Report

Trail Road Battery Energy Storage System (BESS) Fluvial Geomorphology Assessment

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Exhibit A – Disclaimer (General)

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1. Introduction

Hatch Ltd. (Hatch) has been retained by Brookfield BRP Canada Corporation (Brookfield) to conduct a fluvial geomorphic assessment at a discrete section of the Trail Road creek (Creek) to support the design and permitting of a proposed development 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.

The main objective of the fluvial geomorphic assessment was to confirm an appropriate geomorphic hazard (erosion) limit between the banks of the Creek and the proposed footprint of the development property. The scope of work to delineate this hazard/erosion setback involved the completion of a field reconnaissance and desktop analysis. This information was used to identify the characteristic channel morphology and bank stability of the study reach, coupled with the development of an erosion analysis to predict the long-term erosion potential of the watercourse. The results from the fluvial geomorphic assessment will be used to refine, as needed, a preliminary erosion hazard limit for the Project.

1.1 Project and Site Description

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 0.03 km^2 of 0.21 km^2 property at 4186 William McEwan Drive in Richmond, Ontario, which is approximately 23.0 km south of Ottawa. The Project will consist of battery energy storage containers, a substation, access roads and associated electrical infrastructure. A key plan outlining the site location is shown on **Figure 1-1**.

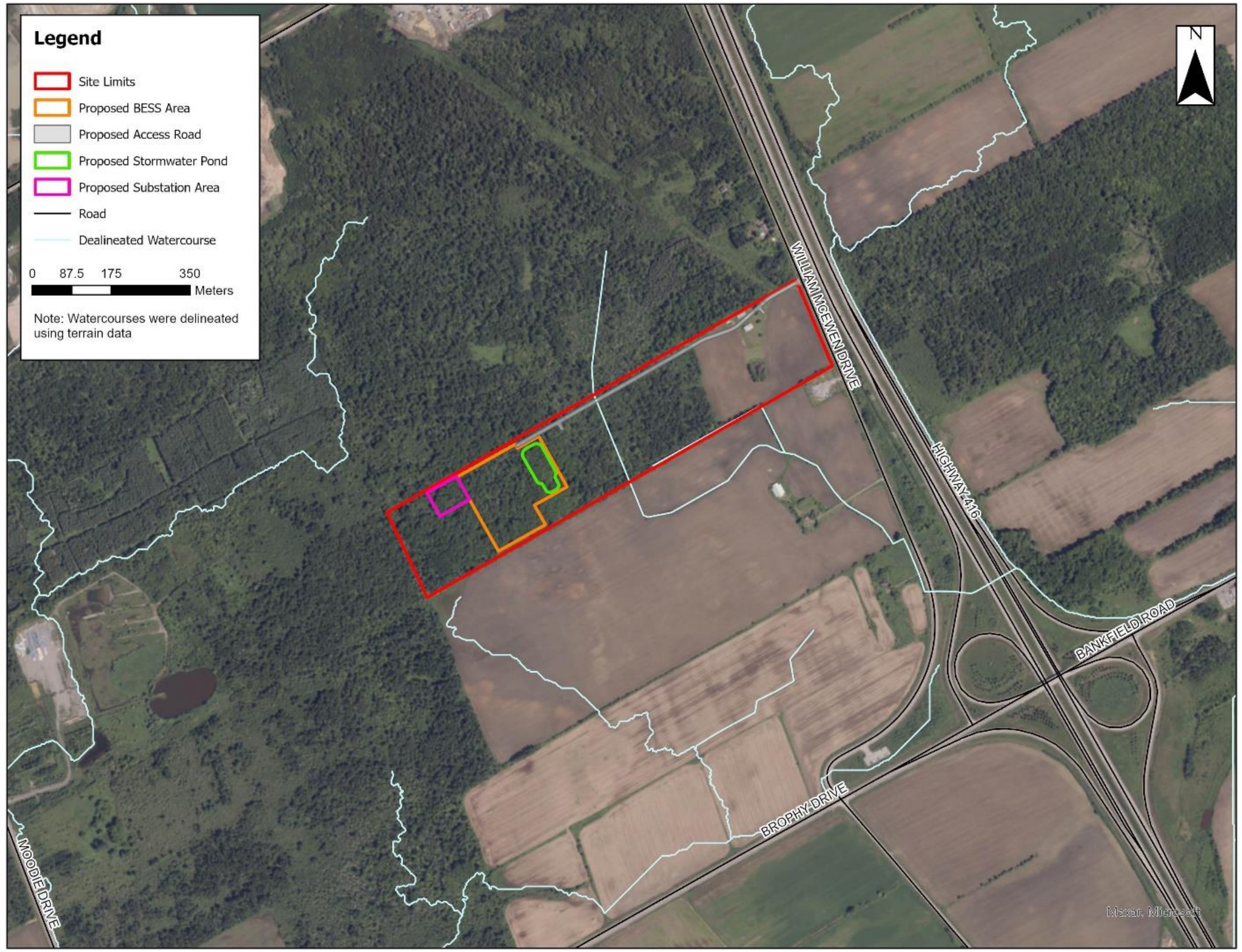


Figure 1-1: Overview of Limits of the Trail Road BESS Project

1.2 Scope of Work

The purpose of this Fluvial Geomorphological Assessment Report is to:

- Review available background information and mapping (e.g., watershed/subwatershed reports, geology, and topography) related to the watercourse and the controlling factors of fluvial geomorphology.
- Examine recent and historical aerial photographs of the site to understand changes in channel form and function over time.
- Undertake a field investigation to document existing channel conditions, including bank characteristics, bed substrate, and geomorphic processes (e.g., erosion, sediment transport, channel migration).
- Delineate the watercourse reach based on a desktop assessment followed by field confirmation.
- Assess fluvial geomorphological hazards (e.g., toe erosion and meander belt migration) and delineate the potential hazard limits.
- Evaluate the potential impacts of the anticipated post-construction conditions on the Creek.
- Provide fluvial geomorphological recommendations for the proposed creek crossing.

This report summarizes findings of the desktop and field-based geomorphological assessment and should be reviewed in combination with the completed preliminary geotechnical investigation (Hatch, 2025).

1.3 Background Reference and Guidelines

The following listed information has been used in this study:

<u>Background Reports and Memos</u>

- Hatch, 2025. Trail Road Battery Energy Storage System (BESS) Preliminary Geotechnical Investigation.
- Hatch, 2025. Trail Road Battery Energy Storage System (BESS) Hydrogeological and Terrain Analysis Study.

<u>Background Reference Data</u>

- Historical Aerial Photographs - Extracted from McMaster University Library, Historical Hamilton Portal and Google Earth Pro.
- Soil and Groundwater Data - Extracted from the Geotechnical Investigation (Hatch 2025).

Guideline Requirements

- Ontario Ministry of Natural Resources (MNR) (2002). Technical Guide. River & Stream Systems: Erosion Hazard Limit.
- Credit Valley Conservation (2015). Fluvial Geomorphic Guidelines.

This technical report presents the methods and results of the fluvial geomorphic assessment at the reach length of the Creek. The remaining part of the document is organized into four main sections. This includes background review and desktop assessment for the Project site in Section 2.0, field investigation and observations in Section 3.0, fluvial hazard evaluation and hydraulic modelling in Section 4.0, and a discussion of the key findings and recommendations in Section 5.0.

2. Background Review and Desktop Assessment

The Project site includes an approximate area of 0.21 km^2 and is located at the east of William McEwen Drive, and a creek crosses the middle of the Project site, from north to south (**Figure 1-1**). The Creek is ultimately draining to the east into the Rideau River, a major tributary to the Ottawa River which comprises large areas of urbanization (specific to the urban core of the City of Ottawa). The Rideau River represents a large, permanently flowing watercourse that drains a watershed area of approximately 4,000 km^2 in the area upstream (south) of the West Hunt Club Road bridge crossing. The river conveys flows from generally south to the north and is located at an elevation of approximately ~10 m below the surrounding tablelands. These flow volumes are understood to be regulated by the operation of a series of downstream water control dams and lock systems (reflective of the Rideau River waterway), as well as the presence of inline lakes (such as at Mooney's Bay). Most of the Rideau River watershed is characterized by undeveloped or unmaintained land use (i.e., mostly natural and former agriculture) which is where the Project site is located.

The Creek in the Project site drains a watershed area of approximately 1.1 km^2 in the area upstream (north) of the Project site and is located in the beginning of the watershed (the headwater zone of the watershed) which is draining into the Rideau River. Note that the headwater streams have relatively steeper slopes compared to the downstream zones, with a V-shaped valley.

The proposed development at the Project site involves the construction of battery energy storage containers, a substation, access roads and associated electrical infrastructure. This proposed development will utilize approximately 0.03 km^2 (or 15.1%) of the total area of the property, while the remaining portion of the land will be designated/maintained as an Environmental Protection Zone (to be undisturbed by the proposed development).

2.1 Existing Documents and Mapping Review

A comprehensive review of existing documents and mapping products was conducted using data provided by two recent studies at the Project site. The first study is preliminary geotechnical investigations (Hatch 2025) that have been conducted at the Project site to support the design and permitting of the proposed development property. Key findings include:

- Borehole Data: Eight boreholes (TR24-1 to TR24-8) were drilled across the site. The borehole logs revealed a consistent soil profile comprising a thin layer of non-organic topsoil (100 to 300 mm deep), followed by layers of silty sand to sandy silt at depths of approximately 6.2 to 6.4 m, and underlain by sandy silt with gravel, with some boreholes reaching a final depth of up to 9.52 m.
- Groundwater Observations: Groundwater levels were recorded at multiple times during and after drilling. Measurements indicated that groundwater was relatively shallow in portions of the site (ranging from 0.7 to 2.5 m below ground surface), with the southwest area showing the shallowest levels, suggesting it may serve as a recharge zone.
- Mapping Outputs: Detailed site plans were produced showing borehole locations, elevations, and key subsurface stratigraphy.

The second study is hydrogeological and terrain analysis (Hatch 2025) that has been conducted to provide an integrated assessment of the hydrogeological and terrain characteristics of the Project site. Its key contributions include:

- Terrain Characterization: The study identified two primary terrain units. The Nearshore Sediments in the northwest are characterized by fine-to-medium grained, calcareous sands with moderate permeability, while the Offshore Marine Deposits in the southeast consist of clay, silty clay, and silt with low permeability, which may affect surface runoff.
- Hydrogeological Conditions: By integrating borehole data from the geotechnical investigation, the study assessed soil conditions, groundwater table elevations, and determined that the general direction of groundwater flow is from west to east. This information supports further assessments of surface runoff, infiltration capacities, and flood risk.

- Mapping Products: The study produced mapping outputs, including a site plan that indicates borehole locations and elevations, terrain unit maps showing the spatial distribution of geological units, and groundwater flow maps generated through interpolation of borehole data. These products are critical for understanding drainage patterns and potential flood hazards.

2.2 Historical Aerial Photographs Assessment

A series of historical aerial photographs were reviewed to determine changes to channels or drainage features on site and surrounding land use and land cover. This information, in part, provides an understanding of the historical factors that have contributed to current channel morphodynamics. Various aerial photographs and satellite images from 1954 to 2024 were retrieved to complete the historical assessment and inform the erosion hazard delineation. Specifically, aerial photographs for the year 1954 (1:30,000) was retrieved from McMaster University Library (Historical Hamilton Portal); and 2002, 2004, 2008, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2020, and 2024 (1:14,000) were retrieved from Google Earth Pro. All historical aerial photographs are provided in Appendix B for reference.

In 1954, the subject property was primarily agricultural land, with evidence of rectangular field patterns and a few hedgerows delineating property boundaries. The Creek is visible crossing the site, following a path along the boundary of an area with multiple trees adjacent to the Project site in the south. It appears to function as a ditch or a natural drainage feature, guiding water toward the downstream portion of the Creek. Surrounding land use included agricultural lands, and no other drainage features were visible on site.

Between 2002 and 2004, the watercourse is present in good condition, with no observable changes compared to the 1954 aerial photography. The surrounding land use appears unchanged.

By 2008, the Creek downstream of the project site appears to have been modified, with constructed side banks with channel widening in the southern portion downstream of the subject lands. No other significant changes to surrounding land use are evident.

By 2012, a small wetland or pond feature is present along the tributary to the south. The constructed side banks of the Creek are no longer visible, and the channel condition appears to deteriorate. This may have resulted from a flooding event. By 2016, the Creek shows signs of widening, and an additional pond feature emerges along the tributary downstream of the project site. Tree cover within the subject property remains consistent.

In 2017, the Creek is reconstructed, with newly formed banks surrounding the widened channel and the natural ponds that had developed in previous years.

By 2020, the constructed banks are no longer visible, and the condition of the Creek continues to degrade through to 2024. In general, the Creek within the Project site follows a straight alignment; however, no visible changes to the planform of the tributary are observable in all aerial imagery due to tree cover.

2.3 Desktop and GIS Analysis

A desktop assessment was conducted to delineate the watercourse reach and its contributing watershed using publicly available digital elevation data and GIS-based analysis. The analysis involved processing digital elevation models (DEMs) to extract terrain features, identify flow accumulation paths, and define watershed boundaries. The Eastern Ontario 2021 to 2022 Digital Terrain Model (DTM) topographic survey was obtained from Ontario GeoHub in TIFF format, with a 0.5 m × 0.5 m grid resolution covering the full study area. Based on field observations, minor adjustments were made to the DEM at the southern portion of the Creek, specifically at the intersection with the southeast site boundary, to better reflect the observed topography and ensure accurate representation of the creek alignment.

Hydrological analysis, including catchment and stream delineation, was performed using ArcGIS to assess surface flow directions. **Figure 2-1** shows the high-level drainage patterns within the study area based on topographic data, field survey photographs, and aerial imagery.

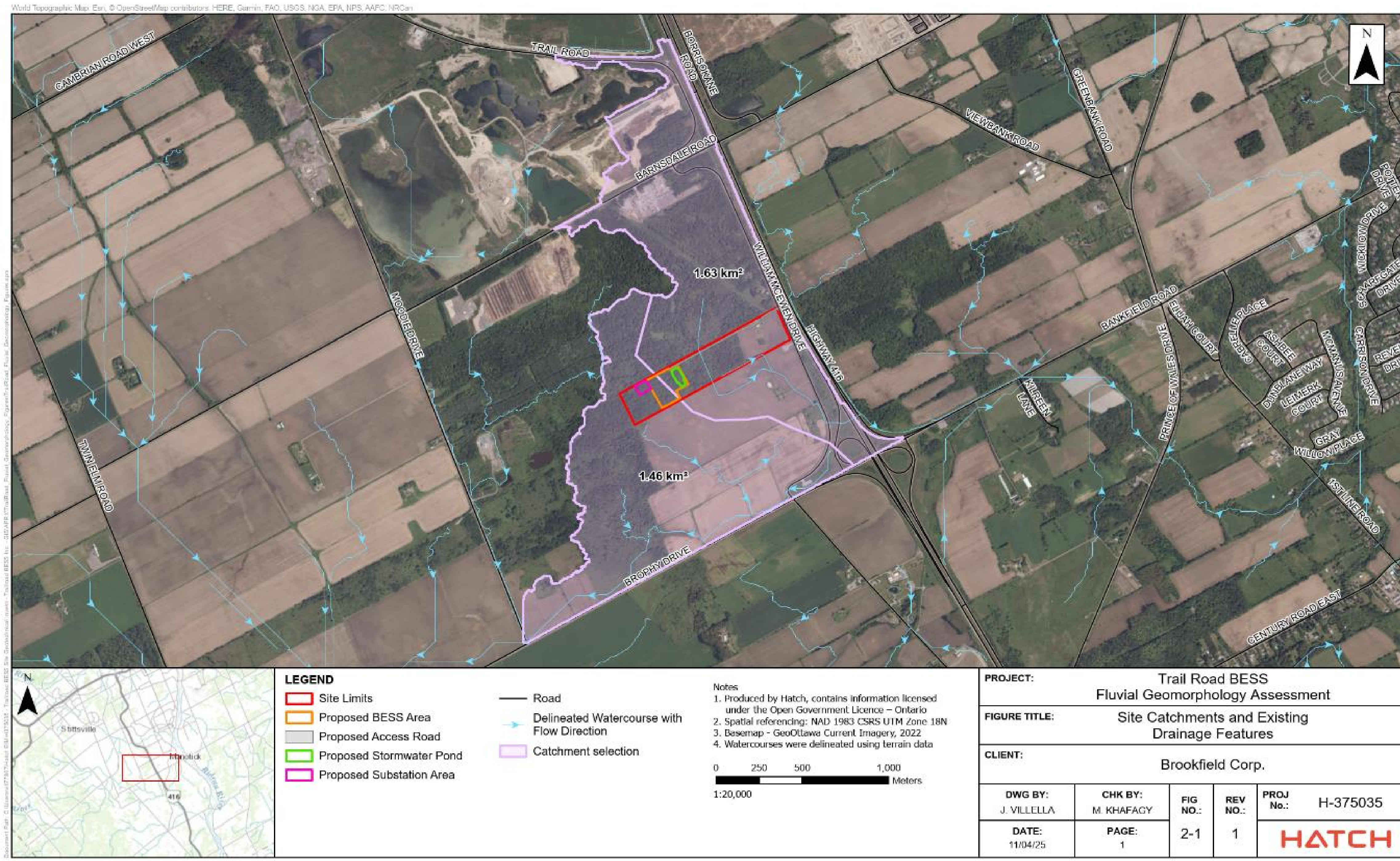


Figure 2-1: Catchments Within the Study Area with Existing Drainage Features and General Drainage Patterns

3. Field Investigation and Observations

A field investigation was conducted on April 7, 2025, to assess the fluvial and geomorphic conditions of the Creek within the Project boundaries. Given the small scale of the watercourse and the proximity of adjacent private properties, observations were collected from the east bank of the Creek. The watercourse was observed to be narrow and situated in an unconfined setting, with an average surface width of approximately 2 m and a shallow depth of around 15 cm. Active flow was present during the site visit, with water observed moving along the channel and pooling in low-lying sections. Field observations are supplemented by representative photographs (Photos 1 to 24), the geographic locations of which are shown in Figure 3-1, and included in Appendix B.

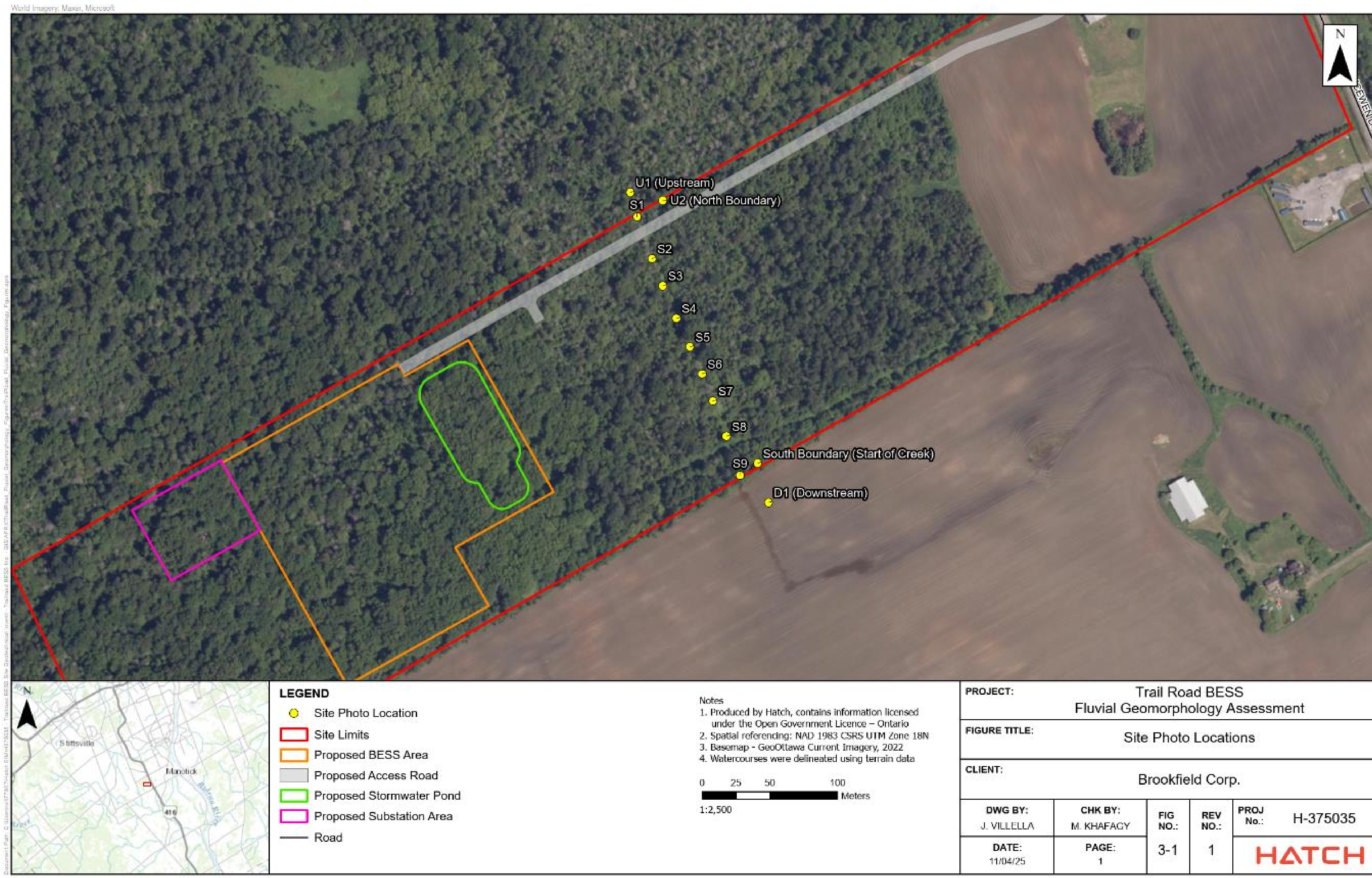


Figure 3-1: Locations of Field Photographs

3.1 Watercourse Conditions

At the north boundary of the Project site, along the property line shared with the adjacent parcel, stagnant water was observed accumulating in a depressed corridor perpendicular to the main Creek alignment as shown in Photo 2 (Appendix B) from location S1. The presence of standing water outside the defined channel zone may also suggest the existence of secondary flow paths or backwater effects during wet periods, although no defined channel is visible in this area.

The watercourse flows through a densely vegetated corridor with mild side slopes (approximately 3:1 or flatter) and no distinct valley walls. The channel bed consists primarily of fine sediments, organic debris, and woody material. Riparian vegetation includes shrubs, saplings, and deadfall along both banks. There were no signs of bank slumping or undercutting, and no erosion control measures (e.g., riprap or engineered stabilization) were noted. The field evidence supports the classification of the reach as a stable, shallow, confined system, with minor erosion activity and limited channel migration potential under current normal hydrologic conditions. Further downstream of the site, within the adjacent property to the southeast, the Creek transitions into an unconfined system. Field observations in this area (Photos 22 to 24 in Appendix B) show that the watercourse widens considerably, with a surface water width of approximately 4 m and a shallow depth of roughly 6 cm. The surrounding land is characterized by saturated soils and extensive muddy conditions, indicating poor drainage and a high groundwater table. These observations are consistent with the high groundwater table identified in the borehole data from the geotechnical investigation (Hatch, 2025). These conditions suggest low channel confinement, with water dispersing laterally across the adjacent field. The lack of defined banks and the spread of water across a broad low-lying zone are consistent with unconfined fluvial characteristics and suggest reduced channel competency and possible overland flow contributions during higher flow periods.

At the south boundary of the Project site (Photo 20 in Appendix B), a secondary reach of the Creek initiates within the property and flows towards the northeast. This tributary represents the beginning of a separate drainage path that converges with the main Creek further east within the adjacent southern property as shown in **Figure 1-1**. The reach appears to be shallow and narrow, with saturated soils and standing water along the low-lying corridor. This segment may represent a seasonally active flow path.

3.2 Observed Fluvial Processes

In several locations, including the area shown at location S8 (Photo 16 in Appendix B), evidence of localized channel adjustment and planform variability was observed. The Creek exhibits minor sinuosity, with lateral deflections of the low-flow channel that suggest active, albeit limited, fluvial processes. These deviations in flow alignment are likely the result of small-scale bank erosion and scour occurring along the outer margins of emerging meander features. While the degree of meandering is minimal due to the confined nature of the corridor and limited stream power, these features may represent the early development of a meander belt within the system.

3.3 Stormwater Management Implications

While a detailed stormwater management (SWM) analysis is beyond the scope of this fluvial geomorphology study, field observations provide important context for future drainage design. Saturated soils along the Creek corridor, the presence of multiple stagnant water zones, and high groundwater levels (as identified in the geotechnical investigation) were observed throughout the site. These conditions suggest that infiltration-based SWM measures (e.g., infiltration ponds or soakaway pits) may be constrained, especially with the low flow capacity of the channel particularly within the unconfined downstream reach. Additionally, the confined nature of the channel upstream indicates limited lateral erosion or channel migration, which may reduce setback requirements but should still be validated through ongoing coordination with SWM designers.

4. Fluvial Hazard Evaluation and Hydraulic Modelling

A Hydraulic Analysis was completed for the Creek to support the delineation of the erosion hazard limit and inform the meander belt allowance. The analysis used the United States Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 6.4.1. Given that the Creek is typically dry outside of storm events, it was assumed that the available Digital Elevation Model (DEM) captured the channel bathymetry with sufficient accuracy. The following subsections outline the development and results of the HEC-RAS 1D model.

4.1 Hydraulic Model Overview

HEC-RAS is a widely accepted software system for simulating one-dimensional water surface profiles along natural and constructed channels. In this study, HEC-RAS was used to model the existing Creek geometry under various design flow events. The software uses the principles of conservation of mass and energy (or momentum) to solve for flow depth and discharge along each cross-section. Outputs from this model are useful for understanding potential overbank flow extents and complement the geomorphological assessment of erosion hazard zones.

4.2 HEC-RAS Model Development

The model geometry was developed using the RAS Mapper toolset. HEC-RAS Mapper is an HEC-RAS extension that provides the user with a set of procedures, tools, and utilities for development of 1D HEC-RAS river hydraulic models. River network, and cross-sections are among the parameters that were developed using the RAS Mapper extension. The HEC-RAS program was designed to evaluate the hydraulic assessment of the Creek and to produce floodplain inundation mapping where required. All input parameters to the HEC-RAS model was defined in geometric data and flow data modules.

4.2.1 Cross-sections

A terrain was created based on the available survey and was used to create cutlines (cross-section lines) within HEC-RAS. The HEC-RAS model includes a total reach length of approximately 760 m. The cutlines are perpendicular to the direction of flow and developed using the RAS Mapper extension. The cross-sections were cut at locations with potential changes (i.e., bends, bridge structure, contraction, expansion, etc.) in the stream. In general, 14 cross-sections were constructed along the river alignment with an average spacing of 50 m. Figure 4-1 shows the HEC-RAS schematic of the cross-sections and river alignment with the terrain.

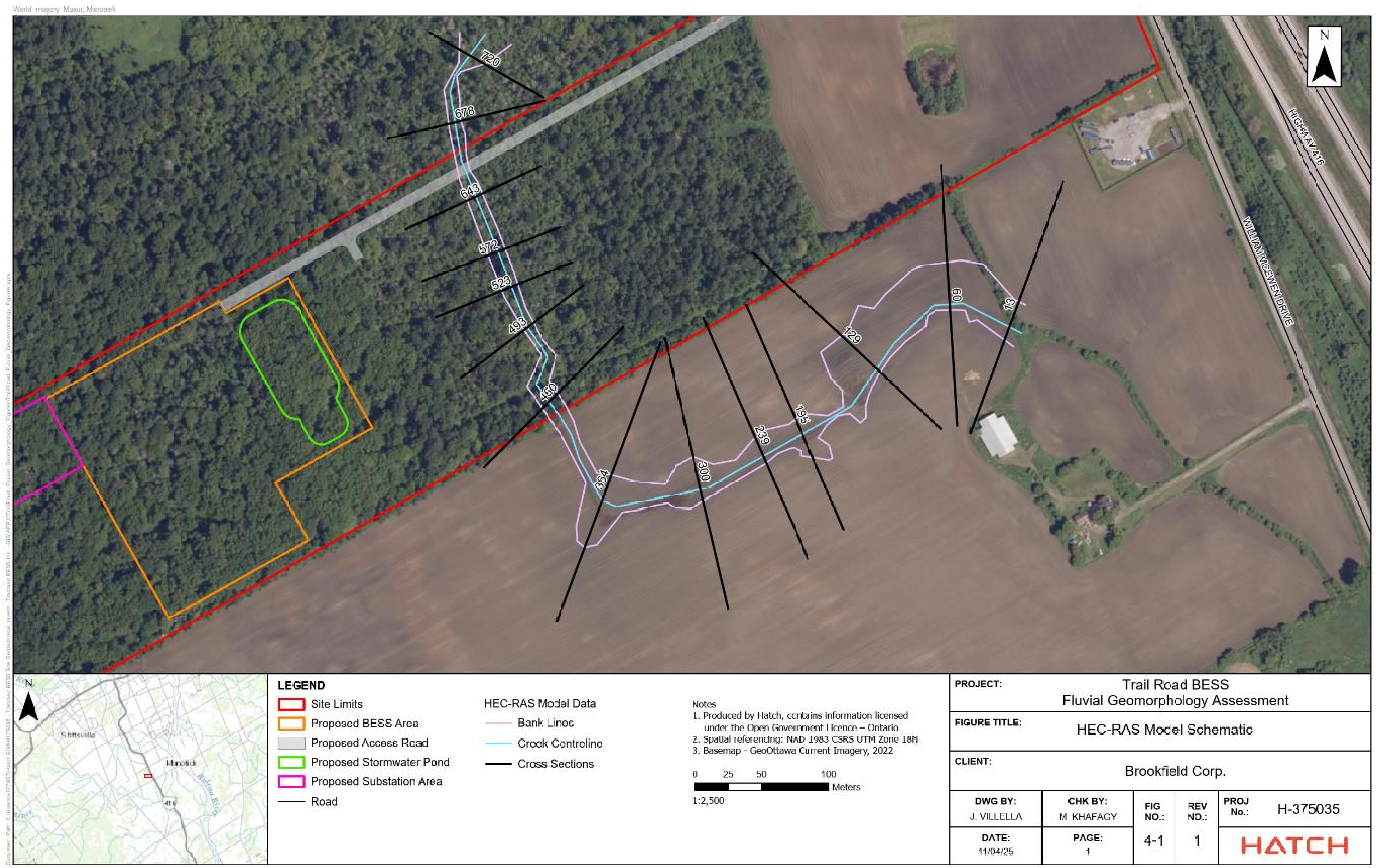


Figure 4-1: HEC-RAS Model Schematic

4.2.2 *Flood Flow Estimation*

The peak flood flows were estimated based on regional flood frequency methods (Ontario Ministry of Natural Resources (MNR), 1985, 2000 and Ontario Ministry of Transportation (MTO), 2016). This method provides the most conservative results that were adopted as the design flood. The Creek has a total drainage area of 1.1 km^2 (**Figure 2-1**). The flow rates used for the model are summarized in .

Table 4-1: Peak Flows of Trail Road Creek

Return Period	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Flow Rate [m^3/s]	7.50	10.97	13.17	15.25	17.93	19.97

4.3 Floodplain Results

The Creek alignment was developed in RAS Mapper by creating the river centreline layer based on the flow path generated in ArcGIS Pro showing the location of the lowest points.

The Hydraulic Analysis was performed for the 2-, 5-, 10-, 25-, 50-, and 100-year events. A Manning's 'n' coefficient of 0.035 was selected for the Creek channel, and 0.045 for the Creek banks based on vegetation and surface conditions following City of Ottawa Sewer Design Guidelines. The floodplain is covered with a heavy mix of vegetation on both banks (Figure 4-4). A summary of HEC-RAS hydraulic results is provided in Appendix C. A normal depth boundary condition was applied at the downstream end, based on the slope of 0.010011 which aligns with the hydraulic gradient line for the 100-year flow event at the downstream cross-section. Note that the flow in the cross-sections is subcritical ($F_r < 1$) for all storm events except for one cross-section at station 460 is supercritical ($F_r > 1$). Figure 4-2 shows the water levels in two cross-sections for 2-year and 100-year storm events.

(a) Cross-section at Station 493 **(b) Cross-section at Station 572**

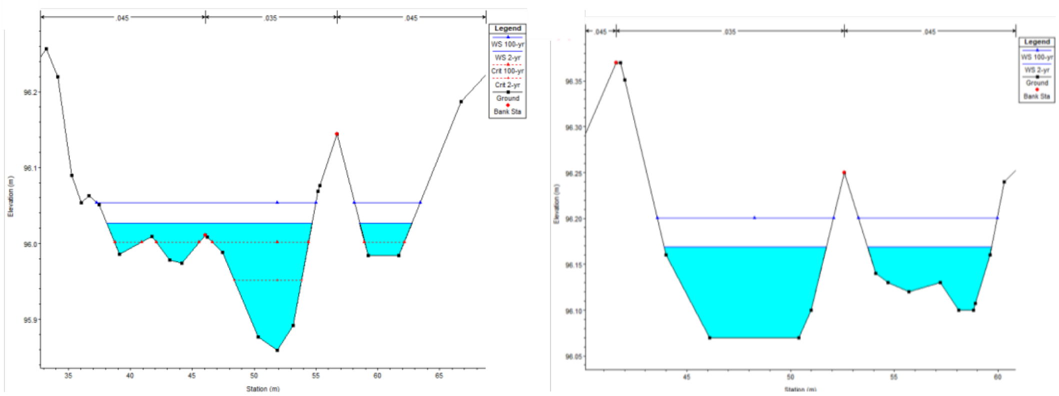


Figure 4-2: Cross-sections with Critical Flow for 2-year and 100-year Storm Event

Figure 4-3 shows the Creek profile for 2-year and 100-year storm events.

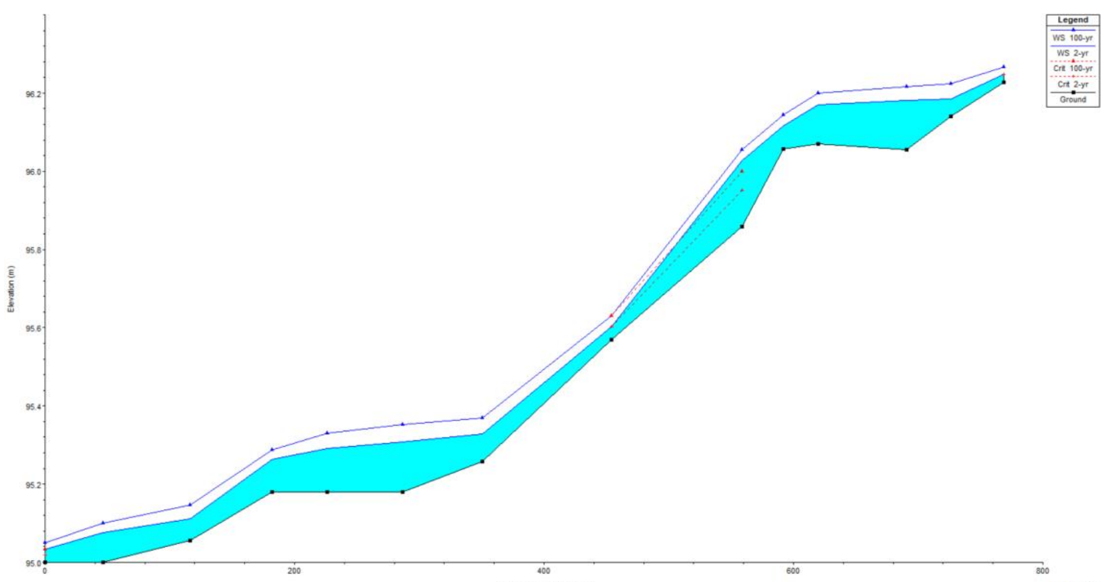


Figure 4-3: Trail Road Creek Profile for 2-year and 100-year Storm Events

The results of the 100-year flood events at the Creek are shown in Figure 4-4 below.

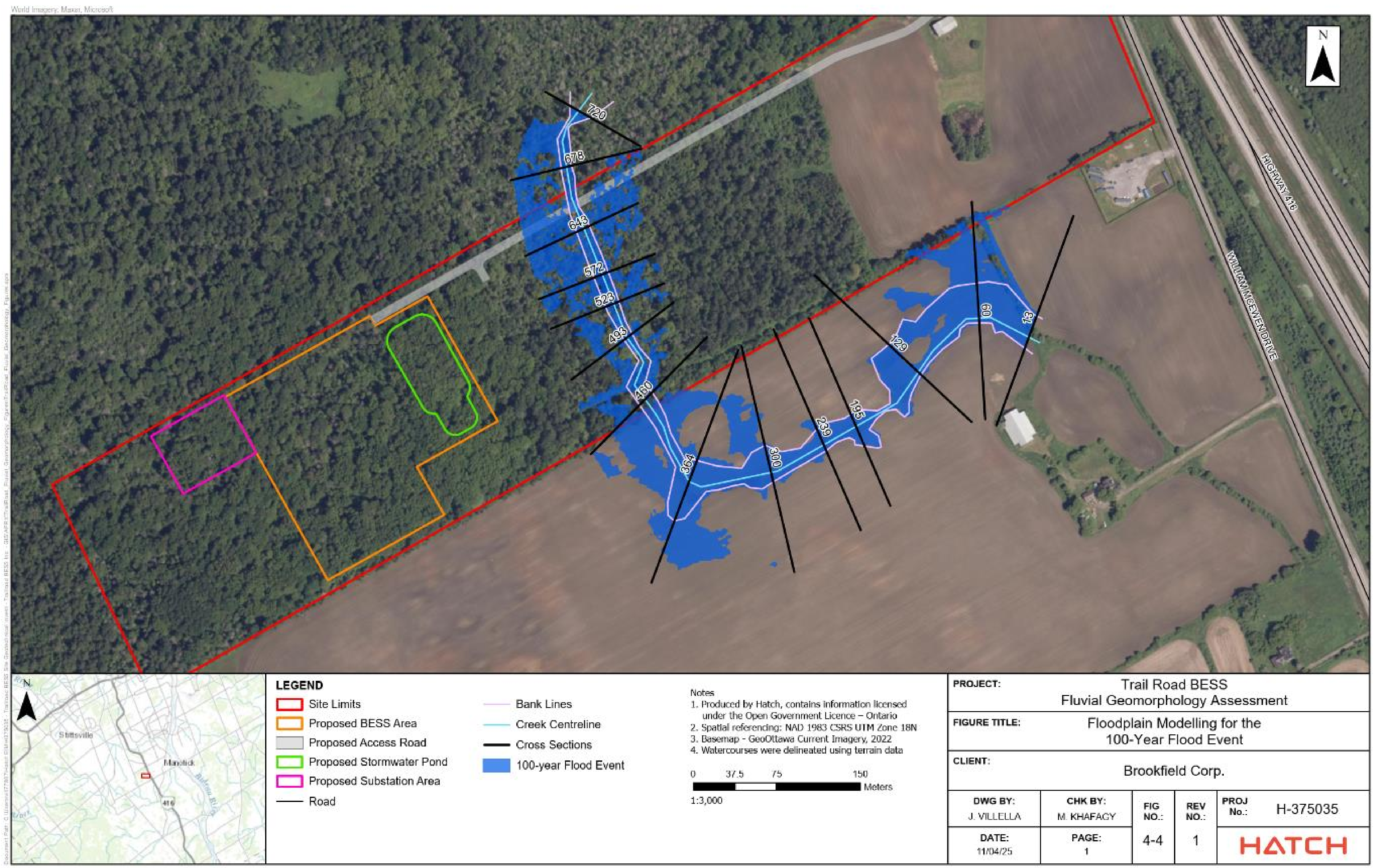


Figure 4-4: Results of Trail Road Creek Floodplain) Modelling for the 100-year Flood Event

4.4 Sediment Transport Assessment

Given the limited contributing watershed area (~1.1 km²), the shallow channel depth (~15 cm), and the absence of significant channelized flow energy, sediment transport modelling is not required for this study. Field observations and historical aerial imagery did not indicate major sediment accumulation or migration zones requiring quantitative analysis. As such, a qualitative geomorphic assessment was deemed sufficient for the objectives of this study.

4.5 Meander Belt and Erosion Hazard Assessment

The delineation of the erosion hazard limit for the creek within the study area is based on an integrated methodology that includes: (1) interpretation of historical aerial photography to identify evidence of channel migration and planform change, (2) field-based geomorphic assessment to characterize channel conditions and erosional activity, and (3) hydraulic modeling using HEC-RAS to delineate the 100-year floodplain extent. While HEC-RAS modelling alone does not determine meander belt widths, its output supports the geomorphic interpretation by identifying flood-prone areas and potential zones of fluvial activity. This multi-evidence approach ensures the erosion hazard assessment reflects the fluvial dynamics at the site.

4.5.1 Toe Erosion and Stable Slope Allowance

Most watercourses in Ontario have a natural tendency to develop and maintain a meandering planform, provided there are no spatial constraints. A meander belt width assessment estimates the lateral extent that a meandering channel has historically occupied and will likely occupy in the future. This assessment is therefore useful for determining the potential erosion hazard to proposed activities adjacent to a given watercourse.

When defining the meander belt width or erosion hazard for a creek system, unconfined and confined valley systems are assessed differently. Confined systems are those where the watercourse is contained within a defined valley, where contact between the watercourse and a valley wall is possible. The erosion hazard for confined systems can be defined based on a toe erosion allowance and stable slope allowance. In contrast, unconfined systems are those with poorly defined valleys or slopes well-outside where the channel could realistically migrate. Unconfined systems are generally found within glaciated plains with flat or gently rolling topography.

As per the fluvial geomorphological assessment and desktop analysis, two distinct geomorphic system types are observed within the study area. The watercourse crossing through the subject property is characterized as a confined system, flowing through a densely vegetated corridor with limited lateral mobility. In contrast, the downstream section of the Creek, south of the Project site, exhibits the characteristics of an unconfined system, as there are no steep or significant valley slopes on either side of the watercourse. This is indicated by wider planform adjustments and signs of active erosion visible in the historical aerial imagery, including the formation of two distinct ponded areas likely resulting from past flood events.

An appropriate approach is to delineate the erosion hazard for the confined systems following MNR Erosion Hazard Limit Technical Guide (2002), where the erosion hazard is comprised of three main components: 1) the toe erosion allowance; 2) the stable slope allowance; and 3) the erosion access allowance. The toe Erosion Allowance represents the potential for channel migration at the base of the valley slope. A toe erosion allowance of 7 m was applied following the MNR Technical Guide (2001). Stable Slope Allowance is to address potential long-term slope instability, where the stable slope allowance is determined based on geotechnical criteria. Based on field observations and desktop review, the Creek within the study area exhibits a shallow bankfull depth of approximately 15 cm, and no defined valley slopes or steep embankments were identified adjacent to the channel. In accordance with the CVC Watershed Planning and Regulation Policies (2010), a stable slope allowance is required only where specific conditions apply, including: slope gradients steeper than 3:1, slope heights equal to or greater than 2 m, visible evidence of slope instability, proximity of bankfull flow to the valley toe of slope (within 15 m), or a known history of slope failure. Not all of these conditions were observed at the subject site.

Therefore, a stable slope allowance is not considered necessary for this reach of the watercourse. Erosion Access Allowance is a minimum access distance is typically applied at the top of the valley slope to allow space for maintenance or future stabilization works. Regarding the erosion access allowance, MNR Technical Guide (2002) guidelines note that for stiff/hard cohesive coil (clays, clay silt) and coarse granular (gravels) tills, a 5 to 8 m erosion access is to be applied. Given the evidence of erosion along the Creek, erosion access allowance of 8 m is recommended.

The proposed development area is located entirely outside the delineated erosion hazard limit associated with the confined system reach of the Creek. As shown in Figure 4-5, there is no overlap between the development footprint and the defined erosion hazard components, including the toe erosion allowance and erosion access allowance. Some considerations should be applied for the proposed service road crossing the Creek and discussed in Section 4.6. This confirms that the development, as currently planned, does not encroach upon areas identified as geomorphologically sensitive or at risk of fluvial erosion.

Figure 4-5: Erosion Hazard Limit of the Confined System Reach

The downstream reach of the Creek transitions into an unconfined system. In such systems, the erosion hazard is better assessed using a meander belt width approach, which reflects the maximum fixed lateral extent of historical and potential future channel migration. As per MNR Technical Guide (2002), the meander belt width is defined as the summation of meander amplitude and erosion access allowance. In this case, the historical aerial photograph analysis confirms lateral channel migration and expansion of the channel and adjacent wetland features over time. An erosion access allowance of 8 m is recommended for the unconfined system reach. Figure 4-6 shows the erosion hazard limit for both reaches of the Creek (Unconfined System) including the Meander belt Width and erosion access allowance.

An appropriate safety factor can be applied to the Erosion Hazard limit as per guideline recommendations. A 2 m safety factor has been applied to both reaches of the creek (the confined and unconfined systems).

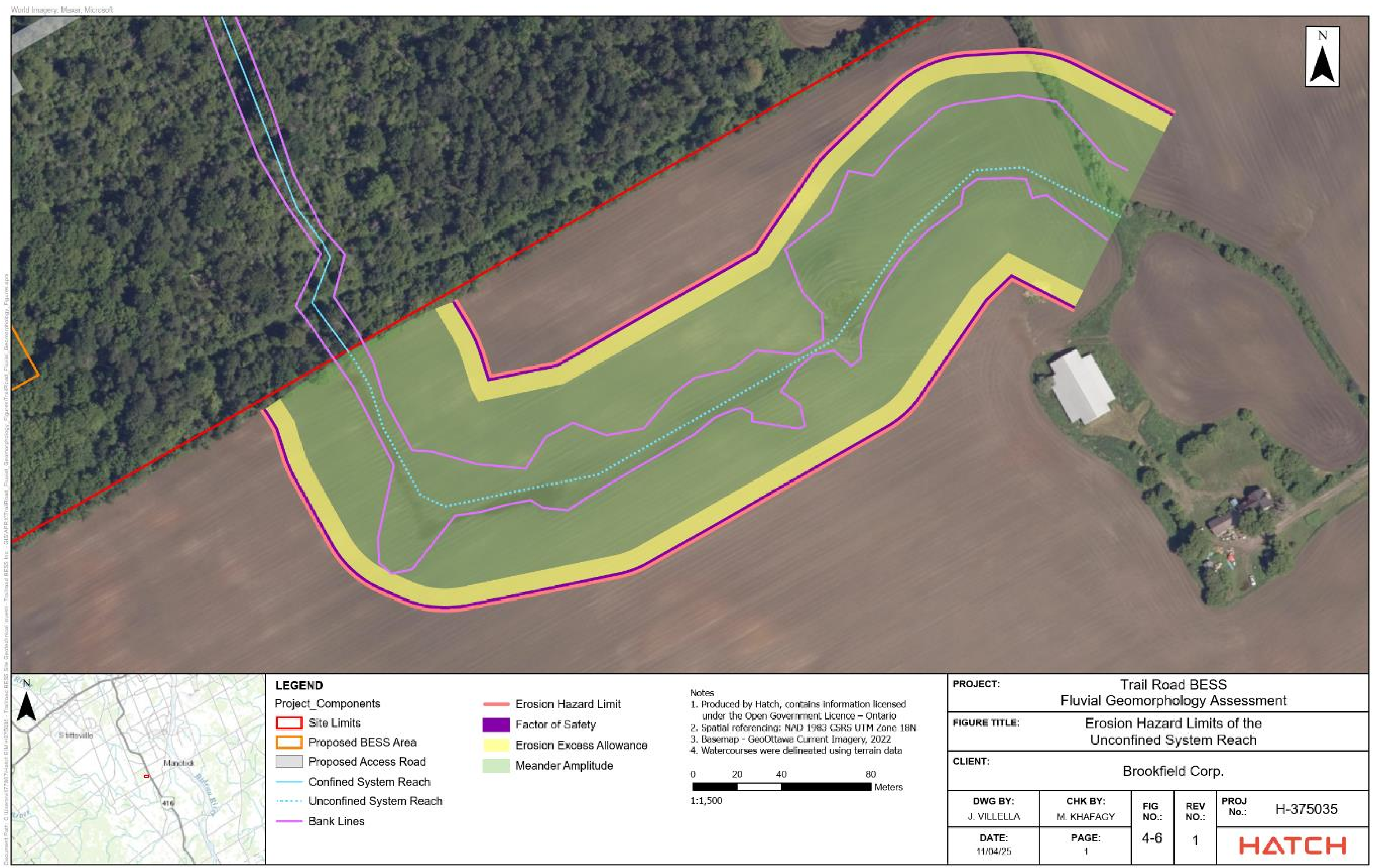


Figure 4-6: Erosion Hazard Limit of the Unconfined System Reach

4.6 Proposed Watercourse Crossing Considerations

A permanent service road is proposed to cross the Creek within the project site. Based on the field investigation conducted on April 7, 2025, the Creek at the crossing location is characterized as a confined, stable reach with running water. No evidence of bank erosion, scour, or instability was observed.

The civil design team has proposed a 450 mm diameter corrugated steel culvert to accommodate this crossing. From a fluvial geomorphology perspective, and in accordance with the Credit Valley Conservation Fluvial Geomorphic Guidelines (2015), the following recommendations should be applied:

- The proposed culvert should be embedded at least 10% of its height into the channel bed to maintain continuity of substrate and prevent outlet scour.
- The culvert invert should align with the existing channel grade to avoid creating perched conditions or disrupting sediment transport.
- Where feasible, a natural bed substrate (e.g., gravel or fines matching the upstream material) should be placed inside the culvert to preserve channel continuity.
- Routine monitoring during and after construction is recommended to confirm that no erosion or bank instability develops at the inlet or outlet areas.
- Given the absence of observed erosion or significant geomorphic activity, no additional channel realignment or erosion control measures are deemed necessary at this time.

These recommendations are made in the context of the current stable channel conditions, and it is advised that future changes in land use, hydrology, or channel form be monitored to ensure continued performance of the crossing structure.

5. Conclusions and Recommendations

A fluvial geomorphological assessment was completed for the Trail Road Creek within the Project site to identify erosion hazards and assess Creek stability. The following are the key conclusions of the assessment:

- The Creek drains a small watershed (~1.1 km²) and is situated in a headwater position within the Rideau River system. It was observed to have shallow depth (~15 cm), narrow width (~2 m), and mild side slopes (~3:1).

- Field observations and historical aerial photographs confirmed that the Creek within the site is a confined, stable system with minimal lateral migration or active erosion. Downstream of the site, the Creek transitions into an unconfined system with signs of past widening and poor drainage conditions.
- Groundwater levels are shallow in several areas, and saturated soils were observed across low-lying areas. These conditions constrain the feasibility of infiltration-based stormwater management (SWM) measures.
- HEC-RAS 1D hydraulic modelling was performed to estimate floodplain extents under various design flow scenarios. The 100-year floodplain delineation supported the erosion hazard assessment and confirmed no encroachment into the proposed development footprint.
- The erosion hazard limits were delineated for both confined and unconfined reaches combining field assessments and historical aerial photograph interpretation and supported by hydraulic modelling. A 7 m toe erosion allowance and 8 m erosion access allowance were applied for the confined system. A meander belt width and 8 m erosion access allowance were used for the unconfined section with a factor of safety of 2 m.
- There is no overlap between the proposed development area and the delineated erosion hazard limits. Continued coordination with the stormwater design team is recommended to ensure integration of fluvial considerations into the development design.
- A proposed service road will permanently cross the creek via a corrugated steel culvert. Based on the current stable channel conditions, the following are recommended:
  - Embed the culvert at least 10% of its height;
  - Align the culvert invert with the channel grade;
  - Place natural bed substrate inside the culvert;
  - Conduct post-construction monitoring; and

6. References

City of Ottawa (October 2012). Sewer Design Guidelines, Second Edition, Document SDG002.

Ontario Ministry of Natural Resources (MNR) (2002). Technical Guide. River & Stream Systems: Erosion Hazard Limit.

Credit Valley Conservation (CVC) (April 2010). Watershed Planning and Regulation Policies.

Credit Valley Conservation (CVC) (April 2015). Fluvial Geomorphic Guidelines.

Hatch (April 2025). Trail Road Battery Energy Storage System (BESS) Preliminary Geotechnical Investigation.

McMaster University Library. Historical Hamilton Portal (Link: https://library.mcmaster.ca/maps/aerialphotos/).

Ontario Ministry of Natural Resources, Ontario Watershed Information Tool (OWIT).

Appendix A
Historical Aerial Photographs

Location: Ottawa, ON
Year: 1954
Scale: 1:30,000
Source: McMaster University Library (Historical Hamilton Portal)
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2002
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2004
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2008
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2012
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2013
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2014
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2015
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2016
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2017
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2018
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2020
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Location: Ottawa, ON
Year: 2024
Scale: 1:14,000
Source: Google Earth Pro
Red Boundary: Site Limits

Appendix B
Field Photographic Record

Photo 1: View looking north (upstream) at the creek on the adjacent property on April 7, 2025.

Photo 2: View looking northeast at the north site boundary (perpendicular to the creek), showing stagnant water on April 7, 2025.

Photo 3: View looking southeast (downstream) at location S1 (Figure 3-1) on April 7, 2025.

Photo 4: View looking southeast (downstream) at location S2 (Figure 3-1) on April 7, 2025.

Photo 5: Side view at location S2 (Figure 3-1) on April 7, 2025.

Photo 6: View looking southeast (downstream) at location S3 (Figure 3-1) on April 7, 2025.

Photo 7: Side view at location S3 (Figure 3-1) on April 7, 2025.

Photo 8: View looking southeast (downstream) at location S4 (Figure 3-1) on April 7, 2025.

Photo 9: Vi Side view at location S4 (Figure 3-1) on April 7, 2025.

Photo 10: View looking southeast (downstream) at location S5 (Figure 3-1) on April 7, 2025.

Photo 11: Side view at location S5 (Figure 3-1) on April 7, 2025.

Photo 12: View looking southeast (downstream) at location S6 (Figure 3-1) on April 7, 2025.

 **Photo 13:** Side view at location S6 (Figure 3-1) on April 7, 2025.	 **Photo 14:** View looking southeast (downstream) at location S7 (Figure 3-1) on April 7, 2025.
 **Photo 15:** Side view at location S7 (Figure 3-1) on April 7, 2025.	 **Photo 16:** View looking southeast (downstream) at location S8 (Figure 3-1) (minor sinuosity) on April 7, 2025.
 **Photo 17:** Side view at location S8 (Figure 3-1) on April 7, 2025.	 **Photo 18:** View looking southeast (downstream) at location S9 (Figure 3-1) on April 7, 2025.

Photo 19: Side view at location S9 (Figure 3-1) on April 7, 2025.

Photo 20: View looking east at the south site boundary from location S9, showing the head of a secondary reach of the creek that initiates on-site and flows eastward on April 7, 2025.

Photo 21: View looking south (downstream) from location D1 (Figure 3-1) on April 7, 2025.

Photo 22: Side view at location D1 (Figure 3-1) on April 7, 2025.

Photo 23: View looking southeast (downstream) from location D1 (Figure 3-1) on April 7, 2025.

Photo 24: View looking east (downstream) from location D1 (Figure 3-1) on April 7, 2025.

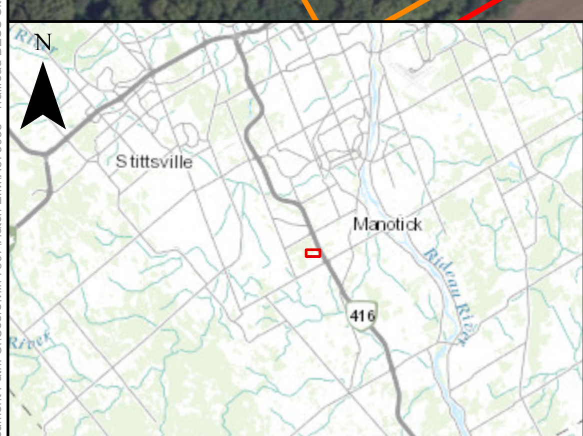
Appendix C
HEC-RAS Hydraulic Results

HEC-RAS Plan: Plan River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Reach 1	720	2-yr	0.24	96.23	96.25	96.25	96.26	0.064182	0.50	0.48	26.09	1.19
Reach 1	720	100-yr	0.49	96.23	96.27		96.28	0.023416	0.49	1.01	27.08	0.81
Reach 1	678	2-yr	0.24	96.14	96.18		96.18	0.000279	0.05	2.84	34.75	0.09
Reach 1	678	100-yr	0.49	96.14	96.22		96.22	0.000397	0.09	4.51	53.47	0.11
Reach 1	643	2-yr	0.24	96.05	96.18		96.18	0.000056	0.04	6.21	72.20	0.04
Reach 1	643	100-yr	0.49	96.05	96.22		96.22	0.000088	0.05	9.11	86.02	0.06
Reach 1	572	2-yr	0.24	96.07	96.17		96.17	0.000876	0.13	2.34	48.90	0.17
Reach 1	572	100-yr	0.49	96.07	96.20		96.20	0.000807	0.16	4.07	61.11	0.17
Reach 1	523	2-yr	0.24	96.06	96.12		96.12	0.006537	0.25	1.15	34.82	0.42
Reach 1	523	100-yr	0.49	96.06	96.14		96.15	0.004744	0.28	2.17	46.55	0.39
Reach 1	493	2-yr	0.24	95.86	96.03	95.95	96.03	0.001408	0.16	1.60	29.12	0.21
Reach 1	493	100-yr	0.49	95.86	96.05	96.00	96.06	0.001713	0.22	2.44	32.56	0.25
Reach 1	460	2-yr	0.24	95.57	95.60	95.60	95.61	0.046341	0.53	0.46	17.95	1.06
Reach 1	460	100-yr	0.49	95.57	95.63	95.63	95.64	0.019502	0.51	0.97	21.14	0.76
Reach 1	364	2-yr	0.24	95.26	95.33		95.33	0.000284	0.07	3.66	71.93	0.09
Reach 1	364	100-yr	0.49	95.26	95.37		95.37	0.000196	0.07	6.86	91.95	0.08
Reach 1	300	2-yr	0.24	95.18	95.31		95.31	0.000268	0.09	2.78	34.69	0.10
Reach 1	300	100-yr	0.49	95.18	95.35		95.35	0.000266	0.11	4.52	43.69	0.10
Reach 1	239	2-yr	0.24	95.18	95.29		95.29	0.000424	0.11	2.15	25.82	0.12
Reach 1	239	100-yr	0.49	95.18	95.33		95.33	0.000529	0.15	3.20	28.06	0.15
Reach 1	195	2-yr	0.24	95.18	95.26		95.26	0.001142	0.14	1.69	29.54	0.19
Reach 1	195	100-yr	0.49	95.18	95.29		95.29	0.001576	0.21	2.41	31.29	0.24
Reach 1	129	2-yr	0.24	95.05	95.11		95.11	0.005722	0.24	1.01	27.13	0.40
Reach 1	129	100-yr	0.49	95.05	95.15		95.15	0.002834	0.25	1.98	29.86	0.31
Reach 1	60	2-yr	0.24	95.00	95.08		95.08	0.000204	0.06	4.14	73.67	0.08
Reach 1	60	100-yr	0.49	95.00	95.10		95.10	0.000286	0.08	6.06	84.55	0.10
Reach 1	13	2-yr	0.24	95.00	95.03	95.02	95.04	0.010016	0.27	0.91	32.21	0.50
Reach 1	13	100-yr	0.49	95.00	95.05	95.03	95.06	0.010019	0.34	1.46	35.60	0.54

Appendix D
Erosion Hazard Limits

World Imagery: Maxar, Microsoft



LEGEND

- Site Limits
- Proposed BESS Area
- Proposed Access Road
- Proposed Stormwater Pond
- Proposed Substation Area
- Road
- Confined System Reach
- Unconfined System Reach
- Bank Lines
- Erosion Hazard Limit
- Toe Erosion Allowance
- Erosion Excess Allowance
- Meander Amplitude
- Factor of Safety

Notes
1. Produced by Hatch, contains information licensed under the Open Government Licence – Ontario
2. Spatial referencing: NAD 1983 CSRS UTM Zone 18N
3. Basemap - GeoOttawa Current Imagery, 2022
4. Watercourses were delineated using terrain data

0 30 60 120 Meters

1:2,250

PROJECT:	Trail Road BESS Fluvial Geomorphology Assessment
FIGURE TITLE:	Erosion Hazard Limits of the Confined and Unconfined System Reaches
CLIENT:	Brookfield Corp.

DWG BY:	CHK BY:	APP NO.:	REV NO.:	PROJ No.:
J. VILLELLA	M. KHAFAGY	D	1	H-375035
DATE: 11/04/25	PAGE: 1			HATCH

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