Effluent Treatment Plant – Alternate Site Irving Pulp and Paper Ltd, Saint John, New Brunswick

Geotechnical Investigation

April 1, 2021

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EFFLUENT TREATMENT PLANT – ALTERNATE SITE IRVING PULP AND PAPER LTD, SAINT JOHN, NEW BRUNSWICK

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Table of Contents

LIST OF TABLES

LIST OF APPENDICES

EFFLUENT TREATMENT PLANT – ALTERNATE SITE IRVING PULP AND PAPER LTD, SAINT JOHN, NEW BRUNSWICK

April 1, 2021

1.0 INTRODUCTION

1.1 GENERAL

Stantec Consulting Ltd. (Stantec), acting at the request of Irving Pulp & Paper Limited (IPP), has carried out a subsurface investigation as part of a scoping exercise to assess the feasibility of an alternate site for the proposed Effluent Treatment Plant (ETP) and associated sludge dewatering system at the IPP mill site in Saint John, New Brunswick, as shown on Stantec Drawing No. 133548756 E-010 – Site Layout – Effluent Treatment Plant – Option 10 provided in **Appendix D**.

The purpose of this geotechnical investigation was to obtain information on the subsurface conditions and depth to bedrock at the site for feasibility level assessment and preliminary geotechnical design.

The scope of work completed for this project included the following:

- Completion of a geotechnical investigation consisting of fourteen (14) boreholes;
- A laboratory testing program;
- Preparation of this report presenting the findings of the field investigations and laboratory analyses, as well as geotechnical recommendations to aid with the preliminary design of various structures proposed within the ETP.

This report has been prepared specifically and solely for the proposed project described herein. It contains a summary of our findings and includes geotechnical recommendations for the proposed development.

1.2 PROPOSED DEVELOPMENT

It is understood that the proposed development will consist of several structures:

- Building – AHU (approximately 25 ft by 25 ft);
- Clarifier (approximately 138 ft diameter);
- MBBR-1 – (approximately 116 ft diameter);
- MBBR-2– (approximately 116 ft diameter);
- Equalization Tank – (approximately 136 ft diameter);
- Heat Exchangers HE-1/HE-2 – (approximately 100 ft by 100 ft); and
- Main Building – Cooling, pH, Pumping, Nutrient, Primary Sludge Tank, Admin, Lab, DAF, Dewatering Secondary Sludge Tank, Electrical (approximately 108 ft by 210 ft);

The exact dimensions, elevations, and locations of each structure, as well as piping, are still in the early design phases and are subject to change. The location of the piping is not fully defined; however, it is assumed it will approximately follow the existing roadway from the Main Building to the proposed Dispersion Tank.

2.0 SITE DESCRIPTION AND GEOLOGY

2.1 SITE DESCRIPTION

The project site is located on the west side of the IPPL Mill in Saint John, New Brunswick as shown on Stantec Drawing No. 133548756 E-010 – Site Layout – Effluent Treatment Plant – Option 10 provided in **Appendix D**.

The site is currently vacant with some grass, tree, or small alder covering the area. Based on the survey conducted, at the locations of the boreholes and bedrock outcrops, the western portion of the proposed development area is relatively flat and slopes down to the east with elevations dropping from 103.17 ft (BH-4) to 21.06 ft (BH-11), at the test locations.

Based on our understanding of the historical site use, the bedrock from this area was previously removed by blasting methods leaving a large flat area to the west and sloping steeply down just west of the proposed Equalization tank and Heat Exchangers. The area has been since backfilled with a heterogenous mixture of fill mixed with woodchips.

The site is bounded by the Emera Brunswick Pipeline Company and Milford Road to the west which both run in an approximate north-south direction, with residential areas along Milford Road. Lee Cove and the main mill area are to the east and the chip yard and other industrial areas to the immediate south.

2.1.1 Review of Local Geological Mapping

Review of available local surficial geological mapping shows the surficial material in the area consisting of *morainal veneer thin or discontinuous deposit of till over bedrock. Hummocky terrain with minor ridges. Reflects bedrock topography. Numerous minor bedrock outcrops.* Generally, less than 3 metres thick.

Bedrock geology mapping from the *New Brunswick Department of Natural Resources, Bedrock Geology of the Saint John Area (NTS 21 G/08), Saint John, Kings, Queens, and Charlotte Counties, New Brunswick, Plate 2005-31 (revised 2015)* suggests the bedrock in the area consists of:

- *Brookville Gneiss: Dark grey to pinkish grey, fine- to medium-grained, banded, and locally migmatitic paragneiss with minor calc-silicate, marble or quartzite layers; grey, medium-grained granodioritic to tonalitic ortho-gneiss with locally abundant biotite schlieren and amphibolite: the gneisses are locally intruded by granodiorite, pegmatite, and diabase.*
- *Deformed Granitoid Rocks (unnamed): Grey strongly deformed monzogranite to granodiorite with augen of feldspar and quartz.*
- *Fairville Granite: Pink to orange, coarse-grained granite, gradational to granodiorite: commonly feldspar megacrystic and elongate enclaves of fine-grained dioritic rocks.*

Based on initial bedrock outcrop observations and rock cores, the bedrock in the immediate vicinity of the development consisted of Brookville Gneiss and Deformed Granitoid Rocks.

3.0 INVESTIGATIVE PROCEDURES

3.1 GENERAL

The geotechnical field investigation was conducted between February 1 and 9, 2021. Fourteen (14) boreholes identified as BH-1 through BH-15 were drilled to depths ranging from 1 ft to 35 ft below existing ground surface using a CME 25 drill rig owned and operated by MEG Drilling of Killams Mills, New Brunswick. Borehole BH-12 was completed at the site for a structure outside the main Effluent Treatment Plant and will be reported under a separate cover.

Boreholes were advanced through overburden soils using the auger or 3”-6” casings with soils regularly sampled using 2” split spoon samplers during the performance of the Standard Penetration Tests (SPT). HQ rock cores were drilled in selected locations to retrieve bedrock samples. The locations of the boreholes are shown on Drawing E-0010 – Site Layout Effluent Treatment Plant Option 10, provided in **Appendix D**.

Stantec personnel supervised the borehole drilling, collected soil samples, collected rock cores, and logged the subsurface conditions encountered at the test locations. Stantec personnel maintained detailed records of the various soil strata encountered in the investigation along with observed water levels. Descriptions of the soils, ground conditions, and bedrock encountered, the sampling, and the testing carried out, are provided on the Borehole Records provided in **Appendix B**.

Soil samples were stored in moisture tight bags and returned to our laboratory for testing and final classification. Rock cores were stored in wooden boxes and returned to our laboratory for testing and final classification. If requested, the samples may be kept in storage for a period of three (3) months from the date of issuance of this report; otherwise, the samples will be discarded after the verification of the soil profile and required laboratory testing is complete. Upon completion of the field program, the boreholes were backfilled with the spoils with without any compaction.

3.2 SITE SURVEY

The borehole locations were laid out in the field by Stantec personnel based on the proposed development footprint, and in relation to the existing site features, surface constraints, and above and below ground utilities. The coordinates of the boreholes were surveyed at the time of the investigation by CFM Service. The as-surveyed borehole coordinates are summarized in Table 1 and reference the IPP Mill Grid.

Table 1 Borehole Coordinates

BOREHOLE ID	NORTHING (ft)	EASTING (ft)	ELEVATION (ft)
BH-1	1423.90	7372.66	94.84
BH-2	1282.00	7345.55	94.16
BH-3	1149.48	7313.79	99.99
BH-4	1011.44	7280.25	103.17
BH-5	1150.73	7563.25	65.95
BH-6	1039.05	7556.74	71.11
BH-7	877.71	7539.59	68.22
BH-8	1017.22	7691.56	45.21
BH-9 (Approx.)	977.46	7763.98	34.75
BH-10	1038.23	7960.26	21.67
BH-11	992.17	8142.38	21.06
BH-13	795.96	7530.24	73.83
BH-14	985.24	7684.42	43.44
BH-15	1522.41	7510.61	87.10

3.3 LABORATORY TESTING

Samples obtained from split-spoons and rock cores were transported to our certified Saint John laboratory for further classification and testing.

The geotechnical laboratory testing program was designed to aid in the visual classification of the soils. Grain size analyses (sieves), moisture content testing, and Atterberg Limit testing were carried out on selected samples retrieved from the boreholes. The findings from the laboratory testing performed on the selected samples are presented on the charts provided in **Appendix C**.

Unconfined compressive strength testing was also completed on the rock cores retrieved during the drilling operations at selected borehole locations.

4.0 SUBSURFACE CONDITIONS

4.1 GENERAL

The soil strata and groundwater conditions encountered at the site are described in detail on the Borehole Logs provided in **Appendix B**. The Symbols and Terms used on the Borehole Logs and Test Pit Records provide a brief explanation of the terminology and graphics used by Stantec and are also provided in **Appendix B.**

Soil classification was based on the procedures described in ASTM D2488 (Standard Practice for Description and Identification of Soils, Visual-Manual Procedure) and ASTM D2487 (Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)).

4.1.1 Proposed Main Building(s) and Equalization Tank

In general, the principal strata encountered at the borehole locations consisted of the following:

- Vegetation / Rootmat;
- FILL: clayey sand with gravel to sandy lean clay to silty sand with gravel to lean clay to silty, clayey sand.
- FILL: Heterogeneous mixture of soil and wood chips.
- GNEISS.

The findings are detailed on the attached Borehole Records: BH-5, BH-6, BH-7, BH-13, and BH-14.

4.1.2 MBBR-1, MBBR-2, Clarifier

In general, bedrock was countered at, or very near, the existing ground surface within the footprint of the MBBR-1, MBBR-2, and Clarifier. The bedrock can be described as GRANITE.

4.1.3 Proposed Piping Location

As stated previously, the proposed piping location(s) has not been clearly defined at the time of writing; however, it is assumed that the piping will follow the existing roadway from the Main Building to a Dispersion Tank (BH-8 through BH-11, and BH-14). In general, the principal strata encountered at the borehole locations for the proposed piping location consisted of the following:

- FILL: Crushed rock.
- FILL: poorly graded sand with gravel to poorly graded gravel with sand, to lean clay to sandy lean clay to clayey sand with gravel.
- Inferred Bedrock (possible boulder, BH-10 only).

The findings are detailed on the attached Borehole Records.

4.2 GROUNDWATER CONDITIONS

The groundwater was observed at six (6) borehole locations during the field investigation at a depth ranging from 4 feet (BH-9) to 25 feet (BH-15) below the existing ground surface.

The groundwater table observed over a short duration may not be representative of the actual site conditions. Groundwater levels can be expected to fluctuate during periods of heavy precipitation associated with seasonal weather trends, or precipitation events, tidal cycles, site use, adjacent site use, and construction activity.

4.3 BEDROCK

Bedrock was proven by HQ coring techniques at two (2) borehole locations: BH-1, and BH-13. The depth to bedrock was inferred in the remaining boreholes with the exception of the boreholes drilled within the roadway area (BH-8 through BH-11).

A description of the rock mass quality description is presented in the *Symbols and Terms used on Borehole and Test Pit Records* presented in **Appendix B**. Rock Quality Designation (RQD) values were determined for the rock core; these values are shown on the Borehole Records also provided in **Appendix B**. In the absence of full core recovery (5 ft run), some RQD values may be reflective of drilling breaks and may not represent the full rock mass.

For reference, Table 2 presents the depth to bedrock below the existing ground surface and the bedrock elevation with respect to IPP Mill Grid / Plant Datum.

The bedrock encountered at the site within the depths of the boreholes was observed to be Fairville Granite (BH-1) and Brookville Gneiss (BH-13).

4.3.1 Granite

The granite was observed to be pink to orange, coarse grained granite as described on the geology mapping. The Rock Quality Designation (RQD) ranged from 74% to 98%. Based on the RQD values, the bedrock in this area (BH-1) consisted of fair to excellent quality GRANITE.

4.3.2 Brookville Gneiss

The colour of the Brookville gneiss was dark grey with green bands or dark grey to pinkish grey with medium grains. The Rock Quality Designation (RQD) ranged from 48% to 74%. Generally, the RQD was found to increase with depth. Based on RQD values, the bedrock in this area (BH-13) consisted of poor to fair quality GNEISS.

Table 2 Bedrock Depth and Elevation Summary

TEST LOCATION ID	GROUND SURFACE ELEVATION (ft)	DEPTH TO BEDROCK (ft) BELOW EXISTING GROUND SURFACE	BEDROCK / *INFERRED* BEDROCK ELEVATION (ft)
BH-1	94.84	5.7	89.1
BH-2	94.16	10.9	83.3
BH-3	99.99	3.0	97.0
BH-4	103.17	1.0	102.2
BH-5	65.95	27.0	39.0
BH-6	71.11	35.0	36.1
BH-7	68.22	15.0	53.2
BH-8	45.21	Not Encountered (possible boulder in BH-10)	
BH-9	34.75		
BH-10	21.67		
BH-11	21.06		
BH-13	73.83	16.1	63.7
BH-14	43.11	24.0	19.1
BH-15	87.10	30.0	57.1

4.3.3 Unconfined Compressive Strength (UCS)

The strength of the intact bedrock was determined by conducting Unconfined Compressive Strength (UCS) on select bedrock samples. A summary of the results of the laboratory testing carried out on the bedrock encountered is presented in Table 3.

Table 3 UCS Testing Summary

Borehole ID	Depth (m)	Density (g/cm^3)*	Rock Type	RQD (%) at test depth	UCS (MPa)
BH-1	14’0” – 14’7”	2.69	Granite	95%	169.3
BH-1	17’0” – 17’6”	2.74	Granite	98%	136.2
BH-13	NA	NA	Gneiss	-	NA**

*Note: Estimated unit weight determined from core samples selected for UCS determination

**No samples of sufficient size to allow for UCS testing

5.0 DISCUSSIONS AND RECOMMENDATIONS

5.1 EMERA BRUNSWICK PIPELINE COMPANY (EBPC)

A portion of the proposed development falls within the 'Prescribed Area' of the existing Emera Brunswick Pipeline Company (EBPC). The Prescribed Area is defined as a *strip of land measured 30 metres perpendicularly on each side from the centreline of the pipe*[1].

The existing pipeline is understood to be a 30" diameter, 14,000 psi thick-walled pipe and is located immediately west of the proposed development. The approximate location of the pipeline as well as the right of way (ROW) and prescribed zone are shown on Drawing No. E-0010 dated March 12, 2021 provided in **Appendix D**.

Work or planned work within this prescribed area requires an **On-Site Activity Permit** to be issued by EBPC. This work includes, but is not limited to:

- Surface Facilities (e.g., buildings, parking lots, monuments)
  - Fencing
  - New Facilities within the prescribed area but not crossing the pipeline
  - Landscaping
- Excavations (e.g., trenches, foundations, boreholes, directions drilling, backfilling, open pits)
- Overhead facilities (e.g., powerlines, towers)
- Abandonment of facilities
- Crossings
  - Surface (e.g., roads, driveways/access roads, sidewalks, railway)
  - Subsurface (e.g., cables, utility pipes, transmission/ distribution pipes)
- Construction.

Blasting activities within 200 metres (656 ft) of the pipeline, even outside the prescribed zone also require an **On-Site Activity Permit.**

5.2 GENERAL

The purpose of the geotechnical investigation was to obtain information on the subsurface conditions at the main site for feasibility level assessment and preliminary geotechnical design.

Within the area of the MBBR-1, MBBR-2, Clarifier, and AHU, bedrock was generally located at, or near, the existing ground surface. It is expected that for these structures, bedrock will be removed, or structural fill will be placed over bedrock, to achieve the design grades.

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[1] Brunswick Pipeline *On-Site Activity Permit Application and Technical Guideline, pp 2 of 25*

While not desirable to have differing foundation types for the same structure, due to the change in grades within the proposed footprint of the Equalization Tank, Heat Exchangers (HE-1 / HE-2), and Main Building, it is expected that a portion of these structures will require bedrock removal, and a portion will be supported by a deep foundation (piles).

Based on our investigation, following bedrock removal, and select structural infilling for the MBBR-1, MBBR-2, Clarifier, and AHU, the site is suitable for strip/spread footings and slab on grade construction.

Any portion of the development where the overburden soils are more than 10 ft in thickness, will require deep foundations.

5.2.1 SITE PREPARATION

The surficial vegetation and rootmat is not considered suitable for support of the structure foundations and should be removed in its entirety from the footprint of the proposed structures.

5.2.2 Bedrock Excavation

At the time of writing, the design grades are considered preliminary; however, it is anticipated that bedrock excavation will be required to reach the final design grades within all, or a portion of, the final footprint of the proposed structures. It is not anticipated that rock breaking alone will be sufficient to remove the rock in its entirety.

Line drilling to define the excavation limits, followed by rock breaking and/or blasting should be considered. The Contractor selected to complete this work should be considered responsible for determining the means and methods for bedrock removal.

The required rock excavation will generate vibrations that will be perceptible by the people in neighbouring properties and could also have a negative impact on infrastructure in proximity. It is recommended that the contract include an operational constraint limiting the acceptance level of vibrations generated by the proposed construction activities. Determination of the acceptable limits should take into consideration the surrounding land uses and activities, including but not limited to the following:

- Proximity to nearby structures;
- Potential impacts to buried services (e.g., gas lines, communication cables, etc.) which may have stringent criteria;
- The potential impact on groundwater levels; and
- The potential impacts on hydraulic properties of the surrounding bedrock formation.

To prevent damage, the typical vibration tolerance levels for both buildings and infrastructure are typically 1 inch/sec to 2 inches/sec; however, the governing criterial should be confirmed by the Owner and in consultation with geotechnical personnel after the pre-construction surveys are completed and prior to the start of construction. In addition, vibration monitoring should be carried out throughout the bedrock excavation activities.

5.2.3 Temporary Excavations

Safe excavation slopes depend on the soil or rock type and the expected excavation depth. At the time of writing, the expected elevation of various structures are as follows:

• MBBR-1	80 ft – 0 in (U/S)
• MBBR-2	75 ft - 0 in (U/S)
• Equalization Tank	53 ft – 0 in (U/S)
• Clarifier	75 ft – 0 in (U/S)
• Heat Exchanger(s)	75 ft – 0 in
• Main Building	52 ft – 0 in (Ground Floor)
• AHU	106 ft – 6 in

Excavation of bedrock within the footprints of MBBR-1, MBBR-2, Heat Exchangers, and Clarifier on order of 5 ft to 35 ft will be required. For preliminary design, excavations within the bedrock should be carried out at 1H:10V. Should weathered bedrock be observed at the surface, slopes should be excavated at 1H:1V.

Excavation of FILL materials up to 20 ft. is anticipated within the footprint of the Equalization Tank and the Main Building. For preliminary design, temporary excavations in FILL should be carried out at 3H:1V. The excavation slopes should be carefully monitored by geotechnical personnel and flattened as, and when, required.

As a minimum, temporary excavations must be sloped in accordance with the applicable New Brunswick Occupational Health and Safety Guidelines. If an excavation cannot be properly sloped or benched, the Contractor should install an engineered shoring system to safely support the temporary excavation.

Temporary slopes within FILL materials should be protected from surface runoff erosion by means of berms and swales located along the top of the slope and by means of plastic sheeting placed over the slope. Soil stockpiles should not be located within 1.5 times the height of the excavation depth to avoid surcharging the excavation walls/slopes.

5.2.4 Structural Fill

Imported structural fill is recommended for use as backfill. Structural fill should consist of an approved clean well graded granular material which is free of organic and deleterious material, such as quarried rock or crushed pit run gravel or other approved inorganic soil. Unless otherwise specified, imported backfill should consist of clean gravel having a maximum particle size of 5 inches and less than 5% by weight passing the 75-micron sieve, maintained at a suitable moisture content to achieve the specified compaction.

The lift thickness used during placement of imported backfill should be compatible with the compaction equipment and material type, so the required density is achieved throughout the lift thickness. Backfill should be placed in lifts suitable to achieve compaction throughout the entire lift thickness with the compaction equipment provided, typically 1 foot, or less. Backfill should be compacted to a minimum of 95 percent of the material's maximum dry density as tested in accordance with ASTM D1557 (modified Proctor). For light, hand-operated compaction equipment, thinner lifts may be necessary to achieve the specified compaction criteria.

It is expected that some structural fill will be required to raise the grade within the (plant) north end of the Main Building. Up to 10 feet of structural fill is anticipated. Structural fill should be placed at maximum slopes of 2H:1V.

Fill placement is also anticipated to raise the grade of the AHU (approximately 15 feet). Excavation and replacement of overburden soils, on the order of 8 feet, is also anticipated within the footprint of the MBBR-1

Fill compaction should be verified by means of field testing. In the event of winter construction, fill should be placed and compacted in an unfrozen condition.

Re-use of excavated site soils for backfilling is best determined at the time of construction.

5.2.5 Rock Fill

It is expected that the bedrock removed from within the footprint of the proposed structures will be used as rock fill where required. The following recommendations should be followed:

- Rock fill should be clean and free of debris with a maximum particle size of 2 ft.
- Rock fill should be placed in lifts not exceeding 4 ft in loose thickness and be compacted throughout the lift thickness to a minimum of 80% relative density.
- Rock fill should not be placed within 4 ft of the structure foundations.
- A transition zone of granular fill should be considered in lieu of geotextile fabric which may tear when placed on rockfill.
  - The transition zone should incorporate a minimum of two smaller aggregate gradations between the rock fill and the base granular material (i.e., 8-10 inch minus and 4 inch minus aggregate) a minimum of 1 foot thickness each.
  - Consideration can also be given to a geotextile fabric between the 4 inch minus aggregate and smaller aggregate materials.

5.3 MBBR-1, MBBR-2, CLARIFIER, AND AHU

5.3.1 Foundations

Based on the bedrock conditions encountered within the area of the MBBR-1, MBBR-2, Clarifier, and AHU, conventional strip/spread footings are feasible for support of the proposed structure(s). The recommendations assume that the footings will be founded on bedrock, or structural fill overlying bedrock.

Following the removal of the existing FILL, structural fill should be placed (if required) and compacted to achieve the required design subgrade elevations, as required.

Excavation down to bedrock and replacement of existing overburden soils with structural fill, within the footprint of the MBBR-1 will be required to meet the foundation design recommendations.

If encountered, weathered, or severely fractured bedrock should be removed from the footing locations. For strip/spread footings founded on sound bedrock, a factored geotechnical bearing resistance at ultimate limit states of 45 tons/sq. ft may be used. For this recommended bearing resistance, total settlements of footings founded on bedrock are expected to be less than ½ inch. A resistance factor of 0.5 has been applied to the ULS value.

If founding on bedrock, bedrock surfaces to receive concrete for the construction of foundations should be cleaned and free of debris. The uneven, clean surface of bedrock should be leveled with a mud slab to achieve a level surface for construction of reinforced concrete footings.

The base of footing excavations should be inspected by qualified geotechnical personnel prior to placing concrete to confirm the recommended bearing pressure.

5.3.2 Slab-on-Grade

The site prepared as detailed herein is suitable for slab on grade construction for the proposed development. The slab can be designed for a modulus of subgrade reaction of 150 tons/ft^3 (valid for a 1 ft by 1 ft square plate) provided the following recommendations are followed.

Following the site clearing and preparation activities, a 6-inch-thick layer of free draining granular material, such as ¾ inch minus crushed stone, should be placed immediately beneath the floor slab for leveling and support purposes. The crushed stone should be compacted to a minimum of 95% of the materials corrected maximum dry density, as determined in accordance with ASTM D1557 (modified Proctor).

The slab on grade should be structurally separated from load bearing walls and/or columns to reduce potential cracking. Perimeter drainage, with a positive outlet, is recommended.

A qualified geotechnical engineer should observe the slab on grade bearing surfaces prior to concrete placement.

5.3.3 Frost Depth

The depth of frost penetration is 5 ft in the area of the proposed development. Therefore, for frost protection, footings founded on structural fill (MBBR-1) should extend a minimum of 5 ft below the final grade, or an equivalent amount of insultation should be used.

If a footing is founded directly on sound bedrock, a reduced soil cover of 2 feet can be used.

The thickness of the insulation and lateral distance the insulation should extend will be based on the final foundation depth and building temperature. Once the final design is complete, Stantec would be pleased to provide you with insulation details for the project.

5.3.4 Seismic Site Classification

For the bedrock conditions encountered within the MBBR-1, MBBR-2, and Clarifier footprints, Seismic Site Class C – Very Dense Soil and Soft Rock (Table 4.1.8.4-A of the National Building Code of Canada (NBC), 2015) can be used. To change the site classification from C to either A or B, a seismic velocity profile within the overburden and bedrock to a depth of 30 m below foundation elevation will be required.

5.4 HEAT EXCHANGERS

The investigation did not extend within the entire footprint of the heat exchangers; however, it was observed during our site walkover, that the existing power poles are founded on a large bedrock outcrop.

Two options will need to be considered for these structures:

1. The majority of the footprint of the heat exchangers will bear on bedrock and only a small portion will require in-filling expected to be less than 10 ft. For this case, it is recommended that the overburden soils be removed down to bedrock and any infilling required be brought to grade with lean concrete. Then the foundation recommendations provided in Section 5.3 can be followed.
2. A portion of the footprint will be founded on bedrock and a portion will be founded on existing FILL materials. In this case, the recommendations provided in Section 5.5 should be followed.

Additional boreholes are recommended to determine which of the above two options is feasible and practical.

5.5 MAIN BUILDING AND EQUALIZATION TANK

5.5.1 Foundations

As stated earlier, it is expected that a portion of these structures will be founded on bedrock and a portion will require deep foundation support as the fill materials in this area are not suitable for support of these structures. Excavation and replacement of existing fill material is not considered practical.

For the portion of the structure founded on bedrock, the recommendations provided in Section 5.3 can be followed.

A gradual transition between the two foundation types will be required. The transition from the pile supported portion to bedrock supported portion is expected to have flexible construction joints to accommodate anticipated differential settlements.

5.5.2 Pile Foundations

Various pile types and sizes may be considered for these structures. At this time, we have reviewed H-Piles (HP 12x89) driven to refusal on bedrock. We would be pleased to review other piles sections, if requested.

The borehole information is given for the location tested and should only be used to determine approximate pile lengths in the immediate area. Based on this assumption, pile lengths are estimated to vary between 10 feet and 33 feet based on the current structure elevations. Pile lengths will increase toward the eastern portion of the site.

The pile tips should have driving shoes for ease of advancing through the overburden soils.

For an HP12x89, the ultimate axial compressive load can be taken as 775 kips and the factored axial compressive load can be taken as 310 kips. A resistance factors of 0.4 was applied to the ultimate axial capacity in calculating the factored compressive load. PDA testing is recommended to validate the estimated axial load capacity.

Uplifts and lateral load analysis, if required, can be provided.

5.5.3 Frost Depth

The depth of frost penetration is 5 ft in the area of the proposed development. Therefore, for frost protection, the pile caps should be founded a minimum of 5 ft below the final exterior grade, or an equivalent amount of insultation should be used and the footings founded on sound bedrock should have a minimum of 2 ft of soil cover.

If required, the thickness of the insulation and lateral distance the insulation should extend will be based on the final foundation depth and building temperature. Once the final design is complete, Stantec would be pleased to provide you with insulation details for the project.

5.5.4 Seismic Site Classification

Based on the overburden soils encountered, the recommended site classification for seismic site response for the Main building and Equalization Tank is Seismic Site Class D as determined in accordance with Table 4.1.8.4.-A of the 2015 National Building Code (NBC).

5.5.5 Lateral Earth Pressures – Retaining Walls

If required, the total lateral pressure on retaining walls will consist of the cumulative loading imposed by the soil pressure, water pressure (if applicable), and surcharge due to surface or traffic loads. It is recommended that the design of the wall be developed based on an at-rest condition against the back of the wall. The retaining/basement walls should be backfilled with well-graded granular structural fill as described further in this sub-section. The geotechnical design parameters summarized in Table 4 should be used in the design of a retaining wall at the project site. The design parameters presented in Table 4 are applicable for a horizontal backfill condition. These parameters should not be used for sloping backfill.

Table 4 Geotechnical Design Parameters- Retaining Walls

PARAMETER	STRUCTURAL FILL
Total Unit Weight (lb/ft^3), γ	125 lb/ft^3
Buoyant Unit Weight (lb/ft^3), γ'	62.6 lb/ft^3
Effective Angle of Internal Friction, φ	30°
Coefficient of Earth Pressure, at rest, K_0	0.50
Coefficient of Earth Pressure, active, K_a	0.33
Coefficient of Earth Pressure, passive, K_p	3.0
Coefficient of friction between Concrete and BEDROCK	0.6

The geotechnical design parameters summarized in Table 4 should be used in the design of permanent retaining walls.

Imported backfill/Structural fill should consist of an approved clean well-graded granular material which is free of organic and deleterious material, such as quarried rock, or crushed pit run gravel, or other approved inorganic soil. Unless otherwise specified, imported backfill should consist of clean gravel having a maximum particle size of 6 inches and less than 5%, by weight, passing the 75-micron sieve.

The lift thickness used during placement of imported/structural fill should be compatible with the compaction equipment and material type so the required density is achieved throughout the lift thickness. Imported/structural fill should be placed in lifts not exceeding 12 inches in loose thickness and be compacted throughout the lift thickness to a minimum of 95 percent of the material’s maximum dry density as tested in accordance with ASTM D1557 (modified Proctor). For light, hand-operated compaction equipment, thinner lifts may be necessary to achieve the specified compaction criteria.

5.6 ROADWAYS

Two options have been considered for the roadway design at the site:

1. Pavement Structure
2. Gravel Structure

These structures have been determined based on heavy-duty traffic (loaded semis) and automobile traffic. It is anticipated that the subgrade will vary from rock to site fill materials.

The recommendations for the roadway structures are as follows:

- Grade the areas to subgrade elevation in both the rock and the fill areas.
- In the transition areas, where the subgrade type changes from fill to rock, if applicable, the rock should be over-broken by 12 inches to facilitate drainage and mitigate differential frost movements.
- If required, structural/imported fill, as described herein, should be used to achieve subgrade elevation.

- Excavated bedrock from the site can be used as subgrade fill provided that it meets the following criteria:
  - Well-graded 6 inch minus rock
  - Compaction can be achieved to the required density.
- Site preparation as described herein should be followed.
- The compacted subgrade surface should be proof rolled with a loaded tandem truck under direct geotechnical supervision. Areas exhibiting more than ½ inch of deflection should be over-excavated and backfilled with structural/imported fill.
- A woven geotextile should be placed between the prepared subgrade and the Aggregate Subbase for the Granular Surface option. Terratrack 200W, or approved equivalent, is recommended.

The required roadway structure is presented in Table 5. Pavement contractors typically design in metric units; therefore, metric units have been provided for this section.

Table 5 Roadway Structure Options

MATERIAL	MATERIAL THICKNESS	
	ASPHALT PAVEMENT	GRANULAR STRUCTURE
Asphalt Surface: Mix Type D	55 mm	NA
Asphalt Base: Mix Type B	65 mm	NA
Aggregate Base, 31.5 mm Crushed Rock	200 mm	150 mm
Aggregate Subbase, 75 mm Crushed Rock	450 mm	400 mm

The asphalt and granular requirements for production and placement should be in accordance with the current applicable NBDTI requirements.

It should also be noted that if the Granular Structure is used initially and then pavement is considered in the future, the granular thicknesses should be increased to meet the design recommendations in the Asphalt Pavement Section.

5.7 GENERAL CONSTRUCTION RECOMMENDATIONS

5.7.1 Construction Dewatering

Based on the groundwater levels measured and the assumed final grades, the majority of the excavation is expected to be above the water table, but localized dewatering may be required depending on seasonal groundwater levels. Construction dewatering may be accomplished by using traditional sump and pump techniques.

5.7.2 Bearing Surfaces

Foundation surfaces should never be cast on loose, soft, or frozen soil, slough, debris, or surfaces covered by standing water. A qualified geotechnical engineer should observe foundation bearing surfaces prior to concrete placement.

5.7.3 Field Inspection

It is recommended that inspection by experienced geotechnical personnel be carried out during site grading as well as foundation and subgrade preparation to ensure that unsuitable materials are removed; only suitable materials are to be used as structural fill (if required), and materials placed are compacted to the required density.

5.7.4 Winter Construction

Should construction be completed during the winter months, care should be taken to ensure that bearing soils remain free of frost penetration prior to, and following, the casting of concrete. The foundation subgrade must be protected from freezing.

Excavations and exposed subgrade should be maintained in a dry and unfrozen condition throughout construction. Soils that become disturbed/softened during construction should be over-excavated and replaced with structural fill as described.

Further recommendations for winter construction can be provided upon request.

6.0 CLOSURE

Use of this report is subject to the Statement of General Conditions, provided in **Appendix A**. It is the responsibility of Irving Pulp & Paper, Limited, who is identified as “the Client” within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report;
- Basis of the report;
- Standard of care;
- Interpretation of site conditions;
- Varying or unexpected site conditions; and
- Planning, design, or construction.

We trust that the information contained in this report is adequate for your present purposes. If you have questions about the contents of this report, or if we can be of further assistance, please do not hesitate to contact us at your convenience at (506) 634-2185.

April 1, 2021

Appendix A STATEMENT OF GENERAL CONDITIONS

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

Appendix B SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

BOREHOLE RECORDS

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

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

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

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

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

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

Terminology describing rock strength:

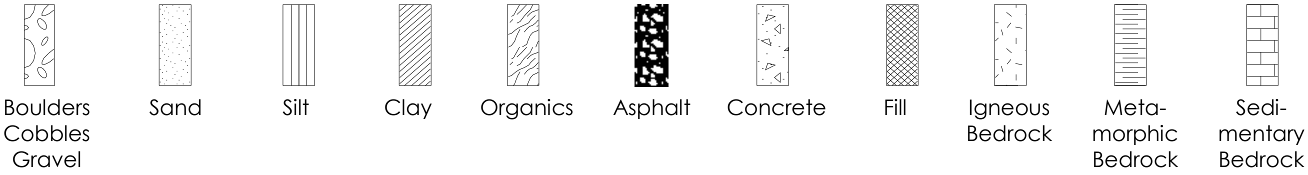
Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

▼	measured in standpipe, piezometer, or well
▽	inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to ‘A’ size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_U	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

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BOREHOLE RECORD

BH-1

CLIENT **IRVING PULP & PAPER LIMITED**
LOCATION **Effluent Treatment Plant - Option 2D**
DATES: BORING **2021/02/01**
WATER LEVEL **Not Observed**
PROJECT No. **121623357**
BOREHOLE No. **BH-1**
DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	94.84	Vegetation and Rootmat at surface					in.	
0		Dark to reddish brown sandy lean CLAY (CL) to clayey SAND (SC) with gravel (inferred from the auger cuttings)						
5	89.1	Fair to excellent quality grey to pink GRANITE			HQ	1	100%	74%
10					HQ	2	96%	95%
15					HQ	3	98%	98%
20	74.3	End of Borehole						
25								

Undrained Shear Strength - psf
2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

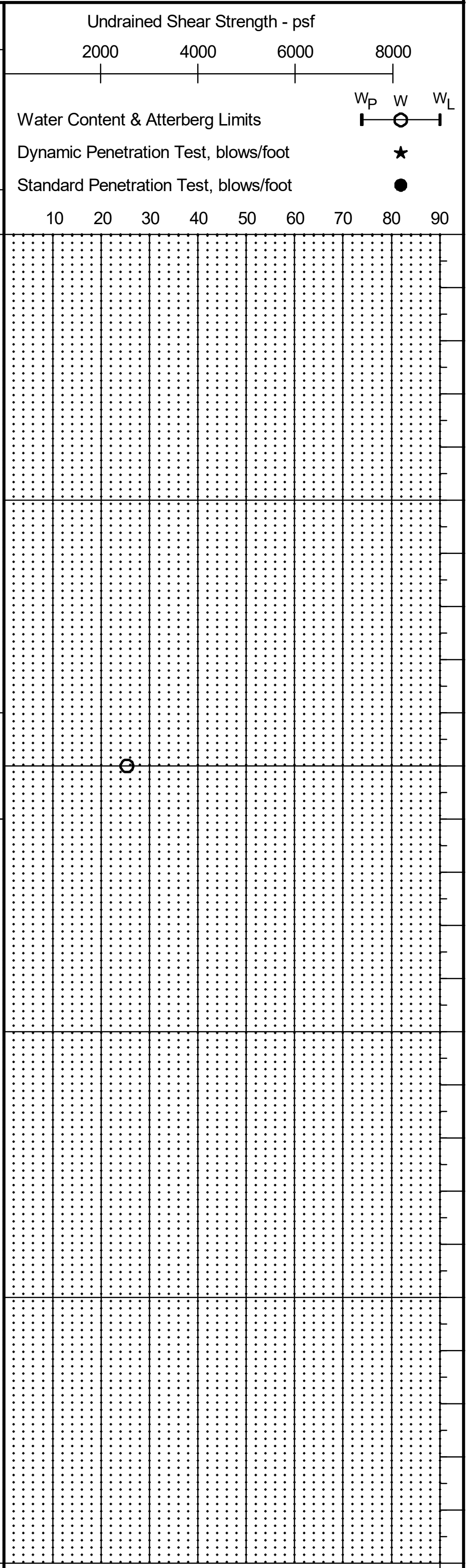
Stantec

BOREHOLE RECORD

BH-2

CLIENT **IRVING PULP & PAPER LIMITED**
LOCATION **Effluent Treatment Plant - Option 2D**
DATES: BORING **2021/02/01**
WATER LEVEL **Not Observed**
PROJECT No. **121623357**
BOREHOLE No. **BH-2**
DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	94.16	Vegetation and Rootmat at surface					in.	
0		Reddish brown clayey SAND (SC) with gravel to sandy lean CLAY (CL) -some cobbles throughout (inferred from the auger cuttings)						
5	85.2	(interface is approximate)						
10		Reddish brown lean CLAY (CL) (inferred from the auger cuttings)			GS	1		
	83.2	Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						
15								
20								
25								



△ Unconfined Compression Test
☐ Field Vane Test
■ Remoulded

Stantec

BOREHOLE RECORD

BH-3

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/01**

WATER LEVEL **Not Observed**

PROJECT No. **121623357**

BOREHOLE No. **BH-3**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	99.99	Vegetation and Rootmat at surface					in.	
0	97.0	Dark brown clayey SAND (SC) with gravel to sandy lean CLAY (CL) (inferred from auger cuttings)	▨					
		Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						
5								
10								
15								
20								
25								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Stantec

BOREHOLE RECORD

BH-4

CLIENT **IRVING PULP & PAPER LIMITED**

PROJECT No. **121623357**

LOCATION **Effluent Treatment Plant - Option 2D**

BOREHOLE No. **BH-4**

DATES: BORING **2021/02/01**

WATER LEVEL **Not Observed**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	103.17	Vegetation and Rootmat at surface					in.	
0	102.2	Brown sandy lean CLAY (CL) to clayey SAND (SC) with gravel -some cobbles (inferred from auger cuttings)	▨					
		Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						
5								
10								
15								
20								
25								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

BOREHOLE RECORD

BH-5

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/01**

WATER LEVEL **12.0 ft on 2021/02/01**

PROJECT No. **121623357**

BOREHOLE No. **BH-5**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	65.95	Vegetation and Rootmat at surface					in.	
0		FILL: dark brown to black heterogeneous fill containing silty sand with gravel -cobbles throughout	▩					
5			▩					
	58.0	(interface is approximate)	▩					
		FILL: dark to light brown sandy lean clay to clayey sand with gravel -cobbles throughout (inferred from auger cuttings)	▩					
10			▩					
			▩	▼				
15			▩					
20			▩					
25								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Continued Next Page

Stantec

BOREHOLE RECORD

BH-5

CLIENT **IRVING PULP & PAPER LIMITED**

PROJECT No. **121623357**

LOCATION **Effluent Treatment Plant - Option 2D**

BOREHOLE No. **BH-5**

DATES: BORING **2021/02/01**

WATER LEVEL **12.0 ft on 2021/02/01**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES			
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD
							in.	
25	39.0	FILL continued -rock fragments at 26 feet	▨					
		Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						
30								
35								
40								
45								
50								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

BOREHOLE RECORD

BH-6

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/01**

WATER LEVEL **18.0 ft on 2021/02/01**

PROJECT No. **121623357**

BOREHOLE No. **BH-6**

DATUM **Plant Datum**

Undrained Shear Strength - psf: 2000, 4000, 6000, 8000

Water Content & Atterberg Limits: W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	71.11	Vegetation and Rootmat at surface					in.	
0		FILL: dark brown to black heterogeneous fill containing silt and clay (inferred from auger cuttings)	▨					
5			▨					
10			▨					
15			▨					
			▨	▼				
20			▨					
		-increased sand content from 22 feet	▨					
25								

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Continued Next Page

Stantec

BOREHOLE RECORD

BH-6

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/01**

WATER LEVEL **18.0 ft on 2021/02/01**

PROJECT No. **121623357**

BOREHOLE No. **BH-6**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SAMPLES N-VALUE OR RQD
25		FILL continued	▩					
35	36.1	Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						

Depth scale: 25, 30, 35, 40, 45, 50

Undrained Shear Strength - psf: 2000, 4000, 6000, 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Stantec

BOREHOLE RECORD

BH-7

CLIENT **IRVING PULP & PAPER LIMITED**

PROJECT No. **121623357**

LOCATION **Effluent Treatment Plant - Option 2D**

BOREHOLE No. **BH-7**

DATES: BORING **2021/02/01**

WATER LEVEL **14.5 ft on 2021/02/01**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY	N-VALUE OR RQD
	68.22	Vegetation and Rootmat at surface					in.	
0		FILL: black heterogenous fill containing sandy clay to clayey sand with gravel (inferred from auger cuttings)	▨					
5			▨					
10			▨					
		-wood chips from 12-14 feet	▨					
	53.2		▨	▼				
15		Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						
20								
25								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits	W_P W W_L
Dynamic Penetration Test, blows/foot	★
Standard Penetration Test, blows/foot	●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

BOREHOLE RECORD

BH-8

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/03**

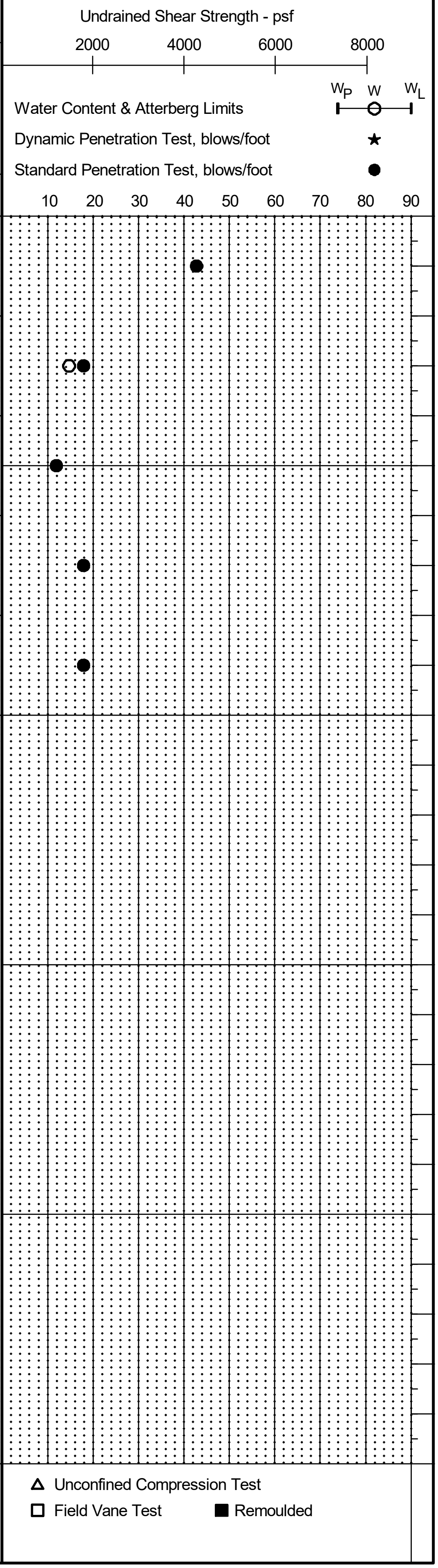
WATER LEVEL **7.0 ft on 2021/02/03**

PROJECT No. **121623357**

BOREHOLE No. **BH-8**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	45.21	Crushed Rock at surface					in.	
0	45.0	FILL: brown poorly graded sand with gravel	▨		SS	1	19	43
		FILL: grey to brown to black clayey sand with gravel to sandy lean clay with gravel	▨		SS	2	8	18
	41.2	FILL: reddish brown, lean clay -with frequent sand seams throughout	▨					
5			▨		SS	3	20	12
			▨	▼	SS	4	24	18
			▨		SS	5	24	18
10	35.2	End of Borehole						
15								
20								
25								



BOREHOLE RECORD

BH-9

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/03**

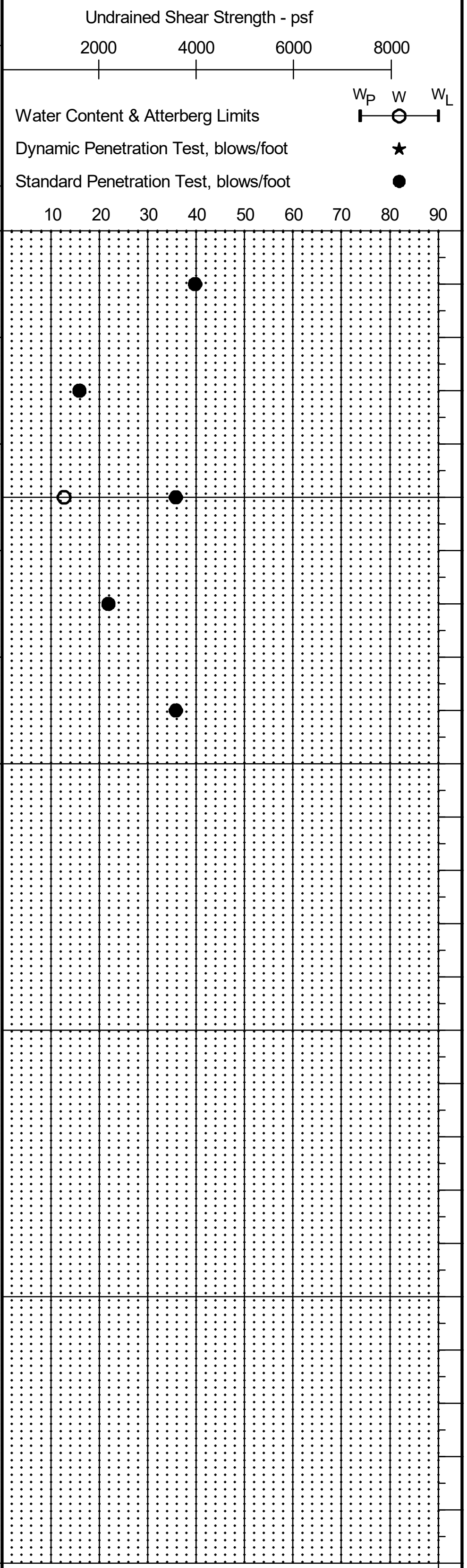
WATER LEVEL **4.0 ft on 2021/02/03**

PROJECT No. **121623357**

BOREHOLE No. **BH-9**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (in.)	SAMPLES N-VALUE OR RQD
0	34.75	Crushed Rock at surface						
	34.5	FILL: brown poorly graded sand with gravel	▨		SS	1	20	40
		FILL: grey to brown clayey sand with gravel to sandy lean clay with gravel	▨		SS	2	13	16
			▨	▼				
5		-some cobbles at 4.5 feet	▨		SS	3	15	36
			▨		SS	4	23	22
	26.8	-rock fragments at 7.5 feet	▨					
		FILL: reddish brown lean clay -with frequent sand seams throughout -some gravel throughout	▨		SS	5	22	36
10	24.8	End of Borehole						
15								
20								
25								



△ Unconfined Compression Test

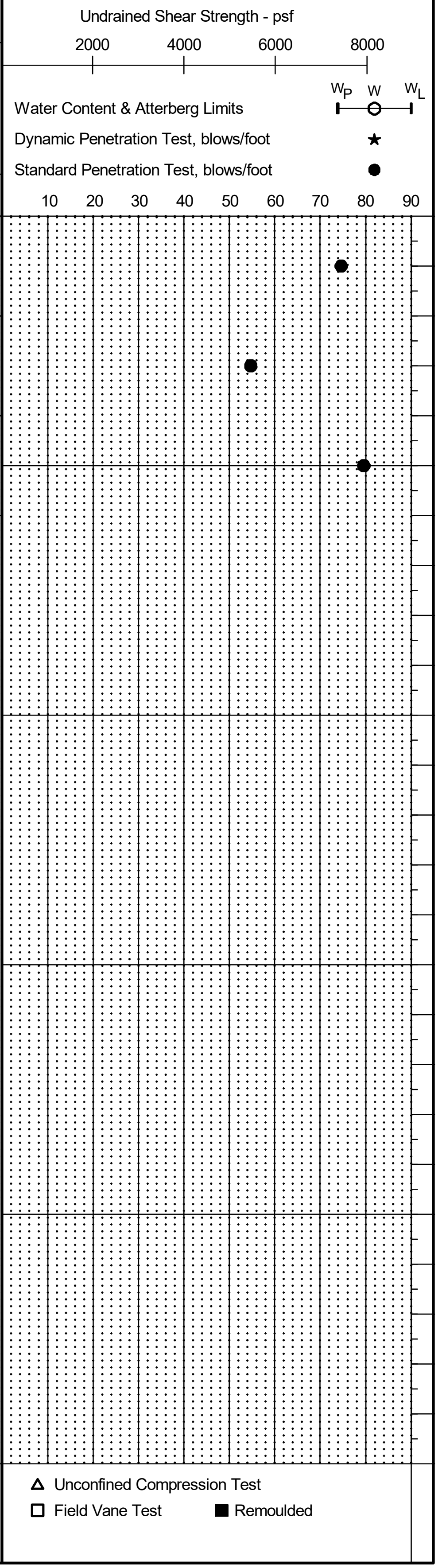
☐ Field Vane Test ■ Remoulded

BOREHOLE RECORD

BH-10

CLIENT **IRVING PULP & PAPER LIMITED**
LOCATION **Effluent Treatment Plant - Option 2D**
DATES: BORING **2021/02/03**
WATER LEVEL **Not Observed**
PROJECT No. **121623357**
BOREHOLE No. **BH-10**
DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY in.	SAMPLES N-VALUE OR RQD
0	21.67	Crushed Rock at surface						
		FILL: grey to black poorly graded sand with gravel to poorly graded gravel with sand -some cobbles throughout	▨		SS	1	24	75
			▨		SS	2	16	55
5	15.7	-some wood fragments at 5 feet	▨		SS	3	13	80/11
		Practical refusal to further penetration of the auger. *Possible BOULDER* End of Borehole						
10								
15								
20								
25								



BOREHOLE RECORD

BH-11

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/03**

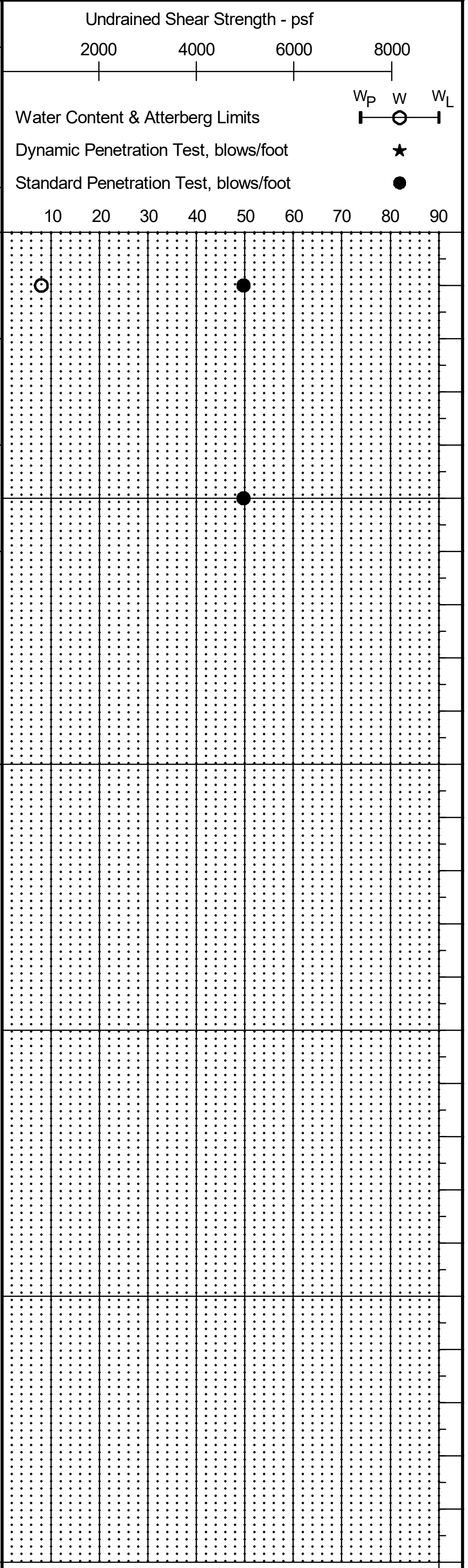
WATER LEVEL **Not Observed**

PROJECT No. **121623357**

BOREHOLE No. **BH-11**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	21.06	Crushed Rock at surface					in.	
0		FILL: grey poorly graded gravel with clay and sand to poorly graded sand with clay and gravel -cobbles and boulders throughout	▨		SS	1	7	50/5
			▨		GS	2		
5			▨		SS	3	10	50/1
			▨		GS	4		
10	11.1	End of Borehole						
15								
20								
25								



△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

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BOREHOLE RECORD

BH-13

CLIENT **IRVING PULP & PAPER LIMITED**

PROJECT No. **121623357**

LOCATION **Effluent Treatment Plant - Option 2D**

BOREHOLE No. **BH-13**

DATES: BORING **2021/02/09**

WATER LEVEL **Not Observed**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	73.83						in.	
0	73.7	FILL: reddish brown clayey sand with gravel						
		Poor to fair quality grey GNEISS -with green bands			HQ	1	98%	48%
5					HQ	2	100%	74%
10	63.7	End of Borehole						
15								
20								
25								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

BOREHOLE RECORD

BH-14

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/09**

WATER LEVEL **Not Observed**

PROJECT No. **121623357**

BOREHOLE No. **BH-14**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
	43.11	Vegetation and Rootmat at surface					in.	
0		FILL: brown sandy lean clay -some gravel (inferred from auger cuttings)	▨					
5			▨					
10			▨					
15			▨					
20			▨					
	19.1	Practical refusal to further penetration of						
25								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Continued Next Page

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BOREHOLE RECORD

BH-14

CLIENT **IRVING PULP & PAPER LIMITED**

PROJECT No. **121623357**

LOCATION **Effluent Treatment Plant - Option 2D**

BOREHOLE No. **BH-14**

DATES: BORING **2021/02/09**

WATER LEVEL **Not Observed**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							in.	
25		the auger *INFERRED BEDROCK*						
		End of Borehole						
30								
35								
40								
45								
50								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Stantec

BOREHOLE RECORD

BH-15

CLIENT **IRVING PULP & PAPER LIMITED**

LOCATION **Effluent Treatment Plant - Option 2D**

DATES: BORING **2021/02/09**

WATER LEVEL **25.0 ft on 2021/02/09**

PROJECT No. **121623357**

BOREHOLE No. **BH-15**

DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
							in.	
0	87.10	Vegetation and Rootmat at surface						
0–25		FILL: heterogeneous fill containing clay (inferred from auger cuttings)	▨					
25				▼				

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Continued Next Page

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BOREHOLE RECORD

BH-15

CLIENT **IRVING PULP & PAPER LIMITED**
PROJECT No. **121623357**
LOCATION **Effluent Treatment Plant - Option 2D**
BOREHOLE No. **BH-15**
DATES: BORING **2021/02/09**
WATER LEVEL **25.0 ft on 2021/02/09**
DATUM **Plant Datum**

DEPTH (ft)	ELEVATION (ft)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES			
					TYPE	NUMBER	RECOVERY	N-VALUE OR RQD
							in.	
25		FILL continued	▨					
30	57.1	Practical refusal to further penetration of the auger *INFERRED BEDROCK* End of Borehole						
35								
40								
45								
50								

Undrained Shear Strength - psf

2000 4000 6000 8000

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/foot ★

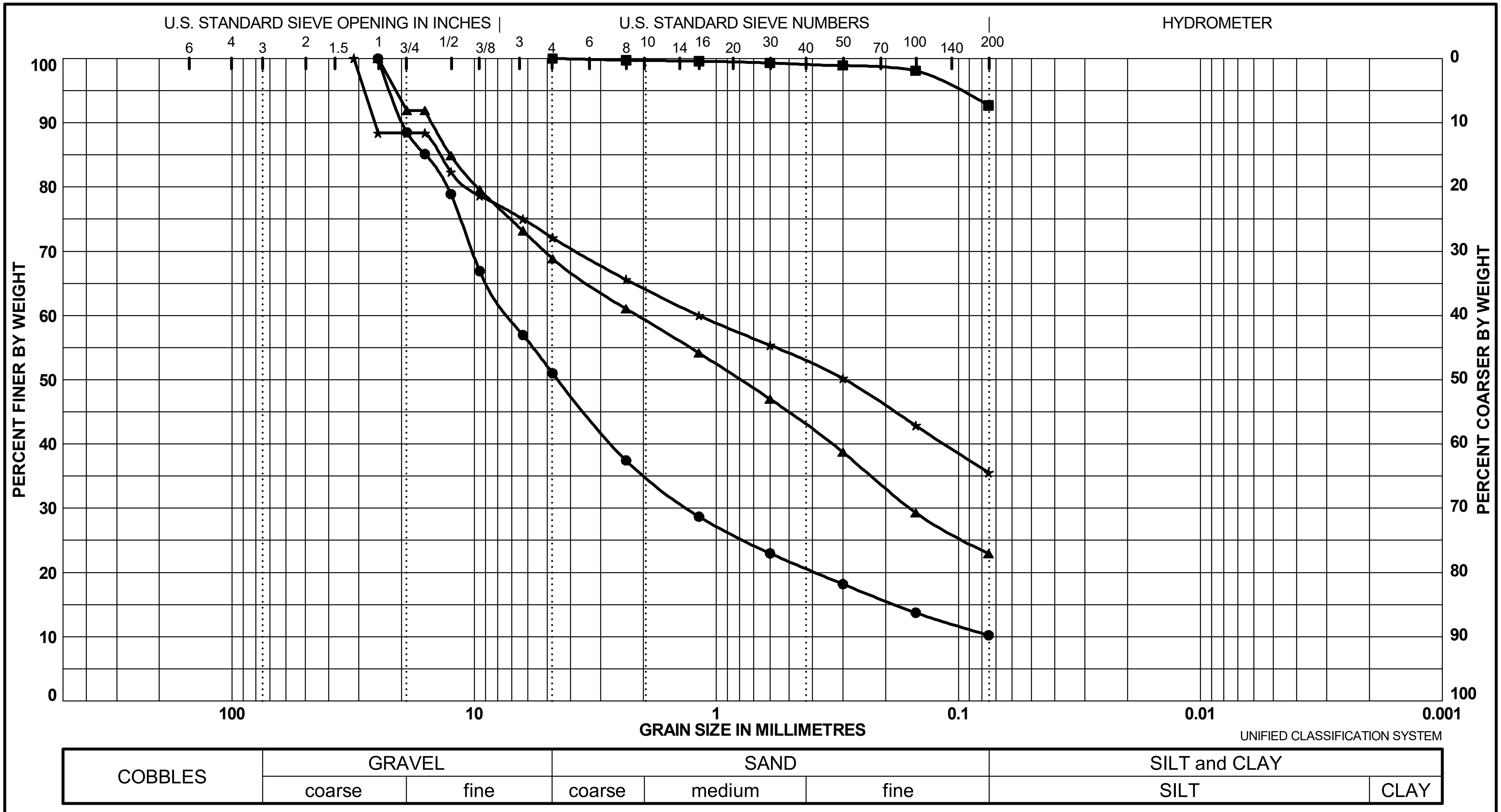
Standard Penetration Test, blows/foot ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

☐ Field Vane Test ■ Remoulded

Appendix C LABORATORY TEST RESULTS



Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH-11	1.0	FILL: Poorly graded gravel with clay and sand	8.1				49.0	40.8	10.2	
■	BH-2	10.0	Lean CLAY (CL)	25.5				0.0	7.3	92.7	
▲	BH-8	3.0	FILL: Clayey sand with gravel	14.8				31.2	45.9	22.9	
★	BH-9	5.0	FILL: Clayey sand with gravel	12.8				27.9	36.6	35.5	

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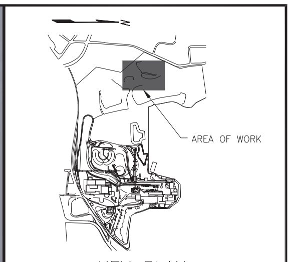
Project:	**Effluent Treatment Plant - Option 2D**	Location:	
Job No.:	**121623357**	Notes:	
Date:	**2021/03/25**	**GRADATION CURVES**	

Appendix D DRAWING



KEY PLAN

PRELIMINARY
FOR INFORMATION ONLY

No.	DATE	BY	DESCRIPTION	CHKD.
C	1 APR 2021	MEO	ISSUED TO CLIENT FOR INFORMATION	
B	12 MAR 2021	MEO	ISSUED TO CLIENT FOR REVIEW AND COMMENTS	
A	26 FEB 2021	MEO	ISSUED TO CLIENT FOR REVIEW AND COMMENTS	

REVISIONS

DWG. No.	TITLE

REFERENCE DRAWINGS

DRAWING STATUS

PRELIMINARY – NOT FOR CONSTRUCTION

DESIGNED H.Olive
DRAWN M.Ouellette
CHECKED
DESIGN
DRAFTING
DATE 02 FEB. 2021
SCALE AS NOTED
PROJECT MANAGER D.T.Mayo
SPECIFICATION No.
PROJECT TECHNICIAN G.T.Gagnon

Stantec

IRVING PULP & PAPER, LIMITED
SAINT JOHN, N.B.

AREA NAME 80 – EFFLUENT TREATMENT PLANT
EFFLUENT TREATMENT PLANT

SITE LAYOUT
EFFLUENT TREATMENT PLANT
OPTION 10

JOB No. 133548756
CONSULTANT DWG. No. E-0010
IPPL DWG. No.
SHT.
REV C

V:\1335\active\133548756\18_structural\3_drawing\1_Sketches\Site_Layout_Test.dwg

Nov 23, 2021 5:51pm meouellette