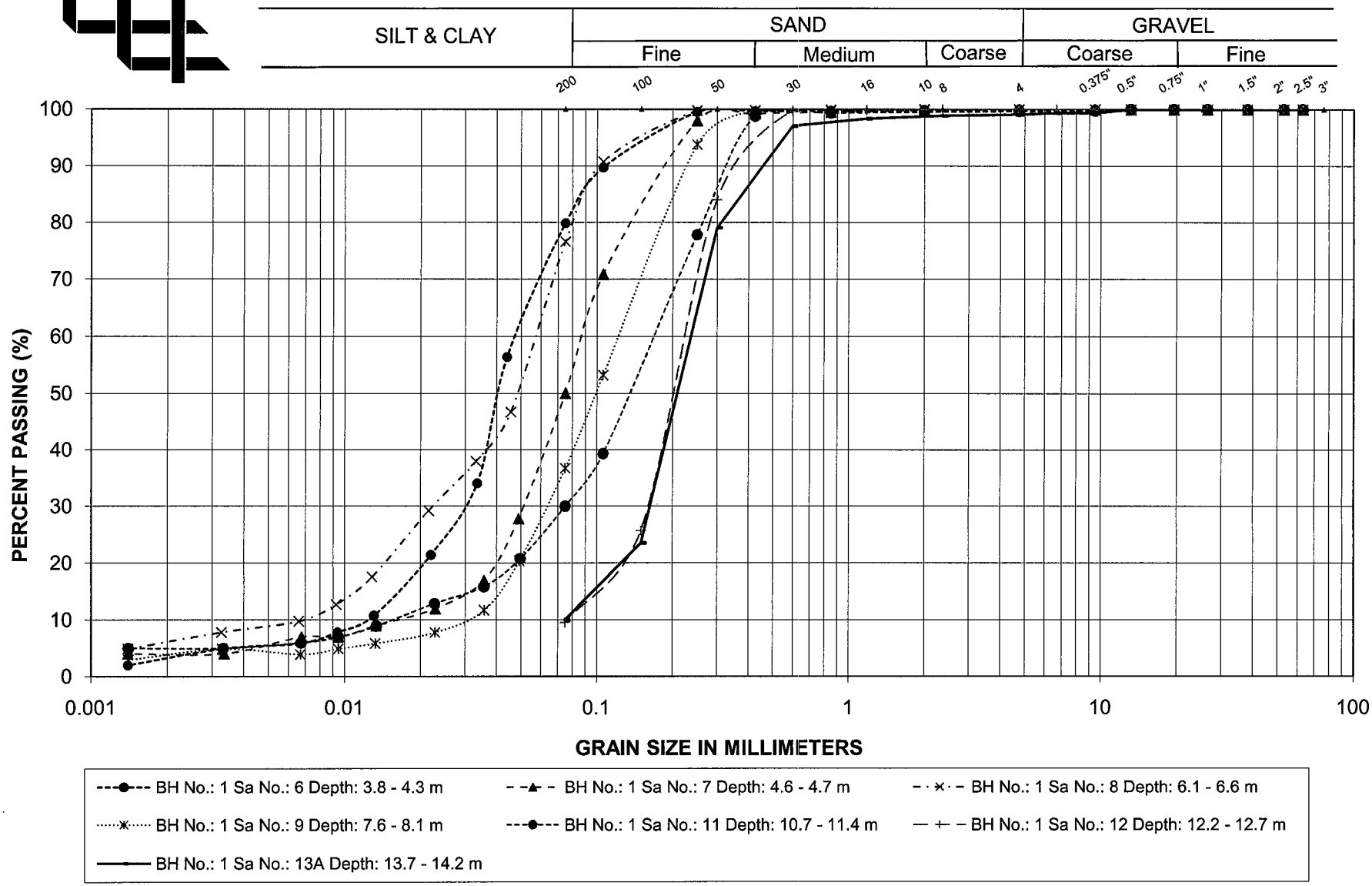
FILL

MERLEX ENGINEERING LTD.

FIGURE L-2

Reference No.: 08094
Date: October 2009

GRAIN SIZE ANALYSIS



PROJECT: Site No. 47-002 - Englehart River Bridge
LOCATION: Highway No. 66

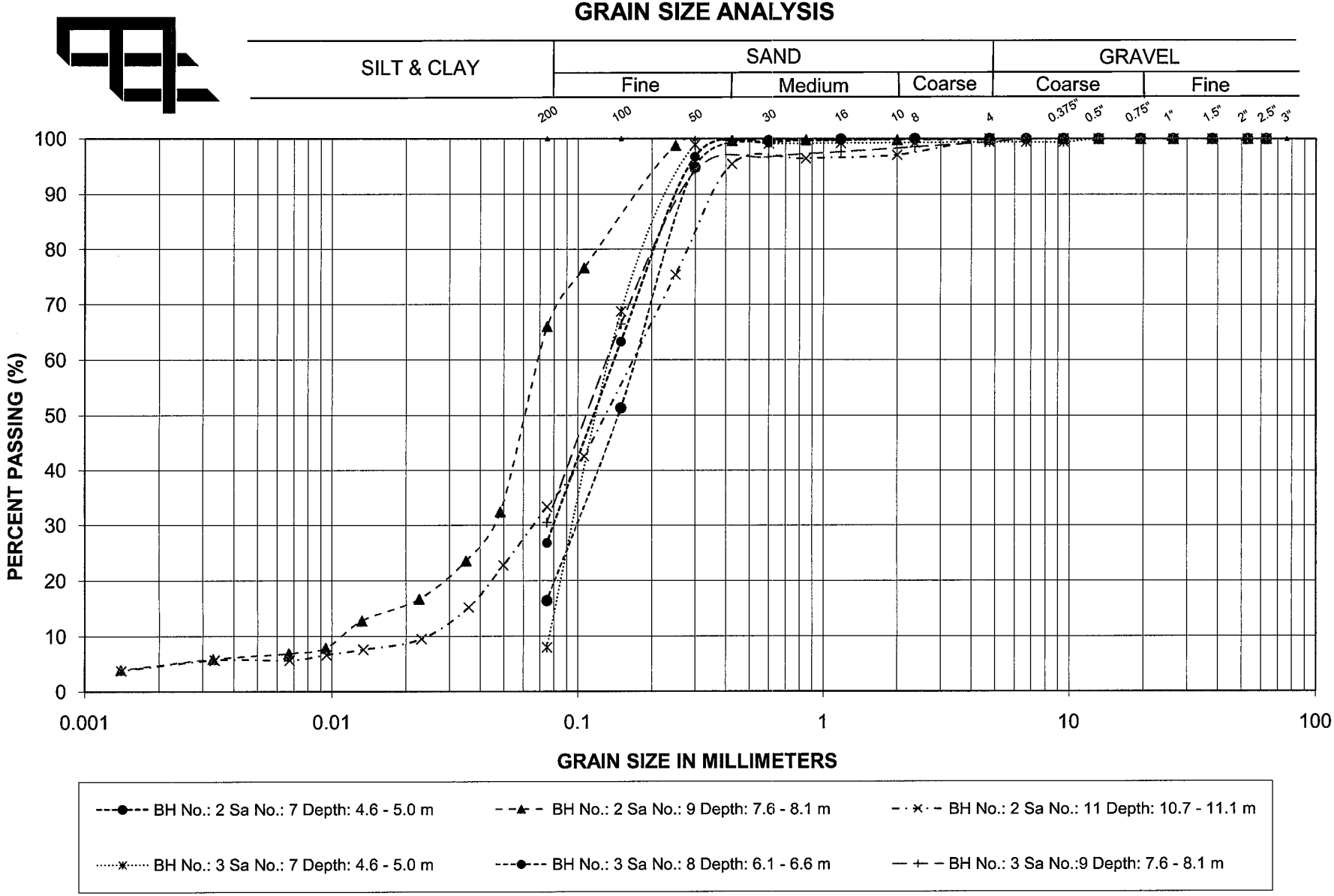
FINE SANDS - with varying silt content

MERLEX ENGINEERING LTD.

FIGURE L-3

Reference No.: 08094
Date: October 2009

GRAIN SIZE ANALYSIS



PROJECT: Site No. 47-002 - Englehart River Bridge
LOCATION: Highway No. 66

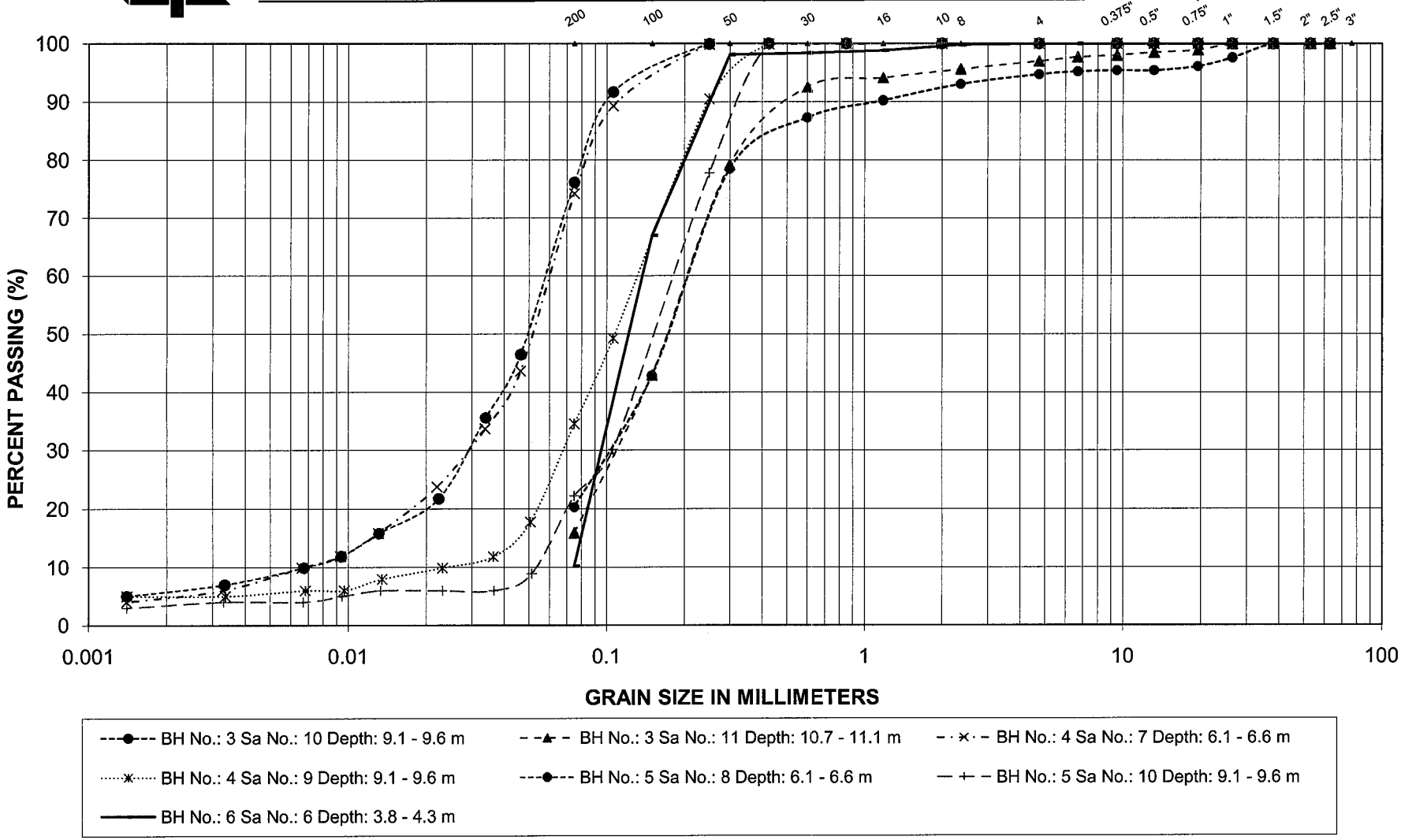
FINE SANDS - with varying silt content

MERLEX ENGINEERING LTD.

FIGURE L-4

Reference No.: 08094
Date: October 2009

GRAIN SIZE ANALYSIS



PROJECT: Site No. 47-002 - Englehart River Bridge
LOCATION: Highway No. 66

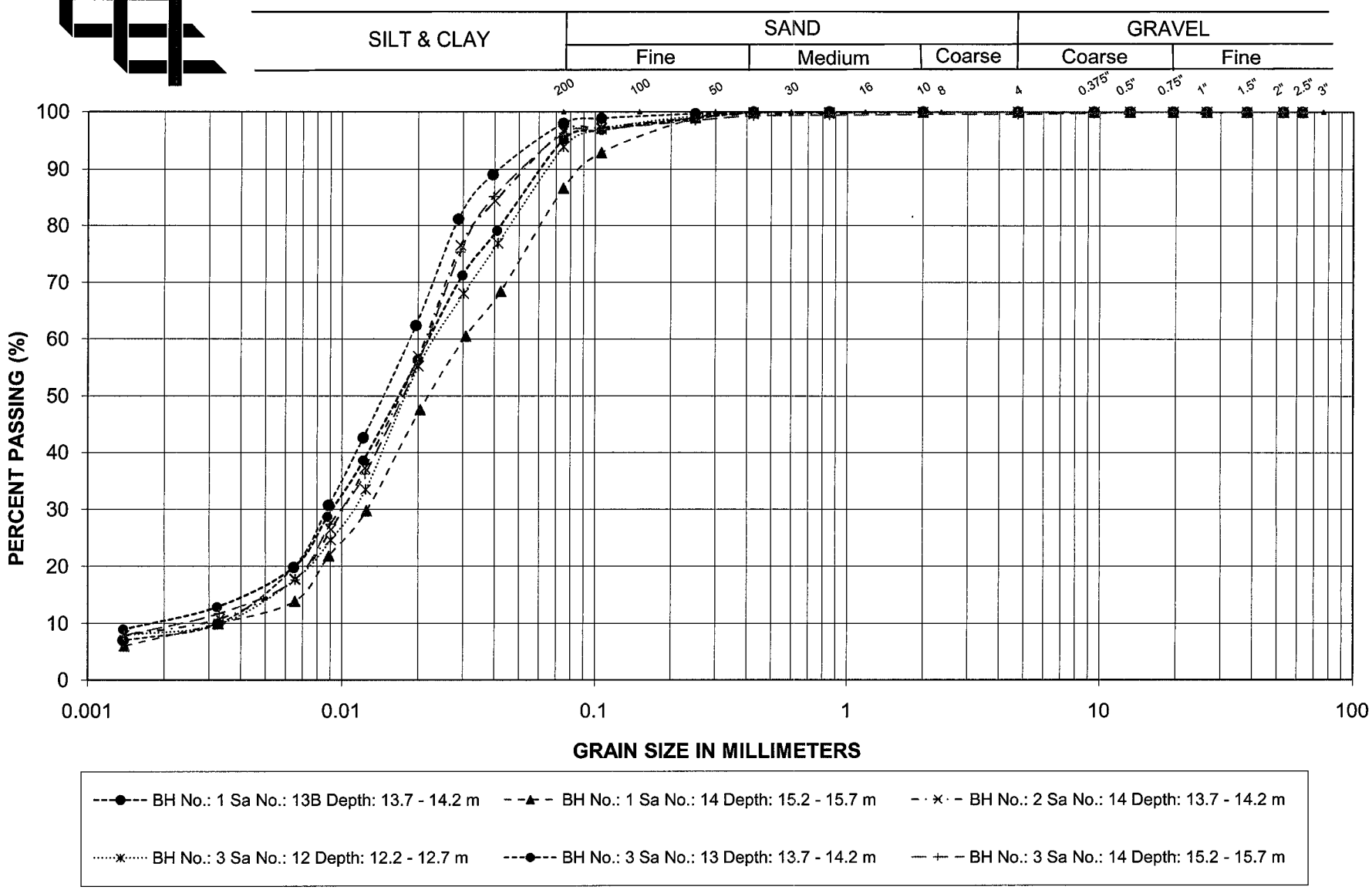
FINE SANDS - with varying silt content

MERLEX ENGINEERING LTD.

FIGURE L-5

Reference No.: 08094
Date: October 2009

GRAIN SIZE ANALYSIS



PROJECT: Site No. 47-002 - Englehart River Bridge
LOCATION: Highway No. 66

SILTS

MERLEX ENGINEERING LTD.

FIGURE L-6

APPENDIX D

Enclosure No. 8 Photo Essay

NSSP Special Provision - Obstructions During Installation of Roadway Protection

Enclosure No. 8

Left: Englehart Road Bridge, Hwy 66 Site 42-002, 1969 Right: Englehart River Bridge	Photos: 1 - 2

Left: Condition of abutment and precast girders. Right: 100 mm asphalt and 250 mm concrete approach slab cores at Borehole No. 3	Photos: 3 - 4

Reference No.: 08/07/08094 Project: Foundation Investigation and Design Report, Highway 66, Englehart River Bridge, Site No. 47-002, Highway 66, From 10.6 km East of Highway 65, Easterly 12.7 km, GWP 412-91-00	Provided By: MEL Date: August & September 2009

Coarse gravel and sand fill at Borehole No. 4.	Photo: 5

Reference No.: 08/07/08094	Provided By: MEL
Project: Foundation Investigation and Design Report, Highway 66, Englehart River Bridge, Site No. 47-002, Highway 66, From 10.6 km East of Highway 65, Easterly 12.7 km, GWP 412-91-00	Date: August & September 2009

BOULDERS/OBSTRUCTIONS DURING INSTALLATION OF PILES FOR ROADWAY PROTECTION SYSTEM- Item -------

Special Provision December 2009

The soils (approach fills) at the site may contain cobbles / boulders or other obstructions. Appropriate equipment and procedures will be required to penetrate obstructions (cobbles and boulders) which may be encountered during the driving of sheet piles.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION