

Technical Memo

H375035

26-06-2025

To: Carl Haeussler, P. Eng
Director, Business Development

From: Mohamed Khafagy, P. Eng

cc: Salim Chemanedji, P. Eng

Brookfield Renewable Trail Road BESS Site Geotechnical Investigation

Hydrogeological and Terrain Analysis Study



1. Introduction

Hatch Ltd. (Hatch) has been retained by Brookfield BRP Canada Corporation (Brookfield) to provide hydrogeological and terrain analysis services as part of the Trail Road Battery Energy Storage System (BESS) project (Project). The Trail Road BESS project is directly responding to the Independent Electricity System Operator's (IESO) request to increase supply and capacity to meet Ontario's growing electricity expenditure and demand by constructing an energy storage facility. The facility will increase renewable grid capacity and storage, enhance flexible grid operations and provide a low carbon initiative to avoid greenhouse gas emissions by reducing reliance on higher carbon intensive facilities.

Brookfield is proposing to develop approximately 32,375 m² of a 214,483 m² property at 4186 William McEwan Drive in Richmond, Ontario, which is approximately 23 km south of Ottawa. The Project will consist of a BESS, a substation, access roads and associated electrical infrastructure. A key plan outlining the site location is shown on Figure 1-1.



Figure 1-1: Overview of Limits of the Trail Road BESS Project.

1.1 Study Area

The Project site is bounded by William McEwan Drive to the east, 1.0 km from Barnsdale Road to the north, 0.7 km from Moodie Drive to the west, and a southern demarcation line located approximately 0.5 km north of Edgeware Line. The Project site has an area of approximately 21.8 ha and falls under the coordinate system NAD83 (CSRS)/MTM Zone 9N of Ontario. The Project site is within the Rideau Falls - Rideau River watershed and the local authority is the Rideau Valley Conservation Authority (RVCA). The battery storage is located on the middle of the site with an area of approximately 22,694 m². The substation area is located west of the battery storage with an area of approximately 3,466 m². The total property area is approximately 217,700 m².

1.2 Scope of Work

The objective of this hydrogeological and terrain analysis study is to:

1. Desktop Review
 - Assess and utilize existing information and data within the study area to provide an effective hydrogeological and terrain analysis for the Project site.
2. Evaluate Hydrogeological Conditions of the study area.

3. Assess Terrain Characteristics

- Conduct a terrain analysis, including the identification of overburden geology, soil characteristics, and groundwater table elevations, to determine the suitability of the site for the proposed development.

The key objectives of this study are to:

- Provide a comprehensive hydrogeological and terrain assessment to support the proposed development at the Project site.

1.3 Hydrogeological and Terrain Analysis Guidelines

The following guidelines and standards were utilized to prepare the Hydrogeological and Terrain Analysis Study for the Project site:

- City of Ottawa (2021). Hydrogeological and Terrain Analysis Guidelines.
- City of Ottawa (2012). Sewer Design Guidelines.
- Central Lake Ontario Conservation, Credit Valley Conservation, Grand River Conservation Authority, Ganaraska Conservation, Toronto and Region Conservation Authority, and Nottawasaga Valley Conservation Authority (2017). Technical Guidelines for Flood Hazard Mapping.
- GeologyOntario, Ministry of Mines, Ontario. Surficial Geology Maps.
- Rideau Valley Conservation Authority (RVCA). Flow and Water Levels Mapping.

2. Hydrogeological Assessment

2.1 Soil Conditions

The site soil conditions are required to properly and accurately demonstrate the hydrologic conditions of the Project site. The soil conditions have a direct impact on the surface runoff conditions, infiltration capacity of the soils, and ultimately influence the future design conditions. **Figure 2-1** shows the locations of the boreholes on the site plan. Further information of the borehole logs is presented in Appendix A in the preliminary geotechnical investigation (Hatch, 2025).

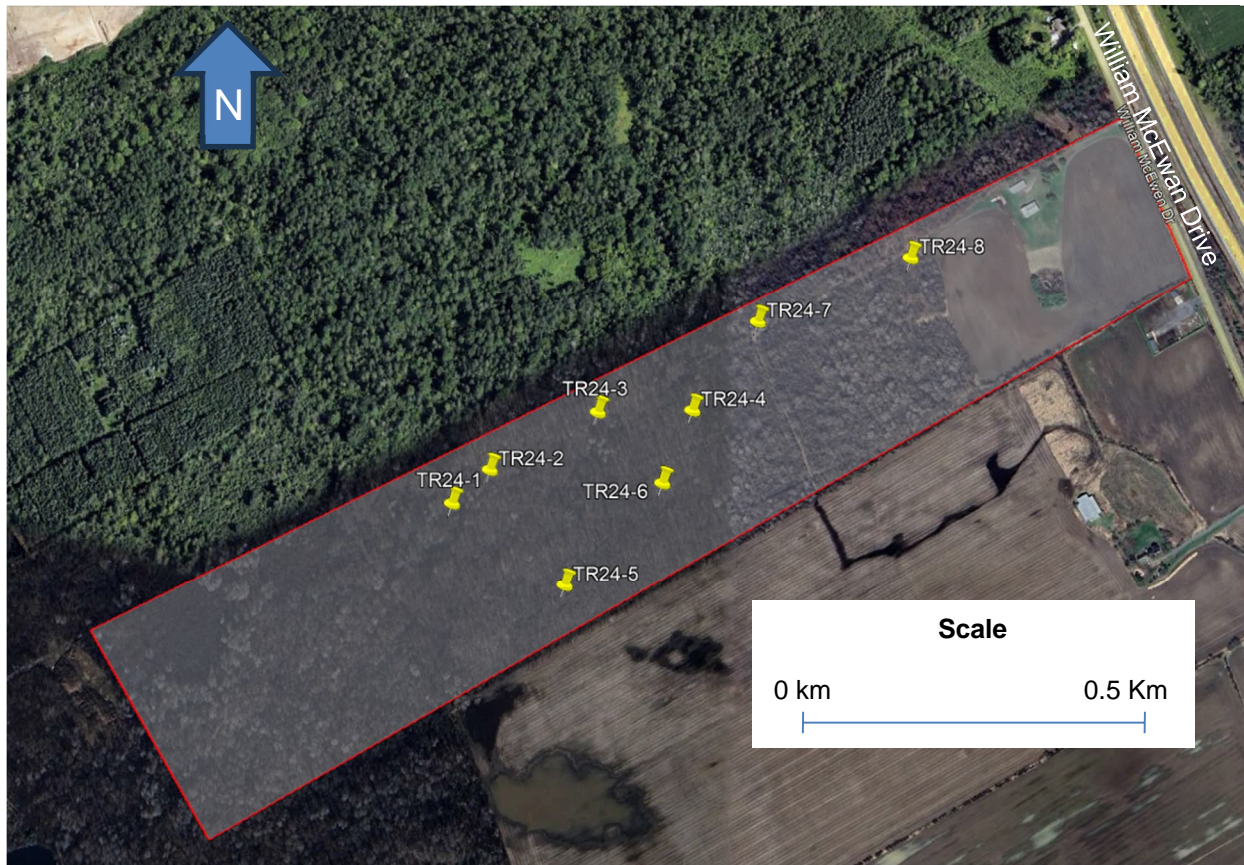


Figure 2-1: Borehole Locations within the Trail Road BESS Project Site

The preliminary geotechnical investigation indicated that the general soil profiles at all boreholes consists of non-organic topsoil (100 mm to 300 mm deep), silty sand to sandy silt (6.2 to 6.4 metres below ground surface (m bgs)), and sandy silt with gravel (at a depth of 9.5 m bgs).

The hydrologic soil group is expected to be soil group “B” for the Project site with an estimated Horton infiltration rates of 6 mm/h (minimum infiltration rate) to 80 mm/h (maximum infiltration rate) as per the Technical Guidelines for Flood Hazard Mapping by Ontario Conservation Authorities. Site soil condition is suitable for the infiltration. This information is to support stormwater management (SWM) planning and design.

2.2 Field Investigation

A total of eight boreholes (TR24-1 to TR24-8) were drilled across the Trail Road BESS Project site to evaluate subsurface soil and groundwater levels (GWLs). The borehole coordinates (NAD83/MTM Zone 9N), elevations, and depths are summarized in **Table 2-1**. The boreholes were drilled to depths ranging from 2.10 m to 9.52 m using a CME 45 Track Mounted drilling rig supplied and operated by OGS Inc. (OGS) of Almonte, Ontario.

Table 2-1: Borehole Locations and Elevations

Borehole ID	Easting (m)	Northing (m)	Elevation (m)	Final Depth (m)	GW Depth and Elevation							
					28-11-2024		29-11-2024		30-11-2024		23-01-2025	
					Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
TR24-1	440,743.19	5,006,933.19	95.52	9.52	2.5	93.02	2.0	93.52	-	-	0.7	94.82
TR24-2	440,789.38	5,006,973.51	95.91	6.60	-	-	1.7	94.21	-	-	-	-
TR24-3	440,920.81	5,007,041.96	96.22	6.60	5.0	91.22	-	-	-	-	-	-
TR24-4	441,034.14	5,007,042.91	95.75	6.40	-	-	-	-	5.5	90.25	-	-
TR24-5	440,878.04	5,006,833.83	95.48	6.45	-	-	4.5	90.98	-	-	-	-
TR24-6	440,997.35	5,006,955.26	95.58	7.05	-	-	4.8	90.78	-	-	1.1	94.48
TR24-7	441,114.04	5,007,148.49	96.00	2.10	Dry		Dry		Dry		Dry	
TR24-8	441,299.36	5,007,224.54	96.26	2.10	Dry		Dry		Dry		Dry	

2.2.1 Subsurface Stratigraphy and Groundwater Observations

The borehole logs revealed primarily silty sand (SM) and sandy silt (ML) strata, interspersed with glacial till at greater depths in some locations. Moisture content varied, with evidence of oxidation and rootlets in the upper layers (depth < 0.7m).

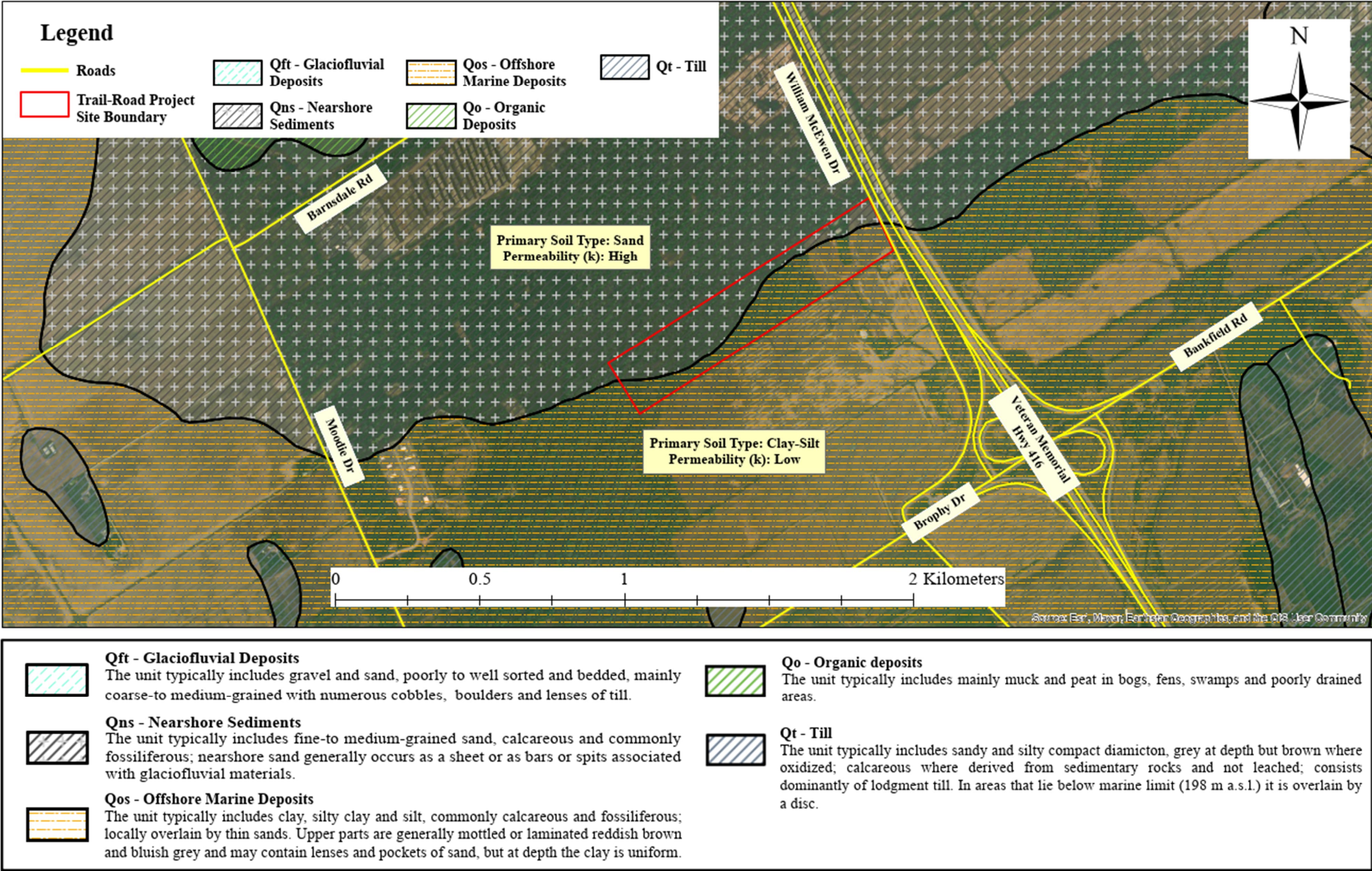
Water levels were recorded during and post-drilling activities, with measured depths ranging from 0.7 m to 5.5 m bgs. Additional details for the boreholes are documented in the borehole logs (Appendix A in the preliminary geotechnical investigation (Hatch, 2025)). The data indicates that the groundwater table is relatively shallow in parts of the site, with groundwater level ranging from approximately 0.7 m bgs to 2.5 m bgs. The shallowest levels were observed in the southwest part of the site, particularly at boreholes TR24-1 (2.0 m bgs) and TR24-2 (1.7 m bgs) in November 2024. These levels became even more shallow in January 2025 at TR24-1 (0.7 m bgs) and TR24-6 (1.1 m bgs), indicating that the southwest area may act as a recharge zone. This area represents approximately 50% of the site. In contrast, deeper groundwater levels were observed in the central area of the site near boreholes TR24-3 (5.0 m bgs) and TR24-4 (5.5 m bgs) in November 2024, while boreholes in the northeast part of the site remained dry. These measurements provide baseline data on groundwater flow, which appears to move generally from west to east. This information will support further analysis in the Groundwater Risk Assessment section.

2.3 Terrain Analysis

The Trail Road Project site consists of two primary terrain units: Nearshore Sediments in the northwest strip and Offshore Marine Deposits in the southeast portion. These units were identified using the geological data from GeologyOntario database, Ministry of Mines, Ontario.

The Nearshore Sediments in the northwest part of the site are composed of fine-to-medium-grained sands that are calcareous and often associated with glaciofluvial materials. These sediments typically occur as sheets or bars near coastal transition zones, exhibiting moderate-to-high permeability due to their sandy texture. This calcareous composition indicates moderate drainage capacity, making this area suitable for surface-level construction activities without significant concerns for water retention or drainage issues.

In contrast, the Offshore Marine Deposits in the southeast part of the site primarily consist of clay, silty clay, and silt. These materials are commonly calcareous, fossiliferous, and poorly permeable due to their fine-grained nature and compactness. The low permeability of this unit may lead to limited drainage capacity, potentially causing surface water runoff and ponding during periods of high precipitation. This characteristic of the soil necessitates careful consideration of SWM planning to mitigate any effects on the development.



2.4 Groundwater Risk Assessment

Groundwater levels at the site are expected to fluctuate seasonally. Given that the available borehole data were collected in November 2024 (corresponding to the dry season), the observed shallow groundwater levels, ranging from 0.7 m bgs at borehole TR24-1 to 1.7 m bgs at borehole TR24-2, may not represent peak conditions. Higher groundwater levels are expected during the spring freshet or following prolonged rainfall events. Therefore, while the measured groundwater levels indicate a potential risk of flooding in the proposed areas designated for the battery storage and substation facilities, this assessment may underestimate the seasonal high water table.

The general directions of groundwater flow, based on the borehole data collected in November 2024, are presented in **Figure 2-3**. The interpolation of groundwater elevation points was performed using the Kriging method to generate the groundwater table map. Due to the single-season data, seasonal variability is not captured; therefore, additional seasonal groundwater elevation monitoring during the wet season is recommended to provide a more robust assessment of the groundwater risk and to confirm the feasibility of constructing the BESS facilities without affecting the site's functionality.

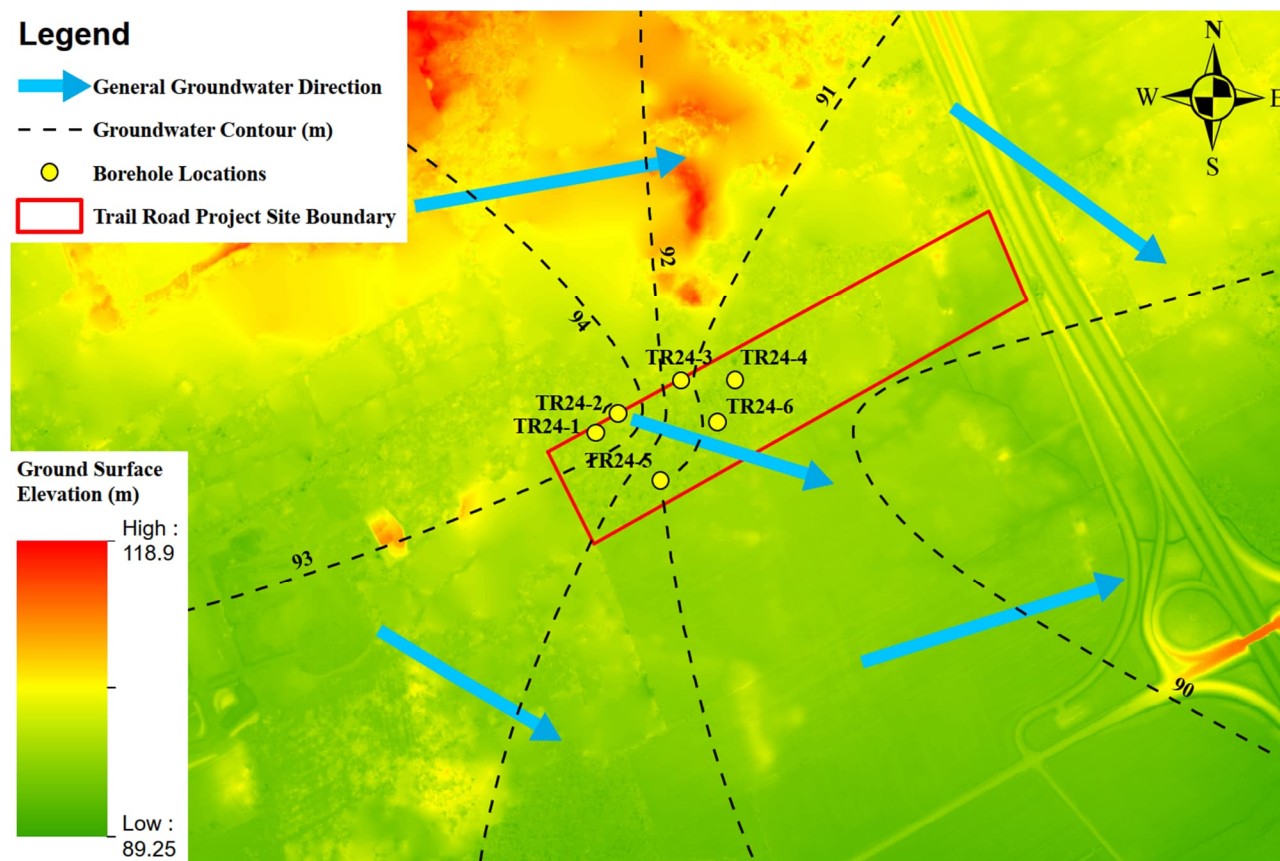


Figure 2-3: General Groundwater Flow Directions

Based on the borehole data, groundwater is not observed at the surface within the Project site, while the RVCA Flow and Water Levels Mapping indicates the presence of a non-Provincially Significant Wetland (non-PSW) covering portions of the site as shown in **Figure 2-4**. Non-PSW wetlands are areas that do not meet the criteria for provincial significance under the Ontario Wetland Evaluation System (OWES), typically due to size, hydrological, or ecological factors.

Although the site development does not involve excavation or interaction with the shallow groundwater table, an environmental study is recommended to thoroughly assess the non-PSW wetland and its potential seasonal characteristics.



Figure 2-4: Non-PSW Wetland in the Project Site

Groundwater quantity and quality assessments are not required for this study, as the site development does not rely on groundwater for water supply or wastewater disposal purposes. However, all groundwater-related assessments and conclusions presented above should be interpreted with caution due to the seasonal limitations of the available data.

2.5 Information Supporting the Stormwater and Drainage Plan

As SWM planning is required to meet the target water quantity, quality and water balance criteria, the implementation of a variety of SWM facilities maybe required. Further SWM guidelines (i.e., Sewer Design Guidelines of City of Ottawa (October 2012)) must be fully considered to undertake the stormwater and drainage plan.

To assess surface runoff characteristics for the Project site, Curve Number (CN) values were determined based on land use and soil conditions (outlined in section 2.2 Soil Conditions) following the Sewer Design Guidelines of City of Ottawa (October 2012). The site consists of a combination of impervious battery storage units, compacted gravel surfaces, and vegetated areas. Hydrologic Soil Group classification is assigned based on borehole logs and available geological data. **Figure 2-5** shows the land use and CN values for the pre-development and post development conditions of the Project site.

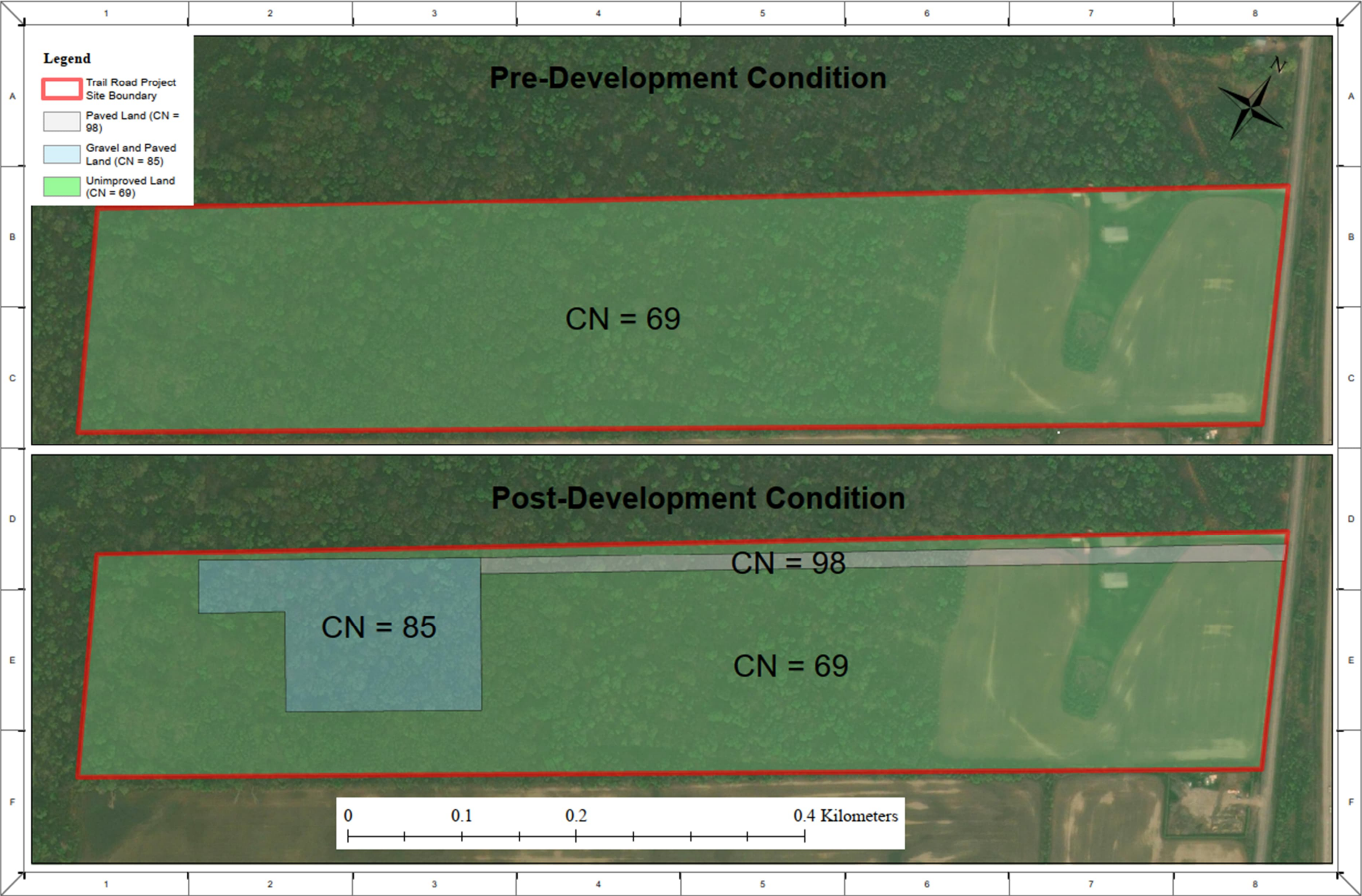


Figure 2-5: Land Use and Curve Number Values for Pre- and Post-Development Conditions of the Project Site

Based on the land use for both pre- and post-development conditions, the average CN value for the pre-development condition is 69 and for the post-development condition is 73. Therefore, SWM measures will be required to mitigate peak runoff flows and ensure compliance with City of Ottawa Sewer Design Guidelines (October 2012).

3. Conclusion and Future Design Recommendations

The following are the key conclusions that can be drawn from the hydrogeological and terrain analysis study:

- The shallow groundwater levels, ranging from 0.7 m bgs at borehole TR24-1 to 1.7 m bgs at borehole TR24-2, indicating a potential risk of flooding in the proposed areas designated for the battery storage and substation facilities.
- The terrain analysis indicated that the northwest part of the site demonstrates higher permeability, which allows for better drainage and suitability for surface-level development. On the other hand, the southeast part of the site features low permeability, requiring targeted approaches for managing surface water and preventing excessive runoff. These variations highlight the importance of incorporating tailored drainage and stormwater control measures in the project planning phase.
- The general soil profiles at all boreholes consists of non-organic topsoil (100 mm to 300 mm deep), silty sand to sandy silt (6.2 to 6.4 metres below ground surface (mbgs)), and sandy silt with gravel (at a depth of 9.5 mbgs). The hydrologic soil group is "B" for the Project site with an estimated Horton infiltration rates of 6 mm/h (minimum infiltration rate) to 80 mm/h (maximum infiltration rate). Site soil condition is suitable for the infiltration.
- Groundwater quantity and quality assessments are not required for this study, as the site development does not rely on groundwater for water supply or wastewater disposal purposes.
- The average CN value for the pre-development condition is 69 and for the post-development condition is 73 indicating a small increase in the peak runoff flows. Therefore, SWM measures will be required to mitigate peak runoff flows and ensure compliance with City of Ottawa Sewer Design Guidelines (October 2012).
- Based on the borehole data, groundwater is not observed at the surface within the Project site, while the RVCA Flow and Water Levels Mapping indicates the presence of a non-Provincially Significant Wetland (non-PSW) covering portions of the site.

4. References

- Surficial Geology Maps. GeologyOntario, Ministry of Mines, Ontario. (Link: [GeologyOntario](#)).
- Flow and Water Levels Mapping. Rideau Valley Conservation Authority (RVCA). (Link: [RVCA GIS Maps](#)).

- Technical Guidelines for Flood Hazard Mapping. Central Lake Ontario Conservation, Credit Valley Conservation, Grand River Conservation Authority, Ganaraska Conservation, Toronto and Region Conservation Authority, and Nottawasaga Valley Conservation Authority (March 2017).
- Preliminary Geotechnical Investigation. Hatch (January 2025). (Report no. H375035-0000-2A0-066-0001).
- Hydrogeological and Terrain Analysis Guidelines. City of Ottawa (March 2021).
- Sewer Design Guidelines. City of Ottawa (October 2012).

Mohamed Khafagy, P. Eng

MK:CH