Final Report for:

ENGLISH RIVER PROPERTY MANAGEMENT

GRASSWOOD WASTEWATER TREATMENT PLANT

GEOTECHNICAL EVALUATION

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Date: September 2, 2020
Project #: 7603-002-00

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Respectfully submitted,

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1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

This report presents the results of the geotechnical evaluation conducted by MPE Engineering Ltd. (MPE), for the proposed Wastewater Treatment Plant (WWTP) located north of Grasswood Rd and west of Hwy 11, on the English River First Nation land, south of the City of Saskatoon. The general site location is presented on Figure 1 (Appendix A). The objective of the work was to observe the general subsurface conditions and prepare geotechnical recommendations related to design and construction of the project.

1.2 PROJECT DETAILS

The overall scope of this project is the design and construction of a proposed WWTP that will meet the capacity and disposal needs for the proposed industrial and commercial development within the Grasswood Development. The proposed main building footprint is approximately 497 m^2 in plan. In addition to the main structure, a below grade holding tank and generator pad are to be constructed. Currently occupying the location of the main structure is a large clay fill stockpile.

The below grade components are expected to be constructed at multiple depths with the deepest up to approximately 6 m below the existing grade. Two options are being considered for the foundation of the main WWTP structure:

- Option 1 – Construct the building at grade with no below grade components. The foundation would be a structurally supported slab supported by a deep foundation.
- Option 2 – Construct the building with a below grade component that is 5.5 m below final ground surface. The foundation would be a structural raft foundation supported on partially pre-consolidated high plastic clay.

1.3 SCOPE OF WORK

The scope of work for this evaluation included three components: A field program comprised of three (3) boreholes, testing of recovered soil samples in MPE's laboratory, and engineering analysis/reporting. This report presents the results of the field and laboratory work and provides recommendations for the design and construction of the proposed development.

2.0 FIELD INVESTIGATION

On March 19th and 20th, 2020, the project field program was carried out using a truck mounted drill rig contracted from Mobile Augers and Research, from Saskatoon. The drill rig was equipped with solid stem continuous-flight augers. Soil samples were retrieved at intervals of approximately 0.6 m. The soil was classified and logged by MPE's field representative, Mr. Brett Tataryn, Geotechnical Technologist. Standard Penetration Testing was generally performed at regular intervals of 1.5 m, unless otherwise noted on the logs. Upon completion of the geotechnical drilling, Mr. Tataryn completed a visual site reconnaissance of the development area to assess geotechnical aspects of the site. Water levels were measured in each of the boreholes 1 week following completion of the drilling.

The site is illustrated in Figure 1, with borehole locations shown. The borehole locations were selected by MPE based on the conceptual site plan. Borehole locations were obtained from handheld GPS with an accuracy of ± 4 m.

Laboratory testing was conducted on the soil samples to aid in the determination of engineering properties. Testing included natural moisture content, Atterberg Limits, standard proctor, and water-soluble sulphate content. The test results are summarized in the borehole logs (Appendix B) and are attached in Appendix C.

3.0 SITE CONDITIONS

3.1 SITE DESCRIPTION

The following is a summary of the surface conditions observed during the site reconnaissance. The area within the proposed WWTP building footprint is currently occupied by a clay fill stockpile up to approximately 6 m thick. The area directly south and east of the proposed structure is comprised of native grasses, shrubs, and deciduous trees. To the west and north is a natural drainage slough. The drainage in the structure footprint area is generally flat to sloping slightly northwest, towards the slough.

3.2 LOCAL GEOLOGY

MPE reviewed surface geology mapping published by the Saskatchewan Geological Survey (SGS). According to the Surficial Geology Map of Saskatchewan, the site's surficial geology is classified as Eolian (hummocky) deposits, bordered to the north by Glaciolacustrine Plain deposits. SGS defines these deposits as follows:

> **Eolian (hummocky) Deposits:** "Fine- and medium-grained sand and silt reworked by wind to form undulating and rolling topography."
>
> **Glaciolacustrine Plain Deposits:** "Sand, silt, and clay accumulations deposited in glacial lakes."

3.3 SOIL STRATIGRAPHY

The soil conditions at the site were generally comprised of stockpiled clay fill, underlain silt, clay, and clay till. Clay fill was observed in each of the boreholes to depths ranging from 1.2 m to 6.5 m, as the boreholes were situated on a large clay fill stockpile. Beneath the clay fill stockpile, there was the native clay layer that extended to the clay till. The clay till, which was observed in boreholes 20BH002 and 20BH003, extended to borehole termination. A summary of the soil layers encountered is provided below.

It should be noted that layers of sand and topsoil were located 0.0 m to 1.5m above native soil in the stockpile. Pockets of sand and topsoil should be expected to be encountered in some of the site excavations near the surface during this project.

For consistency and brevity, it should be understood that all depths are below existing ground surface and all elevations are metres above mean sea level, unless otherwise stated. For a more detailed view of the soil conditions, refer to the borehole logs attached in Appendix B. A description of the terms and symbols used in the borehole logs is also included in Appendix B.

3.3.1 Stockpile Clay Fill

Clay fill was encountered above the native soil in all boreholes in stockpile formation. The clay fill was generally silty, sandy with trace gravel, moist, low to medium plastic, very stiff, and dark brown. Organic material, sand seams, and topsoil were observed in the bottom 1.5 m of the clay fill stockpile.

Moisture contents taken from clay fill samples ranged between 11% and 18%. The average of two Standard Penetration Tests within the clay fill indicated an ‘N’ value of 27 per 300 mm of penetration, indicative of very stiff consistency. Atterberg Limits testing one clay fill sample indicated a Liquid Limit of 26% and a Plastic Limit of 14%, indicative of low plasticity.

3.3.2 Silt

Silt was encountered beneath the fill in all boreholes and extended to depths of 8.5 m and 8.0 m in boreholes 20BH001 and 20BH002, respectively, and to a depth of 2.5 m in borehole 20BH003. The silt was generally clayey, sandy, very moist, firm, low plastic, light brown to orange, and contained trace oxide staining.

Moisture contents taken from silt samples ranged between 24% and 31%. Standard Penetration Testing within the silt till indicated ‘N’ values between 6 to 11 blows per 300 mm of penetration, indicative of firm to stiff consistency. Atterberg Limits testing of one silt sample indicated a Liquid Limit of 29% and a Plastic Limit of 24%, indicative of low plasticity.

3.3.3 High Plastic Clay

Clay was encountered beneath the fill in all boreholes and extended to a depth of 21.8 m and 16.5 m in boreholes 20BH002 and 20BH003, respectively, and to the end of borehole in 20BH001. The clay was generally silty, sandy, laminated, moist to very moist, low becoming high plastic, firm to stiff, brown, and contained trace sulphate crystals 5 mm – 25 mm in size.

Moisture contents taken from clay samples ranged between 30% and 40%. Standard Penetration Testing within the clay till indicated ‘N’ values between 5 to 12 blows per 300 mm of penetration, indicative of firm to stiff consistency.

3.3.4 Clay Till

Clay till was encountered beneath the clay in boreholes 20BH002 and 20BH003 and extended to borehole termination depth. The clay till was generally silty, sandy, trace gravel, moist, hard, medium plastic, and grey.

Moisture contents taken from clay till samples ranged between 12% and 15%. Standard Penetration Testing within the clay till indicated ‘N’ values of 21 and 33 blows per 300 mm of penetration, indicative of very stiff to hard consistency.

3.4 GROUNDWATER CONDITIONS

At the time of drilling, borehole closure was encountered in 20BH001 and 20BH002, caused by saturated high plastic material. Seepage occurred in 20BH003 at a depth of approximately 11.3 m. Groundwater readings taken on March 27th, 2020, are summarized in Table A.

Table A – Groundwater Elevation – Measured March 27, 2020

Borehole Locations	Depth of Standpipe (m)	Seepage (m)	Sloughing (m)	Elevation of Borehole (m)	Groundwater Elevation (m)	
					March 27, 2020	May 15, 2020
20BH001	17.2	none	10.0	513.10	506.30	506.80
20BH002[1]	-	-	-	513.07	-	-
20BH003	17.2	none	7.6	508.77	506.15	-
BH112[2]	3.8	0.5	1.0	508.30	506.39	-

[1] No piezometer installed in 20BH002.

[2] BH112 installed by Clifton Associates in May 2016.

Groundwater levels are expected to fluctuate seasonally and in response to climatic conditions. The water level in the pond to the northwest of the site is expected to affect groundwater levels. The elevation of the pond water level is within centimetres of the groundwater level in the boreholes suggesting that they are hydraulically connected. If groundwater conditions encountered during construction are observed to be drastically different from this report, MPE should be notified so that the implications of the changes can be reviewed.

It should be noted that the standpipes installed for this project were left in place for further readings to be taken prior to construction. These standpipes should be suitably decommissioned by the contractor during construction.

4.0 RECOMMENDATIONS

The site is generally suitable for the proposed WWTP; however, the following will need to be considered:

- The clay fill stockpile occupying the area will either need to be moved prior to construction or a new site will need to be selected.
- Water soluble sulphate present in the soil will dictate the use of an S1 exposure class for concrete in contact with soil.
- Low strength clay extending to a considerable depth will increase the overall foundation costs.
- Buried topsoil and silt soils within frost depth make surfacing the site costly. A gravel surfacing structure is recommended.
- A layer of silt, potentially hydraulically connected to the adjacent pond, will likely increase the care of water for any below grade excavations.

Detailed recommendations are provided in the following subsections. It should be noted that recommendations provided in this report are based on assumed stratigraphy between and surrounding the three discrete borehole locations. An adequate field review should be completed during construction to confirm these assumptions. Recommendations and design parameters presented herein are provided on the assumption that MPE will be retained to provide engineering design review and construction supervision. MPE takes no liability for work performed where MPE is not retained to provide adequate construction supervision services. Construction supervision should include:

- Inspection of bearing surfaces for shallow foundations.
- Full-time monitoring of pile foundation construction.

- Full-time monitoring and compaction testing for earthworks.
- Strength testing for concrete.

4.1 FOUNDATION DESIGN

Shallow foundations are recommended as the preferred foundation for the building, given the depth of firm soils at the site and equipment loading within the building. The shallow foundations can be founded on the partially pre-consolidated high plastic clay layer; however, careful planning and design will be required to be successful. Alternatively, a structural slab supported by a deep foundation system could be used to support the structure. Recommendations for CFA have been provided as the recommended deep foundation for Option 1, optional recommendations have been provided for helical piles.

4.1.1 Limit States Design

Under the Limit States Design methodology, foundation design must consider both the Ultimate Limit State (ULS) as well as the Serviceability Limit State (SLS). All foundations must be designed in accordance with the National Building Code (NBC). For ULS design, soil resistance factors should be applied to the ultimate soil capacity in order to obtain the factored soil capacity. Soil resistance factors, as provided in the NBC and in the Canadian Foundation Engineering Manual 2006 (CFEM), are summarized in Table B.

Table B – Soil Resistance Factors

Ultimate Limit State		Soil Resistance Factor
Shallow Foundations	Bearing Resistance	0.5
	Passive Resistance	0.5
	Sliding Resistance	0.8
Deep Foundations Axial Compressive Capacity	From Semi-Empirical Analysis	0.4
	From Dynamic Monitoring	0.5
	From Static Load Test Results	0.6
Deep Foundations Axial Uplift Capacity	From Semi-Empirical Analysis	0.3
	From Static Load Test Results	0.4
Deep Foundations Lateral Capacity	From Semi-Empirical Analysis	0.5

For SLS design, the load-settlement behaviour of the foundation must be analyzed. Comments on foundation settlement for SLS design are provided in Section 4.1.4. **For this project, the SLS limit states for shallow foundations will govern.**

4.1.2 Shallow Foundations

Shallow foundations are presented as the preferred foundation type for the structure, forming the basis of Option 2. However, this will require careful planning to be successful. Shallow foundations must be placed on natural, firm high plastic clay only, at an approximate elevation of 454.0 ± 0.5 m in the area of the building expansion. A key component of this option is that the foundation is placed within the footprint of the existing site stockpile. The surcharge provided by the preload of the stockpile allows for an increased SLS below the building. It should be noted that the pile has been assumed to be in place for at least 5 years with the approximate shape and depth in the area of the structure. Satellite imagery does suggest that the pile has been at this location for that time period. If the building location is moved, additional borehole exploration may be required.

Any fill, deleterious matter, or soft natural soil that does not meet the design bearing capacity must be completely removed at the time of excavation and replaced with lean mix concrete. As an alternative to replacing with lean mix concrete, the bearing surface may be lowered to more suitable natural soil. The final excavation of the bearing surface should be completed using a smooth trimming bucket and all loose material should be removed from the surface prior to the inspection. The bearing surface should not be allowed to freeze, become desiccated, or saturated at any point during construction. It is considered vital that a perimeter dewatering system be in place, prior to the final excavation of the bearing surface. Water should not be allowed to sit on the bearing surface for any length of time. If any high plastic clay is allowed to become saturated, the surface shall be remediated to the satisfaction of the Geotechnical Engineer.

MPE should be retained to inspect the exposed bearing surface at the time of excavation. Upon positive inspection, a 50 mm thick concrete mudslab should be placed immediately. The intent of the mudslab is to protect the bearing surface from disturbance/deterioration when subjected to construction activity (rebar, forms, and concrete placement). The mudslab will also help seal off small amounts of groundwater seepage. **The mudslab is considered essential and must be placed immediately after excavation. Excavation to final bearing elevation should not proceed until concrete, support equipment/crew, and MPE inspector are on site.** The Contractor may complete the bearing surface excavation in up to three sections, as long as each section meets the above requirements. **Delays in mudslab placement may be grounds for rejection of the bearing surface** if it becomes weathered or disturbed. Rejection will be at the discretion of the Geotechnical Engineer. A protective temporary layer of native soil of at least 300 mm should be left over the bearing surface until final bearing surface excavation.

The net static bearing capacity of the native soil at an elevation of 504.0 ± 0.5 m may be taken as 510 kPa (ultimate). Factoring is required, as discussed in Section 4.1.1. The bearing capacity is based primarily on SPT correlations and laboratory test results. This assumes a slab dimension of approximately 10 m by 20 m. The above estimated ultimate capacity is intended to provide an estimate for planning and will vary depending on the size, stiffness and orientation of the shallow foundation structure. An updated bearing capacity can be prepared once the preferred foundation structure is determined. The use of a SLS bearing capacity of less than 110 kPa should limit total settlement of the structure to less than 25 mm, see Section 4.1.5. Hydrostatic uplift of at least 30 kPa should be considered when designing the slab. For frost protection, the minimum depth of the bearing surface is 3.1 m and must be measured from bottom of footing to finished ground level. However, shallow foundations are anticipated to be founded well below the frost line. See Section 4.6 on frost protection.

4.1.2.1 THICKENED EDGE RAFT (MAT) FOUNDATIONS

Raft foundations are considered flexible, shallow foundations and have additional requirements over strip or spread footings. The modulus of subgrade reaction is a relationship between soil pressure and deflection used in structural analysis of flexible foundations. The following equation can provide an estimate for the modulus of subgrade reaction:

$$k_{s} = 40\ (q_{ult})$$

For this project, a k_s of 4000 kN/m^3 should be used.

The formula assumes that the settlement at the ultimate soil pressure is 25 mm and that the structural member stiffness is 10 or more times greater than the soil stiffness (Bowles 1997). K_s is a parameter of soil structure interaction and is not a unique fundamental soil property. As such, it is recommended that sensitivity analysis be completed for the estimated K_s over a wide range of values.

4.1.3 Deep Foundations

Continuous flight auger CFA piles are presented as the preferred deep foundation type for Option 1. Bored cast-in-place piles are presented as a potential foundation type for the proposed development, however; a risk of seepage and sloughing exists and therefore may require casing. Helical pile parameters are not provided and are not recommended as the preferred deep foundation option for this development. The strength of helical piles decreases with depth, and the bearing surface bears high plastic clay. Recommendations for individual deep foundation types are provided in the following section.

4.1.3.1 BORED CONTINUOUS-FLIGHT-AUGER PILES

If a structural slab is selected for the WWTP building, bored CFA piles are the preferred deep foundation type. Bored CFA concrete piles may be designed on the basis of shaft friction and end bearing. Due to the specialized nature of CFA piles, the pile design is to be completed by the piling contractor and MPE will review the proposed design prior to construction. Preliminary geotechnical design parameters are provided for bored CFA concrete piles in Table C below.

Table C – Preliminary CFA Pile Parameters

Depth Interval (MASL)	Ultimate Shaft Friction (kPa)	Ultimate Bearing Capacity (kPa)
Clay Fill & Overburden (above 504.5)	0	0
High Plastic Clay (505.0 – 491.5)	40	350
Clay Till (below 491.5)	70	1300

Design and construction of bored CFA concrete piles should adhere to the following general recommendations:

- The minimum pile length is 9.0 m; however, pile uplift due to frost should be considered when calculating minimum pile lengths. The minimum pile diameter is 0.4 m.
- Friction should be neglected for any portion of the shaft placed within existing or planned fill materials.

- Piles should be spaced no closer than 2.5 times the base diameter, measured center to center. Where piles are spaced closer than this, overlapping stresses must be considered.
- Full time pressure monitoring and reporting of concrete injection pressure and auger torque is required.
- If CFA piles are selected to support a structural slab of the WWTP building, a minimum of two full scale pile PDA load tests are to be supplied by the piling contractor. The contractor will be responsible for proposing the test pile locations, installing the piles, obtaining third party PDA testing, and providing the PDA test report as well as the updated design. MPE will review and approve the testing plan, as well as the updated design. MPE will accept a GRF of 0.5, for the final design on the basis that the testing program provided by the contractor is successful; however, the contractor should not assume this efficiency. Any designs that have skin friction or bearing values grater than those provided above or with a GRF of greater than 0.4 are at the contractor's risk.

4.1.3.2 BORED CAST IN PLACE PILES

Bored CIP piles are an alternative deep foundation for supporting the generator pad for Option 2. Bored CIP concrete piles may be designed on the basis of shaft friction or end bearing. End bearing should only be included if means are available to clean the pile base of any loose soil prior to placing concrete. Geotechnical design parameters are provided for bored CIP concrete piles in Table D below.

Table D – Bored Cast in Place Pile Parameters

Depth Interval (m)	Ultimate Shaft Friction (kPa)	Ultimate Bearing Capacity (kPa)
Clay Fill & Overburden (above 504.5)	0	0
High Plastic Clay (505.0 – 491.5)	25	260
Clay Till (below 491.5)	60	1200

Design and construction of bored CIP concrete piles should adhere to the following general recommendations:

- The minimum pile length is 9.0 m, however, pile uplift due to frost should be considered when calculating minimum pile lengths.
- The minimum pile diameter is 0.4 m for straight shaft friction piles, and 0.76 m for end bearing piles.
- Friction should be neglected for any portion of the shaft placed within fill materials.
- End bearing should only be considered in design if facilities are available for cleaning the pile base.
- Piles should be spaced no closer than 2.5 times the base diameter, measured center to center. Where piles are spaced closer than this, overlapping stresses must be considered.
- The minimum ratio of depth of cover versus the base diameter (D/B) is 2.5.
- Full length reinforcing is required for piles subject to uplift loading.
- Seepage and sloughing conditions should be expected between elevations of 503.00 m and 505.00 m. The Contractor should make their own estimation of casing requirements, but casing should be on hand before construction begins. The use of casing within weak clay layers is

expected to be difficult.

The piles shall be constructed to dimensions indicated on the pile drawings. The pile tips shall be free of loose material, and water greater than 50mm in depth. If loose material or water is present in the pile base, the piling contractor is to remove it to the satisfaction of the Geotechnical Engineer. The piling contractor may tremie concrete into friction piles if the pile base can be confirmed to be free of loose material. If any pile is not constructed to the satisfaction of the Engineer, the pile may be rejected.

4.1.4 Foundation Settlement – Serviceability Limit State

Foundations designed and constructed according to the recommendations in this report are expected to undergo settlement within typical limits. An estimate for shallow foundation settlement is anticipated to be within 25 mm total settlement and 15 mm differential. Using a SLS bearing capacity for the WWTP structure of less than 110 kPa, would see settlements less than 25 mm**.** However, this estimate, like the bearing capacity, is dependent on the elevation and location of the foundation as well as loading conditions. If a serviceability bearing capacity of greater than 110 kPa is required, additional detailed analysis or sampling can be completed to refine the consolidation relationship of the deep firm high plastic clay.

Deep foundations designed on the basis of shaft resistance only should experience 5 mm to 10 mm of settlement. Deep foundations designed on the basis of end bearing or a combination of end bearing and shaft resistance should be within 10 mm to 15 mm of settlement.

MPE can provide a detailed settlement analysis during the design stage once loads and foundation type have been determined.

4.2 STRUCTURALLY SUPPORTED SLABS

Structurally supported slabs are recommended for the generator pad and may be used for the WWTP structure. The following are recommendations for preparation of the structural slab:

- Subgrade prep and leveling graded to prevent ponding.
- Installation of a 150 mm thick void form on the subgrade for temporary support of the floor slab. Installation of the void form should be according to the manufacturer’s specifications. Care should be taken to select a void form with adequate temporary strength to support the fresh concrete and slab while curing.
- A continuous sheet of 6 mil thick (minimum) polyethylene vapor barrier should be placed between the void form and the bottom of the slab.
- Penetrations through the structurally supported slabs should be separated from the slab to allow for independent movement of utilities as the ground moves below the floor system.

4.3 EXTERIOR SLABS-ON-GRADE

Exterior grade supported concrete slabs are not recommended for this development. If used, they will require careful subgrade preparation to reduce the risks of excessive differential movement.

Grade supported floor slabs are not intended to be used as foundations for heavy equipment or machinery. Heavy equipment or machinery should be supported by independent foundations on structurally supported floors or raft foundations. The recommendations provided in this section are intended to reduce floor movement to within acceptable limits; however, the amount of differential movement due to changes in the moisture profile or frost movements are difficult to quantify. The final performance of the floor slab is primarily a function of subgrade materials, good construction, and proper care of water during and after construction.

The near surface native soils are considered poor subgrade material. If slabs on grade are to be constructed, quality low to medium plastic cohesive or granular backfill below the subgrade to a depth of at least 1.0 m below the slab-on-grade is recommended. Uniformity of lift thickness, moisture, and compaction is essential. A minimum 300 mm thick base layer of crushed granular structural fill is recommended directly beneath all slabs-on-grade.

4.4 EARTHWORKS

4.4.1 Site preparation

Any vegetation, topsoil, concrete, granular layers, and deleterious matter should be removed prior to earth excavation or site preparation. The contractor should complete site stripping and removal of waste in such a way as to limit mixing into existing site soils.

4.4.2 Fill Materials and Compaction

The stockpiled clay fill currently occupying the proposed structure location is considered suitable for use as general engineered fill. It should be noted that the bottom 2 m of the stockpile in contact with the native soil contains variable contents of topsoil, sand, and low plastic silt. This material should be stripped and replaced with more consistent stockpiled clay fill. General engineered fill should be moisture conditioned to -1% of Optimum Moisture Content (OMC) to 2% above OMC and compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD), unless otherwise stipulated in this report. A Sample of the stockpiled clay fill was tested and the SPMDD was found to be 1880 kg/m^3 at 13.0% moisture and the testing report can be found in Appendix C.

Existing site clay fill, mixed with organic material that is greater than approximately 5% by mass, should be stockpiled separately from general engineered fill and only used for landscape fill. The native clay below the clay fill and silt has some natural moisture contents in excess of 40%. Moisture conditioning of this material will likely be required and may be difficult without exceptional drying conditions.

Loose fill should be placed in uniform lifts no thicker than 200 mm and 150 mm for general engineered fill and granular base course, respectively. Moisture conditioning should be expected; however, the Contractor must make their own estimation of moisture conditioning requirements. Granular fill and imported cohesive backfill, should be tested for suitability by MPE prior to arriving on site.

4.4.3 Subgrade Preparation

Subgrade preparation should be completed for all grade supported structures including slabs-on-grade, gravel pavements, aprons, etc. MPE recommends that, following stripping and any excavation, the original ground subgrade should be assessed by means of a proof roll to determine the best course of action for subgrade work. As a minimum, the required depth of subgrade preparation is 300 mm in all areas, unless otherwise stated in this report.

Subgrade preparation should consist of scarification of the original ground surface using appropriate equipment in such a way as to achieve thorough mixing of surface materials. After scarification is completed the mixed material should be moisture conditioned to the general engineered fill specification in Section 4.4.2. After acceptance of the original ground subgrade, general engineered fill should be placed to bring the subgrade to the design elevation.

The design subgrade surface below slabs-on-grade or surfaced areas should be proof rolled using a single axle truck loaded to give 8,200 kg on the rear axle in order to identify any soft areas that require additional work. Soft areas may need to be subcut and replaced with better quality material or reinforced with geo-synthetics. This should be a field determination at the time of construction. Care must be taken during construction to protect the design subgrade surface from weathering or disturbance. If the prepared surface becomes wetted, desiccated, or disturbed from construction traffic, the upper 150 mm at a minimum should be scarified, moisture conditioned, and compacted to the required standard.

A uniformly smooth design subgrade surface should be prepared for the gravel pavement areas containing no ruts, potholes, sheep foot dimples, loose soils, or any imperfections that can retain water on the surface. The design subgrade should be sloped at a minimum of 2% to facilitate drainage of the granular surfacing material.

4.4.4 Site Grading and Drainage

The site should be graded to avoid any ponding of water next to buildings, foundations, and grade supported structures such as sidewalks or pavement. Landscaped areas around the perimeter of buildings should have a minimum 5% slope away from the building. Hard surfaced perimeter aprons and/or sidewalks should have a minimum 2% slope away from the building. Gravel surfaced areas should have grades of no less than 2% to minimize ponding and should be directed to ditches or natural drainage away from the development. Roof drains should have a discharge located a minimum of 2 m away from the building.

4.4.5 Excavation and Backfill

The following recommendations notwithstanding, excavations should be carried out in accordance with Saskatchewan Occupational Health and Safety Regulations. The responsibility of all excavation cutslopes resides with the Contractor, who should take into consideration site-specific conditions regarding soil stratigraphy, groundwater, and precipitation events. All excavations should be reviewed by the Contractor prior to personnel working within the excavation.

Excavation for this project is assumed to be up to 6 m in depth. Excavated side slopes completed in firm clay, clay fill, or saturated silt should be cut back to at least 3H:1V (TYPE 4); however, flatter sideslopes may be required based on encountered conditions such as saturated sand pockets. Some sections where the clay is described as stiff may allow for steeper excavations up to 1H:1V (TYPE 3). However, this decision should be made by an experienced Contractor representative prior to worker entry.

Excavation depths for this development are expected to be below the groundwater table and seepage should be anticipated. The Contractor should have dewatering equipment on site prior to making any excavation and should be prepared to dewater. A ~2 m thick partially saturated silt layer overlies the high plastic clay. The Contractor should expect that **this layer will require special attention and planning by the Contractor for Care of Water and Excavation**. The contractor should consider both seepage and potential soil loss from the bank. A temporary granular filter may be required to prevent soil loss. This unit is expected to be hydraulically connected to the waterbody to the northwest. Seepage should be directed to sumps for removal from the excavation if open dewatering is selected by the contractor. It may be prudent to consult a specialized dewatering/care of water contractor to plan this work. In general, it is the responsibility of the Contractor to consider drainage of the construction excavation to prevent saturation subgrades or bearing surface and to control water entering the excavation.

Temporary spill piles and mobile equipment should be kept at least 3.0 m away from excavations. Backfill of excavations should be placed in uniform lifts not exceeding 200 mm of compacted thickness. Thinner lifts may be required to achieve compaction. Excavation backfill may consist of general engineered fill or lean concrete. Uniform excavation side slopes are important to avoid an abrupt transition from backfill to native soil, which may cause differential settlement at ground surface.

Backfill is not recommended in below freezing temperatures. If backfilling does occur in freezing temperatures, the contractor is to ensure that backfill is not compacted on frozen subgrades and the no frozen material is incorporated into the fill.

4.5 LATERAL EARTH PRESSURES

Lateral earth pressures for below grade structures may be calculated on the assumption of a triangular pressure distribution. For design of below grade walls where the top of the wall will be braced, the at-rest pressure may be assumed. For unbraced walls, the active condition could be considered. Drainage may be installed on the exterior of the wall to prevent buildup of hydrostatic pressure. The following formula may be used to calculate the lateral earth pressure for the at-rest condition:

$$Po = K_o(\gamma H+q) + \gamma_w H_w$$

Where:

- K_o = Coefficient of at-rest earth pressure = 0.6 for high plastic clay
- γ = Bulk unit weight of backfill soil = 17.5 kN/m^3 for high plastic clay
- H = Height of the soil acting on the wall in meters.
- q = Surcharge pressure at ground level in kPa.
- γ_w = 9.81 kN/m^3 (unit weight of water)
- H_w = water head adjacent to wall

As expressed above, the formula includes hydrostatic pressure applied to the below grade structure. In order to eliminate the hydrostatic pressure, the soil adjacent to the below grade structure must be fully drained. Fully drained soil can be achieved through the installation of clean granular backfill adjacent to the exterior underground walls leading to a weeping tile system at the bottom of the foundation. The weeping tile drainage system around the perimeter of all shallow foundations would also have the added benefit of maintaining a relatively consistent moisture profile of the bearing soils and reduce risk of excessive foundation movements. Drainage systems other than granular backfill may also be suitable, such as a drain board waterproofing system. To limit water infiltration from the surface, the upper 600 mm of fill adjacent to the structure should consist of cohesive general engineered fill.

4.6 FROST PROTECTION

The maximum seasonal frost penetration depth was calculated for the near-surface soils using the procedure described in the Canadian Foundation Engineering Manual (CFEM). A mean freezing index of 1,900°C days was used for the site. The maximum seasonal frost penetration depth is estimated to be approximately 2.8 m below final ground surface. The estimated frost penetration depth assumes a uniform soil type with asphalt surfacing or bare ground and without snow cover. The minimum depth for shallow foundations in heated buildings is 1.8 m, for unheated buildings a minimum depth of 2.8 m would be required.

Frost protection of bearing surfaces and piles should be considered during winter construction. If areas such as interior slabs on grade, footings, and piles are exposed to freezing conditions during construction, frost heave or jacking may be encountered. Frost protection of all bearing surfaces and piles is required by the Contractor until backfill has been completed and the building supported by the foundation is heated. Insulated tarps and hording may be required; however, the Contractor must make their own estimation of heating and hording requirements.

Cast-in-place piles exposed to frost action should be checked against frost jacking caused by adhesion forces. For concrete cast-in-place piles, adfreeze bond stress of 65 kPa should be applied to the depth of pile exposed to frost action.

Rigid insulation may be used to provide frost protection equivalent to the required soil cover. Insulation used for frost protection should be placed at a minimum depth of 0.6 m below the finished ground surface. The top 0.6 m of backfill (i.e. above the insulation) should be ignored for equivalent frost penetration calculation purposes. The insulation should be sloped away from the structure to facilitate drainage and continue vertically up the exterior of the structure.

Pipes that are susceptible to freezing conditions should be installed at a depth of 2.8 m below final ground surface or greater. Insulation would be required to provide equivalent frost protection for shallower pipes. Insulation should be designed and installed according to the manufacturer’s recommendations. Buoyancy may need to be considered for insulation below the groundwater surface.

4.7 CONCRETE TYPE

Based on a soluble sulphate content test result of 3.31% obtained from soil samples in the building footprint and visible sulphate minerals within the samples, concrete elements in contact with soil and/or groundwater should have an S-1 exposure classification, as defined by CSA A23.1-14 Table 3, for very severe sulphate exposure. Cement type for this exposure classification includes HS, HSb, HSlb, and HSe. In accordance with CSA A23.1-14 Table 2, concrete with an S-1 exposure classification should have a maximum water/cementitious materials ratio of 0.40 and a minimum compressive strength of 35 MPa at 56 days. The air content should be based on the appropriate air content category for the corresponding nominal maximum aggregate size, as per CSA A23.1-14 Table 4.

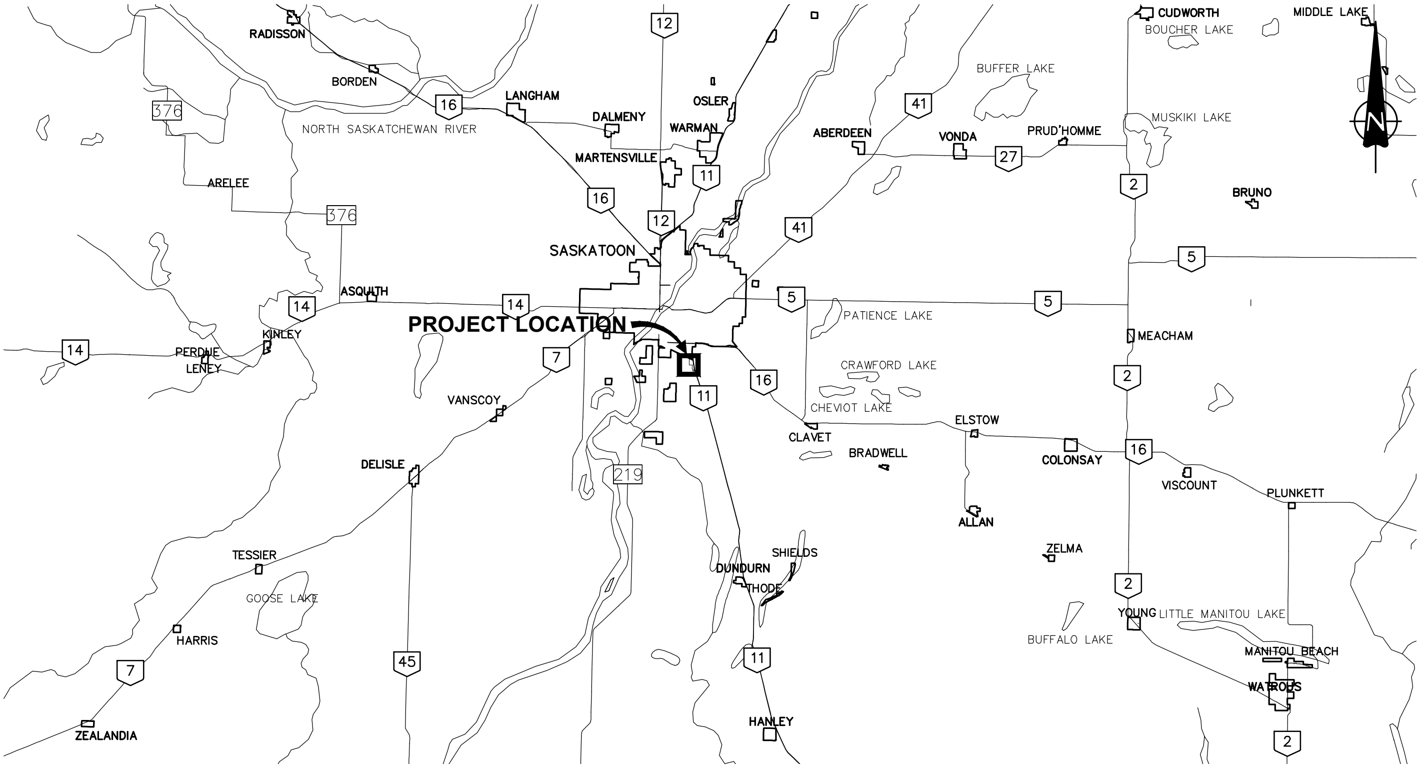
Additional factors such as structural loading or other exposure conditions should be considered when selecting concrete mix and strength requirements. Further recommendations regarding concrete materials can be found in CSA A23.1-14. The Soluble sulphate laboratory test result is included in Appendix C.

4.8 SEISMIC SITE CLASSIFICATION

The Seismic Site Response, according to Table 4.8.1.4.A of the National Building Code (2014), is Classification E, Soft Soil. The classification is based on average soil properties in the upper 30 m of soil.

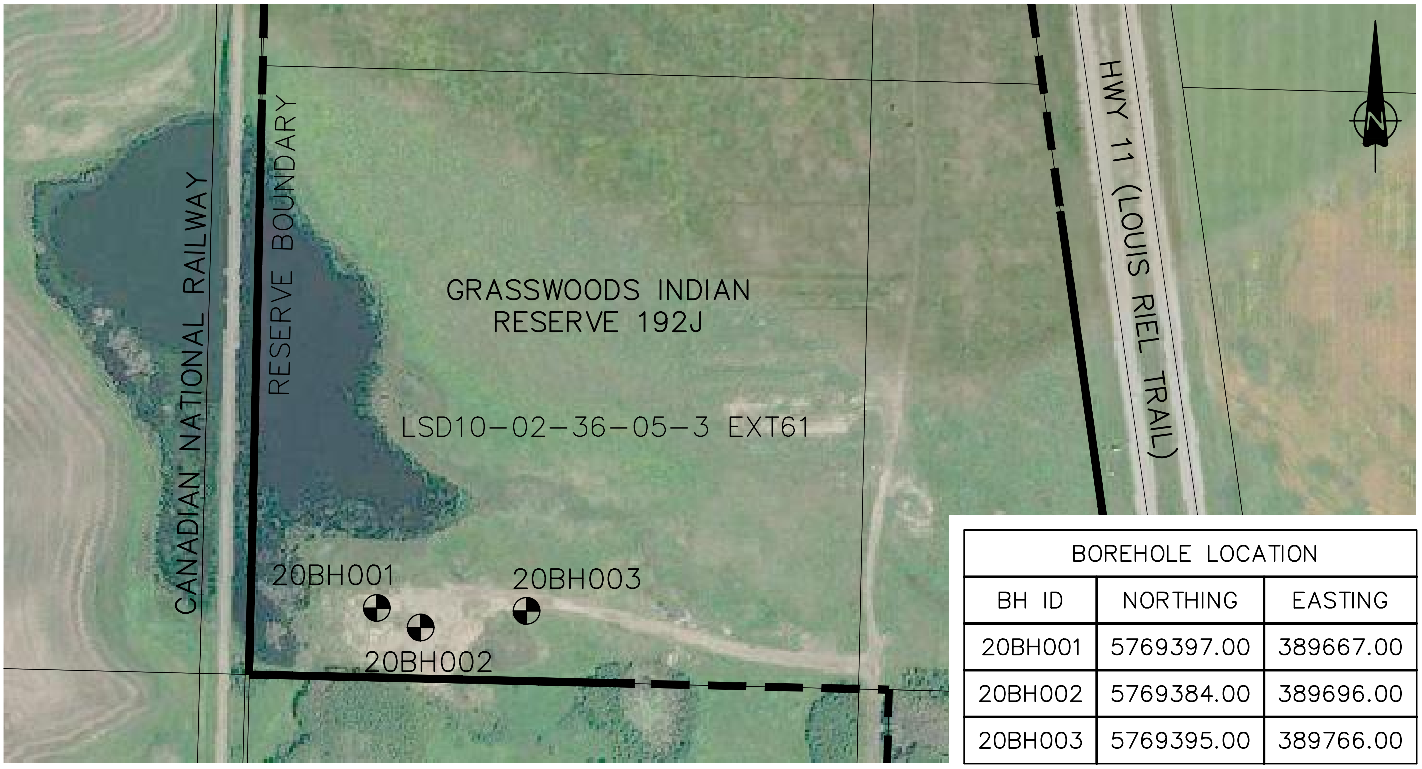
APPENDIX A:

FIGURES



LOCATION PLAN

1:1000000



BOREHOLE LOCATION		
BH ID	NORTHING	EASTING
20BH001	5769397.00	389667.00
20BH002	5769384.00	389696.00
20BH003	5769395.00	389766.00

SITE PLAN

1:10000

MPE
Engineering Ltd.

ENGLISH RIVER PROPERTY MANAGEMENT

WASTEWATER TREATMENT PLANT
BORHOLE LOCATION PLAN

SCALE: AS SHOWN

DATE: MAY 2020

JOB: 7603-002-00

FIGURE 1.1

APPENDIX B:

BOREHOLE LOGS

Engineering Ltd.

BOREHOLE No : 20BH001

PAGE 1 0F 3

CLIENT English River Property Management

PROJECT NAME Wastewater Treatment Plant

PROJECT NUMBER 7603-002-00

PROJECT LOCATION English River First Nation

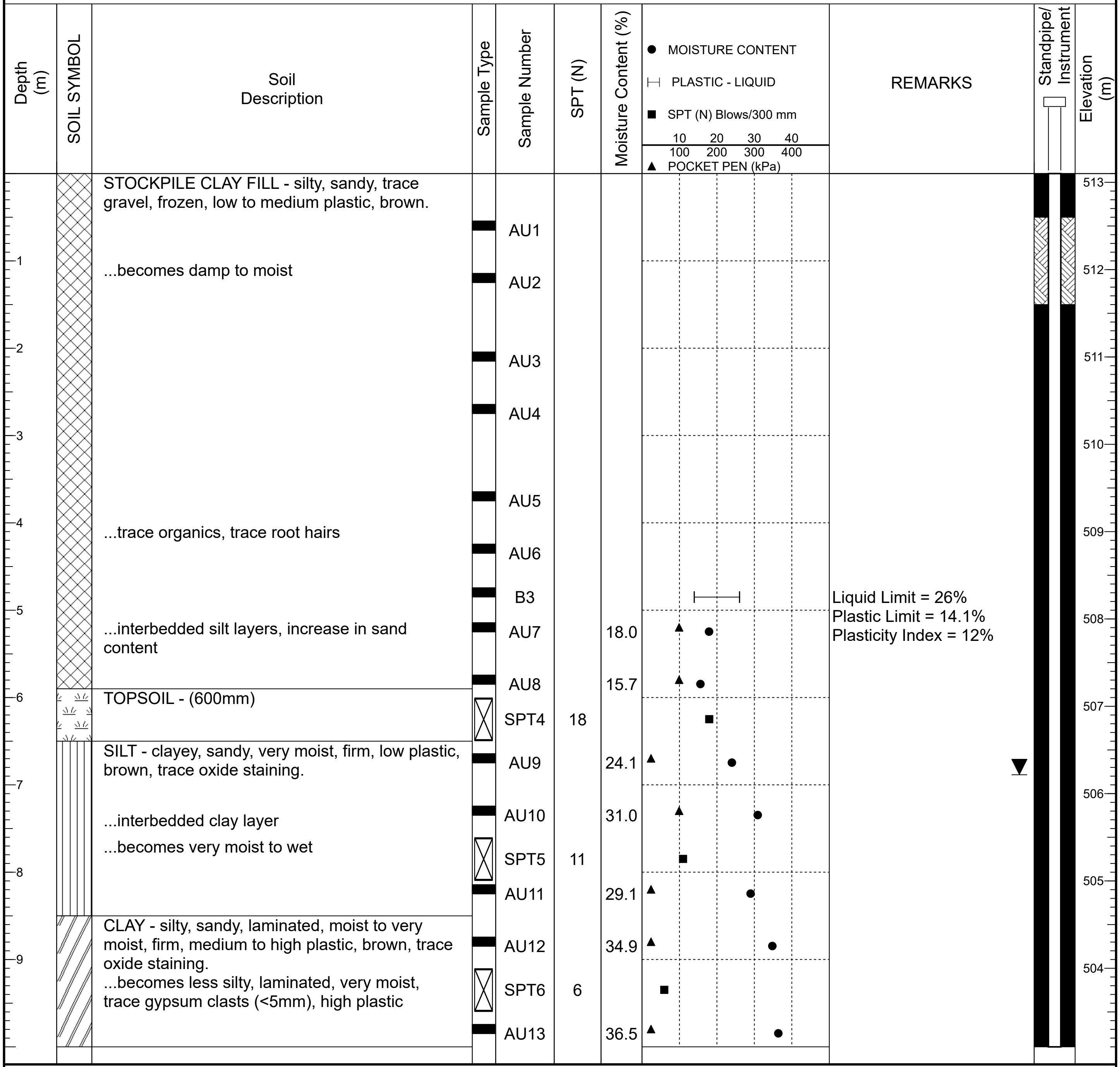
DATE STARTED 03/19/2020 COMPLETED 03/19/2020

GROUND ELEVATION 513.10m N 5769397.000 E 389666.700

DRILLING CONTRACTOR Mobile Augers and Research Ltd.

GROUND WATER LEVEL: 506.30 m

DRILLING METHOD 6" SSA



Soil Description	Sample Number	SPT (N)	Moisture Content (%)	REMARKS
STOCKPILE CLAY FILL - silty, sandy, trace gravel, frozen, low to medium plastic, brown.	AU1			
...becomes damp to moist	AU2			
	AU3			
	AU4			
	AU5			
...trace organics, trace root hairs	AU6			
	B3			Liquid Limit = 26% Plastic Limit = 14.1% Plasticity Index = 12%
...interbedded silt layers, increase in sand content	AU7		18.0	
	AU8		15.7	
TOPSOIL - (600mm)	SPT4	18		
SILT - clayey, sandy, very moist, firm, low plastic, brown, trace oxide staining.	AU9		24.1	
...interbedded clay layer	AU10		31.0	
...becomes very moist to wet	SPT5	11		
	AU11		29.1	
CLAY - silty, sandy, laminated, moist to very moist, firm, medium to high plastic, brown, trace oxide staining.	AU12		34.9	
...becomes less silty, laminated, very moist, trace gypsum clasts (<5mm), high plastic	SPT6	6		
	AU13		36.5	

Notes:

Sloughing observed at 10.0 m. No seepage observed. Borehole located on a large clay fill stockpile approximately 6.5 m above native soil elevation.

Logged By: Brett Tataryn

Reviewed By: Chris McRae

BOREHOLE No : 20BH001

PAGE 2 0F 3

CLIENT	English River Property Management	PROJECT NAME	Wastewater Treatment Plant
PROJECT NUMBER	7603-002-00	PROJECT LOCATION	English River First Nation
DATE STARTED	03/19/2020 COMPLETED 03/19/2020	GROUND ELEVATION	513.10m N 5769397.000 E 389666.700
DRILLING CONTRACTOR	Mobile Augers and Research Ltd.	GROUND WATER LEVEL:	506.30 m
DRILLING METHOD	6" SSA		

Soil Description:

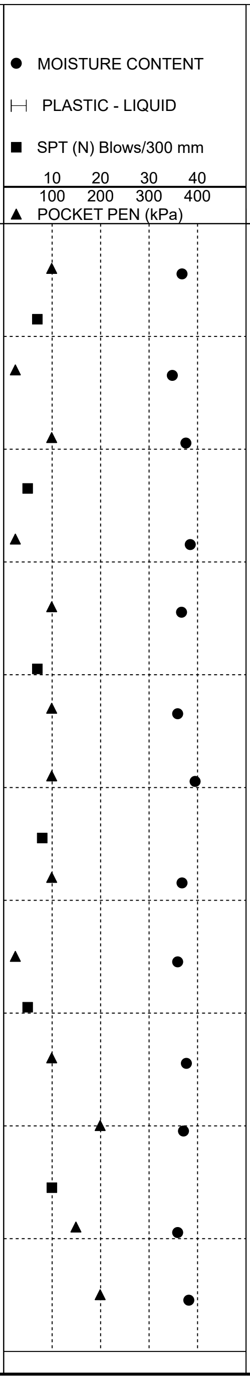
...becomes unoxidized, trace oxide staining, occasional gypsum clasts (<10mm)

...interbedded silt pockets

...trace gypsum clasts (<10mm)

...trace gravel (<5mm)

Sample Number	SPT (N)	Moisture Content (%)
AU14		36.9
SPT7	7	
AU15		34.9
AU16		37.7
SPT8	5	
AU17		38.6
AU18		36.8
SPT9	7	
AU19		36.0
AU20		39.6
SPT10	8	
AU21		36.9
AU22		36.0
SPT11	5	
AU23		37.8
AU24		37.2
SPT12	10	
AU25		36.0
AU26		38.3



REMARKS

Depth (m): 11, 12, 13, 14, 15, 16, 17, 18, 19

Elevation (m): 503, 502, 501, 500, 499, 498, 497, 496, 495, 494

Notes:

Sloughing observed at 10.0 m. No seepage observed. Borehole located on a large clay fill stockpile approximately 6.5 m above native soil elevation.

Logged By: Brett Tataryn

Reviewed By: Chris McRae

Engineering Ltd.

BOREHOLE No : **20BH001**

PAGE 3 0F 3

CLIENT English River Property Management
PROJECT NAME Wastewater Treatment Plant
PROJECT NUMBER 7603-002-00
PROJECT LOCATION English River First Nation
DATE STARTED 03/19/2020 COMPLETED 03/19/2020
GROUND ELEVATION 513.10m N 5769397.000 E 389666.700
DRILLING CONTRACTOR Mobile Augers and Research Ltd.
GROUND WATER LEVEL: 506.30 m
DRILLING METHOD 6" SSA

Depth (m)	SOIL SYMBOL	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	● MOISTURE CONTENT ⊢⊣ PLASTIC - LIQUID ■ SPT (N) Blows/300 mm 10 20 30 40 100 200 300 400 ▲ POCKET PEN (kPa)	REMARKS	Standpipe/ Instrument	Elevation (m)
	▨		⊠	SPT13	12		■		■	493
		End of Borehole @20.3 m								
21										492
22										491
23										490
24										489
25										488
26										487
27										486
28										485
29										484

Notes:

Sloughing observed at 10.0 m. No seepage observed. Borehole located on a large clay fill stockpile approximately 6.5 m above native soil elevation.

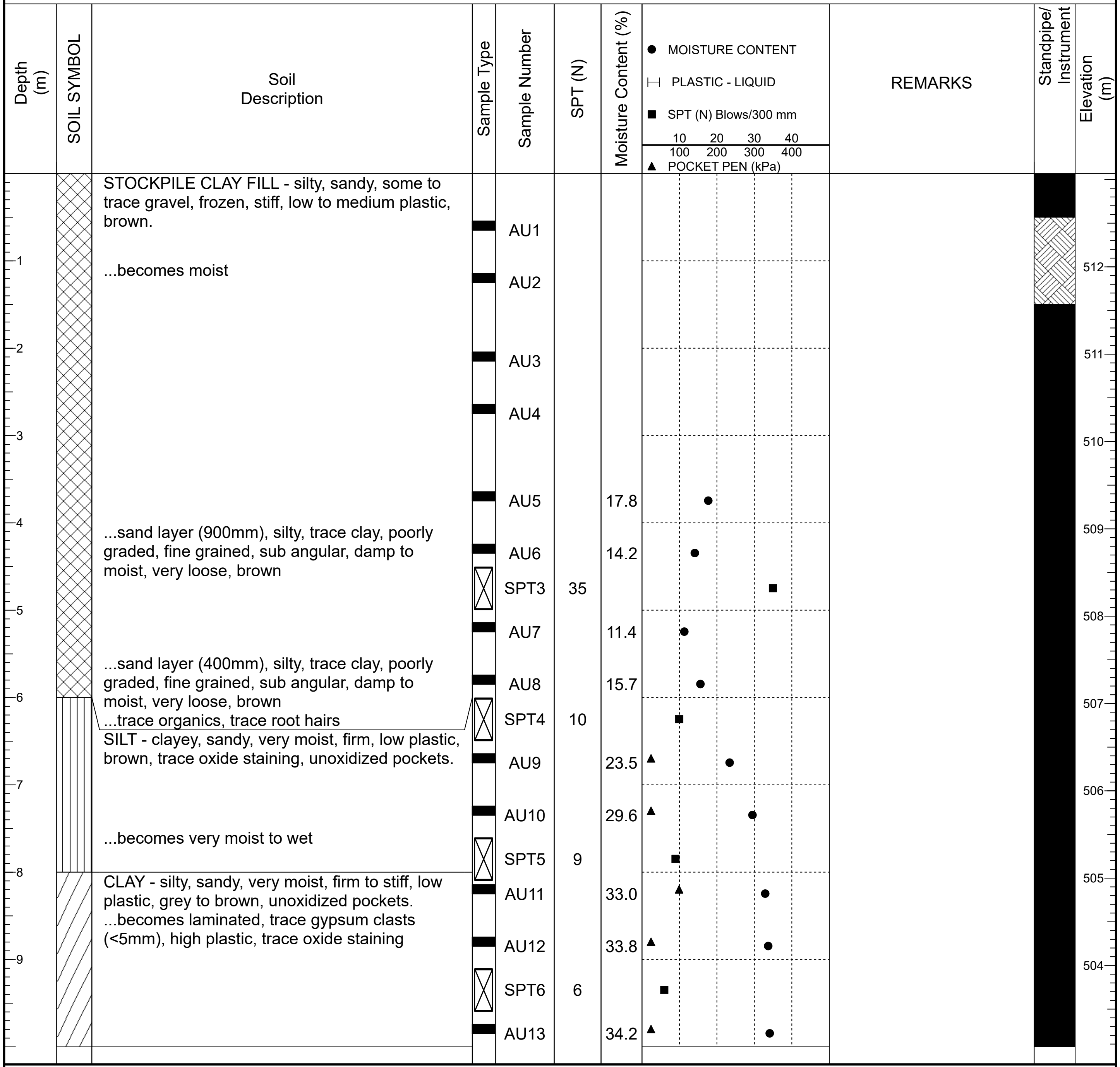
Logged By: Brett Tataryn
Reviewed By: Chris McRae

MPE Engineering Ltd.

BOREHOLE No : **20BH002**

PAGE 1 0F 3

CLIENT English River Property Management
PROJECT NAME Wastewater Treatment Plant
PROJECT NUMBER 7603-002-00
PROJECT LOCATION English River First Nation
DATE STARTED 03/19/2020 COMPLETED 03/19/2020
GROUND ELEVATION 513.07m N 5769383.500 E 389695.900
DRILLING CONTRACTOR Mobile Augers and Research Ltd.
GROUND WATER LEVEL:
DRILLING METHOD 6" SSA



STOCKPILE CLAY FILL - silty, sandy, some to trace gravel, frozen, stiff, low to medium plastic, brown.

...becomes moist

...sand layer (900mm), silty, trace clay, poorly graded, fine grained, sub angular, damp to moist, very loose, brown

...sand layer (400mm), silty, trace clay, poorly graded, fine grained, sub angular, damp to moist, very loose, brown

...trace organics, trace root hairs

SILT - clayey, sandy, very moist, firm, low plastic, brown, trace oxide staining, unoxidized pockets.

...becomes very moist to wet

CLAY - silty, sandy, very moist, firm to stiff, low plastic, grey to brown, unoxidized pockets.

...becomes laminated, trace gypsum clasts (<5mm), high plastic, trace oxide staining

Sample Number	SPT (N)	Moisture Content (%)
AU1		
AU2		
AU3		
AU4		
AU5		17.8
AU6		14.2
SPT3	35	
AU7		11.4
AU8		15.7
SPT4	10	
AU9		23.5
AU10		29.6
SPT5	9	
AU11		33.0
AU12		33.8
SPT6	6	
AU13		34.2

Notes:

Sloughing observed at 7.6 m. No seepage observed. Borehole located on a large clay fill stockpile approximately 6.0 m above native soil elevation.

Logged By: Brett Tataryn
Reviewed By: Chris McRae

Engineering Ltd.

BOREHOLE No : **20BH002**

PAGE 2 0F 3

CLIENT English River Property Management

PROJECT NAME Wastewater Treatment Plant

PROJECT NUMBER 7603-002-00

PROJECT LOCATION English River First Nation

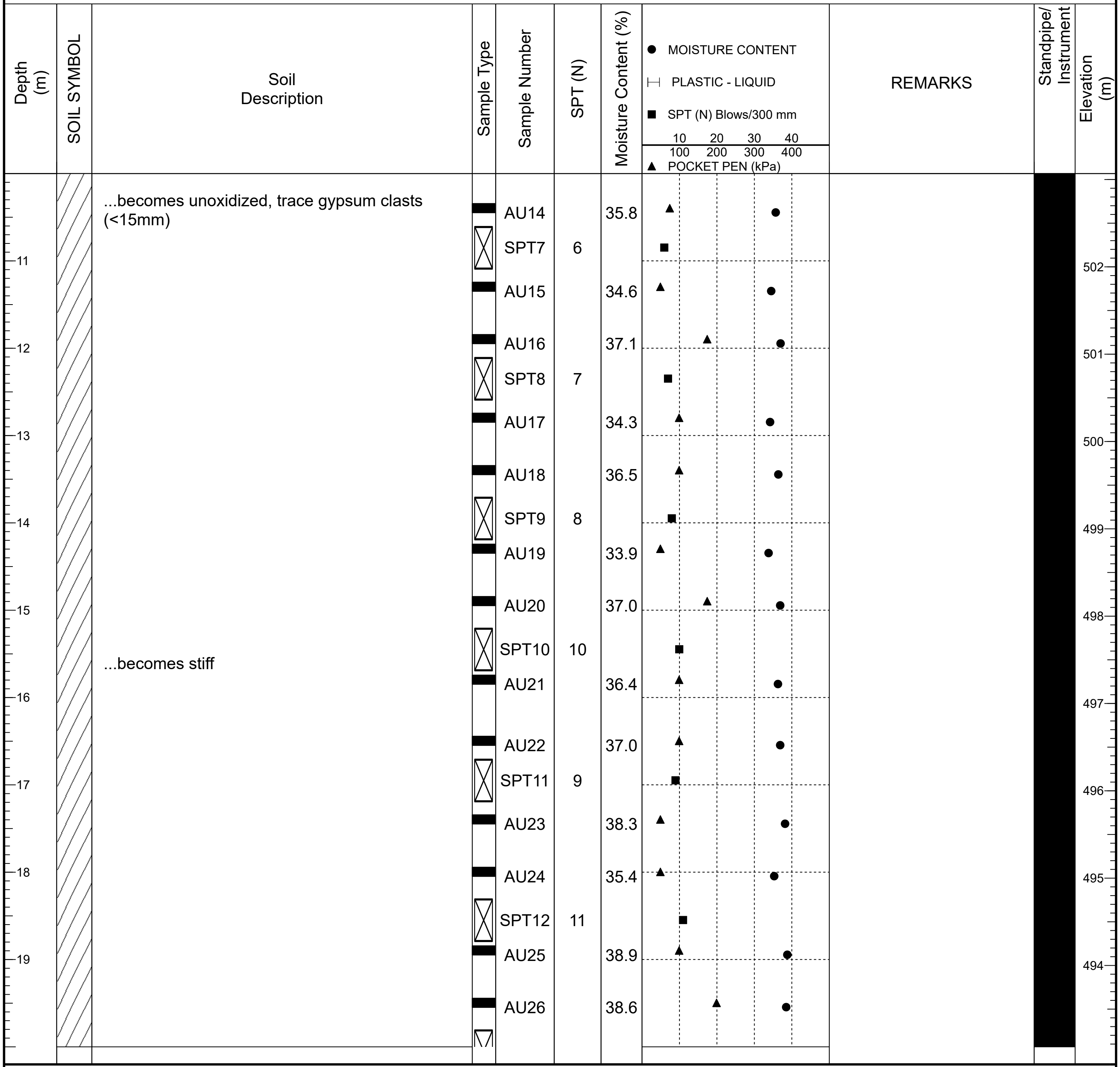
DATE STARTED 03/19/2020 COMPLETED 03/19/2020

GROUND ELEVATION 513.07m N 5769383.500 E 389695.900

DRILLING CONTRACTOR Mobile Augers and Research Ltd.

GROUND WATER LEVEL:

DRILLING METHOD 6" SSA



Soil Description:

...becomes unoxidized, trace gypsum clasts (<15mm)

...becomes stiff

Sample Number	SPT (N)	Moisture Content (%)
AU14		35.8
SPT7	6	
AU15		34.6
AU16		37.1
SPT8	7	
AU17		34.3
AU18		36.5
SPT9	8	
AU19		33.9
AU20		37.0
SPT10	10	
AU21		36.4
AU22		37.0
SPT11	9	
AU23		38.3
AU24		35.4
SPT12	11	
AU25		38.9
AU26		38.6

Notes:

Sloughing observed at 7.6 m. No seepage observed. Borehole located on a large clay fill stockpile approximately 6.0 m above native soil elevation.

Logged By: Brett Tataryn

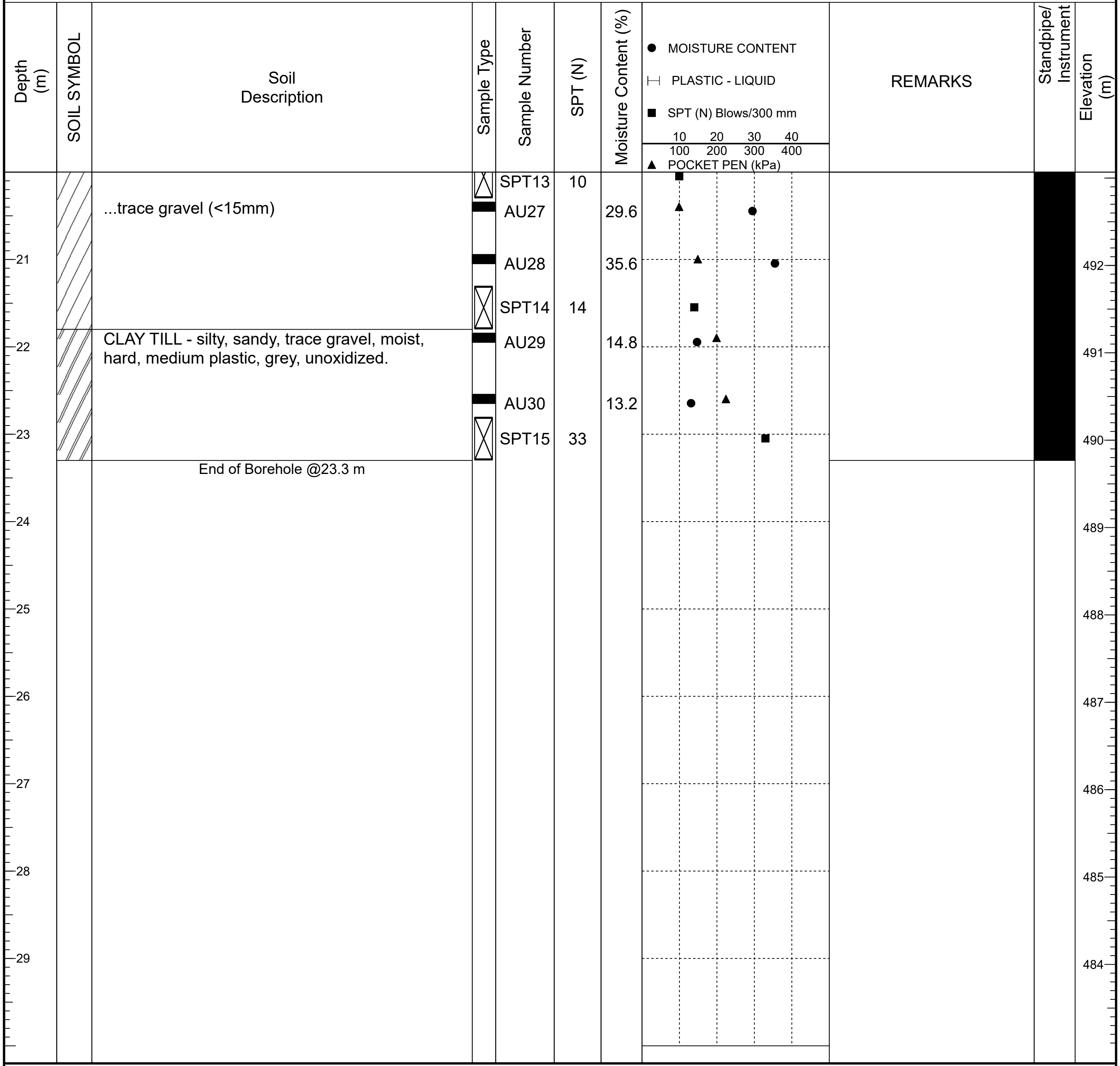
Reviewed By: Chris McRae

Engineering Ltd.

BOREHOLE No : 20BH002

PAGE 3 0F 3

CLIENT: English River Property Management
PROJECT NAME: Wastewater Treatment Plant
PROJECT NUMBER: 7603-002-00
PROJECT LOCATION: English River First Nation
DATE STARTED: 03/19/2020 COMPLETED: 03/19/2020
GROUND ELEVATION: 513.07m N 5769383.500 E 389695.900
DRILLING CONTRACTOR: Mobile Augers and Research Ltd.
GROUND WATER LEVEL:
DRILLING METHOD: 6" SSA



Soil Description	Sample Number	SPT (N)	Moisture Content (%)
	SPT13	10	
...trace gravel (<15mm)	AU27		29.6
	AU28		35.6
	SPT14	14	
CLAY TILL - silty, sandy, trace gravel, moist, hard, medium plastic, grey, unoxidized.	AU29		14.8
	AU30		13.2
	SPT15	33	
End of Borehole @23.3 m			

Notes:

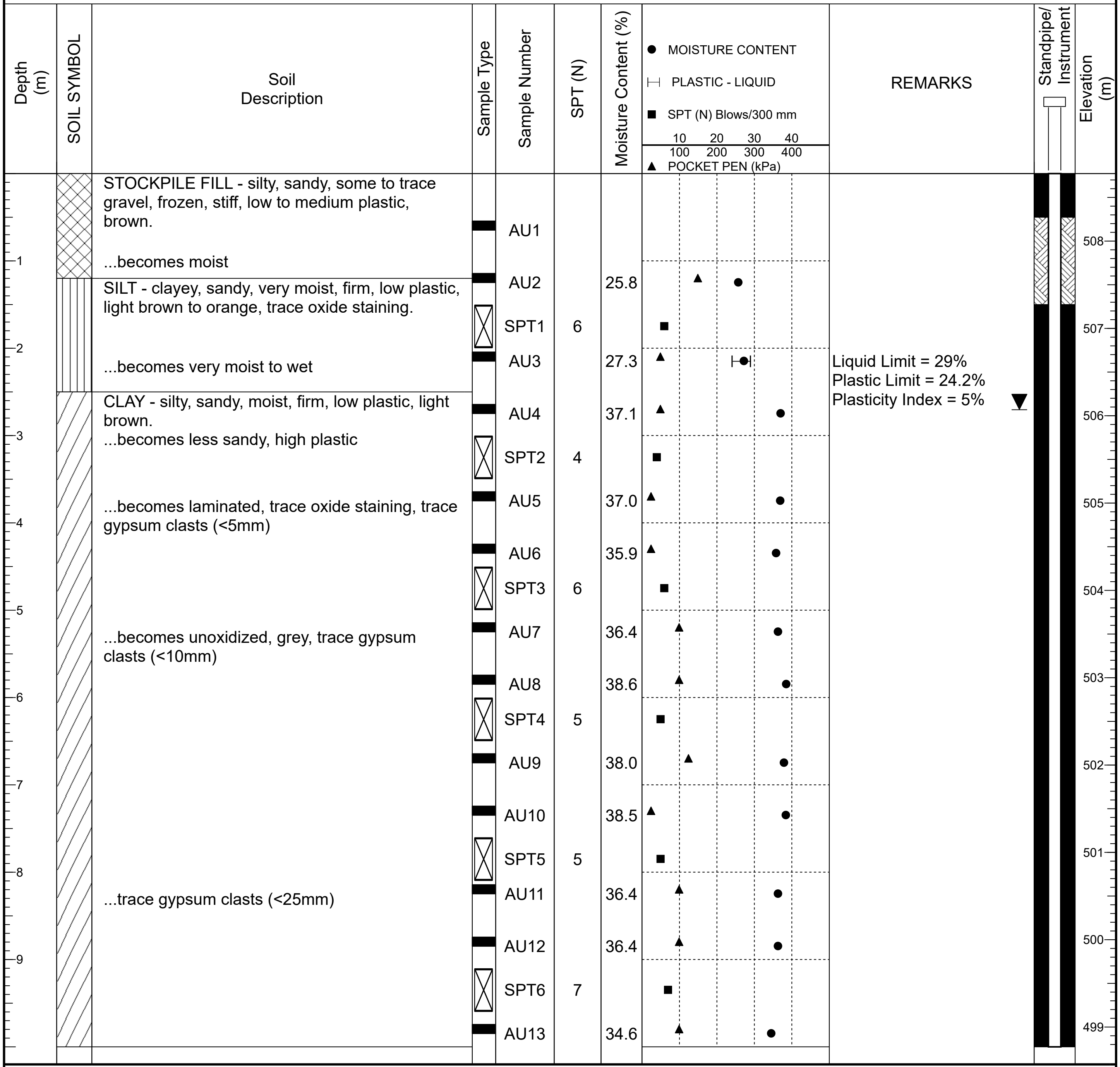
Sloughing observed at 7.6 m. No seepage observed. Borehole located on a large clay fill stockpile approximately 6.0 m above native soil elevation.

Logged By: Brett Tataryn
Reviewed By: Chris McRae

BOREHOLE No : 20BH003

PAGE 1 0F 2

CLIENT: English River Property Management
PROJECT NAME: Wastewater Treatment Plant
PROJECT NUMBER: 7603-002-00
PROJECT LOCATION: English River First Nation
DATE STARTED: 03/20/2020
COMPLETED: 03/20/2020
GROUND ELEVATION: 508.77m
N: 5769394.970
E: 389765.580
DRILLING CONTRACTOR: Mobile Augers and Research Ltd.
GROUND WATER LEVEL: 506.15 m
DRILLING METHOD: 6" SSA



Soil Description	Sample Number	SPT (N)	Moisture Content (%)	REMARKS
STOCKPILE FILL - silty, sandy, some to trace gravel, frozen, stiff, low to medium plastic, brown.	AU1			
...becomes moist	AU2		25.8	
SILT - clayey, sandy, very moist, firm, low plastic, light brown to orange, trace oxide staining.	SPT1	6		
...becomes very moist to wet	AU3		27.3	Liquid Limit = 29% Plastic Limit = 24.2% Plasticity Index = 5%
CLAY - silty, sandy, moist, firm, low plastic, light brown.	AU4		37.1	
...becomes less sandy, high plastic	SPT2	4		
...becomes laminated, trace oxide staining, trace gypsum clasts (<5mm)	AU5		37.0	
	AU6		35.9	
	SPT3	6		
...becomes unoxidized, grey, trace gypsum clasts (<10mm)	AU7		36.4	
	AU8		38.6	
	SPT4	5		
	AU9		38.0	
	AU10		38.5	
	SPT5	5		
...trace gypsum clasts (<25mm)	AU11		36.4	
	AU12		36.4	
	SPT6	7		
	AU13		34.6	

Notes:

No sloughing observed. Seepage observed at 11.3 m. Borehole located on the edge of a large clay fill stockpile approximately 1.2 m above native soil elevation. Water in hole after drilling at 12.2 m.

Logged By: Brett Tataryn
Reviewed By: Chris McRae

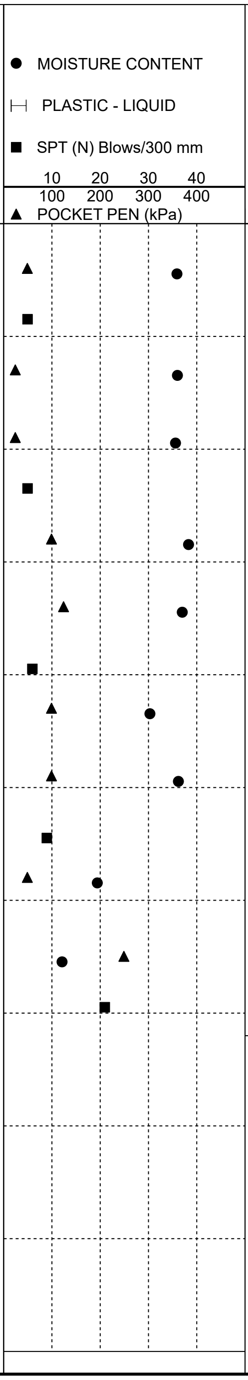
Engineering Ltd.

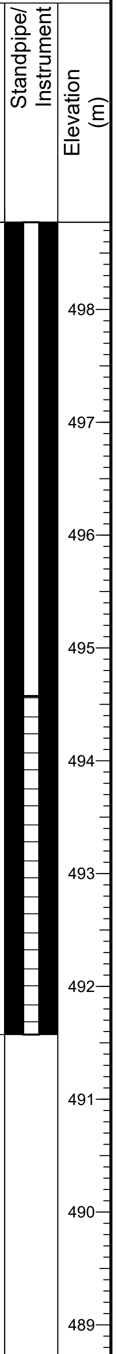
BOREHOLE No : **20BH003**

PAGE 2 0F 2

CLIENT English River Property Management
PROJECT NAME Wastewater Treatment Plant
PROJECT NUMBER 7603-002-00
PROJECT LOCATION English River First Nation
DATE STARTED 03/20/2020 COMPLETED 03/20/2020
GROUND ELEVATION 508.77m N 5769394.970 E 389765.580
DRILLING CONTRACTOR Mobile Augers and Research Ltd.
GROUND WATER LEVEL: 506.15 m
DRILLING METHOD 6" SSA

Soil Description	Sample Number	SPT (N)	Moisture Content (%)	REMARKS
...sand content increases	AU14		36.0	
	SPT7	5		
	AU15		36.1	
...becomes very silty, very moist to wet, no longer laminated	AU16		35.7	
	SPT8	5		
...becomes less silty, moist	AU17		38.4	
	AU18		37.1	
	SPT9	6		
...becomes stiff, trace gravel (<5mm), trace oxide staining	AU19		30.4	
	AU20		36.3	
	SPT10	9		
CLAY TILL - silty, sandy, trace gravel, very moist, hard, medium plastic, grey, unoxidized.	AU21		19.5	
	AU22		12.2	
	SPT11	21		
End of Borehole @17.2 m				





Depth (m): 11, 12, 13, 14, 15, 16, 17, 18, 19

Notes:

No sloughing observed. Seepage observed at 11.3 m. Borehole located on the edge of a large clay fill stockpile approximately 1.2 m above native soil elevation. Water in hole after drilling at 12.2 m.

Logged By: Brett Tataryn

Reviewed By: Chris McRae

APPENDIX C:

LABORATORY TESTING

MPE Engineering Ltd.
#122, 103 Marquis Court
Saskatoon, SK S7P 0C4
Tel: (306)668-1966

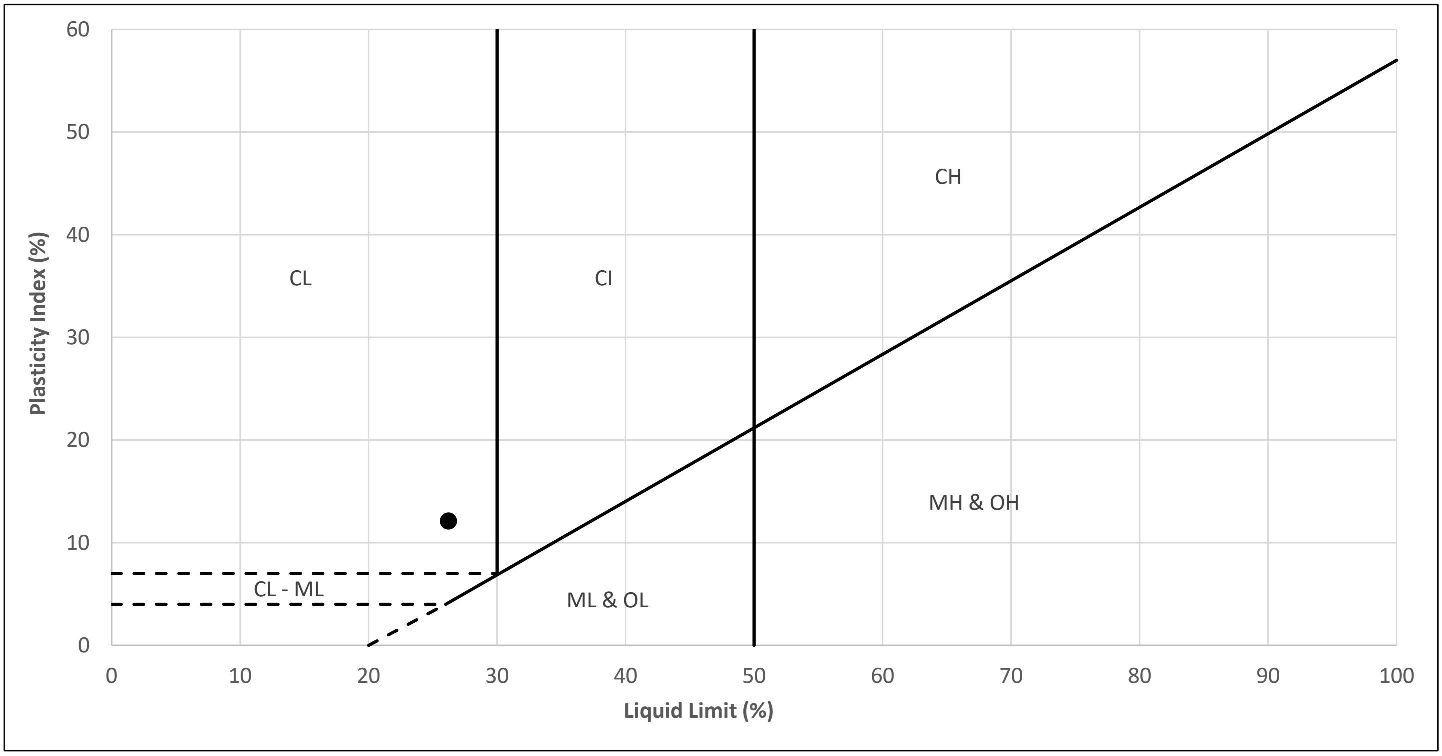
ATTERBERG LIMITS

Project:	Egnlish River First Nation WTP	**Sample #:**	1Bulk3
Project No.:	7603-002-00	**Source:**	20BH001
Owner:	English River Property Management	**Sample By:**	BT
File No.:	AL - 01	**Date Sampled:**	19-Mar-20

Tested in accordance with ASTM D4318 (Liquid Limit, Plastic Limit, and Plasticity of Soils)

Sample Description: Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays

Liquid Limit (LL)	26.2	**In Place Moisture**	13.5
Plastic Limit (PL)	14.1	**Soil Plasticity**	Low
Plasticity Index (PI)	12.1	**Soil Classification**	CL



Comments:

Reviewed By: ___________________________
Kasz Leavitt, Engineering Licensee

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the results is provided only on written request.

MPE Engineering Ltd.
#122, 103 Marquis Court
Saskatoon, SK S7P 0C4
Tel: (306)668-1966

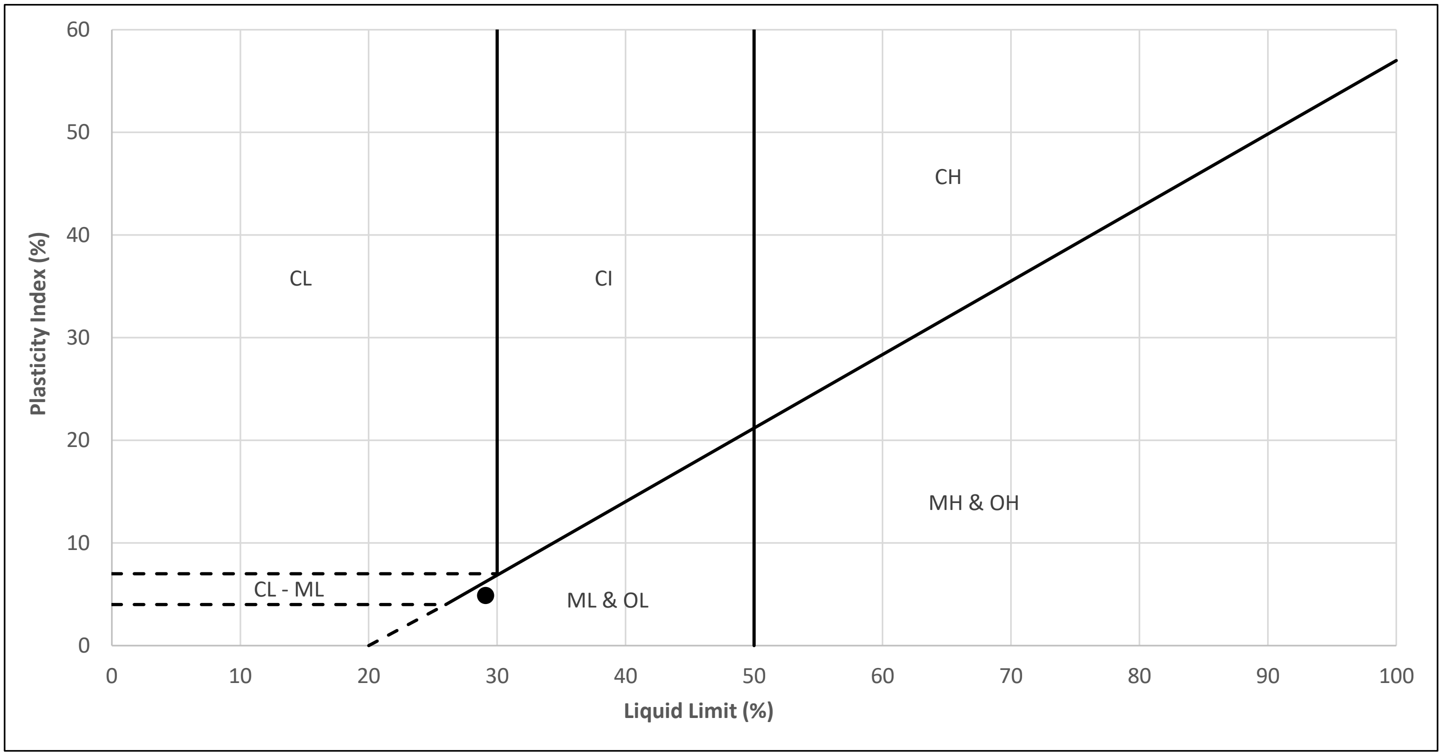
ATTERBERG LIMITS

Project:	Egnlish River First Nation WTP	**Sample #:**	3AU3
Project No.:	7603-002-00	**Source:**	20BH003
Owner:	English River Property Management	**Sample By:**	BT
File No.:	AL - 02	**Date Sampled:**	20-Mar-20

Tested in accordance with ASTM D4318 (Liquid Limit, Plastic Limit, and Plasticity of Soils)

Sample Description: Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity

Liquid Limit (LL)	29.1	**In Place Moisture**	27.3
Plastic Limit (PL)	24.2	**Soil Plasticity**	Low
Plasticity Index (PI)	4.9	**Soil Classification**	ML



Comments:

Reviewed By: ___________________________
Kasz Leavitt, Engineering Licensee

MPE Engineering Ltd.
#122, 103 Marquis Court
Saskatoon, SK S7P 0C4
Tel: (306) 668-1966

MOISTURE - DENSITY RELATIONSHIP REPORT

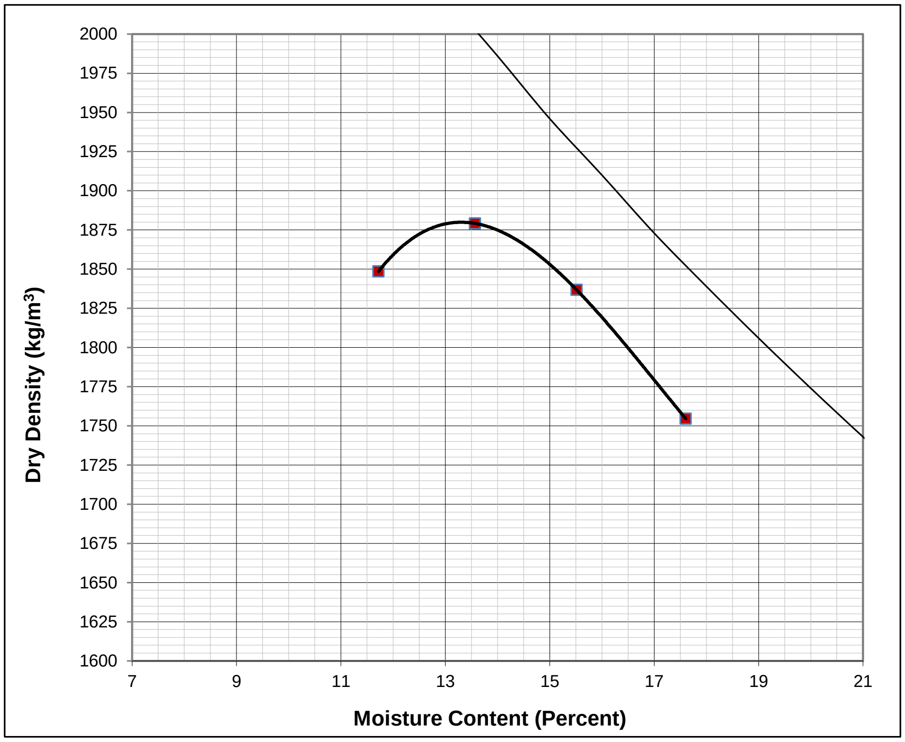
Project:	English River First Nation Wastewater Treatment Plant	**Sample No:**	1
Project No.:	7603-002-00	**Source:**	20BH001
Owner:	English River Project Management	**Sampled By:**	BT
File No.:	MDR - 01	**Date Sampled:**	March 19, 2020

Tested in accordance with ASTM D698/D1557 and D4718 (Standard /Modified Proctor with rock correction)

Maximum Dry Density (kg/m^3): 1880 **Optimum Moisture Content (%): 13.0**

Method used:	Method A (< 25% retained on 5mm)	**Oversize rock in sample (%):**	
Mold size:	101.6mm	**Oversize rock density (kg/m^3):**	
Test Date:	March 26, 2020	**Insitu Moisture Content (%):**	13.5
Tested By:	BT		

Soil Description CL Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays



Test Data

Trail No.	Dry Density kg/m3	Moisture Content (%)
1	1849	11.7
2	1879	13.6
3	1837	15.5
4	1755	17.6

Field oversize correction values:

(where applicable)

Oversize	Corrected Dry Density (kg/m^3)	Adjusted Moisture
5%	1786	13.7%
10%	1692	14.4%
15%	1598	15.3%
20%	1504	16.3%
25%	1410	17.3%
30%	1316	18.6%

Comments:

Checked By: ____________________
Kasz Leavitt, Engineering Licensee

Reporting of these results constitutes a testing service only. Engineering interpretation or evaluation of the results is provided only on written request.

SASKATCHEWAN RESEARCH COUNCIL
Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2
T: 306-933-6932 **F:** 306-933-7922
Toll-free: 1-800-240-8808
E: analytical@src.sk.ca
www.src.sk.ca/analytical

SRC Group # 2020-3281

Mar 30, 2020

MPE Engineering Ltd.
122, 103 Marquis Court
Saskatoon, SK S7P 0C4
Attn: Brett Tataryn

Date Samples Received: Mar-24-2020 Client P.O.: 7603-002-00

All results have been reviewed and approved by a Qualified Person in accordance with the Saskatchewan Environmental Code, Corrective Action Plan Chapter, for the purposes of certifying a laboratory analysis

Results from Lab Section 2 authorized by Keith Gipman, Supervisor

---

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as
    * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
    * Environment Canada
    * US EPA
    * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

* Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

This is a final report.

SASKATCHEWAN
RESEARCH COUNCIL

Environmental Analytical Laboratories
143-111 Research Drive, Saskatoon, SK Canada S7N 3R2

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Toll-free: 1-800-240-8808
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SRC Group # 2020-3281

Mar 30, 2020

MPE Engineering Ltd.

122, 103 Marquis Court
Saskatoon, SK   S7P 0C4
Attn: Brett Tataryn

Date Samples Received: Mar-24-2020

Client P.O.: 7603-002-00

16928 **03/19/2020 3AU7 20BH003 5.2M 19/03/20 *SOIL***

Analyte	Units	16928
Lab Section 2		
Sulfate, water soluble	ug/g	33100

The temperature of the cooler was 18.4 °C upon receipt.

Results are reported on a dry basis.

SRC Group # 2020-3281

Mar 30, 2020

MPE Engineering Ltd.

Analyte Methods

Name	Units	Method
Sulfate, water soluble	ug/g	Chm-620 / Chm-517