LA GRANDE ALLIANCE FEASIBILITY STUDY – PHASE I

PRELIMINARY GEOTECHNICAL INVESTIGATION – POTENTIAL BDH RAILWAY

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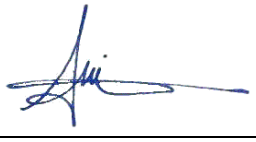
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1.0 Introduction

1.1 General

La Grande Alliance refers to the Memorandum of Understanding (MOU) on the Cree-Québec Sustainable Infrastructure Program in Eeyou Istchee Baie-James, signed between the Cree Nation Government (CNG) and the Government of Québec on February 17, 2020. The purpose of the MOU is to provide a framework for Cree local and regional entities to work closely with relevant Québec government ministries to connect, develop and protect the territory of the Eeyou Istchee Baie-James region of northern Québec in an inclusive and participatory manner. The main objective of La Grande Alliance is to build a promising program for the strategic, predictable, and sustainable development of the territory over a 30-year time horizon.

Infrastructure development is a major component of *La Grande Alliance*. The program aims at improving and building major transportation infrastructure on the territory, including the implementation of a railway alongside the Billy-Diamond Highway to Whapmagoostui, where the construction of a deep-water port is being considered. The current program is divided into three phases. Phase I being carried out by Vision Eeyou Istchee Consortium, focusing on the feasibility design of the following infrastructures:

- Upgrade of the existing access roads between the Billy-Diamond Highway (BDH) and the Cree communities of Waskaganish, Eastmain and Wemindji;
- Upgrade of the existing access road between the Route du Nord and the community of Nemaska;
- New railway along the Billy-Diamond Highway (BDH) between the town of Matagami and KM 257 of the same highway (Rupert River Bridge);
- Recommissioning of the railway line from Grevet (Lebel-sur-Quévillon) to Chapais (approximately 225 km);
- Construction of transfer areas along the Billy-Diamond Highway and Grevet-Chapais line corridors, specifically the area at KM 257;
- Upgrade of the Route du Nord, and;
- Construction of a secondary access road to the Cree Nation of Mistissini.

The location of the infrastructures listed above is shown on Figure 1.

Limitations associated with this report and its contents are provided in the Statement of General Conditions included in Appendix A.

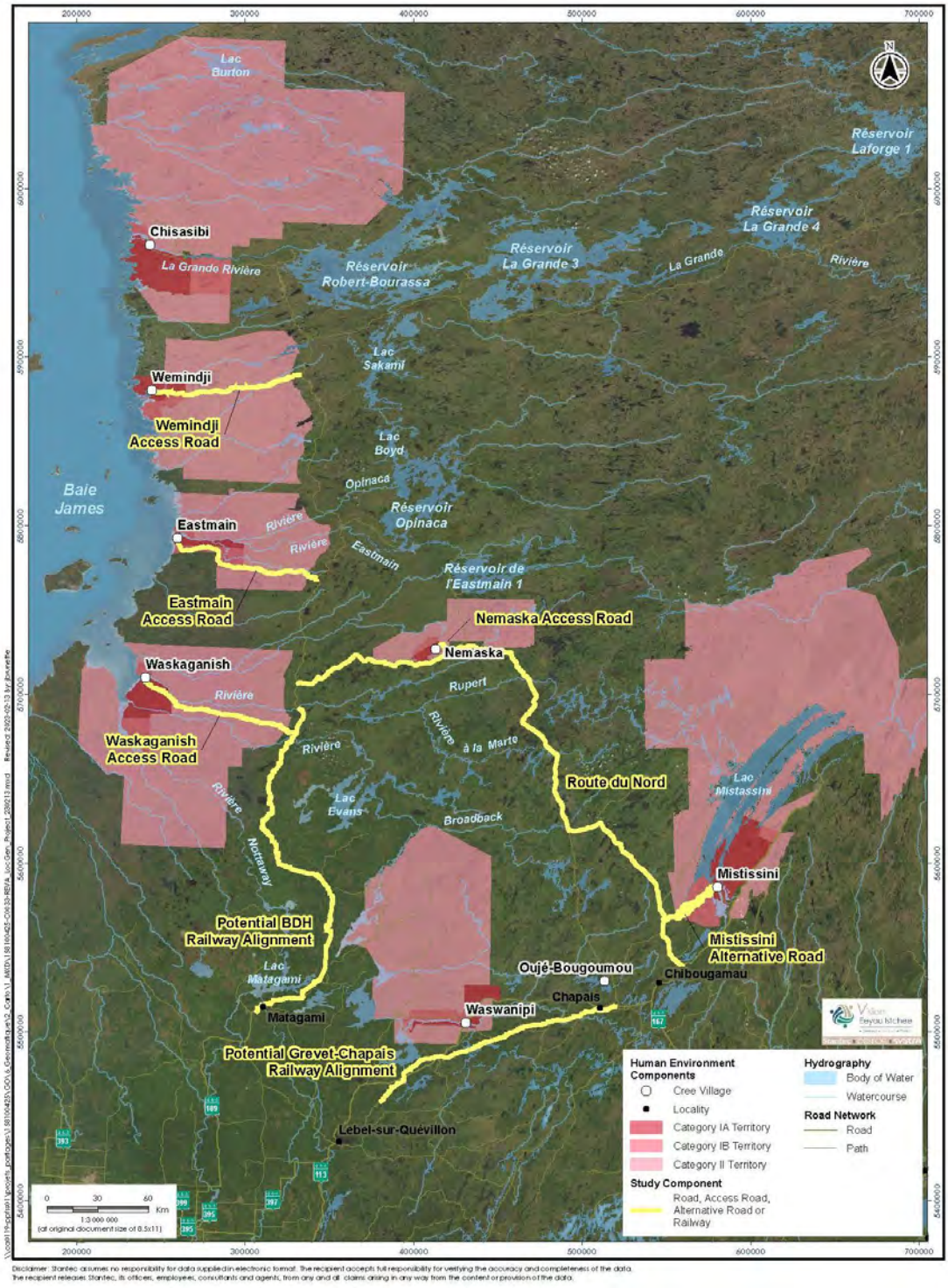


Figure 1 La Grande Alliance – Phase I Feasibility Study Area Overview

1.2 Scope of Work and Objective

As part of the Feasibility Study, the scope of work included carrying out a Preliminary Geotechnical Investigation for some of the transportation infrastructure corridors listed in Section 1.1 of this report.

The current report focuses on the potential Billy-Diamond Highway (BDH) Railway alignment located between the town of Matagami and the bridge of the Rupert River on the BDH, (the “Site”).

The preliminary geotechnical investigation was carried out to determine the site characteristics with regards to the nature and properties of soils and bedrock in place, and to identify areas with organic soil deposits (peats). The information gathered during this investigation was used to estimate the baseline in-situ conditions at the Site that feeds the Feasibility Study for the preliminary design of the potential BDH railway.

1.3 Site and Project Description

The project consists of the design, development, and construction of a new railway that will extend from the town of Matagami at south (KP 0) to the Rupert River at north (KP 253). It should be noted that the term « KM » will be used in this report to refer to the kilometer mark of the BDH while the term « KP » will be used to refer to the kilometer point of the future railway. A key plan showing the location of the Site is presented in Figure 2 below and in Appendix B.

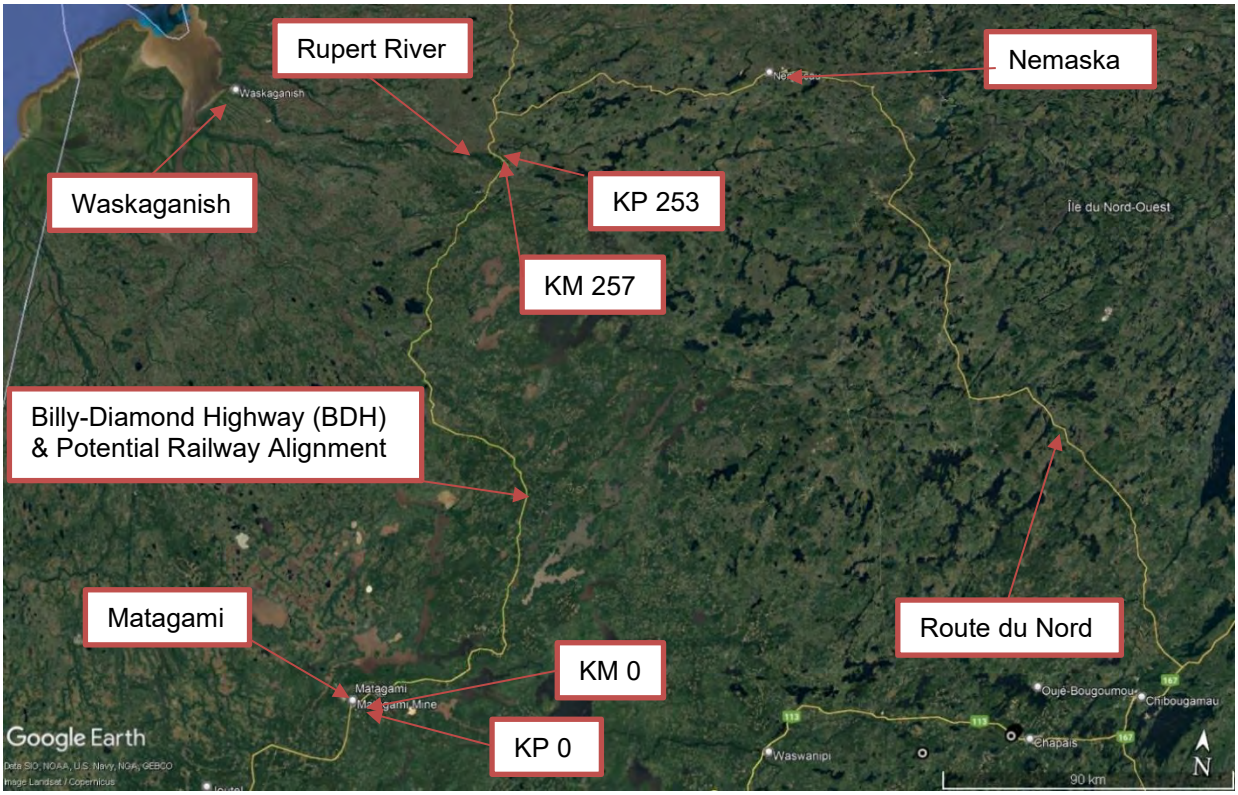


Figure 2 Potential BDH Railway Location (Google Earth)

The potential BDH railway alignment closely follows the actual alignment of the Billy-Diamond Highway and deviates from it at a maximum distance of 4 km in some localized sectors. The railway will be built on mineral and organic soils, in forested and undeveloped areas. A significant portion of the railway will be built on peat; these areas will require special geotechnical attention during the next design phases.

Bridges and culverts will be constructed along the alignment to cross rivers and streams, as well as the Billy-Diamond Highway at some location. The geodetic elevations range from el. ≈290 m at Matagami to el. ≈190 m at the Rupert River Bridge. Several high embankments are also anticipated throughout the proposed alignment.

2.0 Method of Investigation

2.1 Environmental permitting

Before undertaking any geotechnical work on the targeted territory, Vision Eeyou Ischee has ensured to obtain the necessary authorizations and permits for the execution of the work:

- Land use (MERN);
- Tree cutting (MFFP), and;
- Declaration of compliance (MELCC).

All activities conducted on the territory (land occupancy, wood cutting, preparation of accesses and drilling) were carried out in compliance with the current laws and regulations. Also, following the completion of the fieldwork, effort was made at each of the investigated sites to minimize the impact of the work.

2.2 Utility Locates

A request was filed by Stantec to Info-excavation to identify underground public utilities present in the vicinity of the work site. Where present, all identified utilities were marked on the ground prior to the execution of the field work.

2.3 Health and Safety

The Stantec employees who participated in this project familiarized themselves with all the relevant Stantec Safe Work Practices (SWPs) prior to beginning of any fieldwork. In addition, Stantec's pre-job Health and Safety Checklist, that identifies any health and safety risks, was filled out and signed by all the participants in the fieldwork, including the subcontractors. The goal of this document is to identify any potential dangers in order to prevent accidents and injuries from occurring. No health and safety incidents occurred while Stantec was present at the Site.

2.4 Geotechnical Field Investigation

A site investigation specific to the peat areas was carried out as part of this program. The objective was to obtain a preliminary characterization of the organic deposits along the proposed rail alignment. The investigation was carried out using a manual auger and included measuring the thickness of the organic soils, and sampling both the organic and the underlying soils. Organic soils were classified using the Von Post scale. Undrained shear strength testing using a portable field vane was carried out where possible. Results of peat investigation are presented in Appendix E of this report.

In addition, 41 boreholes, identified BH22-01 to BH22-43, were drilled as part of the investigation; two of the initially planned boreholes (BH22-19 and BH22-23) could not drilled. These boreholes were drilled to obtain general information on the geotechnical properties of the soils at future bridge and culvert

locations, as well as at the high embankment sites. They were advanced using a CME drill rig mounted on tracks operated by *Forage Boislard* Inc. under the constant supervision of an experienced Stantec technician. The borehole reports are presented in Appendix C.

At each borehole, the soils were sampled at regular intervals using a 610 mm long and 51 mm external diameter split spoon sampler (*B* size sampler) or a 63 mm external diameter split spoon sampler (*N* size sampler). With the *B* size sampler, the Standard Penetration Tests (SPTs) was recorded as defined in ASTM D-1586. The soils collected from split-spoon samplers were examined and described, and the soil recovery measured and recorded.

The SPT test consists of counting the numbers of blows required to drive a *B* size sampler 12 in. (305 mm) into a soil by means of a 140 lb (63.5 kg) mass falling a height of 30 in. (762 mm). The blow count is referred to as the N-value of the soil, which is a description of its state of compactness.

Shelby tube samplers, or thin-walled hollow steel tubes, were pushed into the ground to extract relatively undisturbed cohesive soil samples during the drilling activities in accordance with ASTM D-1587.

Field vane shear tests were carried out in 12 boreholes to determine the undrained shear strength of intact and remoulded clays at various depths in accordance with ASTM D-2573.

Dynamic cone penetration test (DCPT) was carried out in boreholes B22-06, BH22-09, BH22-15, BH22-24, BH22-30, BH22-31, BH22-34, BH22-35, BH22-36, and BH22-41 after sampling in accordance with BNQ 2501-145. The dynamic cone penetration is a continuous test which uses a drop-weight to drive a cone and rod into the ground. The number of blows for each 12 in. (305 mm) of penetration is recorded until reaching refusal on very dense soils, cobbles, boulders, or bedrock. A continuous resistance versus depth profile is obtained from the dynamic cone penetration test which can provide a visual relationship of soil type or density variations.

The bedrock coring was carried out in boreholes BH22-01, BH22-03, BH22-04, BH22-05, BH22-07, BH22-08, BH22-10, BH22-18, BH22-26, BH22-27, BH22-32, BH22-33, BH22-38, BH22-39, BH22-40, and BH22-43. Conventional rock coring was used to advance the boreholes into bedrock and obtain continuous samples of rock in accordance with ASTM D-2113. A 75.7 mm diameter hole was drilled using a diamond-impregnated, annular, rotary drill bit with an inner diameter of 47.7 mm (*NQ* size sampler). A double inner tube system to recover the rock core samples was used. Throughout the drilling process, water was used as a circulation fluid to both lubricate and cool the drill bit. Geological and engineering descriptions, and rock quality designation (RQD) were recorded on the borehole log for each core run. Rock cores from each borehole were placed in core boxes and transferred to our Laval laboratory.

The field work was conducted under the supervision of engineering staff from Stantec who maintained detailed logs of the subsurface and drilling conditions encountered and obtained representative samples of the various strata encountered. Soils were classified in accordance with the Unified Soil Classification System (USCS) ASTM D-2487 and D-2488. All soil samples were stored in moisture proof bags and returned to our laboratory in Laval, Quebec, for selected laboratory testing. Rock core samples were inspected and logged by Stantec personnel at the borehole locations prior to being transferred to our

laboratory for detailed geological logging and storage. Handling, transportation and storage of soil and bedrock samples were undertaken with care to minimize disturbance.

Standpipe piezometers were installed in boreholes BH22-06, BH22-09, BH22-14, BH22-15, BH22-24, BH22-27, BH22-28, BH22-29, BH22-30, BH22-33, and BH22-37 to allow for the measurement of groundwater levels. The standpipes consisted of 20 mm diameter rigid pipes with a 1.5 m length of screen installed at the bottom of each well, then backfilled with silica sand up to 0.3 m above the top of the screen. The boreholes were sealed with bentonite hole plug.

2.5 Site Survey

Sounding locations for the peat investigation was provided by the geomorphology specialist, based on available cartographic maps. At this stage of the feasibility study, a limited number of test holes per peat area was proposed. It is thus possible that additional peat areas are still to be identified. Coordinates of each sounding location were determined using a handheld GPS providing a 3 m precision. Test hole locations are presented in a summary table in Appendix E.

The geotechnical borehole locations were selected by the team carrying out the project Feasability Study in order to characterize of the *in-situ* conditions at the bridge and culvert locations, as well as the high embankment locations within the future alignment. The boreholes were positioned on Site using the same GPS type, and when the boreholes were drilled at a different location than initially targeted, the new coordinates were recorded by the field technician.

No geodetic elevations were measured during this investigation. All depths presented in this report refer to the ground surface level at the time of the investigation as « meter below ground surface (mbgs) ».

The geodetic coordinates at each borehole location are presented below and are shown on the borehole location plans in Appendix B and the borehole reports in Appendix C. It should be noted that the kilometer point (KP) indicated in this report were provided by the rail design team, based on the latest version of the alignment available at the time of writing this report.

Table 1 Borehole Location and Description

Borehole	Geodetic Coordinates UTM Zone 18		Kilometer Point (KP)	Description
	East (m)	North (m)		
BH22-01	312 812	5 516 753	9.5	High Embankment (5 m)
BH22-02	317 844	5 518 782	15.5	High Embankment (13 m)
BH22-03	316 142	5 652 368	204.8	High Embankment (4 m)
BH22-04	310 635	5 516 329	7.2	Bridge (Bell River)
BH22-05	311 021	5 516 479	7.6	Bridge (Bell River)
BH22-06	316 007	5 518 121	13.4	Bridge / Culvert
BH22-07	326 548	5 520 133	24.4	High Embankment (8 m)

Borehole	Geodetic Coordinates UTM Zone 18		Kilometer Point (KP)	Description
	East (m)	North (m)		
BH22-08	338 055	5 526 704	40.2	Bridge (BDH 1)
BH22-09	333 953	5 523 359	34.7	Bridge / Culvert
BH22-10	318 491	5 609 077	152.0	High Embankment (5 m)
BH22-11	315 926	5 613 752	157.9	High Embankment (7 m)
BH22-12	342 463	5 530 272	46.0	Bridge (BDH 2)
BH22-13	347 587	5 547 028	63.9	Bridge (Amphibolite River)
BH22-14	348 431	5 560 526	80.2	High Embankment (8 m)
BH22-15	347 423	5 540 952	58.4	Bridge (Creek 1)
BH22-16	350 489	5 568 355	89.7	High Embankment (4 m)
BH22-17	350 548	5 570 990	92.4	High Embankment (9 m)
BH22-18	351 733	5 576 272	97.9	High Embankment (10 m)
BH22-20	331 998	5 595 315	128.2	Bridge (Creek 3)
BH22-21	320 001	5 518 883	17.6	High Embankment (5 m)
BH22-22	348 147	5 562 557	82.5	Bridge / Culvert
BH22-24	350 354	5 568 896	90.3	Bridge / Culvert
BH22-25	351 954	5 577 463	99.1	Bridge / Culvert
BH22-26	351 386	5 580 658	102.4	Bridge / Culvert
BH22-27	320 686	5 659 293	213.6	High Embankment (4 m)
BH22-28	347 848	5 586 683	109.5	Bridge / Culvert
BH22-29	347 056	5 587 697	11.7	Bridge (Creek 3)
BH22-30	321 692	5 663 704	218.2	High Embankment (7 m)
BH22-31	319 239	5 603 379	145.2	High Embankment (8 m)
BH22-32	319 708	5 658 695	212.4	High Embankment (5 m)
BH22-33	323 030	5 598 522	138.2	Bridge (Kakaskutatakuch River 3)
BH22-34	319 922	5 600 272	142.0	Bridge / Culvert
BH22-35	310 374	5 625 174	172.2	Bridge / Culvert
BH22-36	315 585	5 639 929	190.9	Bridge / Culvert
BH22-37	314 014	5 647 198	198.8	Bridge / Culvert
BH22-38	312 529	5 618 679	164.3	High Embankment (6 m)
BH22-39	327 606	5 673 307	220.6	Bridge (Broadback River)
BH22-40	315 144	5 634 538	184.7	High Embankment (5 m)
BH22-41	332 367	5 683 588	242.3	Bridge / Culvert
BH22-42	331 297	5 691 869	252.9	Bridge (Rupert River)

Borehole	Geodetic Coordinates UTM Zone 18		Kilometer Point (KP)	Description
	East (m)	North (m)		
BH22-43	313 971	5 643 339	194.9	High Embankment (5 m)

2.6 Laboratory Testing

All collected samples returned to our laboratory were subjected to a detailed visual examination and additional classification by a geotechnical engineer. The following geotechnical laboratory tests were performed on selected samples:

Table 2 Geotechnical Laboratory Tests

Laboratory Testing	Standards	Number of Tests
Grain-size distribution by mechanical sieve (coarse soil fraction)	BNQ 2501-025	125
Grain-size distribution by hydrometer test (fine soil fraction)	BNQ 2501-025	87
Atterberg Limits	BNQ 2501-092	37
Water content	BNQ 2501-170	152
Undrained shear strength by fall cone test	BNQ 2501-110	23
One-dimensional consolidation test	ASTM D-2435	11
Unit Weights	--	38
Compressive strength of intact rock core specimen	ASTMD-7012	11

The results of the laboratory tests are discussed in the text of this report and are presented in Appendix D.

The soil samples will be stored for a period of 12 months after issuing of the final report. Samples will then be discarded unless otherwise directed.

3.0 Subsurface Conditions

3.1 Surficial Material Mapping

Surficial material mapping was conducted along a 250 m wide corridor centered on the potential BDH Railway alignment. Surficial material mapping uses training, experience and expert judgement in the identification and delineation of geomorphological landforms visible on the Earth's surface to interpret and classify the landscape. It provides the basis to support the geotechnical study and helps with the decision-making process to be conducted as part of the following phases of the project.

The surficial material mapping was carried out through the interpretation of available satellite imagery (Google Earth, ESRI and Forêt Ouverte World Imagery) and LiDAR data (provided by the client, 2022). The LiDAR data were processed to create bare-earth hillshade images and one-meter interval contour lines. Available background information (e.g., surficial geology mapping, literature relevant to the terrain conditions) were considered while conducting the mapping. The mapping was also updated based on the results obtained from the geotechnical and peat investigation programs.

For this project, relatively homogeneous terrain units were identified and codified using a texture-oriented classification system inspired from the Hydro-Quebec legend, which is largely used in the James Bay region. The classification system used is presented in Table 3 below.

Table 3 Surficial Material Mapping Legend

Surficial Material Classification	
R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

*No thickness was interpreted for boulder accumulations

Examples of layer overlapping and thickness	
Sm/T	Thin layer of sand (< 2 m thick) over till
S/T	Layer of sand (2 to 6 m thick) over till
S	Sand (> 6 m thick)

Examples of combined symbols	
T+B	Till with boulders at the ground surface
R+Tm/R	Bedrock with a veneer of till (< 2 m thick)
T-SG	Undifferentiated till or sand and gravel

A surficial material map atlas was produced at a scale of 1:15,000 and is presented in Appendix F. Table 4 below presents a statistical summary of the dominant surficial material identified along the potential Billy-Diamond railway alignment.

Table 4 Surficial Material along the Potential BDH Railway Alignment

Dominant surficial material	Distance along the potential BDH Railway Alignment	
	Length (km)	Percent (%)
Clayey silt or silty clay (CM)	75.20	29.8
Peat (Pt)	52.57	20.8
Silty sand or sandy silt (SM)	47.86	19.0
Till (T)	44.50	17.6
Sand (S)	13.36	5.3
Bedrock (R)	8.48	3.4
Sand and gravel (SG)	7.67	3.0
Existing borrow source (BE)	1.73	0.7
Water body (N)	0.88	0.3
Anthropogenic (Ant)	0.25	0.1
Boulders (B)	-	-
Total	**252.50**	**100.0**

3.2 Peat Investigation

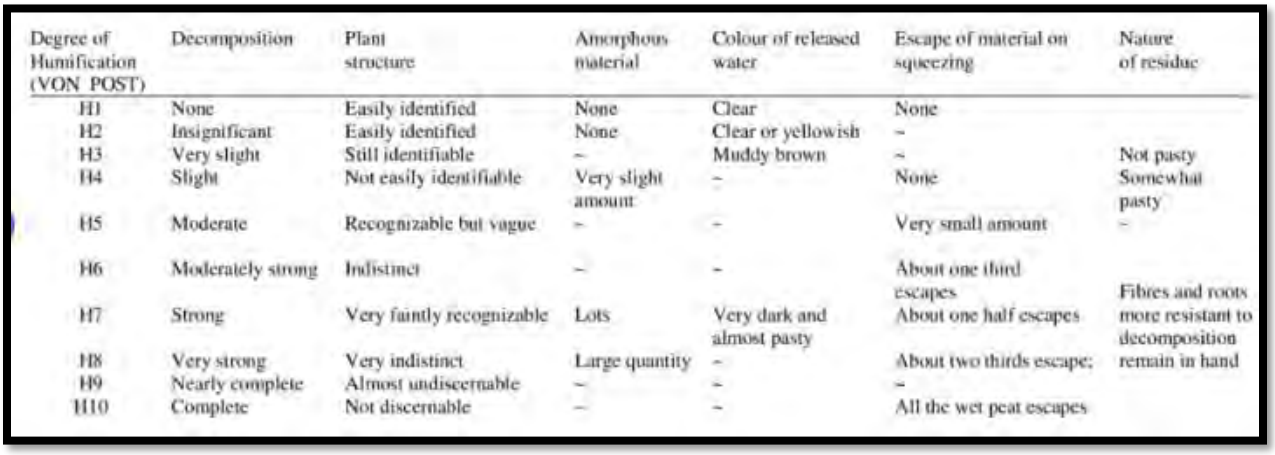
The near coastal clayey plains in James-Bay are usually very rich in organic deposits. As presented in the previous section, the proposed rail alignment crosses about 50 km (20% of total length) of peat areas. For this report, peat areas refer to an organic deposit where flora has been accumulating and decomposing over a long period of time in a poorly drained environment. Each peat area presents usually a thin active top layer above a mix of organic material at different stages of decomposition. This material has a poor bearing capacity and produces large settlements when loaded (DLC, 2012).

The initial soil mapping was carried out using available arial photos to identify the peat locations and the expected surface of each peat area within the proposed alignment. This desktop study identified about 120 peat areas. For each area, test holes were then proposed to collect field data for further identification.

Field data collection included recording the peat thickness, measuring its shear strength, and identifying the nature of the soils underlying the peat. In addition, a brief description of the surroundings was captured (vegetation, body of water, proximity forest, human activities, topography, surface boulders, etc.) The results of this investigation are presented in Appendix E.

As stated, the number of test holes was limited for this feasibility study and the results should be considered as preliminary. It is recommended that a complementary detailed investigation of the peat areas be carried out at a later design stage. Of the 120 peat areas, 51 were identified as having more than 500 mm of peat like material. Based on the observed stratigraphy in the soundings, the average thickness of the organic layer varied between 0.3 and 1.5 m. However, the thickness extended to between 1.5 and 3.0 m in some areas. In general, the organics thickness was more important in the northern section of the proposed alignment.

All auger retrieved samples were visually analyzed and classified using the Von Post scale system. It is based of the degree of decomposition of the organic matter, with H1 being completely non-decomposed and H10 completely decomposed. The classification table is presented below (Figure 3):



Degree of Humification (VON POST)	Decomposition	Plant structure	Amorphous material	Colour of released water	Escape of material on squeezing	Nature of residue
H1	None	Easily identified	None	Clear	None	
H2	Insignificant	Easily identified	None	Clear or yellowish	–	
H3	Very slight	Still identifiable	–	Muddy brown	–	Not pasty
H4	Slight	Not easily identifiable	Very slight amount	–	None	Somewhat pasty
H5	Moderate	Recognizable but vague	–	–	Very small amount	–
H6	Moderately strong	Indistinct	–	–	About one third escapes	
H7	Strong	Very faintly recognizable	Lots	Very dark and almost pasty	About one half escapes	Fibres and roots more resistant to decomposition
H8	Very strong	Very indistinct	Large quantity	–	About two thirds escape;	remain in hand
H9	Nearly complete	Almost undiscernable	–	–	–	
H10	Complete	Not discernable	–	–	All the wet peat escapes	

Figure 3 Von Post Classification

For this study, a total of 120 peat areas have been recognized, and the Von Post classification showed a wide variation across the proposed alignment. Each peat area will require a further investigation. In general, the most frequent class varies from H3 (very slight decomposition) to H7 (strong decomposition). In addition, several locations showed no or insignificant decomposition (H1 and H2). The following chart illustrate the class distribution for the identified peat areas:

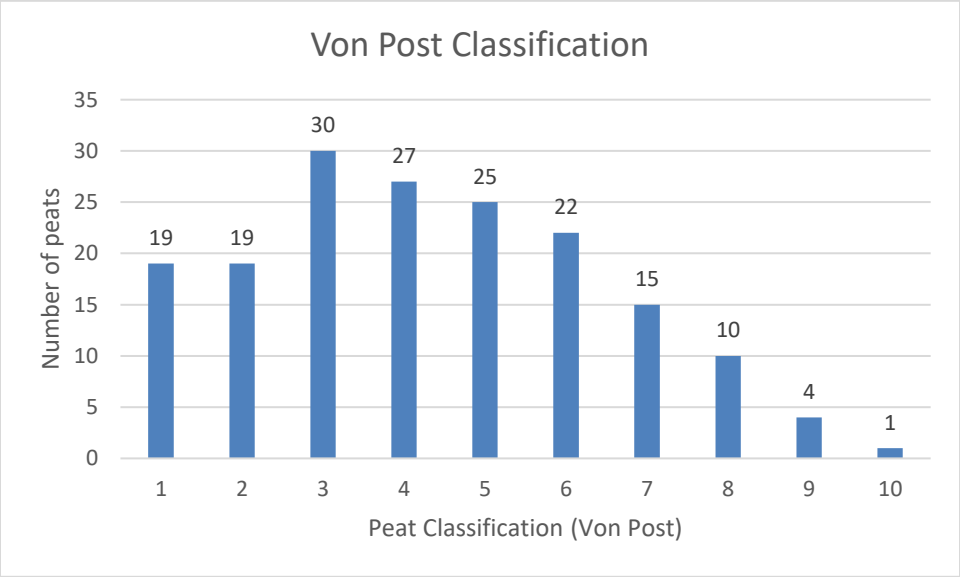


Figure 4 Distribution of Peat Classification

In situ shear strength testing was carried out at selected peat area locations using a handheld field vane. The Quebec Ministry of Transportation has adopted this field test as an acceptable approach when running stability analyses for organic soils, specifically those classified H5 to H10 (DLC, 2012). Readings were recorded every 0.5 m, when possible, and extended in the underlaying clay deposit when intercepted. Shear resistance values in average varied from 12 to 30 kPa indicating a soft to firm consistency. However, multiple tests yielded values under 5 kPa, indicating a very soft consistency.

The auger sampling at the peat areas extended to the underlaying mineral deposit. The type and consistency of the deposit has a direct incidence of the treatment method during construction works, but also plays a role in the global stability of the future rail embankment. The deeper soils at almost all investigated area were identified as clay or clayey silt with a consistency described as firm to very stiff, based on the vane readings. Toward the north end of the alignment, the soils under the peat transitions to a granular material (sandy silt to sand). Some peat areas have been labelled as sitting on a till deposit but none directly on bedrock.

Sampling and testing of the peat were not carried out as part of this terrain mapping investigation. For the feasibility study, the following general parameters for the peat, based on typical textbook values, can be considered for the preliminary design purposes of the future rail embankment.

- In areas with less than 0.5 m of peat, moisture content of 250%.
- In areas with more than 0.5 m of peat, moisture content between 500% and 1000%.
- Organic content of 95%.
- Unit weight of 9 to 11 kN/m^3
- Typical permeability range is between 1x10^{-6} et 1x10^{-3} cm/sec, depending on the decomposition state.

Where less than 0.5 m of peat was observed, it is anticipated that the deposit would have undergone significant drying due to exposure during summer months and would be similar to a peat crust.

Generally, fibrous organic material yield generally a higher moisture content than organics with advanced decomposition state (DLC, 2012).

It is stressed that the above textbook values are provided only as an indication of the potential compressibility of the soils and that a more detailed investigation will be required, including sampling and laboratory testing, to determine site specific characteristic parameter.

3.3 Subsurface Stratigraphy

The borehole records depict conditions at specific locations and on the dates indicated. Subsurface soil and groundwater conditions at locations away from the boreholes could vary from those indicated on the borehole reports.

It should be noted that the term "depth" always refers to the ground surface level during field work (mbgs) as defined previously in section 2.5.

The subsurface stratigraphy summary is presented in the following tables. Table 5 presents the boreholes drilled for the bridges/culverts, while Table 6 presents boreholes drilled for the high embankments. The subsurface conditions observed, and the results of the field and laboratory testing, are detailed in the borehole reports included in Appendix C.

Table 5 Subsurface Stratigraphy Summary – Bridges / Culverts

Kilometer Point (KP)	Description	Borehole	Stratigraphy (Depth, m)						
			Topsoil	Granular Fill	Peat / Organic Soils	Native Cohesive Deposit	Native Granular Deposit	Till	Bedrock
7.2	Bell River	BH22-04	0.00 – 0.13	0.13 – 1.22 (1)	--	1.22 – 2.44	--	2.44 – 3.38 (1)	3.38 – 5.79
7.6	Bell River	BH22-05	0.00 – 0.33	--	--	0.33 – 2.44	--	2.44 – 7.21 (1)	7.21 – 10.31
13.4	--	BH22-06	0.00 – 0.10	--	--	0.10 – 15.85	15.85 – 19.84	--	≥ 19.84 (2)
34.7	--	BH22-09	0.00 – 0.18	--	--	0.18 – 10.67	10.67 – 24. 69	--	≥ 24.69 (2)
40.2	BDH 1	BH22-08	--	0.00 – 2.44	--	--	--	2.44 – 7.21 (1)	7.21 – 12.14
46.0	BDH 2	BH22-12	0.00 – 0.10	--	--	0.10 – 8.53	--	8.53 – 12.37 (1)	≥ 12.37 (3)
58.4	Creek 1	BH22-15	0.00 – 0.10	--	--	0.10 – 8.53	8.53 – 17.98	--	≥ 17.98 (2)
63.9	Amphibolite River	BH22-13	--	0.00 – 0.61	0.61 – 1.22	1.22 – 7.92	7.92 – 11.58	11.58 – 12.80	--
82.5	--	BH22-22	0.00 – 0.18	--	--	0.18 – 13.72	--	13.72 – 17.65	≥ 17.65 (3)
90.3	--	BH22-24	0.00 – 0.25	--	--	0.25 – 18.90	--	18.90 – 25.04	≥ 25.04 (2)
99.1	--	BH22-25	0.00 – 0.08	--	--	0.08 – 9.75	--	9.75 – 14.33 (1)	--
102.4	--	BH22-26	0.00 – 0.05	--	--	0.05 – 3.66	--	3.66 – 5.69	5.69 – 12.80
109.5	--	BH22-28	0.00 – 0.46	--	--	0.46 – 12.19	--	12.19 – 14.61	≥ 14.61 (3)
110.7	Creek 2	BH22-29	0.00 – 0.08	--	--	0.08 – 5.49	5.49 – 7.32	7.32 – 15.62	≥ 15.62 (3)
128.2	Creek 3	BH22-20	--	0.00 – 0.61	--	0.61 – 6.71	6.71 – 13.72	13.72 – 14.94	--
138.2	Kakaskutatakuch River 3	BH22-33	0.00 – 0.10	--	--	0.10 – 1.22	--	1.22 – 5.74 (1)	5.74 – 8.69
142.0	--	BH22-34	0.00 – 0.08	--	--	0.08 – 13.72	13.72 – 21.87	--	≥ 21.87 (2)
172.2	--	BH22-35	--	0.00 – 2.44	--	2.44 – 8.53	8.53 – 15.24	15.24 – 17.63	≥ 17.63 (2)
190.9	--	BH22-36	--	--	0.00 – 1.22	1.22 – 11.58	--	11.58 – 13.67	≥ 13.67 (2)
198.8	--	BH22-37	0.00 – 0.05	--	--	0.05 – 0.91	0.91 – 3.23	3.23 – 7.59 (1)	≥7.59 (2)

Kilometer Point (KP)	Description	Borehole	Stratigraphy (Depth, m)						
			Topsoil	Granular Fill	Peat / Organic Soils	Native Cohesive Deposit	Native Granular Deposit	Till	Bedrock
220.6	Broadback River	BH22-39	0.00 – 0.61	--	0.61 – 1.22	--	---	1.22 – 1.70	1.70 – 4.27
242.3	--	BH22-41	0.00 – 0.05	--	--	0.05 – 19.81	--	19.81 – 20.50	≥ 20.50 (2)
252.9	Rupert River	BH22-42	0.00 – 0.08	--	--	--	0.08 – 3.66 (1)	3.66 – 13.11 (1)	--

(1) Presence of boulders and/or cobbles.
(2) Inferred bedrock following a refusal during the dynamic cone penetration (BNQ 2501-145).
(3) Inferred bedrock following a refusal during drilling.

Table 6 Subsurface Stratigraphy Summary – High Embankments

Kilometer Point (KP)	Height of Embankment (m)	Borehole	Stratigraphy (Depth, m)						
			Topsoil	Granular Fill	Peat / Organic Soils	Native Cohesive Deposit	Native Granular Deposit	Till	Bedrock
9.5	5	BH22-01	0.00 – 0.05	--	--	--	--	0.05 – 0.99	0.99 – 2.51
15.5	13	BH22-02	--	0.00 – 1.22	--	1.22 – 2.44	--	2.44 – 7.92	7.92 – 10.59
17.6	5	BH22-21	0.00 – 0.18	0.18 – 0.61	--	0.61 – 14.33	--	14.33 – 14.94	--
24.4	8	BH22-07	0.00 – 0.10	--	--	--	0.10 – 4.27 (1)	--	4.27 – 5.64
80.2	8	BH22-14	0.00 – 0.05	0.05 – 0.61	--	0.61 – 13.26	--	13.26 – 14.48	--
89.7	4	BH22-16	--	0.00 – 0.61	--	0.61 – 9.14	--	9.14 – 12.93*	--
92.4	9	BH22-17	0.00 – 0.08	--	--	2.44 – 7.92	0.08 – 2.44	7.92 – 14.94	--
97.9	10	BH22-18		0.00 – 3.05 (1)	--	3.05 – 12.19	12.19 – 15.24	--	15.24 – 17.04
145.2	8	BH22-31	--	0.00 – 2.13	2.13 – 3.66	3.66 – 37.19	--	--	--
152	5	BH22-10	0.00 – 0.05	0.05 – 1.22		1.22 – 4.88	--	4.88 – 7.16	7.16 – 8.69
157.9	7	BH22-11	--	0.00 – 2.34	2.34 – 2.44	2.44 – 16.05	--	16.05 – 19.63 (1)	--
164.3	6	BH22-38	--	0.00 – 2.44	--	2.44 – 14.53	--	--	14.53 – 16.54

Kilometer Point (KP)	Height of Embankment (m)	Borehole	Stratigraphy (Depth, m)						
			Topsoil	Granular Fill	Peat / Organic Soils	Native Cohesive Deposit	Native Granular Deposit	Till	Bedrock
184.7	5	BH22-40	--	0.00 – 1.83	--	1.83 – 4.88	--	4.88 – 6.55	6.55 – 7.82
194.9	5	BH22-43	--	0.00 – 2.44	2.44 – 3.63	--	--	--	3.63 – 5.61
204.8	4	BH22-03	--	0.00 – 1.22	--	--	--	1.22 – 1.83 (1)	1.83 – 4.39
212.4	5	BH22-32	--	0.00 – 2.01	--	2.01 – 4.88	--	4.88 – 8.00	8.00 – 9.53
213.6	4	BH22-27	--	0.00 – 2.44	--	2.44 – 9.14	--	9.14 – 16.46 (1)	16.46 – 17.81
218.2	7	BH22-30	0.00 – 0.08	0.08 – 1.22	-	1.22 – 20.12	--	20.12 – 28.04	≥28.04 (2)

(1) Presence of boulders and/or cobbles.

(2) Inferred bedrock following a refusal during the dynamic cone penetration (BNQ 2501-145).

3.3.1 Topsoil

Topsoil was encountered at surface generally in all boreholes and was found to extend to a depth ranging from 0.05 m to 0.61 m below ground surface (mbgs).

3.3.2 Granular Fill

The granular fill was generally encountered on the shoulders, the ditch or gravel road sections around of the Billy Diamond Highway, at a depth ranging from 0.00 to 0.18 m below ground surface. This layer has a thickness ranging from 0.61 to 2.44 m and essentially consisted of a brown grey to brown, gravelly sand to gravel and sand, with some to traces of silt.

The presence of boulders and/or cobbles was observed within this layer at boreholes BH22-04 and BH22-18.

Twenty-two (22) representative samples of this granular fill were selected for grain size distribution. The laboratory results are presented in the following table and are included in Appendix D.

Table 7 Laboratory Results – Granular Fill

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)
BH22-02	SS-01	0.00 – 0.61	8.6		61.7	29.7
BH22-03	SS-01	0.00 – 0.61	10.3		81.5	8.2
BH22-04	SS-01B	0.13 – 0.61	5.6		20.9	73.5
BH22-07	SS-01	0.10 – 0.61	13.0		50.1	36.9
BH22-08	SS-01	0.00 – 0.61	11.0		59.3	29.7
BH22-08	SS-04	1.83 – 2.44	18.4		53.2	28.4
BH22-10	SS-02	0.61 – 1.22	13.5		80.4	6.1
BH22-11	SS-01	0.00 – 0.61	9.8		39.9	50.3
BH22-13	SS-01	0.00 – 0.61	26.9		63.3	9.8
BH22-14	SS-01B	0.05 – 0.61	23.8		57.0	19.2
BH22-16	SS-01	0.00 – 0.61	10.5	14.1	67.2	8.2
BH22-17	SS-02	0.61 – 1.22	4.6	34.4	57.2	3.8
BH22-18	SS-01	0.00 – 0.61	3.9		78.8	17.3
BH22-20	SS-01	0.00 – 0.61	7.4		77.9	14.7
BH22-21	SS-01B	0.18 – 0.61	20.7		54.9	24.4
BH22-27	SS-01	0.00 – 0.61	4.0		40.9	55.1
BH22-31	SS-01	0.00 – 0.61	9.5		41.9	48.9

Borehole	Sample	Depth (m)	Fines (%)	Sand (%)	Gravel (%)
BH22-32	SS-01	0.00 – 0.61	9.0	58.0	33.0
BH22-35	SS-01	0.00 – 0.61	8.0	45.2	46.8
BH22-38	SS-01	0.00 – 0.61	10.3	35.0	54.7
BH22-40	SS-01	0.00 – 0.61	8.7	50.8	40.5
BH22-43	SS-01	0.00 – 0.61	9.0	48.7	42.3

3.3.3 Peat / Organic Soil

An organic soil was encountered on boreholes BH22-11, BH22-13, BH22-31, BH22-36, BH22-39 and BH22-43, at a depth ranging from 0.00 to 2.44 m below ground surface (mbgs).

This layer of organic deposit had a thickness ranging from 0.10 m (at BH22-11) to 1.53 m (at BH22-31) and essentially consisted of peat, black organic soil with a presence of vegetal debris and roots.

3.3.4 Native Cohesive Deposit

With a few exceptions, a native cohesive deposit was encountered in all boreholes, at depths ranging from 0.10 m (at BH22-06) to 3.66 m (at BH22-31) (mbgs). This natural soil essentially consisted of a grey silty clay to a silt and clay with traces of sand and gravel.

Based on available geological mapping, the Billy Diamond Highway is mostly situated within the glaciolacustrine varved clay plains formed when the region was submerged by glacial Lake Barlow-Ojibway. Visually, varved clays consist of thin laminations, rarely exceeding 2 to 3 cm of light silty layers between dark clayey layers. Within the upper reaches of the alignment, Tyrrell Sea marine clays deposits may also be present. Generally, the Barlow-Ojibway varved clays are slightly over consolidated, soft to firm in consistency, with a high compression index.

Sixty-seven (67) representative samples of this native cohesive deposit were selected for hydrometer tests. The laboratory results are presented in the following table and are included in Appendix D.

Table 8 Grain Size Distribution from Hydrometer Tests - Native Cohesive Deposit

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)
			Clay	Silt		
BH22-02	SS-03	1.22 – 1.83	44.9	37.2	17.9	0.0
BH22-04	SS-03	1.22 – 1.83	32.0	51.1	3.7	11.2
BH22-05	SS-02	0.61 – 1.22	48.8	50.0	1.2	0.0
BH22-06	SS-01B	0.10 – 0.61	56.9	35.7	7.4	0.0
BH22-06	SS-09	4.88 – 5.49	74.9	24.4	0.7	0.0

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)
			Clay	Silt		
BH22-09	SS-02	0.61 – 1.22	74.3	21.8	2.9	1.0
BH22-09	SS-08	4.57 – 5.18	83.5	16.3	0.2	0.0
BH22-10	SS-06	3.05 – 3.66	63.5	29.0	6.4	1.1
BH22-10	SS-07	3.66 – 4.27	62.0	31.5	5.1	1.4
BH22-11	SS-08	4.27 – 4.88	71.4	23.9	4.2	0.5
BH22-11	SS-11	6.10 – 6.71	64.1	28.8	5.4	1.7
BH22-11	SS-17	15.24 – 15.85	18.9	78.8	2.3	0.0
BH22-12	SS-01	0.10 – 0.61	66.8	24.7	7.8	0.7
BH22-12	SS-04	1.83 – 2.44	81.0	15.5	2.0	1.5
BH22-12	SS-07	3.66 – 4.27	84.6	15.2	0.2	0.0
BH22-13	SS-06	3.05 – 3.66	80.6	19.0	0.4	0.0
BH22-14	SS-06	3.05 – 3.66	90.2	9.3	0.5	0.0
BH22-15	SS-02	0.61 – 1.22	88.8	10.7	0.5	0.0
BH22-15	SS-04	1.83 – 2.44	84	14.1	1.8	0.1
BH22-15	SS-13	7.32 – 7.92	15.5	83.8	0.7	0.0
BH22-16	SS-05	2.44 – 3.05	53.7	29.7	16.6	0.0
BH22-16	SS-08	4.27 – 4.88	76.5	17.1	6.4	0.0
BH22-17	SS-07	3.66 – 4.27	77	19.4	3.6	0.0
BH22-18	SS-06	3.66 – 4.27	73.0	21.9	4.9	0.2
BH22-18	SS-11	6.71 – 7.32	77.8	22.0	0.2	0.0
BH22-20	SS-02	0.61 – 1.22	46.2	28.4	25.2	0.2
BH22-20	SS-04	1.83 – 2.44	82.3	16.2	1.5	0.0
BH22-20	SS-08	4.27 – 4.88	79.5	20.0	0.5	0.0
BH22-21	SS-04	1.83 – 2.44	53.2	34.1	9.4	3.3
BH22-21	SS-08	4.27 – 4.88	55.5	37.7	6.8	0.0
BH22-22	SS-02	0.61 – 1.22	71.7	26.9	1.4	0.0
BH22-22	SS-06	3.05 – 3.66	74.9	24.0	1.1	0.0
BH22-24	SS-03	1.22 – 1.83	72.5	21.0	6.0	0.5
BH22-24	SS-08	4.27 – 4.88	87.0	12.3	0.7	0.0
BH22-24	SS-13	7.32 – 7.92	78.2	20.8	1.0	0.0
BH22-24	SS-22	18.90 – 19.51	73.6	25.9	0.5	0.0

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)
			Clay	Silt		
BH22-25	SS-01	0.08 – 0.61	40.3	29.4	28.8	1.5
BH22-25	SS-05	2.44 – 3.05	86.8	12.2	1.0	0.0
BH22-26	SS-02	0.61 – 1.22	81.0	18.1	0.5	0.4
BH22-26	SS-05	2.44 – 3.05	81.2	18.5	0.3	0.0
BH22-27	SS-09	4.88 – 5.49	64.6	30.4	3.5	1.5
BH22-27	SS-11	6.10 – 6.71	47.3	44.9	6.4	1.4
BH22-28	SS-02	0.61 – 1.22	86.2	13.3	0.5	0.0
BH22-28	SS-07	4.57 – 5.18	84.9	14.1	1.0	0.0
BH22-29	SS-02	0.61 – 1.22	86.7	12.7	0.6	0.0
BH22-29	SS-07	3.66 – 4.27	76.0	23.3	0.7	0.0
BH22-30	SS-02	0.61 – 1.22	38.8	38.7	19.5	3.0
BH22-30	SS-08	4.27 – 4.88	67.8	28.7	3.5	0.0
BH22-31	SS-11	6.10 – 6.71	46.7	46.3	6.5	0.5
BH22-32	SS-08	4.27 – 4.88	47.9	39.6	11.0	1.5
BH22-33	SS-01B	0.10 – 0.61	28.3	66.3	5.3	0.1
BH22-34	SS-02	0.61 – 1.22	71.1	28.4	0.5	0.0
BH22-34	SS-04	1.83 – 2.44	65.1	31.0	3.6	0.3
BH22-34	SS-10	5.49 – 6.10	43.5	55.8	0.7	0.0
BH22-35	SS-07	3.66 – 4.27	64.0	30.1	5.6	0.3
BH22-36	SS-01	1.22 – 1.83	62.0	29.9	8.1	0.0
BH22-36	SS-02	1.83 – 2.44	66.1	25.7	7.2	1.0
BH22-36	SS-05	3.66 – 4.27	79.6	19.6	0.8	0.0
BH22-36	SS-10	7.32 – 7.92	57.5	29.7	12.3	0.5
BH22-36	SS-15	10.36 – 10.97	40.3	56.8	2.7	0.2
BH22-37	SS-01B	0.05 – 0.61	43.9	35.7	18.5	1.9
BH22-38	SS-11	6.10 – 6.71	60.0	33.8	6.2	0.0
BH22-40	SS-07	3.66 – 4.27	48.8	32.3	14.0	4.9
BH22-41	SS-01B	0.05 – 0.61	60.3	36.1	3.6	0.0
BH22-41	SS-03	1.22 – 1.83	64.8	33.5	1.7	0.0
BH22-41	SS-11	6.10 – 6.71	69.6	30.1	0.3	0.0
BH22-41	SS-17	9.75 – 10.36	67.0	32.8	0.2	0.0

Thirty-seven (37) representative samples of the native cohesive deposit were selected for Atterberg limits testing. The laboratory results are presented in the following table and are included in Appendix D.

Table 9 Atterberg Results – Native Cohesive Deposit

Borehole	Sample	Depth (m)	Water Content (%)	Liquid Limit (W_L) (%)	Plastic Limit (W_P) (%)	Liquid Index (I_L)	Plastic Index (I_P)	USCS
BH22-06	SS-09	4.88 – 5.49	84.4	63	24	1,6	39	CH
BH22-09	SS-08	4.57 – 5.18	84.4	76	26	1,2	50	CH
BH22-10	SS-07	3.66 – 4.27	42.3	54	22	0,6	32	CH
BH22-11	SS-11	6.10 – 6.71	53.5	45	17	1,3	28	CL
BH22-12	SS-07	3.66 – 4.27	66.9	76	30	0,8	46	CH
BH22-13	SS-06	3.05 – 3.66	61.4	67	27	0,9	40	CH
BH22-14	SS-06	3.05 – 3.66	57.8	68	24	0,8	44	CH
BH22-15	SS-02	0.61 – 1.22	47.6	79	30	0,4	43	CH
BH22-15	SS-04	1.83 – 2.44	66.6	70	27	0,9	43	CH
BH22-16	SS-08	4.27 – 4.88	71.1	62	23	1,2	39	CH
BH22-17	SS-07	3.66 – 4.27	70.0	68	26	1,0	42	CH
BH22-18	SS-11	6.71 – 7.32	63.9	70	28	0,9	42	CH
BH22-20	SS-08	4.27 – 4.88	59.6	63	24	0,9	39	CH
BH22-21	SS-08	4.27 – 4.88	71.1	64	23	1,2	41	CH
BH22-22	SS-06	3.05 – 3.66	51.3	62	25	0,7	37	CH
BH22-24	SS-08	4.27 – 4.88	91.4	79	27	1,	52	CH
BH22-24	SS-13	7.32 – 7.92	92.7	82	29	1,2	53	CH
BH22-25	SS-05	2.44 – 3.05	76.3	67	24	1,2	43	CH
BH22-26	SS-05	2.44 – 3.05	26.7	65	27	0,0	38	CH
BH22-27	SS-11	6.10 – 6.71	34.2	36	16	0,9	20	CL
BH22-28	SS-07	4.57 – 5.18	60.1	58	25	1,1	33	CH
BH22-29	SS-07	3.66 – 4.27	71.4	65	23	1,2	42	CH
BH22-30	SS-08	4.27 – 4.88	64.7	62	23	1,1	39	CH
BH22-31	SS-11	6.10 – 6.71	42.1	40	18	1,1	22	CL
BH22-34	SS-04	1.83 – 2.44	42.9	60	23	0,5	37	CH
BH22-34	SS-10	5.49 – 6.10	42.2	48	20	0,8	28	CL
BH22-35	SS-07	3.66 – 4.27	46.1	65	23	0,6	42	CH

Borehole	Sample	Depth (m)	Water Content (%)	Liquid Limit (W_L) (%)	Plastic Limit (W_P) (%)	Liquid Index (I_L)	Plastic Index (I_P)	USCS
BH22-36	SS-02	1.83 – 2.44	39.1	45	20	0,8	25	CL
BH22-36	SS-05	3.66 – 4.27	69.4	58	21	1,3	37	CH
BH22-36	SS-10	7.32 – 7.92	58.6	42	18	1,7	24	CL
BH22-36	SS-15	10.36 – 10.97	46.1	44	19	1,1	25	CL
BH22-38	SS-11	6.10 – 6.71	45.9	51	22	0,8	29	CH
BH22-40	SS-07	3.66 – 4.27	39.4	39	17	1,0	22	CL
BH22-41	SS-01B	0.05 – 0.61	23.6	42	19	0,2	23	CL
BH22-41	SS-03	1.22 – 1.83	46.6	51	21	0,9	30	CH
BH22-41	SS-11	6.10 – 6.71	61.5	58	25	1,1	33	CH
BH22-41	SS-17	9.75 – 10.36	55.2	45	22	1,4	23	CL

The moisture contents obtained on representative samples of this native cohesive deposit range from 23.7% to 92.6%.

Nineteen (19) samples have moisture contents greater than the liquidity limit ($I_L \geq 1.0$), this means that the material could lose its plastic behavior and act as a liquid when excavated and reworked.

Eighteen (18) samples have moisture content lower than the liquidity limit ($0 \geq I_L \geq 1.0$), this means that the material could keep his plastic behavior when excavated and reworked.

Eleven (11) samples of the native cohesive deposit were selected for consolidation tests. The results are presented in the following table and are included in Appendix D.

Table 10 Consolidation Test Results – Native Cohesive Deposit

Borehole	Depth (m)	σ'_{v0} (kPa)	σ'_p (kPa)	OCR	Cr	Cc	Consolidation Condition
BH22-12	4.27 – 4.88	37	104	2.8	0.137	1.690	Over consolidated
BH22-15	2.44 – 3.05	22	58	2.6	0.281	1.671	Over consolidated
BH22-17	4.27 – 4.88	60	85	1.4	0.087	1.508	Over consolidated
BH22-18	7.32 – 7.93	70	82	1.2	0.055	0.887	Over consolidated
BH22-21	5.49 – 6.10	59	74	1.2	0.053	1.095	Over consolidated
BH22-22	2.44 – 3.05	38	> 38	N-A	0.026	0.361	Disturbed Sample
BH22-25	6.10 – 6.71	51	101	2.0	0.045	1.779	Over consolidated
BH22-28	3.05 – 3.66	59	> 59	N-A	0.095	0.292	Disturbed Sample

Borehole	Depth (m)	σ'_{v0} (kPa)	σ'_{p} (kPa)	OCR	Cr	Cc	Consolidation Condition
BH22-30	3.66 – 4.27	43	103	2.4	0.051	0.631	Over consolidated
BH22-34	2.44 – 3.05	46	103	2.2	0.052	0.957	Over consolidated
BH22-36	6.71 – 7.32	44	> 44	N-A	0.228	0.321	Disturbed Sample

Twelve (12) vane shear from the native cohesive deposit were testing. The vane shear results are presented in the following table.

Table 11 Vane Shear Results – Native Cohesive Deposit

Borehole	Depth (m)	Shear Values Intact Cu (kPa) [min-max]	Shear Average Intact Cu (kPa)	Shear Values Removed Cu_R (kPa) [min-max]	Shear Average Removed Cu_R (kPa)
BH22-09	4.27 – 11.27	26 - 63	35	7 - 10	9
BH22-11	5.80 – 8,80	17 – 32	23.8	7	7
BH22-22	3.07 – 14.07	19 - 49	29	6 – 20	11
BH22-24	6.30 – 9.30	15 – 20	17.5	5	5
BH22-25	7.80 – 8.80	33	33	--	--
BH22-28	4.06 – 12.06	24 - 46	36	10 - 17	14
BH22-29	6.00	37	37	--	--
BH22-30	5.10 – 10.10	17 – 68	43.5	17 – 20	18.5
BH22-31	5.70 – 9.70	34 – 64	43.6	17	17
BH22-34	3.80 – 10.80	27 – 56	31.6	7 – 12	9.5
BH22-35	5.70 – 7.70	50 – 111	72.3	--	--
BH22-38	6.80 – 7.80	37 – 49	43	--	--

In-situ field vane shear tests conducted on this native cohesive deposit resulted in undrained shear strength values ranging from approximately 17 kPa to 111 kPa; the weaker, soft to very stiff soils were observed at shallow depths, and the strength of the clay gradually increased with depth such that the high value of 111 kPa was observed at a depth of 7.7 m.

Twenty-five (25) samples from the native cohesive deposit were selected for shear resistance with the Swedish fall cone tests. The shear resistance results are presented in the following table and are included in Appendix D.

Table 12 Swedish Fall Cone – Native Cohesive Deposit

Borehole	Sample	Depth (m)	Shear Resistance Intact Soil Cu (kPa)	Shear Resistance Remoulded Soil Cu_r (kPa)	Moisture Content (%)	Unit Weight (kN/m^3)
BH22-06	ST-08	4.27 – 4.88	15	0.9	95.4	13.9
BH22-09	ST-07	3.66 – 4.27	80	176.4	56.1	16.0
BH22-11	ST-09	4.88 – 5.49	48	11.0	52.3	17.2
BH22-12	ST-21	4.27 – 4.88	26	2.2	79.7	15.0
BH22-15	ST-05	2.44 – 3.05	11	0.8	95.4	14.3
BH22-16	ST-13	4.27 – 4.88	15	1.5	81.4	14.4
BH22-17	ST-20	4.27 – 4.88	23	2.8	99.3	14.8
BH22-18	ST-20	7.32 – 7.93	--	--	69.1	16.0
BH22-20	ST-23	4.88 – 5.49	109	7.1	58.3	16.0
BH22-21	ST-10	5.49 – 6.10	17	1.8	85.7	14.6
BH22-22	ST-05	2.44 – 3.05	48	44.1	52.5	16.2
BH22-24	ST-09	4.88 – 5.49	17	1.5	71.2	14.7
BH22-28	ST-06	3.05 – 3.66	48	44.1	46.6	16.4
BH22-29	ST-08	4.27 – 4.88	23	1.8	81.0	15.4
BH22-30	ST-07	3.66 – 4.27	39	3.6	46.0	16.0
BH22-30	ST-19	18.29 – 18.90	--	--	34.3	17.4
BH22-31	ST-10	5.49 – 6.1	61	19.6	30.9	19.2
BH22-31	ST-22	18.90 – 19.51	--	--	41.5	17.6
BH22-34	ST-05	2.44 – 3.05	39	3.6	68.2	16.3
BH22-35	ST-08	4.27 – 4.88	23	11.0	25.3	19.1
BH22-36	ST-04	3.05 – 3.66	32	3.6	64.6	16.6
BH22-36	ST-09	6.71 – 7.32	3	0.8	52.8	16.3
BH22-36	ST-13	9.14 – 9.75	80	11	32.0	19.0
BH22-38	ST-10	5.49 – 6.10	39	7.1	51.4	17.0
BH22-40	ST-08	4.27 – 4.88	54	14.4	27.7	18.5

The shear resistance tests in laboratory conducted on this native cohesive deposit resulted in undrained shear strength values ranging from approximately 3 kPa to 109 kPa; the weaker, very soft to very stiff soils were observed at shallow depths, and the strength of the clay gradually increased with depth such that the high value of 109 kPa was observed at a depth of 4.88 m to 5.49 m in BH22-20.

Borehole BH21-31 ended within this native cohesive deposit at 37.19 m below ground surface (mbgs).

3.3.5 Native Granular Deposit

A native granular deposit was encountered generally in all boreholes at a depth ranging from 0.05 m (at BH22-01) to 18.90 m (at BH22-24) below ground surface (mbgs). This natural granular deposit generally consisted of a grey silty and gravelly to some gravel sand with some to traces of clay.

Standard Penetration Test N-values measured in this natural soil deposit ranged between 2 to 63 indicated the soil is in very loose to very dense state with an average at 15 indicated a soil at compact state.

Twelve (12) representative samples of this native granular deposit were selected for grain size distribution tests. The laboratory results are presented in the following table and are included in Appendix D.

Table 13 Laboratory Test Results – Native Granular Deposit

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)	USCS
			Clay	Silt			
BH22-04	SS-05	2.44 – 3.05	13.3	37.6	31.6	17.5	ML or MH
BH22-06	SS-23	18.28 – 18.90	5.8		85.9	8.3	SW
BH22-07	SS-04	3.66 – 4.27	12.9		67.2	19.9	SW
BH22-09	SS-13	11.28 – 11.89	1.5	89.6	8.9	0.0	ML or MH
BH22-13	SS-16	9.14 – 9.75	21.9		64.0	14.1	SM
BH22-15	SS-23	15.85 – 16.46	25.4		59.8	14.8	SM
BH22-20	SS-11	6.71 – 7.32	22.3	51.5	24.1	2.1	ML or MH
BH22-25	SS-18	10.97 – 11.58	2.5	24.2	50.7	22.6	SM
BH22-33	SS-03B	1.32 – 1.83	6.3	84.3	7.6	1.8	ML or MH
BH22-34	SS-24	16.76 – 17.37	14.6		83.1	2.3	SM
BH22-37	SS-04	2.44 – 3.05	31.6	30.5	37.6	0.3	ML or MH
BH22-42	SS-01B	0.05 – 0.61	6.0		20.1	73.9	GW

Boreholes BH22-06, BH22-09 BH22-15 and BH22-34 ended within this native granular deposit, at depth ranging from 17.98 m and 24.69 m below ground surface (mbgs).

3.3.6 Till

A native granular deposit was generally encountered in all boreholes at a depth ranging from 2.44 m to 19.81 m below ground surface (mbgs). This natural till deposit generally consisted of a grey silty gravelly sand to a silty sand with some gravel, with traces of clay.

Standard Penetration Test N-values measured in this natural soil deposit ranged between 3 to 100 indicated the soil is in a very loose to dense state.

Moreover, it is important to note that the till is naturally a heterogeneous deposit and that it may exhibit a significant degree of vertical and lateral variability in grain size distribution. It's likely that larger boulders and cobbles may be present in the deposit in greater quantities than in the boreholes used for this investigation.

Twenty-four (24) representative samples of this till deposit were selected for grain size distribution tests. The laboratory results are presented in the following table and are included in Appendix D.

Table 14 Laboratory Test Results – Till

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)	USCS
			Clay	Silt			
BH22-01	SS-02	0.61 – 0.99	2.2	48.2	46.9	2.7	ML or MH
BH22-02	SS-05	2.44 – 3.05	22.7	41.4	34.2	1.7	MLor MH
BH22-02	SS-11	6.10 – 6.71	21.2		53	25.8	SM
BH22-03	SS-03	1.22 – 1.83	53.9		39.5	6.6	ML or MH
BH22-05	SS-05	2.44 – 3.05	6.2	25.8	50.2	17.8	SM
BH22-05	SS-10	5.49 – 5.61	17.8		46.8	35.4	SW
BH22-10	SS-12	6.71 – 7.16	3.8	32.2	43.5	20.5	SM
BH22-12	SS-17	10.36 – 10.97	8.4		56.6	35.0	SW
BH22-14	SS-14	13.87 – 14.48	4.9		71.0	24.1	SW
BH22-16	SS-11	9.14 – 9.75	15.3		60.3	24.4	SW
BH22-17	SS-15	9.14 – 9.75	0.6	37.4	50.5	11.5	SM
BH22-21	SS-17	4.27 – 4.88	19.5	37.8	28.9	13.8	ML or MH
BH22-22	SS-13	13.72 – 14.33	28.8		66.8	4.4	SM
BH22-26	SS-09	4.88 – 5.49	2.6	28.6	53.0	15.8	SM
BH22-27	SS-16	13.72 – 14.33	10.2		49.4	40.4	SW
BH22-28	SS-13	13.72 – 14.33	5.2	25.0	55.2	14.6	SM
BH22-29	SS-17	9.75 – 10.36	4.1	33.0	53.3	9.6	SM
BH22-32	SS-11	6.10 – 6.71	3.7	28.2	47.0	21.1	SM
BH22-33	SS-08	4.27 – 4.88	23.1		56.4	20.5	SM
BH22-35	SS-24	15.85 – 16.46	26.9		54.7	18.4	SM
BH22-37	SS-11	6.40 – 7.01	4.4	39.8	51.4	4.4	SM
BH22-40	SS-10	5.49 – 6.10	11.3	31.6	42.1	15.0	SM

Borehole	Sample	Depth (m)	Fines (%)		Sand (%)	Gravel (%)	USCS
			Clay	Silt			
BH22-42	SS-08	4.27 – 4.88	23.9		48.8	27.3	SW
BH22-42	SS-14	7.92 – 8.53	21.9		69.1	9.0	SM

Boreholes BH22-11 to BH22-14, BH22-16, BH22-17, BH22-20 to BH22-22, BH22-24, BH22-25, BH22-28 to BH22-30, BH22-35 to BH22-37, BH22-41 and BH22-42 ended within this native till deposit, at depth ranging from 7.59 m and 28.04 m below ground surface (mbgs).

3.3.7 Bedrock

According to the *Système d'information géominière du Québec* (SIGEOM), the bedrock in the area is generally composed of sedimentary, metasedimentary, mafic and intermediate volcanic rocks (Basalt, andesite), tonalite, granodiorite, granite, and gneiss, all belonging to the Abitibi Subprovince, Opatica Subprovince, Nemiscau Subprovince and La Grande Subprovince group.

The bedrock was encountered in boreholes BH22-01 to BH22-05, BH22-07, BH22-08, BH22-10, BH22-18, BH22-26, BH22-27, BH22-32, BH22-33, BH22-38, BH22-39, BH22-40 and BH22-43, at depths ranging from 0.99 m to 16.46 m below ground surface (mbgs). The rock was confirmed by coring over a length that varies between 1.37 and 7.11 m. The recovery measured for the different sample varied between 30 and 100 %.

The bedrock samples recovered show that in these boreholes, the bedrock is identified as a grey sandstone in borehole BH22-01 to grey granite in borehole BH22-03 and BH22-43, a grey basalt in boreholes BH22-04 and BH22-07, grey rhyolite in BH22-05, grey monzonite in BH22-08 and grey gneiss in BH22-18, BH22-32 and BH22-38.

For a structural interpretation, the rock quality designation (RQD) was determined on the rock cores recovered during drilling. This value is an indirect assessment of the number of fractures in the rock mass. For all the rock cored in this preliminary geotechnical investigation, the measured value of the RQD varies between 21 and 100 %, corresponding to very poor quality at surface to average quality at greater depths. The various RQD values measured appear to indicate that the rock is of average quality, with an average RQD of about 60%.

Eleven (11) uniaxial compressive strength and density tests were performed on representative bedrock samples. The results are presented in the following table and are included in Appendix D:

Table 15 Laboratory Test Results – Bedrock

Borehole	Sample	Description	Depth (m)	Volumic Weight (kg/m^3)	Unit Weight (kN/m^3)	Compressive Strenght (MPa)	Classification (ISRM, 1981)
BH22-01	DC-03	Sandstone	1.36 – 1.48	2770	27.2	110.1	R5 – Very strong

Borehole	Sample	Description	Depth (m)	Volumic Weight (kg/m^3)	Unit Weight (kN/m^3)	Compressive Strenght (MPa)	Classification (ISRM, 1981)
BH22-03	DC-06	Granit	3.03 – 3.15	2676	26.3	175.4	R5 – Very strong
BH22-04	DC-09	Basalt	4.97 – 5.02	2851	28.1	95.2	R4 – Strong
BH22-05	DC-15	Rhyolite	9.05 – 9.17	2758	27.1	264.6	R6 – Extremely strong
BH22-07	DC-05	Basalt	5.44 – 5.56	3127	30.7	48.9	R3 – Medium strong
BH22-08	DC-14	Monzonite	9.90 – 10.02	2809	27.8	177.3	R5 – Very strong
BH22-10	DC-13	Granit	7.18 – 7.30	2570	25.2	189.1	R5 – Very strong
BH22-18	DC-18	Gneiss	16.06 – 16.18	2645	25.9	146.8	R5 – Very strong
BH22-32	DC-13	Gneiss	8.05 – 8.17	2800	27.5	124.9	R5 – Very strong
BH22-38	DC-18	Gneiss	15.80 – 15.92	2721	26.7	98.7	R4 - Strong
BH22-43	DC-08	Granit	4.83 – 4.95	2690	26.4	176.3	R5 – Very Strong

Boreholes BH22-01 to BH22-05, BH22-07, BH22-08, BH22-10, BH22-18, BH22-26, BH22-27, BH22-32, BH22-33, BH22-38, BH22-39, BH22-40 and BH22-43 ended at depths ranging from 2.51 and 17.81 m below ground surface.

3.4 Groundwater

The depth to the groundwater level was measured in boreholes BH22-06, BH22-09, BH22-14, BH22-15, BH22-24, BH22-27, BH22-28, BH22-29, BH22-30, BH22-33, and BH22-37 and are presented in the following table.

Table 16 Groundwater Levels

Borehole	Groundwater Level (m)	Date
BH22-06	0.00	18/10/2022
BH22-09	1.86	09/11/2022
BH22-14	0.55	02/11/2022
BH22-15	0.30	17/10/2022
BH22-24	0.00	17/10/2022

Borehole	Groundwater Level (m)	Date
BH22-27	0.70	17/10/2022
BH22-28	4.25	04/11/2022
BH22-29	2.37	17/10/2022
BH22-30	0.00	17/10/2022
BH22-33	0.66	05/11/2022
BH22-37	0.00	10/10/2022

Groundwater levels can be expected to fluctuate during periods of heavy precipitation associated with seasonal weather trends, or particular events, site use, adjacent site use, and construction activity. Therefore, it is possible that the groundwater will be different during the planned work.

4.0 Discussions and Recommendations

This section provides general guidance related to the geotechnical design aspects of the construction of the potential Billy-Diamond Highway railway, based on our interpretation of the available subsurface information described herein, and our understanding of the project requirements.

The discussion and recommendations presented in the following sections are to provide the designers with functional information for planning and preliminary design purposes only. A detailed geotechnical investigation and design report, complete with additional boreholes, will be required prior to or during the final design stage of the project.

4.1 Project Summary

The project consists of the design, development and construction of a new railway that will extend from the town of Matagami at south (KP 0) to the Rupert River at north (KP 253).

The potential BDH railway alignment closely follows the actual alignment of the Billy-Diamond Highway and deviates from it a maximum distance of 4 km in some localized sectors. The railway will be built on mineral and organic soils, in forested and undeveloped areas. A significant part of the railway, approximately 20% of the alignment, will be built on peat; these areas will require a special geotechnical attention during the next design phases.

Bridges and culverts will be built along the alignment to cross rivers and streams, as well as the Billy-Diamond Highway at some locations. The geodetic elevations range from el. ≈290 m at Matagami to el. ≈190 m at the Rupert River Bridge. Several high embankments are also anticipated throughout the proposed alignment.

The preliminary geotechnical investigation was carried out to estimate the baseline *in-situ* conditions at the Site that will influence the Feasibility Study for the construction of the potential BDH railway. The following sections outline the geotechnical and material concerns and requirements that will influence the feasibility and the design of the project.

This report discusses construction design methods which may be considered for the preliminary design of the railway, while referring to certain typical concepts applicable to road infrastructures in a northern environment and reflecting the subsurface conditions encountered during the present investigation (presence of fine compressible soils and large areas of organic soils/peat). It provides guidance to the designer in modifying or amending current practices, considering the specific context of the project. A list of relevant elements to consider when selecting the design and construction methods and carrying out a preliminary design is also provided. Finally, recommendations are made to carry out additional and detailed geotechnical studies in specific areas or structure locations.

4.2 Roadbed Construction

4.2.1 General

Section 4.2 discusses issues which will need to be evaluated as part of the design of cuts and fills along the railroad alignment. The roadbed, which will support the sub-ballast and ballast layers, is referred to as the *top of subgrade*.

Where fill is required to raise the ground surface to the proposed top of subgrade, this report refers to the materials required to raise the grade as *embankment fill* which are constructed over the existing *foundation soils.* In fill sections, the top of subgrade will consist of embankment fills, and in cut sections, of foundation soils.

Over 20% of the project alignment crosses areas consisting of peat deposits. The treatment of peat areas is discussed separately in *Section 4.3: Special Considerations for Peat Treatment*.

Most of the project alignment extends the Barlow-Ojibway varved clay plains which are normally to slightly over consolidated, soft to firm in consistency, with a high compression index. The stability of roadbed embankments in clay soils is discussed separately in *Section 4.4: Stability Analysis of Embankments*.

4.2.1.1 Assumed Cross-Section

Design cross-sections will need to be developed as part of the detail design stages. The discussions in this report generally assume the following in fill and cut sections.

- Embankment foreslopes (in fill areas) and ditch foreslopes (in cut areas), to the left and right of the tracks, will be no steeper than 2H:1V but could be flatter to accommodate geotechnical issues.
- Where ditches are required, they would be at least 3.0 m wide at the base but could be wider if deemed necessary to accommodate hydraulics.
- Where ditches are required, the bottom of the ditch would be at least 1.0 m below the bottom of the ballast but could be deeper to accommodate hydraulics.
- Within soil cut areas, the backslope located between the outer ditch line and the natural ground will be no steeper than 2H:1V but could be flatter to accommodate geotechnical issues.
- Within rock cut areas that are less than 6 m in height, the backslopes in sedimentary rock will be 2.5V:1H and 10V:1H in other rock types.
- Within rock cut areas, at detail design it could be determined that a wider ditch is required in some areas to act as a rock catchment area to contain potential rock fall without impeding the hydraulic function of the ditch.
- That interceptor ditches will be constructed above cut slope to prevent surface water runoff from entering the cut areas.

4.2.1.2 Frost Penetration

Based on available information, the mean freezing index along the alignment range from about 2100 to 2200 mean Degree-Days below 0°C, which corresponds to a frost penetration depth of approximately 3.0 m. The AREMA manual suggests that in areas with frost heave problems, a frost treatment depth of 60% of the frost penetration should be used for soil replacement, which would correspond to 1.8 m.

As a preliminary design strategy, except in areas where the roadbed consists of bedrock or a well-grade sand with a USCS symbol of SW, it is recommended that the rail embankment be designed to ensure a minimum vertical height of 1.8 m from the bottom of the ballast to the top of the natural foundation soil. For most soil types, this will ensure that the total seasonal frost heave will be less than 75 mm. The embankment fills placed between the sub-ballast and the natural foundation soil should consist of a soil containing less than 30% silt and clay size particles, commonly referred to as a coarse-SM soil.

In areas where the natural foundation soils consist of clays (CH) or silts (ML), significantly greater frost heave would be anticipated, even when using a frost treatment depth of 1.8 m. The following provides an estimate of anticipated frost heaves when using a 1.8 m frost treatment depth for various soil types encountered along the alignment.

- For soils where the natural foundation soils are designated as SM (silty sands), frost heaving in the order of 50 mm to 75 mm would be expected.
- In the case where the natural foundations soils have been designated as ML (silt and sandy silt), frost heaves in the order of 150 mm would be expected.
- In the case where the natural foundation soils have been designated as CH (clays), frost heaves in the order of up to 300 m would be expected.

Where subgrade transitions are anticipated between ML or CL soil types and other soil types, a frost treatment depth of 2.5 m is recommended, with the limits of the tapered excavations selected based on AREMA Section 1.4.1.7.4: Replacement of Frost-Heaving Material.

As part of the final design, the frost heave tolerances should be reviewed for the rail project. The recommended global frost treatment depth for the project should be selected based on this review.

4.2.1.3 Reuse of Site **Generate** *Soils*

Once the final rail profile has been established, the volumes of potential fill materials should be evaluated. The following soil types should be excluded when assessing the volumes of potential fill materials.

- The native cohesive deposits described as silty clays, and as silt and clay soil, assigned a USCL group symbols of CL and CH, are not considered suitable for reuse. These soils are excessively wet and are not considered compactable for the construction of the embankment fills.
- Organic soils such as peat are also not considered suitable for reuse.

For the construction of embankment fill material to be placed within 1.8 m of the underside of the railway ballast, it should be limited to soils containing less than 30% fine particles (silt and clay size particles) or rock fill materials.

For the construction of embankment fill materials placed lower than 1.8 m below the underside of the railway ballast, all soil types, excluding the silty clays, the silt and clays, and the organic soils are considered suitable.

4.2.2 Natural Foundation Soils

Prior to placement of embankment fill or railway structure (ballast and sub-ballast), the natural foundation soil should be prepared to ensure adequate drainage and to provide sufficient bearing capacity to offer an acceptable factor of safety against the loads that will be imposed by the tracks. In addition, the embankment fill should be designed and constructed to tolerate the settlements associated with the compression of the natural foundation soils. Based on consolidation test results presented in Table 10, it is anticipated, depending on the specific site location, that primarly consolidation settlements within the clay deposits will be initiate once 1 to 2 m of embankment fill is place. Once the profile height has been confirmed, it is recommended that settlement calculations be undertaken to assess the magnitudes of settlements anticipated.

As part of the preliminary design considerations, the following general soil removal should be anticipated when preparing the subgrade.

- Where less than 2.0 m of embankment fill material is to be placed, organic soils and peats should be removed (this is discussed further below).

- Except where peat treatments are proposed, such as discussed in Section 4.3, topsoil, peat thicknesses of less than 1.0 m, and other organic layers, should be stripped from beneath the proposed embankment fill.

- Silty clays, and silt and clay soils within 1.8 m of the underside of the ballast should be removed and replaced with a soil containing less than 30% fine particles or with rockfill.

- Locally soft or wet soils that cannot be compacted to 90% of its optimum dry density as defined by the modified Proctor test should be removed. In this case, the soft soils should be subexcavated and replaced with a compacted fill containing less than 30% fine particles.

- Large areas of soft and wet soils could be treated using geosynthetics (geogrids, geotextiles and geocells) to replace potential subexavation and replacement works. The potential for this application should be assessed as part of the detail design.

Where the natural foundation soils consist of silty clay, or silt and clay (cohesive deposits), special construction techniques may be required to ensure that the embankment fill is stable, both during and after construction, and that the post construction settlements are tolerable. The following construction methods are anticipated.

- In the case tall fills over 3 m, it may be necessary to construct the embankment in stages to avoid overstressing the underlying cohesive soils. Once the embankment heights have been determined, the potential requirement to construct the embankments in stages will need to be evaluated by a geotechnical engineer.

- Depending on the settlement objectives and the proposed embankment heights, preloading and surcharging the site may be required prior to track construction to limit post construction settlements.

The study area includes natural foundation soils consisting of soft compressible fine soils and organic deposits directly underlain by fine compressible soils. It is anticipated that these soils will not be suitable to directly support construction traffic and that a separation barrier should be placed in these areas prior to construction of the embankment fill to prevent soil pumping and disturbance of the natural foundation soil during the construction process. Accordingly, it is recommended that a geotextile be placed on the natural foundation soil in areas where organic soils are to be removed and/or in areas where soft clay (silty clay, silt and clay soil) are present.

It is also suggested that the initial layer of embankment fill be at least 600 mm thick to protect the natural foundation soils, particularly when the embankment is placed on soft soils or on organic soils to prevent the instability of the natural foundation soils; the treatment of peat areas is discussed in Section 4.3. Where the embankment is constructed of rockfill or on peats, the initial layer would be increased to 900 mm (see sections 4.2.5 and 4.3.4).

In all cases, embankment slopes should not be steeper than 2H:1V to ensure the stability of the embankments throughout the construction period and the lifetime of the infrastructure. If slopes steeper than the latter are considered, stability studies should be performed to ensure their short- and long-term stability. Stability analyses that will be performed for every high embankment may imply that a flatter slope at the embankment is required.

4.2.3 Organic Soils

In general, vegetation, topsoil and organic soils should be removed to ensure an appropriate contact between the foundation soils and the embankment fill. The removed organic soils can be stockpiled and reused for landscaping purposes if deemed appropriate; it is noted that an assessment of potential topsoil recovery has not been carried out as part this study.

The excavation of organic soils is not required if more than 2 m of granular fill (including the granular structure of the railway) is anticipated. In cases where the embankment fill is thinner, it should be assumed that the organic soils will be completely excavated.

Where the rail alignment crosses peat areas, the treatment of these soils will require specific investigations. Section 4.3 of this report presents a preliminary analysis of potential treatment methods.

4.2.4 Geogrids

As part of the final design, the use of geogrids should be considered in peat areas where the peat is to remain in place. The use of geogrids is recommended in the following cases:

- Peat deposits which do not have an intact fibrous crust.
- Ditch crossings.
- Culvert transitions.
- Peat deposits with open water.
- Peat surfaces with ruts due to the passage of heavy machinery (ex.: presence of old logging sites in some peatlands of the alignment).
- Initial layer of fill constructed with material other than MG 112, MG 20 (e.g.: rock fill of controlled caliber).

The extended use of geogrids over the entire fill on organic soils is not required. Geogrids will not improve the total capacity of the embankment and will not prevent failure if the control of the thickness of the initial layer is not properly performed.

4.2.5 Fill Construction

Embankment fills will be built in areas where the rail bed must be raised to its final elevation. The composition of the embankment itself and the native foundation soils are the two main components that must be considered for the design of embankments (except high embankments). The geotechnical constraints should be considered when determining the embankment geometry and its material composition.

- Embankment fills must be designed to be fully stable under their own weight and future track loads. Much of the alignment crosses generally weak varved clay deposits which can be prone to global instabilities under tall or over-steep embankments.

- Embankment designs must also consider anticipated settlements. As presented in Section 3.3.4, the clays underlying the site are frequently normally or over-consolidated and are highly compressible.

- The design frost penetration depth in this area is 3.0 m. To limit frost related differential movements, all embankment fill within 1.8 m of the bottom of ballast should consist of soils containing less than 30% fine particles or consist of rockfill.

As much as possible, the embankment fills should be constructed using excavated materials from cut sections and ditch excavations. Since the clayey soils are not considered suitable for reuse, it is likely that the required quantities will be greater than those anticipated for the excavation. It is anticipated that manufactured or imported materials from borrow pits or quarries will be required.

It is also suggested that the initial layer of embankment fill be at least 600 mm thick to protect the natural foundation soils, particularly when the embankment is placed on soft soils or on organic soils (peatlands) to prevent the instability of the natural foundation soils.

For excavated materials to be considered reusable, it must have a water content that facilitates compaction and be free of organic soils; for this reason, the clay soils encountered along the project length are not considered suitable for the construction of embankment fill.

Where fill is to be used behind retaining structures, free-draining backfill materials such as MG-20, MG-56 or CR-14 should be used within a granular wedge extending up from the base of the wall at a slope of 1H:1V.

The construction of embankments must include continuous inspection and testing to ensure that proper fill materials are use and that they are adequately compacted.

Considering the northern context of the Site, a certain flexibility regarding the choice of granular materials may be required. It will be necessary to consider the availability of these materials and the necessary effort to obtain the required grain-size distribution and normally required aggregate physical properties (crushing, screening, transportation, stockpiling, etc.). Available material sources should be reviewed as part of the detail design.

Section 1.2.3.4 of the AREMA outlines specific requirements for the construction of rockfill that could be used as an alternative to mineral soils or granular materials. This option could be considered for reasons of cost/or availability of materials in northern areas. Rockfill will tend to cause long-term settlement due to the gradual compaction of the fill itself. In areas where long-term settlement will not be tolerated, the use of borrow pits materials should be preferred for the construction of the fill. Rockfill should be used primarily in areas where settlement can be corrected, and the surface easily reshaped. The design of rockfill and the establishment of project-specific requirements should be carried out by a geotechnical engineer experienced in the construction of rock fill, taking into account the project-specific conditions (presence of peats areas and fine compressive soils). Where the embankment is constructed of rockfill, the initial layer would be increased to 900 mm.

A balance factor should be calculated in subsequent stages of this project. This factor must consider the following in addition to the total volume of cut and fill to be placed:

- General thickness of organic soils on alignment.
- Average thickness of organic soils in peat areas.
- Anticipated settlement of organic soils and mineral soils beneath the embankments (including high embankments) which will increase the required volume of embankment fill.
- The non-suitable nature of the clay soils due to its wet state.
- Potential reuse of the till soils.
- Presence of boulders.
- Densification of embankment fill materials during placement.

- Anticipated loss of material during transportation and temporary storage.

Based on the Atterberg limits test results carried out on the clay samples, approximately half of the samples had a liquid content above the liquid limit when tested in the laboratory (liquidity index greater than or equal to 1). This implies that the soft clay soils present in the study site could lose their plastic behavior when handled and transported and become difficult to dispose of.

4.2.6 High Embankments

Railway embankments over 4 m in height were considered as "high embankments". A preliminary list of high embankments was provided by the project design team to validate the geotechnical parameters in place at each of these areas. The soil conditions at each of the boreholes drilled in the identified high embankment areas are presented in Table 6 in Section 3.3. Of the 18 high embankment areas identified, nine (9) include embankments of 6 m height or more, and two (2) include embankments of 10 m or more.

According to AREMA, embankments should be designed to account for settlements and to prevent failure of the underlying soils. As previously indicated, where clay deposits have been identified, the natural foundation soils are highly compressible and weak. Potential treatment or soil improvement methods for these areas are discussed further below. Future investigations in the high embankment areas may identify different ground improvement methods to be considered, depending on the soil conditions encountered in future investigations.

In areas with granular or dense soils, or with shallow bedrock, the use of ground improvement methods is not anticipated. Future investigations and analysis in these areas will also be required to confirm the geotechnical parameters to be used to model the behaviour of the natural foundation soils beneath the proposed high embankments.

In the context of the feasibility study, only one borehole was drilled for each high embankment area, which can extend over several hundred meters. The number of boreholes, depth, and in-situ tests to be performed for complementary investigations must be sufficient to provide a reliable representation of the full length of the high embankment area, including the natural foundation soils beneath potential embankment berms, where required. The future investigations in high embankment areas underlain by clay will need to identify construction staging requirements, where applicable.

Each high embankment area should be subjected to a stability and settlement analysis to ensure the stability of the future railway platform. The analysis must consider settlements of the underlying organic soils (when left in place) and the mineral soils. According to AREMA the following should be checked.

- The stability of the embankment under its own weight and imposed loads.
- The stability of the embankment and natural foundation soils system in combination.
- An economic tolerance on the magnitude of anticipated settlement.

For the design of a railway embankment, a safety factor of 1.5 is generally considered adequate. However, if the engineer performing the stability analyses has sufficient information for the analyses, a

smaller safety factor could be considered. If field and laboratory data are inconsistent or inadequate, the engineer should consider increasing the factor safety factor.

In case the required factor of safety cannot be reached, or where settlements are considered excessive, one or more of the soil improvement methods listed in the AREMA can be considered:

- Replacing unsuitable foundation soils with compacted structural fill.
- Flattening embankment slopes or adding berms at the toes of the embankment.
- Installation of a foundation drainage system to reduce pore water pressures.
- Construction of the embankment in several stages.
- Densification of granular foundation soils, where possible.
- Use of light embankment materials (fill).
- Mechanical reinforcement of foundation soils and/or embankment.
- Preloading and surcharging the fill areas to accelerate consolidation of organic or cohesive soils.
- Installation of retaining walls.

It should be anticipated that combinations of these soil improvement methods will be required in all areas identified as high embankment areas where the natural foundation soils consist of clay.

4.2.7 Cuts

Deep cuts (greater than 5 m) must be analyzed in detail and a stability study must be carried out for the final design. For the present feasibility study, it is assumed that no deep cuts will be required within areas underlain by clays; if deep cuts are proposed in the clay deposits, these will require boreholes specifically at those locations to identify a safe slope profile.

Generally, excluding the clay soils, cut slopes of 2H:1V can be considered for the feasibility study for the soils encountered at the site. This assumes that adequate ditch drainage will be provided at the toe of slope and that interceptor drains will be constructed at the top of slopes. Should the detail investigations to be carried at the later stages of the project identify a risk that groundwater could emerge from the face of the slope, special treatments such the placement of granular drainage layer, construction of drainage buttresses, or the installation of toe drains could be considered.

In areas with clay deposits, silt deposits or with unfavourable groundwater conditions, flatter slopes may be required. This would ultimately increase the volume of soils and widen the overall width of the railway construction zone.

For all soil types, it is essential to maintain stable and safe permanent cut slopes. The width of the cut area should be sufficient for the installation of ditches at the bottom of the slope to collect resurging groundwater. In some areas, the results of the stability analyses may justify that the cut slope be benched, or that other measures such as additional drainage systems, erosion protection or filter layers, and revegetation be applied.

Where the factors of safety obtained from the slope stability analyses do not provide a safe geometry, the use of retaining walls could be also considered if the other cost-effective alternatives mentioned above cannot be achieved.

For the design of all cut areas, Article 1.2.2 of the AREMA manual should be consulted. It outlines the essential components and features to be considered in the preparation and design of soil and rock cut areas. It includes factors that may affect the depth of excavations and provides general recommendations for the design and geometry of cut slopes.

4.3 Special Considerations for Peat Treatment

4.3.1 General Considerations

As previously discussed, over 50 km of the rail alignment will be constructed on peat areas, representing approximately 20% of the alignment. The results of the preliminary terrain mapping indicates that 120 distinct peat areas are anticipated along railway alignment. Test holes were advanced at each of the identified peat areas to provide a preliminary summary of the organic soil characteristics which are presented Section 3.2.

Since there is no guide for the construction of railway embankments on peat deposits, the " *Guide pour l'étude et la construction de remblais routiers sur tourbières, DLC 2012* ", published by the *Ministère du transport du Québec*, was used as a guideline, with some aspects adapted to meet the railway's specific conditions and requirements. The geotechnical and railway engineers must maintain a critical mindset and use their best judgement regarding the applicability of the concepts proposed in this guide during the subsequent phases. Discussions should be held to assess the suitability of the methods proposed in this report and to share a part of knowledge with the ministry that considers the experience of the ministry with road projects in similar conditions and environments.

It is noted that, within the framework of the feasibility study, the frequency of surveys and tests conducted on the site provide only a partial understanding on the nature of the peat and its thickness, which is insufficient for the final design. The following discussions are general and discuss the treatment methods for peat areas that could be applied.

4.3.2 Peatland Treatment Methods

For this project, three (3) general methods of organic soil treatment in peat areas can be considered.

- Excavation.
- Traditional embankment (variable initial layer).
- Consolidation (with or without surcharge).

Each of these methods and their associated requirements are briefly described in the following sections. The choice of the treatment method should consider, among other factors, the nature of the infrastructure to be built, the extent and frequency of peat areas, the homogeneity of the organic layer and its thickness, the characteristics of the organic soils, the thickness of the embankment to be built, the nature of the

underlying mineral soils, the construction timeframe, and, lastly, the availability and nature of fill materials to be used.

4.3.2.1 Excavation

This method consists of completely excavating the organic soils over the entire extent of the peat area. This method is generally applied when the organic soils are thin (less than 2 m) and when the height of the embankment to be constructed is less than 2 m. It must also consider the nature of the underlying mineral soils, which must have a better bearing capacity than organic soils. In some cases, it may be more advantageous to slightly raise the profile to avoid the excavation of the organic layer. For the preliminary design, removal of the peat layer should be assumed when the following conditions are met.

- Embankment height less than 2 m.
- Thickness of organic soils less than 2 m.
- Bearing capacity of mineral soils greater than organic soils.

4.3.2.2 Traditional Fill (variable initial layer)

This method consists of constructing the embankment in a conventional manner, without considering the organic layer. It's therefore not necessary to have an instrumentation programme. Traditional fill is typically used for uniform deposits where the thickness of organic soils is less than 1 m and the height of the embankment to be built is greater than 2 m, to ensure the best consolidation of the organic soils.

For preliminary design, it should be anticipated that the peat material would compress by at least 50% of its initial thickness and that the estimated fill volume would need to consider additional materials to compensate for the compression.

The initial layer of the fill should be 600 mm thick if the organic soils are less than 0.5 m thick, and 900 mm thick if the organic soils are between 0.5 and 1 m thick.

- Embankment height greater than 2 m.
- Thickness of organic soils less than 0.5 m (initial layer of 600 mm).
- Thickness of organic soils between 0.5 and 1 m (initial layer of 900 mm).

4.3.2.3 Consolidation (with or without surcharging)

The consolidation method of construction consists of provoking a gradual settlement of the organic deposit, while avoiding any shear failure. It is mainly recommended when the thickness of the organic deposit is uniform and more particularly when there is no pavement, and the profile can be easily corrected following post-construction settlements. It can also be considered when the bearing capacity of the organic or mineral soils is insufficient for the embankment loads. This method is usually used when the organic soils are thicker than 1 m and the embankment height is higher than 2 m. If the embankment is less than 4 m, a surcharge should be applied.

- Embankment height greater than 2 m.
- Thickness of organic soils greater than 1.0 m and less than 4 m (with surcharge).
- Thickness of organic soils greater than 4 m (without surcharge).

A surcharge usually extends at least 600 mm above the finished ballast height, consisting of a granular material that is temporarily installed for a minimum period of 120 days. It may be preferable to construct the embankment fill with the surcharge before winter and leave it in place for the entire cold season. Depending on the settlement objectives, the surcharge height and the settlement period should be determined at the final design stages.

This construction method requires a rigorous monitoring of the settlements throughout the construction period. Therefore, an adequate instrumentation should be installed prior to the construction phase to constantly monitor the settlement progression during the process of construction. The instrumentation should include, but not be limited to, settlement points set in different layer, surface settlement points, and piezometers and lateral displacement indicators in the case where the peat is also underlain by compressible clay soils.

In all cases, the embankment should be constructed as described in Section 4.3.4 below.

4.3.3 Applicable Peat Treatment Method

An approximate list of peat areas along the alignment, and the height of embankment to be constructed was provided by the consultant. The recommended peat treatment methods for each area, based on the previous mentioned methods, are presented in the table below.

Table 17 Recommended Peat Treatment Method

Peat Zone Number	Location (m)	Thickness of Organic Soils (m)	Fill		Recommended Method
			Maximum (m)	Mean (m)	
1	0 to 1+600	0.3	3.9	1.3	Traditional Fill - 600 mm
2	1+600 to 3+600	0.5	13.0	8.9	Traditional Fill - 900 mm
3	3+600 to 4+200	0.3	0.5	0.5	Excavation
4	4+200 to 6+800	0.5	2.5	1.3	Excavation
5	6+800 to 9+200	0.3	14.8	4.2	Traditional Fill - 600 mm
6	9+200 to 13+100	0.5	10.7	2.0	Traditional Fill - 900 mm
7	13+100 to 13+600	0.3	-	-	Excavation
8	13+600 to 13+900	0.8	-	-	Excavation
9	13+900 to 17+500	0.3	13.7	1.3	Traditional Fill - 600 mm
10	17+500 to 17+700	0.9	-	-	Excavation

Peat Zone Number	Location (m)	Thickness of Organic Soils (m)	Fill		Recommended Method
			Maximum (m)	Mean (m)	
11	17+700 to 18+700	0.3	7.7	5.4	Traditional Fill - 600 mm
12	18+700 to 19+000	0.7	-	-	Excavation
13	19+000 to 29+000	0.3	11.9	3.7	Traditional Fill - 600 mm
14	29+000 to 29+400	0.5	1.1	0.9	Excavation
15	29+400 to 33+400	0.3	6.4	2.4	Traditional Fill - 600 mm
16	33+400 to 34+400	1.8	-	-	Excavation
17	34+400 to 55+600	0.3	14.7	3.9	Traditional Fill - 600 mm
18	55+600 to 58+000	0.5	3.8	1.5	Traditional Fill - 900 mm
19	58+000 to 59+500	1	1.3	1.2	Excavation
20	59+500 to 62+000	0.5	1.2	0.7	Excavation
21	62+000 to 66+000	0.3	2.3	1.3	Excavation
22	66+000 to 68+800	0.7	7.5	1.5	Traditional Fill - 900 mm
23	68+800 to 92+300	0.3	15.5	3.1	Traditional Fill - 600 mm
24	92+300 to 94+300	2.7	3.8	3.0	Consolidation with surcharge
25	94+300 to 104+300	0.5	16.8	3.3	Traditional Fill - 900 mm
26	104+300 to 123+000	0.3	8.3	2.4	Traditional Fill - 600 mm
27	123+000 to 123+600	0.8	2.3	0.7	Excavation
28	123+600 to 135+800	0.3	16.2	4.2	Traditional Fill - 600 mm
29	135+800 to 136+300	1	3.0	1.5	Excavation
30	136+300 to 138+800	0.5	9.4	4.0	Traditional Fill - 900 mm
31	138+800 to 139+600	1.5	1.3	0.4	Excavation
32	139+600 to 140+500	0.3	1.8	0.7	Excavation
33	140+500 to 141+200	0.6	1.3	0.5	Excavation
34	141+200 to 143+000	0.3	1.4	0.4	Excavation
35	143+000 to 144+800	0.5	8.0	1.7	Traditional Fill - 900 mm
36	144+800 to 149+400	0.7	5.8	2.8	Traditional Fill - 900 mm
37	149+400 to 150+000	2	3.0	1.4	Consolidation without surcharge
38	150+000 to 153+200	2.2	4.0	2.1	Consolidation with surcharge
39	153+200 to 156+000	1.4	6.5	2.8	Consolidation without surcharge
40	156+000 to 158+800	0.3	7.2	3.0	Traditional Fill - 600 mm
41	158+800 to 159+800	3	12.0	5.7	Consolidation without surcharge
42	159+800 to 165+800	0.3	6.0	3.4	Traditional Fill - 600 mm

Peat Zone Number	Location (m)	Thickness of Organic Soils (m)	Fill		Recommended Method
			Maximum (m)	Mean (m)	
43	165+800 to 167+300	2.8	1.1	0.7	Consolidation with surcharge
44	167+800 to 176+800	1.9	10.1	6.1	Consolidation without surcharge
45	176+800 to 183+800	0.7	5.8	2.3	Traditional Fill - 900 mm
46	183+800 to 187+600	1.7	3.9	1.7	Consolidation without surcharge
47	187+600 to 192+400	0.9	5.6	2.6	Traditional Fill - 900 mm
48	192+400 to 200+800	1.5	5.8	3.0	Consolidation without surcharge
49	200+800 to 201+800	0.3	3.1	1.7	Excavation
50	201+800 to 205+400	2	4.7	2.1	Consolidation without surcharge
51	205+400 to 215+000	2.5	2.0	0.9	Consolidation with surcharge
52	215+000 to 223+600	1.2	10.0	2.0	Consolidation without surcharge
53	223+600 to 238+000	1	13.2	4.9	Traditional Fill - 900 mm
54	238+000 to End	0.5	10.4	5.8	Traditional Fill - 900 mm

4.3.4 Fill Construction on Organic Soils

Regardless of the treatment method chosen for construction on peat, all embankments should be constructed using the same procedure.

The initial layer of embankment laid on organic soils should be composed of granular material, generally sand, type MG 112. To avoid punching of the organic soils, the material shall not contain cobbles with a diameter exceeding 100 mm. This first layer will be 900 mm thick, except in the case of a traditional fill treatment with a 600 mm initial layer (see Section 4.3.3).

In the case where it would be difficult to obtain granular materials of type MG 112, the initial layer of fill should be constructed with a rock fill, the size and grading of the material must be approved in advance. In such a case, the installation of a geotextile and a geogrid is recommended before placement of the initial lift embankment fill.

Controlling the thickness of the initial layer will be of primary importance to the performance of construction operations on peat. Throughout the construction of the initial layer, constant monitoring will be required to identify any areas that are not performing as anticipated. The feasibility of the peat construction methods is critically dependent on the quality of the placement of the initial layer; the final design should determine restrictions on the weight of the equipment used, the spacing and loading of haul trucks and construction vehicles, and the recommended waiting periods between each layer to be followed.

Once the initial layer of embankment fill is in place, the other layers of embankment can be constructed within a time delay determined by the dissipation of pore pressures and the consolidation of the deposit, according to the piezometers and settlement indicators installed.

The completion of the embankment can be done with successive layers of 300 mm thick, compacted with a bulldozer. Between each of the layers, a time delay will be necessary, the time of which will be determined in accordance with the readings recorded by the piezometers. If no piezometers are installed, the normal time delay in days between layers can be estimated at 2.5% of the thickness of the last layer laid, or approximately one week for a 300 mm layer.

Finally, where a surcharge is to be placed to accelerate the consolidation, it should be built to its full height over the entire peat area to be consolidated by surcharge, and it should be tapered progressively with a longitudinal slope of 1V:25H over the embankment in the areas without surcharge. The surcharge should be left in place until a geotechnical engineer confirms, based on the settlement monitoring data, that the compression objectives have been met, a minimum period of 120 days is recommended before removing the granular surcharge.

Given the significant extent of peat treatment anticipated for this project, it is recommended that a properly prepared work plan that meets all the requirements established during the next engineering phases be approved by a geotechnical engineer in charge of the project and by the client. Full-time supervision should then be maintained to ensure that construction and peat consolidation operations are carried out properly.

4.3.5 Settlements in Peats

The consolidation and settlement mechanism of organic soils occurs in two stages, the consolidation of the macroscopic system first, followed by the consolidation of the microscopic system. These two consolidations occur simultaneously, and the settlement curve will be largely influenced by the rate of loading. Secondary settlements will be associated with consolidation of the microscopic void system corresponding to the retained water in the organic soil fibers. Post-construction secondary settlements can therefore be quite long and will depend on the applied loading. The use of drains will increase the dissipation of macroscopic voids and therefore primary settlements but will not greatly affect secondary settlements.

To estimate the additional quantities of material required to achieve the desired profile, it is necessary to anticipate the settlements generated by the placement of the embankments. In addition to the settlements caused by the organic soils (primary and secondary settlements), it will also be necessary to consider the settlements of the underlying mineral soil layer, especially in the case of soft and compressible fine soils (clay). Settlement analyses must be performed in subsequent phases of the project.

Figure 5 below, obtained from the "Guide" of MTQ, can be used to estimate the total thickness of material required to achieve the desired grade for the intended profile, according to the following equation.

It is to be noted that this estimation method is relatively reliable for embankments 1.2 to 2 m thick (accuracy ± 20%) but the accuracy tends to decrease with the increase of the embankment height. For

embankments 1.2 to 2 m thick, in theory, settlements will generally not exceed 50% of the organic layer thickness. Under higher embankments, settlements may be of higher magnitude. This curve should be used only for the purpose of estimating the additional quantities of material required to achieve the final profiles. It should not be used during construction to monitor settlements (use the instrumentation program during construction).

$$Rt = Hr * 100/(100-T)$$

Where:

Rt = total height of the embankment to be constructed.

Hr = expected height above the natural ground surface to reach the fixed level (with or without surcharge).

T = Percentage of expected settlement according to the curve.

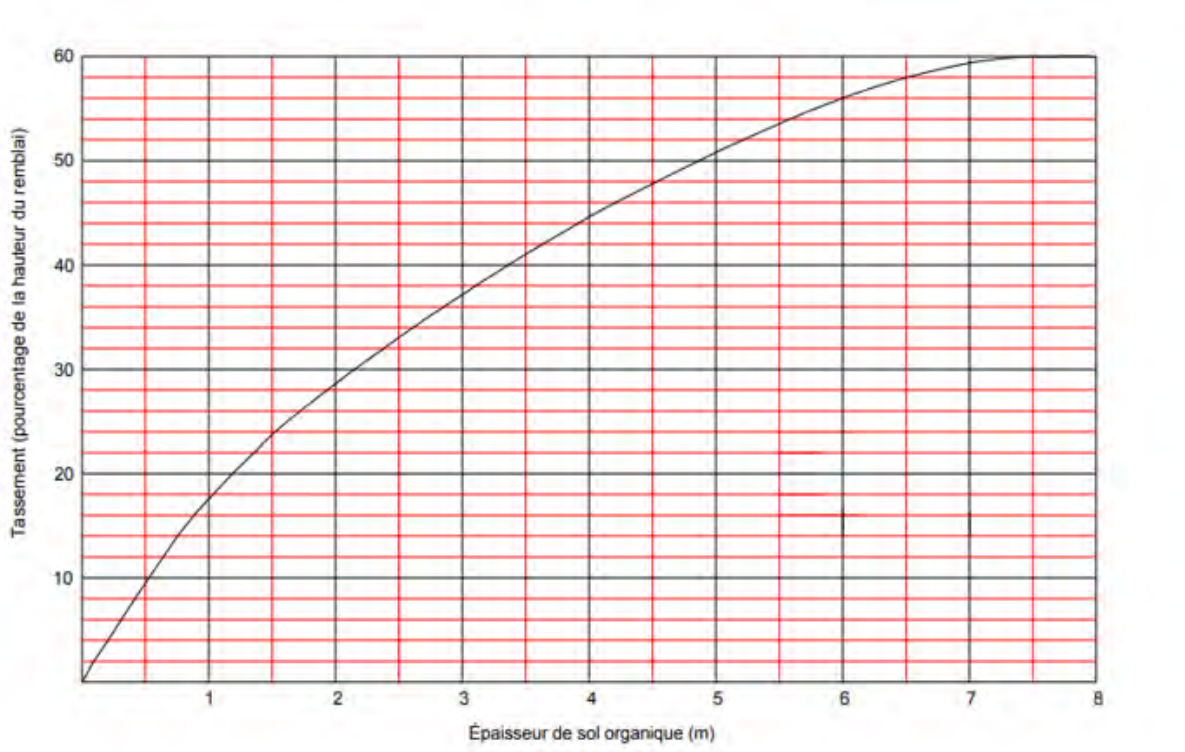


Figure 5 Settlement curve as a function of organic soil thickness (DLC, 2012)

4.3.6 Culverts within Peat Areas

In some cases, temporary drainage of peat areas using culverts may be required to facilitate the construction process. In other cases, the installations of permanents culverts may be required for drainage purposes, or alternatively to maintain a hydraulic connection between portions of the peat areas

to be separated by the rail alignment; the requirements for such culverts would be determined by environmental scientists.

During the construction period, temporary culverts should be installed over and after the initial layer is laid during the peat treatment.

In some cases, permanent culverts may be required to be placed on organic soils that have a considerable thickness. If placing the permanent culvert requires excavation of the organic soils (seating on the mineral soil), grading transitions of 5H:1V, geogrid and 600 mm surcharge should be applied.

4.4 Stability Analysis of Embankments

In addition to stability analyses on high embankments and areas of deep cut, stability analyses will be required in areas of peatlands and/or compressible fine soils.

Organic soils tend to be very compressible and have a low bearing capacity. It will therefore be necessary to ensure that the organic deposit can support the embankment to be placed for the peatland crossover. The short-term stability analysis should consider the undrained shear strength measurements of the organic soils in terms of their vertical and horizontal variability. Anticipated settlement during construction should also be considered in these analyses. A minimum factor of safety of 1.3 is normally judged acceptable for peat stability analyses.

Similarly, it is possible that the mineral deposits underlying the organic soils are too weak to support the embankment without the risk of failure, especially in the presence of soft and compressible fine soils. A geotechnical and stability analysis will be necessary in these areas and will need to account for the behaviour of the organic soils combined with the behaviour of the underlying mineral soils and the minimum safety factor would be 1.5.

In case the minimum safety factors mentioned above cannot be achieved, lowering the embankment profile or height could be considered as a first alternative. Another alternative would be to flatten the embankment slopes and/or add lateral counterweights (berms). The dimensions and geometry of these berms would then be determined by performing new stability calculations. Lastly, if the contribution of the counterweights does not provide sufficient safety factors, light materials such as polystyrene or wood residues could be placed to lighten the embankment (light weight fill).

4.5 Bridges and Culverts

Depressions, watercourses, and roads/roadways along the alignment will be crossed with bridges or culverts.

Each structure will require a detailed geotechnical investigation to supplement the information provided in this preliminary study. Each investigation plan should be based on the proposed structure type and the precise location of the proposed structure. The documents "*Guide de planification et de réalisation des études de reconnaissance de sols"* and its Appendix 1: "*Spécifications pour les forages et sondages d'une étude géotechnique pour le remplacement ou la construction d'ouvrages d'art* " issued by the

Ministère des Transports du Québec should be used as references for the planning of the detailed geotechnical investigations programs. In all cases, the AREMA guidelines regarding soil investigations for the construction of structures should also be considered.

According to the preliminary geotechnical investigation results, soils in the areas of future bridges/culverts may vary greatly from one structure to another. Some structures may rest directly on bedrock or on a dense natural deposit such as the till, where spread footing foundations would be anticipated for bridges, but other structures must be built on highly sensitive and compressible clay soils of significant thickness where piled foundations would be anticipated. As part of the preliminary design considerations, the following can be anticipated.

- Bridge structures in areas underlain clay soils would be supported by piles driven to bedrock, or to refusal within dense till if the dense till is deeper than a few metres.
- Bridges structures in areas underlain by bedrock and dense till would be supported on spread footing foundations.
- Closed box culverts would be anticipated in areas underlain by clay soils, and in some areas, depending on settlement tolerances, the use of light weight fill materials could be required at these culverts.
- Open box culverts would be anticipated in areas underlain by bedrock and dense till.

Special attention will be required in designing the approach embankments to bridges and culverts underlain by clay deposits. For high approach embankments, it should be anticipated that light weight fill (polystyrene blocks) would be required to avoid differential settlements between the structures and the approach embankment fills.

4.6 Railway Structure Design

4.6.1 Ballast and Sub-ballast

The ballast and sub-ballast must be constructed of materials that comply with the Article 2.3.1 of the AREMA. The nature, the manufacturing specifications, as well as the intrinsic properties of the materials used for the railway structure should meet the requirements of this article. In the context of this study, limited research and investigations were carried out on potential borrow pits and quarries located in the vicinity of the alignment to determine the quantities and quality of deposits or bedrock available to be used in the project. Two separate reports were prepared by Stantec to outline these studies (borrow pits and quarries).

The sizing of the ballast and sub-ballast layers must be performed according to AREMA requirements, based on the subgrade conditions encountered in the current summary investigation and the nature and characteristics of the materials to be used (see borrow pits and quarries report).

According to AREMA, a minimum value of 300 mm, after compaction, is recommended for the thickness of ballast and sub-ballast to be placed. These thicknesses must be confirmed in the subsequent

engineering phases, taking into consideration the specific constraints of the project. Furthermore, the requirements of the railway company must be verified. In all cases, to ensure sufficient frost protection of the foundation materials, the total thickness of ballast and sub-ballast should not be less than 600 mm.

4.6.2 Drainage

Adequate drainage is typically provided by ditching, where required, and ensuring that the top of subgrade has a cross-fall of at least 2% to prevent water from accumulating within the sub-ballast and entering the subgrade. Depending on the proposed cut sections, the use of a subdrains may be control groundwater at the base of specific backslope areas, and possibly to lower the water table in areas with highly frost susceptible soils; the design of subdrains should be design with input from a geotechnical engineer.

Ditches will be required to collect surface water, store snow and control rock or debris fall from the cut slopes. The capacity of these ditches will be influenced by their width, depth, and the nature/permeability of the ditch soils. It is recommended to refer to Section 1.2.4 of the AREMA for the design of drainage ditches.

4.7 Recommended Level of Inspection and Testing

To ensure compliance with the design and to confirm assumptions made in this report and by the designers, construction observation, inspection and testing by a geotechnical engineer, as described below, are recommended.

All exposed soils should be inspected by a geotechnical engineer prior to the placement of granular materials. Such inspections are necessary to confirm the expected consistency and nature of the subgrade soils, to ensure that all soft spots have been identified and remediated and that the drainage of surface water has been ensured by the contractor. Subgrade inspections should be carried out to verify nature of the soil subgrade and the granular structure.

All sources of granular materials imported on site should be sampled, tested, and reviewed by a geotechnical engineer.

The placement of granular materials should be observed and tested by geotechnical personnel using nuclear density gauge to ensure all compaction requirements and optimal moisture content are achieved during construction.

5.0 References

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APPENDICES

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 Experts-conseils 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 Experts-conseils 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 Experts-conseils 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.

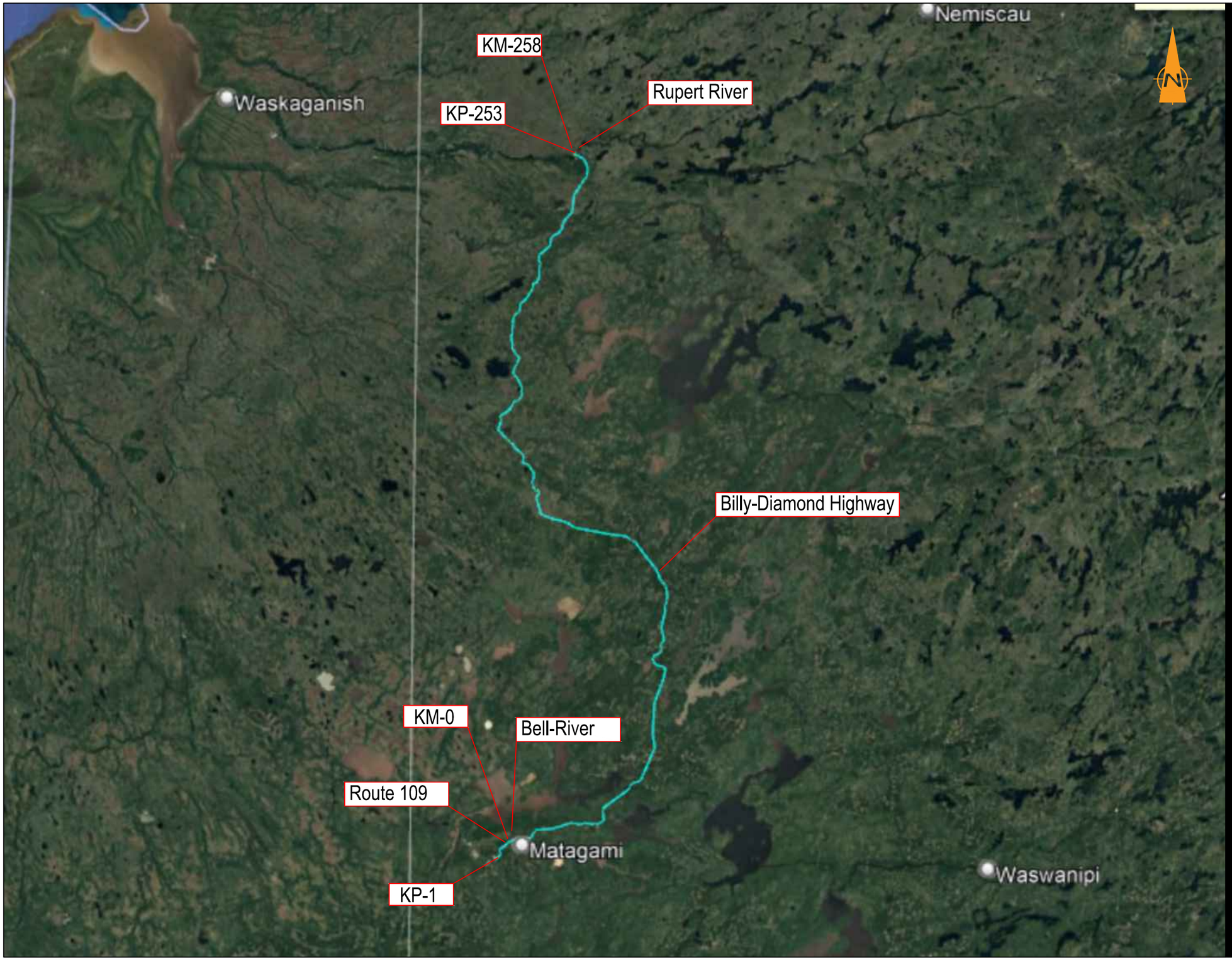
STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

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 Experts-conseils 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 Experts-conseils 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 Experts-conseils will not be responsible to any party for damages incurred as a result of failing to notify Stantec Experts-conseils 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 Experts-conseils, 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 Experts-conseils cannot be responsible for site work carried out without being present.

Appendix B Figures



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Potential BDH Railway Aligment

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Project :
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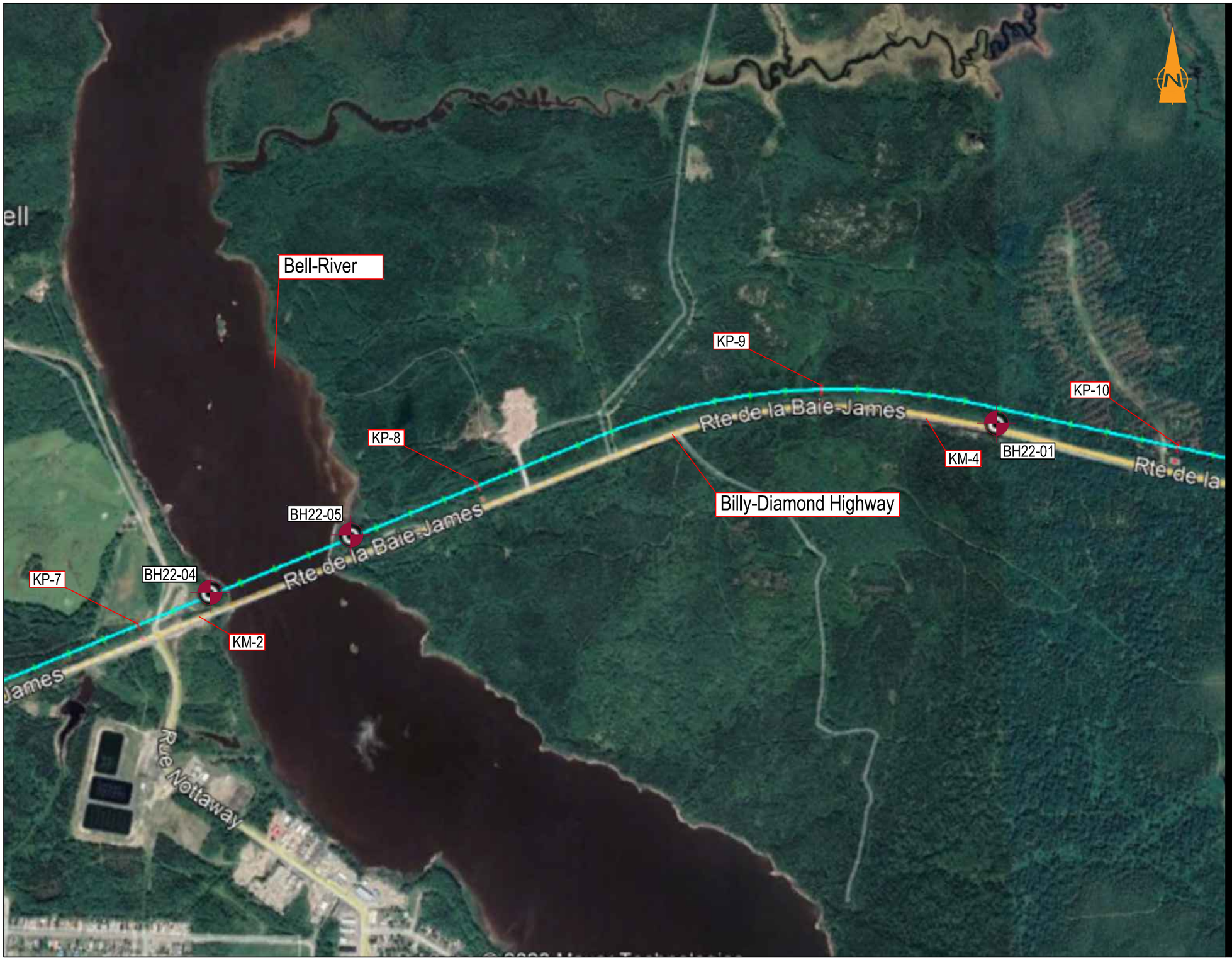
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Potential BDH Railway Aligment

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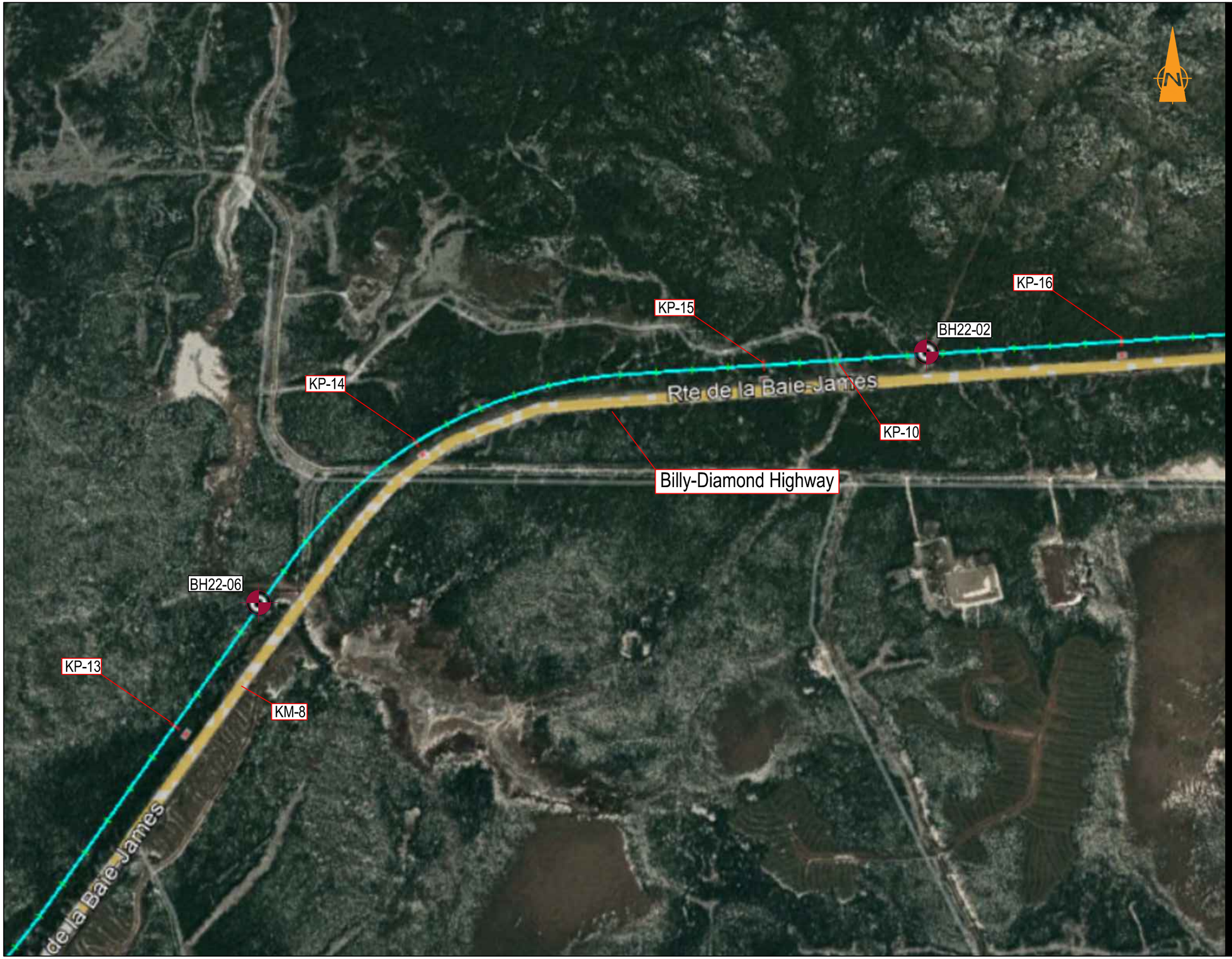
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Potential BDH Railway Aligment

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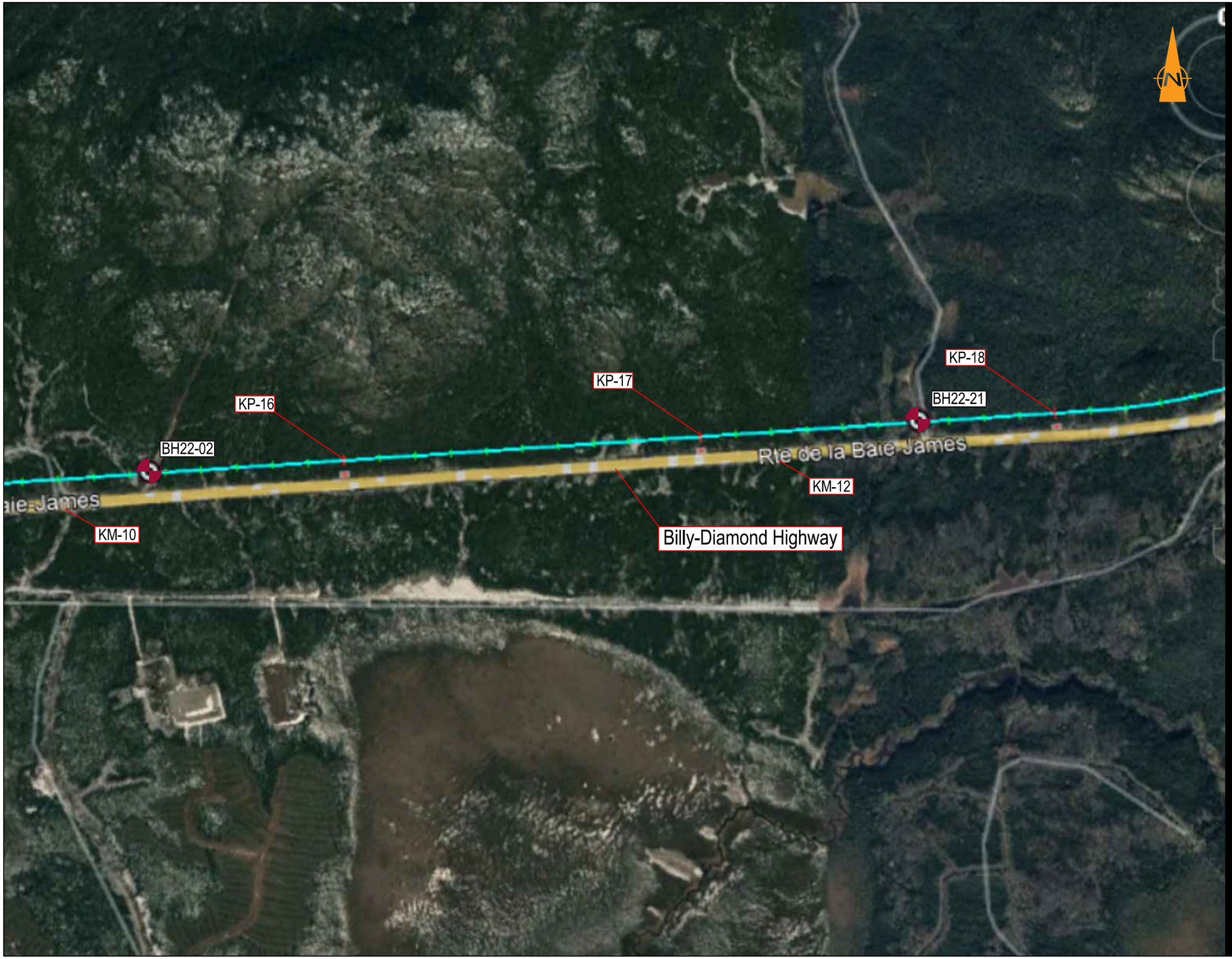
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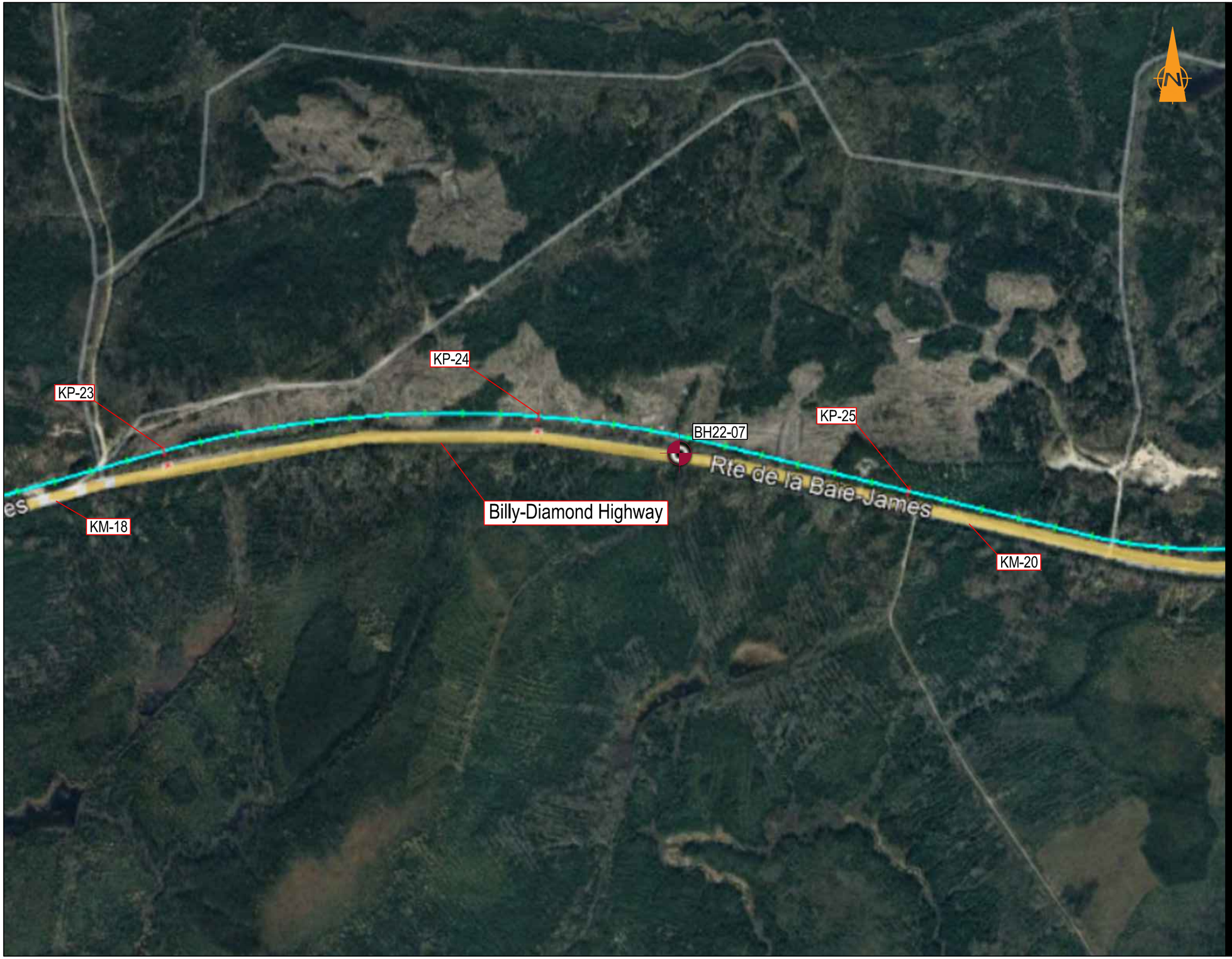
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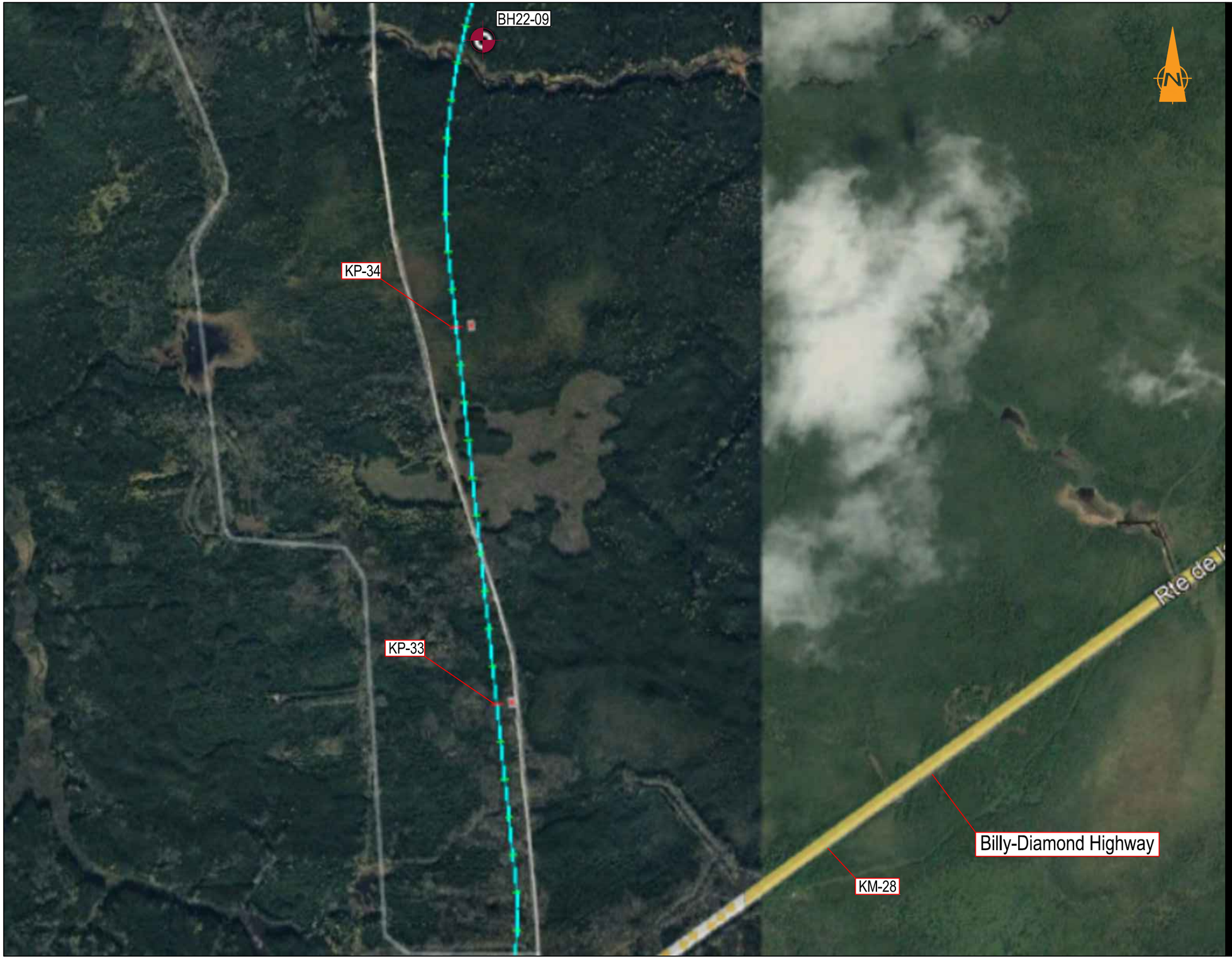
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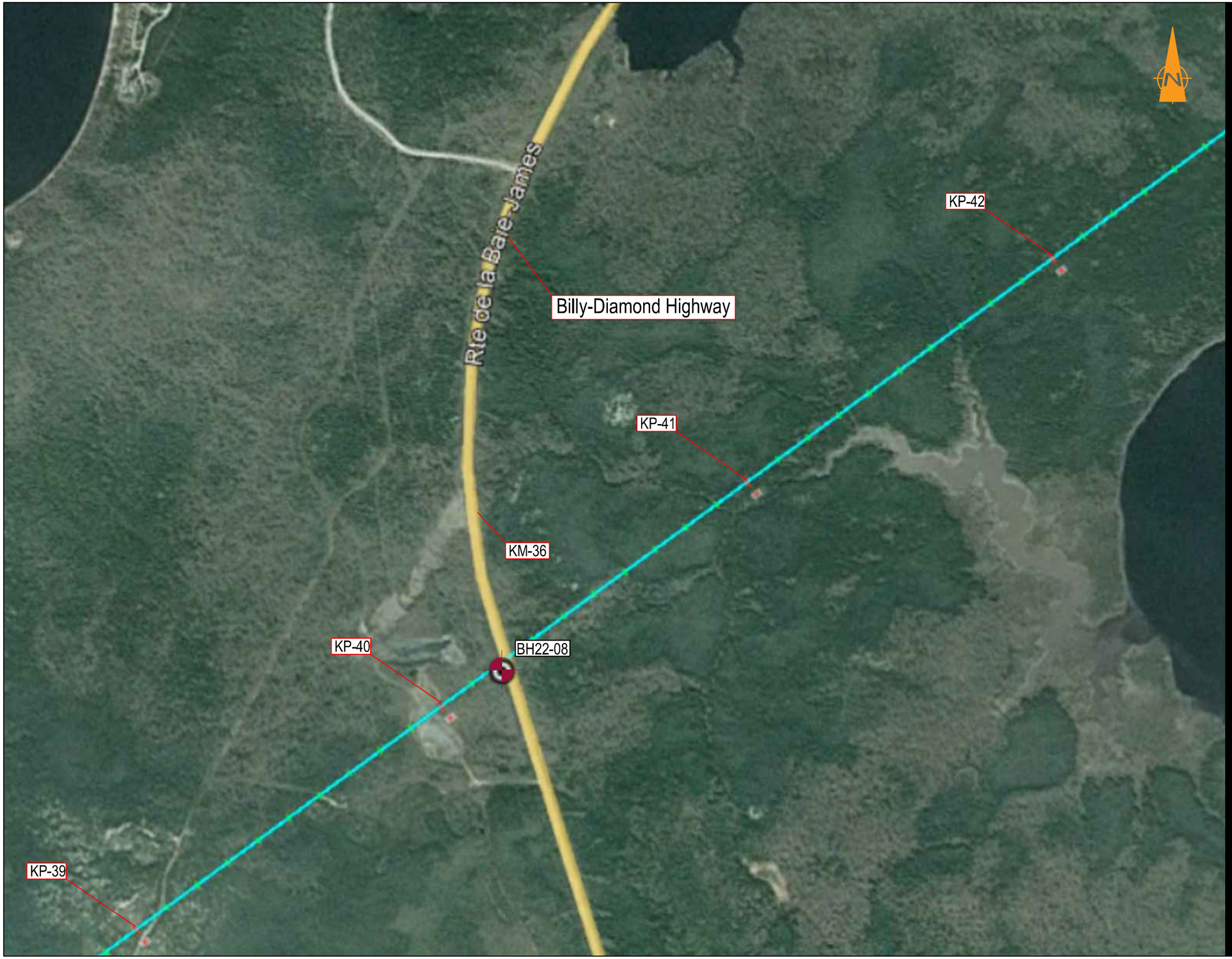
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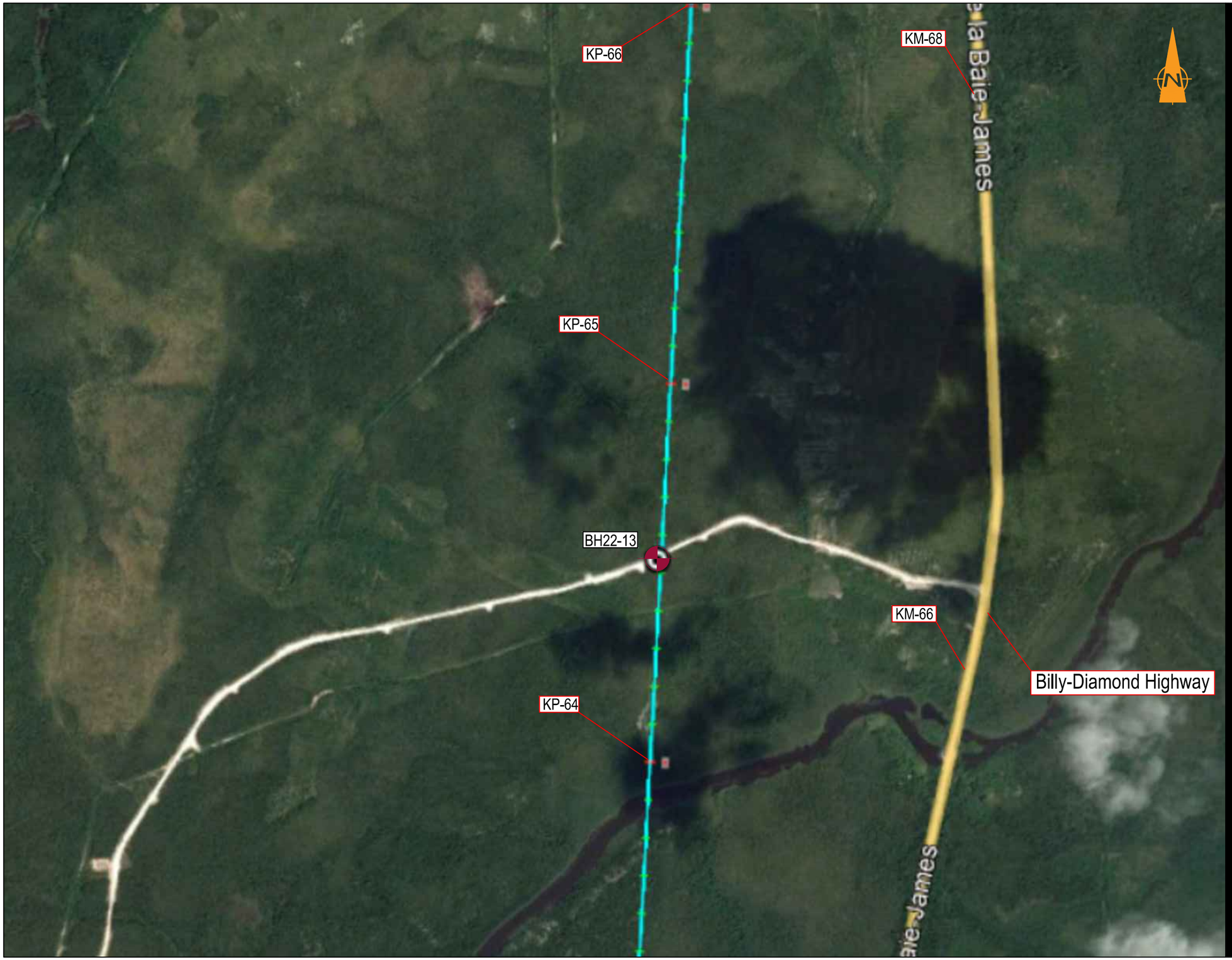
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Potential BDH Railway Aligment

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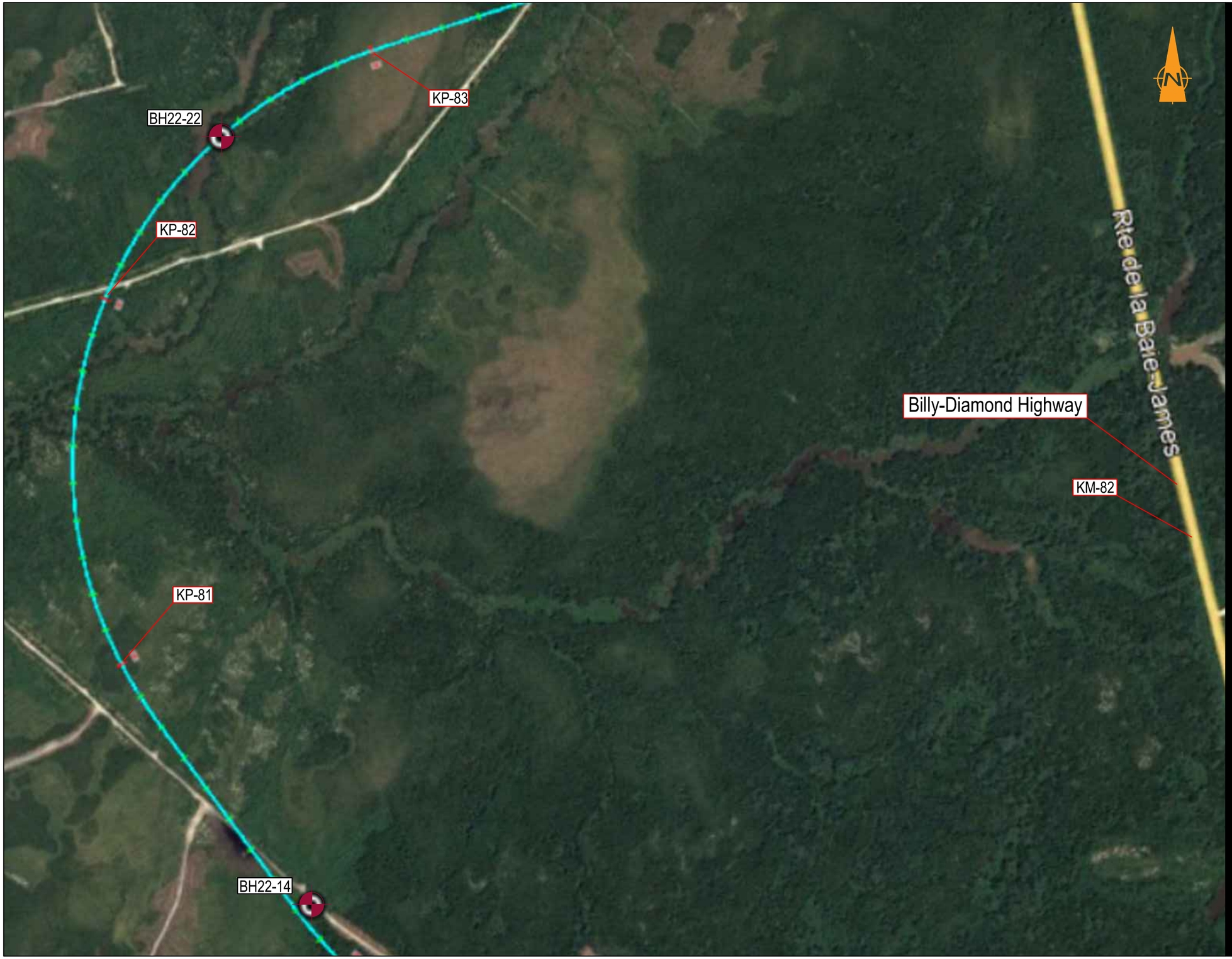
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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-14	348431	5560526
BH22-22	348147	5562557

Graphic scale :

0 100 200 300 400 500 m

Scale : 1/10000

Source :
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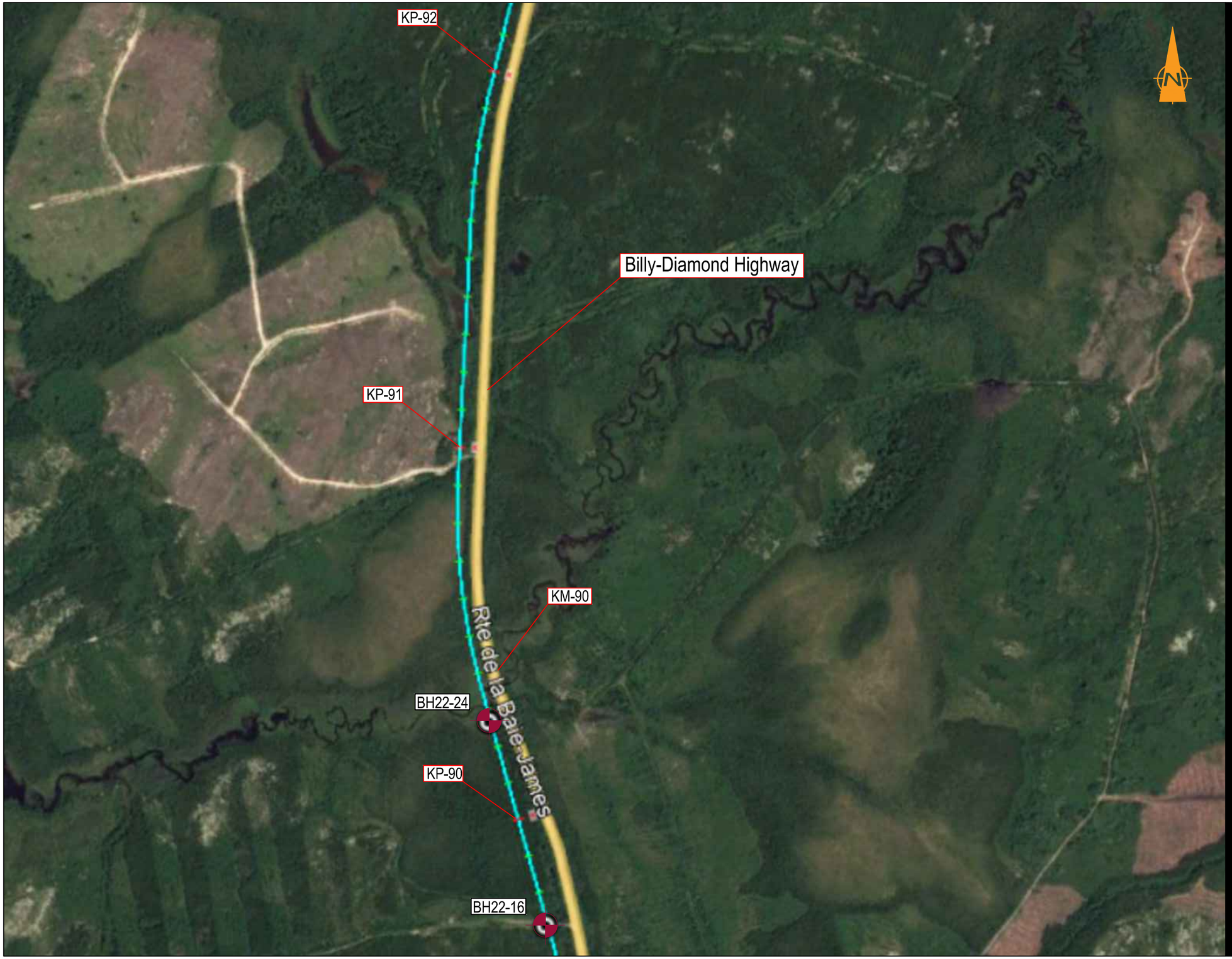
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

Project N° : 158100425.500.710.5	Draft by : S. Veillette, tech.
Date : 2023-02-15	Verified by : T. Coulaux, ing.
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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-16	350489	5568355
BH22-24	350354	5568896

Graphic scale :
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Scale : 1/10000

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Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-24	350354	5568896
BH22-17	350548	5570990

Graphic scale :
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Scale : 1/10000

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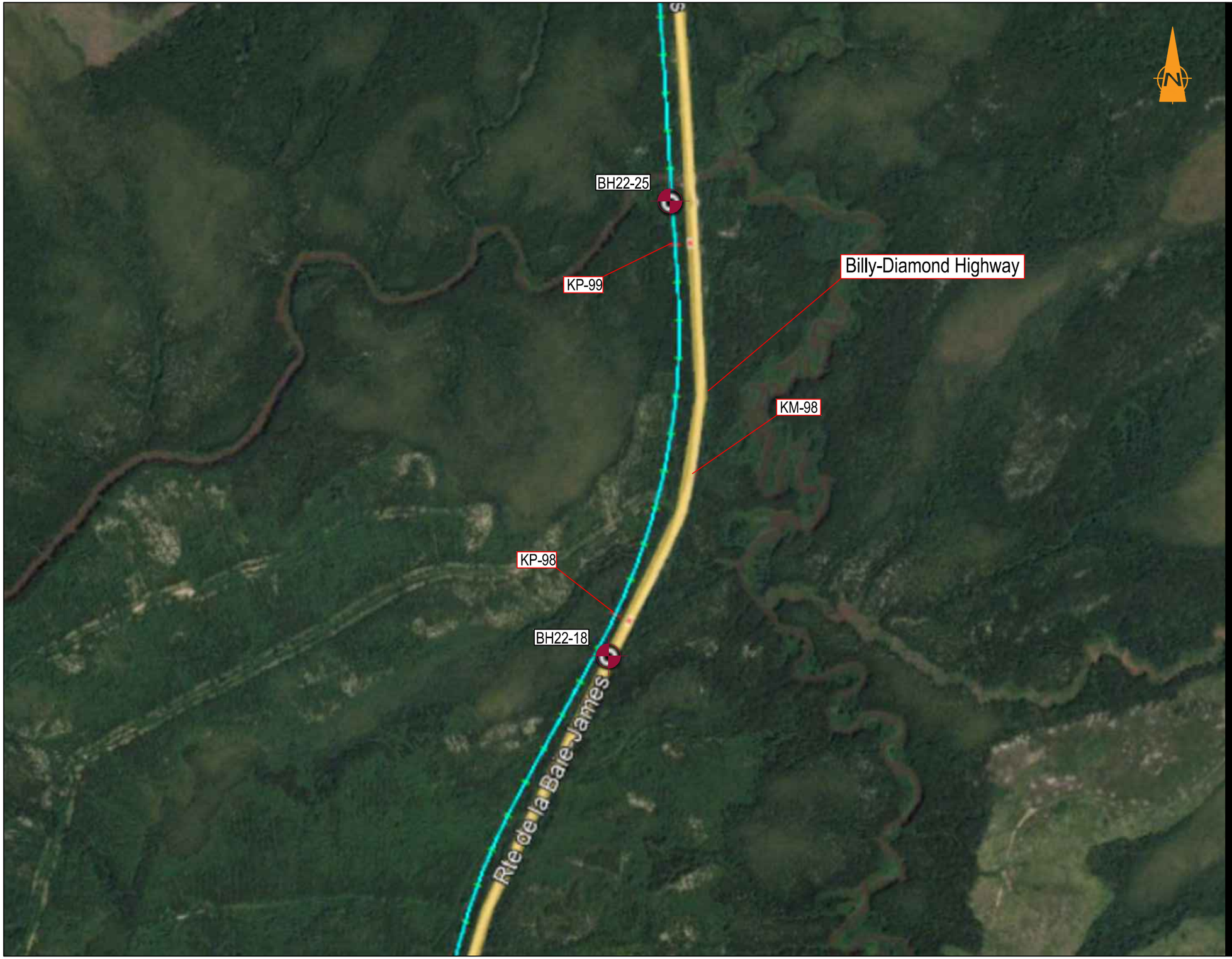
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-18	351733	5576272
BH22-25	351954	5577463

Graphic scale :
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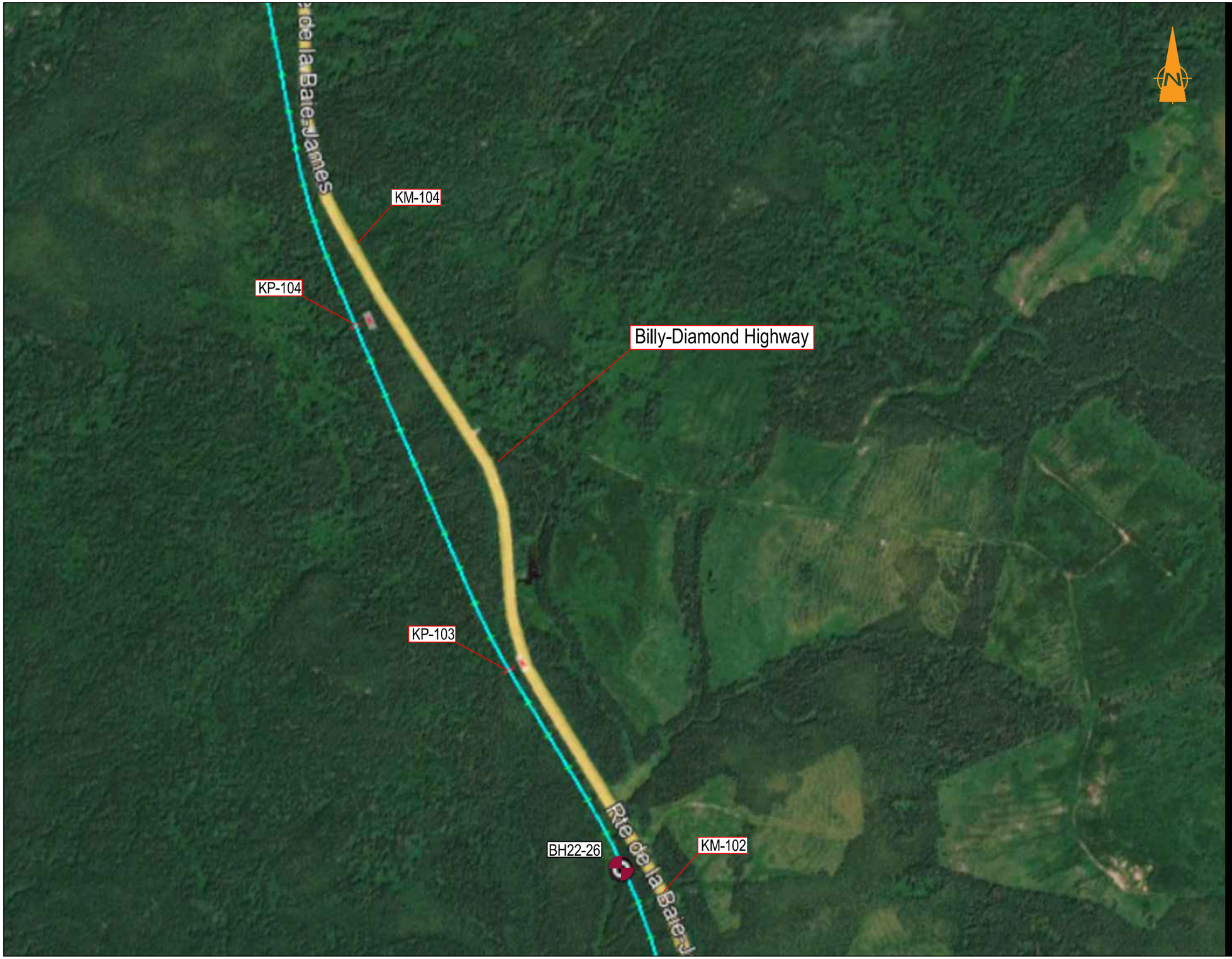
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-26	351386	5580658

Graphic scale :
0 100 200 300 400 500 m

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Location :
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Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)

Borehole N°	East (m)	North (m)
BH22-28	347848	5586683
BH22-29	347056	5587697

Graphic scale :
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Scale : 1/10000

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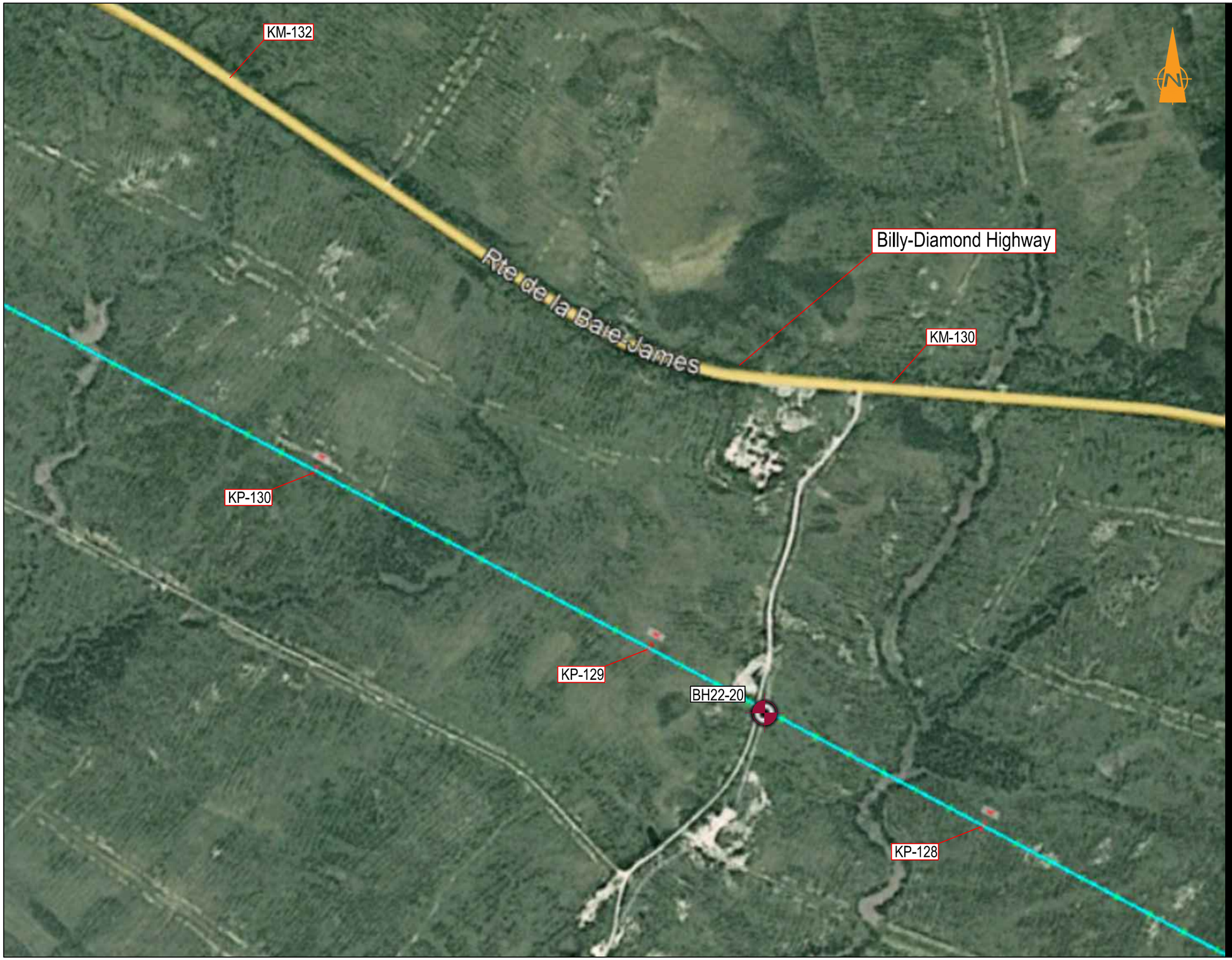
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-20	331998	5595315

Graphic scale :
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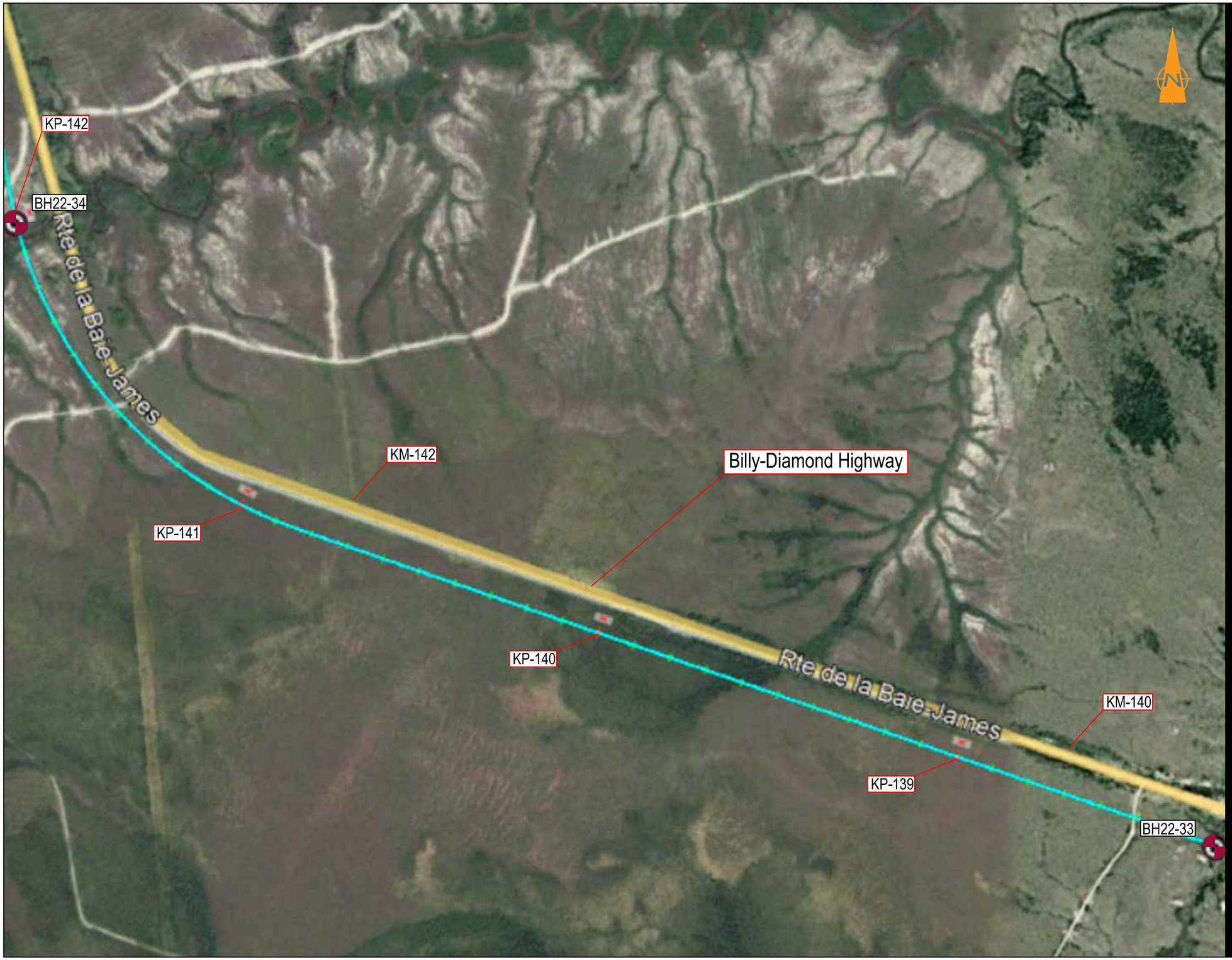
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-33	323030	5598522
BH22-34	319922	5600272

Graphic scale :
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BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-31	319239	5603379

Graphic scale :

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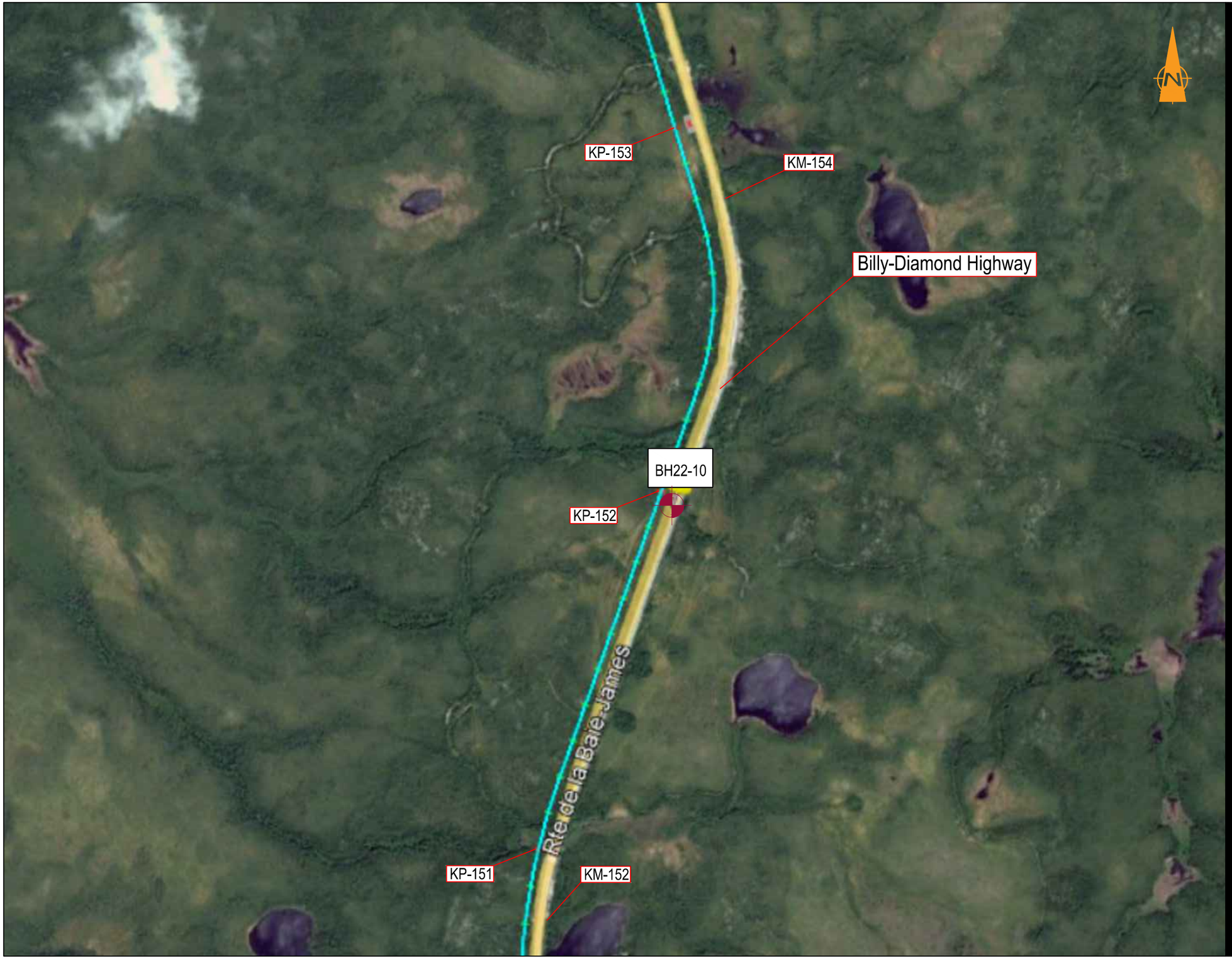
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-10	318491	5609077

Graphic scale :
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Scale : 1/10000

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Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-11	315926	5613752

Graphic scale :

0 100 200 300 400 500 m

Scale : 1/10000

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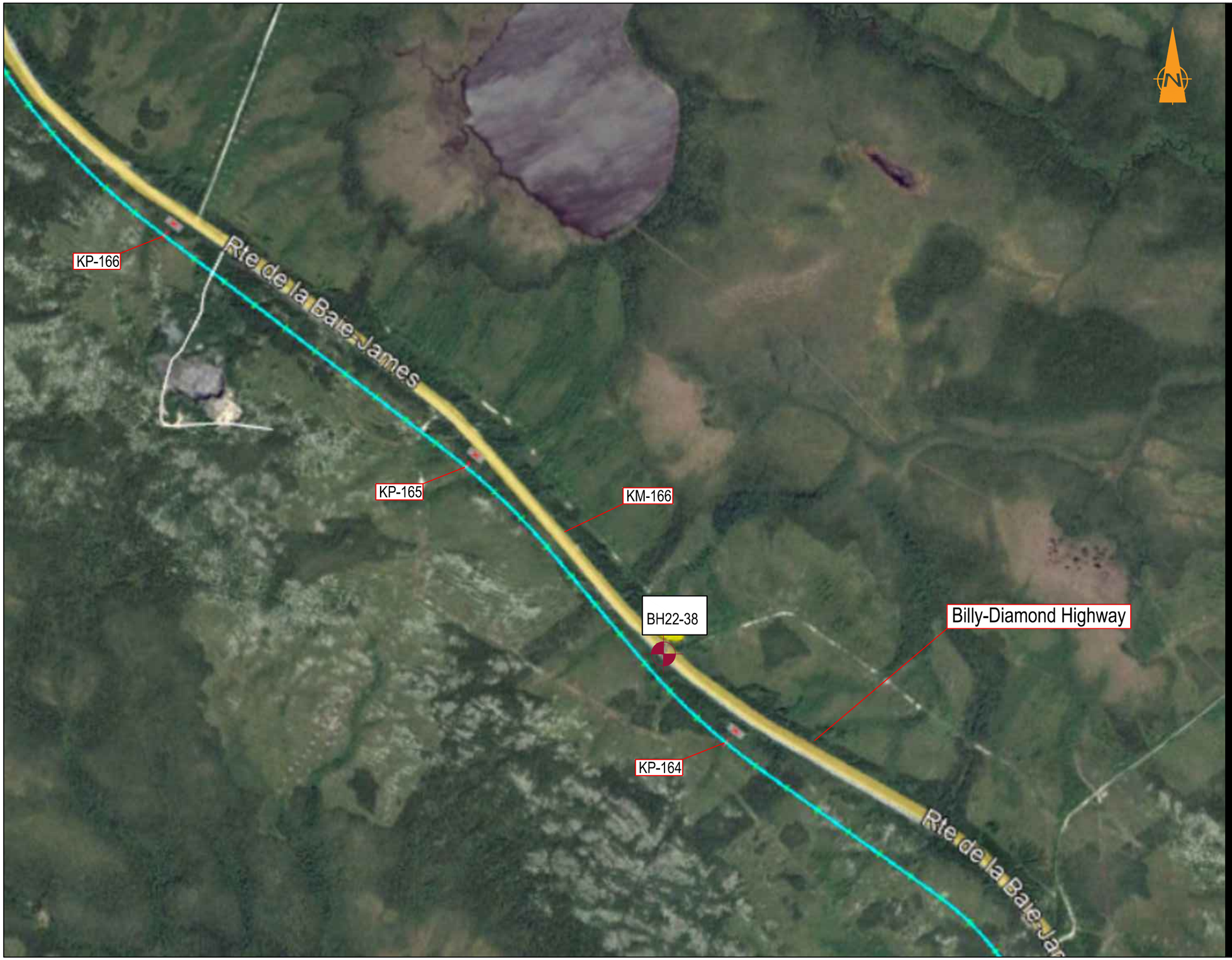
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-38	312529	5618679

Graphic scale :
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Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-40	315144	5634538

Graphic scale :
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Scale : 1/10000

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Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-36	315585	5639929

Graphic scale :

0 100 200 300 400 500 m

Scale : 1/10000

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Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-43	313971	5643339

Graphic scale :
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Scale : 1/10000

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Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-37	314014	5647198

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Scale : 1/10000

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Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-03	316142	5652368

Graphic scale :
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Scale : 1/10000

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Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

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BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-32	319708	5658695
BH22-27	320686	5659293

Graphic scale :

0 100 200 300 400 500 m

Scale : 1/10000

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Fax: 514.739.8499
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Important note :
All dimensions shown in this figure are approximate and the user is responsible for checking them. Stantec should be notified of any errors or omissions as soon as possible.

Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-30	321692	5663704

Graphic scale :
0 100 200 300 400 500 m

Scale : 1/10000

Source :
© Draft with Google Earth 2023

Client :
Cree Development Corporation

Project :
La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation

Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

Project N° : 158100425.500.710.5	Draft by : S. Veillette, tech.
Date : 2023-02-16	Verified by : T. Coulaux, ing.
Drawing n° : 01	Page : 29

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Paper size : 11x17



Stantec

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Saint-Laurent, Quebec H4M 2N6
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Important note :
All dimensions shown in this figure are approximate and the user is responsible for checking them. Stantec should be notified of any errors or omissions as soon as possible.

Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-39	327606	5673307

Graphic scale :

0 100 200 300 400 500 m

Scale : 1/10000

Source :
© Draft with Google Earth 2023

Client :
Cree Development Corporation

Project :
La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation

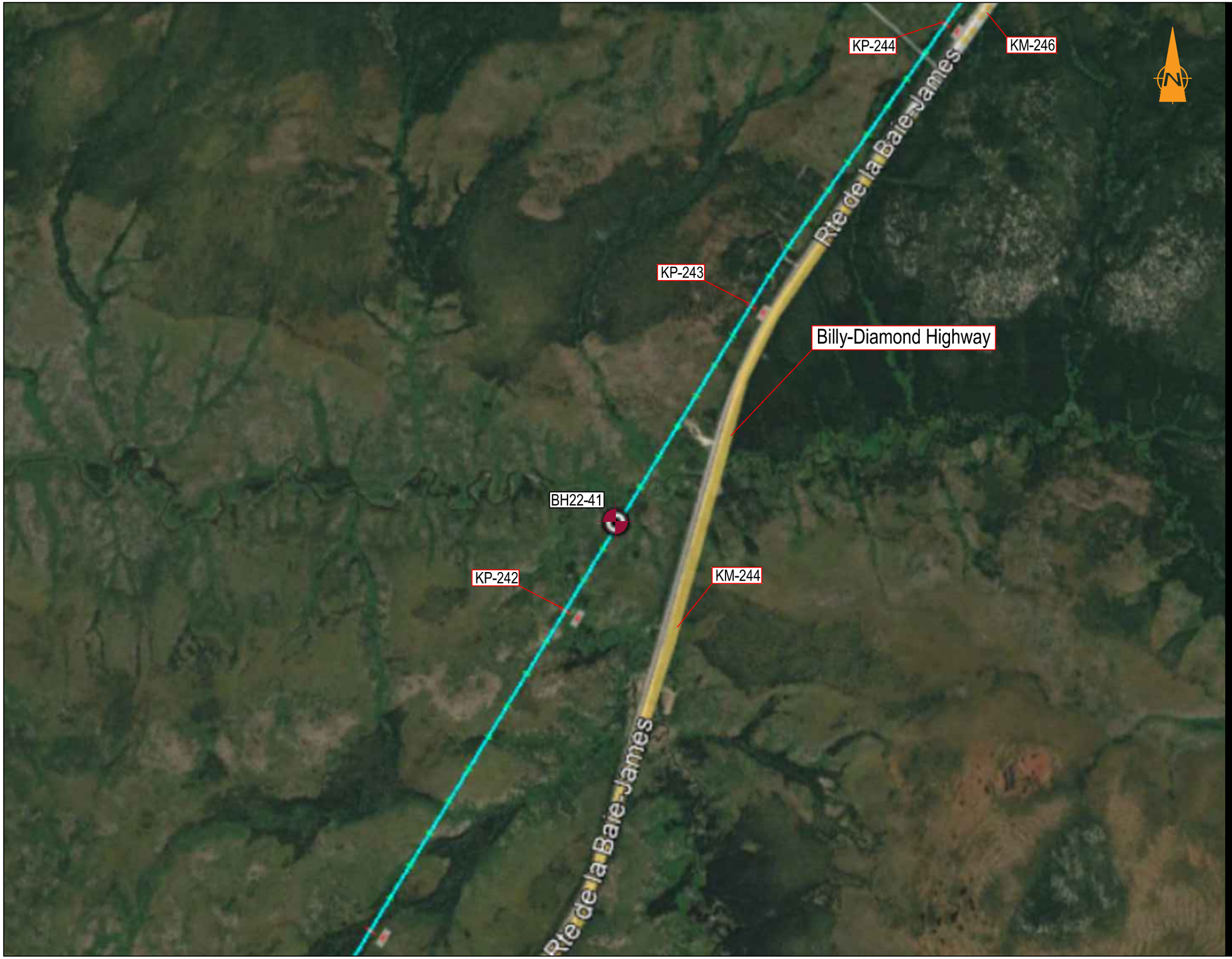
Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

Project N° : 158100425.500.710.5	Draft by : S. Veillette, tech.
Date : 2023-02-16	Verified by : T. Coulaux, ing.
Drawing n° : 01	Page : 30

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Paper size : 11x17



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Important note :
All dimensions shown in this figure are approximate and the user is responsible for checking them. Stantec should be notified of any errors or omissions as soon as possible.

Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-41	332367	5683588

Graphic scale :

0 100 200 300 400 500 m

Scale : 1/10000

Source :
© Draft with Google Earth 2023

Client :
Cree Development Corporation

Project :
La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation

Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

Project N° : 158100425.500.710.5	Draft by : S. Veillette, tech.
Date : 2023-02-16	Verified by : T. Coulaux, ing.
Drawing n° : 01	Page : 31

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Paper size : 11x17



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Important note :
All dimensions shown in this figure are approximate and the user is responsible for checking them. Stantec should be notified of any errors or omissions as soon as possible.

Legend :

BH22-xx — Borehole 2022 (Stantec)

Potential BDH Railway Aligment

Geodesic coordinates (UTM-18)		
Borehole N°	East (m)	North (m)
BH22-42	331297	5691869

Graphic scale :
0 100 200 300 400 500 m

Scale : 1/10000

Source :
© Draft with Google Earth 2023

Client :
Cree Development Corporation

Project :
La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation

Location :
Potential BDH Railway

Figure title :
BOREHOLE LOCATION

Project N° : 158100425.500.710.5	Draft by : S. Veillette, tech.
Date : 2023-02-16	Verified by : T. Coulaux, ing.
Drawing n° : 01	Page : 32

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Paper size : 11x17

Appendix C Borehole Reports

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-01
		X :	312 812	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 516 753	Start date :	2000-09-20
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	2,52 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,05	Brown-black moist TOPSOIL.				A							
			Native till deposit : Grey moist SILT and SAND with traces of gravel and clay, very dense.			SS-01	B	N	50		2-7-16-15			
						SS-02		B	80	R	17-28-50 /8 cm		GA, H	
1	5	0,99	Bedrock : Grey SANDSTONE, of fair quality.			DC-03		NQ	100	62			f'c = 110,1 MPa U.W. = 27.2 kN/m³	
2		2,52	END OF BOREHOLE											
3	10													
4														
	15													
5														
6	20													
7														
	25													
8														

76,3

20 40 60 80 100 120

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-02
		X :	317 844	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 518 782	Start date :	2022-09-16
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	10,59 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

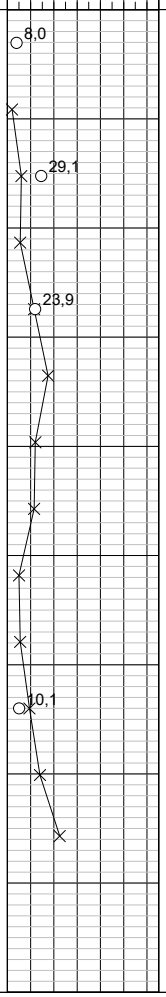
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown moist Gravelly SAND with traces of silt.			SS-01		N	58		8-8-16-14		GA	
1						SS-02		B	29	4	8-2-2-1			
		1,22	Native cohesive deposit : Grey moist to saturated CLAY and SILT with some sand, of firm appearance.			SS-03		B	29	12	6-2-10-10		GA, H	
2	5	1,83	Grey saturated Clayey SILT with some sand, of firm appearance. - Traces of oxidation.			SS-04		B	29	11	10-5-6-13			
		2,44	Till deposit : Grey saturated Sandy and Clayey SILT with traces of gravel, compact. - Traces of oxidation.			SS-05		B	50	23	1-4-19-18		GA, H	
3	10	3,05	Grey saturated Silty SAND with traces to some gravel and traces of clay, dense to compact. - Traces of oxidation.			SS-06		B	79	35	17-18-17-19			
4		4,27	Grey saturated Gravelly SAND with traces of clay, compact.			SS-07		B	38	24	9-12-12-12			
	15					SS-08		B	33	23	11-10-13-14			
5						SS-09		B	71	10	17-5-5-5			
						SS-10		B	8	11	12-5-6-5			
6	20	6,10	Grey saturated Silty and Gravelly SAND, compact.			SS-11		B	63	19	7-13-6-6		GA	
7		6,71	Grey saturated Silty and Sandy GRAVEL, compact.			SS-12		B	33	28	5-16-12-8			
	25	7,32	Grey saturated Silty and Gravelly SAND, dense. - Traces of oxidation.			SS-13		B	100	45	6-12-33-50 /5 cm			
8		7,92	Boulders and rock fragments.			DC-14		NQ	30					



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						DC-15		NQ	45							
10						DC-16		NQ	33							
	35	10,59	END OF BOREHOLE													
11																
12	40															
13																
	45															
14																
15	50															
16																
	55															
17																
18	60															
19																
20	65															
21																
	70															
22																
23	75															
24																

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BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-03
		X :	316 142	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 652 368	Start date :	2022-10-09
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	4,39 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

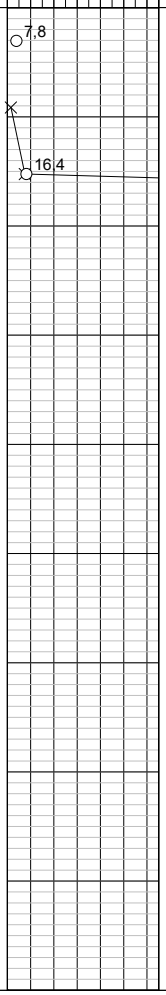
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
0,00		Granular fill : Brown moist SAND with some silt and traces of gravel.			SS-01		N	67		1-3-3-5		GA	
0,61		Brown moist to saturated SAND with some gravel and silt.			SS-02		B	54	3	2-1-2-2			
1,22		Native till deposit : Brown saturated SAND and SILT with traces of gravel, compact. - Presence of boulders.			SS-03		B	54	15	3-5-10-10		GA	
1,83					SS-04		B	0	R	50 /0 cm			
		Bedrock : Grey GRANITE, of good to excellent quality.			DC-05		NQ	89	79				
					DC-06		NQ	94	94			f'c = 175,4 MPa U.W. = 26.3 kN/m³	
4,39		END OF BOREHOLE											



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-04
		X :	310 635	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 516 329	Start date :	2022-09-15
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	5,79 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NQ	Figure :	01

SAMPLE TYPE	
SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY	
Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY	
Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS	
N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

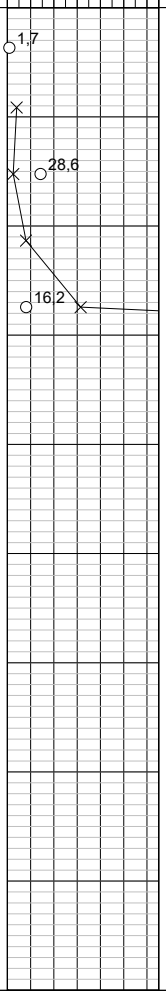
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
0		0,00	Brown-black moist TOPSOIL.				A							
		0,13	Granular fill : Grey moist Sandy GRAVEL with traces of silt.			SS-01	B	N	63		16-23-28-16		GA	
1		0,61	- Presence of cobbles.			SS-02		B	50	8	5-4-4-8			
	5	1,22	Brown moist SILT with traces of sand and gravel. Native cohesive deposit : Grey-brown moist to saturated Clayey SILT with some gravel and traces of sand, of firm appearance.			SS-03		B	54	5	2-3-2-6		GA, H	
2						SS-04		B	67	16	7-7-9-7			
		2,44	Till deposit : Grey saturated Sandy SILT with some gravel and clay, very dense.			SS-05		B	71	63	3-29-34-34		GA, H	
3	10		- Presence of boulders.			SS-06		B	86	R	34-30-50 /3 cm			
		3,38	Bedrock : Grey BASALT, of very poor to good quality.			DC-07		NQ	95	38				
4						DC-08		NQ	98	21				
	15													
5						DC-09		NQ	100	81			f'c = 95,2 MPa U.W. = 28.0 kN/m³	
6	20	5,79	END OF BOREHOLE											
7														
	25													
8														

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-05
Project No.:	158100425.500.710.5	X :	311 021	Page :	1 of 2
Client:	Cree Development Corporation	Y :	5 516 479	Start date :	2022-09-15
Site:	Preliminary Geotechnical Investigation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
	Potential BDH Railway	Equipment :	CME 55	Depth :	10,31 m
		Sampling type :	B, N		
		Corer :	NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

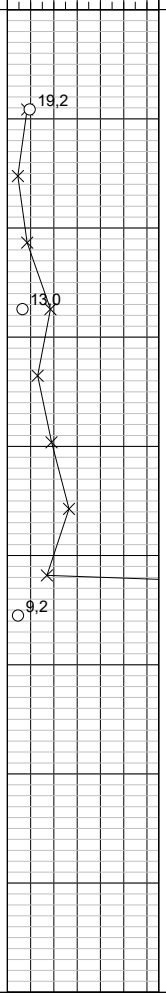
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Brown moist TOPSOIL.											
		0,33	Native cohesive deposit : Brown to brown-grey moist SILT and CLAY with traces of sand, of firm appearance.			SS-01	A	N	75		6-9-16-15			
							B							
1						SS-02		B	63	17	7-9-8-8		GA, H	
		1,22	Brown moist to saturated Clayey SILT with some sand, of firm appearance.			SS-03		B	75	9	5-5-4-2			
2	5	1,83	Grey saturated Clayey SILT with traces of sand and gravel.			SS-04		B	67	17	7-6-11-26			
		2,44	Till deposit : Grey saturated Silty SAND with some gravel and traces of clay, dense to compact.			SS-05		B	50	37	11-23-14-14		GA, H	
3	10					SS-06		B	79	26	18-12-14-15			
		3,66	Grey saturated Sandy to SAND and GRAVEL with some silt, dense to very dense.			SS-07		B	54	38	19-16-22-35			
4						SS-08		B	83	53	34-34-19-15			
	15					SS-09		B	25	34	16-17-17-13			
5						SS-10		B	100	R	34-49-50 /5 cm		GA	
			- Presence of cobbles and boulders.			DC-11		NQ	75					
6	20					DC-12		NQ	20					
		7,21	Bedrock : Grey RHYOLITE, of poor to fair quality.			DC-13		NQ	100	40				
7						DC-14		NQ	100	40				
	25													
8														



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						DC-15		NQ	100	63				f'c = 264,6 MPa U.W. = 27.1 kN/m³		
10		10,31	END OF BOREHOLE													
	35															
11																
12	40															
13																
	45															
14																
15	50															
16																
	55															
17																
18	60															
19																
20	65															
21																
	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-06
		X :	316 007	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 518 121	Start date :	2022-10-18
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	19,84 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-18	0,00 m
Reading 2		m

Remarks : Mesure par tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,10	Brown-black saturated TOPSOIL.				A							
			Native cohesive deposit : Brown to brown-grey saturated CLAY and SILT with traces of sand, of fimr appearance.			SS-01	B	N	33		1-1-3-2	0,00 m	GA, H	
1						SS-02		B	83	5	1-2-3-4			
		1,22	- Presence of roots.											
	5		Brown to brown-grey saturated SILT and CLAY with traces of sand and gravel.			SS-03		B	42	5	1-2-3-3			
2						SS-04		B	88	3	1-2-1-1			
						SS-05		B	42	0	0-0-0-0			
3	10	3,05	Brown-grey saturated Silty CLAY with traces sand and gravel, soft.			SS-06		B	100	0	0-0-0-0			
4						SS-07		B	100	0	0-0-0-0			
	15					ST-08			100				U.W = 13.9 kN/m³	
5		4,88	Grey saturated Silty CLAY with traces of sand, high plasticity, soft, of very strong sensibility.			SS-09		B	100	0	0-0-0-0		GA, H	
						SS-10		B	100	0	0-0-0-0			
6	20					SS-11		B	100	0	0-0-0-0			
7						SS-12		B	100	0	0-0-0-0			
	25					SS-13		B	100	0	0-0-0-0			
8		7,92	Grey saturated Silty CLAY with traces of sand, of soft appearance.			SS-14		B	100	0	0-0-0-0			
						SS-15		B	100	0	0-0-0-0			

20 40 60 80 100 120

27,6

0.915

95,4

84,4

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						SS-16		B	100	0	0-0-0-0					
10						SS-17		B	100	0	0-0-0-0					
	35					SS-18		B	100	0	0-0-0-0					
11						SS-19		B	100	0	0-0-0-0					
12						SS-20		B	100	0	0-0-0-0					
	40															
13																
	45	13,72	Grey saturated Silty CLAY with some sand, of soft to firm appearance.			SS-21		B	29	0	0-0-0-0					
14																
15																
	50					SS-22		B	0	9	2-5-4-3					
16		15,85	Granular deposit : Grey saturated SAND with traces of gravel and silt, loose to compact.													
	55															
17						SS-23		B	13	7	1-5-2-2			GA		
18																
	60					SS-24		B	83	22	13-14-8-8					
19		18,90	End of sampling. Start of dynamic penetration test (Pen-Test).													
	65	19,84	END OF BOREHOLE (Refusal)													
20																
21																
	70															
22																
	75															
23																
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-07
		X :	326 548	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 520 133	Start date :	2022-09-20
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	5,64 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,10	Brown-black moist TOPSOIL.				A							
			Native granular deposit : Brown moist SAND and GRAVEL with traces of silt, compact. - Presence of boulders.			SS-01	B	N	42		1-4-15-48		GA	
1		0,61	Boulders.			DC-06		NQ	63					
	5													
2						SS-07		B	0	8	3-3-5-3			
		2,44	Brown saturated GRAVEL with traces of sand, loose.			SS-02		B	0	8	5-5-3-1			
3	10	3,05	Brown saturated SAND with some gravel and silt, loose to compact. - Presence of organic matters.			SS-03		B	25	11	2-7-4-4			
4						SS-04		B	29	11	3-3-8-32		GA	
	15	4,27	Bedrock : Grey BASALT, of fair quality.											
5						DC-05		NQ	82	53			f'c = 48,9 MPa U.W. = 30.7 kN/m³	
		5,64	END OF BOREHOLE											
6	20													
7														
	25													
8														

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

×: N (standard pen.); ▽: Nc (dyn. pen.); ■: Cu intact; □: Cu remoulded; ◆: Su intact; ◇: Su remoulded

W_P W W_L

20 40 60 80 100 120

12,4

16,5

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-08
		X :	338 055	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 526 704	Start date :	2022-09-22
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	12,14 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE	
SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY	
Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY	
Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS	
N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown-grey moist to brown Gravelly SAND with some silt.			SS-01		N	63		7-10-10-9		GA	
1						SS-02		B	29	20	7-10-10-10			
	5	1,22	Brown moist to saturated Sandy GRAVEL with some silt.			SS-03		B	29	7	1-4-3-5			
2		1,83	Grey saturated Gravelly SAND with some silt.			SS-04		B	54	10	5-5-5-9		GA	
		2,44	Native till deposit : Grey to brown saturated Gravelly to GRAVEL and SAND with some silt, dense to very dense. - Presence of boulders.			SS-05		B	25	38	5-7-31-17			
3	10					SS-06		B	73	R	32-50 /13 cm			
		3,66	Grey saturated Silty and Sandy GRAVEL, very dense. - Presence of boulders.			SS-07		B	100	R	50 /8 cm			
4		4,27	Grey saturated SAND and GRAVEL with some silt, very dense.			SS-08		B	71	100	50-50-50-50			
	15					SS-09		B	100	R	50 /8 cm			
5						SS-10		B	75	R	46-50 /5 cm			
6	20	6,10	Grey Gravelly SAND with some silt, very dense.			SS-11		B	77	R	22-50-50 /8 cm			
7						SS-12		B	89	R	50-50 /8 cm			
		7,21	Bedrock : Grey MONZONITE, of fair to excellent quality.											
	25					DC-13		NQ	100	64				
8														

GA : grain size analysis
H : hydrometer test
C : consolidation
W : water content
W_L : liquid limit
W_P : plastic limit
Dr : specific gravity
k : permeability
f'c : compressive str.
OM : organic matter
CA : chemical analyses
SAV : soil agressivity value

× : N (standard pen.)
▽ : Nc (dyn. pen.)
■ : Cu intact
□ : Cu remoulded
◆ : Su intact
◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

4,5

16,4

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						DC-14		NQ	100	95				f'c = 177,3 MPa U.W. = 27.8 kN/m³		
10	35															
11						DC-15		NQ	100	96						
12	40					DC-16		NQ	70	66						
		12,14	END OF BOREHOLE													
13	45															
14																
15	50															
16																
	55															
17																
18	60															
19																
20	65															
21																
	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-09
		X :	333 953	Page :	1 of 3
Project No.:	158100425.500.710.5	Y :	5 523 359	Start date :	2022-11-06
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	24,69 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-09-11	1,86 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Brown-black TOPOSIL.				A							
		0,18	- Presence of woods and roots.			SS-01	B	N	71		0-2-4-7			
			Native cohesive deposit : Brown moist Silty CLAY with traces of sand and gravel, of firm appearance.			SS-02		B	83	7	2-3-4-4		GA, H	
1		1,22	- Traces of oxidation.											
5			Brown moist Silty CLAY with some sand, of firm appearance.			SS-03		B	83	3	1-1-2-2	1,86 m		
2		1,83	Brown to brown-grey moist to saturated CLAY with some silt and traces of sand, high plasticity, firm to stiff, low sensibility.			SS-04		B	100	2	2-1-1-0			
						SS-05		B	100	0	0-0-0-1			
3	10					ST-06			0					
						ST-07			100				U.W = 16.0 kN/m³	
4														
	15					SS-08		B	100	0	0-0-0-0		GA, H	
5														
6	20					SS-09		B	100	0	0-0-0-0			
7														
	25					SS-10		B	100	0	0-0-0-0			
8														

TESTS

GA : grain size analysis
H : hydrometer test
C : consolidation
W : water content
W_L : liquid limit
W_P : plastic limit
Dr : specific gravity
k : permeability
f'c : compressive str.
OM : organic matter
CA : chemical analyses
SAV : soil agressivity value

× : N (standard pen.)
▽ : Nc (dyn. pen.)
■ : Cu intact
□ : Cu remoulded
◆ : Su intact
◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

38,5
80
56,1
35
84,4
7 29
6 26
9 26
32

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35	10,67	Granular deposit : Grey-brown saturated SILT with traces of sand and clay, very loose.			SS-11		B	100	0	0-0-0-0				9 33	
11						SS-12		B	71	4	4-2-2-3				10 35	
12	40					SS-13		B	58	4	3-2-2-2			GA, H	10 25,0 63	
13						SS-14		B	58	2	2-1-1-1					
14	45	13,72	Brown saturated Sandy SILT with traces of clay and gravel, loose.			SS-15		B	54	6	6-3-3-2					
15	50	15,24	Brown-grey saturated SAND with some silt and traces of gravel and clay, loose.			SS-16		B	100	5	6-2-3-3					
16	55	16,76	Grey-brown saturated SAND with some gravel and silt, compact.			SS-17		B	96	10	5-3-7-3					
17																
18	60					SS-18		B	88	2	3-1-1-4					
19		18,90	End of sampling. Start of dynamic penetration test (Pen-Test).												1 0 1 5 8 15 18 18 21 24 25 23 16 18 25 35 33 52	
20	65															
21	70															
22																
23	75															
24																

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		24,69	END OF BOREHOLE (Refusal on inffered bedrock)													

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-10
		X :	318 491	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 609 077	Start date :	2022-10-12
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	8,69 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

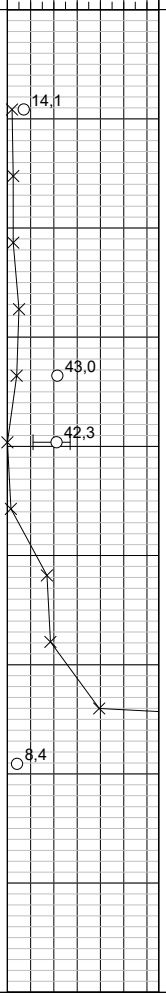
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,05	Brown-black moist TOPSOIL.				A							
			Granular fill : Brown moist SAND with some silt and traces of gravel.			SS-01	B	N	54		2-3-2-2			
1						SS-02		B	58	4	1-2-2-2		GA	
		1,22	Native cohesive deposit : Brown-grey Clayey SILT with some sand and traces of gravel, of firm appearance. - Presence of roots.			SS-03		B	25	5	1-1-4-4			
2	5					SS-04		B	58	5	2-2-3-5			
		2,44	Grey-brown saturated Clayey SILT with some sand, of firm appearance.			SS-05		B	83	10	3-4-6-6			
3	10	3,05	Grey-brown to grey Silty CLAY with traces of sand and gravel, of firm appearance, high plasticity.			SS-06		B	42	8	6-5-3-3		GA, H	
4						SS-07		B	100	0	0-0-0-2		GA, H	
	15					SS-08		B	100	3	0-0-3-4			
5		4,88	Till deposit : Grey saturated Silty SAND with some gravel and clay, dense.			SS-09		B	100	34	8-9-25-35			
		5,49	Grey saturated Gravelly and Silty SAND with traces of clay, dense to very dense.			SS-10		B	63	37	2-9-28-25			
6	20					SS-11		B	67	79	46-50-29-22			
7						SS-12		B	75	R	15-14-50 /10 cm		GA, H	
		7,16	Bedrock : Pink-grey GRANITE, of good quality.											
	25					DC-13		NQ	97	86			f'c = 189,1 MPa U.W. = 25.2 kN/m³	
8		8,69	END OF BOREHOLE											



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-11
		X :	315 926	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 613 752	Start date :	2022-10-12
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	19,63 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

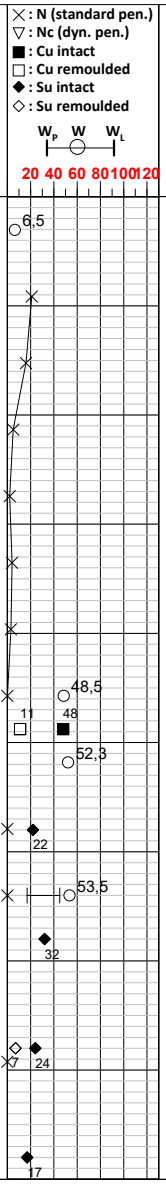
STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown to grey moist to saturated GRAVEL and SAND with traces of silt.			SS-01		N	71		9-12-12-15		GA	
1						SS-02		B	71	21	11-10-11-9			
	5					SS-03		B	33	16	7-8-8-4			
2						SS-04	A	B	58	5	3-2-3-3			
		2,34	Brown-black saturated TOPSOIL.				B							
		2,44	Native cohesive deposit : Grey-brown saturated Clayey SILT with some sand and traces of gravel, of firm appearance. - Presence of organic matters.			SS-05		B	33	2	1-1-1-2			
3	10					SS-06		B	50	4	3-1-3-3			
		3,66	Grey saturated Silty CLAY with traces of sand and gravel, firm, high sensibility.											
4						SS-07		B	100	3	2-1-2-2			
	15					SS-08		B	100	0	0-0-0-0		GA, H	
5						ST-09			100				U.W = 17.2 kN/m³	
						SS-10		B	100	0	0-0-0-0			
6	20	6,10	Grey saturated Silty CLAY with traces of sand and gravel, medium plasticity, soft.			SS-11		B	100	0	0-0-0-0		GA, H	
7														
	25					SS-12		B	100	0	0-0-0-0			
8														



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35	10,67	Grey saturated Silty and Sandy CLAY with traces of gravel, of firm appearance.			SS-13		B	63	0	0-0-0-0				
11						SS-14		B	42	0	0-0-0-0				
12	40					SS-15		B	100	0	0-0-0-0				
13															
14	45	13,72	Granular deposit : Grey saturated SILT with some clay and traces of sand, compact.			SS-16		B	100	12	3-6-6-6				
15	50					SS-17		B	100	14	6-7-7-14		GA, H	28,8	
16		16,05	Boulders.			DC-18		NQ	45						
17	55	17,27	Till deposit : Grey saturated Gravelly SAND with traces of clay, compact.												
18	60														
19						SS-19		N	57	R	4-4-25-50 /8 cm				
20	65	19,63	END OF BOREHOLE (Refusal)												
21															
22	70														
23															
24	75														

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-12
		X :	342 463	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 530 272	Start date :	2022-09-21
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	12,55 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE	
SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY	
Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY	
Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS	
N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

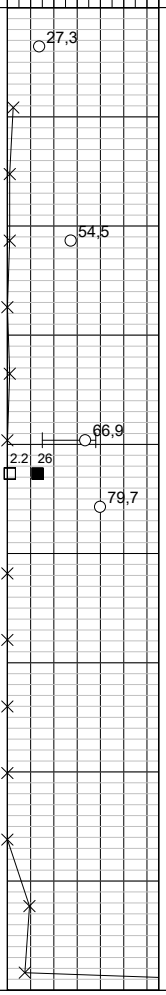
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,10	Brown moist TOPSOIL. - Presence of roots.			SS-01	A	N	67		4-6-4-6		GA, H	
							B							
		0,61	Native cohesive deposit : Brown moist Silty CLAY with traces of sand and gravel, of firm appearance.			SS-02		B	25	5	1-2-3-5			
1	5		Grey moist to saturated CLAY with some silt and traces of sand and gravel, of firm appearance.			SS-03		B	83	2	1-1-1-1			
2						SS-04		B	100	2	2-1-1-2		GA, H	
						SS-05		B	83	0	0-0-0-0			
3	10	3,05	Grey saturated CLAY with some silt and traces of sand, high plasticity, firm, very strong sensibility.			SS-06		B	100	2	0-1-1-1			
4						SS-07		B	100	0	0-0-0-1		GA, H	
	15					ST-21			100				U.W = 15.0 kN/m³ C	
5						SS-08		B	100	0	0-0-0-0			
6	20					SS-09		B	100	0	0-0-0-0			
						SS-10		B	100	0	0-0-0-0			
7		6,71	Grey saturated Silty and Sandy CLAY, of stiff appearance.			SS-11		B	67	0	0-0-0-0			
	25					SS-12		B	88	0	0-0-0-0			
8		7,92	Grey saturated Sandy CLAY with some silt and traces of gravel, of stiff appearance.			SS-13		B	63	19	4-10-9-6			
		8,53				SS-14		B	71	15	6-3-12-22			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80100120	
			Till deposit : Grey saturated Gravelly SAND with some silt and traces of clay, compact to very dense. - Traces of oxidation.			SS-15		B		R	50 /13 cm			
		9,75												
10			Grey saturated SAND and GRAVEL with traces of silt, compact to very dense.			SS-16		B	25	32	15-17-15-12			
	35					SS-17		B	50	29	10-14-15-18		GA	8,3
11						SS-18		B	67	38	29-17-21-17			
						SS-19		B	67	R	6-17-50 /8 cm			
12	40	12,19				SS-20		B	86	R	49-50 /3 cm			
		12,37	Grey saturated Sandy GRAVEL with traces of silt, very dense. - Presence of cobbles.											
13			END OF BOREHOLE (Refusal on very dense soil or boulders)											
	45													
14														
15	50													
16														
	55													
17														
18														
	60													
19														
20	65													
21														
	70													
22														
23	75													
24														

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-13
		X :	347 587	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 547 028	Start date :	2022-09-17
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	12,80 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown moist Silty SAND with traces of gravel.			SS-01		N	75	R	5-50 /5 cm		GA	
		0,61	- Presence of boulders.											
1			Brown-black moist ORGANIC MATTERS.			SS-02		B	21	3	2-1-2-3			
		1,22	Native cohesive deposit : Grey moist to saturated Clayey SILT with some gravel and traces of sand, of stiff appearance.											
	5					SS-03		B	42	5	10-3-2-3			
2		1,83	- Presence of roots.			SS-04		B	100	4	2-3-1-2			
		2,44	Grey saturated CLAY with some silt and traces of sand, high plasticity, of firm appearance.			SS-05		B	71	0	0-0-0-0			
3	10		Grey saturated CLAY with some silt and traces of sand, high plasticity.			SS-06		B	100	0	0-0-0-0		GA, H	
		3,66	Grey saturated Silty CLAY with traces of gravel and sand, of soft appearance.											
4						SS-07		B	67	0	0-0-0-0			
	15					SS-08		B	100	0	0-0-0-0			
5						SS-09		B	100	0	0-0-0-0			
		5,49	Grey saturated CLAY with some silt and traces of sand, of soft appearance.			SS-10		B	100	0	0-0-0-0			
6	20					SS-11		B	100	0	0-0-0-0			
		6,71	Grey saturated Silty CLAY with some sand, of firm appearance.			SS-12		B	100	0	0-0-0-0			
7		7,32	Grey saturated CLAY and SAND with some silt, of stiff appearance.			SS-13		B	42	0	0-0-0-1			
	25													
8		7,92	Granular deposit : Grey saturated Silty SAND with traces of gravel and clay, compact.			SS-14		B	29	16	12-7-9-6			
						SS-15		B	42	10	2-3-7-12			

TESTS: W_P W W_L — 20 40 60 80 100 120 — 0,0 — 61,4

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Grey saturated Silty SAND with some gravel, dense.			SS-16		B	67	49	12-34-15-5		GA	14,0	
10		9,75	Grey saturated GRAVEL with some sand and traces of silt, compact.			SS-17		B	25	15	4-12-3-3				
	35	10,36	Grey saturated SAND and GRAVEL with traces of silt, loose to compact.			SS-18		B	17	5	2-2-3-2				
11						SS-19		B	21	5	7-3-2-6				
12						SS-20		B	58	27	22-14-13-24				
	40	12,19	Till deposit : Grey saturated Gravelly SAND with some silt, dense to very dense.			SS-21		B	75	52	44-29-23-19				
13		12,80	END OF BOREHOLE												
	45														
14															
15	50														
16															
	55														
17															
18															
	60														
19															
20	65														
21															
	70														
22															
23	75														
24															

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BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-14
		X :	348 431	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 560 526	Start date :	2022-11-02
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	14,48 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-11-09	0,55 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,05	Brown moist TOPSOIL.				A							
			Granular fill :			SS-01	B	N	63		8-19-10-3	0,55 m	GA	
		0,61	Brown moist to saturated Silty SAND with some gravel.											
1			- Traces of oxidation.			SS-02		B	63	15	4-5-10-9			
		1,22	Native cohesive deposit :											
	5		Grey saturated Clayey and Sandy SILT, of firm appearance.			SS-03		B	71	4	3-2-2-2			
2			Brown saturated Silty CLAY with some sand, of firm to soft appearance.			SS-04		B	100	4	3-3-1-2			
						SS-05		B	42	1	0-0-1-1			
3	10	3,05	Grey saturated CLAY with traces of silt and sand, high plasticity, of stiff appearance.			SS-06		B	100	0	0-0-0-0		GA, H	
4														
	15					SS-07		B	100	0	0-0-0-0			
5														
6	20					SS-08		B	100	0	0-0-0-0			
7														
	25					SS-09		B	100	0	0-0-0-0			
8														

TESTS: GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

×: N (standard pen.); ▽: Nc (dyn. pen.); ■: Cu intact; □: Cu remoulded; ◆: Su intact; ◇: Su remoulded

W_P W W_L

20 40 60 80 100 120

16,3

57,8

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					SS-10		B	100	0	0-0-0-0					
11						SS-11		B	100	0	0-0-0-0					
12	40					SS-12		B	100	0	0-0-0-0					
13		13,26	Till deposit : Grey saturated SAND with traces of silt and gravel, compact.			SS-13		B	0	12	14-6-6-10					
14	45	13,87	Brown-grey saturated Gravelly SAND with traces of silt, very dense.			SS-14		B	54	52	4-15-37-28			GA	10,0	
15	50	14,48	END OF BOREHOLE													
16																
17	55															
18																
19	60															
20																
21	65															
22																
23	70															
24																
	75															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-15
		X :	347 423	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 540 952	Start date :	2022-10-17
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	17,98 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-17	0,30 m
Reading 2		m

Remarks : Mesure par tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,10	Brown moist TOPSOIL.											
			Native cohesive deposit : Brown moist to saturated Clayey SILT with traces of sand and gravel. - Presence of organic matters, wood and roots.			SS-01		N	13		2-1-2-1	0,30 m		
1		0,61				SS-02		B	63	4	1-2-2-3		GA, H	
	5	1,22	Brown saturated CLAY with some silt and traces of sand, high plasticity.			SS-03		B	33	2	1-1-1-1			
2		1,83	Brown-grey saturated Clayey SILT with traces of sand. - Presence of roots.			SS-04		B	100	0	0-0-0-0		GA, H	
			Grey saturated CLAY with some silt and traces of gravel, high plasticity.			ST-05			100				U.W = 14.3 kN/m³ C	
3	10	3,05	Grey saturated CLAY with some silt and traces of sand, of soft appearance.			SS-06		B	100	0	0-0-0-0			
4						SS-07		B	100	0	0-0-0-0			
	15					SS-08		B	100	0	0-0-0-0			
5		4,88	Grey saturated CLAY and SILT with traces of sand, of soft appearance.			SS-09		B	100	0	0-0-0-0			
						SS-10		B	100	0	0-0-0-0			
6	20	6,10	Grey saturated CLAY with some silt and traces of sand, of soft appearance.			SS-11		B	100	0	0-0-0-0			
		6,71	Grey saturated Silty and Sandy CLAY, of firm appearance.			SS-12		B	42	4	0-1-3-3			
7		7,32	Granular deposit : Grey saturated SILT with some clay and traces of sand, loose to very loose.			SS-13		B	100	7	1-3-4-2		GA, H	
	25													
8						SS-14		B	42	3	0-1-2-2			
		8,53	Grey saturated Gravelly to GRAVEL and SAND with traces of clay, very			SS-15		B	50	4	12-2-2-4			

47,6; 66,6; 0,81; 95,4; 34,5

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
			loose to compact.			SS-16		B	42	23	19-11-12-12					
10		9,75	Grey saturated Gravelly SAND, compact.			SS-17		B	42	20	9-10-10-8					
	35					SS-18		B	96	28	14-13-15-28					
11						SS-19		B	83	26	7-15-11-13					
		11,58	Grey saturated Gravelly SAND with some clay, dense.			SS-20		B	71	31	14-15-16-16					
12	40															
13																
	45	13,72	Grey saturated Silty SAND with some gravel, compact.			SS-21		B	50	34	33-23-11-15					
14																
15																
	50					SS-22		B	58	14	10-5-9-12					
16						SS-23		B	83	25	13-10-15-17			GA		
		16,46	End of sampling. Start of dynamic penetration test (Pen-Test).													
	55															
17																
18		17,98	END OF BOREHOLE (Refusal)													
	60															
19																
	65															
20																
21																
	70															
22																
	75															
23																
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-16
		X :	350 489	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 568 355	Start date :	2022-09-18
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	12,93 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	TESTS	REMARKS
		0,00	Granular fill : Grey moist SAND with some silt and clay and traces of gravel.		SS-01		N	29		8-6-2-2	GA, H	
1		0,61	Native cohesive deposit : Brown moist Clayey SILT with some gravel and traces of sand, of firm appearance.		SS-02		B	17	8	3-4-4-7		
	5	1,22	Grey moist to saturated Clayey SILT with some sand and traces of gravel, of firm appearance. - Presence of roots.		SS-03		B	58	6	2-3-3-5		
2		1,83			SS-04		B	71	5	3-3-2-3		
		2,44	Brown saturated Clayey SILT with some sand and gravel, of firm appearance. - Presence of organic matters.		SS-05		B	100	3	1-2-1-1	GA, H	
3	10	3,05	Grey saturated Silty CLAY with some sand, of firm appearance. - Presence of organic matters.		SS-06		B	88	2	1-1-1-1		
		3,66	Grey saturated Silty CLAY with traces of sand and gravel, of firm appearance.		SS-07		B	100	0	0-0-0-0		
4		4,27	Grey saturated Sandy and Silty CLAY, of firm appearance. Grey saturated CLAY with some silt and traces of sand, high plasticity, soft, very strong sensibility.		SS-08		B	100	0	0-0-0-0	GA, H	
	15				ST-13			100			U.W = 14.4 kN/m³	
5												
					SS-09		B	100	0	0-0-0-0		
6	20											
7												
	25	7,62	Grey saturated Clayey SILT with some sand and traces of gravel, of firm appearance.		SS-10		B	58	2	3-1-1-3		
8												

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Till deposit : Grey saturated Gravelly SAND with some silt, compact.			SS-11		B	50	12	8-5-7-11		GA	8,5	
10	35	10,67	Boulders and/or cobbles.			DC-14		NQ	21						
12	40	12,50	Grey saturated Sandy GRAVEL with traces of silt, compact.			SS-12		NQ	100	R	9-13-50 /13 cm				
13		12,93	END OF BOREHOLE (Refusal on very dense soil, boudlers and/or cobbles)												
14	45														
15	50														
16															
17	55														
18															
19	60														
20	65														
21															
22	70														
23	75														
24															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-17
		X :	350 548	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 570 990	Start date :	2022-09-22
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	14,94 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

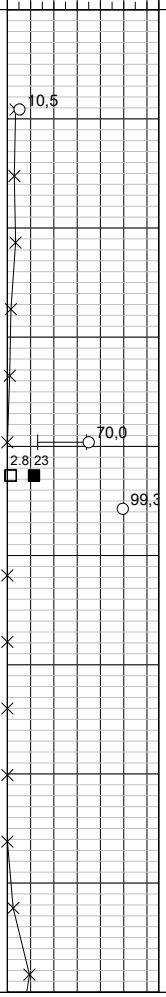
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,08	Brown-black moist TOPSOIL.				A							
			Native granular deposit : Brown-grey to grey moist to saturated Silty SAND with traces of clay and gravel, loose.			SS-01	B	N	38		0-1-3-5			
1						SS-02		B	42	7	3-5-2-3		GA, H	
	5					SS-03		B	17	6	3-2-4-4			
2						SS-04		B	38	7	4-4-3-4			
		2,44	Cohesive deposit : Grey saturated Clayey SILT with traces of sand and gravel, of firm appearance.			SS-05		B	100	3	1-2-1-2			
3	10	3,05				SS-06		B	100	2	1-1-1-2			
			Grey saturated CLAY with some silt and traces of sand, high plasticity, soft, very strong sensibility.			SS-07		B	100	0	0-0-0-0		GA, H	
4						ST-20			100				U.W = 14.8 kN/m³ C	
	15					SS-08		B	100	0	0-0-0-0			
5						SS-09		B	75	0	0-0-0-0			
	20					SS-10		B	100	0	0-0-0-0			
6						SS-11		B	100	0	0-0-0-0			
	25					SS-12		B	67	0	0-0-0-0			
7		7,92	Till deposit : Grey saturated Gravelly SAND with some silt and traces of clay, loose.			SS-13		B	100	5	6-3-2-3			
		8,53	Grey saturated Sandy and Silty			SS-14		B	21	19	30-10-9-6			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	GRAVEL with traces of clay, compact.													
			Grey saturated SAND and SILT with some gravel and traces of clay, compact.			SS-15		B	100	10	6-5-5-4			GA, H	9,0	
10	35															
11						SS-16		B	38	13	8-6-7-9					
12	40	12,19	Grey saturated Gravelly to GRAVEL and SAND with some silt, compact to very dense.			SS-17		B	54	16	13-8-8-12					
13																
14	45					SS-18		B	42	11	11-6-5-11					
						SS-19		B	58	57	35-24-33-45					
15		14,94	END OF BOREHOLE													
	50															
16																
17	55															
18																
19	60															
20																
21	65															
22																
23	70															
24																
	75															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-18
		X :	351 733	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 576 272	Start date :	2022-09-23
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	17,04 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
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Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
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Very spaced	2000 - 6000 mm
Wide	> 6000 mm

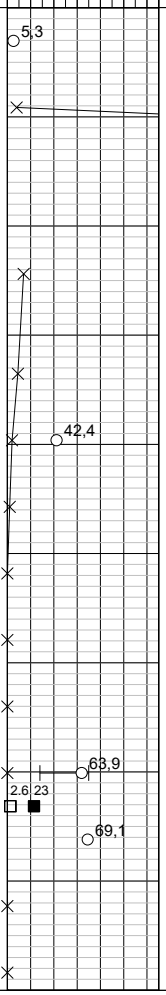
STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Grey moist SAND with some gravel and traces of silt. - Traces of oxidation.			SS-01		N	38		2-2-3-5		GA	
1						SS-02		B	50	8	2-2-6-10			
		1,22	Grey moist to saturated GRAVEL and SAND with traces of silt. - Presence of boulders. BOULDERS.			SS-03		B	20	R	14-20-50 /5 cm			
2	5	1,57				DC-21		NQ	81					
		2,13	Grey saturated Gravelly SAND with some silt.			SS-04		B	33	14	9-7-7-6			
3	10	3,05	Native cohesive deposit : Grey saturated Silty CLAY with traces of sand and gravel, of firm appearance.			SS-05		B	54	9	2-4-5-4			
4						SS-06		B	100	4	2-2-2-1		GA, H	
	15					SS-07		B	71	2	1-1-1-1			
5		4,88	Grey saturated Silty CLAY with traces of sand, high plasticity, of soft appearance.			SS-08		B	100	0	0-0-0-0			
						SS-09		B	92	0	0-0-0-0			
6	20					SS-10		B	100	0	0-0-0-0			
7						SS-11		B	100	0	0-0-0-0		GA, H	
	25					TS-20			100				U.W = 16.0 kN/m³ C	
8						SS-12		B	100	0	0-0-0-0			
						SS-13		B	100	0	0-0-0-0			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					SS-14		B	100	0	0-0-0-0					
11						SS-15		B	100	0	0-0-0-0					
12	40	12,19	Granular deposit : Grey saturated Clayey SAND with some gravel and silt, very loose.			SS-16		B	29	4	0-0-4-3					
13	45	13,72	Grey saturated Gravelly SAND with traces of silt, compact.			SS-17		B	25	25	7-13-12-8					
14	50	15,24	Bedrock : Grey Biotite GNEISS, of good to fair quality.			DC-18		NQ	100	80				f'c = 146,8 MPa U.W. = 25.9 kN/m³		
15						DC-19		NQ	100	57						
16	55	17,04	END OF BOREHOLE													
17																
18	60															
19																
20	65															
21	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-20
		X :	331 998	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 595 315	Start date :	2022-09-19
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	14,94 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

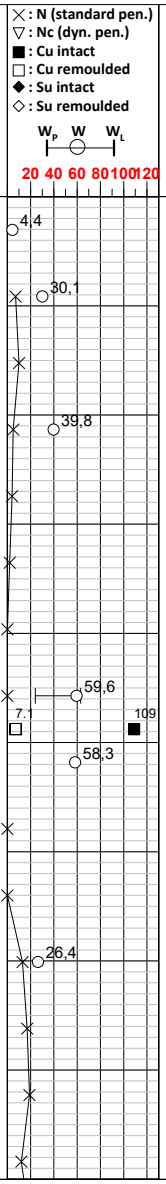
STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Grey moist SAND with some gravel and traces of silt.			SS-01		N	58		11-9-9-7		GA	
		0,61	Native cohesive deposit : Brown moist Sandy and Silty CLAY with traces of gravel, of firm appearance. - Presence of wood.			SS-02		B	38	7	2-2-5-6		GA, H	
1	5	1,22	Grey moist to saturated CLAY with some silt and traces of sand, of firm appearance. - Presence of wood. - Presence of roots.			SS-03		B	50	10	4-5-5-6			
2		2,44	Grey saturated Silty CLAY with some sand, of firm appearance.			SS-04		B	100	5	3-3-2-3		GA, H	
						SS-05		B	67	4	2-2-2-3			
3	10	3,05	Grey saturated Clayey to CLAY and SILT with traces of sand, of firm appearance.			SS-06		B	100	2	1-1-1-1			
4						SS-07		B	100	0	0-0-0-1			
	15	4,27	Grey saturated Silty CLAY and traces of sand, high plasticity, very stiff, very strong sensibility.			SS-08		B	100	0	0-0-0-0		GA, H	
5						ST-23			100				U.W = 16.2 kN/m³	
						SS-09		B	54	0	0-0-0-0			
6	20					SS-10		B	79	0	0-0-0-0			
		6,71	Granular deposit : Grey saturated Clayey and Sandy SILT with traces of gravel.			SS-11		B	50	13	1-6-7-5		GA, H	
7		7,32	Grey saturated Silty SAND with some clay and traces of gravel, compact.			SS-12		B	42	17	5-8-9-12			
	25					SS-13		B	38	19	9-9-10-10			
8						SS-14		B	42	12	3-6-6-8			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Grey saturated Gravelly SAND with some silt, compact.			SS-15		B	79	20	3-8-12-14					
10		9,75	Grey saturated SAND with some silt and traces of clay, compact. - Traces of oxidation.			SS-16		B	42	18	8-8-10-12					
	35	10,36	Grey saturated Gravelly to traces of gravel SAND with some silt, compact.			SS-17		B	38	18	9-9-9-8					
11						SS-18		B	83	14	5-6-8-11					
12	40					SS-19		B	33	15	2-6-9-8					
						SS-20		B	83	15	6-8-7-9					
13																
	45	13,72	Till deposit : Grey saturated Silty and Gravelly SAND, dense to very dense.			SS-21		B	100	33	3-14-19-26					
14						SS-22		B	83	65	42-33-32-44					
15		14,94	END OF BOREHOLE													
	50															
16																
	55															
17																
18																
	60															
19																
20	65															
21																
	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-21
		X :	320 001	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 518 883	Start date :	2022-09-17
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	14,94 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

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SYMBOLS

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	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

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QUALIFICATIVE	RQD
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GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Brown-black moist TOPSOIL.				A							
		0,18	- Presence of roots.			SS-01	B	N	63		3-4-6-3		GA	
		0,61	Granular fill : Brown moist Gravelly SAND with traces of silt.			SS-02		B	38	5	2-1-4-4			
	5	1,22	Native cohesive deposit : Grey moist Clayey SILT with traces of sand, of firm appearance.			SS-03		B	100	4	2-3-1-2			
		1,83	- Presence of wood. Grey moist to saturated Silty CLAY with traces of sand, of firm appearance.			SS-04		B	100	4	2-2-2-3		GA, H	
						SS-05		B	71	2	1-1-1-1			
	10		Grey saturated Silty CLAY with traces of sand and gravel, of soft appearance. - Presence of roots.			SS-06		B	100	2	1-1-1-1			
		3,66	Grey saturated CLAY and SILT with traces of sand, of soft appearance.			SS-07		B	100	2	1-1-1-1			
	15					SS-08		B	100	0	0-0-0-0		GA, H	
		4,88	Grey saturated Silty CLAY with some sand and traces of gravel, soft, very sensitivity.			SS-09		B	100	0	0-0-0-0			
						ST-10			100				U.W = 14.6 kN/m³ C	
	20					SS-11		B	100	0	0-0-0-0			
	25	7,62	Grey saturated CLAY with some silt and sand and traces of gravel, of soft appearance.			SS-12		B	29	0	0-0-0-0			

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						SS-13		B	100	0	0-0-0-0					
10	35															
						SS-14		B	100	0	0-0-0-0					
11																
12	40															
						SS-15		B	100	0	0-0-0-0					
13																
	45	13,72	Grey saturated Sandy and Silty CLAY with traces of gravel, of firm appearance.			SS-16		B	67	0	0-0-0-11					
14		14,33	Till deposit : Grey saturated Sandy SILT with some clay and gravel, very dense.			SS-17		B	67	89	43-40-49-50			GA, H	20,5	
15	50	14,94	END OF BOREHOLE													
16																
	55															
17																
18																
	60															
19																
	65															
20																
21	70															
22																
	75															
23																
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-22
		X :	348 147	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 562 557	Start date :	2022-11-03
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	17,65 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

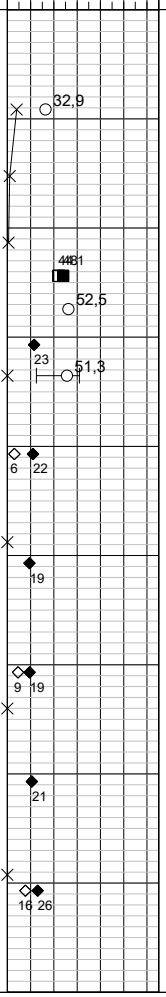
QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00											GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value	
		0,18	Brown-black moist TOPSOIL. - Presence of wood. - Presence of roots.			SS-01	A / B	N	79		1-2-4-7			
1		0,61	Native cohesive deposit : Grey moist Silty CLAY with traces of sand, of firm appearance.			SS-02		B	67	8	2-4-4-5		GA, H	
	5	1,22	Brown moist Clayey SILT with some sand, of stiff appearance.			SS-03		B	42	2	1-1-1-1			
2			Brown moist to saturated CLAY with some silt and sand, of soft appearance.			SS-04		B	100	1	0-1-0-0			
						ST-05			100				U.W = 16.2 kN/m³ C	
3	10	3,05	Grey saturated Silty CLAY with traces of sand, high plasticity, firm, low sensibility.			SS-06		B	100	0	0-0-0-0		GA, H	
4														
	15					SS-07		B	100	0	0-0-0-0			
5														
6	20					SS-08		B	100	0	0-0-0-0			
7														
	25					SS-09		B	100	0	0-0-0-0			
8														



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35	11				SS-10		B	100	0	0-0-0-0				30	
															2025	
11						SS-11		B	100	0	0-0-0-0				37	
12	40														2 36	
						SS-12		B	100	0	0-0-0-0					
13															42	
	45	13,72	Till deposit : Brown saturated Silty SAND with traces of gravel, dense to loose.			SS-13		B	42	39	4-29-10-4			GA	25,1 15 49	
14						SS-14		B	71	3	4-1-2-1					
15	50					SS-15		B	0	12	4-6-6-4					
16		15,85	Brown saturated Gravelly SAND and SILT, dense to compact.			SS-16		B	100	32	6-17-15-10					
	55															
17						SS-17		B	54	16	6-3-13-22					
						SS-18		B	100	R	12-50 /13 cm					
18		17,65	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobble)													
	60															
19																
20	65															
21																
	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-24
		X :	350 354	Page :	1 of 3
Project No.:	158100425.500.710.5	Y :	5 568 896	Start date :	2022-10-16
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	25,04 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-17	0,00 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

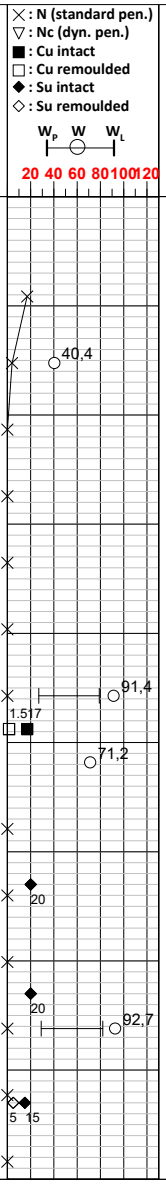
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Brown saturated TOPSOIL.			SS-01	A	N	29		1-1-2-2	0,00 m		
		0,25	- Presence of wood. - Presence of roots.				B							
1			Native cohesive deposit : Brown saturated Silty CLAY with traces of sand and gravel, of firm appearance.			SS-02		B	25	17	3-8-9-10			
	5		- Presence of wood.			SS-03		B	79	4	2-2-2-2		GA, H	
2		1,83	- Presence of roots.			SS-04		B	100	0	0-0-0-0			
			Grey saturated CLAY with some silt and traces of sand, high plasticity, soft, very strong sensibility.			SS-05		B	83	0	0-0-0-1			
3	10					SS-06		B	92	0	0-0-0-0			
4						SS-07		B	75	0	0-0-0-0			
	15					SS-08		B	100	0	0-0-0-0		GA, H	
5						ST-09			100				U.W = 14.7 kN/m³	
6	20					SS-10		B	100	0	0-0-0-0			
						SS-11		B	100	0	0-0-0-0			
7						SS-12		B	100	0	0-0-0-0			
		7,32	Grey saturated Silty CLAY with traces of sand, high plasticity, of soft appearance.			SS-13		B	100	0	0-0-0-0		GA, H	
	25					SS-14		B	100	0	0-0-0-0			
8						SS-15		B	100	0	0-0-0-0			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					SS-16		B	100	0	0-0-0-0				15	
						SS-17		B	100	0	0-0-0-0					
11						SS-18		B	100	0	0-0-0-0					
						SS-19		B	100	0	0-0-0-0					
12	40					SS-20		B	100	0	0-0-0-0					
						SS-21		B	100	0	0-0-0-0					
13																
	45					SS-22		B	88	0	0-0-0-0			GA, H	83,3	
14																
15	50					SS-23		B	100	0	0-0-0-0					
16																
	55					SS-24		B	100	0	0-0-0-0					
17																
18																
	60					SS-25		B	100	0	0-0-0-0					
19		18,90	Till deposit : Grey saturated Silty and Gravelly SAND with traces of clay, loose.			SS-26		B	54	8	5-3-5-7					
		19,51	End of sampling. Start of dynamic penetration test (Pen-Test).													
20	65														24 17 37 14 8 15 7 9 62 23 24 15 13 17 37 25 28	
21	70															
22																
23	75															
24																

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80100120	
25		25,04	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobbles)													
26	85															
27																
28	90															
29																
30	95															
31																
32	100															
33	105															
34	110															
35																
36	115															
37																
38	120															
39	125															
	130															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-25
		X :	351 954	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 577 463	Start date :	2022-09-23
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	14,33 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,08	Brown-black moist TOPSOIL.				A							
			Native cohesive deposit : Brown moist to saturated Sandy and Silty CLAY with traces of gravel, of firm appearance.			SS-01	B	N	63		1-3-7-8		GA, H	
1						SS-02		B	38	3	1-1-2-1			
		1,22	- Presence of roots.											
	5		Brown saturated Clayey SILT with traces of gravel, of soft appearance.			SS-03		B	100	0	0-0-0-0			
2		1,83	Grey saturated Silty CLAY with traces of gravel, of soft appearance.			SS-04		B	100	0	0-0-0-0			
		2,44	- Presence of roots. - Presence of wood.			SS-05		B	71	0	0-0-0-0		GA, H	
3	10		Grey saturated CLAY with some silt and traces of sand, high plasticity, of soft appearance.			SS-06		B	25	0	0-0-0-0			
		3,05												
		3,66	Grey saturated CLAY with some sand and traces of silt and gravel, of firm appearance.			SS-07		B	100	0	0-0-0-0			
4			Grey saturated Silty to some silt CLAY with traces of sand, firm.			SS-08		B	100	0	0-0-0-0			
	15													
5						SS-09		B	75	0	0-0-0-0			
						SS-10		B	100	0	0-0-0-0			
6	20					ST-22			100				U.W. = 15.2 kN/m³ C	
						SS-11		B	100	0	0-0-0-0			
7														
	25					SS-12		B	100	0	0-0-0-0			
8						SS-13		B	100	0	0-0-0-0			
						SS-14		B	100	0	0-0-0-0			

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						SS-15		B	100	0	0-0-0-0				
10		9,75	Till deposit : Grey saturated Sandy CLAY with traces of silt and gravel, of firm appearance. - Presence of cobbles.			SS-16		B	63	11	47-8-3-4				
	35	10,36				SS-17		B	67	12	6-4-8-15				
11		10,97	Grey saturated Clayey and Silty SAND with some gravel, compact. Grey saturated Gravelly SAND with traces of silt, loose.			SS-18		B	42	8	5-5-3-5		GA, H	9,4	
12						SS-19		B	33	16	5-8-8-3				
	40	12,19	Grey saturated GRAVEL and SAND with traces of silt and clay, compact to very dense. - Presence of cobbles.			SS-20		B	8	21	11-10-11-11				
13															
	45					SS-21		B	58	88	17-38-50-40			15,2	
14		14,33	END OF BOREHOLE												
15	50														
16															
	55														
17															
18															
	60														
19															
20	65														
21	70														
22															
	75														
23															
24															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-26
		X :	351 386	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 580 658	Start date :	2022-09-24
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	12,80 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,05	Brown-black moist TOPSOIL.				A							
			Native cohesive deposit : Brown moist Silty CLAY with traces of sand and gravel, of firm appearance. - Presence of wood. - Presence of roots.			SS-01	B	N	50		1-3-4-4			
1		0,61				SS-02		B	54	12	2-6-6-7		GA, H	
	5	1,22	Brown moist CLAY with some silt and traces of sand, of firm appearance. - Presence of roots.			SS-03		B	100	1	1-1-0-1			
2		1,83	Brown moist to saturated SILT with some clay and traces of sand, of firm appearance.			SS-04		B	100	2	1-1-1-1			
		2,44	Brown saturated CLAY with some silt and traces of sand, high plasticity, of soft appearance. - Presence of wood. - Presence of roots.			SS-05		B	100	0	0-0-0-1		GA, H	
3	10					SS-06		B	100	8	2-2-6-12			
		3,66	Brown to grey saturated Silty to some silt CLAY with traces of sand, of soft appearance.			SS-07		B	46	12	5-6-6-12			
4	15		Till deposit : Grey saturated Silty SAND with some gravel, compact to very dense.			SS-08		B	17	24	10-12-12-12			
5						SS-09		B	92	77	23-28-49-48		GA, H	
						SS-10		B	75	R	50-50 /5 cm			
		5,69	Bedrock : Grey GRANITE, of poor to good quality.											
6	20					DC-11		NQ	95	85				
7														
	25					DC-12		NQ	100	33				
8														

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					DC-13		NQ	100	30						
11						DC-14		NQ	100	82						
12	40					DC-15		NQ	100	50						
13		12,80	END OF BOREHOLE			DC-16		NQ	100							
14	45															
15	50															
16																
17	55															
18																
19	60															
20																
21	65															
22	70															
23																
24	75															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-27
		X :	320 686	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 659 293	Start date :	2022-10-07
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	17,81 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-17	0,00 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown saturated GRAVEL and SAND with traces of silt, loose to very loose.			SS-01		N	33		3-5-8-5	0,00 m	GA	
1	5					SS-02		B	42	9	4-4-5-6			
						SS-03		B	50	8	7-4-4-4			
2						SS-04		B	21	2	2-1-1-4			
		2,44	Native cohesive deposit : Grey saturated Sandy SILT and CLAY, of firm appearance.			SS-05		B	50	5	2-3-2-3			
3	10	3,05	Grey saturated Clayey SILT with some to traces of sand and gravel, of firm appearance.			SS-06		B	79	9	3-5-4-3			
4						SS-07		B		6	2-3-3-7			
		4,27	Grey saturated Silty CLAY with traces of sand and gravel, of firm appearance.			SS-08		B		7	2-3-4-9			
5	15					SS-09		B		4	2-3-1-2		GA, H	
6						ST-10			100				U.W. = 18.0 kN/m³	
	20	6,10	Grey saturated CLAY and SILT with traces of sand and gravel, medium plasticity, of soft appearance.			SS-11		B	100	2	3-1-1-2		GA, H	
7														
	25					SS-12		B	100	0	0-0-0-1			
8														

W_P W W_L

20 40 60 80 100 120

7,9 — 36,5 — 41,6 — 34,2

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Till deposit : Grey saturated Clayey and Sandy SILT with traces of gravel, very dense.			SS-13		B	67	R	7-3-50 /15 cm				
10		9,96	BOULDERS.												
	35					DC-20		NQ	39						
11															
		11,58	Grey saturated GRAVEL with traces of sand, dense.			SS-14		N	29		15-22-10-8				
12	40	12,19	Grey saturated SAND and GRAVEL with traces of silt, compact.			SS-15		B	17	25	11-14-11-15				
13															
	45					SS-16		B	46	10	1-2-8-10		GA	7.1	
14															
15															
	50					SS-17		B	0	11	9-6-5-2				
16			- Presence of boulders.			SS-18		B	67	R	9-50 /15 cm				
		16,46	Bedrock : Grey GRANITE, of excellent quality.												
	55					DC-19		NQ	100	99					
17															
18		17,81	END OF BOREHOLE												
	60														
19															
	65														
20															
21															
	70														
22															
	75														
23															
24															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-28
		X :	347 848	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 586 683	Start date :	2022-11-04
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	14,61 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-11-09	4,25 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Bnrown-black moist TOPSOIL. - Presence of wood. - Presence of roots.			SS-01	A	N	46		1-2-1-6			
		0,46					B							
1			Native cohesive deposit : Brown moist CLAY with some silt and traces of sand, of firm appearance.			SS-02		B	75	12	2-5-7-8		GA, H	
	5	1,22	Brown to grey moist to saturated CLAY with some silt and traces of sand, high plasticity, firm, low sensitivity.			SS-03		B	100	7	2-3-4-3			
2						SS-04		B	100	3	1-1-2-1			
						ST-05			0					
3	10					ST-06			100				U.W = 16.4 kN/m³ C	
4												4,25m		
	15					SS-07		B	100	0	0-0-0-0		GA, H	
5														
6	20					SS-08		B	100	0	0-0-0-0			
7														
	25					SS-09		B	100	0	0-0-0-0			
8														

TESTS

GA : grain size analysis
H : hydrometer test
C : consolidation
W : water content
W_L : liquid limit
W_P : plastic limit
Dr : specific gravity
k : permeability
f'c : compressive str.
OM : organic matter
CA : chemical analyses
SAV : soil agressivity value

× : N (standard pen.)
▽ : Nc (dyn. pen.)
■ : Cu intact
□ : Cu remoulded
◆ : Su intact
◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

36,3
44
81
46,6
41
60,1
24
35
17
38
46

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						SS-10		B	100	3	0-2-1-0				15 39	
10															37	
	35															
11						SS-11		B	100	3	1-1-2-1				13 27	
12																
	40	12,19	Till deposit : Brown saturated SAND with some silt and clay, loose.			SS-12		B	71	8	6-4-4-5				33	
13																
	45	13,72	Grey-brown saturated Silty SAND with some gravel and traces of clay, dense.			SS-13		B	71	39	47-21-18-14			GA, H	10,2	
14						SS-14		B	100	R	14-50 /13 cm					
		14,61	END OF BOREHOLE (Refusal on very dense soil, boudlers and/or cobbles)													
15	50															
16																
	55															
17																
18																
	60															
19																
20	65															
21																
	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-29
		X :	347 056	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 587 697	Start date :	2022-10-15
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	15,62 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-18	2,37 m
Reading 2		m

Remarks : Mesure par tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

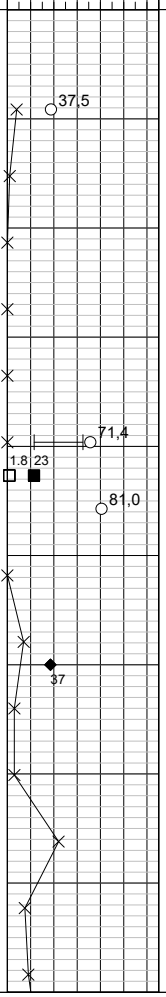
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,08	Brown-black moist TOPSOIL.				A							
			Native cohesive deposit : Brown moist CLAY with some silt and traces of sand, of firm appearance. - Presence of wood.			SS-01	B	N	75		1-4-8-9			
1						SS-02		B	79	8	2-3-5-5		GA, H	
	5					SS-03		B	42	2	0-1-1-1			
2		1,83	Brown moist to saturated Clayey SILT with traces of sand and gravel, of soft appearance.			SS-04		B	100	0	0-0-0-0	2,37 m		
						SS-05		B	63	0	0-0-0-0			
3	10	3,05	Brown to grey saturated Silty CLAY with traces of sand, high plasticity, soft, very strong sensitivity.			SS-06		B	100	0	0-0-0-1			
4						SS-07		B	75	0	0-0-0-0		GA, H	
	15					ST-08			100				U.W = 15.4 kN/m³	
5						SS-09		B	100	0	0-0-0-0			
		5,49	Native granular deposit : Grey saturated Sandy SILT with traces of gravel, compact.			SS-10		B	83	14	5-7-7-9			
6	20	6,10	Grey saturated Gravelly SAND with some clay, loose.			SS-11		B	58	6	1-1-5-5			
7						SS-12		B	71	6	6-3-3-3			
		7,32	Till deposit : Grey saturated Silty SAND with traces of gravel and clay, compact to very dense.			SS-13		B	21	44	18-19-25-17			
8	25					SS-14		B	50	15	13-5-10-12			
						SS-15		B	17	18	7-7-11-9			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						SS-16		B	54	26	16-11-15-23					
10						SS-17		B	71	49	20-21-28-43			GA, H	12,0	
	35					SS-18		B	100	90	50-41-49-50					
11						SS-19		B	63	73	28-42-31-21					
12						SS-20		B	83	100	50-50-50-44					
	40															
13																
	45															
14						SS-21		B	71	100	33-50-50-50					
15																
	50					SS-22		B	80	R	33-50-50 /8 cm					
		15,62	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobbles)													
16																
	55															
17																
18																
	60															
19																
	65															
20																
21																
	70															
22																
	75															
23																
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-30
		X :	321 692	Page :	1 of 3
Project No.:	158100425.500.710.5	Y :	5 663 704	Start date :	2022-10-06
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	28,04 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-17	0,00 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,08	Brown-black moist TOPSOIL. Cohesive fill : Brown to brown-grey moist CLAY and SILT with some sand and traces of gravel.			SS-01	A	N	42		2-1-2-2	0.00 m		
1							B							
						SS-02		B	63	12	1-6-6-8		GA, H	
	5	1,22	Brown-grey moist to saturated Clayey SILT with some to traces of sand and traces of gravel. - Presence of roots. - Presence of wood.			SS-03		B	50	6	1-3-3-5			
2						SS-04		B	92	7	3-3-4-2			
						SS-05		B	92	1	0-0-1-1			
3	10	3,05	Native cohesive deposit : Grey saturated Silty CLAY with traces of sand, high plasticity, stiff to firm, very strong sensitivity.			SS-06		B	100	3	2-2-1-1			
4						ST-07			100				U.W = 16.0 kN/m³ C	
	15					SS-08		B	88	0	0-0-0-0		GA, H	
5						SS-09		B	100	0	0-0-0-0			
6	20					SS-10		B	100	0	0-0-0-0			
						SS-11		B	100	0	0-0-0-0			
7														
	25					SS-12		B	100	0	0-0-0-0			
8														

GA : grain size analysis
H : hydrometer test
C : consolidation
W : water content
W_L : liquid limit
W_P : plastic limit
Dr : specific gravity
k : permeability
f'c : compressive str.
OM : organic matter
CA : chemical analyses
SAV : soil agressivity value

× : N (standard pen.)
▽ : Nc (dyn. pen.)
■ : Cu intact
□ : Cu remoulded
◆ : Su intact
◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

27,1 3,6 39 46,0 64,7 68 64 17 46 34

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Grey saturated Silty CLAY with traces of sand and gravel, of soft appearance.			SS-13		B	100	0	0-0-0-0			32 20	
10	35					SS-14		B	75	2	0-1-1-1				
11	40					SS-15		B	100	0	0-0-0-0				
12	45					SS-16		B	100	0	0-0-0-0				
13	50					SS-17		B	100	0	0-0-0-0				
14	55					SS-18		B	100	0	0-0-0-0				
15	60					ST-19			100				U.W = 17.4 kN/m³	34,3	
16		18,90	Grey saturated Silty and Sandy CLAY.			SS-20		B	100	22	3-7-15-13				
17	65	19,51	End of sampling. Start of dynamic penetration test (Pen-Test).											2 34 35 30 26 15 14 11 11 10 22 20 45 45 42 26	
18															
19	70														
20															
21	75														
22															
23															
24															

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
25															12 20 25 17 17 24 14 14 18 24 36 94	
26	85															
27																
28	90	28,04	END OF BOREHOLE													
29	95															
30																
31	100															
32	105															
33																
34	110															
35																
36	115															
37																
38	120															
39	125															
	130															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-31
		X :	319 239	Page :	1 of 3
Project No.:	158100425.500.710.5	Y :	5 603 379	Start date :	2022-10-13
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	37,19 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

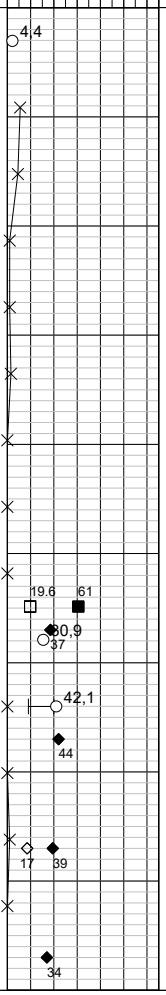
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown to grey moist to saturated Gravelly to GRAVEL and SAND with traces of silt.			SS-01		N	50		7-10-15-12		GA	
1						SS-02		B	63	11	8-6-5-5			
	5					SS-03		B	33	9	5-6-3-3			
2						SS-04	A	B	71	2	1-1-1-2			
		2,13	Black-grey saturated ORGANIC MATTERS with traces of clay.				B							
						SS-05		B	17	2	1-1-1-2			
3	10					SS-06		B	33	3	2-2-1-2			
		3,66	Native cohesive deposit : Grey saturated Clayey SILT with traces of sand, of firm appearance.			SS-07		B	100	0	0-0-0-0			
4						SS-08		B	100	0	0-0-0-0			
	15													
5		4,88	Grey saturated CLAY and SILT with traces of sand and gravel, medium plasticity, stiff, medium sensitivity.			SS-09		B	100	0	0-0-0-0			
						ST-10			100				U.W = 19.2 kN/m³	
6	20					SS-11		B	100	0	0-0-0-0		GA, H	
						SS-12		B	71	0	0-0-0-0			
7														
	25					SS-13		B	83	2	0-1-1-1			
8		7,92	Grey saturated CLAY with traces of sand, gravel and clay, of firm appearance.			SS-14		B	71	0	0-0-0-0			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Grey saturated Clayey to some clay SILT with some sand, of firm appearance.			SS-15		B	79	0	0-0-0-0			64	
10	35	10,67	Grey saturated CLAY and SILT with traces of sand, of soft appearance.			SS-16		B	100	0	0-0-0-0				
12	40					SS-17		B	100	0	0-0-0-0				
13	45					SS-18		B	100	0	1-0-0-0				
15	50	15,24	Grey saturated CLAY with some silt and traces of sand and gravel, of soft appearance.			SS-19		B	100	0	0-0-0-0				
16	55					SS-20		B	100	0	0-0-0-0				
17	60					SS-21		B	100	0	0-0-0-0				
18						ST-22			100				U.W = 17.6 kN/m³	41,5	
19	65	19,51	End of sampling. Start of dynamic penetration test (Pen-Test)											0 0 0 3 3 3 3 3 3 4 4 4 4 4 5 5	
20															
21	70														
22															
23	75														
24															

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
25															6 5 5 7 7	
26	85														8 7 7	
27															6 8 8 9	
28	90														8 9 8	
29	95														9 9 9	
30															9 9 10	
31	100														10 11 8	
32	105														10 12 11	
33															20 17 21	
34	110														21 25 18	
35	115														25 24 15	
36															18 18 15	
37	120														24 25 26	
		37,19	END OF BOREHOLE													
38	125															
39																
	130															

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BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-32
		X :	319 708	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 658 695	Start date :	2022-10-08
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	9,53 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

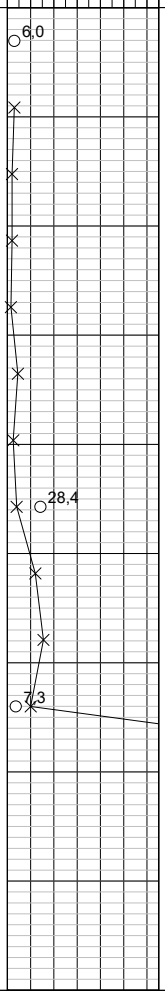
STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L — 20 40 60 80 100 120

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown moist Gravelly SAND with traces of silt.			SS-01		N	63		4-6-5-5		GA	
		0,61	Brown moist SAND with traces of gravel and silt.			SS-02		B	54	6	3-2-4-4			
1	5	1,22	Brown moist to saturated Gravelly SAND with some silt. - Presence of organic matters.			SS-03		B	25	4	2-3-1-1			
2		2,01	Native cohesive deposit : Brown saturated Clayey SILT with traces of sand, of firm appearance. - Presence of organic matters.			SS-04	A / B	B	63	4	1-2-2-5			
		2,44	Grey-brown saturated Clayey SILT with some gravel, of firm appearance.			SS-05		B	17	3	1-1-2-3			
3	10	3,05	Grey-brown Silty CLAY with some sand and gravel, of firm appearance. - Presence of roots.			SS-06		B	21	9	3-4-5-6			
4		3,66	Grey saturated CLAY and SILT with some sand and traces of gravel, of firm appearance.			SS-07		B	71	5	1-1-4-2			
	15					SS-08		B	100	8	2-3-5-2		GA, H	
5		4,88	Till deposit : Grey saturated SILT with some gravel and traces of sand, compact.			SS-09		B	92	24	4-9-15-20			
		5,49	Grey saturated Silty SAND and GRAVEL, dense.			SS-10		B	46	31	7-17-14-12			
6	20	6,10	Grey saturated Gravelly and Silty SAND with traces of clay, compact.			SS-11		B	92	20	13-10-10-7		GA, H	
7														
	25	7,62	Grey saturated SAND with some gravel and silt, dense.			SS-12		B	47	R	12-36-50 /8 cm			
8		8,00	Bedrock : Grey Biotite GNEISS, of good quality.			DC-13		NQ	88	82			f'c = 124,9 MPa U.W. = 27.5 kN/m³	



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								TESTS		
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	REMARKS
		9,53	END OF BOREHOLE												
10	35														
11															
12	40														
13															
	45														
14															
15	50														
16															
	55														
17															
18	60														
19															
20	65														
21															
	70														
22															
23	75														
24															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-33
Project No.:	158100425.500.710.5	X :	323 030	Page :	1 of 1
Client:	Cree Development Corporation	Y :	5 598 522	Start date :	2022-11-05
Site:	Preliminary Geotechnical Investigation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
	Potential BDH Railway	Equipment :	CME 55	Depth :	8,69 m
		Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
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Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-11-09	0,00 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

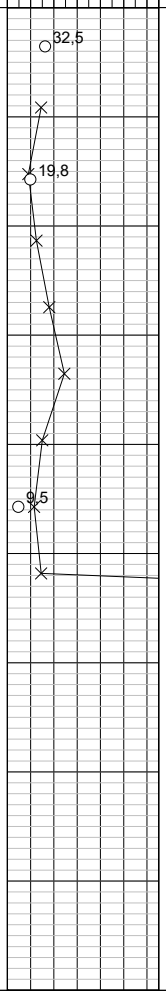
QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00											GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		0,10	Brown-black saturated TOPSOIL.				A							
			Native cohesive deposit : Grey saturated Clayey SILT with traces of sand and gravel, of firm appearance.			SS-01	B	N	92		1-1-2-4	0,00 m	GA, H	
1						SS-02		B	54	29	2-25-4-2			
		1,22	Till deposit :				A							
5		1,32	Grey saturated SILT with traces of sand, clay and gravel, compact.			SS-03	B	B	63	18	3-7-11-8		GA, H	
2			Brown saturated SAND wiith traces of silt and gravel, compact.			SS-04		B	71	25	8-10-15-18			
		2,44	- Traces of oxidation.											
			Brown saturated Gravelly SAND with some silt, dense.			SS-05		B	58	36	21-19-17-15			
3	10	3,05	Brown-grey to brown saturated Gravelly and Silty SAND, compact to very dense.			SS-06		B	63	49	18-26-23-15			
4						SS-07		B	29	30	9-18-12-8			
	15					SS-08		B	100	23	14-15-8-8		GA	
5						SS-09		B	100	29	9-13-16-16			
			- Presence of boulders.			SS-10		B	90	R	24-50 /10 cm			
		5,74	Bedrock :											
6	20		Grey GRANITE, of excellent to good quality.			DC-11		NQ	100	91				
7														
	25					DC-12		NQ	100	85				
8		8,69	END OF BOREHOLE											



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-05

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-34
		X :	319 922	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 600 272	Start date :	2022-10-14
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	21,87 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,08	Brown-black moist TOPSOIL. Native cohesive deposit : Brown moist Silty CLAY with traces of sand, of firm appearance.			SS-01	A / B	N	71		1-1-5-6			
1						SS-02		B	75	4	2-1-3-3		GA, H	
	5	1,22	Brown moist to saturated Silty CLAY with traces of sand and gravel, high plasticity, firm, very stronf sensibility..			SS-03		B	100	1	0-0-1-1			
2						SS-04		B	100	1	1-0-1-0		GA, H	
						ST-05			100				U.W = 16.3 kN/m³ C	
3	10					SS-06		B	100	0	0-0-0-0			
		3,66	Brown saturated CLAY with traces of silt, sand and gravel, firm.			SS-07		B	100	0	0-0-0-0			
4		4,27	Brown to grey saturated SILT and CLAY with traces of sand, medium plasticity.			SS-08		B	100	0	0-0-0-0			
	15													
5						SS-09		B	100	0	0-0-0-0			
						SS-10		B	67	0	0-0-0-0		GA, H	
6	20													
						SS-11		B	100	0	0-0-0-0			
		6,71	Grey saturated Silty to some silt CLAY with traces of sand, firm to stiff.			SS-12		B	100	0	0-0-0-0			
7														
	25					SS-13		B	100	0	0-0-0-0			
8														
						SS-14		B	100	0	0-0-0-0			
						SS-15		B	100	0	0-0-0-0			

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					SS-16		B	100	0	0-0-0-0					
						SS-17		B	100	0	0-0-0-0				27	
11						SS-18		B	100	0	0-0-0-0				56	
						SS-19		B	63	0	0-0-0-0					
12	40					SS-20		B	100	0	0-0-0-0					
						SS-21		B	100	0	0-0-0-0					
13																
	45	13,72	Granular deposit : Grey saturated Clayey SAND with some silt, compact.			SS-22		B	50	12	3-7-5-3					
14																
15																
	50	15,24	Grey saturated SAND with some silt and traces of clay and gravel, very loose.			SS-23		B	42	3	3-2-1-4					
16																
	55	16,76	Grey saturated SAND with some silt and traces of gravel, loose.			SS-24		B	75	6	1-3-3-5			GA	20,1	
17																
18																
	60					SS-25		B	42	8	3-4-4-4					
19		18,90	End of sampling. Start of dynamic penetration test (Pen-Test).												36 40 11 8 13 12 25 45 100 100	
	65															
20																
21	70															
		21,87	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobbles)													
22																
	75															
23																
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-35
		X :	310 374	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 625 174	Start date :	2022-10-14
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	17,63 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

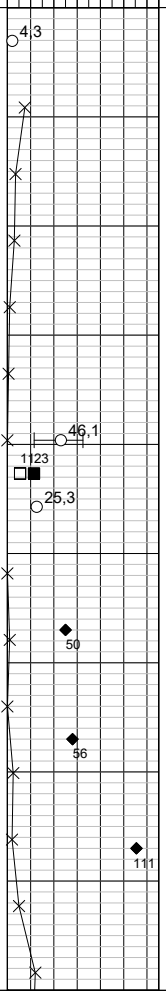
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

×: N (standard pen.); ▽: Nc (dyn. pen.); ■: Cu intact; □: Cu remoulded; ◆: Su intact; ◇: Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown moist GRAVEL and SAND with traces of silt.			SS-01		N	50		4-9-8-10		GA	
1						SS-02		B	58	15	8-9-6-8			
	5	1,22	Brown moist to saturated Silty SAND with some gravel.			SS-03		B	50	7	4-3-4-3			
2		1,83	Brown saturated SAND and GRAVEL with traces of silt.			SS-04		B	33	6	5-3-3-3			
		2,44	Native cohesive deposit : Brown saturated Clayey SILT with some sand and traces of gravel, of firm appearance.			SS-05		B	50	2	2-1-1-1			
3	10	3,05	Grey saturated Sandy and Silty CLAY with some gravel, of firm appearance.			SS-06		B	58	1	0-0-1-1			
		3,66	Grey saturated Silty CLAY with some to traces of gravel and sand, high plasticity, firm to stiff, very strong sensitivity.			SS-07		B	42	0	0-0-0-0		GA, H	
4	15					ST-08			100				U.W = 19.1 kN/m³	
5						SS-09		B	100	0	0-0-0-0			
						SS-10		B	67	2	0-1-1-2			
6	20					SS-11		B	79	0	0-0-0-0			
7						SS-12		B	100	5	1-2-3-2			
		7,32	Grey saturated Clayey SILT with traces of sand, very stiff.			SS-13		B	100	4	2-2-2-3			
8	25	7,92	Grey saturated Silty CLAY with some sand and traces of gravel, of firm appearance.			SS-14		B	100	10	5-5-5-7			
		8,53				SS-15		B	63	24	1-12-12-16			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
		9,14	Granular deposit : Grey saturated Sandy SILT with some clay, compact.			SS-16		B	38	22	15-11-11-10					
10			Grey saturated SAND with some to traces of silt and gravel, compact to loose.			SS-17		B	46	13	3-5-8-8					
	35					SS-18		B	33	8	3-4-4-5					
11						SS-19		B	42	7	2-4-3-3					
12						SS-20		B	42	6	3-3-3-2					
	40					SS-21		B	42	9	5-5-4-4					
13																
	45					SS-22		B	21	6	4-4-2-3					
14																
15																
	50	15,24	Till deposit : Grey saturated Silty SAND with some gravel, loose to very dense.			SS-23		B	58	51	18-22-29-30					
16						SS-24		B	100	72	34-30-42-50			GA	10,9	
	55					SS-25		B	67	60	37-30-30-45					
17		17,07	End of samplig. Start of dynamic penetration test (Pen-Test)												62 100	
		17,63	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobbles)													
18	60															
19																
20	65															
21	70															
22																
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-36
		X :	315 585	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 639 929	Start date :	2022-10-11
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	13,67 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE	
SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY	
Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY	
Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS	
N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Brown-black moist TOPSOIL (Peat).											
1		1,22	Native cohesive deposit : Grey saturated CLAY with some silt and traces of sand, high plasticity, firm, strong sensitivity.			SS-01		B	25	0	0-0-0-0		GA, H	
2	5					SS-02		B	83	4	0-2-2-2		GA, H	
3						SS-03		B	100	2	2-1-1-1			
4	10					ST-04			100				U.W = 16.6 kN/m³	
5						SS-05		B	100	0	0-0-0-0		GA, H	
6	15					SS-06		B	100	0	0-0-0-0			
7						SS-07		B	100	0	0-0-0-0			
8	20					SS-08		B	100	0	0-0-0-0			
9						ST-09			100				U.W = 16.3 kN/m³ C	
10	25	7,32	Grey saturated Silty CLAY with some sand and traces of gravel, medium plasticity, very soft, medium sensitivity.			SS-10		B	100	0	0-0-0-0		GA, H	
11						SS-11		B	100	3	0-1-2-2			
12	30					SS-12		B	100	3	1-1-2-2			
13						ST-13			100				U.W = 19.0 kN/m³	

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

×: N (standard pen.); ▽: Nc (dyn. pen.); ■: Cu intact; □: Cu remoulded; ◆: Su intact; ◇: Su remoulded

W_P W W_L

20 40 60 80 100 120

52,8 39,1 3,6 32 64,6 69,4 0,8 58,6 42,9 11 80 32,0

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : **T. Coulaux, ing.**

Date : **2023-04-04**

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						ST-13			100				U.W = 19.0 kN/m³		
10		9,75	Grey saturated Silt and CLAY with traces of sand and gravel, medium plasticity, of soft appearance.			SS-14		B	83	0	0-0-0-2				
	35					SS-15		B	100	11	1-1-10-6		GA, H	46,1	
11						SS-16		B	50	8	4-4-4-1				
		11,58	Till deposit : Grey saturated SAND with some silt and traces of gravel, dense.			SS-17		B	58	30	4-11-19-19				
12	40	12,19	End of sampling. Start of dynamic penetration test (Pen-Test).											21 20 13 43 100	
13	45	13,67	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobbles)												
14															
15	50														
16															
17	55														
18															
19	60														
20															
21	65														
22	70														
23															
24	75														
25	80														

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-37
Project No.:	158100425.500.710.5	X :	314 014	Page :	1 of 1
Client:	Cree Development Corporation	Y :	5 647 198	Start date :	2022-10-10
Site:	Preliminary Geotechnical Investigation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
	Potential BDH Railway	Equipment :	CME 55	Depth :	7,59 m
		Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1	2022-10-10	0,00 m
Reading 2		m

Remarks : Screenig tube

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,05	Brown saturated TOPSOIL.				A							
			Native cohesive deposit : Brown saturated CLAY and SILT with some sand and traces of gravel.			SS-01	B	N	92		1-2-2-6		GA, H	
1		0,91	Granular deposit : Grey saturated Silty and Clayey SAND with traces of gravel, compact.			SS-02	A B	B	100	11	6-4-7-8			
	5					SS-03		B	4	14	4-5-9-10			
2						SS-04		B	21	23	11-12-11-13		GA, H	
		2,44	Grey saturated SILT with some gravel, compact to dense.			SS-05		B	67	13	3-3-10-20			
3	10	3,23	Till deposit : Grey saturated SAND and SILT, dense.			SS-06	A B	B	63	36	15-17-19-17			
		3,66	Grey saturated SAND with some silt and gravel, very dense.			SS-07		B	100	R	50 /13 cm			
4		4,32	- Presence of boulders.			SS-08	A	B	0	R	50 /5 cm			
	15	4,55	BOULDERS. Grey saturated SAND and SILT with traces of clay and gravel, very dense.			DC-09	B	NQ	47					
5														
6	20					SS-10		B	100	R	32-47-50 /10 cm			
						SS-11		B	75	55	54-28-27-26		GA, H	
7						SS-12		B	100	60	34-29-31-50 /13 cm			
	25	7,59	END OF BOREHOLE (Refusal on very dense soil, boulders and/or cobbles)											
8														

GA : grain size analysis
H : hydrometer test
C : consolidation
W : water content
W_L : liquid limit
W_P : plastic limit
Dr : specific gravity
k : permeability
f'c : compressive str.
OM : organic matter
CA : chemical analyses
SAV : soil agressivity value

× : N (standard pen.)
▽ : Nc (dyn. pen.)
■ : Cu intact
□ : Cu remoulded
◆ : Su intact
◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

24,5
28,4
8,9

0,00 m

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-38
		X :	312 529	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 618 679	Start date :	2022-10-11
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	16,54 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown moist GRAVEL and SAND with some silt.			SS-01		N	58		3-8-12-13		GA	
1						SS-02		B	50	20	7-11-9-6			
	5	1,22	Brown moist to saturated SAND and GRAVEL with some silt. - Presence of organic matters.			SS-03		B	33	9	3-2-7-6			
2		1,83	Brown saturated Gravelly SAND and SILT.			SS-04		B	71	12	8-6-6-6			
		2,44	Native cohesive deposit : Brown saturated Sandy and Clayey SILT with some gravel, of firm appearance.			SS-05		B	33	6	3-3-3-5			
3	10					SS-06		B	25	6	4-3-3-2			
		3,66	Brown saturated Silty CLAY with some sand, of firm appearance.			SS-07		B	83	3	1-2-1-1			
4		4,27	Brown to grey saturated Clayey SILT with traces of sand, of firm appearance.			SS-08		B	100	0	0-0-0-0			
	15	4,88	Grey saturated Silty CLAY with traces of sand, high plasticity, stiff to firm, low sensitivity.			SS-09		B	100	2	1-1-1-1			
5						ST-10			100				U.W = 17.0 kN/m³	
	20					SS-11		B	100	0	0-0-0-0		GA, H	
6														
7														
	25	7,62	Grey saturated CLAY with traces of silt, sand and gravel, firm.			SS-12		B	100	0	0-0-0-0			
8														

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

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STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					SS-13		B	67	0	0-0-0-0					
11						SS-14		B	83	0	0-0-0-0					
12	40	12,19	Grey saturated Silty and Sandy to traces of sand CLAY, of firm appearance.			SS-15		B	92	0	0-0-0-0					
13	45					SS-16		B	100	0	0-0-0-4					
14		14,53	Rock fragments.			DC-17		NQ	100							
15	50	15,75	Bedrock : Grey Biotite GNEISS, of excellent quality.			DC-18		NQ	100	100				f'c = 98.7 MPa U.W. = 26.7 kN/m³		
16		16,54	END OF BOREHOLE													
17	55															
18																
19	60															
20																
21	65															
22																
23	70															
24																
	75															

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-39
		X :	327 606	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 673 307	Start date :	2022-10-09
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	4,27 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	REMARKS
0		0,00	Brown-black moist TOPSOIL (Peat).										
1		0,61	Brown-black moist to saturated ORGANIC MATTERS.										
	5	1,22	Till deposit : Grey saturated SAND with some gravel and traces of silt, compact.			SS-01		B	21	R	15-13-11-50 /3 cm		
2		1,70	Bedrock : Grey-pink GRANITE, of poor to excellent quality.			DC-02		NQ	100	37			
3	10					DC-03		NQ	100	97			
4		4,27	END OF BOREHOLE										
	15												
5													
6	20												
7													
	25												
8													

TESTS

GA : grain size analysis
H : hydrometer test
C : consolidation
W : water content
W_L : liquid limit
W_P : plastic limit
Dr : specific gravity
k : permeability
f'c : compressive str.
OM : organic matter
CA : chemical analyses
SAV : soil agressivity value

× : N (standard pen.)
▽ : Nc (dyn. pen.)
■ : Cu intact
□ : Cu remoulded
◆ : Su intact
◇ : Su remoulded

W_P W W_L

20 40 60 80 100 120

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-40
		X :	315 144	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 634 538	Start date :	2022-10-10
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	7,82 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ Figure : 01		

SAMPLE TYPE	
SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY	
Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY	
Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS	
N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

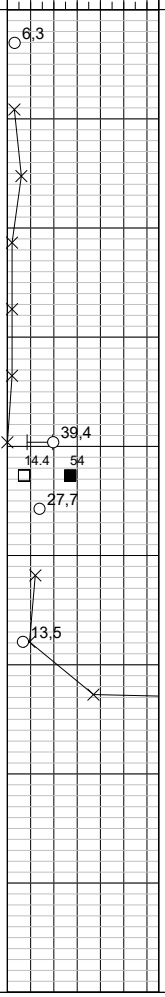
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Brown moist to saturated SAND and GRAVEL with traces of silt. - Presence of roots. - Traces of oxidation.			SS-01		N	71		4-8-6-5		GA	
1						SS-02		B	38	6	4-3-3-2			
		1,22	Brown saturated Sandy and Gravelly SILT. - Presence of wood.			SS-03		B	33	12	1-4-8-10			
2	5	1,83	Native cohesive deposit : Brown-grey saturated Clayey SILT with some sand, of firm appearance.			SS-04		B	33	4	3-2-2-5			
		2,44	Grey saturated Clayey SILT with traces of sand and gravel, of firm appearance.			SS-05		B	88	4	2-2-2-3			
3	10					SS-06		B	92	4	3-2-2-2			
		3,66	Grey saturated Silty CLAY with some sand and traces of gravel, medium plasticity, firm, medium sensitivity.			SS-07		B	100	0	0-0-0-0		GA, H	
4	15					ST-08			100				U.W = 18.5 kN/m³	
		4,88	Till deposit : Grey saturated Silty SAND with some gravel and clay, compact to very dense.			SS-09		B	67	24	8-7-17-28			
5						SS-10		B	75	19	2-2-17-25		GA, H	
	20					SS-11		B	74	74	27-25-49-50 /3 cm			
6						SS-12		B	100	R	50 /10 cm			
		6,55	Bedrock : Grey GRANITE, of good quality.			DC-13		NQ	100	85				
7	25													
		7,82	END OF BOREHOLE											
8														



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-05

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-41
		X :	332 367	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 683 588	Start date :	2022-10-07
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	20,50 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

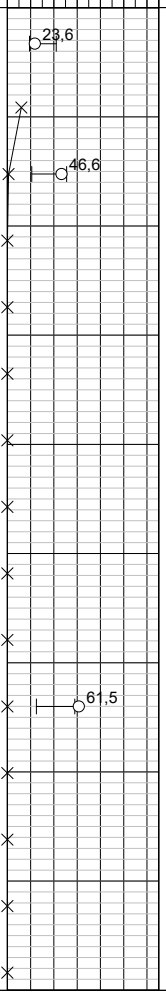
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,05	Brown-black moist TOPSOIL.				A							
			Native cohesive deposit : Brown moist CLAY and SILT with traces of sand, medium plasticity, of firm appearance.			SS-01	B	N	63		2-5-11-15		GA, H	
1						SS-02		B	83	12	3-5-7-8			
		1,22	Grey saturated Silty CLAY with traces of sand, high plasticity, of firm to soft appearance.											
	5					SS-03		B	100	1	0-0-1-1		GA, H	
2						SS-04		B	100	0	0-0-0-1			
						SS-05		B	92	0	0-0-0-0			
3	10					SS-06		B	100	0	0-0-0-0			
4						SS-07		B	100	0	0-0-0-0			
	15					SS-08		B	100	0	0-0-0-0			
5						SS-09		B	100	0	0-0-0-0			
						SS-10		B	100	0	0-0-0-0			
6	20					SS-11		B	100	0	0-0-0-0		GA, H	
7						SS-12		B	100	0	0-0-0-0			
	25					SS-13		B	100	0	0-0-0-0			
8						SS-14		B	100	0	0-0-0-0			
						SS-15		B	100	0	0-0-0-0			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES								WATER LEVEL / WATER INFLOW	TESTS		REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm			GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
10	35					SS-16		B	100	0	0-0-0-0					
						SS-17		B	100	0	0-0-0-0			GA, H	55,2	
11						SS-18		B	100	0	0-0-0-0					
						SS-19		B	100	0	0-0-0-0					
12	40					SS-20		B	100	0	0-0-0-0					
						SS-21		B	100	0	0-0-0-0					
13						ST-22			100							
		13,51	End of sampling. Start of dynamic penetration test (Pen-Test).												0 0 0 0 0 0 0 0 0 0 0 6 10 11 12 10 13 10 12 9 8 15 22 100	
14	45															
15	50															
16																
17	55															
18																
19	60															
20																
	65															
		20,50	END OF BOREHOLE (Refusal on inferred bedrock)													
21																
22	70															
23	75															
24																

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-42
		X :	331 297	Page :	1 of 2
Project No.:	158100425.500.710.5	Y :	5 691 869	Start date :	2022-10-08
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	H. Desrochers, CPI
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	13,11 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

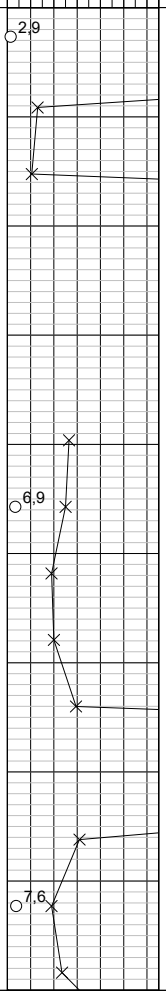
Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00												
		0,08	Brown-black moist TOPSOIL. Native granular deposit : Grey moist Sandy GRAVEL with traces of silt, dense to compact. - Presence of boulders.			SS-01	A	N	33	R	6-23-19-50 /0 cm		GA	
							B							
1						SS-02		B	33	26	11-10-16-13			
	5	1,35	Grey moist some gravel to Gravelly SAND with some silt, compact to very dense.			SS-03	A	B	38	21	8-12-9-5			
							B							
2						SS-04		B	100	R	5-50 /8 cm			
						SS-05		B	85	R	14-52-50 /3 cm			
3	10	2,77	BOULDERS.			DC-06		NQ	93					
		3,66	Till deposit : Grey moist Silty and Gravelly SAND, dense to very dense.			SS-07		B	67	53	18-28-25-28			
4	15					SS-08		B	46	50	17-31-19-31		GA	
5						SS-09		B	58	38	19-16-22-14			
						SS-10		B	71	40	13-17-23-25			
6	20					SS-11		B	54	59	13-30-29-33			
		6,71	Grey moist Silty SAND with traces of gravel, very dense.			SS-12		B	100	R	50 /13 cm			
7														
	25					SS-13		B	58	62	18-31-31-32			
8						SS-14		B	100	38	19-18-20-34		GA	
						SS-15		B	67	47	31-22-25-32			



General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

STRATIGRAPHY					SAMPLES							WATER LEVEL / WATER INFLOW	TESTS	REMARKS
DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm		GA : grain size analysis H : hydrometer test C : consolidation W : water content W_L : liquid limit W_P : plastic limit Dr : specific gravity k : permeability f'c : compressive str. OM : organic matter CA : chemical analyses SAV : soil agressivity value	×: N (standard pen.) ▽: Nc (dyn. pen.) ■: Cu intact □: Cu remoulded ◆: Su intact ◇: Su remoulded W_P W W_L 20 40 60 80 100 120	
						SS-16		B	71	104	9-44-60-63			
10						SS-17		B	90	R	48-50 /10 cm			
						SS-18		B	0	R	50 /0 cm			
	35	10,67	BOULDERS.											
11						DC-19		NQ	56					
12	40													
						DC-20		NQ	23					
13		13,11	END OF BOREHOLE											
	45													
14														
15	50													
16														
	55													
17														
18														
	60													
19														
20	65													
21														
	70													
22														
23	75													
24														

BOREHOLE REPORT

Project:	La Grande Alliance - Feasibility Study - Phase I	Coordinate :	Geo. System : UTM Zone: 18	Borehole :	BH22-43
		X :	313 971	Page :	1 of 1
Project No.:	158100425.500.710.5	Y :	5 643 339	Start date :	2022-10-09
Client:	Cree Development Corporation	Type of borehole :	Hollow Stem Auger + Diamond Core	Inspector :	A. Bogaert, tech.
Site:	Preliminary Geotechnical Investigation	Equipment :	CME 55	Depth :	5,61 m
	Potential BDH Railway	Sampling type :	B, N		
		Corer :	NW/NQ	Figure :	01

SAMPLE TYPE

SS	Split spoon
CS	Continuous sampling
DC	Diamond rock core
AS	Auger
TW	Thin wall sampler
ST	Shelby tube
MA	Manual sample

QUALITATIVE TERMINOLOGY

Clay	< 0.002 mm
Silt	0.002 - 0.08 mm
Sand	0.08 - 5 mm
Gravel	5 - 80 mm
Cobbles	80 - 200 mm
Boulders	> 200 mm

QUANTITATIVE TERMINOLOGY

Traces	< 10 %
Some	10 - 20 %
Adjective (...y)	20 - 35 %
and (ex: and gravel)	> 35 %
Main word	Dominant fraction

SYMBOLS

N	Standard penetration value (ASTM D 1586)
Nc	Dynamic cone penetration value (BNQ 2501-145)
RQD	Rock Quality Designation (%)

GROUNDWATER

	Date	Depth
Reading 1		m
Reading 2		m

Remarks :

SAMPLE STATE

- Remoulded
- Intact (thin wall sampler)
- Lost
- Core (diamond rock core)

MECHANIC CHARACTERISTICS OF SOILS

COMPACTION	INDEX "N"	CONSISTENCY	Cu OR Su (kPa)
Very loose	0 - 4	Very soft	< 12
Loose	4 - 10	Soft	12 - 25
Compact	10 - 30	Firm	25 - 50
Dense	30 - 50	Stiff	50 - 100
Very dense	> 50	Very stiff	100 - 200
		Hard	> 200

ROCK QUALITY DESIGNATION

QUALIFICATIVE	RQD
Very poor	< 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %

JOINTS SPACING

Very tight	< 20 mm
Tight	20 - 60 mm
Close	60 - 200 mm
Moderately spaced	200 - 600 mm
Spaced	600 - 2000 mm
Very spaced	2000 - 6000 mm
Wide	> 6000 mm

STRATIGRAPHY / SAMPLES / TESTS

GA : grain size analysis; H : hydrometer test; C : consolidation; W : water content; W_L : liquid limit; W_P : plastic limit; Dr : specific gravity; k : permeability; f'c : compressive str.; OM : organic matter; CA : chemical analyses; SAV : soil agressivity value

× : N (standard pen.); ▽ : Nc (dyn. pen.); ■ : Cu intact; □ : Cu remoulded; ◆ : Su intact; ◇ : Su remoulded

W_P W W_L

DEPTH (m)	DEPTH (ft)	DEPTH (m)	DESCRIPTION OF SOILS AND ROCK	SYMBOL	STATE	TYPE N°	SUB - SAMPLE	CALIBER	RECOVERY (%)	N - RQD	Standard penetration test BLOWS/150mm	WATER LEVEL / WATER INFLOW	TESTS	REMARKS
		0,00	Granular fill : Grey-brown moist SAND and GRAVEL with traces of silt.			SS-01		N	75		9-14-17-14		GA	
1		0,61	Brown moist SAND with some gravel, compact.			SS-02		B	67	19	10-7-12-10			
	5	1,22	Brown to grey moist to saturated SAND and GRAVEL with some silt, loose.			SS-03		B	33	6	8-3-3-4			
2		1,83	Brown saturated Gravelly SAND with some silt, loose.			SS-04		B	42	5	5-2-3-3			
		2,44	- Presence of organic matters. Brown to grey saturated ORGANIC MATRERS with some clay and sand.			SS-05		B	0	3	1-2-1-1			
3	10					SS-06		B	35	1	0-0-1-50 /13 cm			
4		3,63	Bedrock : Grey GRANITE, of fair to excellent quality.			DC-07		NQ	91	60				
	15													
5						DC-08		NQ	98	98			f'c = 176,3 MPa U.W. = 26.4 kN/m³	
		5,61	END OF BOREHOLE											
6	20													
7														
	25													
8														

20 40 60 80 100 120

7,6

General remarks: **Boreholes positionned on site with a handled GPS of 3 m precision.**

Verified by : T. Coulaux, ing.

Date : 2023-04-04

Appendix D Laboratory Test Results

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

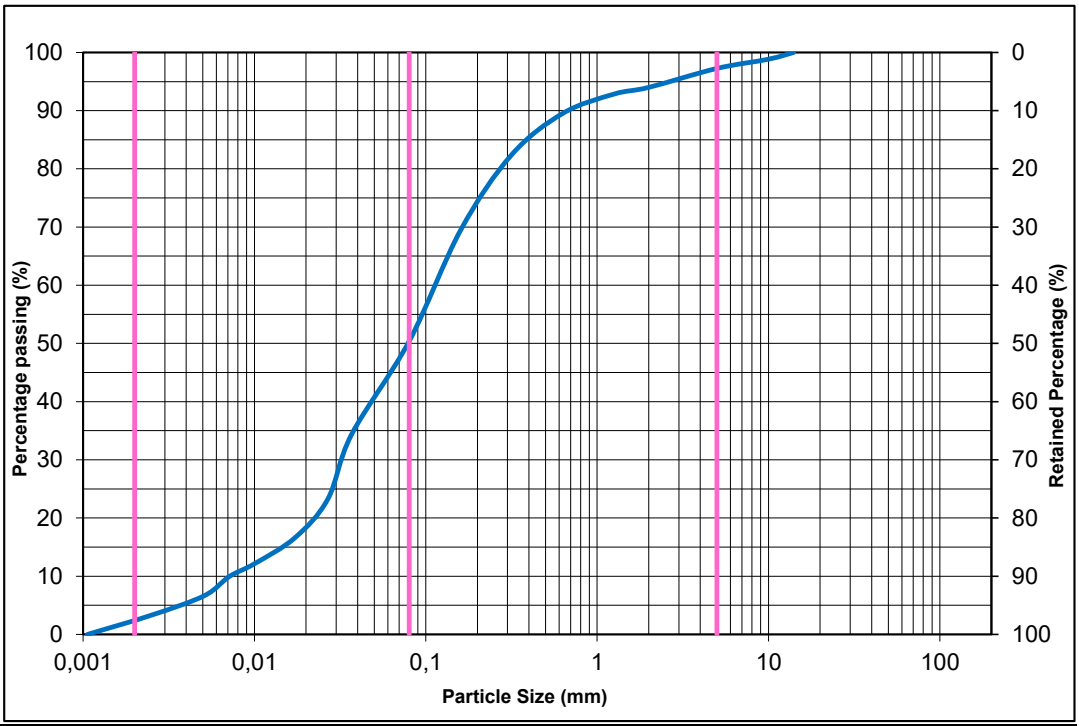
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-01 SS-02
Depth : 0,61 - 0,99m

Material Description : Silt and Sand, traces of Gravel, traces of Clay

Grain Size Analysis (BNQ 2501-025)

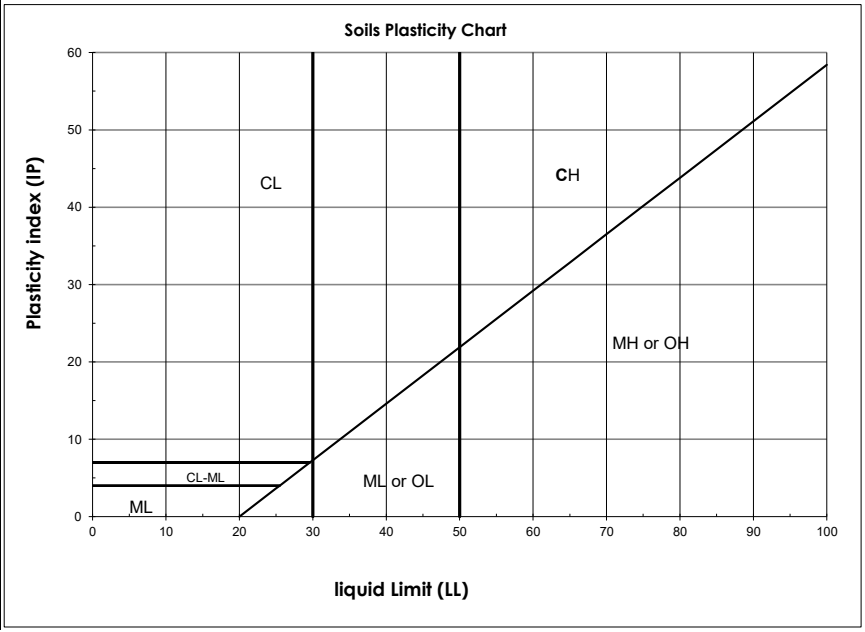
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	97
2,00	94
1,25	93
0,630	90
0,315	82
0,160	70
0,080	50,4



% Gravel: 2,7 % Sand : 46,9 % Silt: 48,2 % Clay: 2,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	76,3



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

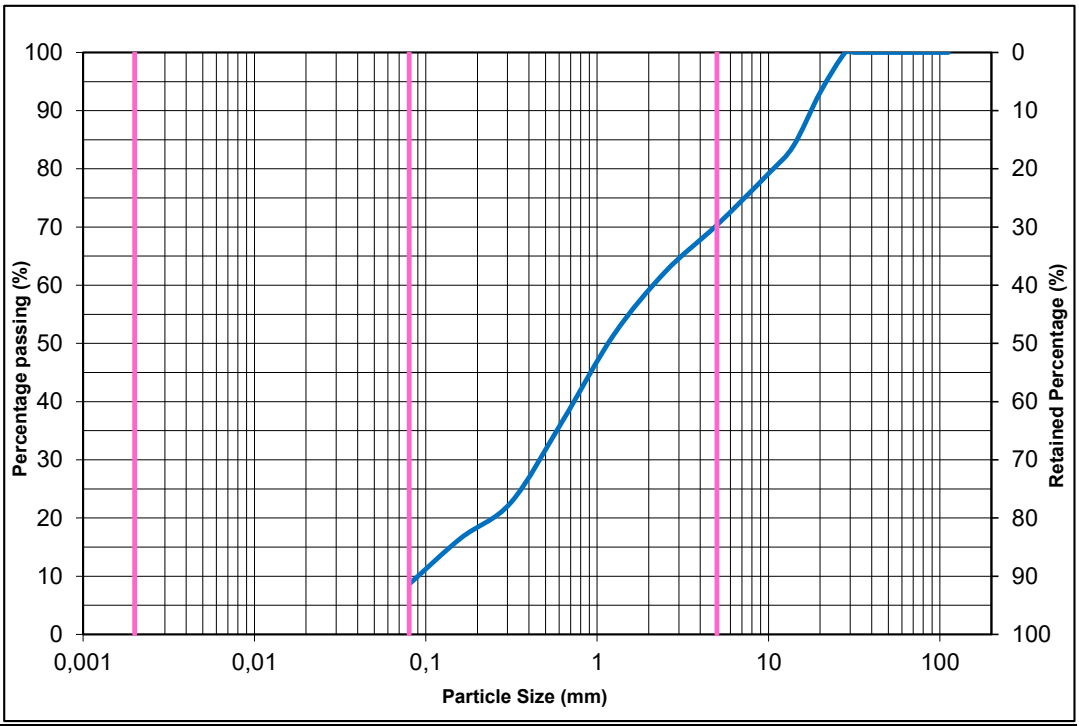
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-02 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravely Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

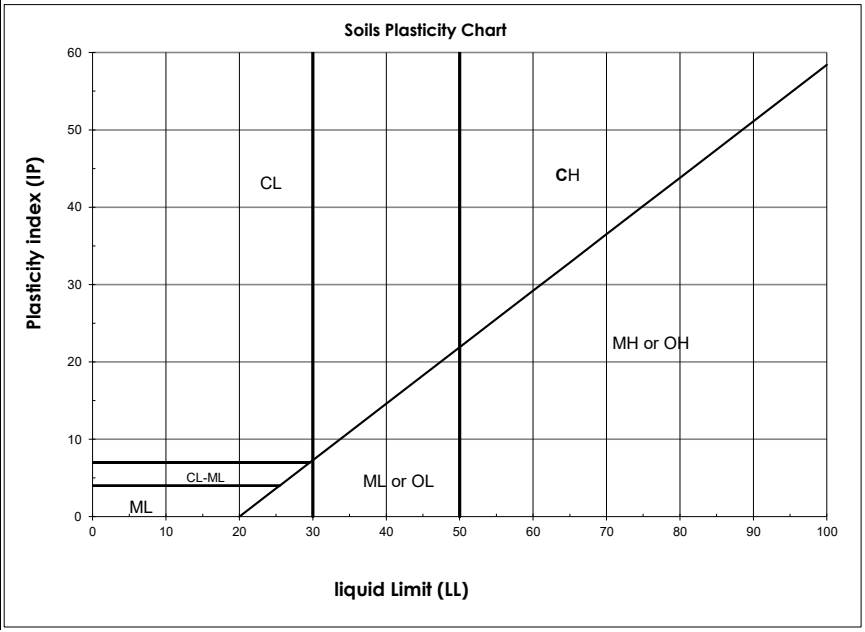
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	93
14,0	84
10,0	79
5,00	70
2,50	62
1,25	51
0,630	37
0,315	23
0,160	17
0,080	8,6



% Gravel : 29,7 % Sand : 61,7 % Fine particles : 8,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,0



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

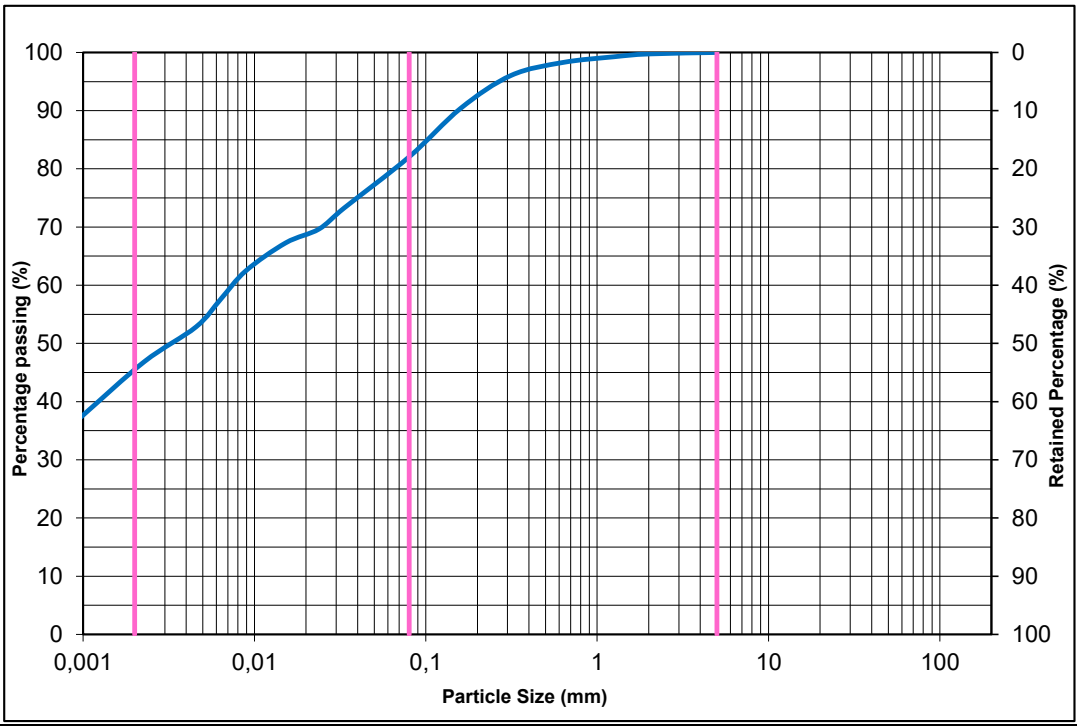
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-02 SS-03
Depth : 1,22 - 1,83m

Material Description : Clay and Silt, some Sand

Grain Size Analysis (BNQ 2501-025)

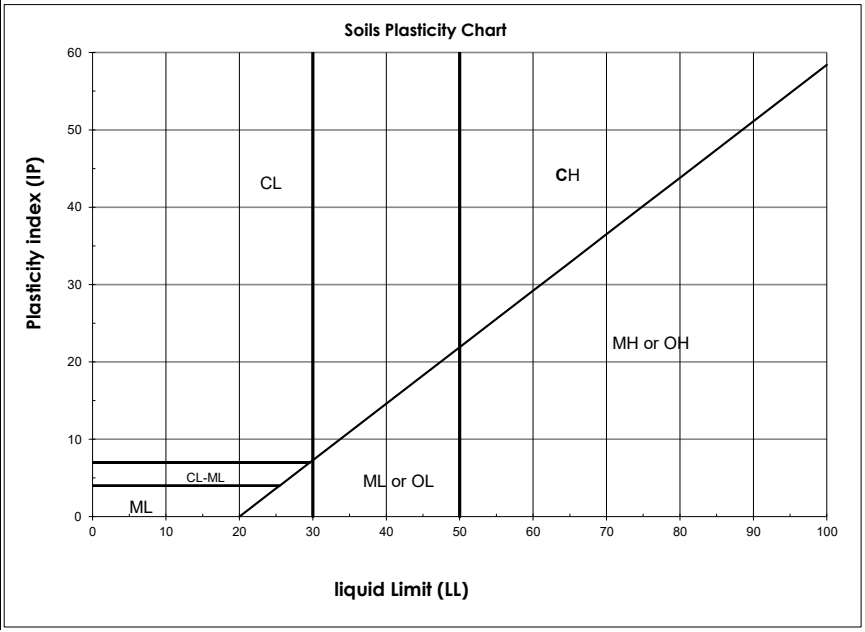
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	99
0,630	98
0,315	96
0,160	90
0,080	82,1



% Gravel: 0,0 % Sand : 17,9 % Silt: 37,2 % Clay: 44,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	29,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

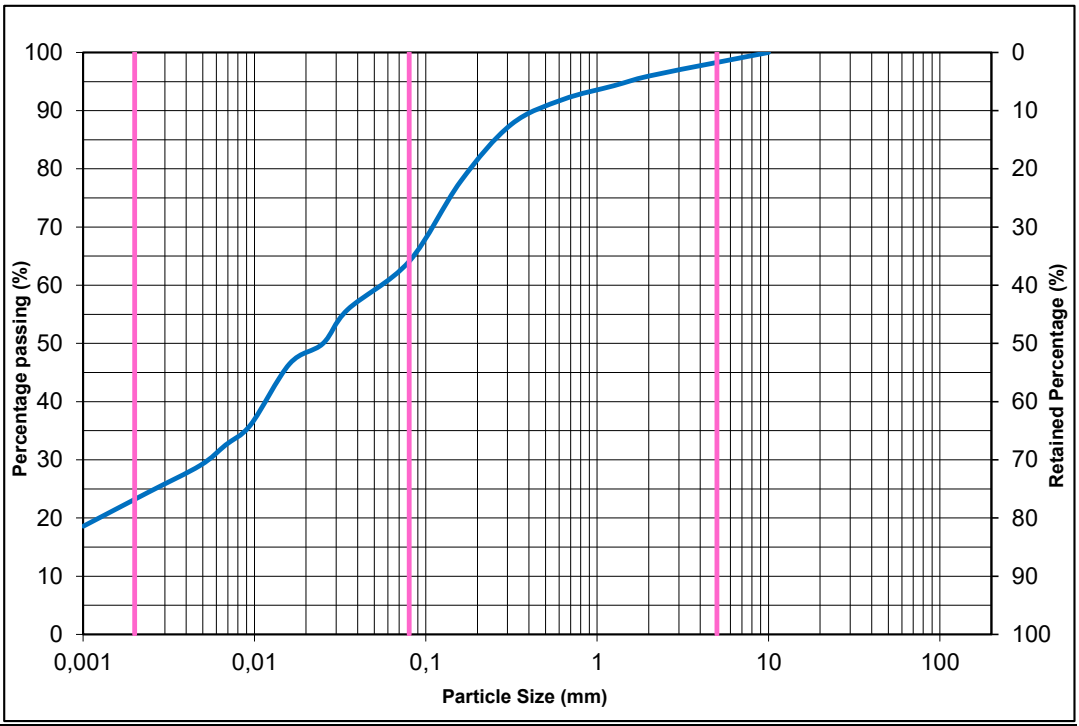
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-02 SS-05
Depth : 2,44 - 3,05m

Material Description : Clayey, Sandy Silt, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

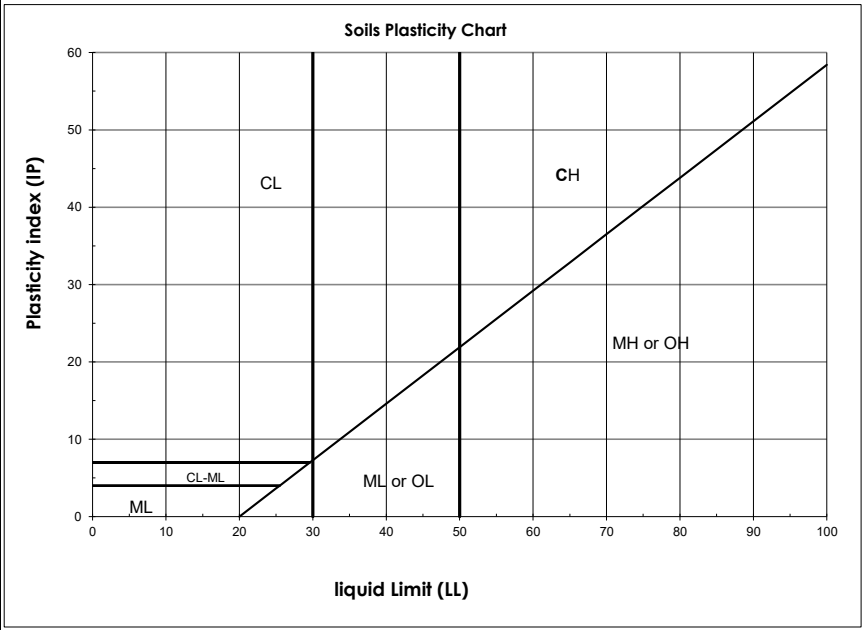
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	98
2,00	96
1,25	94
0,630	92
0,315	88
0,160	78
0,080	64,1



% Gravel: 1,7 % Sand : 34,2 % Silt: 41,4 % Clay: 22,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	23,9



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

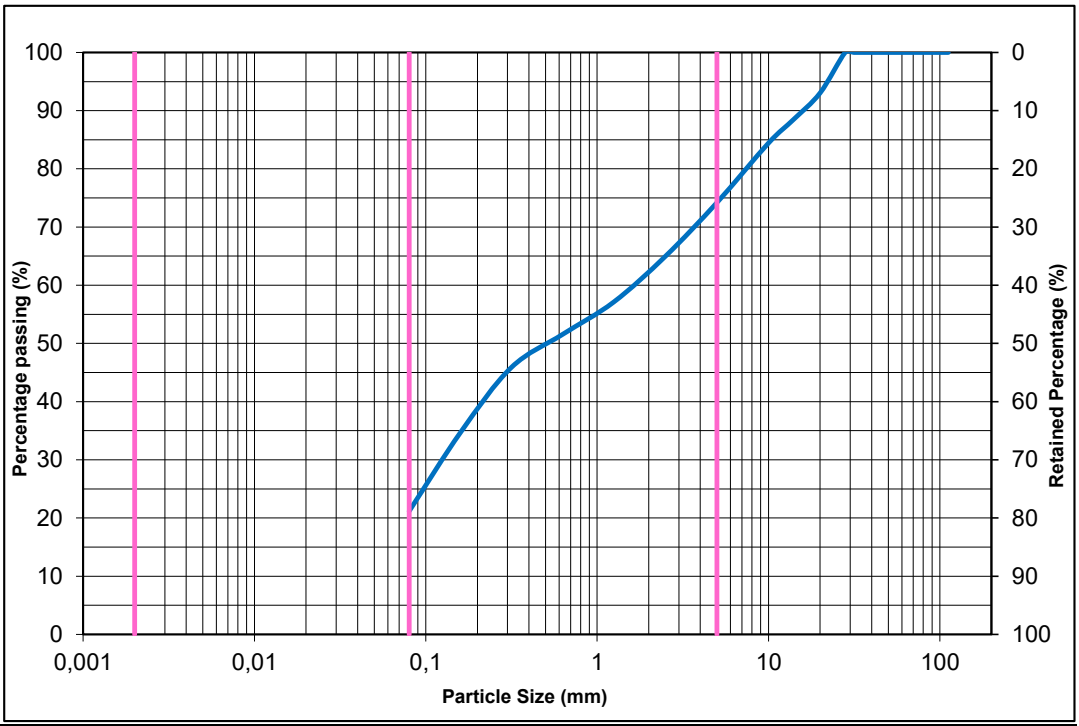
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-02 SS-11
Depth : 6,10 - 6,71m

Material Description : Silty, gravely Sand

Grain Size Analysis (BNQ 2501-025)

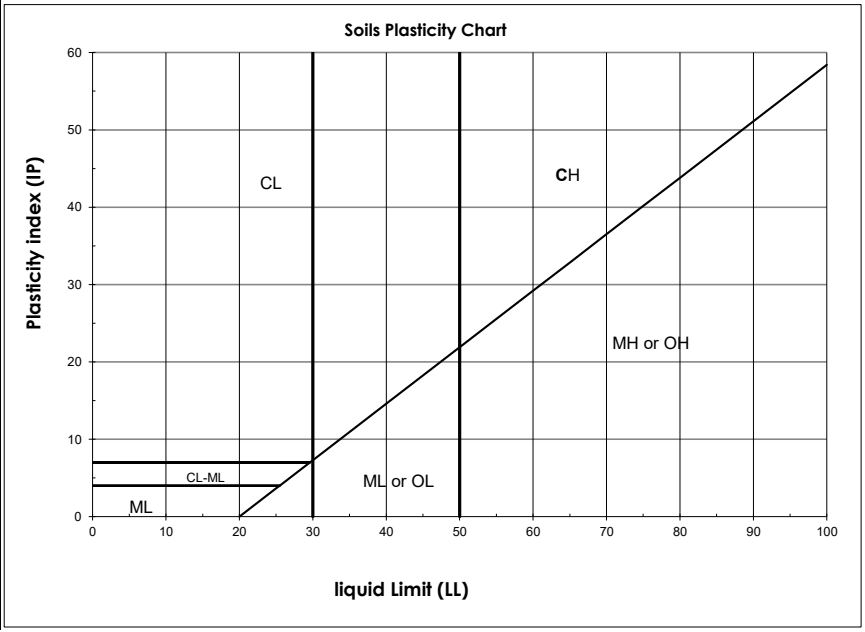
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	93
14,0	88
10,0	84
5,00	74
2,50	65
1,25	57
0,630	52
0,315	46
0,160	35
0,080	21,2



% Gravel : 25,8 % Sand : 53,0 % Fine particles : 21,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	10,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

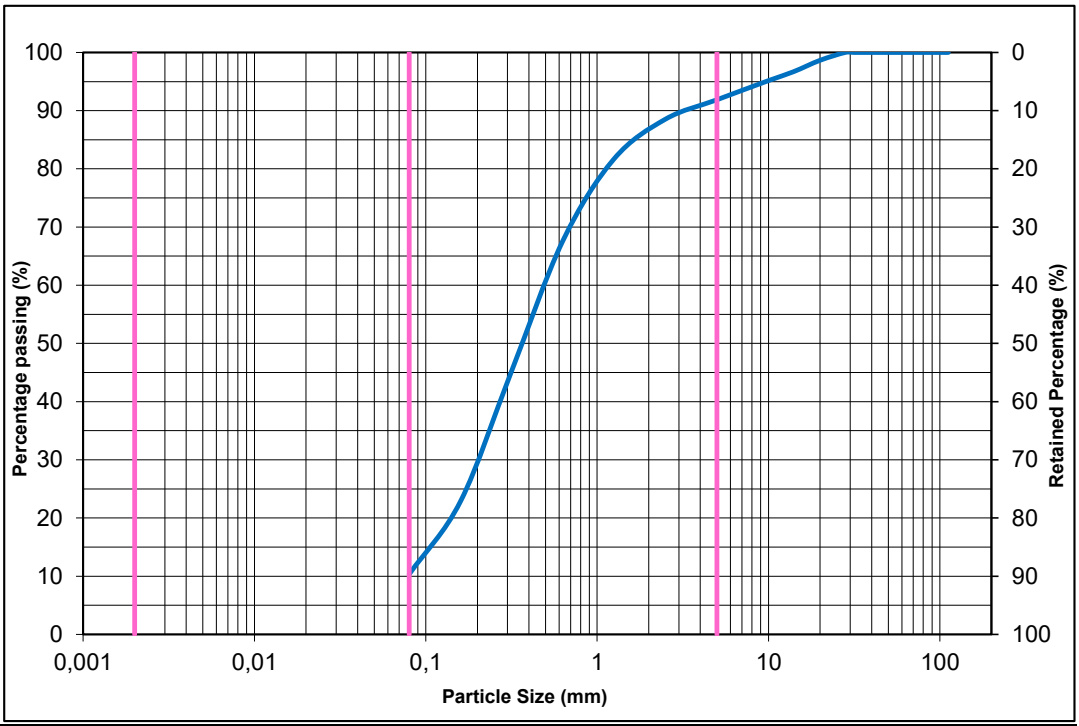
Sampled by : Hugo Desrochers
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-03 SS-01
Depth : 0,00 - 0,61m

Material Description : Sand, some fine particles, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

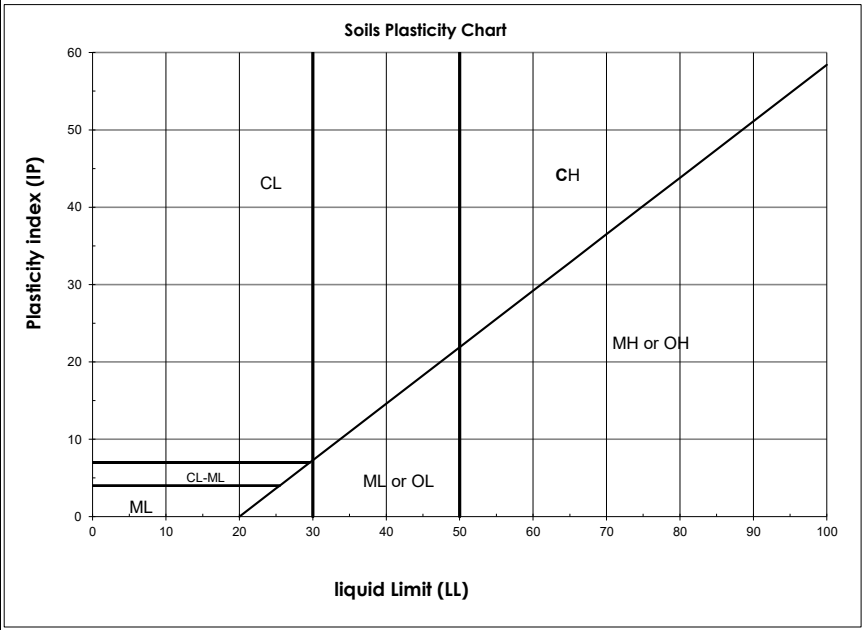
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	99
14,0	97
10,0	95
5,00	92
2,50	89
1,25	82
0,630	68
0,315	45
0,160	23
0,080	10,3



% Gravel : 8,2 % Sand : 81,5 % Fine particles : 10,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	7,8



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

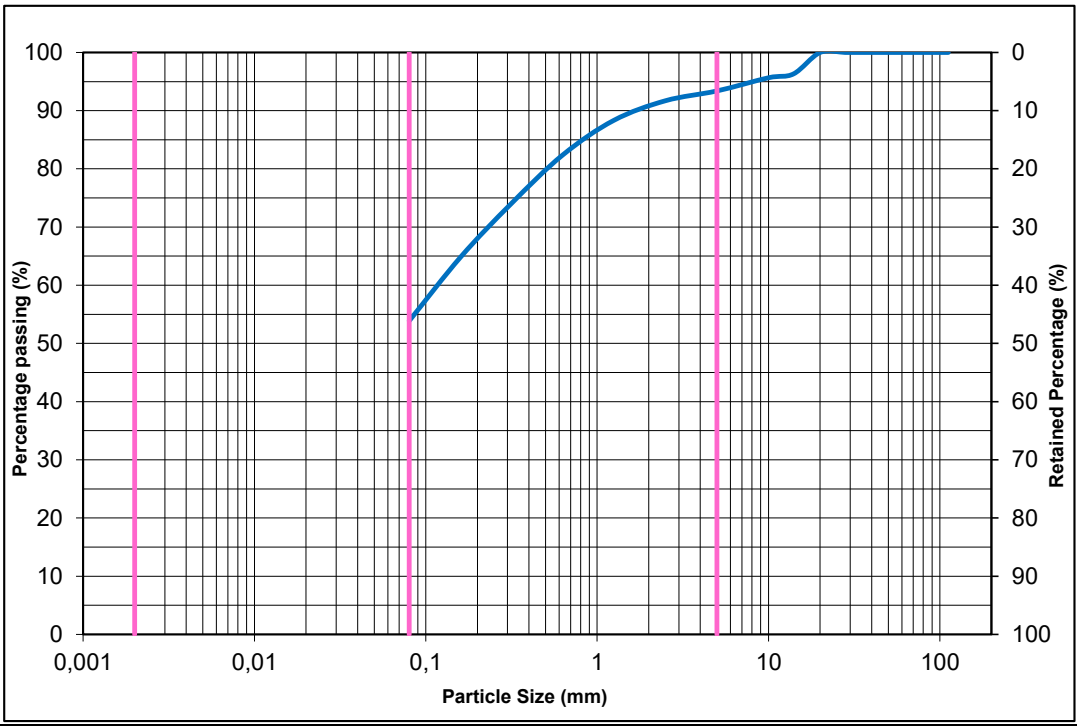
Sampled by : Hugo Desrochers
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-03 SS-03
Depth : 1,22 - 1,83m

Material Description : Fine particles and Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

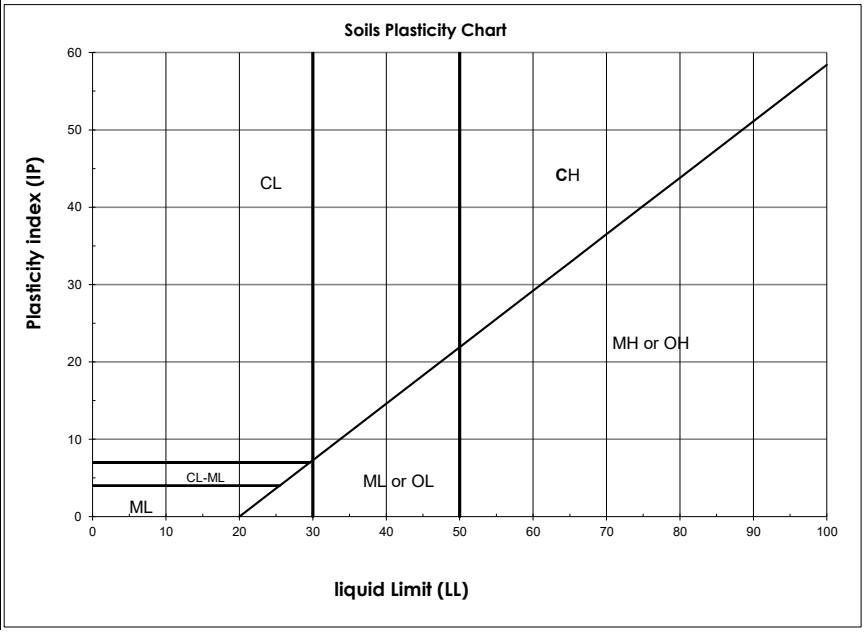
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	96
10,0	96
5,00	93
2,50	92
1,25	88
0,630	82
0,315	74
0,160	65
0,080	53,9



% Gravel : 6,6 % Sand : 39,5 % Fine particles : 53,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	16,4



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

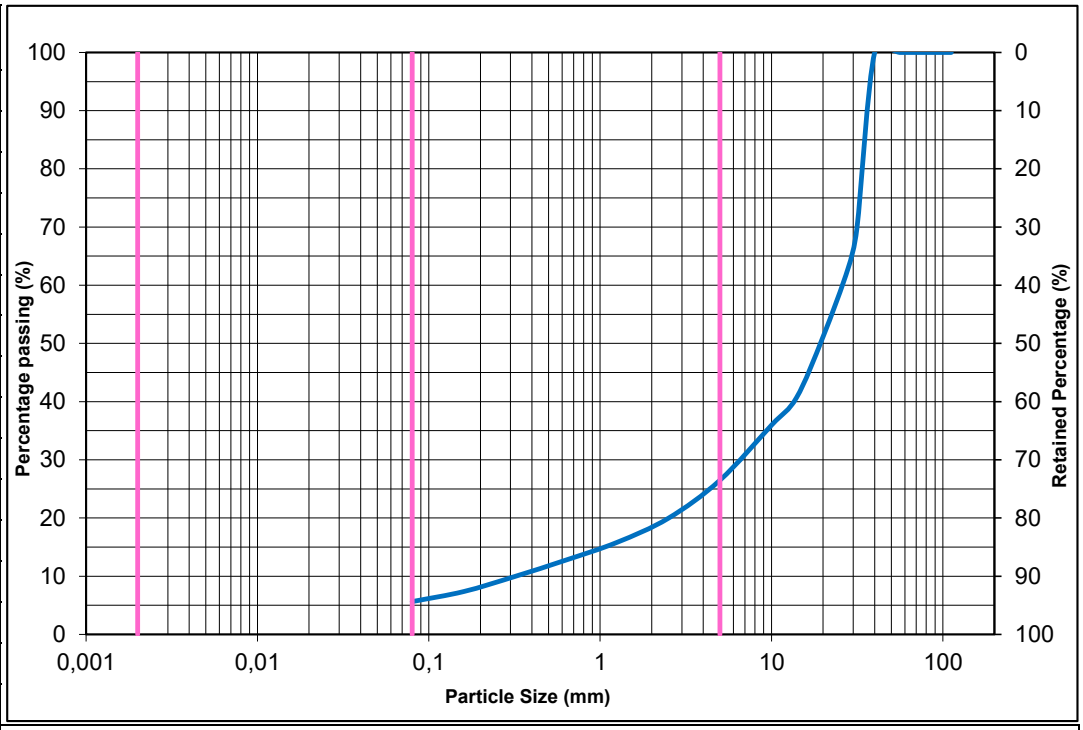
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-04 SS-01B
Depth : 0,13 - 0,61m

Material Description : Sandy Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

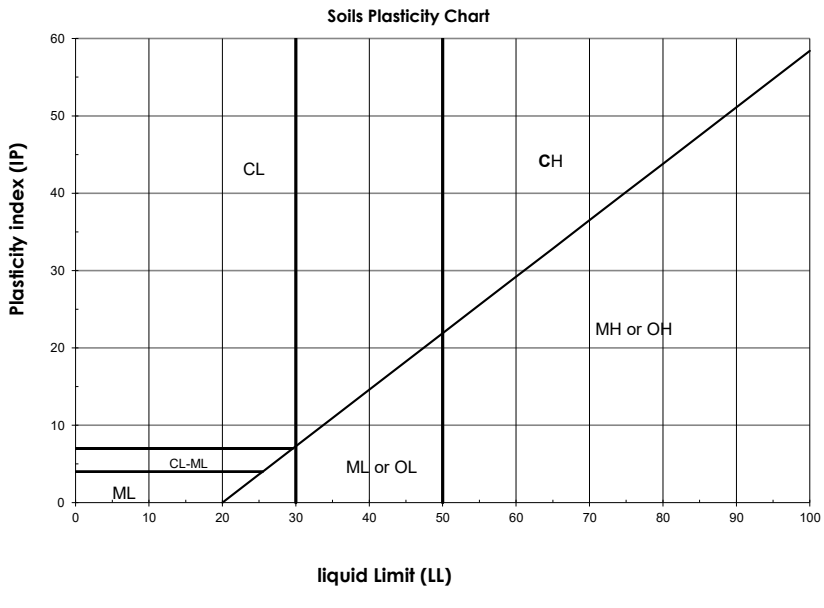
Openings Dimensions	Cumulative Results
mm	%
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40,0	100
31,5	70
28,0	63
20,0	51
14,0	41
10,0	36
5,00	26
2,50	20
1,25	16
0,630	13
0,315	10
0,160	7
0,080	5,6



% Gravel : 73,5 % Sand : 20,9 % Fine particles : 5,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	1,7



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

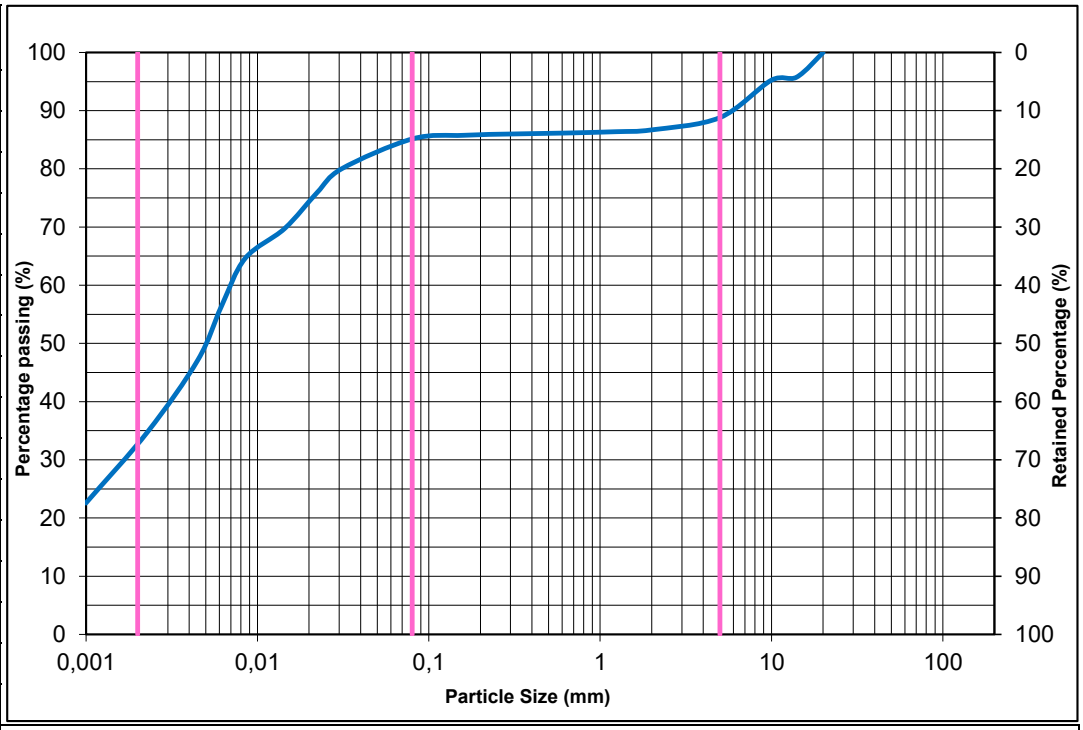
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-04 SS-03
Depth : 1,22 - 1,83m

Material Description : Clayey Silt, some Gravel, traces of Sand

Grain Size Analysis (BNQ 2501-025)

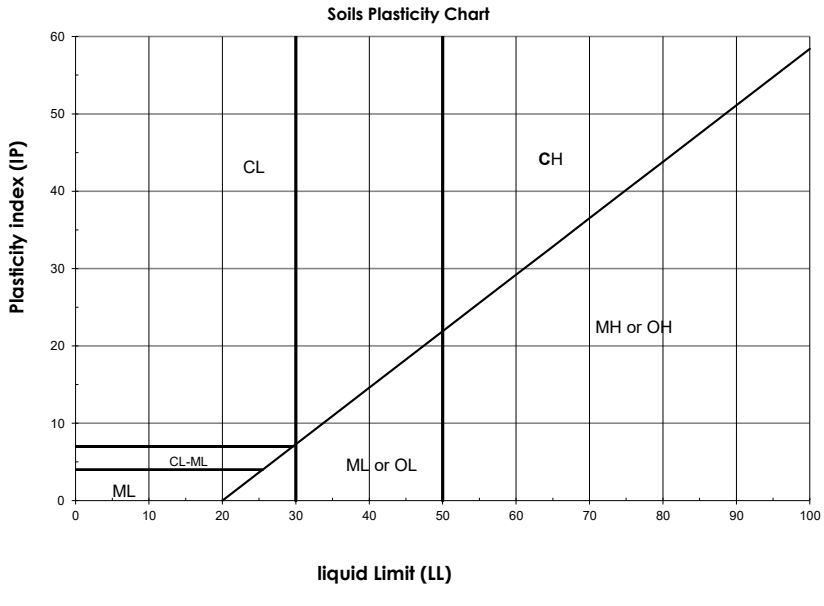
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	96
10,0	95
5,00	89
2,00	87
1,25	86
0,630	86
0,315	86
0,160	86
0,080	85,1



% Gravel: 11,2 % Sand : 3,7 % Silt: 53,1 % Clay: 32,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	28,6



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

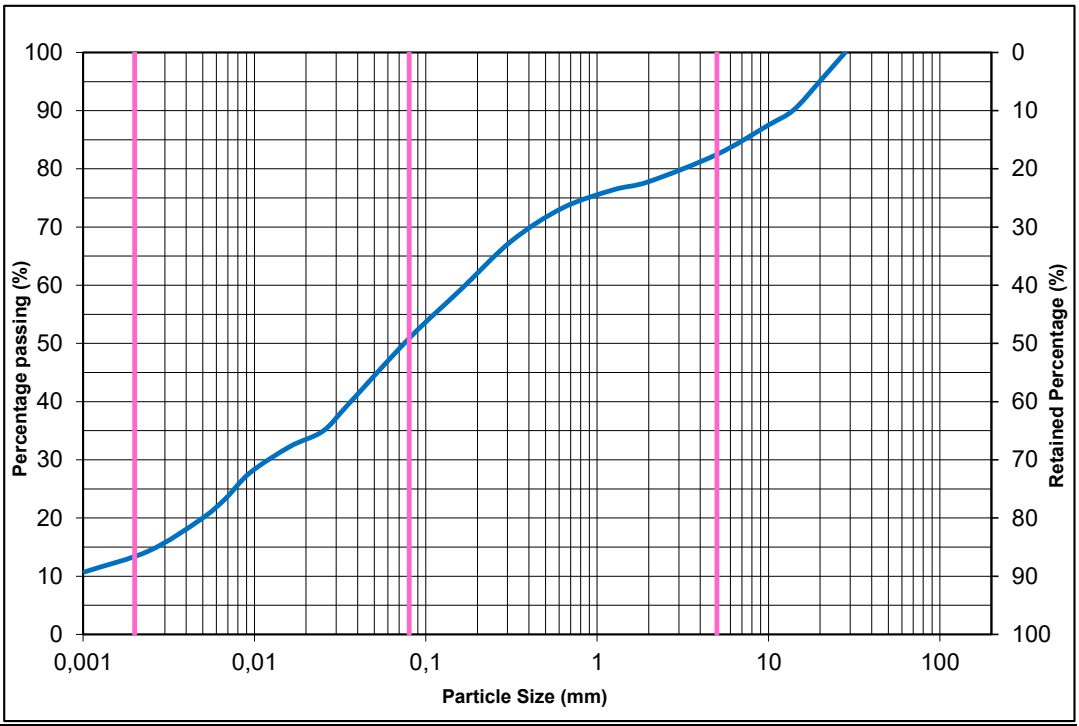
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-04 SS-05
Depth : 2,44 - 3,05m

Material Description : Sandy Silt, some Gravel, some Clay

Grain Size Analysis (BNQ 2501-025)

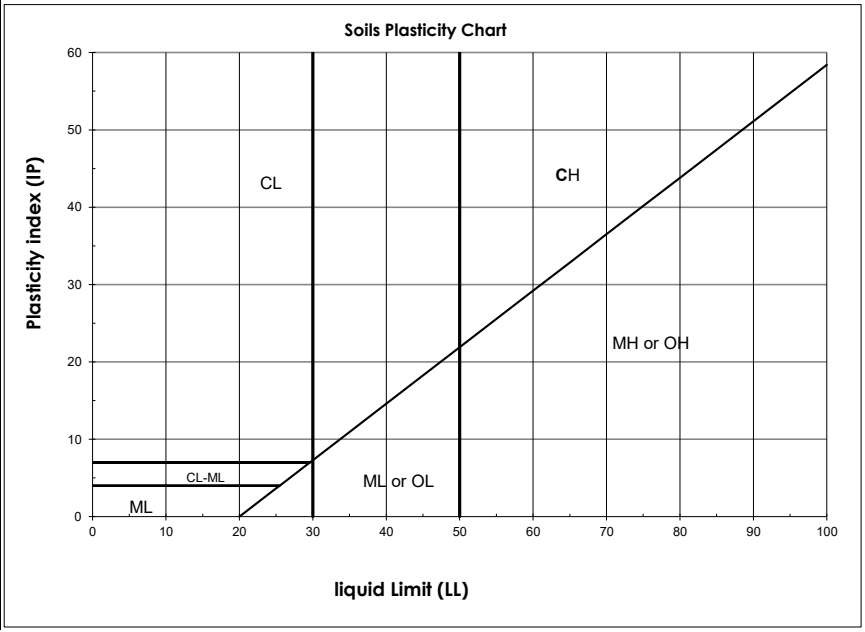
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	95
14,0	90
10,0	88
5,00	82
2,00	78
1,25	76
0,630	73
0,315	68
0,160	59
0,080	50,9



% Gravel: 17,5 % Sand : 31,6 % Silt: 37,6 % Clay: 13,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	16,2



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

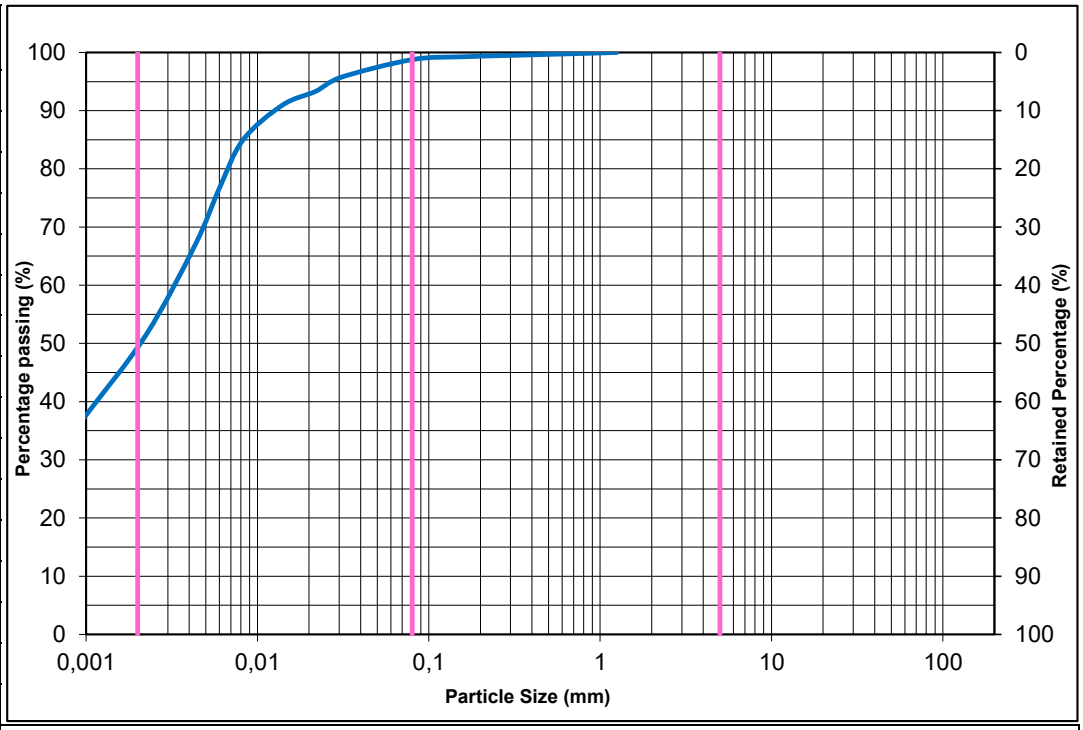
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-05 SS-02
Depth : 0,61 - 1,22m

Material Description : Silt and Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

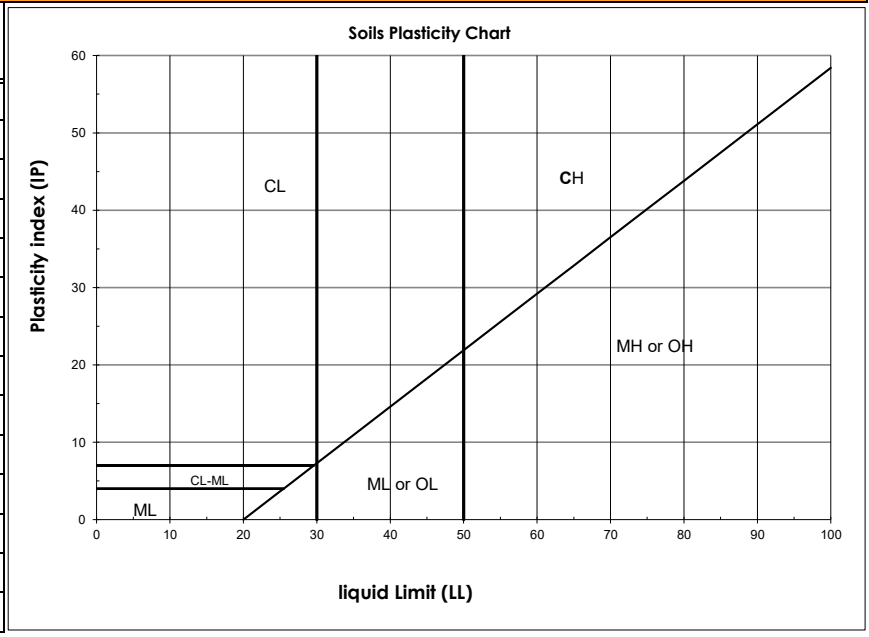
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	99
0,080	98,8



% Gravel: 0,0 % Sand : 1,2 % Silt: 50,0 % Clay: 48,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	19,2



Remarks :

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

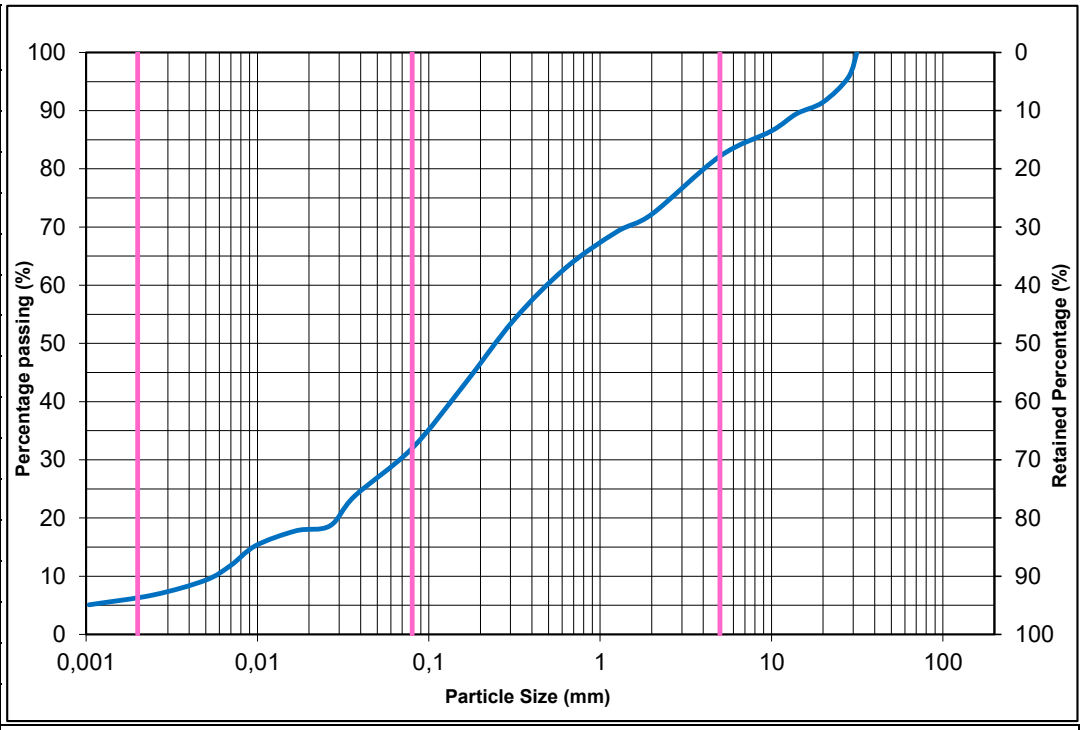
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-05 SS-05
Depth : 2,44 - 3,05m

Material Description : Silty Sand, some Gravel, traces of Clay

Grain Size Analysis (BNQ 2501-025)

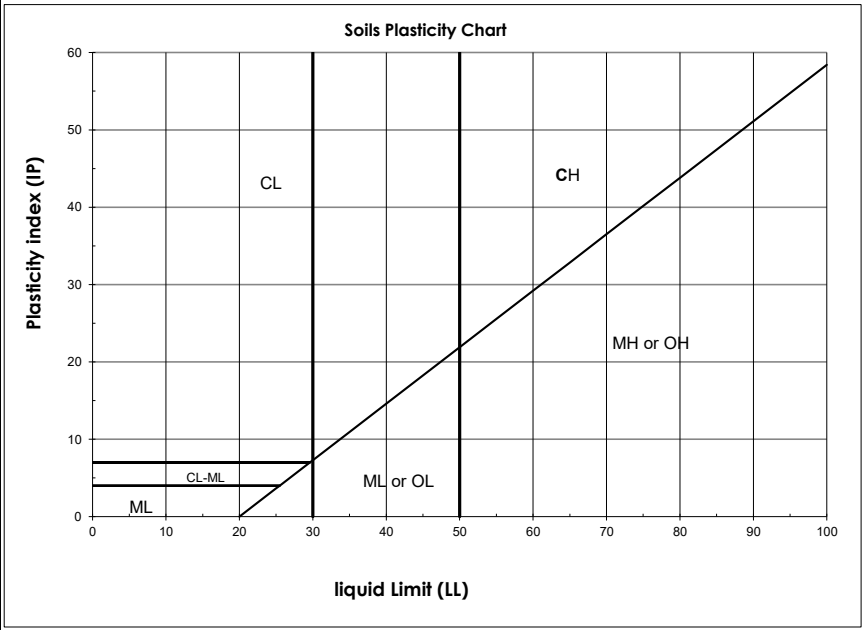
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	96
20,0	91
14,0	89
10,0	87
5,00	82
2,00	72
1,25	69
0,630	63
0,315	54
0,160	43
0,080	32,0



% Gravel: 17,8 % Sand : 50,2 % Silt: 25,8 % Clay: 6,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	13,0



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

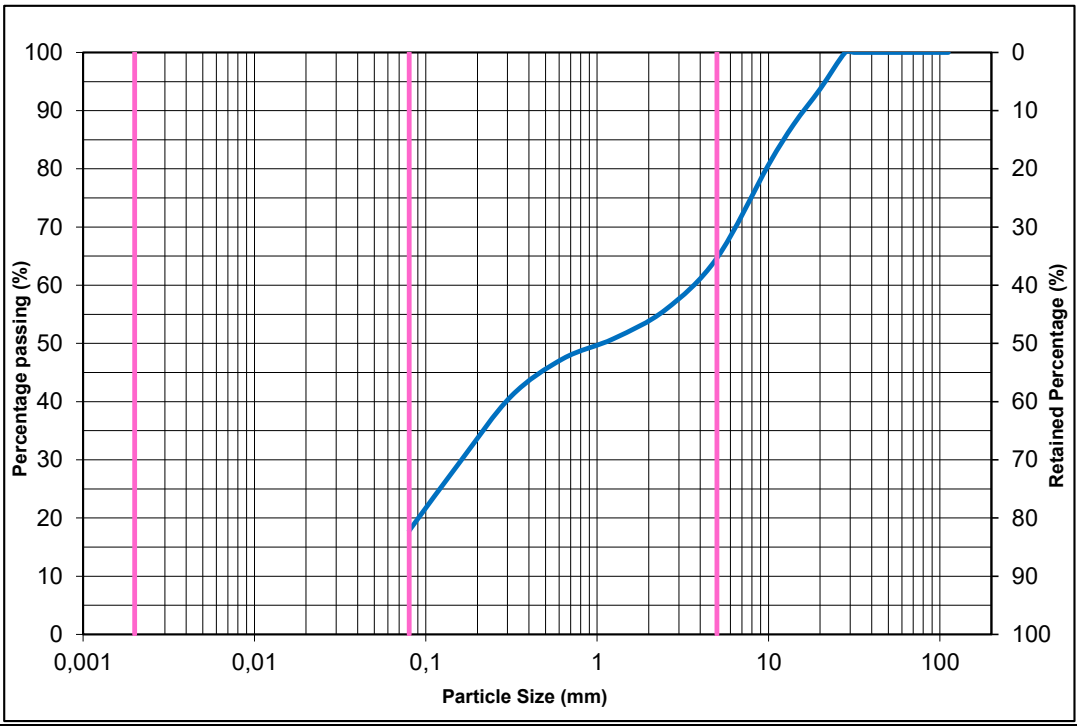
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-05 SS-10
Depth : 5,49 - 5,61m

Material Description : Sand and Gravel, some fine particles

Grain Size Analysis (BNQ 2501-025)

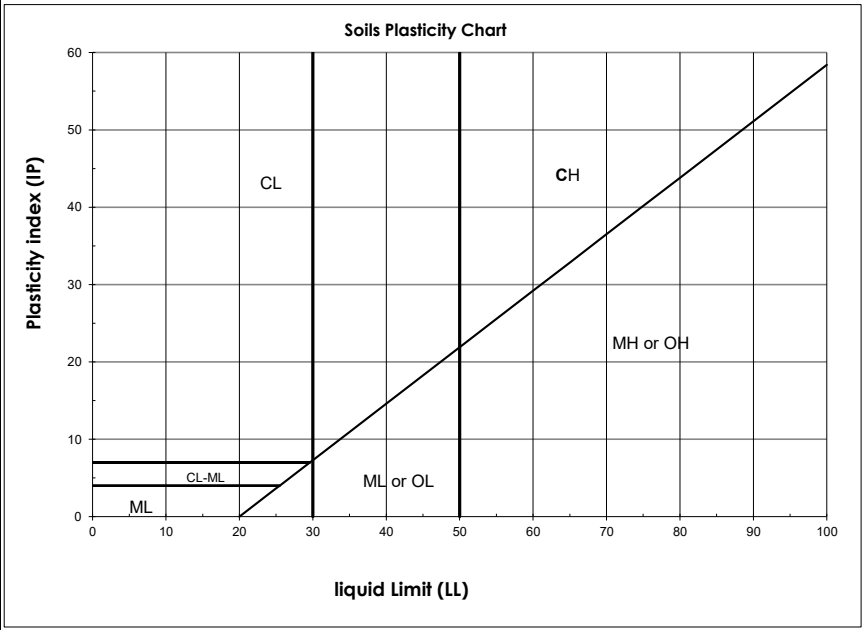
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	94
14,0	88
10,0	81
5,00	65
2,50	56
1,25	51
0,630	47
0,315	41
0,160	30
0,080	17,8



% Gravel : 35,4 % Sand : 46,8 % Fine particles : 17,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	9,2



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

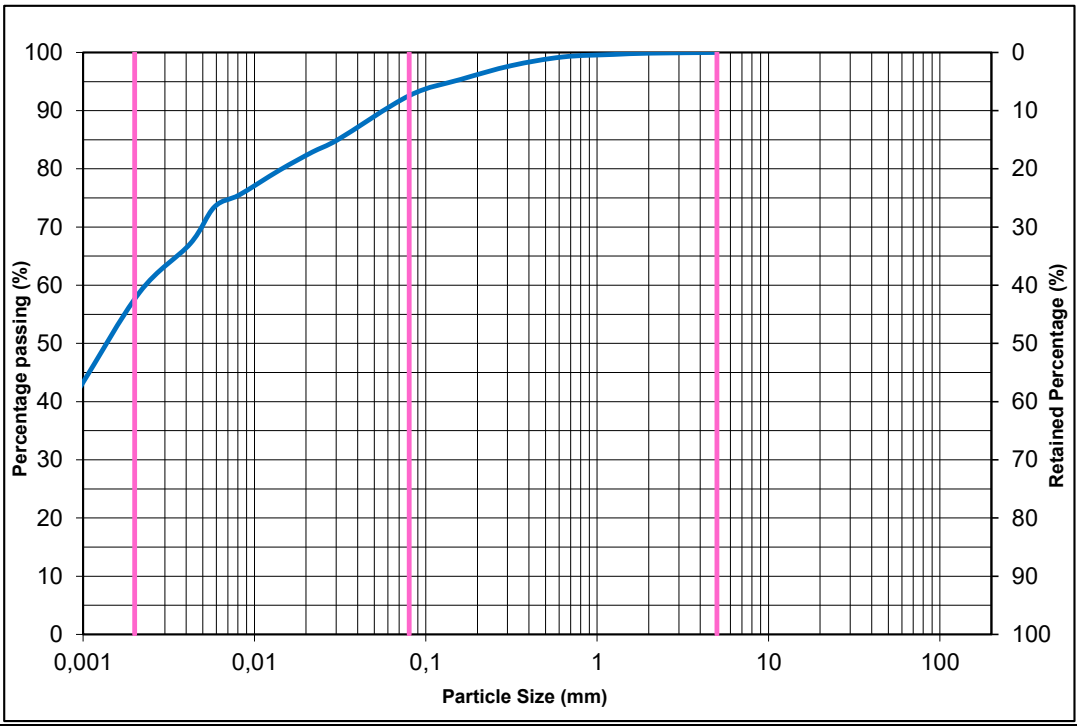
Sampled by : Hugo Desrochers
Sampling Date : October 18, 2022

Project No : 158100425.500.710.5
Sample No : BH22-06 SS-01B
Depth : 0,10 - 0,61m

Material Description : Clay and Silt, traces of Sand

Grain Size Analysis (BNQ 2501-025)

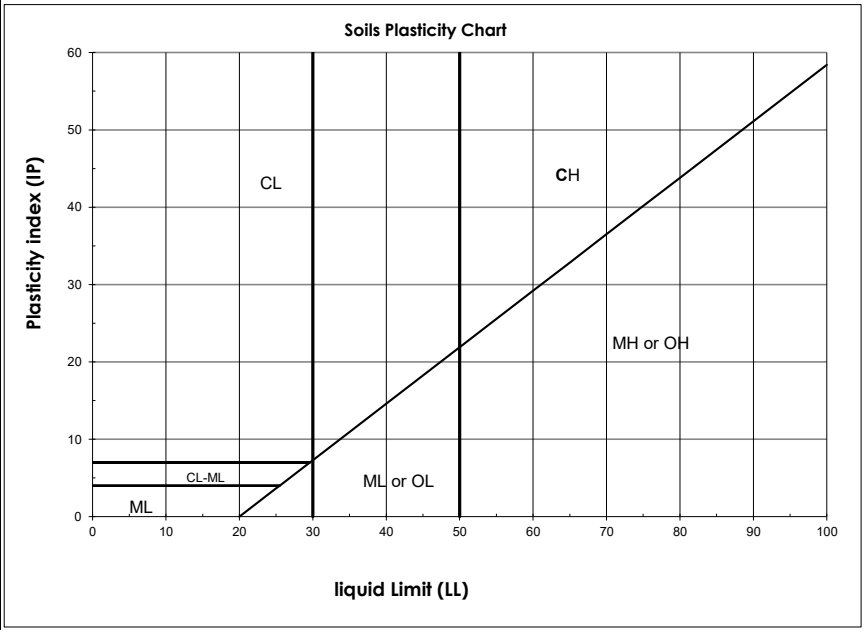
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	99
0,315	98
0,160	95
0,080	92,6



% Gravel: 0,0 % Sand : 7,4 % Silt: 35,7 % Clay: 56,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	27,6



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

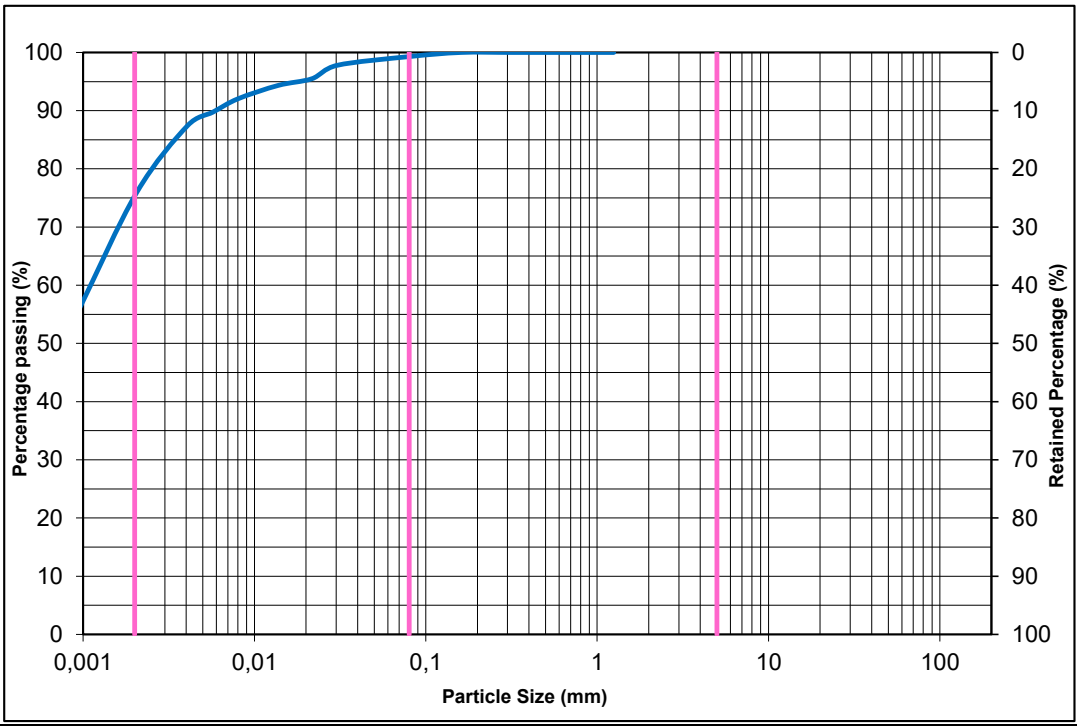
Sampled by : Hugo Desrochers
Sampling Date : October 18, 2022

Project No : 158100425.500.710.5
Sample No : BH22-06 SS-09
Depth : 4,88 - 5,49m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

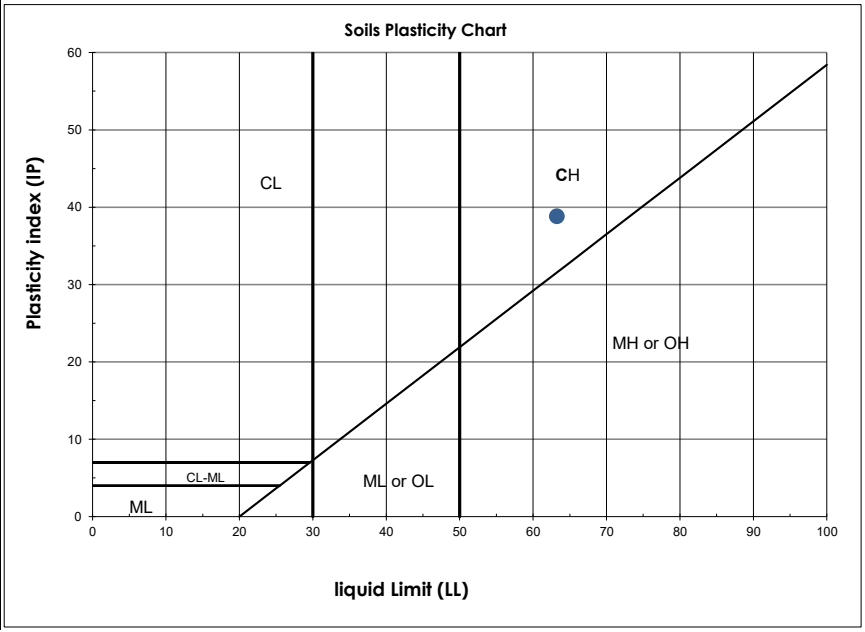
Openings Dimensions	Cumulative Results
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,3



% Gravel: 0,0 % Sand : 0,7 % Silt: 24,4 % Clay: 74,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	84,4
Liquid Limit (BNQ 2501-092)	63
Plastic Limit (BNQ 2501-092)	24
Plasticity Index (BNQ 2501-092)	39



Remarks :

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Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

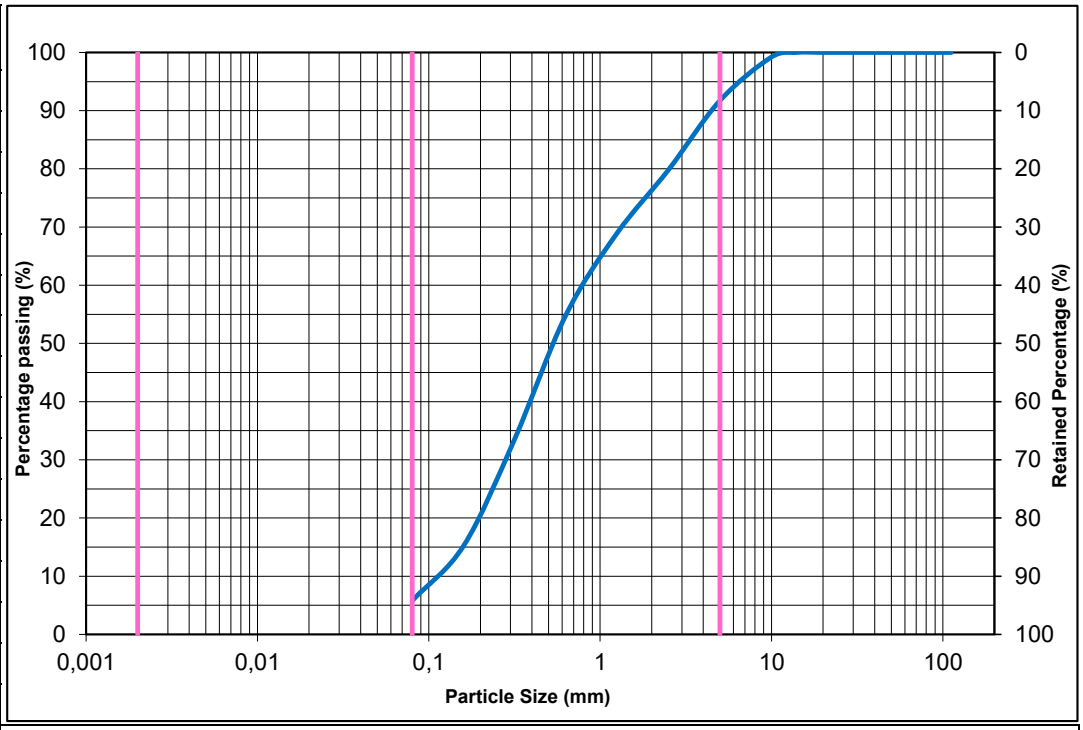
Sampled by : Hugo Desrochers
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-06 SS-23
Depth : 18,28 - 18,90m

Material Description : Sand, traces of Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

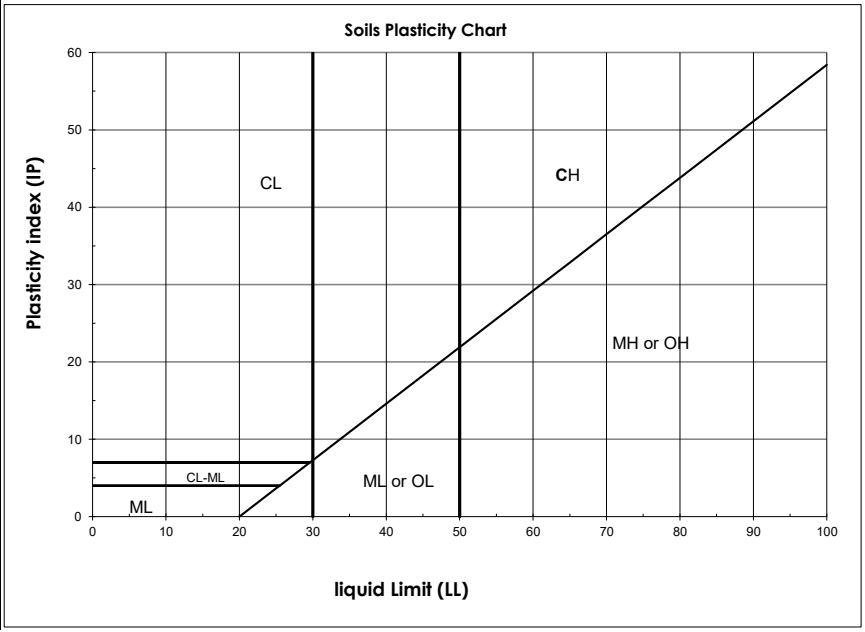
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	92
2,50	80
1,25	69
0,630	55
0,315	33
0,160	15
0,080	5,8



% Gravel : 8,3 % Sand : 85,9 % Fine particles : 5,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	13,0



Remarks :

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Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

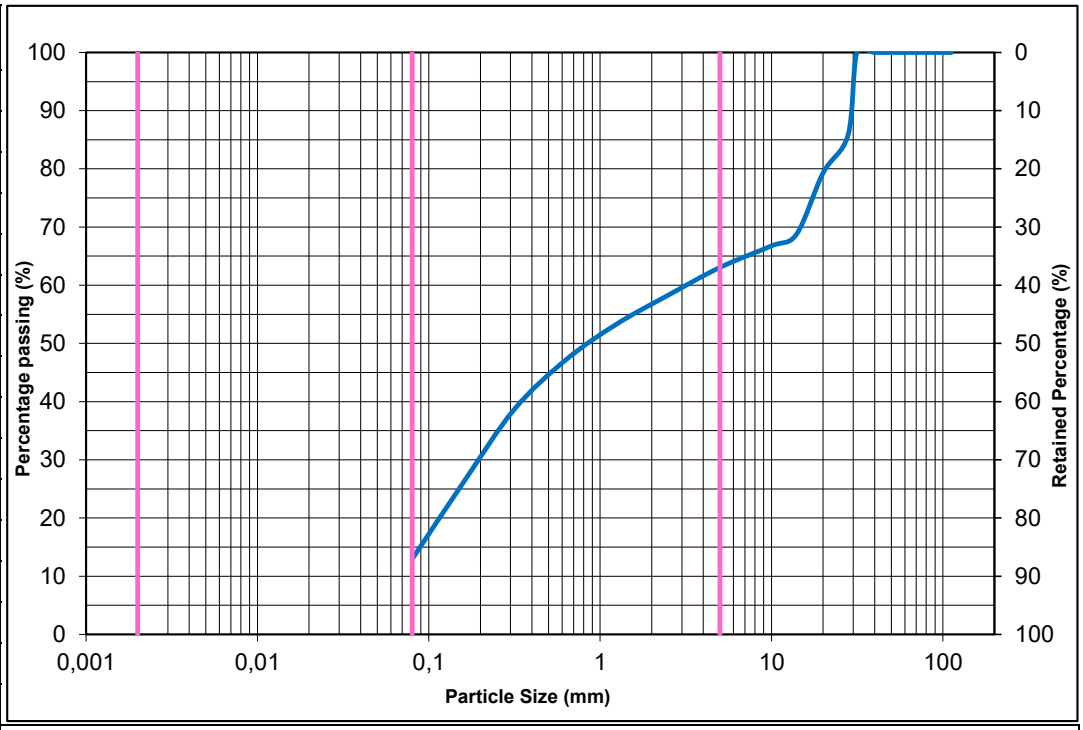
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 20, 2022

Project No : 158100425.500.710.5
Sample No : BH22-07 SS-01
Depth : 0,10 - 0,61m

Material Description : Sand and Gravel, some fine particles

Grain Size Analysis (BNQ 2501-025)

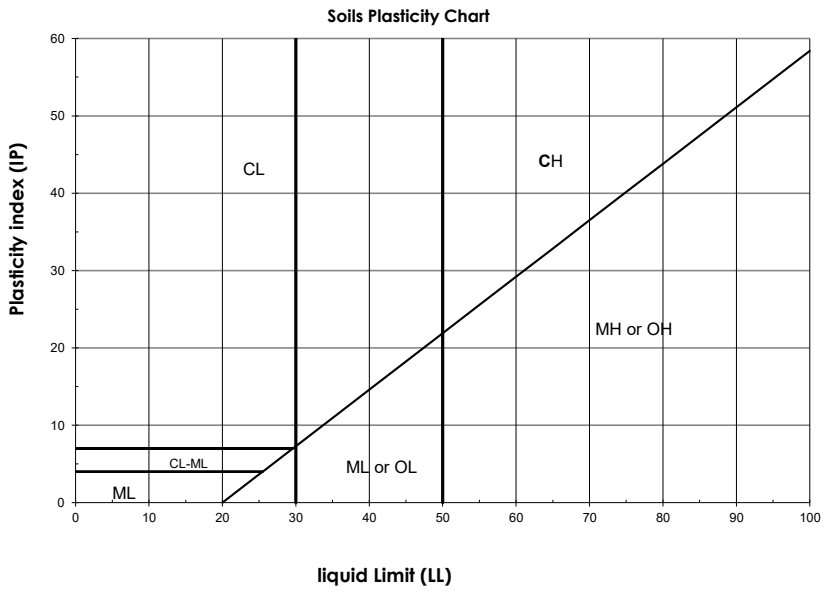
Openings Dimensions	Cumulative Results
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56,0	100
40,0	100
31,5	100
28,0	86
20,0	79
14,0	69
10,0	67
5,00	63
2,50	58
1,25	53
0,630	47
0,315	39
0,160	26
0,080	13,0



% Gravel : 36,9 % Sand : 50,1 % Fine particles : 13,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	12,4



Remarks :

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Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

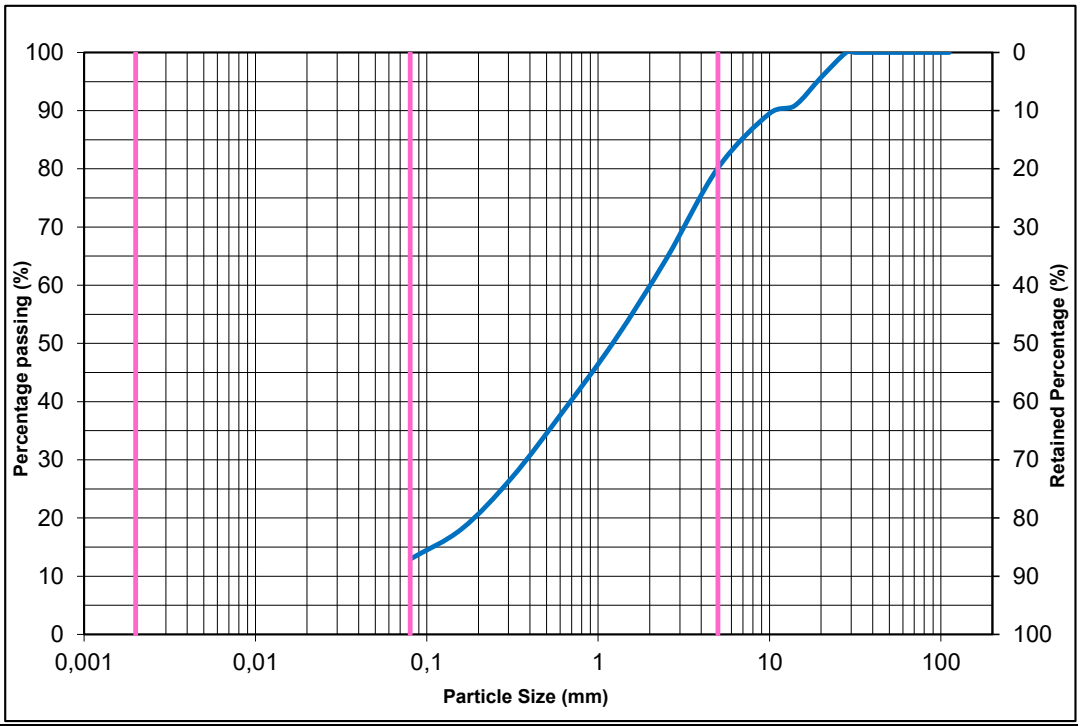
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 20, 2022

Project No : 158100425.500.710.5
Sample No : BH22-07 SS-04
Depth : 3,66 - 4,27m

Material Description : Sand, some Gravel, some fine particles

Grain Size Analysis (BNQ 2501-025)

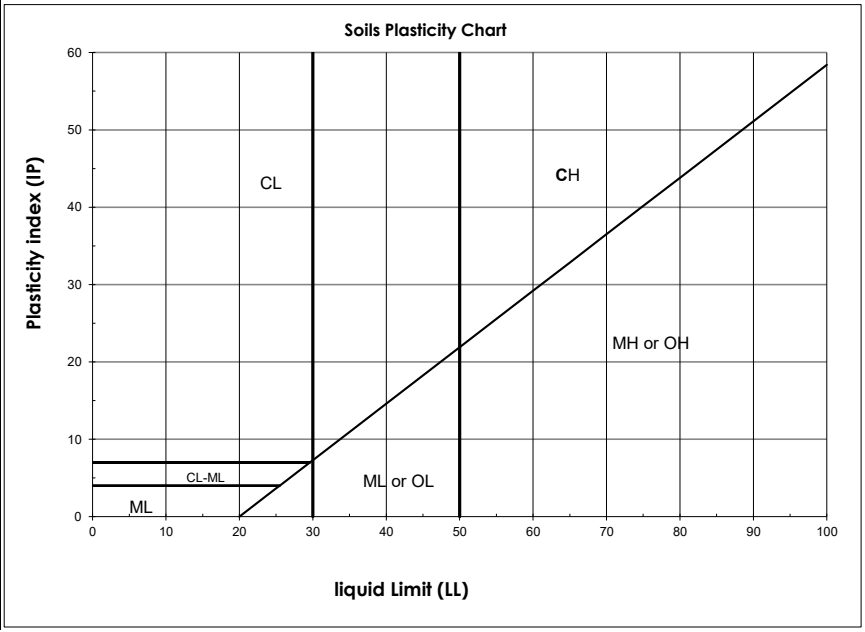
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	91
10,0	90
5,00	80
2,50	65
1,25	51
0,630	38
0,315	27
0,160	18
0,080	12,9



% Gravel : 19,9 % Sand : 67,2 % Fine particles : 12,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	16,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

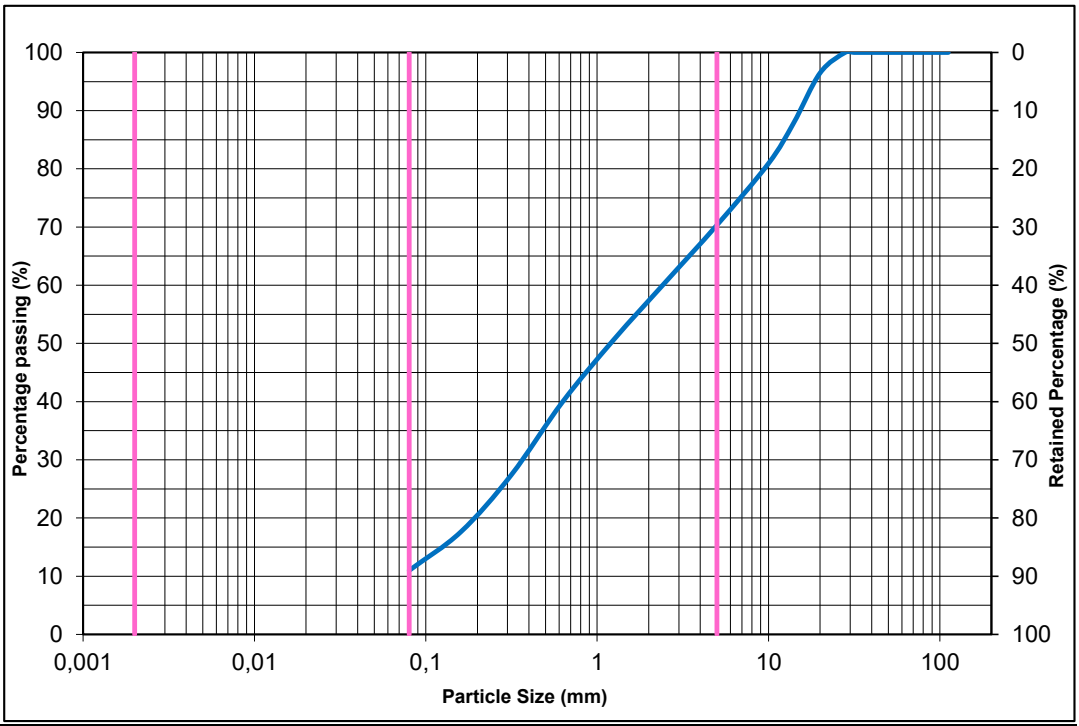
Sampled by : Hugo Desrochers
Sampling Date : September 26, 2022

Project No : 158100425.500.710.5
Sample No : BH22-08 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravely Sand, some fine particles

Grain Size Analysis (BNQ 2501-025)

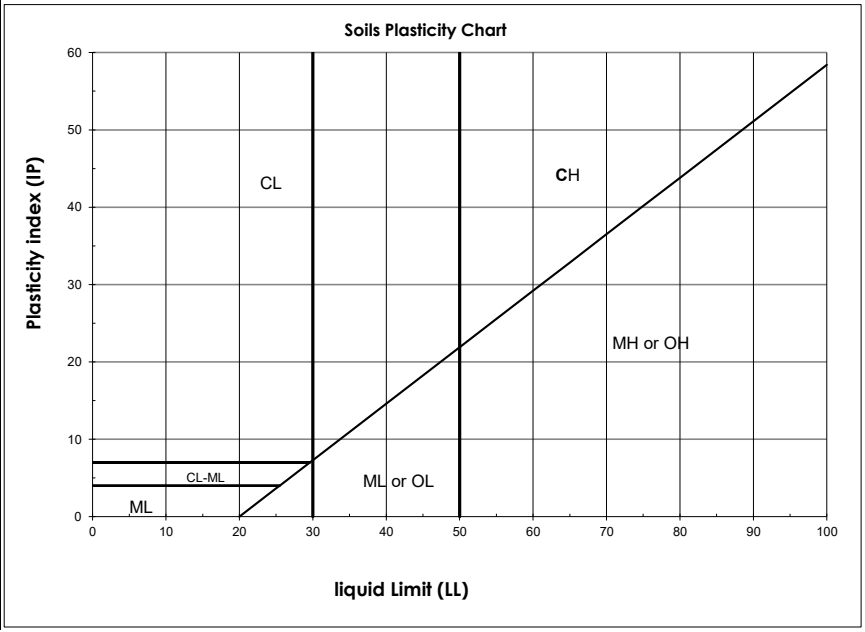
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	88
10,0	81
5,00	70
2,50	61
1,25	51
0,630	40
0,315	27
0,160	18
0,080	11,0



% Gravel : 29,7 % Sand : 59,3 % Fine particles : 11,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	4,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

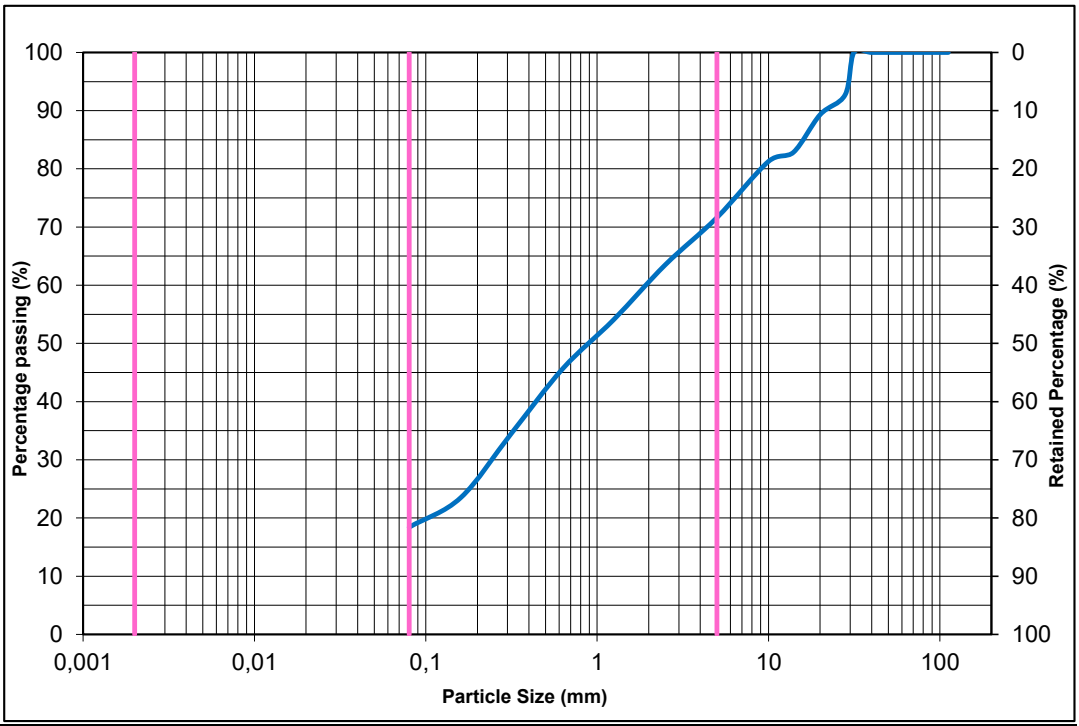
Sampled by : Hugo Desrochers
Sampling Date : September 26, 2022

Project No : 158100425.500.710.5
Sample No : BH22-08 SS-04
Depth : 1,83 - 2,44m

Material Description : Gravely Sand, some fine particles

Grain Size Analysis (BNQ 2501-025)

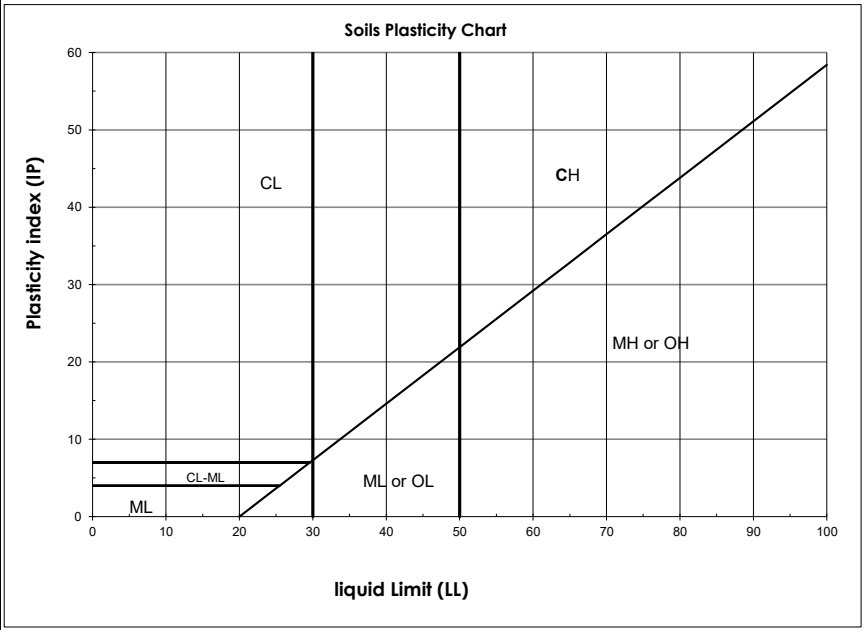
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	93
20,0	89
14,0	83
10,0	81
5,00	72
2,50	64
1,25	54
0,630	46
0,315	34
0,160	24
0,080	18,4



% Gravel : 28,4 % Sand : 53,2 % Fine particles : 18,4

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	16,4



Remarks :

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LABORATORY TESTING REPORT

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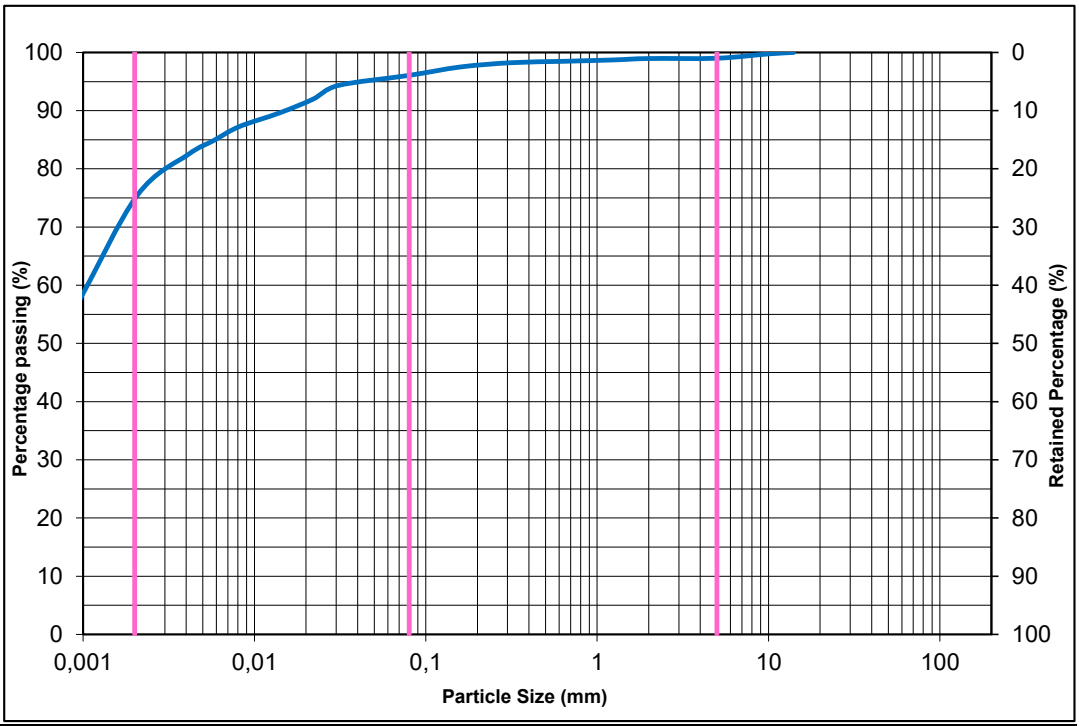
Sampled by : Hugo Desrochers
Sampling Date : November 06, 2022

Project No : 158100425.500.710.5
Sample No : BH22-09 SS-02
Depth : 0,61 - 1,22m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

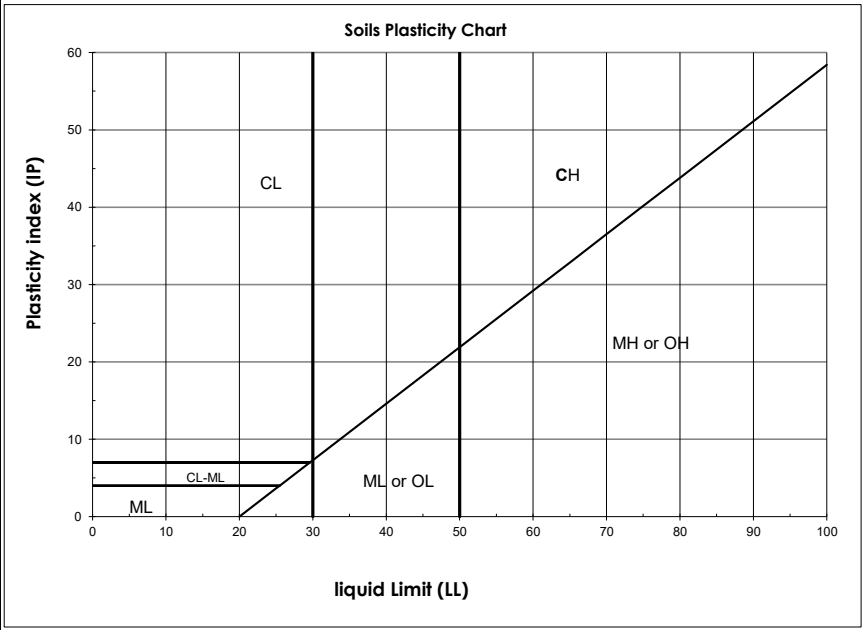
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	99
1,25	99
0,630	98
0,315	98
0,160	98
0,080	96,1



% Gravel: 1,0 % Sand : 2,9 % Silt: 21,8 % Clay: 74,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	38,5



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LABORATORY TESTING REPORT

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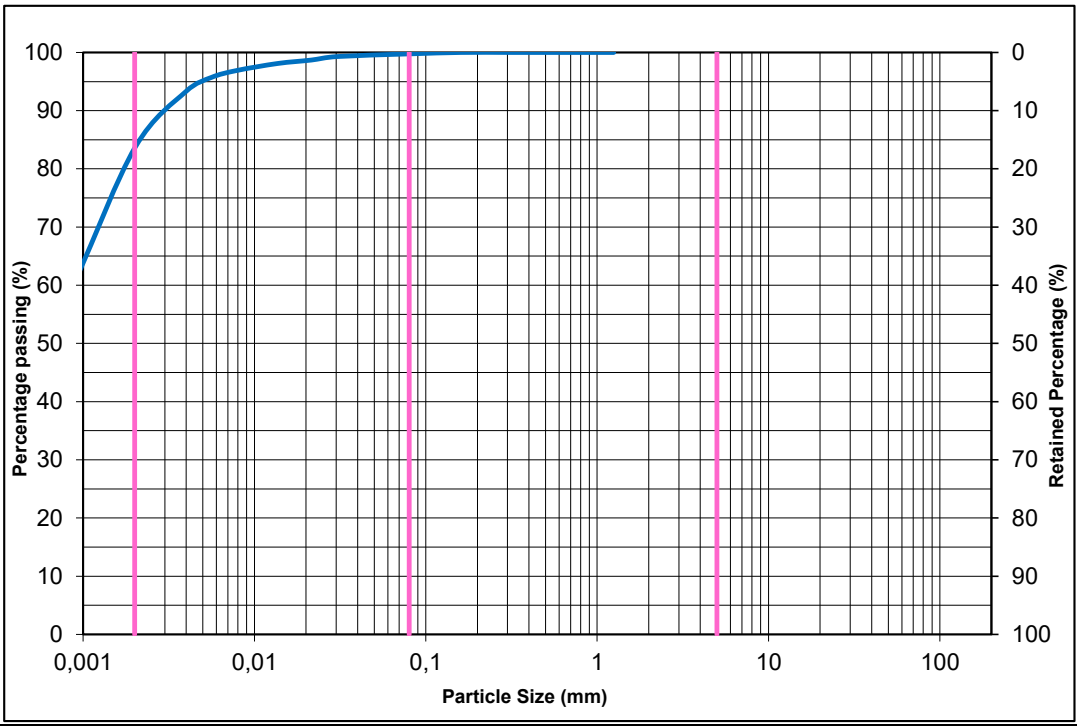
Sampled by : Hugo Desrochers
Sampling Date : November 06, 2022

Project No : 158100425.500.710.5
Sample No : BH22-09 SS-08
Depth : 4,57 - 5,18m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

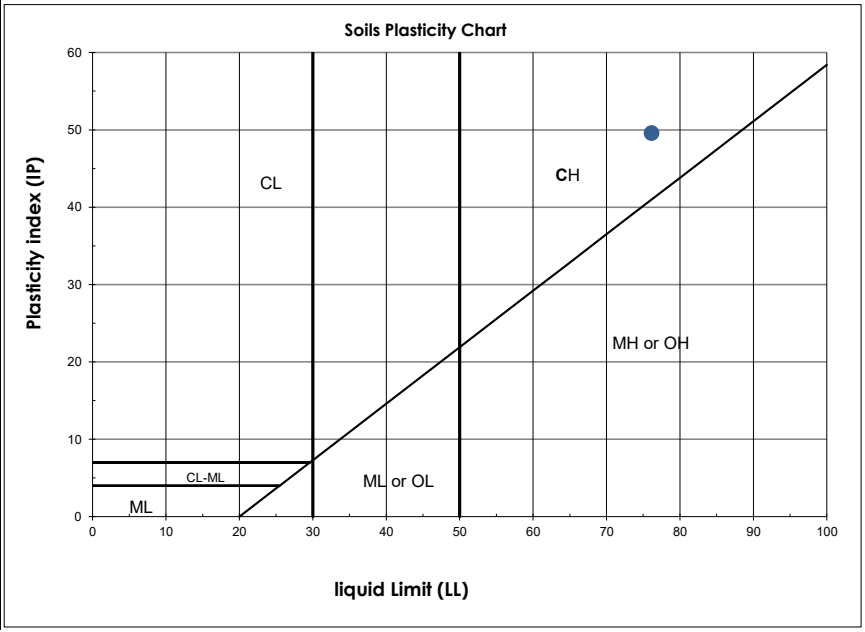
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,8



% Gravel: 0,0 % Sand : 0,2 % Silt: 16,3 % Clay: 83,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	84,4
Liquid Limit (BNQ 2501-092)	76
Plastic Limit (BNQ 2501-092)	26
Plasticity Index (BNQ 2501-092)	50



Remarks :

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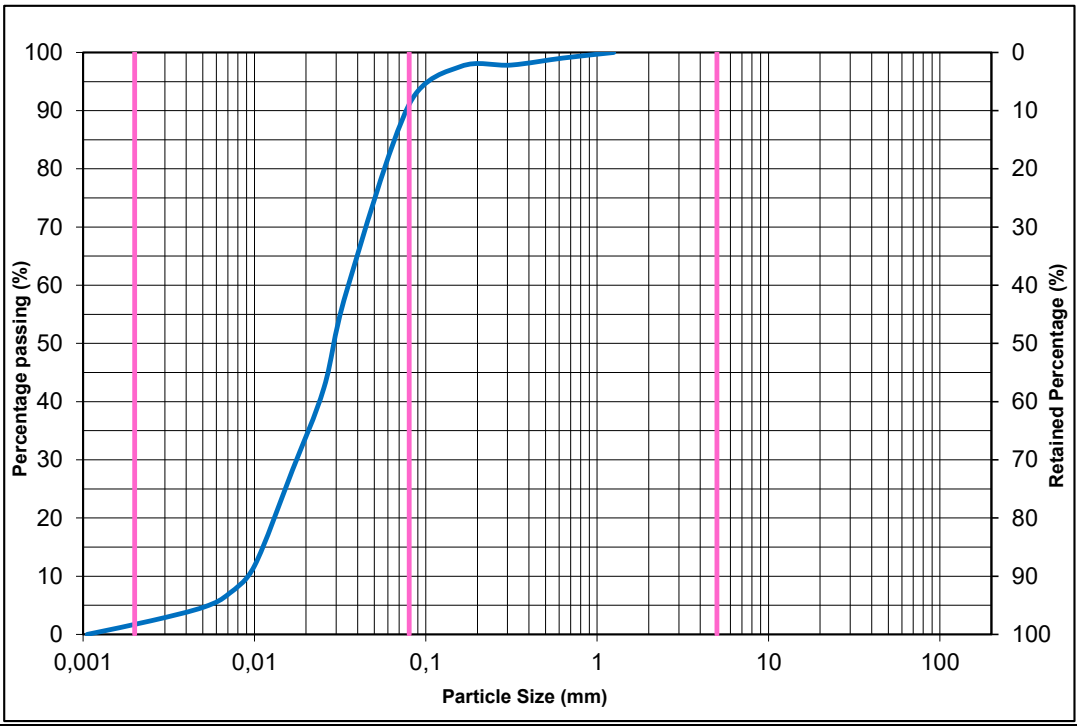
Sampled by : Hugo Desrochers
Sampling Date : November 06, 2022

Project No : 158100425.500.710.5
Sample No : BH22-09 SS-13
Depth : 11,28 - 11,89m

Material Description : Silt, traces of Sand, traces of Clay

Grain Size Analysis (BNQ 2501-025)

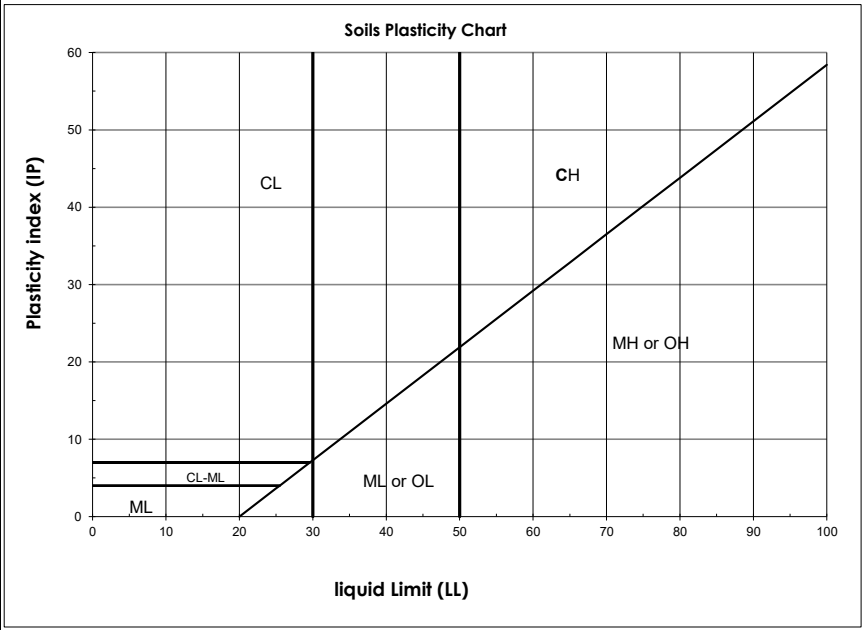
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	99
0,315	98
0,160	98
0,080	91,1



% Gravel: 0,0 % Sand : 8,9 % Silt: 89,6 % Clay: 1,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	25,0



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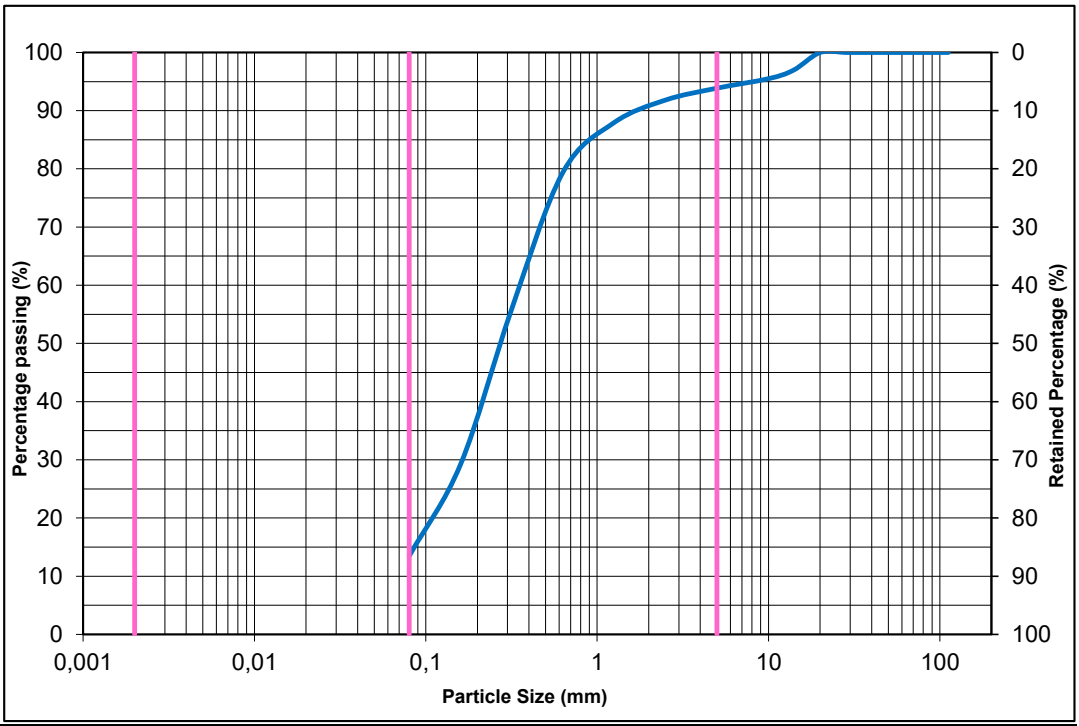
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-10 SS-02
Depth : 0,61 - 1,22m

Material Description : Sand, some fine particles, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

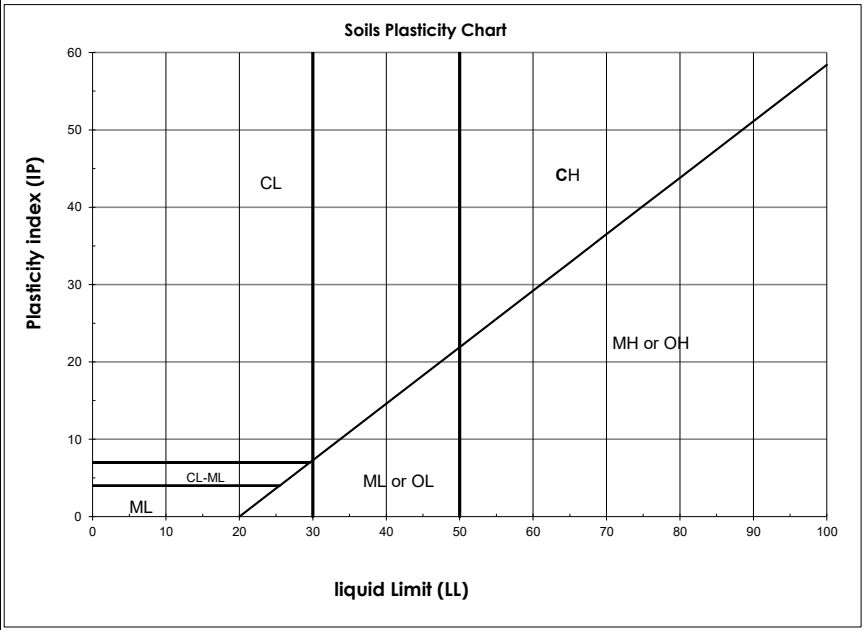
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	97
10,0	95
5,00	94
2,50	92
1,25	88
0,630	79
0,315	56
0,160	29
0,080	13,5



% Gravel : 6,1 % Sand : 80,4 % Fine particles : 13,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	14,1



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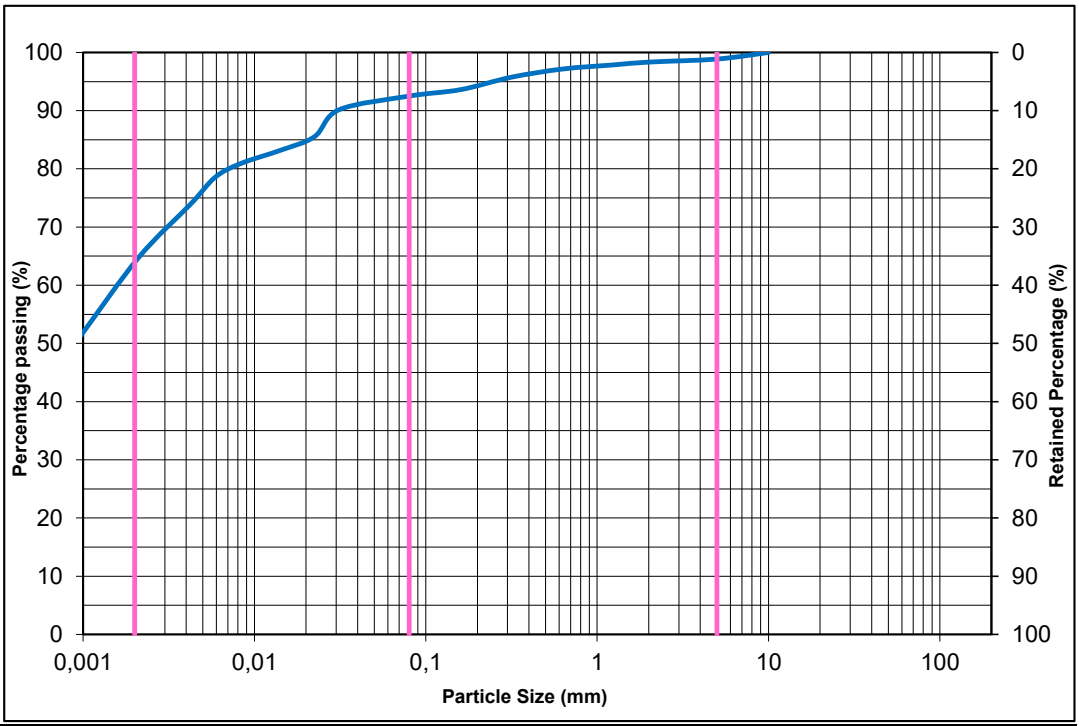
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-10 SS-06
Depth : 3,05 - 3,66m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

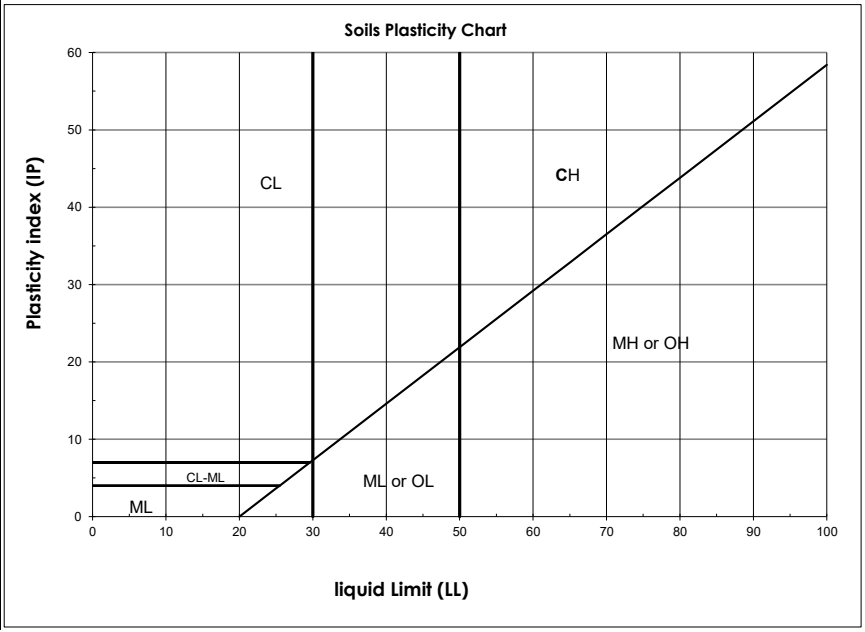
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	98
1,25	98
0,630	97
0,315	96
0,160	94
0,080	92,5



% Gravel: 1,1 % Sand : 6,4 % Silt: 29,0 % Clay: 63,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	43,0



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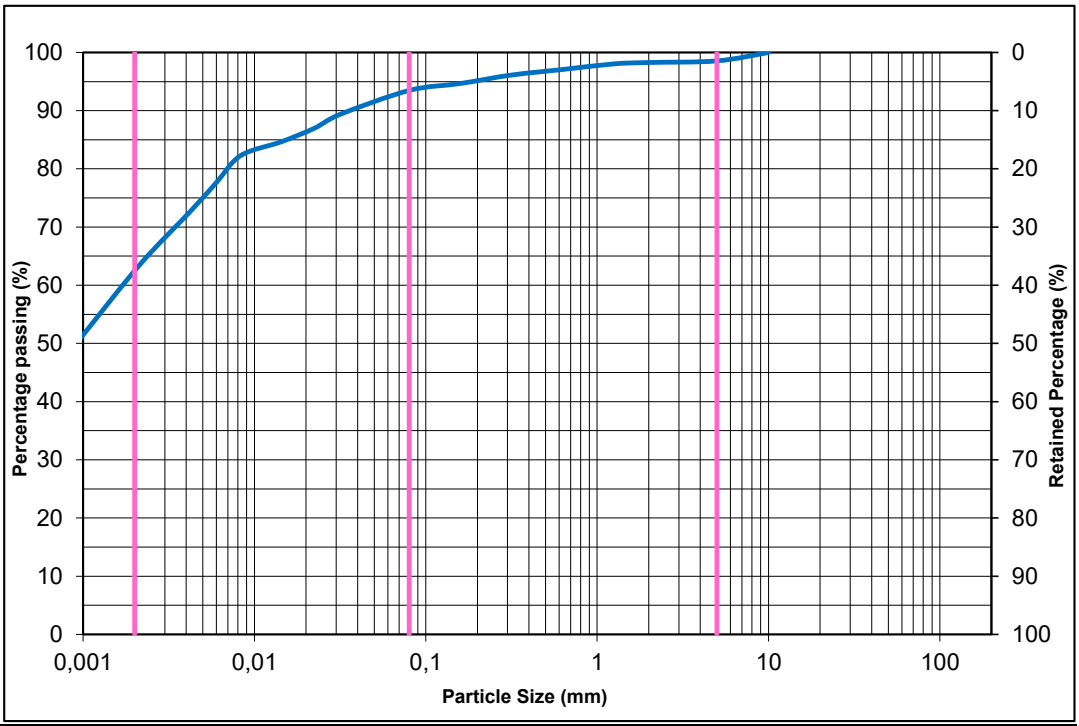
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-10 SS-07
Depth : 3,66 - 4,27m

Material Description : Silty Clay, traces of Sand, traces of Gravel, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

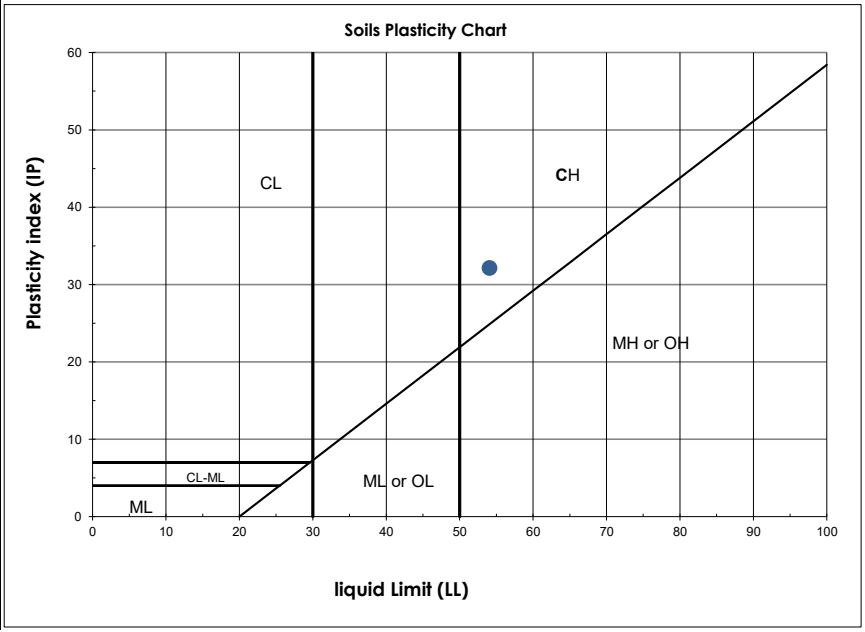
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	98
1,25	98
0,630	97
0,315	96
0,160	95
0,080	93,5



% Gravel: 1,4 % Sand : 5,1 % Silt: 31,5 % Clay: 62,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	42,3
Liquid Limit (BNQ 2501-092)	54
Plastic Limit (BNQ 2501-092)	22
Plasticity Index (BNQ 2501-092)	32



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LABORATORY TESTING REPORT

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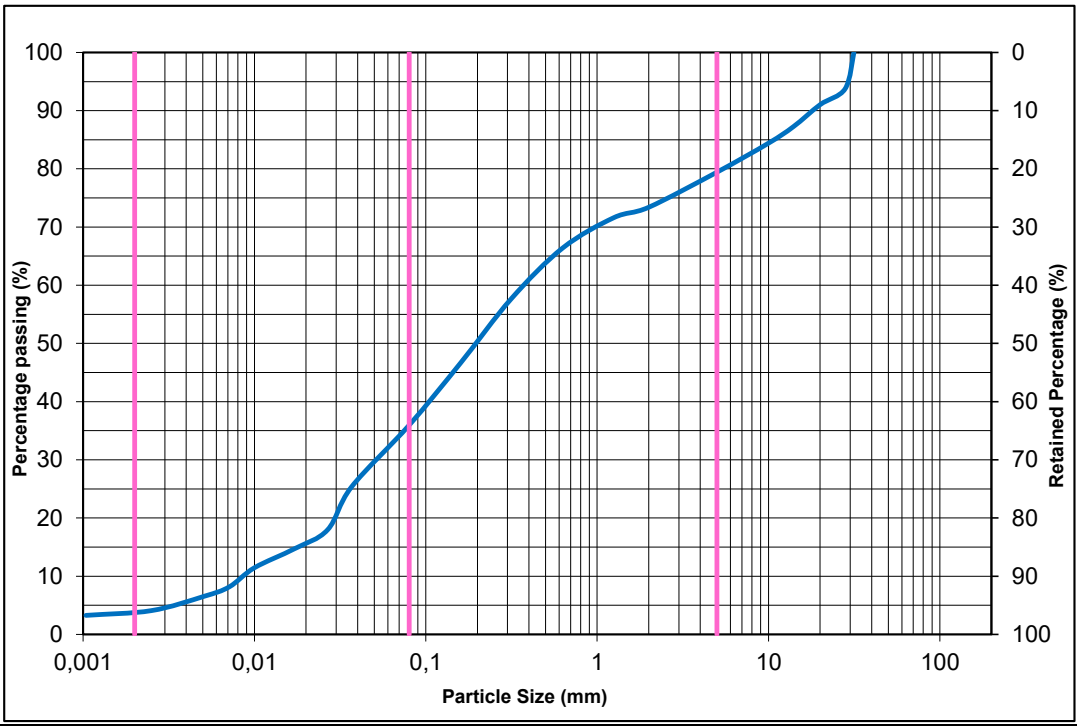
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-10 SS-12
Depth : 6,71 - 7,16m

Material Description : Gravely, Silty Sand, traces of Clay

Grain Size Analysis (BNQ 2501-025)

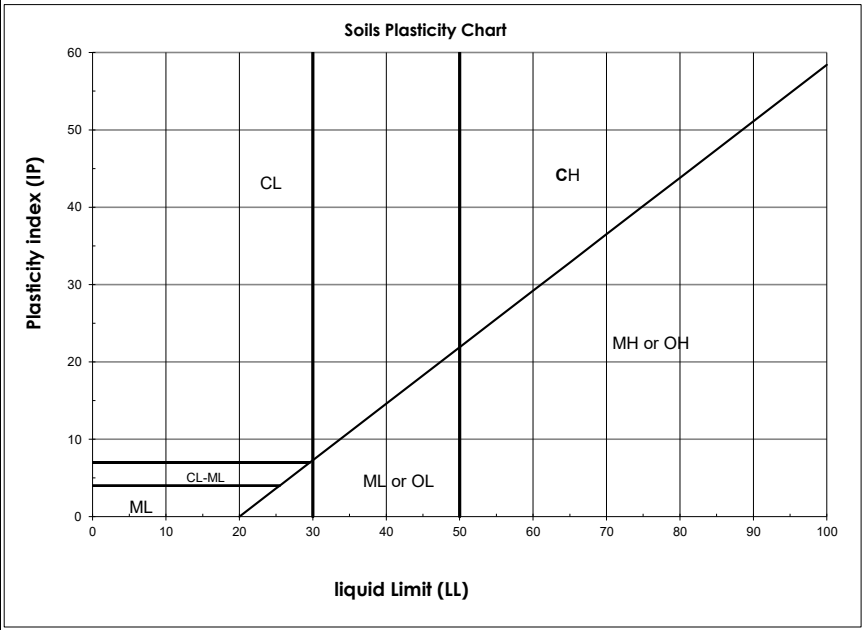
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	94
20,0	91
14,0	87
10,0	84
5,00	79
2,00	73
1,25	72
0,630	66
0,315	58
0,160	47
0,080	36,0



% Gravel: 20,5 % Sand : 43,5 % Silt: 32,2 % Clay: 3,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,4



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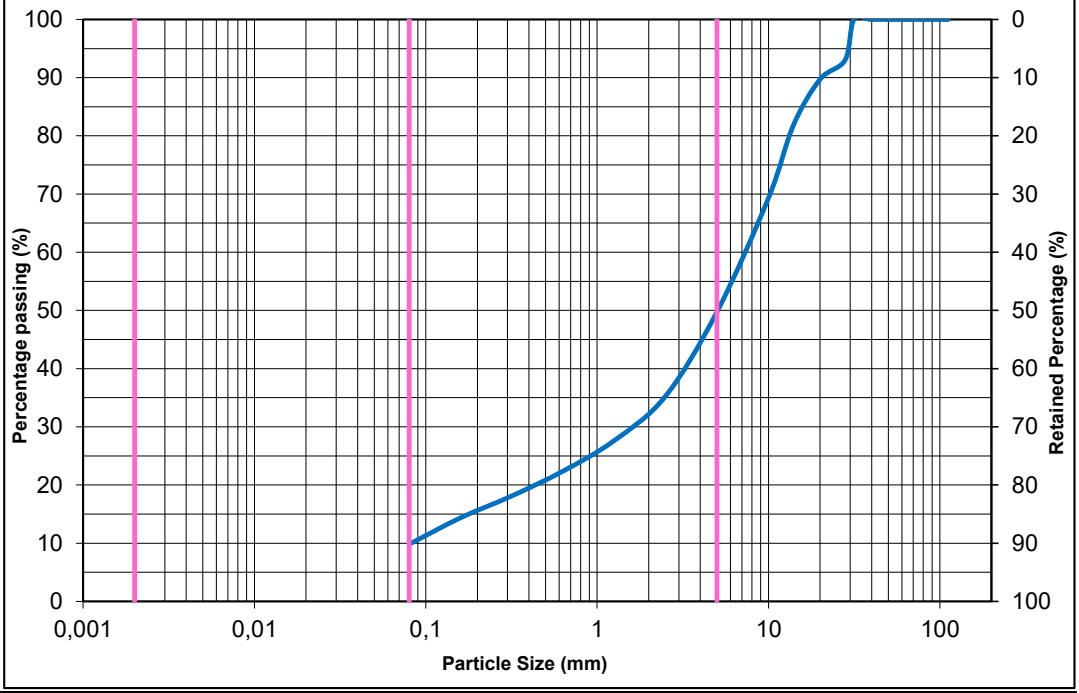
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-11 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravel and Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

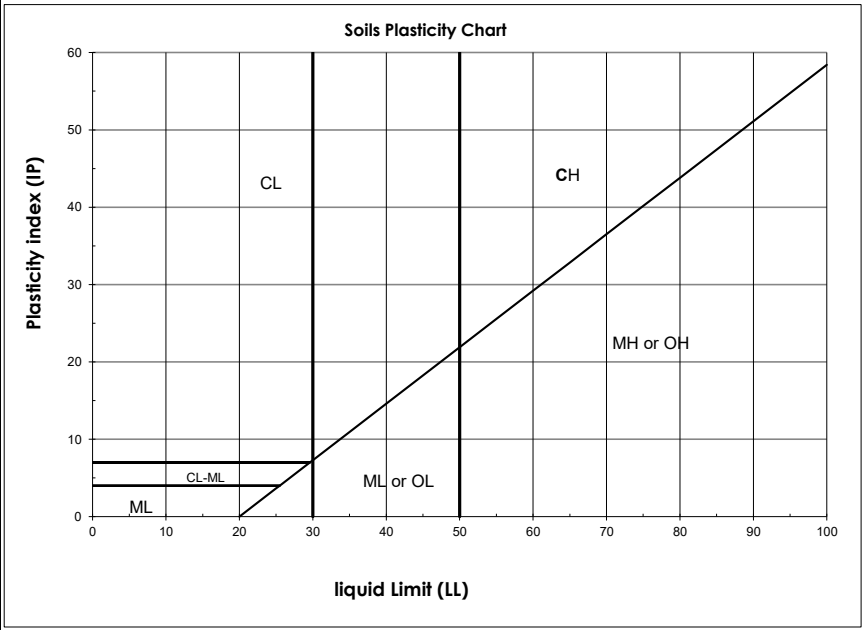
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	93
20,0	90
14,0	82
10,0	69
5,00	50
2,50	35
1,25	28
0,630	22
0,315	18
0,160	14
0,080	9,8



% Gravel : 50,3 % Sand : 39,9 % Fine particles : 9,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	6,5



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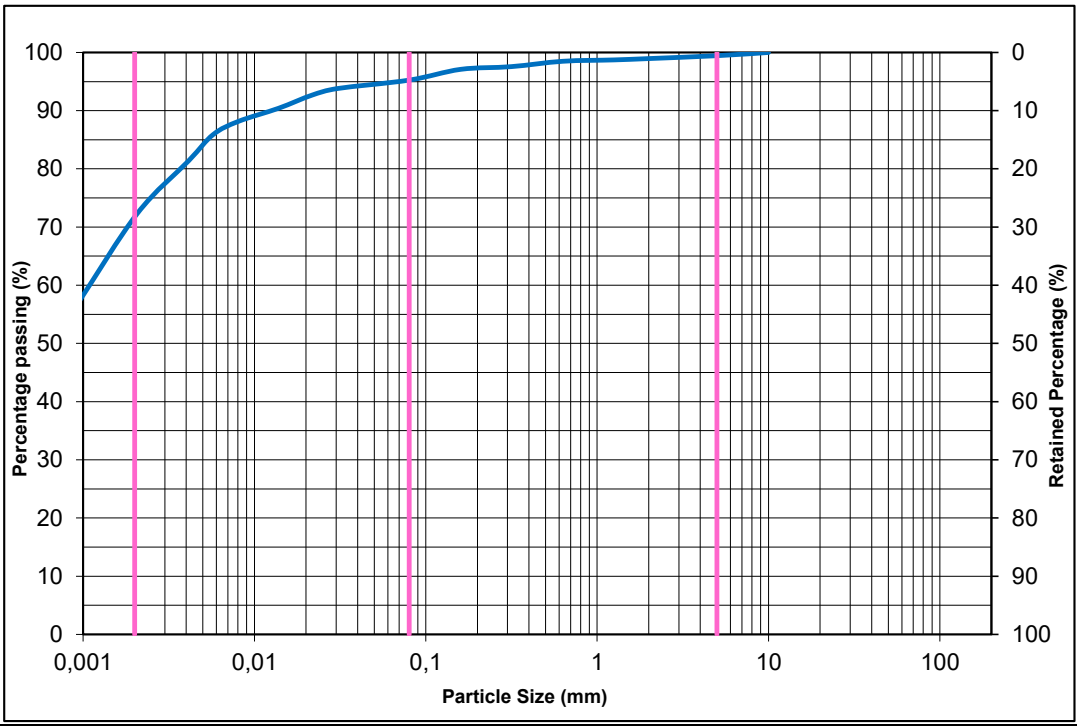
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-11 SS-08
Depth : 4,27 - 4,88m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

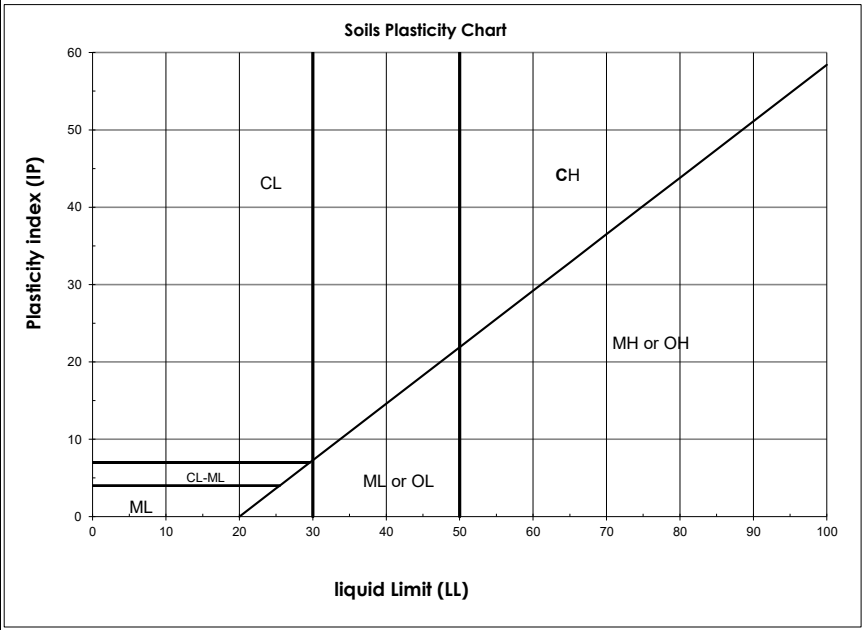
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	99
1,25	99
0,630	98
0,315	98
0,160	97
0,080	95,3



% Gravel: 0,5 % Sand : 4,2 % Silt: 23,9 % Clay: 71,4

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	48,5



Remarks :

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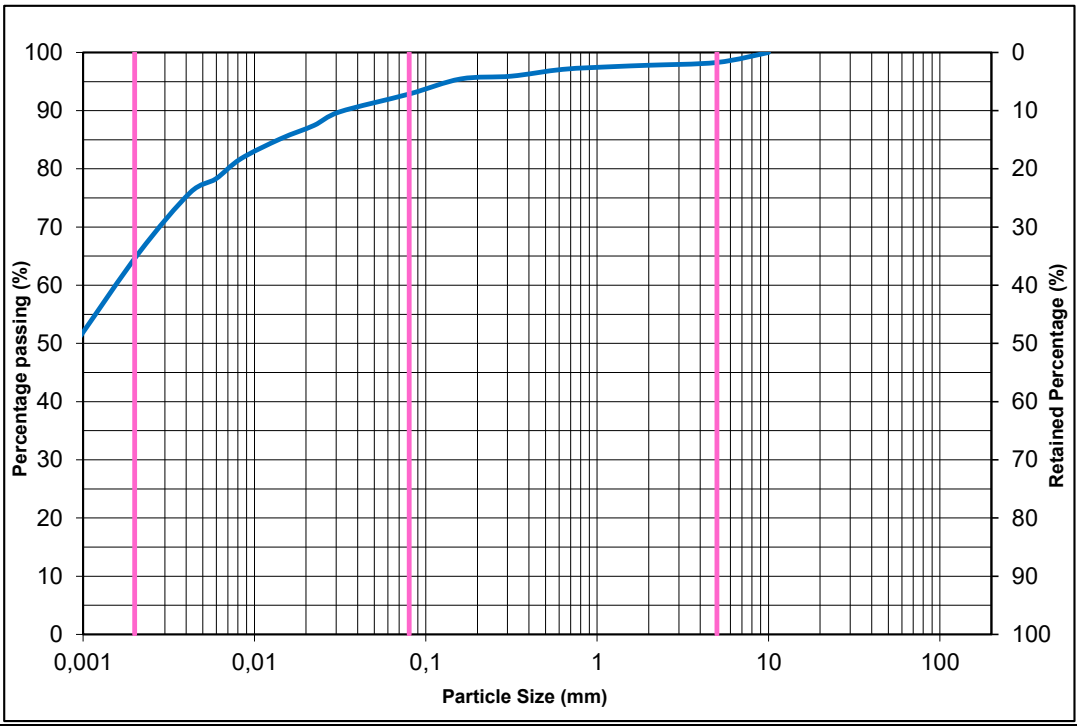
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-11 SS-11
Depth : 6,10 - 6,71m

Material Description : Silty Clay, traces of Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

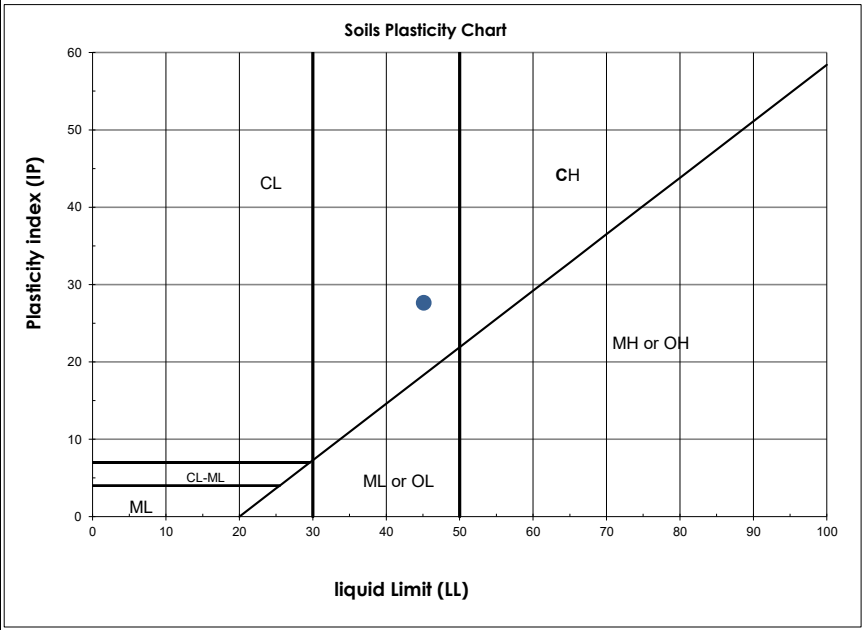
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	98
2,00	98
1,25	98
0,630	97
0,315	96
0,160	95
0,080	92,9



% Gravel: 1,7 % Sand : 5,4 % Silt: 28,8 % Clay: 64,1

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	53,5
Liquid Limit (BNQ 2501-092)	45
Plastic Limit (BNQ 2501-092)	17
Plasticity Index (BNQ 2501-092)	28



Remarks :

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LABORATORY TESTING REPORT

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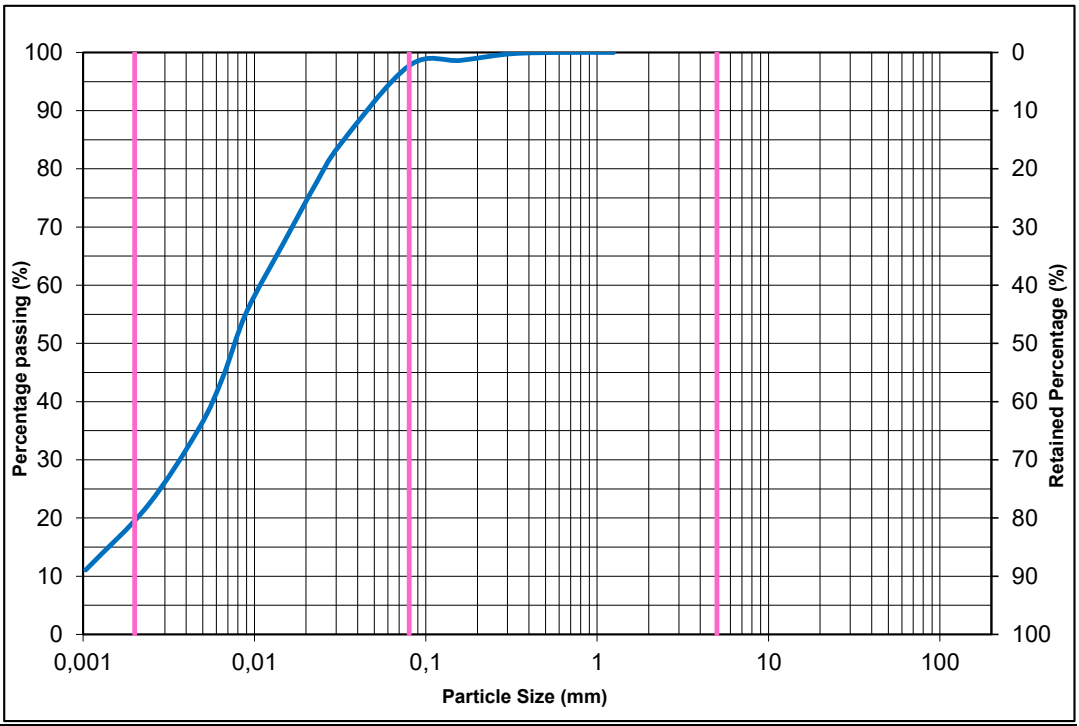
Sampled by : Hugo Desrochers
Sampling Date : October 12, 2022

Project No : 158100425.500.710.5
Sample No : BH22-11 SS-17
Depth : 15,24 - 15,85m

Material Description : Silt, some Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

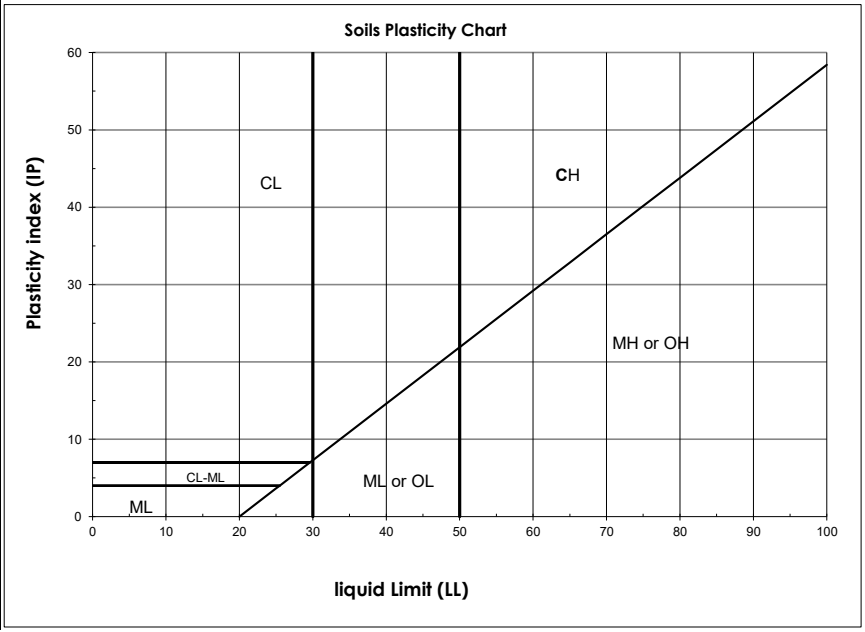
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	99
0,080	97,7



% Gravel: 0,0 % Sand : 2,3 % Silt: 78,8 % Clay: 18,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	28,8



Remarks :

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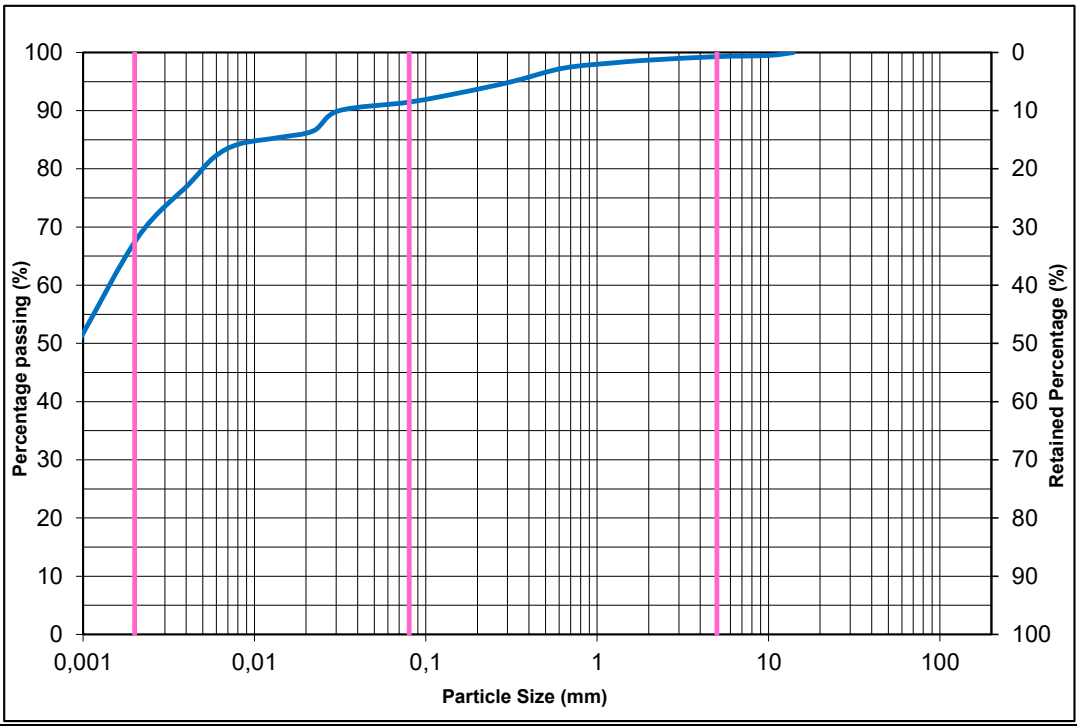
Sampled by : Hugo Desrochers
Sampling Date : September 21, 2022

Project No : 158100425.500.710.5
Sample No : BH22-12 SS-01B
Depth : 0,10 - 0,61m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

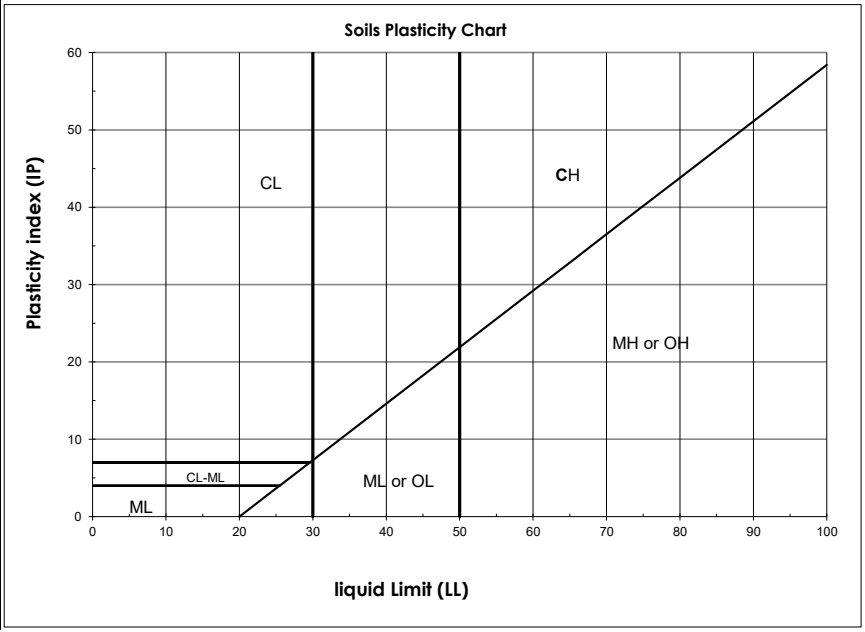
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	99
2,00	99
1,25	98
0,630	97
0,315	95
0,160	93
0,080	91,5



% Gravel: 0,7 % Sand : 7,8 % Silt: 24,7 % Clay: 66,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	27,3



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec

2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

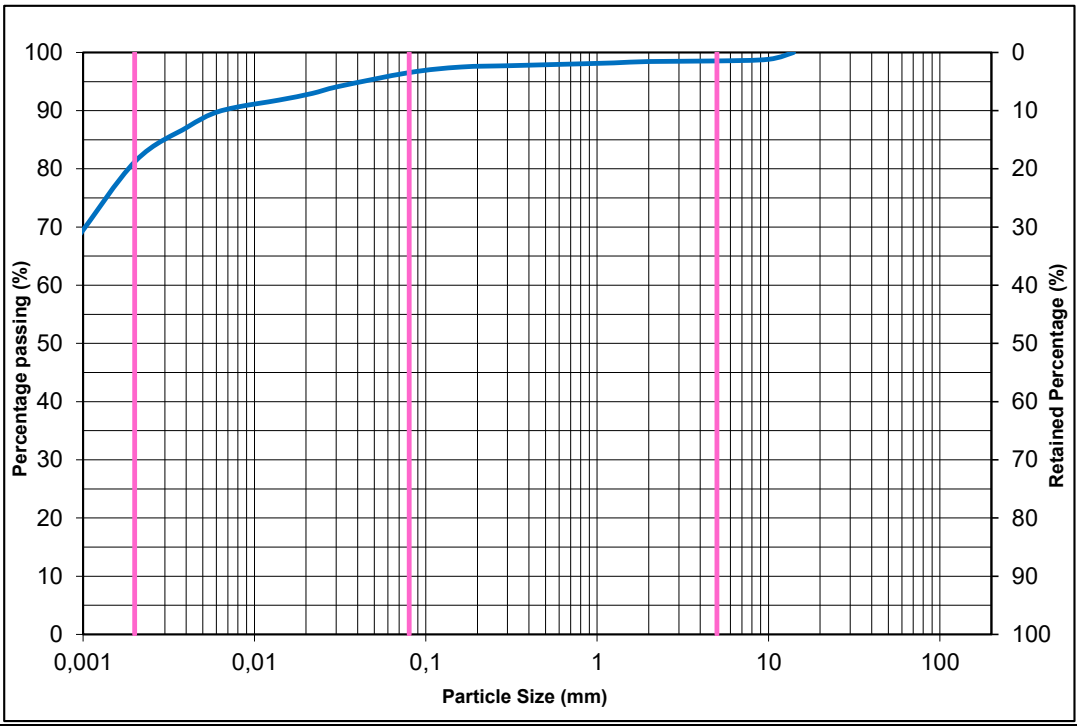
Sampled by : Hugo Desrochers
Sampling Date : September 21, 2022

Project No : 158100425.500.710.5
Sample No : BH22-12 SS-04
Depth : 1,83 - 2,44m

Material Description : Clay, some Silt, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

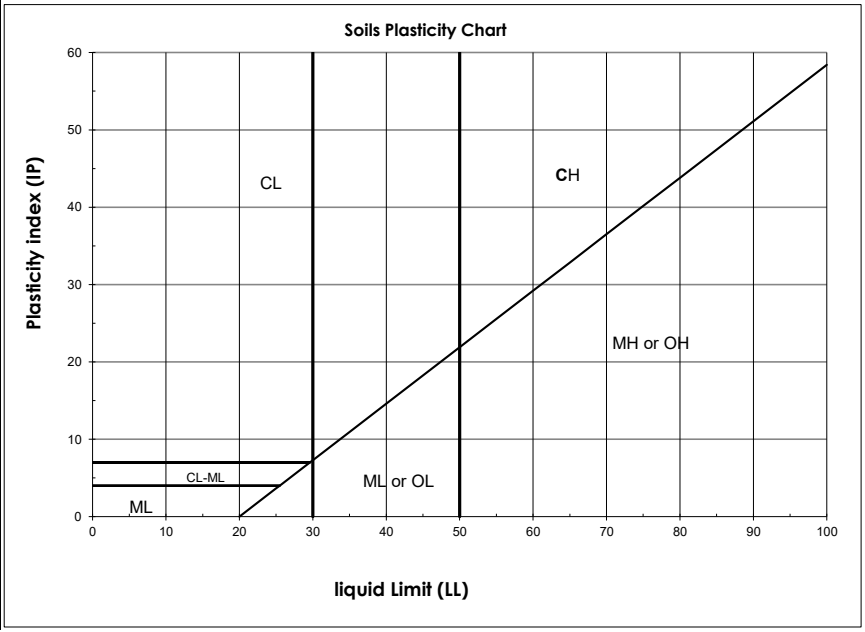
Openings Dimensions	Cumulative Results
mm	%
112	100
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	99
2,00	98
1,25	98
0,630	98
0,315	98
0,160	97
0,080	96,5



% Gravel: 1,5 % Sand : 2,0 % Silt: 15,5 % Clay: 81,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	54,5



Remarks :

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LABORATORY TESTING REPORT

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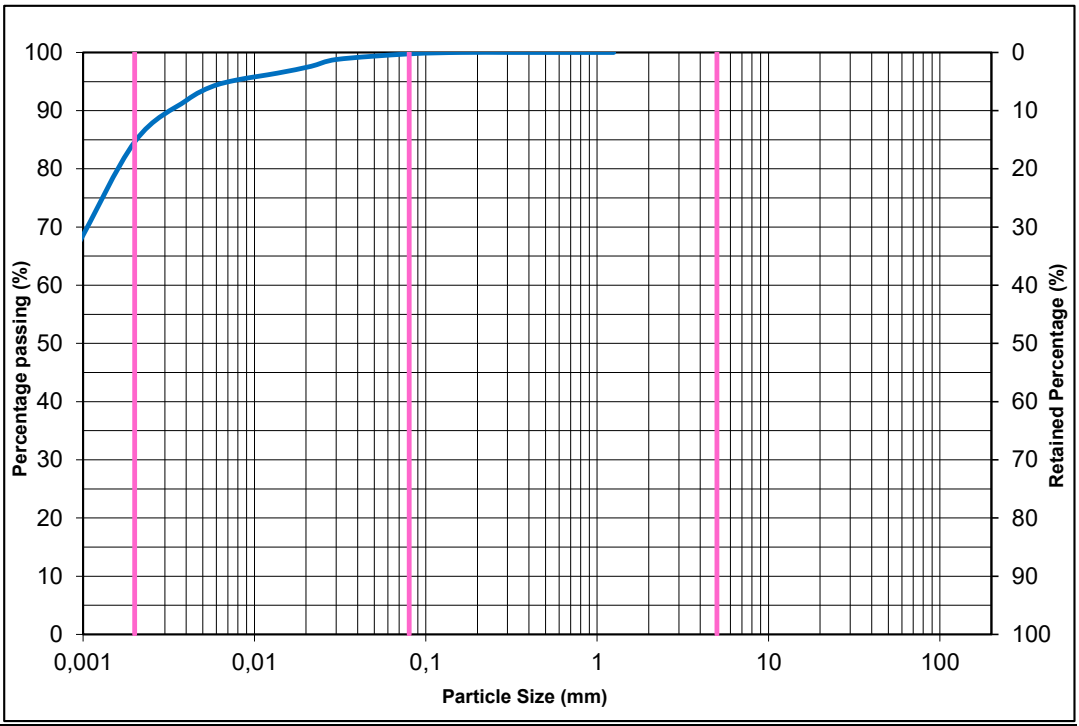
Sampled by : Hugo Desrochers
Sampling Date : September 21, 2022

Project No : 158100425.500.710.5
Sample No : BH22-12 SS-07
Depth : 3,66 - 4,27m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

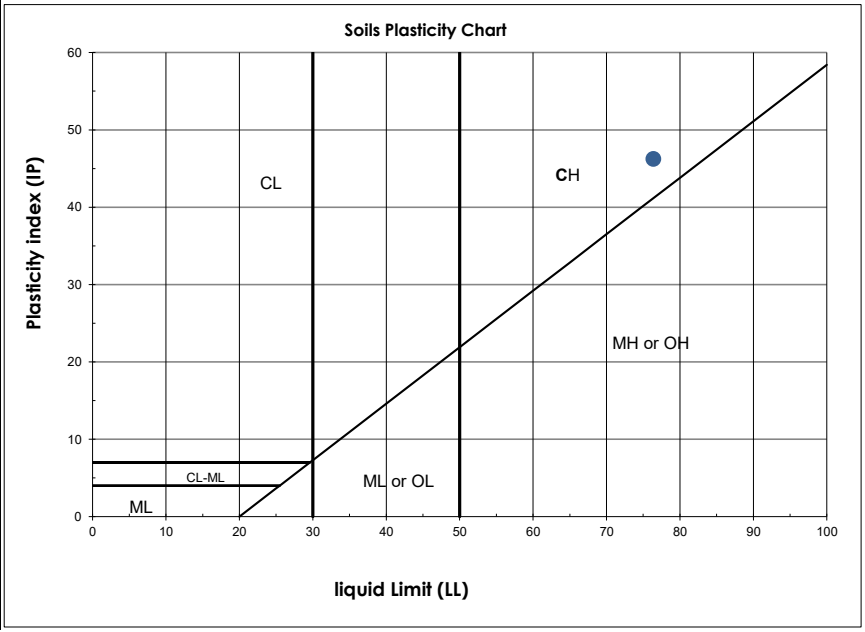
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,8



% Gravel: 0,0 % Sand : 0,2 % Silt: 15,2 % Clay: 84,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	66,9
Liquid Limit (BNQ 2501-092)	76
Plastic Limit (BNQ 2501-092)	30
Plasticity Index (BNQ 2501-092)	46



Remarks :

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Date : January 25, 2023

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

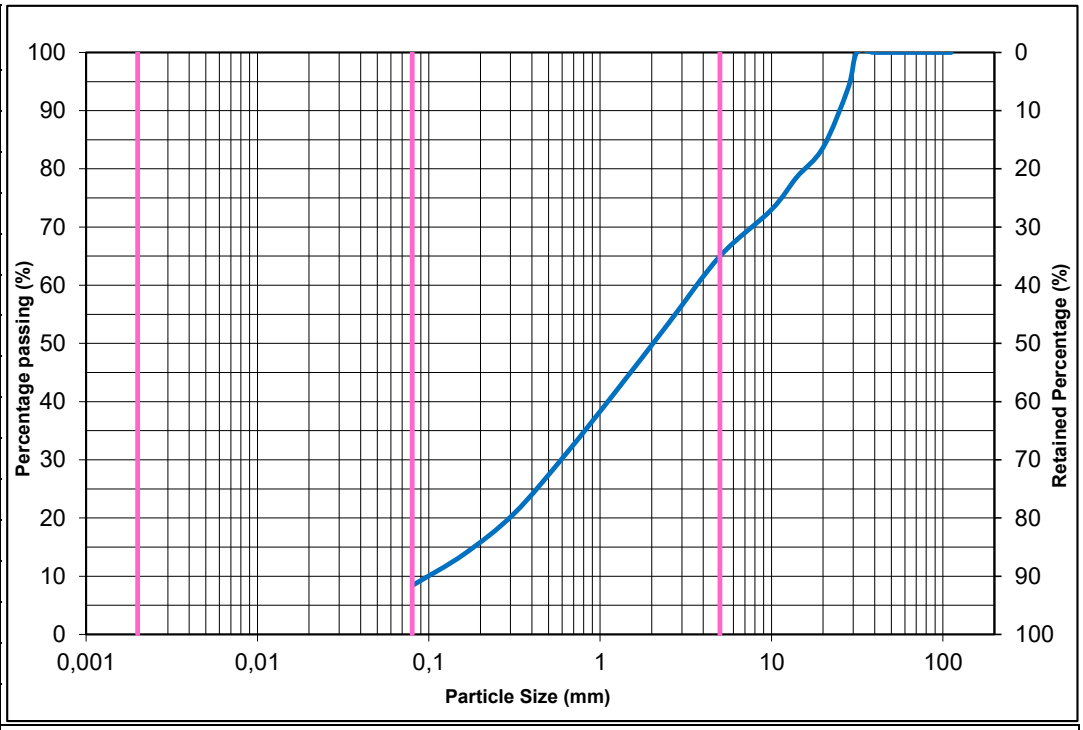
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 21, 2022

Project No : 158100425.500.710.5
Sample No : BH22-12 SS-17
Depth : 10,36 - 10,97m

Material Description : Sand and Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

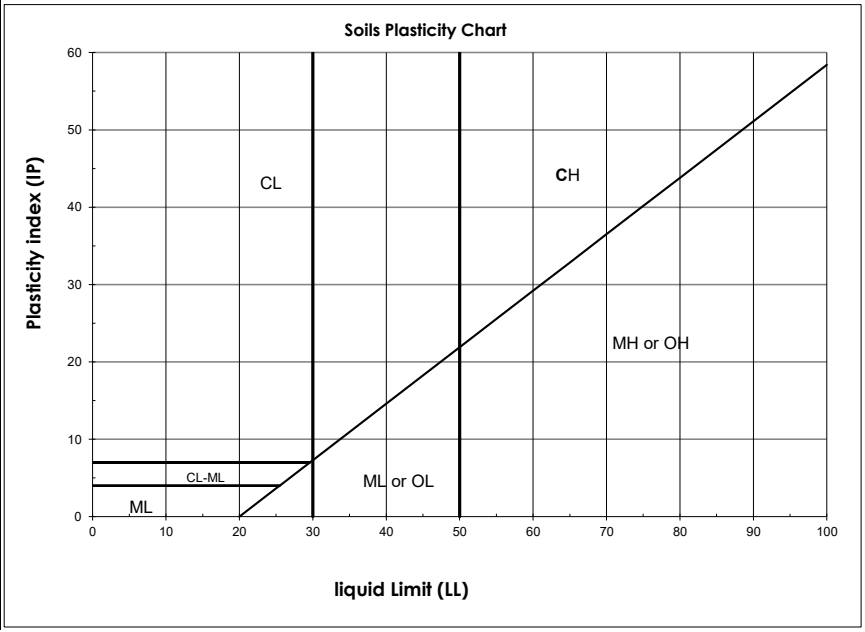
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	94
20,0	84
14,0	79
10,0	73
5,00	65
2,50	53
1,25	42
0,630	31
0,315	21
0,160	14
0,080	8,4



% Gravel : 35,0 % Sand : 56,6 % Fine particles : 8,4

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,3



Remarks :

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Date : January 24, 2023

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

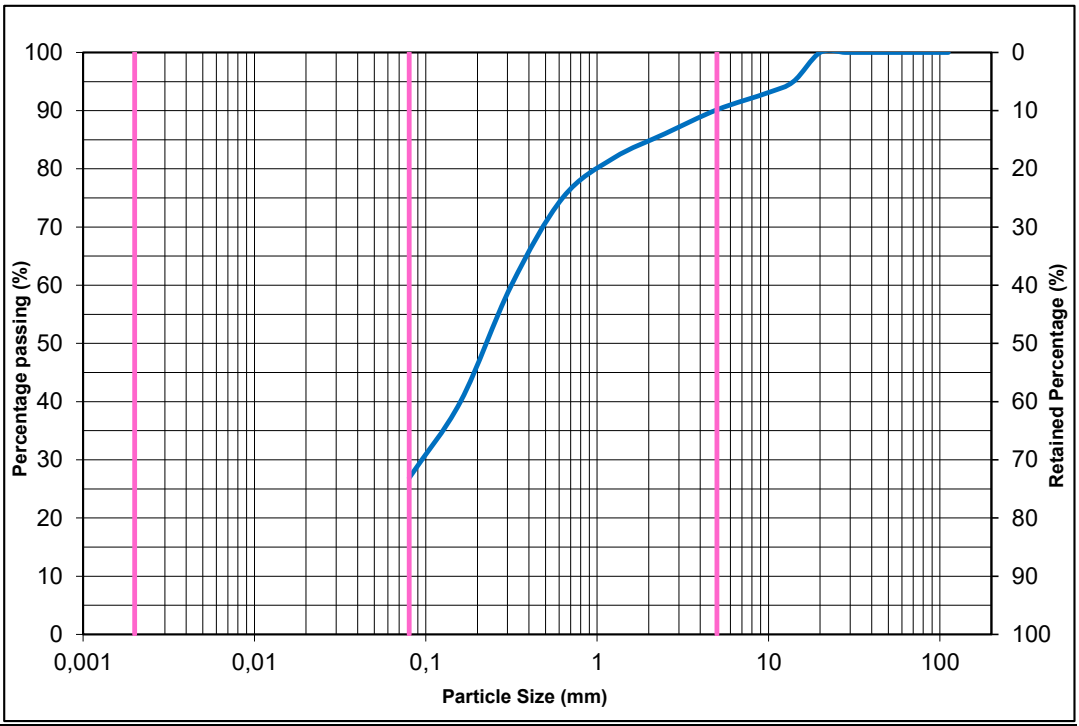
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-13 SS-01
Depth : 0,00 - 0,61m

Material Description : Silty Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

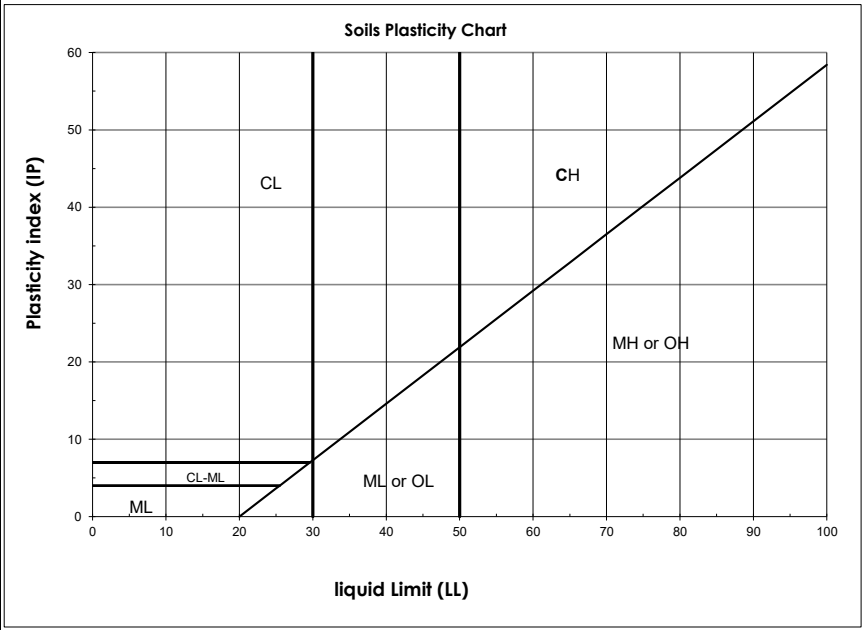
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	95
10,0	93
5,00	90
2,50	86
1,25	82
0,630	75
0,315	60
0,160	40
0,080	26,9



% Gravel : 9,8 % Sand : 63,3 % Fine particles : 26,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	6,0



Remarks :

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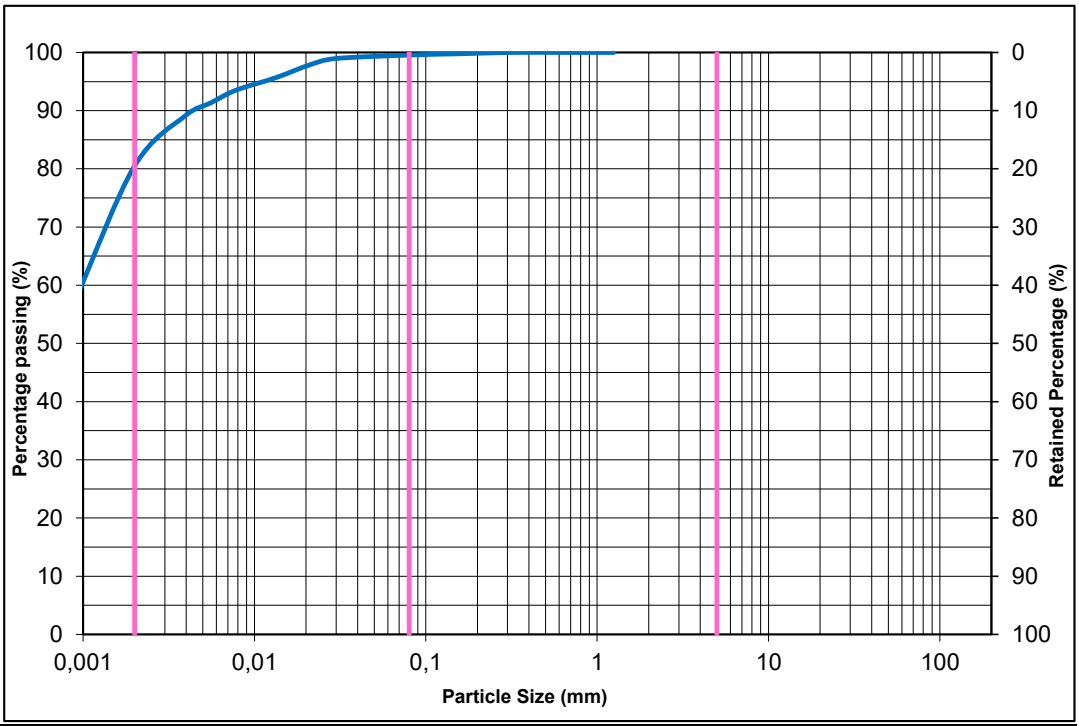
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-13 SS-06
Depth : 3,05 - 3,66m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

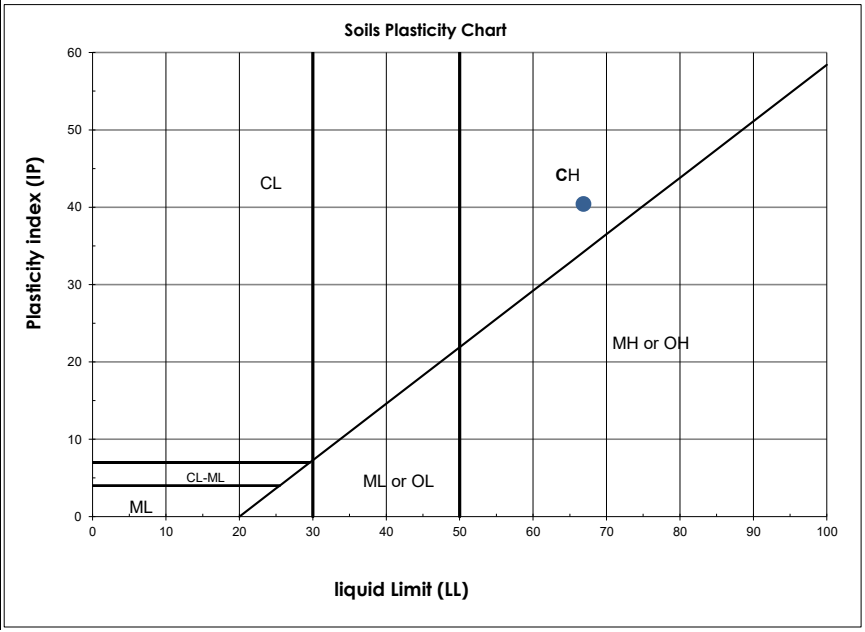
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,6



% Gravel: 0,0 % Sand : 0,4 % Silt: 19,0 % Clay: 80,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	61,4
Liquid Limit (BNQ 2501-092)	67
Plastic Limit (BNQ 2501-092)	27
Plasticity Index (BNQ 2501-092)	40



Remarks :

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

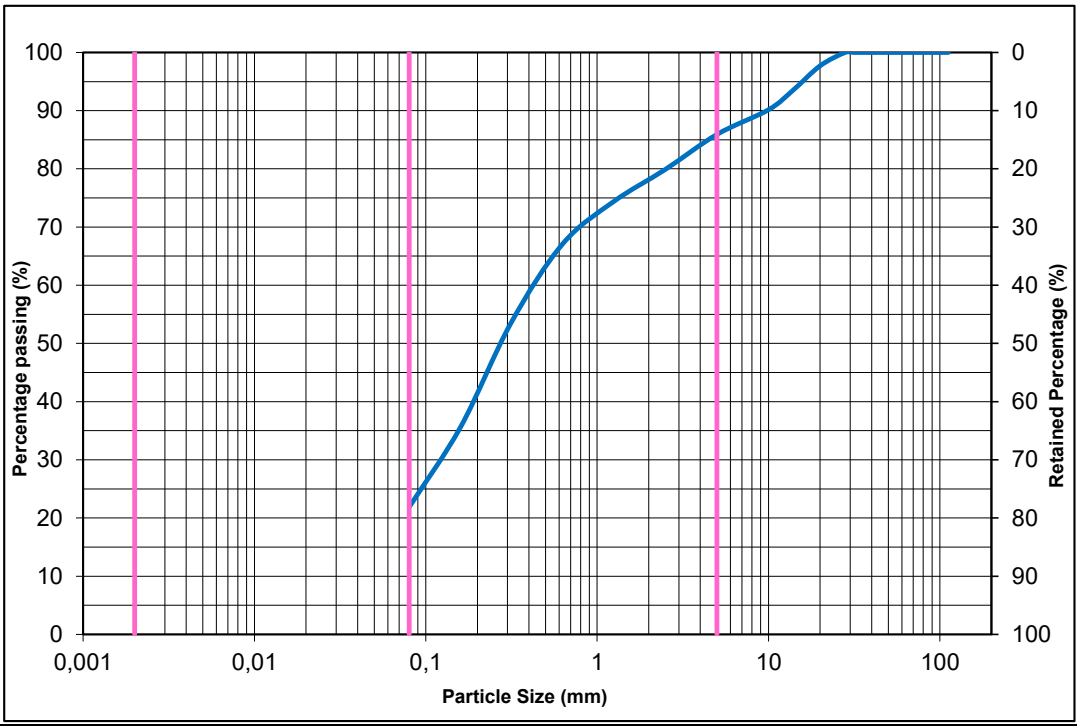
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-13 SS-16
Depth : 9,14 - 9,75m

Material Description : Silty Sand, some Gravel

Grain Size Analysis (BNQ 2501-025)

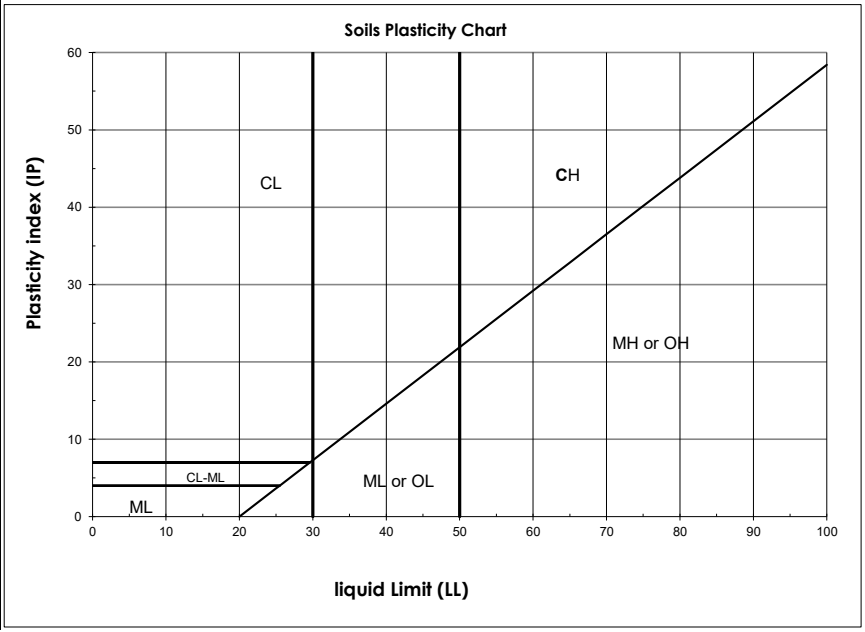
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	98
14,0	94
10,0	90
5,00	86
2,50	80
1,25	74
0,630	67
0,315	54
0,160	36
0,080	21,9



% Gravel : 14,1 % Sand : 64,0 % Fine particles : 21,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	14,0



Remarks :

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Date : January 24, 2023

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

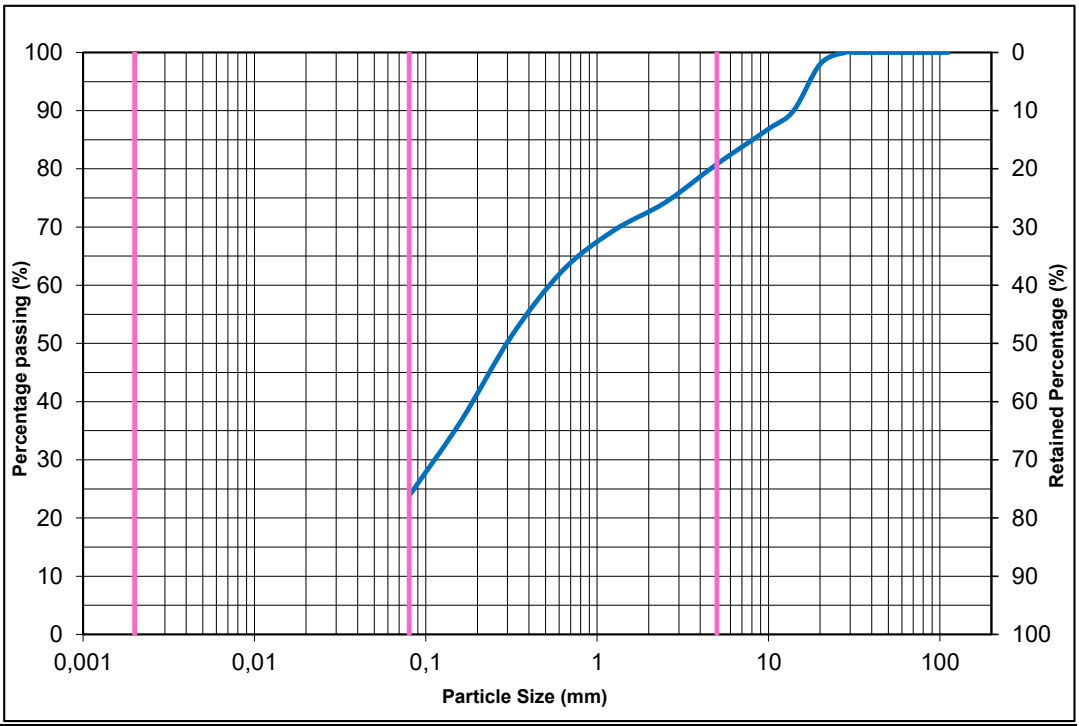
Sampled by : Hugo Desrochers
Sampling Date : November 02, 2022

Project No : 158100425.500.710.5
Sample No : BH22-14 SS-01B
Depth : 0,05 - 0,61m

Material Description : Silty Sand, some Gravel

Grain Size Analysis (BNQ 2501-025)

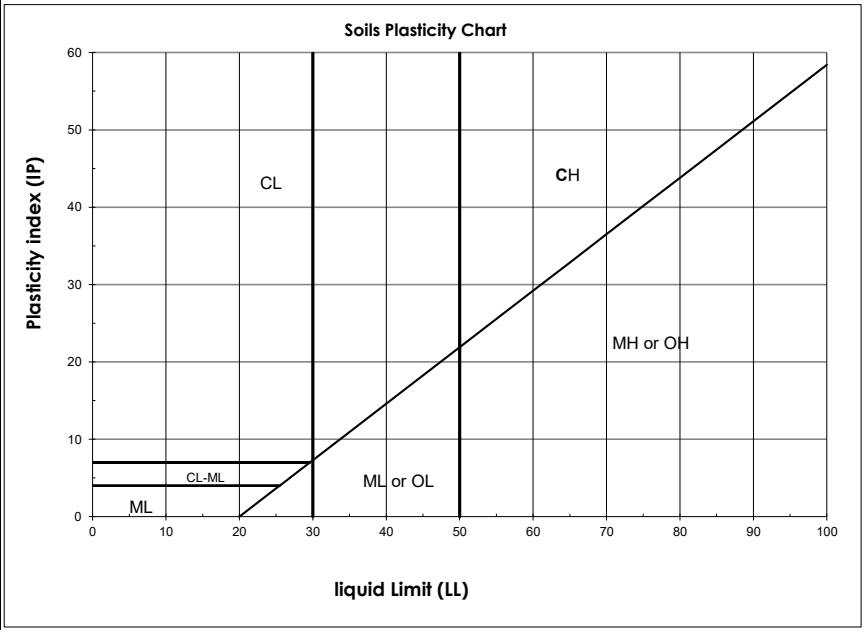
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	98
14,0	90
10,0	87
5,00	81
2,50	74
1,25	69
0,630	63
0,315	51
0,160	37
0,080	23,8



% Gravel : 19,2 % Sand : 57,0 % Fine particles : 23,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	16,9



Remarks :

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Date : January 26, 2023

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

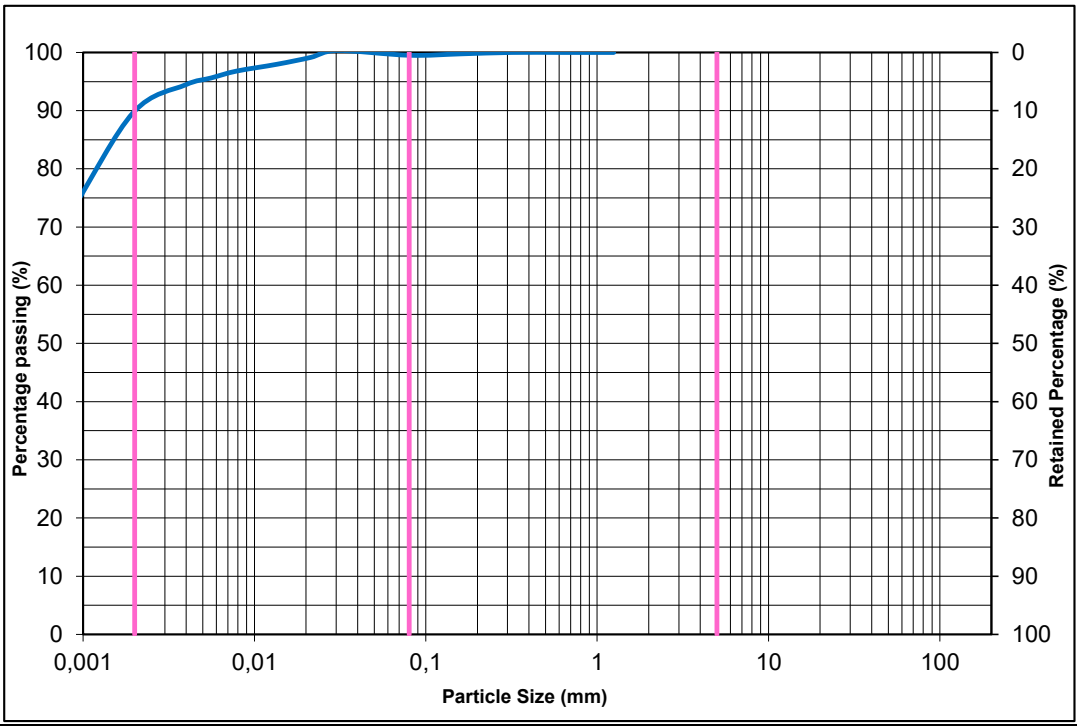
Sampled by : Hugo Desrochers
Sampling Date : November 02, 2022

Project No : 158100425.500.710.5
Sample No : BH22-14 SS-06
Depth : 3,05 - 3,66m

Material Description : Clay, traces of Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

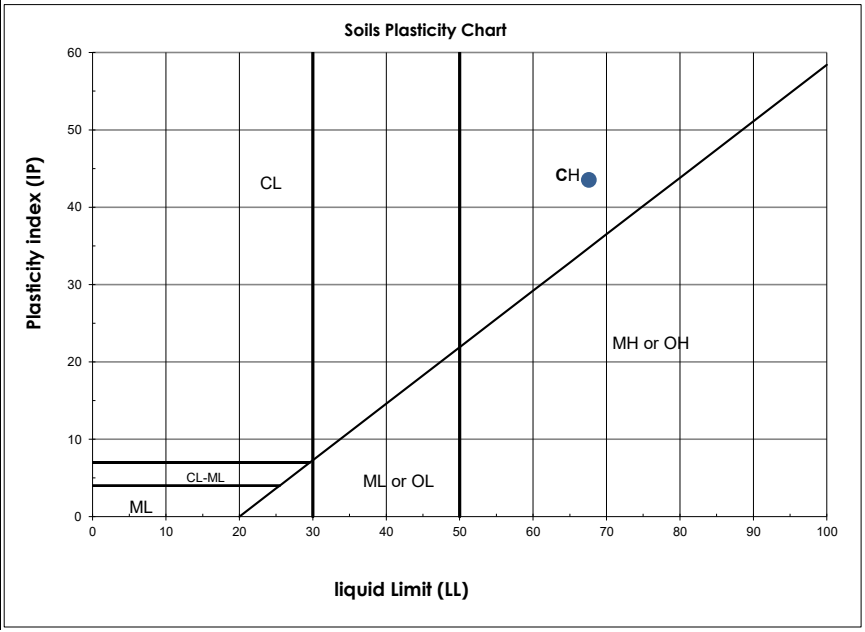
Openings Dimensions	Cumulative Results
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,5



% Gravel: 0,0 % Sand : 0,5 % Silt: 9,3 % Clay: 90,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	57,8
Liquid Limit (BNQ 2501-092)	68
Plastic Limit (BNQ 2501-092)	24
Plasticity Index (BNQ 2501-092)	44



Remarks :

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LABORATORY TESTING REPORT

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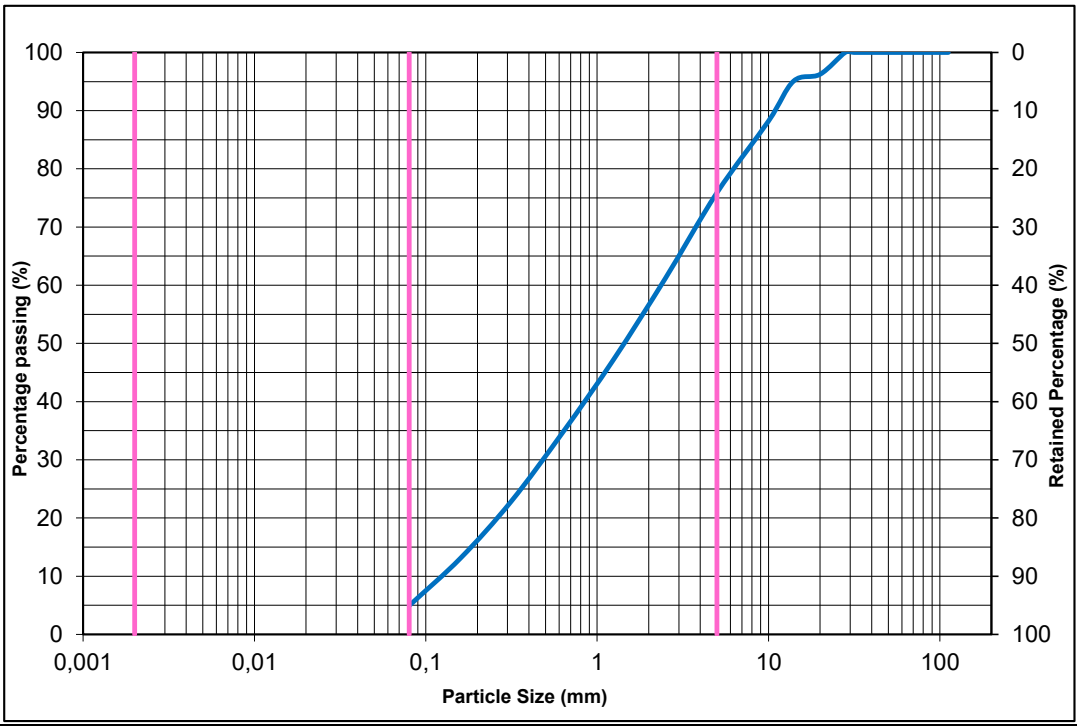
Sampled by : Hugo Desrochers
Sampling Date : November 02, 2022

Project No : 158100425.500.710.5
Sample No : BH22-14 SS-14
Depth : 13,87 - 14,48m

Material Description : Gravely Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

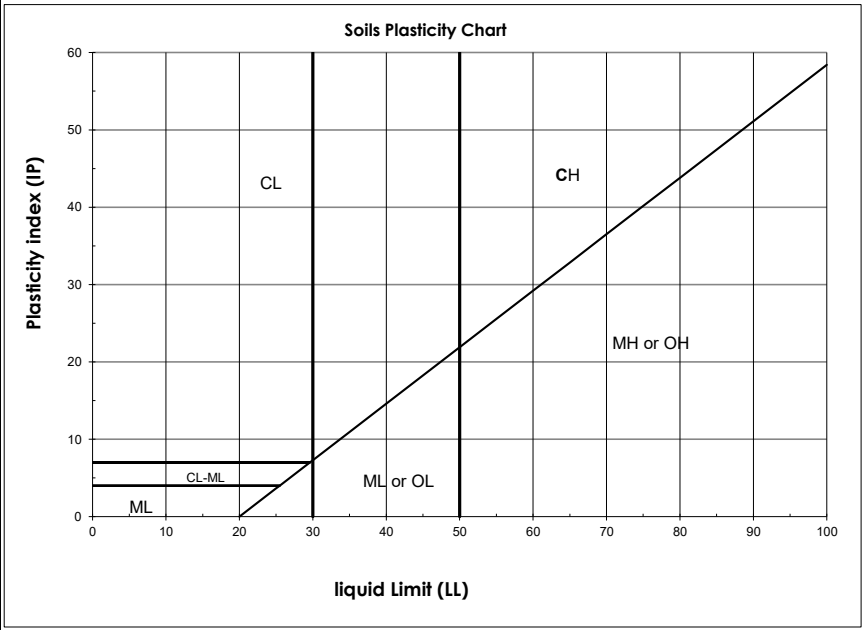
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	95
10,0	88
5,00	76
2,50	61
1,25	47
0,630	35
0,315	23
0,160	13
0,080	4,9



% Gravel : 24,1 % Sand : 71,0 % Fine particles : 4,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	10,0



Remarks :

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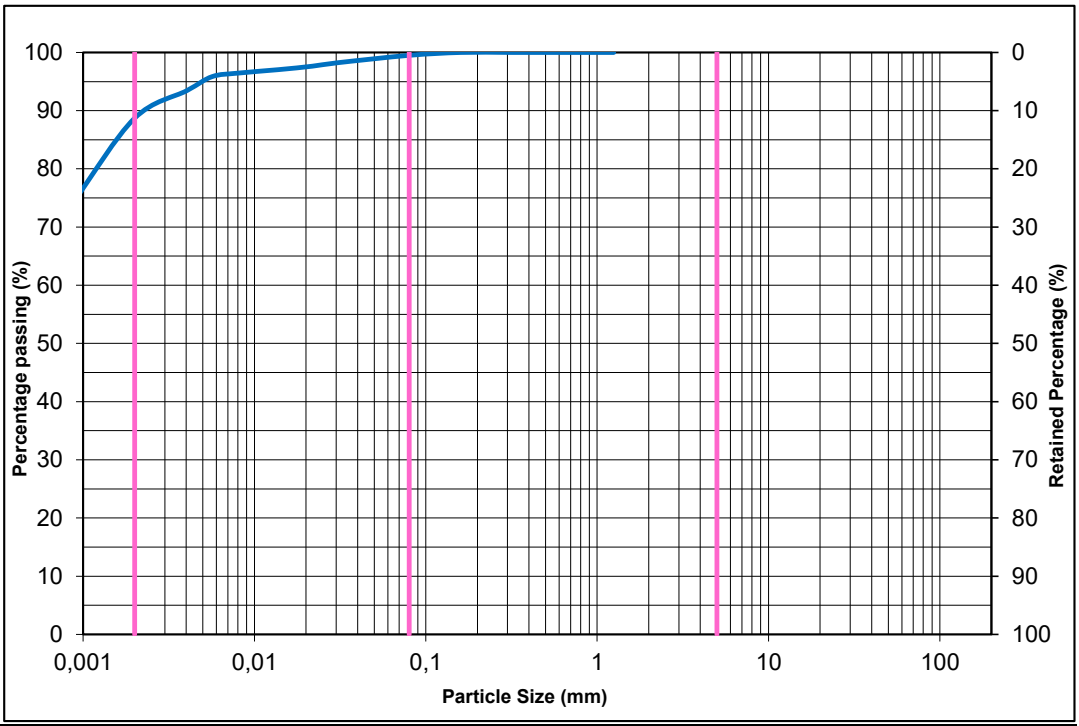
Sampled by : Hugo Desrochers
Sampling Date : October 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-15 SS-02
Depth : 0,61 - 1,22m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

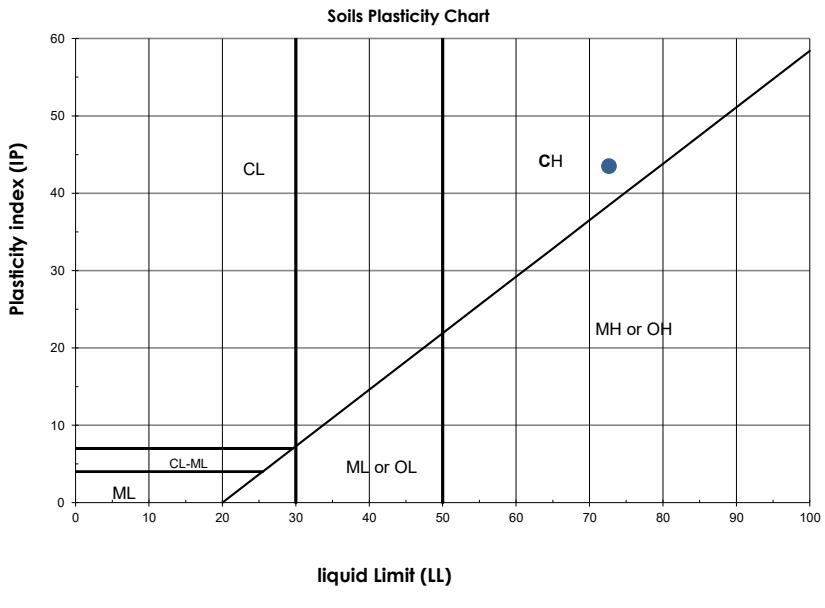
Openings Dimensions	Cumulative Results
mm	%
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,5



% Gravel: 0,0 % Sand : 0,5 % Silt: 10,7 % Clay: 88,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	47,6
Liquid Limit (BNQ 2501-092)	73
Plastic Limit (BNQ 2501-092)	30
Plasticity Index (BNQ 2501-092)	43



Remarks :

Prepared by : Benoit Cyr, Geo.

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LABORATORY TESTING REPORT

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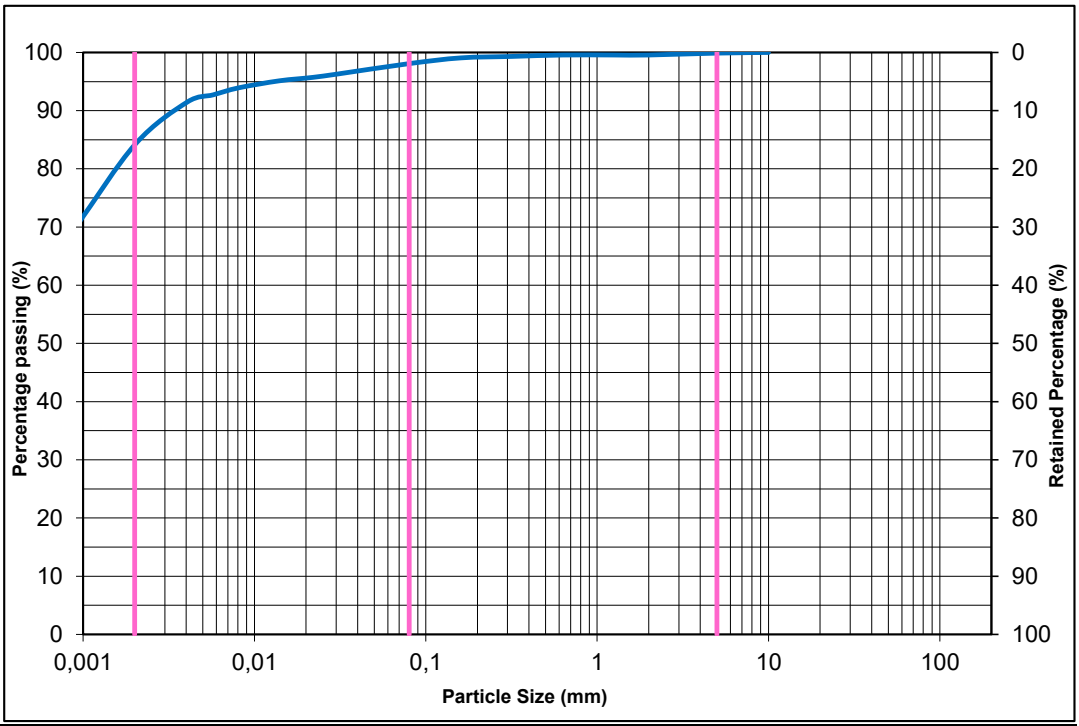
Sampled by : Hugo Desrochers
Sampling Date : October 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-15 SS-04
Depth : 1,83 - 2,44m

Material Description : Clay, some Silt, traces of Sand, traces of Gravel, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

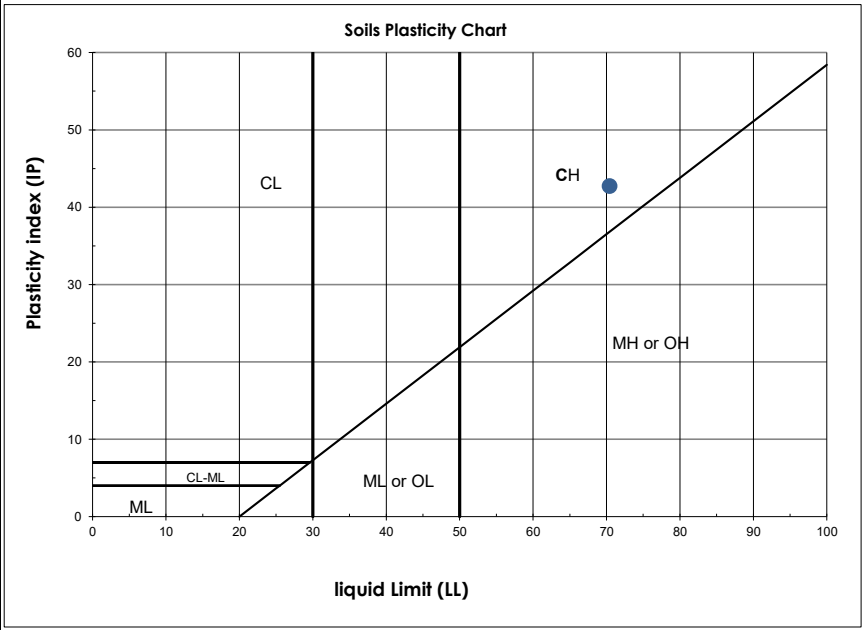
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	99
0,160	99
0,080	98,1



% Gravel: 0,1 % Sand : 1,8 % Silt: 14,1 % Clay: 84,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	66,6
Liquid Limit (BNQ 2501-092)	70
Plastic Limit (BNQ 2501-092)	27
Plasticity Index (BNQ 2501-092)	43



Remarks :

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Date : January 25, 2023

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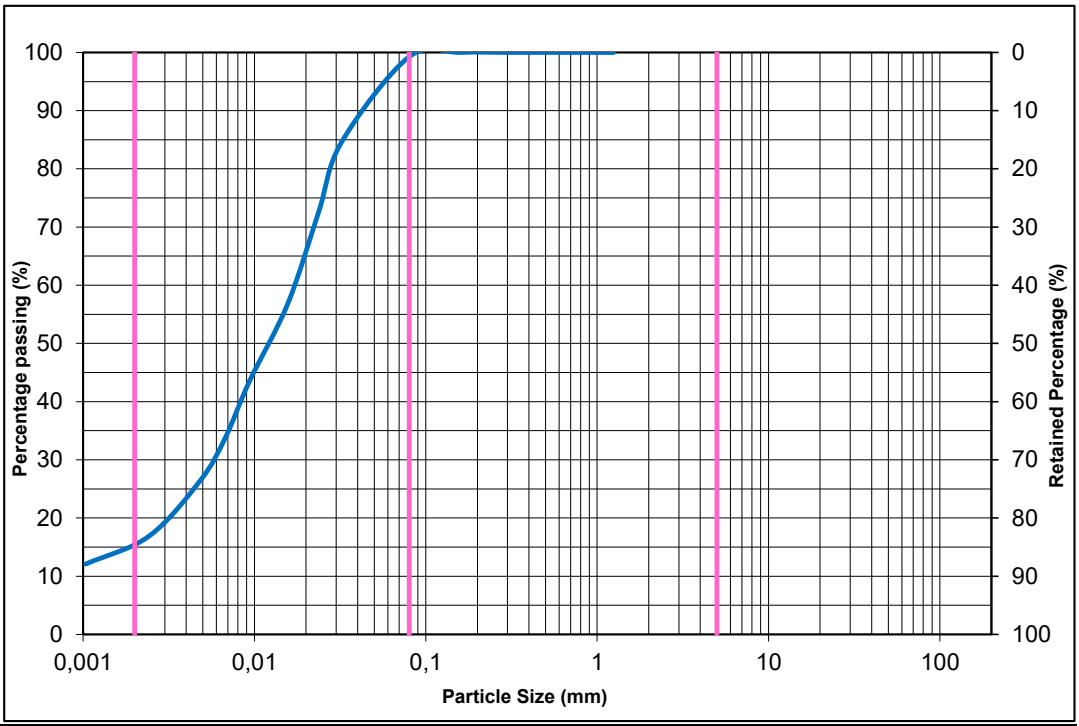
Sampled by : Hugo Desrochers
Sampling Date : October 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-15 SS-13
Depth : 7,32 - 7,92m

Material Description : Silt, some Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

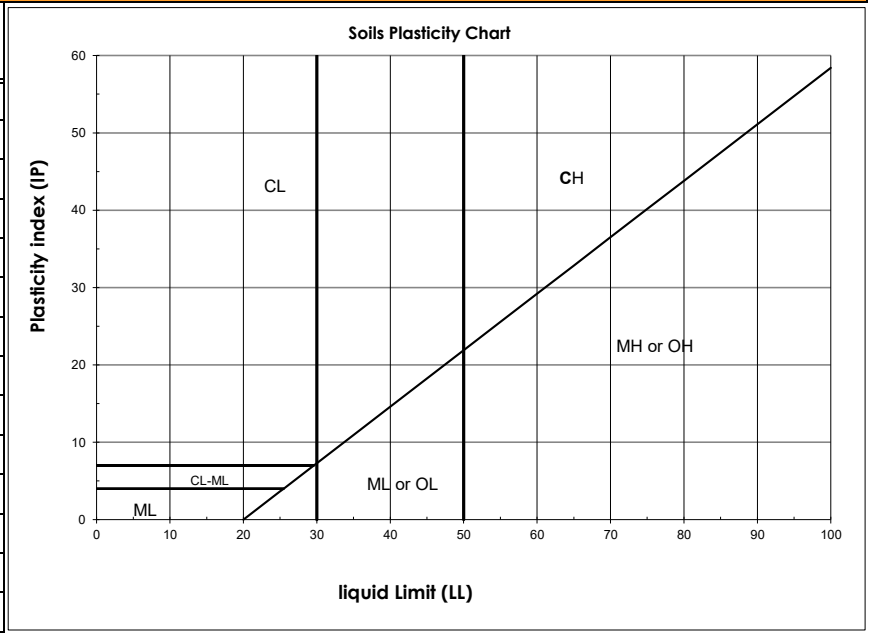
Openings Dimensions	Cumulative Results
mm	%
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,3



% Gravel: 0,0 % Sand : 0,7 % Silt: 83,8 % Clay: 15,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	34,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec

2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

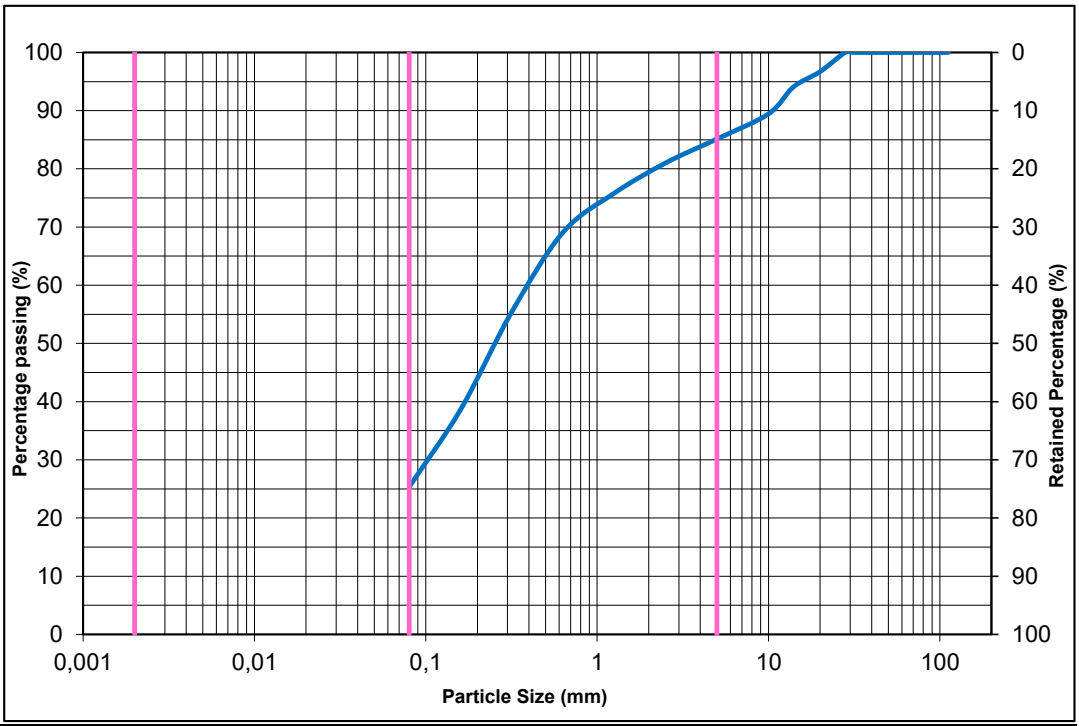
Sampled by : Hugo Desrochers
Sampling Date : October 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-15 SS-23
Depth : 15,85 - 16,46m

Material Description : Silty Sand, some Gravel

Grain Size Analysis (BNQ 2501-025)

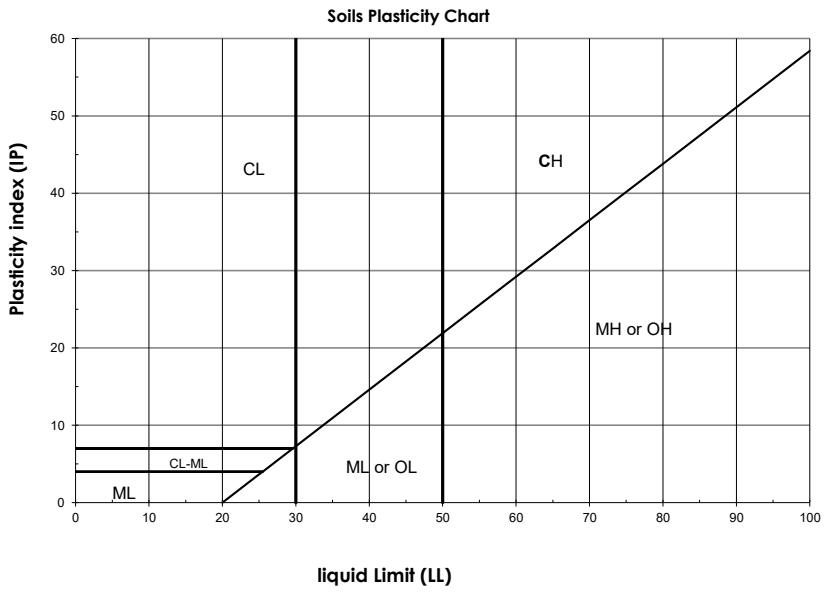
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	97
14,0	94
10,0	89
5,00	85
2,50	81
1,25	76
0,630	69
0,315	55
0,160	39
0,080	25,4



% Gravel : 14,8 % Sand : 59,8 % Fine particles : 25,4

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,1



Remarks :

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Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

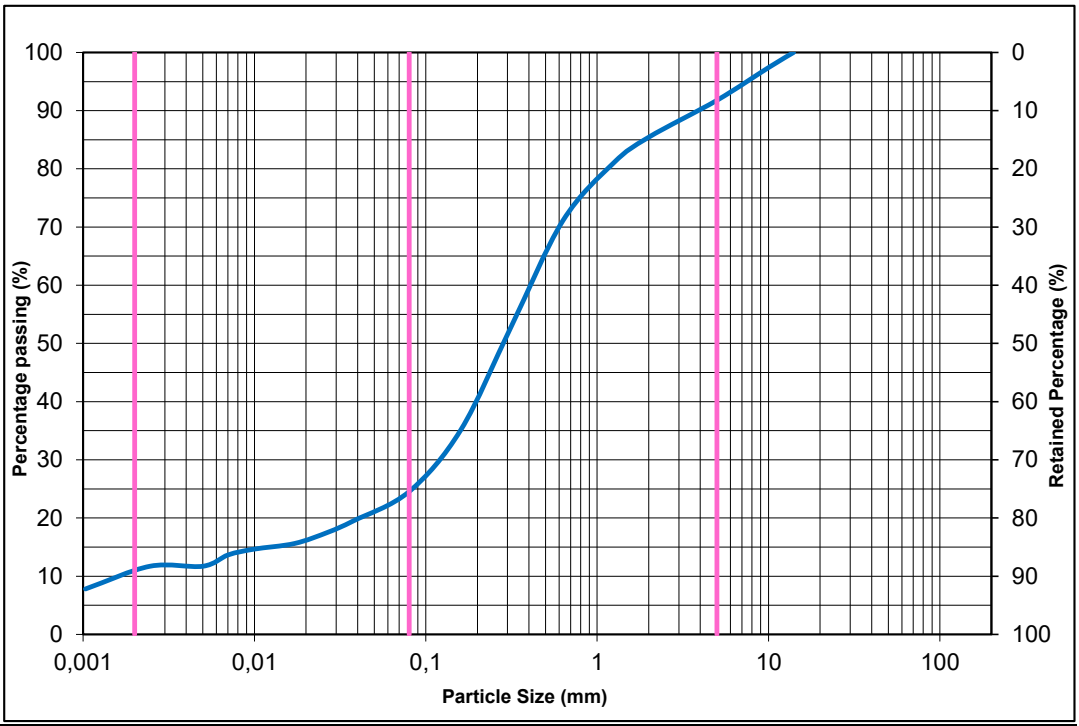
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 18, 2022

Project No : 158100425.500.710.5
Sample No : BH22-16 SS-01
Depth : 0,00 - 0,61m

Material Description : Sand, some Silt, some Clay, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

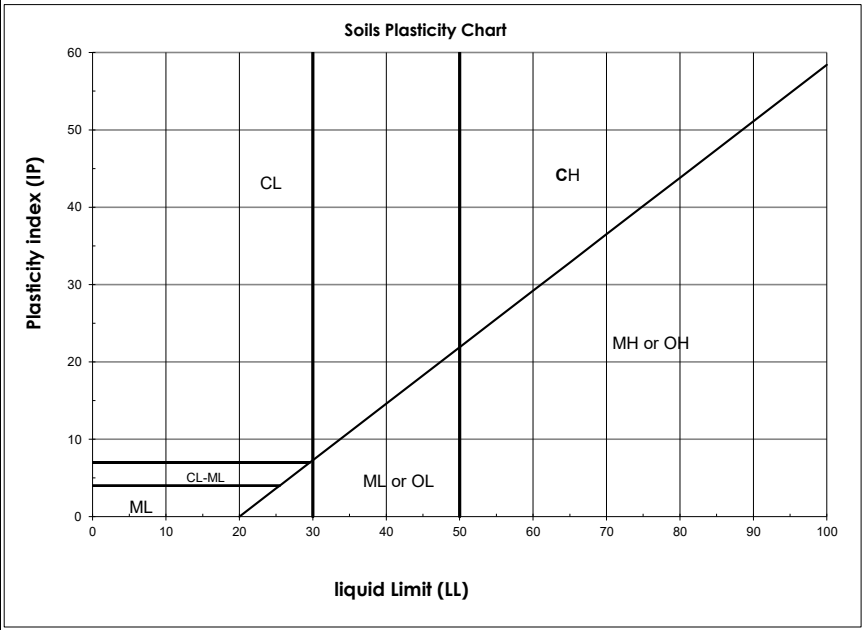
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	97
5,00	92
2,00	85
1,25	81
0,630	71
0,315	53
0,160	35
0,080	24,6



% Gravel: 8,2 % Sand : 67,2 % Silt: 14,1 % Clay: 10,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	11,4



Remarks :

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

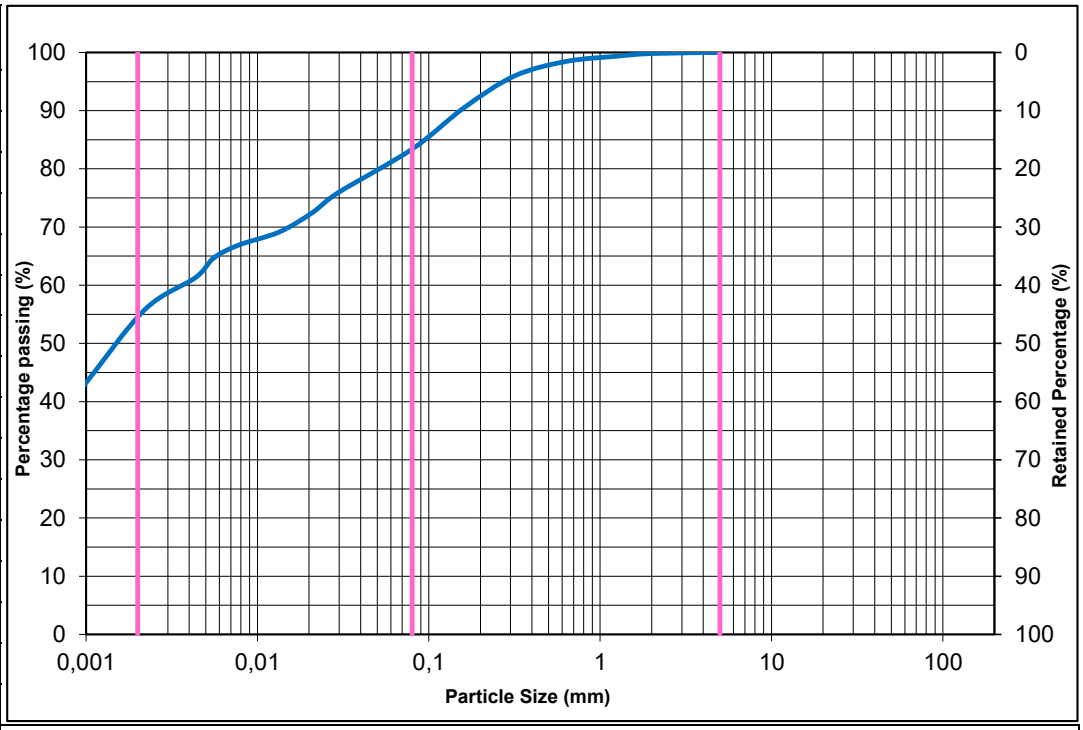
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 18, 2022

Project No : 158100425.500.710.5
Sample No : BH22-16 SS-05
Depth : 2,44 - 3,05m

Material Description : Silty Clay, some Sand

Grain Size Analysis (BNQ 2501-025)

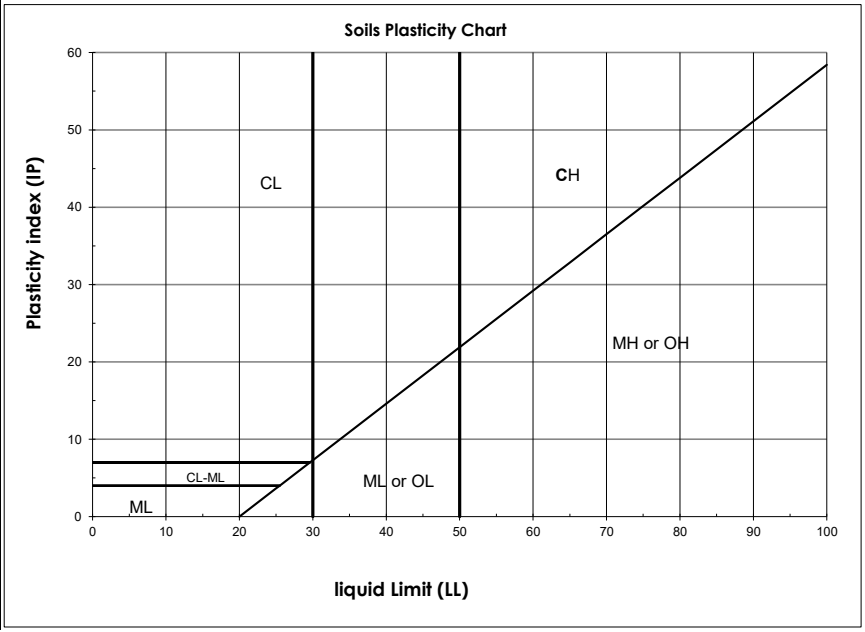
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	99
0,630	98
0,315	96
0,160	90
0,080	83,4



% Gravel: 0,0 % Sand : 16,6 % Silt: 29,7 % Clay: 53,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	46,1



Remarks :

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

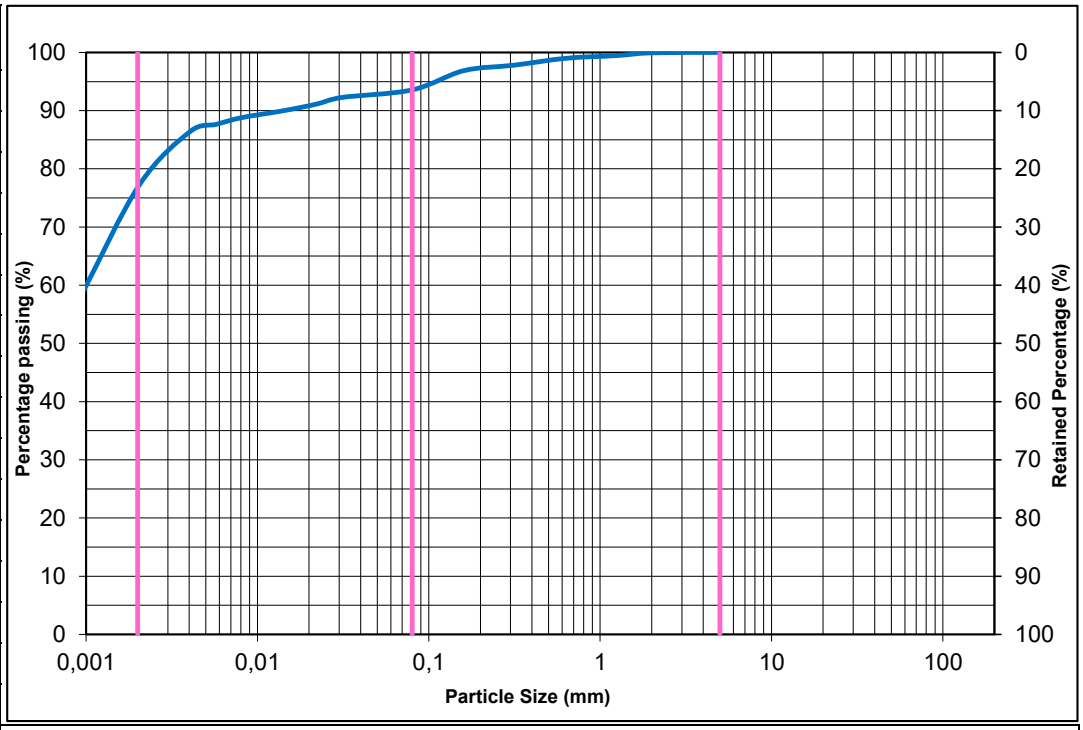
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 18, 2022

Project No : 158100425.500.710.5
Sample No : BH22-16 SS-08
Depth : 4,27 - 4,88m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

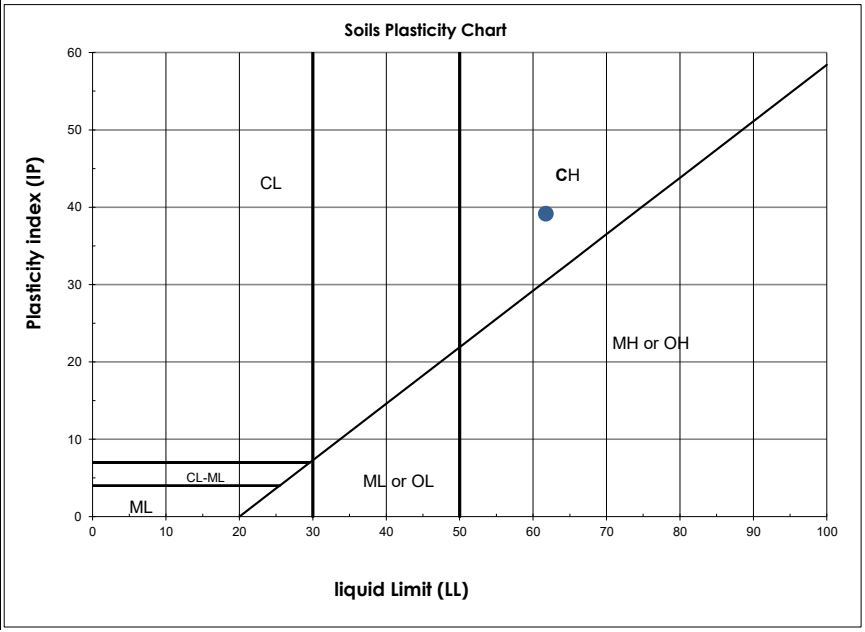
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	99
0,630	99
0,315	98
0,160	97
0,080	93,6



% Gravel: 0,0 % Sand : 6,4 % Silt: 17,1 % Clay: 76,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	71,1
Liquid Limit (BNQ 2501-092)	62
Plastic Limit (BNQ 2501-092)	23
Plasticity Index (BNQ 2501-092)	39



Remarks :

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

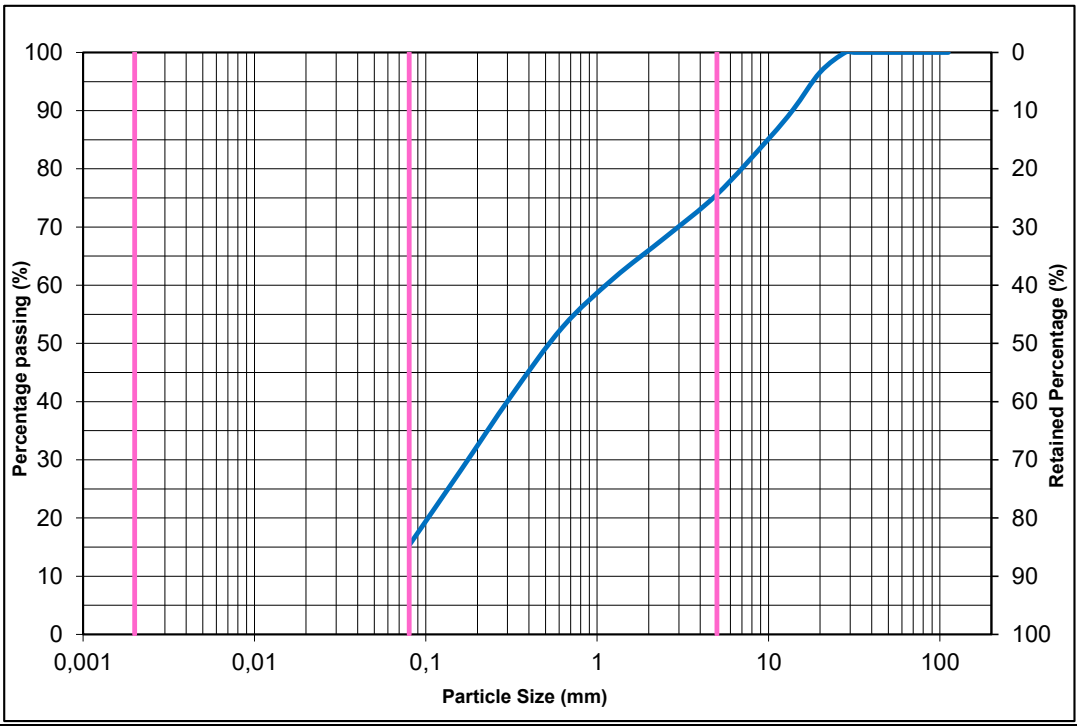
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 18, 2022

Project No : 158100425.500.710.5
Sample No : BH22-16 SS-11
Depth : 9,14 - 9,75m

Material Description : Gravely Sand, some fine particles

Grain Size Analysis (BNQ 2501-025)

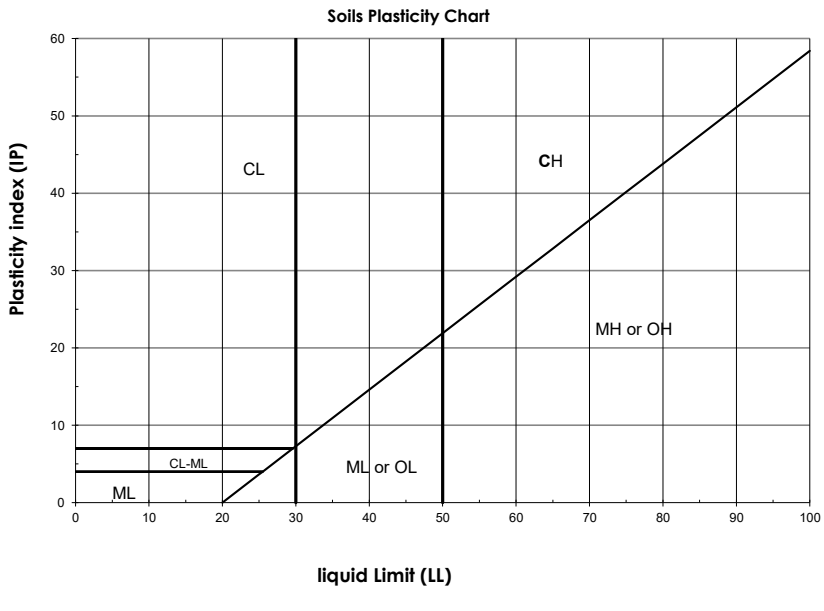
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	97
14,0	90
10,0	85
5,00	76
2,50	68
1,25	61
0,630	53
0,315	41
0,160	28
0,080	15,3



% Gravel : 24,4 % Sand : 60,3 % Fine particles : 15,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,5



Remarks :

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

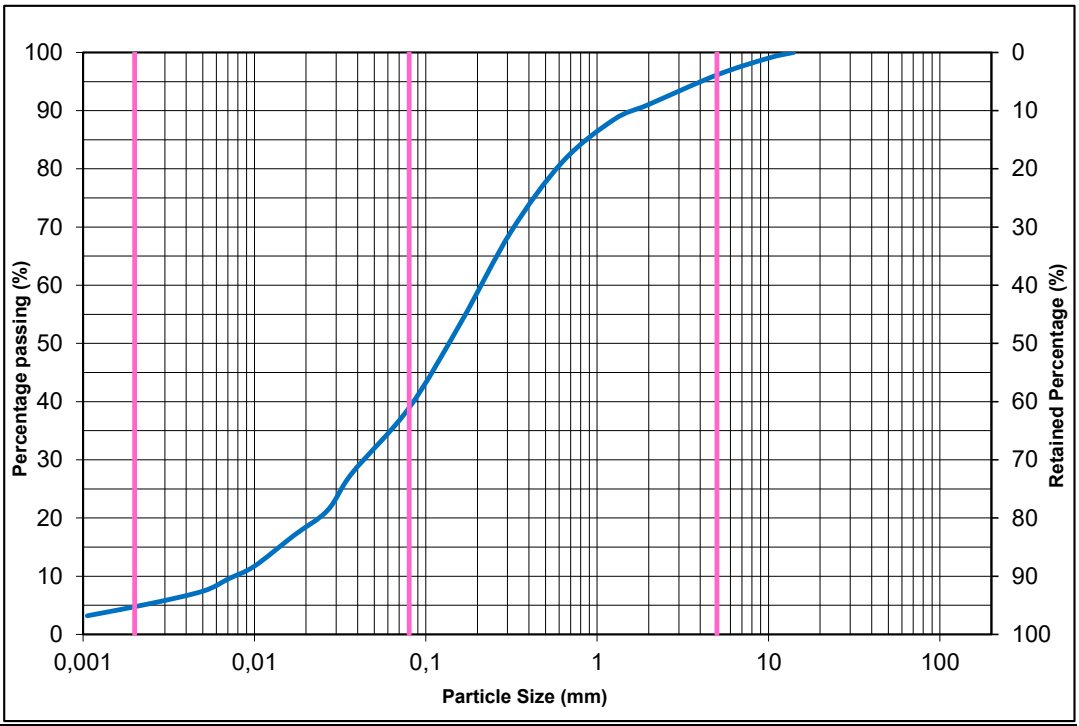
Sampled by : Hugo Desrochers
Sampling Date : September 22, 2022

Project No : 158100425.500.710.5
Sample No : BH22-17 SS-02
Depth : 0,61 - 1,22m

Material Description : Silty Sand, traces of Clay, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

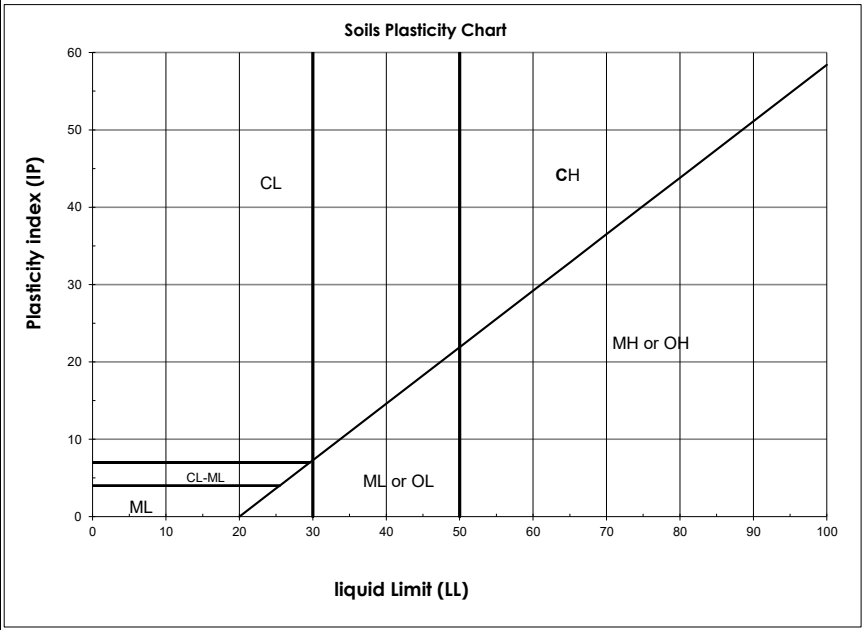
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	96
2,00	91
1,25	88
0,630	81
0,315	69
0,160	54
0,080	39,0



% Gravel: 3,8 % Sand : 57,2 % Silt: 34,4 % Clay: 4,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	10,5



Remarks :

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Date : January 25, 2023

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

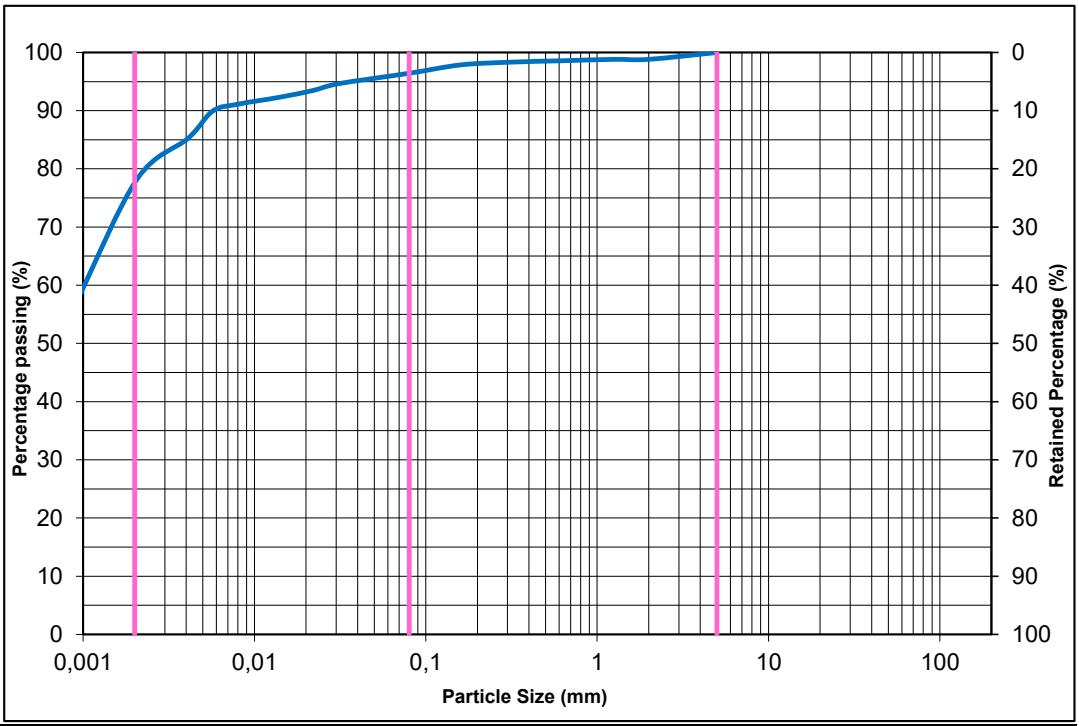
Sampled by : Hugo Desrochers
Sampling Date : September 22, 2022

Project No : 158100425.500.710.5
Sample No : BH22-17 SS-07
Depth : 3,66 - 4,27m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

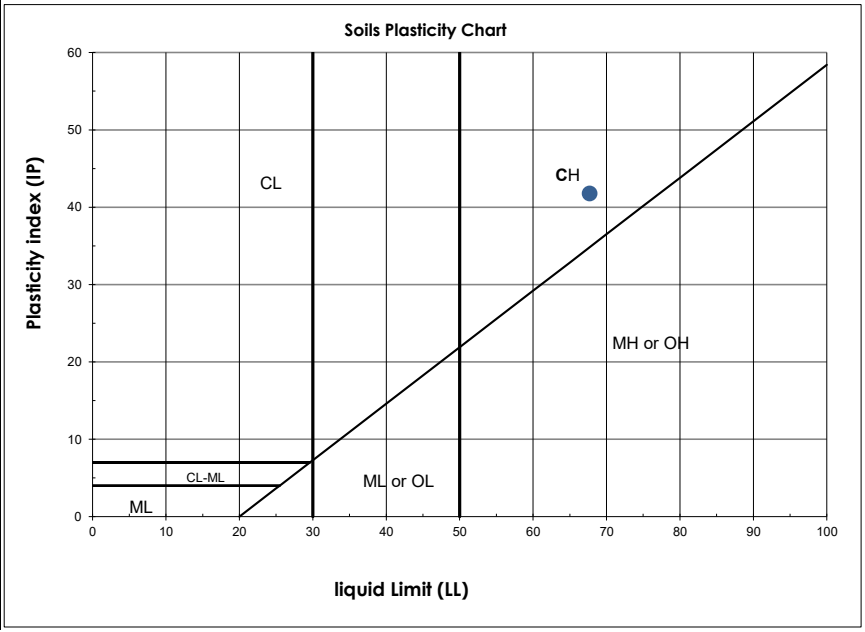
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	99
1,25	99
0,630	99
0,315	98
0,160	98
0,080	96,4



% Gravel: 0,0 % Sand : 3,6 % Silt: 19,4 % Clay: 77,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	70,0
Liquid Limit (BNQ 2501-092)	68
Plastic Limit (BNQ 2501-092)	26
Plasticity Index (BNQ 2501-092)	42



Remarks :

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Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

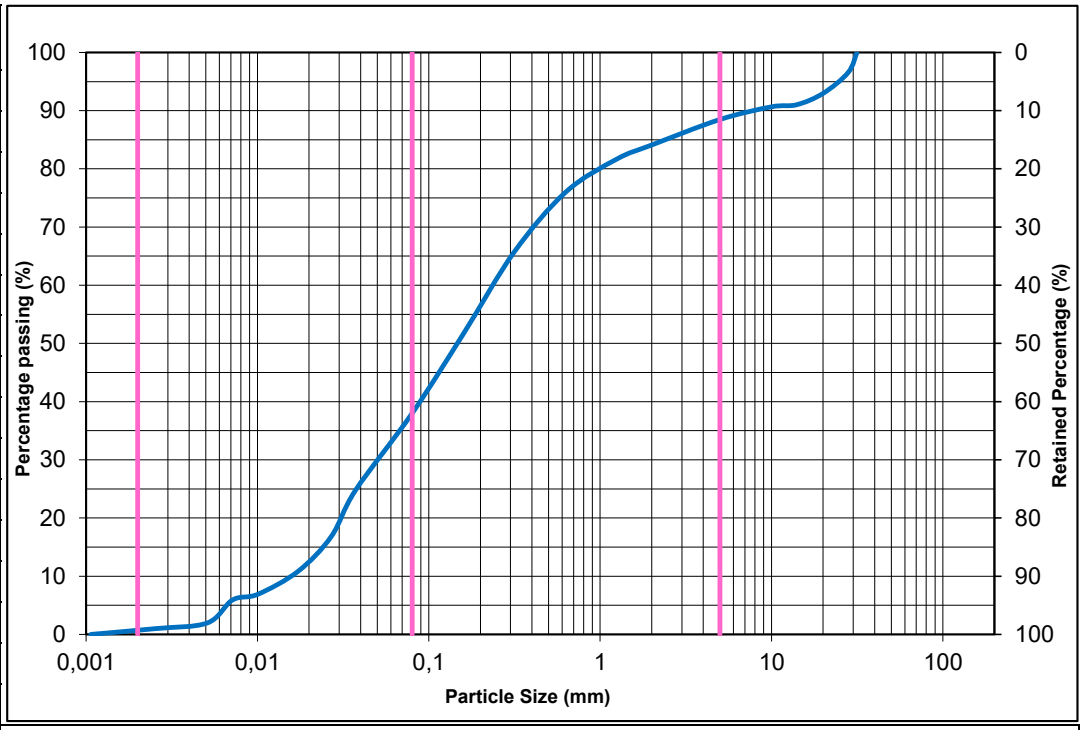
Sampled by : Hugo Desrochers
Sampling Date : September 22, 2022

Project No : 158100425.500.710.5
Sample No : BH22-17 SS-15
Depth : 9,15 - 9,75m

Material Description : Sand and Silt, some Gravel, traces of Clay

Grain Size Analysis (BNQ 2501-025)

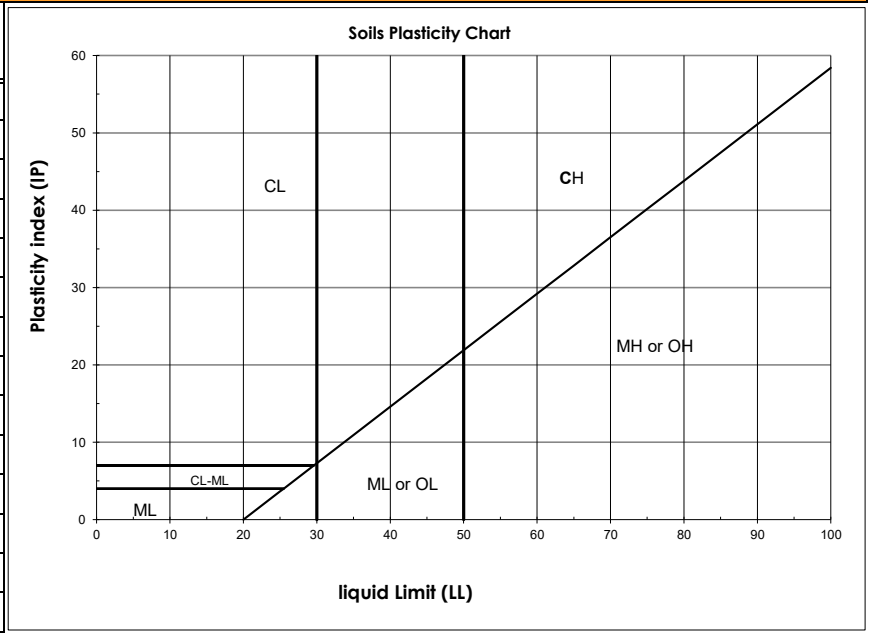
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	97
20,0	93
14,0	91
10,0	91
5,00	88
2,00	84
1,25	82
0,630	76
0,315	66
0,160	52
0,080	38,0



% Gravel: 11,5 % Sand : 50,5 % Silt: 37,4 % Clay: 0,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	9,0



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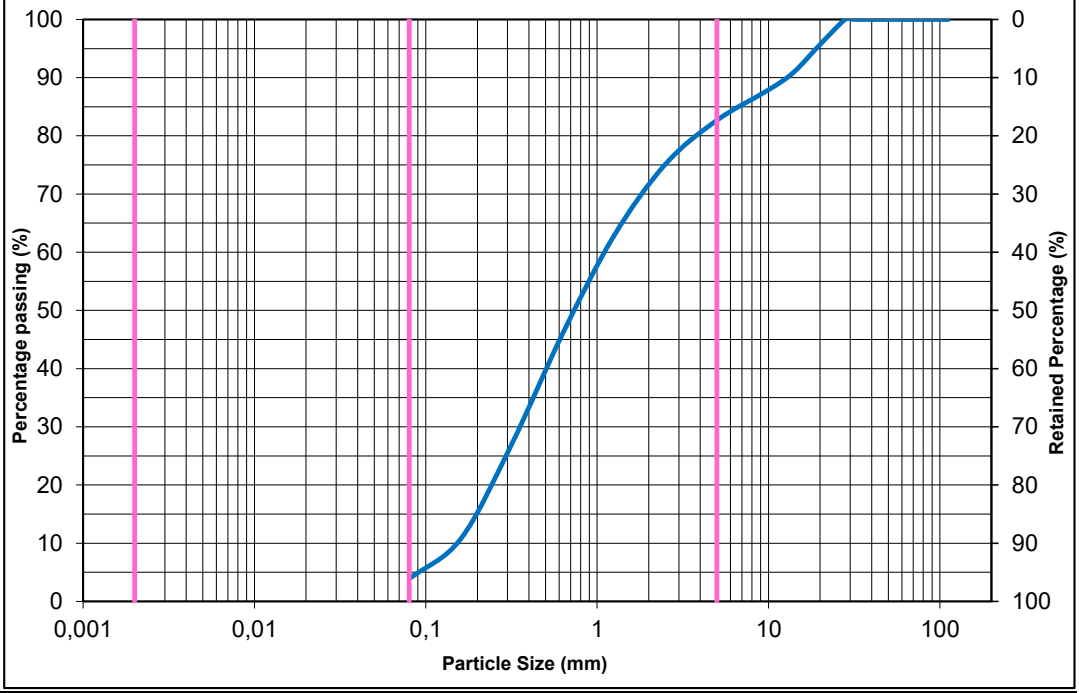
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-18 SS-01
Depth : 0,00 - 0,61m

Material Description : Sand, some Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

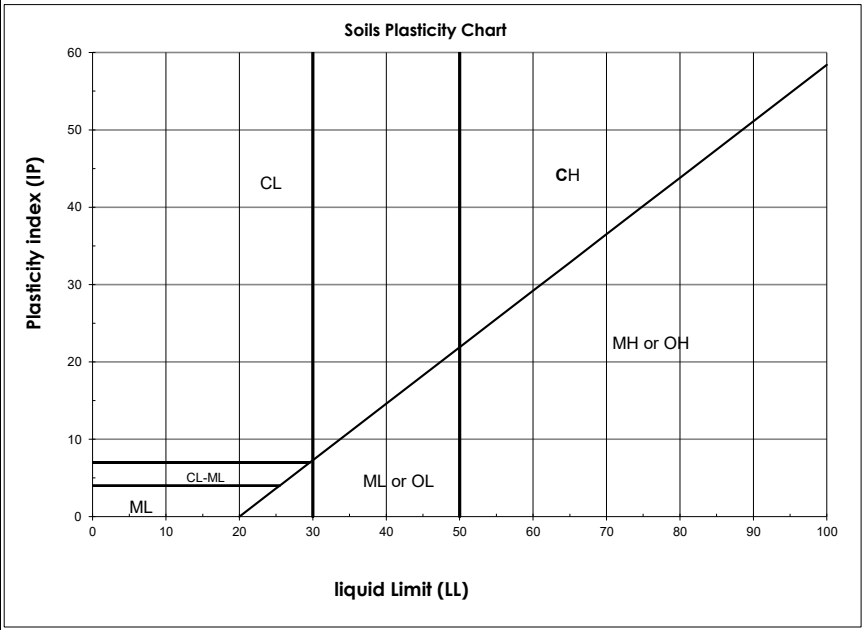
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	91
10,0	88
5,00	83
2,50	75
1,25	63
0,630	46
0,315	27
0,160	11
0,080	3,9



% Gravel : 17,3 % Sand : 78,8 % Fine particles : 3,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	5,3



Remarks :

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

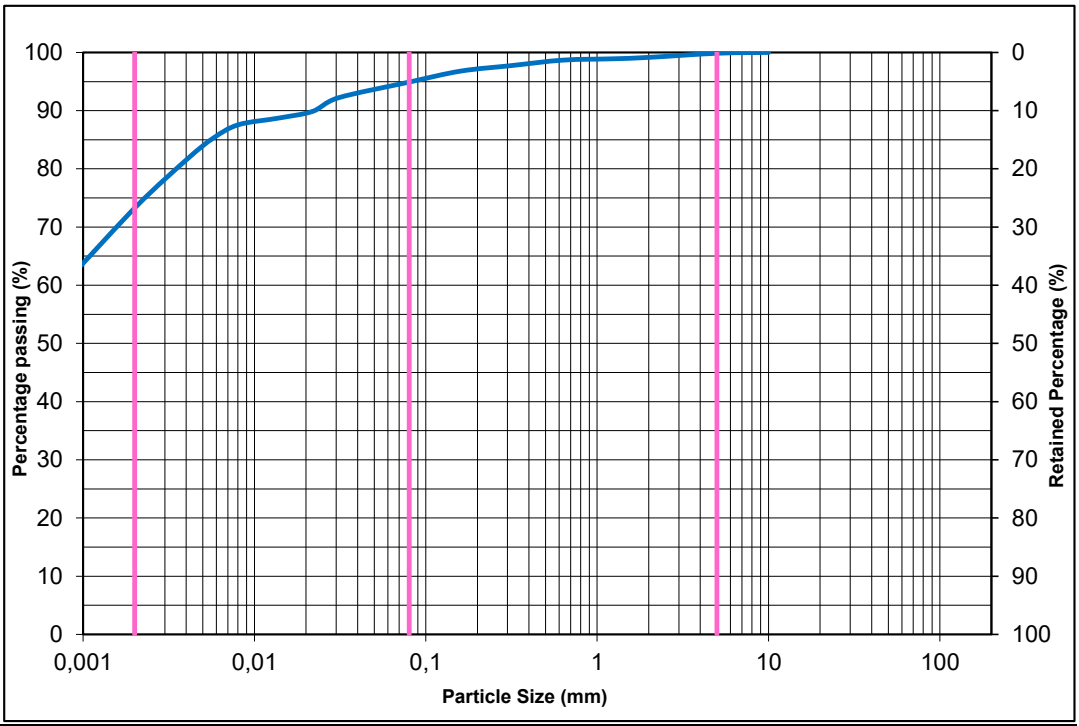
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-18 SS-06
Depth : 3,66 - 4,27m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

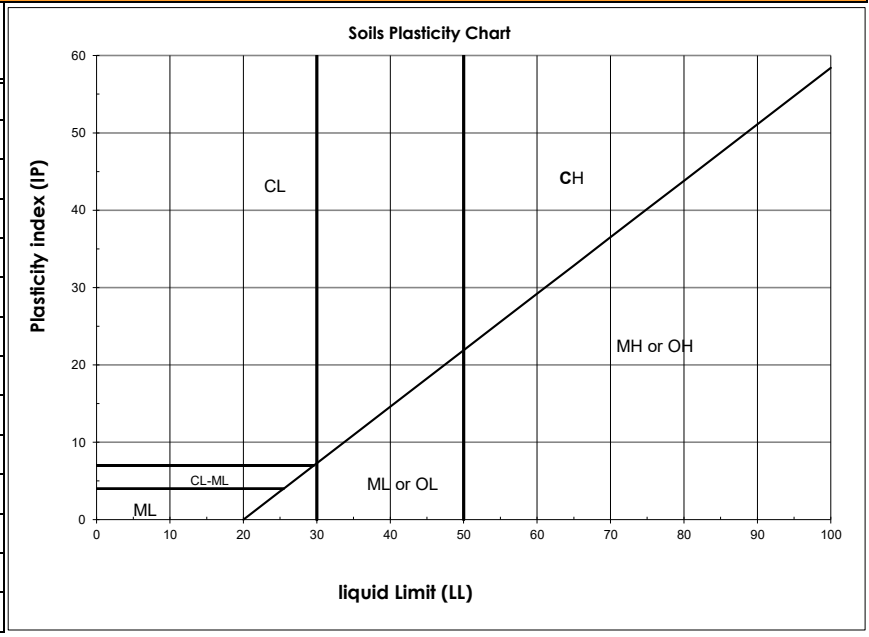
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	99
1,25	99
0,630	99
0,315	98
0,160	97
0,080	94,9



% Gravel: 0,2 % Sand : 4,9 % Silt: 21,9 % Clay: 73,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	42,4



Remarks :

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LABORATORY TESTING REPORT

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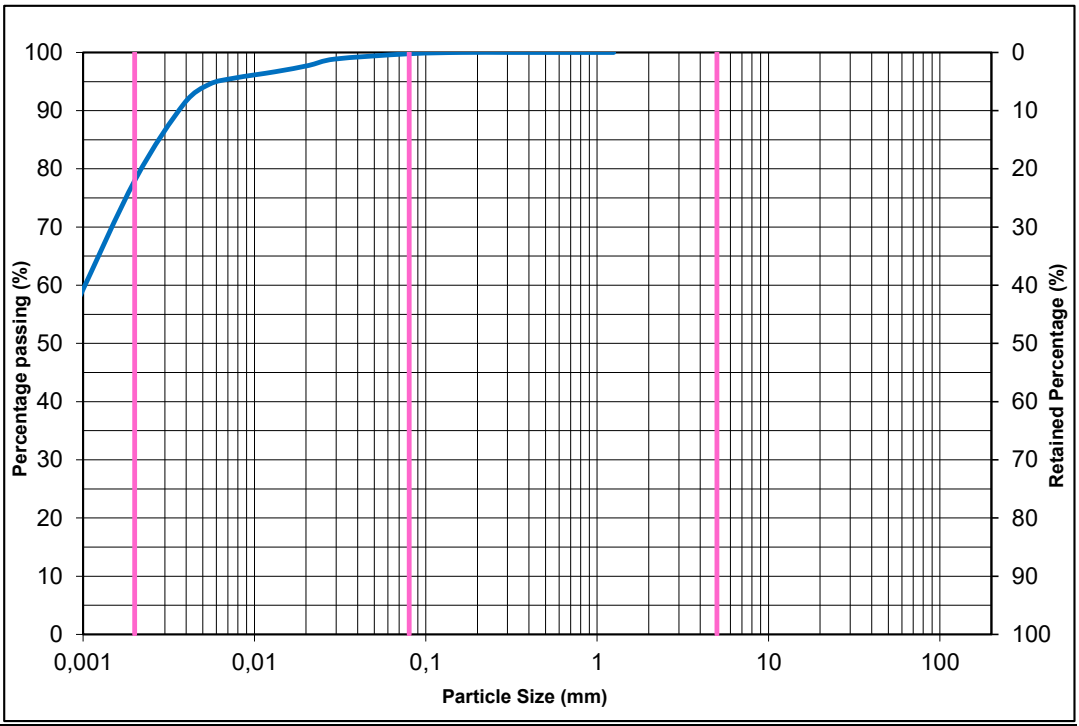
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-18 SS-11
Depth : 6,71 - 7,32m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

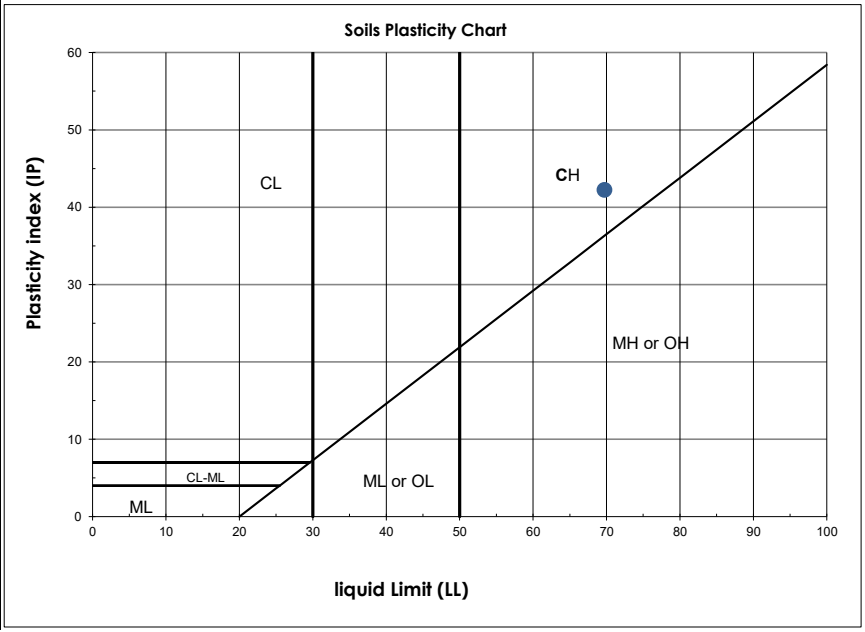
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,8



% Gravel: 0,0 % Sand : 0,2 % Silt: 22,0 % Clay: 77,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	63,9
Liquid Limit (BNQ 2501-092)	70
Plastic Limit (BNQ 2501-092)	28
Plasticity Index (BNQ 2501-092)	42



Remarks :

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LABORATORY TESTING REPORT

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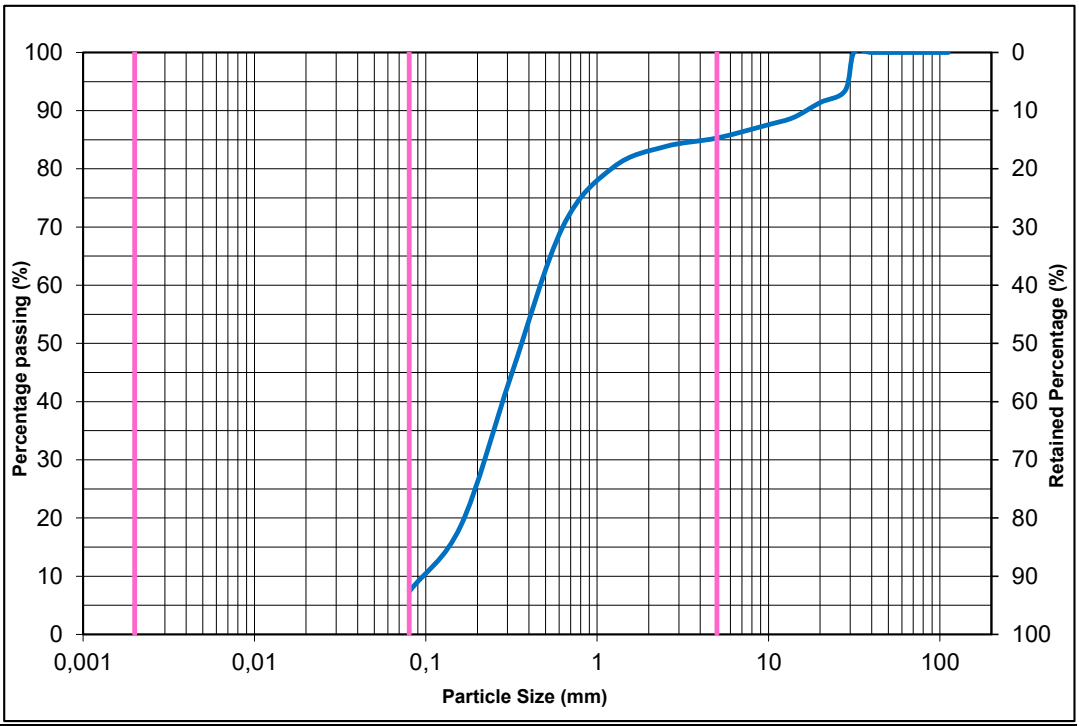
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 19, 2022

Project No : 158100425.500.710.5
Sample No : BH22-20 SS-01
Depth : 0,00 - 0,61m

Material Description : Sand, some Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

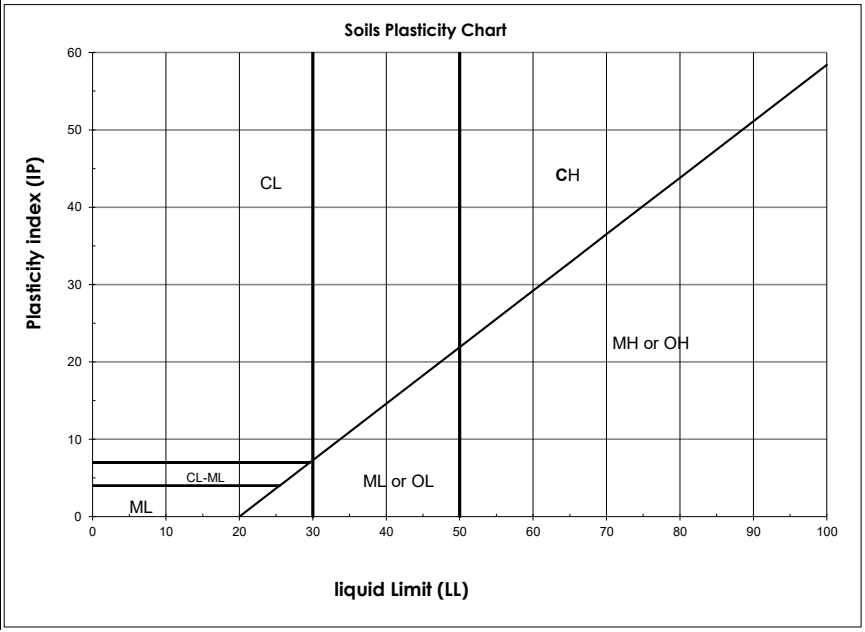
Openings Dimensions	Cumulative Results
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56,0	100
40,0	100
31,5	100
28,0	93
20,0	91
14,0	89
10,0	88
5,00	85
2,50	84
1,25	80
0,630	70
0,315	45
0,160	19
0,080	7,4



% Gravel : 14,7 % Sand : 77,9 % Fine particles : 7,4

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	4,4



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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LABORATORY TESTING REPORT

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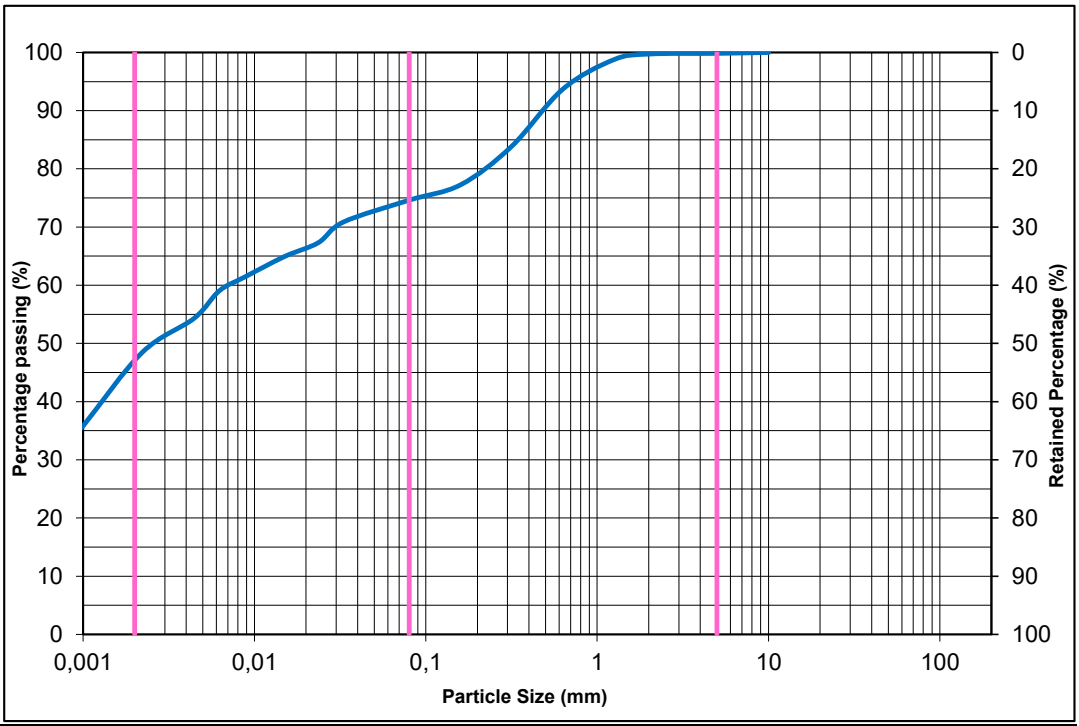
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 19, 2022

Project No : 158100425.500.710.5
Sample No : BH22-20 SS-02
Depth : 0,61 - 1,22m

Material Description : Sandy, Silty Clay, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

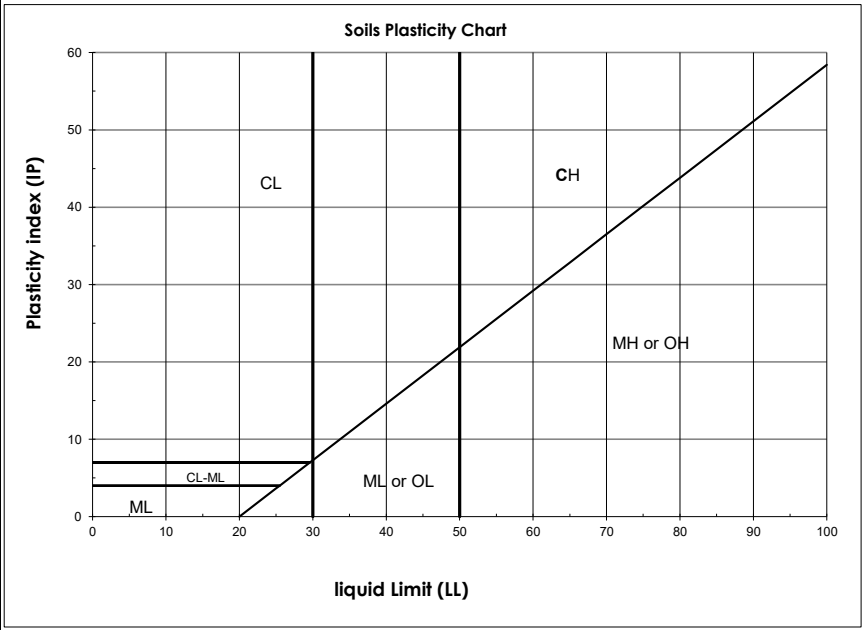
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	99
0,630	94
0,315	84
0,160	77
0,080	74,6



% Gravel: 0,2 % Sand : 25,2 % Silt: 28,4 % Clay: 46,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	30,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

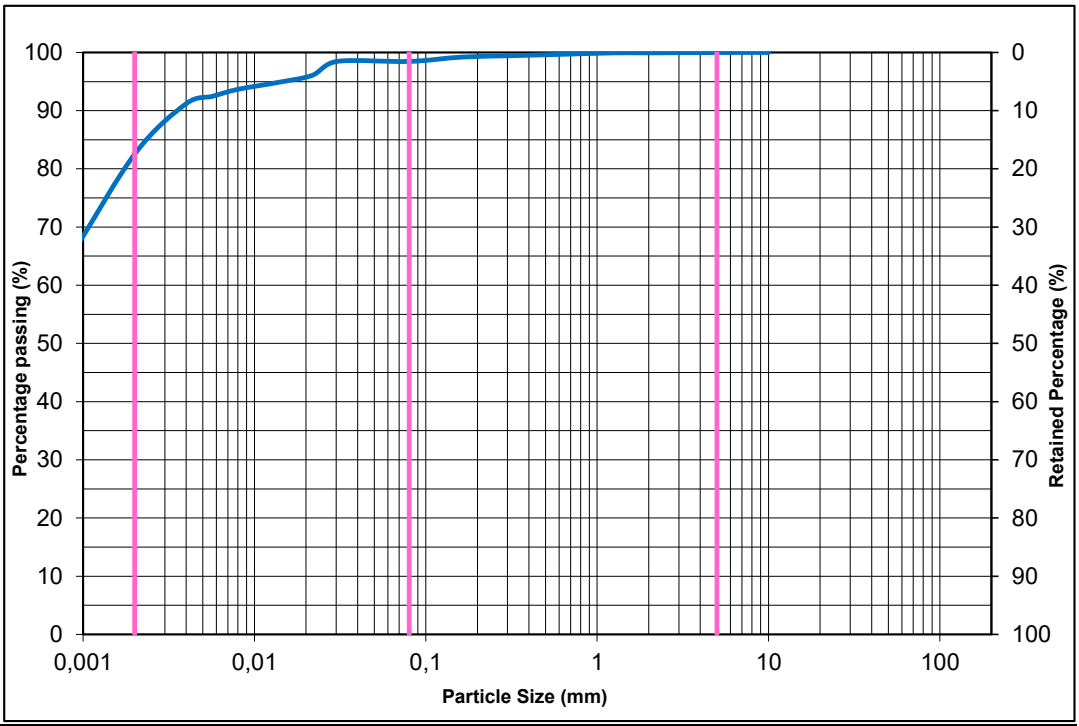
Sampled by : Hugo Desrochers
Sampling Date : September 19, 2022

Project No : 158100425.500.710.5
Sample No : BH22-20 SS-04
Depth : 1,83 - 2,44m

Material Description : Clay, some Silt, traces of Sand

Grain Size Analysis (BNQ 2501-025)

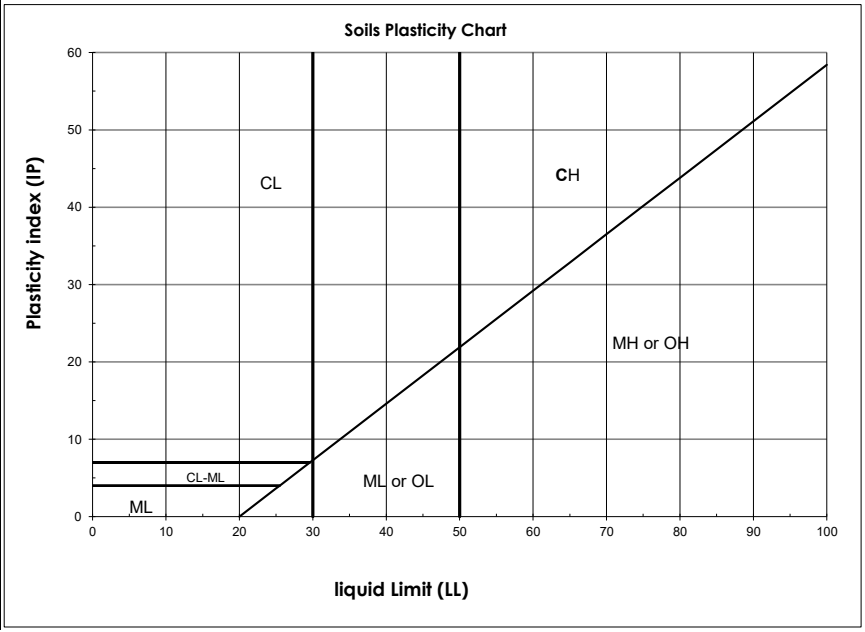
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	99
0,160	99
0,080	98,5



% Gravel: 0,0 % Sand : 1,5 % Silt: 16,2 % Clay: 82,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	39,8



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

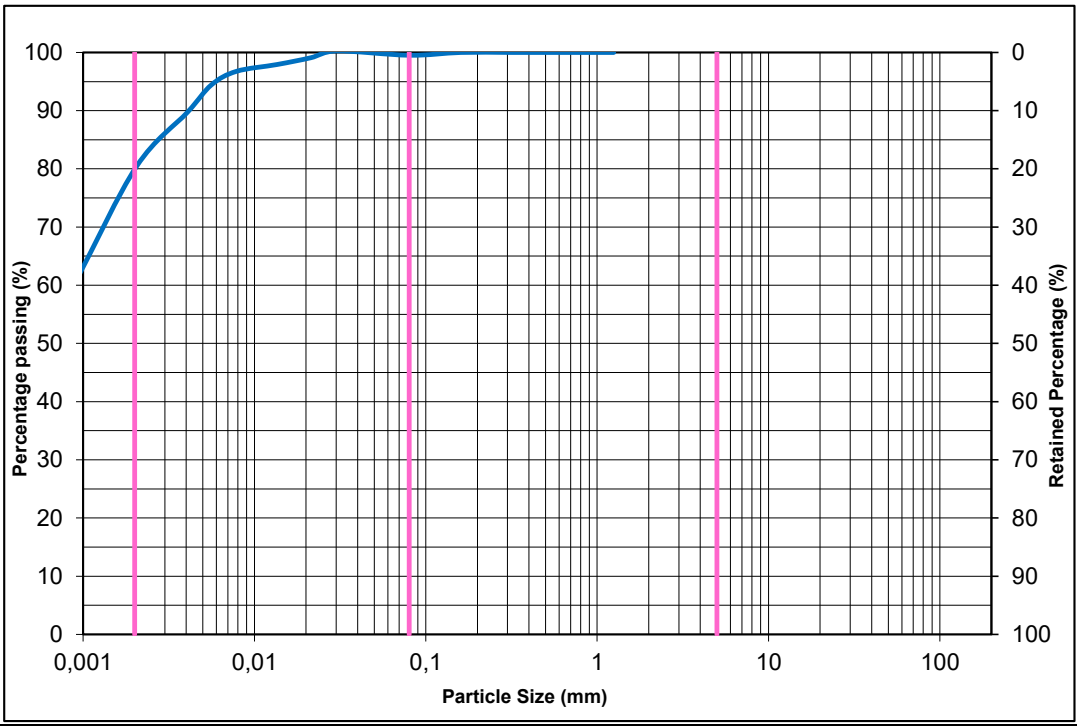
Sampled by : Hugo Desrochers
Sampling Date : September 19, 2022

Project No : 158100425.500.710.5
Sample No : BH22-20 SS-08
Depth : 4,27 - 4,88m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

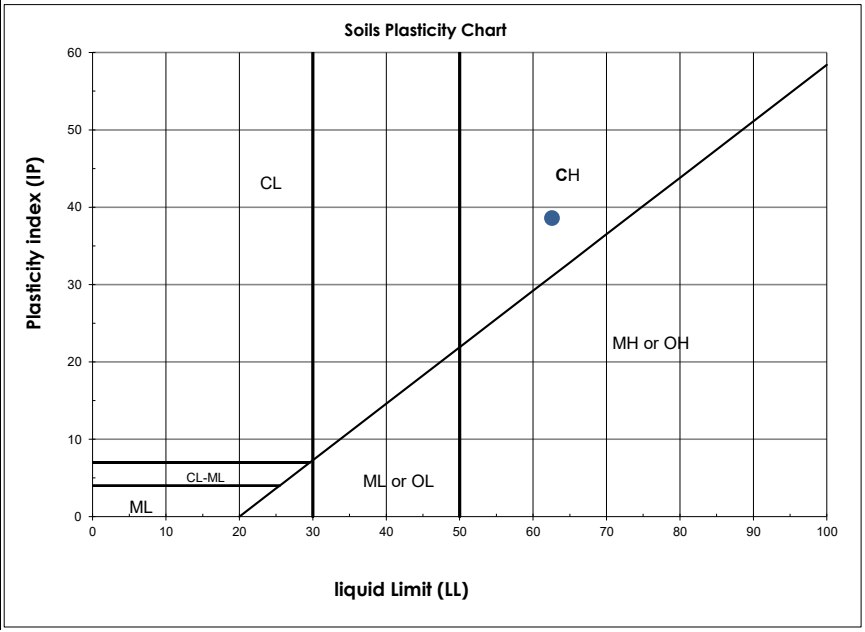
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,5



% Gravel: 0,0 % Sand : 0,5 % Silt: 20,0 % Clay: 79,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	59,6
Liquid Limit (BNQ 2501-092)	63
Plastic Limit (BNQ 2501-092)	24
Plasticity Index (BNQ 2501-092)	39



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

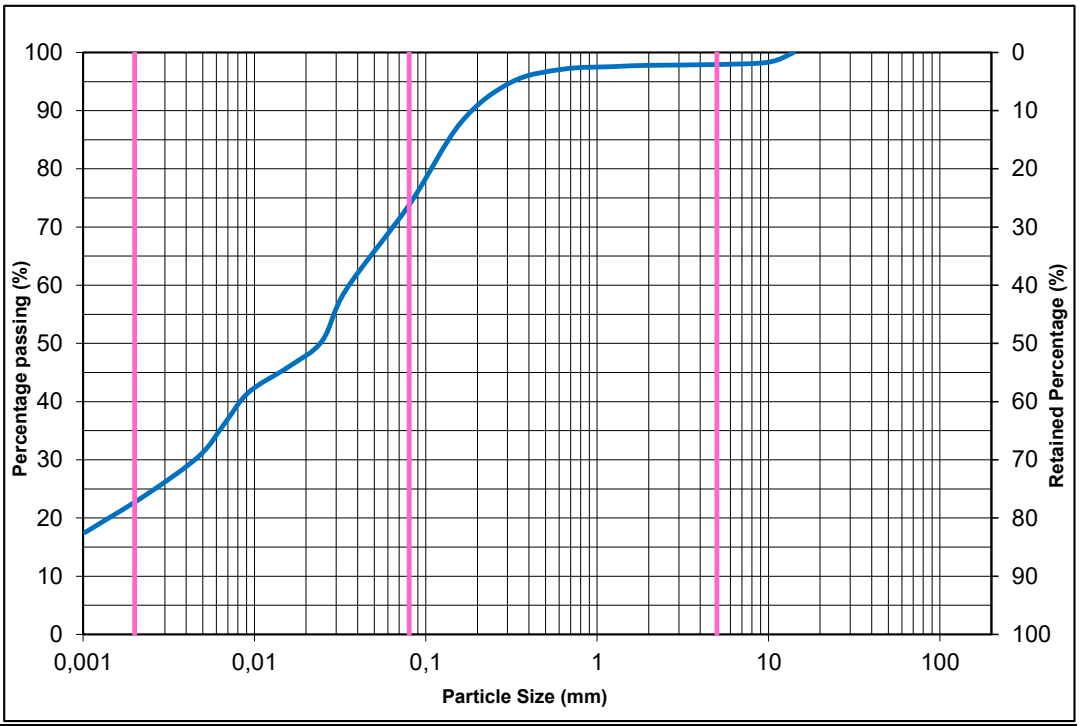
Sampled by : Hugo Desrochers
Sampling Date : September 19, 2022

Project No : 158100425.500.710.5
Sample No : BH22-20 SS-11
Depth : 6,71 - 7,32m

Material Description : Clayey, Sandy Silt, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

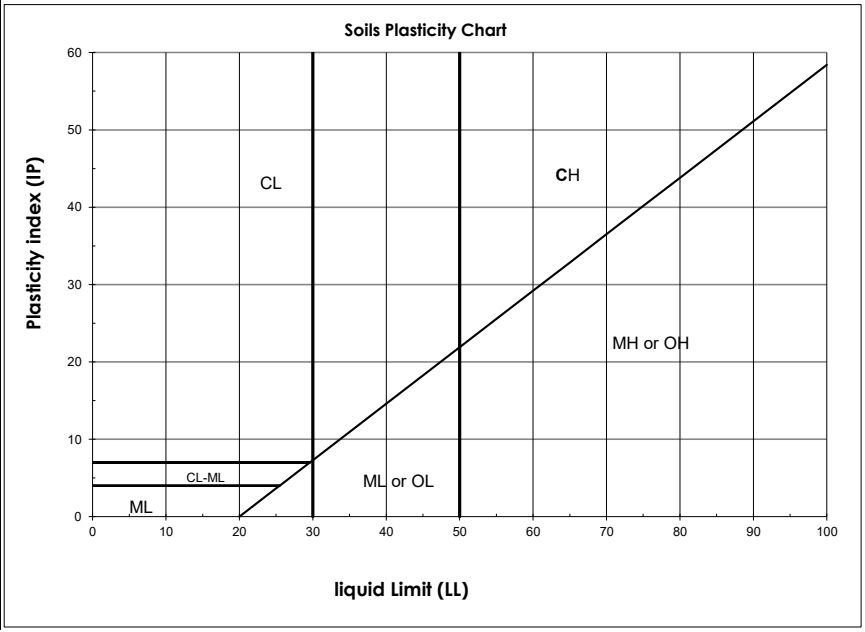
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	98
5,00	98
2,00	98
1,25	98
0,630	97
0,315	95
0,160	88
0,080	73,8



% Gravel: 2,1 % Sand : 24,1 % Silt: 51,5 % Clay: 22,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	26,4



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

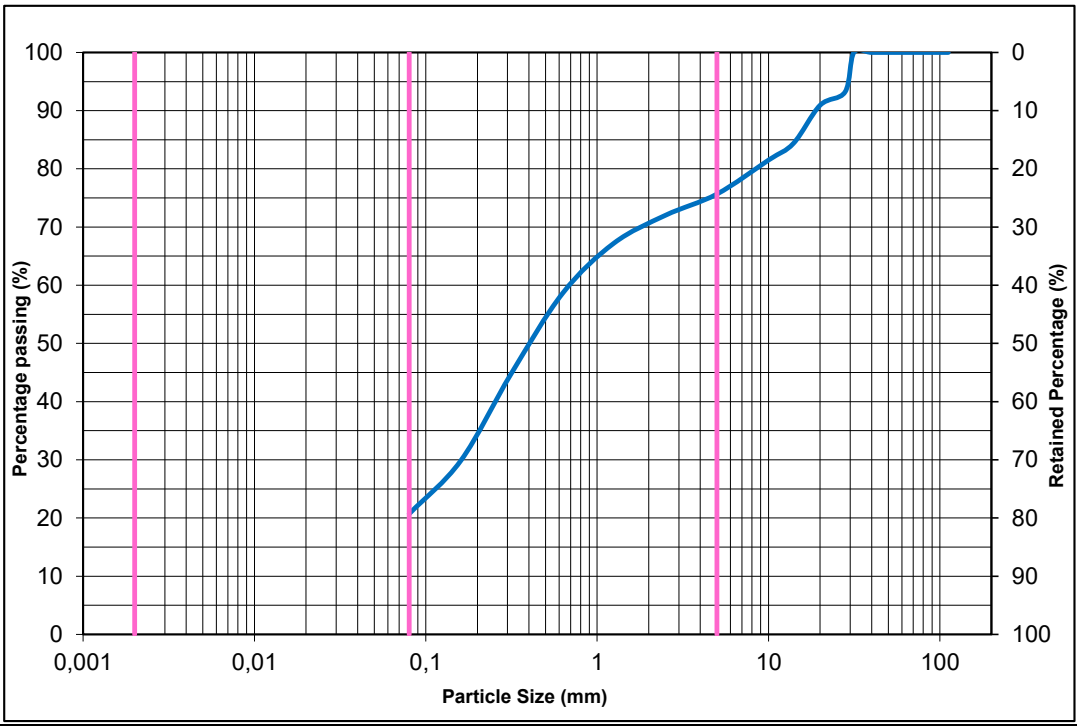
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-21 SS-01B
Depth : 0,18 - 0,61m

Material Description : Silty, gravely Sand

Grain Size Analysis (BNQ 2501-025)

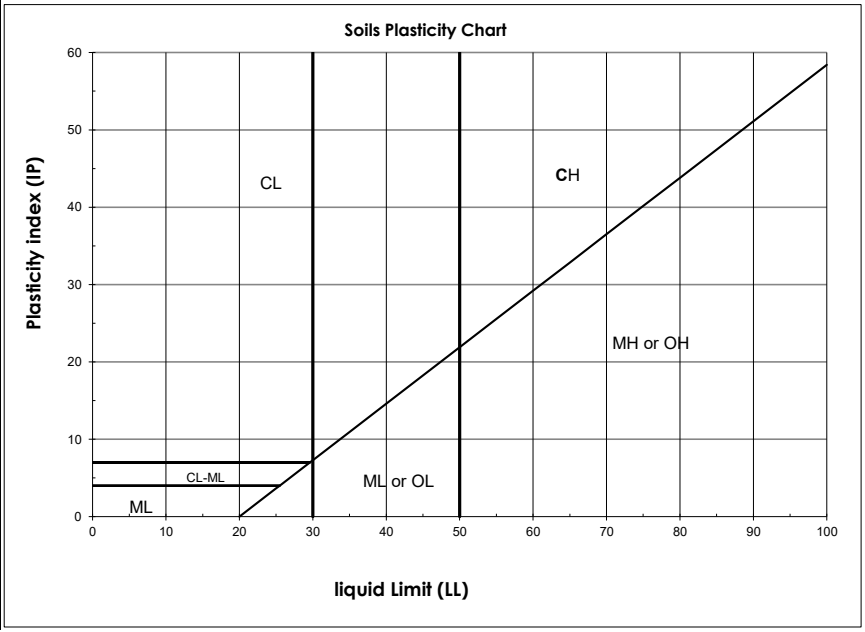
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	93
20,0	91
14,0	84
10,0	82
5,00	76
2,50	72
1,25	67
0,630	59
0,315	45
0,160	30
0,080	20,7



% Gravel : 24,4 % Sand : 54,9 % Fine particles : 20,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,7



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

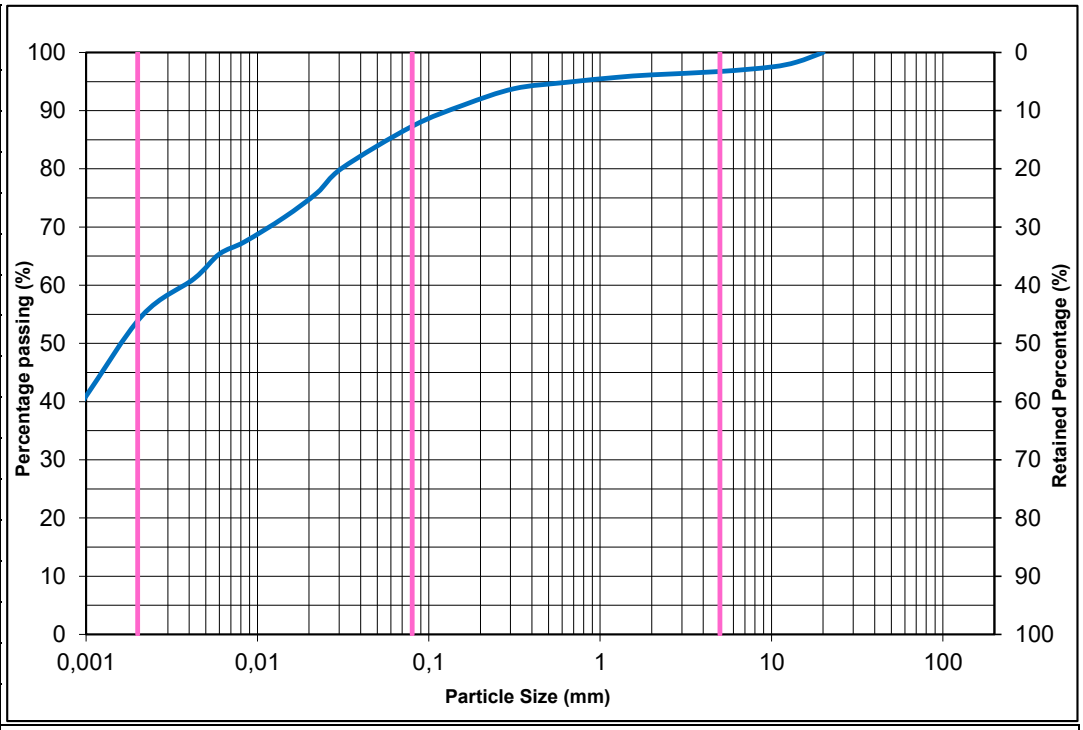
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-21 SS-04
Depth : 1,83 - 2,44m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

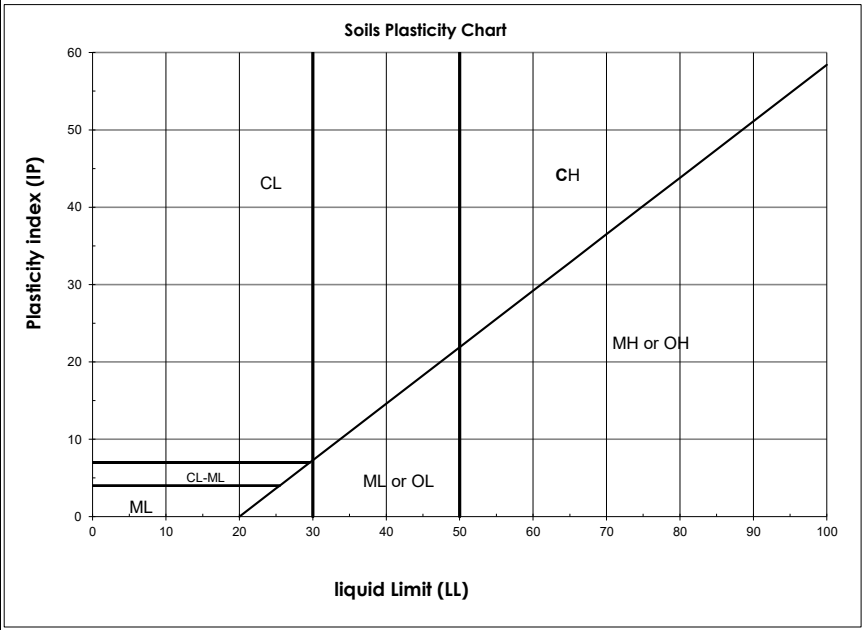
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	98
10,0	98
5,00	97
2,00	96
1,25	96
0,630	95
0,315	94
0,160	91
0,080	87,3



% Gravel: 3,3 % Sand : 9,4 % Silt: 34,1 % Clay: 53,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	31,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

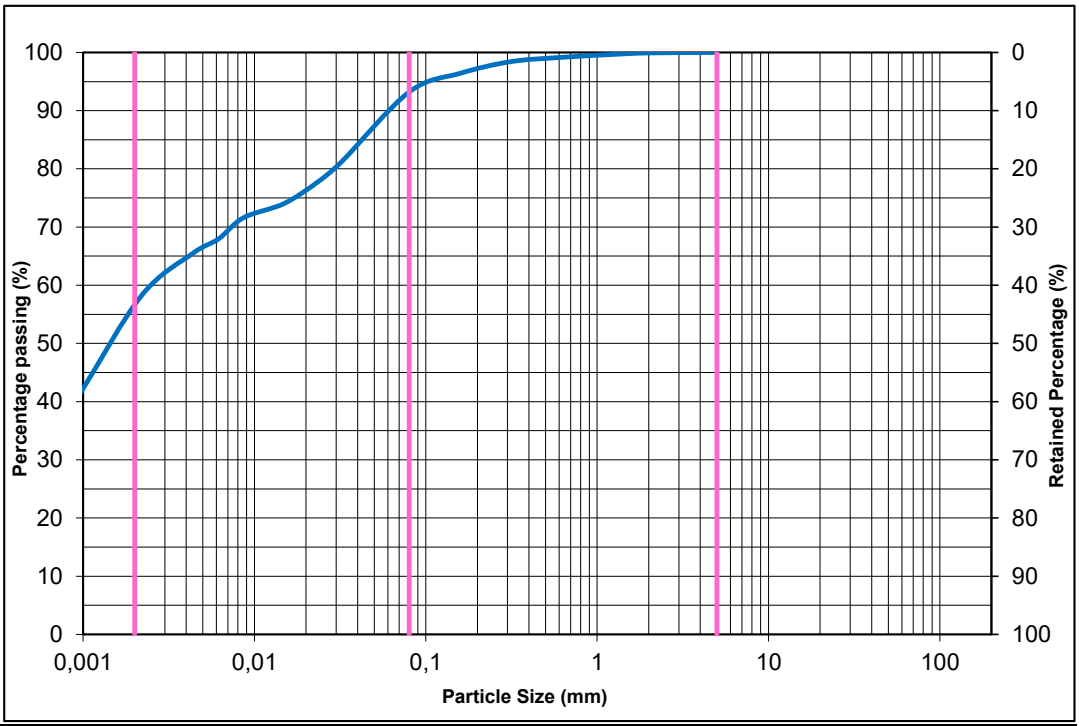
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-21 SS-08
Depth : 4,27 - 4,88m

Material Description : Clay and Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

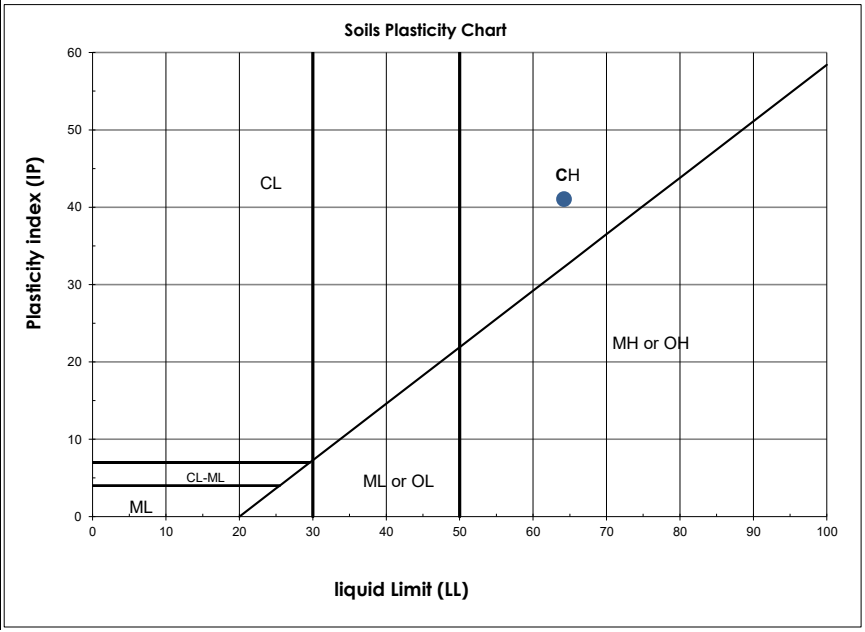
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	99
0,315	98
0,160	96
0,080	93,2



% Gravel: 0,0 % Sand : 6,8 % Silt: 37,7 % Clay: 55,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	71,1
Liquid Limit (BNQ 2501-092)	64
Plastic Limit (BNQ 2501-092)	23
Plasticity Index (BNQ 2501-092)	41



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

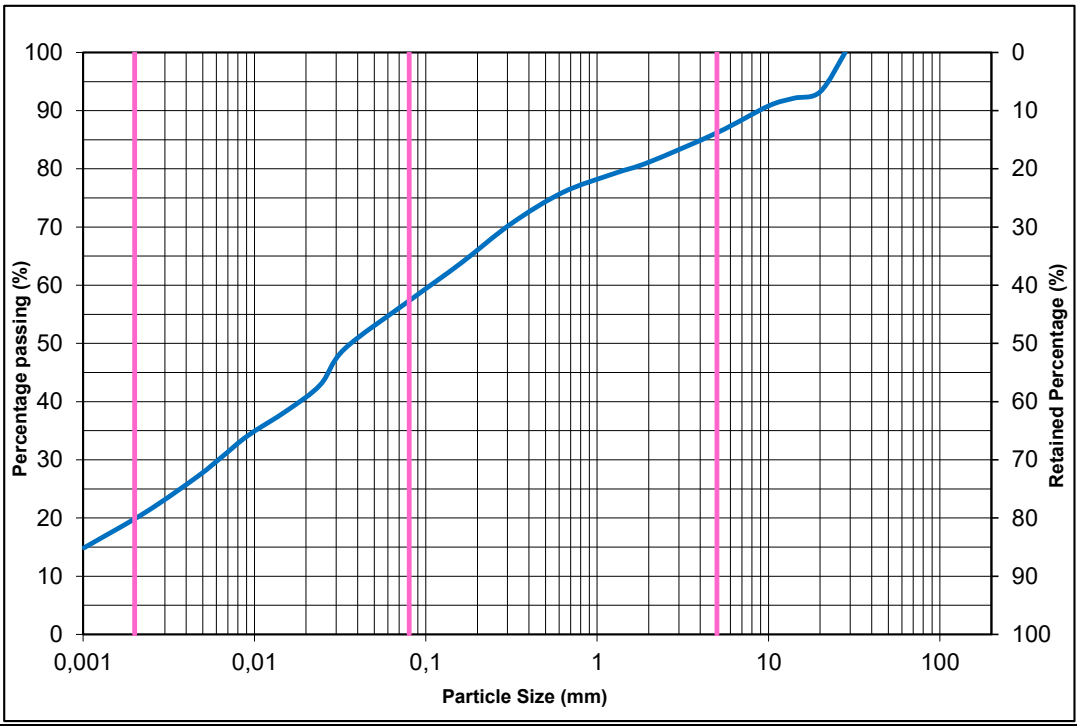
Sampled by : H. Desrochers / A. Bogaert
Sampling Date : September 17, 2022

Project No : 158100425.500.710.5
Sample No : BH22-21 SS-17
Depth : 4,27 - 4,88m

Material Description : Sandy Silt, some Clay, some Gravel

Grain Size Analysis (BNQ 2501-025)

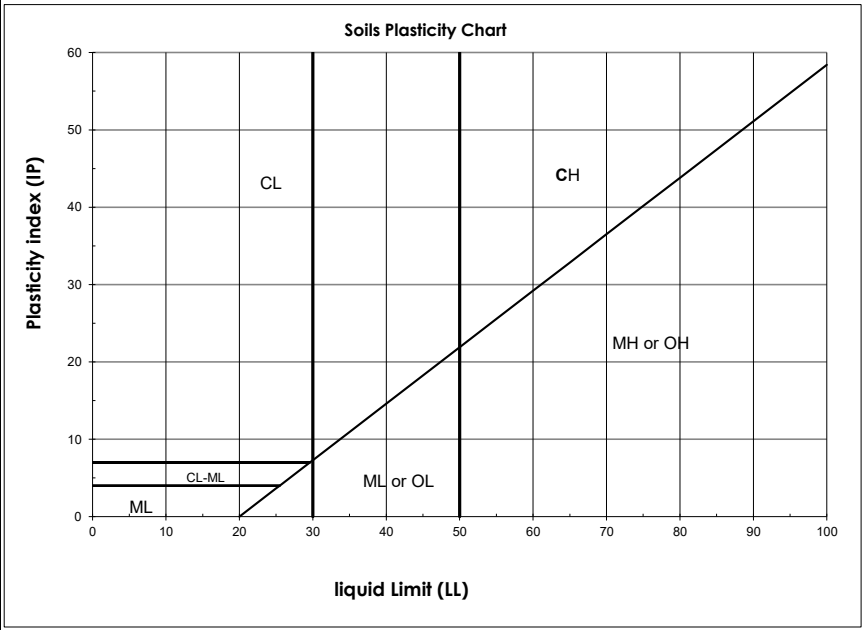
Openings Dimensions	Cumulative Results
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	93
14,0	92
10,0	91
5,00	86
2,00	81
1,25	79
0,630	76
0,315	71
0,160	64
0,080	57,3



% Gravel: 13,8 % Sand : 28,9 % Silt: 37,8 % Clay: 19,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	20,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

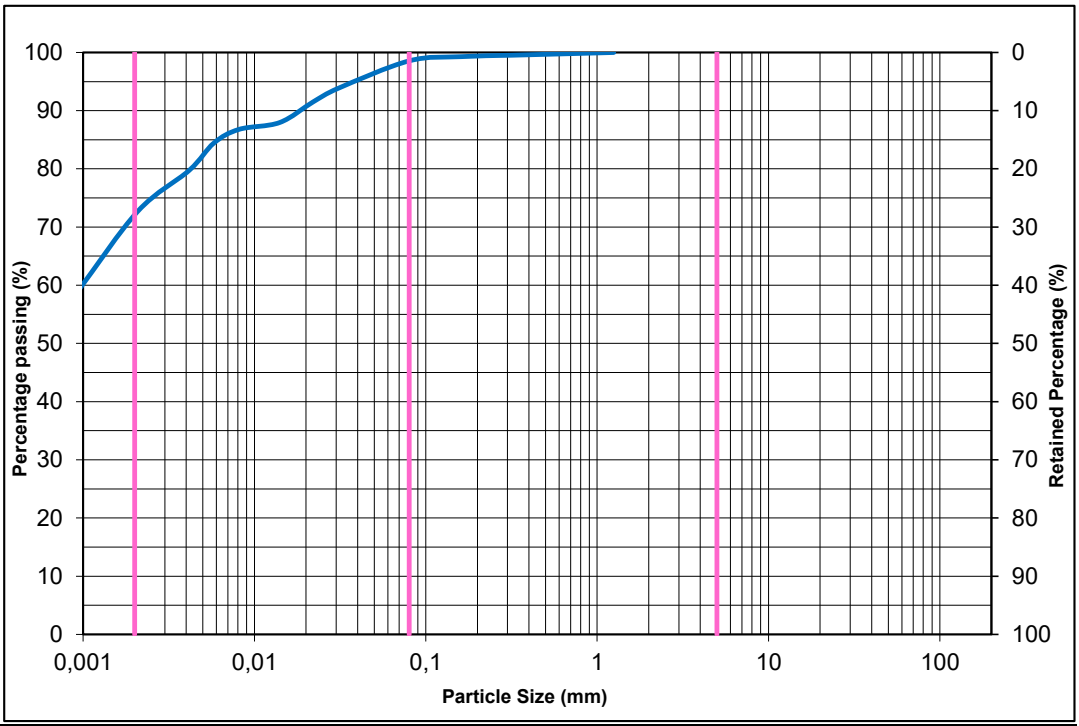
Sampled by : Hugo Desrochers
Sampling Date : November 03, 2022

Project No : 158100425.500.710.5
Sample No : BH22-22 SS-02
Depth : 0,61 - 1,22m

Material Description : Silty Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

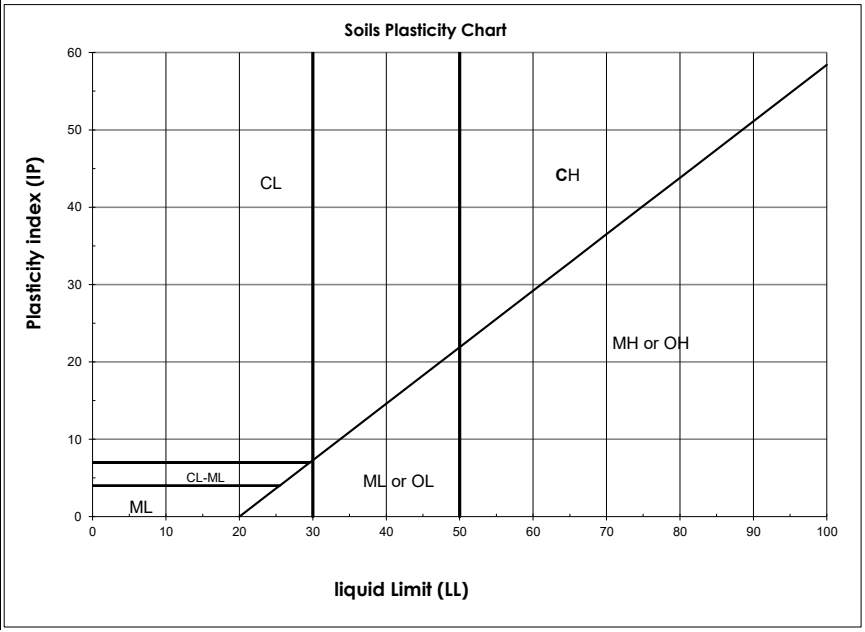
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	99
0,080	98,6



% Gravel: 0,0 % Sand : 1,4 % Silt: 26,9 % Clay: 71,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	32,9



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

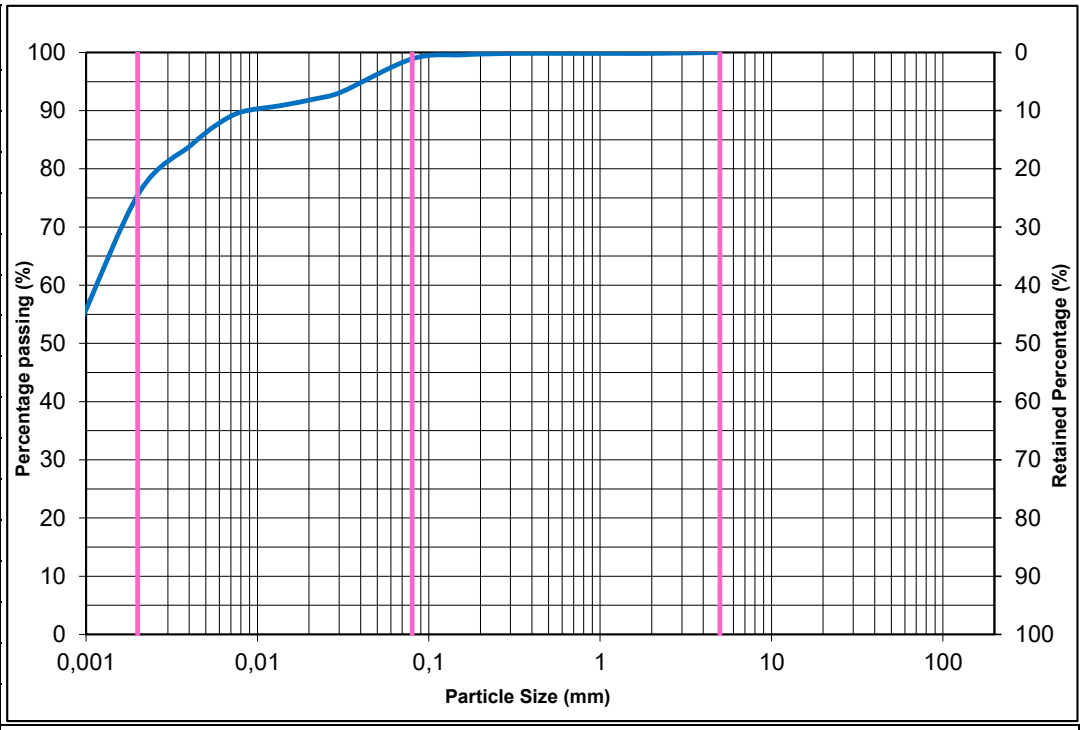
Sampled by : Hugo Desrochers
Sampling Date : November 03, 2022

Project No : 158100425.500.710.5
Sample No : BH22-22 SS-06
Depth : 3,05 - 3,66m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

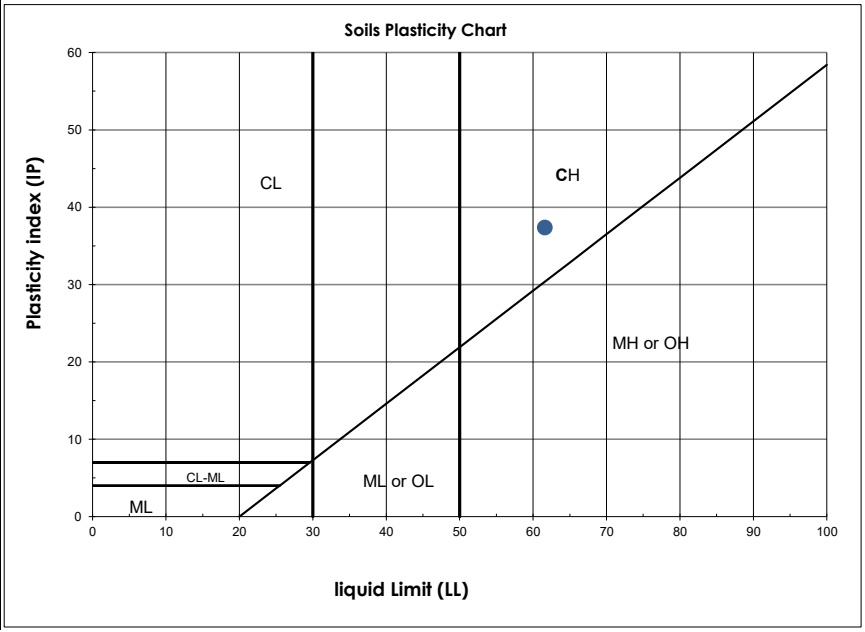
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	98,9



% Gravel: 0,0 % Sand : 1,1 % Silt: 24,0 % Clay: 74,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	51,3
Liquid Limit (BNQ 2501-092)	62
Plastic Limit (BNQ 2501-092)	25
Plasticity Index (BNQ 2501-092)	37



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

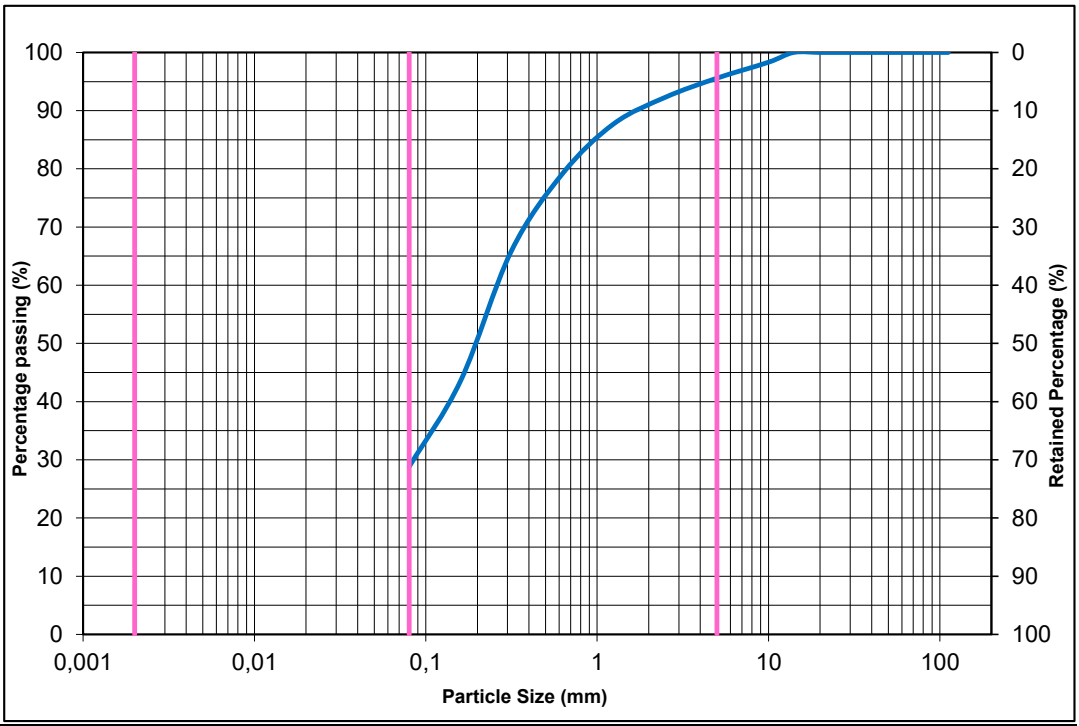
Sampled by : Hugo Desrochers
Sampling Date : November 03, 2022

Project No : 158100425.500.710.5
Sample No : BH22-22 SS-13
Depth : 13,72 - 14,33m

Material Description : Silty Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

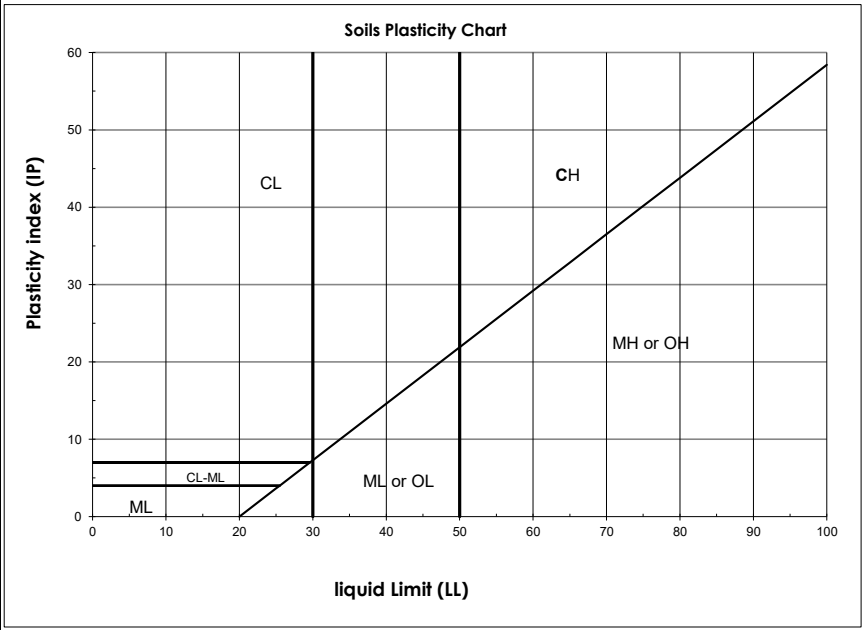
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	98
5,00	96
2,50	92
1,25	88
0,630	79
0,315	66
0,160	44
0,080	28,8



% Gravel : 4,4 % Sand : 66,8 % Fine particles : 28,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	25,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

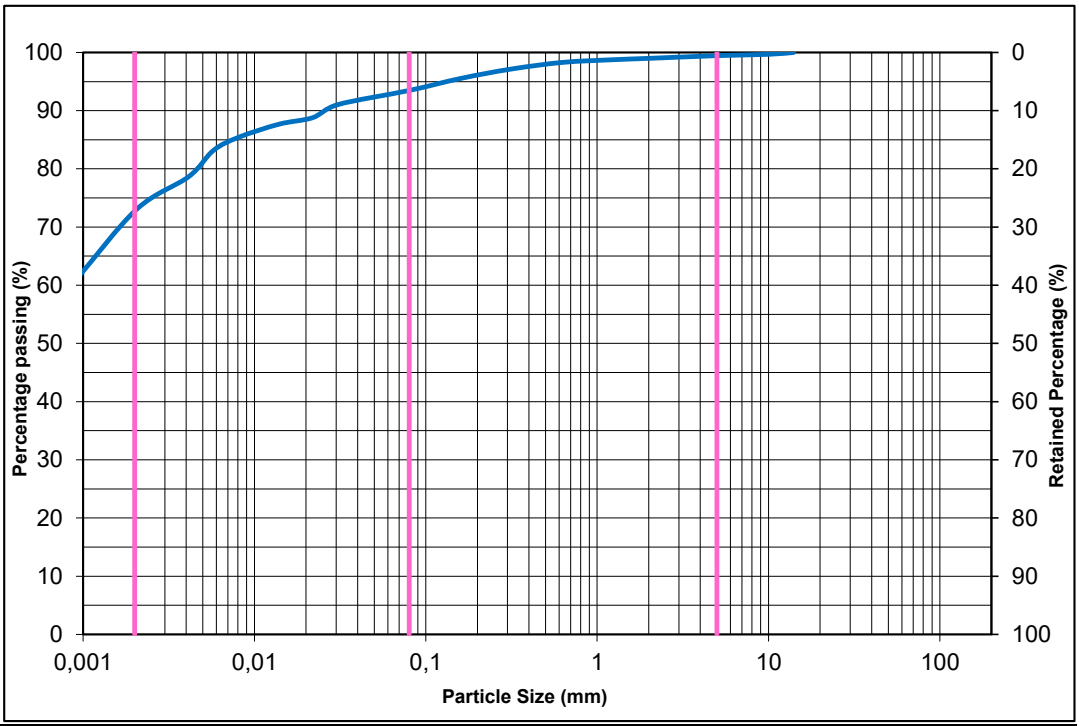
Sampled by : Hugo Desrochers
Sampling Date : October 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-24 SS-03
Depth : 1,22 - 1,83m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

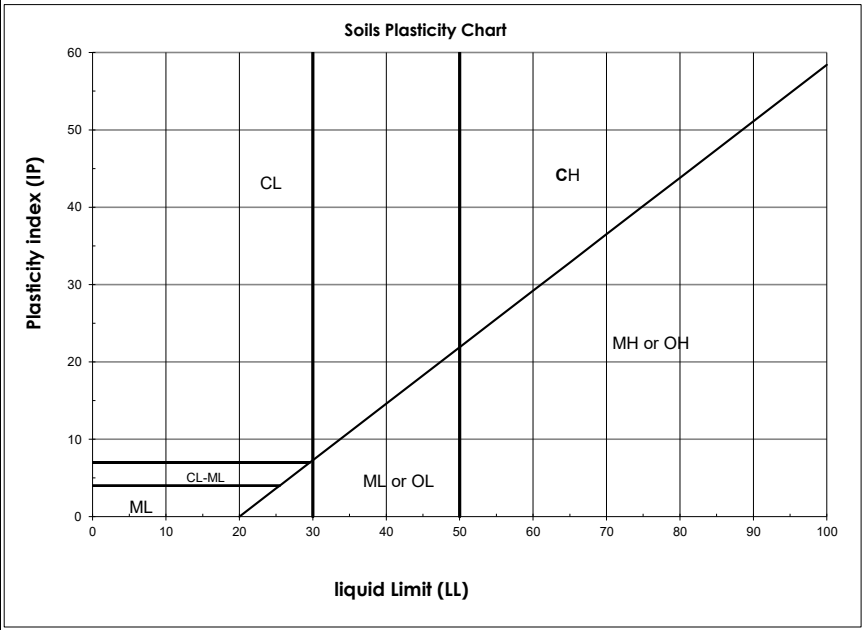
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	99
1,25	99
0,630	98
0,315	97
0,160	96
0,080	93,5



% Gravel: 0,5 % Sand : 6,0 % Silt: 21,0 % Clay: 72,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	40,4



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 13, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

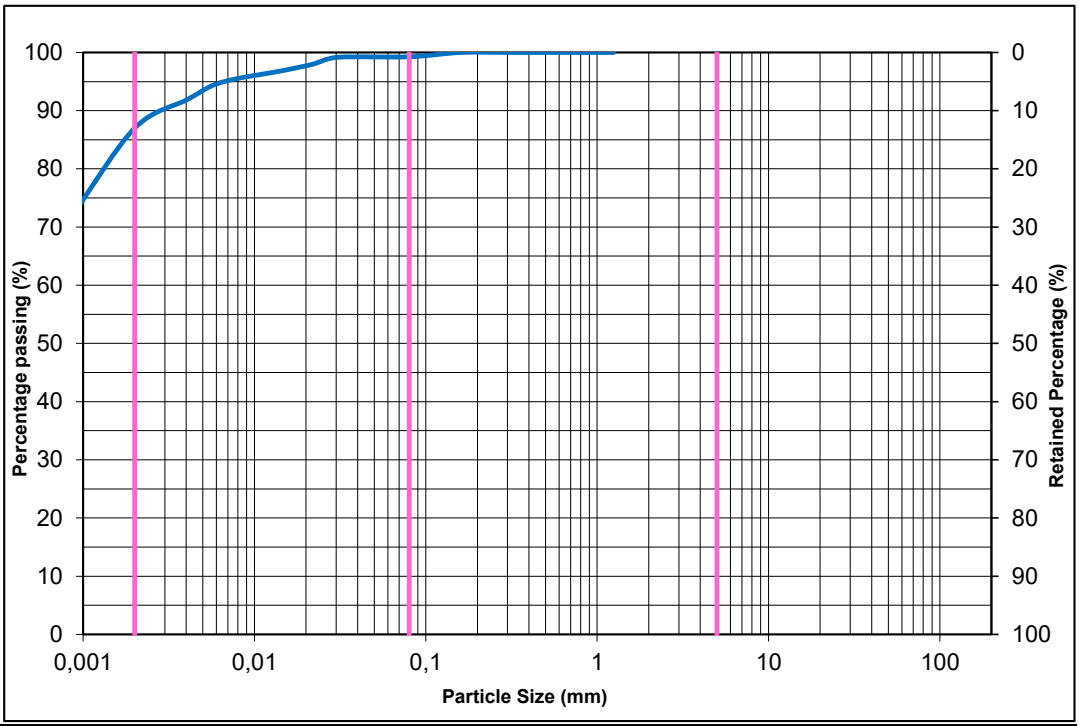
Sampled by : Hugo Desrochers
Sampling Date : October 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-24 SS-08
Depth : 4,27 - 4,88m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

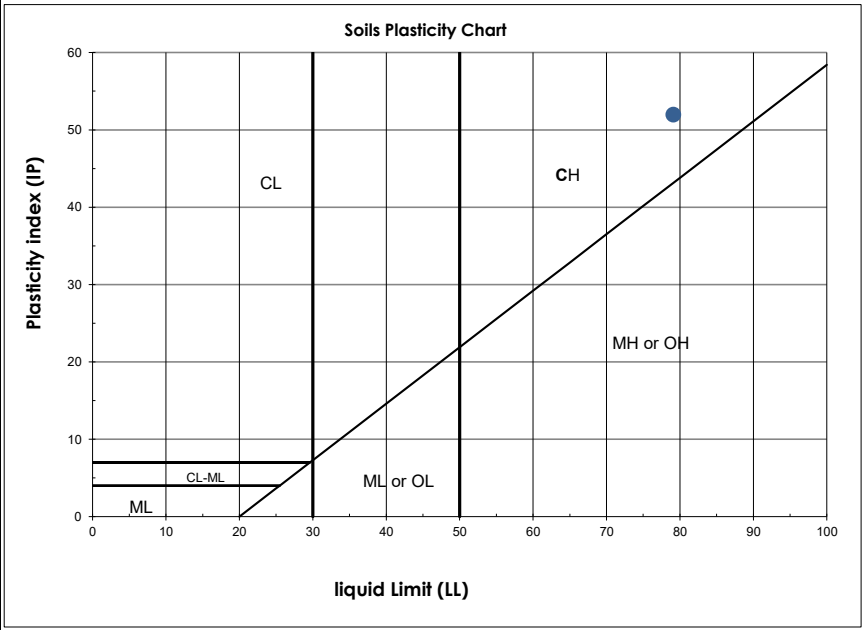
Openings Dimensions	Cumulative Results
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56,0	100
40,0	100
31,5	100
28,0	100
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14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,3



% Gravel: 0,0 % Sand : 0,7 % Silt: 12,3 % Clay: 87,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	91,4
Liquid Limit (BNQ 2501-092)	79
Plastic Limit (BNQ 2501-092)	27
Plasticity Index (BNQ 2501-092)	52



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

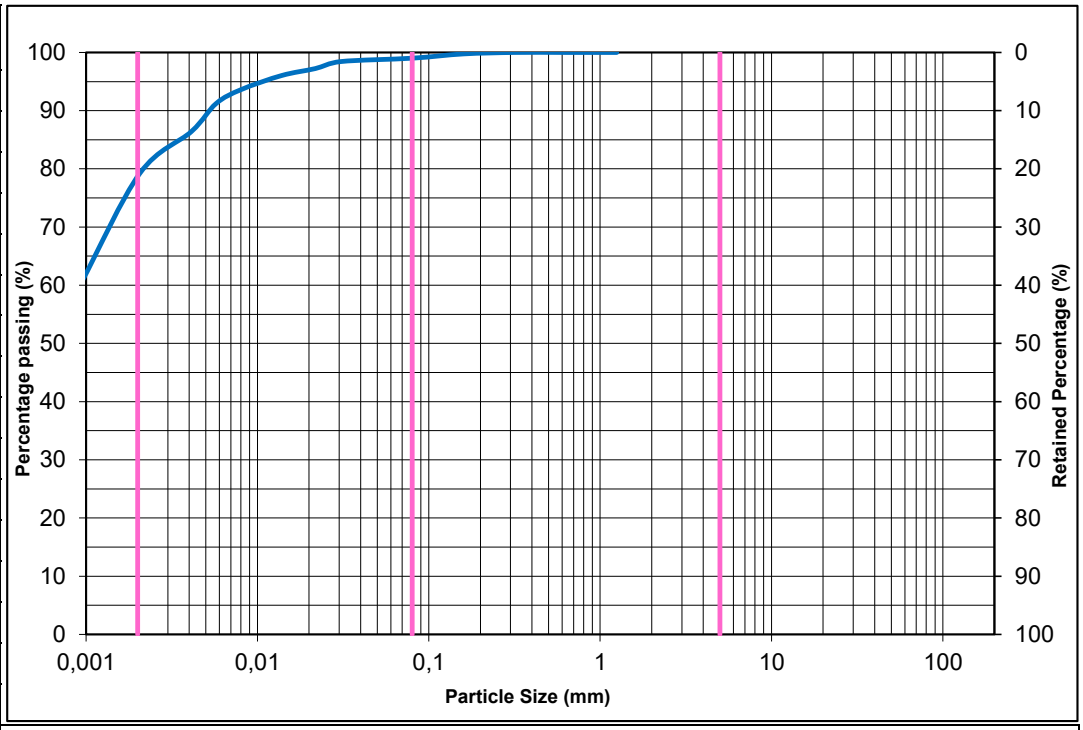
Sampled by : Hugo Desrochers
Sampling Date : October 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-24 SS-13
Depth : 7,32 - 7,92m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

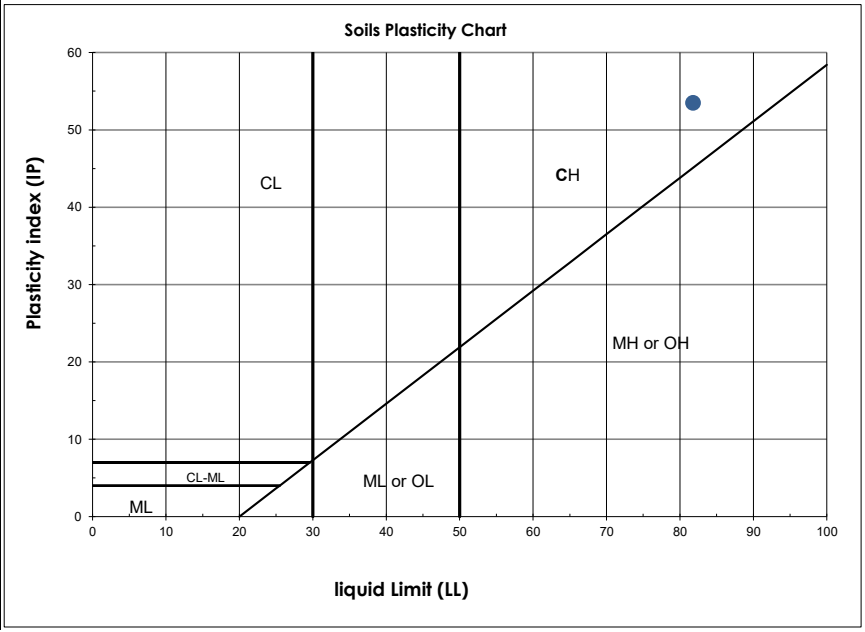
Openings Dimensions	Cumulative Results
mm	%
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,0



% Gravel: 0,0 % Sand : 1,0 % Silt: 20,8 % Clay: 78,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	92,7
Liquid Limit (BNQ 2501-092)	82
Plastic Limit (BNQ 2501-092)	29
Plasticity Index (BNQ 2501-092)	53



Remarks :

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

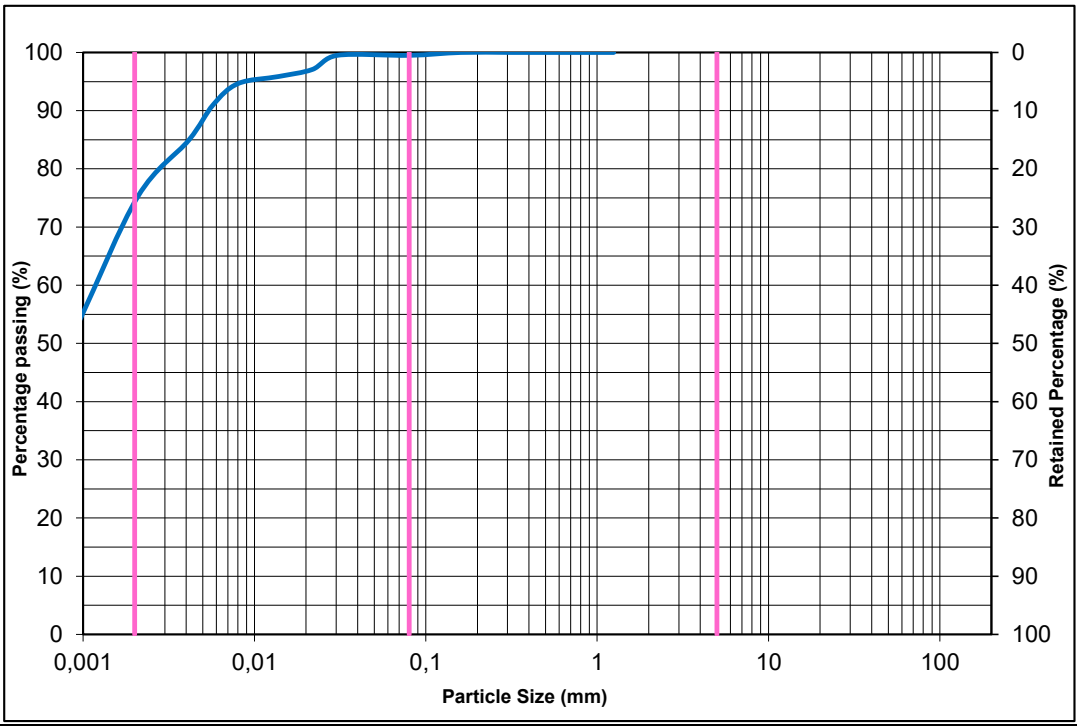
Sampled by : Hugo Desrochers
Sampling Date : October 16, 2022

Project No : 158100425.500.710.5
Sample No : BH22-24 SS-22
Depth : 18,90 - 19,51m

Material Description : Silty Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

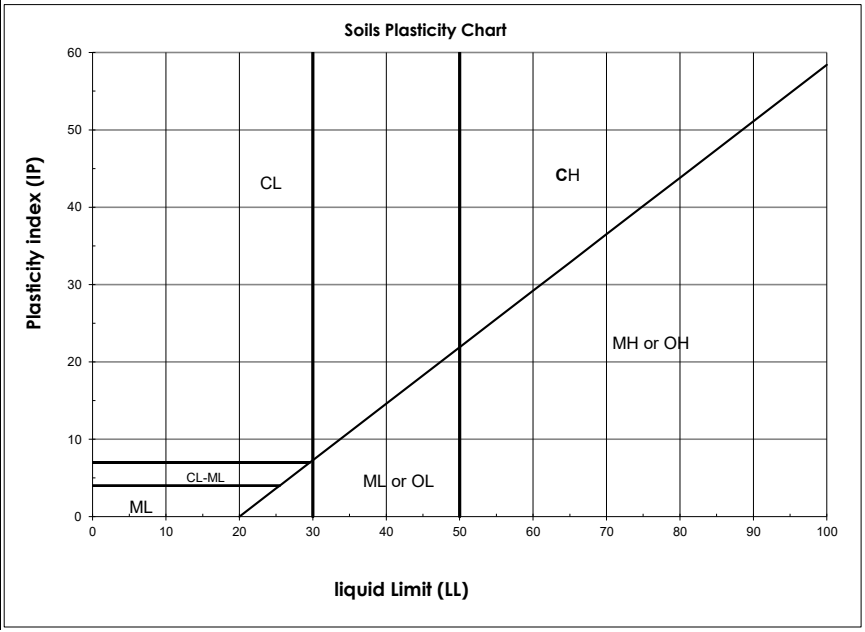
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,5



% Gravel: 0,0 % Sand : 0,5 % Silt: 25,9 % Clay: 73,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	83,3



Remarks :

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

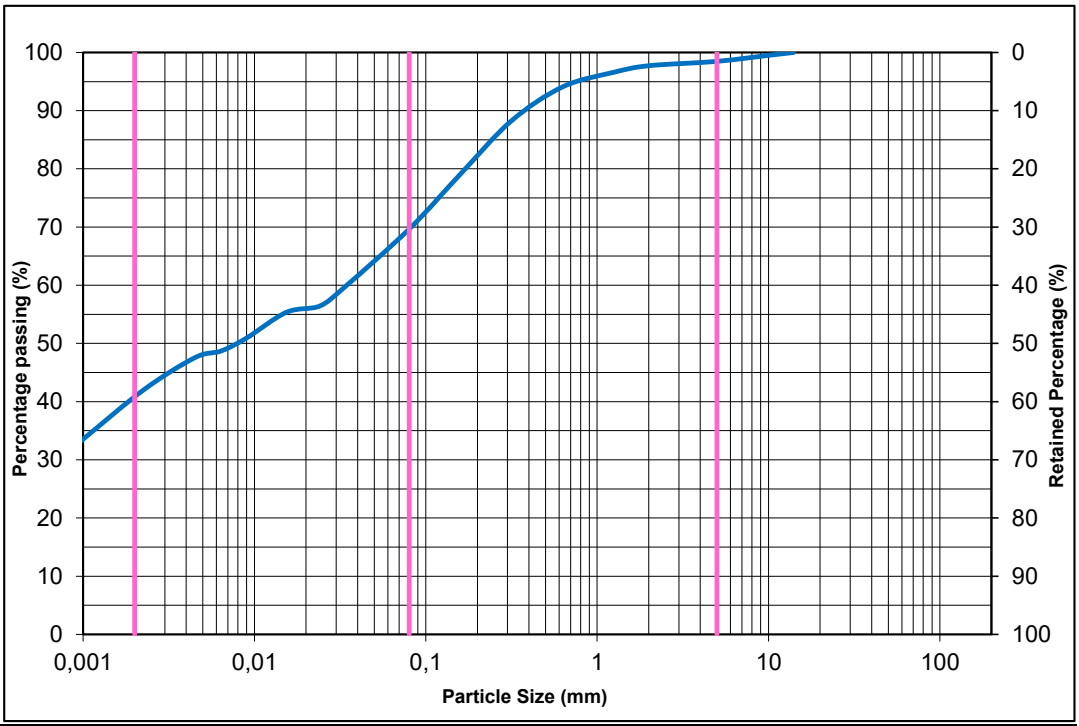
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-25 SS-01B
Depth : 0,08 - 0,61m

Material Description : Sandy, Silty Clay, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

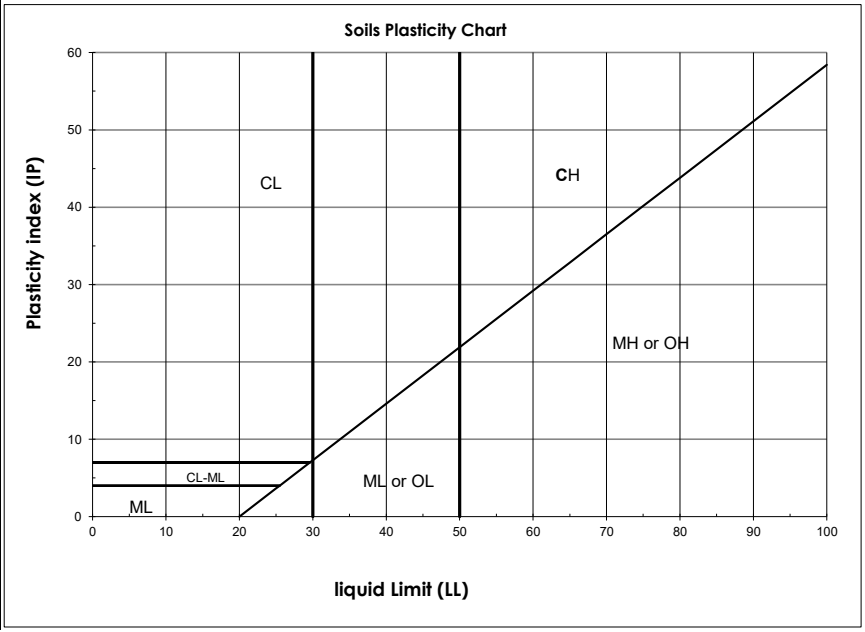
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	98
2,00	98
1,25	97
0,630	94
0,315	88
0,160	79
0,080	69,7



% Gravel: 1,5 % Sand : 28,8 % Silt: 29,4 % Clay: 40,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	18,8



Remarks :

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Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

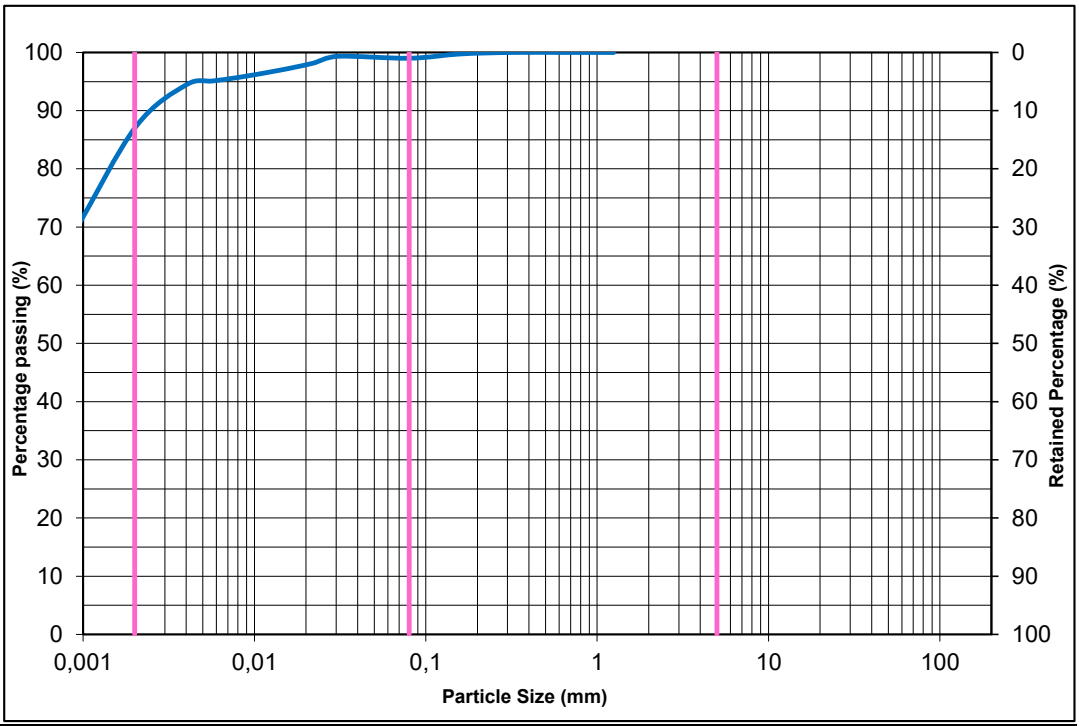
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-25 SS-05
Depth : 2,44 - 3,05m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

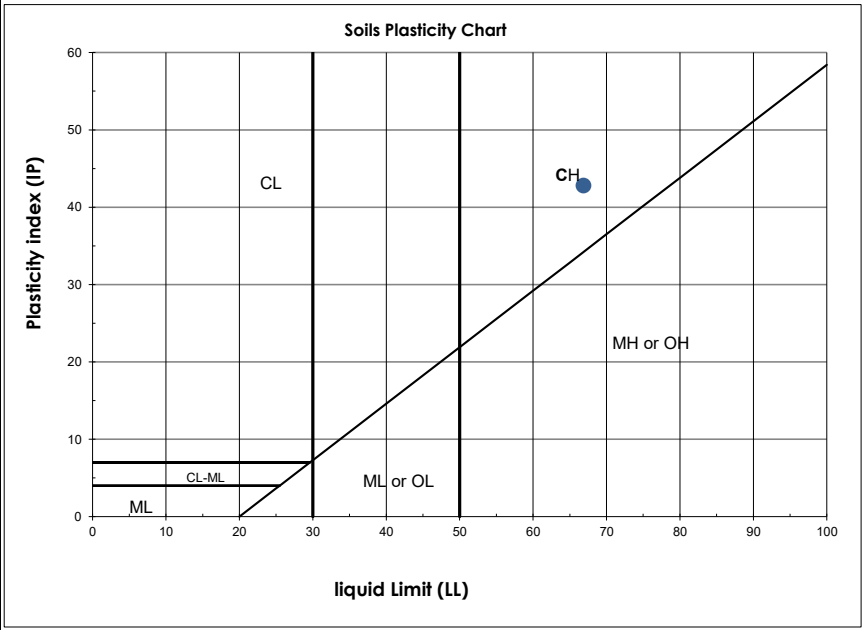
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,0



% Gravel: 0,0 % Sand : 1,0 % Silt: 12,2 % Clay: 86,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	76,3
Liquid Limit (BNQ 2501-092)	67
Plastic Limit (BNQ 2501-092)	24
Plasticity Index (BNQ 2501-092)	43



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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

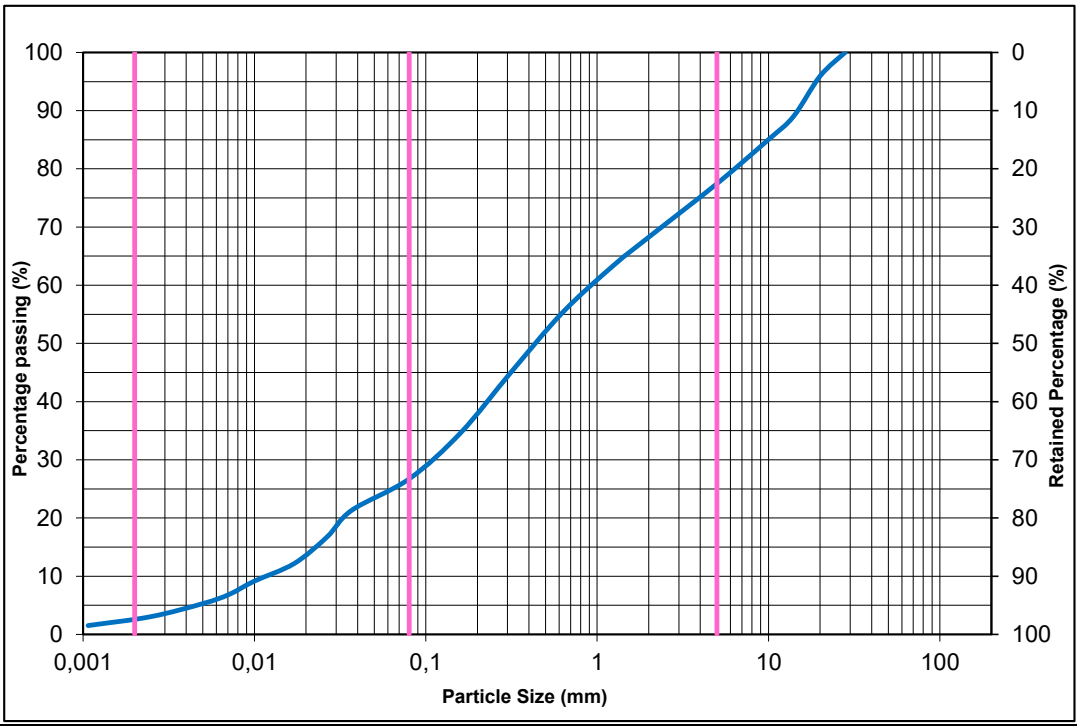
Sampled by : Hugo Desrochers
Sampling Date : September 23, 2022

Project No : 158100425.500.710.5
Sample No : BH22-25 SS-18
Depth : 10,97 - 11,58m

Material Description : Gravely, Silty Sand, traces of Clay

Grain Size Analysis (BNQ 2501-025)

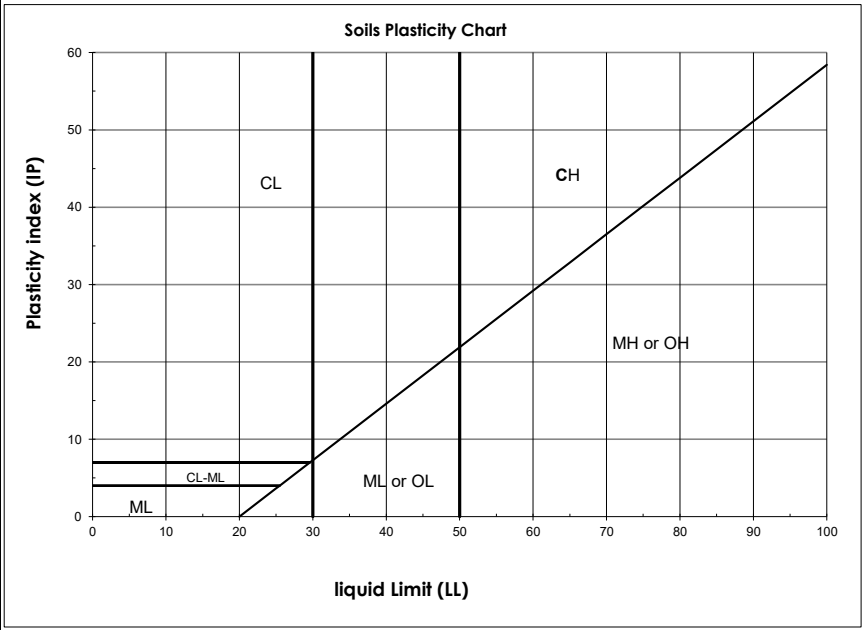
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	89
10,0	85
5,00	77
2,00	68
1,25	63
0,630	55
0,315	45
0,160	35
0,080	26,7



% Gravel: 22,6 % Sand : 50,7 % Silt: 24,2 % Clay: 2,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	9,4



Remarks :

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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

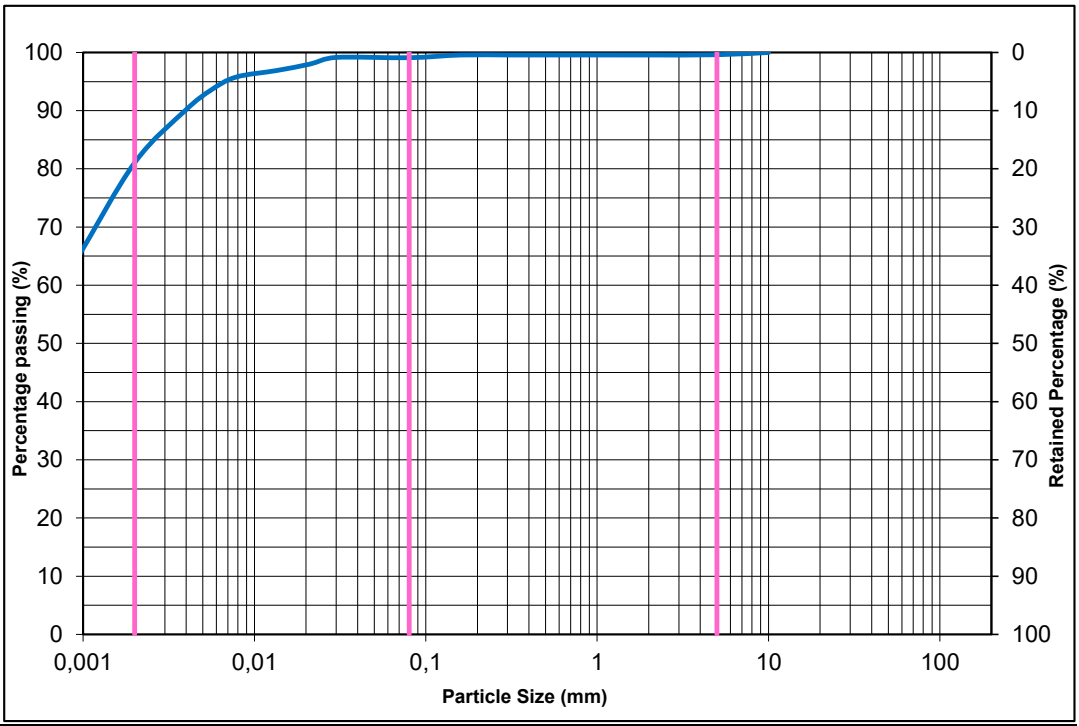
Sampled by : Hugo Desrochers
Sampling Date : September 24, 2022

Project No : 158100425.500.710.5
Sample No : BH22-26 SS-02
Depth : 0,61 - 1,22m

Material Description : Clay, some Silt, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

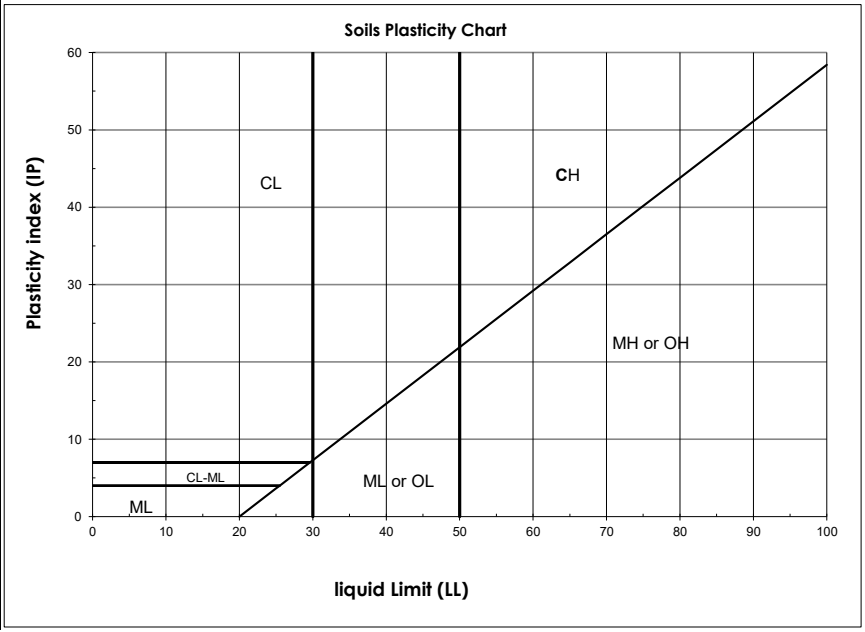
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,1



% Gravel: 0,4 % Sand : 0,5 % Silt: 18,1 % Clay: 81,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	33,7



Remarks :

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

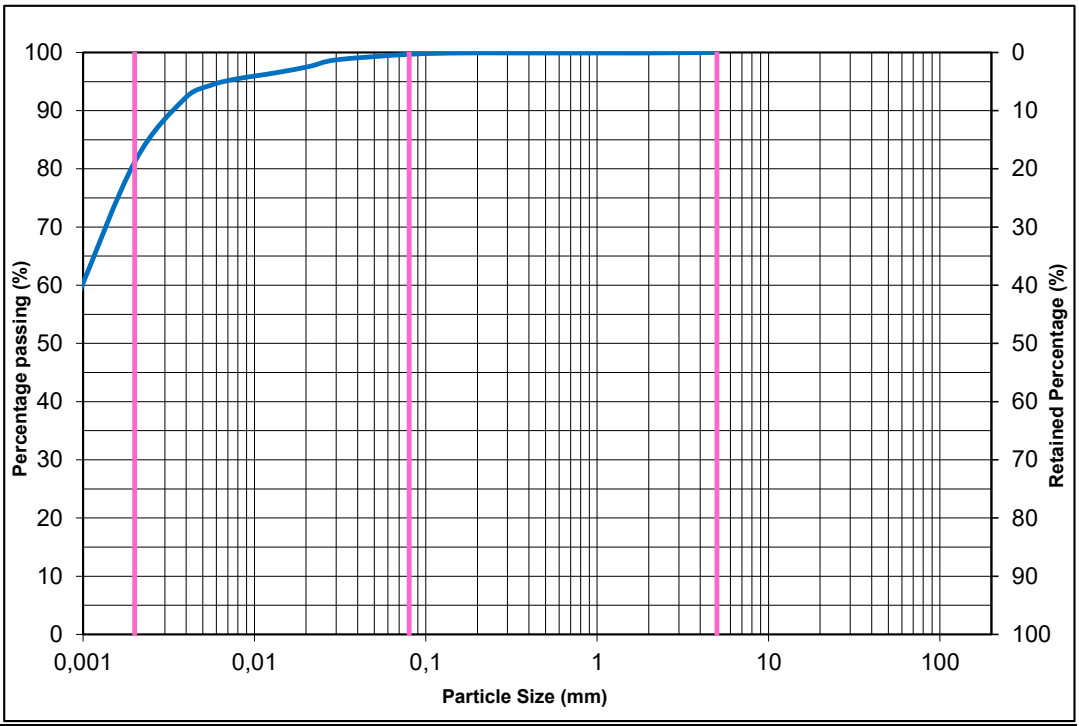
Sampled by : Hugo Desrochers
Sampling Date : September 24, 2022

Project No : 158100425.500.710.5
Sample No : BH22-26 SS-05
Depth : 2,44 - 3,05m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

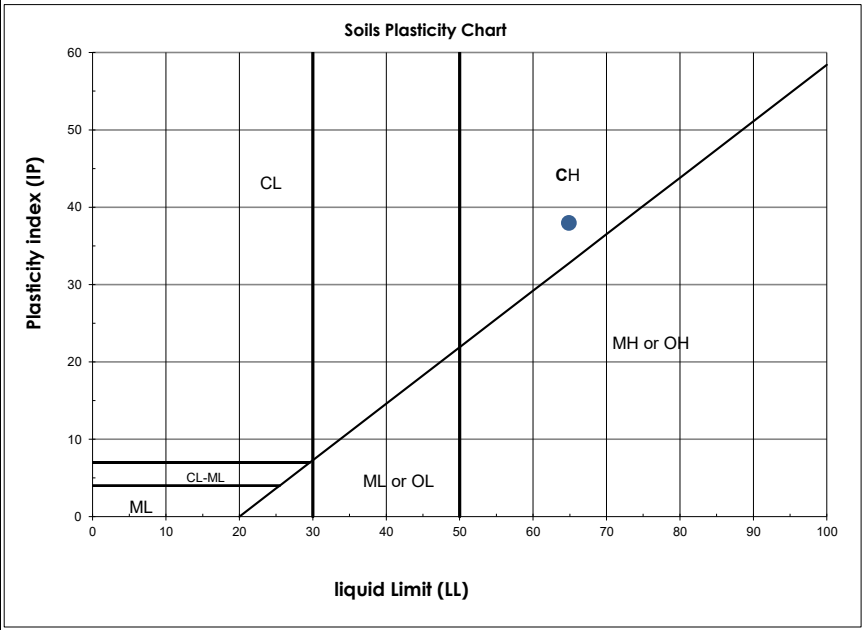
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,7



% Gravel: 0,0 % Sand : 0,3 % Silt: 18,5 % Clay: 81,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	26,7
Liquid Limit (BNQ 2501-092)	65
Plastic Limit (BNQ 2501-092)	27
Plasticity Index (BNQ 2501-092)	38



Remarks :

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Date : January 25, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

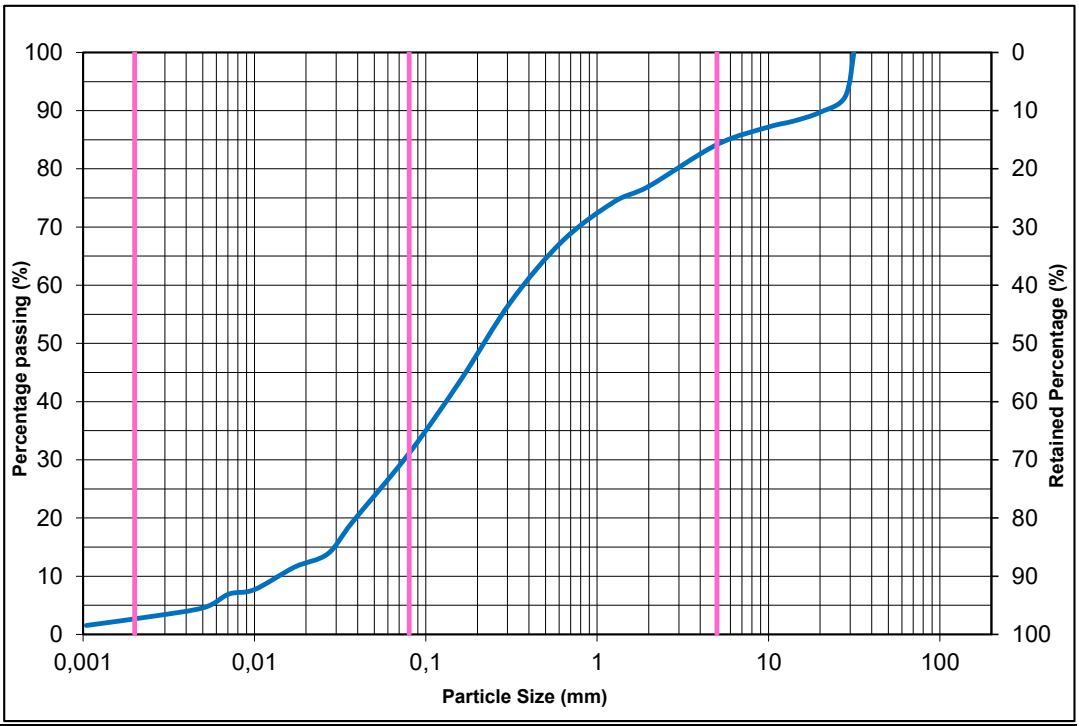
Sampled by : Hugo Desrochers
Sampling Date : September 24, 2022

Project No : 158100425.500.710.5
Sample No : BH22-26 SS-09
Depth : 4,88 - 5,49m

Material Description : Silty Sand, some Gravel, traces of Clay

Grain Size Analysis (BNQ 2501-025)

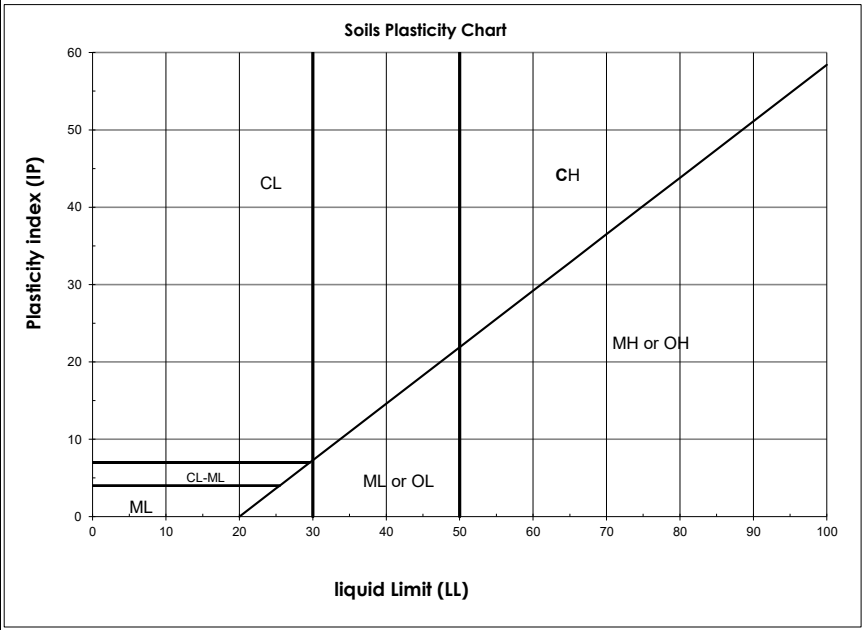
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	92
20,0	90
14,0	88
10,0	87
5,00	84
2,00	77
1,25	74
0,630	68
0,315	57
0,160	44
0,080	31,2



% Gravel: 15,8 % Sand : 53,0 % Silt: 28,6 % Clay: 2,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	9,8



Remarks :

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2273 Michelin Street,
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LABORATORY TESTING REPORT

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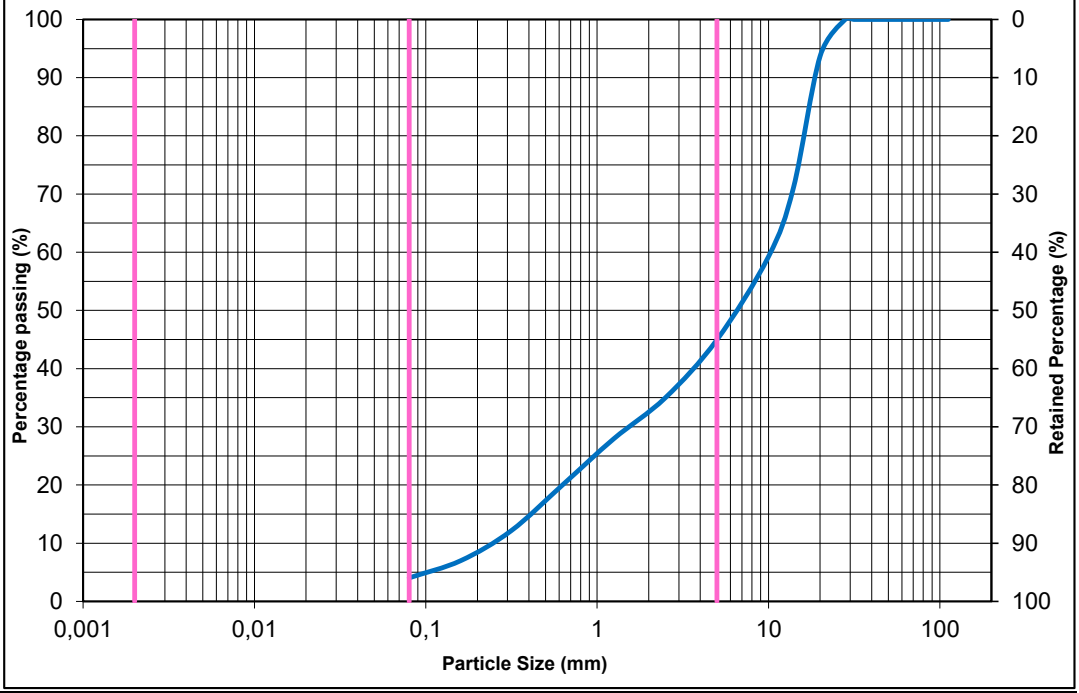
Sampled by : Hugo Desrochers
Sampling Date : October 07, 2022

Project No : 158100425.500.710.5
Sample No : BH22-27 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravel and Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

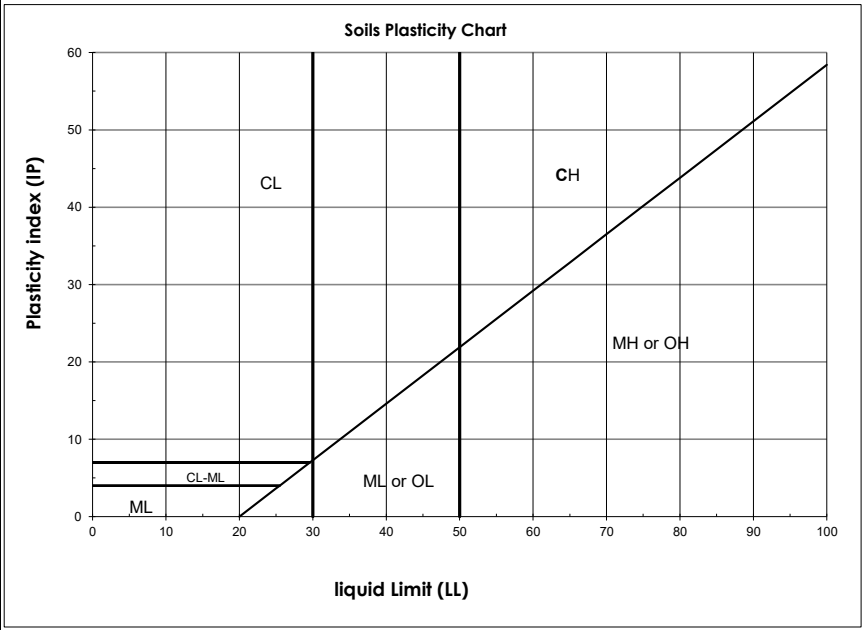
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	94
14,0	71
10,0	59
5,00	45
2,50	35
1,25	28
0,630	20
0,315	12
0,160	7
0,080	4,0



% Gravel : 55,1 % Sand : 40,9 % Fine particles : 4,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	7,9



Remarks :

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LABORATORY TESTING REPORT

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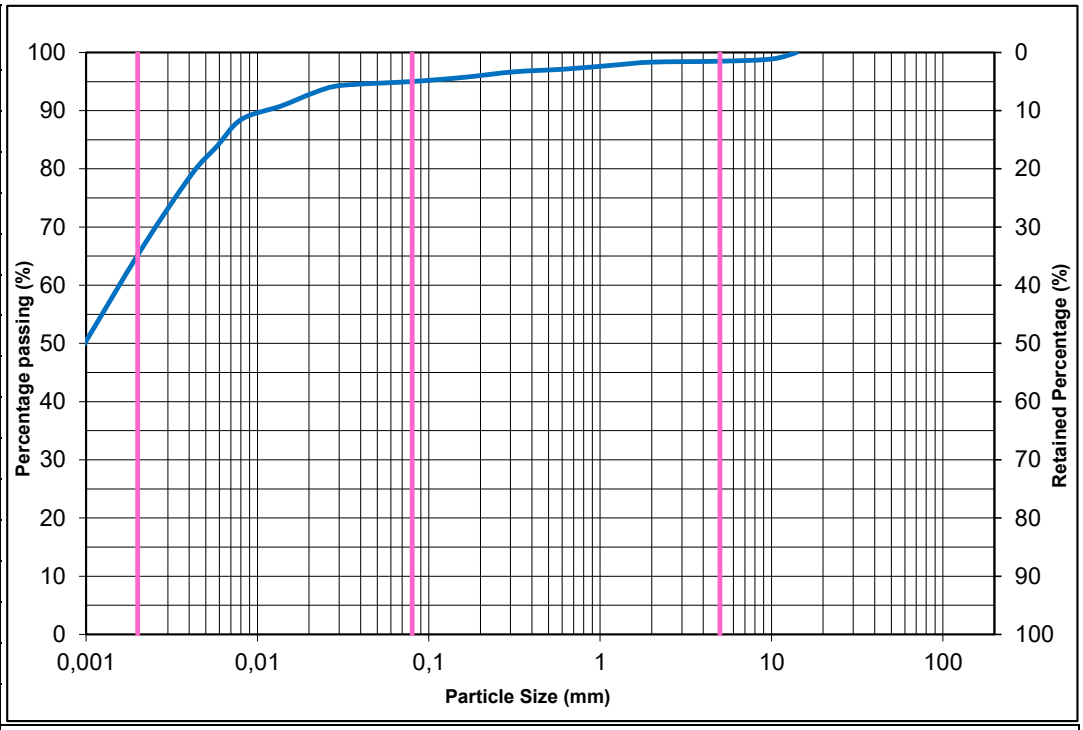
Sampled by : Hugo Desrochers
Sampling Date : October 07, 2022

Project No : 158100425.500.710.5
Sample No : BH22-27 SS-09
Depth : 4,88 - 5,49m

Material Description : Silty Clay, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

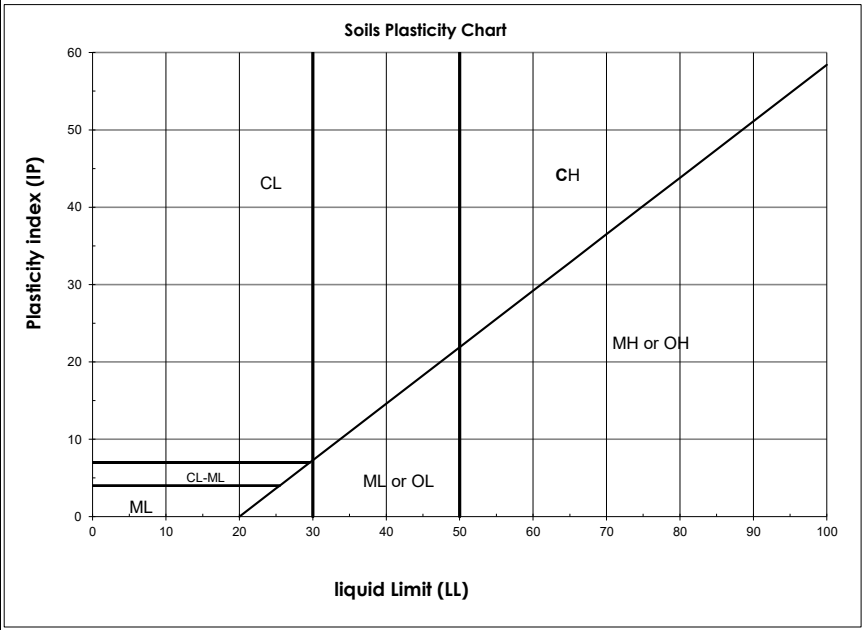
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	98
2,00	98
1,25	98
0,630	97
0,315	97
0,160	96
0,080	95,0



% Gravel: 1,5 % Sand : 3,5 % Silt: 30,4 % Clay: 64,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	36,5



Remarks :

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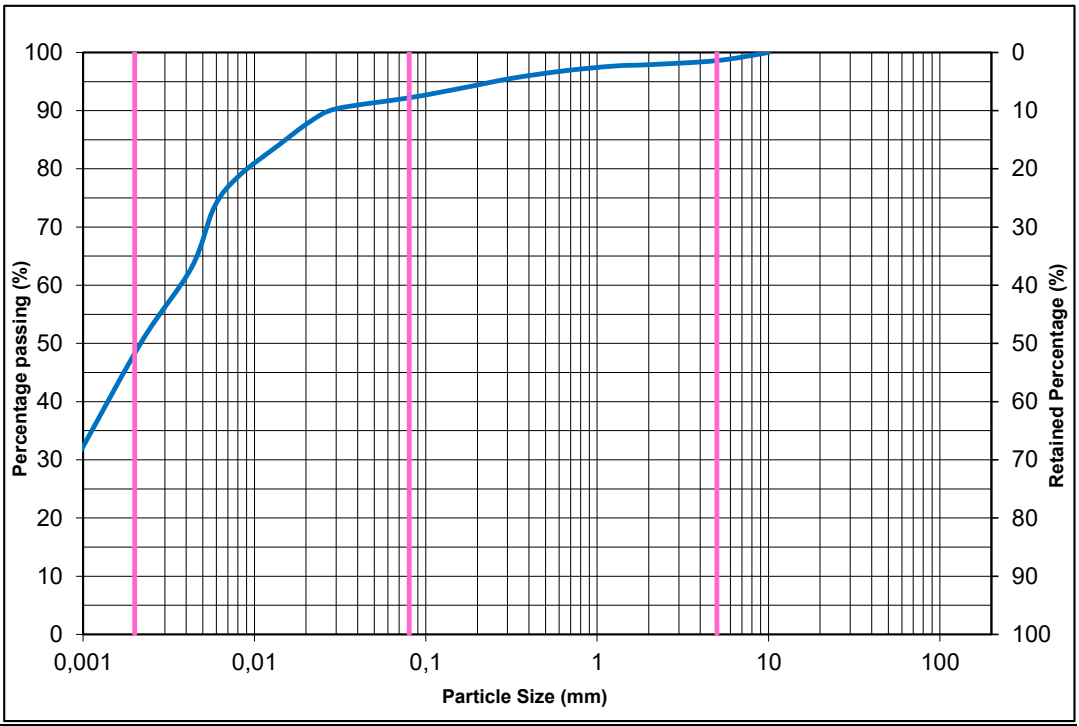
Sampled by : Hugo Desrochers
Sampling Date : October 07, 2022

Project No : 158100425.500.710.5
Sample No : BH22-27 SS-11
Depth : 6,10 - 6,71m

Material Description : Clay and Silt, traces of Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

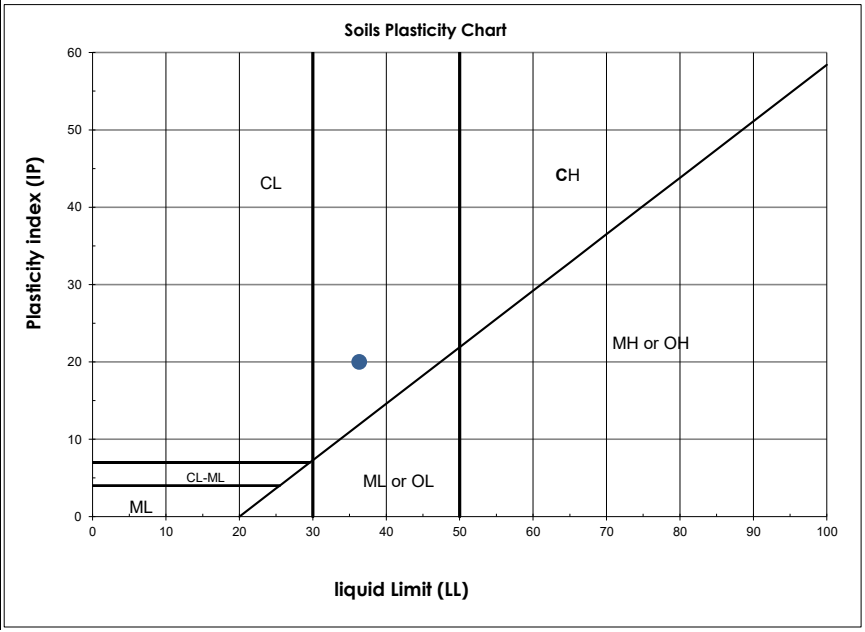
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	98
1,25	98
0,630	97
0,315	96
0,160	94
0,080	92,2



% Gravel: 1,4 % Sand : 6,4 % Silt: 44,9 % Clay: 47,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	34,2
Liquid Limit (BNQ 2501-092)	36
Plastic Limit (BNQ 2501-092)	16
Plasticity Index (BNQ 2501-092)	20



Remarks :

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LABORATORY TESTING REPORT

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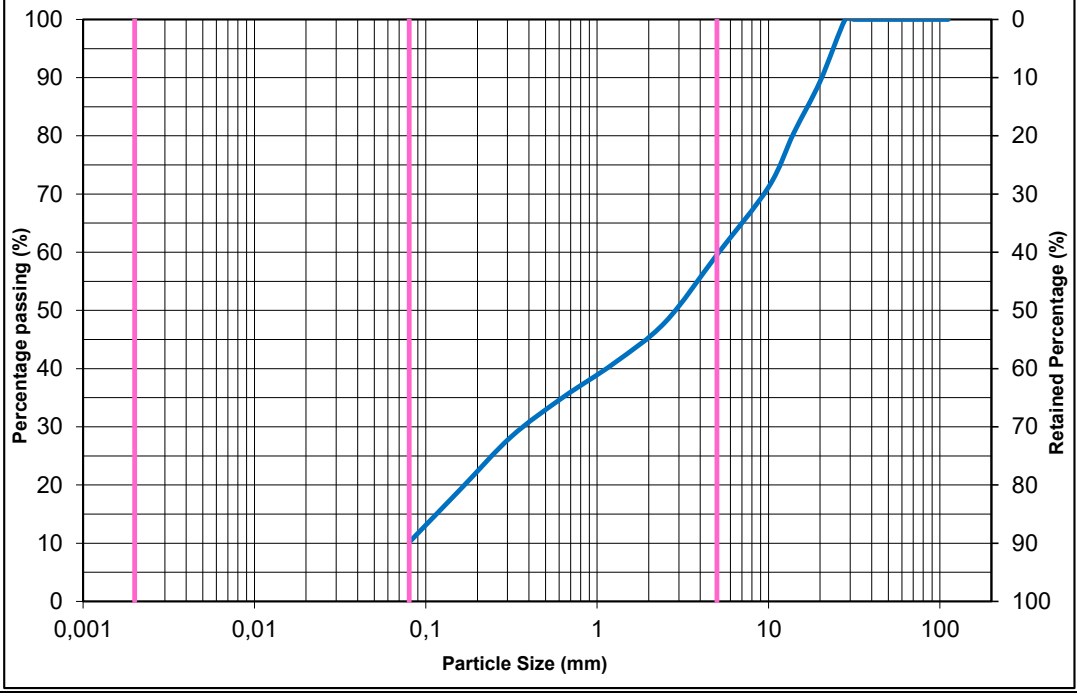
Sampled by : Hugo Desrochers
Sampling Date : October 07, 2022

Project No : 158100425.500.710.5
Sample No : BH22-27 SS-16
Depth : 13,72 - 14,33m

Material Description : Sand and Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

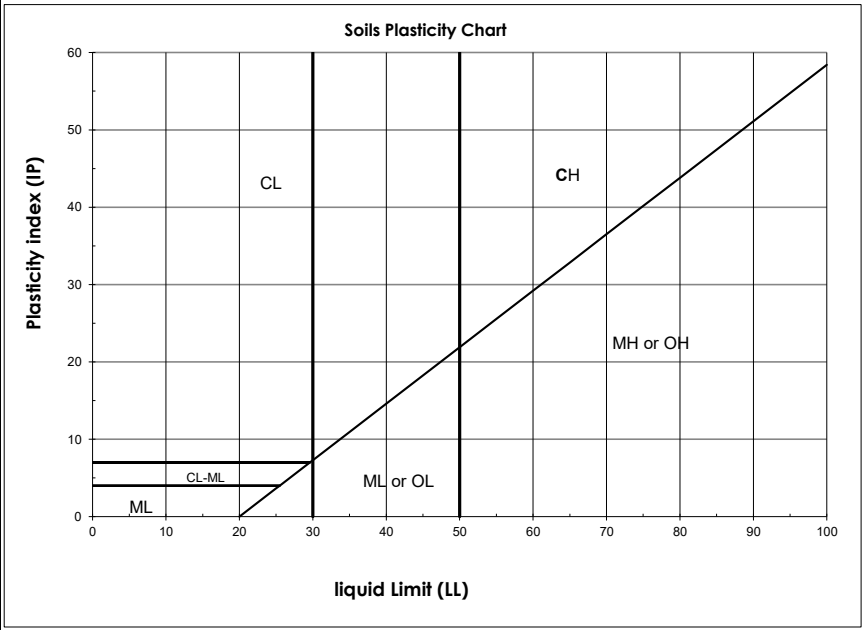
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	89
14,0	80
10,0	71
5,00	60
2,50	48
1,25	41
0,630	35
0,315	28
0,160	19
0,080	10,2



% Gravel : 40,4 % Sand : 49,4 % Fine particles : 10,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	7,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 13, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

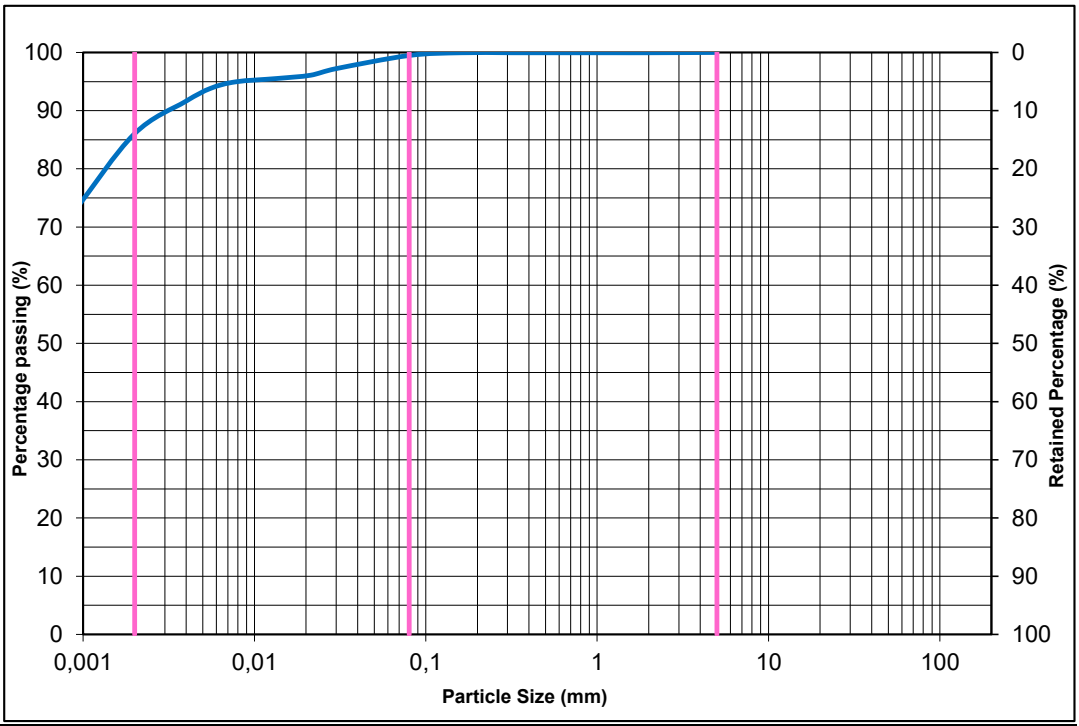
Sampled by : Hugo Desrochers
Sampling Date : November 04, 2022

Project No : 158100425.500.710.5
Sample No : BH22-28 SS-02
Depth : 0,61 - 1,22m

Material Description : Clay, some Silt, traces of Sand

Grain Size Analysis (BNQ 2501-025)

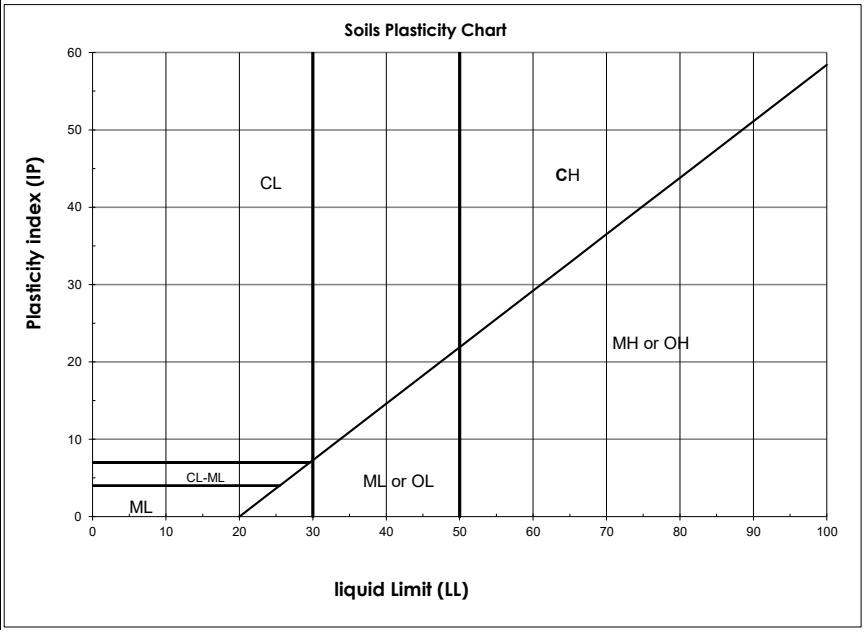
Openings Dimensions	Cumulative Results
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,5



% Gravel: 0,0 % Sand : 0,5 % Silt: 13,3 % Clay: 86,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	36,3



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

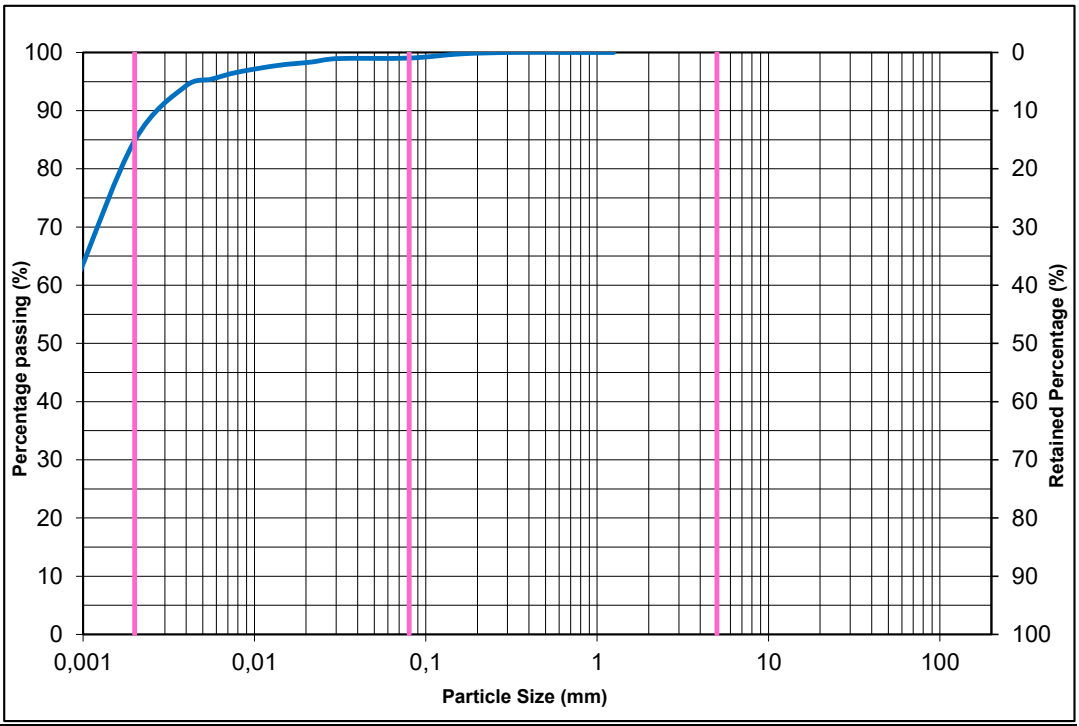
Sampled by : Hugo Desrochers
Sampling Date : November 04, 2022

Project No : 158100425.500.710.5
Sample No : BH22-28 SS-07
Depth : 4,57 - 5,18m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

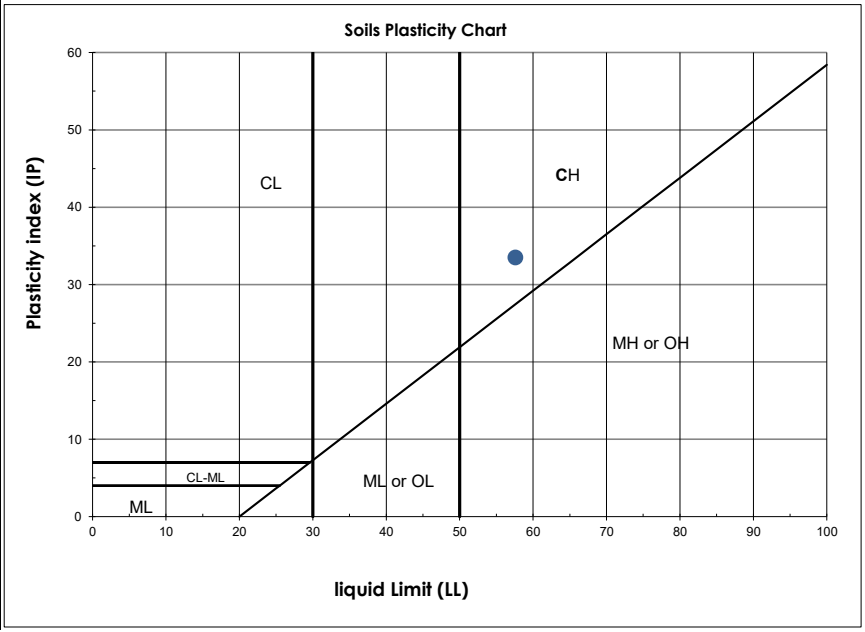
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,0



% Gravel: 0,0 % Sand : 1,0 % Silt: 14,1 % Clay: 84,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	60,1
Liquid Limit (BNQ 2501-092)	58
Plastic Limit (BNQ 2501-092)	25
Plasticity Index (BNQ 2501-092)	33



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

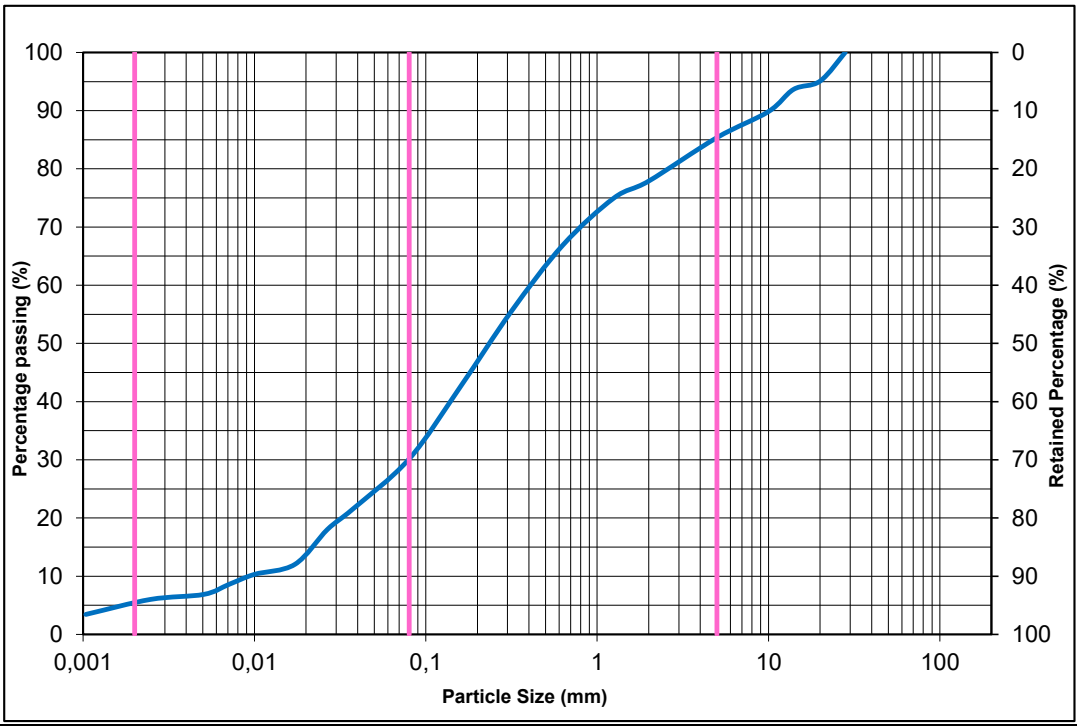
Sampled by : Hugo Desrochers
Sampling Date : November 04, 2022

Project No : 158100425.500.710.5
Sample No : BH22-28 SS-13
Depth : 13,72 - 14,33m

Material Description : Silty Sand, some Gravel, traces of Clay

Grain Size Analysis (BNQ 2501-025)

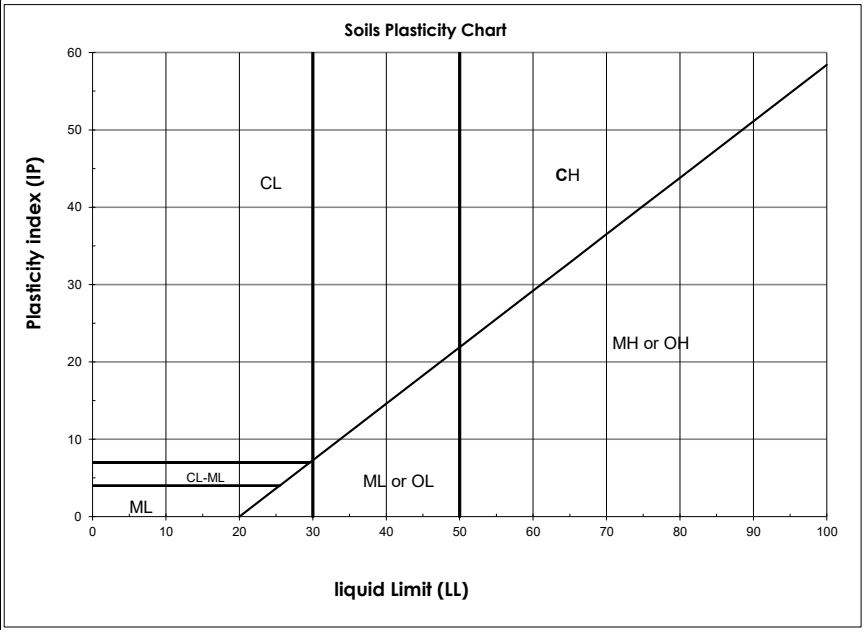
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	95
14,0	94
10,0	90
5,00	85
2,00	78
1,25	75
0,630	67
0,315	55
0,160	43
0,080	30,2



% Gravel: 14,6 % Sand : 55,2 % Silt: 25,0 % Clay: 5,2

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	10,2



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

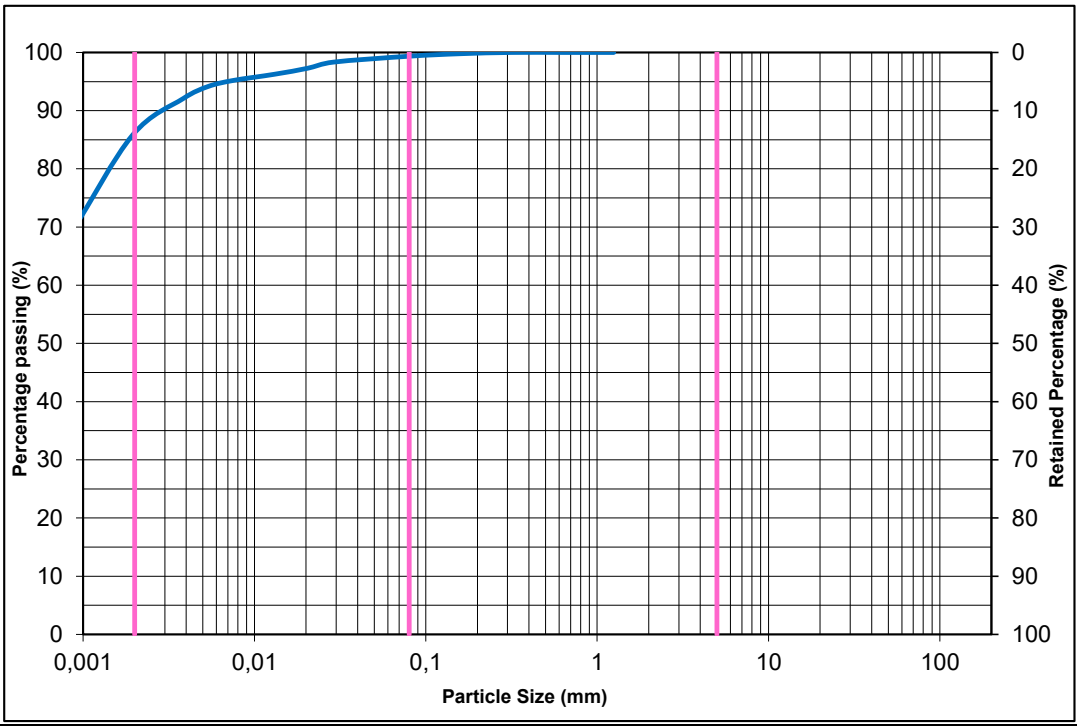
Sampled by : Hugo Desrochers
Sampling Date : October 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-29 SS-02
Depth : 0,61 - 1,22m

Material Description : Clay, some Silt, traces of Sand

Grain Size Analysis (BNQ 2501-025)

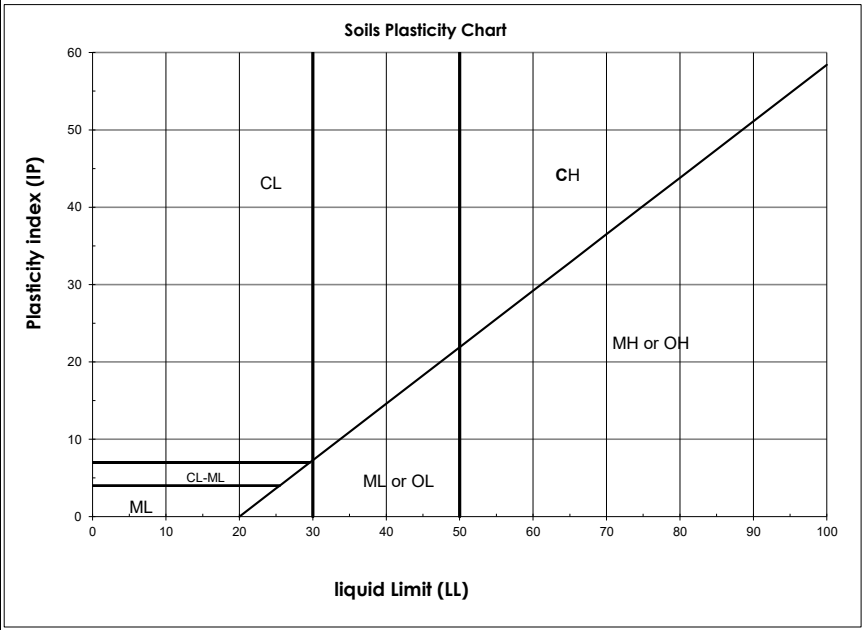
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,4



% Gravel: 0,0 % Sand : 0,6 % Silt: 12,7 % Clay: 86,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	37,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

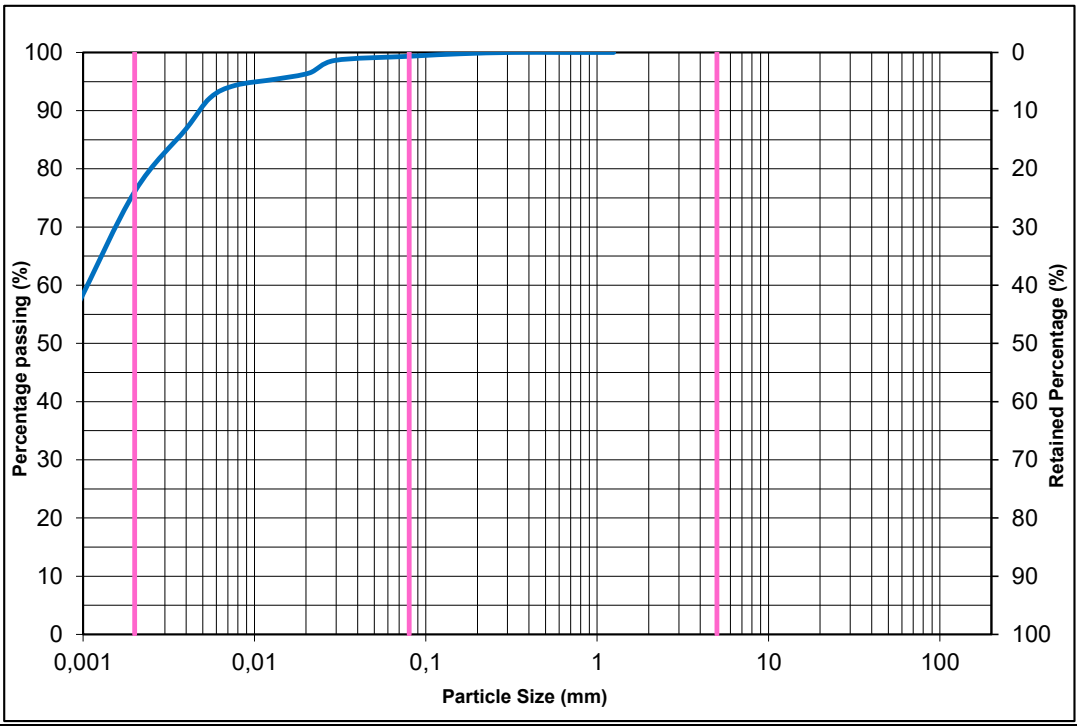
Sampled by : Hugo Desrochers
Sampling Date : October 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-29 SS-07
Depth : 3,66 - 4,27m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

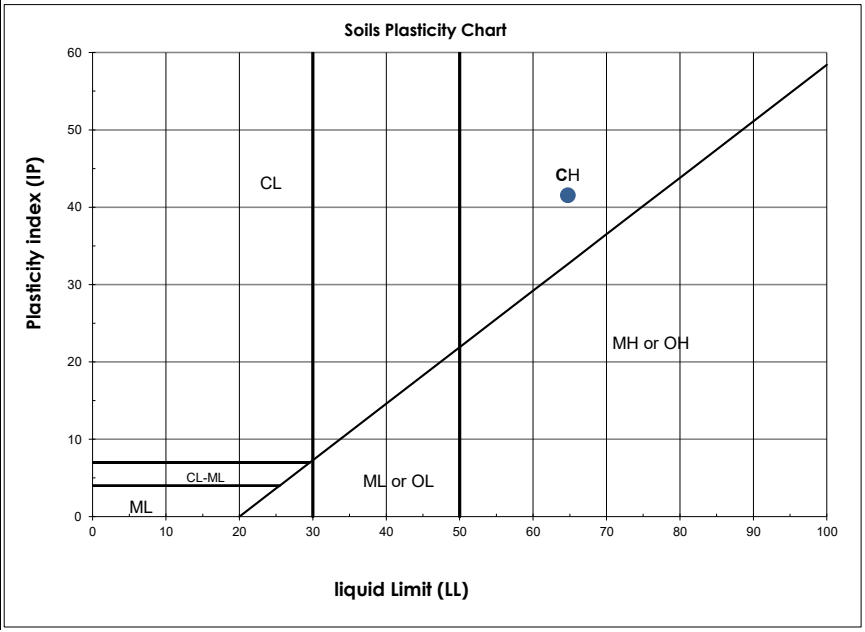
Openings Dimensions	Cumulative Results
mm	%
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,3



% Gravel: 0,0 % Sand : 0,7 % Silt: 23,3 % Clay: 76,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	71,4
Liquid Limit (BNQ 2501-092)	65
Plastic Limit (BNQ 2501-092)	23
Plasticity Index (BNQ 2501-092)	42



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

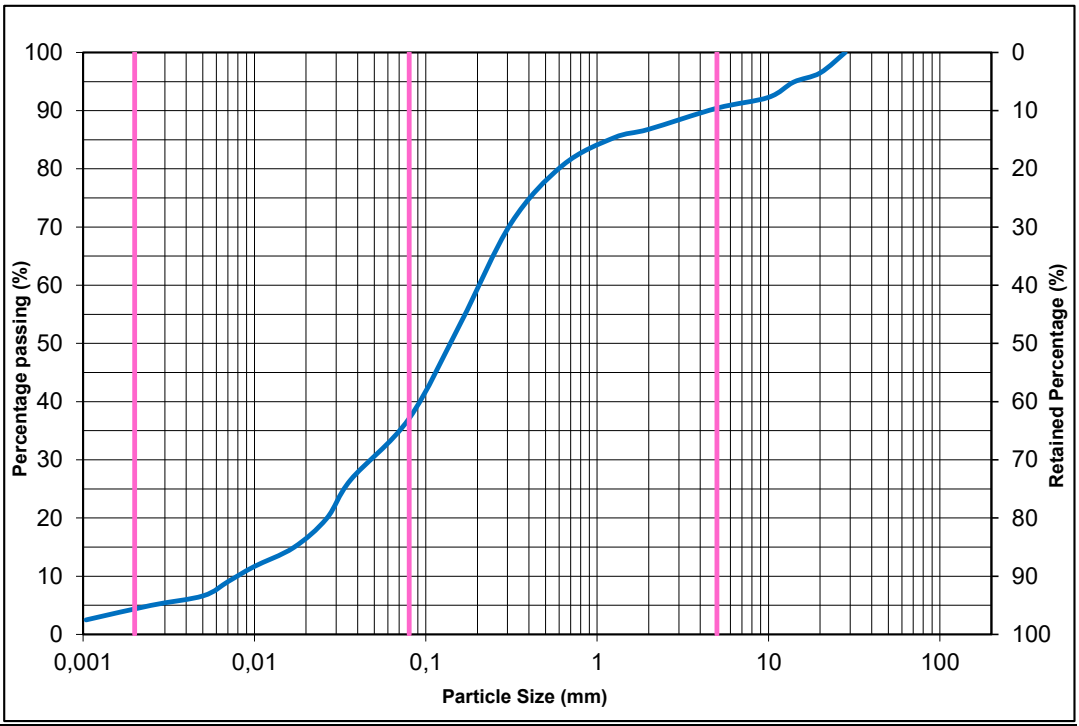
Sampled by : Hugo Desrochers
Sampling Date : October 15, 2022

Project No : 158100425.500.710.5
Sample No : BH22-29 SS-17
Depth : 9,75 - 10,36m

Material Description : Silty Sand, traces of Gravel, traces of Clay

Grain Size Analysis (BNQ 2501-025)

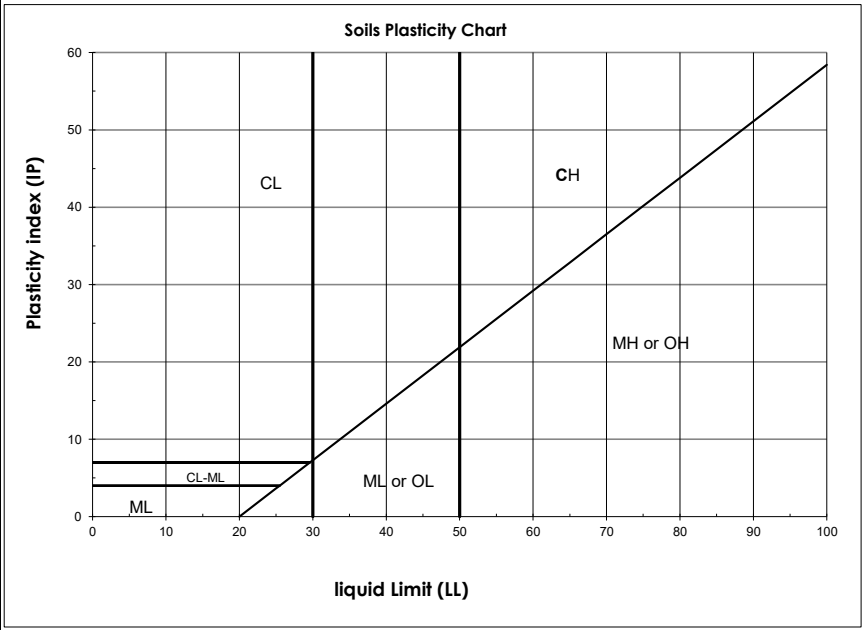
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	95
10,0	92
5,00	90
2,00	87
1,25	85
0,630	81
0,315	71
0,160	54
0,080	37,1



% Gravel: 9,6 % Sand : 53,3 % Silt: 33,0 % Clay: 4,1

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	12,0



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

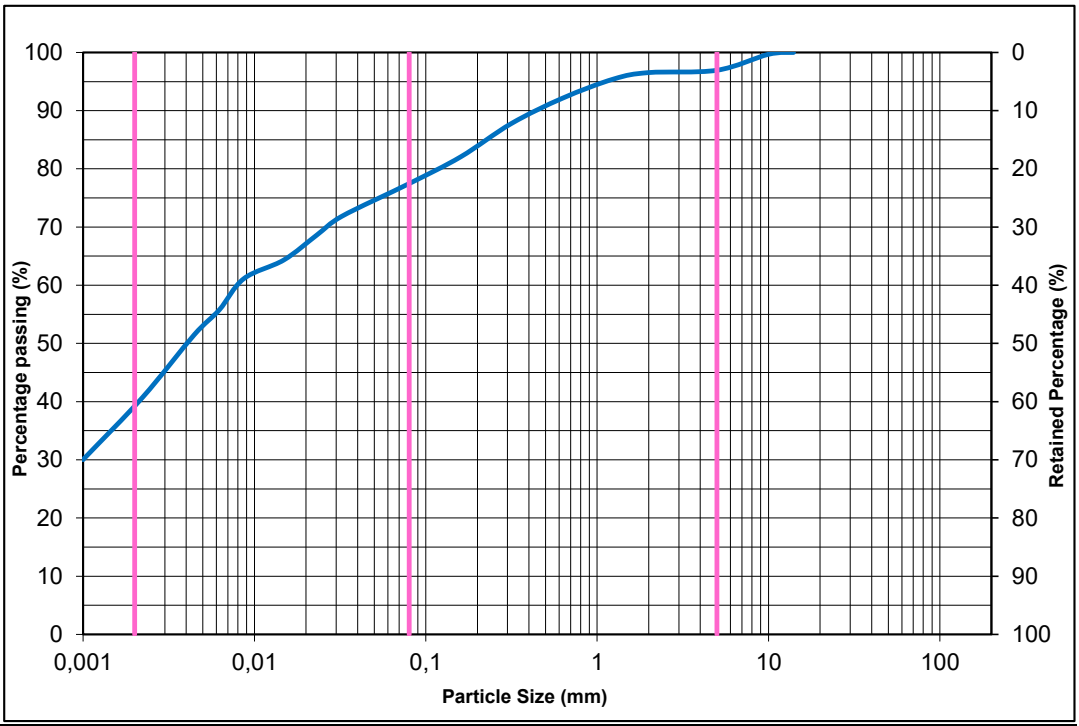
Sampled by : Hugo Desrochers
Sampling Date : October 06, 2022

Project No : 158100425.500.710.5
Sample No : BH22-30 SS-02
Depth : 0,61 - 1,22m

Material Description : Clay and Silt, some Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

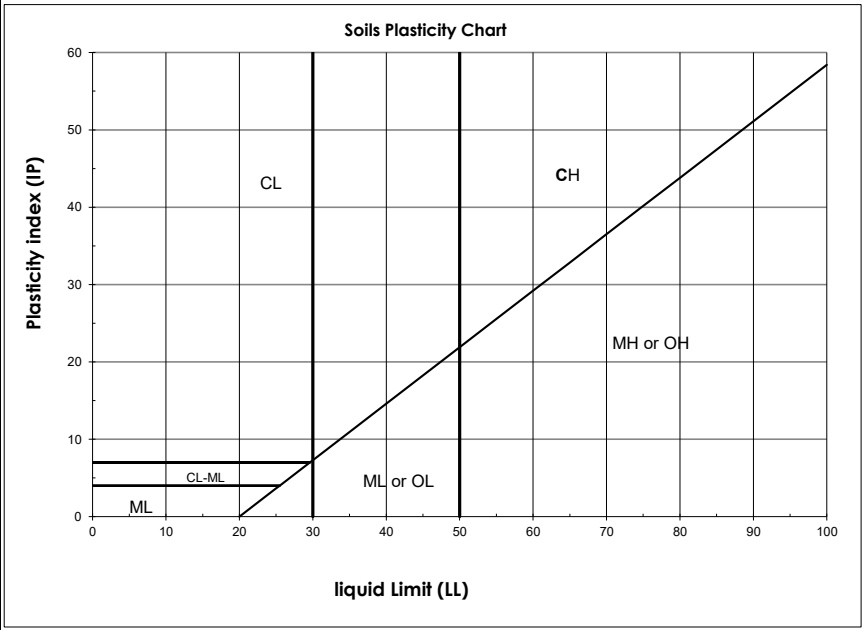
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	97
2,00	97
1,25	95
0,630	92
0,315	88
0,160	82
0,080	77,5



% Gravel: 3,0 % Sand : 19,5 % Silt: 38,7 % Clay: 38,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	27,1



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

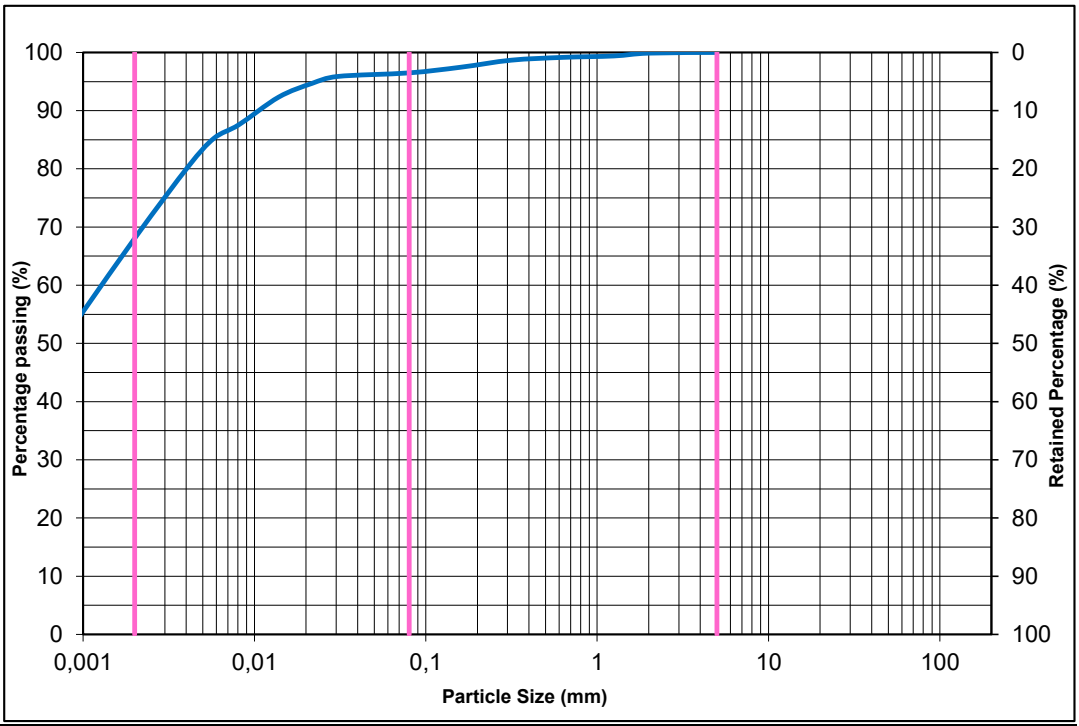
Sampled by : Hugo Desrochers
Sampling Date : October 06, 2022

Project No : 158100425.500.710.5
Sample No : BH22-30 SS-08
Depth : 4,27 - 4,88m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

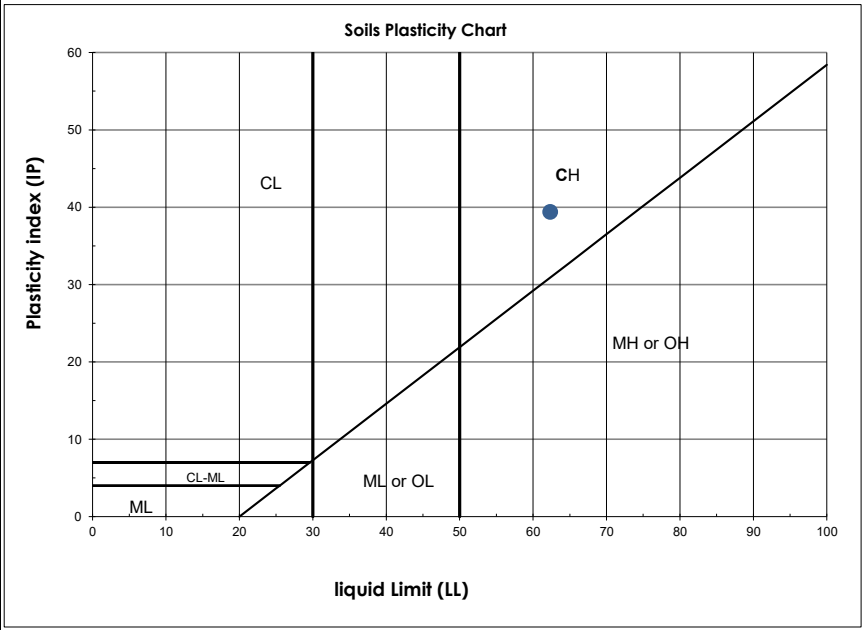
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	99
0,630	99
0,315	99
0,160	97
0,080	96,5



% Gravel: 0,0 % Sand : 3,5 % Silt: 28,7 % Clay: 67,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	64,7
Liquid Limit (BNQ 2501-092)	62
Plastic Limit (BNQ 2501-092)	23
Plasticity Index (BNQ 2501-092)	39



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

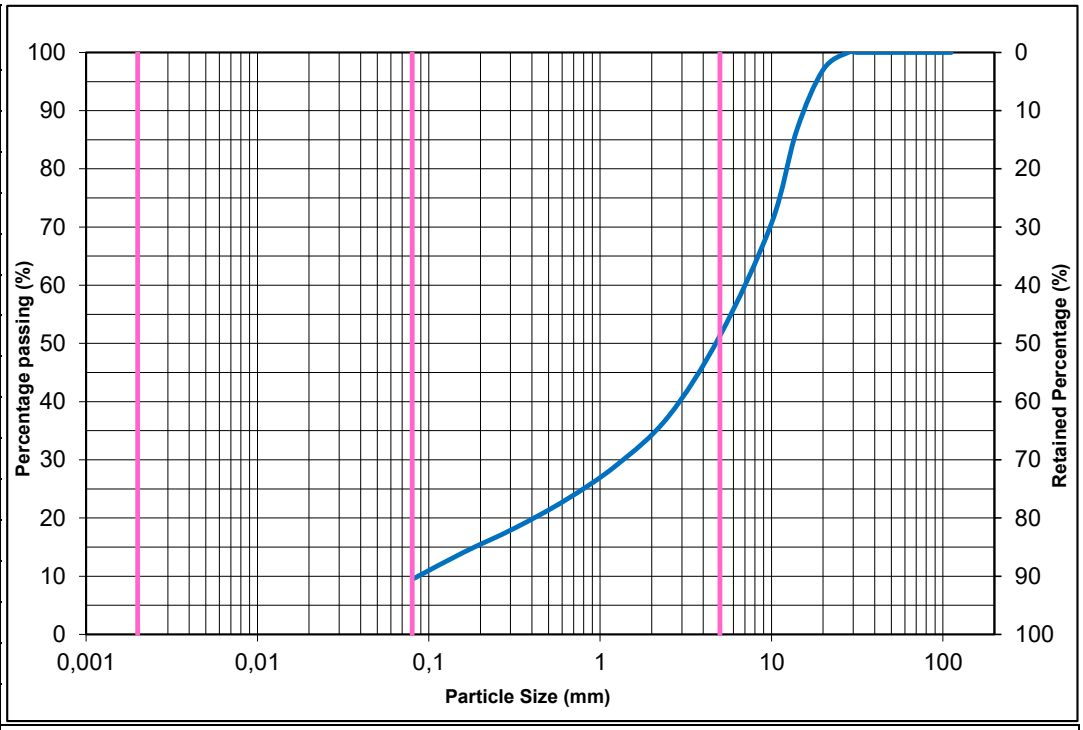
Sampled by : Hugo Desrochers
Sampling Date : October 13, 2022

Project No : 158100425.500.710.5
Sample No : BH22-31 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravel and Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

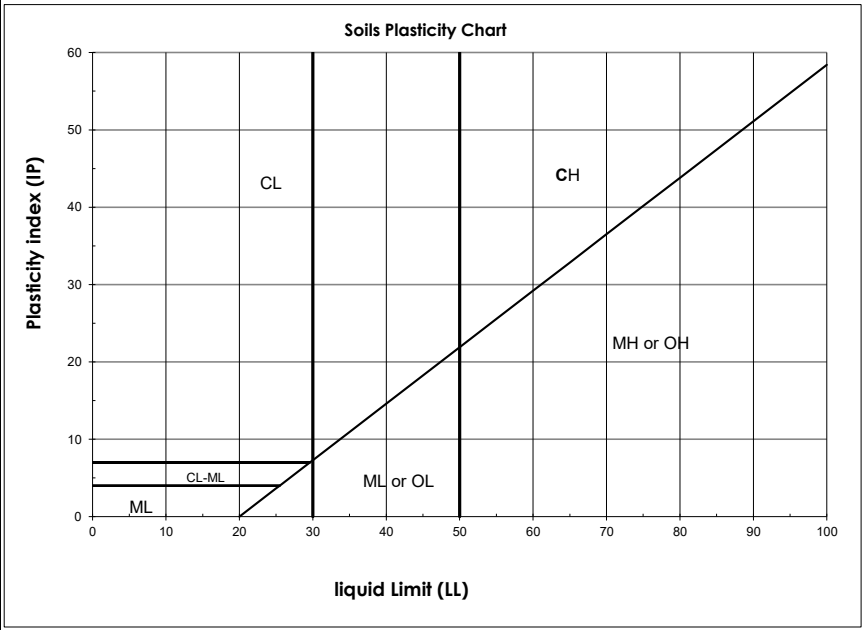
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	97
14,0	87
10,0	71
5,00	51
2,50	37
1,25	29
0,630	23
0,315	18
0,160	14
0,080	9,5



% Gravel : 48,6 % Sand : 41,9 % Fine particles : 9,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	4,4



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 13, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

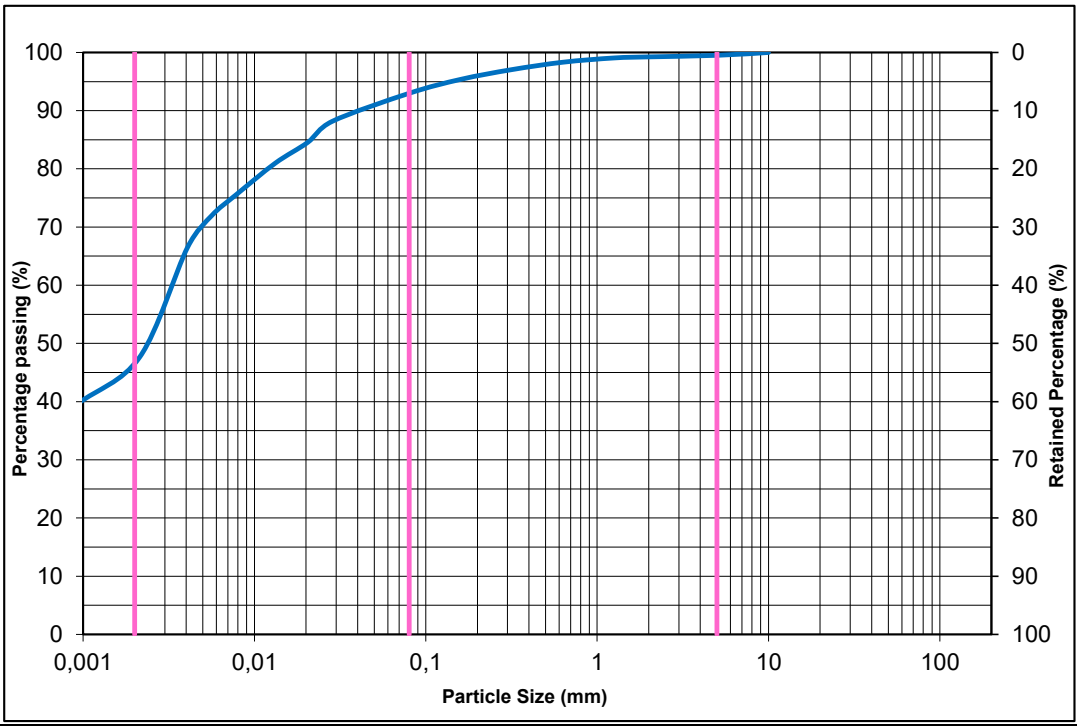
Sampled by : Hugo Desrochers
Sampling Date : October 13, 2022

Project No : 158100425.500.710.5
Sample No : BH22-31 SS-11
Depth : 6,10 - 6,71m

Material Description : Clay and Silt, traces of Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

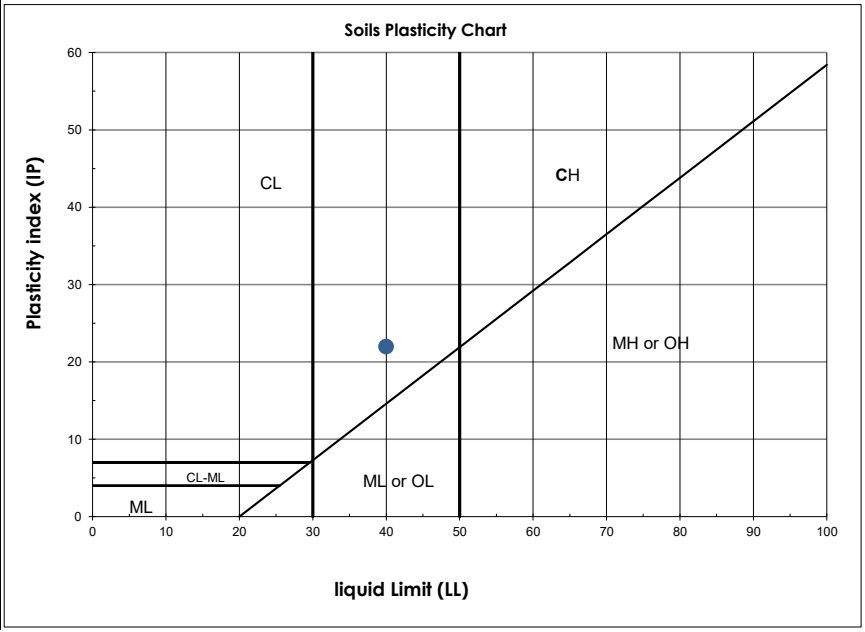
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	99
1,25	99
0,630	98
0,315	97
0,160	95
0,080	93,0



% Gravel: 0,5 % Sand : 6,5 % Silt: 46,3 % Clay: 46,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	42,1
Liquid Limit (BNQ 2501-092)	40
Plastic Limit (BNQ 2501-092)	18
Plasticity Index (BNQ 2501-092)	22



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 24, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

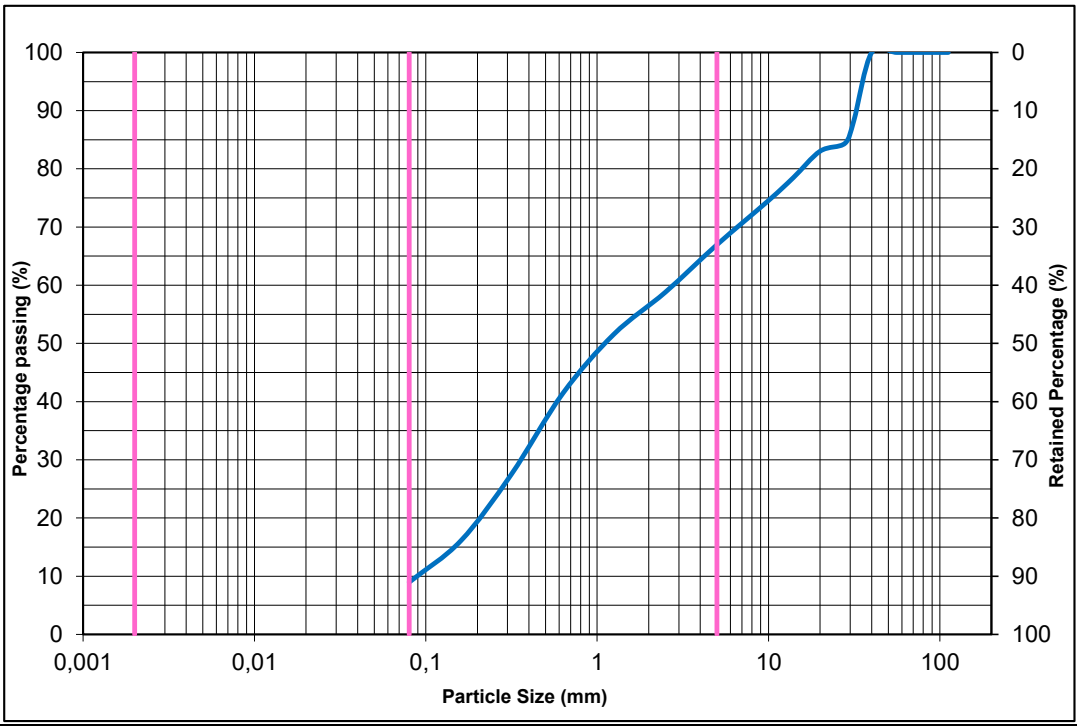
Sampled by : Hugo Desrochers
Sampling Date : October 08, 2022

Project No : 158100425.500.710.5
Sample No : BH22-32 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravely Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

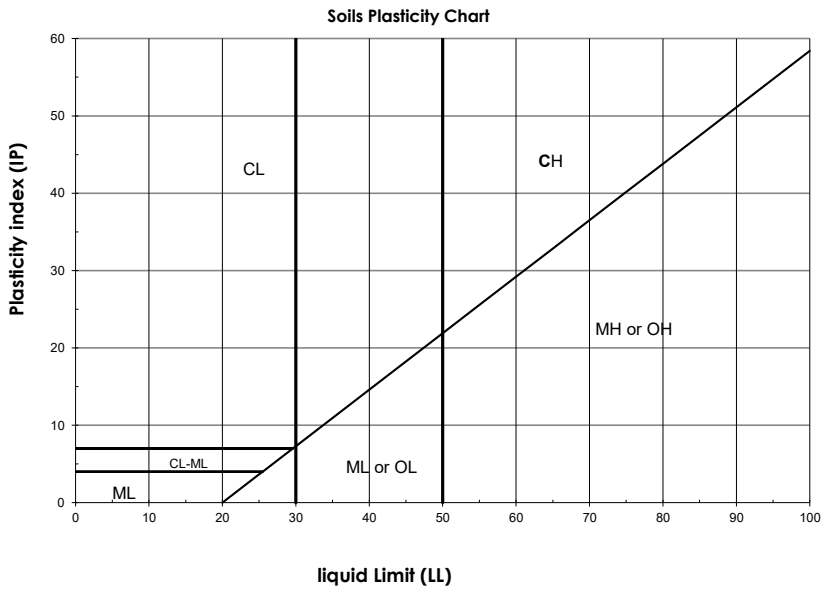
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	88
28,0	84
20,0	83
14,0	79
10,0	75
5,00	67
2,50	59
1,25	52
0,630	41
0,315	27
0,160	16
0,080	9,0



% Gravel : 33,0 % Sand : 58,0 % Fine particles : 9,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	6,0



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

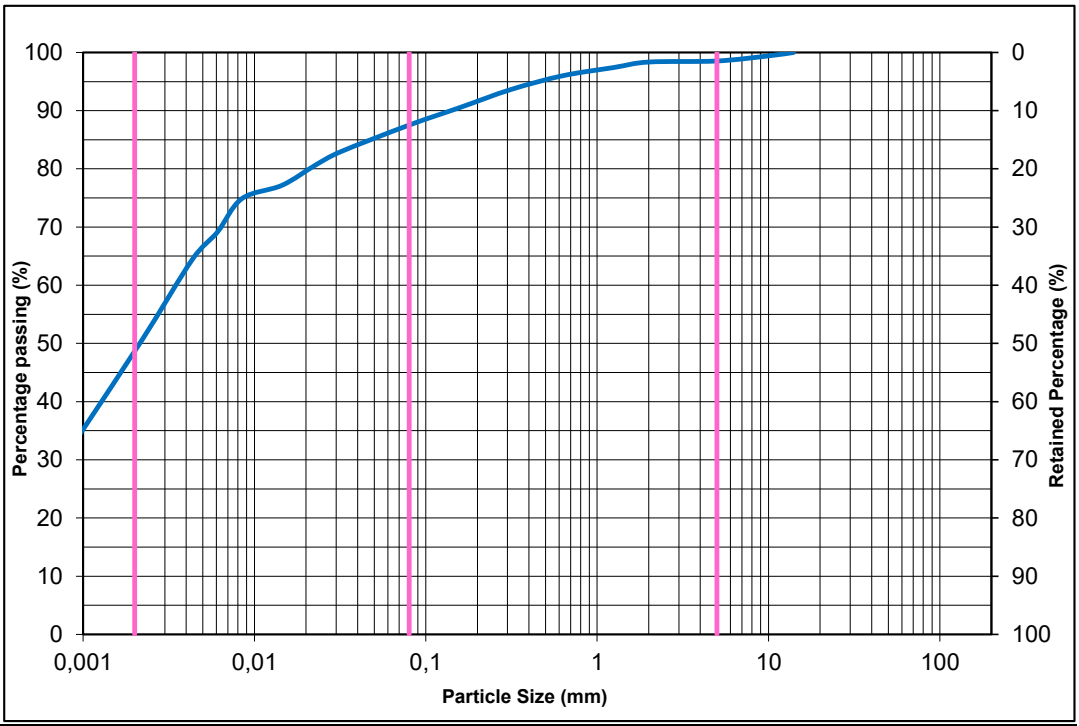
Sampled by : Hugo Desrochers
Sampling Date : October 08, 2022

Project No : 158100425.500.710.5
Sample No : BH22-32 SS-08
Depth : 4,27 - 4,88m

Material Description : Clay and Silt, some Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

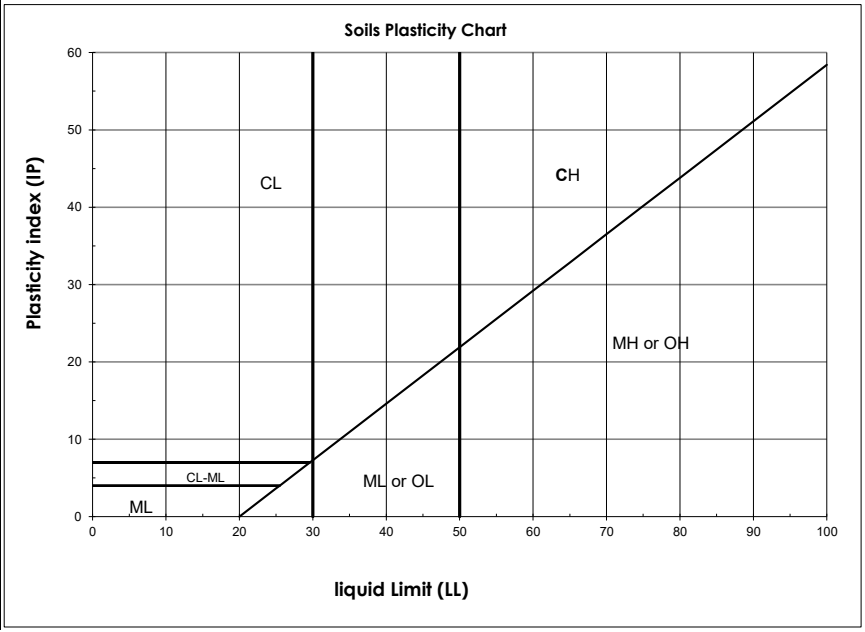
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	99
2,00	98
1,25	97
0,630	96
0,315	94
0,160	91
0,080	87,5



% Gravel: 1,5 % Sand : 11,0 % Silt: 39,6 % Clay: 47,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	28,4



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

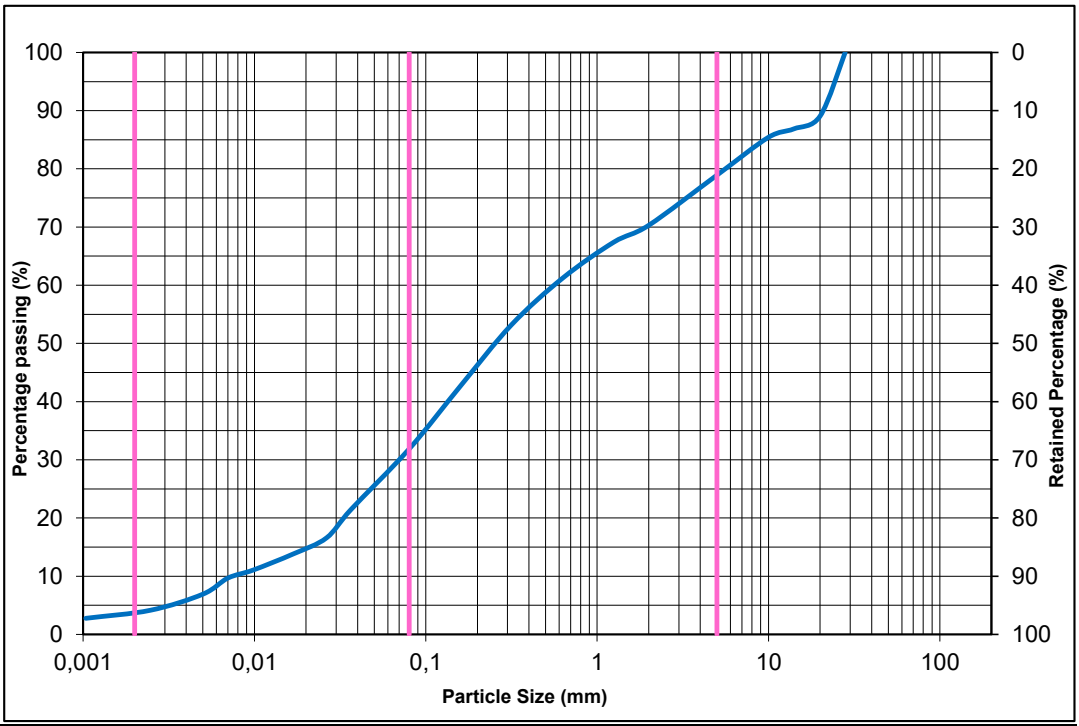
Sampled by : Hugo Desrochers
Sampling Date : October 08, 2022

Project No : 158100425.500.710.5
Sample No : BH22-32 SS-11
Depth : 6,10 - 6,71m

Material Description : Gravely, Silty Sand, traces of Clay

Grain Size Analysis (BNQ 2501-025)

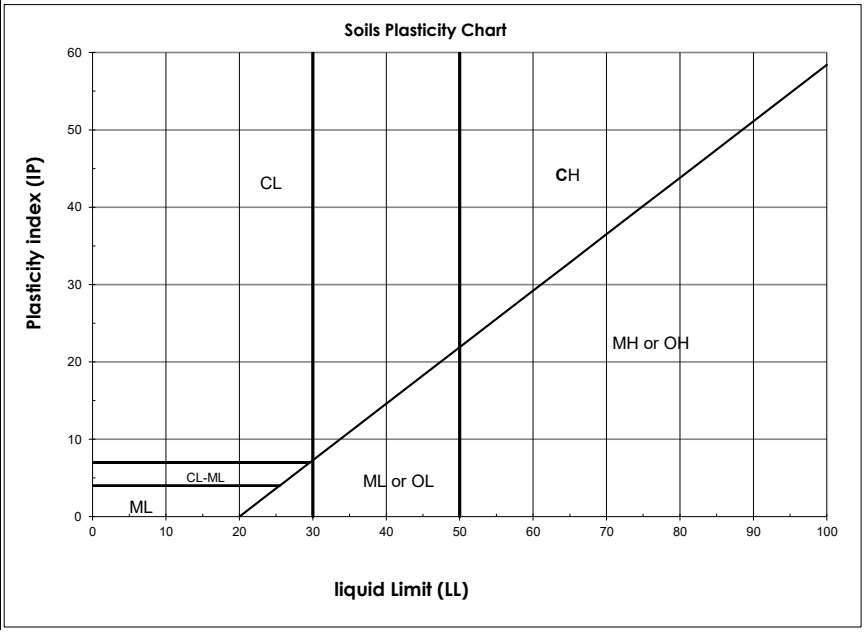
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	89
14,0	87
10,0	85
5,00	79
2,00	70
1,25	67
0,630	61
0,315	53
0,160	43
0,080	31,9



% Gravel: 21,1 % Sand : 47,0 % Silt: 28,2 % Clay: 3,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	7,3



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

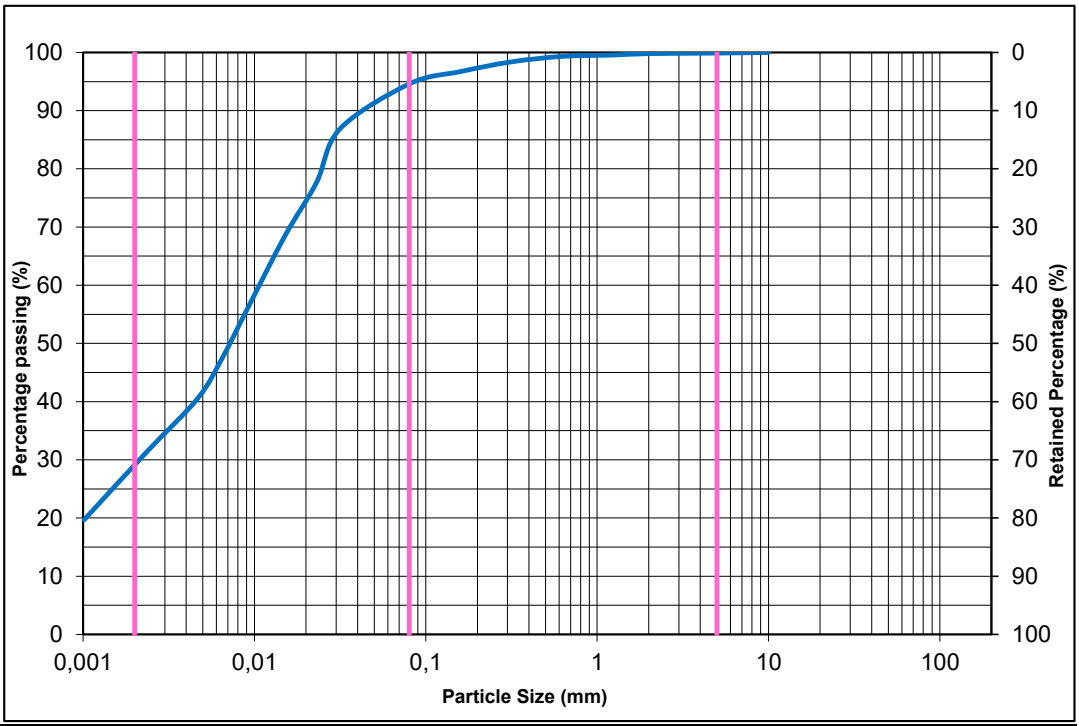
Sampled by : Hugo Desrochers
Sampling Date : November 05, 2022

Project No : 158100425.500.710.5
Sample No : BH22-33 SS-01B
Depth : 0,10 - 0,61m

Material Description : Clayey Silt, traces of Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

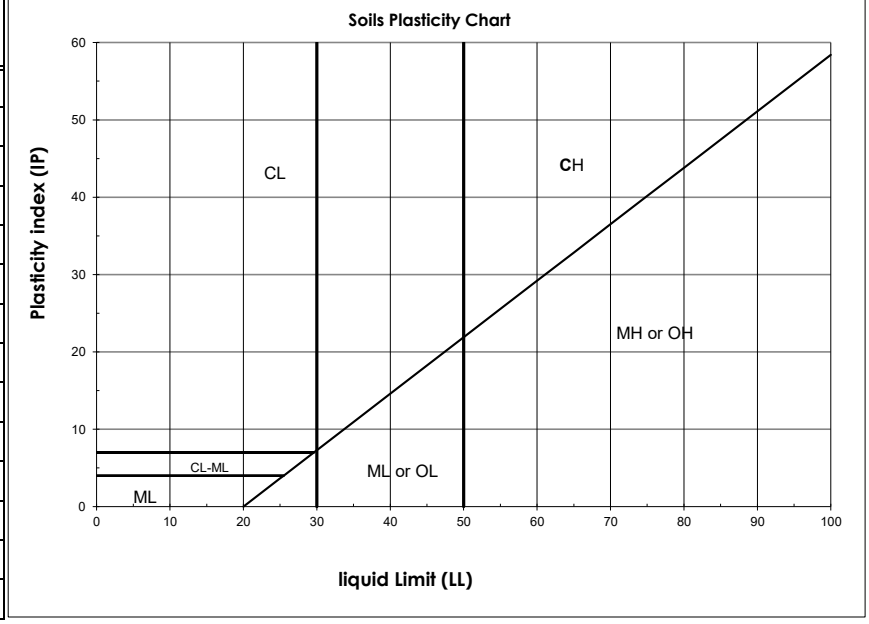
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	99
0,315	98
0,160	97
0,080	94,6



% Gravel: 0,1 % Sand : 5,3 % Silt: 66,3 % Clay: 28,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	32,5



Remarks :

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LABORATORY TESTING REPORT

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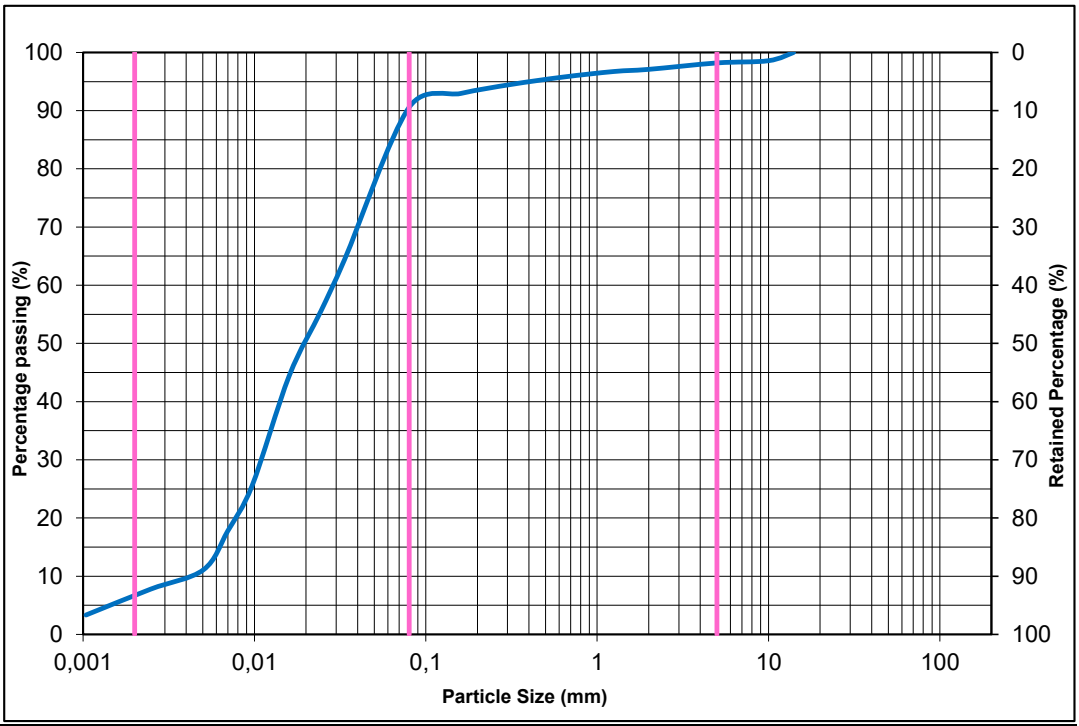
Sampled by : Hugo Desrochers
Sampling Date : November 05, 2022

Project No : 158100425.500.710.5
Sample No : BH22-33 SS-03B
Depth : 1,32 - 1,83m

Material Description : Silt, traces of Sand, traces of Clay, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

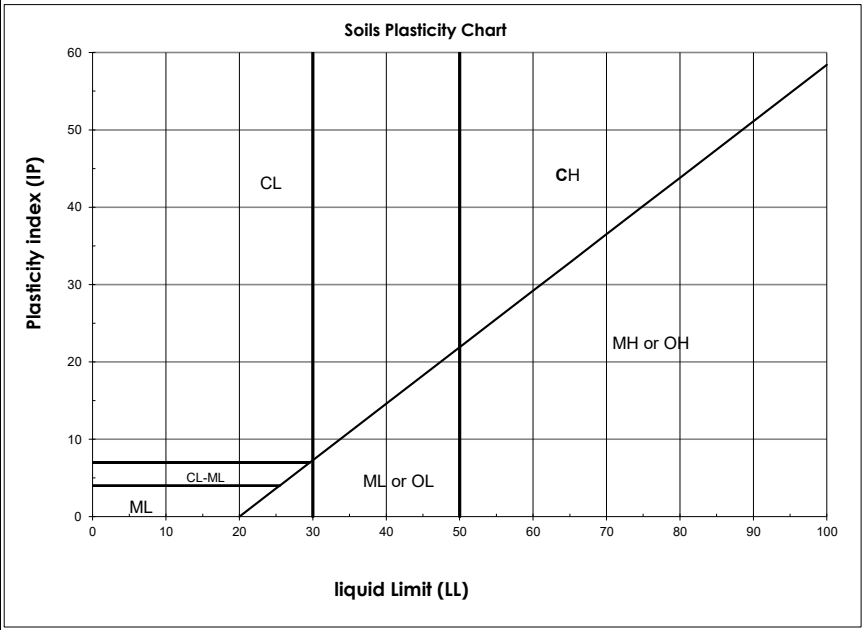
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	98
2,00	97
1,25	97
0,630	96
0,315	95
0,160	93
0,080	90,6



% Gravel: 1,8 % Sand : 7,6 % Silt: 84,3 % Clay: 6,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	19,8



Remarks :

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LABORATORY TESTING REPORT

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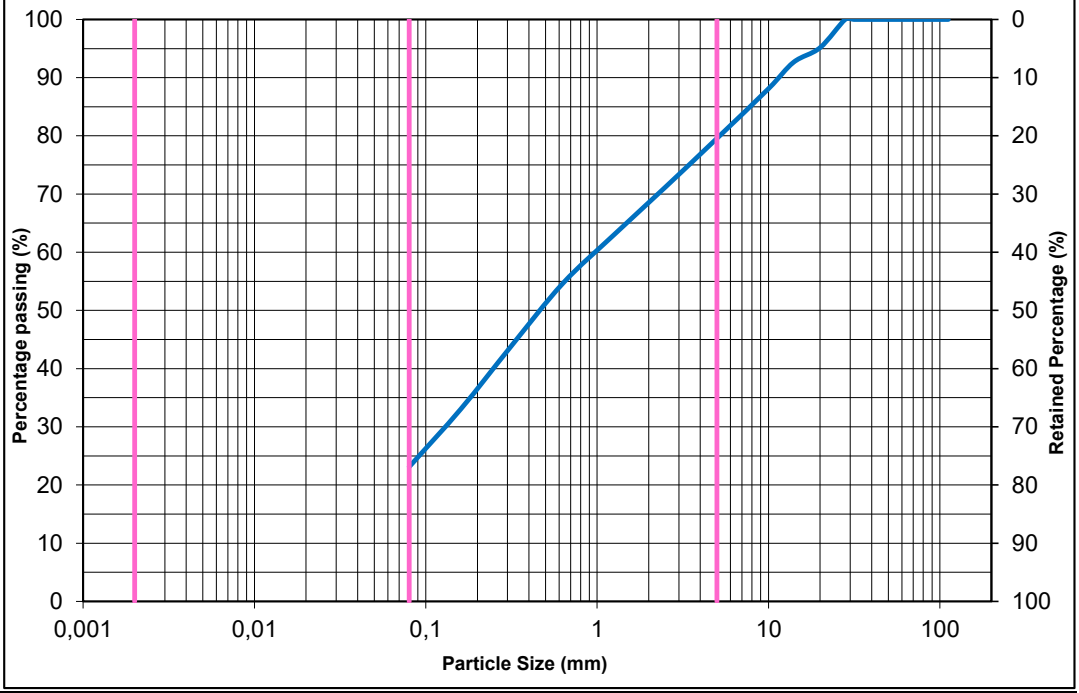
Sampled by : Hugo Desrochers
Sampling Date : November 05, 2022

Project No : 158100425.500.710.5
Sample No : BH22-33 SS-08
Depth : 4,27 - 4,88m

Material Description : Gravely, Silty Sand

Grain Size Analysis (BNQ 2501-025)

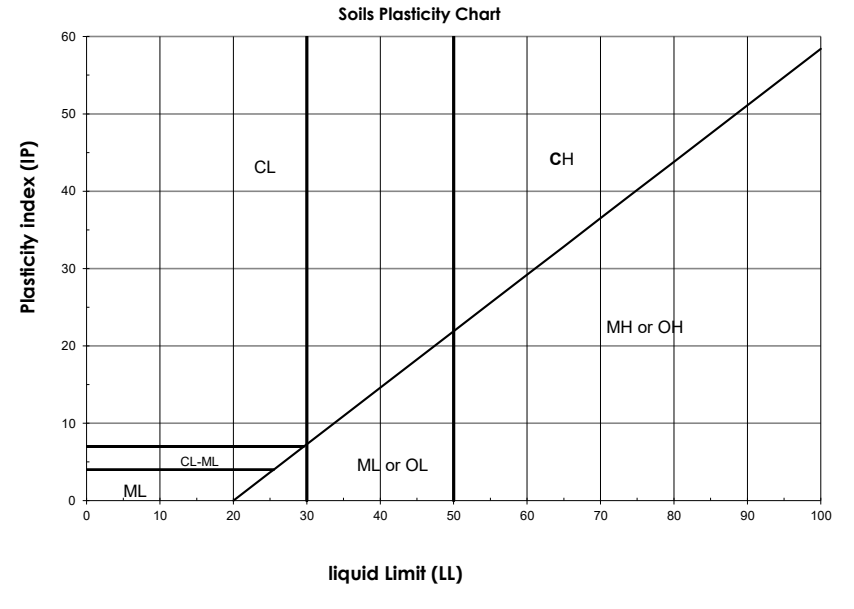
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	95
14,0	93
10,0	88
5,00	80
2,50	71
1,25	63
0,630	55
0,315	44
0,160	33
0,080	23,1



% Gravel : 20,5 % Sand : 56,4 % Fine particles : 23,1

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	9,5



Remarks :

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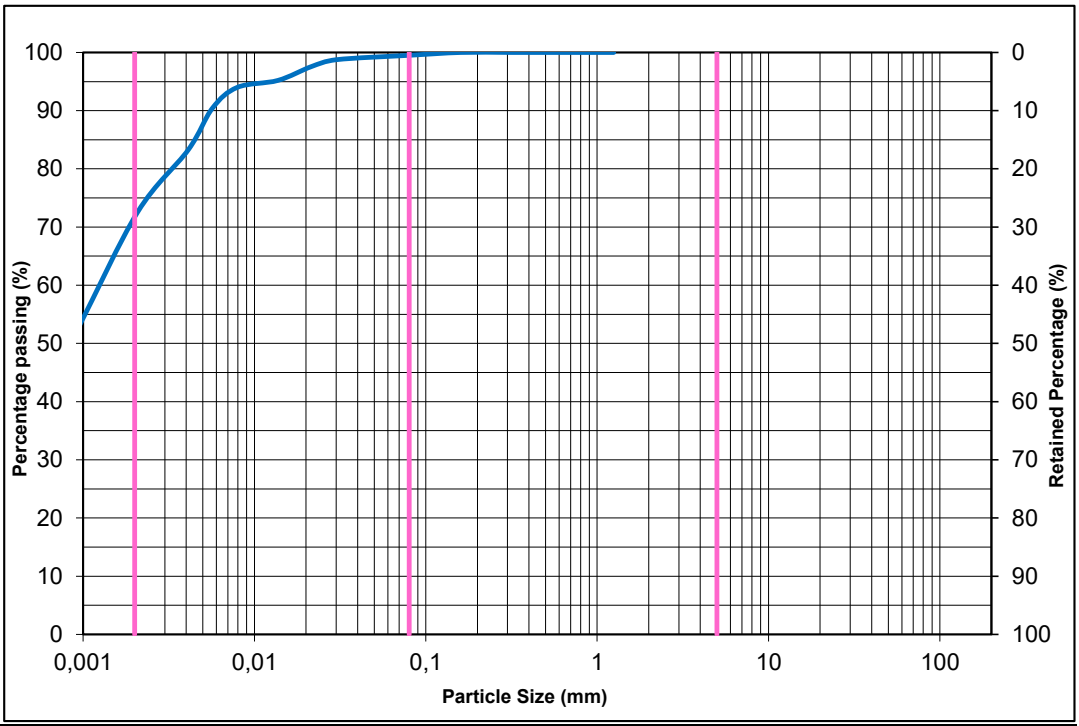
Sampled by : Hugo Desrochers
Sampling Date : October 14, 2022

Project No : 158100425.500.710.5
Sample No : BH22-34 SS-02
Depth : 0,61 - 1,22m

Material Description : Silty Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

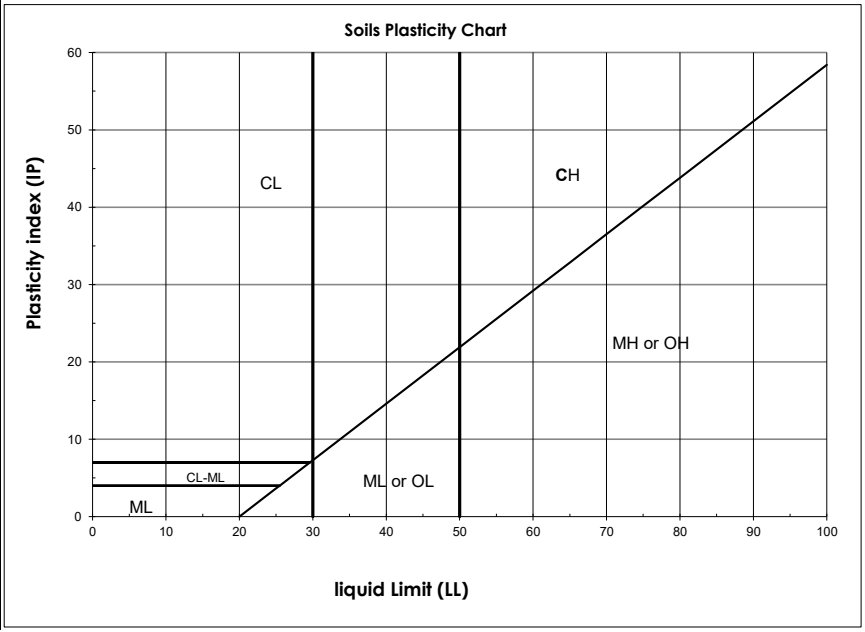
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,5



% Gravel: 0,0 % Sand : 0,5 % Silt: 28,4 % Clay: 71,1

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	40,5



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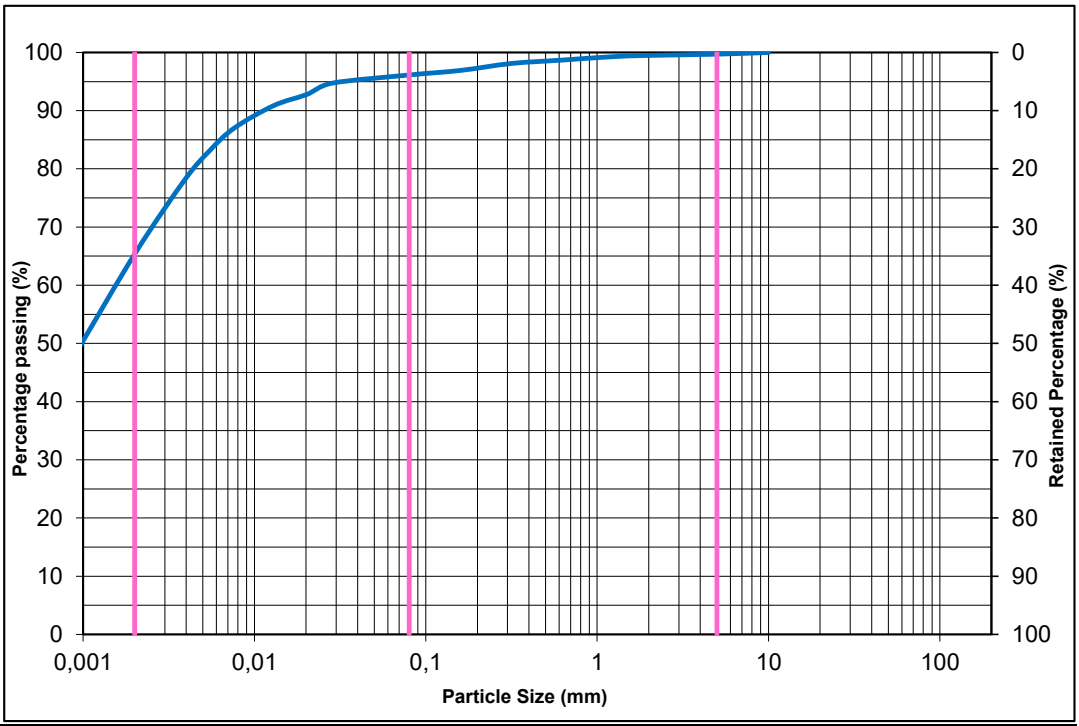
Sampled by : Hugo Desrochers
Sampling Date : October 14, 2022

Project No : 158100425.500.710.5
Sample No : BH22-34 SS-04
Depth : 1,83 - 2,44m

Material Description : Silty Clay, traces of Sand, traces of Gravel, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

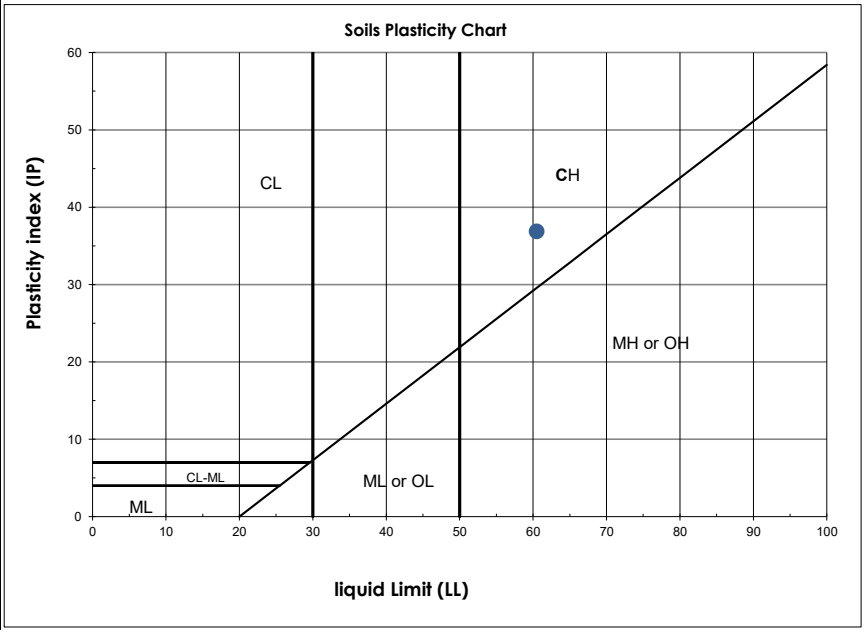
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	99
1,25	99
0,630	99
0,315	98
0,160	97
0,080	96,1



% Gravel: 0,3 % Sand : 3,6 % Silt: 31,0 % Clay: 65,1

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	42,9
Liquid Limit (BNQ 2501-092)	60
Plastic Limit (BNQ 2501-092)	23
Plasticity Index (BNQ 2501-092)	37



Remarks :

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LABORATORY TESTING REPORT

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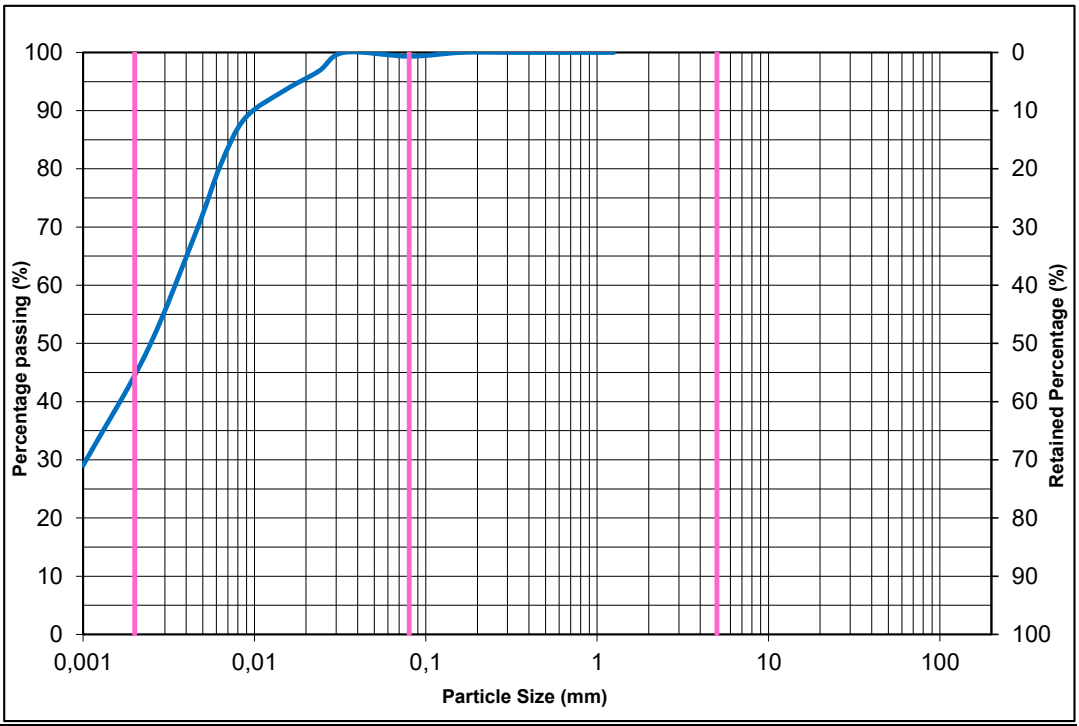
Sampled by : Hugo Desrochers
Sampling Date : October 14, 2022

Project No : 158100425.500.710.5
Sample No : BH22-34 SS-10
Depth : 5,49 - 6,10m

Material Description : Silt and Clay, traces of Sand, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

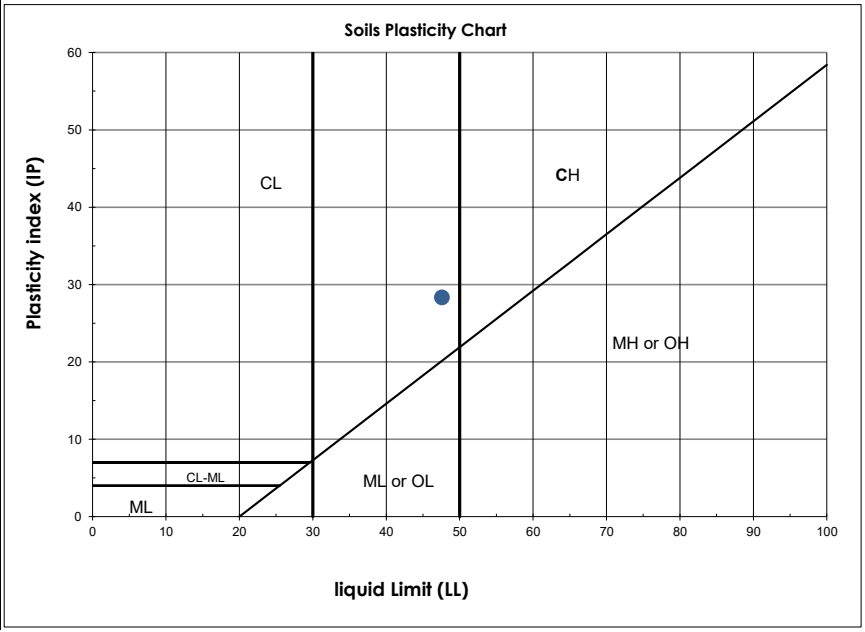
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,3



% Gravel: 0,0 % Sand : 0,7 % Silt: 55,8 % Clay: 43,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	42,2
Liquid Limit (BNQ 2501-092)	48
Plastic Limit (BNQ 2501-092)	20
Plasticity Index (BNQ 2501-092)	28



Remarks :

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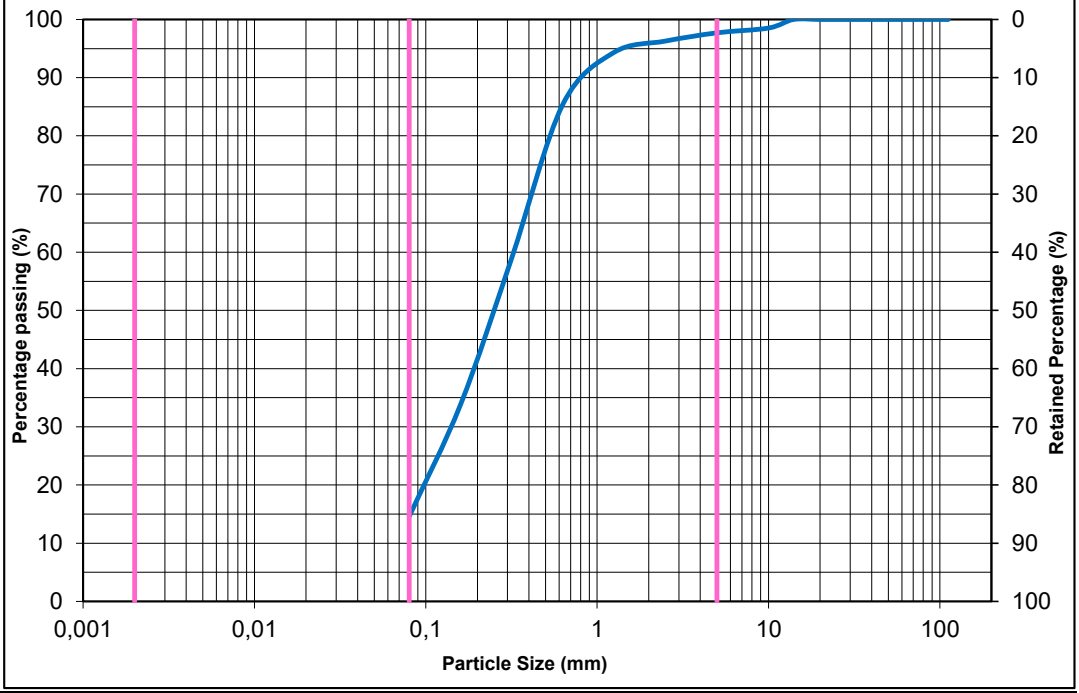
Sampled by : Hugo Desrochers
Sampling Date : October 14, 2022

Project No : 158100425.500.710.5
Sample No : BH22-34 SS-24
Depth : 16,76 - 17,37m

Material Description : Sand, some fine particles, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

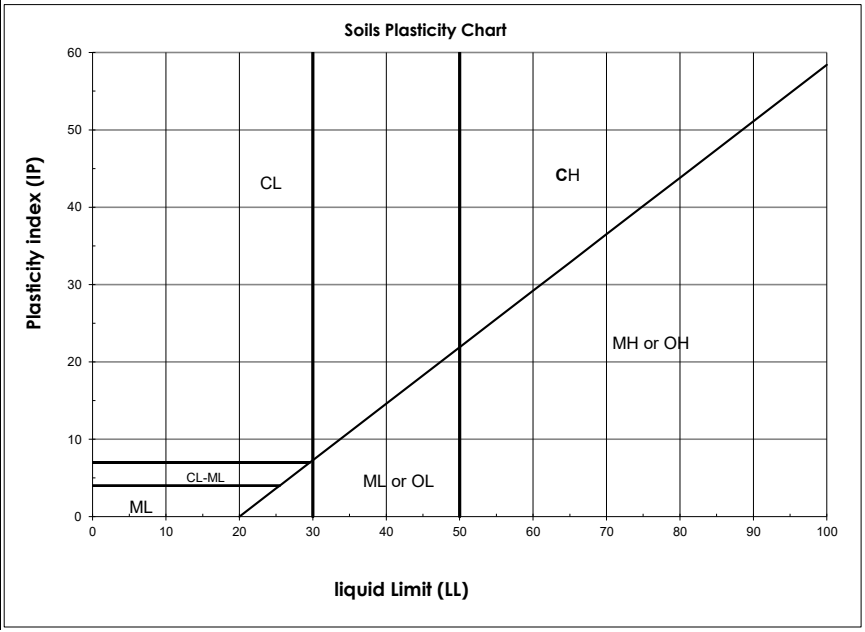
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	99
5,00	98
2,50	96
1,25	94
0,630	85
0,315	59
0,160	34
0,080	14,6



% Gravel : 2,3 % Sand : 83,1 % Fine particles : 14,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	20,1



Remarks :

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Date : January 25, 2023

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LABORATORY TESTING REPORT

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Project : LGA - Potential BDH Railway

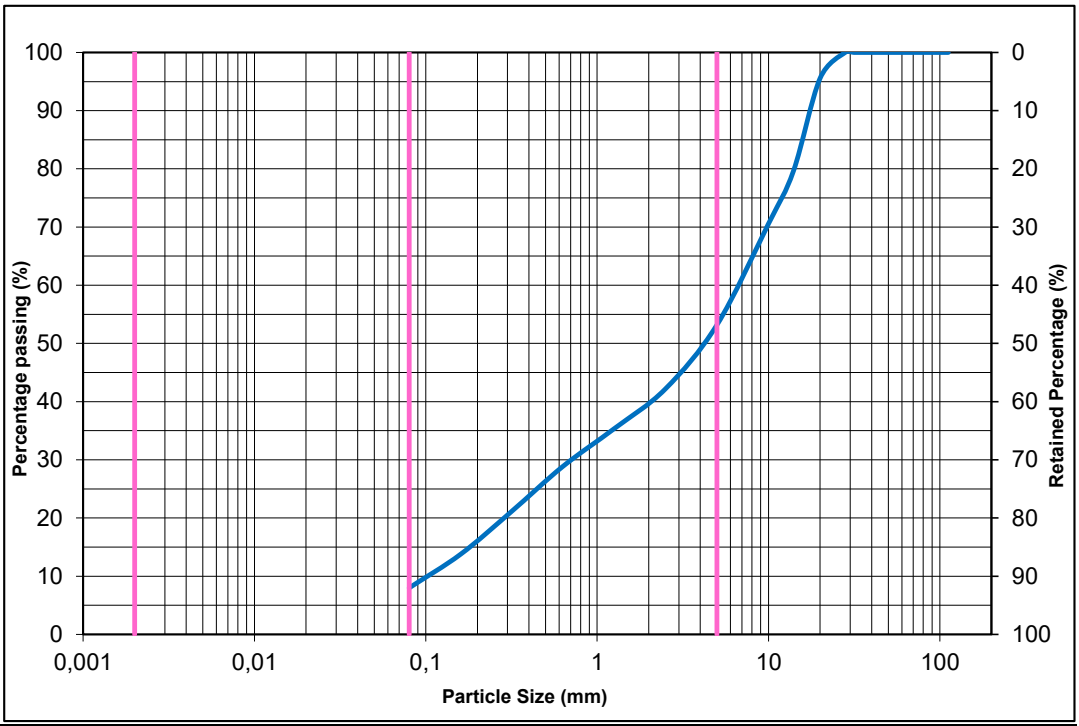
Sampled by : Hugo Desrochers
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-35 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravel and Sand, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

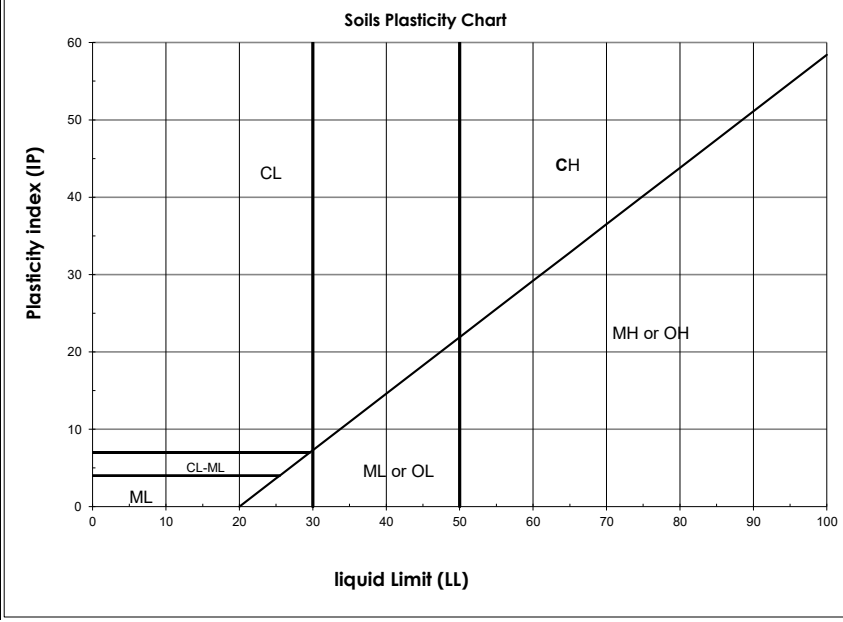
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	96
14,0	80
10,0	71
5,00	53
2,50	42
1,25	35
0,630	29
0,315	21
0,160	14
0,080	8,0



% Gravel : 46,8 % Sand : 45,2 % Fine particles : 8,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	4,3



Remarks :

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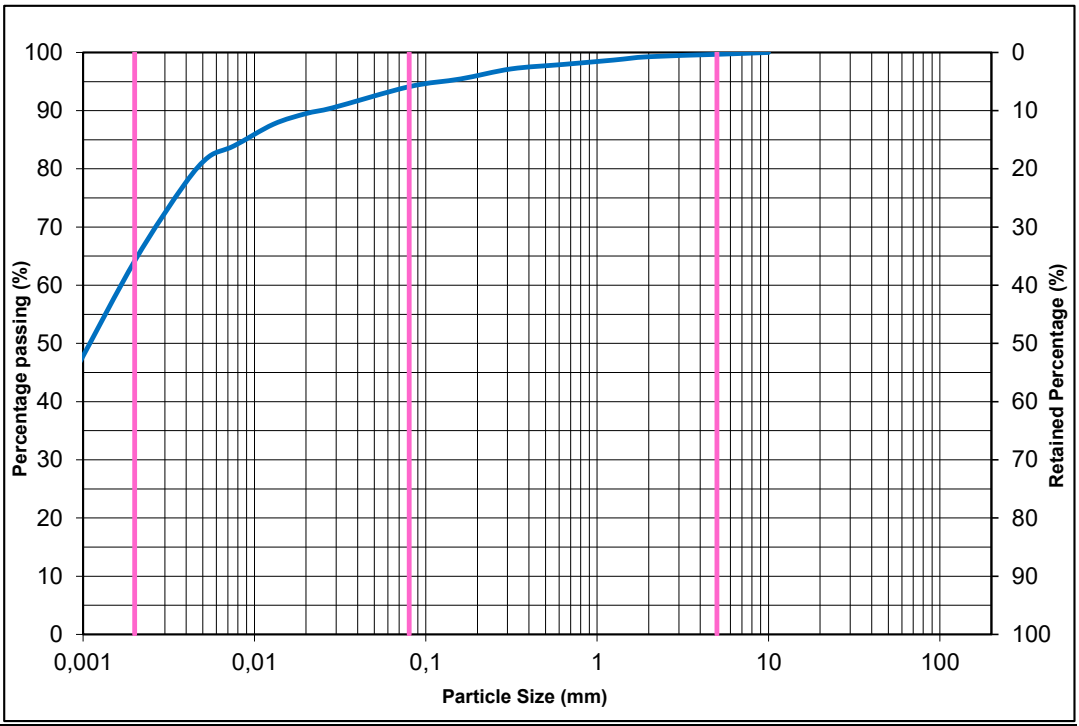
Sampled by : Hugo Desrochers
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-35 SS-07
Depth : 3,66 - 4,27m

Material Description : Silty Clay, traces of Sand, traces of Gravel, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

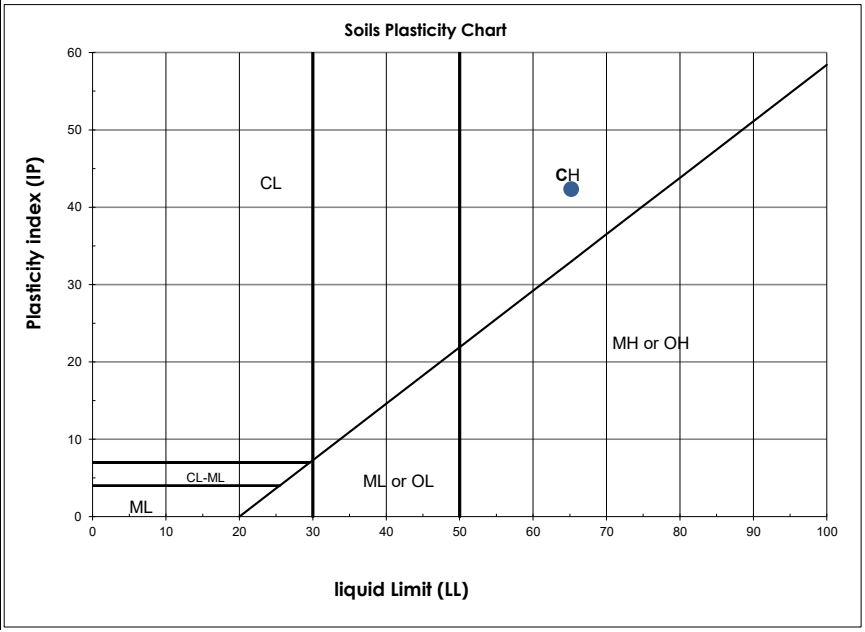
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	99
1,25	99
0,630	98
0,315	97
0,160	95
0,080	94,1



% Gravel: 0,3 % Sand : 5,6 % Silt: 30,1 % Clay: 64,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	46,1
Liquid Limit (BNQ 2501-092)	65
Plastic Limit (BNQ 2501-092)	23
Plasticity Index (BNQ 2501-092)	42



Remarks :

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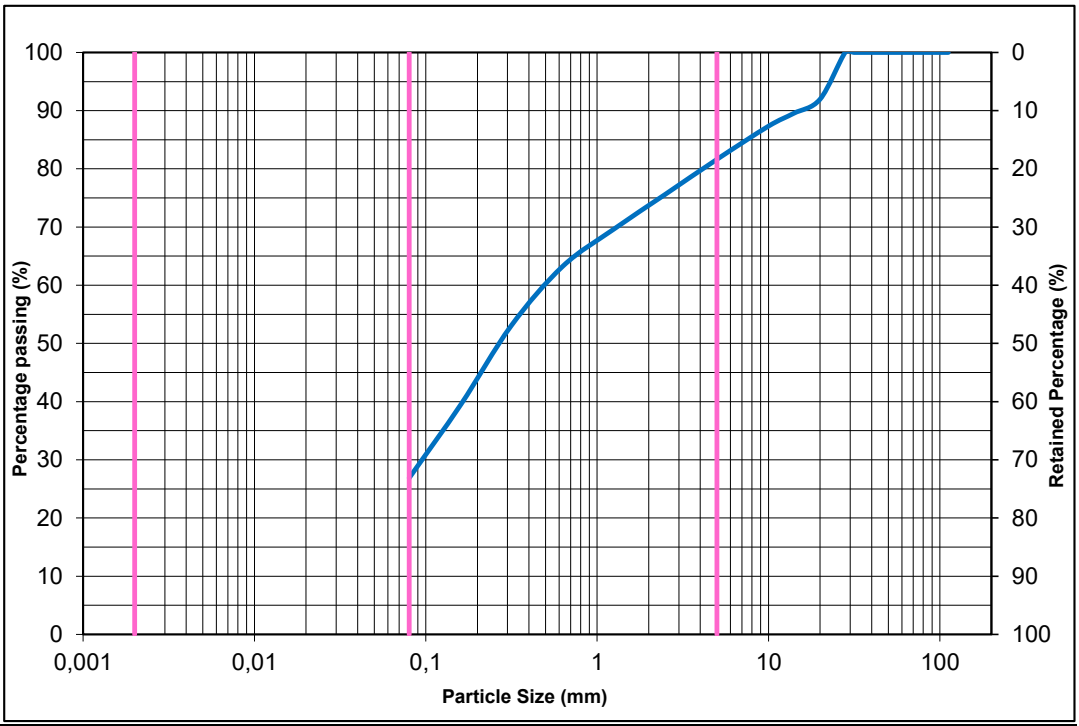
Sampled by : Hugo Desrochers
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-35 SS-24
Depth : 15,85 - 16,46m

Material Description : Silty Sand, some Gravel

Grain Size Analysis (BNQ 2501-025)

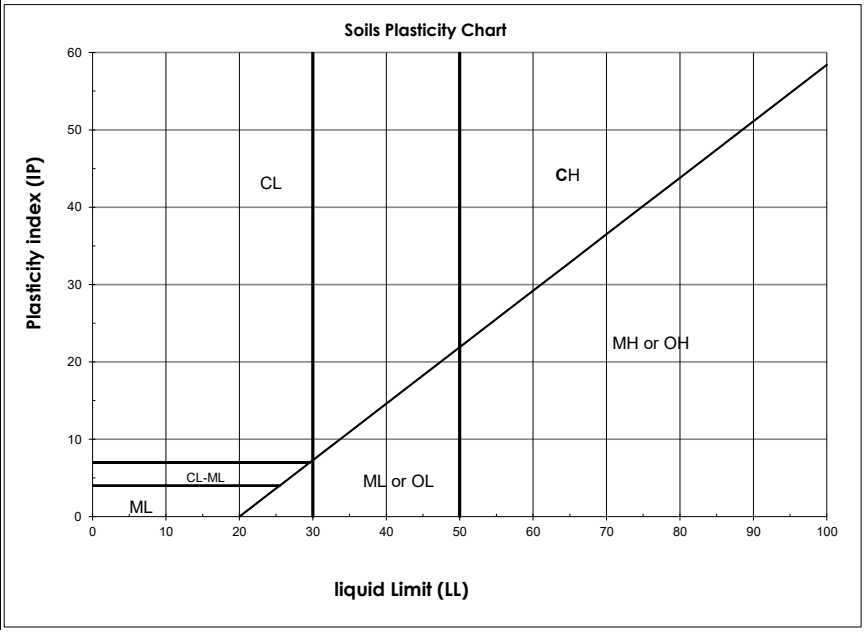
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	92
14,0	90
10,0	87
5,00	82
2,50	76
1,25	70
0,630	63
0,315	53
0,160	39
0,080	26,9



% Gravel : 18,4 % Sand : 54,7 % Fine particles : 26,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	10,9



Remarks :

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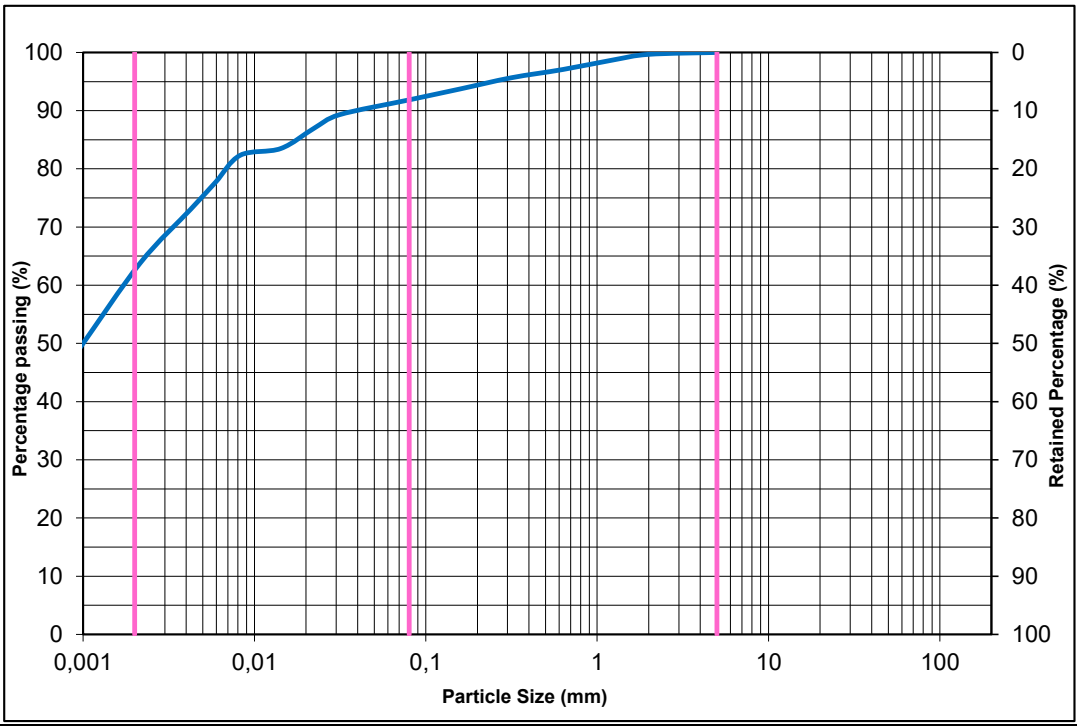
Sampled by : Élie Ferland
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-36 SS-01
Depth : 1,22 - 1,83m

Material Description : Silty Clay, traces of Sand

Grain Size Analysis (BNQ 2501-025)

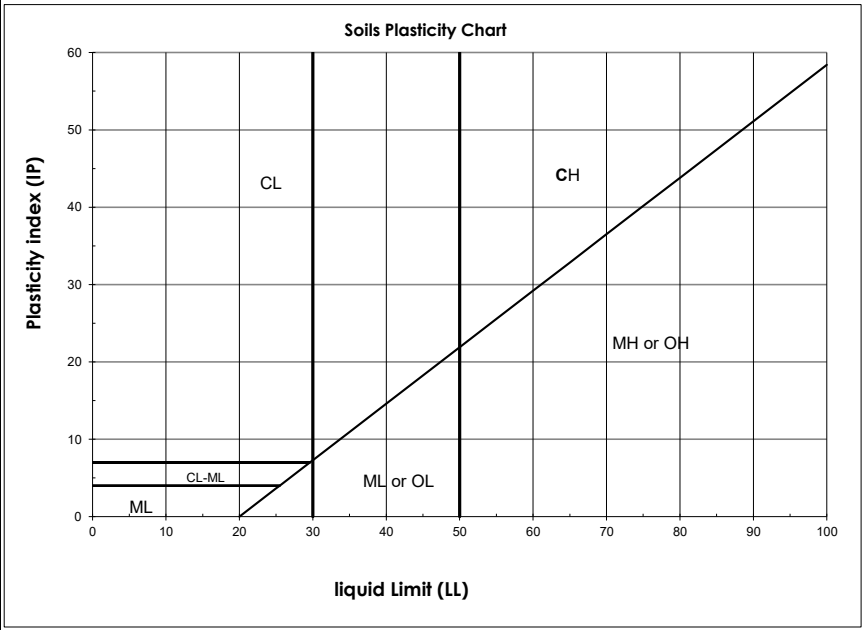
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	99
0,630	97
0,315	96
0,160	94
0,080	91,9



% Gravel: 0,0 % Sand : 8,1 % Silt: 29,9 % Clay: 62,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	52,8



Remarks :

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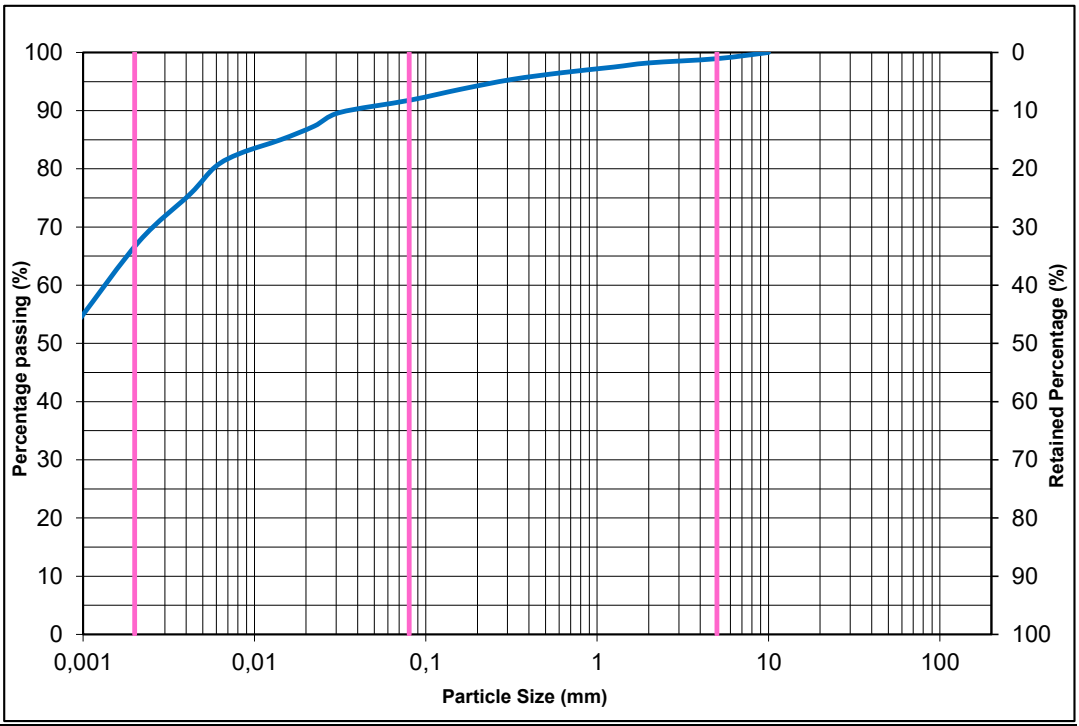
Sampled by : Élie Ferland
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-36 SS-02
Depth : 1,83 - 2,44m

Material Description : Silty Clay, traces of Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

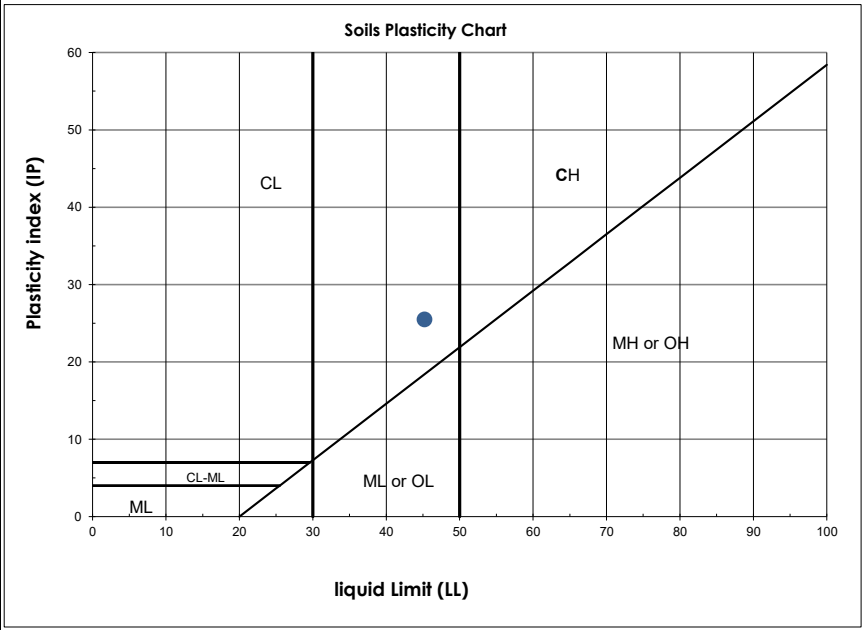
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	99
2,00	98
1,25	97
0,630	97
0,315	95
0,160	94
0,080	91,8



% Gravel: 1,0 % Sand : 7,2 % Silt: 25,7 % Clay: 66,1

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	39,1
Liquid Limit (BNQ 2501-092)	45
Plastic Limit (BNQ 2501-092)	20
Plasticity Index (BNQ 2501-092)	25



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

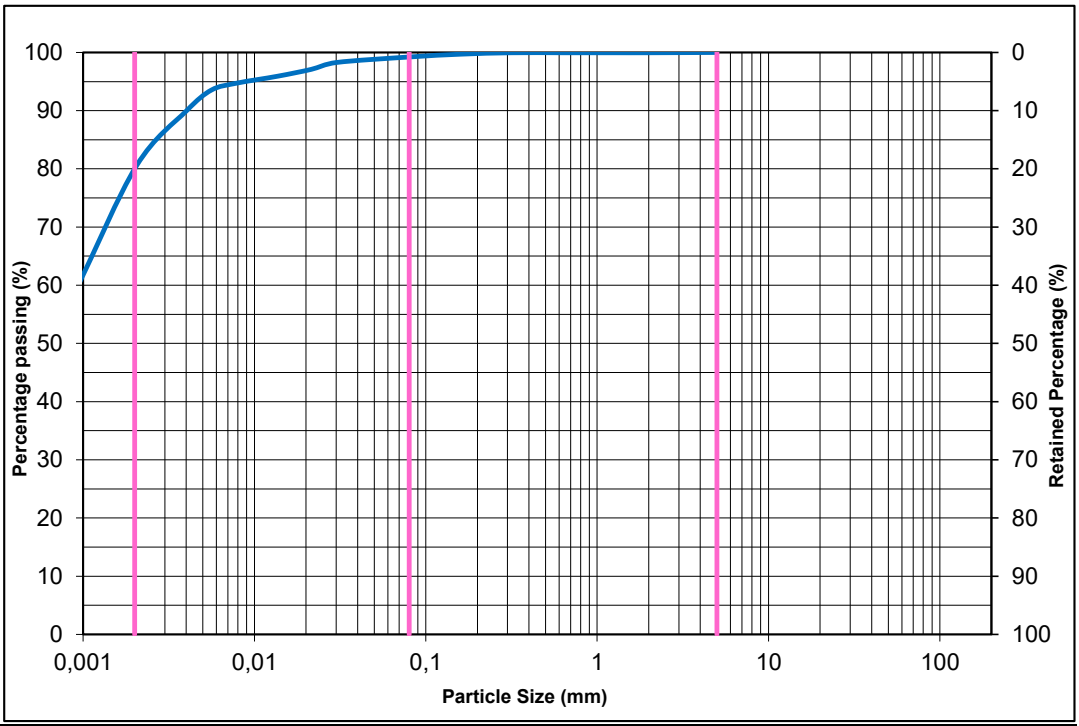
Sampled by : Élie Ferland
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-36 SS-05
Depth : 3,66 - 4,27m

Material Description : Clay, some Silt, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

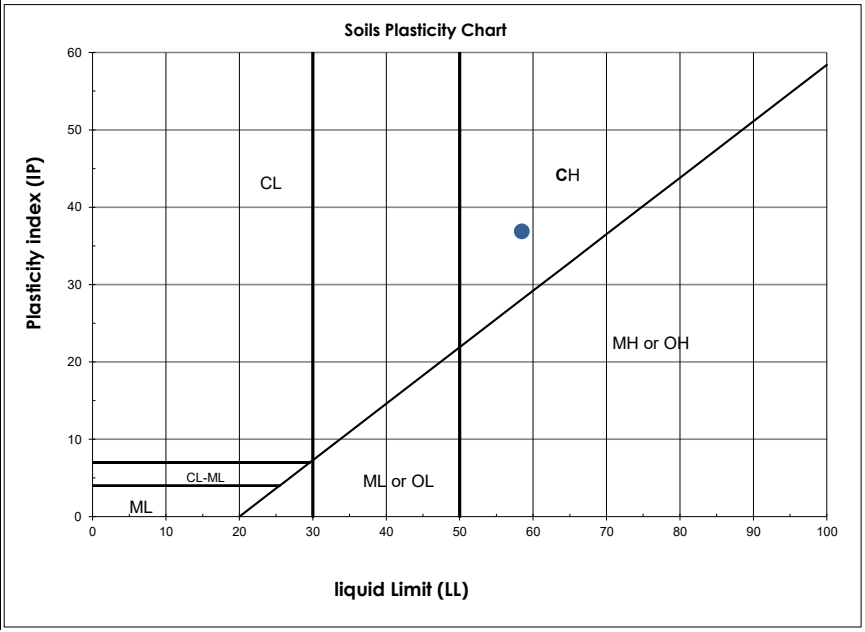
Openings Dimensions	Cumulative Results
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28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,2



% Gravel: 0,0 % Sand : 0,8 % Silt: 19,6 % Clay: 79,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	69,4
Liquid Limit (BNQ 2501-092)	58
Plastic Limit (BNQ 2501-092)	21
Plasticity Index (BNQ 2501-092)	37



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

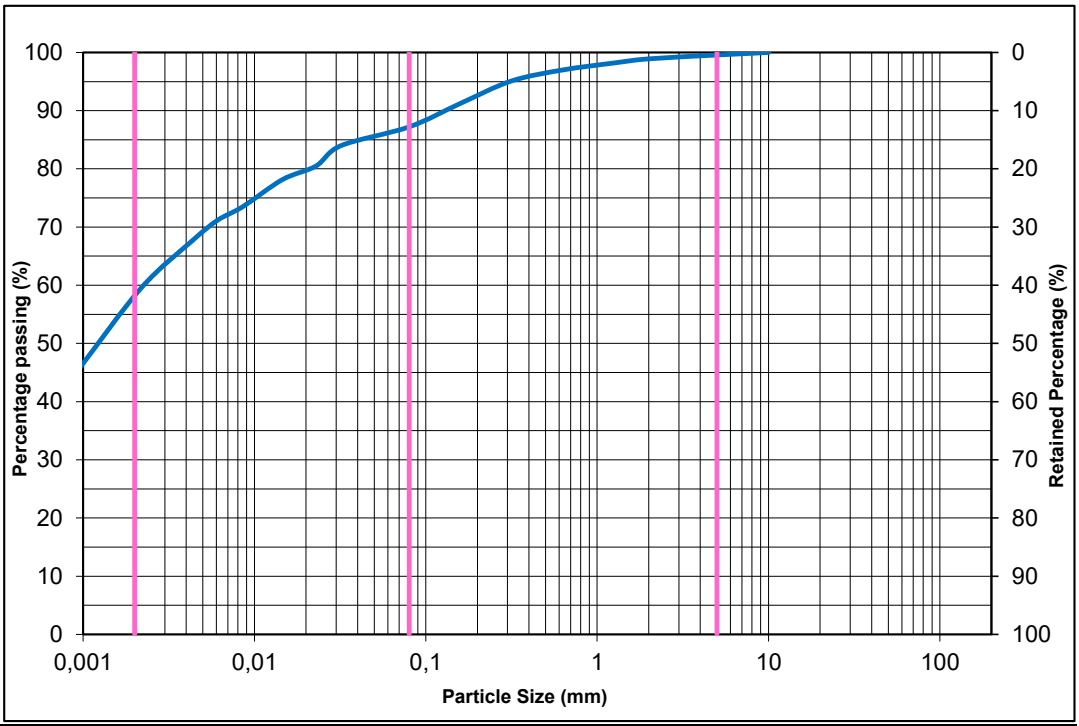
Sampled by : Élie Ferland
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-36 SS-10
Depth : 7,32 - 7,92m

Material Description : Silty Clay, some Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

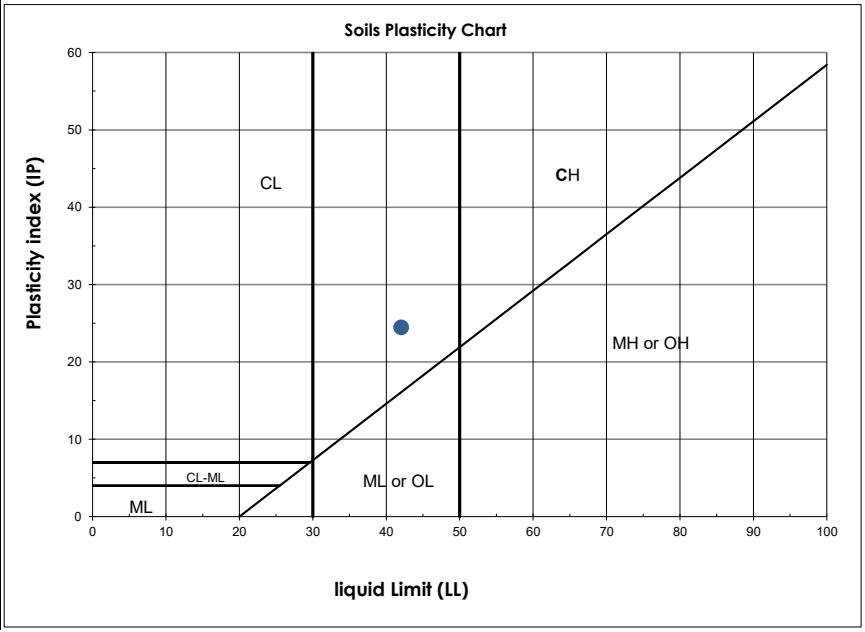
Openings Dimensions	Cumulative Results
mm	%
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	99
1,25	98
0,630	97
0,315	95
0,160	91
0,080	87,2



% Gravel: 0,5 % Sand : 12,3 % Silt: 29,7 % Clay: 57,5

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	58,6
Liquid Limit (BNQ 2501-092)	42
Plastic Limit (BNQ 2501-092)	18
Plasticity Index (BNQ 2501-092)	24



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

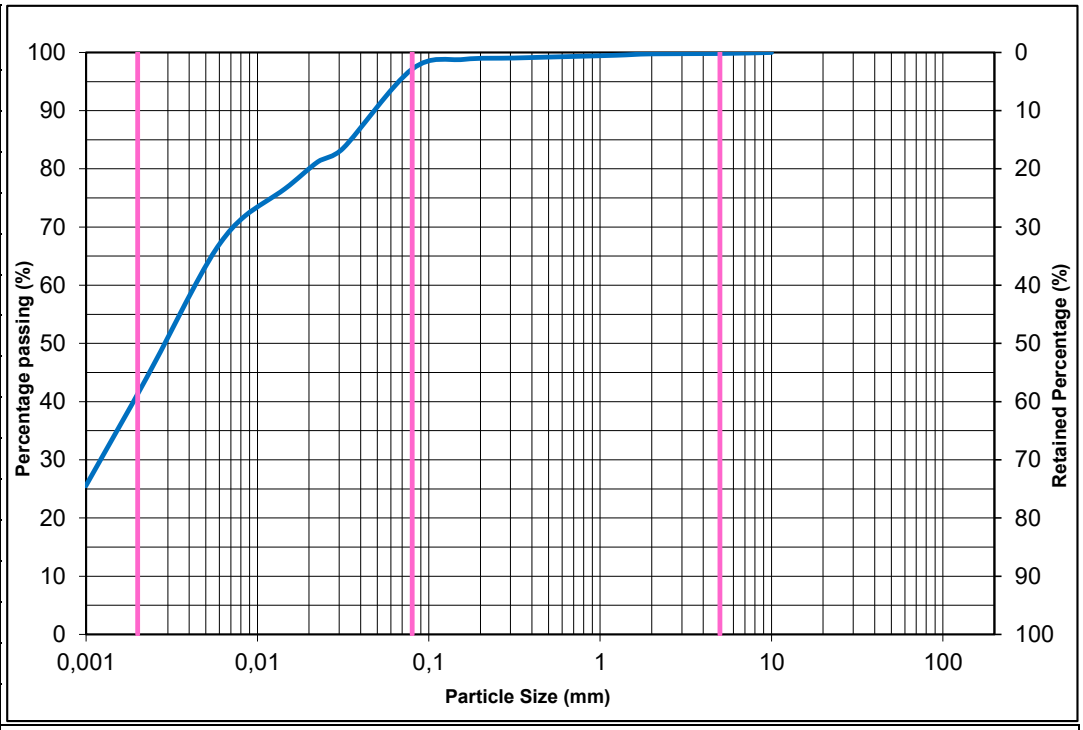
Sampled by : Élie Ferland
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-36 SS-15
Depth : 10,36 - 10,97m

Material Description : Silt and Clay, traces of Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

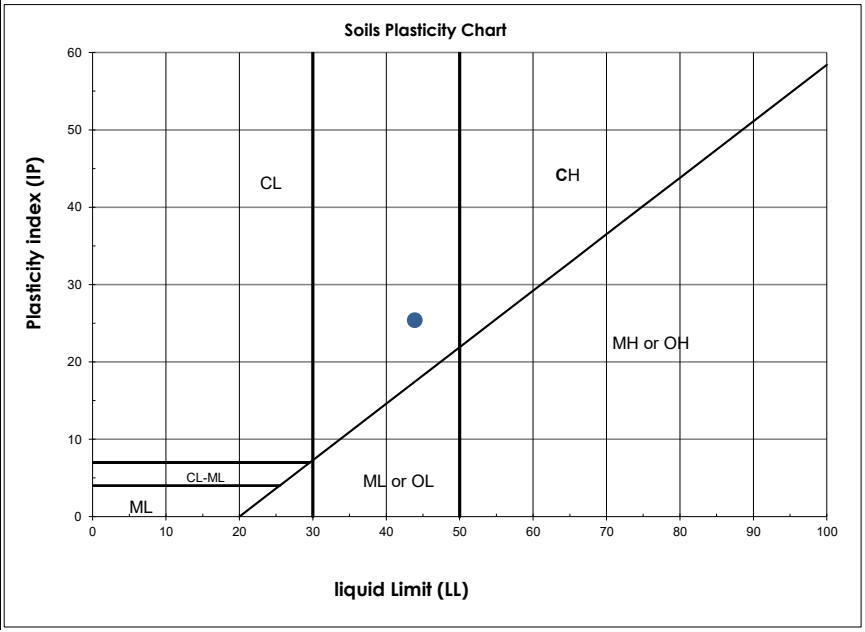
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	99
0,315	99
0,160	99
0,080	97,1



% Gravel: 0,2 % Sand : 2,7 % Silt: 56,8 % Clay: 40,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	46,1
Liquid Limit (BNQ 2501-092)	44
Plastic Limit (BNQ 2501-092)	19
Plasticity Index (BNQ 2501-092)	25



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

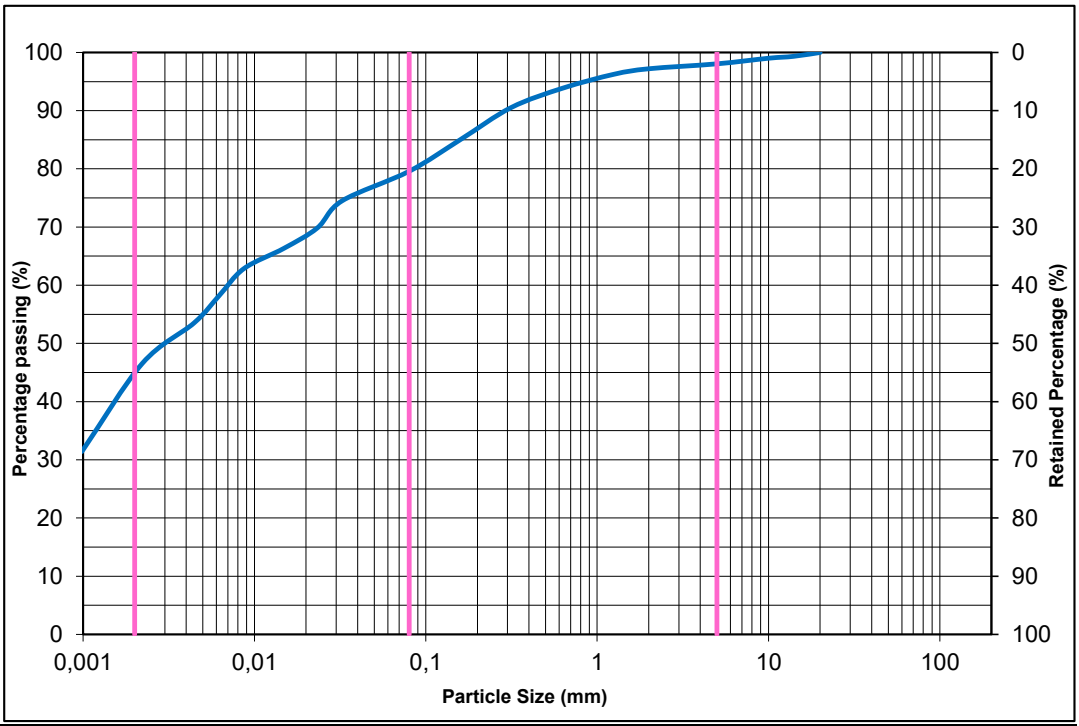
Sampled by : Élie Ferland
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-37 SS-01B
Depth : 0,05 - 0,61m

Material Description : Clay and Silt, some Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

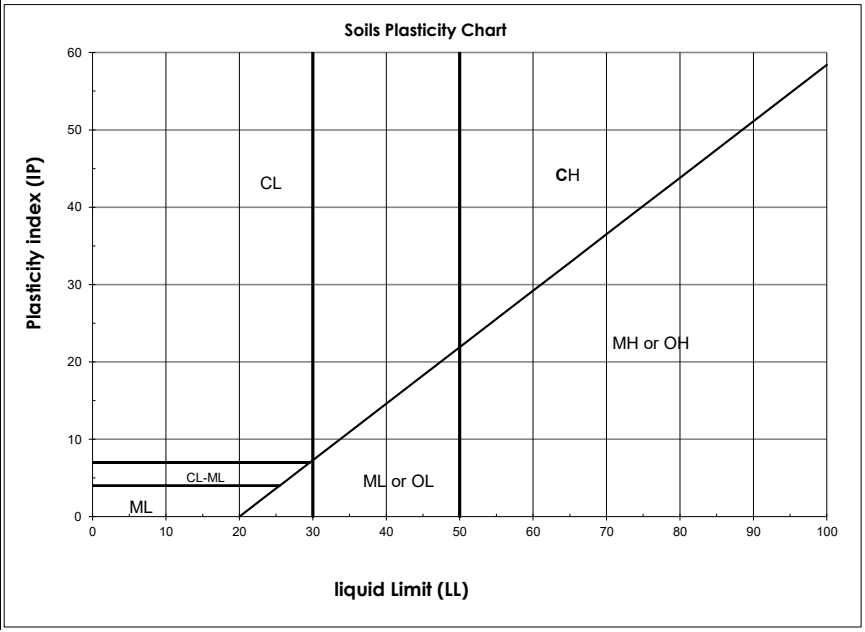
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	99
10,0	99
5,00	98
2,00	97
1,25	96
0,630	94
0,315	91
0,160	85
0,080	79,6



% Gravel: 1,9 % Sand : 18,5 % Silt: 35,7 % Clay: 43,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	24,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

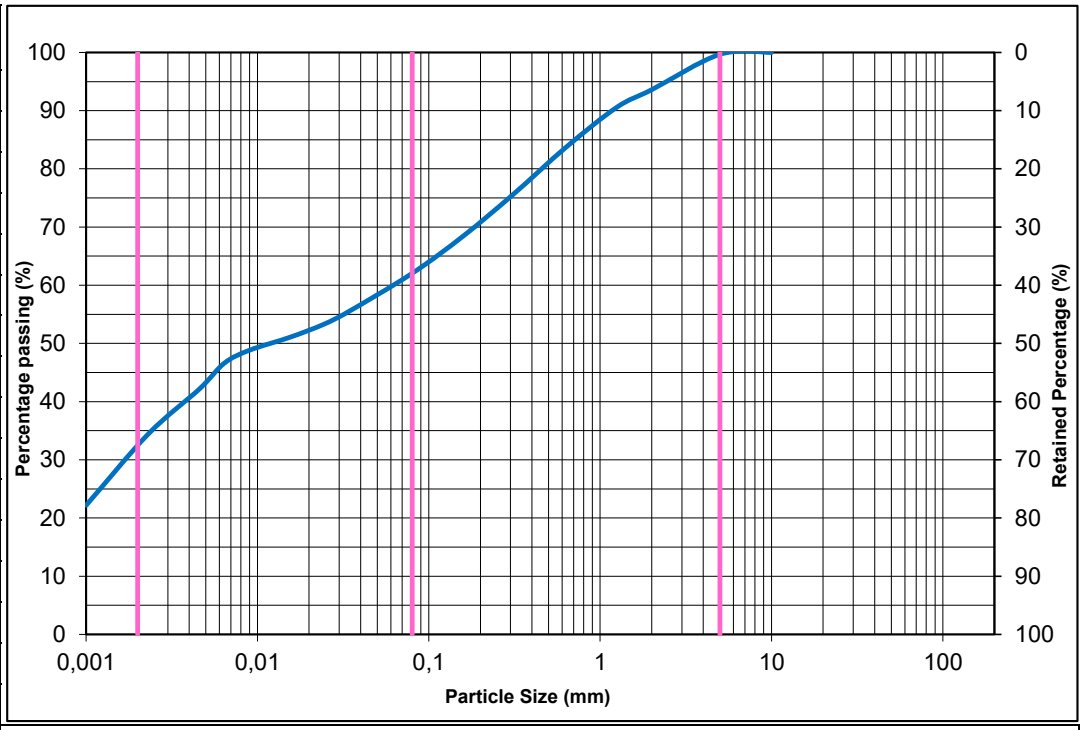
Sampled by : Élie Ferland
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-37 SS-04
Depth : 2,44 - 3,05m

Material Description : Silty, Clayey Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

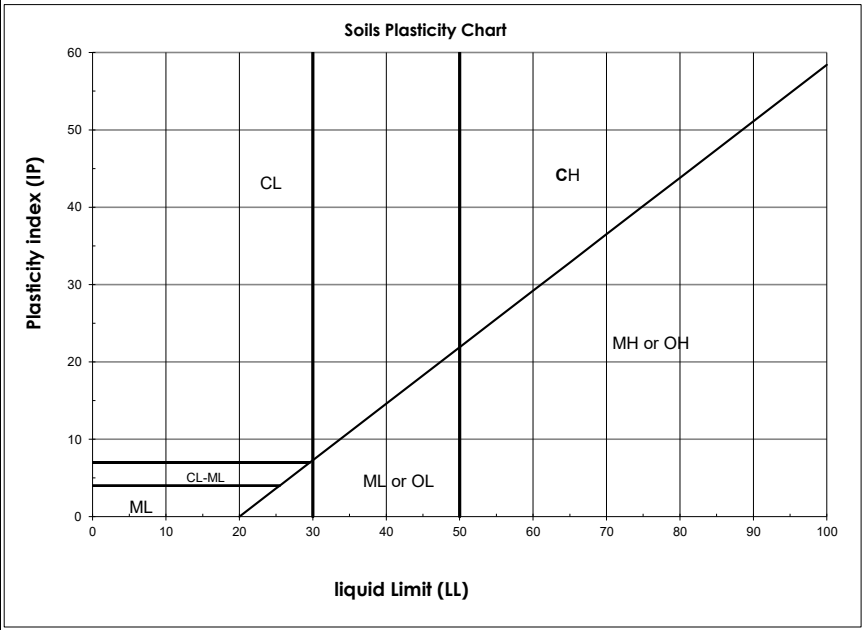
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	94
1,25	91
0,630	84
0,315	76
0,160	69
0,080	62,1



% Gravel: 0,3 % Sand : 37,6 % Silt: 30,5 % Clay: 31,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	28,4



Remarks :

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Date : January 26, 2023

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

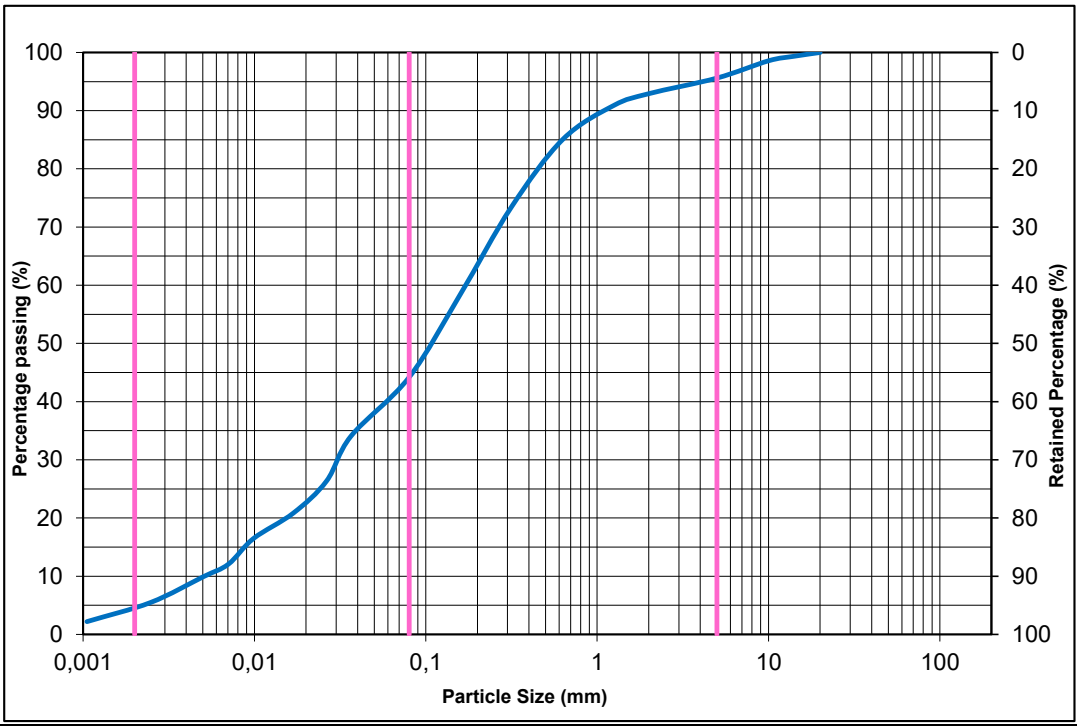
Sampled by : Élie Ferland
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-37 SS-11
Depth : 6,40 - 7,01m

Material Description : Sand and Silt, traces of Clay, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

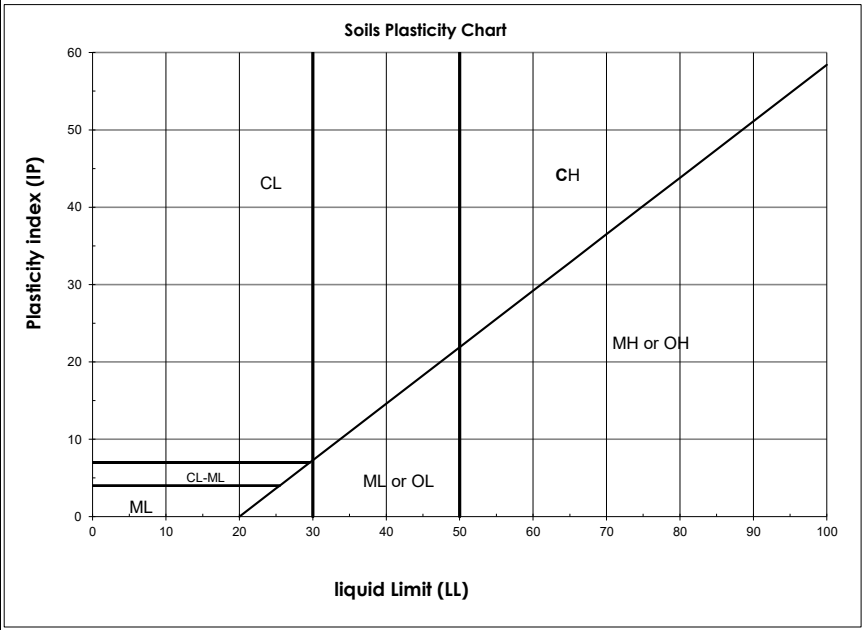
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	99
10,0	99
5,00	96
2,00	93
1,25	91
0,630	85
0,315	73
0,160	59
0,080	44,2



% Gravel: 4,4 % Sand : 51,4 % Silt: 39,8 % Clay: 4,4

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	8,9



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

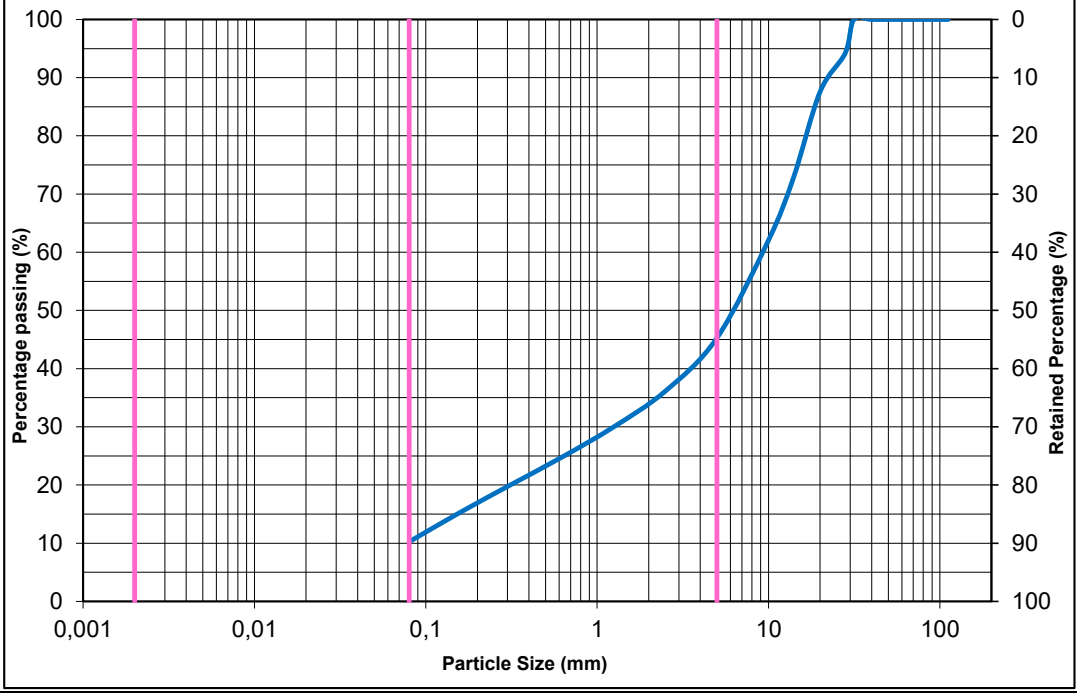
Sampled by : Hugo Desrochers
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-38 SS-01
Depth : 0,00 - 0,61m

Material Description : Gravel and Sand, some fine particles

Grain Size Analysis (BNQ 2501-025)

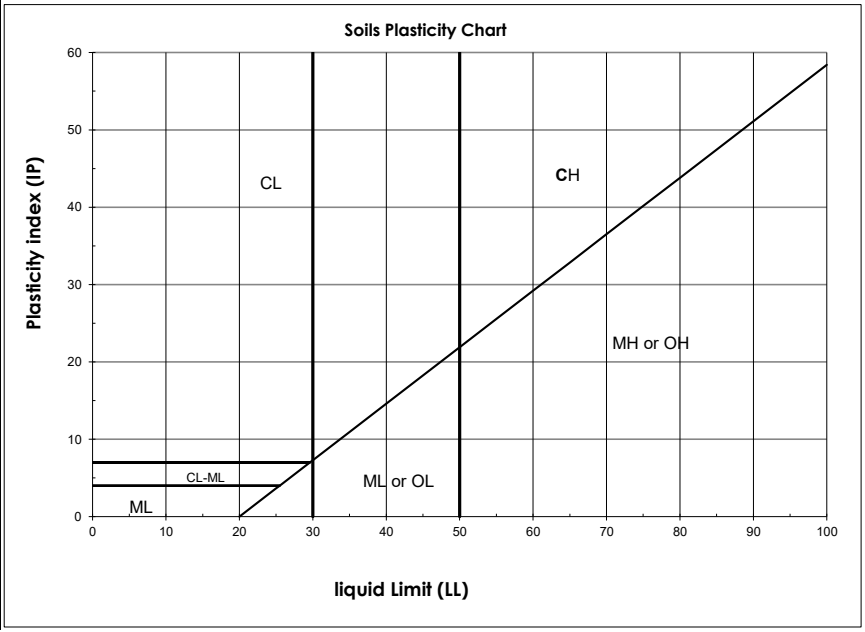
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	94
20,0	88
14,0	73
10,0	62
5,00	45
2,50	36
1,25	30
0,630	25
0,315	20
0,160	15
0,080	10,3



% Gravel : 54,7 % Sand : 35,0 % Fine particles : 10,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	3,9



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 25, 2023

Stantec
2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

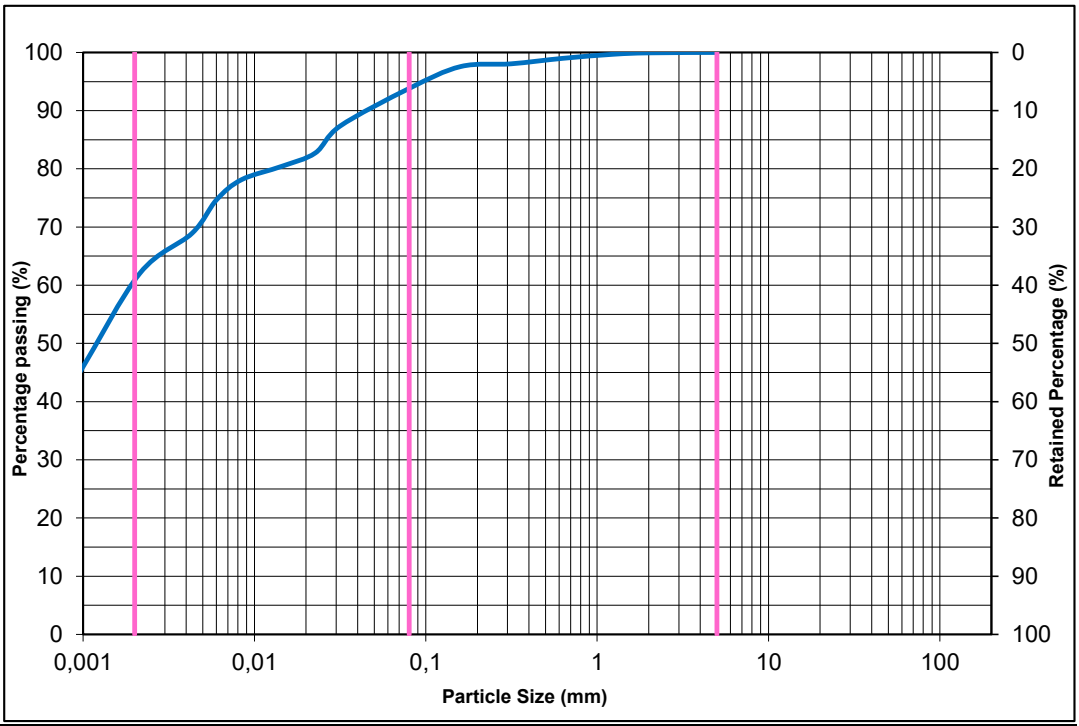
Sampled by : Hugo Desrochers
Sampling Date : October 11, 2022

Project No : 158100425.500.710.5
Sample No : BH22-38 SS-11
Depth : 6,10 - 6,71m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

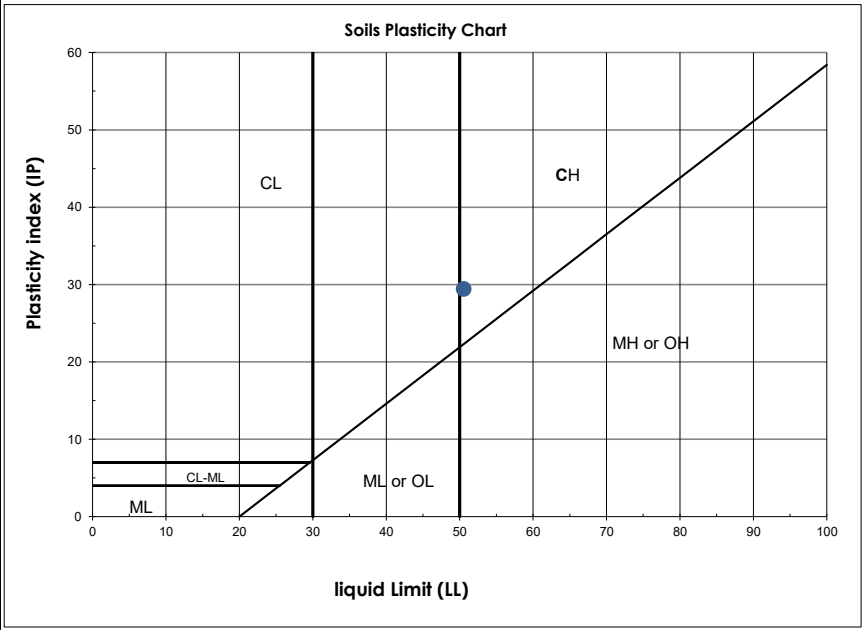
Openings Dimensions	Cumulative Results
mm	%
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80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	99
0,315	98
0,160	98
0,080	93,8



% Gravel: 0,0 % Sand : 6,2 % Silt: 33,8 % Clay: 60,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	45,9
Liquid Limit (BNQ 2501-092)	51
Plastic Limit (BNQ 2501-092)	22
Plasticity Index (BNQ 2501-092)	29



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

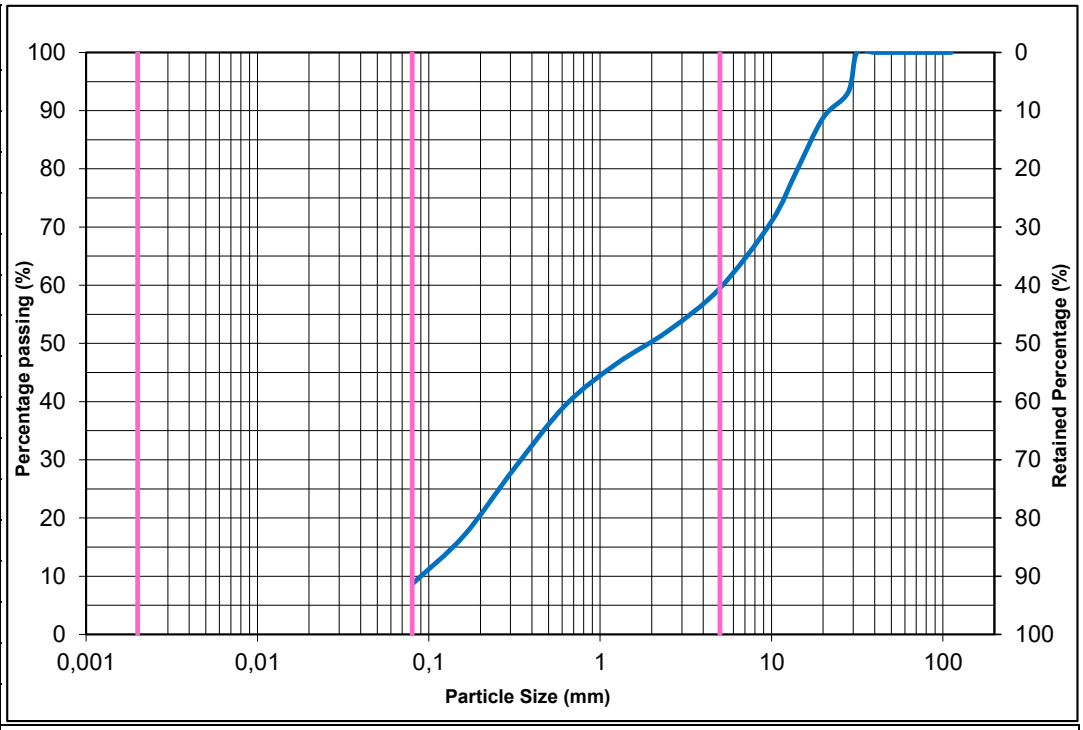
Sampled by : Hugo Desrochers
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-40 SS-01
Depth : 0,00 - 0,61m

Material Description : Sand and Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

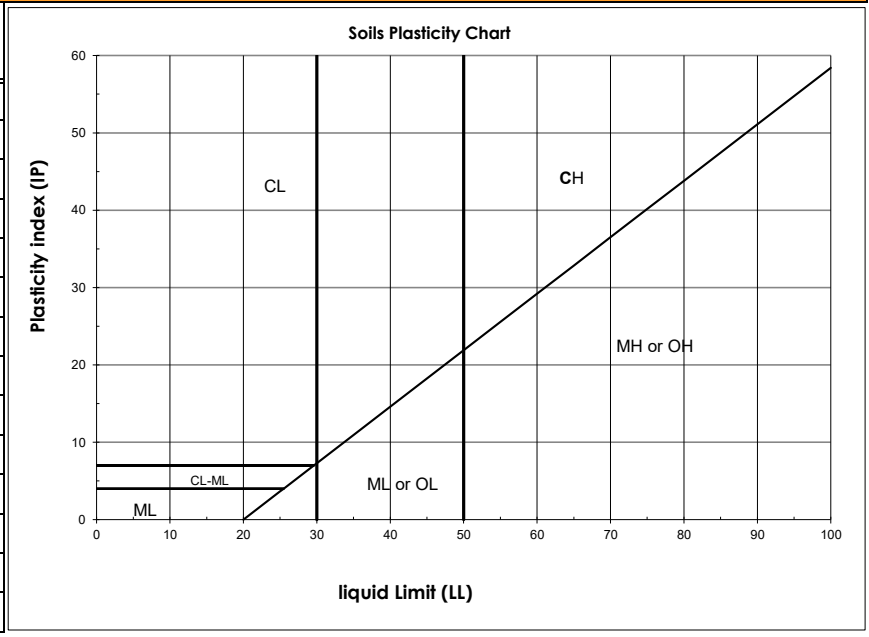
Openings Dimensions	Cumulative Results
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56,0	100
40,0	100
31,5	100
28,0	93
20,0	89
14,0	80
10,0	71
5,00	60
2,50	52
1,25	47
0,630	39
0,315	28
0,160	17
0,080	8,7



% Gravel : 40,5 % Sand : 50,8 % Fine particles : 8,7

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	6,3



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

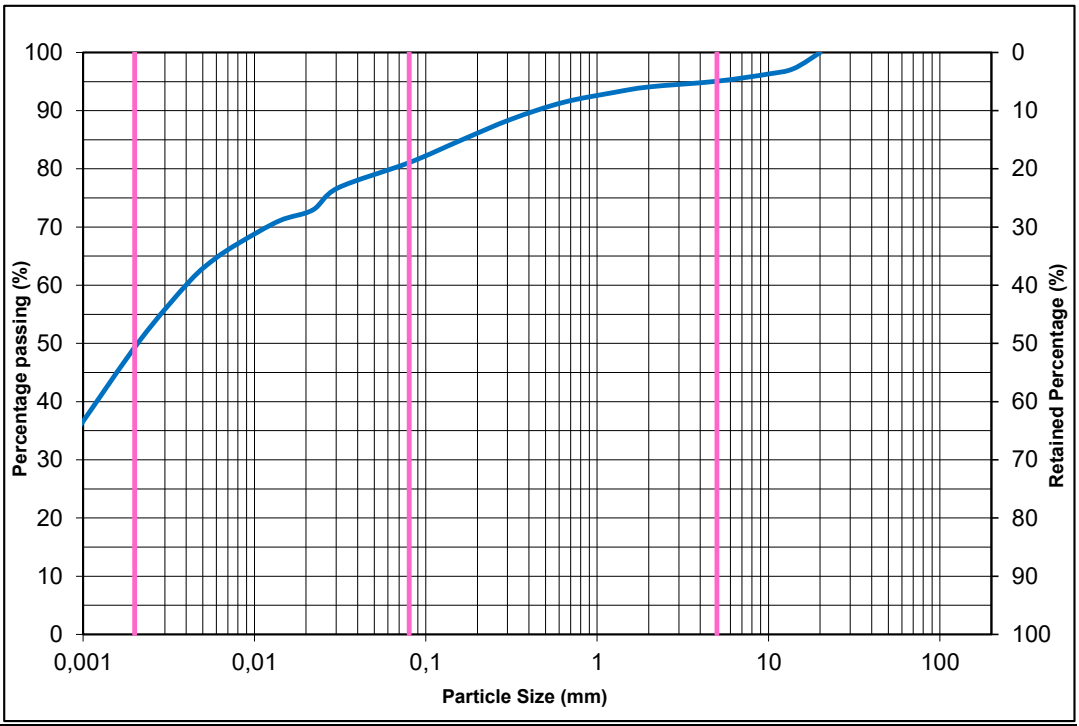
Sampled by : Hugo Desrochers
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-40 SS-07
Depth : 3,66 - 4,27m

Material Description : Silty Clay, some Sand, traces of Gravel, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

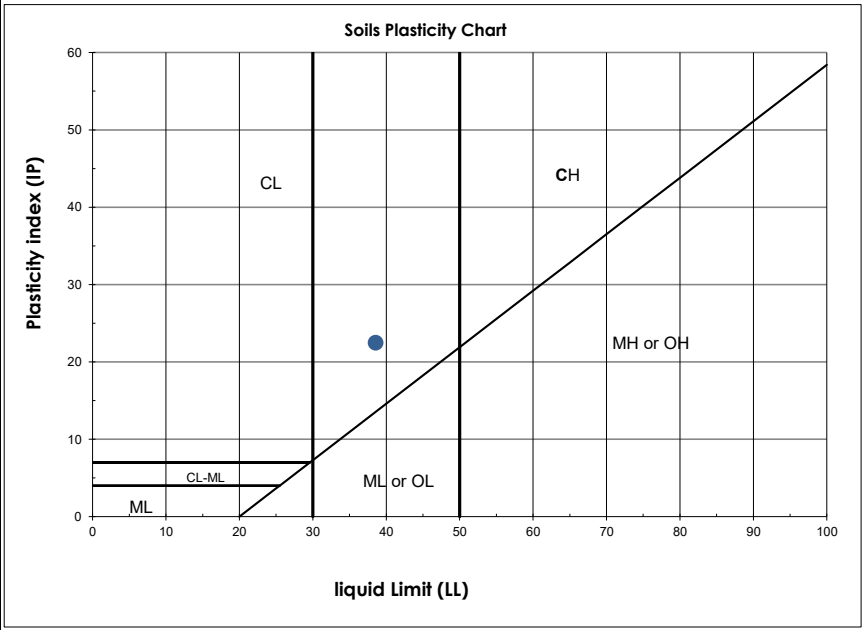
Openings Dimensions	Cumulative Results
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40,0	100
31,5	100
28,0	100
20,0	100
14,0	97
10,0	96
5,00	95
2,00	94
1,25	93
0,630	91
0,315	89
0,160	85
0,080	81,1



% Gravel: 4,9 % Sand : 14,0 % Silt: 32,3 % Clay: 48,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	39,4
Liquid Limit (BNQ 2501-092)	39
Plastic Limit (BNQ 2501-092)	17
Plasticity Index (BNQ 2501-092)	22



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

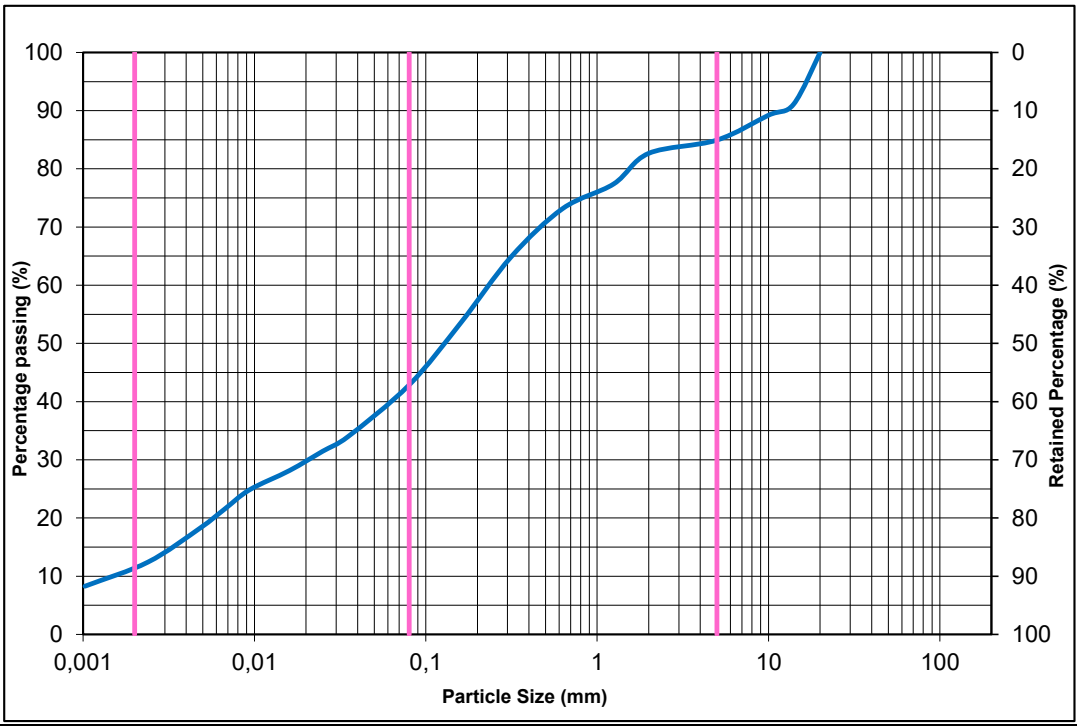
Sampled by : Hugo Desrochers
Sampling Date : October 10, 2022

Project No : 158100425.500.710.5
Sample No : BH22-40 SS-10
Depth : 5,49 - 6,10m

Material Description : Silty Sand, some Gravel, some Clay

Grain Size Analysis (BNQ 2501-025)

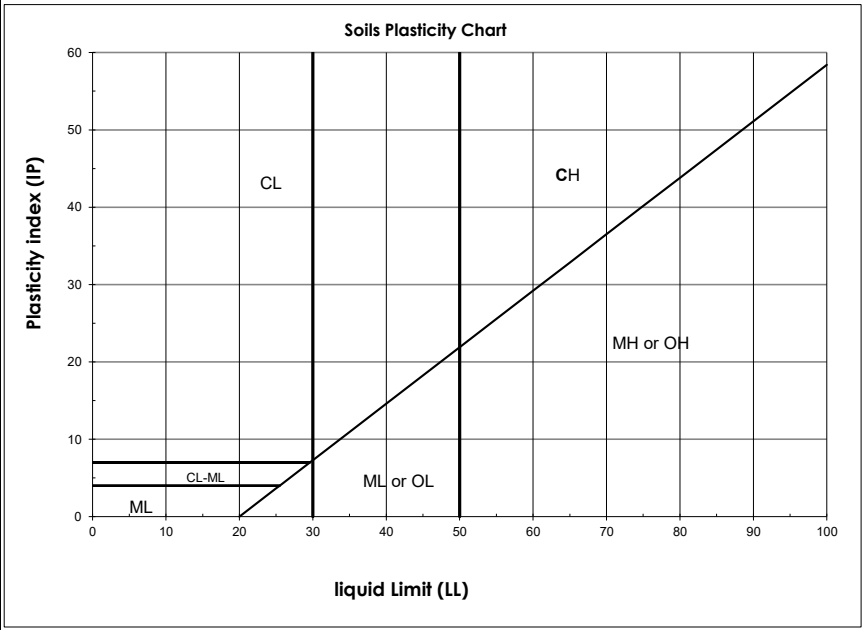
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	91
10,0	89
5,00	85
2,00	83
1,25	77
0,630	73
0,315	65
0,160	54
0,080	42,9



% Gravel: 15,0 % Sand : 42,1 % Silt: 31,6 % Clay: 11,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	13,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

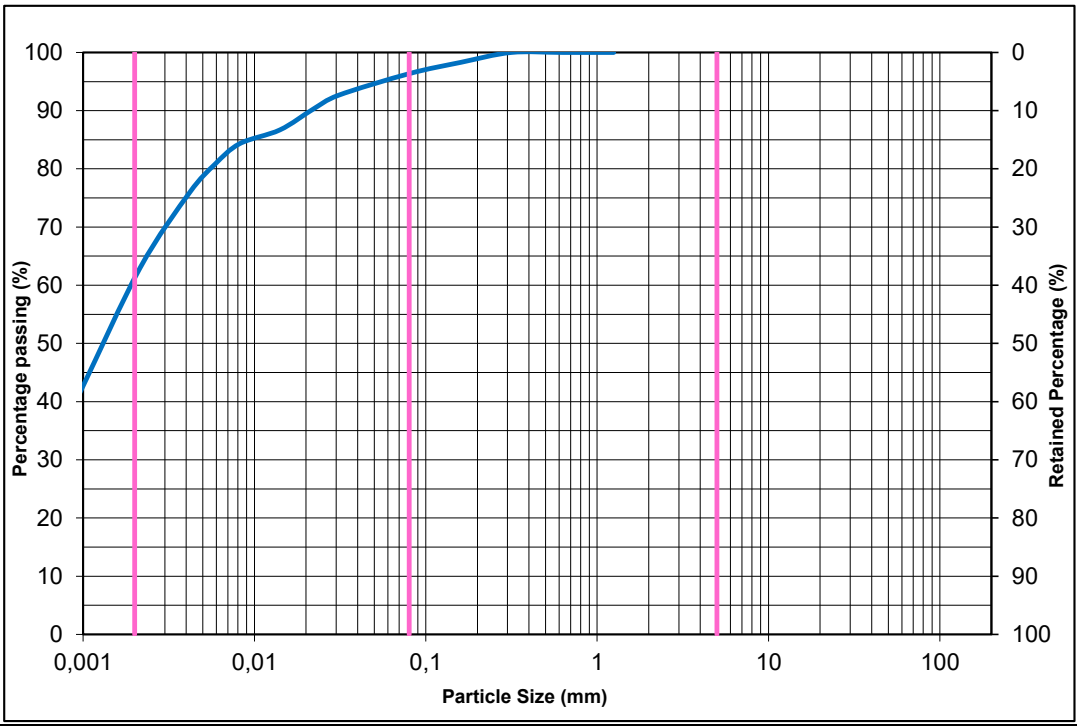
Sampled by : Élie Ferland
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-41 SS-01B
Depth : 0,05 - 0,61m

Material Description : Clay and Silt, traces of Sand, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

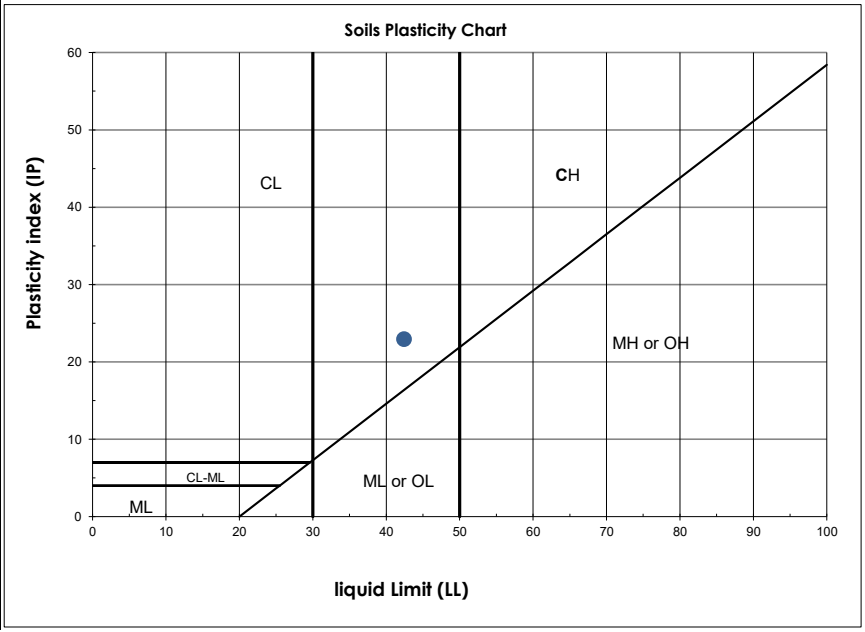
Openings Dimensions	Cumulative Results
mm	%
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56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	98
0,080	96,4



% Gravel: 0,0 % Sand : 3,6 % Silt: 36,1 % Clay: 60,3

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	23,6
Liquid Limit (BNQ 2501-092)	42
Plastic Limit (BNQ 2501-092)	19
Plasticity Index (BNQ 2501-092)	23



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

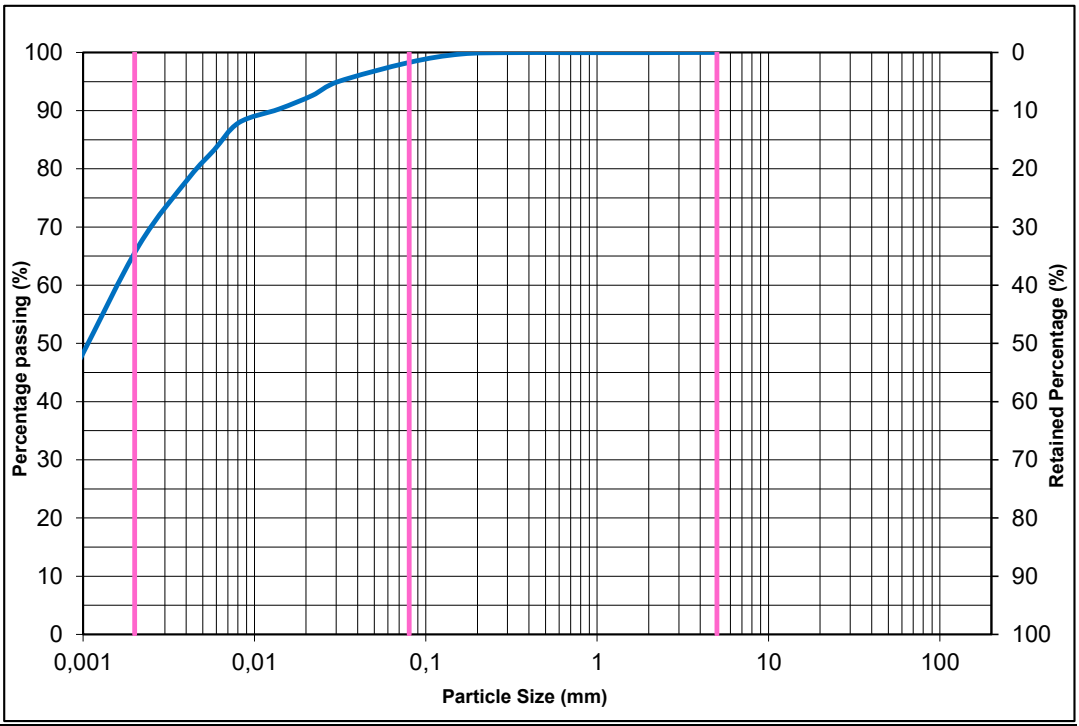
Sampled by : Élie Ferland
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-41 SS-03
Depth : 1,22 - 1,83m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

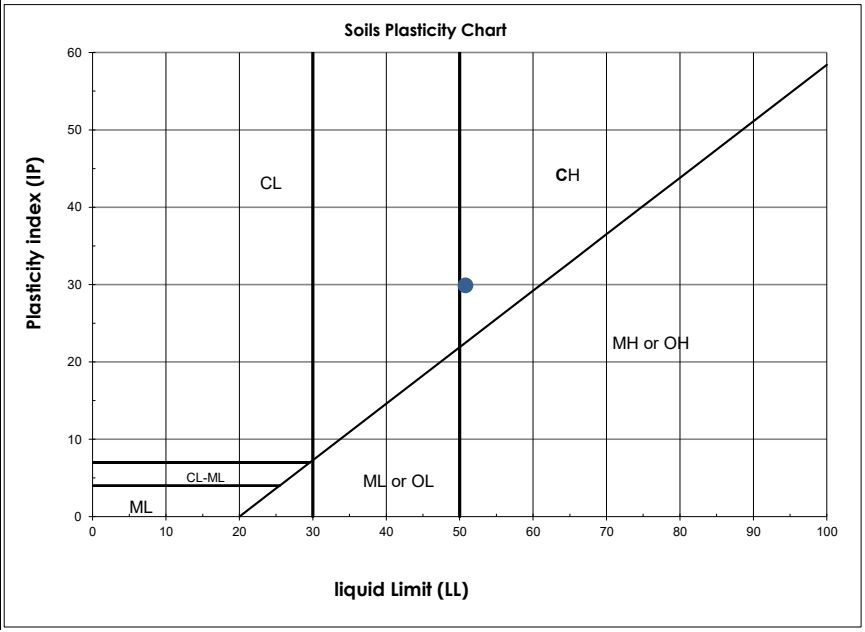
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	98,3



% Gravel: 0,0 % Sand : 1,7 % Silt: 33,5 % Clay: 64,8

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	46,6
Liquid Limit (BNQ 2501-092)	51
Plastic Limit (BNQ 2501-092)	21
Plasticity Index (BNQ 2501-092)	30



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec

2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

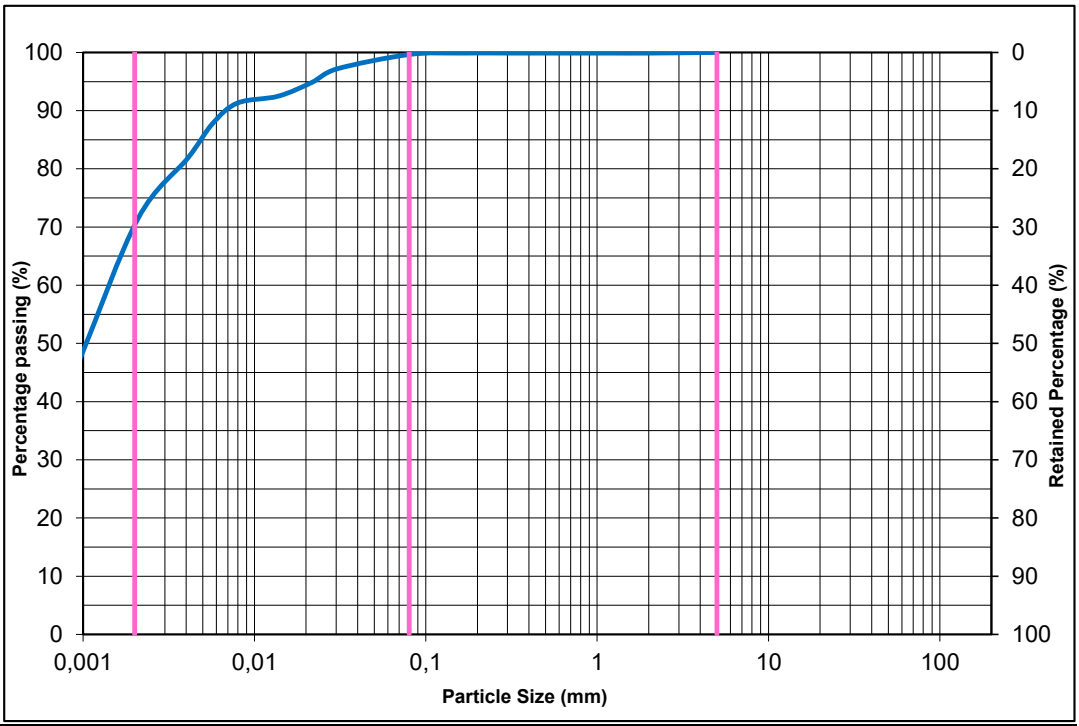
Sampled by : Élie Ferland
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-41 SS-11
Depth : 6,10 - 6,71m

Material Description : Silty Clay, traces of Sand, high plasticity (CH)

Grain Size Analysis (BNQ 2501-025)

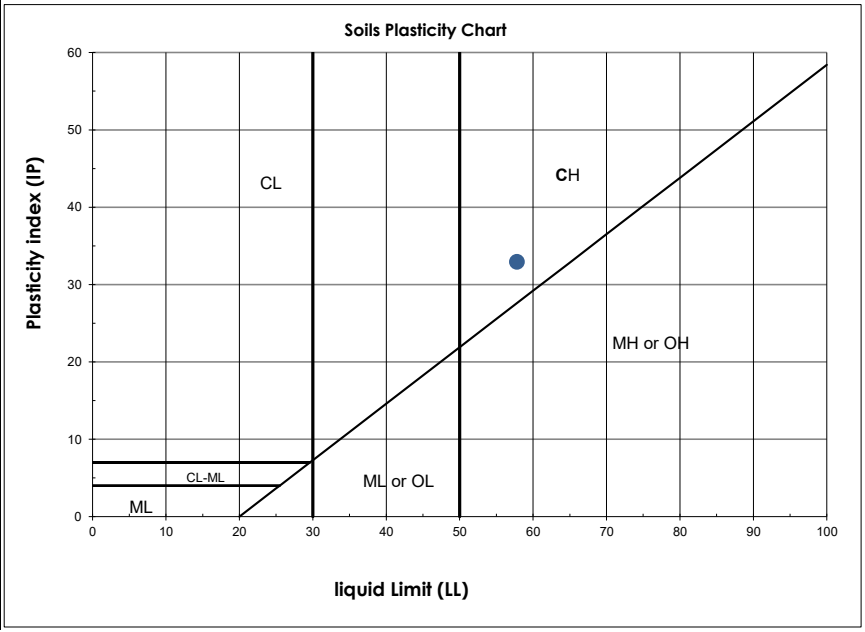
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,7



% Gravel: 0,0 % Sand : 0,3 % Silt: 30,1 % Clay: 69,6

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	61,5
Liquid Limit (BNQ 2501-092)	58
Plastic Limit (BNQ 2501-092)	25
Plasticity Index (BNQ 2501-092)	33



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

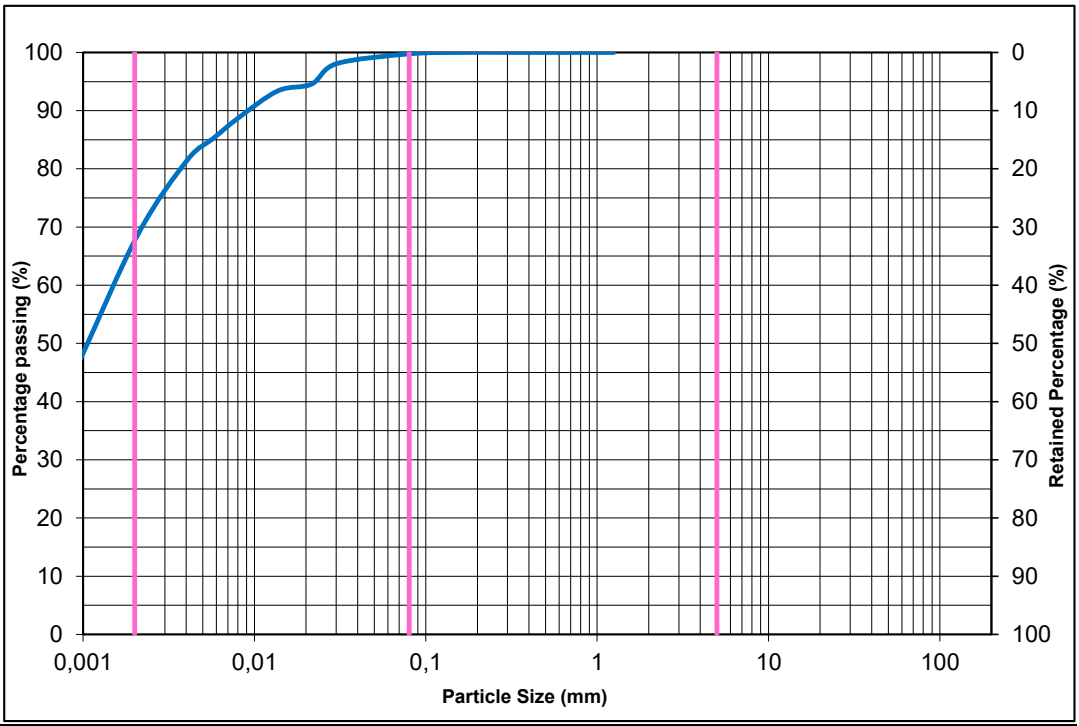
Sampled by : Élie Ferland
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-41 SS-17
Depth : 9,75 - 10,36m

Material Description : Silty Clay, traces of Sand, medium plasticity (CL)

Grain Size Analysis (BNQ 2501-025)

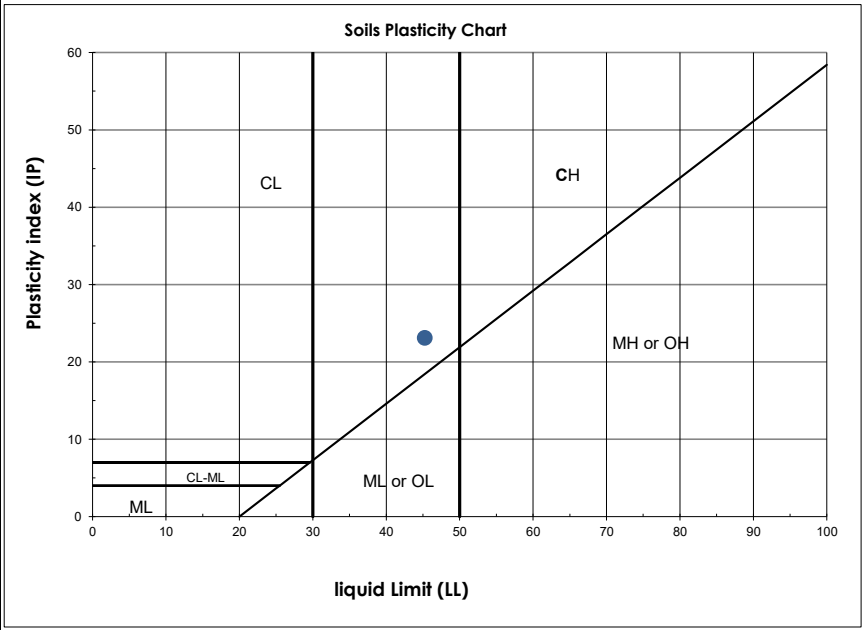
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	100
14,0	100
10,0	100
5,00	100
2,00	100
1,25	100
0,630	100
0,315	100
0,160	100
0,080	99,8



% Gravel: 0,0 % Sand : 0,2 % Silt: 32,8 % Clay: 67,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	55,2
Liquid Limit (BNQ 2501-092)	45
Plastic Limit (BNQ 2501-092)	22
Plasticity Index (BNQ 2501-092)	23



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

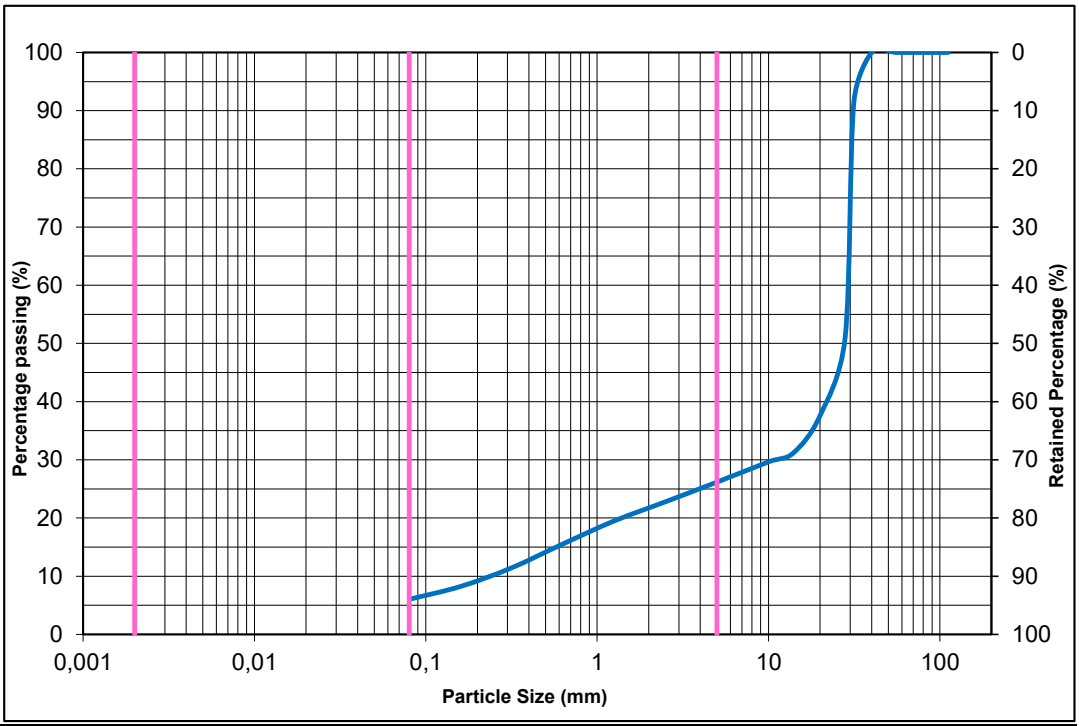
Sampled by : Élie Ferland
Sampling Date : October 08, 2022

Project No : 158100425.500.710.5
Sample No : BH22-42 SS-01B
Depth : 0,05 - 0,61m

Material Description : Sandy Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

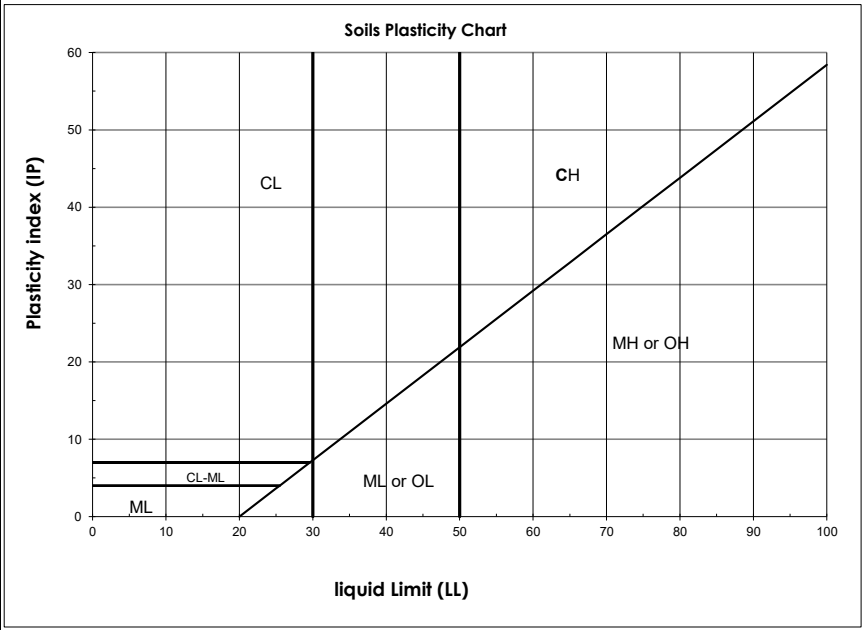
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	91
28,0	51
20,0	38
14,0	31
10,0	30
5,00	26
2,50	23
1,25	19
0,630	16
0,315	11
0,160	8
0,080	6,0



% Gravel : 73,9 % Sand : 20,1 % Fine particles : 6,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	2,9



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

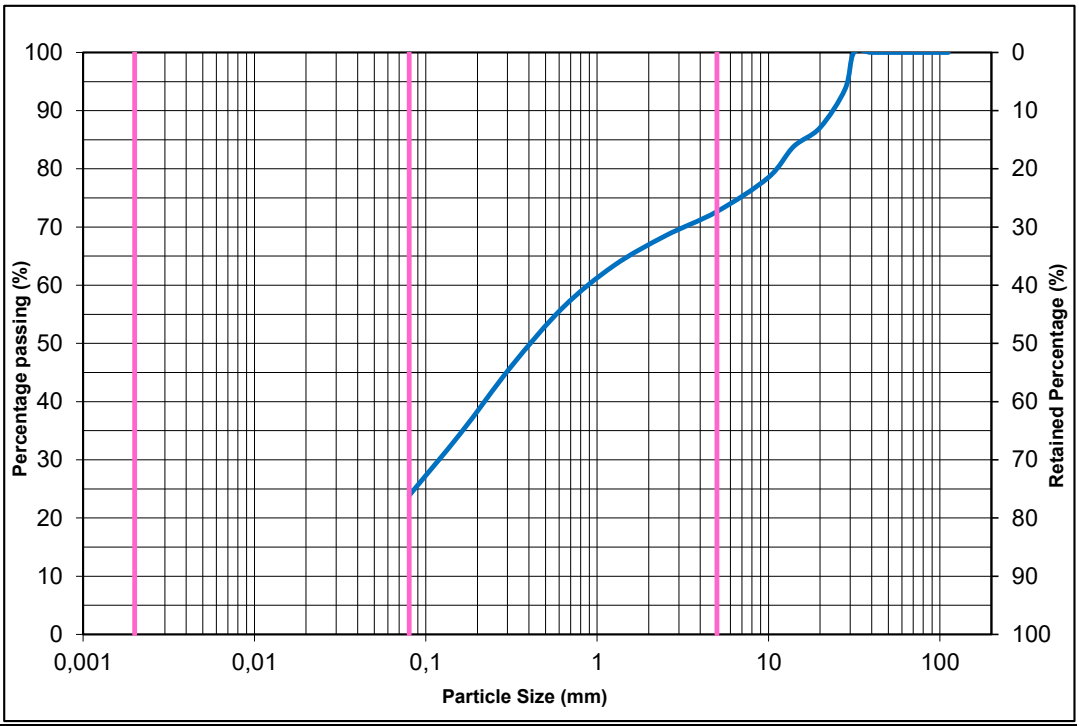
Sampled by : Élie Ferland
Sampling Date : October 08, 2022

Project No : 158100425.500.710.5
Sample No : BH22-42 SS-08
Depth : 4,27 - 4,88m

Material Description : Silty, Gravely Sand

Grain Size Analysis (BNQ 2501-025)

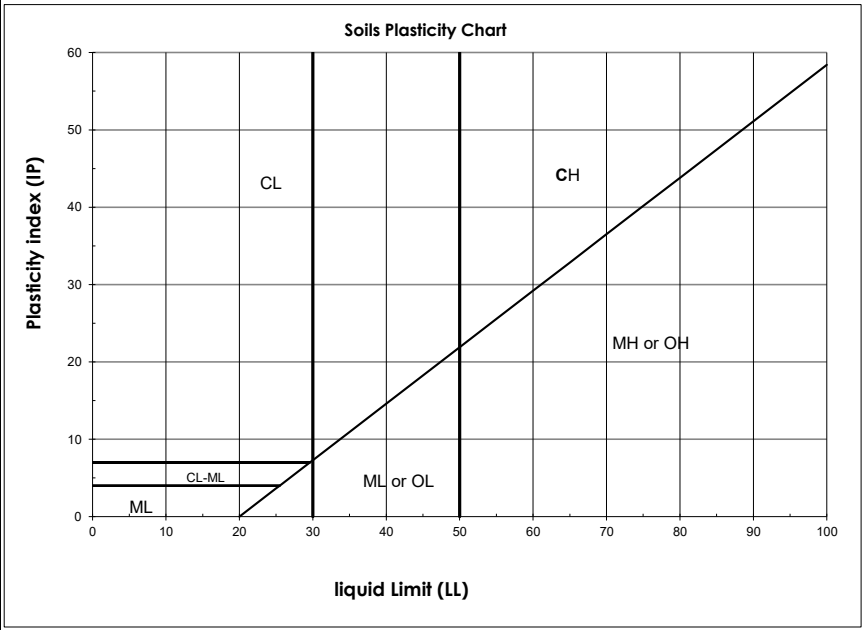
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	94
20,0	87
14,0	84
10,0	79
5,00	73
2,50	68
1,25	63
0,630	56
0,315	46
0,160	35
0,080	23,9



% Gravel : 27,3 % Sand : 48,8 % Fine particles : 23,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	6,9



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
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LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

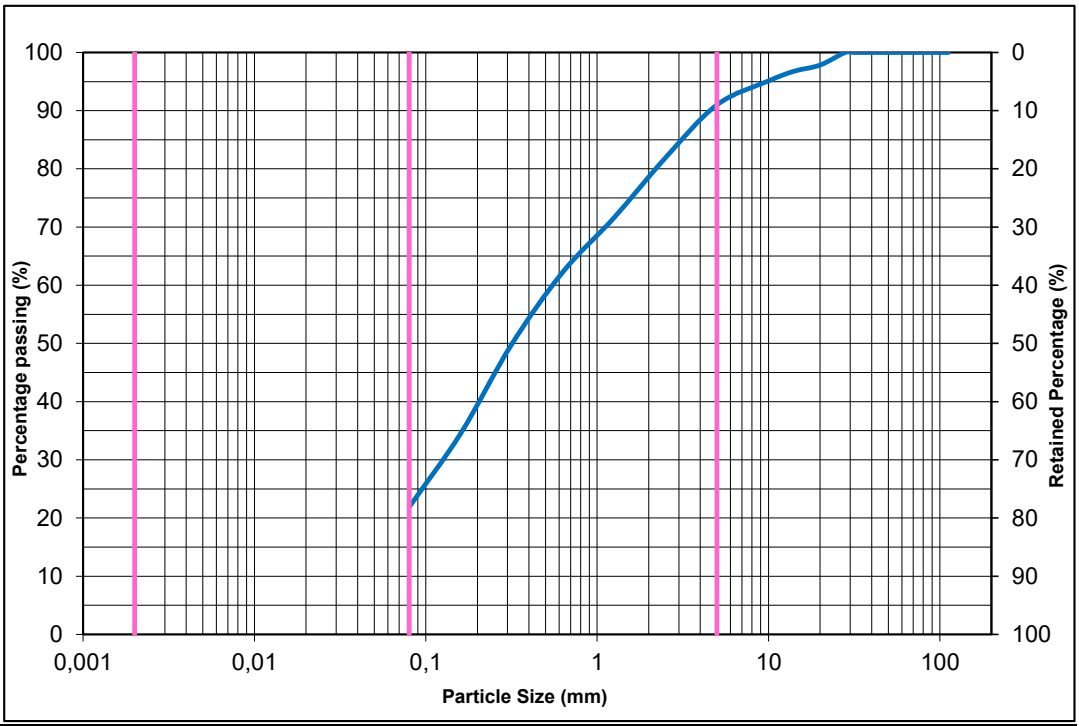
Sampled by : Élie Ferland
Sampling Date : October 08, 2022

Project No : 158100425.500.710.5
Sample No : BH22-42 SS-14
Depth : 7,92 - 8,53m

Material Description : Silty Sand, traces of Gravel

Grain Size Analysis (BNQ 2501-025)

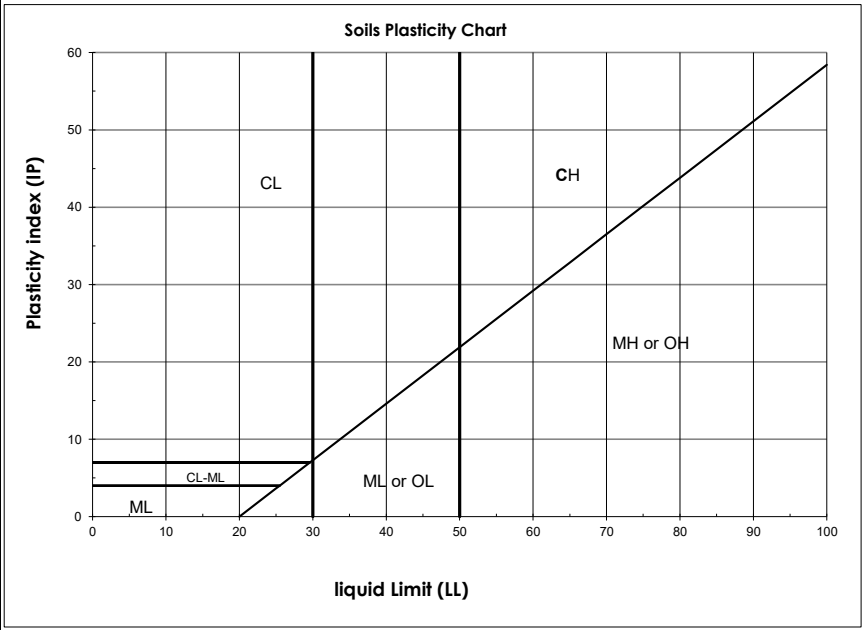
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	98
14,0	97
10,0	95
5,00	91
2,50	82
1,25	72
0,630	62
0,315	50
0,160	35
0,080	21,9



% Gravel : 9,0 % Sand : 69,1 % Fine particles : 21,9

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	11,5



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

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2273 Michelin Street,
Laval QC, H7L 5B8

LABORATORY TESTING REPORT

Client : Cree Developpment Corporation (CDC)
Project : LGA - Potential BDH Railway

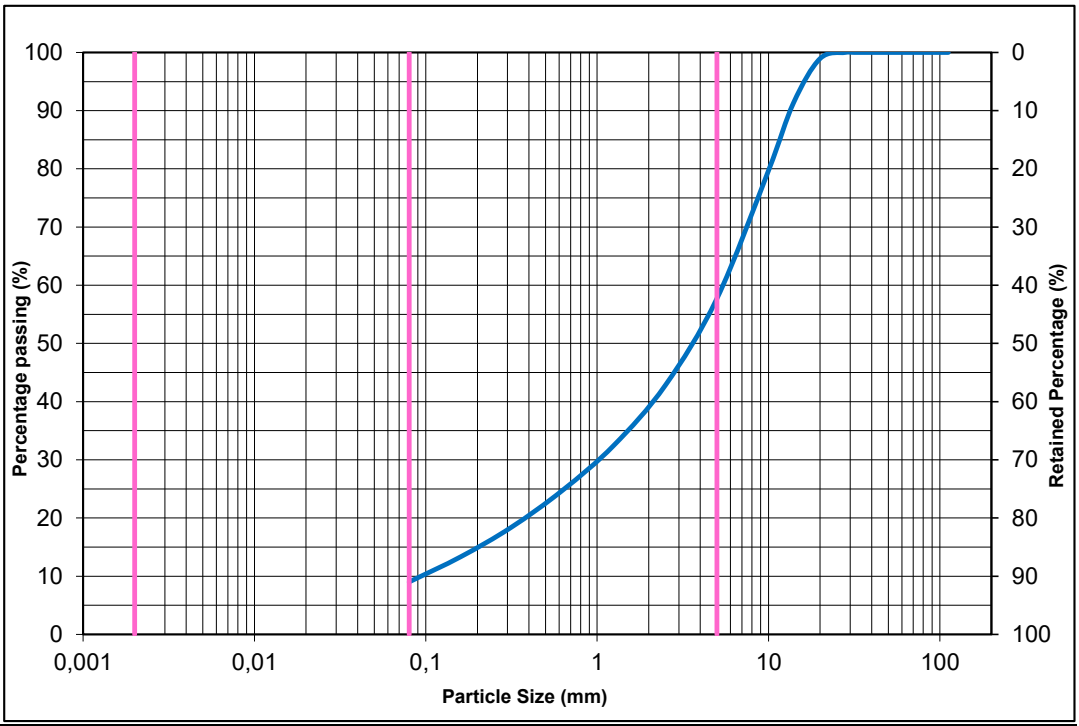
Sampled by : Hugo Desrochers
Sampling Date : October 09, 2022

Project No : 158100425.500.710.5
Sample No : BH22-43 SS-01
Depth : 0,00 - 0,61m

Material Description : Sand and Gravel, traces of fine particles

Grain Size Analysis (BNQ 2501-025)

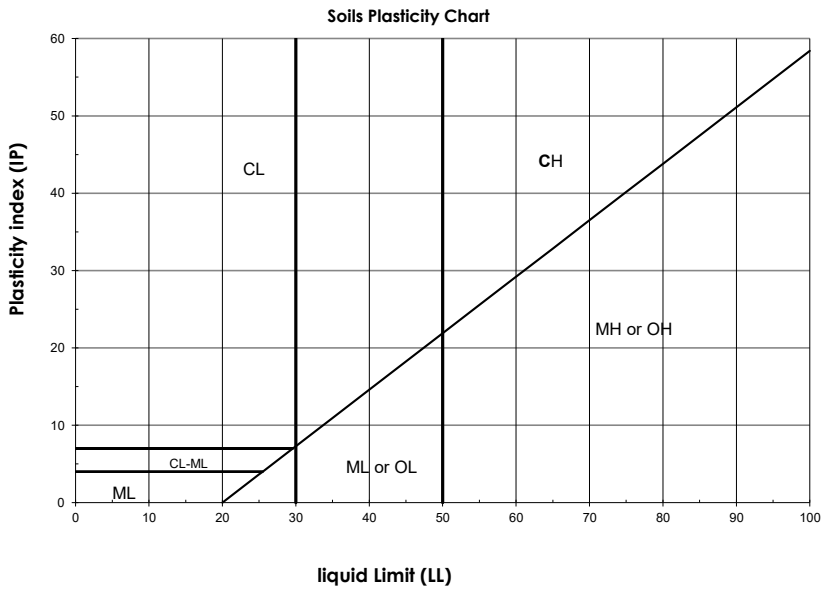
Openings Dimensions	Cumulative Results
mm	%
112	100
80,0	100
56,0	100
40,0	100
31,5	100
28,0	100
20,0	99
14,0	91
10,0	80
5,00	58
2,50	43
1,25	32
0,630	25
0,315	18
0,160	13
0,080	9,0



% Gravel : 42,3 % Sand : 48,7 % Fine particles : 9,0

Other tests

Test / Standard	Results
Water Content (NQ 2501-170) (%)	7,6



Remarks :

Prepared by : Benoit Cyr, Geo.

Date : January 26, 2023

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-01
Depth : 1,36 - 1,48m
Sampled by : Hugo Desrochers
Sample No : DC-03
Date of sampling : September 20, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
113,0	47,0	2,4	0,543	2770	Dry	331	1min 55sec	42960	110,1

Description	Sample before testing	Sample after testing
Sandstone		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

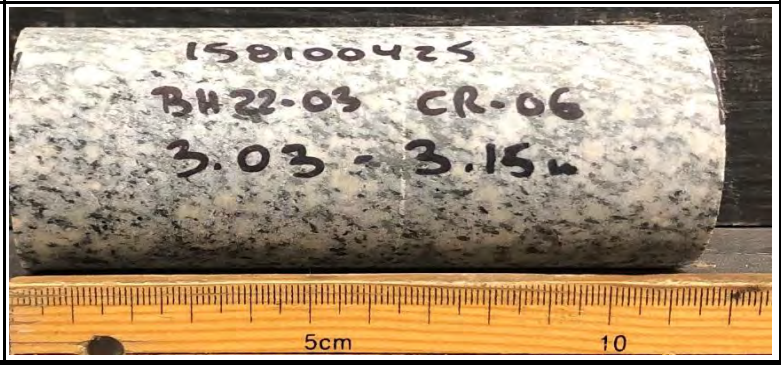
Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-03
Depth : 3,03 - 3,15m
Sampled by : Hugo Desrochers
Sample No : DC-06
Date of sampling : October 09, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
120,0	48,0	2,5	0,581	2676	Dry	331	3min 20sec	71350	175,4

Description	Sample before testing	Sample after testing
Granit		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

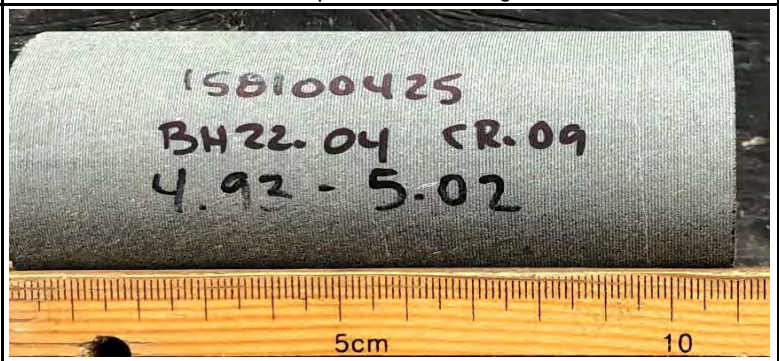
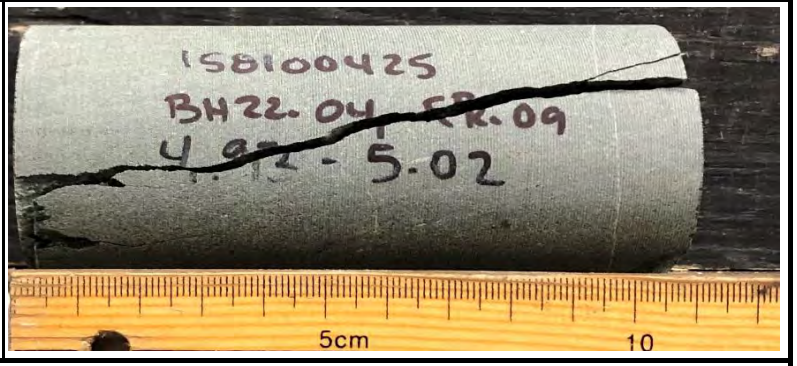
Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-04
Depth : 4,97 - 5,02m
Sampled by : Hugo Desrochers
Sample No : DC-09
Date of sampling : September 15, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
111,0	47,0	2,4	0,549	2851	Dry	331	1min 35sec	37110	95,2

Description	Sample before testing	Sample after testing
Basalt		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-05
Depth : 9,05 - 9,17m
Sampled by : Hugo Desrochers
Sample No : DC-15
Date of sampling : September 15, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
112,0	47,0	2,4	0,536	2758	Dry	331	5min 10sec	103210	264,6

Description	Sample before testing	Sample after testing
Rhyolite		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

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2273 Michelin Street
Laval QC, H7L 5B8

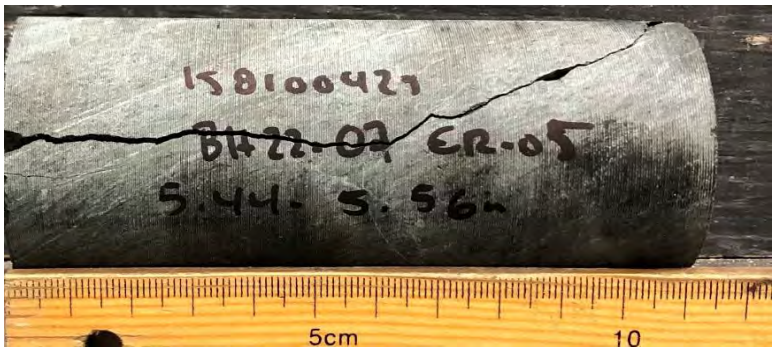
Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-07
Depth : 5,44 - 5,56m
Sampled by : Hugo Desrochers
Sample No : DC-05
Date of sampling : September 20, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
113,0	47,0	2,4	0,613	3127	Dry	331	0min 55sec	19070	48,9

Description	Sample before testing	Sample after testing
Basalt		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-08
Depth : 9,90 - 10,02m
Sampled by : Hugo Desrochers
Sample No : DC-14
Date of sampling : September 26, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
109,0	48,0	2,3	0,554	2809	Dry	331	3min 40sec	72140	177,3

Description	Sample before testing	Sample after testing
Monzonite		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

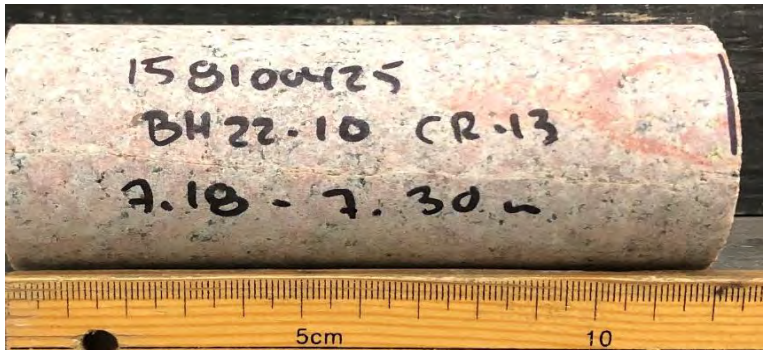
Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-10
Depth : 7,18 - 7,30m
Sampled by : Hugo Desrochers
Sample No : DC-13
Date of sampling : October 10, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
123,0	48,0	2,6	0,572	2570	Dry	331	3min 45sec	76930	189,1

Description	Sample before testing	Sample after testing
Granit		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

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Laval QC, H7L 5B8

Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-18
Depth : 16,06 - 16,18m
Sampled by : Hugo Desrochers
Sample No : DC-18
Date of sampling : September 23, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
112,0	48,0	2,3	0,536	2645	Dry	331	2min 55sec	59710	146,8

Description	Sample before testing	Sample after testing
Biotite Gneiss		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-32
Depth : 8,05 - 8,17m
Sampled by : Hugo Desrochers
Sample No : DC-13
Date of sampling : October 08, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
121,0	48,0	2,5	0,613	2800	Dry	331	2min 10sec	50800	124,9

Description	Sample before testing	Sample after testing
Biotite Gneiss		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

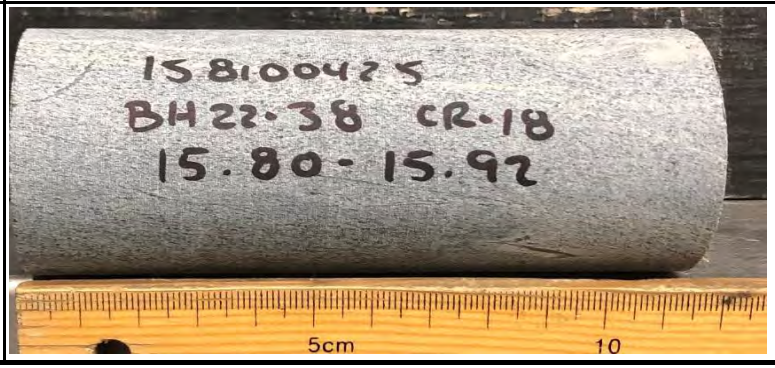
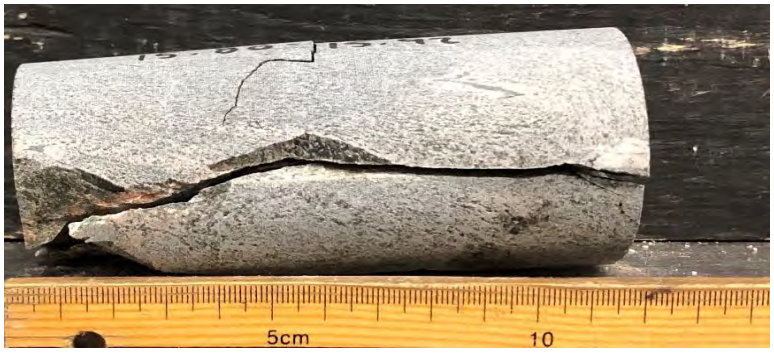
Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-38
Depth : 15,80 - 15,92m
Sampled by : Hugo Desrochers
Sample No : DC-18
Date of sampling : October 11, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
119,0	48,0	2,5	0,586	2721	Dry	331	1min 40sec	40140	98,7

Description	Sample before testing	Sample after testing
Biotite Gneiss		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec
2273 Michelin Street
Laval QC, H7L 5B8

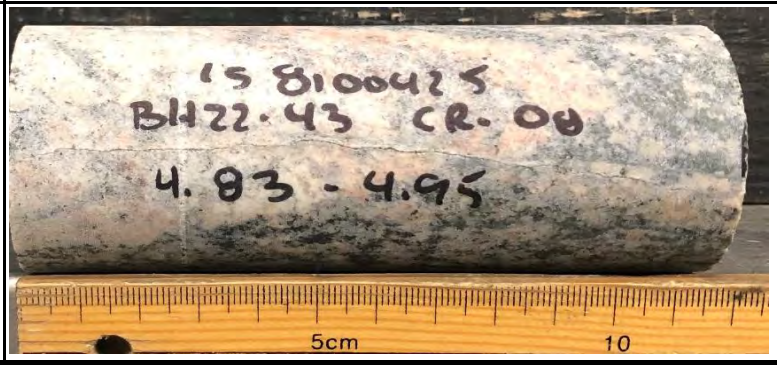
Compressive Strength of Intact Rock Core Specimens, ASTM D 7012, Method C

Client : Cree Developpment Corporation (CDC)
Project : La Grande Alliance Feasability Study - Phase 1
Project No : 158100425.500.710.5
Preliminary Geotechnical Investigations-Potential BDH Railway

Borehole No : BH22-43
Depth : 4,83 - 4,95m
Sampled by : Hugo Desrochers
Sample No : DC-08
Date of sampling : October 08, 2022

Apparatus :
Loading Device no : LAV-011
Caliper no : LAV-104
Scale Protractor no : LAV-029
Scale no : LAV-012

Average Length (mm)	Average Diameter (mm)	L/D Ratio	Weight (Kg)	Volumic Weight (kg/m³)	Humidity Conditions	Targeted Loading Rate (lbs/sec)	Time to Failure	load at failure (lbs)	Compressive Strength (MPa)
121,0	48,0	2,5	0,589	2690	Dry	331	3min 50sec	71720	176,3

Description	Sample before testing	Sample after testing
Granit		

Remarks :

Tested by : Marc Clairoux
Date : January 11, 2023
Approved by : Benoit Cyr, Geo.

Stantec Consulting Ltd.
2781 Lancaster Rd, Suite 100 A&B, Ottawa ON K1B 1A7

December 01, 2022
File: 158100425.500.710.5-Billy Diamond

Reference: ASTM D2216 & ASTM D 7263, Method B

The following table summarizes 10 Moisture contents & Unit Weights results.

Source	Depth (m)	Moisture Content (%)	Unit Weight (γ) KN/m^3
BH22-12 ST21	4.27-4.88	81.3	15.0
BH22-17 ST20	4.27-4.88	95.9	14.8
BH22-18 ST20	7.32-7.93	69.1	16.0
BH22-20 ST23	4.88-5.49	58.3	16.2
BH22-21 ST10	5.49-6.10	89.7	14.6
BH22-25 ST22	6.10-6.71	80.9	15.2
BH22-16 ST13	4.27-4.88	80.6	14.4
BH22-36 ST04	3.06-3.66	64.6	16.6
BH22-36 ST09	6.71-7.32	52.7	16.3
BH22-36 ST13	9.14-9.75	34.6	19.0

Sincerely,

Stantec Consulting Ltd.



Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
Fax: 613-722-2799
brian.prevost@stantec.com

Stantec Consulting Ltd.
2781 Lancaster Rd, Suite 100 A&B, Ottawa ON K1B 1A7

December 22, 2022
File: 158100425.500.710.5-Billy Diamond

Reference: ASTM D2216 & ASTM D 7263, Method B

The following table summarizes 17 Moisture contents & Unit Weights results.

Source	Depth (m)	Moisture Content (%)	Unit Weight (γ) KN/m^3
BH22-06 ST08	4.27-4.88	95.4	13.9
BH22-11 ST09	4.88-5.49	52.3	17.2
BH22-15 ST05	2.44-3.05	95.4	14.3
BH22-24 ST09	4.88-5.49	71.2	14.7
BH22-27 ST10	5.49-6.10	41.6	18.0
BH22-29 ST08	4.27-4.88	81.0	15.4
BH22-30 ST07	3.66-4.27	46.0	16.0
BH22-30 ST19	18.29-18.90	34.3	17.4
BH22-31 ST10	5.49-6.10	30.9	19.2
BH22-31 ST22	18.90-19.51	41.5	17.6
BH22-34 ST05	2.44-3.05	68.2	16.3
BH22-35 ST08	4.27-4.88	25.3	19.1
BH22-38 ST10	5.49-6.10	51.4	17.0
BH22-40 ST08	4.27-4.88	27.7	18.5
BH22-09 ST07	3.66-4.27	56.1	16.0
BH22-22 ST05	2.44-3.05	52.5	16.2
BH22-28 ST-06	3.05-3.66	46.6	16.4

Sincerely,

Stantec Consulting Ltd.



Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
Fax: 613-722-2799
brian.prevost@stantec.com

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 1 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-12		Description de l'échantillon	:	Very sensitive silty caly, grey, fraible, very wet
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	September 21, 2022
N° forage	: BH22-12	N° d'éch. : ST-21	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	12.5	☒	Contenant n°	6
2	13.0	☒	Masse du contenant (g)	61.70
3	12.0	☒	Masse du contenant + sol humide (g)	135.05
4	12.0	☒	Masse ddu contenant + sol sec (g)	102.51
5	12.0	☒	Teneur en eau (%)	79.7

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 26 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	9.0	9.0	Contenant n°	6
2	9.0	9.0	Masse du contenant (g)	61.70
3	9.0	9.0	Masse du contenant + sol humide (g)	135.05
Facultatif			Masse du contenant + sol sec (g)	102.51
Facultatif			Teneur en eau (%)	79.7
Pénétration moyenne (mm)	9.0 ☒	9.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 2.2 kPa

REMARQUES

Description: Very sensitive silty clay, grey, fraible, very wet

Sensibilité (Cu/Cu_r)

12

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 01-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 2 **Rév.**

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-17		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	September 22, 2022
N° forage	: BH22-17	N° d'éch. : ST-20	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	13.0	☒	Contenant n°	39
2	13.0	☒	Masse du contenant (g)	16.07
3	13.0	☒	Masse du contenant + sol humide (g)	41.16
4	13.0	☒	Masse ddu contenant + sol sec (g)	28.66
5	13.0	☒	Teneur en eau (%)	99.3

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 23 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	8.0	8.0	Contenant n°	39
2	8.0	8.0	Masse du contenant (g)	16.07
3	8.0	8.0	Masse du contenant + sol humide (g)	41.16
Facultatif			Masse du contenant + sol sec (g)	28.66
Facultatif			Teneur en eau (%)	99.3
Pénétration moyenne (mm)	8.0 ☒	8.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 2.8 kPa

REMARQUES

Description: Sensitive to very sensitive silty clay, grey, fraible, very wet

Sensibilité (Cu/Cu_r)

8

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :

Rapport n° : 3 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-18		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Friday, September 23, 2022
N° forage	: BH22-18	N° d'éch. : ST-20	Par	:	Stantec
Profondeur	: 7.32-7.93 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	13.0	☒	Contenant n°	11
2	13.0	☒	Masse du contenant (g)	61.82
3	13.0	☒	Masse du contenant + sol humide (g)	110.59
4	13.0	☒	Masse ddu contenant + sol sec (g)	90.59
5	13.0	☒	Teneur en eau (%)	69.5

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 23 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	8.5		8.5		Contenant n°	11
2	8.0		8.0		Masse du contenant (g)	61.82
3	8.0		8.0		Masse du contenant + sol humide (g)	110.59
Facultatif					Masse du contenant + sol sec (g)	90.59
Facultatif					Teneur en eau (%)	69.5
Pénétration moyenne (mm)	8.2	☒	8.2	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 2.6 kPa

REMARQUES

Description: Very sensitive silty clay, grey, fraible, very wet

Sensibilité (Cu/Cu_r)

9

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :

Rapport n° : 4 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-20		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Monday, September 19, 2022
N° forage	: BH22-20	N° d'éch. : ST-23	Par	:	Stantec
Profondeur	: 4.88-5.49 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	6.0	☒	Contenant n°	13
2	6.0	☒	Masse du contenant (g)	61.90
3	6.0	☒	Masse du contenant + sol humide (g)	328.50
4	6.0	☒	Masse ddu contenant + sol sec (g)	230.35
5	6.0	☒	Teneur en eau (%)	58.3

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 109 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	5.0	5.0	Contenant n°	13
2	5.0	5.0	Masse du contenant (g)	61.90
3	5.0	5.0	Masse du contenant + sol humide (g)	328.50
Facultatif			Masse du contenant + sol sec (g)	230.35
Facultatif			Teneur en eau (%)	58.3
Pénétration moyenne (mm)	5.0 ☒	5.0 ☒	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 7.1 kPa

REMARQUES

Description: Very sensitive silty clay, brown, fraible, very moist

Sensibilité (Cu/Cu_r)

15

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 5 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-21		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Saturday, September 17, 2022
N° forage	: BH22-21	N° d'éch. : ST-10	Par	:	Stantec
Profondeur	: 5.49-6.10 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	15.0	☒	Contenant n°	20
2	15.0	☒	Masse du contenant (g)	16.09
3	15.0	☒	Masse du contenant + sol humide (g)	53.89
4	15.0	☒	Masse ddu contenant + sol sec (g)	36.45
5	15.0	☒	Teneur en eau (%)	85.7

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 17 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	10.0	10.0	Contenant n°	20
2	10.0	10.0	Masse du contenant (g)	16.09
3	10.0	10.0	Masse du contenant + sol humide (g)	53.89
Facultatif			Masse du contenant + sol sec (g)	36.45
Facultatif			Teneur en eau (%)	85.7
Pénétration moyenne (mm)	10.0 ☒	10.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 1.8 kPa

REMARQUES

Description: Very sensitive silty clay, grey, fraible, very wet

Sensibilité (Cu/Cu_r)

9

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 1-Dec-22

Approuvé par : **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône
NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 6 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-16		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Sunday, September 18, 2022
N° forage	: BH22-16	N° d'éch. : ST-13	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	16.0	☒	Contenant n°	19
2	16.0	☒	Masse du contenant (g)	15.90
3	16.0	☒	Masse du contenant + sol humide (g)	47.18
4	16.0	☒	Masse ddu contenant + sol sec (g)	33.14
5	16.0	☒	Teneur en eau (%)	81.4

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 15 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	11.0	11.0	Contenant n°	19
2	11.0	11.0	Masse du contenant (g)	15.90
3	11.0	11.0	Masse du contenant + sol humide (g)	47.18
Facultatif			Masse du contenant + sol sec (g)	33.14
Facultatif			Teneur en eau (%)	81.4
Pénétration moyenne (mm)	11.0 ☒	11.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 1.5 kPa

REMARQUES

Description: Very sensitive silty clay, grey, fraible, very wet

Sensibilité (Cu/Cu_r)

10

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 7 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-36		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Tuesday, October 11, 2022
N° forage	: BH22-36	N° d'éch. : ST-04	Par	:	Stantec
Profondeur	: 3.05-3.66 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	11.0	☒	Contenant n°	14
2	11.0	☒	Masse du contenant (g)	61.64
3	11.0	☒	Masse du contenant + sol humide (g)	200.09
4	11.0	☒	Masse ddu contenant + sol sec (g)	145.76
5	11.0	☒	Teneur en eau (%)	64.6

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 32 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	7.0	7.0	Contenant n°	14
2	7.0	7.0	Masse du contenant (g)	61.64
3	7.0	7.0	Masse du contenant + sol humide (g)	200.09
Facultatif			Masse du contenant + sol sec (g)	145.76
Facultatif			Teneur en eau (%)	64.6
Pénétration moyenne (mm)	7.0 ☒	7.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 3.6 kPa

REMARQUES

Description: Very sensitive silty clay, grey, fraible, very wet

Sensibilité (Cu/Cu_r)

9

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 8 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-36		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Tuesday, October 11, 2022
N° forage	: BH22-36	N° d'éch. : ST-09	Par	:	Stantec
Profondeur	: 6.71-7.32 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☒ 100g / 30° ☐ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	18.0	☒	Contenant n°	12
2	18.0	☒	Masse du contenant (g)	15.32
3	18.0	☒	Masse du contenant + sol humide (g)	45.78
4	18.0	☒	Masse ddu contenant + sol sec (g)	35.26
5	18.0	☒	Teneur en eau (%)	52.8

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 3 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	15.0	15.0	Contenant n°	12
2	15.0	15.0	Masse du contenant (g)	15.32
3	15.0	15.0	Masse du contenant + sol humide (g)	45.78
Facultatif			Masse du contenant + sol sec (g)	35.26
Facultatif			Teneur en eau (%)	52.8
Pénétration moyenne (mm)	15.0 ☒	15.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 0.8 kPa

REMARQUES

Description: Medium to sensitive silty clay, grey, varved/fraible, very moist

Sensibilité (Cu/Cu_r)

4

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :

Rapport n° : 9 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-36		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	Tuesday, October 11, 2022
N° forage	: BH22-36	N° d'éch. : ST-13	Par	:	Stantec
Profondeur	: 9.14-9.75 m		Reçu le	:	Thursday, October 27, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	7.0	☒	Contenant n°	25
2	7.0	☒	Masse du contenant (g)	15.37
3	7.0	☒	Masse du contenant + sol humide (g)	46.30
4	7.0	☒	Masse ddu contenant + sol sec (g)	38.81
5	7.0	☒	Teneur en eau (%)	32.0

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 80 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	4.0	4.0	Contenant n°	25
2	4.0	4.0	Masse du contenant (g)	15.37
3	4.0	4.0	Masse du contenant + sol humide (g)	46.30
Facultatif			Masse du contenant + sol sec (g)	38.81
Facultatif			Teneur en eau (%)	32.0
Pénétration moyenne (mm)	4.0 ☒	4.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 11.0 kPa

REMARQUES

Description: Sensitive silty clay with sand seams and gravel, grey, moist

Sensibilité (Cu/Cu_r)

7

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 1-Dec-22

Approuvé par : Daniel Boateng **Date :** 6-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 1 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-06		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 18, 2022
N° forage	: BH22-06	N° d'éch. : ST-08	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☒ 100g / 30° ☐ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	8.0	☒	Contenant n°	7
2	8.0	☒	Masse du contenant (g)	62.10
3	8.0	☒	Masse du contenant + sol humide (g)	169.05
4	8.0	☒	Masse ddu contenant + sol sec (g)	116.83
5	8.0	☒	Teneur en eau (%)	95.4

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : **15** **kPa**

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	14.0	14.0	Contenant n°	7
2	14.0	14.0	Masse du contenant (g)	62.10
3	14.0	14.0	Masse du contenant + sol humide (g)	169.05
Facultatif			Masse du contenant + sol sec (g)	116.83
Facultatif			Teneur en eau (%)	95.4
Pénétration moyenne (mm)	14.0 ☒	14.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : **0.9** **kPa**

REMARQUES

Description: Extremely sensitive silty clay, grey, very wet

Sensibilité (Cu/Cu_r)

17

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rdriguez **Date :** 7-Dec-22

Approuvé par : Daniel Boateng **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône
NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 2 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-11		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 12, 2022
N° forage	: BH22-11	N° d'éch. : ST-09	Par	:	Stantec
Profondeur	: 4.88-5.49 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	9.0	☒	Contenant n°	4
2	9.0	☒	Masse du contenant (g)	15.00
3	9.0	☒	Masse du contenant + sol humide (g)	45.69
4	9.0	☒	Masse ddu contenant + sol sec (g)	35.39
5	9.0	☒	Teneur en eau (%)	50.5

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 48 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	4.0		4.0		Contenant n°	4
2	4.0		4.0		Masse du contenant (g)	15.00
3	4.0		4.0		Masse du contenant + sol humide (g)	45.69
Facultatif					Masse du contenant + sol sec (g)	35.39
Facultatif					Teneur en eau (%)	50.5
Pénétration moyenne (mm)	4.0	☒	4.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 11.0 kPa

REMARQUES

Description: Medium to sensitive silty clay, dark grey, friable/varved, wet

Sensibilité (Cu/Cu_r)

4

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 3 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-15		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 17, 2022
N° forage	: BH22-15	N° d'éch. : ST-05	Par	:	Stantec
Profondeur	: 2.44-3.05 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	19.0	☒	Contenant n°	32
2	19.0	☒	Masse du contenant (g)	15.62
3	19.0	☒	Masse du contenant + sol humide (g)	49.30
4	19.0	☒	Masse ddu contenant + sol sec (g)	32.80
5	19.0	☒	Teneur en eau (%)	96.0

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 11 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	15.0	15.0	Contenant n°	32
2	15.0	15.0	Masse du contenant (g)	15.62
3	15.0	15.0	Masse du contenant + sol humide (g)	49.30
Facultatif			Masse du contenant + sol sec (g)	32.80
Facultatif			Teneur en eau (%)	96.0
Pénétration moyenne (mm)	15.0 ☒	15.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 0.8 kPa

REMARQUES

Description: Very sensitive silty clay, grey, friable, very wet

Sensibilité (Cu/Cu_r)

14

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 2-Dec-22

Approuvé par : Daniel Boateng **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 4 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-24		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 16, 2022
N° forage	: BH22-24	N° d'éch. : ST-09	Par	:	Stantec
Profondeur	: 4.88-5.49 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	15.0	☒	Contenant n°	AL1
2	15.0	☒	Masse du contenant (g)	61.92
3	15.0	☒	Masse du contenant + sol humide (g)	241.26
4	15.0	☒	Masse ddu contenant + sol sec (g)	166.66
5	15.0	☒	Teneur en eau (%)	71.2

$\bar{P}_{100}^2 = \frac{\Sigma P_{100}^2}{N}$ $\bar{P}_{400}^2 = \frac{\Sigma P_{400}^2}{N}$

$Cu = \frac{g K_{30} m_{100}}{\bar{P}_{100}^2}$ $Cu = \frac{g K_{30} m_{400}}{\bar{P}_{400}^2}$

$g = 9,8$ $K_{30} = 1,0$

Résistance (Cu) : 17 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	11.0	11.0	Contenant n°	AL1
2	11.0	11.0	Masse du contenant (g)	61.92
3	11.0	11.0	Masse du contenant + sol humide (g)	241.26
Facultatif			Masse du contenant + sol sec (g)	166.66
Facultatif			Teneur en eau (%)	71.2
Pénétration moyenne (mm)	11.0 ☒	11.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\bar{P}_{60}^2 = \frac{\Sigma P_{60}^2}{N}$ $\bar{P}_{10}^2 = \frac{\Sigma P_{10}^2}{N}$

$Cu_r = \frac{g K_{60} m_{60}}{\bar{P}_{60}^2}$ $Cu_r = \frac{g K_{60} m_{10}}{\bar{P}_{10}^2}$

$g = 9,8$ $K_{60} = 0,3$

Résistance (Cu_r) : 1.5 kPa

REMARQUES

Description: Very sensitive silty clay, grey, friable, wet

Sensibilité (Cu/Cu_r)

11

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 6 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-29		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 15, 2022
N° forage	: BH22-29	N° d'éch. : ST-08	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	13.0	☒	Contenant n°	19
2	13.0	☒	Masse du contenant (g)	61.73
3	13.0	☒	Masse du contenant + sol humide (g)	229.50
4	13.0	☒	Masse ddu contenant + sol sec (g)	154.40
5	13.0	☒	Teneur en eau (%)	81.0

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 23 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	10.0		10.0		Contenant n°	19
2	10.0		10.0		Masse du contenant (g)	61.73
3	10.0		10.0		Masse du contenant + sol humide (g)	229.50
Facultatif					Masse du contenant + sol sec (g)	154.40
Facultatif					Teneur en eau (%)	81.0
Pénétration moyenne (mm)	10.0	☒	10.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 1.8 kPa

REMARQUES

Description: Very sensitive silty clay, grey, very wet

Sensibilité (Cu/Cu_r)

13

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône
NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 7 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-30		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 6, 2022
N° forage	: BH22-30	N° d'éch. : ST-07	Par	:	Stantec
Profondeur	: 3.66-4.27 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	10.0	☒	Contenant n°	29
2	10.0	☒	Masse du contenant (g)	15.85
3	10.0	☒	Masse du contenant + sol humide (g)	56.52
4	10.0	☒	Masse ddu contenant + sol sec (g)	44.34
5	10.0	☒	Teneur en eau (%)	42.8

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 39 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	7.0		7.0		Contenant n°	29
2	7.0		7.0		Masse du contenant (g)	15.85
3	7.0		7.0		Masse du contenant + sol humide (g)	56.52
Facultatif					Masse du contenant + sol sec (g)	44.34
Facultatif					Teneur en eau (%)	42.8
Pénétration moyenne (mm)	7.0	☒	7.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 3.6 kPa

REMARQUES

Description: Very sensitive silty clay, dark grey,trace gravel, very moist

Sensibilité (Cu/Cu_r)

11

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 2-Dec-22

Approuvé par : Daniel Boateng **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 8 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-31		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 13, 2022
N° forage	: BH22-31	N° d'éch. : ST-10	Par	:	Stantec
Profondeur	: 5.49-6.10 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	8.0	☒	Contenant n°	17
2	8.0	☒	Masse du contenant (g)	15.44
3	8.0	☒	Masse du contenant + sol humide (g)	51.76
4	8.0	☒	Masse ddu contenant + sol sec (g)	43.92
5	8.0	☒	Teneur en eau (%)	27.5

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 61 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	3.0	3.0	Contenant n°	17
2	3.0	3.0	Masse du contenant (g)	15.44
3	3.0	3.0	Masse du contenant + sol humide (g)	51.76
Facultatif			Masse du contenant + sol sec (g)	43.92
Facultatif			Teneur en eau (%)	27.5
Pénétration moyenne (mm)	3.0 ☒	3.0 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 19.6 kPa

REMARQUES

Description: Medium sensitive silty clay, grey, varved, moist

Sensibilité (Cu/Cu_r)

3

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône
NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 9 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-34		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 14, 2022
N° forage	: BH22-34	N° d'éch. : ST-05	Par	:	Stantec
Profondeur	: 2.44-3.05 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	10.0	☒	Contenant n°	36
2	10.0	☒	Masse du contenant (g)	15.64
3	10.0	☒	Masse du contenant + sol humide (g)	49.03
4	10.0	☒	Masse ddu contenant + sol sec (g)	35.35
5	10.0	☒	Teneur en eau (%)	69.4

$\bar{P}_{100}^2 = \frac{\Sigma P_{100}^2}{N}$ $\bar{P}_{400}^2 = \frac{\Sigma P_{400}^2}{N}$

$Cu = \frac{g K_{30} m_{100}}{\bar{P}_{100}^2}$ $Cu = \frac{g K_{30} m_{400}}{\bar{P}_{400}^2}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 39 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	7.0		7.0		Contenant n°	36
2	7.0		7.0		Masse du contenant (g)	15.64
3	7.0		7.0		Masse du contenant + sol humide (g)	49.03
Facultatif					Masse du contenant + sol sec (g)	35.35
Facultatif					Teneur en eau (%)	69.4
Pénétration moyenne (mm)	7.0	☒	7.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\bar{P}_{60}^2 = \frac{\Sigma P_{60}^2}{N}$ $\bar{P}_{10}^2 = \frac{\Sigma P_{10}^2}{N}$

$Cu_r = \frac{g K_{60} m_{60}}{\bar{P}_{60}^2}$ $Cu_r = \frac{g K_{60} m_{10}}{\bar{P}_{10}^2}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 3.6 kPa

REMARQUES

Description: Sensitive silty clay, brown/grey, fraible/desiccated, wet

Sensibilité (Cu/Cu_r)

11

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 2-Dec-22

Approuvé par : Daniel Boateng **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 10 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-35		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 10, 2022
N° forage	: BH22-35	N° d'éch. : ST-08	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	13.0	☒	Contenant n°	29
2	13.0	☒	Masse du contenant (g)	15.87
3	13.0	☒	Masse du contenant + sol humide (g)	57.27
4	13.0	☒	Masse ddu contenant + sol sec (g)	48.02
5	13.0	☒	Teneur en eau (%)	28.8

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 23 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	4.0		4.0		Contenant n°	29
2	4.0		4.0		Masse du contenant (g)	15.87
3	4.0		4.0		Masse du contenant + sol humide (g)	57.27
Facultatif					Masse du contenant + sol sec (g)	48.02
Facultatif					Teneur en eau (%)	28.8
Pénétration moyenne (mm)	4.0	☒	4.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 11.0 kPa

REMARQUES

Description: Insensitive to Medium sensitive silty clay, grey, moist

Sensibilité (Cu/Cu_r)

2

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 11 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-38		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 11, 2022
N° forage	: BH22-38	N° d'éch. : ST-10	Par	:	Stantec
Profondeur	: 5.49-6.10 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	10.0	☒	Contenant n°	23
2	10.0	☒	Masse du contenant (g)	15.51
3	10.0	☒	Masse du contenant + sol humide (g)	52.07
4	10.0	☒	Masse ddu contenant + sol sec (g)	40.86
5	10.0	☒	Teneur en eau (%)	44.2

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 39 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	5.0		5.0		Contenant n°	23
2	5.0		5.0		Masse du contenant (g)	15.51
3	5.0		5.0		Masse du contenant + sol humide (g)	52.07
Facultatif					Masse du contenant + sol sec (g)	40.86
Facultatif					Teneur en eau (%)	44.2
Pénétration moyenne (mm)	5.0	☒	5.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 7.1 kPa

REMARQUES

Description: Sensitive silty clay, trace gravel, grey/dark grey, very moist

Sensibilité (Cu/Cu_r)

5

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône
NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 12 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-40		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	October 10, 2022
N° forage	: BH22-40	N° d'éch. : ST-08	Par	:	Stantec
Profondeur	: 4.27-4.88 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	8.5	☒	Contenant n°	AL 7
2	8.5	☒	Masse du contenant (g)	16.11
3	8.5	☒	Masse du contenant + sol humide (g)	50.21
4	8.5	☒	Masse ddu contenant + sol sec (g)	43.89
5	8.5	☒	Teneur en eau (%)	22.8

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 54 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)	Lectures série 2 (mm)	Teneur en eau	
1	3.5	3.5	Contenant n°	AL 7
2	3.5	3.5	Masse du contenant (g)	16.11
3	3.5	3.5	Masse du contenant + sol humide (g)	50.21
Facultatif			Masse du contenant + sol sec (g)	43.89
Facultatif			Teneur en eau (%)	22.8
Pénétration moyenne (mm)	3.5 ☒	3.5 ☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 14.4 kPa

REMARQUES

Description: Medium sensitive to sensitive silty clay, trace gravel, grey, moist

Sensibilité (Cu/Cu_r)

4

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** 21-Dec-22

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 13 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-09		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	November 6, 2022
N° forage	: BH22-09	N° d'éch. : ST-07	Par	:	Stantec
Profondeur	: 3.66-4.27 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	7.0	☒	Contenant n°	AL16
2	7.0	☒	Masse du contenant (g)	15.37
3	7.0	☒	Masse du contenant + sol humide (g)	52.12
4	7.0	☒	Masse ddu contenant + sol sec (g)	39.00
5	7.0	☒	Teneur en eau (%)	55.5

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 80 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	1.0		1.0		Contenant n°	AL16
2	1.0		1.0		Masse du contenant (g)	15.37
3	1.0		1.0		Masse du contenant + sol humide (g)	52.12
Facultatif					Masse du contenant + sol sec (g)	39.00
Facultatif					Teneur en eau (%)	55.5
Pénétration moyenne (mm)	1.0	☒	1.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 176.4 kPa

REMARQUES

Description: Non sensitive silty clay, brown, moist

Sensibilité (Cu/Cu_r)

0

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Daniel Boateng **Date :** DC 21

Approuvé par : Denis Rodriguez **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône
NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 14 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-22		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	November 3, 2022
N° forage	: BH22-22	N° d'éch. : ST-05	Par	:	Stantec
Profondeur	: 2.44-3.05 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	8.0	☒	Contenant n°	33
2	9.0	☒	Masse du contenant (g)	15.51
3	9.0	☒	Masse du contenant + sol humide (g)	44.91
4	9.0	☒	Masse ddu contenant + sol sec (g)	34.79
5	10.0	☒	Teneur en eau (%)	52.5

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 48 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	2.0		2.0		Contenant n°	33
2	2.0		2.0		Masse du contenant (g)	15.51
3	2.0		2.0		Masse du contenant + sol humide (g)	44.91
Facultatif					Masse du contenant + sol sec (g)	34.79
Facultatif					Teneur en eau (%)	52.5
Pénétration moyenne (mm)	2.0	☒	2.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 44.1 kPa

REMARQUES

Description: Non sensitive silty clay, brown/grey, wet

Sensibilité (Cu/Cu_r)

1

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 2-Dec-22

Approuvé par : Daniel Boateng **Date :** 22-Dec-22

Résistance au cisaillement : Méthode du pénétromètre à cône

NQ 2501-110

Client : Cree Development Corporation
Projet : La Grande Alliance - Feasibility Study - Phase I
Preliminary Geotechnical Investigation
Endroit : Potential BDH Railway

Dossier : 158100425.500.710.5
Réf. client :
Rapport n° : 15 Rév.

ÉCHANTILLONNAGE

N° d'échantillon	: BH22-28		Description de l'échantillon	:	
N° d'éch. client	:				
Endroit échantillonné	:		Prélevé le	:	November 4, 2022
N° forage	: BH22-28	N° d'éch. : ST-06	Par	:	Stantec
Profondeur	: 3.05-3.66 m		Reçu le	:	November 23, 2022

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT INTACT (Cu)

CÔNE utilisé ☐ 100g / 30° ☒ 400g / 30° Appareil n° Cône n° Balance n°

Essai n°	Lectures (mm)		Teneur en eau	
1	9.0	☒	Contenant n°	17
2	9.0	☒	Masse du contenant (g)	15.43
3	9.0	☒	Masse du contenant + sol humide (g)	44.71
4	9.0	☒ x	Masse ddu contenant + sol sec (g)	34.47
5	9.0	☒	Teneur en eau (%)	53.8

$\overline{P}_{100}^{\,2} = \frac{\Sigma P_{100}^{\,2}}{N}$ $\overline{P}_{400}^{\,2} = \frac{\Sigma P_{400}^{\,2}}{N}$

$Cu = \frac{g\,K_{30} m_{100}}{\overline{P}_{100}^{\,2}}$ $Cu = \frac{g\,K_{30} m_{400}}{\overline{P}_{400}^{\,2}}$

$g = 9{,}8$ $K_{30} = 1{,}0$

Résistance (Cu) : 48 kPa

RÉSISTANCE AU CISAILLEMENT À L'ÉTAT REMANIÉ (Cu_r)

CÔNE utilisé ☒ 60g / 60° ☐ 10g / 60° Appareil n° Cône n° Balance n°

Essai n°	Lectures série 1 (mm)		Lectures série 2 (mm)		Teneur en eau	
1	2.0		2.0		Contenant n°	17
2	2.0		2.0		Masse du contenant (g)	15.43
3	2.0		2.0		Masse du contenant + sol humide (g)	44.71
Facultatif					Masse du contenant + sol sec (g)	34.47
Facultatif					Teneur en eau (%)	53.8
Pénétration moyenne (mm)	2.0	☒	2.0	☐	*L'écart entre les 2 pénétrations moyennes doit être ≤ 0,3 mm : La valeur la plus élevée doit être retenue pour le calcul du Cu_r.*	*Conforme*

$\overline{P}_{60}^{\,2} = \frac{\Sigma P_{60}^{\,2}}{N}$ $\overline{P}_{10}^{\,2} = \frac{\Sigma P_{10}^{\,2}}{N}$

$Cu_r = \frac{g\,K_{60} m_{60}}{\overline{P}_{60}^{\,2}}$ $Cu_r = \frac{g\,K_{60} m_{10}}{\overline{P}_{10}^{\,2}}$

$g = 9{,}8$ $K_{60} = 0{,}3$

Résistance (Cu_r) : 44.1 kPa

REMARQUES

Description: Non sensitive silty clay, brown/grey, friable/desiccated, very moist

Sensibilité (Cu/Cu_r)

1

Sensibilité au remaniement	
< 2	Insensible
2 - 4	Sensibilité moyenne
4 - 8	Sensible
8 - 16	Très sensible
> 16	Extrêmement sensible

Préparé par : Denis Rodriguez **Date :** 5-Dec-22

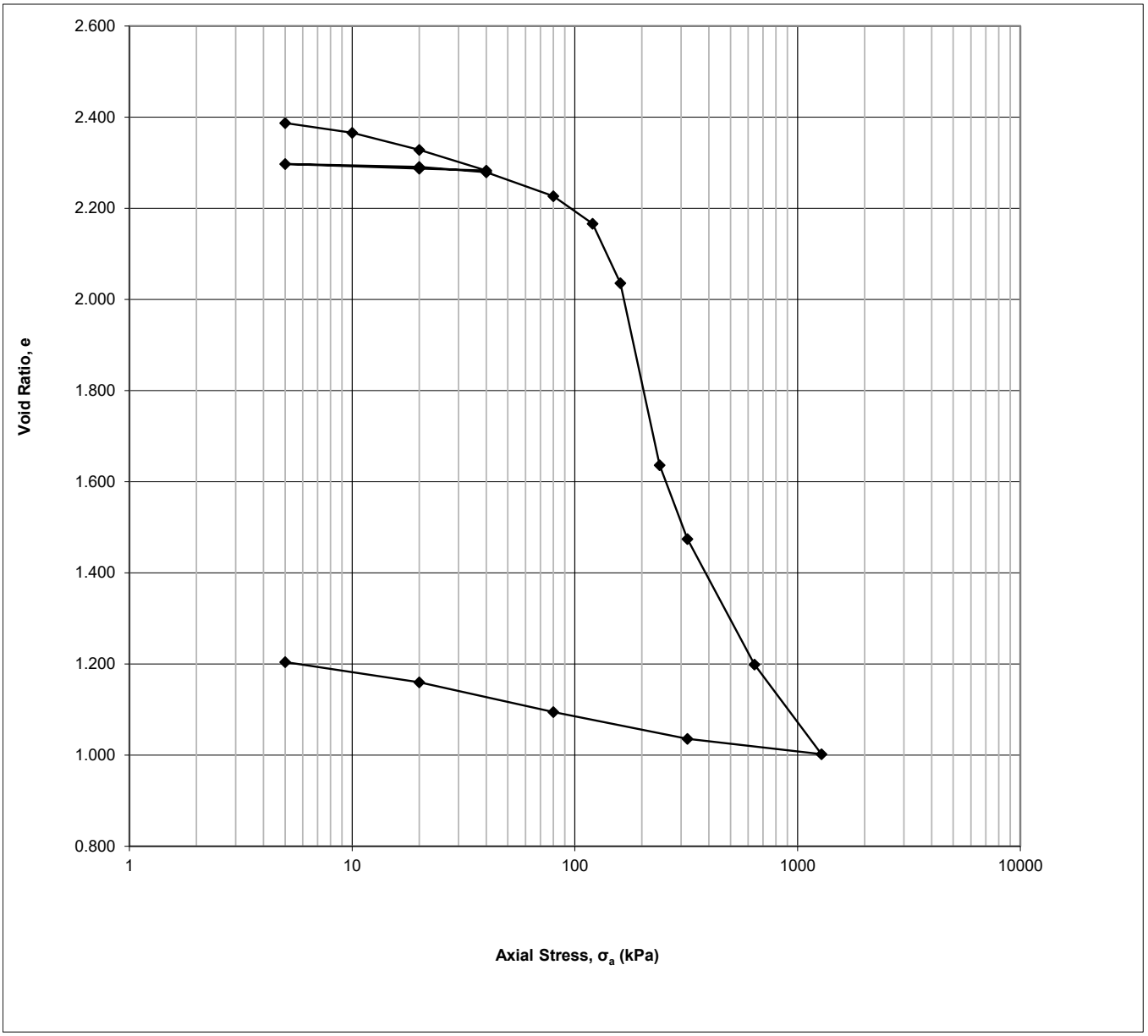
Approuvé par : Daniel Boateng **Date :** 22-Dec-22

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-12**
Sample No.	**ST-21**
Sample Depth	**4.27-4.88 m.**



Checked by: D. Boateng Date: November 29, 2022

Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-12
No. Depth	ST-21
Sample Date Test	4.27-4.88 m.
Number	September 21, 2022
Technician Name	One
	Daniel Boateng

Soil Description & Classification

Silty clay, grey, friable, very wet	
Specific Gravity of Solids	2.750
Average water content of trimmings %	81.24
Additional Notes (information source, occurence and size of large isolated particles etc.)	
Specific Gravity of Solids was Assumed	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	58.98
Dry Mass	g	31.56
Density	Mg/m^3	1.502
Dry Density	Mg/m^3	0.804
Water Content	%	86.88
Degree of Saturation	%	98.7
Height of Solids	mm	5.84
Initial Void Ratio		2.422

Final Specimen Conditions

Water Content	%	49.21
Final Void Ratio		1.204
Final Height	mm	12.88

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consolidator
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-12
No. Depth	ST-21
Sample Date Test	4.27-4.88 m.
Number	September 21, 2022
Technician Name	One
	Daniel Boateng

Test Procedure

Date Started		November 14, 2022
Date Finished		November 15, 2022
Machine Number		Frame C
Cell Number		C
Ring Number		C
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	2.422
1	20.0	5	0.1984	19.8016	1.01	2.387
2	21.5	10	0.3181	19.6819	1.63	2.366
3	24.8	20	0.5313	19.4687	2.72	2.329
4	31.5	40	0.7921	19.2079	4.07	2.283
5	20.0	20	0.7874	19.2126	3.94	2.287
6	20.0	5	0.7272	19.2728	3.63	2.298
7	20.0	20	0.7644	19.2356	3.83	2.291
8	20.0	40	0.8263	19.1737	4.16	2.279
9	41.5	80	1.0923	18.9077	5.70	2.227
10	78.3	120	1.3608	18.6392	7.46	2.167
11	229.3	160	1.8207	18.1793	11.28	2.036
12	265.3	240	4.2640	15.7360	22.95	1.636
13	187.0	320	5.4136	14.5864	27.69	1.474
14	119.8	640	6.8414	13.1586	35.74	1.199
15	98.0	1280	8.0813	11.9187	41.49	1.002
16	25.3	320	8.0941	11.9059	40.50	1.036
17	42.0	80	7.7539	12.2461	38.78	1.095
18	74.5	20	7.3857	12.6143	36.88	1.160
19	86.5	5	7.3672	12.6328	35.58	1.204

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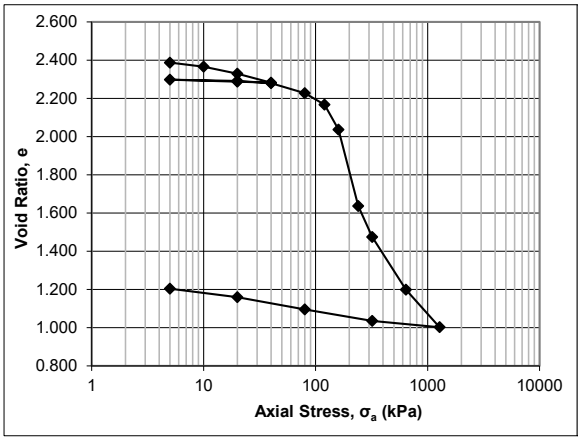
One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

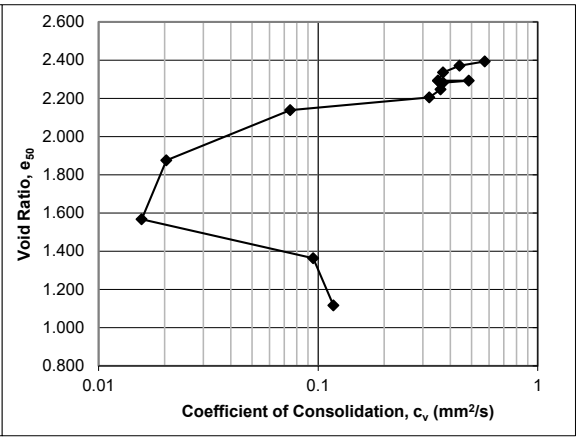
Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-12
No. Depth	ST-21
Sample Date Test	4.27-4.88 m.
Number	September 21, 2022
Technician Name	One
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.1679	19.8321	0.84	2.393			145	5.74E-01
2	8	0.2977	19.7023	1.49	2.371			187	4.41E-01
3	15	0.5054	19.4946	2.53	2.335			217	3.71E-01
4	30	0.7529	19.2471	3.76	2.293			223	3.52E-01
5	30	0.7915	19.2085	3.96	2.286				
6	13	0.7416	19.2584	3.71	2.295				
7	13	0.7594	19.2406	3.80	2.292			162	4.85E-01
8	30	0.8164	19.1836	4.08	2.282			211	3.70E-01
9	60	1.0232	18.9768	5.12	2.247			211	3.61E-01
10	100	1.2658	18.7342	6.33	2.205			232	3.21E-01
11	140	1.6605	18.3395	8.30	2.138			956	7.46E-02
12	200	3.1918	16.8082	15.96	1.876			2942	2.04E-02
13	280	4.9911	15.0089	24.96	1.568			3038	1.57E-02
14	480	6.1847	13.8153	30.92	1.364			426	9.49E-02
15	960	7.6301	12.3699	38.15	1.116			276	1.17E-01
16	800	8.1597	11.8403	40.80	1.026				
17	200	7.9007	12.0993	39.50	1.070				
18	50	7.5627	12.4373	37.81	1.128				
19	13	7.3707	12.6293	36.85	1.161				





Filename: V:\01216\active\other_pc_projects\158100425.500.710.5Billy Diamond\Consoli Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log



Photo No.: 1	Borehole: BH22-12 ST-12	Depth: 4.27-4.88 m

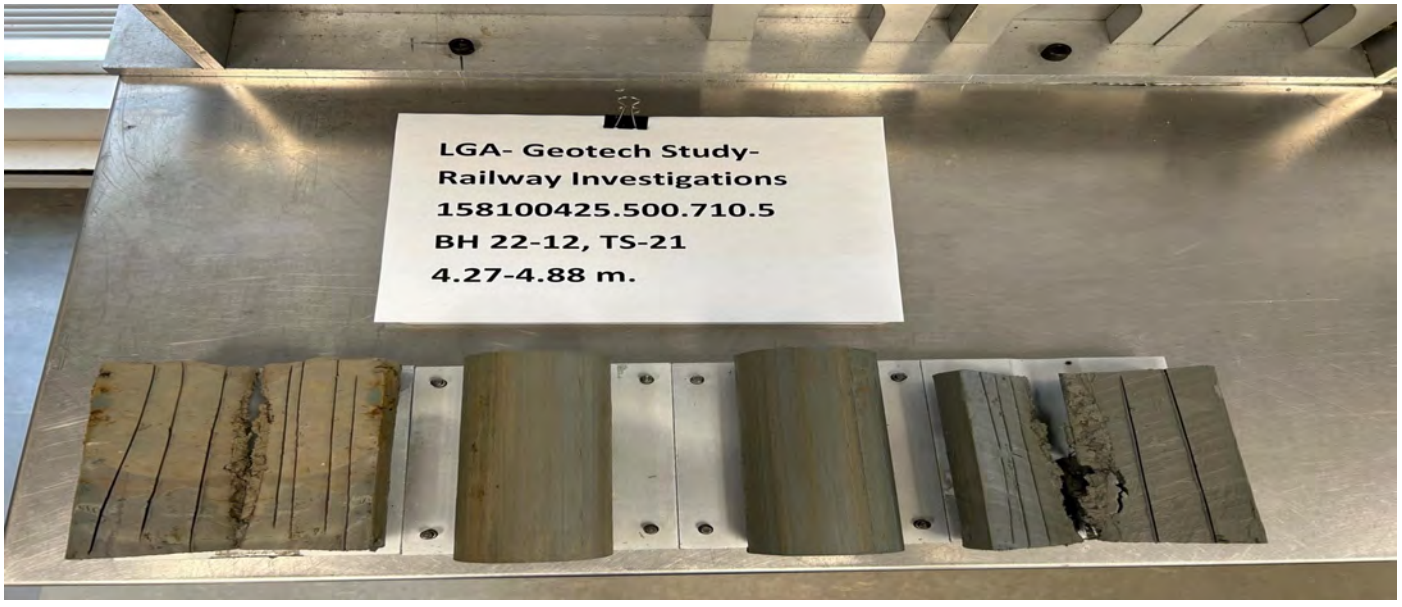


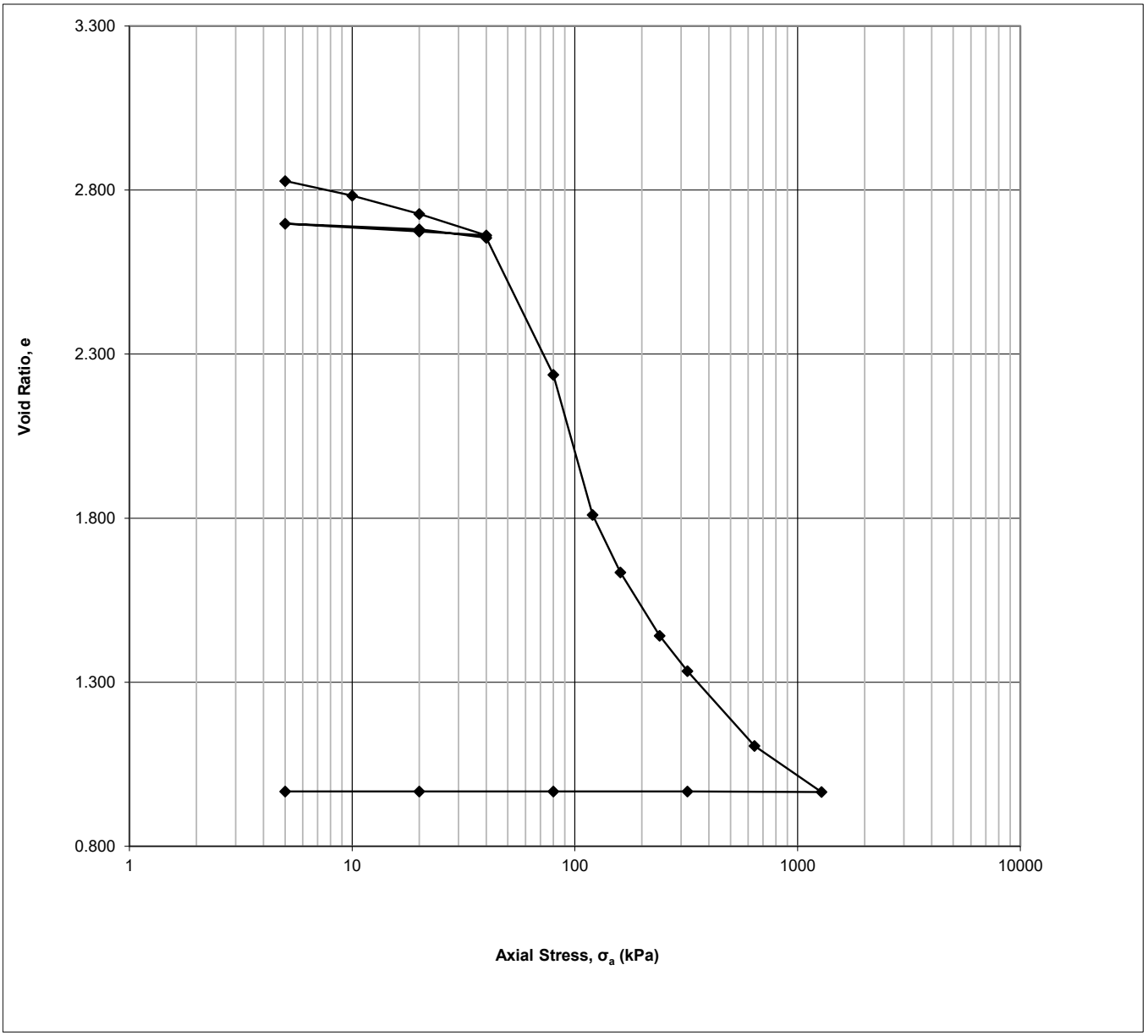
Photo No.: 2	Borehole: BH22-12 ST-12	Depth: 4.27-4.88 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-15**
Sample No.	**ST-05**
Sample Depth	**2.44-3.05 m**



Checked by: D. Boateng Date: December 15, 2022

Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-15
No. Depth	ST-05
Sample Date	2.44-3.05 m
Test Number	October 17, 2022
Technician Name	Seven
	Daniel Boateng

Soil Description & Classification

Silty clay, grey, friable, very wet

Specific Gravity of Solids	2.750
Average water content of trimmings %	95.38

Additional Notes (information source, occurence and size of large isolated particles etc.)

1. Specific gravity of solids was assumed, 2. Sample did not rebound due to significant strain

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	56.55
Dry Mass	g	27.51
Density	Mg/m^3	1.440
Dry Density	Mg/m^3	0.701
Water Content	%	105.56
Degree of Saturation	%	99.2
Height of Solids	mm	5.09
Initial Void Ratio		2.926

Final Specimen Conditions

Water Content	%	47.40
Final Void Ratio		0.967
Final Height	mm	10.02

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab request Date: December 15, 2022

Checked by: D. Boateng Date: December 15, 2022

Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-15
No. Depth	ST-05
Sample Date	2.44-3.05 m
Test Number	October 17, 2022
Technician Name	Seven
	Daniel Boateng

Test Procedure

Date Started		December 2, 2022
Date Finished		December 3, 2022
Machine Number		Frame C
Cell Number		C
Ring Number		C
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	2.926
1	29.8	5	0.4497	19.5503	2.49	2.828
2	29.8	10	0.7033	19.2967	3.63	2.783
3	31.5	20	0.9711	19.0289	5.04	2.728
4	56.5	40	1.2584	18.7416	6.70	2.662
5	20.0	20	1.2830	18.7170	6.42	2.674
6	23.3	5	1.1595	18.8405	5.81	2.698
7	20.0	20	1.2437	18.7563	6.24	2.681
8	31.5	40	1.3540	18.6460	6.90	2.655
9	352.3	80	2.4078	17.5922	17.53	2.237
10	247.5	120	5.6683	14.3317	28.42	1.810
11	199.0	160	6.5297	13.4703	32.88	1.635
12	147.3	240	7.3649	12.6351	37.80	1.442
13	123.8	320	8.0252	11.9748	40.54	1.334
14	95.0	640	9.0616	10.9384	46.35	1.106
15	45.8	1280	9.9093	10.0907	49.94	0.965
16	20.0	320	9.9795	10.0205	49.90	0.967
17	20.0	80	9.9796	10.0204	49.90	0.967
18	19.8	20	9.9794	10.0206	49.90	0.967
19	20.0	5	9.9792	10.0208	49.90	0.967

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab rec
Date: December 15, 2022

D. Boateng Date: December 15, 2022
Checked by: R. Ghassemi Date: December 15, 2022
Approved by:

One-Dimensional Consolidation Test using Incremental Loading

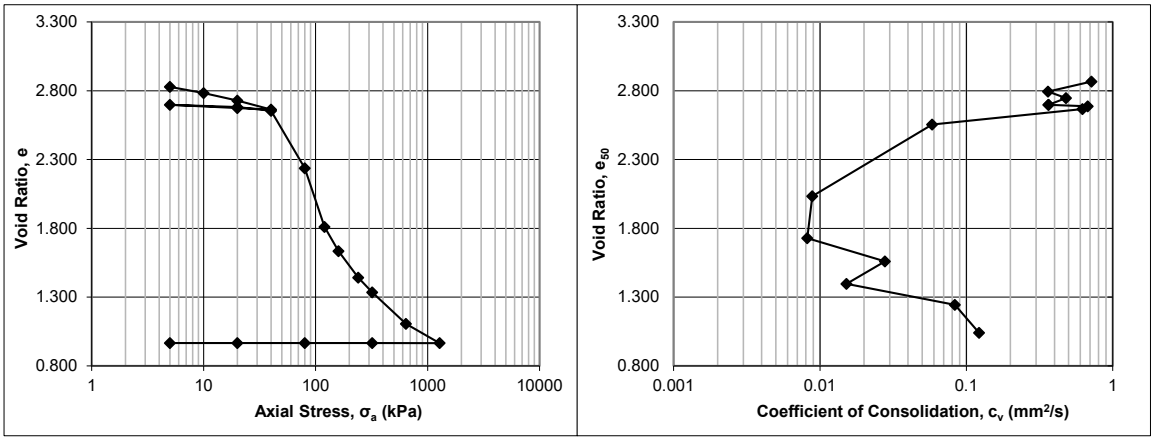
ASTM D2435/D2435M - 11(2020)

Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-15
No. Depth	ST-05
Sample Date Test	2.44-3.05 m
Number	October 17, 2022
Technician Name	Seven
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.3008	19.6992	1.50	2.867			115	7.16E-01
2	8	0.6681	19.3319	3.34	2.794			219	3.61E-01
3	15	0.9125	19.0875	4.56	2.746			161	4.80E-01
4	30	1.1606	18.8394	5.80	2.698			206	3.65E-01
5	30	1.2985	18.7015	6.49	2.671				
6	13	1.2048	18.7952	6.02	2.689				
7	13	1.2196	18.7804	6.10	2.686			110	6.77E-01
8	30	1.3162	18.6838	6.58	2.667			119	6.23E-01
9	60	1.8962	18.1038	9.48	2.553			1189	5.84E-02
10	100	4.5450	15.4550	22.73	2.033			5707	8.87E-03
11	140	6.0982	13.9018	30.49	1.729			5002	8.19E-03
12	200	6.9568	13.0432	34.78	1.560			1298	2.78E-02
13	280	7.7895	12.2105	38.95	1.397			2078	1.52E-02
14	480	8.5701	11.4299	42.85	1.243			331	8.37E-02
15	960	9.6069	10.3931	48.03	1.040			187	1.22E-01
16	800	9.9818	10.0182	49.91	0.966				
17	200	9.9796	10.0204	49.90	0.967				
18	50	9.9793	10.0207	49.90	0.967				
19	13	9.9792	10.0208	49.90	0.967				



Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

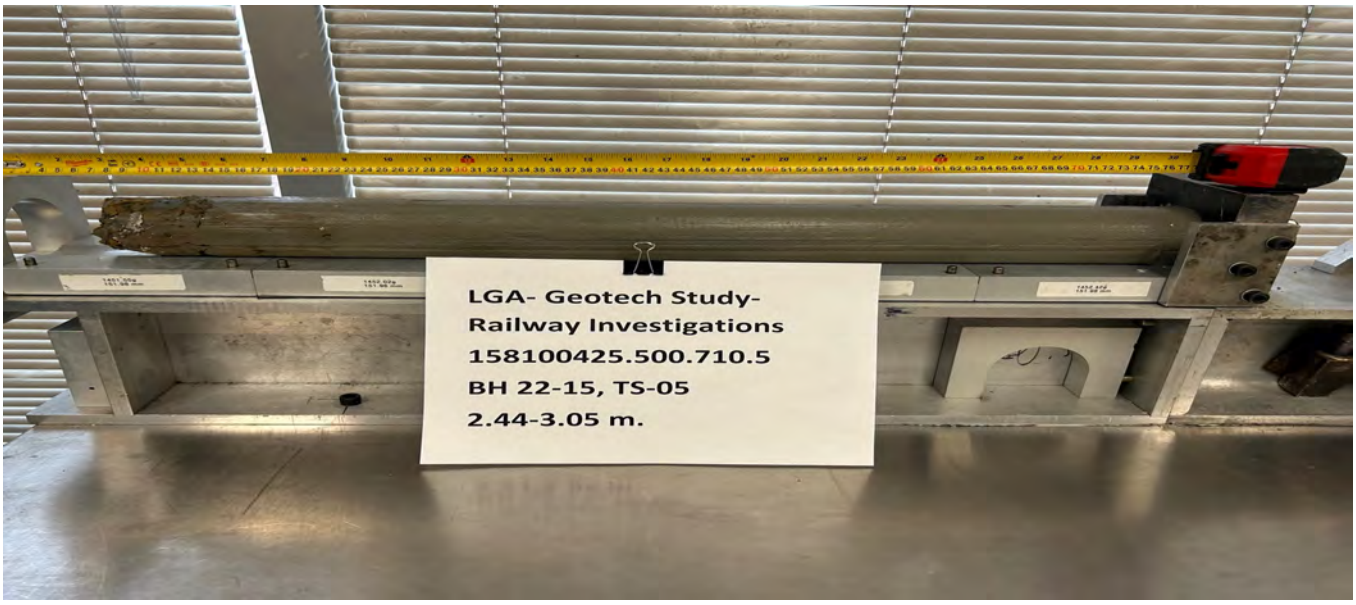


Photo No.: 1	Borehole: BH22-15 ST-05	Depth: 2.44-3.05 m



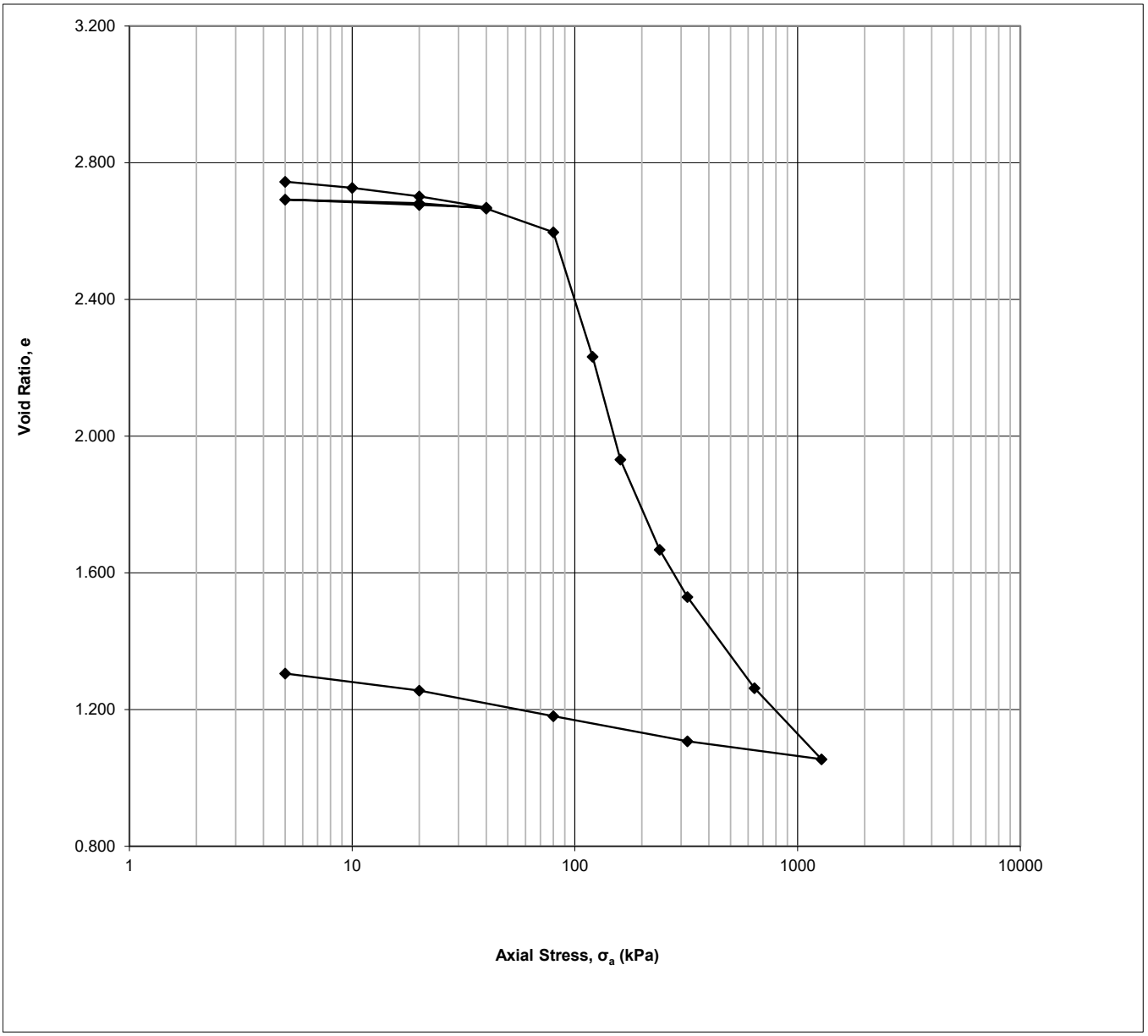
Photo No.: 2	Borehole: BH22-15 ST-05	Depth: 2.44-3.05 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I** **Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-17**
Sample No.	**ST-20**
Sample Depth	**4.27-4.88 m.**



Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample No.	BH22-17
Depth	ST-20
Sample Date Test	4.27-4.88 m.
Number	September 22, 2022
Technician Name	Two
	Daniel Boateng

Soil Description & Classification

Silty clay, grey, friable, very wet	
Specific Gravity of Solids	2.750
Average water content of trimmings %	95.87
Additional Notes (information source, occurence and size of large isolated particles etc.)	
Specific Gravity of Solids was Assumed	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	57.37
Dry Mass	g	28.69
Density	Mg/m^3	1.461
Dry Density	Mg/m^3	0.731
Water Content	%	99.97
Degree of Saturation	%	99.5
Height of Solids	mm	5.31
Initial Void Ratio		2.764

Final Specimen Conditions

Water Content	%	50.47
Final Void Ratio		1.305
Final Height	mm	12.25

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consolidator
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-17
No. Depth	ST-20
Sample Date Test	4.27-4.88 m.
Number	September 22, 2022
Technician Name	Two
	Daniel Boateng

Test Procedure

Date Started		November 14, 2022
Date Finished		November 16, 2022
Machine Number		Frame D
Cell Number		D
Ring Number		D
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	2.764
1	20.0	5	0.0927	19.9073	0.52	2.745
2	20.0	10	0.1905	19.8095	1.00	2.726
3	24.8	20	0.3182	19.6818	1.65	2.702
4	33.3	40	0.4846	19.5154	2.53	2.669
5	20.0	20	0.4644	19.5356	2.32	2.677
6	20.0	5	0.3835	19.6165	1.92	2.692
7	20.0	20	0.4349	19.5651	2.19	2.682
8	21.5	40	0.5119	19.4881	2.60	2.666
9	61.5	80	0.7743	19.2257	4.45	2.597
10	413.8	120	2.7136	17.2864	14.12	2.233
11	325.0	160	4.4792	15.5208	22.13	1.931
12	153.8	240	5.6731	14.3269	29.13	1.668
13	145.5	320	6.5163	13.4837	32.80	1.530
14	108.5	640	7.7417	12.2583	39.89	1.263
15	88.0	1280	8.8580	11.1420	45.41	1.055
16	27.0	320	8.7942	11.2058	44.02	1.107
17	54.3	80	8.4112	11.5888	42.07	1.181
18	85.0	20	8.0270	11.9730	40.08	1.255
19	107.3	5	8.0038	11.9962	38.76	1.305

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Date: November 29, 2022

Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

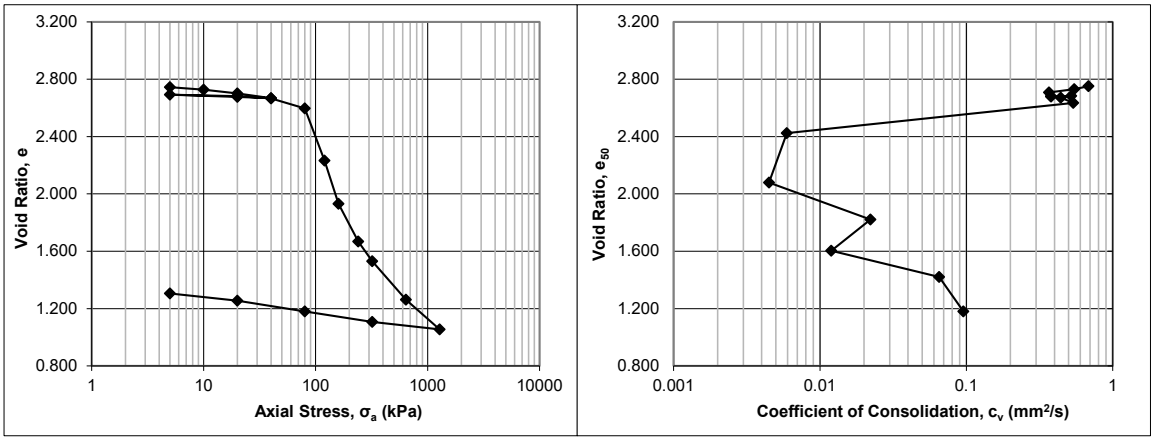
One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-17
No. Depth	ST-20
Sample Date Test	4.27-4.88 m.
Number	September 22, 2022
Technician Name	Two
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.0679	19.9321	0.34	2.751			123	6.83E-01
2	8	0.1746	19.8254	0.87	2.731			152	5.47E-01
3	15	0.2944	19.7056	1.47	2.709			224	3.67E-01
4	30	0.4438	19.5562	2.22	2.681			214	3.80E-01
5	30	0.4721	19.5279	2.36	2.675				
6	13	0.4074	19.5926	2.04	2.687				
7	13	0.4260	19.5740	2.13	2.684			156	5.21E-01
8	30	0.4964	19.5036	2.48	2.671			182	4.43E-01
9	60	0.6864	19.3136	3.43	2.635			147	5.39E-01
10	100	1.8038	18.1962	9.02	2.425			11809	5.94E-03
11	140	3.6370	16.3630	18.18	2.080			12652	4.49E-03
12	200	5.0126	14.9874	25.06	1.821			2155	2.21E-02
13	280	6.1673	13.8327	30.84	1.603			3391	1.20E-02
14	480	7.1398	12.8602	35.70	1.420			537	6.53E-02
15	960	8.4158	11.5842	42.08	1.180			298	9.53E-02
16	800	8.8872	11.1128	44.44	1.091				
17	200	8.5885	11.4115	42.94	1.148				
18	50	8.2148	11.7852	41.07	1.218				
19	13	8.0084	11.9916	40.04	1.257				



Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

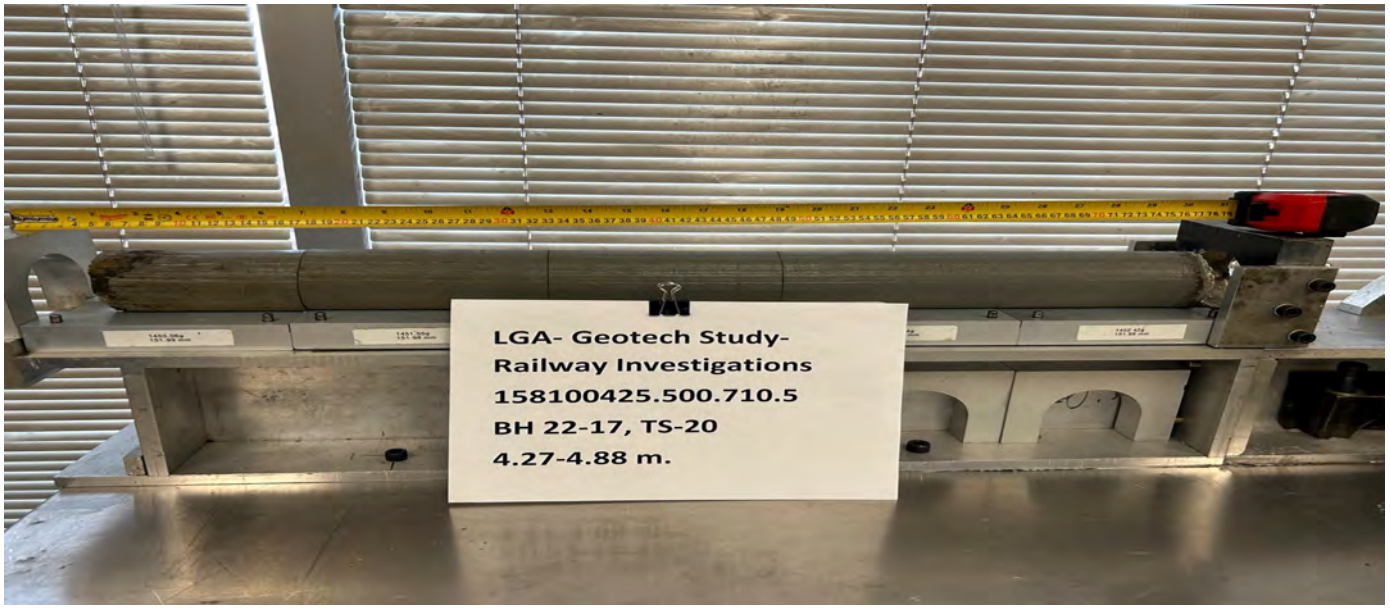


Photo No.: 1	Borehole: BH22-17 ST-20	Depth: 4.27-4.88 m



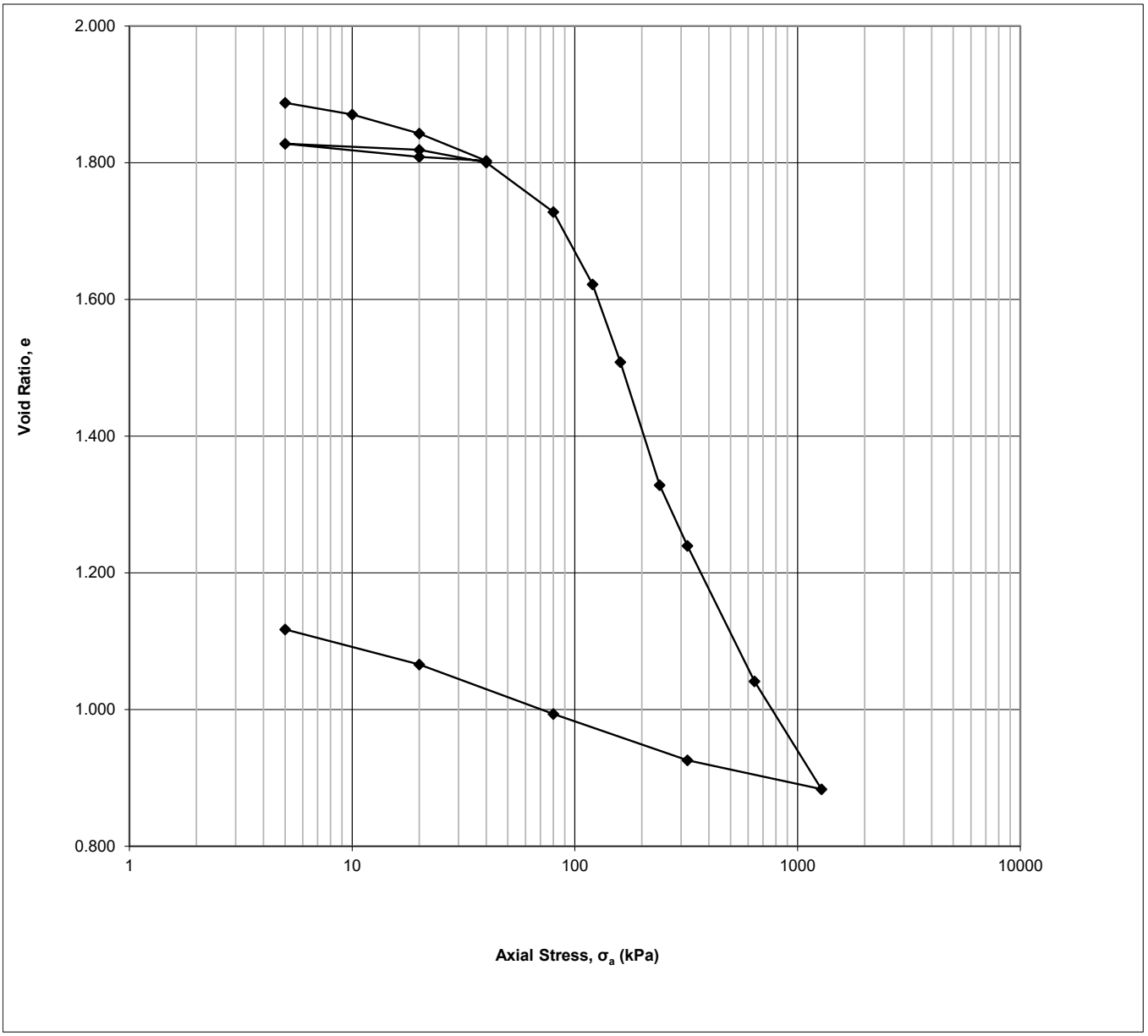
Photo No.: 2	Borehole: BH22-17 ST-20	Depth: 4.27-4.88 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-18**
Sample No.	**ST-20**
Sample Depth	**7.32-7.93 m.**



Checked by: D. Boateng Date: November 29, 2022

Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-18
No. Depth	ST-20
Sample Date Test	7.32-7.93 m.
Number	September 23, 2022
Technician Name	Three
	Daniel Boateng

Soil Description & Classification

Silty clay, grey, friable, wet	
Specific Gravity of Solids	2.750
Average water content of trimmings %	69.10
Additional Notes (information source, occurence and size of large isolated particles etc.)	
Specific Gravity of Solids was Assumed	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	62.11
Dry Mass	g	37.13
Density	Mg/m^3	1.582
Dry Density	Mg/m^3	0.946
Water Content	%	67.28
Degree of Saturation	%	96.9
Height of Solids	mm	6.88
Initial Void Ratio		1.908

Final Specimen Conditions

Water Content	%	45.14
Final Void Ratio		1.117
Final Height	mm	14.56

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consolidator
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole	BH22-18
Sample No.	ST-20
Depth	7.32-7.93 m.
Sample Date	September 23, 2022
Test Number	Three
Technician Name	Daniel Boateng

Test Procedure

Date Started		November 14, 2022
Date Finished		November 16, 2022
Machine Number		Frame E
Cell Number		E
Ring Number		E
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	1.908
1	21.5	5	0.1479	19.8521	0.72	1.888
2	25.0	10	0.2518	19.7482	1.30	1.871
3	29.8	20	0.4262	19.5738	2.26	1.843
4	43.3	40	0.6975	19.3025	3.64	1.803
5	21.5	20	0.6851	19.3149	3.43	1.809
6	38.3	5	0.5577	19.4423	2.78	1.828
7	23.3	20	0.6111	19.3889	3.08	1.819
8	33.3	40	0.7162	19.2838	3.72	1.800
9	90.0	80	1.1205	18.8795	6.20	1.728
10	175.8	120	1.7768	18.2232	9.85	1.622
11	178.0	160	2.7514	17.2486	13.76	1.508
12	193.8	240	3.9759	16.0241	19.95	1.328
13	145.0	320	4.5847	15.4153	23.00	1.240
14	110.0	640	5.8162	14.1838	29.82	1.041
15	93.0	1280	6.8865	13.1135	35.24	0.884
16	32.0	320	6.7447	13.2553	33.78	0.926
17	67.8	80	6.2905	13.7095	31.46	0.994
18	124.0	20	5.7971	14.2029	28.97	1.066
19	153.0	5	5.7304	14.2696	27.21	1.117

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consoli
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

One-Dimensional Consolidation Test using Incremental Loading

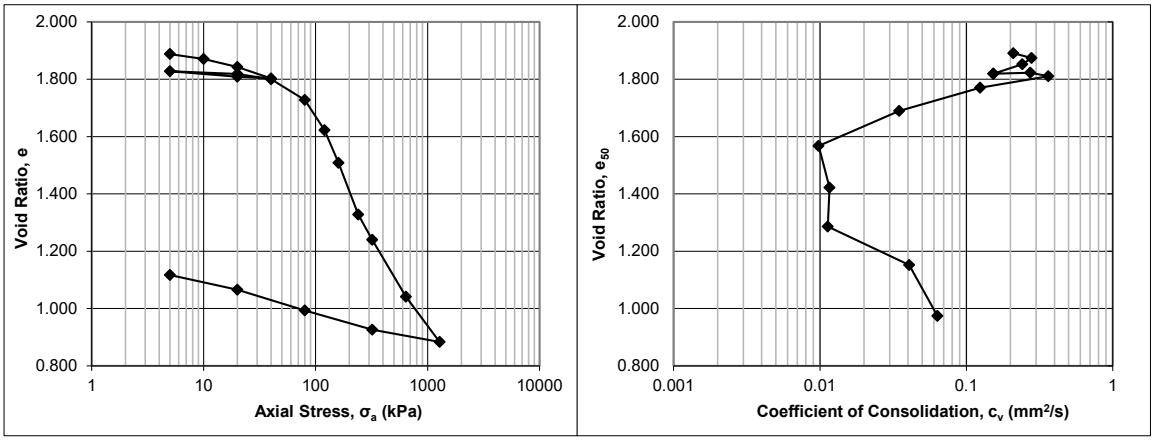
ASTM D2435/D2435M - 11(2020)

Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-18
No. Depth	ST-20
Sample Date Test	7.32-7.93 m.
Number	September 23, 2022
Technician Name	Three
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.1221	19.8779	0.61	1.891			399	2.10E-01
2	8	0.2338	19.7662	1.17	1.874			296	2.79E-01
3	15	0.3882	19.6118	1.94	1.852			337	2.42E-01
4	30	0.6129	19.3871	3.06	1.819			521	1.53E-01
5	30	0.7014	19.2986	3.51	1.806				
6	13	0.6123	19.3877	3.06	1.819				
7	13	0.5896	19.4104	2.95	1.823			292	2.74E-01
8	30	0.6757	19.3243	3.38	1.810			218	3.64E-01
9	60	0.9509	19.0491	4.75	1.770			620	1.24E-01
10	100	1.5084	18.4916	7.54	1.689			2084	3.48E-02
11	140	2.3425	17.6575	11.71	1.568			6746	9.80E-03
12	200	3.3457	16.6543	16.73	1.422			5055	1.16E-02
13	280	4.2799	15.7201	21.40	1.286			4637	1.13E-02
14	480	5.2024	14.7976	26.01	1.152			1141	4.07E-02
15	960	6.4242	13.5758	32.12	0.974			615	6.36E-02
16	800	6.8774	13.1226	34.39	0.908				
17	200	6.5031	13.4969	32.52	0.963				
18	50	6.0378	13.9622	30.19	1.030				
19	13	5.7614	14.2386	28.81	1.071				



Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

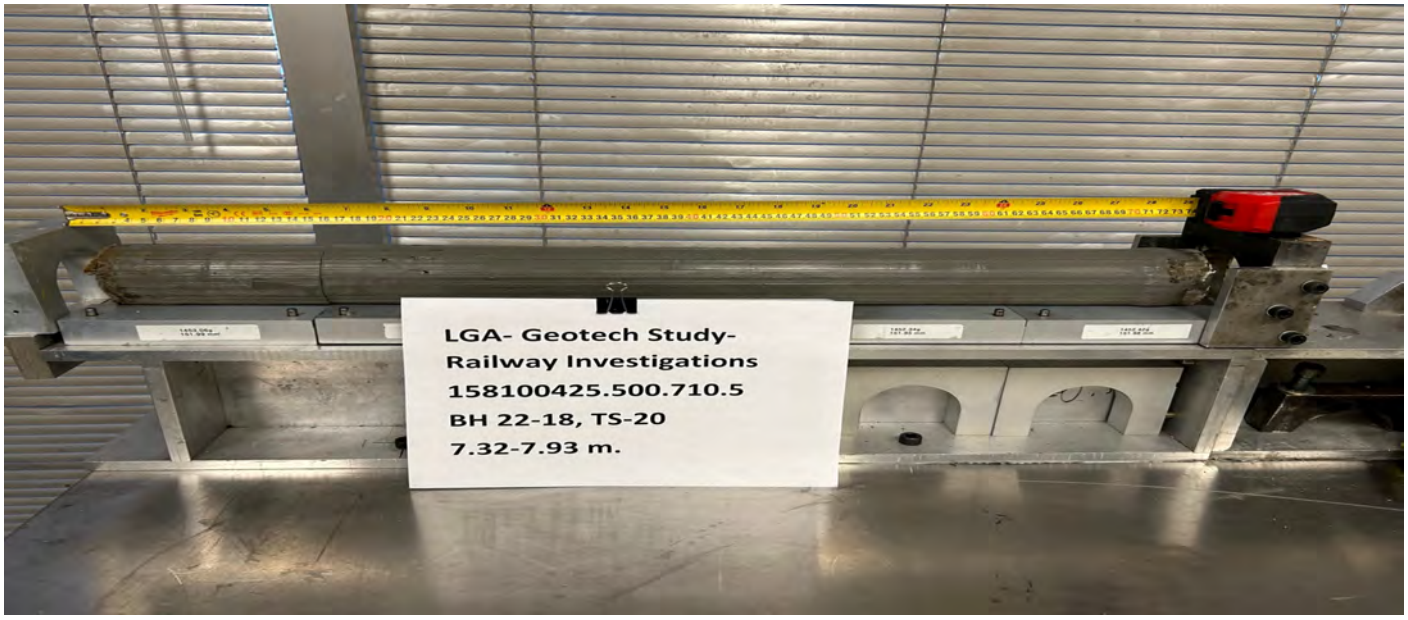


Photo No.: 1	Borehole: BH22-18 ST-20	Depth: 7.32-7.93 m



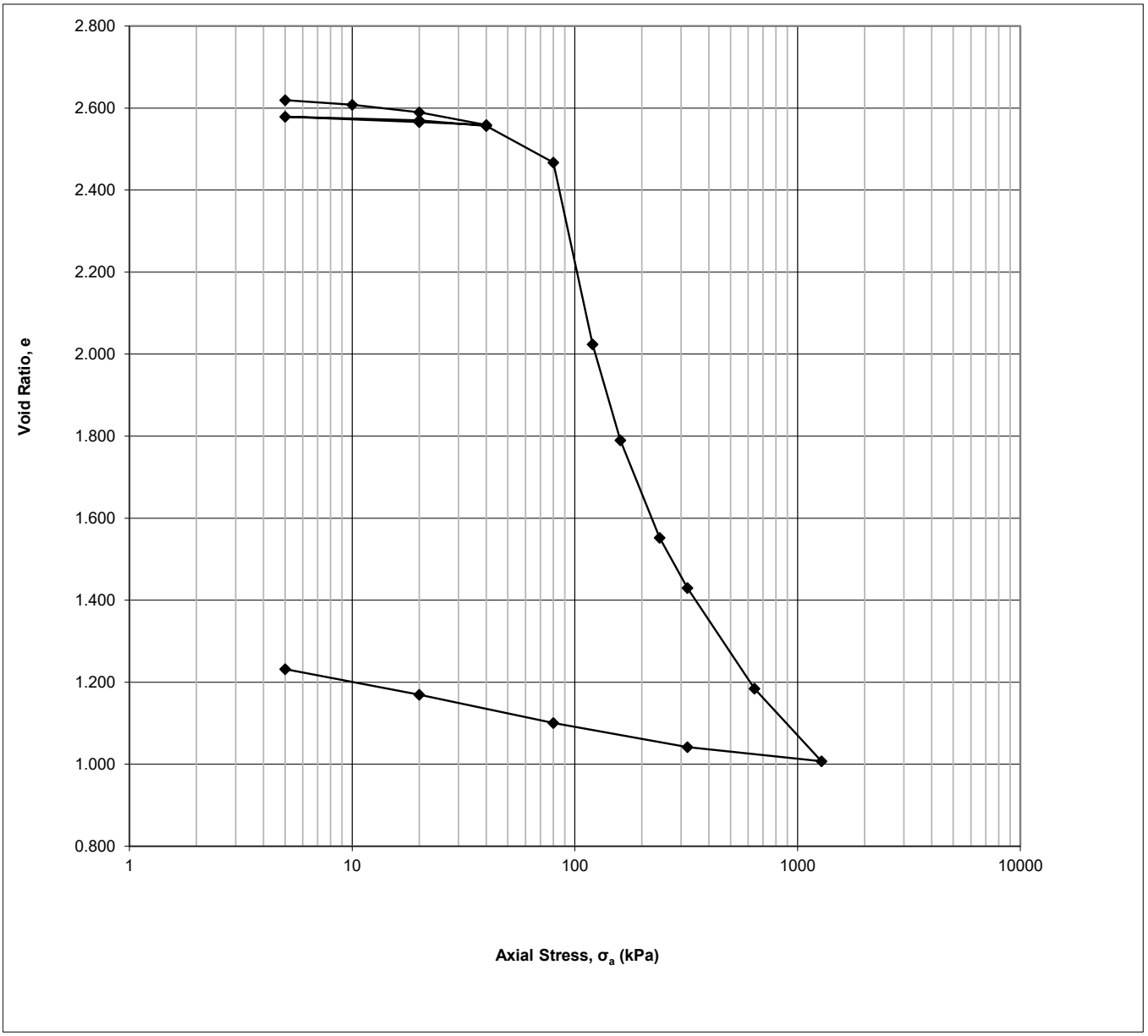
Photo No.: 2	Borehole: BH22-18 ST-20	Depth: 7.32-7.93 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-21**
Sample No.	**ST-10**
Sample Depth	**5.49-6.10 m.**



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Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Checked by: D. Boateng Date: November 29, 2022

Approved by: R. Ghassemi Date: November 29, 2022

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole	BH22-21
Sample No.	ST-10
Depth	5.49-6.10 m.
Sample Date	September 17, 2022
Test Number	Four
Technician Name	Daniel Boateng

Soil Description & Classification

Silty clay, grey, friable, very wet

Specific Gravity of Solids		2.750
Average water content of trimmings	%	89.84

Additional Notes (information source, occurence and size of large isolated particles etc.)

Specific Gravity of Solids was Assumed

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	57.71
Dry Mass	g	29.67
Density	Mg/m^3	1.470
Dry Density	Mg/m^3	0.756
Water Content	%	94.51
Degree of Saturation	%	98.5
Height of Solids	mm	5.49
Initial Void Ratio		2.640

Final Specimen Conditions

Water Content	%	47.42
Final Void Ratio		1.232
Final Height	mm	12.21

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consolidator
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date:

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-21
No. Depth	ST-10
Sample Date Test	5.49-6.10 m.
Number	September 17, 2022
Technician Name	Four
	Daniel Boateng

Test Procedure

Date Started		November 14, 2022
Date Finished		November 15, 2022
Machine Number		Frame F
Cell Number		F
Ring Number		F
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration	Axial Stress σ_a	Corrected Deformation ΔH	Specimen Height H	Axial Strain ε_a	Void Ratio e
	min	kPa	mm	mm	%	
Seating	0.0	0	0.0000	20.0000	0.00	2.640
1	20.0	5	0.1114	19.8886	0.56	2.619
2	20.0	10	0.1667	19.8333	0.87	2.608
3	20.0	20	0.2630	19.7370	1.38	2.590
4	20.0	40	0.4246	19.5754	2.22	2.559
5	20.0	20	0.4064	19.5936	2.04	2.566
6	20.0	5	0.3349	19.6651	1.67	2.579
7	20.0	20	0.3812	19.6188	1.91	2.570
8	20.0	40	0.4519	19.5481	2.30	2.556
9	61.5	80	0.7850	19.2150	4.74	2.467
10	225.5	120	3.0953	16.9047	16.92	2.024
11	139.0	160	4.6436	15.3564	23.36	1.790
12	94.0	240	5.8275	14.1725	29.88	1.552
13	72.3	320	6.5793	13.4207	33.24	1.430
14	60.5	640	7.8044	12.1956	39.98	1.185
15	48.8	1280	8.8226	11.1774	44.85	1.007
16	20.0	320	8.7771	11.2229	43.90	1.042
17	32.0	80	8.4565	11.5435	42.29	1.101
18	52.3	20	8.0866	11.9134	40.39	1.170
19	65.8	5	7.7495	12.2505	38.67	1.232

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5Billy Diamond\Consoli Date: November 29, 2022

Checked by: D. Boateng Date: November 29, 2022

Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

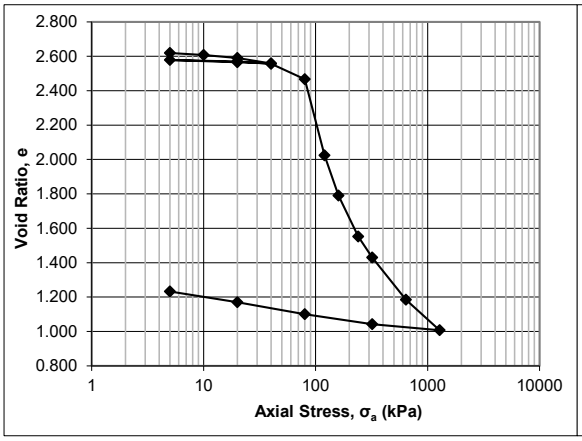
ASTM D2435/D2435M - 11(2020)

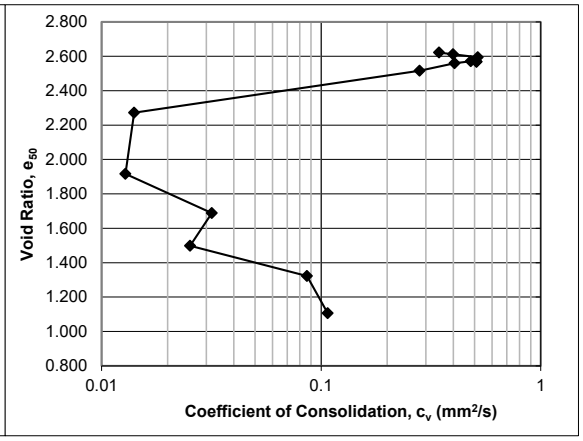
Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-21
No. Depth	ST-10
Sample Date Test	5.49-6.10 m.
Number	September 17, 2022
Technician Name	Four
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.1009	19.8991	0.50	2.621			244	3.45E-01
2	8	0.1564	19.8436	0.78	2.611			209	3.99E-01
3	15	0.2448	19.7552	1.22	2.595			160	5.17E-01
4	30	0.3923	19.6077	1.96	2.568			160	5.10E-01
5	30	0.4113	19.5887	2.06	2.565				
6	13	0.3495	19.6505	1.75	2.576				
7	13	0.3761	19.6239	1.88	2.571			170	4.80E-01
8	30	0.4435	19.5565	2.22	2.559			200	4.05E-01
9	60	0.6828	19.3172	3.41	2.516			281	2.81E-01
10	100	2.0170	17.9830	10.08	2.273			4877	1.41E-02
11	140	3.9768	16.0232	19.88	1.916			4238	1.28E-02
12	200	5.2289	14.7711	26.14	1.688			1455	3.18E-02
13	280	6.2699	13.7301	31.35	1.499			1581	2.53E-02
14	480	7.2385	12.7615	36.19	1.322			401	8.62E-02
15	960	8.4265	11.5735	42.13	1.106			265	1.07E-01
16	800	8.8363	11.1637	44.18	1.032				
17	200	8.6027	11.3973	43.01	1.074				
18	50	8.2714	11.7286	41.36	1.134				
19	13	8.0052	12.0599	40.03	1.183				





Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

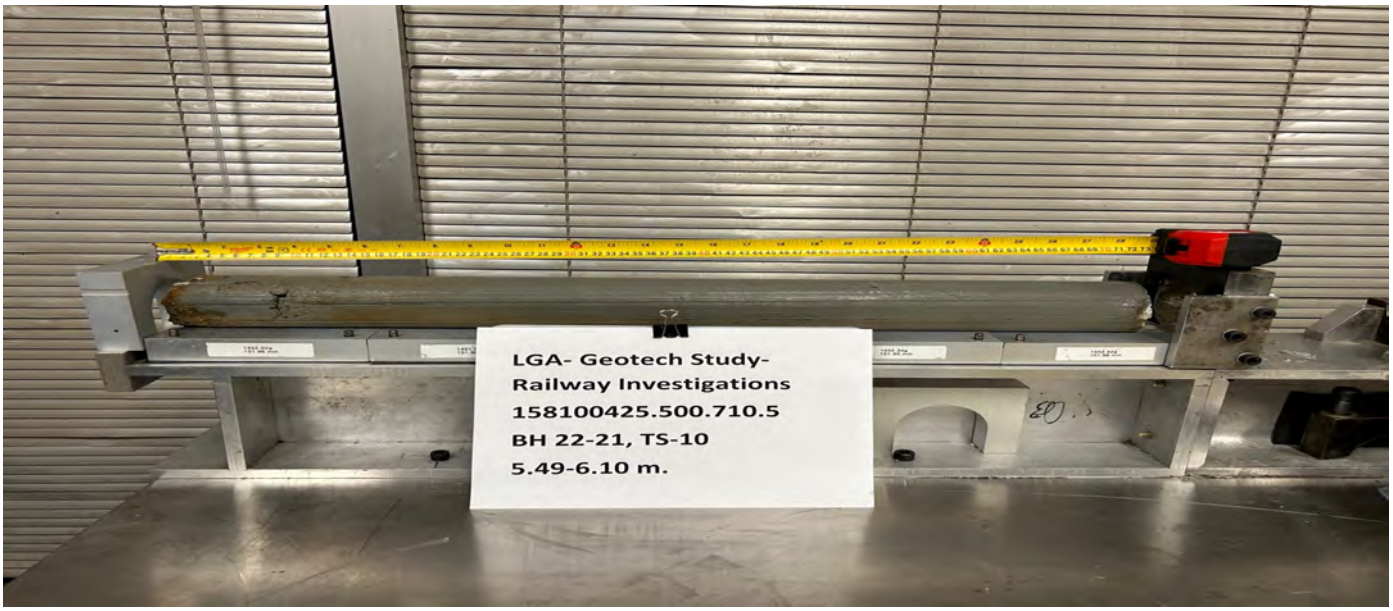


Photo No.: 1	Borehole: BH22-21 ST-10	Depth: 5.49-6.10 m



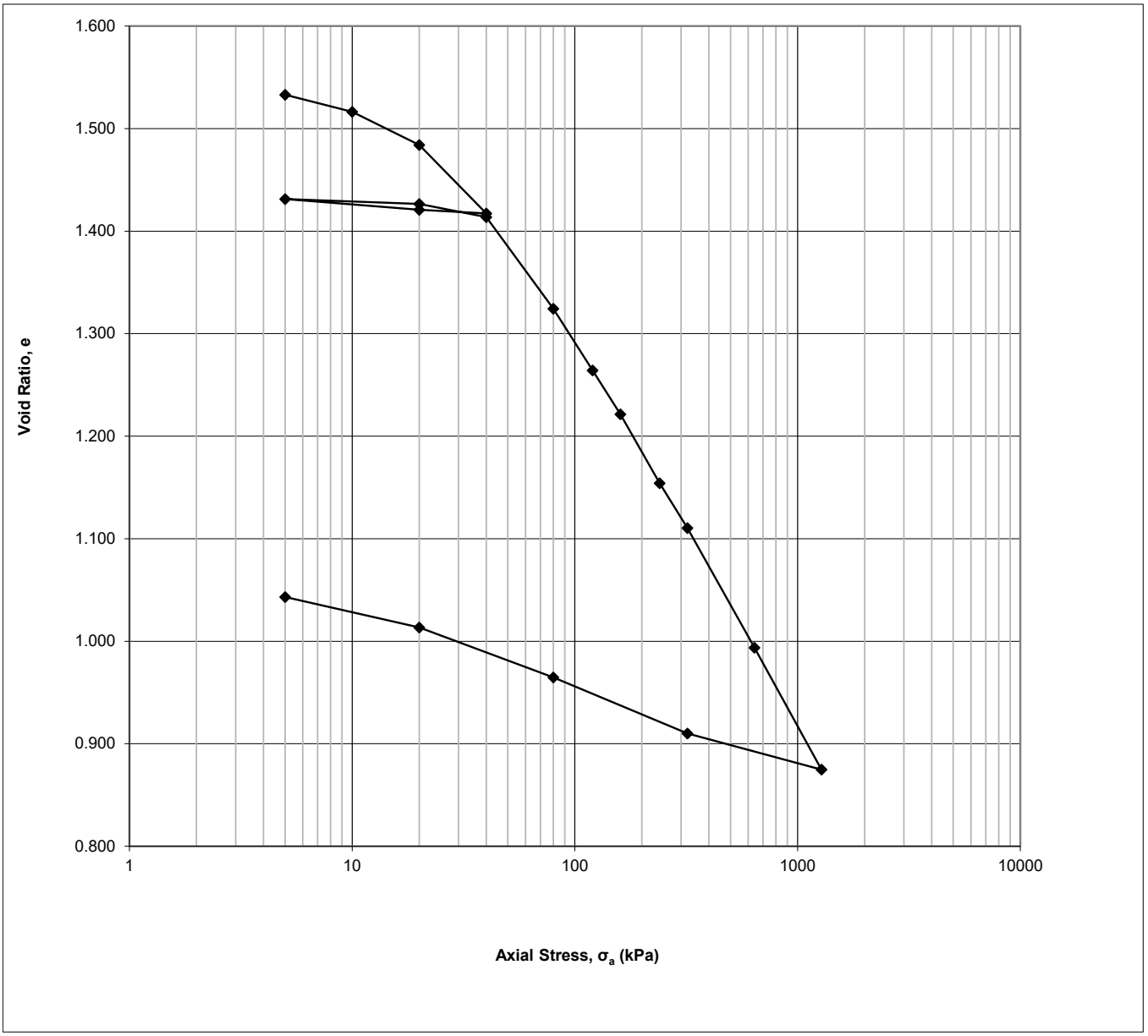
Photo No.: 2	Borehole: BH22-21 ST-10	Depth: 5.49-6.10 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-22**
Sample No.	**ST-05**
Sample Depth	**2.44-3.05 m**



Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample No.	BH22-22
Depth	ST-05
Sample Date Test Number	2.44-3.05 m
	November 3, 2022
	10
Technician Name	Daniel Boateng

Soil Description & Classification

Silty clay, brown/grey, friable, wet

Specific Gravity of Solids	2.750
Average water content of trimmings %	52.41

Additional Notes (information source, occurence and size of large isolated particles etc.)

Specific gravity of solids was assumed

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	66.27
Dry Mass	g	42.48
Density	Mg/m^3	1.688
Dry Density	Mg/m^3	1.082
Water Content	%	56.00
Degree of Saturation	%	99.9
Height of Solids	mm	7.87
Initial Void Ratio		1.542

Final Specimen Conditions

Water Content	%	42.04
Final Void Ratio		1.043
Final Height	mm	16.07

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab request Date: December 15, 2022

Checked by: D. Boateng Date: December 15, 2022

Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-22
No. Depth	ST-05
Sample Date Test	2.44-3.05 m
Number	November 3, 2022
Technician Name	10
	Daniel Boateng

Test Procedure

Date Started		December 2, 2022
Date Finished		December 3, 2022
Machine Number		Frame F
Cell Number		F
Ring Number		F
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	1.542
1	20.0	5	0.0692	19.9308	0.36	1.533
2	24.8	10	0.1608	19.8392	1.02	1.516
3	36.5	20	0.4030	19.5970	2.29	1.484
4	63.3	40	0.7870	19.2130	4.92	1.417
5	20.0	20	0.9556	19.0444	4.78	1.421
6	23.3	5	0.8728	19.1272	4.36	1.431
7	20.0	20	0.9048	19.0952	4.55	1.426
8	26.5	40	0.9978	19.0022	5.05	1.414
9	87.0	80	1.7174	18.2826	8.57	1.324
10	68.5	120	2.2120	17.7880	10.94	1.264
11	58.5	160	2.5429	17.4571	12.62	1.221
12	63.5	240	3.0290	16.9710	15.26	1.154
13	57.0	320	3.3987	16.6013	16.99	1.110
14	62.0	640	4.2524	15.7476	21.57	0.994
15	57.0	1280	5.1866	14.8134	26.25	0.875
16	26.8	320	4.9690	15.0310	24.87	0.910
17	53.8	80	4.5474	15.4526	22.72	0.965
18	75.8	20	4.1290	15.8710	20.80	1.013
19	74.0	5	4.1175	15.8825	19.63	1.043

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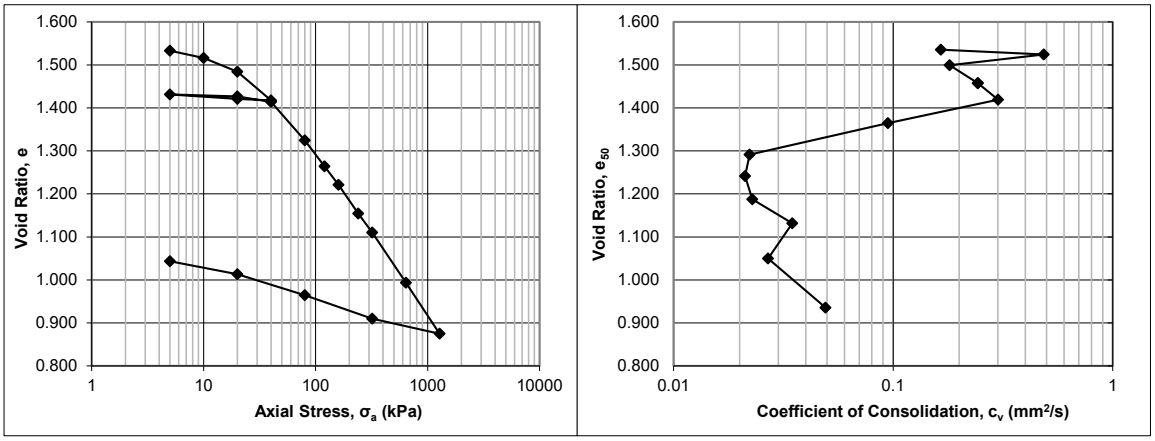
One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-22
No. Depth	ST-05
Sample Date Test	2.44-3.05 m
Number	November 3, 2022
Technician Name	10
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.0533	19.9467	0.27	1.535			511	1.65E-01
2	8	0.1393	19.8607	0.70	1.524			172	4.86E-01
3	15	0.3365	19.6635	1.68	1.499			453	1.81E-01
4	30	0.6686	19.3314	3.34	1.457			326	2.43E-01
5	30	0.9633	19.0367	4.82	1.420				
6	13	0.9037	19.0963	4.52	1.427				
7	13	0.8966	19.1034	4.48	1.428			258	3.00E-01
8	30	0.9683	19.0317	4.84	1.419			811	9.47E-02
9	60	1.3989	18.6011	6.99	1.364			3304	2.22E-02
10	100	1.9748	18.0252	9.87	1.291			3255	2.12E-02
11	140	2.3677	17.6323	11.84	1.241			2887	2.28E-02
12	200	2.7893	17.2107	13.95	1.188			1808	3.47E-02
13	280	3.2280	16.7720	16.14	1.132			2210	2.70E-02
14	480	3.8719	16.1281	19.36	1.050			1121	4.92E-02
15	960	4.7721	15.2279	23.86	0.936			908	5.42E-02
16	800	5.0819	14.9181	25.41	0.896			635	7.43E-02
17	200	4.7445	15.2555	23.72	0.939				
18	50	4.3340	15.6660	21.67	0.991				
19	13	4.1396	15.8604	20.70	1.016				



Filename: V:\01216\active\other_pc_projects\158100425.500.710.5Billy Diamond_Lab rec
Date: December 15, 2022
Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date: December 15, 2022

Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

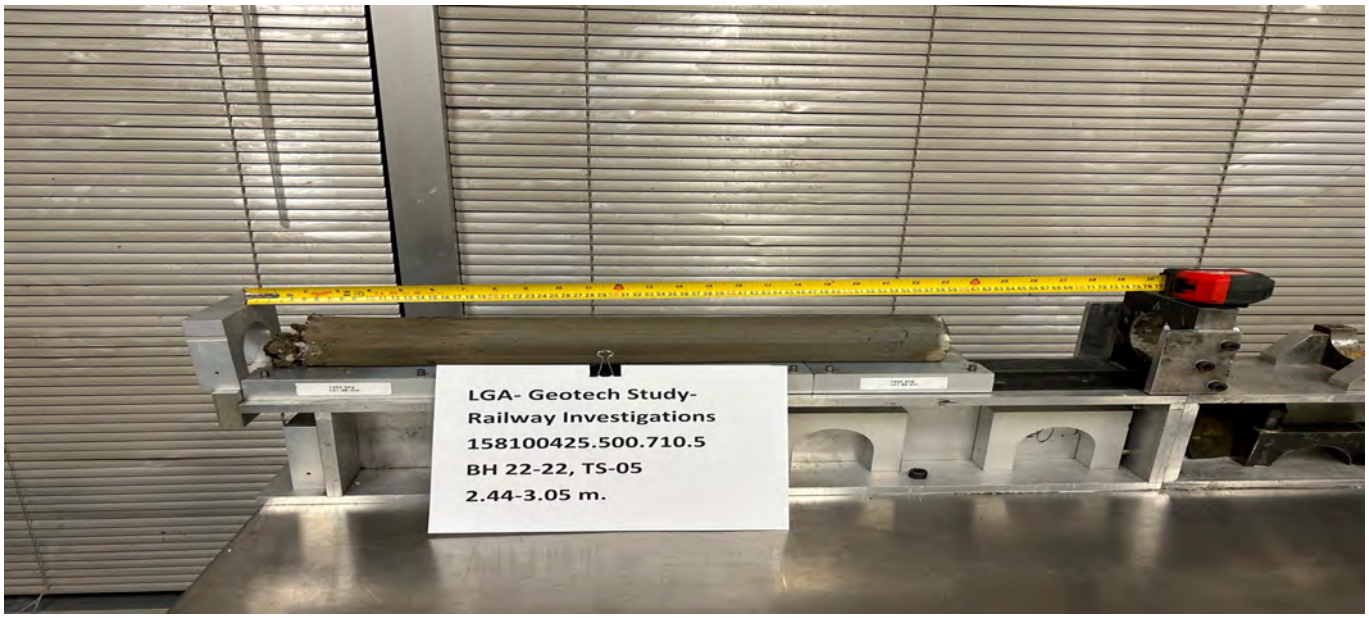


Photo No.: 1	Borehole: BH22-22 ST-05	Depth: 2.44-3.05 m



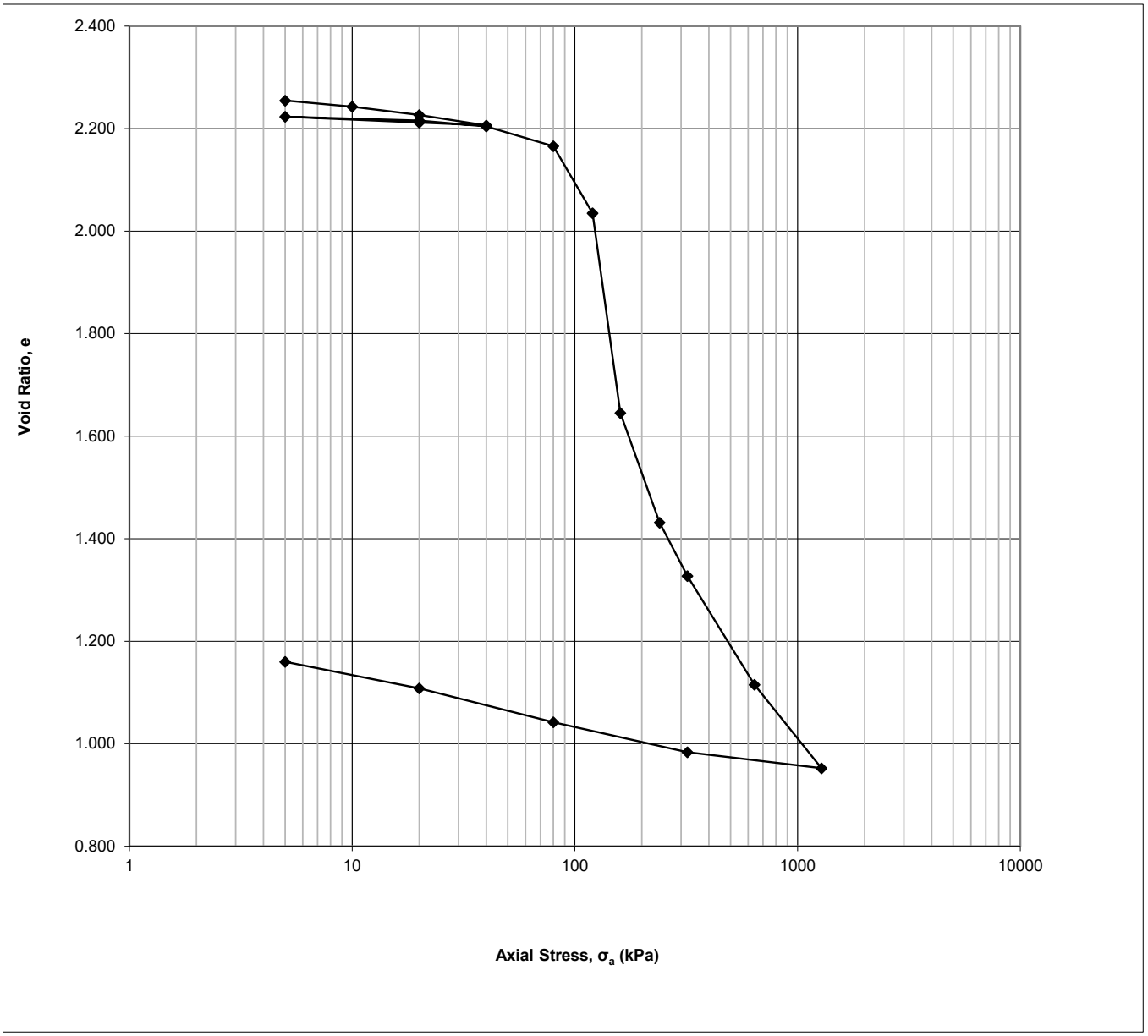
Photo No.: 2	Borehole: BH22-22 ST-05	Depth: 2.44-3.05 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-25**
Sample No.	**ST-22**
Sample Depth	**6.10-6.71 m.**



Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-25
No. Depth	ST-22
Sample Date Test	6.10-6.71 m.
Number	September 23, 2022
Technician Name	Five
	Daniel Boateng

Soil Description & Classification

Silty clay, grey, friable, very wet	
Specific Gravity of Solids	2.750
Average water content of trimmings %	80.90
Additional Notes (information source, occurence and size of large isolated particles etc.)	
Specific Gravity of Solids was Assumed	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	59.46
Dry Mass	g	32.66
Density	Mg/m^3	1.514
Dry Density	Mg/m^3	0.832
Water Content	%	82.06
Degree of Saturation	%	97.8
Height of Solids	mm	6.05
Initial Void Ratio		2.307

Final Specimen Conditions

Water Content	%	44.70
Final Void Ratio		1.160
Final Height	mm	13.06

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consolidator
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-25
No. Depth	ST-22
Sample Date Test	6.10-6.71 m.
Number	September 23, 2022
Technician Name	Five
	Daniel Boateng

Test Procedure

Date Started		November 15, 2022
Date Finished		November 16, 2022
Machine Number		Frame C
Cell Number		C
Ring Number		C
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration	Axial Stress σ_a	Corrected Deformation ΔH	Specimen Height H	Axial Strain ε_a	Void Ratio e
	min	kPa	mm	mm	%	
Seating	0.0	0	0.0000	20.0000	0.00	2.307
1	20.0	5	0.3114	19.6886	1.57	2.255
2	20.0	10	0.3793	19.6207	1.94	2.242
3	20.0	20	0.4747	19.5253	2.41	2.227
4	28.5	40	0.5934	19.4066	3.04	2.206
5	20.0	20	0.5745	19.4255	2.87	2.212
6	20.0	5	0.5043	19.4957	2.52	2.223
7	20.0	20	0.5489	19.4511	2.75	2.215
8	20.0	40	0.6129	19.3871	3.09	2.204
9	43.5	80	0.7998	19.2002	4.26	2.166
10	142.3	120	1.4843	18.5157	8.21	2.035
11	325.0	160	3.9638	16.0362	20.01	1.645
12	174.8	240	5.0238	14.9762	26.47	1.431
13	129.8	320	5.8115	14.1885	29.63	1.327
14	102.8	640	6.9744	13.0256	36.04	1.115
15	79.3	1280	8.0234	11.9766	40.96	0.952
16	25.3	320	7.9958	12.0042	40.02	0.983
17	42.0	80	7.6419	12.3581	38.24	1.042
18	77.8	20	7.2588	12.7412	36.25	1.108
19	98.3	5	6.9278	13.0722	34.69	1.160

Stantec

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consoli
Date: November 29, 2022
Checked by: D. Boateng Date: November 29, 2022
Approved by: R. Ghassemi Date: November 29, 2022

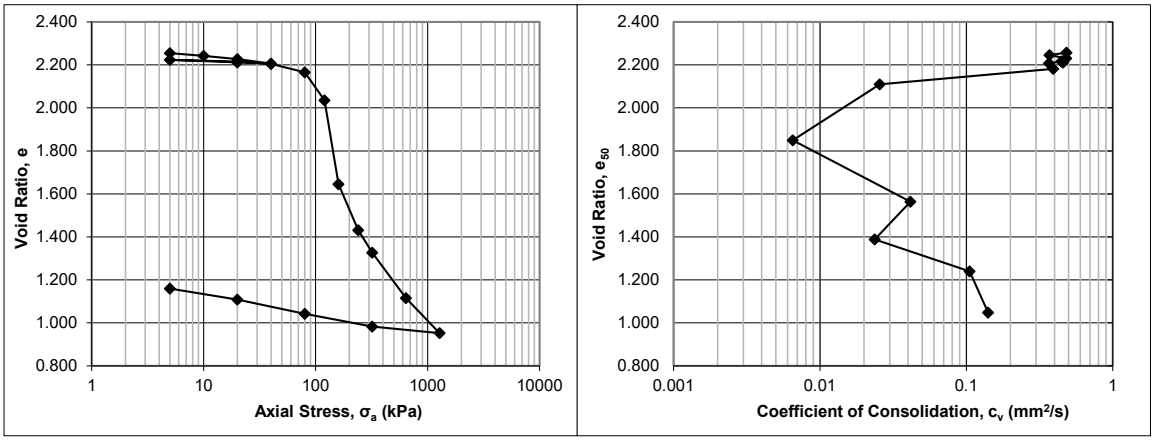
One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-25
No. Depth	ST-22
Sample Date Test	6.10-6.71 m.
Number	September 23, 2022
Technician Name	Five
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.2971	19.7029	1.49	2.257			170	4.84E-01
2	8	0.3672	19.6328	1.84	2.246			221	3.70E-01
3	15	0.4573	19.5427	2.29	2.231			168	4.81E-01
4	30	0.5719	19.4281	2.86	2.212			175	4.58E-01
5	30	0.5805	19.4195	2.90	2.211				
6	13	0.5225	19.4775	2.61	2.220				
7	13	0.5423	19.4577	2.71	2.217			180	4.47E-01
8	30	0.6036	19.3964	3.02	2.207			217	3.67E-01
9	60	0.7549	19.2451	3.77	2.182			200	3.92E-01
10	100	1.1924	18.8076	5.96	2.109			2928	2.56E-02
11	140	2.7677	17.2323	13.84	1.849			9655	6.52E-03
12	200	4.4963	15.5037	22.48	1.563			1226	4.15E-02
13	280	5.5512	14.4488	27.76	1.389			1871	2.37E-02
14	480	6.4546	13.5454	32.27	1.239			369	1.05E-01
15	960	7.6128	12.3872	38.06	1.048			231	1.41E-01
16	800	8.0622	11.9378	40.31	0.974				
17	200	7.8006	12.1994	39.00	1.017				
18	50	7.4461	12.5539	37.23	1.076				
19	13	7.0885	12.9115	35.44	1.135				



Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

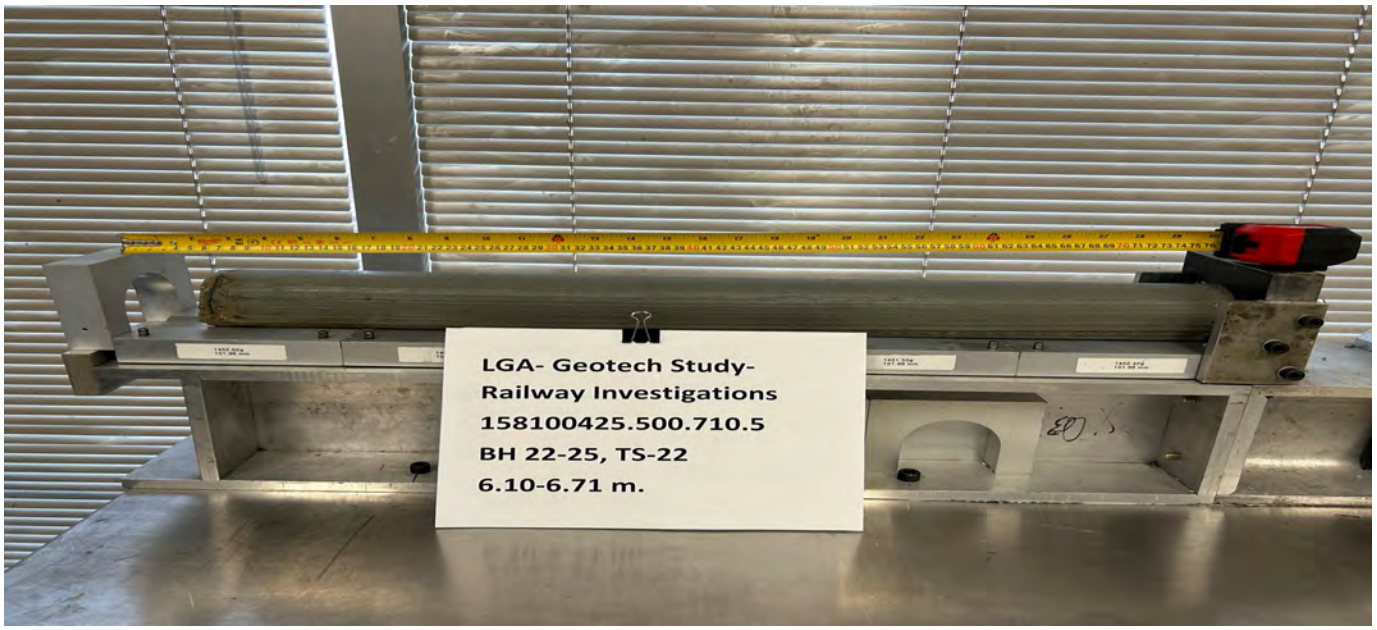


Photo No.: 1	Borehole: BH22-25 ST-22	Depth: 6.10-6.71 m

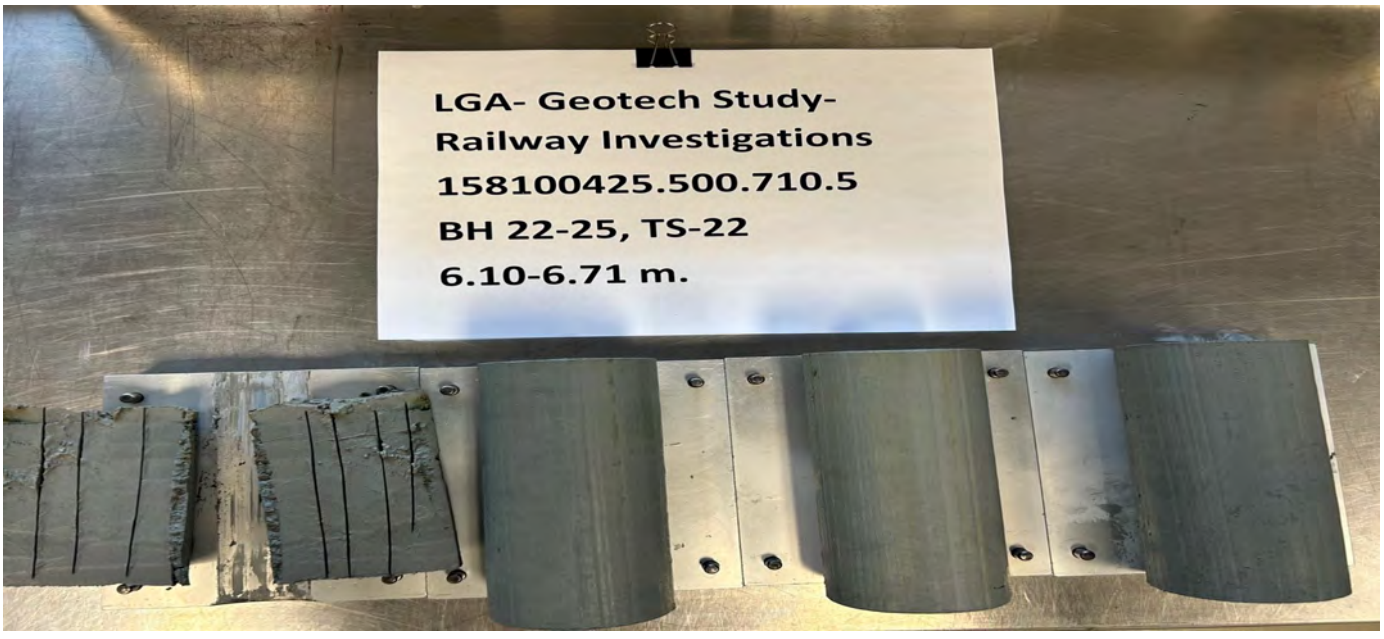


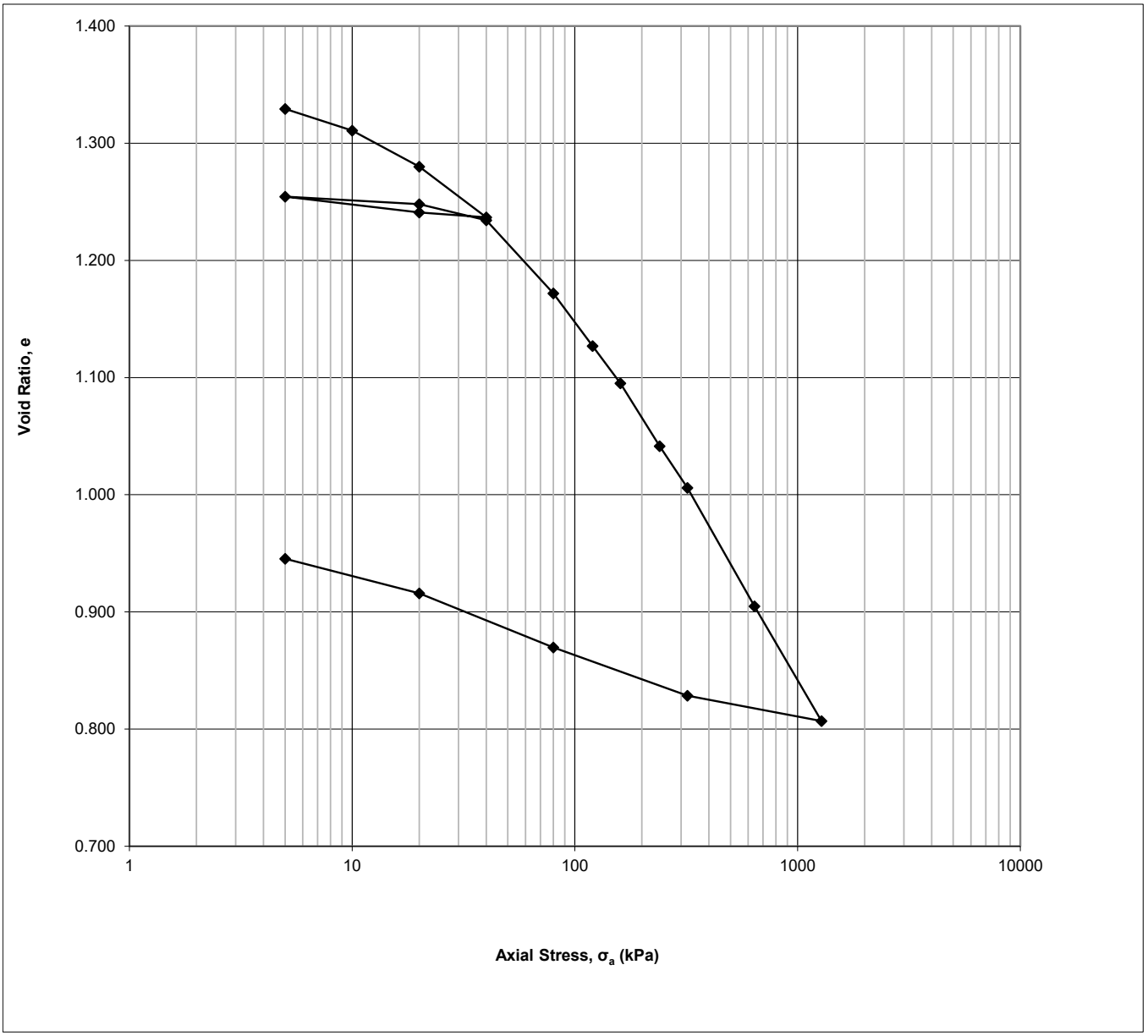
Photo No.: 2	Borehole: BH22-25 ST-22	Depth: 6.10-6.71 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-28**
Sample No.	**ST-06**
Sample Depth	**3.05-3.66 m**



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Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Checked by: D. Boateng Date: December 15, 2022

Approved by: R. Ghassemi Date: December 15, 2022

Specimen Details

Project Name	LGA Geotechnical Study-Railway Investigations
Project Location	Quebec, Canada-(Billy Diamond Site)
Borehole	BH22-28
Sample No.	ST-06
Depth	3.05-3.66 m
Sample Date	November 4, 2022
Test Number	11
Technician Name	Daniel Boateng

Soil Description & Classification

Silty clay, brown/grey, friable/desiccated, very moist	
Specific Gravity of Solids	2.750
Average water content of trimmings %	46.65
Additional Notes (information source, occurence and size of large isolated particles etc.)	
Specific gravity of solids was assumed	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	67.22
Dry Mass	g	45.64
Density	Mg/m^3	1.712
Dry Density	Mg/m^3	1.162
Water Content	%	47.28
Degree of Saturation	%	95.2
Height of Solids	mm	8.45
Initial Void Ratio		1.366

Final Specimen Conditions

Water Content	%	36.79
Final Void Ratio		0.945
Final Height	mm	16.44

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab request Date: December 15, 2022

Checked by: D. Boateng Date: December 15, 2022

Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-28
No. Depth	ST-06
Sample Date Test	3.05-3.66 m
Number	November 4, 2022
Technician Name	11
	Daniel Boateng

Test Procedure

Date Started		December 5, 2022
Date Finished		December 6, 2022
Machine Number		Frame C
Cell Number		C
Ring Number		C
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	1.366
1	26.5	5	0.2584	19.7416	1.56	1.329
2	38.0	10	0.4529	19.5471	2.35	1.311
3	59.8	20	0.6897	19.3103	3.64	1.280
4	74.8	40	1.0123	18.9877	5.47	1.237
5	21.5	20	1.0587	18.9413	5.29	1.241
6	41.5	5	0.9483	19.0517	4.72	1.254
7	23.3	20	0.9899	19.0101	5.00	1.248
8	35.0	40	1.0933	18.9067	5.58	1.234
9	78.5	80	1.4890	18.5110	8.22	1.172
10	80.3	120	1.9642	18.0358	10.11	1.127
11	82.0	160	2.2585	17.7415	11.45	1.095
12	82.3	240	2.6682	17.3318	13.72	1.041
13	84.0	320	2.9848	17.0152	15.22	1.006
14	82.3	640	3.7984	16.2016	19.50	0.905
15	75.5	1280	4.6173	15.3827	23.64	0.807
16	25.0	320	4.5400	15.4600	22.72	0.829
17	53.8	80	4.1968	15.8032	20.99	0.870
18	97.8	20	3.8151	16.1849	19.03	0.916
19	99.8	5	3.7628	16.2372	17.78	0.945

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5Billy Diamond_Lab rec Date: December 15, 2022
Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date: December 15, 2022

One-Dimensional Consolidation Test using Incremental Loading

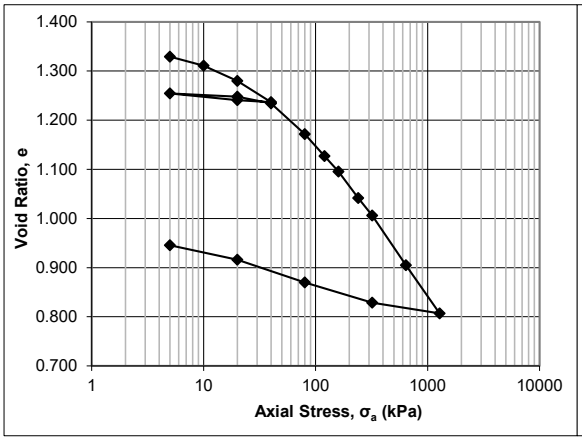
ASTM D2435/D2435M - 11(2020)

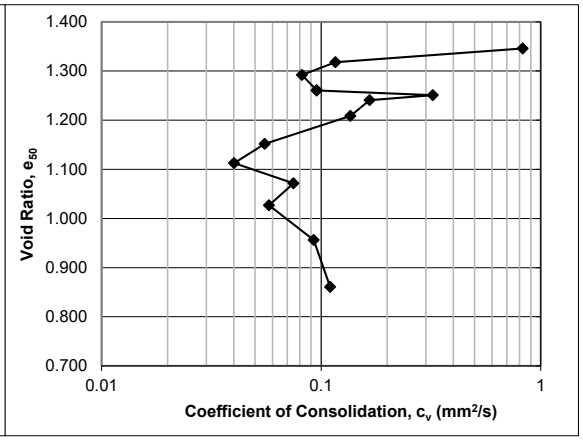
Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-28
No. Depth	ST-06
Sample Date Test	3.05-3.66 m
Number	November 4, 2022
Technician Name	11
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.1706	19.8294	0.85	1.346			101	8.29E-01
2	8	0.4078	19.5922	2.04	1.318			701	1.16E-01
3	15	0.6262	19.3738	3.13	1.292			972	8.18E-02
4	30	0.8928	19.1072	4.46	1.261			810	9.56E-02
5	30	1.0703	18.9297	5.35	1.240				
6	13	0.9933	19.0067	4.97	1.249				
7	13	0.9761	19.0239	4.88	1.251			238	3.23E-01
8	30	1.0604	18.9396	5.30	1.241			457	1.66E-01
9	60	1.3303	18.6697	6.65	1.209			544	1.36E-01
10	100	1.8140	18.1860	9.07	1.152			1265	5.54E-02
11	140	2.1446	17.8554	10.72	1.112			1683	4.02E-02
12	200	2.4908	17.5092	12.45	1.071			867	7.49E-02
13	280	2.8674	17.1326	14.34	1.027			1074	5.79E-02
14	480	3.4655	16.5345	17.33	0.956			626	9.25E-02
15	960	4.2750	15.7250	21.38	0.860			477	1.10E-01
16	800	4.6031	15.3969	23.02	0.822				
17	200	4.3595	15.6405	21.80	0.850				
18	50	3.9987	16.0013	19.99	0.893				
19	13	3.7819	16.2181	18.91	0.919				





Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

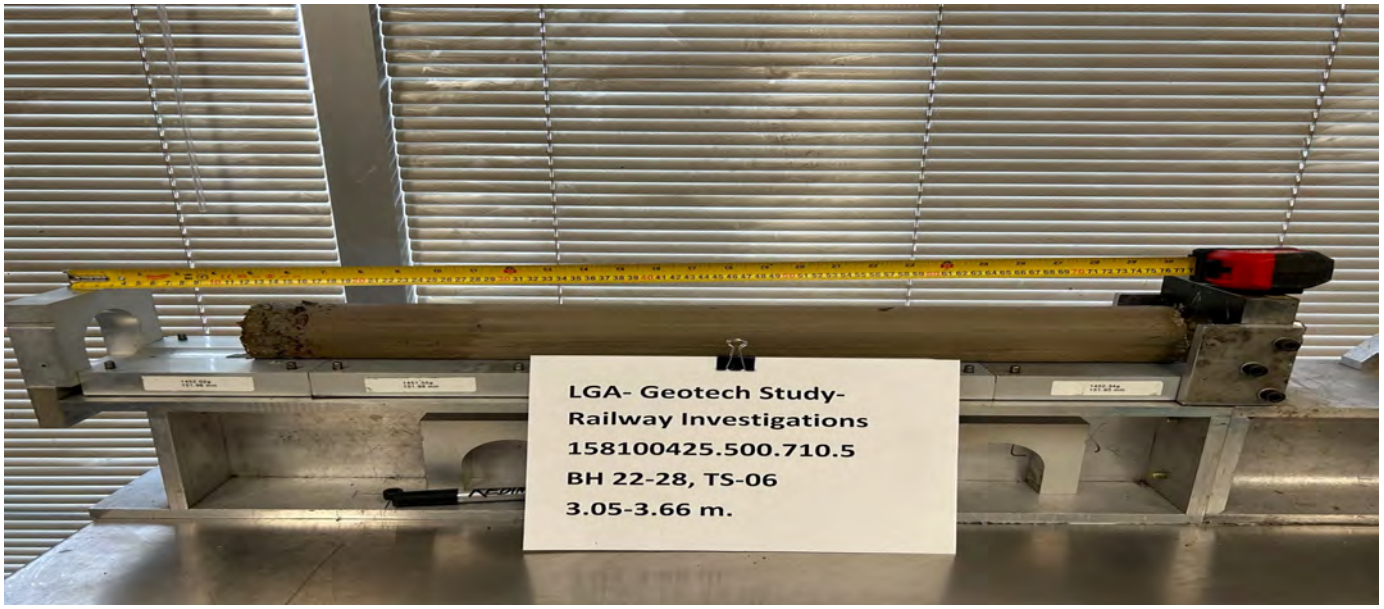


Photo No.: 1	Borehole: BH22-22 ST-06	Depth: 3.05-3.66 m



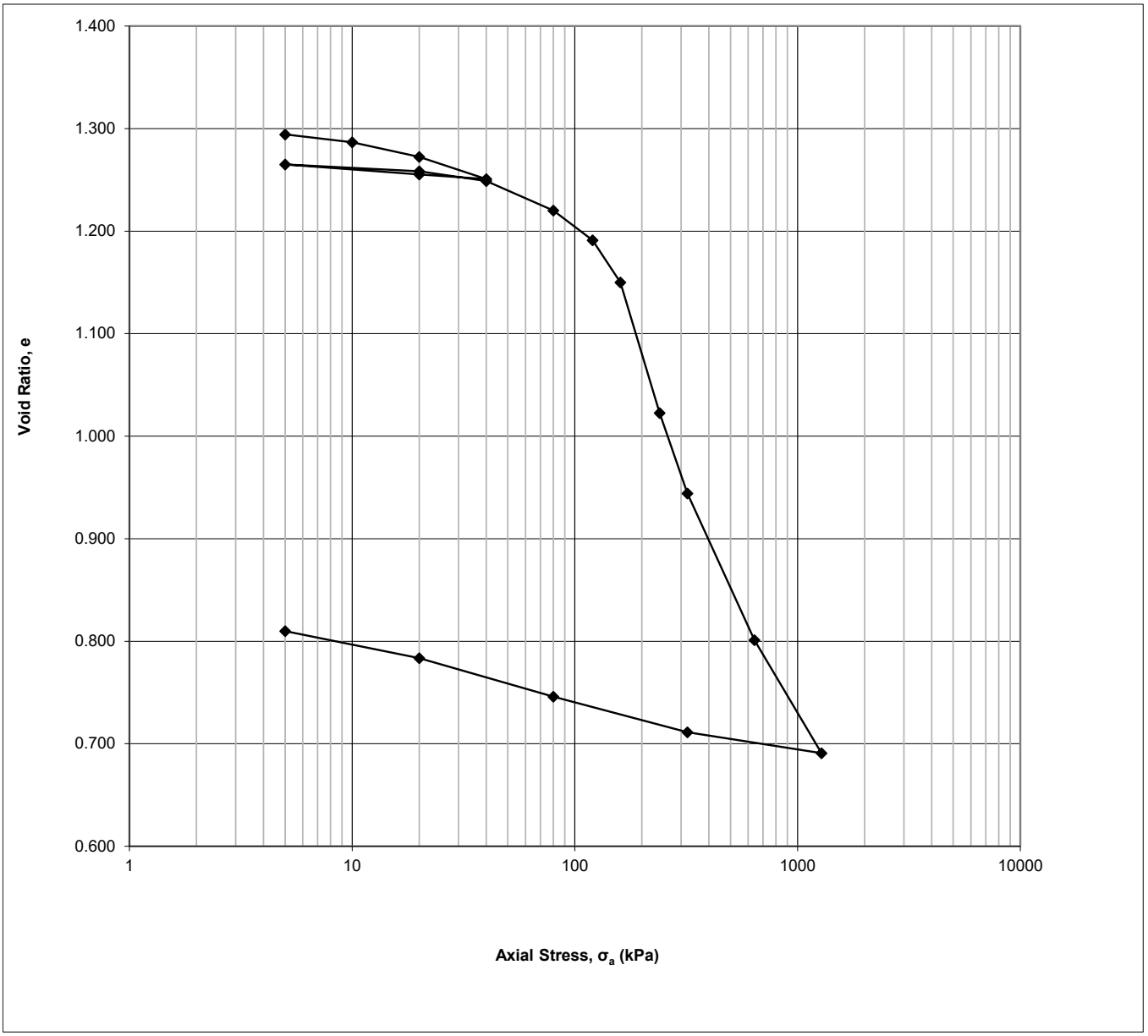
Photo No.: 2	Borehole: BH22-22 ST-06	Depth: 3.05-3.66 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I** **Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-30**
Sample No.	**ST-07**
Sample Depth	**3.66-4.27 m**



Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-30
No. Depth	ST-07
Sample Date Test	3.66-4.27 m
Number	Thursday, October 6, 2022
Technician Name	Eight
	Daniel Boateng

Soil Description & Classification

Silty clay, dark grey, trace gravel, moist	
Specific Gravity of Solids	2.750
Average water content of trimmings %	45.98
Additional Notes (information source, occurence and size of large isolated particles etc.)	
Specific gravity of solids was assumed	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	68.84
Dry Mass	g	46.77
Density	Mg/m^3	1.753
Dry Density	Mg/m^3	1.191
Water Content	%	47.19
Degree of Saturation	%	99.1
Height of Solids	mm	8.66
Initial Void Ratio		1.309

Final Specimen Conditions

Water Content	%	31.20
Final Void Ratio		0.810
Final Height	mm	15.68

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab request Date: December 15, 2022

Checked by: D. Boateng Date: December 15, 2022

Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-30
No. Depth	ST-07
Sample Date Test	3.66-4.27 m
Number	Thursday, October 6, 2022
Technician Name	Eight
	Daniel Boateng

Test Procedure

Date Started		December 2, 2022
Date Finished		December 3, 2022
Machine Number		Frame D
Cell Number		D
Ring Number		D
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	1.309
1	20.0	5	0.1206	19.8794	0.64	1.294
2	21.5	10	0.1853	19.8147	0.97	1.287
3	29.8	20	0.2905	19.7095	1.58	1.272
4	31.8	40	0.4693	19.5307	2.52	1.251
5	20.0	20	0.4641	19.5359	2.32	1.255
6	21.5	5	0.3817	19.6183	1.91	1.265
7	20.0	20	0.4339	19.5661	2.20	1.258
8	21.5	40	0.5088	19.4912	2.61	1.249
9	46.5	80	0.7142	19.2858	3.85	1.220
10	66.8	120	0.9431	19.0569	5.11	1.191
11	123.8	160	1.2699	18.7301	6.88	1.150
12	206.5	240	2.3069	17.6931	12.41	1.022
13	143.0	320	3.1101	16.8899	15.81	0.944
14	119.5	640	4.2198	15.7802	22.00	0.801
15	80.8	1280	5.2162	14.7838	26.77	0.691
16	23.5	320	5.1726	14.8274	25.88	0.711
17	47.0	80	4.8728	15.1272	24.38	0.746
18	77.8	20	4.5616	15.4384	22.76	0.783
19	89.5	5	4.5396	15.4604	21.61	0.810

Stantec

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab rec Date: December 15, 2022 | Checked by: D. Boateng Date: December 15, 2022 | Approved by: R. Ghassemi Date: December 15, 2022

One-Dimensional Consolidation Test using Incremental Loading

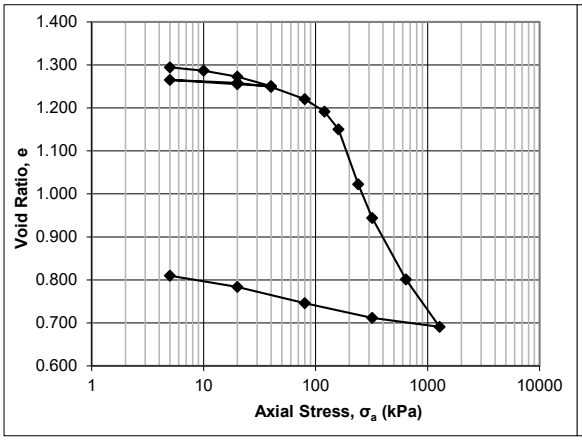
ASTM D2435/D2435M - 11(2020)

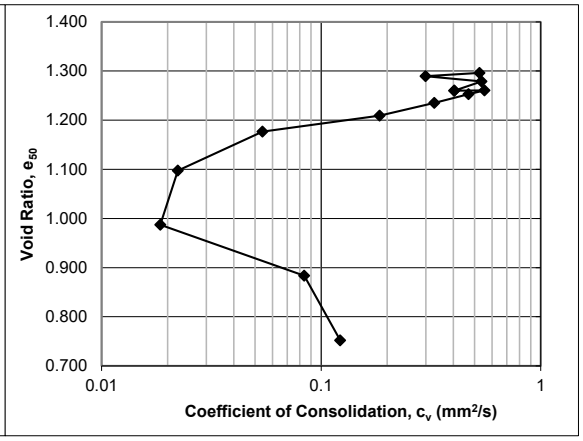
Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-30
No. Depth	ST-07
Sample Date Test	3.66-4.27 m
Number	Thursday, October 6, 2022
Technician Name	Eight
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.1103	19.8897	0.55	1.296			159	5.27E-01
2	8	0.1704	19.8296	0.85	1.289			279	2.99E-01
3	15	0.2628	19.7372	1.31	1.279			154	5.37E-01
4	30	0.4233	19.5767	2.12	1.260			201	4.04E-01
5	30	0.4746	19.5254	2.37	1.254				
6	13	0.4100	19.5900	2.05	1.262				
7	13	0.4209	19.5791	2.10	1.260			146	5.56E-01
8	30	0.4869	19.5131	2.43	1.253			172	4.69E-01
9	60	0.6385	19.3615	3.19	1.235			242	3.28E-01
10	100	0.8627	19.1373	4.31	1.209			420	1.85E-01
11	140	1.1464	18.8536	5.73	1.177			1394	5.41E-02
12	200	1.8342	18.1658	9.17	1.097			3145	2.22E-02
13	280	2.7864	17.2136	13.93	0.987			3395	1.85E-02
14	480	3.6875	16.3125	18.44	0.883			674	8.38E-02
15	960	4.8235	15.1765	24.12	0.752			400	1.22E-01
16	800	5.2263	14.7737	26.13	0.706				
17	200	5.0033	14.9967	25.02	0.731				
18	50	4.7106	15.2894	23.55	0.765				
19	13	4.5441	15.4559	22.72	0.784				





Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

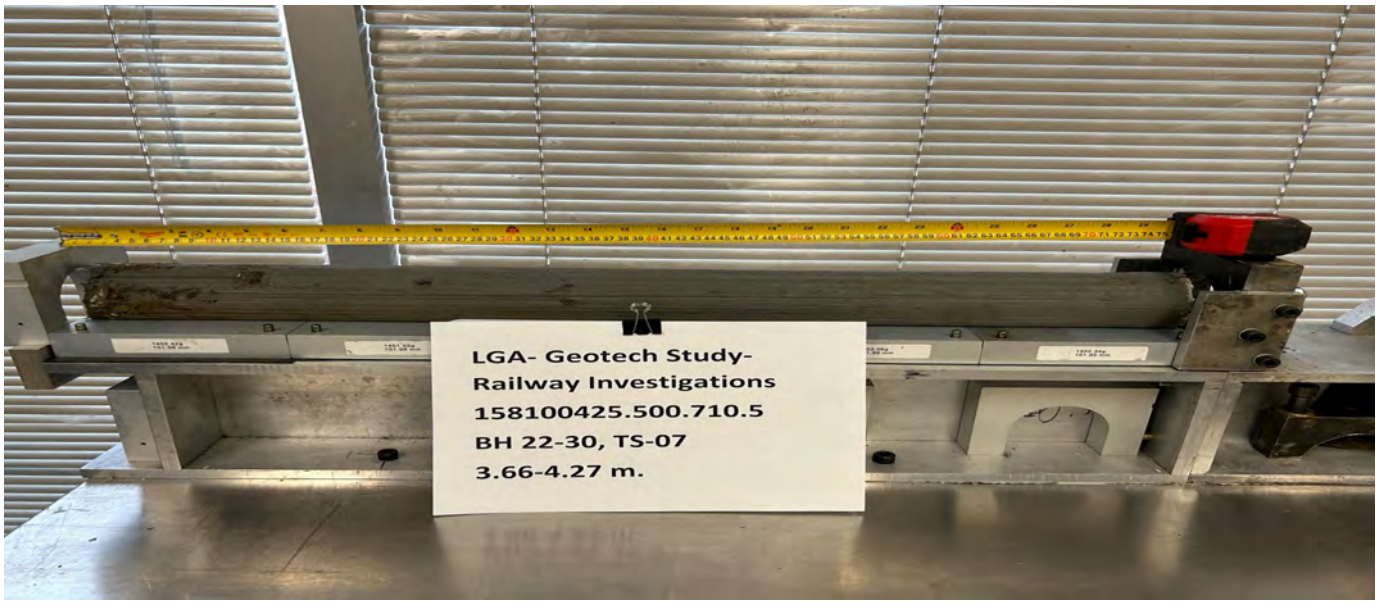


Photo No.: 1	Borehole: BH22-30 ST-07	Depth: 3.66-4.27 m



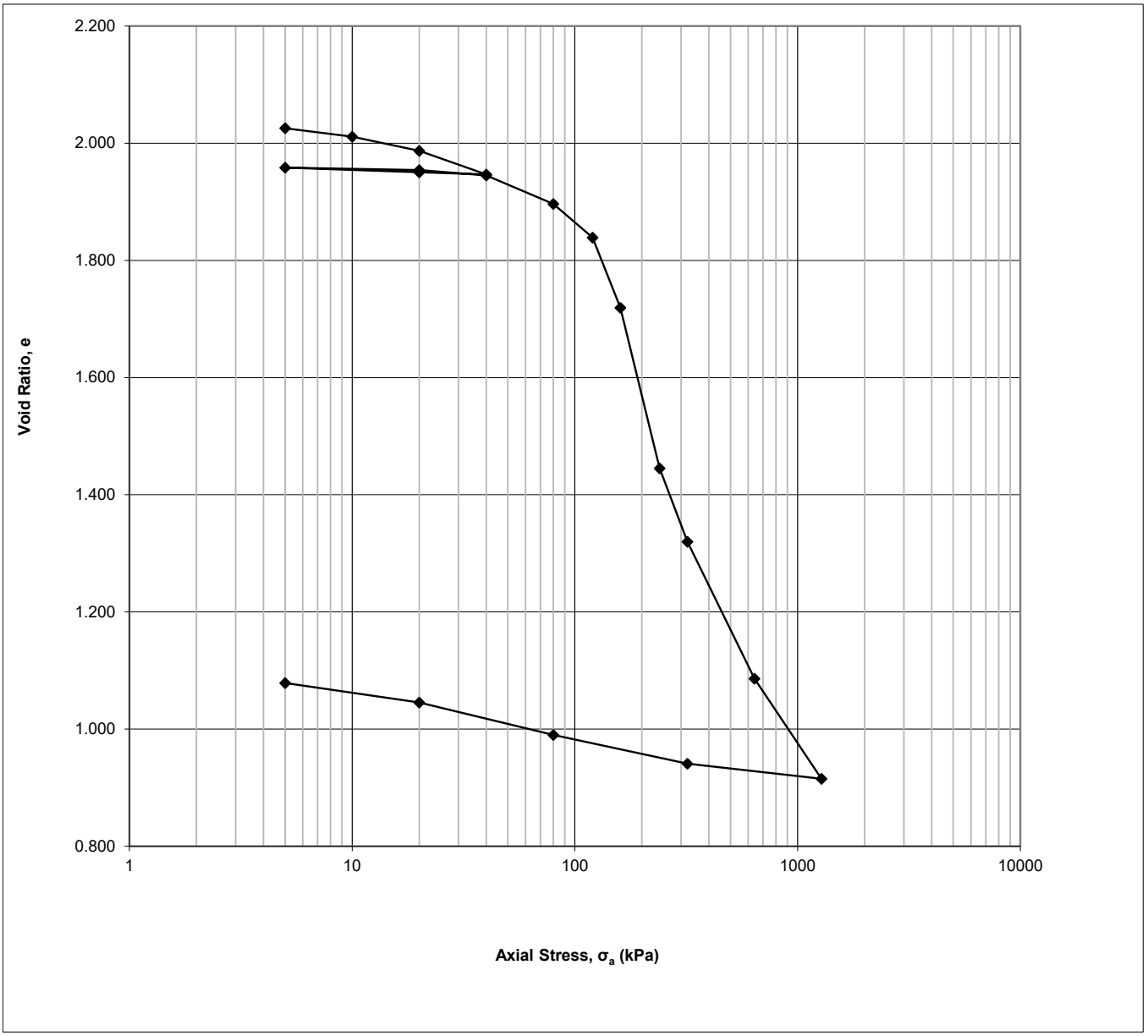
Photo No.: 2	Borehole: BH22-30 ST-07	Depth: 3.66-4.27 m

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-34**
Sample No.	**ST-05**
Sample Depth	**2.44-3.05 m**



Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date: December 15, 2022

Stantec Consulting Ltd.

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample No.	BH22-34
Depth	ST-05
Sample Date Test	2.44-3.05 m
Number	October 14, 2022
Technician Name	Nine
	Daniel Boateng

Soil Description & Classification

Silty clay, brown/grey, friable/desiccated, wet

Specific Gravity of Solids		2.750
Average water content of trimmings	%	67.98

Additional Notes (information source, occurence and size of large isolated particles etc.)

Specific gravity of solids was assumed

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	61.74
Dry Mass	g	35.60
Density	Mg/m^3	1.572
Dry Density	Mg/m^3	0.907
Water Content	%	73.43
Degree of Saturation	%	99.3
Height of Solids	mm	6.59
Initial Void Ratio		2.033

Final Specimen Conditions

Water Content	%	42.84
Final Void Ratio		1.079
Final Height	mm	13.70

Stantec

Stantec Consulting Ltd.

Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond_Lab request: December 15, 2022
Date: December 15, 2022
Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date:

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-34
No. Depth	ST-05
Sample Date Test	2.44-3.05 m
Number	October 14, 2022
Technician Name	Nine
	Daniel Boateng

Test Procedure

Date Started		December 2, 2022
Date Finished		December 3, 2022
Machine Number		Frame E
Cell Number		E
Ring Number		E
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	2.033
1	20.0	5	0.0517	19.9483	0.26	2.026
2	23.3	10	0.1376	19.8624	0.74	2.011
3	26.5	20	0.2899	19.7101	1.53	1.987
4	33.3	40	0.5469	19.4531	2.86	1.947
5	20.0	20	0.5490	19.4510	2.74	1.950
6	20.0	5	0.4976	19.5024	2.48	1.958
7	20.0	20	0.5217	19.4783	2.62	1.954
8	21.5	40	0.5770	19.4230	2.92	1.945
9	56.8	80	0.8317	19.1683	4.52	1.896
10	73.5	120	1.1443	18.8557	6.41	1.839
11	154.3	160	1.8599	18.1401	10.36	1.719
12	186.5	240	3.8518	16.1482	19.40	1.445
13	151.5	320	4.6694	15.3306	23.53	1.320
14	102.8	640	6.0485	13.9515	31.23	1.086
15	82.5	1280	7.1978	12.8022	36.87	0.915
16	25.0	320	7.1962	12.8038	36.01	0.941
17	48.8	80	6.8779	13.1221	34.40	0.990
18	94.8	20	6.5256	13.4744	32.58	1.045
19	99.8	5	6.5043	13.4957	31.48	1.079

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5Billy Diamond_Lab rec Date: December 15, 2022
Checked by: D. Boateng Date: December 15, 2022
Approved by: R. Ghassemi Date: December 15, 2022

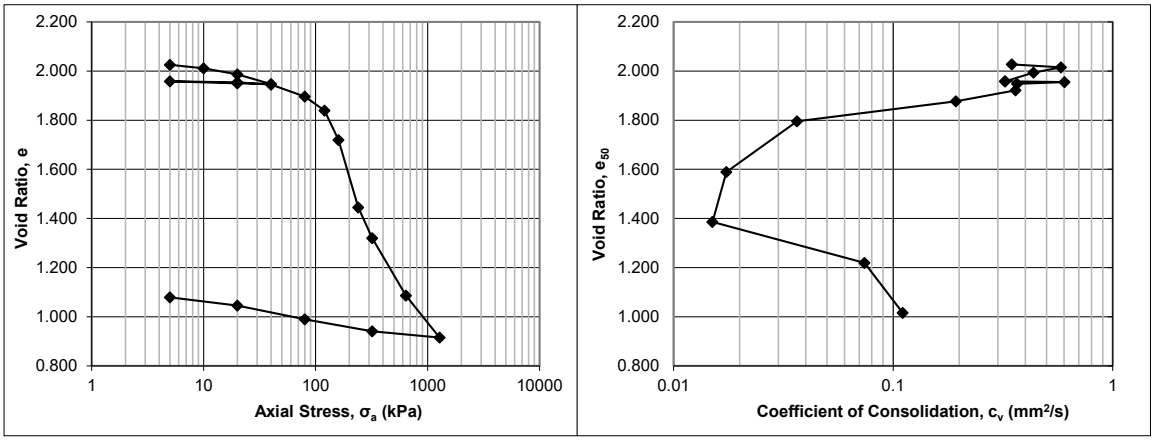
One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-34
No. Depth	ST-05
Sample Date Test	2.44-3.05 m
Number	October 14, 2022
Technician Name	Nine Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.0424	19.9576	0.21	2.027			243	3.48E-01
2	8	0.1237	19.8763	0.62	2.015			144	5.82E-01
3	15	0.2620	19.7380	1.31	1.994			189	4.36E-01
4	30	0.4969	19.5031	2.48	1.958			249	3.24E-01
5	30	0.5540	19.4460	2.77	1.949				
6	13	0.5129	19.4871	2.56	1.956				
7	13	0.5157	19.4843	2.58	1.955			133	6.03E-01
8	30	0.5657	19.4343	2.83	1.948			218	3.67E-01
9	60	0.7357	19.2643	3.68	1.922			218	3.61E-01
10	100	1.0333	18.9667	5.17	1.877			395	1.93E-01
11	140	1.5656	18.4344	7.83	1.796			1973	3.65E-02
12	200	2.9321	17.0679	14.66	1.589			3549	1.74E-02
13	280	4.2670	15.7330	21.33	1.386			3489	1.50E-02
14	480	5.3666	14.6334	26.83	1.220			612	7.41E-02
15	960	6.7085	13.2915	33.54	1.016			339	1.11E-01
16	800	7.2570	12.7430	36.28	0.933				
17	200	7.0217	12.9783	35.11	0.968				
18	50	6.6954	13.3046	33.48	1.018				
19	13	6.5083	13.4917	32.54	1.046				



Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log



Photo No.: 1	Borehole: BH22-34 ST-05	Depth: 2.44-3.05 m



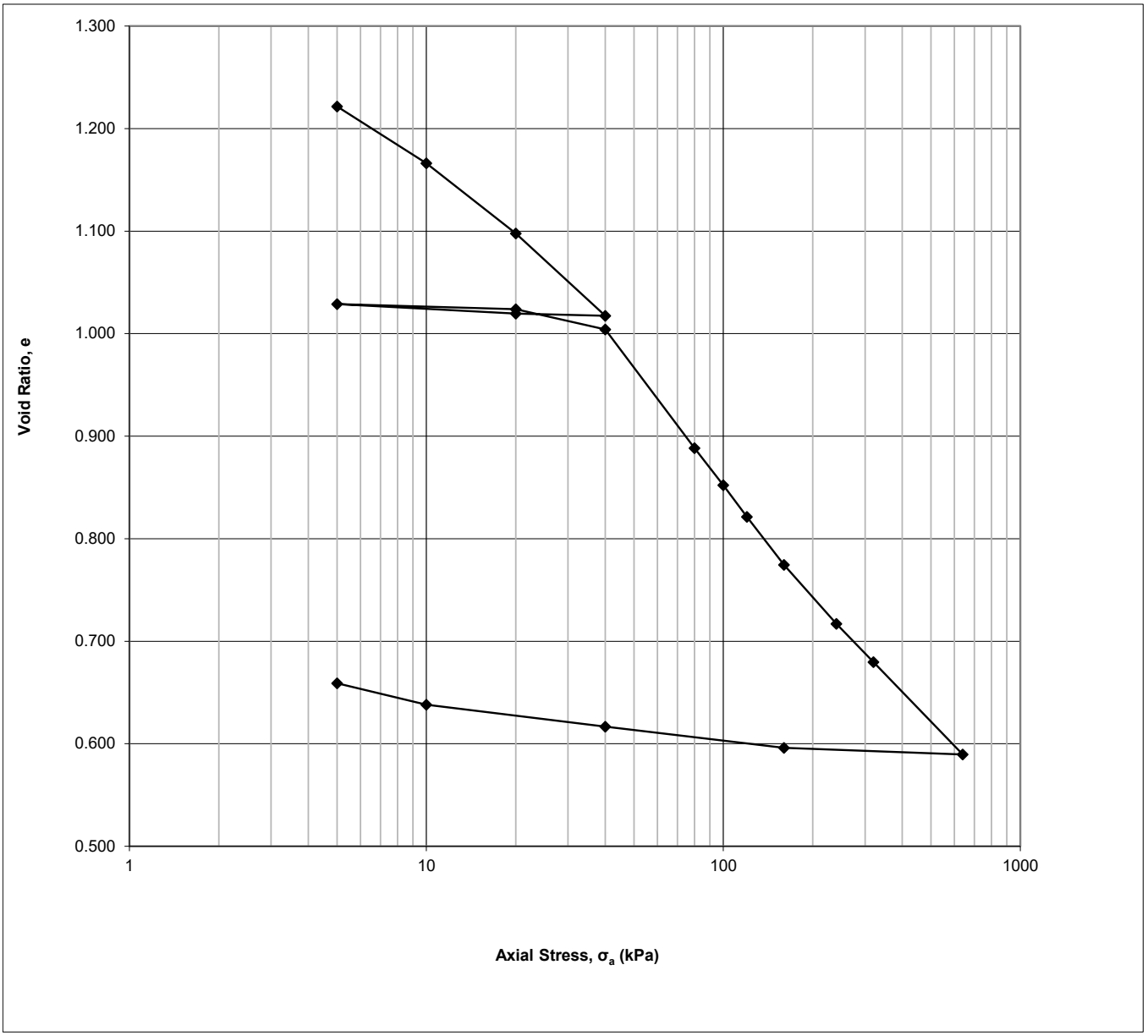
Photo No.: 2	Borehole: BH22-34 ST-05	Depth: 2.44-3.05 m

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One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**La Grande Alliance - Feasibility Study - Phase I** **Preliminary Geotechnical Investigation**
Project No.	**158100425.500.710.5**
Borehole No.	**BH22-36**
Sample No.	**ST-09**
Sample Depth	**6.71-7.32 m.**



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One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Checked by: D. Boateng Date: November 30, 2022

Approved by: R. Ghassemi Date: November 30, 2022

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample No.	BH22-36
Depth	ST-09
Sample Date Test	6.71-7.32 m.
Number	October 11, 2022
Technician Name	Six
	Daniel Boateng

Soil Description & Classification

Silty clay, grey, very soft, wet		
Specific Gravity of Solids		2.750
Average water content of trimmings	%	52.59

Additional Notes (information source, occurence and size of large isolated particles etc.)

1. Specific Gravity of Solids was Assumed 2. Sample is very soft, looks disturbed and appears to collapse under it's own weight

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	69.29
Dry Mass	g	47.33
Density	Mg/m^3	1.764
Dry Density	Mg/m^3	1.205
Water Content	%	46.40
Degree of Saturation	%	99.6
Height of Solids	mm	8.77
Initial Void Ratio		1.282

Final Specimen Conditions

Water Content	%	25.78
Final Void Ratio		0.659
Final Height	mm	14.43

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Filename: V:\01216\active\other_pc_projects\158100425.500.710.5\Billy Diamond\Consolidator
Date: November 30, 2022
Checked by: D. Boateng Date: November 30, 2022
Approved by: R. Ghassemi Date: November 30, 2022

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Project Location	Potential BDH Railway
Borehole Sample	BH22-36
No. Depth	ST-09
Sample Date Test	6.71-7.32 m.
Number	October 11, 2022
Technician Name	Six
	Daniel Boateng

Test Procedure

Date Started		November 15, 2022
Date Finished		November 16, 2022
Machine Number		Frame F
Cell Number		F
Ring Number		F
Trimming Procedure		Cutting ring/Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		De-aired Tap Water
Test Method		B
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020) Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	1.282
1	63.8	5	0.3592	19.6408	2.63	1.222
2	55.3	10	0.9680	19.0320	5.06	1.166
3	65.3	20	1.5676	18.4324	8.07	1.098
4	71.5	40	2.2246	17.7754	11.58	1.017
5	20.0	20	2.2964	17.7036	11.49	1.020
6	21.5	5	2.2175	17.7825	11.08	1.029
7	20.0	20	2.2563	17.7437	11.30	1.024
8	38.3	40	2.3939	17.6061	12.16	1.004
9	85.0	80	3.3374	16.6626	17.24	0.888
10	65.0	100	3.7878	16.2122	18.82	0.852
11	63.5	120	4.0648	15.9352	20.18	0.821
12	65.3	160	4.4185	15.5815	22.22	0.775
13	55.3	240	4.8853	15.1147	24.75	0.717
14	50.3	320	5.2287	14.7713	26.38	0.680
15	47.0	640	5.9645	14.0355	30.34	0.590
16	20.0	160	6.0092	13.9908	30.05	0.596
17	25.0	40	5.8302	14.1698	29.14	0.617
18	38.5	10	5.6425	14.3575	28.20	0.638
19	30.3	5	5.4606	14.5394	27.29	0.659

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Checked by: D. Boateng Date: November 30, 2022

Approved by: R. Ghassemi Date: November 30, 2022

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One-Dimensional Consolidation Test using Incremental Loading

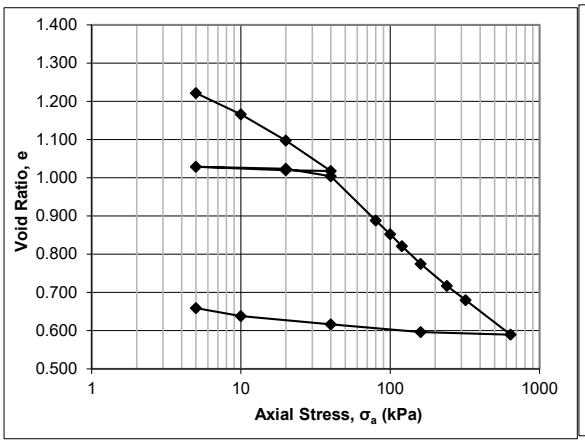
ASTM D2435/D2435M - 11(2020)

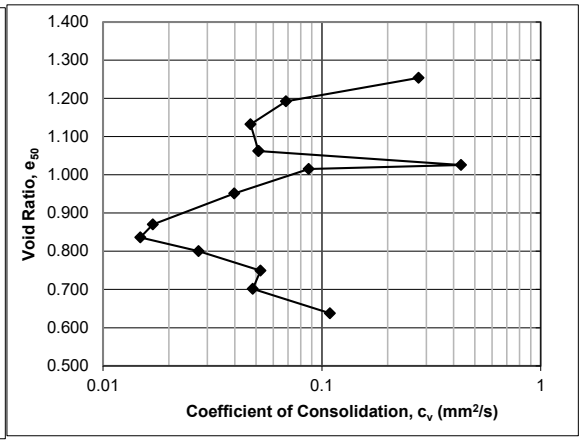
Specimen Details

Job Ref.	La Grande Alliance - Feasibility Study - Phase I - Preliminary Geotechnical Investigation
Job Location	Potential BDH Railway
Borehole Sample	BH22-36
No. Depth	ST-09
Sample Date Test	6.71-7.32 m.
Number	October 11, 2022
Technician Name	Six
	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm^2/s	Time t_{90} sec	Coeff. Consol. c_v mm^2/s
Seating	0								
1	3	0.2439	19.7561	1.22	1.254			299	2.77E-01
2	8	0.7806	19.2194	3.90	1.193			1142	6.86E-02
3	15	1.3089	18.6911	6.54	1.132			1570	4.72E-02
4	30	1.9247	18.0753	9.62	1.062			1350	5.13E-02
5	30	2.3018	17.6982	11.51	1.019				
6	13	2.2496	17.7504	11.25	1.025				
7	13	2.2403	17.7597	11.20	1.026			155	4.32E-01
8	30	2.3373	17.6627	11.69	1.015			759	8.72E-02
9	60	2.8962	17.1038	14.48	0.951			1556	3.99E-02
10	90	3.6067	16.3933	18.03	0.870			3370	1.69E-02
11	110	3.9057	16.0943	19.53	0.836			3710	1.48E-02
12	140	4.2205	15.7795	21.10	0.800			1932	2.73E-02
13	200	4.6669	15.3331	23.33	0.749			951	5.24E-02
14	280	5.0856	14.9144	25.43	0.702			974	4.84E-02
15	480	5.6443	14.3557	28.22	0.638				
16	400	6.0314	13.9686	30.16	0.594				
17	100	5.8979	14.1021	29.49	0.609				
18	25	5.7298	14.2702	28.65	0.628				
19	8	5.5848	14.4152	27.92	0.645				





Stantec	Project No.: 158100425.500.710.5 Project Name: La Grande Alliance - Feasibility Study Phase I - Preliminary Geotechnical Investigation	Photo Log

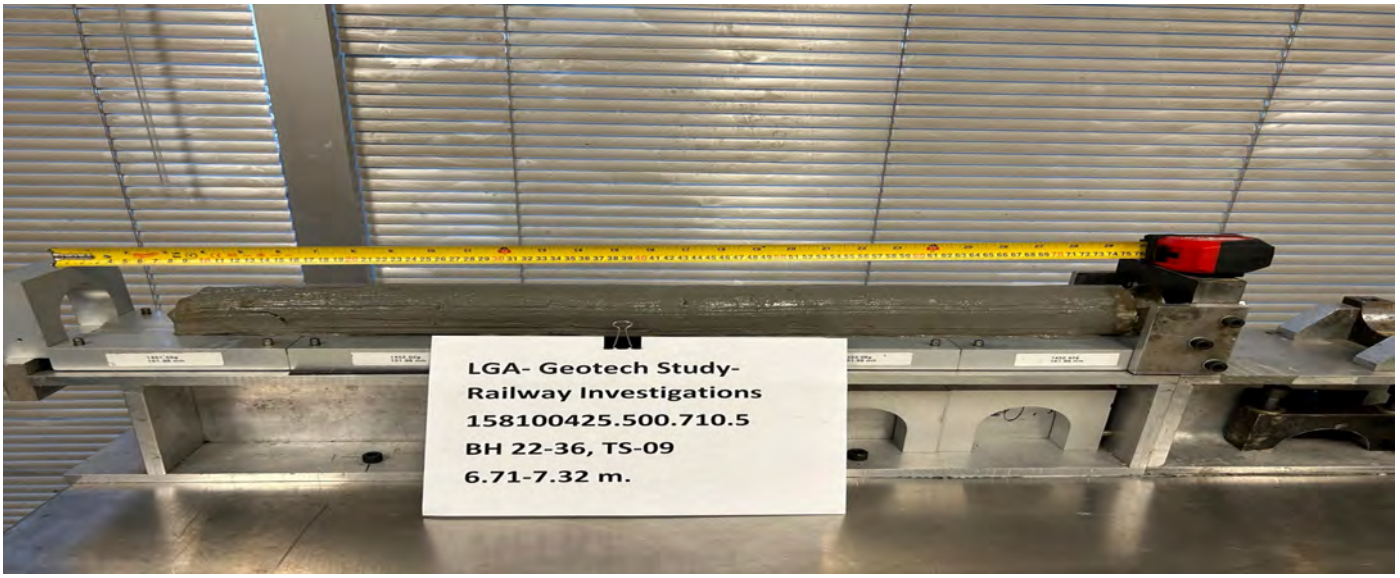


Photo No.: 1	Borehole: BH22-36 ST-09	Depth: 6.71-7.32 m



Photo No.: 2	Borehole: BH22-36 ST-09	Depth: 6.71-7.32 m

Appendix E Peat Investigations

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #2: Peatland on brownish/greyish silty clay, flat topography, Subsurface water ≈5cm below ground surface (BGS), machinery tracks on site, light tree coverage, light herbaceous coverage												
TA02-01	4.4	0	0	221101	5513820	0	0.45	Peat	30 (0.25)	5	H7	
						0.45	0.55	clay	118 (0.55)			
TA02-02	4.4	0	0	221133	5513830	0	0.35	Peat		5	H7	
						0.35	+	clay, some silt				
Site #3: Forested peatland on brown silty clay with some sand, flat topography, Subsurface water flush with ground surface, logging activities (clear cut), no tree coverage, moderate herbaceous coverage												
TA03-01	5.1	0	0	221582	5514200	0	0.5	Peat	16 (0.25)		H5	
						0.5	0.75	Clay	124 (0.75)			
TA03-02	5.1	0	0	221582	5514200	0	0.4	Peat			H5	
						0.4	+	Clay				
Site #4: Presence of peatmoss but not totally a peatland,Strong slope descending toward SW, till hill East of site, blocks on the ground east of site, moderate tree coverage, no herbaceous coverage												
TA04-01	9.1	0	0	225139	5515860	0	0.2	Peat			H2	
						0.2	+	Till				
Site #5: forested peatland on brown silty clay, light slope descending toward NE, dense tree coverage, light herbaceous coverage												
TA05-01	11.2	0	0	227289	5515650	0	0.25	Peat			H1-2	
						0.25	0.35	Silty clay	96 (0.3)			
TA05-02	11.2	0	0	227318	5515660	0	0.15	Peat			H2	
						0.15	+	Sandy silt, some clay				
Site #6: forested peatland on brownish/beige clayey silt with traces of sand, flat topography, dense tree coverage, moderate herbaceous coverage												
TA06-01	12.3	0	0	228172	5516290	0	0.45	Peat	21 (0.3)		H1	
						0.45	0.6	Clayey silt	126 (0.6)			
TA06-02	12.3	0	0	228189	5516300	0	0.5	Peat			H2	
						0.5	+	Clayey silt				
Site #7: forested peatland on grey clay with traces of silt, flat topography, small water stream near TA07-01, moderate tree coverage, moderate herbaceous coverage												
TA07-01	13.7	0	0	228972	5517480	0	0.43	Peat	12 (0.3)	10	H4	
						0.43	0.8	Clay	86 (0.8)	10		

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
TA07-02	13.7	0	20	229011	5517490	0	0.82	Peat			H3	
						0.82	+	Clay				
Site #8: forested peatland on beige clayey silt with traces of gravel, flat topography, dense tree coverage, light herbaceous coverage												
TA08-01	14.4	0	0	229518	5517780	0	0.22	Peat			H2	
						0.22	35	Clayey silt	80 (0.35)			
TA08-02	14.4	0	0	229530	5517790	0	0.1	Peat			H2	
						0.1	+	Clayey silt				
Site #9: Not a peatland, forested area with humus on brownish/beige silt with some clay, sporadic peat moss patch on site												
TA09-01	17.6	0	0	232675	5518030	0	0.1	humus			H1	
						0.1	0.25	Silt	130 (0.25)			
Site #10 (233 890,14E 5 518 276,84N m): Not a peatland, slope descending toward SE, dense leafy tree coverage, denses herbaceous coverage												
Site #11: Forested peatland on silt with some clay and traces of sand, slope descending toward S, dense tree coverage, dense herbaceous coverage												
TA11-01	21.1	35		236074	5518950	0	0.27	Peat			H5	
						0.27	0.5	Silt	98 (0.5)			
TA11-02	21.1	60		236054	5518960	0	0.3	Peat			H5	
						0.3	+	Silt				
Site #13: Forested peatland on brownish/greyish clayey silt, flat topography, dense tree coverage, dense herbaceous coverage												
TA13-01	27.7	0	0	242462	5519430	0	0.35	Peat			H4-H5	
						0.35	+	Clayey silt	>130 (0.4)			
TA13-02	27.7	0	0	242435	5519440	0	0.05	Peat			H2	
						0.05	+					
Site #14: Forested peatland on brownish/beige clayey silt, slope descending toward N, moderate tree cover, dense herbaceous coverage												
TA14-01	29.2	0	0	243941	5519180	0	0.3	Peat			H3	
						0.3	0.4	Clayey silt	88 (0.4)			
TA14-02	29.2	0	0	243908	5519170	0	0.5	Peat			H7	
						0.5	+	Silt				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #16 (245 973,01E 5 519 649,99N m): Not a peatland, no peat moss, slope descending toward SE, river bank, moderate tree coverage, dense herbaceous coverage												
Site #17: Forested peatland on sandy silt with traces of clay, flat topography, on the side of a logging road, moderate tree cover, light herbaceous cover												
TA17-01	33.3	0	0	246574	5521250	0	0.1	Peat			H2	
						0.1	0.3	Sandy Silt	98 (0.3)			
TA17-02	33.3		30	246602	5521260	0	0.2	Peat			H1	
						20	+	Silt				
Site #18: Peatland on gray clay with some silt, flat topography, light tree coverage, dense herbaceous cover												
TA18-01	34	0	0	246507	5522030	0	1.11	Peat	17 (0.5) 60 (1)	0	H7	
						1.11	1.3	Clay	83 (1.3)			
TA18-02	34		20	246519	5522060	0	1.83	Peat		0	H6	
						1.83	+	Clay				
Site #19: Forested peatland on brown silt with some clay, light slope descending toward W, moderate tree coverage, moderate herbaceous coverage												
TA19-01	34.5	70		246413	5522520	0	0.3	Peat	1 (0.25)		H3	
						0.3	0.4	Silt	98 (0.4)			
TA19-02	34.5	125		246358	5522530	0	0.35	Peat			H2	
						0.35	+	Silt				
Site #22: Forested peatland on brown sandy silt with some clay, light slope descending toward W, adjacent to a quarry, moderate tree coverage, light herbaceous coverage												
TA22-01	40.3	220		250617	5526480	0	0.12	Peat			H2	
						0.12	0.25	Sandy silt	83 (0.25)			

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #24: Not a peatland, logging activity (recent clear cut) on clay, flat topography, no tree coverage, light herbaceous coverage												
TA24-01	46.2		80	255161	5529860	0	0.1	Clay	95 (0.1)			
Site #27: Peatland on clay with traces of sand and silt, flat topography, moderate tree coverage, dense herbaceous coverage												
TA27-01	54		400	258621	5536710	0	0.55	Peat	2 (0.25)		H1	
						0.55	0.65	Clay	110 (0.65)			
TA27-02	54		360	258648	5536670	0	0.33	Peat			H2	
						0.33	+	Clay				
Site #28: Forested peatland on sand with some silt and traces of clay, flat topography, dense tree coverage, dense herbaceous coverage												
TA28-01	54.8		58	259181	5537140	0	0.2	Peat			H3	
						0.2	0.35	Sand	32 (0.3)			
TA28-02	54.8		20	259212	5537100	0	0.15	Peat			H3	
						0.15	+	Sand				
Site #29: Forested peatland on brownish/blackish clay with some sand and silt, flat topography, dense tree coverage, dense herbaceous coverage												
TA29-01	56.6		25	259922	5538780	0	0.5	Peat	3 (0.2)		H4	
						0.5	0.75	Clay	69 (0.55)			
TA29-02	56.6		25	259930	5538760	0	0.55	Peat			H4	
						0.55	+	Clay				
Site #30 (259 689,45E 5 540 610,82N m): Not a peatland, flat topography, presence of a little pond, no tree coverage, dense herbaceous coverage												
Site #31: Forested peatland on brownish/blackish clay with some sand and silt, light slope descending toward S, dense tree coverage (black spruce), dense herbaceous coverage												
TA31-01	60.4	0	0	259510	5542600	0	0.45	Peat			H2	
						0.45	0.6	Clay	85 (0.5)			
TA31-02	60.4	0	0	259850	5544020	0	0.48	Peat			H2	
						0.48	+	Clay				
Site #32: Cutted forested peatland on beige clay with some sand and silt, flat topography, recent logging operation (<5 years), no tree coverage, dense herbaceous coverage												
TA32-01	61.9		290	259850	5544020	0	0.08	Peat			H1	
						0.08	20	Clay	98 (0.2)			

Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #3: Forested peatland on grey clay with traces of silt, flat topography, dense tree coverage (black spruce, larsh), moderate herbaceous coverage												
TA33-01	64.5	0	0	259744	5546570	0	0.37	Peat		0	H4-5	
						0.37	0.5	Clay	97 (0.5)			
TA33-02	64.5	0	0	259793	5548900	0	0.67	Peat		0	H7	
						0.67	+	Clay				
Site #34: Peatland on clay with some silt and sand, light slope descending toward N, adjacent to a quarry, moderate tree coverage, dense herbaceous coverage												
TA34-01	66.8	85		259793	5548900	0	0.55	Peat	17 (0.35)	25	H5	
						0.55	0.65	Clay	112 (0.6)			
TA34-02	66.8	85		261283	5554100	0	0.11	Peat		25	H6	This survey site is right at the limit between the forest and the edge of the peatland
						0.11	+	Clay				
Site #35: Peatland on brown Clay with some sand and silt, flat topography, small ponds on site, traces of recent logging activities, mopderate tree coverage, dense herbaceous coverage												
TA35-01	72	200		261283	5554100	0	0.1	Peat		0	H1	
						0.1	0.35	Clay	91 (0.35)			
TA35-02	72	200		262627	5557570	0	0.2	Peat		0	H1	
						0.2	+	Clay				
Site #37: Peatland on brownish/beige clay with traces of silt, flat topography, traces of loggfing activity/logging roads, moderate toclear cut tree coverage, dense herbaceous coverage												
TA37-01	75.9	0	0	262627	5557570	0	0.12	Peat		36	H3	
						0.12	25	Clay	96 (0.25)			
TA37-02	76	0	0	261690	5564810	0	0.24	Peat		36	H3	
						0.24	+	Clay				
Site #42: Peatland on clay with some silt and traces of sand, flat topography, logging traces of logging activities (selective cut), light tree coverage, dense herbaceous coverage												
TA42-01	86.2	0	0	261690	5564810	0	0.38	Peat			H3	
						0.38	0.5	Clay	97 (0.5)			
TA42-02	86.2	30		261875	5565440	0	0.35	Peat			H3	
						0.35	+	Clay				
Site #43 (261 874,32E 5 565 434,92N m): Not a peat land, traces of old logging activity, dense tree coverage, dense herbaceous coverage												

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #44: Peatland on brown Clay with some sand and silt, flat topography, small ponds on site, Logging activity SW of site,moderate tree coverage, dense herbaceous coverage												
TA44-01	90.1	0	0	262133	5568400	0	0.43	Peat	29 (0.3)		H8	
						0.43	0.6	Clay	>130 (0.5)			
TA44-02	90.1	0	0	261989	5569140	0	0.41	Peat		0	H5	
						0.41	+	Clay				
Site #45: Peatland on Grey/blue clay, flat topography, multiple ponds on site, light tree coverage (black spruce), light herbaceous coverage												
TA45-01	90.8	0	0	261989	5569140	0	2.5	Peat	12 (0.5), 18 (1), 38 (1.5), 17 (2)		H6	Textbook peatland
						2.5	3	Clay	70 (0.3)			
TA45-02	90.7	15		262278	5571100	0	2.7	Peat			H6	
						2.7	+	Clay				
Site #46: Not a peatland, flat topography, traces of logging activities, no tree coverage, dense herbaceous coverage												
SC46-01	92.8	0	0	262278	5571100			Clay	>130 (0.8)			
Site #47: Peatland on Clay with traces of sand and silt, flat topography, moderate tree coverage, dense herbaceous coverage												
TA47-01	95.8	0	0	262900	5573970	0	0.45	Peat	14 (0.3)		H4	
						0.45	0.6	Clay	>130 (0.6)			
TA47-02	95.8	0	0	263283	5576080	0	0.45	Peat			H4	
						0.45	+	Clay				
Site #48: Peatland on clay with traces of sand and silt, flat topography, a small stream crosses the peatland, traces of logging activity on site but sampling was done in undisturbed peat, no tree coverage, dense herbaceous coverage												
TA48-01	97.9	0	0	263283	5576080	0	0.62	Peat	8 (0.3)		H3	
						0.62	1.05	Clay	128 (1)			
TA48-02	97.9	0	0	263482	5577080	0	0.43	Peat			H3	
						0.43	+	Clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #49: Forested peatland on beige clay with some sand and silt, flat topography, near logging road, moderate to dense tree coverage, light herbaceous coverage												
TA49-01	99	0	0	263482	5577080	0	0.23	Peat			H1-2	
						0.23	0.45	Clay	118 (0.4)			
TA49-02	99	0	0	263376	5578900	0	0.18	Peat			H1-2	
						0.18	+	Clay				
Site #50: Forested peatland on sandy clay with some silt, flat topography, near logging road, dense tree coverage, dense herbaceous coverage												
TA50-01	100.8	0	0	263376	5578900	0	0.5	Peat			H3	
						0.5	0.65	Sandy clay	>130 (0.6)			
TA50-02	100.8	0	0	227289	5515650	0	0.53	Peat			H3	
						0.53	+	Sandy clay				
Site #51: Peatland on grey clay with traces of silt,flat topography, near a logging road, moderate tree coverage, dense herbaceous coverage												
TA51-01	101.7	0	0	263155	5579790	0	0.51	Peat	3 (0.3)	10		
						0.51	0.65	Clay	80 (0.6)			
TA51-02	101.7	0	0	262948	5580280	0	0.65	Peat		10		
						0.65	+	Clay				
Site #52: Forested peatland on brownish/beige clay with some sand and silt, slope descending toward S, peatland at the foot of the slope, dense tree coverage, moderate herbaceous coverage												
TA52-01	102.3	0	0	262948	5580280	0	0.15	Peat			H1	
						0.15	0.25	Clay	60 (0.25)			
TA52-02	102.3	0	0	261029	5583640	0	0.2	Peat			H1	
						0.2	+	Clay				
Site #54: Peatland on brownish/beige clay, flat to undulated topgraphy, dense tree coverage, moderate herbaceous coverage												
TA54-01	106.2	0	0	261029	5583640	0	0.13	Peat/humus			H1	
						0.13	0.3	Clay	>130 (0.3)			
TA54-02	106.2	20		260919	5584670	0	0.2	Peat/humus			H1	
						0.2	+	Clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #55: Peatlant on clay, light slope, moderate tree coverage, light herbaceous coverage												
TA55-01	107		388	260919	5584670	0	0.19	Peat			H2	
						0.19	0.3	Clay	>130 (0.3) *medium panel*			
Site #56: Forested peatland on clay with some sand and silt, flat topography, small streams on site, dense tree coverage, dense herbaceous coverage												
TA56-01	110.2		30	258790	5586910	0	0.17	Peat/humus			H1	no other sample necessary since the soil is lightly or not decomposed at all, the peat looks more like forest humus
						0.17	0.3	Clay	>130 (0.3) *medium panel*			
Site # 58: Peatland on grey clay, flat topography, moderate tree coverage, dense herbaceous coverage												
TA58-01	118.4	0	0	253310	5592820	0	0.54	Peat	15 (0.3)		H4	
						0.54	0.94	Clay	>130 (0.9)			
TA58-02	118.4		25	248602	5594170	0	0.84	Peat			H4	
						0.84	+	Clay				
Site #59: Forested peatland on brown clay with some sand and silt, light slope toward SW, dense tree coverage, dense herbaceous coverage												
TA59-01	123.2		558	248602	5594170	0	0.17	Peat			H4	
						0.17	0.4	Clay	>130 (0.4)			
Site #61: Peatland on clay with some silt, flat topography, moderate tree coverage, dense herbaceous coverage												
TA61-01	136.1	0	0	236226	5597140	0	1.1	Peat	29 (0.45)		H7	
						1.1	1.2	Clay	118 (1.15)			
TA61-02	136.1	0	0	233256	5598030	0	1.52	Peat			H7	
						1.52	+	Clay				
Site #62: Peatland on pale grey clay with some silt, flat topography, light tree coverage (<1m), dense herbaceous coverage												
TA62-01	139.3	0	0	233256	5598030	0	0.47	Peat	19 (0.3)	0	H5	
						0.47	0.55	Clay	128 (0.55)			
TA62-02	139.2		20	231827	5598540	0	0.46	Peat		0	H5	
						0.46	+	Clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #63: Peatland on pale grey clay, flat topography, light tree coverage, dense herbaceous coverage												
TA63-01	140.8	0	0	231827	5598540	0	0.65	Peat	10 (0.3)		H5	
						0.65	0.8	Clay	125 (0.8)			
TA63-02	140.8	0	0	230122	5602700	0	0.71	Peay			H5	
						0.71	+	Clay				
Site #64: Peatland on greyish silty clay, flat topography, small ponds on site,												
TA64-01	145.5	0	0	230122	5602700	0	0.3	Peat		30		
						0.3	0.5	Clay	90 (0.5)			
TA64-02	145.5	0	0	230720	5604510	0	0.73	Peat		30		
						0.73	+	Clay				
Site# 65: Peatland on grey silty clay, flat topography, light tree coverage, dense herbaceous coverage												
TA65-01	147.5	0	0	230720	5604510	0	0.61	Peat	2 (0.25)		H4	
						0.61	0.75	Silty clay	77 (0.75)			
TA65-02	147.5	0	0	229217	5605920	0	0.75	Peat			H4	
						0.75	+	Silty clay				
Site# #66: Peatland on till, flat topography, no tree coverage, dense herbaceous coverage												
TA66-01	149.7	25		229217	5605920	0	2	Peat	28 (0.5), 70 (1), 41 (1.5), 60 (2)		H6	
						2	2.57	Till				
TA66-02	149.7	25		229014	5607200	0	1.7	Peat			H6	
						1.7	+	Clayey silt				
Site #67: Forested peatland on sandy silt or till, flat topography, blocks embedded in the ground in TA67-02, dense tree coverage, dense herbaceous coverage												
TA67-01	150.9	0	0	229014	5607200	0	0.28	Peat			H5	
						0.28	0.4	Sandy silt	89 (0.37)			
TA67-02	150.9	20		229395	5608250	0	0.15	Peat			H4	
						0.15	+	Till (sand with some gravel traces of silt)				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #68: Peatland on grey clay with some silt, flat topography, moderate tree coverage, moderate herbaceous coverage												
TA68-01	152.1	0	0	229395	5608250	0	2.24	Peat	20 (0.5), 56 (1), 68 (1.5)	0	H7	
						2.24	2.3	Clay	94 (2.25)			
TA68-02	152	0	0	229448	5609090	0	0.5	Peat		0	H6	
						0.5	+	Clay				
Site #69: Peatland on grey clay with some silt, flat topography, light to moderate tree coverage, dense herbaceous coverage												
TA69-01	152.9	0	0	229448	5609090	0	1.75	Peat	22 (0.5), 51 (1), 75 (1.5)		H8	Not possible to go further down with the auger
						1.75	2	Clay	121 (2)			
TA69-02	152.9	0	0	228481	5610870	0	1.39	Peat			H8	
						1.39	+	Clay				
Site #70: Peatland on pale grey silty clay, flat topography, moderate tree coverage, dense herbaceous coverage												
TA70-01	155	0	0	228481	5610870	0	0.55	Peat	6 (0.3)		H8	
						0.55	0.65	Silty clay	>130 (0.6)			
TA70-02	155	15		228972	5517480	0	0.55	Peat			H8	
						0.55	+	Silty clay				
Site #71: Forested peatland on brown silt with some clay and sand, flaty topography, dense tree coverage, dense herbaceous coverage												
TA71-01	56.2	0	0	227685	5611700	0	0.54	Peat	30 (0.3)		H10	
						0.54	0.65	Silt	>130 (0.65)			
TA71-02	156.2	0	0	226774	5613850	0	0.6	Peat			H6	
						0.6	+	Silt				
Site #72: Peatland on grey silty clay with some sand, flat topography, moderate tree coverage, dense herbaceous coverage												
TA72-01	159	0	0	226774	5613850	0	3	Peat	13 (0.5), 12 (1), 35 (1.5), 40 (2), 48 (2.5)		H6	
						3	+	Silty clay	>130 (3.1)			
TA72-02	159	0	0	222005	5618720	0	2.8	Peat			H7	
						2.8	+	Silty clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #73: Peatland on brown silty clay, flat topography, quarry ≈80m to the NW, moderate tree coverage, dense herbaceous coverage												
TA73-01	166	0	0	222005	5618720	0	0.73	Peat	58 (0.5)		H8	
						0.73	1	Silty clay	>130 (1)			
TA73-02	165.9	0	0	220299	5620660	0	1	Peat			H8	
						1	+	Silty clay				
Site #75: Peatland on grey clay with traces of silt, flat topography, light to no tree coverage, moderate herbaceous coverage												
TA75-01	168.6	30		220299	5620660	0	1.7	Peat	17 (0.5), 32 (1.1)	0	H4	
						1.7	1.9	Clay	128 (1.75)			
TA75-02	168.6	30		220901	5623570	0	1.85	Peat		0	H5	
						1.85	+	Clay				
Site #76: Peatland on grey silty clay, fklat topography, light to moderate tree coverage, moderate herbaceous coverage												
TA76-01	171.7		20	220901	5623570	0	0.6	Peat	22 (0.3)		H4	
						0.6	0.8	Silty clay	97 (0.8)			
TA76-02	171		24	224289	5627410	0	0.7	Peat			H4	
						0.7	+	Silty clay				
Site #77: Forested peatland on brownish/beige silty clay, flat topography, moderate to dense tree coverage, dense herbaceous coverage												
TA77-01	177.1		25	224289	5627410	0	0.55	Peat	20 (0.3)	30	H8	
						0.5	0.65	Silty clay	109 (0.65)			
TA77-02	177.1		23	226493	5629930	0	0.45	Peat		30	H6	
						0.45	+	Silty clay				
Site #78: Forested peatland on brown clayey silt with some sand, flat topography, moderate tree coverage, dense herbaceous coverage												
TA78-01	180.9		30	226493	5629930	0	0.4	Peat	16 (0.3)		H4	
						0.4	0.7	Clayey silt	>130 (0.7)			
TA78-02	180.9	0	0	226042	5632440	0	0.65	Peat			H3	
						0.65	+	Clayey silt				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #80: forested peatland on greyish/beige silty clay with some sand, flat topography, dense tree coverage, moderate herbaceous coverage												
TA80-01	183.5	0	0	226042	5632440	0	0.2	Peat		0	H3	
						0.2	0.3	Silty clay	92 (0.3)			
TA80-02	183.5	0	0	229518	5517780	0	0.9	Peat		0	H4	
						0.9	1	Silty clay	>130 (1)			
Site #81: Forested peatland on grey clay, flat topography, mdorate tree coverage, dense herbaceous coverage												
TA81-01	185.6		30	224952	5634300	0	1.7	Peat	35 (0.6), 60 (1)		H6	
						1.7	1.9	Clay	120 (1.7)			
TA81-02	185.6		15	224419	5635570	0	1.7	Peat			H6	
						1.7	+	Clay				
Site #82: Forested peatland on till (gravely sand), 2 to 5% slope descending toward SW, multi metric blocks on and below the surface, dense tree coverage, dense herbaceous coverage												
TA82-01	187.2	0	0	224419	5635570	0	0.61	Peat	13 (0.3)		H5	
						0.61	0.75	Till (gravely sand)	72 (0.7)			
TA82-02	187.2	25		224970	5637120	0	0.95	Peat			H5	
						0.95	+	Till (gravely sand)				
Site #83: Forested peatland on beige clayey silt with some sand, undulated topography, dense tree coverage, dense herbaceous coverage												
TA83-01	188.2	0	0	224970	5637120	0	0.53	Peat	16 (0.3)		H4	
						0.53	0.65	Clayey silt	>130 (0.6)			
TA83-02	188.2	0	0	224592	5640710	0	0.95	Peat			H2-3	
						0.95	+	Clayey silt				
Site #85: Peatland on grey sandy clay, flat topography, light tree coverage, dense herbaceous coverage												
TA85-01	193.2	0	0	224592	5640710	0	1.53	Peat	32 (0.6), 78 (1)		H7	
						1.53	1.6	Sandy clay	108 (1.6)			
TA85-02	193.2	0	0	224169	5645990	0	1.62	Peat			H5	
						1.62	+	Sandy clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #86: Peatland on grey silty clay, flat topography, moderate tree coverage, dense herbaceous coverage												
TA86-01	198.7.	0	0	224169	5645990	0	1.54	Peat	28 (0.6) 78 (1m)		H5	
						1.54	1.6	Silty clay	>130 (1.6)			
TA86-02	198.7	0	0	224777	5649890	0	1.93	Peat			H5	
						1.93	+	Silty clay				
Site #88: Peatland on silty clay with some sand, flat topography, moderate tree coverage, dense herbaceous coverage												
TA88-01	202.6	0	0	224777	5649890	0	1.43	Peat	40 (0.50) 60 (1)		H7	
						1.43	1.5	Silty clay	>130 (1.60			
TA88-02	202.6	0	0	225953	5650810	0	1.5	Peat			H5	
						1.5	+	Silty clay				
Site #89: Forested peatland on beige silty sand, flat topography, presence blocks embedded at the interface of peat and silty sand, mdoerate to dense tree coverage, moderate to dense herbaceous coverage												
TA89-01	204.2	0	0	225953	5650810	0	0.77	Peat	18 (0.4) 115 (0.8)		H4	
						0.77	0.85	Silty sand				
TA89-02	204.2	0	0	232675	5518030	0	0.92	Peat			H5	
						0.92	+	Silty sand				
Site #91: Peatland on grey silty clay, flat topography, light to moderate tree coverage, dense herbaceous coverage												
TA91-01	206.1	0	0	226250	5652710	0	2.5	Peat	21 (0.5) 32 (1) 40 (1.5) 31 (2)		H3	
						2.5	2.6	Silty clay	104 (2.60			
TA91-02	206.1		15	227373	5653750	0	2.5	Peat			H3	
						2.5	+	Silty clay				
site #92: Forested peatland on brownish/black silt and sand, flat topography, bedrock seen 20m south of the road, dense tree coverage, dense herbaceous coverage												
TA92-01	207.7	0	0	227373	5653750	0	0.64	Peat	26 (0.6)		H6	
						0.64	1	Silt and sand	104 (1m)			
TA92-02	207.7	0	0	228359	5655080	0	0.5	Peat			H3	
						0.5	+	bedrock				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #93: Peatland on grey silty clay, flat topography, moderate tree coverage, moderate herbaceous coverage												
TA93-01	209.3	0	0	228359	5655080	0	1.6	Peat	18 (0.5) 60 (1)		H6	
						1.6	2	Silty clay	120 (1.6) >130 (2)			
TA93-02	209.3	0	0	229433	5656710	0	1.5	Peat			H6	
						1.5	+	Silty clay				
Site #94: Peatland on unknow deposit, flat topography, moderate tree coverage, dense herbaceous coverage,												
TA94-01	211.3	0	0	229433	5656710	0	2.5	Peat	31 (0.5), 72 (1), 129 (1.5) 125 (2) >130 (2.5)		H6	
						2.5	+	Unknown				Unable to touch the bottom of peat accumulation with the auger or the scisometer. It looks like the bottom would be fine sediment (silty clay, clay) according to scisometer readings but unable to confirm it since we were never able to bring it back to the surface
TA94-02	211.3	0	0	229524	5657640	0	2.5	Peat			H6	
						2.5	+	Unknown				idem to TA94-01
Site #95: Forested peatland on grey silty clay, flat topography, moderate to dense tree coverage, dense herbaceous coverage												
TA95-01	212.3	0	0	229524	5657640	0	1.32	Peat	38 (0.5) 75 (1)		H6	
						1.32	1.4	Silty clay	>130 (1.4)			
TA95-02	212.3	0	0	230280	5658260	0	2.1	Peat			H5	
						2.1	+	Silty clay				
Site #97: Forested peatland on brown silty clay with traces of sand or sand and silt, flat topography, dense tree coverage, dense herbaceous coverage												
TA97-01	215.7	15		231166	5660380	0	1.22	Peat	22 (0.5) 41 (1)		H6	
						1.22	1.3	Silty clay	>130 (1.3)			
TA97-02	215.7	25		231169	5661350	0	0.35	Peat			H3-4	
						0.35	+	Sand and silt				
Site #98: Peatland on grey clay with some silt, flat topography, moderate tree coverage, dense herbaceous coverage												
TA98-01	216.7	0	0	231169	5661350	0	1	Peat	18 (0.5)		H3	
						1	1.2	Clay	126 (1) >130 (1.2)			
TA98-02	216.7	0	0	231353	5662410	0	1.2	Peat			H2	
						1.2	+	Clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #99: Forested peatland on brown clayey silt, light slope descending toward S, dense tree coverage, dense herbaceous coverage												
TA99-01	217.7	0	0	231353	5662410	0	0.56	Peat	2 (0.3)		H4	
						0.56	0.6	Clayey silt	83 (0.6)			
TA99-02	217.7	0	0	259689	5540610	0	1	Peat			H4	
						1	1.63	Clayey silt	110 (1) 88 (1.6)			
Site #100: Forested peatland on grey clay with some silt and traces of sand, flat topography, moderate tree covering, dense herbaceous coverage.												
TA100-01	219.8	0	0	231103	5664350	0	0.8	Peat	32 (0.5)		H3	
						0.8	0.9	Clay	92 (0.85)			
TA100-02	219.8	0	0	233890	5518280	0	0.73	Peat			H3	
						0.73	+	Clay				
Site #101: Forested peatland on grey to black silt with some clay, flat topography, moderate tree coverage, dense herbaceous coverage												
TA101-01	221.3	0	0	231670	5665720	0	1.01	Peat	27 (0.3) 84 (0.6)		H3	
						1.01	1.05	Silt	127 (1.05)			
TA101-02	221.3	0	0	232675	5666610	0	1.21	Peat			H3	
						1.21	+	Silt				
Site #102: Forested peatland on beige silty clay with traces of sand, flat topography, dense tree coverage, moderate herbaceous coverage												
TA102-01	222.7	0	0	232675	5666610	0	0.45	Peat	18 (0.3)		H3	
						0.45	0.55	Silty clay	92 (0.5)			
TA102-02	222.7	0	0	233519	5667350	0	0.4	Peat			H3-4	
						0.4	+	Silty clay				
Site #103: Forested peatland on grey to black silty clay, slope descending toward NW, moderate tree coverage, dense herbaceous coverage												
TA103-01	223.8	0	0	233519	5667350	0	0.75	Peat	33 (0.6)		H7	
						0.75	0.85	Silty clay	99 (0.85)			
TA103-02	223.9	0	0	234326	5669640	0	0.7	Peat			H5	
						0.7	+	Silty clay				

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Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #104: Forested peatland on silty clay with traces of sand, flat topography, moderate tree coverage, dense herbaceous coverage												
TA104-01	226.2	0	0	234326	5669640	0	0.55	Peat	10 (0.3)		H2	
						0.55	0.6	Silty clay	98 (0.6)			
TA104-02	226.2	35		235466	5670580	0	0.65	Peat			H2	
						0.65	+	Silty clay				
Site #105: Forested peatland on brownish/beige silty clay with some sand, flat topography, moderate tree coverage, dense herbaceous coverage												
TA105-01	227.9	0	0	235466	5670580	0	0.4	Peat	17 (0.3)		H5	
						0.4	0.5	Silty clay	64 (0.5)			
TA105-02	227.9	35		236941	5671870	0	0.6	Peat			H5	
						0.6	+	Silty clay				
Site #106: Forested peatland on grey clay with some silt, flat topography, moderate tree coverage, dense herbaceous coverage												
TA106-01	229.9	0	0	236941	5671870	0	1.6	Peat	22 (0.5) 48 (1)		H5	
						1.6	1.7	Clay	112 (1.7)			
TA106-02	229.9	0	0	237263	5673310	0	1.2	Peat			H7	
						1.2	+	Clay				
Site #107: Forested peatland on beige silt with some clay, on top of a slope, moderate tree coverage, dense herbaceous coverage												
TA107-01	231.4	45		237263	5673310	0	0.15	Peat			H4	
						0.15	0.6	Silt	70 (0.6)			
TA107-02	231.4	45		238322	5674280	0	0.2					
						0.2	+	Clayey silt			H4	
Site #108: Peatland on grey silty clay, flat topography, bedrock seen near TA108-01, light tree coverage, dense herbaceous coverage												
TA108-01	222.9		311	238322	5674280	0	0.6	Peat	8 (0.3)	0	H9	
						0.6	0.7	Silty clay	93 (0.7)			
TA108-02	223		336	239897	5677460	0	0.85	Peat		0	H9	
						0.85	+	Silty clay				

Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #109: Peatland on grey silty clay, flat topography, light tree coverage, light herbaceous coverage,												
TA109-01	236.4	0	0	239897	5677460	0	0.67	Peat	18 (0.4)		H8	
						0.67	0.7	Silty clay	>130 (0.7)			
TA109-02	236.4	0	0	239967	5678170	0	0.87	Peat			H6	
						0.87	+	Silty clay				
Site #110: Not a peatland												
TA110-01	237.1	25		239967	5678170							
Site #111: Peatland on sand, flat topography, light tree coverage, dense herbaceous coverage												
TA111-01	238.4		200	240358	5679350	0	0.38	Peat	2 (0.2)		H9	
						0.38	0.5	Sand	19 (0.50			
TA111-02	238.4		240	240462	5680860	0	0.35	Peat			H9	
						0.35	+	Sand				
Site #112: Peatland on beige clayey silt with some sand, flat topography, small stream on theside of the road, light tree coverage, dense herbaceous coverage												
TA12-01	239.9	0	0	240462	5680860	0	0.41	Peat	3 (0.2)		H4	
						0.41	0.45	Clayey silt	128 (0.45)			
TA112-02	239.9	0	0	240906	5681390	0	0.28	Peat			H5	
						0.28	+	Clayey silt				
Site #113: Peatland on grey silty clay, flat topography, bedrock seen on the surface, light tree coverage, dense herbaceous coverage												
TA113-01	240.6		115	240906	5681390	0	0.4	Peat	2 (0.3)	0	H4	
						0.4	0.5	Silty clay	99 (0.5)			
TA113-02	240.6		60	241830	5682760	0	0.55	Peat		0	H6	
						0.55	+	Silty clay				

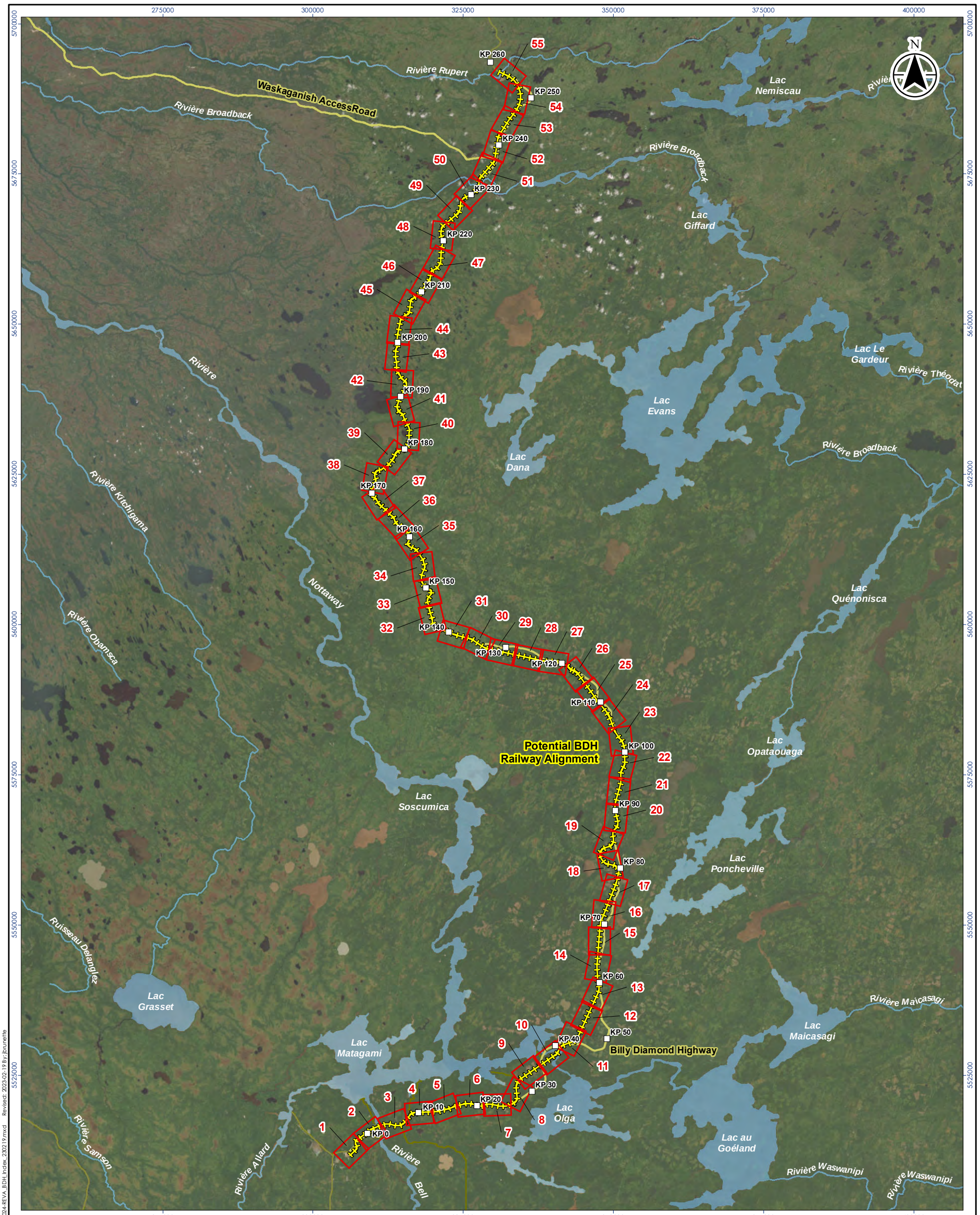
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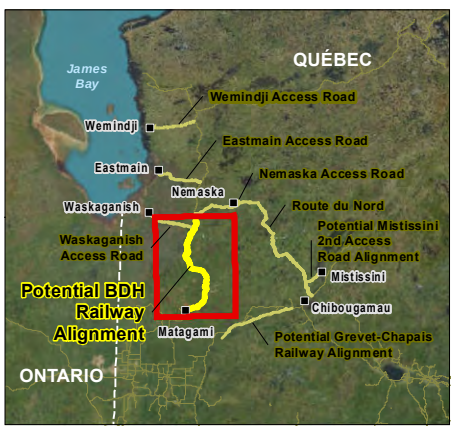
Investigation Summary

City/region : Baie James (Billy Diamond road)	Project : La Grande Alliance - Feasability Study - Phase 1
KP :	Project # : 158100425.500.750.4
Client: Cree Development Corporation	Geotechnical Project Manager : Timothée Coulaux, ing.
Date : 02/08/2022 to 12/08/2022	Technician(s) : Raphaelle Croteau & Élie Ferland
Survey type: Manual auger surveying (TA), Manual scisometer test (SC)	

Survey	Localisation (m)					Depth (m)		Description	Scisometer (kPa) (Depth m)	Approximate water level BGS (cm)	Von Post Classification	Comments
	KP	Offset (m)		Coordinates (MTM9)								
		L	R	X	Y	From	To					
Site #114: Peatland on grey silty clay, flat topography, small ponds observed on site, light tree coverage, dense herbaceous coverage												
TA114-01	242.2		155	241830	5682760	0	0.47	Peat	10 (0.4)		H8	
						0.47	0.5	Silty clay	>130 (0.5)			
TA114-02	242.2		155	242985	5684730	0	0.44	Peat			H5	
						0.44	+	Silty clay				
Site #115: Burned forested peatland on grey silty clay with some sand, flat topography, light tree coverage, dense herbaceous coverage												
TA115-01	244.5	0	0	242985	5684730	0	3	Peat	22 (0.5) 34 (1) 34 (1.5) 48 (2) 60 (2.5) 77 (3)	5	H7	We only had 3m of auger and scisometer length on site
						3	+	Unknown				
TA115-02	244.4	15		243747	5689060	0	2.5	Peat		5	H7	
						2.5	+	Silty clay				
Site #117: Forested peatland on beige clayey silt with some sand, flat topography, moderate tree coverage, light herbaceous coverage												
TA117-01	249		280	243747	5689060	0	0.5	Peat	6 (0.3)		H2	
						0.55	0.55	Clayey silt	84 (0.55)			
TA117-02	249		280	241762	5690580	0	0.45	Peat			H4	
						0.45	+	Clayey silt				
Site #119: Forested peatland on beige sitly clay with traces of sand, light slope descending toward E, moderate tree coverage, moderate herbaceous coverage												
TA11901	251.5	0	0	241762	5690580	0	0.18	Peat			H3	
						0.18	0.25	Silty clay	74 (0.25)			
TA119-02	251.4	0	0	241051	5690930	0	0.38	Peat			H3	
						0.38	+	Silty clay				
Site #120: Peatland on beige silty clay with traces of sand, flat topography, mdoerate tree coverage, moderate herbaceous coverage												
TA120-01	252.2	0	0	241051	5690930	0	0.28	Peat			H3	
						0.28	0.35	Silty clay	107 (0.35)			
TA120-02	252.2		40	240117	5691400	0	0.35	Peat			H3	
						0.35	+	Silty clay				

Appendix F Surficial Material Map Atlas





Projected Component

Potential BDH Railway Alignment

Study Component

Access Road

Hydrography

Body of Water

Watercourse

Road Network

Kilometric Point (MTQ, 2021)

Road Network

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Surficial Material: Stantec, 2023
3. Road Network: Adresses Québec, 2021, MTQ, 2021 and Stantec, 2022
4. Hydrography: MRNF, 2012
5. Orthoimagery: ESRI-World Imagery, 2012 to 2021

0 6,5 13 Km

1:650 000

(At Original document size of 11x17)

Vision Eeyou Istchee

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA

Prepared by Julie Brunette on 2023-02-19

Technical Review by Manuel Verpaelst on 2023-02-19

Independent Review by F. Vinet on 2023-02-19

Client/Project

Cree Development Corporation

La Grande Alliance – Feasibility Study

Phase 1 – Preliminary Geotechnical Investigation

Map No.

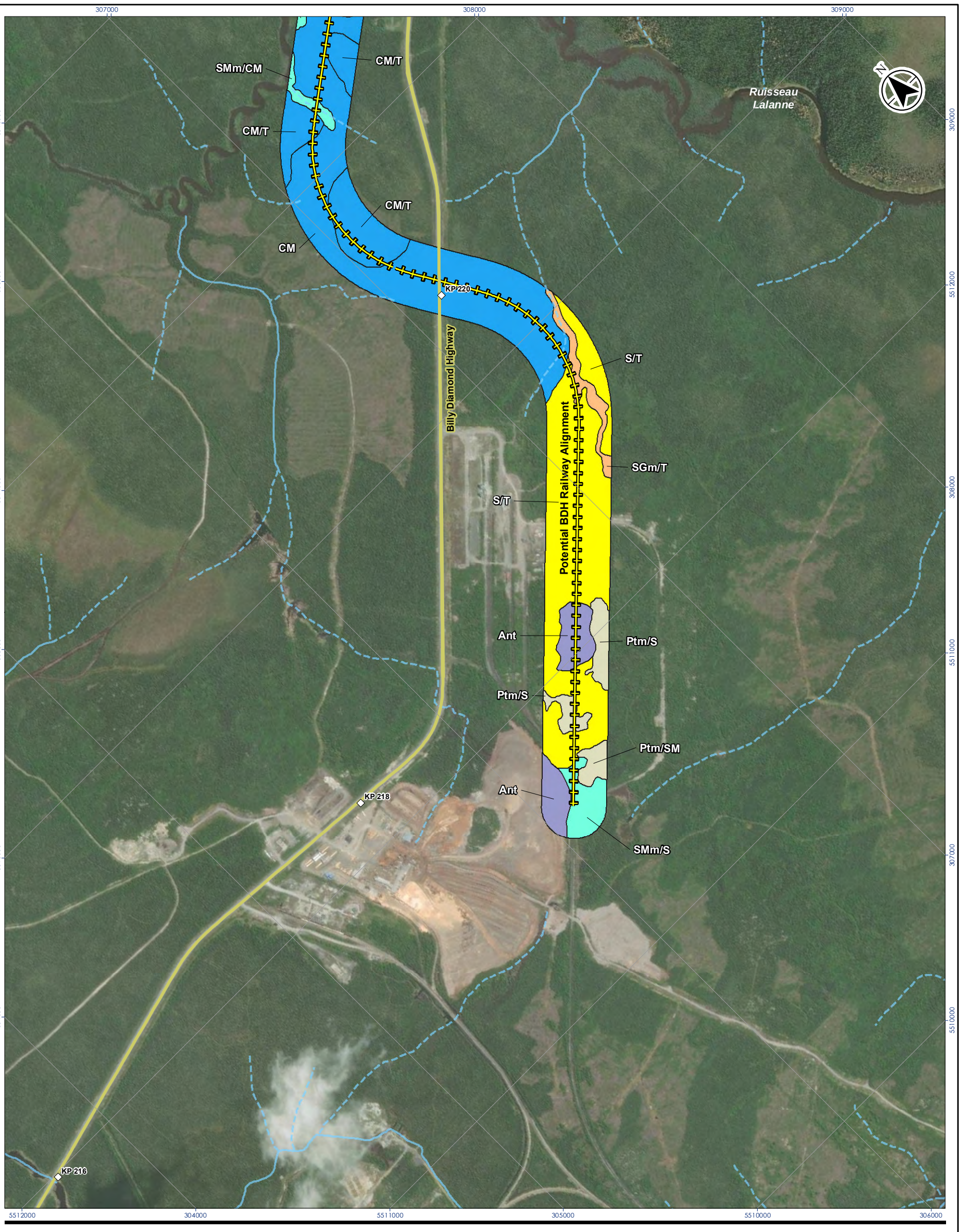
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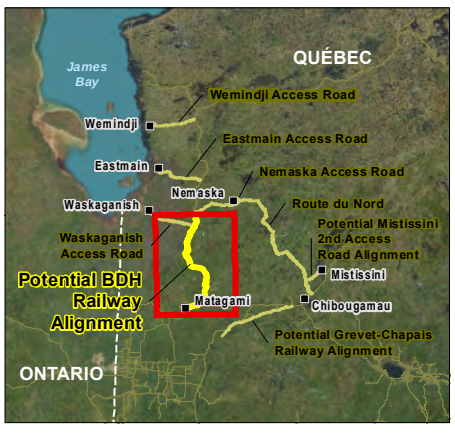
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Surficial Material – Potential BDH Railway

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Vision Eeyou Istchee has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.
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Notes

1. Coordinate System: NAD 1983 CSRS MTM 9
2. Surficial Material: Stantec, 2023
3. Road Network: Adresses Québec, 2021 and MTQ, 2021
4. Hydrography: GRHQ, 2017
5. Orthoimagery: ESRI-World Imagery, 2012 to 2021

0 0,15 0,3 Km

1:15 000 (At Original document size of 11x17)

Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
S/T	Layer of sand (2 to 6 m thick) over till
S	Sand (> 6 m thick)

Examples of Combined Symbols

T+B	Till with boulders at the ground surface
R+Tm/R	Bedrock with a veneer of till (< 2 m thick)
T-SG	Undifferentiated till or sand and gravel

** No Thickness was Interpreted for Boulder Accumulations*

Generalized Surficial Material Classification

- Sand and gravel (< 2 m thick)
- Sand (> 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Anthropogenic

Vision Eeyou Istchee — Connect • Develop • Protect

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
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La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

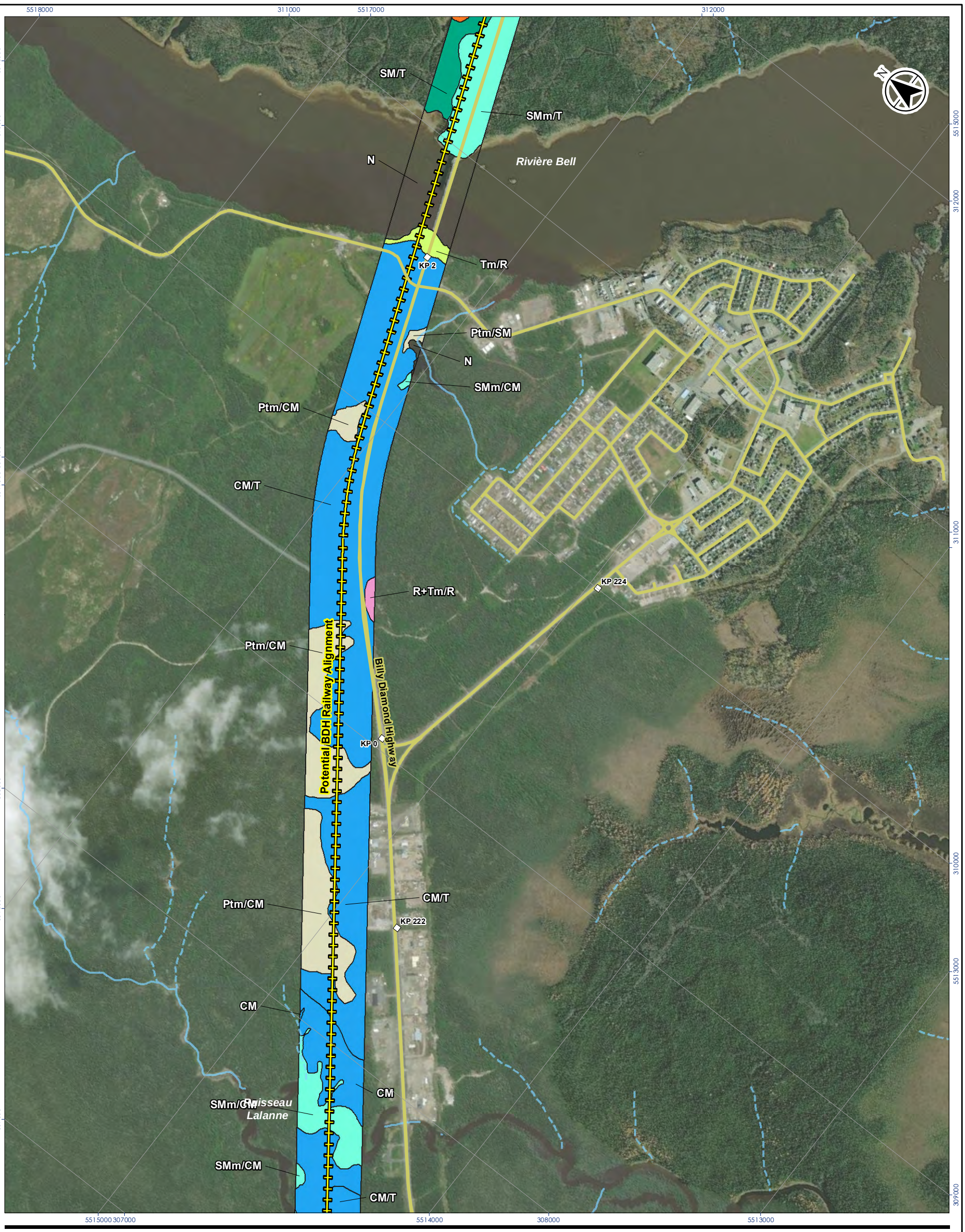
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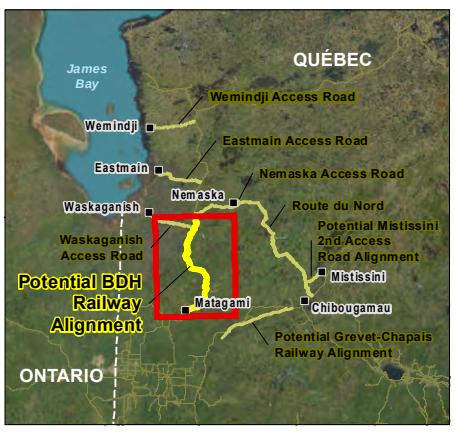
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

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- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Water Body

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

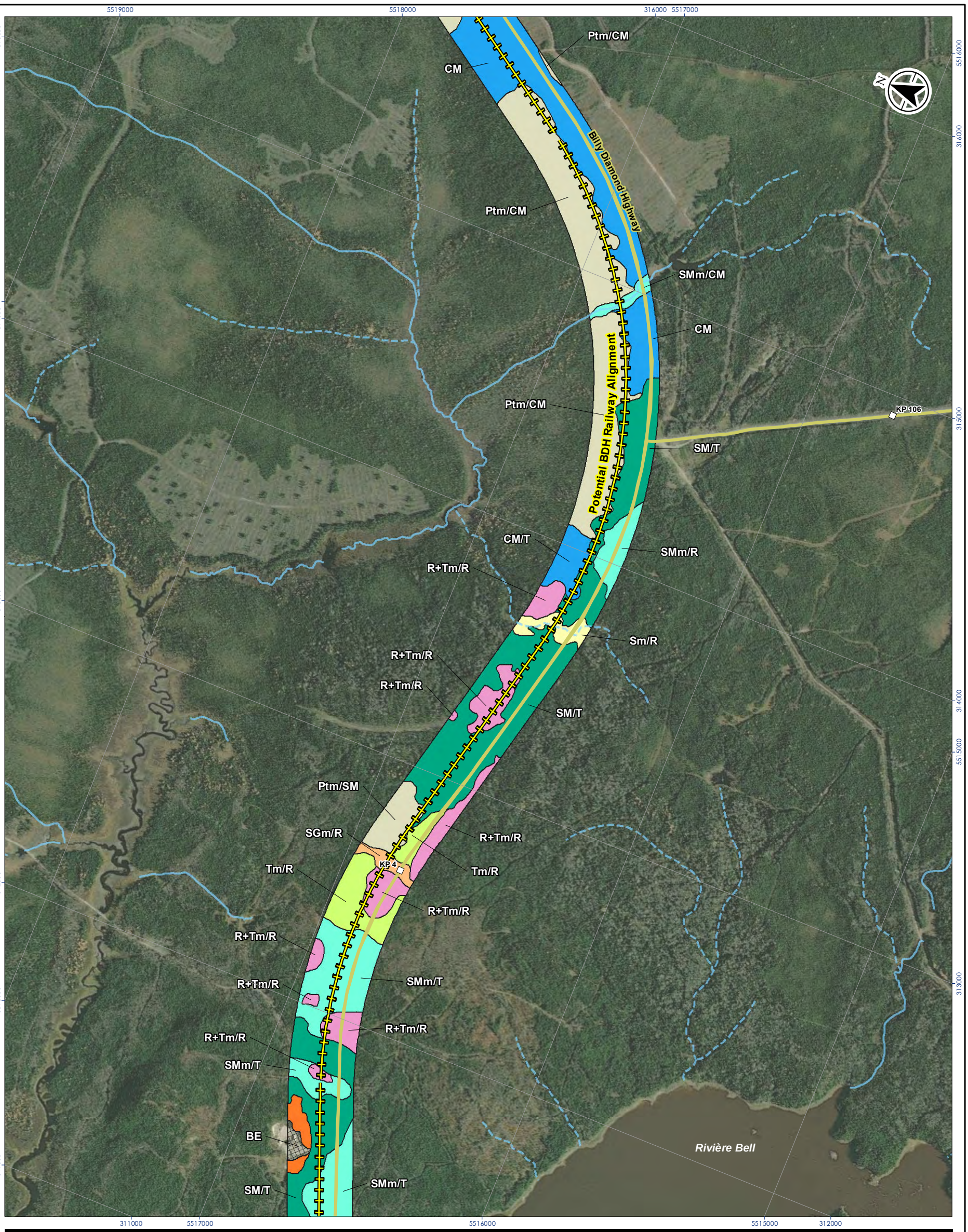
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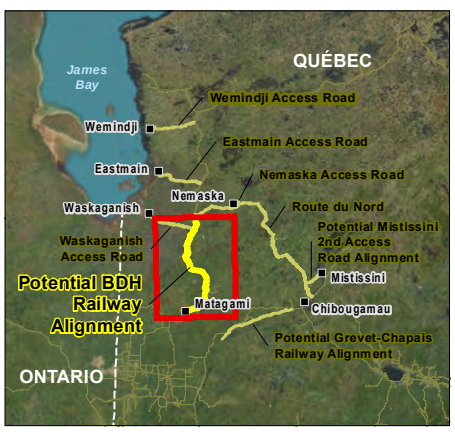
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Surficial Material – Potential BDH Railway

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Projected Component

- Potential BDH Railway Alignment

Hydrography

- Permanent Watercourse
- Intermittent Watercourse

Road

- Kilometric Point (MTQ, 2021)
- Road

Surficial Material

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- Silty sand or silty clay (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Existing Borrow Source

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0 0,15 0,3 Km

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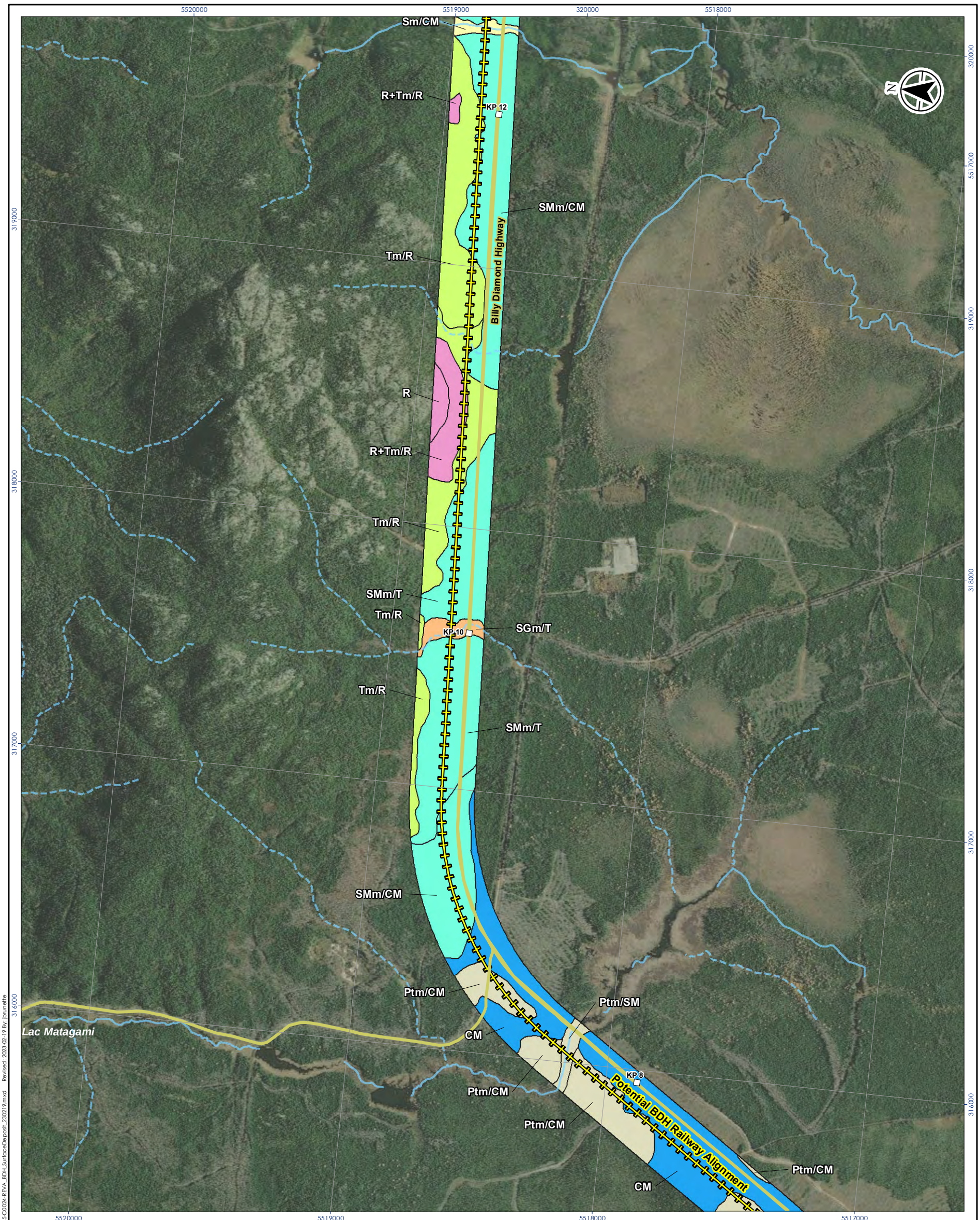
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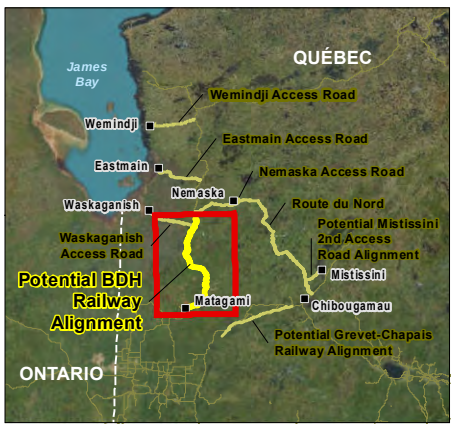
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Peat (< 2 m thick)

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Project Location

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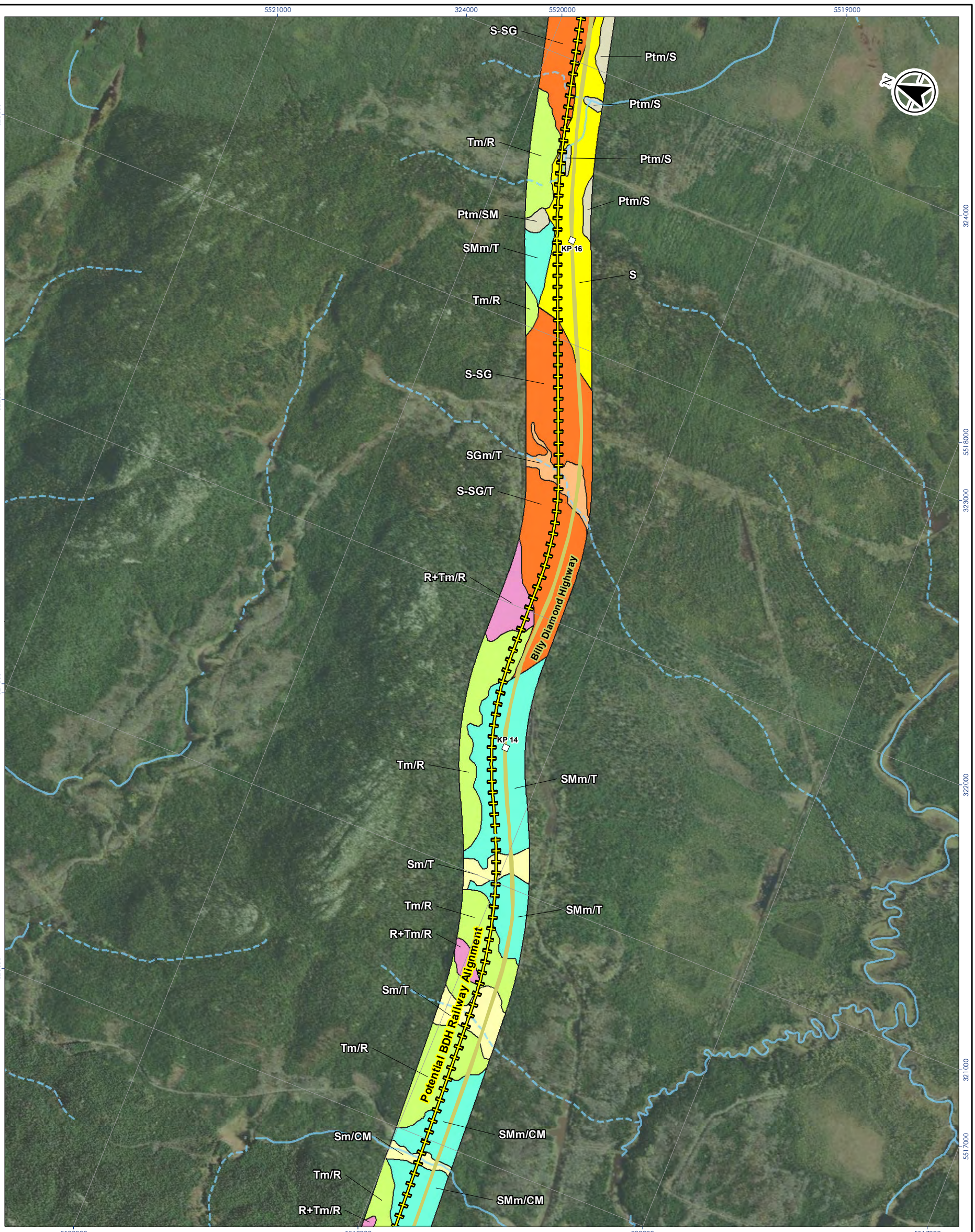
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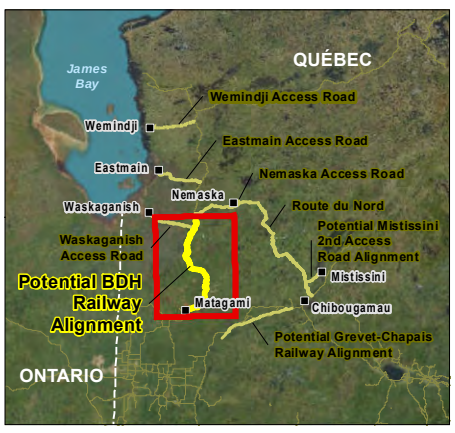
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Sand (< 2 m thick)
- Sand (> 2 m thick)
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- Peat (< 2 m thick)

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Project Location

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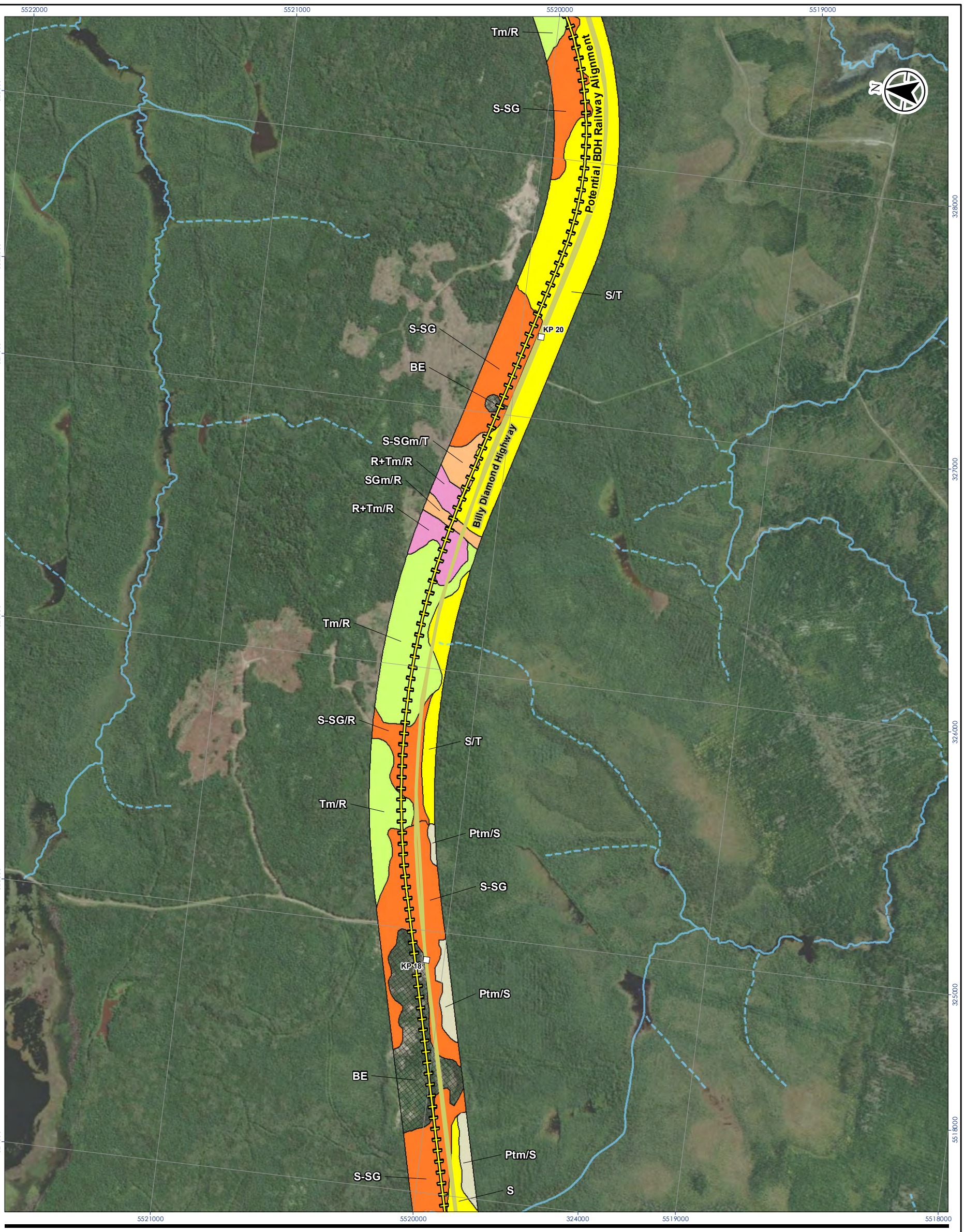
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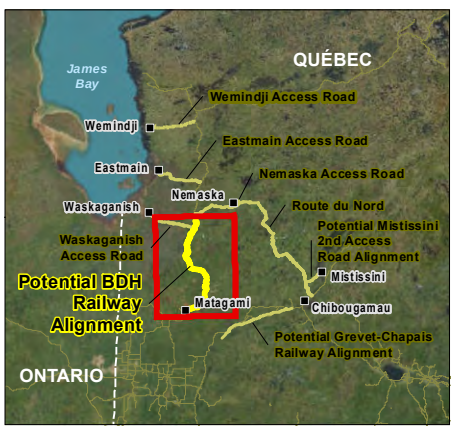
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Sand (> 2 m thick)
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- Existing Borrow Source

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Project Location

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La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

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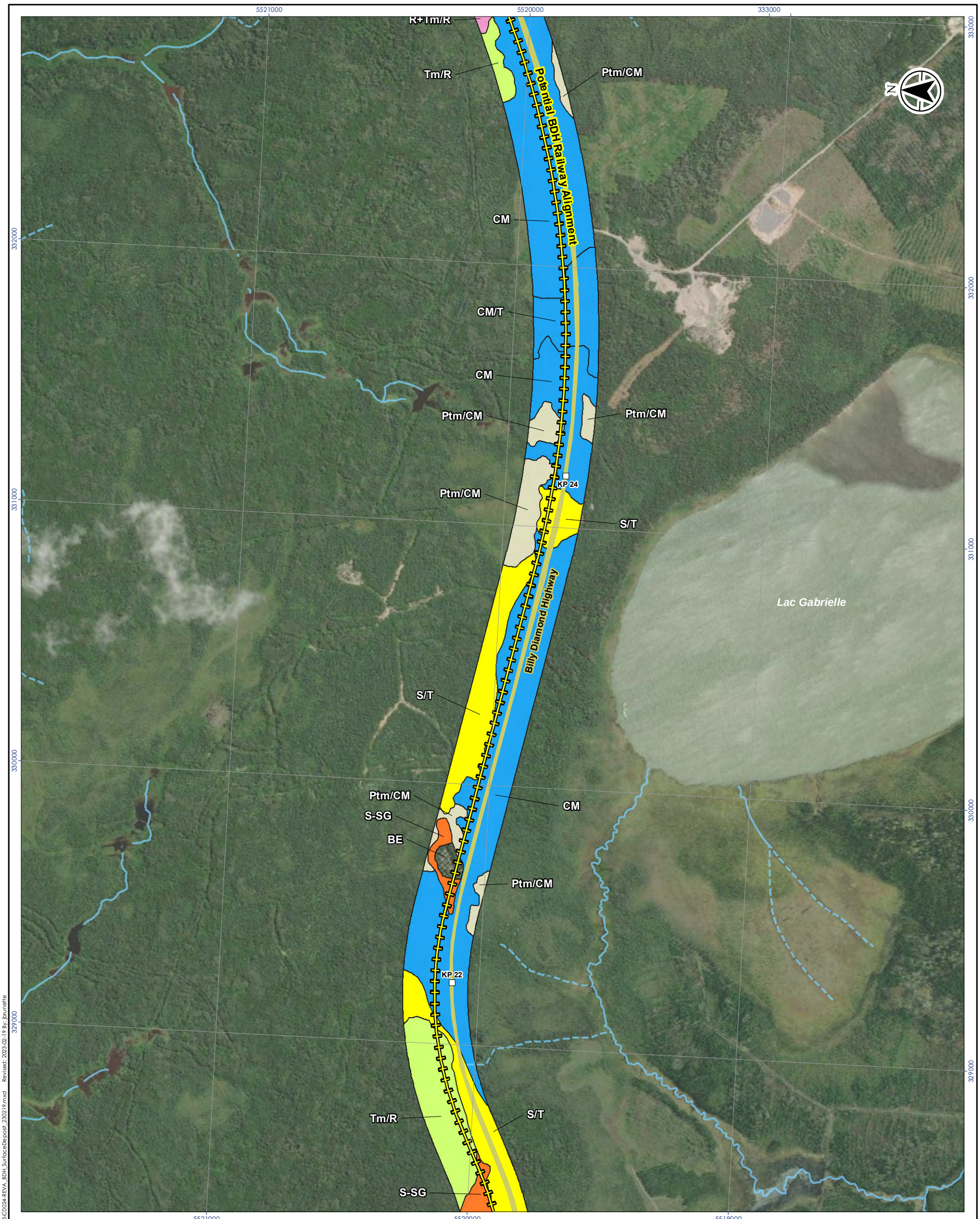
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Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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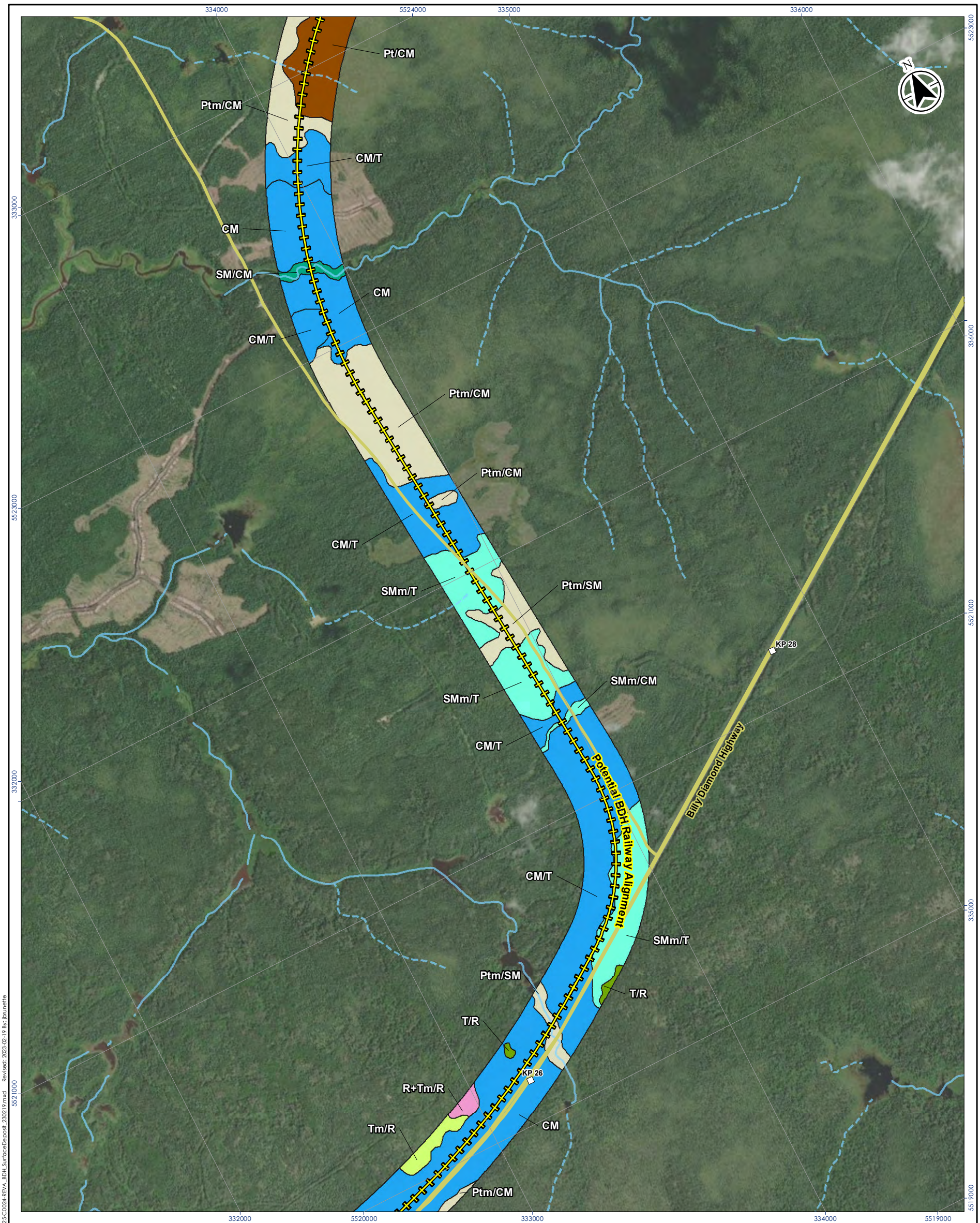
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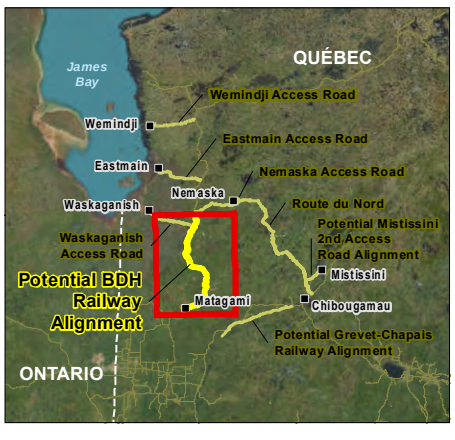
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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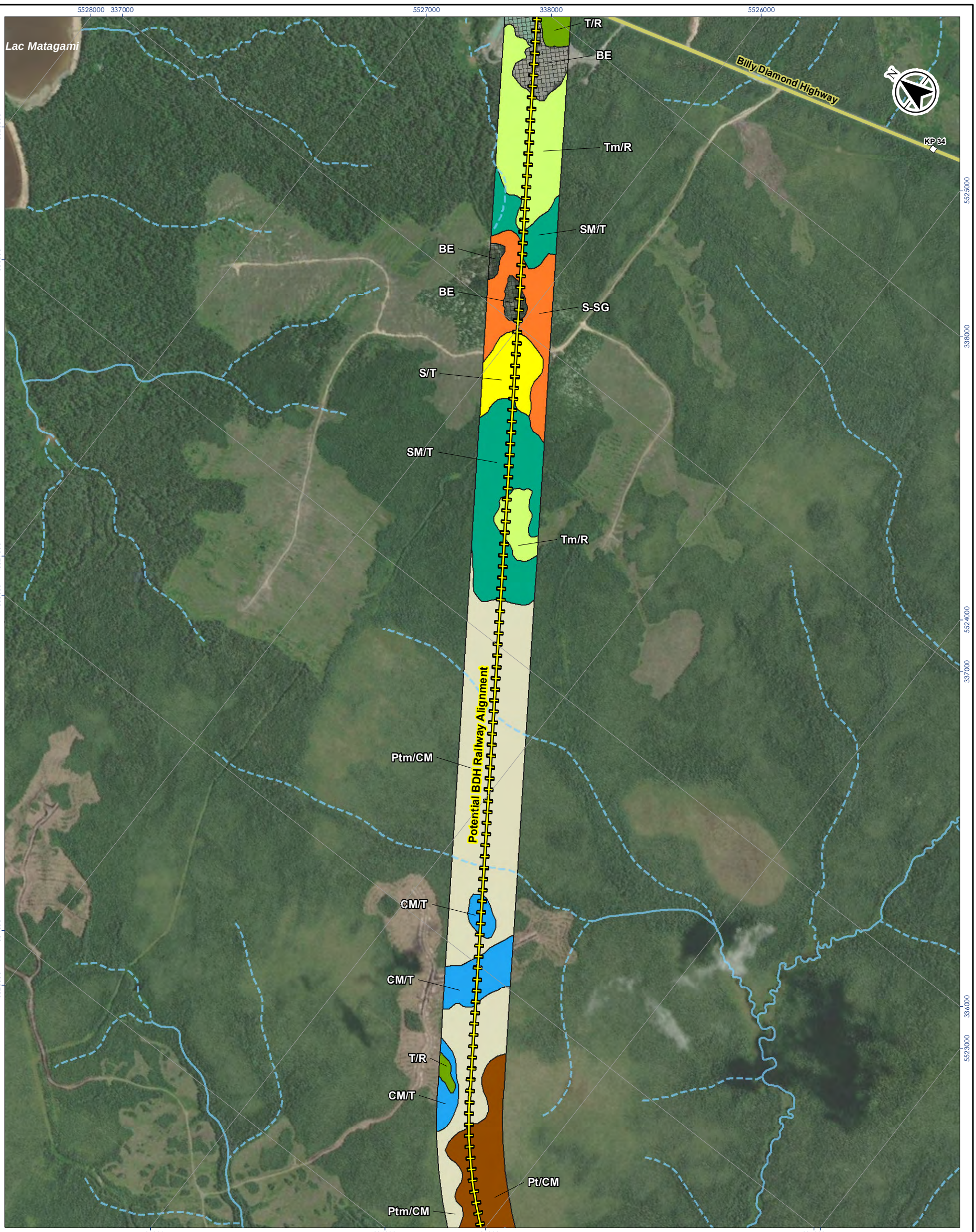
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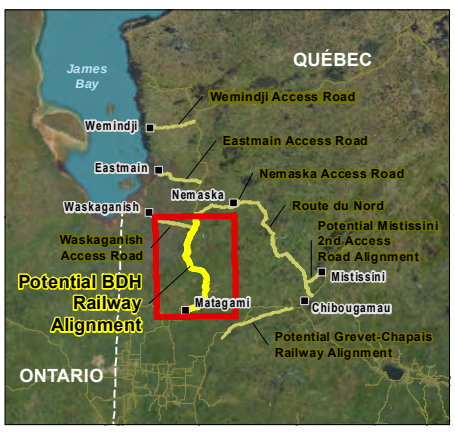
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
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Examples of Layer Overlapping and Thickness

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- Peat (< 2 m thick)
- Peat (> 2 m thick)
- Existing Borrow Source

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

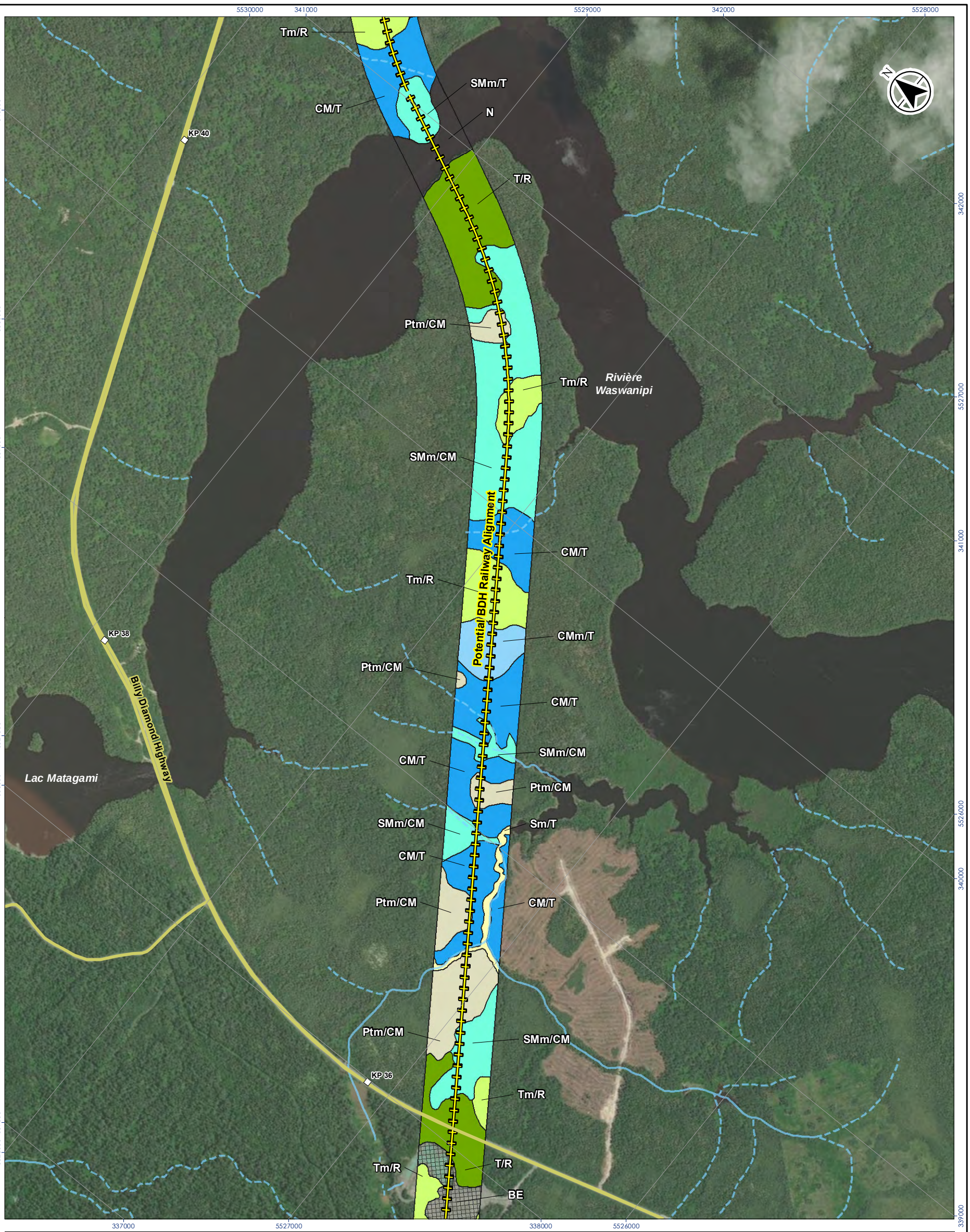
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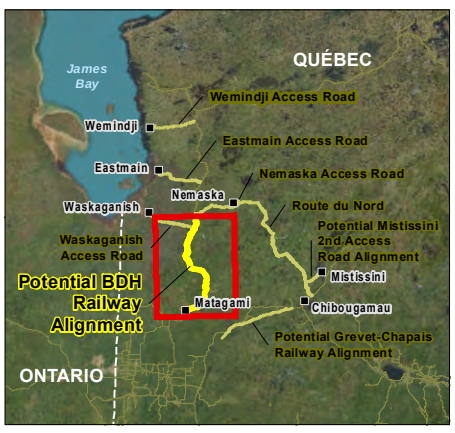
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

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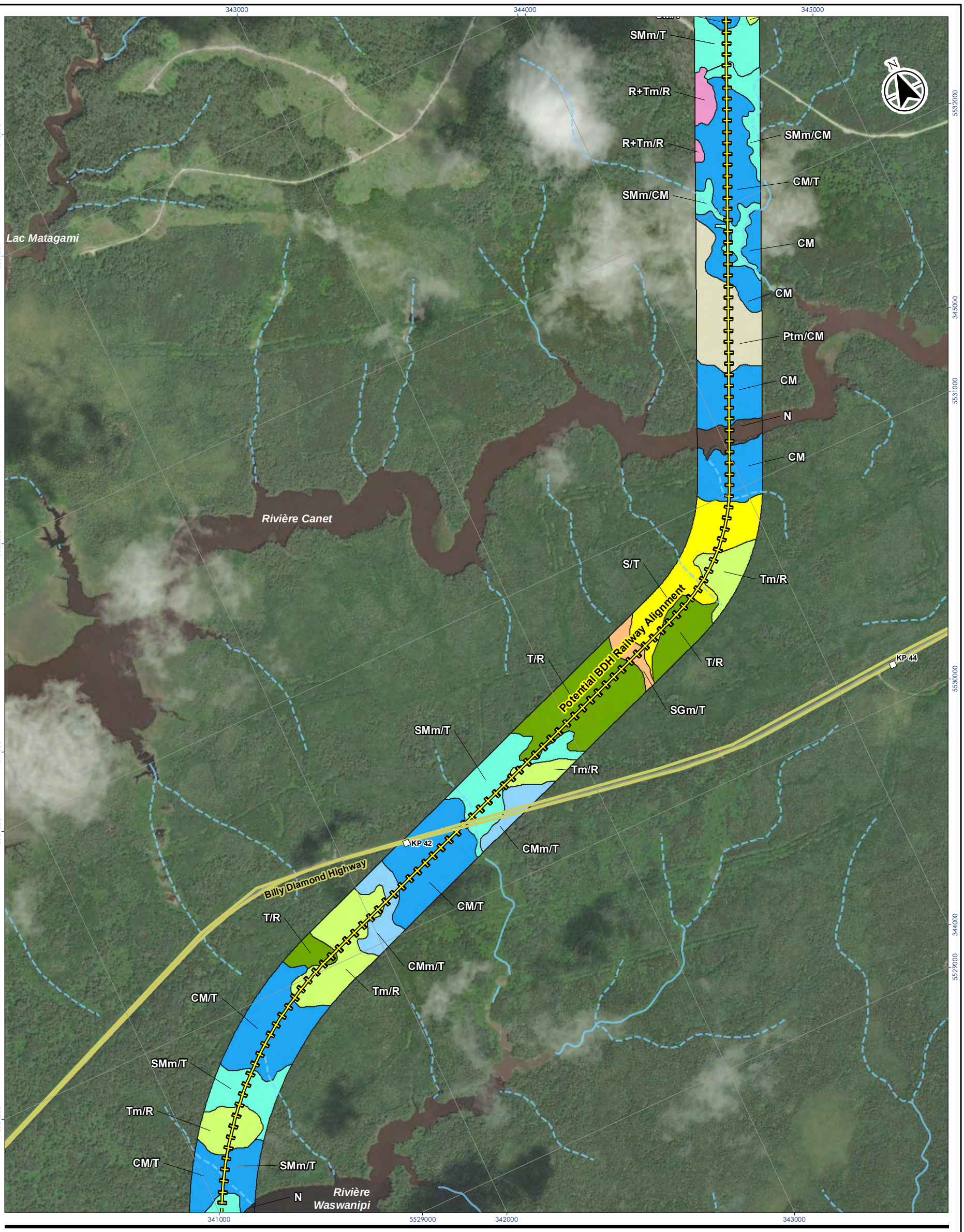
10

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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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Project Location

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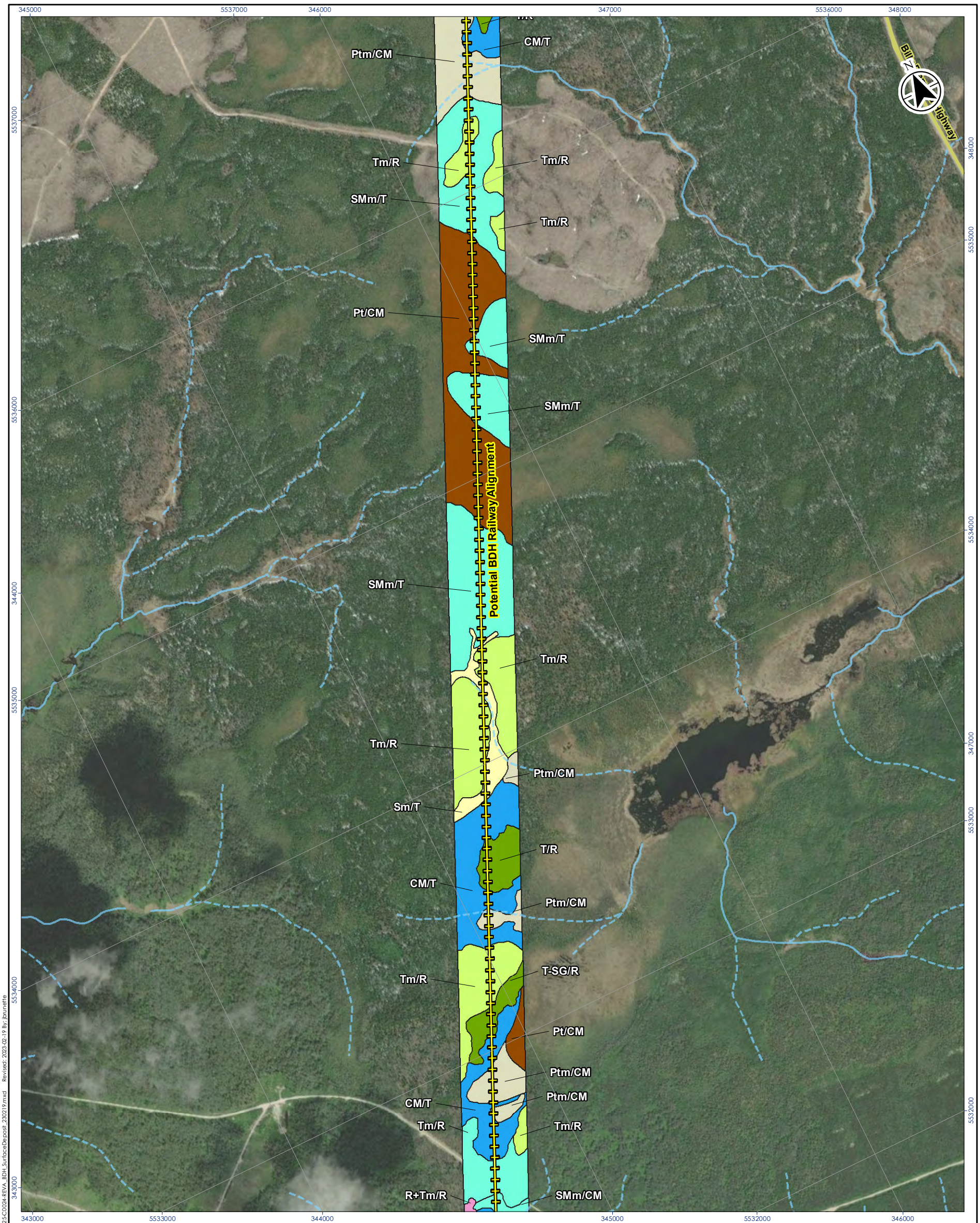
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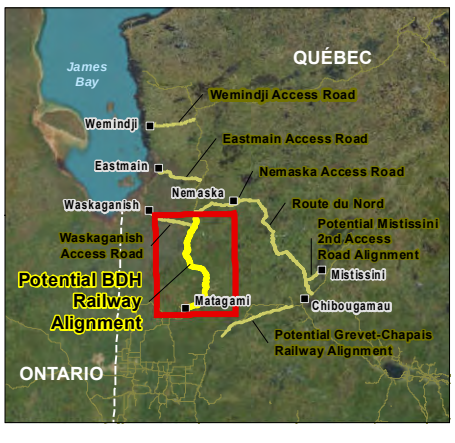
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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0 0,15 0,3 Km

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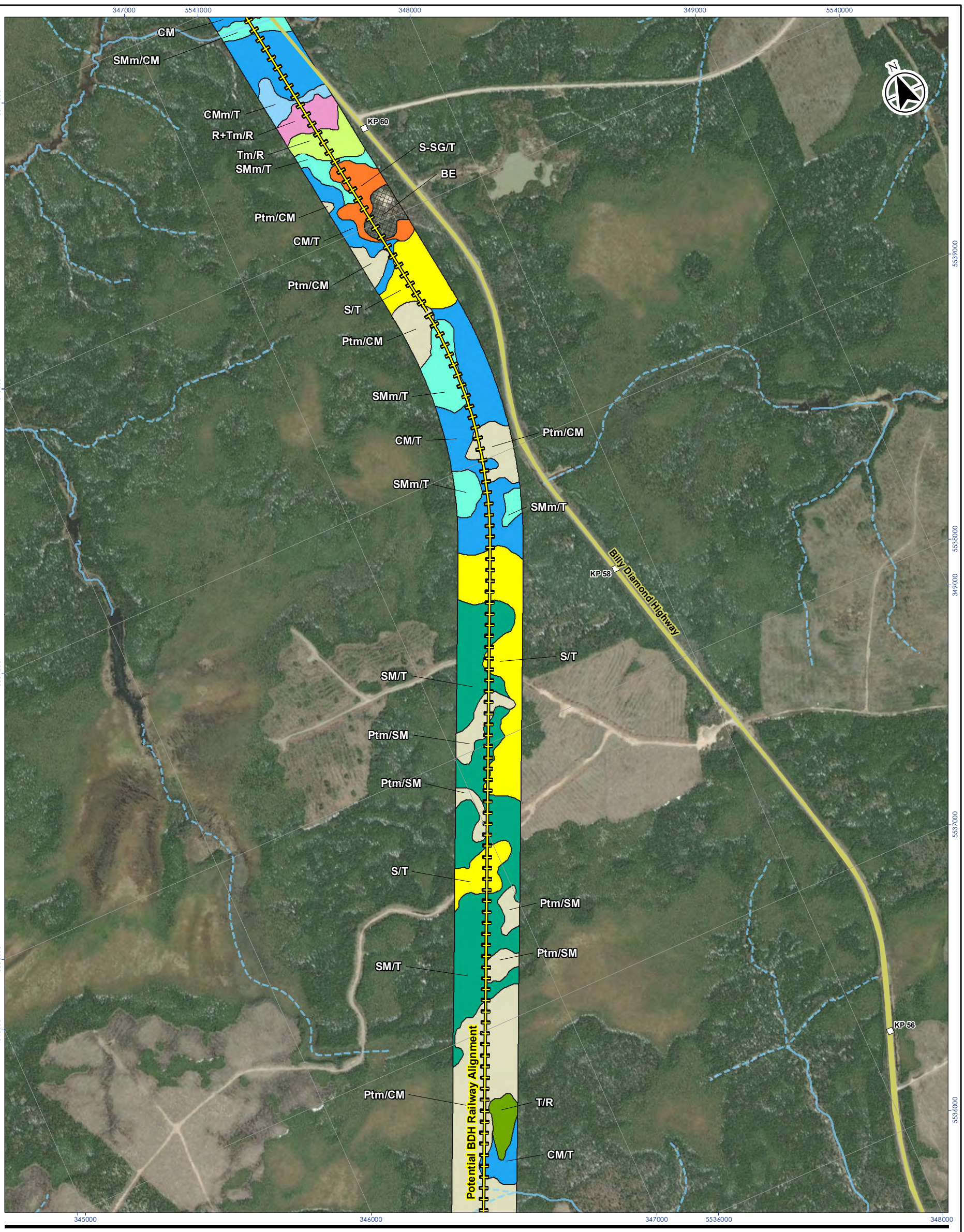
12

Title

Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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Project Location

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La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

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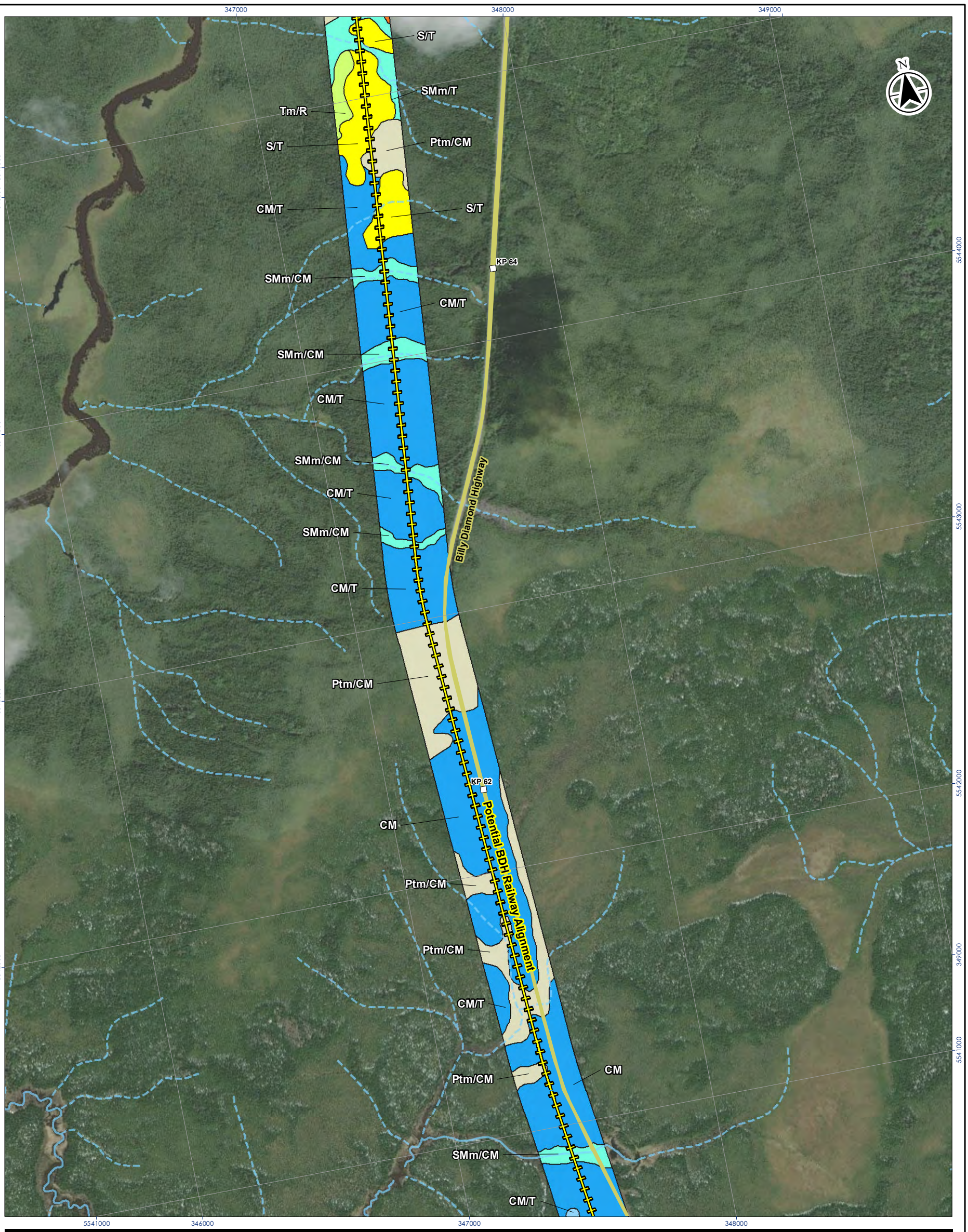
13

Title

Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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0 0,15 0,3 Km

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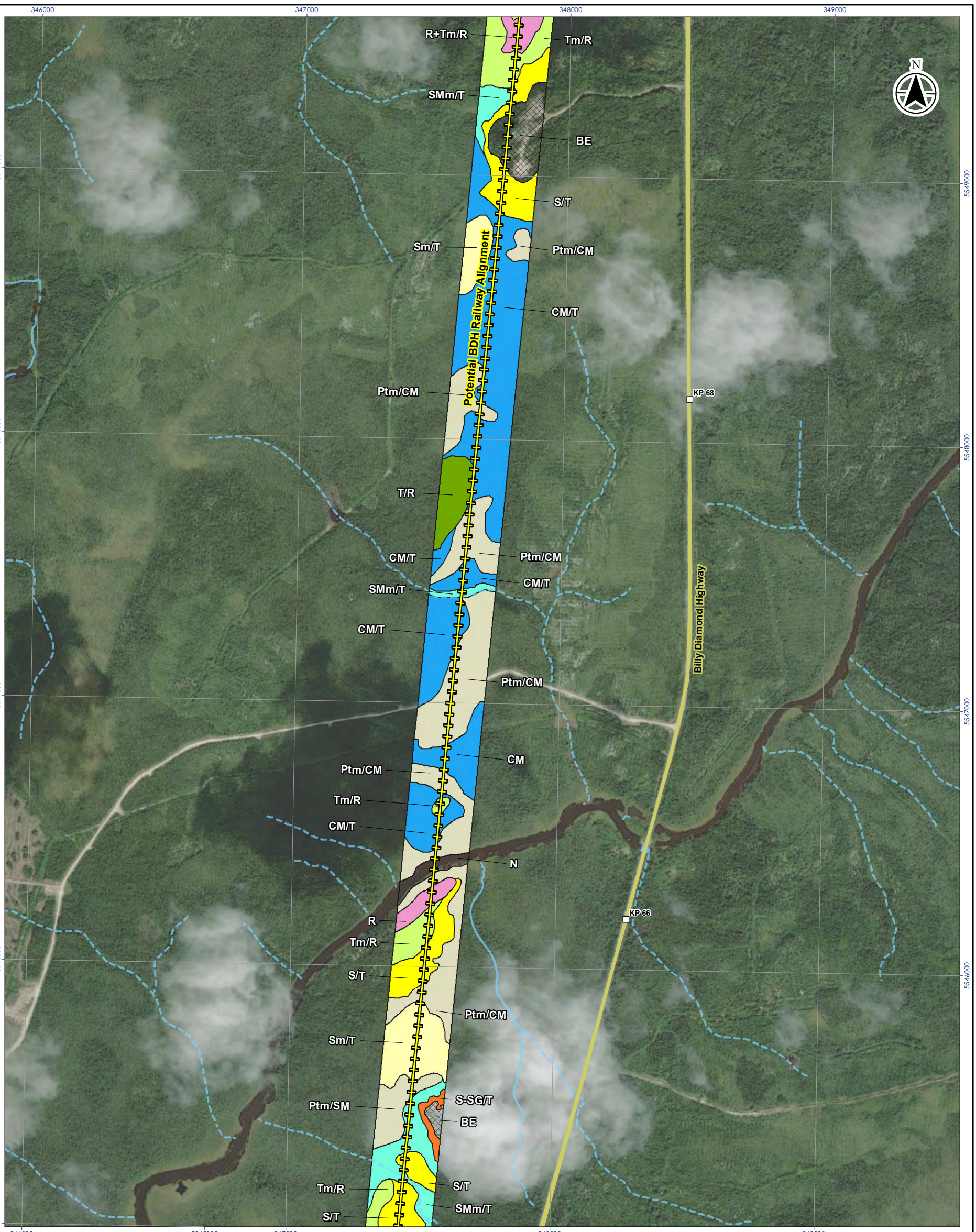
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Surficial Material – Potential BDH Railway

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Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

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Road

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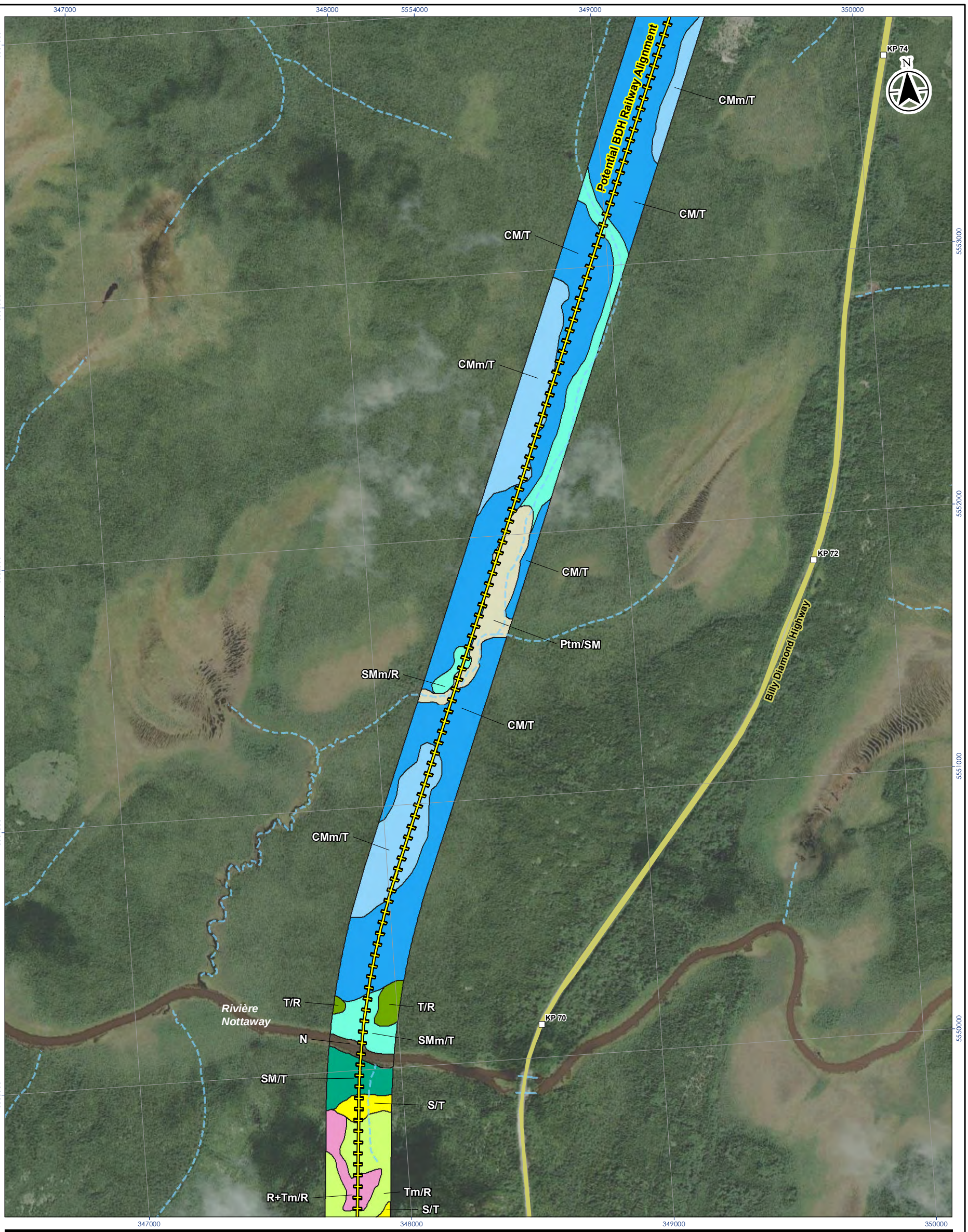
15

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Surficial Material – Potential BDH Railway

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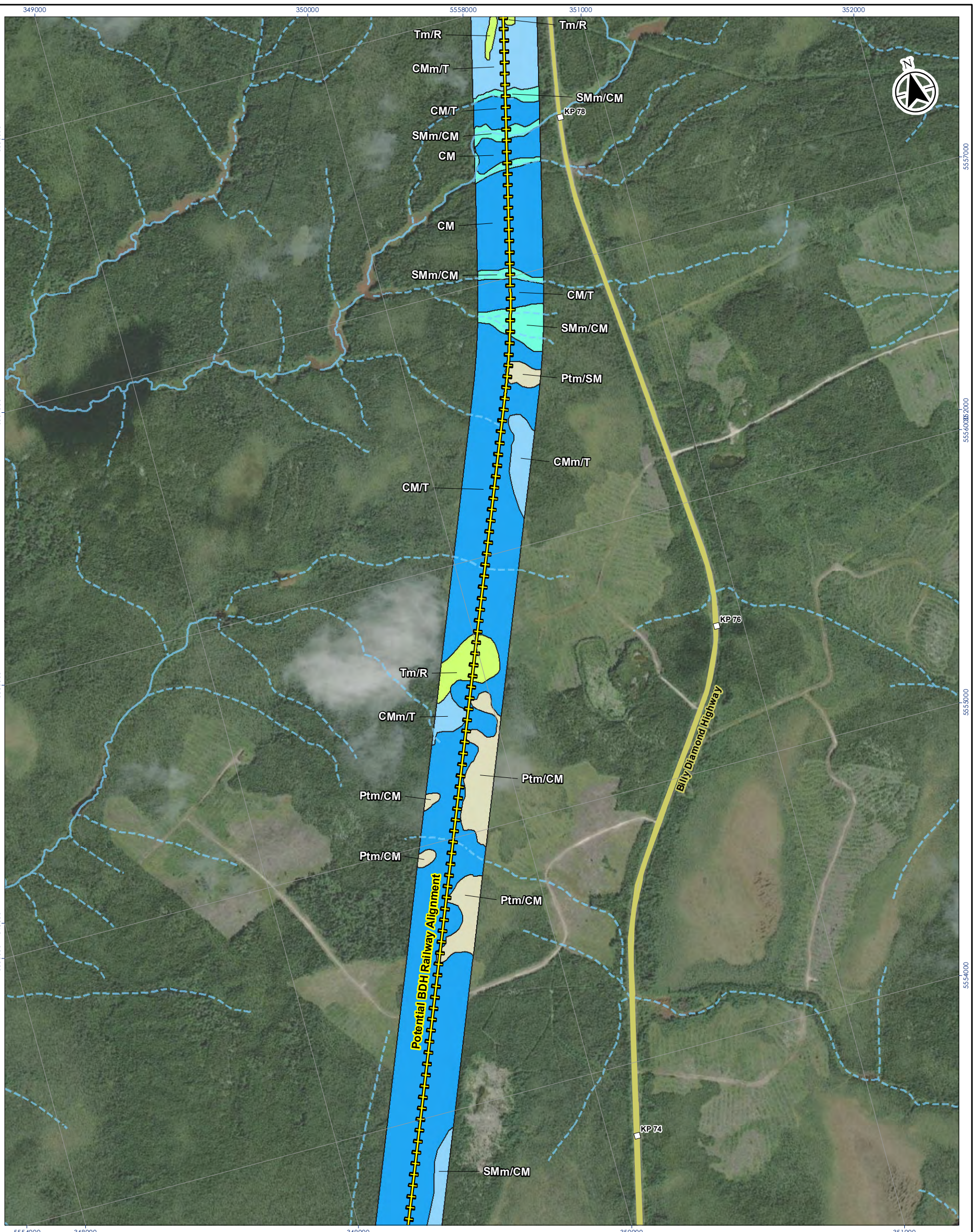
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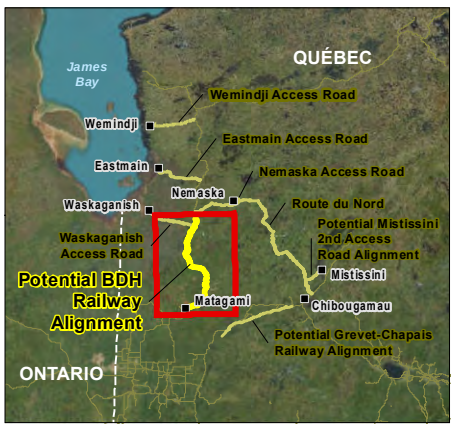
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Notes

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5. Orthoimagery: ESRI-World Imagery, 2012 to 2021

0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
S/T	Layer of sand (2 to 6 m thick) over till
S	Sand (> 6 m thick)

Examples of Combined Symbols

T+B	Till with boulders at the ground surface
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T-SG	Undifferentiated till or sand and gravel

** No Thickness was Interpreted for Boulder Accumulations*

Generalized Surficial Material Classification

- Till (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Clayey silt or silty clay (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

Vision Eeyou Istchee
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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

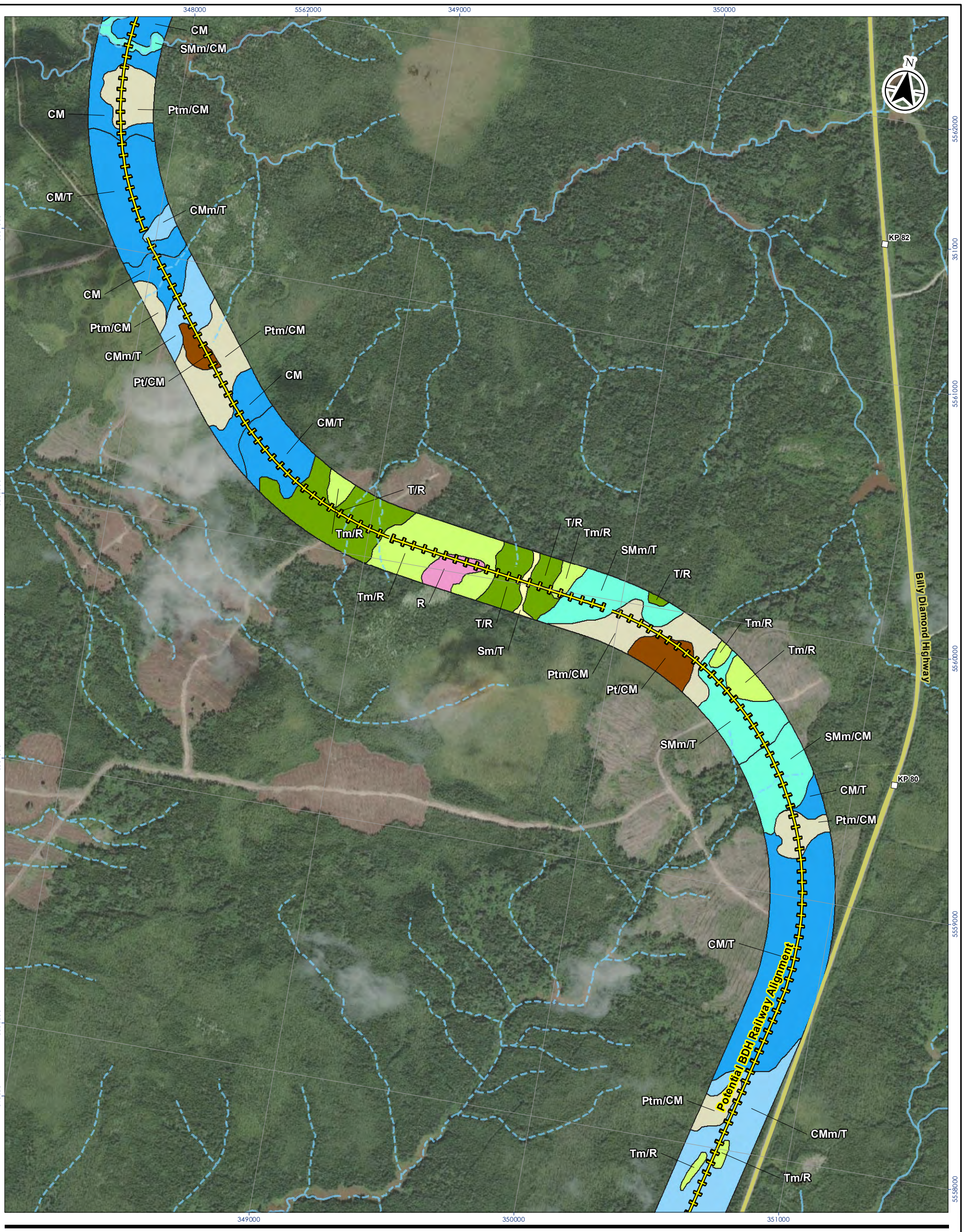
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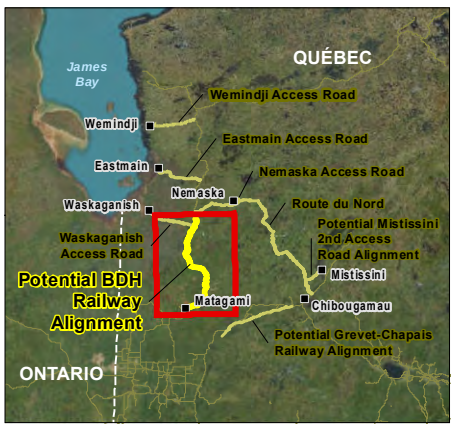
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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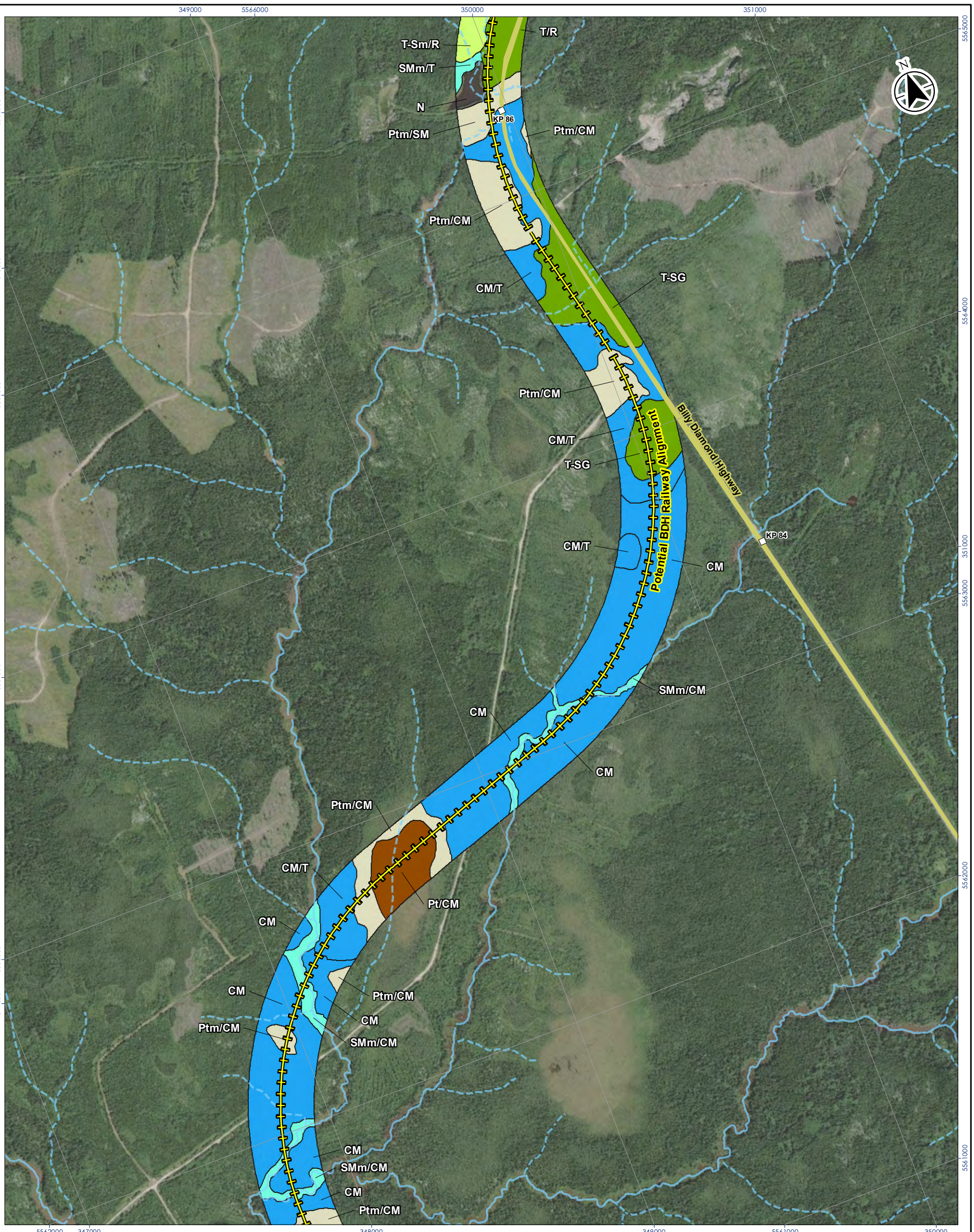
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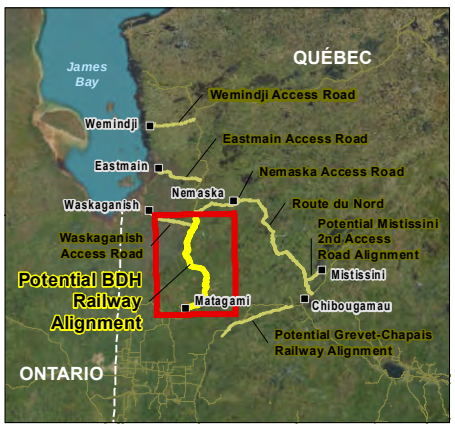
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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- Peat (> 2 m thick)
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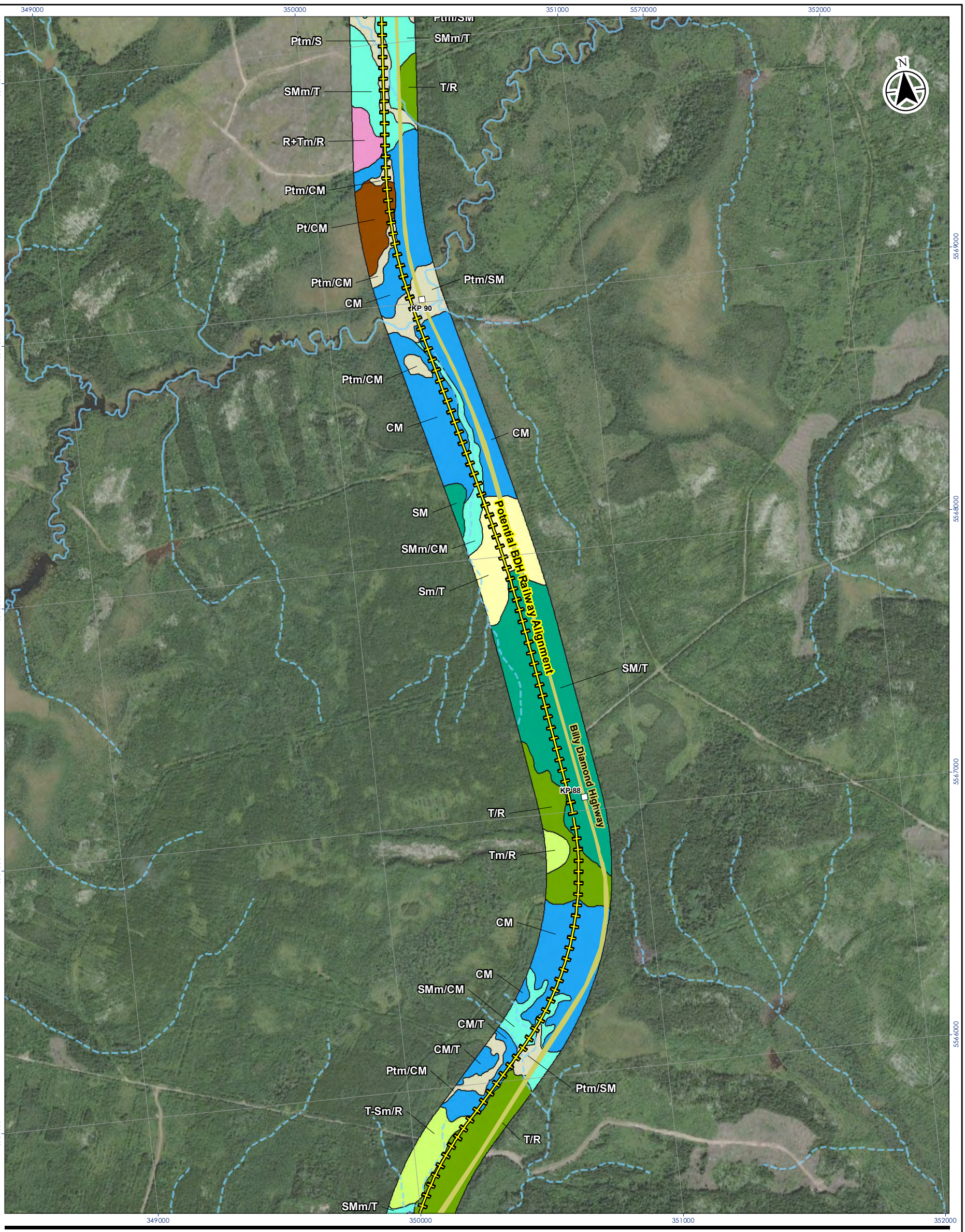
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Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Till (> 2 m thick)
- Sand (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)
- Water Body

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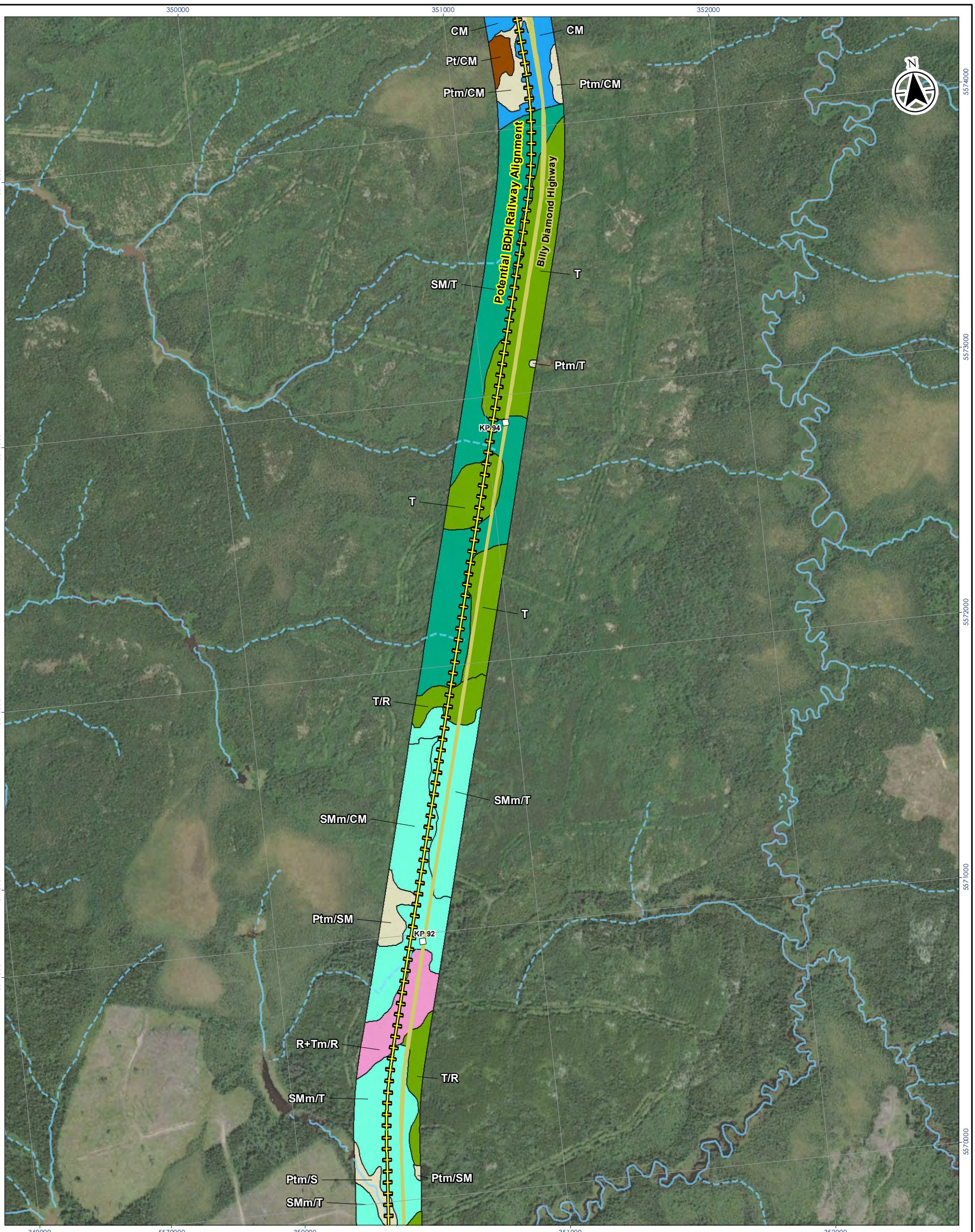
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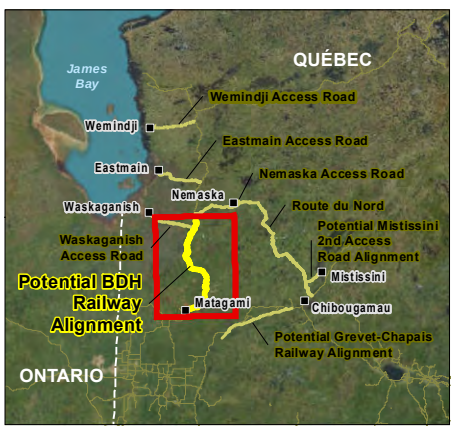
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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** No Thickness was Interpreted for Boulder Accumulations*

Generalized Surficial Material Classification

- Bedrock
- Till (> 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)

Vision Eeyou Istchee
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Project Location

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La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

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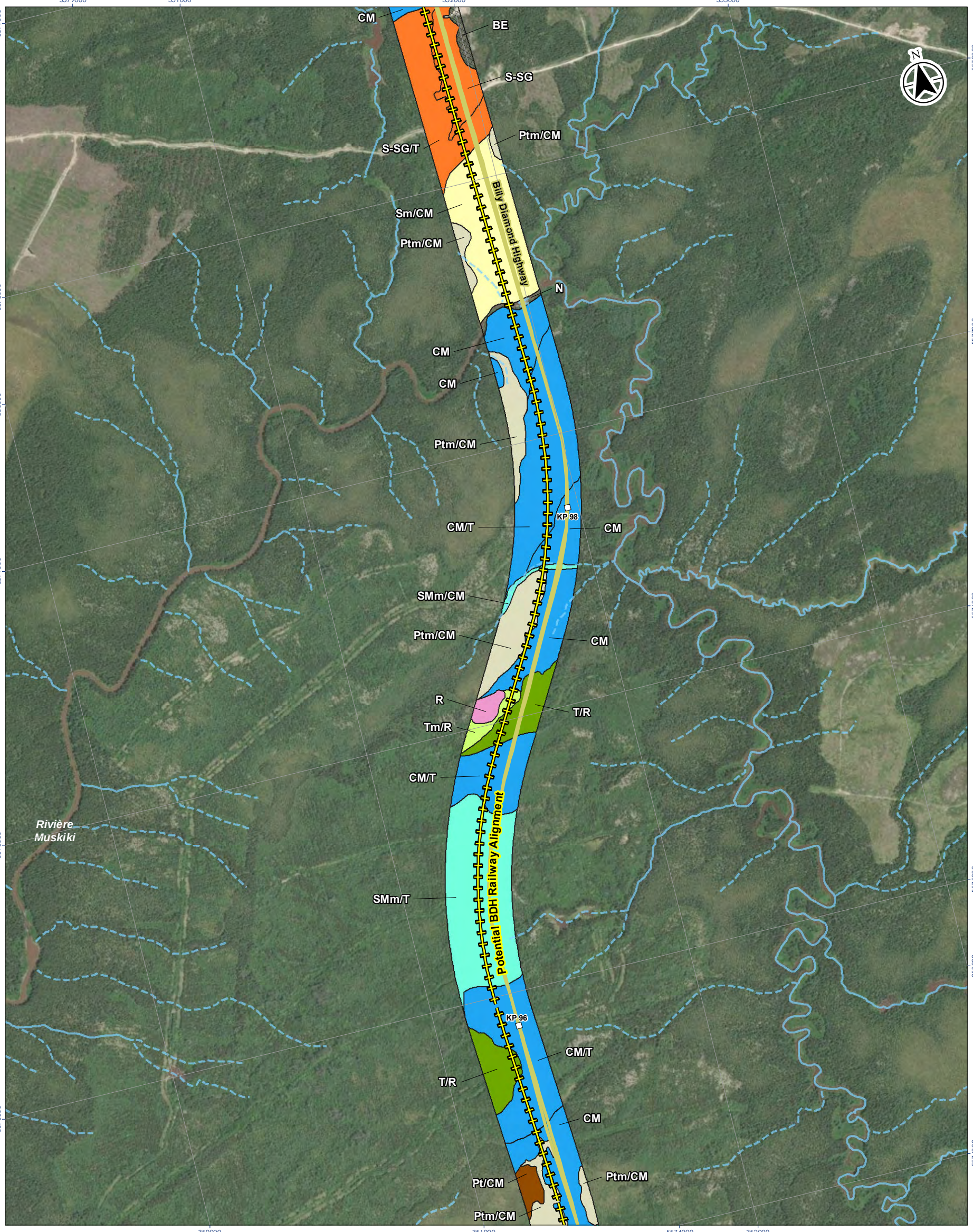
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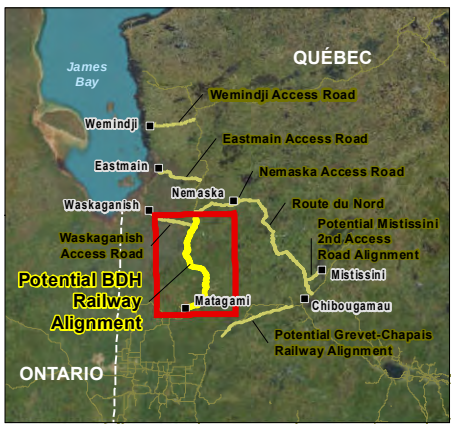
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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- Peat (> 2 m thick)
- Existing Borrow Source
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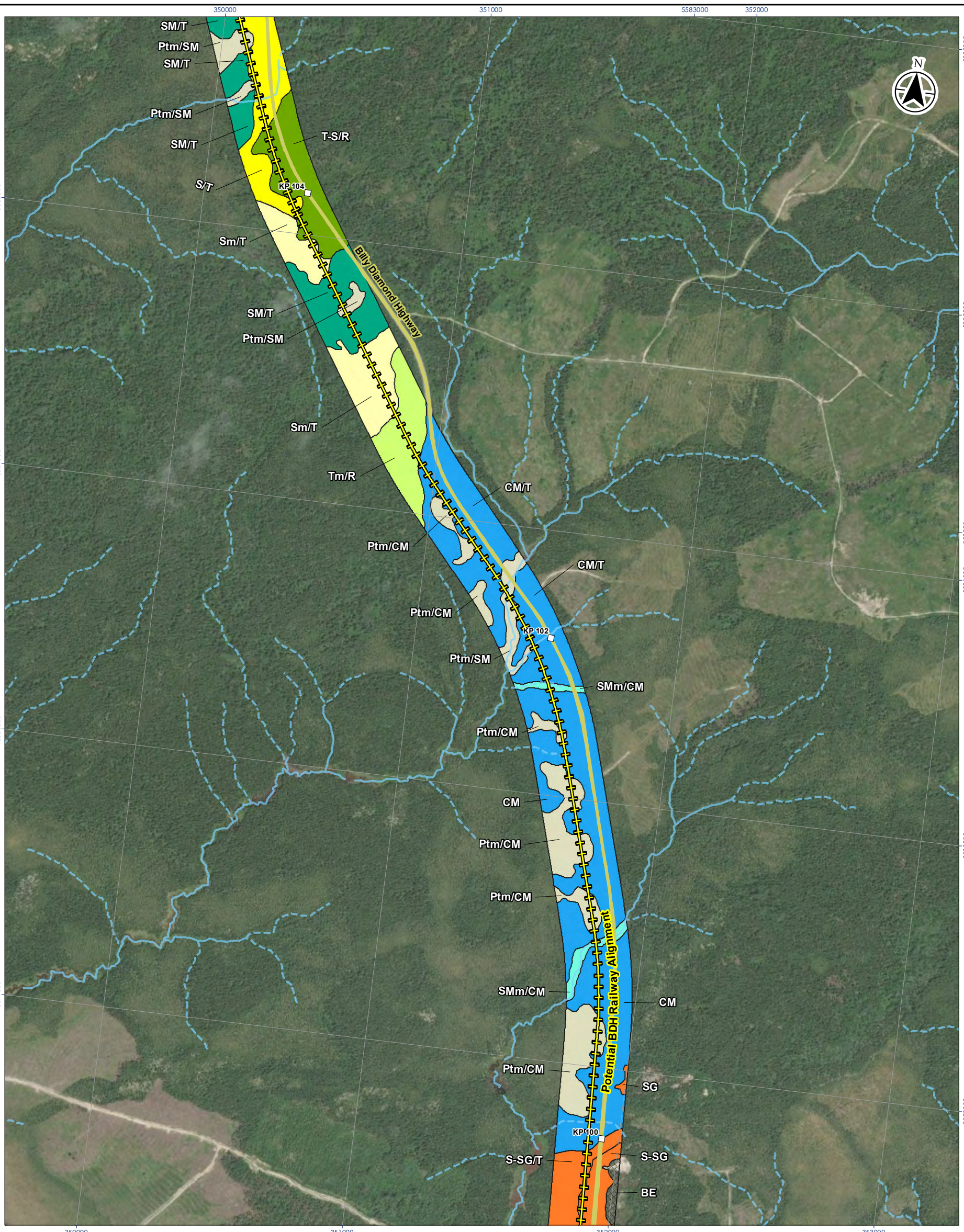
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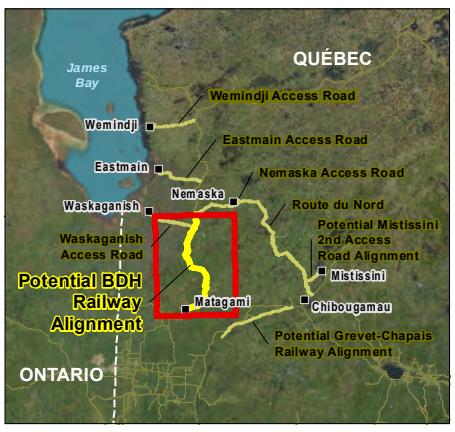
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Surficial Material – Potential BDH Railway

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Potential BDH Railway Alignment

Hydrography

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Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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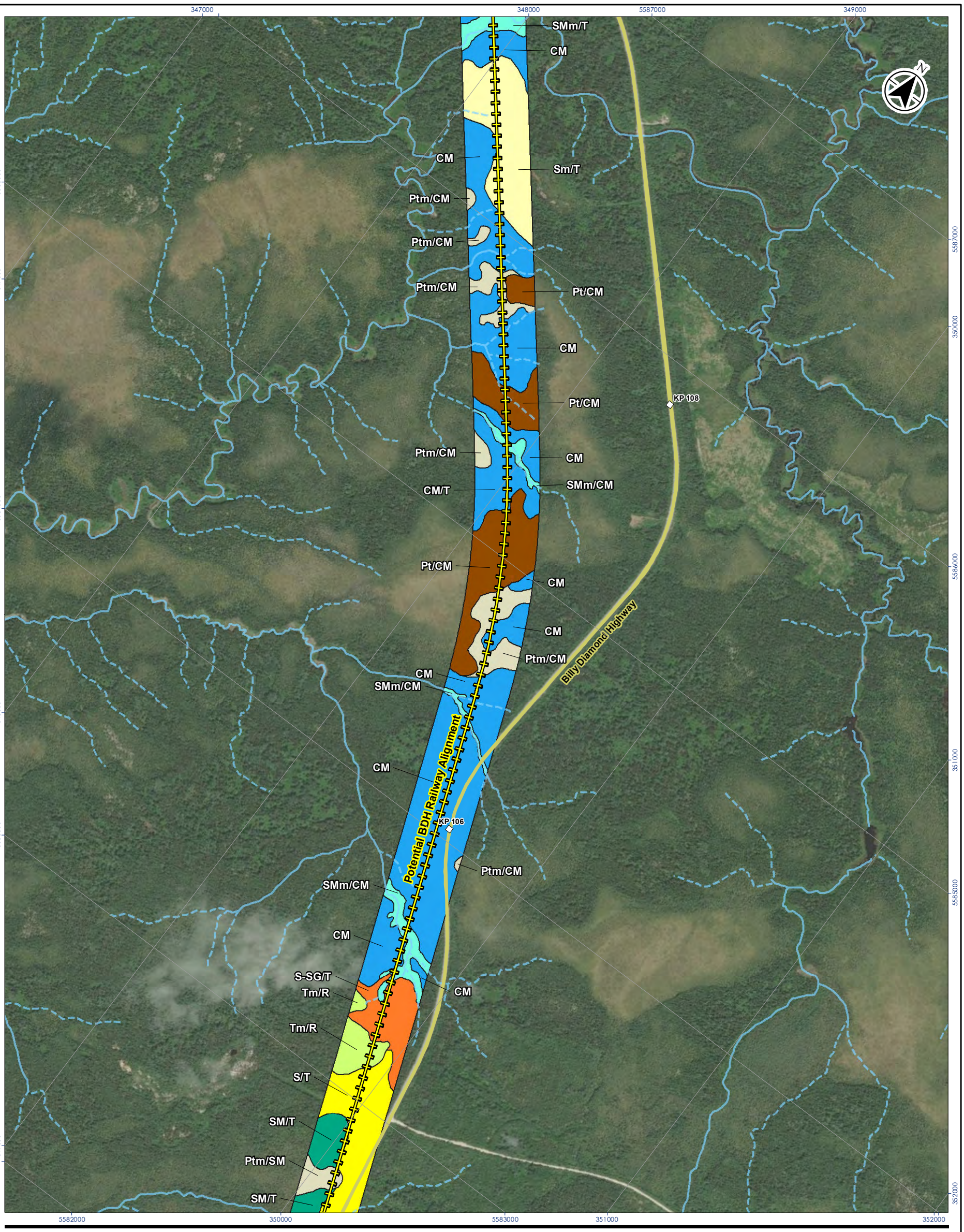
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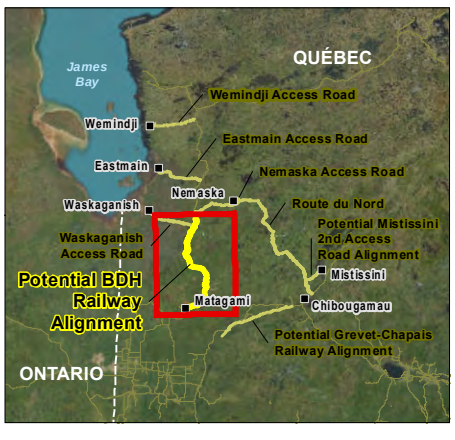
Title

Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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- Till (< 2 m thick)
- Sand and gravel (> 2 m thick)
- Sand (< 2 m thick)
- Sand (> 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)

Notes

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0 0,15 0,3 Km

1:15 000 (At Original document size of 11x17)

Vision Eeyou Istchee

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA

Prepared by Julie Brunette on 2023-02-19

Technical Review by Manuel Verpaelst on 2023-02-19

Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation

La Grande Alliance – Feasibility Study

Phase 1 – Preliminary Geotechnical Investigation

Map No.

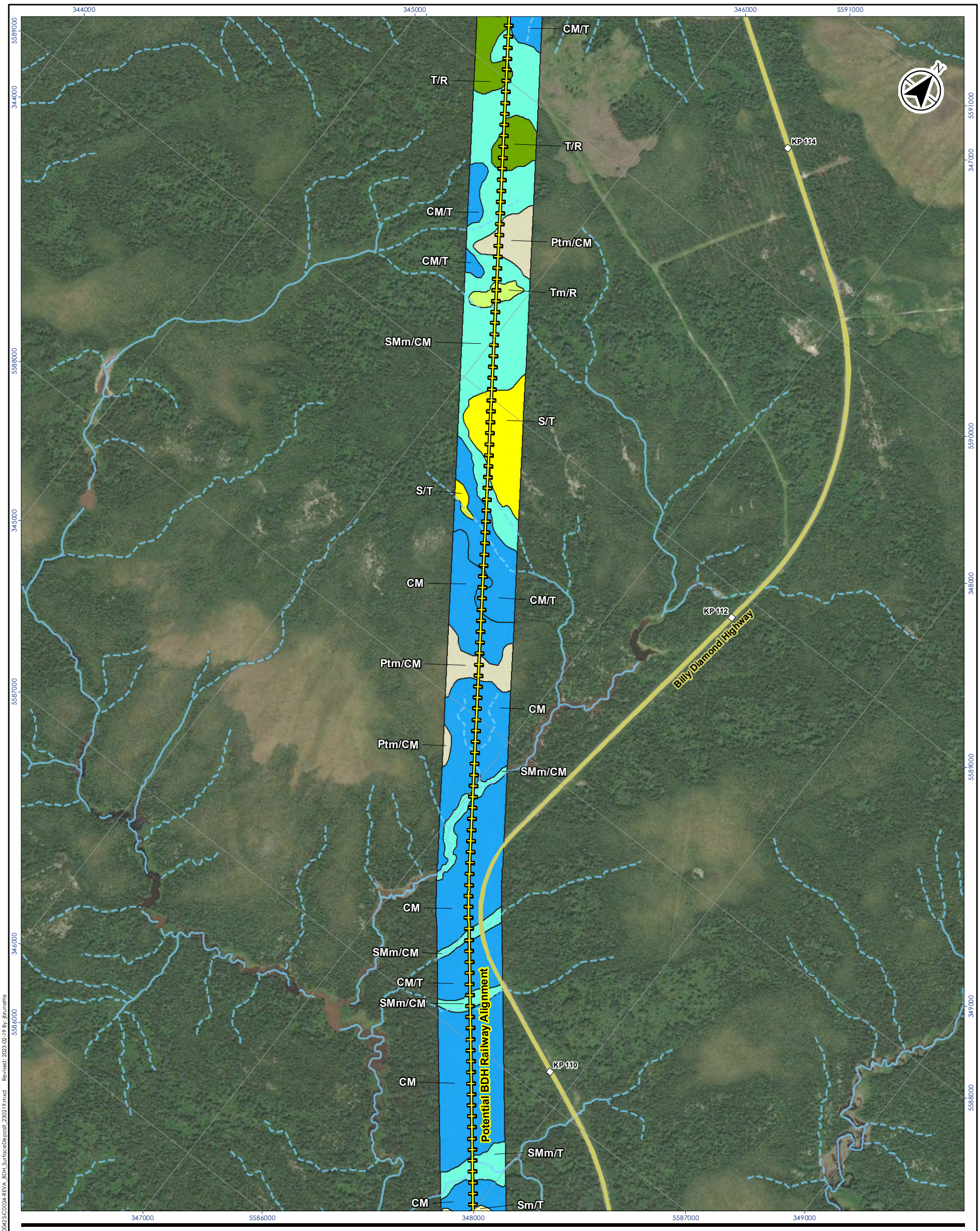
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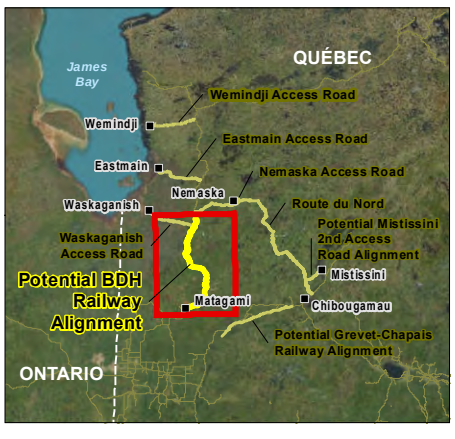
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
S/T	Layer of sand (2 to 6 m thick) over till
S	Sand (> 6 m thick)

Examples of Combined Symbols

T+B	Till with boulders at the ground surface
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T-SG	Undifferentiated till or sand and gravel

** No Thickness was Interpreted for Boulder Accumulations*

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- Sand (> 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

Vision Eeyou Istchee — Connect • Develop • Protect

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Project Location

Eeyou Istchee, Québec

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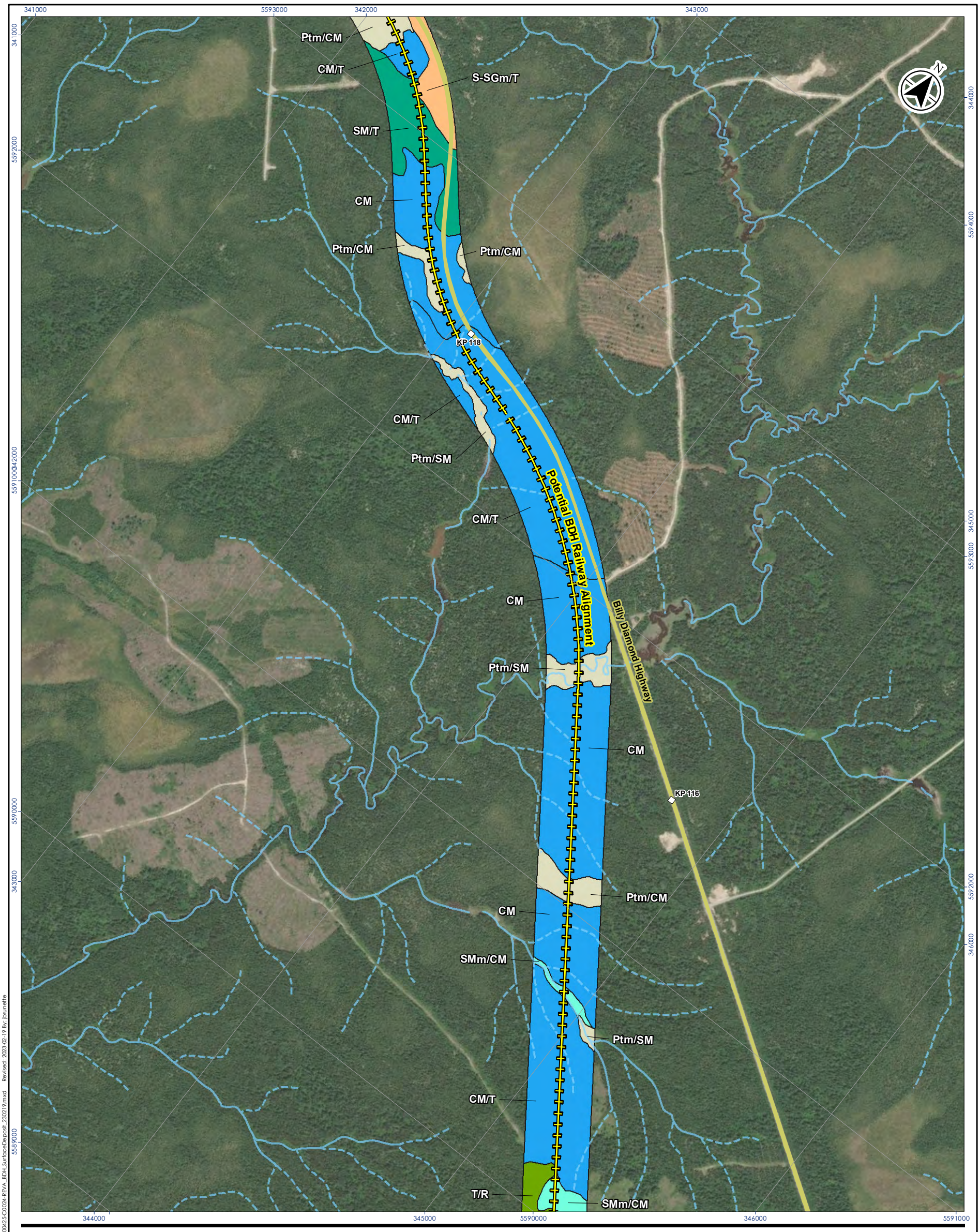
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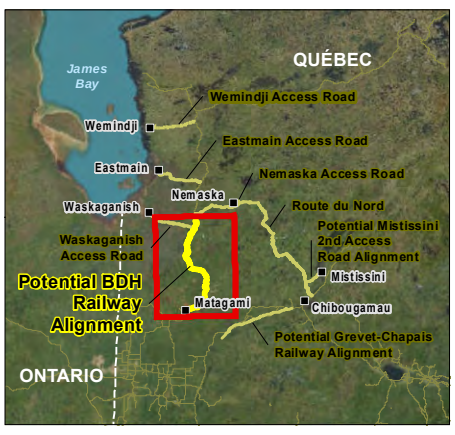
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
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Pt	Peat
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Generalized Surficial Material Classification

- Till (> 2 m thick)
- Sand and gravel (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

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Project Location

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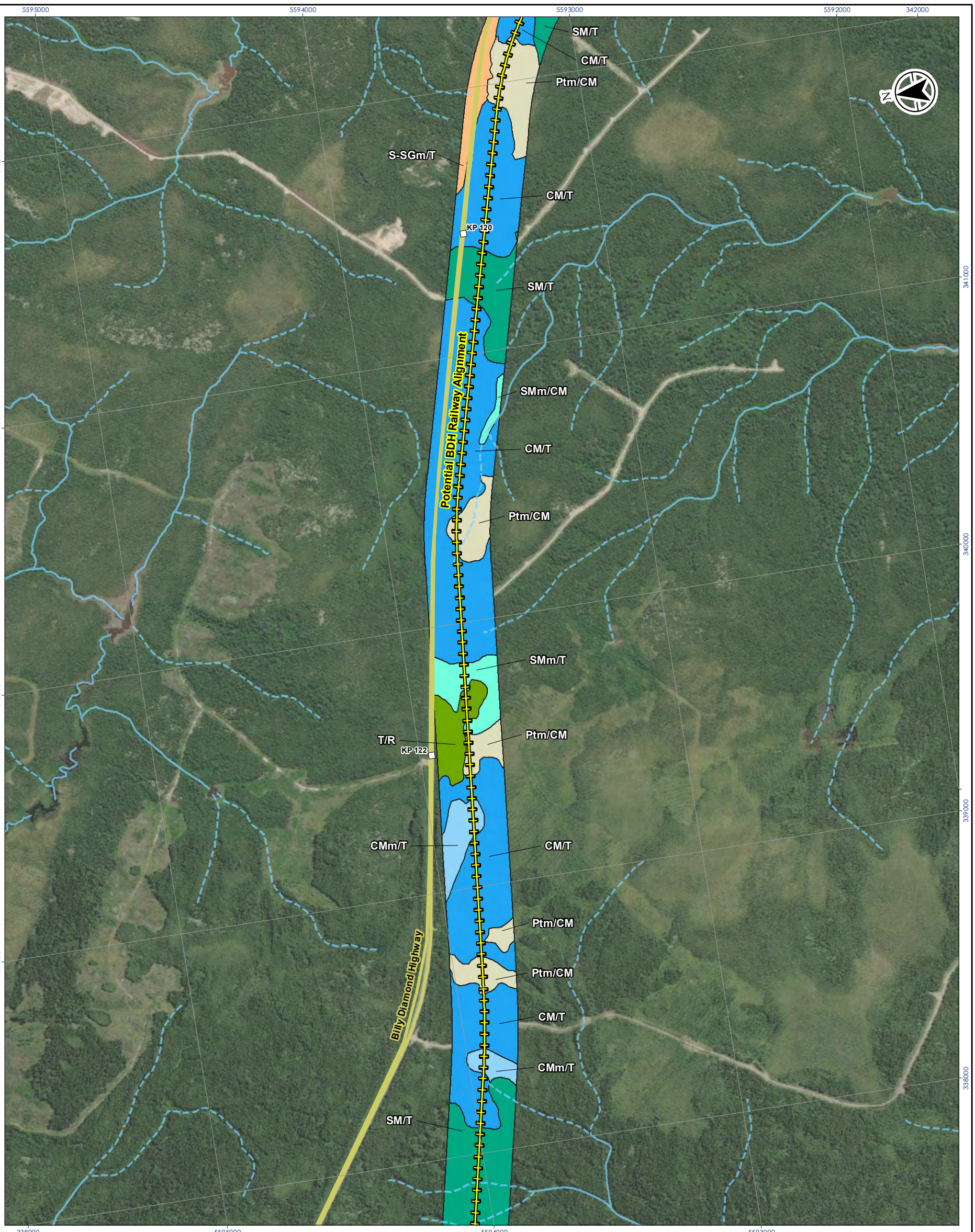
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Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
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- Sand and gravel (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

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Project Location

Eeyou Istchee, Québec

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Client/Project

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La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

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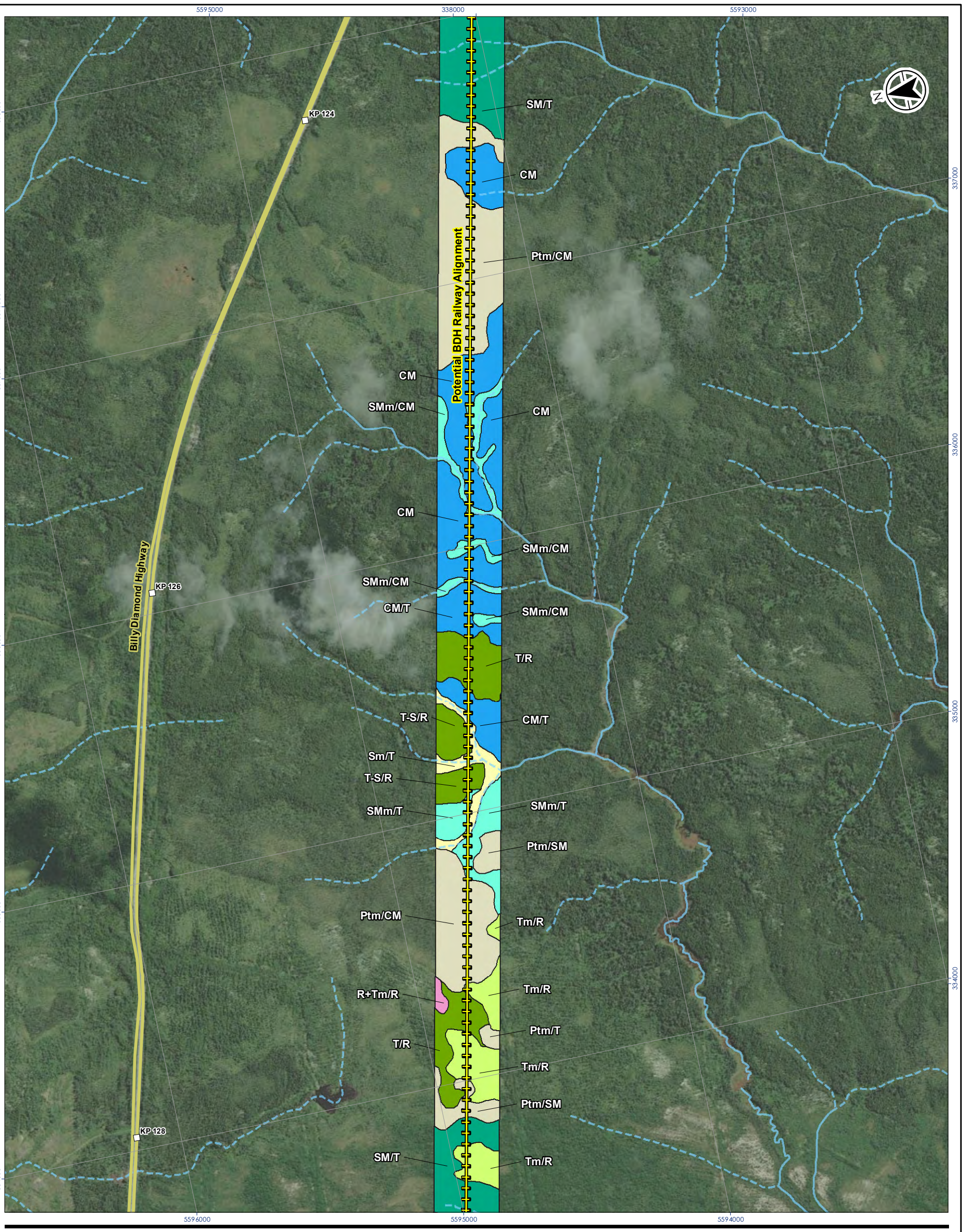
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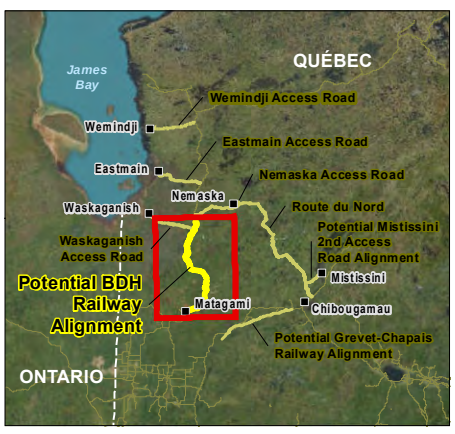
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

1:15 000 (At Original document size of 11x17)

Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
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- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

Vision Eeyou Istchee — Connect • Develop • Protect

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Project Location

Eeyou Istchee, Québec

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La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

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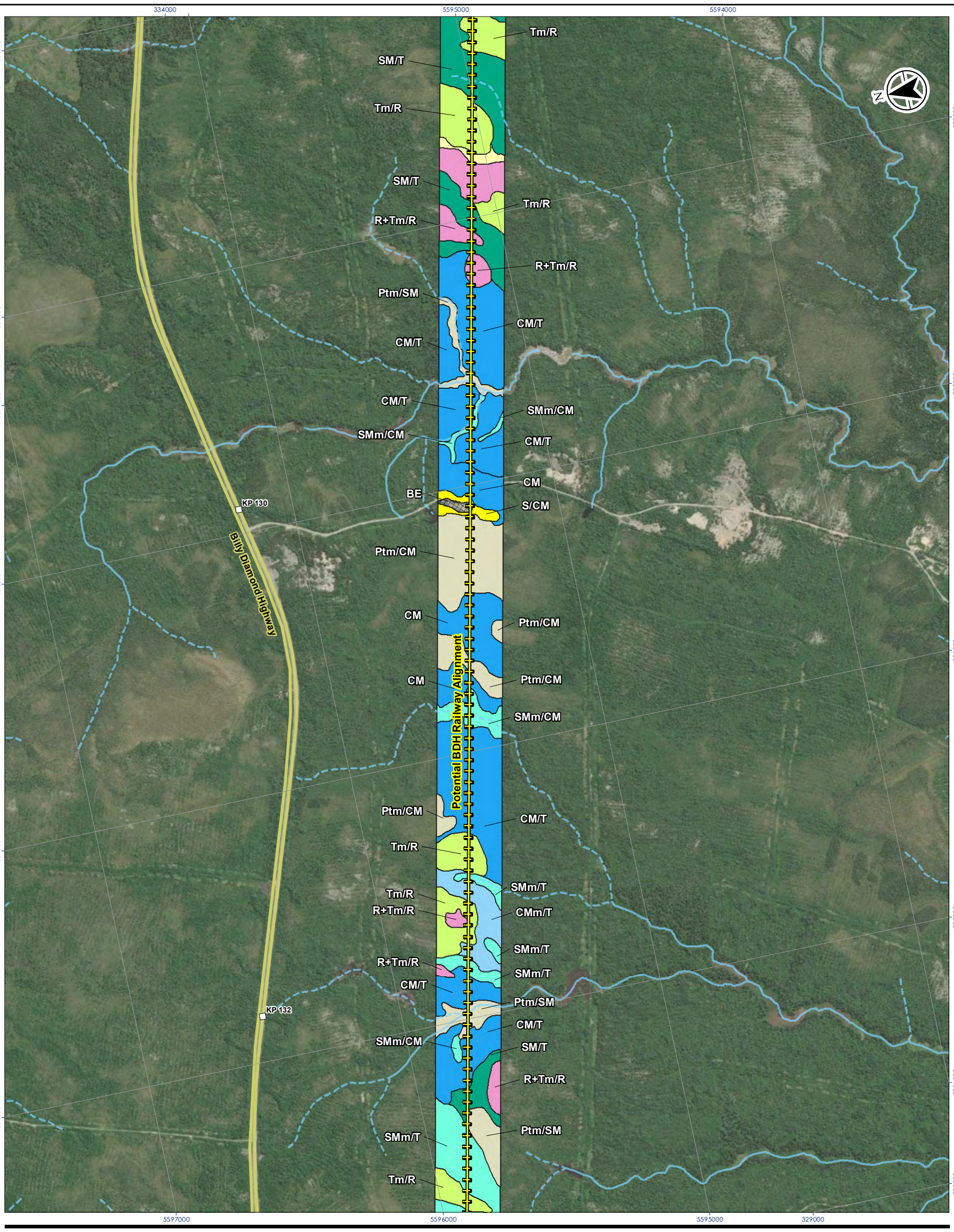
28

Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

1:15 000 (At Original document size of 11x17)

Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
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Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

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- Sand (< 2 m thick)
- Sand (> 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Existing Borrow Source

Vision Eeyou Istchee — Connect • Develop • Protect

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Project Location

Eeyou Istchee, Québec

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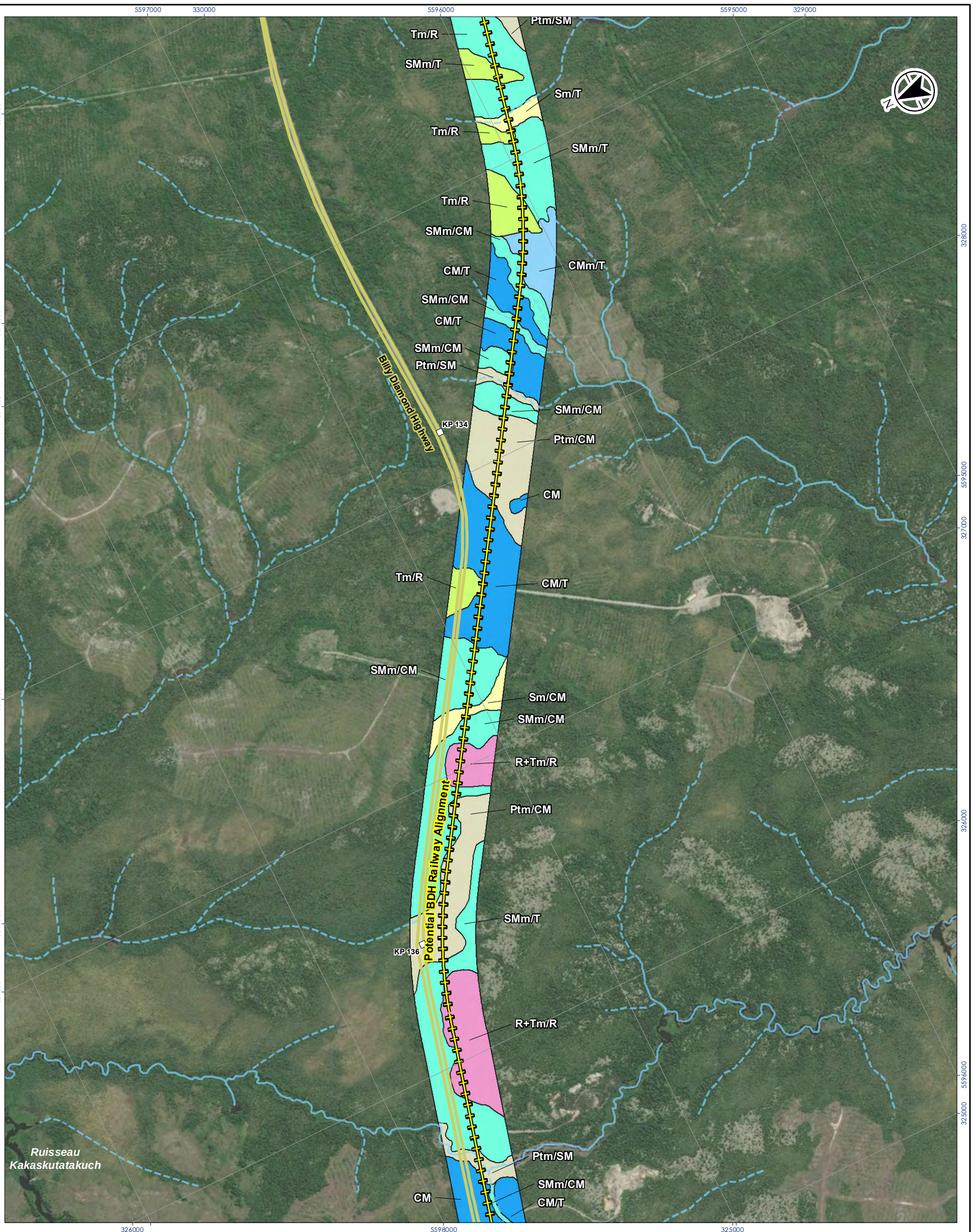
29

Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
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- Sand (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Clayey silt or silty clay (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

Vision Eeyou Istchee
Connect • Develop • Protect
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Project Location

Eeyou Istchee, Québec

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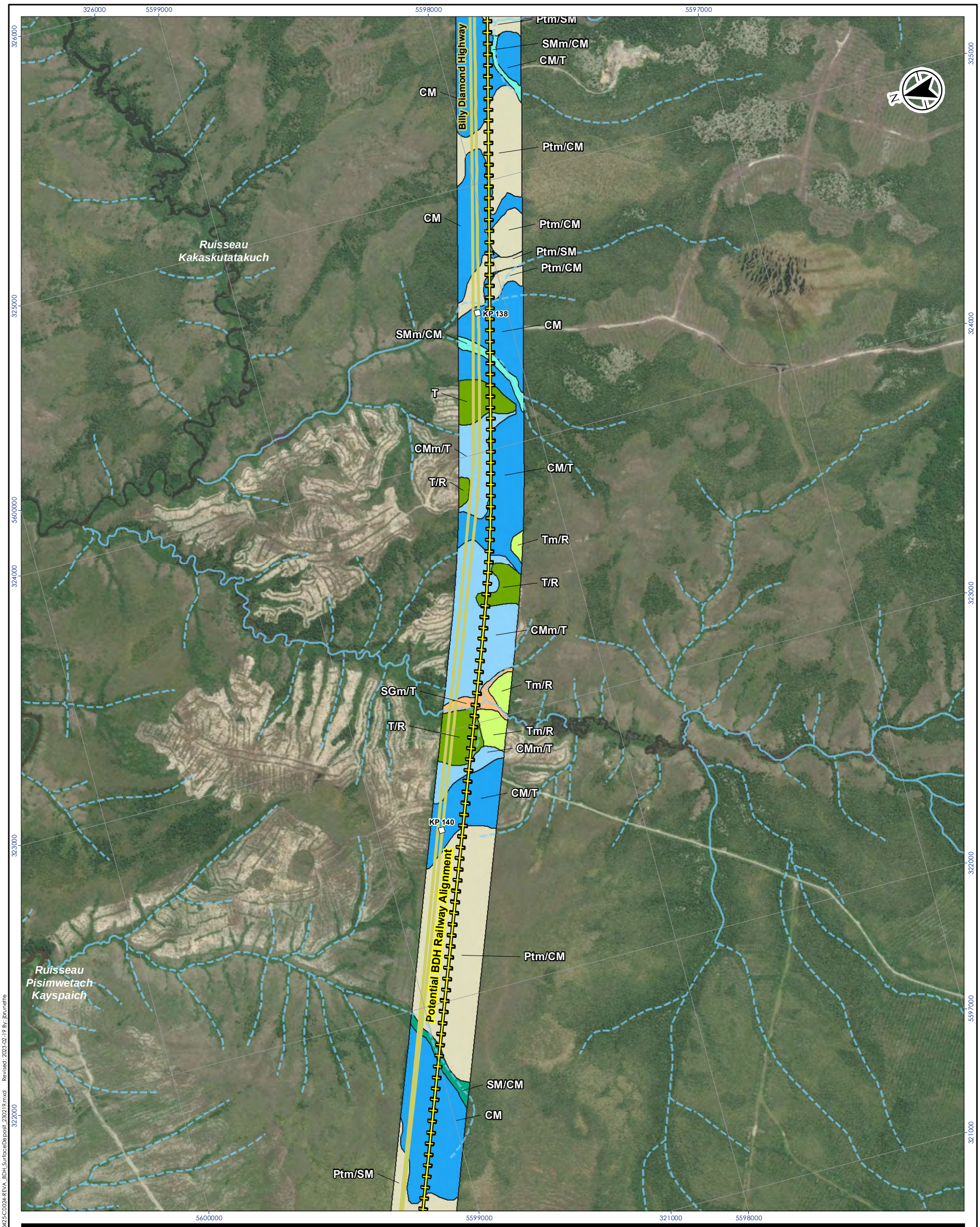
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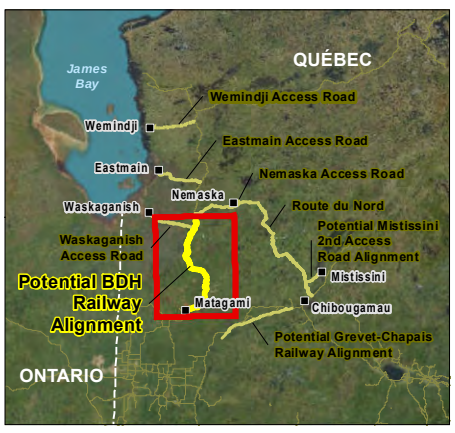
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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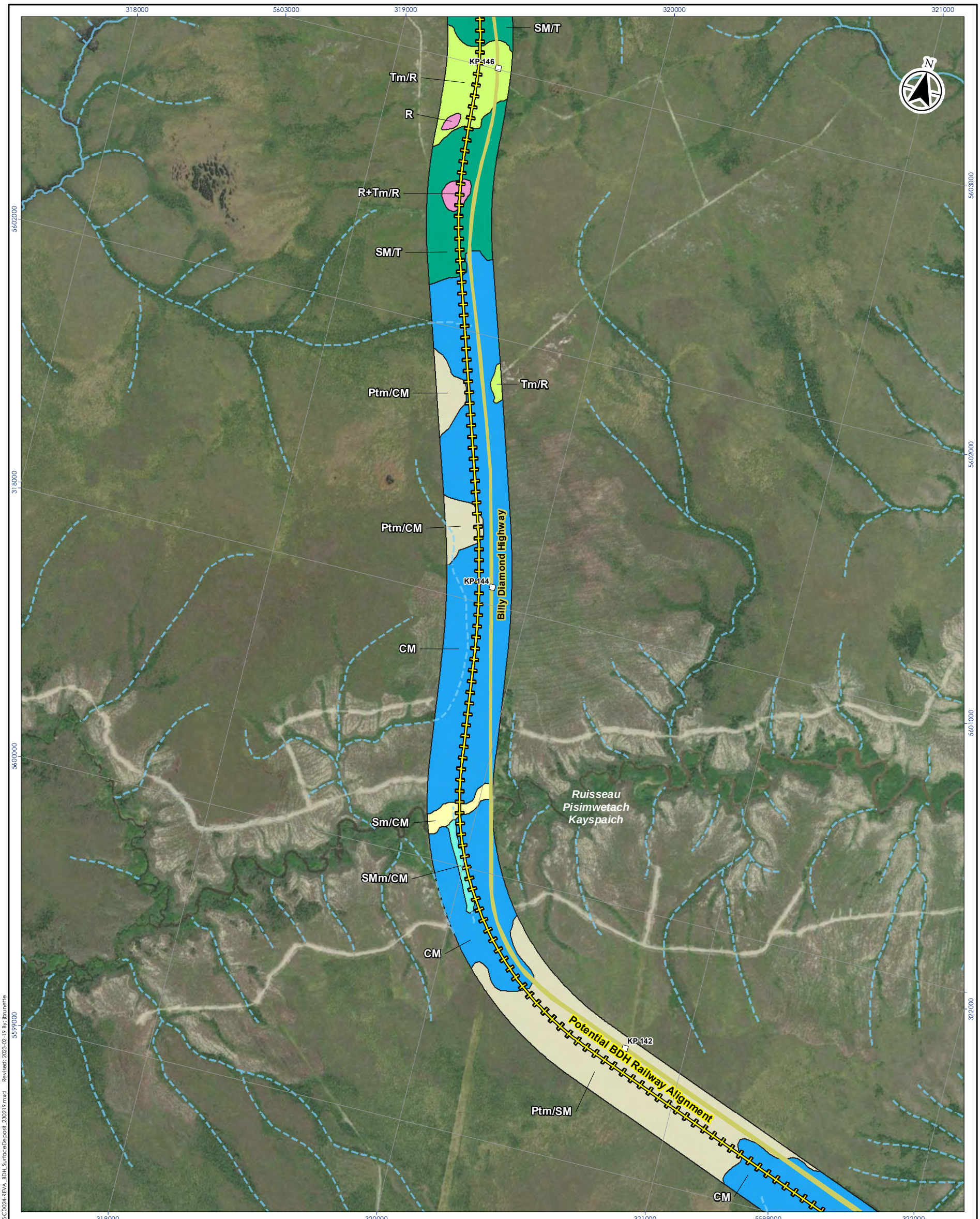
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Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

1:15 000 (At Original document size of 11x17)

Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
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Generalized Surficial Material Classification

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- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

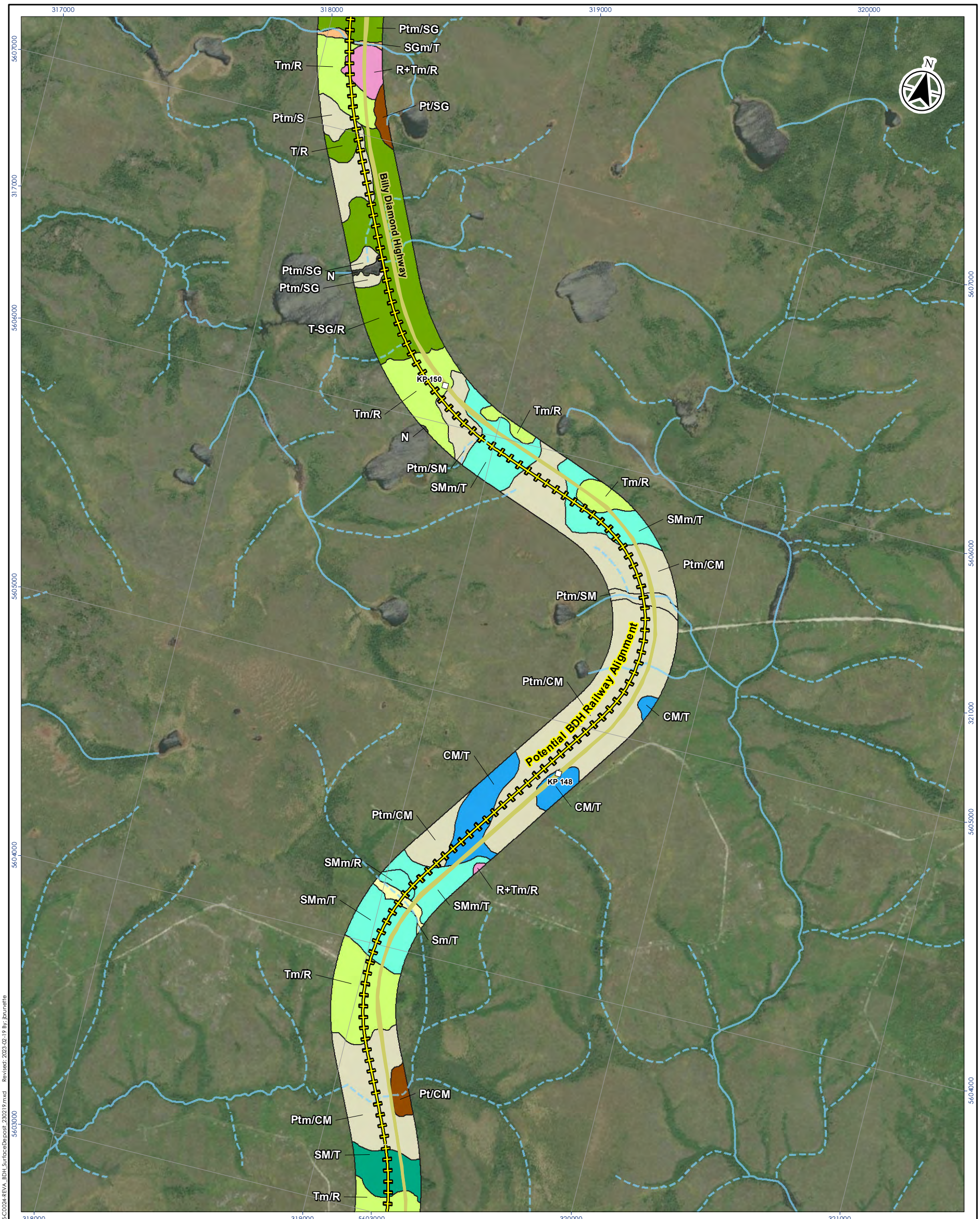
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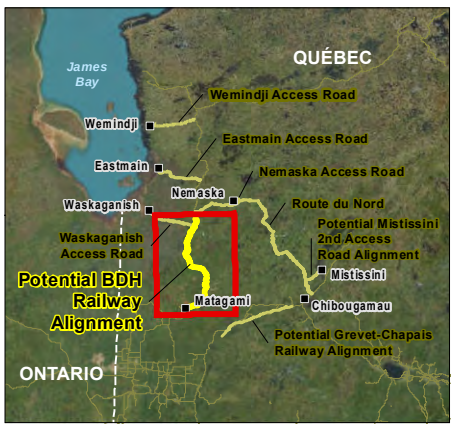
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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- Peat (> 2 m thick)
- Water Body

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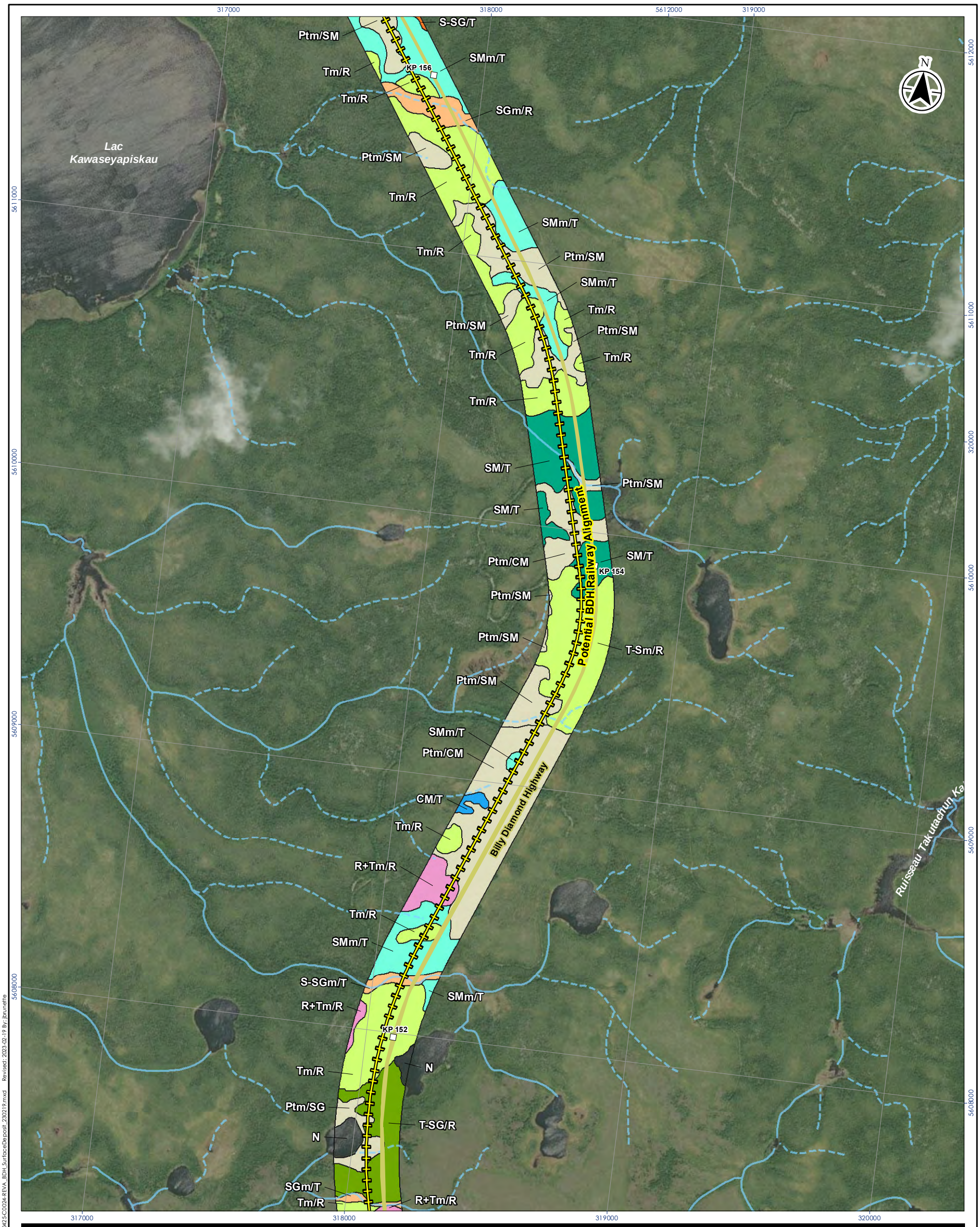
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Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Silty sand or sandy silt (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Water Body

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Project Location

Eeyou Istchee, Québec

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La Grande Alliance – Feasibility Study
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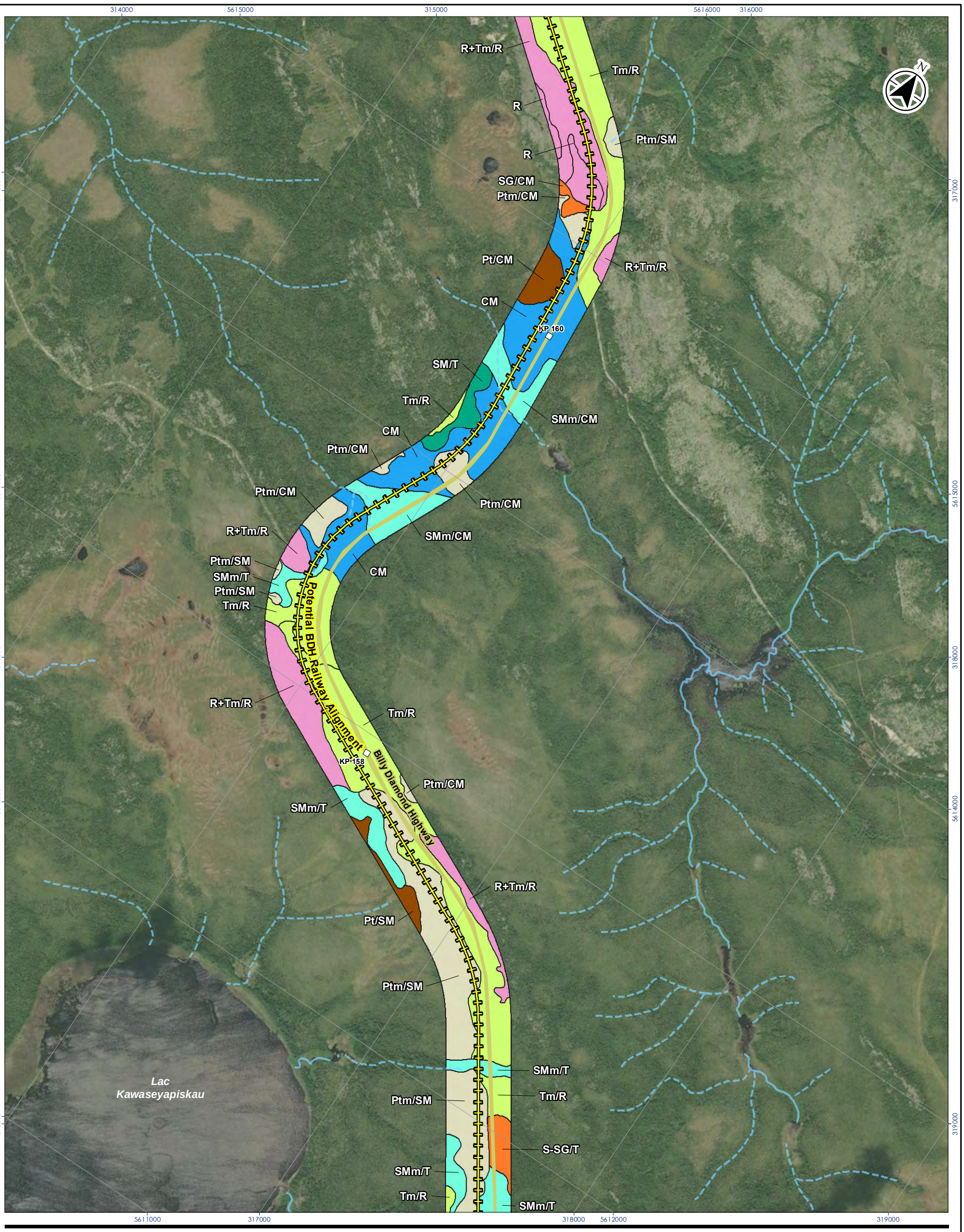
34

Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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- Peat (> 2 m thick)

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Project Location

Eeyou Istchee, Québec

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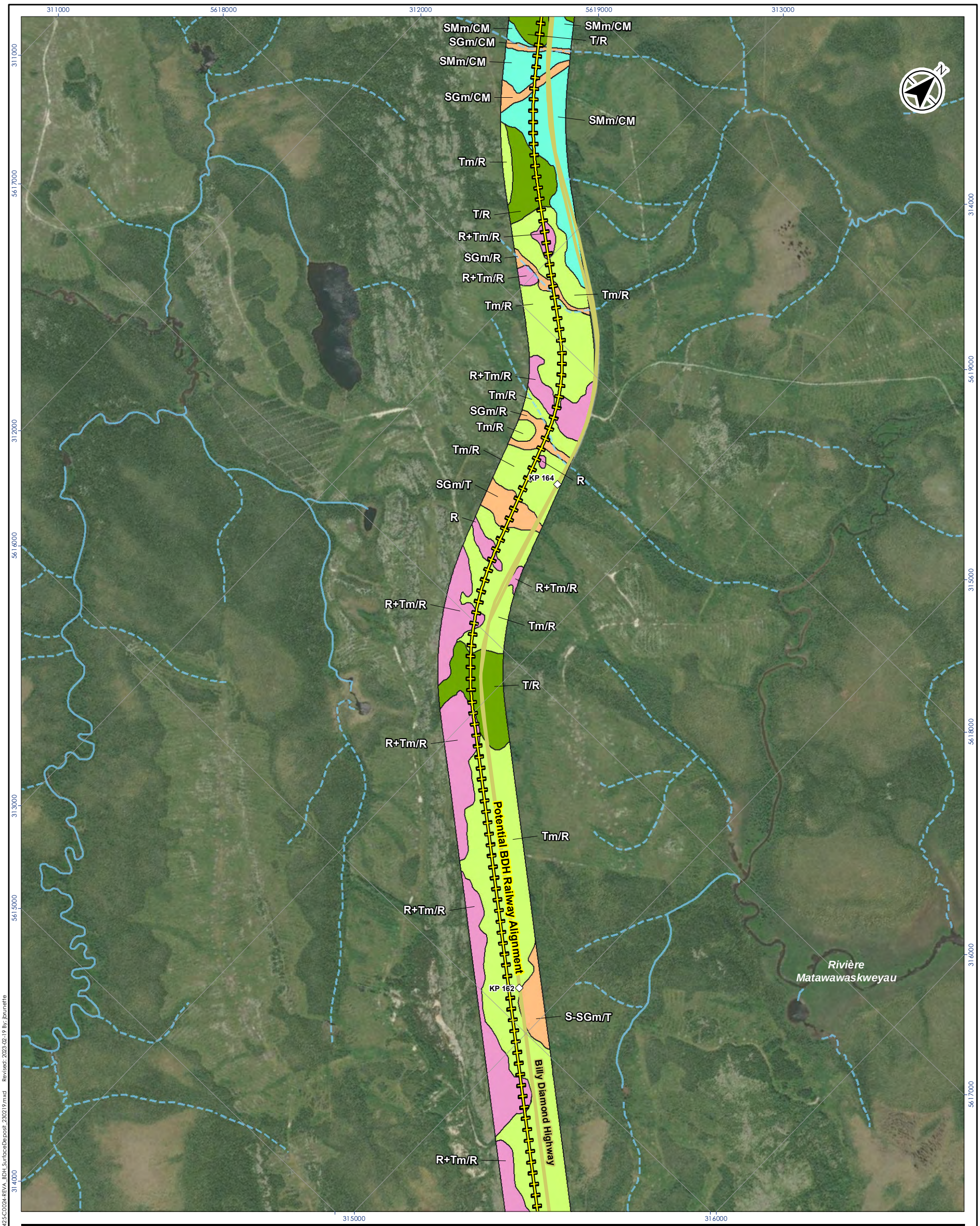
35

Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Sand and gravel (< 2 m thick)
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Vision Eeyou Istchee — Connect • Develop • Protect

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Project Location

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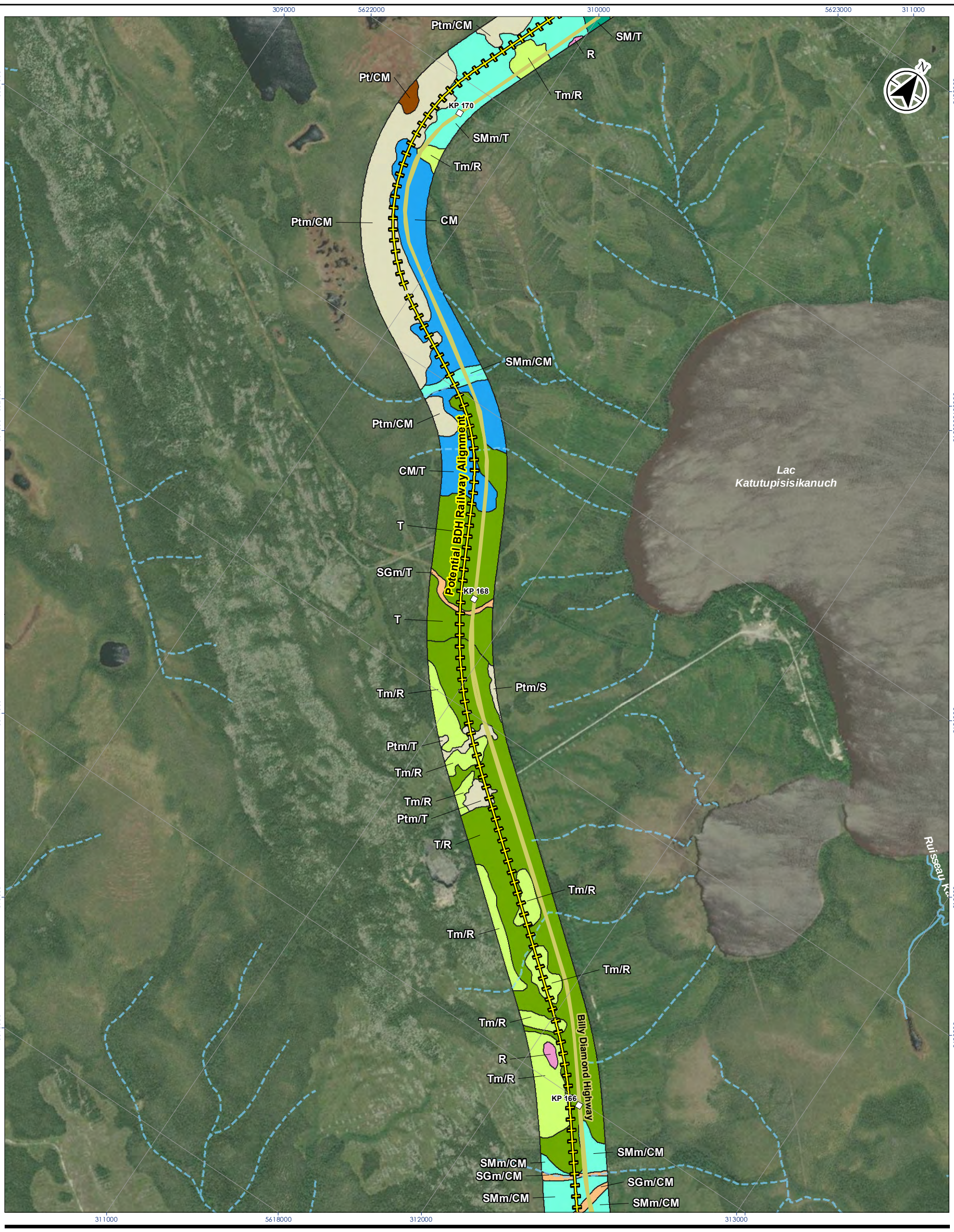
36

Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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Project Location

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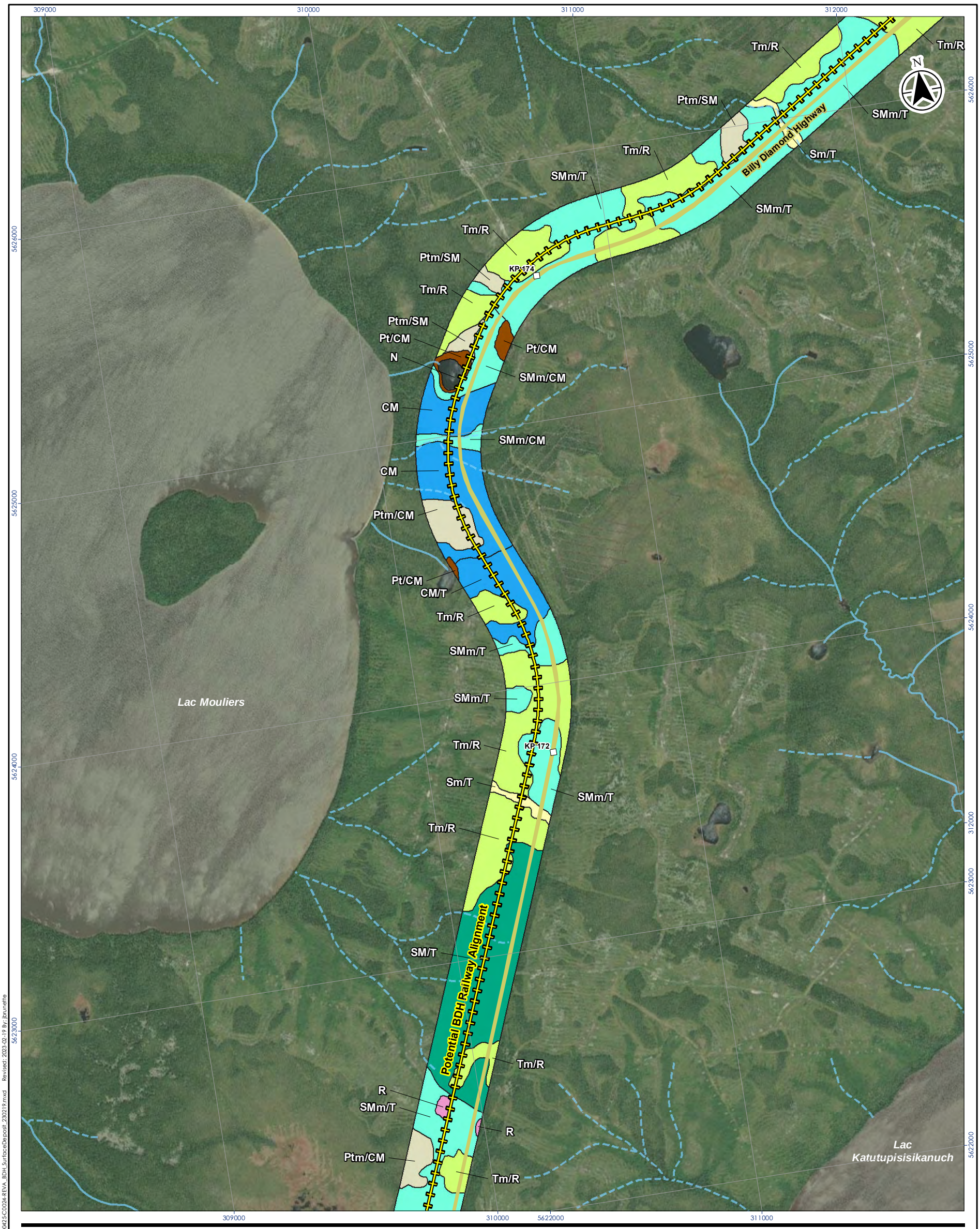
37

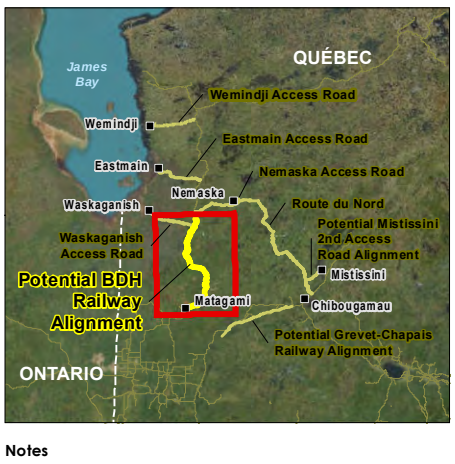
Title

Surficial Material – Potential BDH Railway

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Intermittent Watercourse

Road

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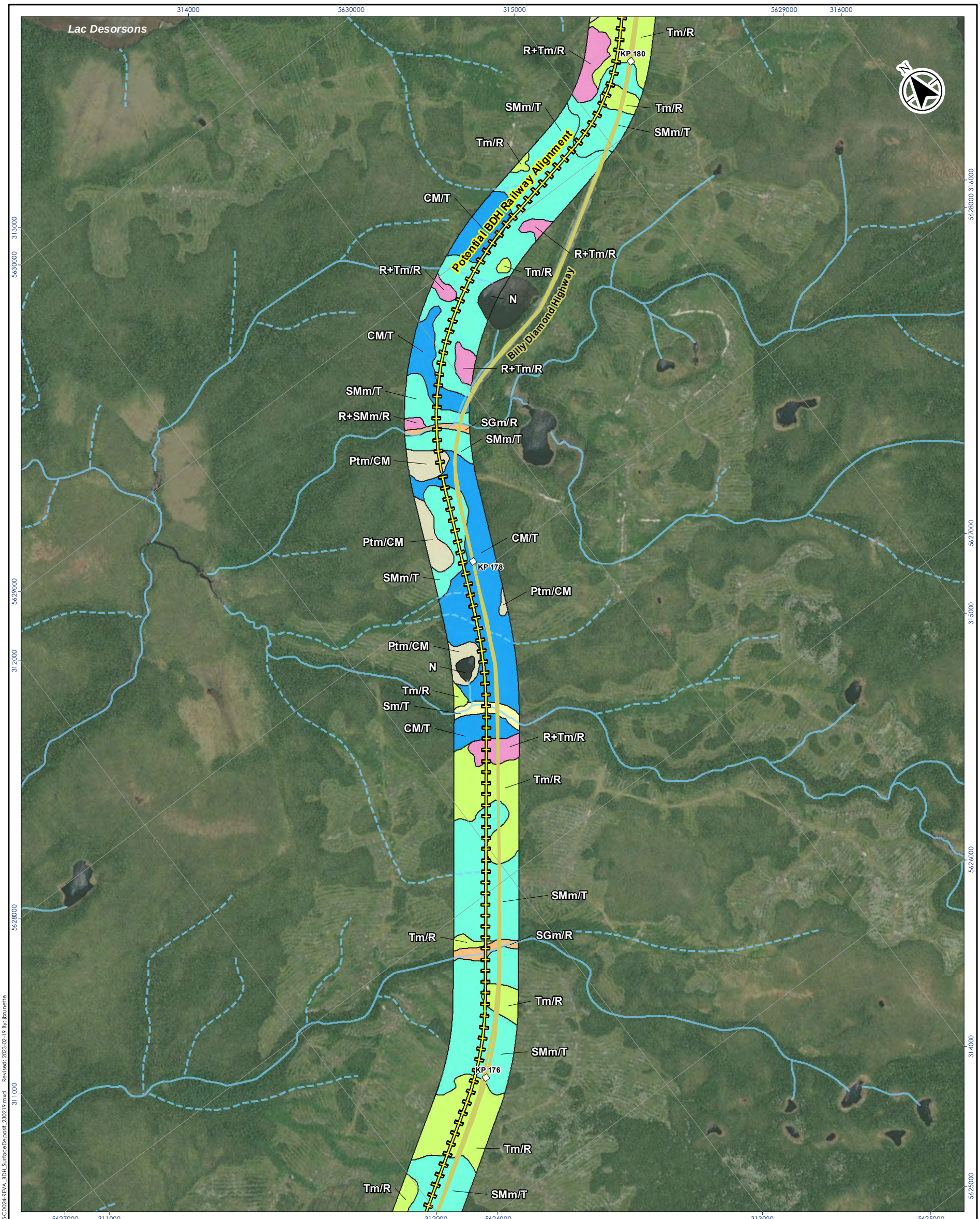
38

Title

Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

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0 0,15 0,3 Km

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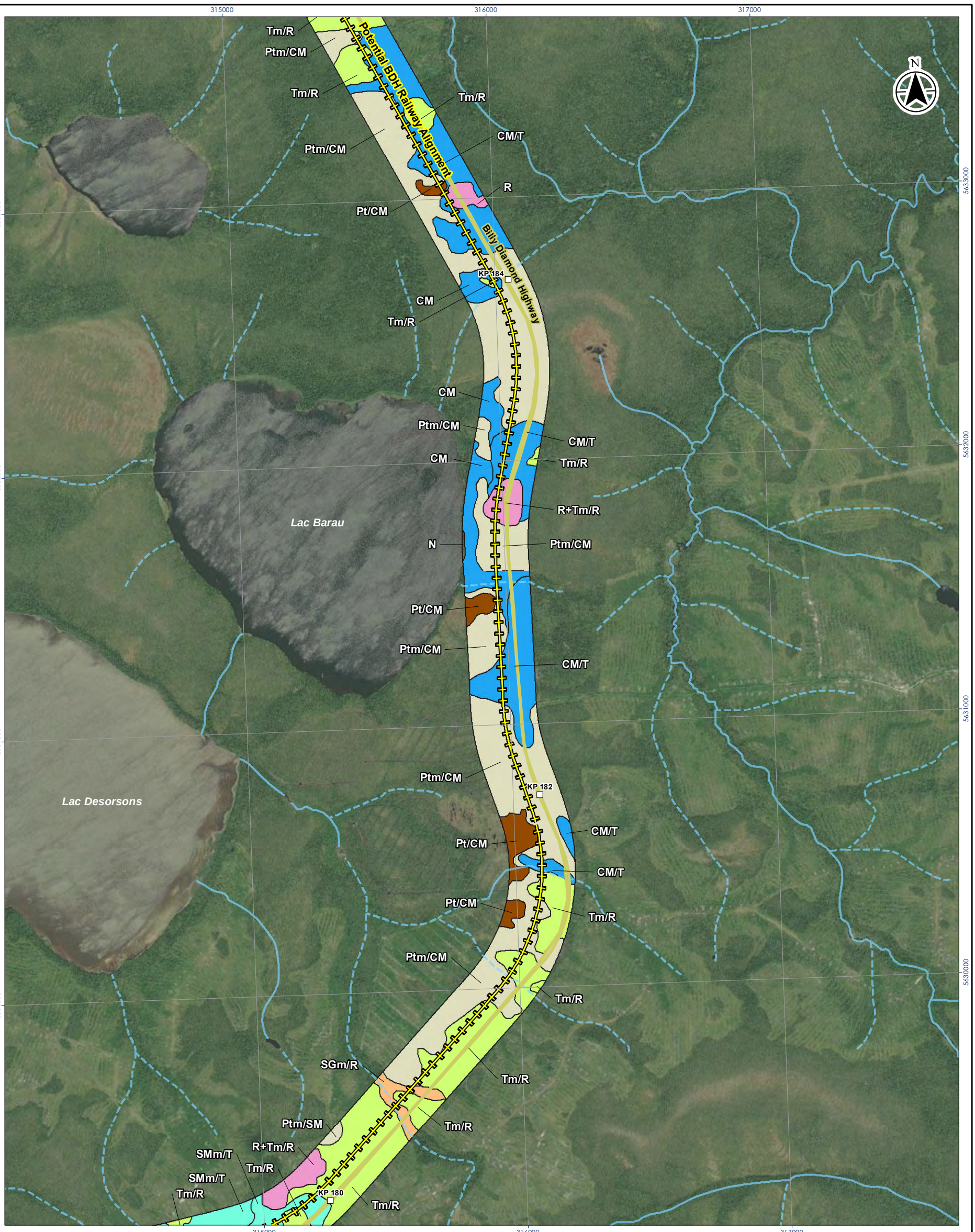
Map No. **39**

Title

Surficial Material – Potential BDH Railway

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Projected Component

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Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
S/T	Layer of sand (2 to 6 m thick) over till
S	Sand (> 6 m thick)

Examples of Combined Symbols

T+B	Till with boulders at the ground surface
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T-SG	Undifferentiated till or sand and gravel

** No Thickness was Interpreted for Boulder Accumulations*

Generalized Surficial Material Classification

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- Till (< 2 m thick)
- Sand and gravel (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)
- Water Body

Vision Eeyou Istchee — Connect • Develop • Protect

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Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

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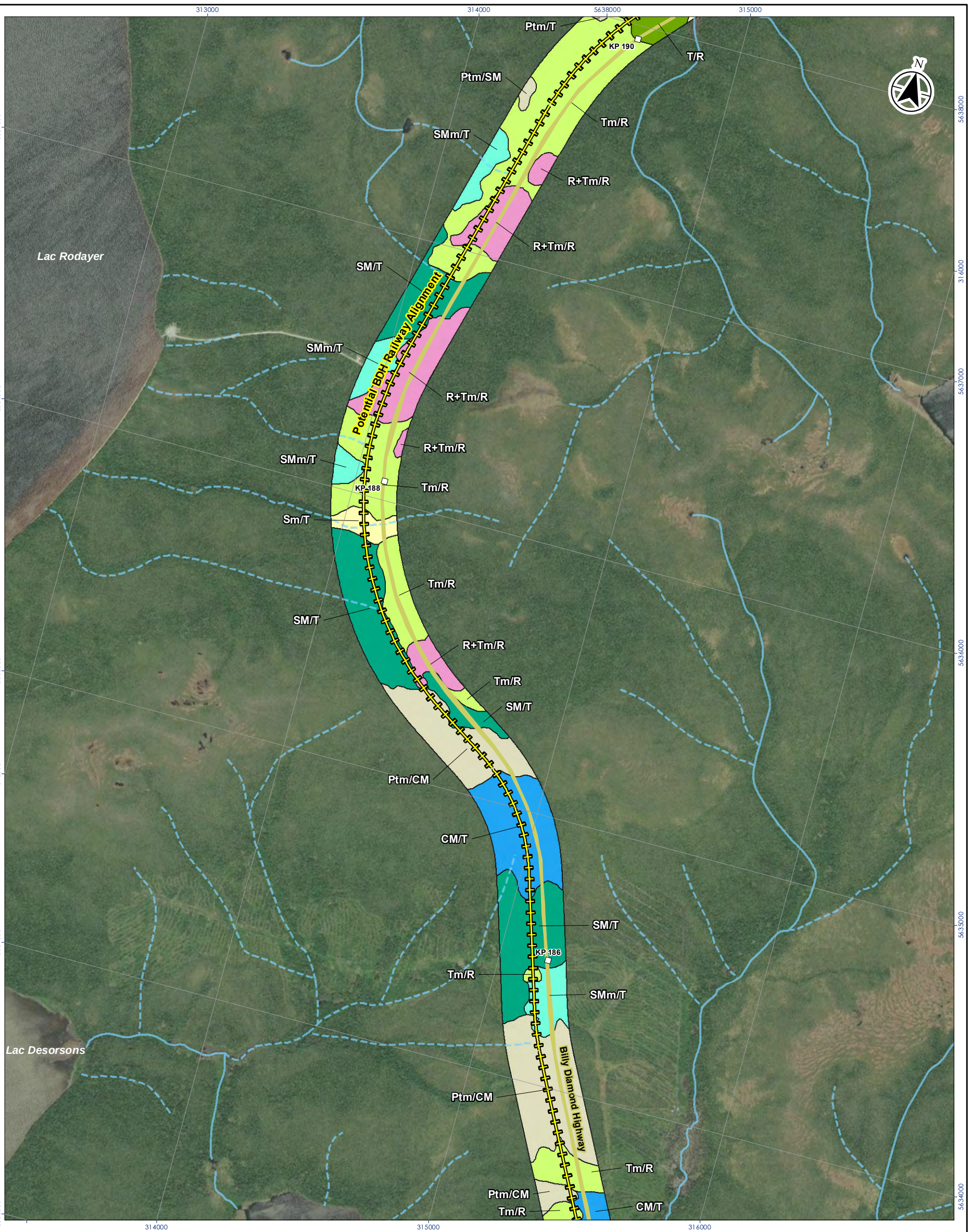
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Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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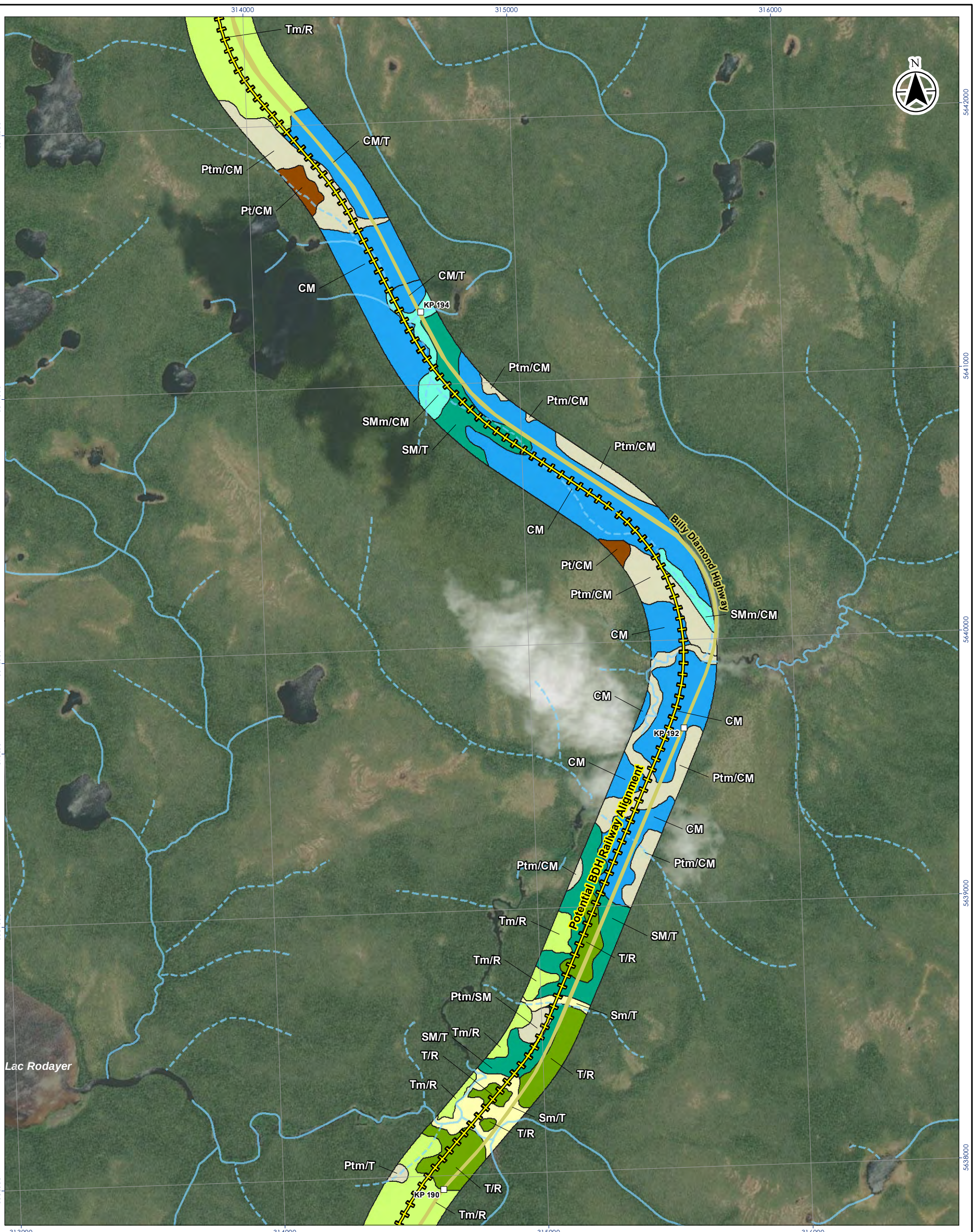
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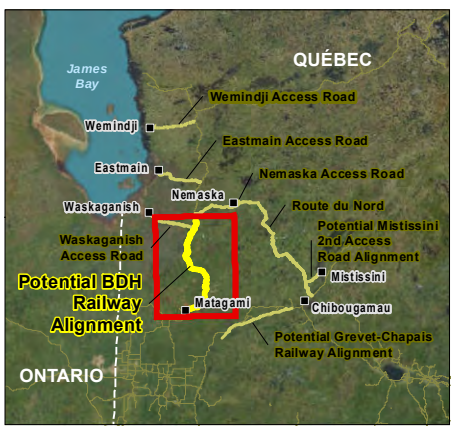
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Surficial Material – Potential BDH Railway

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Vision Eeyou Istchee

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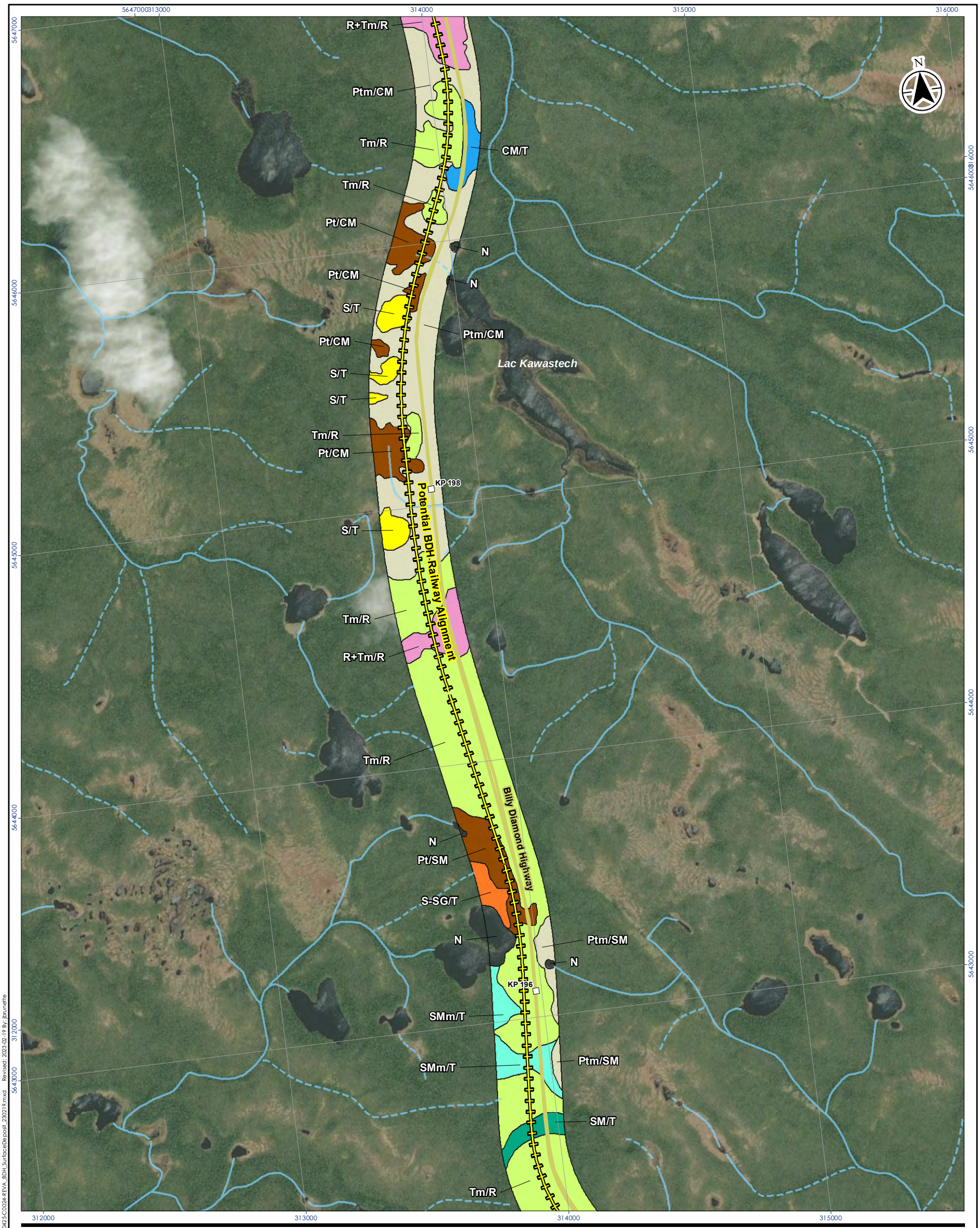
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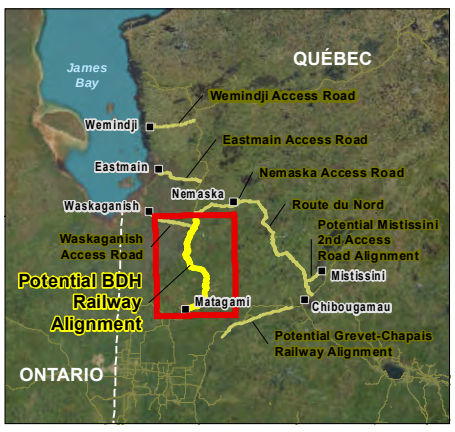
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

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Kilometric Point (MTQ, 2021)

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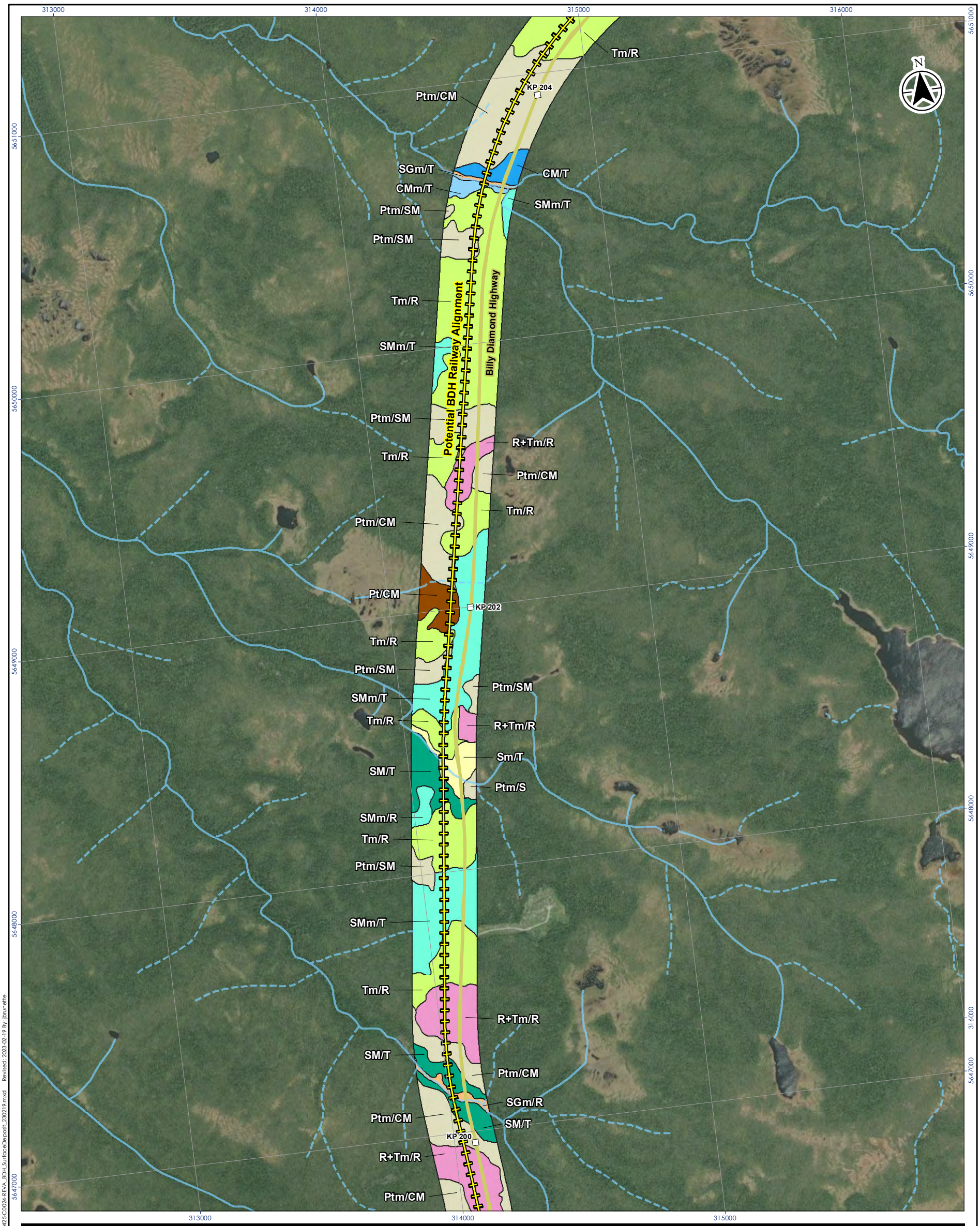
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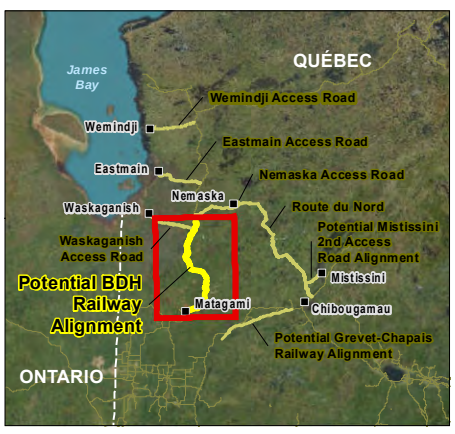
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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Vision Eeyou Istchee — Connect • Develop • Protect

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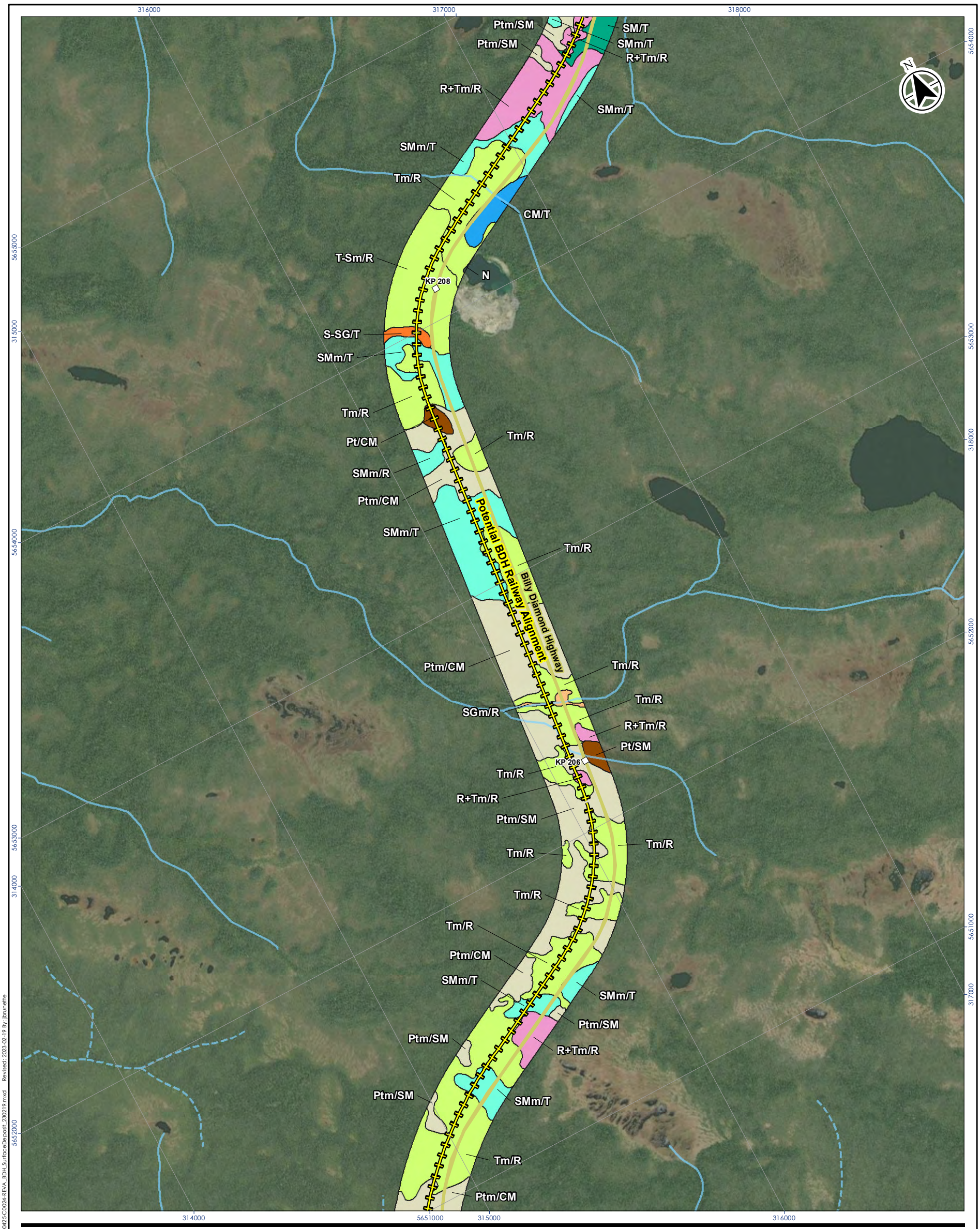
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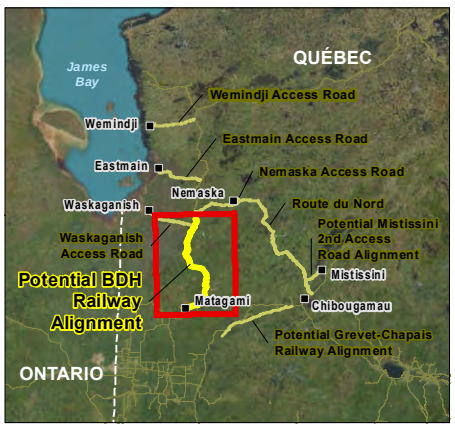
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Surficial Material – Potential BDH Railway

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Projected Component

Potential BDH Railway Alignment

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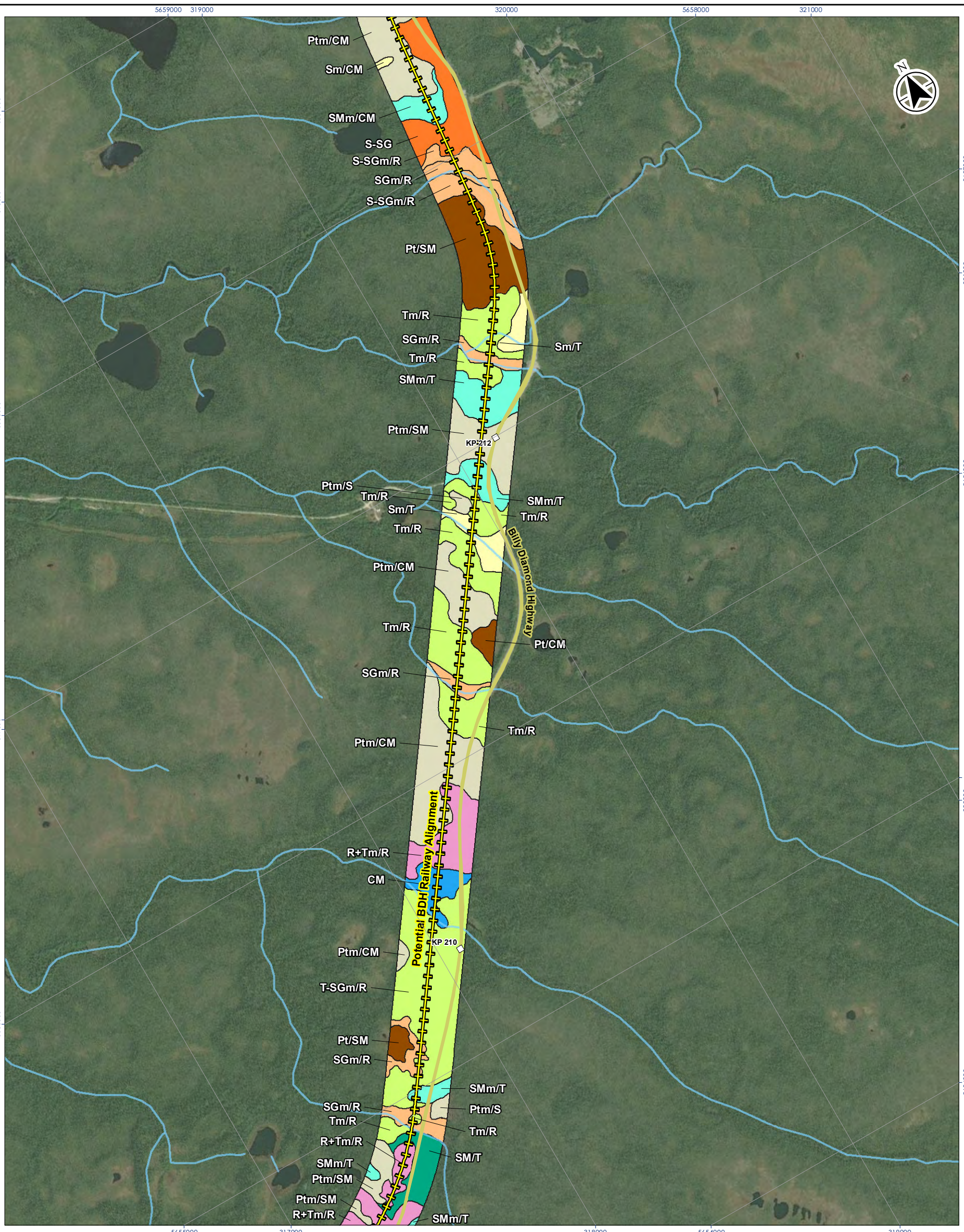
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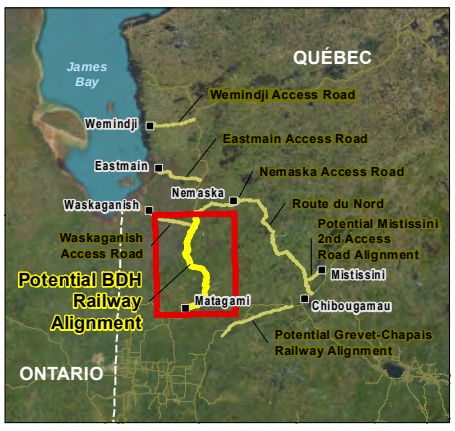
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Surficial Material – Potential BDH Railway

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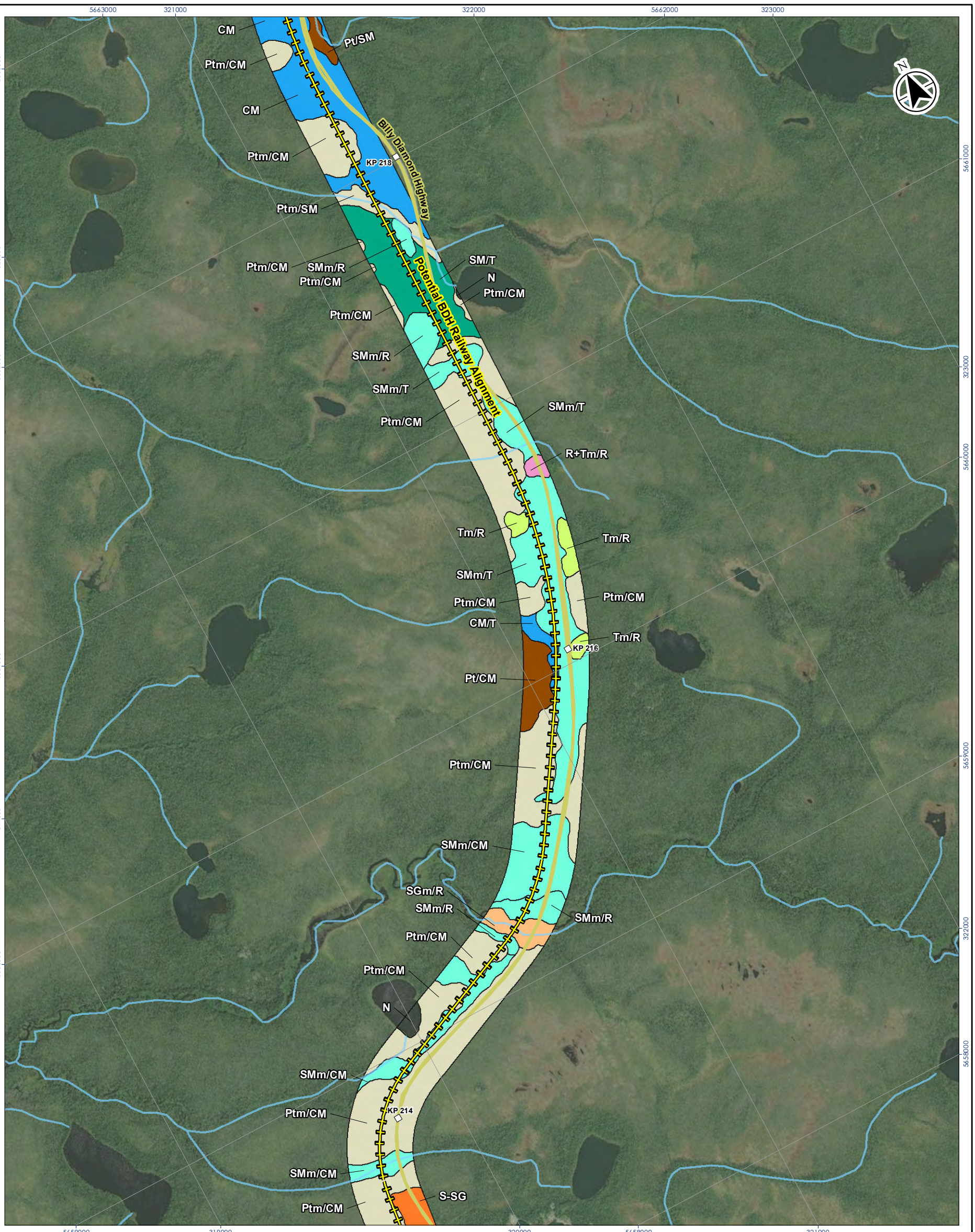
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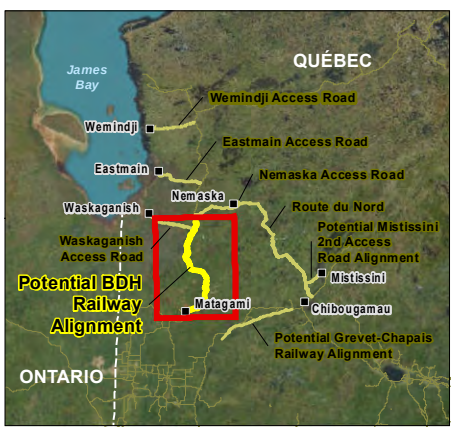
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Surficial Material – Potential BDH Railway

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Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

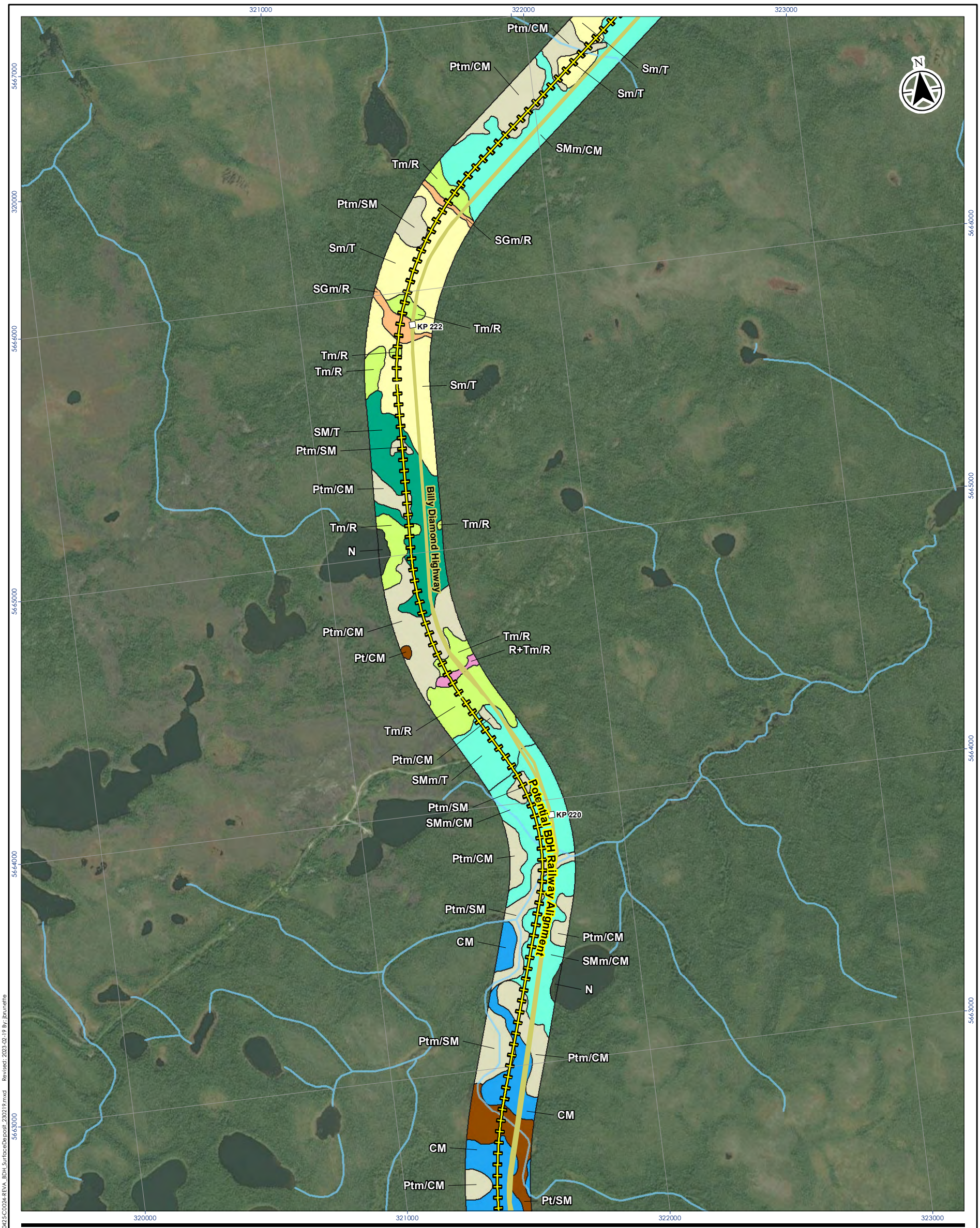
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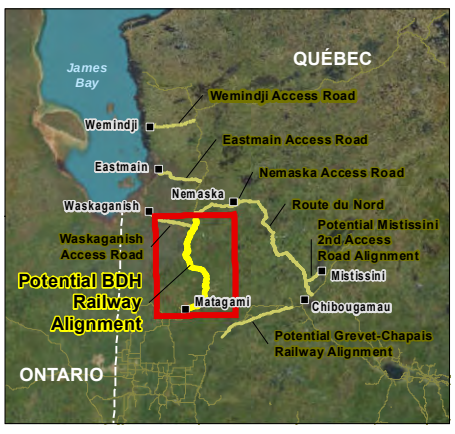
Title

Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
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- Sand (< 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
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- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)
- Water Body

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Project Location

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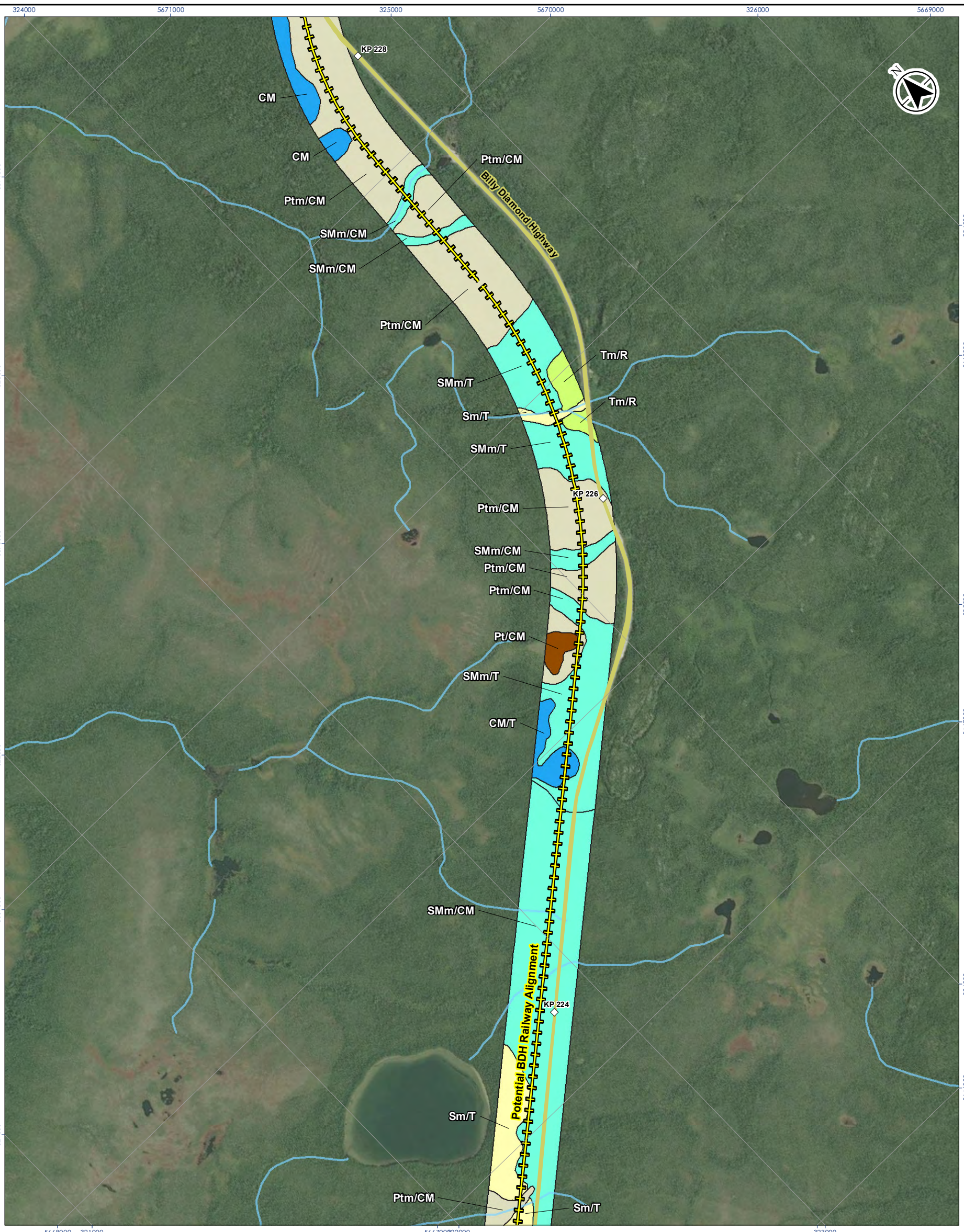
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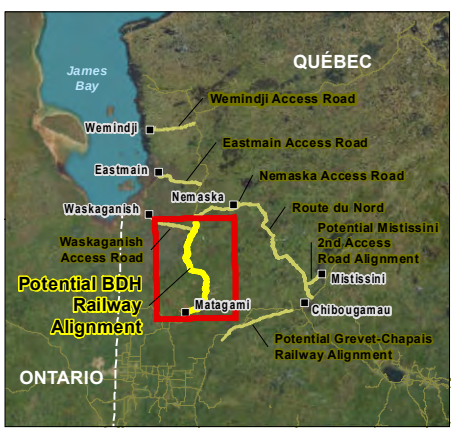
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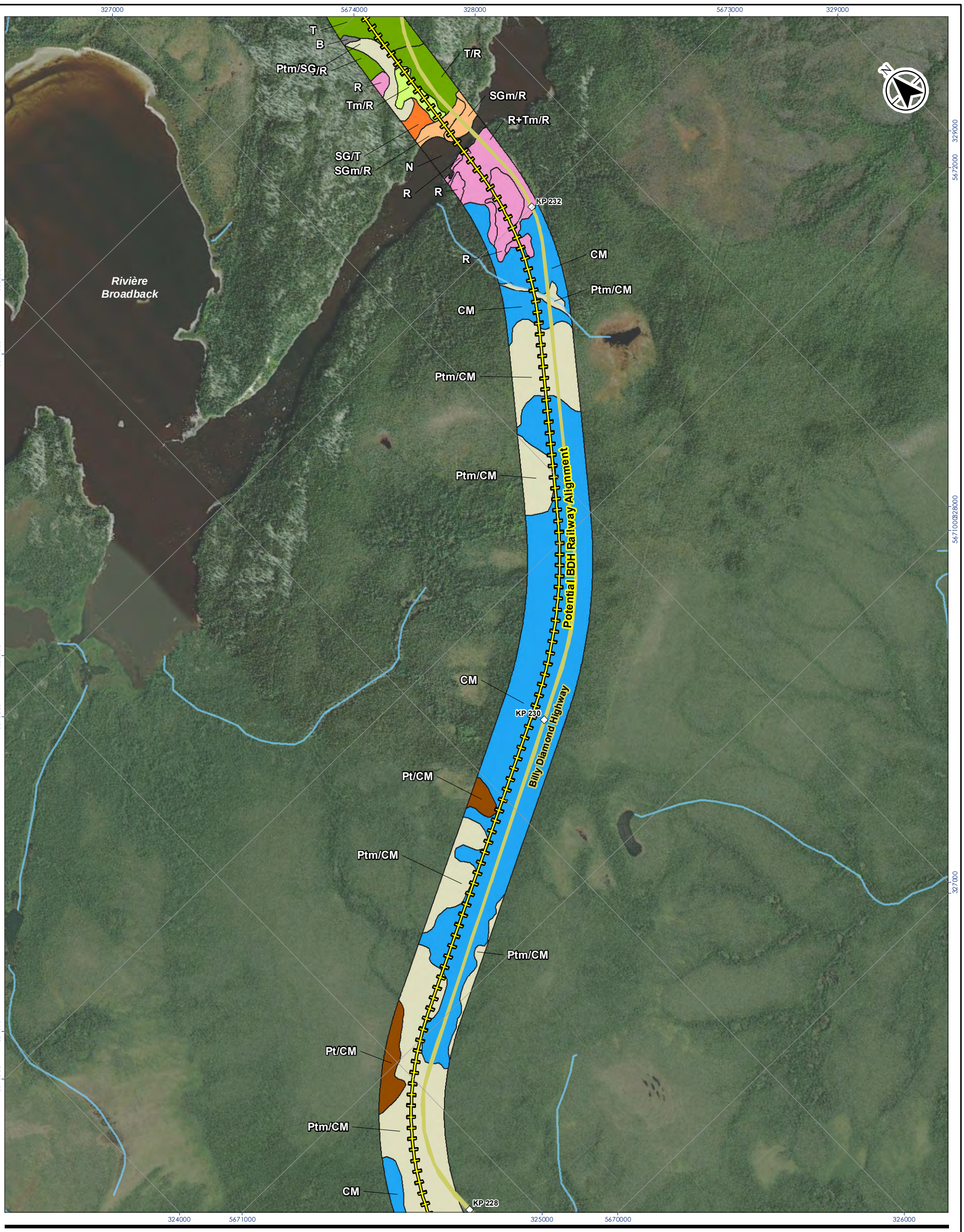
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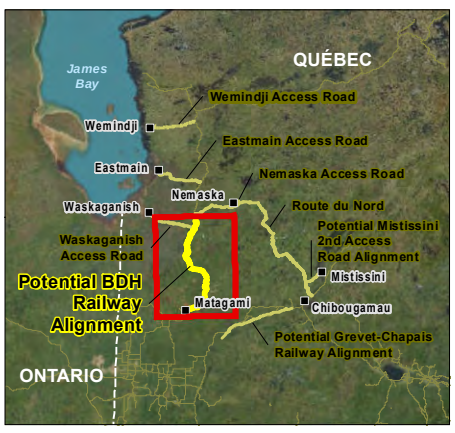
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Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

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- Sand and gravel (< 2 m thick)
- Sand and gravel (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)
- Boulders
- Water Body

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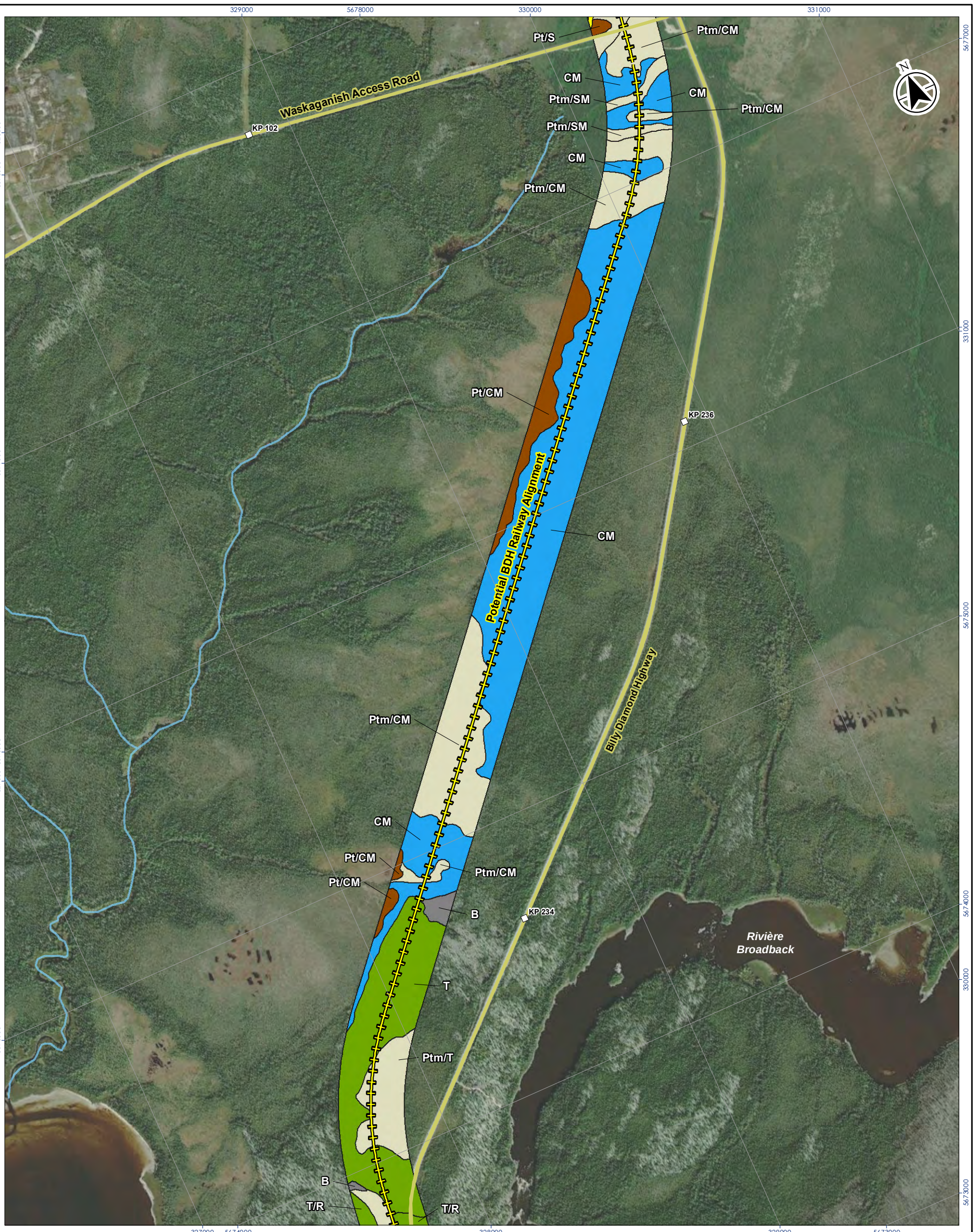
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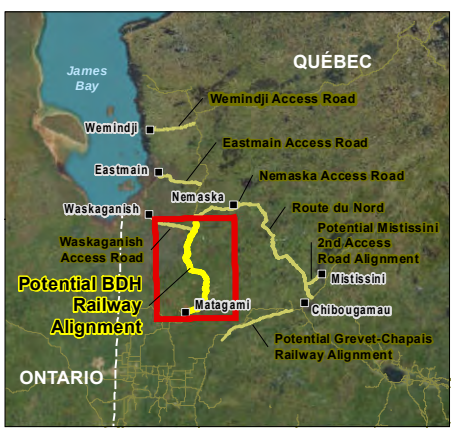
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Surficial Material – Potential BDH Railway

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Projected Component
- Potential BDH Railway Alignment

Hydrography
- Permanent Watercourse
- Intermittent Watercourse

Road
- Kilometric Point (MTQ, 2021)
- Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
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T-SG	Undifferentiated till or sand and gravel

** No Thickness was Interpreted for Boulder Accumulations*

Generalized Surficial Material Classification
- Till (> 2 m thick)
- Sand (> 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Peat (> 2 m thick)
- Boulders

Notes
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0 0,15 0,3 Km

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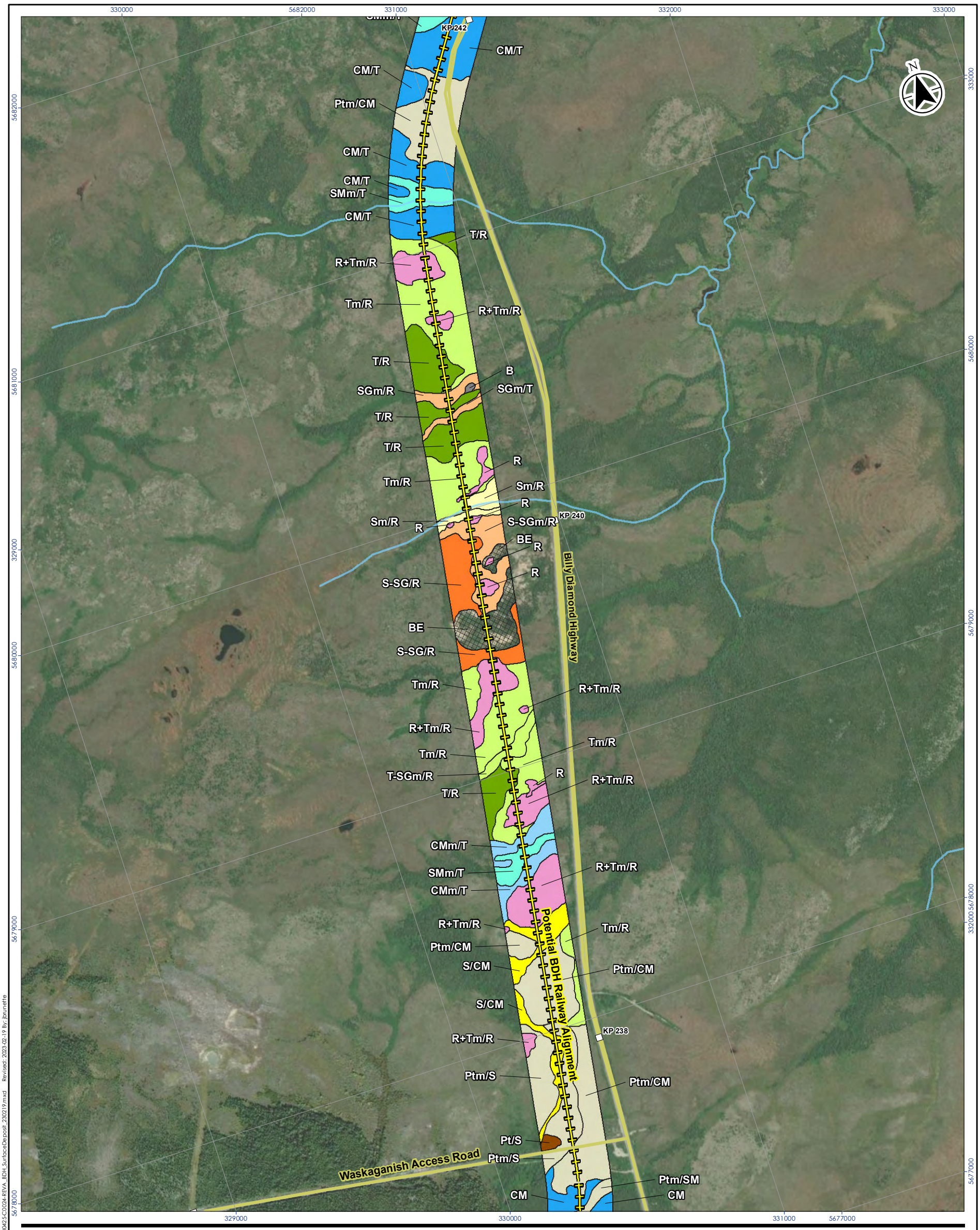
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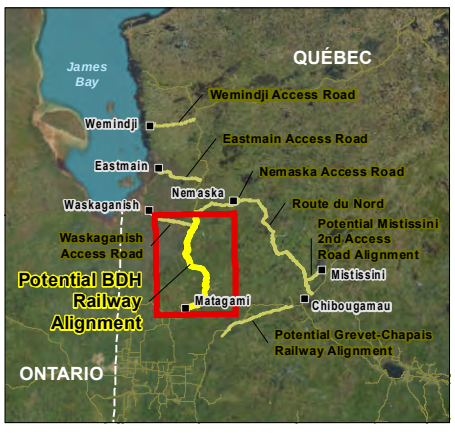
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Title
Surficial Material – Potential BDH Railway

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0 0,15 0,3 Km

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Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

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- Boulders
- Existing Borrow Source

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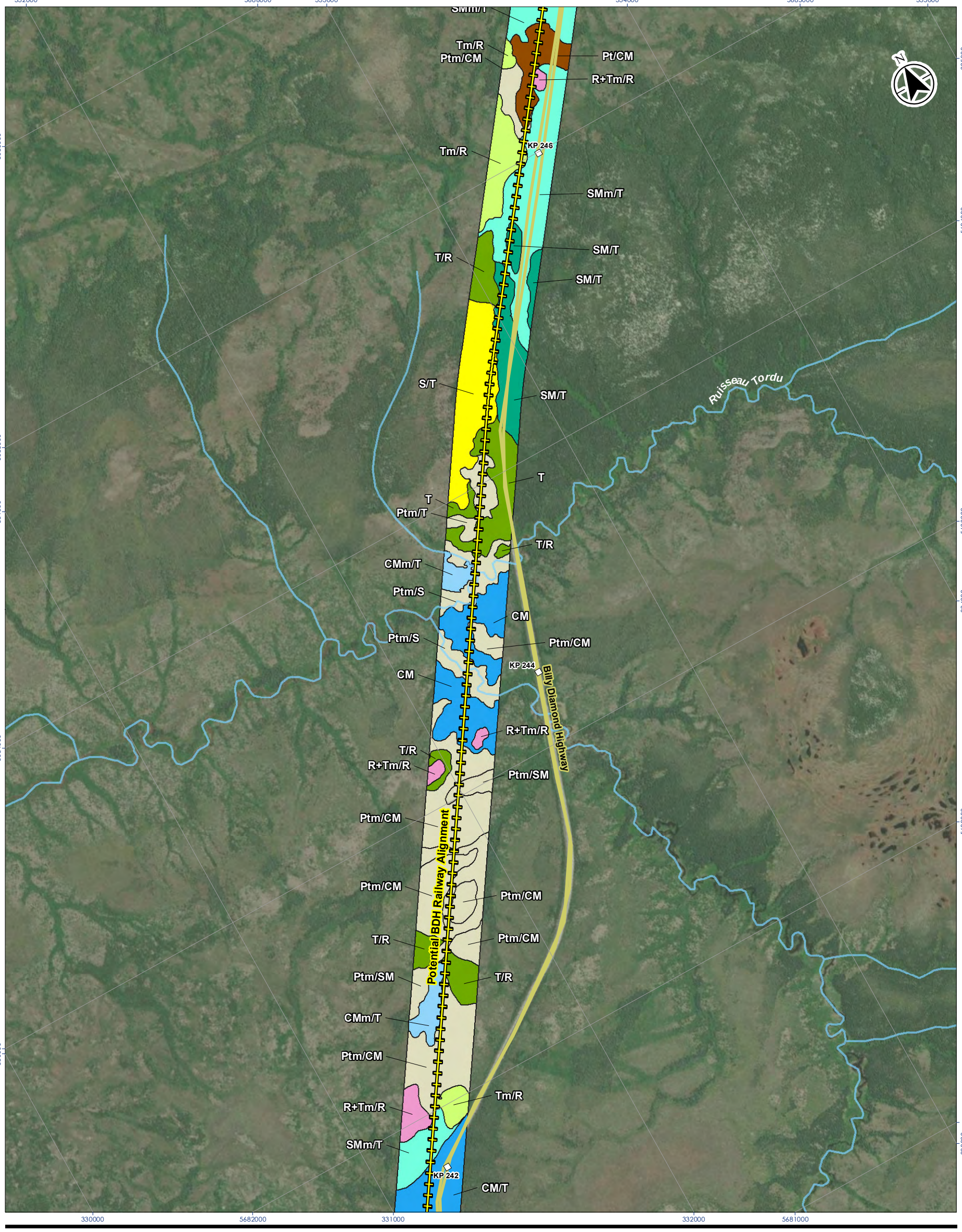
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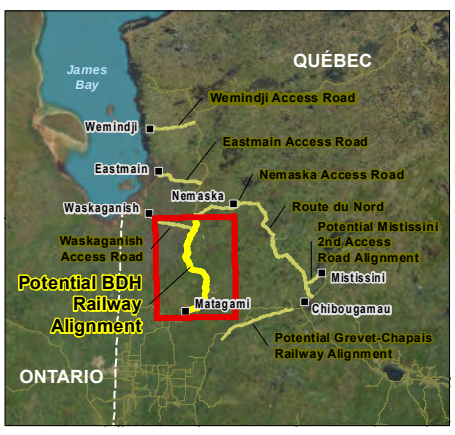
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Surficial Material – Potential BDH Railway

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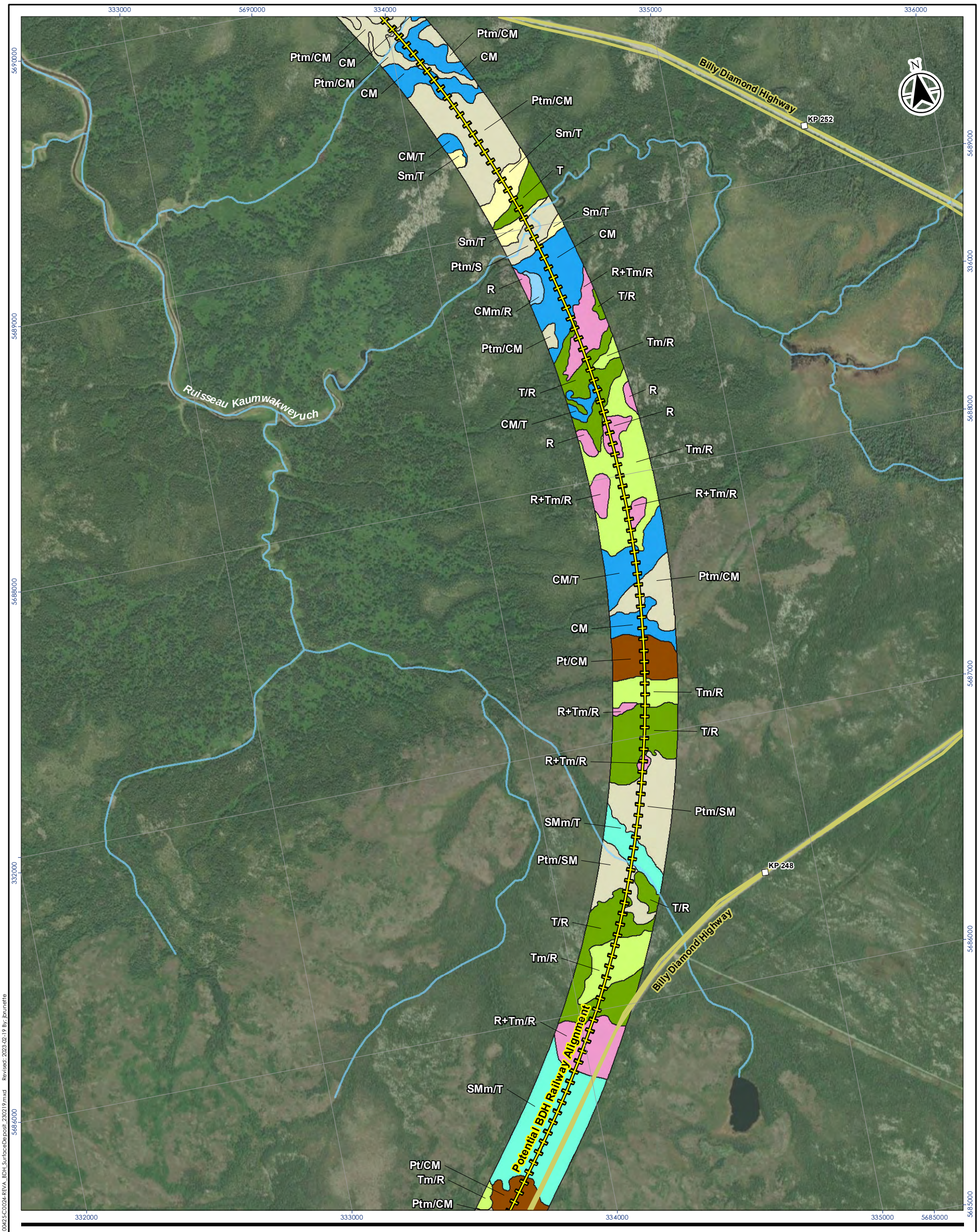
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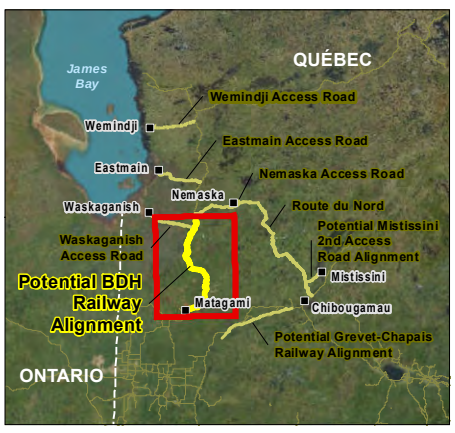
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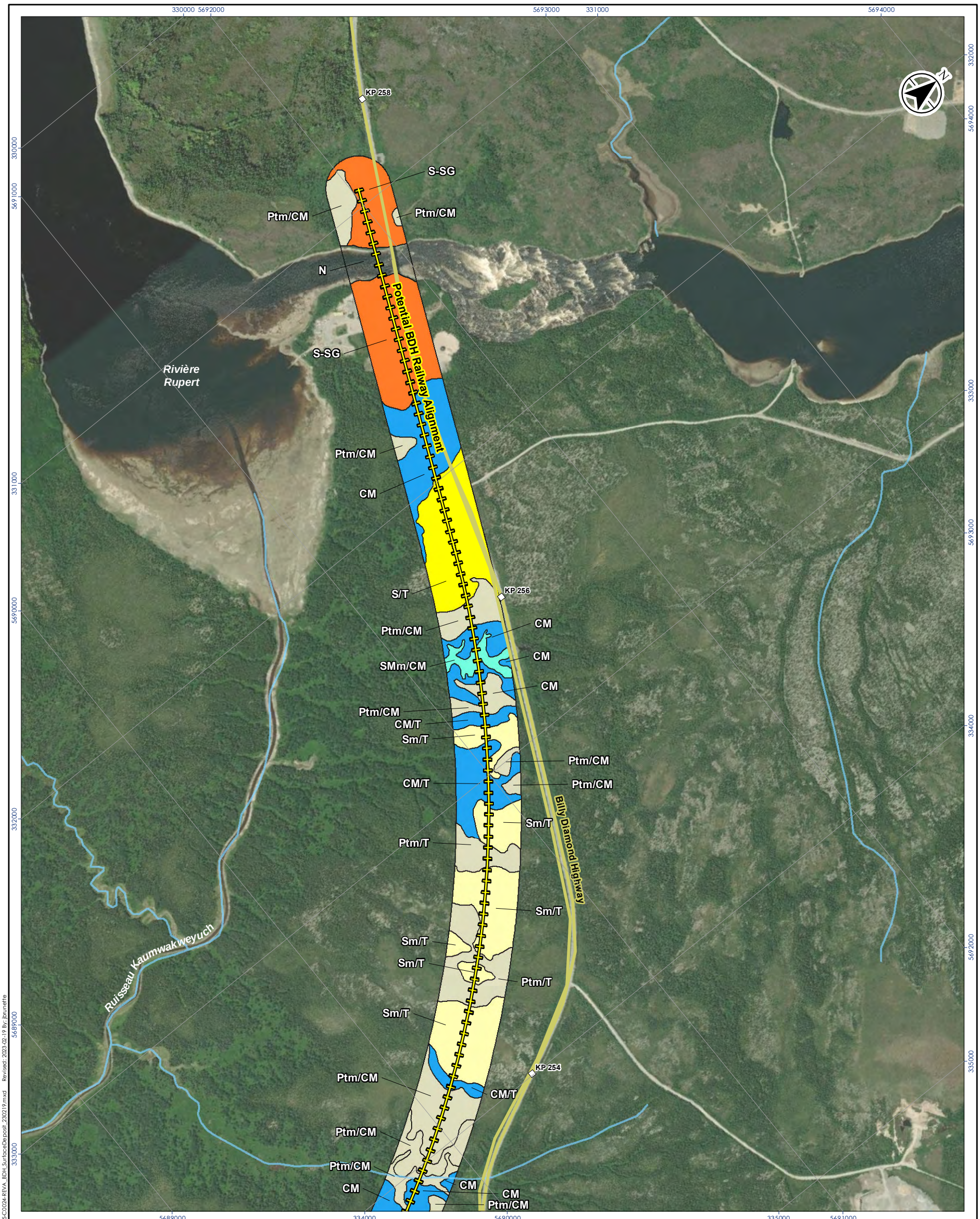
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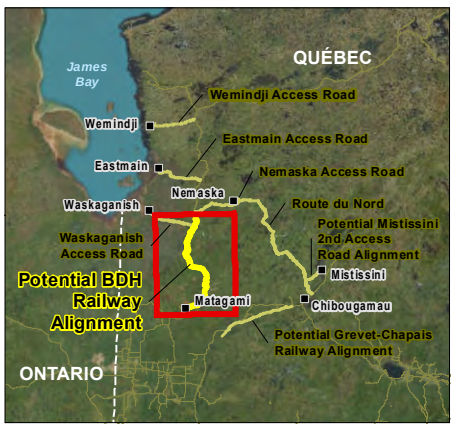
Title

Surficial Material – Potential BDH Railway

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Notes

1. Coordinate System: NAD 1983 CSRS MTM 9
2. Surficial Material: Stantec, 2023
3. Road Network: Adresses Québec, 2021 and MTQ, 2021
4. Hydrography: GRHQ, 2017
5. Orthoimagery: ESRI-World Imagery, 2012 to 2021

0 0,15 0,3 Km

1:15 000 (At Original document size of 11x17)

Projected Component

Potential BDH Railway Alignment

Hydrography

Permanent Watercourse

Intermittent Watercourse

Road

Kilometric Point (MTQ, 2021)

Road

Surficial Material

Surficial Material Classification

R	> 80 % of bedrock
T	Till
SG	Sand and Gravel
S	Sand
SM	Silty sand or sandy silt
CM	Clayey silt or silty clay
Pt	Peat
B	Boulders*
BE	Existing borrow Source
N	Water body
Ant	Anthropogenic

Examples of Layer Overlapping and Thickness

Sm/T	Thin layer of sand (< 2 m thick) over till
S/T	Layer of sand (2 to 6 m thick) over till
S	Sand (> 6 m thick)

Examples of Combined Symbols

T+B	Till with boulders at the ground surface
R+Tm/R	Bedrock with a veneer of till (< 2 m thick)
T-SG	Undifferentiated till or sand and gravel

** No Thickness was Interpreted for Boulder Accumulations*

Generalized Surficial Material Classification

- Sand and gravel (> 2 m thick)
- Sand (< 2 m thick)
- Sand (> 2 m thick)
- Silty sand or sandy silt (< 2 m thick)
- Clayey silt or silty clay (> 2 m thick)
- Peat (< 2 m thick)
- Water Body

Vision Eeyou Istchee — Connect • Develop • Protect

Stantec | DESFOR | SYSTRA

Project Location

Eeyou Istchee, Québec

158100425-C0024 REVA
Prepared by Julie Brunette on 2023-02-19
Technical Review by Manuel Verpaelst on 2023-02-19
Independent Review by Frédéric Vinet on 2023-02-19

Client/Project

Cree Development Corporation
La Grande Alliance – Feasibility Study
Phase 1 – Preliminary Geotechnical Investigation

Map No.

55

Title

Surficial Material – Potential BDH Railway

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