Appendix N

Final Physiography, Terrain and Soils Technical Support Document

MARTEN FALLS FIRST NATION
COMMUNITY ACCESS ROAD

Physiography, Terrain, and Soils Technical Support Document: Existing Conditions & Effects Assessment

February 2026

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This limitations statement is considered an integral part of this report.

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Executive Summary

This Report presents the existing conditions and effects assessment for the physiography, terrain, and soils discipline that has been prepared in support of the *Marten Falls First Nation Community Access Road Environmental Assessment / Impact Statement Report*. The report provides a comprehensive assessment of potential effects of the Marten Falls First Nation Community Access Road Project (Project) on physiography, terrain, and soils. This assessment includes consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments. The physiography, terrain, and soils assessment used widely accepted scientific practices and incorporated Indigenous Knowledge, when available.

Physiography, terrain, and soils represent a Valued Component and was selected based on the potential for effects on terrain and soils to influence the establishment of plant species and vegetation communities and associated wildlife habitat and species over time. The physiography, terrain, and soils assessment provides information used to support the assessment of other Valued Components, such as surface water, fish and fish habitat, vegetation, and wildlife and wildlife habitat.

Existing Conditions

At a regional scale, the Project is located in Northern Ontario, connecting the community of Marten Falls First Nation (Oji-Cree translation, *Wegwajihwana*) with the provincial highway network approximately 120 kilometres (km) to the south southwest.

A summary of the existing conditions for physiography, terrain, and soils within the effects assessment Local Study Area follows.

Physiography and Bedrock Geology

The majority of the Local Study Area for the physiography, terrain, and soils effects assessment is in the Severn Upland physiographic subdivision, the remainder in the northeast part of the Local Study Area, is part of the Hudson Bay Lowland physiographic subdivision (Bostock, 1970). The Severn Uplands are characterized by a rocky landscape scattered with lakes, and deposits from Pleistocene glaciation (Thurston, 1991). These deposits include glaciolacustrine clays and former shorelines of proglacial lakes, glaciofluvial sediments, and glacial tills and moraines (Thurston, 1991). In addition, organic soils have formed on poorly drained glacial lake plains (Dredge and Cowan, 1989). The Hudson Bay Lowland is a low, swampy plain, containing numerous string bogs and shallow lakes (Thurston, 1991).

The bedrock geology consists of two distinct groups of rocks. The first and largest group consists primarily of Neoarchean to Mesoarchean (2.5 to 3.2 billion years) felsic intrusions, felsic to mafic metavolcanics, and metasedimentary rocks (Ontario Geological Survey, 2011). The second group is characterized by much younger Ordovician (444 to 488 million years) sedimentary rocks composed of shale, limestone, dolostone, and siltstone (Ontario Geological Survey, 2011). The contact between the younger Ordovician rocks and the Archean volcanic rocks is approximately 25 km from the community of Marten Falls First Nation.

Terrain

Terrain is primarily level peatlands with some areas of undulating landscape. Peatlands dominate the northern portion of the Project, with moraine (till) in the south with outcrops of bedrock. The slope of the local terrain ranges from level, to slopes of more than 60% grade associated with the banks of watercourses, and side slopes of several topographically significant upland features. There are 10 terrain units present, which are approximately distributed as follows:

- 62% organic (peatlands);
- 27% moraine (till);
- 3.5% glaciolacustrine clays and silts;
- 4% open water;
- 1.5% glaciofluvial sands and gravels;
- 1% fluvial deposits; and
- Less than 1% each of colluvium (landslides), lacustrine (lake) deposits, bedrock, and anthropogenic (disturbed).

Geohazards

A geological hazard assessment was completed as part of the desktop assessment to assist with the selection and design of the Preferred Route. The following were considered in the geological hazard assessment:

- **Seismic** — Based on a database for earthquake acceleration (Kolaj et al., 2023), the peak horizontal ground acceleration values are 0.01 g and below the threshold for light damage. A review of several earthquake databases (NRCan, 2023; Halchuk et al., 2015; Lamontagne et al., 2018) indicate no earthquakes have been recorded, and no active Quaternary-aged faults were identified in any of the references reviewed for this Project (Ontario Geological Survey, 2011). The potential hazard of liquefaction occurring due to ground shaking is considered to be very low;

- **Landslides and Slumps** — Twenty-four landslides or slumps have been documented and were found to be dominantly associated with steeper slopes and the banks of fluvial systems;
- **Permafrost Degradation** — The Project is located within an area considered to be unfrozen, however the northern boundary is approximately 20 km south of an area mapped as having isolated patches of permafrost (Heginbottom et al., 1995), and therefore potential exists for isolated patches of permafrost. Five instances of potential permafrost were noted. The potential permafrost locations are mainly found in the northeastern 24 km of the route, northwest of Ogoki, with two locations documented in the Construction Disturbance Area, one in the SG-12 pit area and another in the SG-19 pit area;
- **Isostatic Rise** — Although in northern Ontario the land is rising faster than elsewhere in Canada, data from the Canadian Base Network indicate the Project is located is in an area where the crust is rebounding at approximately 6 to 7 mm per year (Henton et al., 2006);
- **Inundation / Flooding** — Flooding due to spring melt and rainfall has been noted adjacent to active floodplains, and ponding due to beaver (Oji-Cree translation, *amik*) activity has also been identified;
- **Karst** — Based on available bedrock geology mapping (Ontario Geological Survey, 2011), the potential for karst is considered to be low; and
- **Soil Erosion** — The potential for wind and water erosion of soil is linked to disturbance of vegetation and soils.

Special Geologic and Geomorphic Features

Special geologic and geomorphic features were identified that may affect construction, operation, and maintenance activities. The features considered are:

- **Potential Pits and Quarries** — Potential pits include any areas mapped as glaciofluvial (FG) and potential quarries include any terrain unit mapped as bedrock (R) or thin till veneers (Mx) overlying bedrock. Twelve potential pits and four potential quarries were identified;
- **Eskers** — Eskers are low ridges composed of glaciofluvial sand and gravel and are potential sources of aggregate material. Eleven eskers were identified;
- **Organic Soils** — Organic material is the dominant surficial material present, accounting for just over 62% of the total area;

- **Permafrost and Permafrost Degradation** — As described previously, five instances of potential permafrost were noted. The potential permafrost locations are mainly found in the northeastern 24 km of the route, northwest of Ogoki, with two locations documented in the Construction Disturbance Area, one in the SG-12 pit area and another in the SG-19 pit area; and
- **Steep Slopes and Colluvium** — As described previously, 24 landslides or slumps have been identified and are mainly associated with steeper slopes adjacent to rivers or creeks.

Soils

Soils are dominantly organic and account for over 65% of the total area. Based on field data, mineral soil material textures vary from coarser sands to very fine heavy clay. The mineral soils are dominantly classified as Luvisolic with Brunisolic soils the second most common soil Great Group. Brunisolic soils were dominantly classified as Eutric based on pH values being greater than 5.5.

Reclamation Suitability

Approximately 2.6% of the soils were assigned a Good or Fair reclamation suitability rating, 20% of the soils were assigned a Poor reclamation suitability rating, and approximately 8% were assigned an unsuitable suitability rating. Poor and even unsuitable assigned ratings do not mean the material cannot be used for reclamation and vegetative regrowth, but that it may require careful planning, good management, and possible soil amendments to change the rating to a more suitable category. Approximately 69% of the area was not rated for reclamation suitability as these areas include bedrock, water, anthropogenic areas, and organic soils.

Soil Sensitivities

The following provides a summary of soil management risk ratings for wind erosion risk, water erosion risk and soil compaction risk. Approximately 69% was unrated for wind erosion, water erosion and soil compaction risk, as these areas include bedrock, water, and organic soils.

- Wind erosion risk: approximately 8.5% low risk, 20.8% moderate risk, and 1.5% high risk;
- Water erosion risk: approximately 24.3% very low or low risk, 4.8% moderate risk, and 1.7% high or severe risk;
- Soil sensitivity to acidification: over 70% of the soils were rated as having a low or moderate sensitivity to acidification; and

- Compaction risk: approximately 14.8% low risk, 6.5% moderate risk, and 9.6% high risk. Areas of Organic soils have not been rated but would likely be at a high risk for compaction due to their low load bearing materials being easy to displace.

Potential Effects and Proposed Mitigations

An analysis was completed to evaluate Project components and activities and associated effects that could potentially affect physiography, terrain, and soils.

Project activities that would have the potential to affect physiography, terrain, and soils during the Project lifespan include:

- Land clearing;
- Blasting rock;
- Construction of the Community Access Road;
- Constructing bridges and installing culverts;
- Constructing, operating, and decommissioning temporary infrastructure;
- Mobilization of equipment, supplies, and personnel;
- Operation of the Preferred Route; and
- Maintenance of the Preferred Route.

As part of the process of assessing Project–environment interactions, proposed environmental design features and mitigation measures were considered to determine whether effects on the environment could be avoided or reduced to negligible levels. Proposed mitigation measures such as the stripping and stockpiling of topsoil would provide materials for decommissioning activities (reclamation), and erosion control techniques would minimize soil loss.

After mitigation measures were considered for the potential effects on each Project–environment interaction (**Section 7.3**), it was determined that many interactions could be removed from the assessment due to the elimination or reduction of effects to negligible. Five interactions resulting in the alteration of terrain and soil conditions (i.e., quantity, distribution, and quality) could still adversely affect soil productivity and the types of ecosystems that could be reclaimed on the landscape. These were carried forward into the residual effects analysis (**Section 7.4**).

Residual Effects Assessment

A residual effects assessment was conducted to characterize the potential effects of the Project on physiography, terrain, and soils. The residual effects assessment considered seven potential effects (**Section 7.3.1**) from Project activities:

- Changes to terrain quantity and distribution;
- Changes to terrain quantity and distribution (esker landforms);
- Change to quantity and distribution of terrain units (slope stability);
- Changes to quantity and distribution of soils;
- Changes to soil quality (compaction and admixing);
- Changes to soil quality from contamination due to potential leaks or spills of deleterious or hazardous substances; and
- Changes to soil quality from the transport and deposition of air contaminant emissions (e.g., Potential Acid Inputs) and particulate matter (dust).

Of these potential effects, four were characterized as predicted residual effects: changes to terrain quantity and distribution, changes to esker landforms, changes to soil quantity and distribution, and changes to soil quality from accidental spills and leaks. During the Construction Phase, 4,700 ha of new disturbance would be created in the Construction Disturbance Area with 704 ha of this area being reclaimed, leaving 3,996 ha of permanent disturbance during the Operations and Maintenance Phase. This permanent disturbance is approximately 85% of the Construction Disturbance Area, and 3.4% of the Local Study Area. Changes to the distribution of terrain and soil units were noted to be of negligible magnitude based on this and not carried forward into the cumulative effects assessment. It was assumed accidental spills and leaks would be confined to the Construction Disturbance Area, and with mitigation would not have residual effects and not be carried forward into the cumulative effects assessment.

Changes to the distribution of terrain and soil units were noted to be of negligible magnitude, but certain likelihood, and have been carried forward to the cumulative effects assessment. Change to terrain quantity and distribution (esker landforms) is considered to be medium in magnitude. There are eleven polygons mapped as eskers in the Local Study Area. During the Construction Phase, five of these have been identified as potential sand and gravel resources within the Construction Disturbance Area and will be permanently disturbed, meaning approximately 45% of the esker landforms mapped in the Local Study Area will be permanently disturbed or removed. This potential effect was carried forward into the cumulative effects assessment.

Cumulative Effects Assessment

For the physiography, terrain, and soils Valued Component, three residual effects (changes to terrain quantity and distribution, changes to terrain quantity and distribution [esker landforms], and changes to soil quantity and distribution) were carried forward for assessment of cumulative effects. Although the development of the Project, the Northern Road Link project, and Anaconda and Painter Lake Road Upgrades project, will permanently disturb the landscape within the Regional Study Area, only 1.1% of the Regional Study Area is anticipated to be cumulatively disturbed. Therefore, the cumulative effect on changes to terrain and soil quantity and distribution is considered to be negligible.

The Project is anticipated to disturb 5 out of 16 eskers present in the Regional Study Area. It was determined if the Northern Road Link and Anaconda and Painter Lake Road Upgrades projects implement mitigation measures to limit the development of esker landforms for sand and gravel extraction during construction, the effect could be minimized; however, cumulative changes from the physical alteration of eskers have the potential to occur if the esker landforms contained within the Regional Study Area of the Project are used as sources of road building materials (sand and gravel resources). The Project will still affect 31% of the eskers in the Regional Study Area, so this cumulative effect is considered to be medium in magnitude.

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1. Introduction

This Report presents the existing conditions and effects assessment for the physiography, terrain, and soils discipline and is being prepared in support of the *Marten Falls First Nation Community Access Road Environmental Assessment / Impact Statement Report*.

Marten Falls First Nation (Oji-Cree translation, *wegwajihwana*) is a remote First Nation community in northern Ontario, approximately 430 km from Thunder Bay, Ontario, located at the junction of the Albany (Oji-Cree translation, *Keshijih'wano Wih Ziibih*) and Ogoki (Oji-Cree translation, *Zakamosgwanih' Ziibih*) rivers. Marten Falls First Nation is proposing a multi-purpose Community Access Road (the Project) that will connect the community to the Ontario provincial highway network. The Project includes the construction and operation of a road with the following key characteristics:

- Approximately 184 km (See **Section 6** for further details on the selection of the Preferred Route) of a two-lane gravel road on a new right-of-way;
- Approximately 100 m wide right-of-way cleared to a width of 60 m; and
- Proposed designated speed limit of 80 km per hour.

Marten Falls First Nation is currently accessible year-round by air transportation out of Thunder Bay, Ontario and Nakina, Ontario, and by a winter access road constructed on an annual basis, if winter conditions permit. Since the 1990s, Marten Falls First Nation has received provincial funding to maintain the 140 km of winter road to the community.

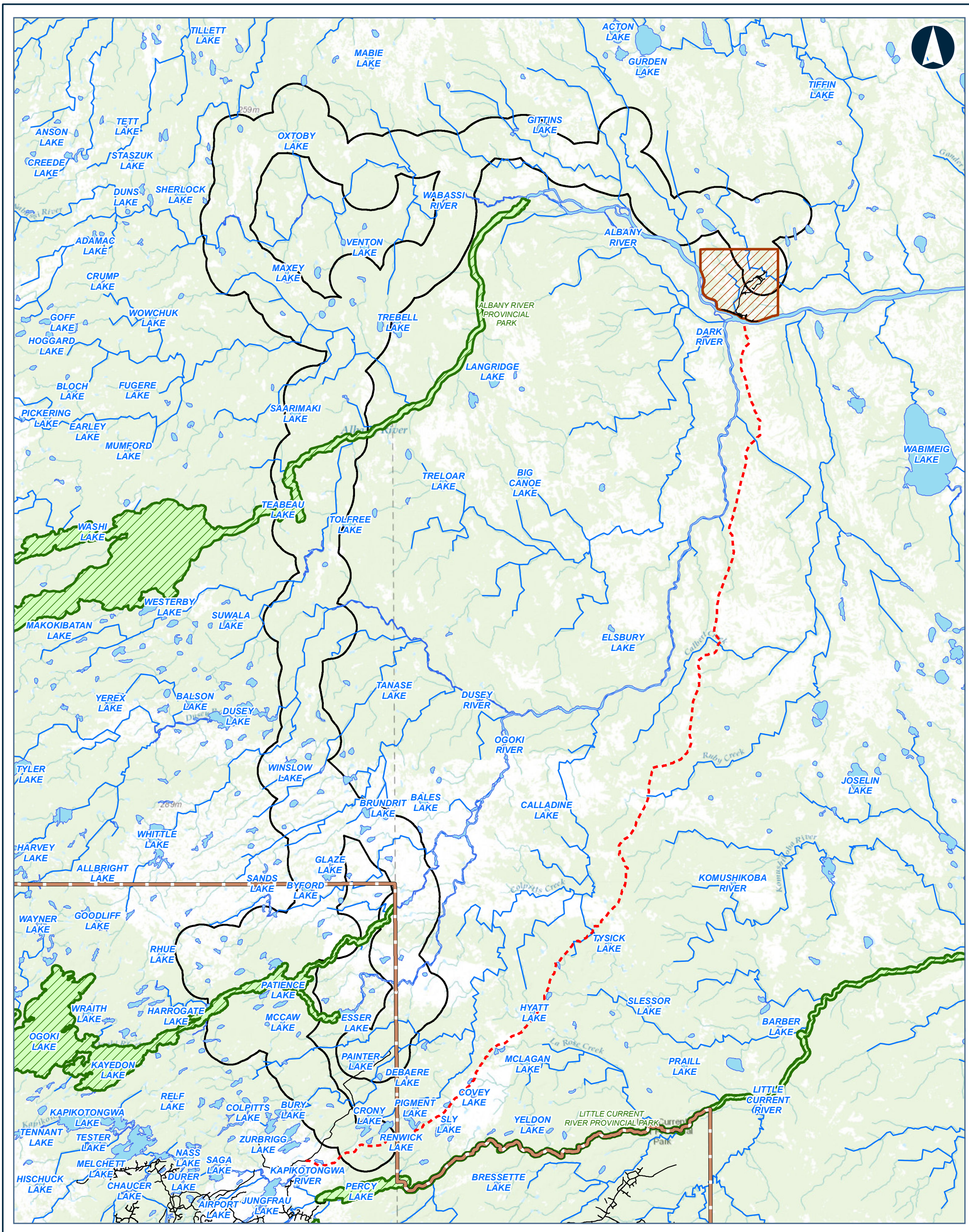
1.1. Project Overview

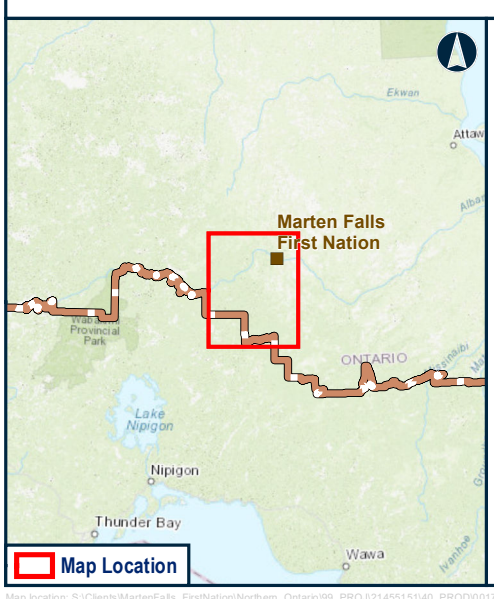
The Project consists of a Community Access Road from Painter Lake Road located approximately 57 km north of Nakina, Ontario to the community of Marten Falls First Nation (**Figure 1-1**). The Community Access Road will serve community access and industrial supply needs for both the community (e.g., fuel, construction supplies and water treatment supplies) and industrial proponents (e.g., mining and forestry). Therefore, to minimize infrastructure corridors in the Far North, the Project will be for a multi-purpose road built to meet industrial use specifications.

In April 2018, Marten Falls First Nation signed an agreement with the Ministry of the Environment, Conservation and Parks to prepare an environmental assessment under the *Ontario Environmental Assessment Act*, 1990 to support the development of the Community Access Road. A study under the Ontario *Environmental Assessment Act* was formally initiated by Marten Falls First Nation in March 2019 when the *Notice of Commencement for a Terms of Reference* for the Project was published.

All-season public roads that require 75 km or more of new right-of-way, as per Schedule 1 (51) of the Physical Activities Regulations under the *Impact Assessment Act*, may be subject to the *Impact Assessment Act* (Government of Canada, 2019b). After considering the detailed Project Description, the Impact Assessment Agency of Canada (the Agency) determined that a federal Impact Assessment was required for the Community Access Road and an Impact Statement needed to be submitted to the Impact Assessment Agency of Canada for review and approval. The Impact Assessment Agency of Canada prepared and released the *Marten Falls First Nation Community Access Road Project: Tailored Impact Statement Guidelines* in February 2020 (Impact Assessment Agency of Canada, 2020a) to outline the information and studies necessary to conduct the Impact Assessment.

The federal and provincial governments are cooperating on the assessment of the Community Access Road, in accordance with the Cooperation Plan (Impact Assessment Agency of Canada, 2020b). The Co-operation Plan allows Marten Falls First Nation to prepare one single Environmental Assessment / Impact Statement submission to satisfy both the federal and provincial processes.





Legend

- ROAD
- WINTER ROAD
- WATERBODY
- WATERCOURSE
- FAR NORTH BOUNDARY
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- PROJECT STUDY AREA

Notes:
None

Data Source:
Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase,

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

PROJECT LOCATION

0 5 10 20
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026	1:450,000 * when printed 11"x17"
Rev:0	

Figure 1-1

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Map location: S:\Clients\MartenFalls_FirstNation\Northern_Ontario\99_PROJ\21455151\40_PROD\0017_Vegetation_EC_Reporting\21455151-0017-RT-0001_1-1.mxd
Date Saved: 2/10/2026 9:37:12 PM User Name: INGU06951

1.2. Report Overview

This report includes the following:

- A summary of the Project components and activities (**Section 2, Project Description**);
- A compilation of information shared by Indigenous Peoples and other interested persons related to physiography, terrain, and soils (**Section 3, Information Shared by Indigenous Peoples and Other Interested Persons Which Informed This Report**);
- Study methods and assessment scope (**Section 4, Study Methods and Assessment Scope**);
- A description of existing conditions for physiography, terrain, and soils (**Section 5, Existing Conditions**);
- A summary of the selection of the Preferred Route as it relates to physiography, terrain, and soils (**Section 6, Selection of the Preferred Route**);
- The residual effects assessment (**Section 7, Residual Effects Assessment**);
- The cumulative effects assessment (**Section 8, Cumulative Effects Assessment**);
- A summary of monitoring programs and future commitments related physiography, terrain, and soils (**Section 9, Monitoring Programs and Future Commitments**); and
- An overall summary and recommendations (**Section 10, Summary and Recommendations**).

As described in the *Environmental Assessment / Impact Statement Report* and in **Section 6** of this Report, the characterization of existing conditions for the Project was completed on two alternative routes (Alternative 1 and 4). The data collected through the characterization of existing conditions were used to inform the selection of the Preferred Route (**Section 6**). The residual (**Section 7**) and cumulative (**Section 8**) effects assessments were completed on the selected Preferred Route.

1.3. Qualifications of Individuals

A list of names and qualifications of the authors and technical reviewers of this Report is presented in **Table 1-1**.

Table 1-1: Qualifications of Individuals

Name	Title / Role	Years of Experience	Qualifications
Anne Sommerville	Lead Terrain Scientist	18	Ph.D., P.Ag.
Christiane Brouwer	Senior Soil and Terrain Scientist	19	P.Ag.
Kyle Hodgson (departed staff member)	Principal Agrologist	23	P.Ag.

Ph.D. = Doctor of Philosophy; P.Ag. = Professional Agrologist.

2. Project Description

For information on the Preferred Route, please refer to **Section 6**.

2.1. Project Components

2.1.1. Community Access Road

The Project will consist of an approximately 184 km all-season road within a 100 m wide right-of-way, 60 m of which will be cleared of vegetation. The road will be approximately 11 m in width to accommodate a two-lane gravel road with culverts and two-lane bridges at water crossing locations. Traffic levels for the Project have been estimated at 700 vehicles per day for the north-south section and 100 vehicles a day for the east-west section of the Marten Falls First Nation Community Access Road. These volumes are reflective of the anticipated peak traffic in 2046.

Road embankment design mitigations are being further considered in high-suitability habitat for caribou where feasible. Operational mitigations such as lower speed limits, signage about wildlife risks, roadside vegetation management, and snow berm height management will be further planned and implemented to facilitate safe wildlife crossing of the road.

The predominant building materials will be blasted rockfill and composite excavation material capped with granular surface material. The majority of blasted rockfill will be obtained from rock outcrops within and / or adjacent to the right-of-way. Building materials will be primarily obtained through the pits and quarries developed specifically to support construction of the Project (**Section 2.1.3**).

Early investigations on permafrost have shown the Project is located within the isolated patches permafrost zone (Heginbottom et al., 1995), with some possible locations identified in test holes and helicopter reconnaissance by KGS Group (2019a,b). Excavation within identified permafrost areas will be avoided, whenever possible, as cutting into surface vegetation can disturb the permafrost regime resulting in thaw and unstable ground. As a precaution, the design will primarily use fill along access roads to minimize any permafrost degradation and will follow the recommendations outlined in a Permafrost Management Plan.

The proposed approach to road construction through peatlands endeavours to keep peat in place while promoting natural water flow. A permeable embankment made of quarried rock or selected granular material will be placed over the peat, supported by heavy geogrid to prevent clogging and allow settlement. To preserve peatland hydrogeology, 900-mm equalization culverts will be installed at appropriate intervals, informed by additional field programs and studies (i.e. peatlands hydrogeological monitoring, water budget study, and a field program to develop a detailed map of peat thickness), to be carried out during subsequent design phases of the Project.

For further information on the proposed construction approach, please refer to *Appendix W* under the *Final Environmental Assessment / Impact Statement Report*.

2.1.2. Bridges and Culverts

Permanent bridges will be required for the various waterbodies to be crossed by the Community Access Road. The bridges will range in size from clear span to multi-span bridges and will accommodate two lanes of traffic with appropriate shoulder widths. The foundation supports for the bridge abutments are expected to consist of driven steel piles, drilled concrete piles or concrete spread footings. Bridges will be designed to meet the 1 in 100-year flood scenario design, fish passage requirements, and navigation requirements, as required, based on federal and provincial regulations.

For certain waterbody crossings, culverts will be constructed using either corrugated steel pipe culverts or box culverts with minimum culvert diameters of 900 mm. The culverts will either be closed or open bottom depending on fisheries sensitivities and soil conditions. The culverts will be designed to accommodate fish passage, where appropriate. Permanent culverts along the Community Access Road will be designed to withstand expected and anticipated climate change conditions, such as increased rainfall, higher temperatures, frequent freeze-thaw cycles, and heightened flooding risks.

Equalization culverts will be installed at locations where it is determined that spring-melt or storm runoff needs to pass from one side of the Community Access Road to the other to prevent flooding and / or erosion. The purpose of equalization culverts is to maintain the existing surface water drainage patterns in the area. Culverts will be put in place as construction progresses along the Project.

Additional design measures and wildlife crossing mitigation options will be incorporated on select bridges and culverts located in high-suitability habitat for Species at Risk and road mortality vulnerable species (i.e., amphibians and reptiles). These measures will be further considered during detail design and implemented during construction at prioritized locations to facilitate safe wildlife passage above or below the Community Access Road and reduce the risk of barriers to movement across the project area during operations.

The type of crossing structure for individual waterbodies may change during detailed design based on site-specific conditions.

2.1.3. Pits and Quarries

Pits and quarries will be developed to provide crushed rock and granular materials for the construction of the Project. Most of the rock required for construction is expected to come from quarry sites adjacent to the Project. Temporary access roads will be established to connect the various Project components, as required, and will be limited in length to the extent feasible.

All materials will be subject to a geotechnical verification process to confirm they possess the desired physical properties for use in construction. The development and operation of all pits and quarries will be subject to the aggregate permitting process under the *Aggregate Resources Act* and follow the Aggregate Resources of Ontario: Site Plan Standards (Government of Ontario, 2020). Permitted pits and quarries will follow the progressive and final rehabilitation requirements outlined in the approved site plans under the Act.

Only material that has been cleared through a geochemical verification process will be utilized for the road surface to avoid acid rock drainage or metal leaching. Monitoring of runoff will be conducted; further details about this specific type of monitoring will be available in the Surface Water Management Plan of which the Owner/Operator will be responsible to follow all applicable Ontario permitting guidelines.

2.1.4. Temporary Infrastructure for Construction

The temporary infrastructure includes temporary access roads, staging areas, camps, and debris, and / or timber stockpiles. Temporary access roads may be required to access the right-of-way during construction. The purpose of the temporary access roads is to facilitate emergency, equipment, and personnel access, and to provide access to and from pits and quarries, staging areas, camps, and debris and / or timber stockpiles. The temporary access roads will be cleared, but not grubbed, to approximately 10 m wide to accommodate equipment movement. The temporary access roads will be limited in length to the extent feasible. Temporary bridges and culverts will be required to cross the various waterbodies along the temporary access roads.

Temporary construction camps, staging areas, and stockpile areas are anticipated to be established at various locations along the right-of-way and / or near other Project components. These components are proposed to support crews and to store equipment, vehicles, materials, and supplies.

Upon completion of construction, sand and gravel pits, as well as quarries, including temporary access roads leading to the pits and quarries will be rehabilitated (progressive and final rehabilitation) and surrendered in accordance with the *Aggregate Resources Act.* Vegetation will be established, as outlined on the required Rehabilitation Plan to align with the *Aggregate Resources of Ontario: Site Plan (2020) Standards.*

2.2. Project Activities

The Project is planned to occur in two phases: Construction, and Operations and Maintenance. Numerous Project activities will occur over in each phase, including:

- Construction Phase Project activities:
  - Clearing of the right-of-way (e.g., remove and dispose of trees, shrubs, fallen timber, and surface litter, strip organic materials, grub).
  - Blasting rock (e.g., remove rock at quarries, and as required, at specific locations in association with road and bridge construction).
  - Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter (organic material), and soil handling and replacement from stockpiles at decommissioning).
  - Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, and watercourse bank grading to improve approaches if required).
  - Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels).
  - Mobilizing equipment, supplies, and personnel (e.g., haulage of materials, soil and liquid waste management, fuel storage, hazardous materials handling, sewage and effluent treatment, and water storage and effluent monitoring for temporary construction camps).
- Operations and Maintenance Phase Project activities:
  - Operating the Preferred Route.
  - Maintaining the Preferred Route, including:
    - Excavation at pits, and excavations and / or blasting at quarry sites;
    - Dewatering within pits and quarry sites;
    - Grading road surface (e.g., washout repair, correct grade);
    - Conducting erosion control (e.g., apply native seed mix);
    - Conducting dust suppression (e.g., apply environmentally friendly dust products);
    - Clearing vegetation on road shoulders (e.g., mow grass, remove brush and small trees);

- Removing snow (e.g., plow);
- Conducting bridge and culvert maintenance (e.g., seasonal inspections debris removal);
- Conducting ditch maintenance (e.g., maintain drainage to design standard by excavating, filling, trimming, and shaping ditches); and
- Conducting road maintenance (e.g., fix settlement, break-up of road surface, slope failures.

3. Information Shared by Indigenous Peoples and Other Interested Persons Which Informed This Report

In the course of completing the description of existing conditions and effects assessment, information provided by Indigenous Knowledge holders, Indigenous community members, regulators, and public stakeholders was used to develop the approach and assessment conducted for this study. This information and how it informed the development of this report are described below. This section does not detail all the information, comments or questions received related to the Project and is limited to only the information which informed this Report. For a full description of all consultation and engagement related to the Community Access Road refer to the *Record of Consultation and Engagement for the Environmental Assessment / Impact Statement Report (Appendix X)*. Information related to the Indigenous Knowledge Program can be found in the *Marten Falls First Nation Community Access Road: Aboriginal and / or Treaty Rights and Interests Existing Conditions Report* (Dillon, 2026a).

3.1. Indigenous Knowledge

Indigenous Knowledge refers to Indigenous systems of knowledge as well as cultural practices related to the production of knowledge based on traditional belief systems, relationships to the environment, and community practices. It is the accumulated and living knowledge built upon the historical experiences of Indigenous Peoples living on the land and adapting to social, economic, environmental, spiritual, and political change (Chiefs of Ontario, n.d.). It includes knowledge about the natural environment (e.g., locations of caribou seasonal use and calving areas), the relationships between environmental changes and species or ecosystems, and how potential effects on the environment can be avoided or reduced.

Indigenous land and resource use refers to specific areas and resources used for traditional purposes when Indigenous Peoples learn and practice their Indigenous Knowledge (Garvin & Northern Forestry Centre [Canada], 2001). This includes the areas and sites used for hunting, trapping, fishing, and gathering and the resources harvested, as well as cultural sites, features and practices - sometimes referred to as Traditional Land Use.

In 2019, the Marten Falls First Nation Community Access Road Project Team launched a program to collect Indigenous Knowledge. The Indigenous Knowledge Program is a critical component of the information base upon which the assessments will rely. The information generated through the Indigenous Knowledge Program has been woven with scientific approaches, and both knowledge systems will be given equal consideration in forming the foundation for existing conditions, predicting potential Project effects, and determining appropriate mitigation and monitoring methods.

The Indigenous Knowledge Program occurs in two concurrent phases:

1. Collecting existing Indigenous Knowledge and information on Indigenous land and resource use to help inform the early stages of the assessments; and

2. Completing Project-specific Indigenous Knowledge and lands and resource use studies.

The protection and confidentiality of Indigenous Knowledge and information on Indigenous land and resource use is of the utmost importance to the Project Team. To honour and respect this important information, Indigenous Knowledge Sharing Agreements were established with interested communities prior to the use of community information. The Sharing Agreement outlines how confidential and sensitive information will be woven into the Project's Environmental Assessment / Impact Assessment and design processes.

All Indigenous communities and groups identified by the Ministry of the Environment, Conservation and Parks and the Impact Assessment Agency of Canada through the *Indigenous Engagement and Partnership Plan* have had the opportunity to participate in the Indigenous Knowledge Program. The Indigenous Knowledge Program provides interested Indigenous communities an opportunity to share existing Indigenous Knowledge and information on Indigenous land and resource use and cultural values that may be relevant to the Project, and / or complete Project-specific studies to collect and share Indigenous Knowledge and information on Indigenous land and resource use and cultural values. The Indigenous Knowledge Program included opportunities for Indigenous communities and groups to meet with the Proponent (Marten Falls First Nation) to discuss the program, ask questions, and share concerns and interests.

The Proponent strove to respectfully collaborate with Indigenous communities on how Indigenous Knowledge and information on Indigenous land and resource use and cultural values were considered in reporting, and how potential impacts on Aboriginal and Treaty Rights and Interests were assessed. Measures to support this included but were not limited to:

- Engaging Indigenous communities to solicit information on Indigenous Knowledge and Indigenous land and resource use and cultural values, informing existing conditions;
- Providing Indigenous communities with draft sections of the *Environmental Assessment / Impact Statement Report*;

- Illustrating how Indigenous Knowledge and information on Indigenous land and resource use and cultural values has been integrated and confirming it has been presented appropriately; and
- Completing collaborative working sessions with Indigenous communities for the effects assessment on Aboriginal and Treaty Rights and Interests. Further information on how potential effects on Indigenous Rights were assessed is provided in the *Aboriginal and Treaty Rights and Interests Study Plan* (Dillon, 2021).

Information provided by Indigenous Knowledge holders, recognized as such by their Indigenous community, has been obtained through literature review and shared directly by Indigenous nations in support of this Project through face-to-face meetings or receipt of Indigenous Knowledge reports. The information, some of which is confidential, that has been used to inform this reporting is described in **Table 3-1**.

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Table 3-1: Indigenous Knowledge

Topic	Indigenous Community	Details	Section Reference
■ Peatlands (Oji-Cree translation, *maashkiigwabo*) and wetlands noted throughout area	■ Attawapiskat First Nation (Attawapiskat First Nation, 2015)	■ Attawapiskat First Nation noted that peatlands in Ontario's Far North store approximately one-third of Ontario's total carbon emissions.	■ **Section 5.3.1.3** ■ **Attachment B** provides details related to peatland and wetland delineation.
■ Peatlands and wetlands noted throughout area	■ Red Sky Independent Métis Nation (AECOM, 2020b)	■ Red Sky Independent Métis Nation noted there are a lot of wetlands in the area.	■ **Section 5.3.1.3** ■ **Attachment B** provides details related to peatland and wetland delineation.
■ Peatlands and wetlands noted throughout area	■ Marten Falls First Nation (Marten Falls First Nation, 2020)	■ Marten Falls First Nation noted that peatlands comprise a large portion of the proposed planning area. The peatlands are important for caribou (Oji-Cree translation, *atik*), nesting areas for sandhill crane (Oji-Cree translation, *ojihjak*) and sharp tailed grouse (Oji-Cree translation, *ahgusk*) and are important for water regulation across the landscape and represent a large amount of stored carbon.	■ **Section 5.3.1.3** ■ **Attachment B** provides details related to peatland and wetland delineation.
■ Areas of high ground west of the proposed Albany River crossings	■ Marten Falls First Nation (Marten Falls First Nation, 2023)	■ Marten Falls First Nation noted that highlands, on the west side of the proposed Albany River crossings, with large trees and thick bush, help protect moose (Oji-Cree translation, *moozoog*) from wolves.	■ **Attachment B** provides details on terrain mapping, including points of high ground.

Topic	Indigenous Community	Details	Section Reference
■ Effect of blasting on cultural / spiritual sites ■ The effect of the development on the natural landscape	■ Marten Falls First Nation (Marten Falls First Nation, 2023) ■ Aroland First Nation (Dillon, 202b)	■ Marten Falls First Nation noted concerns that blasting techniques used to break up rock formations as part of road development might negatively affect cultural / spiritual sites; specifically, rocks / bedrock areas with oral histories attached that are of importance to Marten Falls First Nation. The community noted concerns that development will affect their connection to the land and that activities could alter the natural landscape, thereby impacting the beauty, tranquility, silence, and special places of Marten Falls First Nation's traditional territory. ■ Other communities including Aroland First Nation also noted concerns about general / overall landscape disturbances.	■ **Section 7.3.1.1.1** ■ **Section 7.3.1.1.2** ■ **Attachment B-4a** to **B-4g** provides details on the delineation of bedrock areas.
■ Concerns related to pollution impacts	■ Marten Falls First Nation (Marten Falls First Nation, 2023)	■ Indigenous Knowledge obtained from Marten Falls First Nation noted general concerns and suggested mitigation measures regarding impacts of pollution.	■ **Section 7.3.1.2.1**

3.2. Indigenous Engagement

The content presented in **Section 3.2** reflects information that was available at the time the *Draft Environmental Assessment / Impact Statement Report* was prepared. No updates have been made to this section for the *Final Environmental Assessment / Impact Statement Report*. For the most up-to-date and comprehensive documentation of engagement, please refer to *Appendix X - Record of Consultation and Engagement* under the *Final Environmental Assessment / Impact Statement Report*, which serves as the source for all community-specific engagement input received during later phases of the Project.

In addition to the Indigenous Knowledge provided by Indigenous Knowledge holders, information was collected from all Indigenous community members with interests in this Project. The information that has been used to inform this Report is described in **Table 3-2**.

Table 3-2: Indigenous Engagement

Topic	Indigenous Community	Details	Section Reference
■ Peatlands	■ Mushkegowuk Council (Mushkegowuk Council, 2022)	■ Mushkegowuk Council noted general concerns related to potential impacts to peatlands and highlighted the importance of considering information on peat depth and stratification in Project studies (from a carbon perspective). ■ The *Physiography, Terrain, and Soils Technical Support Document: Existing Conditions & Effects Assessment Report* provides information about overall peatland characteristics and peatland delineation as part of the terrain mapping in **Attachment B-4a to B-4g**.	■ **Attachment B-4a to B-4g**

3.3. Regulator and Public Stakeholder Input

In March 2025, the *Draft Environmental Assessment / Impact Statement Report* was submitted to Regulators, government experts and Indigenous communities for review as part of the Environmental Assessment / Impact Assessment process. All comments received during the review period were carefully evaluated by the Marten Falls First Nation Community Access Road Project Team, and the Report was updated where appropriate.

The content presented in **Section 0** reflects information that was available at the time the *Draft Environmental Assessment / Impact Statement Report* was prepared. No updates have been made to this section for the *Final Environmental Assessment / Impact Statement Report*. For the most up-to-date and comprehensive documentation of regulator and public stakeholder input, please refer to *Appendix X - Record of Consultation and Engagement* under the *Final Environmental Assessment / Impact Statement Report*, which serves as the source for all comments received during later phases of the Project.

The Proponent engaged with Regulators and Public Stakeholders with technical knowledge related to the Valued Components to inform aspects of this report. The information and how it informed the development of this report are described in **Table 3-3**.

Table 3-3: Public, Agency and Other Input

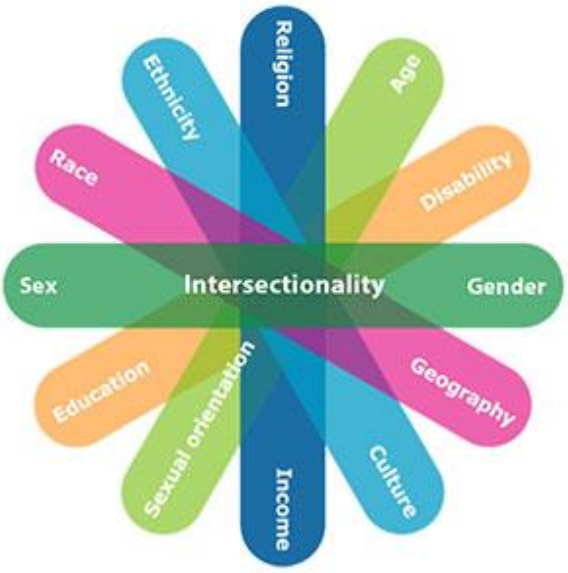
Topic	Provided By	Details	Section Reference
Study Plans	■ Impact Assessment Agency of Canada (IAAC, 2022) ■ Ministry of the Environment, Conservation and Parks (MECP, 2022)	■ The Impact Assessment Agency of Canada noted that any edits to the *Physiography, Terrain and Soils and Vegetation and Peatlands Work Plan* methodology as a result of agency comments should be reflected in the Environmental Assessment. ■ Deviations were anticipated to be required as the Project evolved due to challenges encountered in the field, alternative methodologies being developed, comments from regulators, and as updated guidance became available. These deviations are captured within the study methods and assessment scope.	■ **Section 4.1** ■ **Table 4-1**
Aggregate	■ Marten Falls First Nation (Marten Falls First Nation, 2022)	■ Marten Falls First Nation noted that the shorter Project route in the north end of the proposed alternatives does not have aggregate. The community suggested that the Project Team could consider obtaining aggregate from areas along the longer route and use it to build the shorter route. As a result of this feedback, areas of potential aggregate have been delineated as part of the terrain mapping.	■ **Attachment B-4a to B-4g**

3.4. Gender-Based Analysis Plus

The *Impact Assessment Act* of Canada (Government of Canada, 2019) requires Gender-Based Analysis Plus to be applied to Impact Assessments in Canada. Gender-Based Analysis Plus is not a specific set of methods for Impact Assessments, but rather an approach that is adapted to the Project and the communities potentially affected and / or being engaged.

Gender-Based Analysis Plus is an approach to assessing inequalities and effects of policies, programs, and projects on diverse groups and identities. These identities could include (but are not limited to): gender, sexual orientation, age, race, ethnicity, class, religion, and mental or physical disability (Women and Gender Equality Canada, 2022). These identities can also intersect or overlap; for example, where an individual identifies as being both Indigenous and an Elder or youth.

Figure 3-1: Gender-Based Analysis Plus Intersecting Identity Factors



Source: (Canadian Institutes of Health Research, 2022)

The Gender-Based Analysis Plus approach involves understanding how certain vulnerable groups such as Indigenous Peoples, women, Elders, youth, Two-Spirit, Lesbian, Gay, Bisexual, Transgender, Queer, Questioning, Intersex, and Asexual persons experience, and could be disproportionately affected by a project. Understanding how these groups could be affected by projects allow for more targeted, sensitive, and appropriate enhancement measures, mitigations, monitoring, and follow-up (Impact Assessment Agency of Canada, 2021).

It is important to understand that vulnerability in Impact Assessment is understood primarily, but not solely, as a structural vulnerability. This means that in many cases it is the systems and power structures that make certain groups more vulnerable (Impact Assessment Agency of Canada, 2021). For Indigenous Peoples this includes historical and ongoing colonialism, loss of lands and culture, intergenerational trauma, and the residential school system that have resulted in significant social, economic, health, and well-being disparities relative to the non-Indigenous Canadian population (Kim, 2019). Exceptions to this are where vulnerability may be associated with biological sex, pregnancy, or age in relation to environmental determinants of health and exposure to contaminants, for example.

4. Study Methods and Assessment Scope

This section of the Report provides a summary of the study methods and assessment scope for the existing conditions and effects assessment for physiography, terrain, and soils.

4.1. Study and Work Plan Purpose, Objectives and Deviations

As required by the *Impact Assessment Act* (Government of Canada, 2019) and referenced in the *Tailored Impact Statement Guidelines* (Impact Assessment Agency of Canada, 2020), study plans and work plans were developed for disciplines as required. The purpose of the study plan is to explain:

- The existing conditions study methodology that will result in a comprehensive description of the existing environment potentially affected by the Project;
- The process for ensuring efficient and transparent data management and analysis; and
- Developing the discipline specific effects assessment methodology.

Work plans included details on how to action the study plans, containing information such as location of sampling sites, scheduling, and sequencing.

The Draft All Season Community Access Road: Physiography, Terrain, and Soils Study Plan (Draft Study Plan; **Attachment A**) and *All Season Community Access Road: Physiography, Terrain and Soils and Vegetation and Peatlands Field Logistics Workplan* (*Physiography, Terrain, and Soils and Vegetation and Peatlands Workplan*; **Attachment A**), including comments from regulators can be found in can be found in **Attachment A**.

In some instances, through the execution of this study, the approach deviated from what was described in the Draft Study Plan. These deviations are outlined in **Table 4-1.** Deviations were required as the Project evolved due to challenges encountered in the field, alternative methodologies being developed, comments from regulators, and as updated guidance became available**.** General changes such as changes to section headings, organization of sections and subsections, and changes to phrasing and tense have been made throughout. These administrative changes have not been documented in **Table 4-1**.

Table 4-1: Deviations from Draft Study Plan

Section Reference	Description of Change	Rationale
4.2.2 Valued Components and Indicators	The Valued Component measurement indicators and selection rationale were updated to support a biophysical component.	The indicators and rationale in the Draft Study Plan did not support a biophysical component but were driven by geotechnical and civil engineering.
4.2.3 Spatial Boundaries	The Draft Study Plan previously used the term "Local Study Area" to define the 5 km corridor which is being studied in the existing conditions section, and within which the footprint of the Project will be further refined. This area has been retitled as the "Project Study Area."	This change eliminates confusion between the Project Study Area and the Discipline Specific Local Study Area.
4.2.3 Spatial Boundaries	The Local Study Area was defined in the Draft Study Plan as a 3 km buffer on either side of the centreline of Alternative 1 and Alternative 4. The Local Study Area was expanded to include additional Construction Disturbance Areas outside of the Local Study Area, such as pits and quarries. These additional Construction Disturbance Areas were buffered by 500 m and included in the Local Study Area.	The change in the extent of the Local Study Area helps to ensure all Project components are included within the Local Study Area.
4.4.1 Project–Environment Interactions	Mobilization of equipment, supplies and personnel, and operation of the Preferred Route were not identified as Project–environment interactions in the Draft Study Plan. These have been added as Project–environment interactions.	Mobilization of equipment, supplies and personnel, and operation of the Preferred Route may change soil quality from fugitive dust or contamination from leaks and spills.
4.4.2.4 Characterization of Predicted Residual Effects	The definitions for the magnitude effect characteristic have been revised to provide a more concise and rational definition for both terrain and soil.	For terrain, determining the extent of topographical variation cannot be quantified as it is currently not known where cut and fill will be completed along the alignment. The magnitude definitions for soil are based on soil concentrations which are not defined in the Draft Study Plan. Determining the extent of soil disturbed as an area is a more applicable and rational measurement to use.

Section Reference	Description of Change	Rationale
4.3.1.4 Soil Suitability for Reclamation, **4.3.1.5 Soil Sensitivities,** **5.7.3 Reclamation Suitability, and** **5.7.4 Soil Sensitivities**	Comment #GE-03 on the *Physiography, Terrain, and Soils Study Plan* reiterated the requirements of Section 8.4 of the *Tailored Impact Statement Guidelines.* Added additional scope and methods to support specifically the requirement to "provide maps depicting soil depth by horizon and soil order within the Project site area to support soil salvage and reclamation efforts, and to outline potential for soil erosion." **Section 4.3.1.4 and Section 4.3.1.5** provide the methodology for determining reclamation suitability and erosion risk ratings. **Section 5.7.3** and **Section 5.7.4** provide the results of these calculations, based on desktop and field investigations. Soil maps are presented in **Attachments B** and **H**.	It was not clear in the study plan the scope that would be completed to address Section 8.4 of the *Tailored Impact Statement Guidelines* specific to soil maps depicting soil horizon and soil order as only terrain mapping was mentioned in reference to this requirement.

km = kilometre; m = metre.

4.2. Study Scoping

4.2.1. Temporal Boundaries

Project phases, which are temporal boundaries, are developed to establish the timeframes within which potential effects of the Project will be considered. The Project is planned to occur in two phases, which are briefly described below.

- **Construction Phase**—The time from start of construction, including site preparation activities, to the start of operations and maintenance of the Community Access Road. Decommissioning of construction works is included in the Construction Phase. The Construction Phase is anticipated to take approximately three to ten years to complete; and
- **Operations and Maintenance Phase**—The Operations and Maintenance Phase starts once construction activities are complete and lasts for the life of the Project. The Operations and Maintenance Phase of the Project is considered to be permanent based on the expected timeline for when major refurbishment of road components (e.g., bridges), is anticipated.

There are currently no plans to decommission the Community Access Road as there is no expected / known end date for its need. Therefore, future suspension, decommissioning, and eventual abandonment will not be considered in this report. It will be considered if and when a decommissioning or abandonment application is made for the Community Access Road.

In determining the temporal boundaries, in particular the long duration of Operations and Maintenance Phase, consideration was given to the long-term effects on the well-being of present and future generations.

4.2.2. Valued Components and Indicators

The Impact Assessment Agency of Canada describes **Valued Components** as the environmental, health, social, economic, or additional elements or conditions of the natural and human environment that may be affected by a proposed project and area of concern or value to the public, Indigenous Peoples, federal authorities and interested parties (Impact Assessment Agency of Canada, 2021).

The physiography, terrain, and soils Valued Component has been determined through consideration of the following factors:

- Valued Component presence in the study area;
- The extent to which the Valued Component is linked to the interests or exercise of Aboriginal and Treaty Rights of Indigenous Peoples, and whether an Indigenous community has requested the Valued Component;
- The extent to which the effects (real or perceived) of the Project and related activities have the potential to interact with the Valued Component;
- The extent to which the Valued Component may be under cumulative stress from other past, existing, or future undertakings in combination with other human activities and natural processes;
- The extent to which the Valued Component is linked to federal, provincial, territorial, or municipal government priorities (e.g., legislation, programs, and policies);
- The possibility that adverse or positive effects on the Valued Component would be of particular concern to Indigenous Groups, the public, or federal, provincial, territorial, municipal, or Indigenous governments; and,
- Whether the potential effects of the Project on the Valued Component can be measured and / or monitored or would be better established through the analysis of a proxy Valued Component.

The selection of physiography, terrain, and soils as a Valued Component is based on the potential for effects on physiography, terrain, and soils to influence the establishment of plant species and vegetation communities and associated wildlife habitat and species over time. The physiography, terrain, and soils assessment provides information used to support other Valued Component assessments such as fish and fish habitat, vegetation, wildlife and wildlife habitat, and surface water quality.

Indicators represent the resource, feature, or issue related to the Valued Component that, if changed, may demonstrate an effect on the environment. Indicators may be characterized quantitatively or qualitatively. For example, effects from changes to the availability and distribution of Valued Components are often expressed through quantitative assessment of direct vegetation removals as well as predicted indirect effects on retained vegetation. For the *Environmental Assessment / Impact Statement Report*, the indicators for physiography, terrain, and soils are as follows:

- **Quantity and distribution of terrain units**—refers to the amount (area in ha) of each terrain unit and the way each unit is distributed on the landscape. Terrain quantity and distribution are linked to the soil map unit measurement indicator, but terrain focuses on the underlying parent material (i.e., material in which soils form). Metrics of terrain unit quantity and distribution include surficial material, topography, and slope stability;
- **Quantity and distribution of soil map units**—refers to the amount (area in ha) of each soil map unit and the way each soil map unit is distributed on the landscape. The soil map unit quantity and distribution are linked to the terrain quantity and distribution, but soil map units focus on the mineral and organic material. Metrics of soil map unit quantity and distribution include soil classification, coarse fragment content, and soil texture; and
- **Soil quality (i.e., productivity, reclamation suitability)**—refers to the productivity of the soil as a growth medium on the landscape. Productivity is typically reduced in human-altered environments due to changes in physical properties of soils (e.g., removal of soil and compaction). Metrics used to evaluate soil quality include soil chemistry, soil suitability for reclamation, erosion sensitivity, sensitivity to acidification (i.e., measure of susceptibility to chemical changes after experiencing acid inputs), and sensitivity to compaction.

The indicators for the physiography, terrain, and soils Valued Components were initially outlined in the *Terms of Reference* (AECOM, 2020a) and then refined in the *Draft Physiography, Terrain, and Soils Study Plan* (**Attachment A**). A summary of the Valued Components and indicators selected for the assessment of Project effects on physiography, terrain, and soils and the rationale for their selection, are provided in **Table 4-2.**

Table 4-2: Physiography, Terrain, and Soils Indicators

Valued Component	Indicators	Rationale for Selection	Measures of Change
Physiography, Terrain, and Soils	Quantity and distribution of terrain units, which includes surficial materials, topography, and slope stability	Provide physical structure and foundation for aquatic and terrestrial ecosystems	Quantity (area in ha) and distribution
	Quantity and distribution of soil map units		Quantity (area in ha) and distribution
	Soil quality (i.e., productivity, reclamation suitability)		Changes in physical properties of soils (e.g., admixing and compaction)

ha = hectare.

4.2.3. Spatial Boundaries

4.2.3.1. Project Study Areas

General Project study areas were established for the scoping of field programs, and to delineate study areas for discipline specific surveys. These general Project boundaries are described in **Table 4-3.**

Table 4-3: Project Study Areas Definition and Description

Study Area	Definition	Description
Construction Disturbance Area	Area of expected direct disturbance	100 m wide Community Access Road right-of-way, temporary work areas, worker camps, pits, quarries, and temporary and permanent access roads
Project Study Area	The area where most of the direct effects of the Project are likely to occur	The area within 2.5 km (total of 5 km) of the centreline of the route alternatives

m = metre; km = kilometre.

4.2.3.2. Physiography, Terrain, and Soils Study Areas

Discipline specific study areas identify the geographic extents within which potential effects of the Project are likely to occur and will be considered in the *Environmental Assessment / Impact Statement Report*. Discipline-specific Local and Regional Study Areas were subsequently defined for the Project. In defining these areas, the following was considered:

- Location and other characteristics of the discipline relative to the Project;
- The anticipated extent of the potential Project effects;
- Federal, provincial, regional, and local government administrative boundaries;
- Input from Indigenous communities;
- Community knowledge and Indigenous Knowledge;
- Current or traditional land and resource use by Indigenous communities;
- Exercise of Aboriginal and Treaty Rights of Indigenous Peoples, including cultural and spiritual practices; and
- Physical, ecological, technical, social, health, economical, and cultural considerations.

As described in the *Environmental Assessment / Impact Statement Report* and in **Section 6** of this report, the characterization of existing conditions for the Project was completed on two alternative routes (Alternative 1 and Alternative 4). The data collected through the characterization of existing conditions were used to inform the selection of the Preferred Route. The Residual and Cumulative Effects Assessment will be completed on the selected Preferred Route. Therefore, separate discipline specific study areas were defined for existing conditions and the effects assessment.

4.2.3.2.1. Existing Conditions Study Areas

The existing conditions spatial boundaries for physiography, terrain, and soils are defined by a Construction Disturbance Area, a Local Study Area, and Regional Study Area. These spatial boundaries were applied to each alternative, considering the Project components within the Construction Disturbance Area.

The Construction Disturbance Area includes the Project footprint, which encompasses a 100 m wide right-of-way for each Route Alternative (i.e., Alternative 1 and Alternative 4) and all temporary and / or permanent pits, quarries, construction camps, and temporary access roads. The right-of-way is only expected to be cleared to a width of 60 m for permanent use with the remaining 40 m to be temporarily cleared to accommodate activities such as the construction of temporary laydown areas, and the implementation of debris and / or timber stockpiles.

Alternative 1 includes approximately 226 km of new all-weather road, while Alternative 4 comprises approximately 194 km in length of new all-weather road. The Construction Disturbance Area was designed to capture the potential direct effects of the Project at the immediate local scale for the physiography, terrain, and soils discipline (i.e., the area of direct disturbance where physiography, terrain, and soils are most likely to be directly affected by Project infrastructure and activities).

The existing conditions Local Study Area includes the Construction Disturbance Area and extends 3 km from the centreline of the right-of-way for the route alternatives (total 6 km width). Where elements of the Construction Disturbance Area (e.g., pits and quarries) fall outside the 3 km extension from centreline, a 500 m buffer was applied (**Figure 4-1**). The existing conditions Local Study Area was designed to capture the local effects of the Project on physiography, terrain, and soils that may extend beyond the Construction Disturbance Area with the understanding that the spatial extent of this Local Study Area is intended to account for the local area where effects of the Project are likely to be measurable.

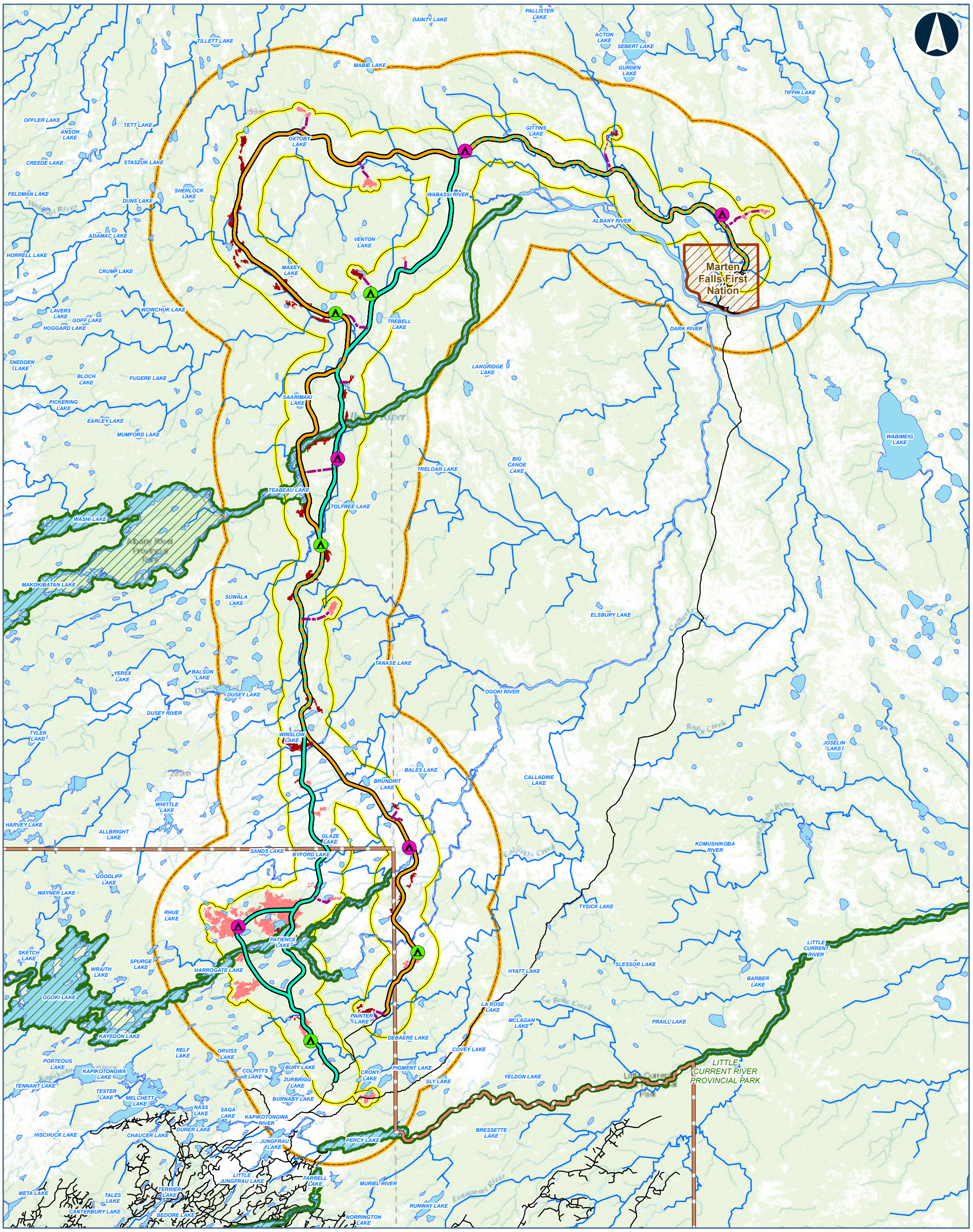
The existing conditions Regional Study Area is defined as an 11 km buffer on either side of the Project centreline to allow for assessment of cumulative and indirect effects of the Project on the broader landscape, while remaining representative of the types of physiography, terrain, and soils found within the Regional Study Area (total 22 km width).

The existing conditions spatial boundaries are further described in **Table 4-4** and illustrated on **Figure 4-1**.

Table 4-4: Physiography, Terrain, and Soils Existing Conditions Study Area Descriptions and Rationale

Study Area	Area	Geographic Extent	Rationale
Construction Disturbance Area	12,665 ha	Area encompassing the Project footprint including the 100 m wide Community Access Road right-of-way, temporary construction access roads, work areas, worker camps, and long-term pits and quarries and temporary access roads	Area of direct disturbance that includes the area where physiography, terrain, and soil is most likely to be directly affected by Project infrastructure and activities
Local Study Area	197,960 ha	3 km buffer on either side of the centreline of Alternative 1 and Alternative 4, and 500 m buffer around additional Construction Disturbance Areas beyond the 3 km buffer	Designed to address the area where indirect effects of the Project are likely to occur beyond the Construction Disturbance Area
Regional Study Area	587,762 ha	8 km buffer of the Local Study Area which includes an 11 km buffer on either side of the centreline of Alternative 1 and Alternative 4	Boundary of 11 km on either side of the Project centreline allowing for assessment of cumulative and indirect effects of the Project on the broader landscape, while remaining representative of types of physiography, terrain, and soils found within the Regional Study Area

ha = hectare; m = metre; km = kilometre.



LEGEND

CONSTRUCTION DISTURBANCE AREA

POTENTIAL CAMP SITE (SIZE)

- 50 PERSONS
- 200 PERSONS

- APPROXIMATE ACCESS ROAD TO POTENTIAL CONSTRUCTIONS CAMP
- APPROXIMATE ACCESS ROAD TO POTENTIAL AGGREGATE SITE

ROUTE ALTERNATIVES

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

POTENTIAL AGGREGATE SOURCE

- BEDROCK
- SAND AND GRAVEL

- FAR NORTH BOUNDARY
- ROAD
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- WATERCOURSE
- WATERBODY
- PHYSIOGRAPHY, TERRAIN, AND SOILS LSA
- PHYSIOGRAPHY, TERRAIN, AND SOILS RSA

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

Existing Conditions Physiography, Terrain, and Soils Study Areas

0 2.75 5.5 11 16.5 22
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Jan, 2026	1:480,000 * when printed 11"x17"
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Figure 4-1

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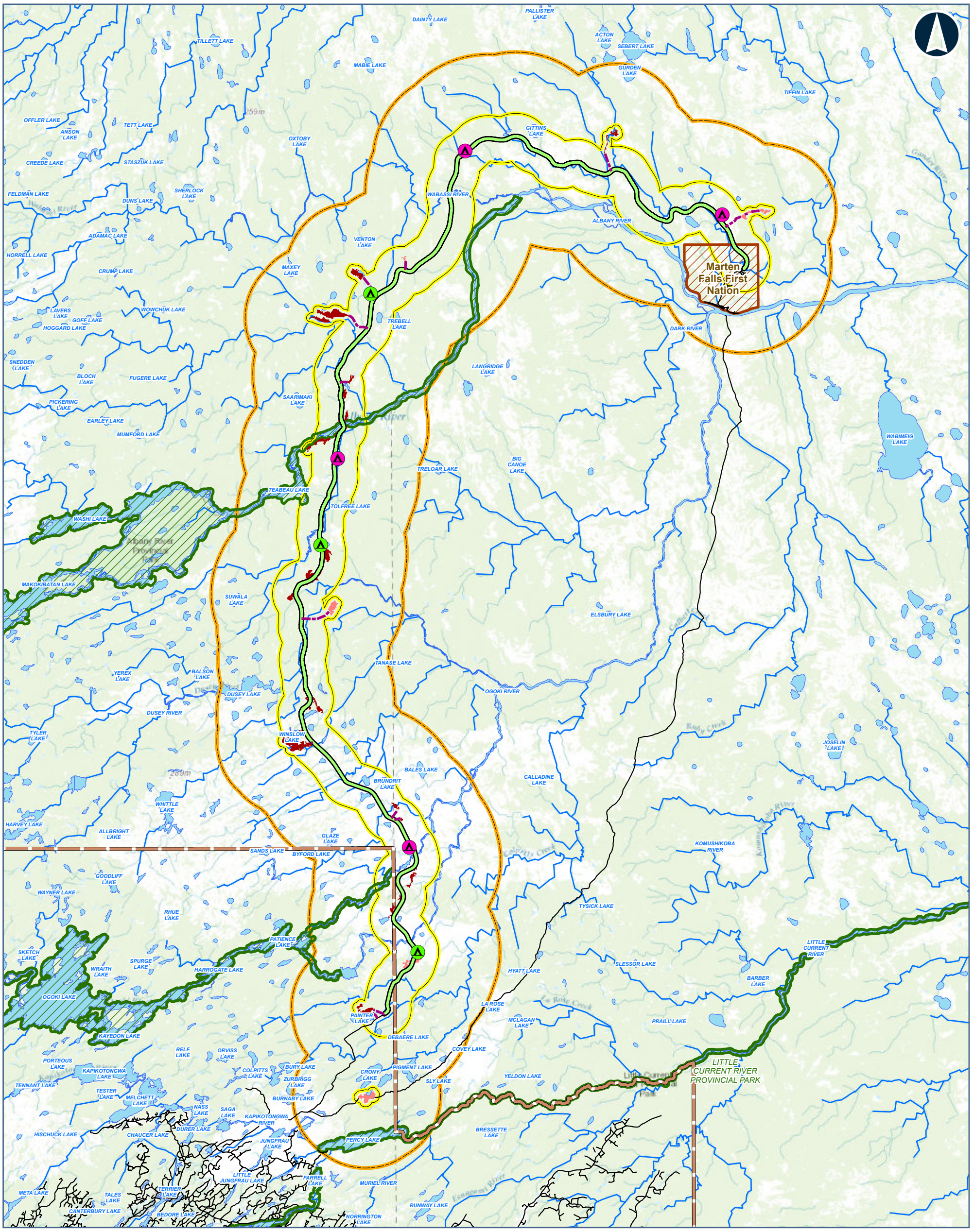
4.2.3.2.2. Effects Assessment Study Areas

The selection of a Preferred Route (**Section 6**) resulted in refined study areas that represent the same geographic extents of the existing condition study areas (i.e., inclusion of Construction Disturbance Area and buffered distance from the centreline); however, they are only applied to one route corridor instead of two. The revised areas are described in **Table 4-5** and shown on **Figure 4-2**. These areas also include features such as potential pits and quarries, access roads and worker camps.

Table 4-5: Physiography, Terrain, and Soils Effects Assessment Study Areas Description and Rationale

Study Area	Area	Geographic Extent	Rationale
Construction Disturbance Area	4,700 ha	Area encompassing the Project footprint including the 100 m wide Community Access Road right-of-way of the Preferred Route, pits and quarries, and the temporary infrastructure for construction including access roads, staging areas, camps, and debris and / or timber stockpiles	Area of direct disturbance that includes the area where physiography, terrain, and soil is most likely to be directly affected by Project infrastructure and activities
Local Study Area	115,959 ha	3 km buffer on either side of the centreline of the Preferred Route and additional construction development areas beyond the 3 km buffer	Designed to address the area where indirect effects of the Project are likely to occur beyond the Construction Disturbance Area
Regional Study Area	453,876 ha	8 km buffer of the Local Study Area which includes an 11 km buffer on either side of the centreline of the Preferred Route	Boundary of 11 km on either side of the Project centreline as well as an 8 km buffer of the Local Study Area allowing for assessment of cumulative and indirect effects of the Project on the broader landscape, while remaining representative of types of physiography, terrain, and soils found within the Regional Study Area

ha = hectare; m = metre; km = kilometre.



LEGEND

CONSTRUCTION DISTURBANCE AREA

POTENTIAL CAMP SITE (SIZE)

- 50 PERSONS
- 200 PERSONS

APPROXIMATE ACCESS ROAD TO POTENTIAL AGGREGATE SITE

APPROXIMATE ACCESS ROAD TO POTENTIAL CONSTRUCTIONS CAMP

PREFERRED ROUTE

POTENTIAL AGGREGATE SOURCE

- BEDROCK
- SAND AND GRAVEL

FAR NORTH BOUNDARY

ROAD

FIRST NATION COMMUNITY

PROVINCIAL PARK

WATERCOURSE

WATERBODY

PHYSIOGRAPHY, TERRAIN, AND SOILS LSA

PHYSIOGRAPHY, TERRAIN, AND SOILS RSA

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

PHYSIOGRAPHY,TERRAIN AND SOILS EFFECTS ASSESSMENT STUDY AREAS

0 2.75 5.5 11 16.5 22
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 4-2

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4.3. Existing Conditions Study Design and Methods

4.3.1. Desktop Assessment

4.3.1.1. Information Sources

For the purpose of characterizing the physiography, terrain, and soil conditions within the Construction Disturbance Area, Local Study Area, and Regional Study Area, the following reports and maps were included in the compilation and review of existing information:

- *Bedrock Geology of Ontario* (Ontario Geological Survey, 2011);
- *Quaternary Geology of Ontario, East-Central Sheet* (Barnett et al., 1991);
- *Surficial Geology of the Fort Hope Area Northeast, Northern Ontario* (Barnett et al., 2013a);
- *Surficial Geology of the Fort Hope Area Southeast, Northern Ontario* (Barnett et al., 2013b);
- *Surficial Geology of the Nakina Area Northeast, Northern Ontario* (Barnett et al., 2013c);
- *Surficial Geology of the Ogoki Area Northwest, Northern Ontario* (Gao and Yeung, 2018);
- *Aggregate Resources of Ontario* (Ontario Geological Survey, 2021);
- *Far North Predictive Mapping* (Ontario Geological Survey, 2018);
- Find Pits and Quarries (interactive web page) (Government of Ontario, 2021);
- *2010 Geology and Terrain Unit Geotechnical Data Report*. *Canada Chrome Proposed Infrastructure Corridor* (Golder, 2010);
- *Cliffs Chromite Project Environmental Assessment. Terrestrial Vegetation and Soil Technical Supporting Document Part 2: Integrated Transportation System* (Golder, 2013);
- Marten Falls First Nation Testhole Logs and Lab Testing Data (KGS Group, 2019a);
- *Environmental Assessment and Preliminary Design Services for Marten Falls Community Access Road Geotechnical Report* (KGS Group, 2020a);
- *Environmental Assessment and Preliminary Design Services for Marten Fall Community Access Road Aggregate Resources Report* (KGS Group, 2020b);
- Permafrost – Canada. National Atlas of Canada (Heginbottom et al., 1995); and
- *Standard Practice for Aggregate Resource Evaluation* (MOT, 2002).

4.3.1.2. Terrain Mapping

Terrain mapping combines terrain, soil, and landscape features with biological features to delineate areas with similar topography and soil properties. It subdivides the landscape into relatively homogenous terrain units based on:

- Soil parent materials;
- Overburden thickness / depth to bedrock;
- Underlying surficial material;
- Surface expression (topography);
- Slope;
- Aspect;
- Soil drainage; and
- Ongoing geomorphological processes.

Terrain mapping was completed within the Local Study Area and Construction Disturbance Area at a scale of 1:5,000 and entailed the development of relatively homogeneous terrain units based on several attributes: surficial material type, surface expression, depth to bedrock, slope gradient, and soil drainage. All mapping adhered to the *Terrain Classification System for British Columbia* (Howes and Kenk, 1997). In addition, each terrain unit was assigned a stability class based on the terrain stability classification presented in Table 3 in *Mapping and Assessing Terrain Stability Guidebook, 2nd edition* (BC Ministry of Environment, 1999). The terrain stability classes from the Guidebook have been assigned a stability rating by WSP Canada Inc. based on surficial materials, surface expression, geomorphological processes, and soil drainage as follows:

- Class I: Stable;
- Class II: Generally stable;
- Class III: Moderately stable;
- Class IV: Potentially unstable; and
- Class V: Unstable.

Preliminary terrain mapping was completed for the Construction Disturbance Area and Local Study Area using 3-D softcopy mapping tools (ArcGIS and PurVIEW) using the following:

- 1:60,000 scale black and white aerial photos acquired in 1973, 1975, and 1976 from the National Air Photo Library in Ottawa, Ontario;
- 1:33,000 scale 20 cm resolution colour aerial photographs acquired in 2019 by KBM Resources Group's aerial survey division;
- 1 m Light Detection and Ranging data (20 to 80 cm Vertical Accuracy) and associated hillshade; and
- Colour 20 cm resolution orthophotos from May to June of 2019.

To develop the final terrain mapping, field data were collected in May and October of 2022 (**Section 4.3.2**) to verify expected trends in terrain landscape composition. Vegetation and peatland data (e.g., areas identified as upland, riparian, or wetland, and depth of peat) collected in 2021, 2022, and 2023 were also incorporated into the final terrain mapping along with Golder Associates Ltd. (2010) and KGS Group (2019a) borehole information, more extensive Light Detection and Ranging data, and high resolution orthophotos from May 2021.

Terrain mapping was updated in polygons where field data were collected, and data were extrapolated to other polygons in the area by using the Light Detection and Ranging data and associated hillshade, and 20 cm resolution orthophotos. Surficial material textures were assigned only to those polygons where a borehole was completed or where WSP Canada Inc. field data were collected.

4.3.1.3. Soil Mapping

Soil mapping is a process that incorporates pedology and geomorphology to describe a landscape in terms of a taxonomy combining soil development with the physical and chemical properties of surficial materials.

Soil units were mapped at 1:5,000 scale or larger in the Construction Disturbance Area and Local Study Area to characterize soils and provide detail for baseline inventory of soils and reclamation planning. At this scale, the complexity of soil types and landscape features are represented by soil map units which are individual polygons encompassing areas of similar dominant surficial materials. The soil map units are defined based on commonly occurring soil types found within the delineation and the range of dominant slope gradients, topographic assemblages, and drainages.

Polygon linework and attributes generated during the terrain mapping process (**Section 4.3.1.2**) served as the basis for soil mapping, with refinements being made based on field data. Soil map units, which were defined based on similar dominant surficial materials, surficial material texture, soil development, soil drainage, depth to bedrock, and surface expression, were used to represent the array of soil types and landscape features within both the Local Study Area and Construction Disturbance Area and were assigned to mapped polygons. Soil management and reclamation planning attributes such as upper and lower lift reclamation suitability, as well as soil wind erosion, water erosion, and compaction risks, were also assigned to mapped polygons within the Local Study Area and Construction Disturbance Area, as described in **Section 4.3.1.4** and **Section 4.3.1.5.** Soils were mapped as per federal standards (Mapping System Working Group, 1981).

4.3.1.4. Soil Suitability for Reclamation

Soil attributes recorded during the field surveys and from analytical data (described in **Section 4.3.2.1**) were compared to the criteria for evaluating soil reclamation suitability after removal and salvage of surface and subsurface layers and assigned a suitability class (**Table 4-6, Table 4-7, Table 4-8**). Soil suitability for reclamation focuses on chemical and physical characteristics affecting the soil's suitability for reclamation and usefulness for revegetation during reclamation and is referred to as soil quality (Alberta Soils Advisory Committee, 1987).

Reclamation suitability was quantitatively determined based on the soil characteristics for each of the soil map units for the Project. If multiple calculations were generated based on lab results for the same soil map unit, the most representative profile was chosen for the assigned ratings. *The Soil Quality Criteria Relative to Disturbance and Reclamation* (Alberta Soils Advisory Committee, 1987) was adopted for the Project and adapted based on conditions in the Construction Disturbance Area and Local Study Area. Upper lift and lower lift criteria for the Northern Forest Region (Alberta Soils Advisory Committee, 1987) were used to develop the assigned suitability classes (**Table 4-6, Table 4-7,** and **Table 4-8**). The most limiting criteria determines the overall reclamation suitability rating for each soil map unit. It should be noted a "poor" rating does not necessarily mean the soil cannot be used for reclamation, but when salvaged, would require careful planning and good management (Alberta Soils Advisory Committee, 1987). Soil rated as "unsuitable" due to one limitation may have been assigned an overall better rating (e.g., poor) as management practices can be used to result in a more suitable soil material for reclamation purposes (Alberta Soils Advisory Committee, 1987). Some map units were not assigned ratings as they are non-soils (rock, water) or are considered disturbed (anthropogenic). This soil quality system is for use in mineral soils only; however, organic soils should be considered for salvage and used as a soil conditioner (Alberta Soils Advisory Committee, 1987).

Table 4-6: Criteria for Evaluating Suitability of Surface Material (Upper Lift) for Revegetation in the Northern Forest Region

Rating / Property	Good	Fair	Poor	Unsuitable
Reaction (pH)	5.0 to 6.5	4.0 to 5.0, 6.5 to 7.5	3.5 to 4.0, 7.5 to 9.0	<3.5, >9.0
Salinity (electrical conductivity) (dS/m)	<2	2 to 4	4 to 8	>8
Sodicity (sodium adsorption ratio)	<4	4 to 8	8 to 12	>12
Saturation (%)	30 to 60	20 to 30, 60 to 80	15 to 20, 80 to 120	<15, >120
Stoniness / Rockiness (% area)	<30 / <20	30 to 50 / 20 to 40	50 to 80 / 40 to 70	>80 / >70
Texture	Fine Sandy Loam Very Fine Sandy Loam Loam Silty Loam Sandy Loam	Clay Loam Sandy Clay Loam Silty Clay Loam	Loamy Sand Silty Clay Clay Heavy Clay Sand	N/A
Moist Consistency	Very friable, friable	Loose, firm	Very firm	Extremely firm
$CaCO_3$ Equivalent (%)	<2	2 to 20	20 to 70	>70

Source: Alberta Soils Advisory Committee, 1987. Table 8 – Northern Forest Region. More details are provided in the source document.
$CaCO_3$ = calcium carbonate; dS/m = deciSiemens per metre; < = less than; > = greater than; N/A = not applicable; % = percent.

Table 4-7: Criteria for Evaluating the Suitability of Subsurface Material (Lower Lift) for Revegetation in the Northern Forest Region

Rating / Property	Good	Fair	Poor	Unsuitable
Reaction (pH)	5.0 to 7.0	4.0 to 5.0, 7.0 to 8.0	3.5 to 4.0, 7.5 to 9.0	<3.5, >9.0
Salinity (electrical conductivity) (dS/m)	<3	3 to 5	4 to 8	>8
Sodicity (sodium adsorption ratio)	<4	4 to 8	8 to 12	>12
Saturation (%)	30 to 60	20 to 30, 60 to 80	15 to 20, 80 to 100	<15, >100
Coarse Fragments (% Vol)	<30[a] <15[b]	30 to 50[a] 15 to 30[b]	50 to 70[a] 30 to 50[b]	>70[a] >50[b]

Rating / Property	Good	Fair	Poor	Unsuitable
Texture	Fine Sandy Loam Sandy Loam Very Fine Sandy Loam Loam Silty Loam Sandy Loam	Clay Loam Silty Clay Silty Clay Loam	Loamy Sand Clay Heavy Clay Sand	Bedrock
Moist Consistency	Very friable, friable, firm	Loose, very firm	Extremely firm	Hard rock
$CaCO_3$ Equivalent (%)	<5	5 to 20	20 to 70	>70

Source: Alberta Soils Advisory Committee, 1987. Table 9 – Northern Forest Region. More details are provided in the source document.
Notes:
(a) Matrix texture (modal) finer than sandy loam.
(b) Matrix texture (modal) sandy loam and coarser.
dS/m = deciSiemens per metre; < = less than; > = greater than; % = percent; % Vol = percent by volume; $CaCO_3$ = calcium carbonate.

Table 4-8: Soil Suitability Class Descriptions for Criteria Relative to Disturbance and Reclamation

Suitability Class	Description
Good	No soil limitations to slight soil limitations that affect use for plant growth
Fair	Moderate soil limitations that affect use but can be overcome by proper planning and good management
Poor	Severe soil limitations that make use questionable; careful planning and very good management are required
Unsuitable	Limitations of soil chemical or physical properties are so severe that reclamation is not possible or economically feasible

Source: Alberta Soils Advisory Committee, 1987.

4.3.1.5. Soil Sensitivities

4.3.1.5.1. Wind Erosion

Soil erosion potential refers to the risk of degradation in soil quality or soil loss from erosive forces, typically wind and water (i.e., physical loss of soil or organic matter). The loss of surface soil by erosion may result in a reduction in soil quality and the ability for soil to support vegetation.

Soil erosion was evaluated using rates of erosion risk for dry, exposed mineral soils (i.e., vegetation cover has been removed). Wind erosion risk is dependent on soil and site characteristics such as soil texture, coarse fragment content, site exposure, and frequency and speed of wind. Wind erosion risk ratings are generally texturally based; therefore, organic soils are not rated but are inherently resistant to wind erosion because of their physical characteristics.

It should be noted that wet soils, such as Gleysols, or frozen soils are generally not susceptible to wind erosion, but a change in a soil's state (e.g., frozen) or moisture regime can alter the risk of erosion. High erosion potential does not necessarily equate with poor quality soil; however, a high erosion potential at a given location increases the risk of soil degradation.

The dominant soil texture assigned to each soil map unit was used to establish soil sensitivity to wind erosion (wind erosion risk). This was done based primarily on texture and a dimensionless index adapted from Coote and Pettapiece (1989). The criteria for determining wind erosion risk are presented in **Table 4-9.**

Table 4-9: Criteria for Determining Wind Erosion Risk

Soil Texture	Wind Erosion Risk Class
Very fine sand, sand, coarse sand, loamy sand, gravelly sand, and humic organic materials	High
Sandy loam, loam, silt loam, sandy clay loam, sandy clay, and mesic	Moderate
Silt, silty clay loam, clay loam, silty clay, clay, heavy clay, and fibric	Low

Source: Adapted from Coote and Pettapiece, 1989.

4.3.1.5.2. Water Erosion

The potential water erosion rating was estimated using the Revised Universal Soil Loss Equation for Application in Canada (Wall et al., 2002). The Revised Universal Soil Loss Equation for Application in Canada equation is an equation that is applicable for Canada and was developed to predict the average soil losses by soil erosion via water. Characteristics of soils and terrain (i.e., soil textures, drainage) recorded during the field programs were used, where possible, to calculate the estimated soil loss. Estimated soil loss by water erosion (A) was calculated using the Revised Universal Soil Loss Equation for Application in Canada equation A = R * K * LS * C * P, then ranked into one of the five erodibility classes of very low, low, moderate, high, and severe as per Wall et al. (2002). Units composed of mainly water (N), rock or bedrock (R), or anthropogenic polygons were not assigned ratings.

Inputs considered when estimating soil loss include rainfall and runoff (R), soil erodibility factor (K), slope factor (LS), crop / vegetation and management factor (C), and support or management practices (P). Details are as follows:

- The rainfall and runoff factor (R) was estimated to be 300 for the Project based on Figure R-3a in Wall et al. (2002). There is no rainfall factor listed on Isoerodent (rainfall erosivity) maps or tables in Wall et al. (2002) for the Local Study Area, and therefore, 300 was chosen as it represents the R value at the furthest north latitude that is provided by Wall et al. (2002) and at a similar longitude;

- The soil erodibility factor (K) was established using laboratory soil textures (particle size analysis) for the representative mineral soil within a soil map unit and the soil erodibility values for common surface textures with less than 2% organic matter content (Table K-3 in Wall et al., 2002). For profiles having variable surface and subsurface textures, the most limiting was chosen to take a conservative approach;
- Slope length (L) and slope gradient (S) were assigned based on field data, where present. The median value of the slope length and slope gradient classes were assigned to best represent each polygon. In areas where no field data were available, slope gradient values were established in ArcGIS using a 1 m Digital Elevation Model to assign dominant slope gradients in each polygon. Slope length values were assigned based on measuring slope lengths in ArcGIS, extrapolation (the most common slope length recorded for similar map units in the limits of disturbance), and professional judgment. These values were used to calculate the slope factor (slope or topographic factor) value for each polygon. To take a more conservative approach, slope factor values for existing conditions were determined using Table LS-3 in Wall et al. (2002) to account for disturbed soil conditions, with little or no cover;
- The crop / vegetation and management factor (C) was given the value of 1; and
- Management practices (P) factor was given the value of 1.

Water erosion risk in the Local Study Area was assigned spatially, meaning rather than assigning a risk to a soil map unit, ratings were assigned based on the dynamic landscape. The slope factor calculation was determined from a three-metre resolution Digital Elevation Model which is generated by a tool (ESRI, 2018), and the erosivity data (the R value) were applied from a global rainfall erosivity index (Panagos and Ballabio, 2017).

4.3.1.5.3. Soil Sensitivity to Acidification

Soil sensitivity to acidification is a measure of a soil's susceptibility to experiencing a decrease in pH in response to acid inputs. Soil sensitivity to acidification is inversely related to a soil's natural buffering capacity, which is the capacity of the soil to resist pH change.

The soil map units in the Local Study Area were rated for sensitivity to acidification, with ratings based on the sensitivity to the loss of base cations (i.e., primarily calcium, magnesium, and potassium), sensitivity to acidification, and sensitivity to solubilization (i.e., dissolving into soil water) of aluminum (Holowaychuk and Fessenden, 1987). Mineral soil map units in the Local Study Area were rated for sensitivity to acidification using the chemical criteria published by Holowaychuk and Fessenden (1987; **Table 4-10**). If ratings between the upper lift and lower lift differed, the most conservative / limiting rating was assigned to that soil map unit. The sensitivity rating for Organic Soil Map Units in the Local Study Area was based on the type of peatland (Turchenek et al., 1998; **Table 4-11**).

Peatland classifications from the peatland and vegetation mapping (WSP, 2024a) were used to assign the ratings for the peatland sensitivity to acidification in areas mapped as organic map units (O1, O2). If a soil polygon did not align with peatland polygon boundaries, the dominant peatland classification within that organic map unit was assigned to the entire soil map unit. For organic soil map units having no correlation with peatland mapping, a "moderate-rich fen" peatland type was assigned. Richness ratings were assigned based on the correlation in **Table 4-12**.

Mineral soil samples collected during the 2022 field programs were analyzed for cation exchange capacity. The soil cation exchange capacity measures the amount of cations that can be held in the soil at pH of 7.0 and is expressed in milliequivalents per 100 grams (mEq/100 g). The cation exchange capacity indicates the potential of the soil to retain nutrients (Hausenbuiller, 1972).

Table 4-10: Criteria for Rating the Sensitivity Potential of Mineral Soils to Acidic Inputs

Cation Exchange Capacity (mEq/100 g)	pH	Overall Sensitivity Rating
<6	<6.5	High
	>6.5	Low
6 to 15	<4.6	High
	4.6 to 6.0	Moderate
	>6.0	Low
>15	<4.6	High
	4.6 to 5.5	Moderate
	>5.6	Low

Source: Adapted from Holowaychuk and Fessenden, 1987.
mEq/100 g = milliequivalents of ammonium cation adsorbed by 100 grams of dry soil; < = less than; > = greater than.

Table 4-11: Criteria for Rating the Sensitivity Potential of Peatland Soils to Acidic Inputs

Peatland Type	Sensitivity to:		Overall Sensitivity Rating
	Base Loss	Acidification	
Extreme-rich fen	Low	Low	Low
Moderate-rich fen	Low to moderate	Low	Low
Bog and poor fen	Moderate to high	Moderate	Moderate

Source: Turchenek et al., 1998.

Table 4-12: Criteria for Rating the Sensitivity Potential of Peatland Soils to Acidic Inputs

Peatland Type	Associated Peatland Classification	Overall Sensitivity Rating
Extreme-rich fen	B141	Low
Moderate-rich fen	B136, B140, B128, B144, B135, B146, B129, B147, B149, “organic conifer swamp”	Low
Bog and poor fen	B126, B137, B139, B127, B138	Moderate

4.3.1.5.4. Compaction Risk Ratings

Compaction risk is associated with soil physical properties, the moisture content when the soil is disturbed, and the nature of the applied force (Cannon and Landsburg, 1990). Compacted soil can have decreased soil porosity which is an important property of soil to control moisture availability to vegetation and can result in greater amounts of surface runoff (Archibald et al., 1997). Soil compaction risk was assigned to soil units based on their texture, coarse fragment content, and drainage. Soil compaction ratings were assigned based on a generalized rating system for compaction risk (**Table 4-13)**, which was developed using professional judgment and adaption from two compaction systems. Both compaction systems were designed for forestry applications and are soil and moisture based, so are applicable to the Construction Disturbance Area and Local Study Area. The matrix considers the combined influences of soil texture, coarse fragment content, and soil drainage. Organic soils were not rated for compaction but are susceptible to compaction due to their low load bearing materials being easy to displace (British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 1999).

Table 4-13: Compaction Risk Matrix

Drainage	Soil Textural Class				
	Fragmental (>70% Coarse Fragments) and Very Coarse Textures: Sand, Loamy Sand	Moderately Coarse Textures: Sandy Loam, fine Sandy Loam	Medium Textures: Silt Loam, Silt, Loam	Moderately Fine Textures: Sandy Clay Loam, Clay Loam, Silty Clay Loam, Silt	Fine / Very Fine Textures: Sandy Clay, Silty Clay, Clay, Heavy Clay
Rapid	Low	Low	Low	Low	Moderate
Well	Low	Low	Low	Moderate	Moderate
Moderately Well	Low	Low	Low	Moderate	Moderate
Imperfect	Low	Low	Moderate	High	High
Poor	Moderate	Moderate	High	High	High
Very Poor (Organic)	Not rated				

Source: Adapted from *British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development 1999 and Compaction and Rutting Hazard for Soils in Ontario* (Archibald et al., 1997).
Notes: > = greater than; % = percent.

4.3.1.6. Geological Hazard Assessment

A geological hazard assessment was completed in the Regional Study Area to assist with selecting and designing the preferred Community Access Road alignment with the overall goal of minimizing the road alignment through areas with known or suspected geological hazards. The assessment was completed in a desktop environment by reviewing publicly available documents and the detailed terrain mapping (**Section 4.3.1.2**) where applicable. Geological hazards identified for the assessment include:

- Seismic (i.e., earthquakes);
- Liquefaction;
- Landsliding / Slumping;
- Permafrost degradation (e.g., thermokarst subsidence);
- Isostatic rise;
- Inundation (flooding);
- Karst; and
- Soil erosion.

4.3.1.7. "Special" Geologic and Geomorphic Features

"Special" geological and geomorphic features include eskers, potential pits and quarries, areas of organic soils, areas of potential permafrost, areas showing evidence of active permafrost degradation (e.g., thermokarst), areas of steep slopes and other potential hazards which may affect construction and maintenance activities. The detailed terrain mapping (**Section 4.3.1.2**) was used to highlight areas such as those mentioned, and the following rules were applied for each feature:

- Eskers – any terrain unit that was mapped as glaciofluvial (FG), and had a "ridged" (r) surface expression;
- Potential pits – any terrain unit mapped as glaciofluvial material;
- Potential quarries – any terrain unit mapped as bedrock (R) or thin till veneers (Mx) overlying bedrock;
- Areas of organic soils – any terrain unit mapped as organic (O), or any terrain unit that had organic material mapped as a subdominant component (second decile is "O");
- Areas of permafrost – no part of the Local Study Area falls within a permafrost zone, however if the geoprocess "X" was mapped (potential permafrost), these are identified on the map; and
- Areas of steep slopes and other potential hazards – any terrain unit mapped as colluvium (C), or any terrain unit with a minimum slope of 50% or greater. This is based on input from Project team engineers about what constitutes "steep slope" limitations for construction and maintenance.

4.3.2. Field Investigations

4.3.2.1. 2022 Soil and Terrain Field Investigations

The objective of the field investigations was to verify preliminary terrain and soil mapping by completing inspection points to collect specific soil and terrain data. A combination of visual and ground site inspections was used to collect data in the field. Ground plots describe the soil conditions by digging a test pit and recording soil profile data, terrain data, and other localized data. Visual descriptions describe field observations with or without digging a test pit and can provide information to support mapping. Visual inspection sites generally describe available data on surficial materials, slope, and drainage or geomorphological processes existing in an area.

Field surveys were completed in May and October of 2022 using a combination of visual and ground inspection sites to collect baseline data. Inspection sites were chosen based on results of the desktop assessment and preliminary terrain and soil mapping (**Sections 4.3.1.2** and **4.3.1.3**) and were accessed by helicopter and foot where possible.

The first, spring program was focused on collecting data in the broader Local Study Area, while the second, fall program targeted soil and terrain data collection from the Construction Disturbance Area.

Terrain data collected at each inspection site follow guidelines found in the *Field Manual for Describing Terrestrial Ecosystems Second Edition* (British Colombia Ministry of Forests and Range and British Colombia Ministry of Environment, 2010). Soil field data were collected following the manual for describing soils in the field (Expert Committee on Soil Survey, 1982) and the Canadian System of Soil Classification (Soil Classification Working Group,1998).

Soil pits were excavated using a hand shovel and Dutch auger to a maximum depth of 120 cm for mineral soils and 220 cm for organic soils. At representative soil sites, soil was collected from each horizon and submitted for chemical or geochemical analysis. Laboratory analysis included the parameters listed in **Attachment E – Soil Laboratory Data**.

The following soil and terrain information was recorded for soil survey inspection sites, where applicable:

- Global Positioning System location (easting / northing);
- Slope position, gradient, and aspect;
- Soil surficial (parent) material and texture;
- Surficial material expression;
- Subsurface material and texture;
- Subsurface material expression;
- Geomorphological processes (if applicable);
- Soil horizon designation and thickness, including organic / litter layer;
- Soil horizon structure (if applicable), consistence, colour, texture, and coarse fragment content (%);
- Presence of mottling;
- Seepage and / or water table depth;
- Drainage; and
- Soil subgroup classification.

At representative soil sites, mineral soil was collected from each horizon of the soil profiles, wherever possible. The following laboratory analyses were run on representative modal soil profiles:

- pH (pH @ 25°C [1:2 calcium chloride extract]);
- Particle size (soil texture – % gravel, sand, silt, clay) (hydrometer);
- Soil salinity (electrical conductivity);
- Soil sodicity (sodium adsorption ratio);
- Total organic carbon;
- Saturation % (water holding capacity);
- Total nitrogen (nitrite and nitrate);
- Plant available nutrients (available nitrogen, phosphorus, potassium, and sodium; cation exchange capacity; and exchangeable cations);
- Saturated paste extractables (sodium adsorption ratio, calcium, conductivity saturated paste, magnesium, pH in water, and saturated paste, potassium, % saturation, sodium);
- Theoretical gypsum requirement;
- Cation exchange capacity (soil cyclopiazonic acid membrane conductance);
- Total metals:(aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium, zinc, zirconium);
- Polyaromatic hydrocarbons in soil;
- Volatile organic compounds in soil; and
- Radionuclides by gamma spectrometry.

4.3.2.2. Previous Field Investigations

In 2009 and 2010, Golder Associates Ltd. conducted preliminary geotechnical field investigations, terrain unit mapping, laboratory and field testing, geophysical surveys, and hydrotechnical support for the major river crossings for the Canada Chrome Proposed Infrastructure Corridor project. Subsurface investigations included the drilling, sampling, and testing of 811 drilled boreholes and 188 hand-augered holes. In total, 314 boreholes completed by Golder Associates Ltd. (2010) are within the physiography, terrain, and soils Local Study Area, and these were reviewed and considered during the development of the final terrain mapping.

In 2019, KGS Group completed geotechnical field investigations in support of the Preliminary Design for the Marten Falls First Nation Community Access Road Project. The focus of these field investigations was to confirm and classify surficial geology along the proposed routes. The field investigation included geotechnical drilling activities to characterize key areas along the routes being considered, with emphasis on confirming and classifying the surficial geology along the routes. In total, 72 hand-augered and 22 drilled test holes were completed for the geotechnical reconnaissance and investigation report (KGS Group, 2019a, 2020a). Of these, 42 hand-augered and 18 drilled test holes are located in the physiography, terrain, and soils Local Study Area, and these were reviewed and considered during the development of the final terrain mapping.

An aggregate resources report was also completed by KGS Group (2020b) and included a review and evaluation of available investigations and laboratory data (Golder, 2010; KGS Group, 2019a), and the identification and assessment of potential bedrock and aggregate sources. Based on the laboratory analysis KGS Group (2020b) concluded that the surficial geology interpreted as part of the Ontario Geological Survey surficial geology mapping (Barnett et al., 2013a,b,c; Gao and Yeung, 2018) is fairly accurate and representative of the soils encountered in these areas. However, KGS Group (2020b) also note that the Project area is sizeable, and variability of soil types will be encountered during construction within each terrain unit. To determine potential bedrock and granular sites the Ontario Geological Survey (2018) surficial geology mapping was used to identify areas of bedrock and glaciofluvial ice-contact deposits, followed by a helicopter flyover at each of the potential sites to assess their suitability (KGS Group, 2019b). KGS Group identified 41 aggregate sources along the proposed route, including 16 potential bedrock sites and 25 potential granular sites / areas.

4.4. Effects Assessment

The following is a high-level overview of the approach for the identification, assessment, and evaluation of the potential effects:

- Review construction and operations activities to identify potential interaction(s) that could result in environmental effects;
- Characterize the existing conditions for both route alternatives;
- Identify potential environmental effects of the Preferred Route and recommend mitigation measures to avoid or minimize identified effects, as well as identify opportunities to enhance benefits to the environment;
- Predict and assess potential environmental effects remaining after taking into consideration the recommended mitigation measures (i.e., residual effects) using direction, magnitude, geographic extent, duration, frequency, reversibility, and likelihood;

- Predict cumulative effects that may result from a combination of the residual effects of the Preferred Route with the effects of other past, present, and reasonably foreseeable projects; and
- Identify a follow-up program for the Preferred Route that includes monitoring to verify the prediction of the effects assessment and effectiveness of the mitigation measures, and a requirement for monitoring of the commitments made in the *Terms of Reference* and *Environmental Assessment / Impact Statement Report*.

The following sections provide discipline-specific input and considerations as they pertain to the methodology for effects assessment. For detailed descriptions of the methodology used to inform this study refer to the *Environmental Assessment / Impact Statement Report*. Refer to **Section 6** for details related to the Preferred Route, including revised Study Areas which have been used in the effects assessment.

4.4.1. Project–Environment Interactions

Considering the Project components and activities presented in **Section 2**, interactions were identified between the Project components and activities to the existing conditions of physiography, terrain, and soils Valued Components. These interactions support the identification of potential effects, both direct and indirect, that may result in changes to physiography, terrain, and soils. The likely Project–environment interactions were identified based on professional judgment, activities planned to occur, and as described in the *Marten Falls Community Access Road Project Tailored Impact Statement Guidelines* (Impact Assessment Agency of Canada, 2020) as well as projects of similar magnitude and / or location. **Table 4-14** provides the preliminary analysis of Project–environment interactions for physiography, terrain, and soils that was presented in the *Physiography, Terrain, and Soils Study Plan* (Golder , 2021)). The analysis of Project–environment interactions for physiography, terrain, and soils that are likely to have a potential effect is provided in **Section 7.2**.

Table 4-14: Project–Environment Interactions

Project Phases	Project Activities	Physiography, Terrain, and Soils
Construction Phase	Clearing of the right-of-way (e.g., remove and dispose of trees, shrubs, fallen timber, and surface litter, strip organic materials, grub)	**X**
	Blasting rock (e.g., remove rock at quarries, and as required, at specific locations in association with road and bridge construction)	**X**
	Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning)[(a)]	**X**
	Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, watercourse bank grading to improve approaches if required)	**X**
	Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels)	**X**
	Mobilization of equipment, supplies, and personnel (e.g., haulage of materials, solid and liquid waste management, fuel storage, and hazardous materials handling, sewage and effluent treatment and water storage and effluent monitoring for temporary construction camps)	**X**
Operations and Maintenance Phase	Operate the Preferred Route	**-**
	Maintain the Preferred Route[(b)]	**X**

Notes:
(a) Includes construction and use of this equipment or infrastructure.
(b) Includes general maintenance activities (e.g., grading, erosion control, excavation at pits / quarries and processing aggregate, dust suppression), seasonal maintenance activities (e.g., clear vegetation on road shoulders, snow clearing and bridge and culvert maintenance, ditch maintenance), and special maintenance activities (e.g., slope failures and road settlement / break-up).
X = interaction.

4.4.2. Assessing Residual Effects

4.4.2.1. Potential Effects

Following the identification of the Project–environment interactions, a comparative analysis of the existing conditions for the Preferred Route was conducted to determine the potential effects of the Project. The potential effects are described as either direct or indirect. The potential direct effects resulting from the Project–environment interactions were based on input received through the Indigenous Knowledge Program and Consultation and Engagement Program, regulatory agency guidance, and professional judgement.

A **direct effect** is an immediate change to an environmental component caused by a project activity at the same time and place as the activity.

An **indirect effect** occurs when a change resulting from a project activity leads to subsequent changes in other environmental component, which may occur later in time or at a different location but are reasonably foreseeable.

Residual effects are the effects that remain after the application of mitigation measures. These effects are described in **Section 7** and include descriptions in detail of the potential adverse and positive residual effects in relation to each temporal phase of the Project as outlined in **Section 4.2.1**.

Discipline interactions occur when a change to one Valued Component resulting from a project activity causes a change to another Valued Component in another discipline (e.g., changes in fish abundance or distribution could indirectly affect recreational tourism).

Physiography, terrain, and soils may be indirectly affected by changes to other environmental disciplines. The Atmospheric Environment can affect soil quality by aerial deposition of pollutants from Project activities directly to the soil surface. Climate change may affect soil quality with a potential increase in precipitation and / or extreme rainfall events (flooding) increasing the risk of soil erosion (e.g., the creation of rills, gullies, and increased scour) and reducing soil quality. The increase in scour due to extreme rainfall events may affect terrain stability at culverts and bridges. Changes to Surface Water may affect soil quality due to changes in flow patterns increasing soil erosion and leaching of minerals and nutrients. In addition, changes to Surface Water may affect the decomposition of organic matter resulting in changes to soil quality and the distribution and extent of organic soils. Changes to Groundwater (Oji-Cree translation, *anamakamigwabo*) levels may affect terrain stability, or soil productivity. Changes to Geochemistry (i.e., bedrock with the potential for acid rock drainage being exposed through blasting processes) may affect soil quality through changes in soil pH. Changes to Vegetation and Peatlands may also affect soil quality, as the removal of vegetation or peatlands may increase soil erosion. **Table 4-15** provides a preliminary identification of how changes to other environmental disciplines may result in indirect effects on the physiography, terrain, and soils Valued Component. The degree of risk for discipline interactions to physiography, terrain, and soils as a result to changes to another discipline varies depending on activity.

Project effects on physiography, terrain, and soils can also indirectly affect other disciplines. Effects on Aboriginal and Treaty Rights and Interests can occur where changes to physiography, terrain, and soils take place in areas of cultural spiritual significance.

Surface Water flow patterns can be altered by changes to the terrain (topography) and the quality of the water can be affected by an increase in sediment entering into the water due to soil erosion. This increase in sediment entering creeks, rivers and lakes can also affect Fish and Fish Habitat. Effects on Groundwater may occur through terrain alterations affecting groundwater recharge rates. Effects on Geochemistry may occur through the blasting of bedrock or the removal of soil exposing underlying bedrock that has acid rock drainage potential. The extent and distribution of Vegetation communities, Peatlands, and associated Wildlife habitat (e.g., denning and calving areas) can be altered by changes to the physiography, terrain, and soils. Effects on Land and Resource Use and Economy can occur where changes to physiography, terrain, and soils takes place in areas currently used for recreation and tourism or forestry operations. Human Health and Community Safety can be affected by changes to soil quality due to dust deposition, emissions, spills, and contaminants resulting in soil which is unable to support vegetation growth. Visual Aesthetics can be altered by the creation of pits, quarries, and stockpiles due to changes in the physiography, terrain, and soils.

Table 4-15: Potential Indirect Interactions Between Physiography, Terrain, and Soils and Other Disciplines

Indirect Interactions with Physiography, Terrain, and Soils	Disciplines and Associated Valued Components																
	Aboriginal and Treaty Rights and Interests	Atmospheric Environment	Climate Change	Acoustic and Vibration Environment	Physiography, Terrain, and Soils	Surface Water	Groundwater and Geochemistry	Vegetation	Peatlands	Wildlife	Fish and Fish Habitat	Social	Economy	Land and Resource Use	Human Health and Community Safety	Visual Aesthetics	Archaeological and Cultural Heritage
Indirect effects on physiography, terrain, and soils as a result of changes in other disciplines	-	X	X	-		X	X	X	X	-	-	-	-	-	-	-	-

X = Potential pathway for indirect effect as a result of the Project;
- = No pathway for indirect effect is anticipated as a result of the Project.

4.4.2.2. Mitigation and Enhancement Measures

Following the identification of potential effects, the effects assessment has explored technically and economically feasible mitigation measures to avoid or minimize the identified negative effects. In addition, enhancement measures to increase positive effects beyond those that are already inherent to the design have been considered where appropriate. These measures consist of industry-standard practices, federal and provincial standard specifications, regulator-mandated measures, best management practices, Indigenous and community recommendations and recommendations from environmental professionals based on expertise, scientific publications, experience, and judgement.

It is important that mitigation and enhancement measures are achievable, measurable, verifiable, and monitored for compliance and effectiveness during all temporal phases as part of the Project follow-up monitoring plan. Recommended environmental monitoring will verify the potential environmental effects predicted, evaluate the effectiveness of mitigation and enhancement measures, and identify the process the Proponent will follow if mitigation and enhancement measures are not effective.

The *Tailored Impact Statement Guidelines* (Impact Assessment Agency of Canada, 2020) Section 20 requirements and *Terms of Reference* Requirements (AECOM, 2020) for physiography, terrain, and soils are provided in **Table 4-16.** The applicability of these requirements has been evaluated and will be adapted to the needs of the site, environment, and Project activities.

Table 4-16: *Tailored Impact Statement Guidelines* Section 20 Requirements and *Terms of Reference* Requirements

Tailored Impact Statement Guidelines Section 20 Requirement	Section Addressed In
Describe the standard mitigation practices, policies and commitments that constitute proven technically and economically feasible mitigation measures and that are to be applied as part of standard practice regardless of location.	■ Mitigation measures are provided in **Section 7.3.1.**
Describe the Sediment and Erosion Control Plan, including the proposed mitigation measures and their effectiveness on the contaminants of concern.	■ Mitigation measures are provided in **Section 7.3.1.** ■ The Sediment and Erosion Control Plan will be completed once the detailed construction design has advanced.
Describe the Project's environmental protection plan and its environmental management system through which the Proponent will deliver this plan. The plan must provide an overall perspective on how potentially adverse effects would be minimized and managed over time.	■ General mitigations are provided in **Section 7.3.1.** ■ An Environmental Protection Plan will be developed once the detailed construction design is available.
Include mitigation measures for all Project components and where components are to be decommissioned and abandoned, include planned activities to do so. Project components that may be abandoned and decommissioned during the construction or operation phases may include access roads, temporary laydown areas, aggregate extraction sites and other temporary sites (if it will no longer be used).	■ Mitigation measures are provided in **Section 7.3.1.**
Describe measures to be used for stockpiling all stripped peat for use during site reclamation or describe the plan for stockpiling stripped peat and mitigate effects related to its long-term stockpiling or removal.	■ Mitigation measures are provided in **Section 7.3.1.**
Specify the actions, works, minimal disturbance footprint techniques, best available technology, best environmental practices, corrective measures, or additions planned during the Project's various phases to eliminate or reduce adverse effects.	■ Actions will be completed once the detailed construction design has advanced. ■ Mitigation measures are provided in **Section 7.3.1.**

***Terms of Reference* Requirement**	Section Addressed In
Potential effects of road construction include changes to topography due to cut and fill for grading, blasting of bedrock and removal of overburden needed for the Community Access Road, construction access roads and structure foundations.	■ Changes to Terrain Quantity and Distribution are discussed in **Section 7.3.1.1.1.**
Quarries, borrow areas and aggregate source areas are likely to be sourced locally, which will create pits and depressions where materials have been extracted in the area of the Project. Changes to topography as a result of the Project may cause indirect effects, such as changes to surface water drainage and sub-catchment areas.	■ Changes to Terrain Quantity and Distribution are discussed in **Section 7.3.1.1.1**. ■ Changes to Terrain Quantity and Distribution (Esker Landforms) are discussed in **Section 7.3.1.1.2.**
Blasting may result in areas of slope instability. Where unstable rock structures are encountered, design modifications (e.g., minor refinements to the route) may be implemented to minimize potential effects from erosion, settlement, slope instability, foundation failure or rock fall hazards that could occur as a result of construction.	■ Existing slope stability conditions are provided in **Section 7.1.5**. ■ Changes to Quantity and Distribution of Terrain Units (Slope Stability) is provided in **Section 7.3.1.1.3.**
Changes in soil quality and quantity may occur during construction due to increased potential for erosion, sedimentation, mixing and compaction resulting from vegetation clearing, excavation, use of heavy equipment and stockpiling of cleared materials.	■ Changes to Quantity and Distribution of Soils is provided in **Section 7.3.1.1.4.** Changes to Soil Quality from Compaction and Admixing is provided in **Section 7.3.1.1.5.**
Aggregate rock, with potential for Acid Rock Drainage and Metal Leaching may result in changes to surface and groundwater chemistry.	■ Pits and Quarries are discussed in **Section 2.1.3.** ■ Discipline Interactions and Potential Effects are discussed in **Section 4.4.2.1.** ■ Acid Rock Drainage and Metal Leaching are discussed in **Appendix H - Final Groundwater and Geochemistry Technical Support Document**
Changes in soil quality may also occur due to accidental release of contaminants during construction from the use of equipment and machinery (e.g., use of chemicals, explosives and fuel, equipment washing) and from vehicles during operation of the CAR (e.g., leaks and spills from road users).	■ Changes to Soil Quality from Contamination due to Potential Leaks or Spills are discussed in **Section 7.3.1.2.1.**
Road salt is not expected to be used during winter maintenance, however, the EA will conservatively assess the potential effects of road salt on soil quality, particularly along the road edges.	■ Changes to Soil Quality from the Transport and Deposition of Air Contaminant Emissions (e.g., Potential Acid Inputs) and Particulate Matter (Dust) are provided in **Section 7.3.1.2.2**.

4.4.2.3. Predicting Residual Effects

Following the identification of direct and indirect effects and identification of mitigation and enhancement measures, residual effects are predicted. Once predicted, residual effects are characterized by residual effects characteristics, which is described below. Any predicted residual effects are also carried forward into the Cumulative Effects Assessment which is described in **Section 4.4.3.**

4.4.2.4. Characterization of Predicted Residual Effects

Predicted residual effects, if identified, will be described in terms of the effects assessment characteristics presented in **Table 4-17.** These effect characteristics are described in detail in the *Environmental Assessment / Impact Statement Report*. The section that follows outlines how these characteristics were applied as well as any discipline-specific characteristics, if applicable.

Table 4-17: Residual Effects Characteristics

Effects Characteristic	Definition	Description
Context	■ Social context ■ Ecological context ■ Timing of effect in relation to sensitive activities	■ See description below in **Discipline Specific Characteristics**
Direction	■ Direction of change from existing conditions	■ Positive: change in measurement indicator results in net gain or positive effect ■ Neutral: no change to existing condition or change in measurement indicator results in a net balance ■ Negative: change in measurement indicator results in a net loss or adverse effect
Magnitude	■ The expected change from existing conditions	■ Negligible, low, medium, high ■ See description below in **Discipline Specific Characteristics**
Geographic Extent	■ The spatial area in which the effect is expected to occur	■ Construction Development Area: effect is confined within the direct physical disturbance of the Project ■ Local: effect extends outside the Construction Development Area into the Local Study Area ■ Regional: effect extends into the Regional Study Area but is confined to the Regional Study Area ■ Beyond Regional: effect extends beyond the Regional Study Area

Effects Characteristic	Definition	Description
Duration	■ The period of time in which the effect is expected to occur	■ Short term: effect ends before the end of construction ■ Medium term: the effect occurs during construction and ends soon after operation begins and / or maintenance ends soon after the activity causing the effect ends ■ Long term: the effect occurs during construction and persists into operation and / or the effect is considered permanent, or the likelihood of reversibility is low or uncertain
Frequency	■ How often the effect is expected to occur	■ Infrequent: The effect is expected to occur rarely (e.g., once or a few times) ■ Frequent: The effect is expected to occur intermittently (e.g., during dry summers) ■ Continuous: the effect is expected to occur continuously
Reversibility	■ The ability to return to existing conditions	■ Reversible: the effect is not permanent and can be reversed within a clearly defined time period ■ Irreversible: the effect is permanent
Likelihood	■ Probability that the effect will occur	■ Unlikely: the effect is not likely to occur but is not impossible ■ Possible: the effect may occur, but is not likely ■ Probable: the effect is likely to occur, but is uncertain ■ Certain: the effect will occur
Uncertainty	■ The potential for observed results to deviate from predictions made	■ See description below in **Discipline Specific Characteristics**
Direct / Indirect	■ Nature of the pathway through which the effect occurs.	■ Direct effects are typically immediate and spatially aligned with the activity. Indirect effects may be delayed or spatially removed but are causally linked and predictable.

4.4.2.4.1. Discipline-Specific Characteristics

In addition to the residual effects characteristics described in **Table 4-17**, characterization of the following discipline specific characteristics are required to characterize residual effects to determine the significance of those effects from the Project on physiography, terrain, and soils.

4.4.2.4.1.1. Ecological and Social Context

The social context within which a project's potential effects may occur has been taken into account when considering the effects criteria. Effects criteria consider the physical characteristics of an effect (e.g., magnitude, geographical extent, timing, and duration), as well as the context-specific value characteristics (e.g., environmental, health, social and economic conditions). Context is considered one of the most critical factors when evaluating effects, and the effects assessment has considered potential or existing effects or pressures on social, economic and health conditions affecting the sensitivity or resilience of a Valued Component.

Ecological context for physiography, terrain, and soils considers resilience, adaptive capacity, status and trends, and applicable legislation and best management practices. The current and future sensitivity and resilience of the physiography, terrain, and soils Valued Component to change from the Project, are considered. The ecological context of the effect includes a discussion of the environmental consequences of the predicted effect.

The social context of the effect includes a discussion of the social and cultural consequences of the predicted effect and includes Indigenous Knowledge where available. The current and future sensitivity and resilience of the Valued Component to change caused by the Project has also been considered.

4.4.2.4.1.2. Magnitude

Magnitude refers to the amount of change in a measurable parameter relative to the existing conditions of a Valued Component, with and without the project in place, or to other standards or guidelines. It is a measure of the intensity or the degree of change (i.e., effect size) caused by the project and other developments, if applicable, relative to existing conditions.

When evaluating the magnitude of effects, this study considers both the proportion of the Valued Component affected within identified spatial boundaries and the relative effect.

For magnitude, environmental discipline-specific definitions are required and are provided in **Table 4-18**.

Table 4-18: Physiography, Terrain, and Soils Magnitude Definition

Magnitude Level	
Rating	**Definition**
Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect size (e.g., ha of a terrain unit)

ha = hectare.

Established guidelines, thresholds, or screening values were considered where available. Magnitude is presented as a quantitative or qualitative expression of effect size relating to the respective measurement indicators. When categorical definitions were used, magnitude was classified as negligible, low, medium, or high and supported by a reasoned narrative.

While most criteria were assigned categorical ratings, magnitude ratings for physiography, terrain, and soils were provided in specific terms (i.e., narrative or numeric quantification) in the residual effects assessment (**Section 7**). Applying a category rating to a criterion such as magnitude might lead to confusion or misinterpretation of the effects assessment or result in the criterion not being easily categorized in a meaningful way. For example, characterizing magnitude solely using an ordinal scale (i.e., low, medium, or high) for physiography, terrain, and soils is often not appropriate as additional context is required to properly characterize the effects. Universal effect size boundaries, such as a 20% change in a terrain or soil map unit at the Local Study Area scale used to define a high magnitude effect, work poorly because these size boundaries fail to consider context. Depending on the ecological context, a 20% change from existing conditions in the study area may be required to cause a high magnitude effect on some units, whereas a 2% change in the study area may be sufficient to cause a high magnitude effect for other units. When categorical definitions were used, magnitude was classified as negligible, low, medium, or high and supported by a reasoned narrative.

4.4.2.4.1.3. Determination of Significance

A determination of significance of residual effects on the physiography, terrain, and soils Valued Component cannot be completed as this Valued Component does not have an assessment endpoint. Assessment endpoints are qualitative expressions that represent the key properties of the environment that should be protected. Assessment endpoints for biophysical Valued Components (e.g., Valued Components within the fish and wildlife disciplines) typically consider the maintenance of self-sustaining and ecologically effective populations.

Physiography, terrain, and soils was selected as a Valued Component since these elements provide the physical foundation for functioning terrestrial ecosystems and local biological processes. Physiography, terrain, and soils are critical to the effects assessment and determination of significance for other biophysical Valued Component; however, the importance or significance of changes in physiography, terrain, and soils can only be evaluated in context of Valued Components with assessment endpoints, as these Valued Components are the ultimate receptors of value to humans and the environment.

As an example, changes in physiography, terrain, and soils are challenging to evaluate without the context of what these changes would mean to the maintenance of self-sustaining and ecologically effective populations of vegetation and wildlife Valued Components. As such, the assessment of physiography, terrain, and soils Valued Components does not include an assessment of significance for identified residual effects.

4.4.2.4.1.4. Prediction Confidence and Uncertainty

Prediction confidence refers to the degrees of certainty in the predicted residual effects and associated determination of significance. All Impact Assessments involve some level of uncertainty, often over many geographic, biophysical, and social dimensions, and observed results may deviate, to some degree, from predictions made in the assessment. Therefore, the residual effects predictions vary in their level of certainty, which could be related to a number of factors, such as project design and components, existing conditions, spatial and temporal scope, Valued Component response, effectiveness of mitigation measures, overall scope of factors considered, and natural and human causes of accidental events.

Transparency in describing sources of uncertainty is critical to understanding the confidence that can be attributed to the analysis of effects and is important to decision-making. Efforts to address uncertainties have been focused on those uncertainties that are most meaningful to decision-making, such as how the biophysical and human environment will respond to changes and the efficacy of mitigation measures.

Prediction confidence for physiography, terrain, and soils in effects analyses can be related to the availability and accuracy of baseline data, accuracy and scale of available background data (i.e., published surficial geology maps), level of understanding of the strength of Project–environment interactions in terms of the effects they are likely to have on physiography, terrain, and soils, level of certainty associated with the effectiveness of proposed mitigations, where applicable, and the level of understanding of baseline terrain and soils conditions and range of natural variation.

Uncertainty was managed by reviewing as much background and historical data as possible and conducting relevant baseline studies in the Local Study Area, completing quality assurance and quality control of baseline data and mapping, using data to make inferences about potential changes to physiography, terrain, and soils from Project effects, and comparing assessment results to relevant published scientific literature.

There is some residual uncertainty regarding the quantity and distribution of reclaimed terrain and soil units, and the level of soil productivity for revegetation during and after Construction and Operations. Monitoring is proposed to be used to address residual uncertainty by evaluating the progress of reclamation activities. Different approaches and methods would be implemented, if necessary, to establish a trajectory towards the

successful regeneration and succession of vegetation ecosystems that are functionally similar to natural plant communicates in the region.

Each of the potential residual effects was assigned a level of uncertainty as a means of ranking the confidence in the predicted effects on physiography, terrain, and soils. The levels of uncertainty were defined as:

- **Low**— Uncertainty was considered to be low if there were baseline data at an appropriate Survey Intensity Level to support the scale of mapping, the Project-related effects are clearly understood, and the level of certainty associated with the effectiveness of proposed mitigations is high;
- **Moderate**—Uncertainty was considered to be moderate if there were representative baseline data for most of the terrain map units and soil map units in the Construction Disturbance Area, the Project-related effects are mostly understood, and the level of certainty associated with the effectiveness of proposed mitigations is moderate to high; and
- **High**— Uncertainty was considered to be high if there were no baseline data available, the Project-related effects are poorly understood, and the level of certainty associated with the effectiveness of proposed mitigations is low or unknown.

4.4.3. Assessing Cumulative Effects

The Impact Assessment Agency of Canada defines **Cumulative Effects** as “changes to the environment, health, social and economic conditions, as a result of the project’s residual environmental, health, social and economic effects combined with the existence of other past, present and reasonably foreseeable physical activities, as well as within activities of the project itself from multiple emissions and discharges (e.g., simultaneous operations) to understand synergistic or additive effects” (Impact Assessment Agency of Canada, 2020). Cumulative effects may result if:

- The implementation of the project has the potential to cause direct residual adverse effects on the Valued Components, taking into account the application of technically and economically feasible mitigation measures; and
- The same Valued Component may be affected by other past, present, and future physical activities.

A cumulative effect on an environmental, health, social, or economic component may be important even if the Project's effects on this component by themselves are minor. The method for assessment of cumulative effects is consistent with the *Tailored Impact Statement Guidelines*, *Operational Policy Statement: Assessing Cumulative Environmental Effects* under the *Canadian Environmental Assessment Act*, 2012 (Canadian Environmental Assessment Agency, 2013), and the *Interim Technical Guidance for Assessing Cumulative Environmental Effects* under the *Canadian Environmental Assessment Act*, 2012 (Canadian Environmental Assessment Agency, 2018). The identification and assessment of cumulative effects will be undertaken as follows:

- Identify and assess the residual effects of the Project;
- Define the spatial and temporal boundaries for cumulative effects based on the residual effects predicted;
- Identify other past, present, and reasonably foreseeable activities with effects likely to overlap in type of effect (i.e., Valued Component), temporally, and spatially with the predicted residual effects of the Project; and
- Predict potential cumulative effects and identify additional mitigation.

4.4.3.1. Cumulative Effects Scoping

4.4.3.1.1. Valued Components with Residual Effects

The cumulative effects assessment builds on the results of the residual effects assessment described in **Section 7** and will consider the incremental changes that are predicted to have a likely residual adverse effect on a Valued Component. The Valued Components that do not have a residual effect predicted, or the residual adverse effect is of negligible magnitude, and the likelihood is unlikely or possible to occur, or positive in direction, will not be carried forward into the cumulative effects assessment. All residual effects on Valued Components identified will be brought into the cumulative effects assessment. The rationale for the exclusion of Valued Components from the cumulative effects assessment will be provided.

4.4.3.1.2. Temporal and Spatial Boundaries

Temporal boundaries, as described in **Section 4.2.1,** correspond to the duration that the likely residual adverse effects of the Project are predicted to occur. *The Tailored Impact Statement Guidelines* (Impact Assessment Agency of Canada, 2020) indicate the cumulative effects assessment should look at potential effects throughout the life cycle of the Project, including decommissioning and abandonment; however, there are currently no plans to decommission the Project. Therefore, this assessment is limited to identifying and assessing cumulative effects during the Project Construction and Operations and Maintenance Phases.

Spatial boundaries, which are the study area(s) within which the geographic extent of cumulative effects will be studied, may vary by the residual effects of each Valued Component selected. For example, the geographic extent of residual effects on the migration patterns of wildlife Valued Components may differ from the geographic extent of habitat loss to the same Valued Components as a result of the Project. The spatial boundaries used to assess cumulative effects are described in **Section 4.2.3.**

4.4.3.1.3. Identification of Past, Present, and Reasonably Foreseeable Developments

Activities that were considered in the cumulative effects assessment included other past and existing anthropogenic (i.e., human-made) developments and future activities that are reasonably foreseeable. For an activity to be considered foreseeable and included in the cumulative effects assessment, sufficient information about the activity must have been available to make a reasonable assessment of its potential effects (i.e., in the planning / approvals / design stage). This included induced development that is certain or reasonably foreseeable and activities with additive effects, where appropriate (Canadian Environmental Assessment Agency, 2018). Reasonably foreseeable activities that were not considered are those for which formal plans have not been publicly disclosed and information is not available. For a potential future project to be considered in the cumulative effects assessment, preliminary information such as activity description, activity size, footprint, project components, and anticipated timelines are needed to evaluate if the Project and the potential future project will overlap. The full list of past, present, and reasonably foreseeable developments considered in the cumulative effects assessment is presented in the *Environmental Assessment / Impact Statement Report*.

To determine which past, present, and reasonably foreseeable developments and their activities should be considered in the physiography, terrain, and soils cumulative effects assessment, the following questions were answered. If effects of the activities of the projects are expected to overlap in type, time, and space with the residual effects of physiography, terrain, and soils Valued Components, it was assumed that those activities would act cumulatively and be assessed for cumulative effects with the Project.

- Do the Project's activities overlap in the type of effects (e.g., effects on soil quality)?
- Do the Project's activities overlap in the timing of effects (i.e., do they overlap with the cumulative effect temporal boundaries with the identified residual effects)?
- Do the Project's activities overlap in the location of effects (i.e., do they overlap with the cumulative effect spatial boundaries)?

Furthermore, Valued Components that did not have a residual effect predicted, or the residual effect is of negligible magnitude, unlikely or possible to occur, or positive in direction, the effect was not carried forward into the cumulative effects assessment.

4.4.3.2. Cumulative Effects Assessment

Following the scoping of the cumulative effects assessment, cumulative effects were assessed for the applicable physiography, terrain and soils Valued Component. Cumulative effects on the physiography, terrain and soils Valued Component will be identified reviewing the effects of the Project with and without the other activities. Effects of past activities (i.e., activities that have been carried out) will be used to contextualize the current state of the Valued Component.

Mitigation measures that are technically and economically feasible to eliminate or reduce adverse cumulative effects were described. A qualitative assessment of the effectiveness of the measures was provided, taking into consideration all applicable reasonably foreseeable developments to provide a regional context. Cumulative effects will be characterized using the same effects characteristics presented in **Table 4-17.**

4.5. Identify Monitoring Programs and Future Commitments

Following the residual and cumulative effects assessments, effects monitoring programs are recommended to verify the prediction of the effects assessment and the effectiveness of the mitigation and enhancement measures presented in this report. Commitments made in this report are also presented to support compliance monitoring to evaluate whether the Project has been constructed, implemented, and operated in accordance with the commitments made.

4.6. Predicting Future Conditions

The prediction of potential future conditions or amount of change from existing conditions included:

- An estimated area of the terrain units (surficial materials) with the potential for permanent alteration or destruction during the Construction Phase within the Construction Disturbance Area;
- An estimated area of soil map units with the potential for permanent alteration or destruction during the Construction Phase within the Construction Disturbance Area; and
- Estimated areas of soil quality (i.e., productivity, reclamation suitability) with the potential for permanent alteration or destruction during the Construction Phase within the Construction Disturbance Area.

Qualitative review of the potential future conditions and potential changes to sensitive features within the Construction Disturbance Area were described. The predictions of changes as a result of the Project and future conditions were used to inform the effects assessment and identify mitigation and enhancement measures.

4.7. Data Management and Analysis

Data management, including quality assurance and quality control was completed to minimize potential for data entry and analysis errors, prepare datasets for analysis, and limit sensitive data distribution in accordance to established agreements.

A quality assurance / quality control program was implemented to verify that data collection, data entry, and data analysis were conducted with a high level of confidence. Quality assurance / quality control of field data, data manipulation, and data summary calculations consisted of:

- Reviewing and verifying field data on site, at the end of each day, and at the end of each field shift to maintain data quality and consistency;
- Using iPads to provide consistent use of field codes; and
- Transferring and backing-up field data and field photos to online databases and laptops regularly.

Database checks included verifying values outside of expected ranges for each parameter. Calculations of summary statistics were verified by recalculating minimum and maximum values, evaluating relationships between parameters, querying sample sizes, and medians for a subset of the data. Mapping products and data analysis results were reviewed by WSP Canada Inc. soils and terrain specialists who were not directly involved in the final products. The specific tasks for post-field data management and quality assurance / quality control were as follows:

- Complete daily field summary report;
- Download all photographs and Global Positioning System locations to file server; and,
- Review Global Positioning System coordinates for accuracy.

4.7.1. Field Surveys

To maintain consistency and for quality assurance / quality control of the data collected, standardized datasheets (either digital or paper) paired with mapping software were used in the field. Field studies followed technical protocols that outlined specific work instructions and were developed to follow federally and provincially acceptable methods. Completeness and accuracy of field data were verified daily during field verification and field photos and coordinate information were backed up regularly.

4.7.2. Geographic Information Systems

Where existing conditions data are available in Geographic Information Systems format, this information will be provided to the Impact Assessment Agency of Canada as electronic geospatial data file(s) compliant with the International Organization for Standardization 19115 standard. This will support the Government of Canada's commitment to Open Science and Data and will facilitate the sharing of information with the public through the Canadian Impact Assessment Registry Internet Site and the Government's Open Science and Data Platform. The Impact Assessment Agency of Canada intends to make the geospatial data files available to the public under the terms of the Open Government Licence – Canada as applicable with exclusion of sensitive species at risk and Indigenous Knowledge.

Complete datasets from all survey sites will be provided upon finalization of this report. They will be in the form of complete and quality assured relational databases, with precisely georeferenced site information, precise observation / visit information and with observations and measurements in un-summarized form. Databases and Geographic Information Systems files will be accompanied by detailed metadata that meets International Organization for Standardization 19115 standards. Documentation and digital files will be provided for all results of analyses that allow for a clear understanding of the methods and a replication of the results. All geographic data, along with accompanying metadata, pertaining to species at risk will be provided to Natural Heritage Information Centre and the Ministry of the Environment, Conservation and Parks – Species at Risk Branch.

4.7.3. Data Analysis

Soil attributes recorded during the field surveys and from analytical data were used to determine soil suitability for reclamation, soil sensitivity to wind and water erosion, soil sensitivity to acidification, and compaction risk ratings. Details on the analysis are provided in **Sections 4.3.1.4** and **4.3.1.5**.

5. Existing Conditions

The existing conditions are described based on a combination of information obtained through engagement and consultation, desktop assessment, field investigation, and modelling for both alternatives (Alternative 1 and Alternative 4).

5.1. Regional Physiography

Physiography is a description of the surface features of the Earth, with an emphasis on their mode of origin (Bates and Jackson, 1987). The majority of the Marten Falls First Nation Community Access Road Regional Study Area is located in the Severn Upland, with the remainder in the far northeast of the Regional Study Area, part of the Hudson Bay Lowland (Bostock, 1970). The Severn Upland is a subdivision of the James Region physiographic region and part of the Canadian Shield (Bostock, 1970). It is described as low and rolling, with local relief only exceeding 60 to 90 m in deeply incised canyons (Dredge and Cowan, 1989). Elevations rise from near sea level in the north to approximately 500 to 600 m towards the southwest (Dredge and Cowan, 1989). The Hudson Bay Lowland is a subdivision of the Hudson region and part of the Canadian Shield (Bostock, 1970). It is described as a low-lying bedrock plain formed by subaerial denudation in post-Devonian times and mantled to a variable degree by glacial and marine sediments (Dredge and Cowan, 1989). The area is low, and almost flat, with elevations rising gently from sea level to 120 m (Dredge and Cowan, 1989).

The Canadian Shield has been subjected to long periods of subaerial erosion (processes such as weathering and mass movement) since the late Archean (3,000 to 2,500 million years ago), and it has been suggested that at least 6,000 m of erosion has occurred since the last mountain building episode (Dredge and Cowan, 1989). Glaciation has played a major role in the shaping of the Canadian landscape (Barnett, 1992). The most recent influence on the physiography was the Late Wisconsinan continental glaciation which began approximately 115,000 years ago and reached its maximum extent approximately 20,000 years ago (Barnett, 1992). The Regional Study Area was covered by glacial ice at this time. As the ice started to melt and retreat, large proglacial lakes developed along the southern edge of the ice sheet, where meltwater was impounded (Dredge and Cowan, 1989). By 9,000 years Before Present Glacial Lake Ojibway had formed across the Regional Study Area, and as the ice continued to retreat Glacial Lake Ojibway expanded northwards and may have merged with Glacial Lake Agassiz to form a continuous waterbody that drained through the Ottawa River (Dyke and Prest, 1987). By 8,400 years Before Present Glacial Lake Ojibway and Agassiz (perhaps confluent) had expanded into the Hudson and James Bay Lowlands. At this time, the length of ice margin standing in these proglacial lakes was approximately 3,100 km, and the lakes still drained via the Ottawa River (Dyke and Prest, 1987).

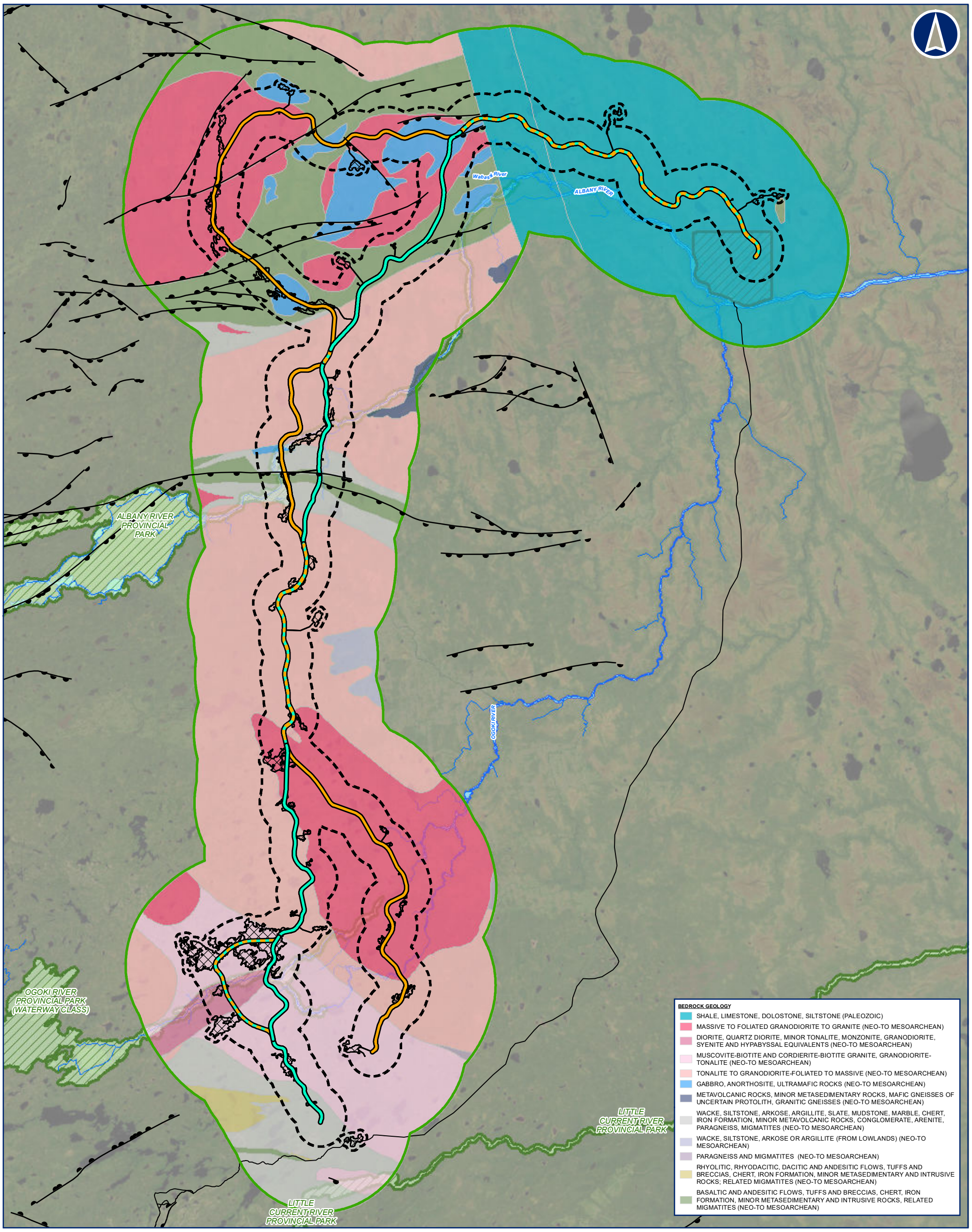
The ice margin was unstable resulting in extensive calving of icebergs into Glacial Lakes Ojibway and Agassiz, which left iceberg scour marks in the underlying sediments (Barnett, 1992). At some point between 7,900 and 8,000 years Before Present (Veillette, 1994) Glacial Lake Ojibway drained catastrophically northwards when the ice dam separating the lake from the sea broke, causing the lake water level to drop by 250 m and ending Glacial Lake Ojibway (Dyke and Prest, 1987). Lakes and ponds surrounded by circular, doughnut like ridges of clay are believed to be the result of stranded icebergs (Veillette, 1994). The isostatically depressed land surrounding Hudson Bay was inundated by the Tyrrell Sea, which extended as much as 300 km inland beyond the present coast (Dredge and Cowan, 1989; Dredge and Dyke, 2020). The eastern part of the Regional Study Area around Ogoki may have been inundated by the edge of the Tyrrell Sea at its maximum extent. Glacio-isostatic rebound, and regression of the sea has created a wedge of marine sediments that thicken towards the present coast (Dredge and Dyke, 2020). The landscape continues to isostatically rebound from the removal of the weight of glacial ice which depressed the surface of the Earth at a rate of about 100 cm per century around James Bay (Oji-Cree translation, *Wee-nee-peg-kook*) (Dredge and Dyke, 2020).

Today, the Severn Uplands are characterized by a rocky landscape scattered with lakes and deposits from the Pleistocene glaciation (Thurston, 1991). These deposits include glaciolacustrine clays and former shorelines of proglacial lakes, glaciofluvial sediments, and glacial tills and moraines (Thurston, 1991). In addition, over the last 8,000 years, up to 4 m of organic sediment has accumulated on the flat, poorly drained glacial lake and marine plains formerly covered by Glacial Lakes Agassiz and Ojibway (Dredge and Cowan, 1989). The Hudson Bay Lowland is a low, swampy plain, containing numerous string bogs and shallow lakes (Thurston, 1991).

Regional Bedrock Geology (**Figure 5-1**) displays 1:250,000 scale bedrock geology mapping for the Regional Study Area by Ontario Geological Survey (2011). The bedrock geology in the Regional Study Area consists of two distinct groups of rocks. The first and largest group consists primarily of Neoarchean to Mesoarchean (2.5 to 3.2 billion years) felsic intrusions, felsic to mafic metavolcanics, and metasedimentary rocks(Ontario Geological Survey, 2011). The second group is characterized by much younger Ordovician (444 to 488 million years) sedimentary rocks of the Red Head Rapids Formation and the Churchill River Group, both of which are composed of shale, limestone, dolostone, and siltstone (Ontario Geological Survey, 2011). The contact between the younger Ordovician rocks and the Archean volcanic rocks is approximately 25 km from the community of Marten Falls First Nation.

The most common Archean volcanic rocks within the Regional Study Area are felsic intrusions belonging to the suite of foliated to massive rocks composed of tonalite to granodiorite (Ontario Geological Survey, 2011). These rocks are mainly found in the central part of the Regional Study Area. Metasedimentary rocks composed of paragneiss and migmatites dominate the southern end of the Regional Study Area, and mafic to intermediate metavolcanic rocks composed of basaltic and andesitic flows, tuffs, and breccias and related migmatites occur in the northern part of the Regional Study Area (Ontario Geological Survey, 2011).

There are numerous northwest trending mafic dykes throughout the Regional Study Area which have been dated to 2.45 billion years (Ontario Geological Survey, 2011). The mafic dykes are slightly younger than the Archean felsic to mafic metavolcanics and therefore cut across this suite of rocks.



Legend

- FAULT
- ROAD

COMMUNITY ACCESS ROAD ALTERNATIVES

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE
- WATERCOURSE
- WATERBODY
- CONSTRUCTION DISTURBANCE
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

Notes:

1. Ontario Geological Survey. 2011. 1:250,000 scale Bedrock Geology of Ontario. Ontario Geological Survey, Miscellaneous Release – Data 126, Revision 1. Available at: http://www.geologyontario.mndm.gov.on.ca/ogsearth.html

Data Source:

Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

BEDROCK GEOLOGY IN THE EXISTING CONDITIONS REGIONAL STUDY AREA

0 5 10 20
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026	1:450,000 * when printed 11"x17"
Rev:0	

Figure 5-1

Contains information provided by Ontario Ministry of the Environment, Conservation and Parks or by Ontario Ministry of Natural Resources and Forestry (Copyright: Queen's Printer of Ontario 2020), through a Sensitive Data License Agreement. This drawing has been prepared for use of AECOM client and may not be reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM express written consent. The use of Sensitive Data in this drawing does not constitute an endorsement by the Ministry for this drawing or by AECOM of the Sensitive Data.

Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_GEN_002_GIS_BedrockGeologyRSA_Rev0.mxd
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5.2. Regional Surficial Geology

Surficial geology mapping was completed at a 1:1,000,000 scale for Northern Ontario by Barnett et al. (1991). This mapping was included in the 1:1,000,000 scale seamless coverage of the Quaternary geology for the province of Ontario (Ontario Geological Survey, 1997). In 2008, the Ontario government launched the Far North Information and Knowledge Management Program to permanently protect half of the Far North region of Ontario. Predictive surficial geology mapping at a scale of 1:100,000 scale was completed as part of the program. The mapping was completed using SPOT satellite imagery, a digital elevation model, and hydrology data as the main sources for the remote predictive mapping (Ontario Geological Survey, 2018). Four of the predictive surficial geology maps cover the Marten Falls First Nation Regional Study Area (Barnett et al., 2013a,b,c; Gao and Yeung, 2018) and were reviewed during the preliminary terrain mapping of the Local Study Area. The predictive surficial geology mapping is referred to as Ontario Geological Survey (2018) for the remainder of the report.

The following provides a description of the surficial materials in the Regional Study Area based on the predictive surficial geology mapping by Ontario Geological Survey (2018) and shown in **Figure 5-2**. Barnett et al. (2013a,b,c) acknowledge access to the borehole samples, logs, and data generated by Golder Associates Ltd. (2010) for the Canada Chrome Corporation, which they incorporated into the predictive mapping.

The southern part of the Regional Study Area, including the sections of Alternative 1 and Alternative 4 between Percy Lake and Winslow Lake, has been mapped as mainly till. The dominant till in this area is described as a massive to bedded diamicton with a sandy silt to silt matrix, moderate to high clast content, and low to high matrix carbonate content. The till in the eastern part of this area is described as having a clayey silt to clay matrix, low to moderate clast content, and moderate to high matrix carbonate content. Drumlins, streamlined ridges, or hills of till with the long axis parallel to the direction of former glacier flow have also been mapped as linear features in the southern part of the Regional Study Area. Numerous bedrock outcrops have been mapped west of Alternative 4 in this southern area, and a veneer of till (less than 1 m in thickness) has been mapped adjacent to many of the bedrock outcrops. Pockets of fine grained glaciolacustrine sediments composed of silt, clay, and some fine sand have been mapped east of Alternative 1, and small areas of glaciofluvial ice contact deposits composed of sand and gravel have also been mapped throughout the southern part of the Regional Study Area. More recent sediments mapped in this area include fluvial sediments composed of sand and gravel and accumulations of organic material (labelled as bogs and fens). The organic material has been mapped as pockets throughout the southern part of the Regional Study Area, but there are more extensive areas of organic accumulation east of Alternative 1 south of Dusey Lake (Oji-Cree translation, *Atikameko Zakaihkan*).

The remainder of the Regional Study Area (from Winslow Lake north) has been mapped as mainly organic material and described as bogs and fens. Areas of till are scattered throughout the rest of the Regional Study Area and are described as being composed of clayey silt to clay with low to moderate clast content. The coarse textured till composed of sandy silt to silt with a moderate to high clast content has been mapped near the community of Marten Falls First Nation. Iceberg keel marks have been mapped in the till west of the community of Marten Falls First Nation. These were formed by the grounding of icebergs in the glacial lake which covered this area during deglaciation. Small areas of glaciolacustrine and glaciofluvial sediments have been mapped near Teabeau Lake and the Albany River, between the Dusey and Patiigohsing Rivers, and the Alternative 1 route from Gourlie Creek (Oji-Cree translation, *Onagwa'ihgan Ziibih*) north to an unnamed lake at the edge of the Regional Study Area approximately 4.5 km southeast of Tillett Lake. Fluvial sediments have been mapped adjacent to rivers and streams throughout the area. Eskers, sinuous low ridges composed of sand and gravel, formed from deposition from meltwater running through a channel beneath or within glacier ice (Howes and Kenk, 1997), have been mapped in areas characterized by glaciofluvial sediments.

Wabassi River
ALBANY RIVER
ALBANY RIVER PROVINCIAL PARK
OGOKI RIVER
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
LITTLE CURRENT RIVER PROVINCIAL PARK
LITTLE CURRENT RIVER PROVINCIAL PARK

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WATERBODY
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SURFICIAL GEOLOGY

- ORGANIC DEPOSITS (FEN)
- ORGANIC DEPOSITS (BOG)
- FLUVIAL DEPOSITS (RECENT)
- FLUVIAL DEPOSITS (ABANDONED)
- MARINE BEACH AND NEAR-SHORE DEPOSITS
- GLACIOLACUSTRINE BEACH AND NEAR-SHORE DEPOSITS
- GLACIOLACUSTRINE BASIN DEPOSITS
- GLACIOFLUVIAL ICE-CONTACT DEPOSITS
- CLAYEY-SILT TO CLAY TILL
- SANDY SILT TO SILT TILL
- SILTY SAND TO SAND TILL
- THIN SEDIMENT OVER BEDROCK
- BEDROCK (PRECAMBRIAN)

Notes:

1. Barnett, P.J., K.H. Yeung, and J.D. McCallum. 2013a. Surficial geology of the Fort Hope area northeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3724, scale 1:100 000.
2. Barnett, P.J., K.H. Yeung, and J.D. McCallum. 2013b. Surficial geology of the Fort Hope area southeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3736, scale 1:100 000.
3. Barnett, P.J., K.H. Yeung, and J.D. McCallum. 2013c. Surficial geology of the Nakina area northeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3744, scale 1:100 000.
4. Gao, C. and K.H. Yeung. 2018. Surficial geology of the Ogoki area northwest, northern Ontario. Ontario Geological Survey, Preliminary Map P.3725, scale 1:100 000.

Data Source:

Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, AAFC, NRCan

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL GEOLOGY IN THE EXISTING CONDITIONS REGIONAL STUDY AREA

0 2.5 5 10 15 20
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026 | 1:450,000 * when printed 11"x17"

Rev:0

Figure 5-2

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5.3. Terrain

Figure B-1a to **B-1u** (**Attachment B – Existing Conditions Detailed Mapping Figures**) provides a larger scale (1:50,000), more detailed display of the surficial materials and geomorphological processes mapped in the Local Study Area.

5.3.1. Surficial Materials

5.3.1.1. Till (Moraine)

Till is described as material associated with glacier activity, and can be transported beneath, beside, on, within, and in front of a glacier (Howes and Kenk, 1997). It has highly variable textural, structural, and topographic characteristics which depend on the source of the material incorporated by the glacier and the mode of deposition (Howes and Kenk, 1997). In the Local Study Area, all the till materials were recorded as being high in silt, however in some areas the till has more clay with the silt, and in other areas the till is slightly coarser and has more sand with the silt. A distinguishing characteristic in what was identified as till is the presence of coarse fragments. The till observed in the field varied in coarse fragment content with content ranging from 1% to 65%. Till with a lower clast content, generally less than 20%, tends to have a higher clay content, while coarser sediments (silt and sand) are associated with till that has a higher clast content. The till with the higher clast content is generally located in the southern part of the Local Study Area, south of Winslow Lake and closer to areas where bedrock is exposed. In areas where bedrock was exposed, or near the surface, veneers (between 0.2 and 1.0 m in thickness) and thin veneers (less than 0.2 m) of till are mapped overlying undulating bedrock, in combination with the bedrock outcrops. The largest extents of these thin till and bedrock areas are located at the southern end of the study area near Colpitts Creek (Alternative 4), north and south of the Ogoki River (Alternative 1), and north of the Ogoki River (Alternative 4). Till blankets (between 1 and 3 m in thickness) are mapped extending away from these shallow bedrock areas as the drift thickness increases with distance from the bedrock outcrops. Undulating till and till plains are described as being more than 3 m in thickness and are mapped throughout the Local Study Area (**Attachment B**).

5.3.1.2. Glaciolacustrine

Glaciolacustrine materials include lacustrine sediments deposited in or along the margins of glacial (ice-dammed) lakes (Howes and Kenk, 1997). Their topographic expression can be hummocky or irregular which is indicative of collapse of the material due to melting of supporting ice, and the melting of buried or partly buried ice can create kettles (depressions) on the surface (Howes and Kenk, 1997). Glaciolacustrine materials in the Local Study Area were described as exclusively clays and silts, with some clay documented as being “heavy clay”, meaning the clay content of the material is greater than 60% (Government of Manitoba, 2007).

During field studies, layers of silt and clay were often noted in this material (**Figure 5-3**), and these layers may represent seasonal deposition through suspension with the finer grained clay being deposited during the winter months. Glaciolacustrine materials were often found underlying organic accumulations, but also in association with features resembling eskers, and large, upland features. These upland features commonly exhibit distinct gullies around the outer perimeter, and in several cases field studies show that the gullies are formed on coarser glaciofluvial sediment (**Figure 5-4**). Many of these upland areas were identified as glaciofluvial sand and gravel material in previous mapping (Ontario Geological Survey, 2018); however, field studies established these esker-like features are more commonly silt and clay than sand and gravel. This is particularly evident along the western portion of Alternative 4 near Gourlie Creek and the Wabassi River (Oji-Cree translation, *Wabihzii Wih Ziibih*), Alternative 4 east of the Albany River, and Alternative 1 and 4 between the Patiigohsing and Dusey Rivers. Areas where apparent kettles are noted (**Figure 5-5**) were also previously mapped as coarse textured glaciofluvial material (Ontario Geological Survey, 2018), however boreholes (Golder, 2010 and KGS, 2019a) and field data from WSP Canada Inc. found these materials were more akin to glaciolacustrine sediments with textures of silty clay and clayey silt being noted rather than sand and gravel.

Figure 5-3: M22S258 – An Example of Layered Silt Loam, Silty Clay Loam, and Silt Loam Found in Association with Glaciolacustrine Sediment

Figure 5-4: Example of a Significant Upland Feature Displayed in Light Detection and Ranging Hillshade Data Approximately 3.5 km Southeast of the Patiigohsing River (Alternative 1 and 4) Composed of Glaciolacustrine Sediment with Evidence of Gully Erosion Around the Outer Perimeter

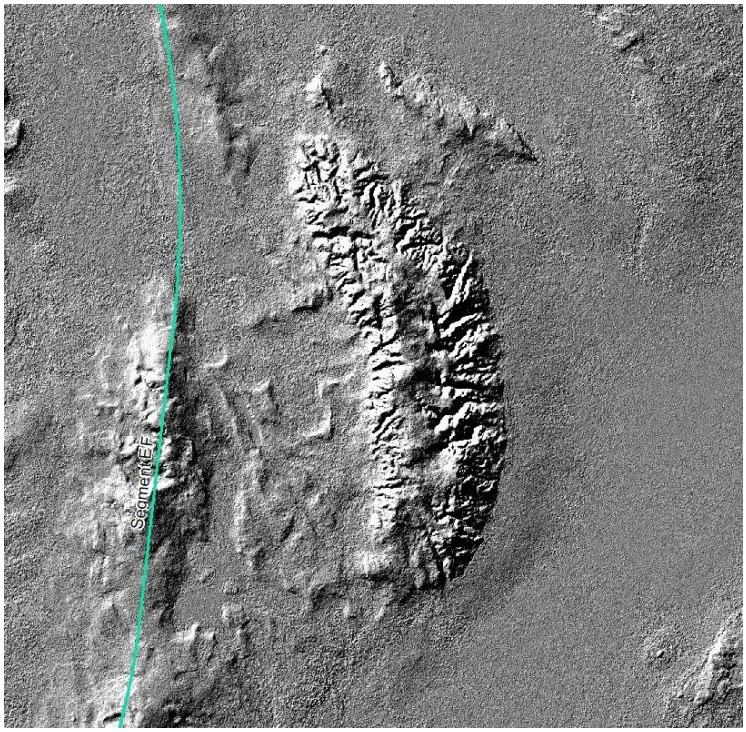
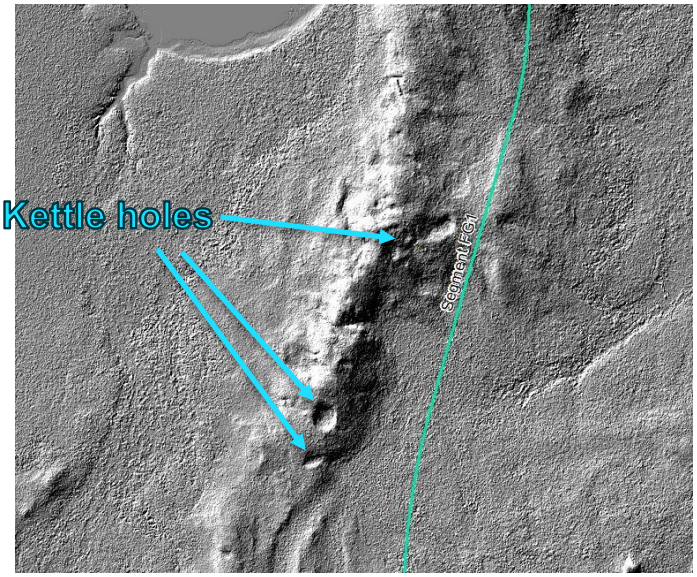


Figure 5-5: Example of Kettles (Depressions) in a Glaciolacustrine Ridged Area Approximately 850 m South of Teabeau Lake (Alternative 1) Displayed in Light Detection and Ranging Hillshade Data



5.3.1.3. Organic

In saturated ground conditions, vegetative matter can accumulate, creating organic material (Howes and Kenk, 1997). These organic accumulations vary in thickness, but when thicker than 40 cm, they are associated with bogs, fens, and swamps, and are mapped as organic parent material (peatlands). Organic material is abundant in the Local Study Area and was commonly found overlying silty clay textured glaciolacustrine and till sediment. In areas with thinner drift thickness (exposed bedrock, till veneers, and thin till veneers), such as north of the Ogoki River on Alternative 4, organic matter is commonly found in the depressions and level areas between, and surrounding the till-capped bedrock undulations, or exposed bedrock outcrops. Thicker, more extensive organic deposits are located in the northern part of the Local Study Area (both Alternative 1 and 4), north of Gourlie Creek and extending to the community of Marten Falls First Nation. Lenticular patterned fens with peat likely thicker than 3 m are present in the areas south and east of Gittins Lake (Alternative 1 and 4) (**Figure 5-6**).

Indigenous Knowledge obtained from Attawapiskat First, Marten Falls First Nation, and Red Sky Independent Métis Nation was acknowledged within the assessment of terrain within the Local Study Area (AECOM, 2020b; Attawapiskat First Nation, 2015; Marten Falls First Nation, 2020). In particular, within the delineation of peatlands and wetlands, as well as overall terrain mapping. This included information from Attawapiskat First Nation, which highlighted the importance of peatlands, noting that peatlands in Ontario's Far North store approximately one-third of Ontario's carbon emissions, and information from Red Sky Independent Métis Nation, noting that there was an overall abundance of wetlands in the Local Study Area (AECOM, 2020b; Attawapiskat First Nation, 2015). Marten Falls First Nation also noted that peatlands are important for wildlife species habitat and water regulation across the landscape (Marten Falls First Nation, 2020).

Figure 5-6: Patterned Fens Mapped as Organic Material Approximately 4 km Southeast of Gittins Lake

5.3.1.4. Glaciofluvial

Glaciofluvial sediments are materials that exhibit evidence of having been deposited by glacial meltwater streams either directly in front of, or in contact with glacier ice (Howes and Kenk, 1997). Although glaciofluvial sediment can vary in particle size and associated texture due to variations in the speed and energy of water flow in the glacial meltwater streams, it is generally associated with coarser textured sand and gravel, and commonly appropriate for aggregate use. Glaciofluvial material ranges from non-sorted and non-bedded gravel resulting from very rapid aggradation at an ice front, to moderately to well sorted, stratified gravel (Howes and Kenk, 1997). Slump structures, and hummocky or irregular terrain may be present and are indicative of collapse of the material due to melting of supporting ice that is buried or partly buried (kettles) (Howes and Kenk, 1997). Surficial geology mapping by Ontario Geological Survey (2018) has mapped glaciofluvial sediments as linear, ridged features, and significant landforms such as eskers, kames, ice-marginal deltas and subaqueous fans, and as part of end and recessional moraines along glacier margins. The detailed terrain mapping indicates there is approximately 2,446.6 ha (1.2%) of glaciofluvial material within the Local Study Area and approximately 863.6 ha (6.9%) in the Construction Disturbance Area (**Table 5-1**, **Figure B-1a** to **B-1u**; **Attachment B**).

It should be noted that some areas mapped as glaciofluvial reflect the Ontario Geological Survey (2018) mapping that was used as a background resource and is based on landscape features which were not confirmed to contain sand and gravel. Several areas of glaciofluvial sediment were confirmed in the field through ground truthing and notable areas are listed below:

- Alternative 4, immediately south of BR-02, approximately 2.0 km northwest of Painter Lake Road (M22S180) – approximately 55 cm of loamy sand with approximately 30% gravel noted overlying sandy clay till (approximately 6.6 ha);
- Alternative 4, approximately 650 m north of SG-01 (M22S172) – approximately 25 cm of pebbly sand with approximately 20% gravel noted overlying clayey sandy silt till (approximately 55.7 ha);
- Alternative 4, SG-11, south of the Albany River crossing – KGS Group (2019a) borehole TH-WA-15 indicates boulders overlying 16 m of sand and gravel (approximately 13.7 ha, but adjacent glaciofluvial polygons likely have similar materials);
- Alternative 1, SG-15, approximately 6.5 km west of Trebell Lake (M22K026) – thicker deposits of sand and silty sand, but with no significant coarse fragments noted. One area mapped as a veneer over till with field site noting 24 cm sand overlying till (approximately 41.3 ha);
- Alternative 4, SG-18 –adjacent to the south shore of Mink Lake (M22SAD1, M22C026, and M22C027). Thick deposits of glaciofluvial material range in texture from coarse pebbly sand and gravelly sand to silty gravelly sand (**Figure 5-7**) on slopes between 1% and 28% (approximately 116.4 ha);
- Alternative 1, SG-15, approximately 3.4 km northwest of *nihgiko'zaagaihgan* (Otter Lake) – Thick (greater than 3 m in thickness) sand and silty sand with 0% to 5% coarse fragments (M22K019) with areas of sand blankets (between 1 and 3 m thick) overlying clayey silty sand glaciolacustrine deposits (approximately 19.5 ha); and
- Alternative 1 and 4 near Ogoki Post (M22C025) – a relatively small area (approximately 0.8 ha) of silty, gravelly sand found approximately 200 m northeast from the large esker near Ogoki that is already being used as an aggregate source. Described as layers of fine and coarse sand with coarse fragment content ranging from 3% to 40%. Surrounded by till and organic soil.

Figure 5-7: M22SAD1 – Typical Glaciofluvial Sediment Associated with a Significant Upland Feature (SG-18) South of Mink Lake

Areas previously mapped as glaciofluvial (Ontario Geological Survey 2018) where clays and silts were found during field verification processes by Golder (2010), KGS (2019a), and WSP Canada Inc. were mapped as glaciolacustrine, and this mapping was extrapolated to surrounding areas with a similar landform signature. The remaining sediment mapped as glaciofluvial by the Ontario Geological Survey (2018), but with no field verification, has been left as glaciofluvial material as there was no field evidence to update to a different material. However, some of these areas may not contain suitable aggregate sources based on field findings for similar areas. It is recommended that these areas be ground-truthed where there may be interaction with the proposed development to confirm the presence or absence of potential aggregate resources.

5.3.1.5. Fluvial

Fluvial (alluvial) sediments are materials transported and deposited by streams and rivers, and generally consist of gravel and / or sand and / or silt (Howes and Kenk, 1997). They are often relatively well sorted and show stratification (Howes and Kenk, 1997). Fluvial sediments often vary in texture in association with the speed and energy of water flow. In slower, low energy depositional environments, finer textures are found, and in faster, higher energy environments, coarser materials are deposited.

Materials usually reflect the surrounding sediment available for transport, and therefore in the Marten Falls First Nation Local Study Area, materials were recorded to contain high amounts of silt, however textures documented in the field varied from sandy gravel to silty clay. The thickness of the fluvial sediments varies with both thicker deposits of fluvial material, and thinner deposits of fluvial veneers overlying other materials such as glaciolacustrine, lacustrine, and till present in the Local Study Area. Many fluvial areas have had organic material accumulate adjacent to, and within the fluvial system and have been mapped as organic materials overlying fluvial sediment. Fluvial material is also often characterized by containing buried organic material (**Figure 5-8**), deposited during flood events. A large portion of the fluvial areas mapped in the Local Study Area are poorly drained and have water included in the terrain unit to account for the active stream channels, and inundated areas with pooling water, most often due to beaver (*Castor canadensis*, *amik*) activity.

Figure 5-8: M22C007 – Example of Typical Fluvial Sediment Texture (Sandy Clayey Silt) with Buried Organic Material from Inundation and Flood Events

5.3.1.6. Lacustrine

Lacustrine sediments have settled from suspension and underwater gravity flows, such as turbidity currents, in bodies of standing fresh water, and include sediments that have accumulated at their margins through wave action (Howes and Kenk, 1997). They often consist of stratified fine sand, silt, and / or clay deposited by suspension with coarser sediments (e.g., stratified sand and gravel) associated with beaches and other littoral sediments transported and deposited by wave action (Howes and Kenk, 1997).

Lacustrine sediments often reflect the textures of the source material originally in the area, so silts and clays have commonly been noted in the Local Study Area as associated lacustrine textures during field verification. This material is often poorly drained due to inundation and slope position. Some thicker (greater than 3 m) deposits of lacustrine material have been mapped in the Local Study Area, however in areas where field verification was completed, only veneers of lacustrine overlying a variety of other materials (e.g., till, glaciolacustrine, and fluvial) were identified.

5.3.1.7. Colluvium

Colluvium is material that has reached its present position as a result of direct, gravity-induced movement, and generally consists of massive to moderately well-stratified, non-sorted to poorly sorted sediments (Howes and Kenk, 1997). Given that colluvium is the movement downslope of the original parent material, the character of the deposit depends on the nature of the material from which it was derived, and the processes by which it was deposited (Howes and Kenk, 1997). Few colluvial areas were identified in the Local Study Area, however nine areas of colluvium were mapped within the Construction Disturbance Area. These were mapped based on field findings as well as desktop review, and brief details on the nine areas identified are provided below:

- Alternative 1, north bank of the Ogoki River, shallow landslides and slumps on the outer bend of the river;
- Alternative 1, northeast edge of SG-05, based on review of Light Detection and Ranging data, what appears to be shallow landslides overlying bedrock;
- Alternative 1 and 4, north bank of the Dusey River, shallow landslides on the outer bend of the river;
- Alternative 1, north bank of the Albany River, shallow landslides on the outer bend of the river;
- Alternative 4, SG-12, approximately 585 m north of the Albany River, based on review of Light Detection and Ranging data, what appears to be shallow slumps in thick glaciolacustrine sediments;
- Alternative 1 and 4, approximately 1.8 km southeast of Jojab (Joseph) Lake, on what may have been an old meander bend of a meandering unnamed creek that drains Jojab Lake. Identified by review of Light Detection and Ranging data;
- Alternative 1 and 4, approximately 575 m north of the end of the proposed alignment near the community of Marten Falls First Nation, shallow landslides on the north bank of the outside bend of a meandering unnamed creek;
- Alternative 1 and 4, approximately 400 m north of the end of the proposed alignment near the community of Marten Falls First Nation, shallow landslides on the south bank outside bend of a meandering unnamed creek; and

- Alternative 1 and 4, approximately 225 m north of the end of the proposed alignment near the community of Marten Falls First Nation, based on review of Light Detection and Ranging data, possible shallow slumps on edge of area mapped as till.

Five of the colluvial areas are associated with shallow landslides and / or slumps on the outer bends of active meandering rivers, and one is associated with the bank of an abandoned channel of a meandering river. The remaining three areas of colluvium are not associated with active rivers but may be associated with former channels or meltwater erosion during deglaciation. Further details on colluvial areas not associated with active rivers are provided in **Section 5.4.3**.

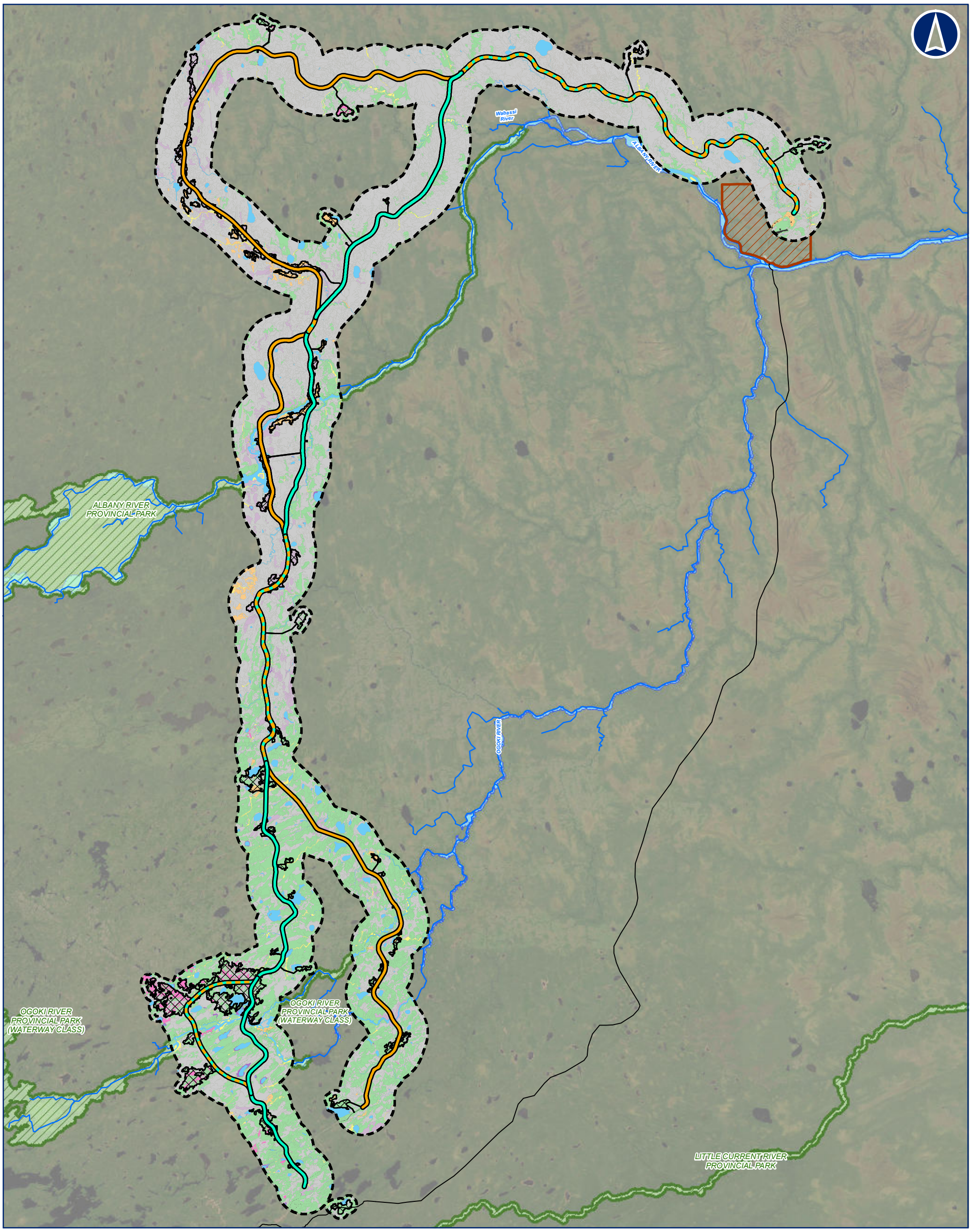
5.3.2. Summary of Surficial Materials Distribution

Results from the desktop review and field assessment components identified 11 surficial material types in the Local Study Area and Construction Disturbance Area. These surficial materials are listed in **Table 5-1** with associated area and proportion (percentage) of each material mapped in the Local Study Area and Construction Disturbance Area. An overview of the desktop mapping results is displayed on **Figure 5-9**. Within the Construction Disturbance Area, till accounts for approximately 32.6% of the terrain, and approximately 35.9% is mapped as organic soils. Glaciolacustrine sediments account for almost 15.0% of the terrain, and glaciofluvial sediments and bedrock each account for approximately 7.6% of the Construction Disturbance Area.

Table 5-1: Surficial Materials in the Local Study Area and Construction Disturbance Area

Surficial Material	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Anthropogenic (A)	64.2	<0.1	1.9	<0.1
Colluvium (C)	71.7	<0.1	5.9	<0.1
Weathered Bedrock (D)	2.5	<0.1	-	-
Fluvial (F)	2,237.2	1.1	102.5	0.8
Glaciofluvial (FG)	2,446.6	1.2	961.6	7.6
Lacustrine (L)	302.8	0.2	9.1	0.1
Glaciolacustrine (LG)	8,224.9	4.2	1,886.1	14.9
Moraine (till) (M)	57,352.1	29.0	4,132.0	32.6
Open Water (N)	8,757.6	4.4	55.5	0.4
Organic (O)	116,624.8	58.9	4,544.8	35.9
Bedrock (R)	1,875.5	0.9	965.8	7.6
Total[(a)]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
Numbers may not add up due to rounding.
ha = hectare; % = percent; < = less than, - = not present.



Legend

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- WATERBODY
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

DOMINANT SURFICIAL MATERIAL
- ANTHROPOGENIC - A
- BEDROCK - R
- COLLUVIUM - C
- FLUVIAL - F
- GLACIOFLUVIAL MATERIAL - FG
- GLACIOLACUSTRINE - LG
- LACUSTRINE - L
- MORAINAL/TILL - M
- ORGANIC - O
- WATERBODY - N

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

DISTRIBUTION OF DOMINANT SURFICIAL MATERIAL OVERVIEW

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026	1:400,000 * when printed 11"x17"
Rev:0	

Figure 5-9

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5.3.3. Drainage

Drainage in the Construction Disturbance Area and Local Study Area ranges from very poorly drained organics to very rapidly drained bedrock outcrops. **Table 5-2** summarizes the drainage mapped in the Local Study Area and Construction Disturbance Area, and the extent of the dominant drainage in each terrain polygon is shown in **Figure B-2a** to **B-2g**, **Attachment B**.

Approximately 61.6% of the Local Study Area is very poorly drained, with a further 11.4% poorly or imperfectly drained. Approximately 23.4% of the Local Study Area is inferred to be well drained (moderately well, well, rapidly, or very rapidly drained). In the Construction Disturbance Area, 38.0% of the area is inferred to be very poorly drained, with approximately 10.0% imperfectly or poorly drained. Approximately 51.7% of the Construction Disturbance Area is inferred to be well drained (moderately well, well, rapidly, or very rapidly drained).

Table 5-2: Drainage in the Local Study Area and Construction Disturbance Area

Drainage	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Very rapid (x)	1,497.2	0.8	1,075.9	8.5
Rapid (r)	1,673.3	0.8	829.2	6.5
Well (w)	24,150.1	12.2	3,086.8	24.4
Moderately well (m)	18,912.6	9.6	1,552.2	12.3
Imperfect (i)	12,826.5	6.5	851.8	6.7
Poor (p)	9,721.5	4.9	420.0	3.3
Very Poor (v)	122,007.5	61.6	4,808.3	38.0
Null (open water or anthropogenic)	7,171.1	3.6	41.1	0.3
Total[(a)]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
Numbers may not add up due to rounding.
ha = hectare; % = percent.

5.3.4. Terrain Stability

Terrain in the Local Study Area and Construction Disturbance Area is mainly stable, meaning landslide initiation following vegetation removal or construction is unlikely. Approximately 99.7% of the Construction Disturbance Area and 96.3% of the Local Study Area is regarded as stable (Classes I, II, and III). These areas are expected to have negligible to low likelihood of landslide initiation following vegetation and soil disturbance.

Potentially unstable terrain (Class IV) with a moderate likelihood of landslide initiation, and unstable terrain (Class V), with a high likelihood of landslide initiation, each account for less than 0.1% of the Local Study Area and the Construction Disturbance Area. Potentially unstable terrain includes areas of till, colluvium, or glaciofluvial deposits with steeper slopes that may show signs of slow and shallow failure, gullying, or seepage. These areas are mapped to have slopes that range from 5% to 70% grade. Unstable terrain has evidence of rapid mass movement and is mapped as colluvium. It should be noted only some of the areas mapped as potentially unstable or unstable terrain were field checked. Details on unstable terrain can be found in **Section 5.5.3.** Further study is recommended to determine the potential effect of Class IV and V terrain stability to infrastructure planning within the Construction Disturbance Area.

Terrain units classified as open water or anthropogenic were not rated for stability and comprise approximately 3.6% of the Local Study Area and 0.3% of the Construction Disturbance Area.

Table 5-3 lists each stability class and the associated area and proportion (percentage) of the Local Study Area and Construction Disturbance Area of each stability class.

Table 5-3: Terrain Stability Classes in the Local Study Area and Construction Disturbance Area

Terrain Stability Class[a]	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Stable (I)	179,385.0	90.6	10,645.7	84.1
Generally stable (II)	10,519.0	5.3	1,795.5	14.2
Moderately stable (III)	805.4	0.4	177.7	1.4
Potentially unstable (IV)	53.3	<0.1	3.0	<0.1
Unstable (V)	26.0	<0.1	2.3	<0.1
Null (open water or anthropogenic)	7,171.1	3.6	41.1	0.3
Total[b]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
Adapted from British Columbia Ministry of Environment (1999).
Numbers may not add up due to rounding.
ha = hectare; % = percent; < = less than.

5.4. Geohazards

A geological hazard assessment in the Regional Study Area was completed as part of the desktop assessment to assist with the selection and design of the preferred Community Access Road alignment with the overall goal of minimizing road alignment through areas with known or suspected geological hazards. Geological hazards considered for the assessment include seismic, liquefaction, landslides / slumps, permafrost degradation, isostatic rise, inundation / flooding, karst, and soil erosion. The following sections provide the results of the desktop review for the geological hazard assessment.

5.4.1. Seismic

Strong ground shaking from large earthquakes can potentially result in wave propagation damage to infrastructure caused by lateral and vertical ground movements, or accelerations (O'Rourke and Liu, 1999, 2012). The potential hazard from earthquake wave propagation is commonly measured by the ground shaking parameter of peak horizontal ground acceleration, expressed as a percentage of the Earth's gravitational acceleration (g). Earthquake strong ground shaking may also trigger liquefaction, lateral spreading of saturated soil, and landslides.

The database for earthquake acceleration used for this geological hazard assessment was the Geological Survey of Canada's acceleration hazard mapping (Kolaj et al., 2023). A peak horizontal ground acceleration with a 10% probability of exceedance in a 50-year period, which represents a return period of 475 years, has been used for the analysis. Empirical correlations of potential damage related to peak horizontal ground acceleration by Wald et al. (1999) indicate that light damage to engineered surface structures generally does not occur until the acceleration range of 0.09 to 0.18 g. Moderate damage begins to occur in the acceleration range of about 0.18 to 0.34 g, and moderate to severe damage occurs at accelerations from 0.34 to 1.24 g and greater.

Based on the peak horizontal ground acceleration hazard mapping by Kolaj et al. (2023), the peak horizontal ground acceleration values within the Regional Study Area are 0.01 g and below the threshold for light damage (0.09 to 0.18 g) identified by Wald et al. (1999).

No active Quaternary-aged faults were identified within the Regional Study Area in any of the references reviewed for this Project (Ontario Geological Survey 2011).

Based on review of several earthquake databases containing records of earthquakes back to 1600 (i.e., NRCan, 2023; Halchuk et al., 2015; Lamontagne et al., 2018), no earthquakes have been recorded within the Regional Study Area. The closest earthquake recorded occurred on June 24, 2006, was a magnitude of 2.1, and it occurred approximately 54.2 km southeast of the community of Marten Falls First Nation at a depth of 18 km (NRCan, 2023). Typically, earthquakes less than 3.5 magnitude are recorded on local seismographs but are generally not felt (NRCan, 2021a).

5.4.2. Liquefaction

Liquefaction involves the transformation of a granular material from a solid to a liquified state as a result of increased porewater pressure and reduced effective stress (Youd et al., 2001). Seismic liquefaction typically occurs when loose to moderately dense granular soils with poor drainage, such as silty sands, or sands and gravels containing seams of impermeable sediments, are saturated during strong ground shaking events (Youd et al., 2001). If the ground shaking results in liquefaction and lateral spreading, this can result in damage (e.g., cracks) occurring to above and below ground infrastructure.

Areas that are interpreted to be frequently or permanently saturated near the ground surface and are located in areas interpreted to contain relatively young (i.e., Holocene) alluvium (fluvial), lacustrine (i.e., lake bed) deposits, or similar, that appear to consist of loose to moderately dense granular soils are assumed to have liquefaction potential if subjected to strong ground shaking.

Based on surficial geology mapping by the Ontario Geological Survey (2018), there are areas of stratified sand and gravel fluvial sediments within the Regional Study Area. Given their location in the landscape adjacent to rivers these fluvial sediments are likely to be saturated or potentially saturated at some point throughout the year, especially during spring melt or heavy rainfall events. However, the peak horizontal ground acceleration values in this area are very low (0.01 g, Kolaj et al., 2023) and therefore the potential hazard for liquefaction due to ground shaking is considered to be very low.

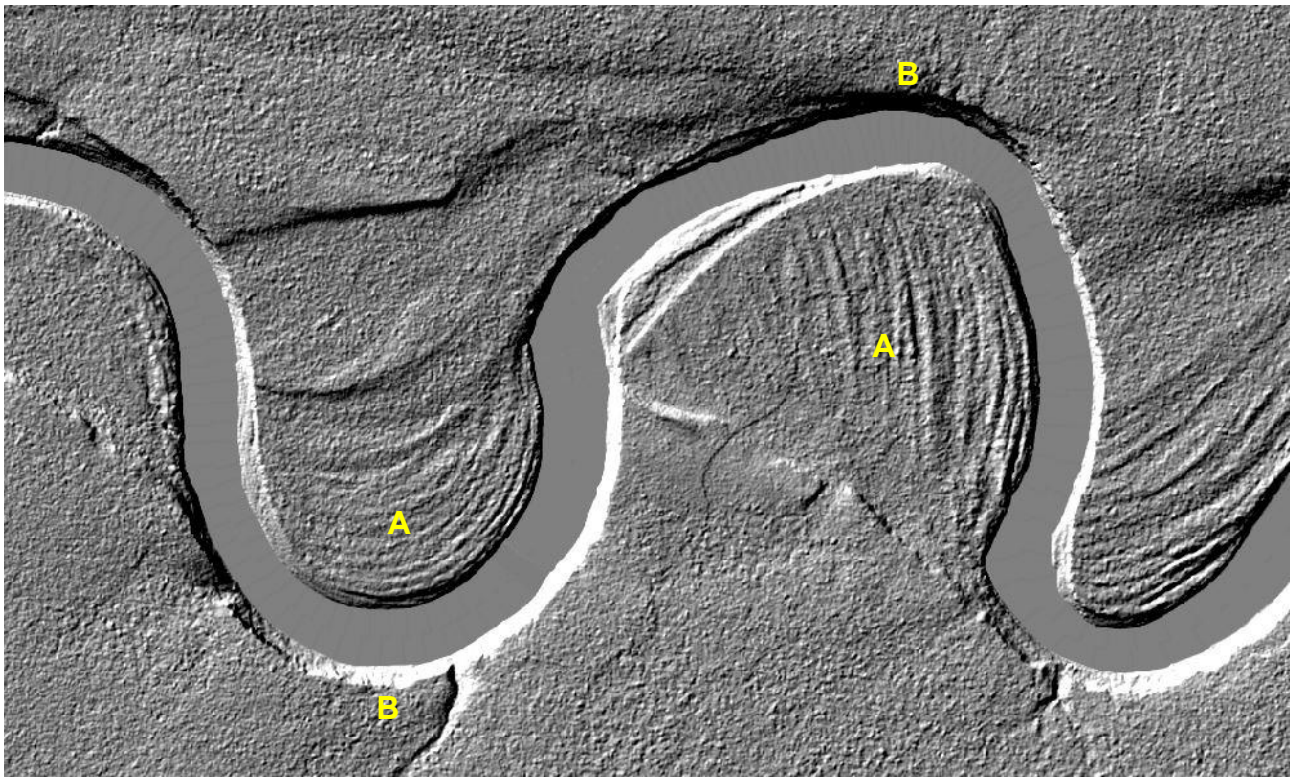
5.4.3. Landslides and Slumps

Landslides and slumps are the result of slope failure and the subsequent downslope movement of falling, rolling, sliding, or flowing of dry, moist, or saturated debris derived from surficial material and / or bedrock (Howes and Kenk, 1997). The slope failure may be the result of undercutting of the toe of a slope by riverbank erosion, human activity (e.g., road cuts, mining), earthquakes, heavy rain, snowmelt, or changes in the water level or groundwater. Small areas of landslides or slumps were identified during the detailed terrain mapping of the Local Study Area. These areas are mapped as colluvium (**Figure B-1a** to **B-1u**; **Attachment B**), which is defined as materials that have reached their present positions as a result of direct, gravity-induced movement involving no agent of transportation such as water or ice, although the moving material may have contained water and / or ice (Howes and Kenk, 1997). Surficial geology mapping completed by Ontario Geological Survey (2018) has been used for the Regional Study Area, however, based on the scale of mapping, areas of colluvium have not been delineated as landslides and slumps tend to be localized and can be of small extent. The following is based on landslides and slumps identified within the Local Study Area.

The landscape of the Local Study Area is generally quite subdued, but small landslides and / or slumps have been mapped as part of the detailed terrain mapping. The majority of landslides and slumps have been mapped adjacent to rivers and streams throughout the Local Study Area. The watercourses in the Local Study Area meander across the landscape resulting in the formation of point bars on the inner bend of the meander where the water has lower energy and sediments are deposited, and the river erodes into the outer bank of the meander where the water is flowing faster and has more energy (**Figure 5-10**). Erosion of the toe of the slope on the outer bank of the river results in failure of the slope and the formation of landslides and slumps.

The extent of most of the landslides and slumps mapped is generally restricted to the outer bend of the rivers where the slope is actively being eroded, and the cut banks are up to approximately 6 m in height. It can be assumed that given similar conditions (i.e., meandering rivers and streams) these types of failures are also occurring within the Regional Study Area.

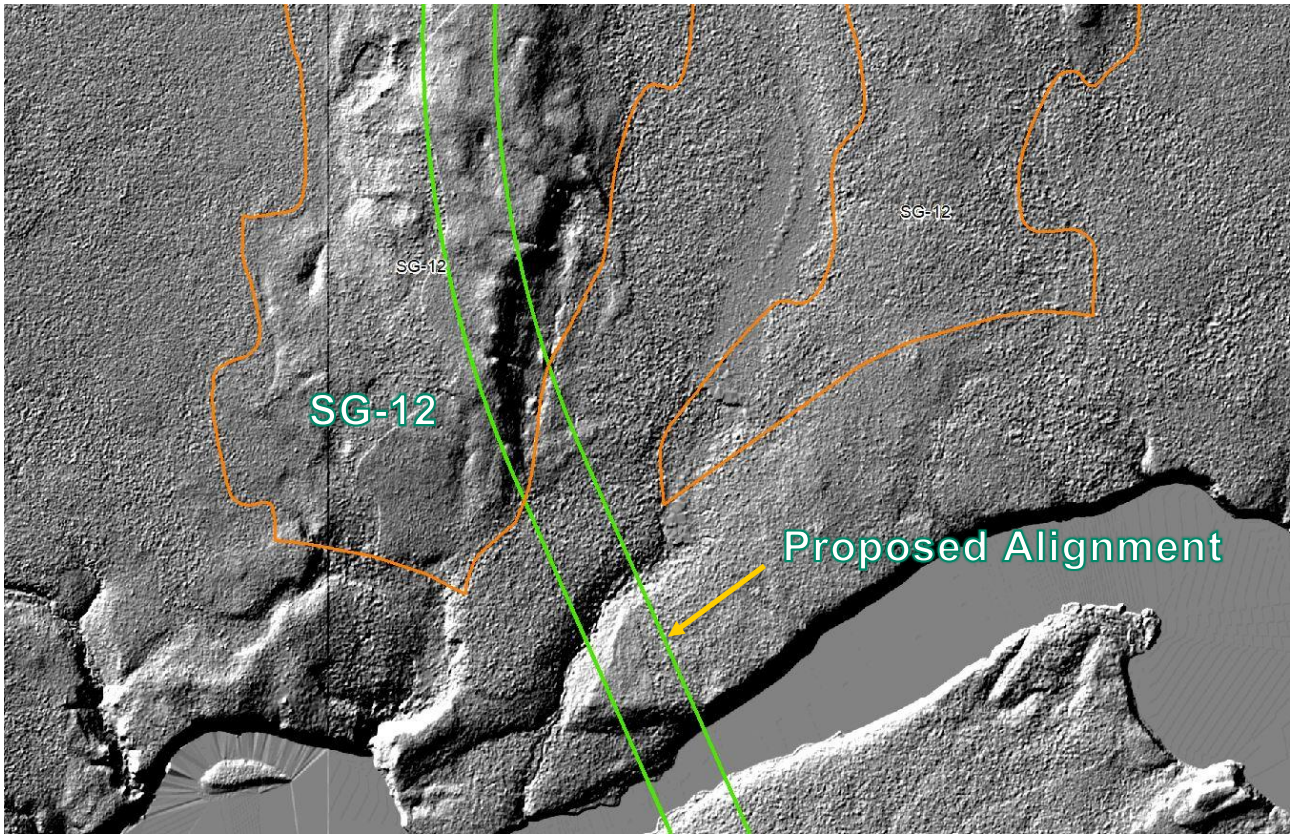
Figure 5-10: Meandering on the Wabassi River, Alternative 4. The Light Detection and Ranging Data Clearly Shows Areas of Deposition on Point Bars (A) on Inner Meander Bends, and Steep Slopes (B), some with Failures on Outside Meander Bends



Four landslides / slumps not adjacent to active watercourses were also mapped in the Local Study Area. Details follow.

- The first is located approximately 585 m north of the Albany River, at the edge of SG-12 (**Figure 5-11** and **Figure B-1k**, **Attachment B**), and it is also crossed by the proposed Project alignment. The failure is a slow slump in glaciolacustrine sediments, and it is currently not known if the slump is active, dormant, or relict. There is currently no erosion at the base of the slope, and therefore, it is likely the slump was formed at a time when drainage patterns were different (e.g., during deglaciation) and flowing water at the base of the slope eroded into the sediments, causing the slope to fail;
- Located approximately 1.8 km southeast of Jojab (Joseph) Lake, Alternative 1 and 4, approximately 7 m south of the Project alignment and approximately 304 m north of an unnamed stream (**Figure B-1u**, **Attachment B**). The failure is a slow slump in till, and it is currently not known if the slump is active, dormant, or relict. There is currently no erosion at the base of the slope; however, review of Light Detection and Ranging data suggests the failure may be located on a former outer bend of a meander on the unnamed stream. The stream in this area is currently quite straight, and it is possible the meander bend with the slumping was eventually cut off from the river;
- Located approximately 455 m northeast of Winslow Lake on the northeast edge of SG-05. Based on review of Light Detection and Ranging data, the failure appears to be characterized by slow and shallow landslides in thin till (less than 1 m) overlying bedrock. It is currently not known if the failure is active, dormant, or relict. There is currently no erosion at the base of the slope and therefore the cause of the failure is currently not known; and
- The final area is located at the northeast end of the Project alignment (Alternative 1 and 4) near the community of Marten Falls First Nation. It is located approximately 225 m north of the end of the Project alignment and approximately 22 m east of the Project alignment (**Figure B-1u**, **Attachment B**). The failure is a slow slump in till, and it is currently not known if the slump is active, dormant, or relict. There is currently no erosion at the base of the slope; however, review of Light Detection and Ranging data suggests the failure is located on the edge of a former channel of an unnamed stream and the toe of slope was likely eroded by the river when it occupied this channel.

Figure 5-11: Potential Landslide / Slump North of The Albany River, Intersecting SG-12 and the Proposed Alignment



5.4.4. Permafrost Degradation

Permafrost is defined as a state of the ground, whether soil or rock, which remains at or below 0°C for long periods of time (Heginbottom et al., 1995). The minimum period is from one winter, through the following summer, and into the next winter; however, most permafrost has existed for much longer (Heginbottom et al., 1995). The definition only considers temperature of the ground and therefore permafrost is a strictly thermal phenomenon and is independent of material (Heginbottom et al., 1995). At temperatures below 0°C almost all soil moisture occurs in the form of ground ice, which usually exists at temperatures close to its melting point and therefore is liable to melt if the ground warms (Heginbottom et al., 1995). Thermokarst is found in areas of permafrost degradation and is characterized by ground surface depressions created by the thawing of ice-rich permafrost and associated soil subsidence (Howes and Kenk, 1997). Thermokarst depressions are commonly filled with small lakes.

The Regional Study Area is located within an area of Canada that is considered to be unfrozen (Heginbottom et al., 1995). However, the north end of the Regional Study Area is approximately 12 km south of an area mapped as having isolated patches of permafrost (i.e., less than 10% of the land area), with less than 10% ground ice content in the upper 10 to 20 m of the ground (Heginbottom et al., 1995). Low resolution soil mapping (NRCan, 2021b) identifies potential Cryosolic soils approximately 2 to 3 km west of the western boundary of the Regional Study Area in the Albany Provincial Park area. The predictive surficial geology mapping completed by the Ontario Geological Survey (2018) identified palsas in the northern part of the Regional Study Area (the west-east trending section of Alternative 1 and Alternative 1 and 4). Palsas are low ice-rich peat mounds that have a frozen peat and mineral soil core and are found in areas with discontinuous permafrost (Brown, 1968). Therefore, it is possible there may be isolated patches of permafrost within the northern and western parts of the Regional Study Area.

A helicopter reconnaissance by KGS Group (2019b) identified areas of potential permafrost in the northern part of the Regional Study Area, providing an example near Oxtoby Lake (Alternative 1). The areas of potentially frozen ground were identified from the air and are described as low-lying terrain with an abundance of black spruce trees (Oji-Cree translation, *shikobaatikog*) (KGS Group, 2019b). In addition, 12 hand augers or test holes completed by KGS Group (2019a) noted temperatures below freezing (between 0^{o}C and -2.5^{o}C) at the base of the holes at depths ranging from 1.5 to 10.3 m below ground surface. All 12 of the test holes or hand augers where temperatures below freezing were measured are located north of the Albany River, and therefore it is possible there are isolated patches of permafrost within the Regional Study Area. Two of the test holes (TH19-08 and TH19-17) are located within proposed pit areas, SG-12 and SG-19, respectively. A temperature of -2.0^{o}C was measured at a depth of 10.3 m at TH19-08, and a temperature of -0.4^{o}C was measured at a depth of 9.1 m at TH19-17. The soil texture noted at TH19-08 is described as 1.8 m of silt overlying greater than 4 m of silty sand with no coarse fragments. Soil at TH19-17 is mainly sand with minor silt and clay, and between 4% and 21% coarse fragment content. Further investigations are recommended in these areas to determine the extent of potential permafrost.

One area of potential permafrost or permafrost degradation was identified during terrain mapping at the western edge of the Local Study Area approximately 630 m southwest of SG-16 (Alternative 1, **Figure B-3e**, **Attachment B**). As the conditions of this area could not be confirmed through field verification, potential for permafrost or permafrost degradation in this area remains. Frozen ground was not encountered in any of the field inspections completed during the terrain and soil field programs in 2022. Given the lack of baseline data on permafrost in the Project area, it is recommended that additional permafrost studies be completed to determine the potential extent and depth of permafrost, as well as the potential for thaw settlement and terrain instability associated with thawing within the Local Study Area.

5.4.5. Isostatic Rise

During the last glaciation, which reached its maximum extent approximately 20,000 years ago (Barnett, 1992), Canada was covered by thick glacial ice. The weight of the ice caused the land beneath the ice to be pressed down into the earth, and after the glacial ice melted, the weight of the ice had disappeared, and the land started to rise or rebound (Fyon, 2020). This process of rebound is still occurring today, about 15,000 years after the last ice age started to end (Fyon, 2020).

In northern Ontario, the land is rising faster than elsewhere in Canada as the ice sheet that covered the Regional Study Area was centred where Hudson Bay is now located. It is estimated that in Ontario, the weight of the glacier pushed the land down by approximately 270 to 280 m (Fyon, 2020). Horizontal and vertical movements of the Canadian landmass are measured through the Canadian Base Network, a network of highly stable pillar monuments with forced-centering mounts for Global Positioning System receiver antennas (Henton et al., 2006). The closest Canadian Base Network station to the Regional Study Area is located at Longlac, Ontario (NRCan, 2022). The data from the Canadian Base Network throughout Canada are used to model vertical rates of movement and preliminary results indicate the Regional Study Area is in an area where the crust is rebounding at approximately 6 to 7 mm per year (Henton et al., 2006). Uplift rates in the Hudson Bay area (near Peawanuck, Ontario) are close to 13 mm per year with rates decreasing with distance from Hudson Bay. Areas of southern Saskatchewan and Alberta are sinking at a rate of approximately 4 mm per year (Henton et al., 2006). On the national scale, glacial isostatic adjustment is the most significant geodynamic process driving vertical deformation (Henton et al., 2006).

5.4.6. Inundation / Flooding

Inundation or flooding is a natural and recurring event for a river or waterbody, and it occurs during spring melt or after heavy rainfall events, when the excess water from the spring melt or heavy rainfall results in the water overflowing the natural or artificial confines of the river or waterbody (Parker, 1994). In addition to flooding caused by climatic conditions, beaver activity commonly results in flooding of land behind the dams constructed by beavers (Oji-Cree translation, *amikwag*).

There are numerous rivers, streams, and waterbodies within the Regional Study Area. Flooding due to spring melt and heavy rainfall was noted adjacent to active floodplains during fieldwork in May 2022. Beavers are also active throughout the Regional Study Area creating localized ponds behind the dams. Areas of inundation were identified during the terrain mapping and are shown in **Figure B-1a** to **B-1u**; **Attachment B**.

5.4.7. Karst

Karst is a geological term referring to a type of terrain that forms because of the dissolution of carbonate rocks such as limestone and dolomite due to an interaction between bedrock and groundwater. Subsidence features are typically associated with karst processes and include sinkholes, surface caves, subsurface voids, and underground bodies of water (Ford, 1998). Karst topography represents a potential hazard to roads primarily because of the potential for collapse of subsurface voids and the formation of sinkholes at the surface.

Karst subsurface hazards were assessed by reviewing publicly available bedrock geology mapping (Ontario Geological Survey, 2011). Limestone and dolostone are mapped as part of the Red Head Rapids Formation and the Churchill River Group at the northeast end of Community Access Road alignment near the community of Marten Falls First Nation. Limestone rapids are mentioned in the *Marten Falls First Nation Aboriginal and / or Treaty Rights and Interests: Existing Conditions Report* (Dillon, 2026a) on the south side of the Albany River which supports the presence of limestone bedrock in the Regional Study Area. An extensive search was conducted through the Ontario Geological Survey and the Geological Survey of Canada's publication websites to determine if karst processes have been identified in either of these bedrock formations. No publications discussing karst processes in the Red Head Rapids Formation, or the Churchill River Group were identified, and therefore the potential for karst in the Regional Study Area is considered to be low.

5.4.8. Soil Erosion

Soil erosion potential refers to the risk of degradation in soil quality or soil loss from erosive forces, typically wind and water (i.e., physical loss of soil or organic matter). Erosion can lead to decreased soil productivity because it removes fine particles from the surface soil layers where organic matter is concentrated. Fine soil particles provide nutrient retention capacity and when these particles are removed, along with organic matter, the root zone can become nutrient depleted. The loss of surface soil by erosion may result in a reduction in soil quality and the ability for soil to support vegetation. Soil mapping available for the Regional Study Area is very small scale but indicates the southern portion of the Regional Study Area may be susceptible to wind erosion if sandier Brunisols are present (**Section 5.6.4.1**). The potential for wind and water erosion is linked to disturbance of vegetation and soils and therefore in general is restricted to the Construction Disturbance Area. **Section 5.6.4.1** and **Section 5.6.4.2** discuss the potential for wind and water erosion within the Local Study Area.

5.5. Special Geologic and Geomorphic Features

Figures B-3a to **B-3g**; **Attachment B** provides the distribution of special geologic and geomorphic features within the Local Study Area that may affect construction, operation, and maintenance activities. The features considered for this include eskers, pits and quarries, areas of organic soils, areas of permafrost, areas showing evidence of active permafrost degradation (i.e., thermokarst), and areas of steep slopes (greater than 50% grade). Each of these features was identified based on the detailed terrain mapping (**Section 5.3**).

5.5.1. Potential Pits and Quarries

Potential pits and quarries are shown on **Figures B-4a** to **B-4g**; **Attachment B** and are identified based on the detailed terrain mapping. Potential pits include any terrain unit mapped as glaciofluvial (FG) and potential quarries include any terrain unit mapped as bedrock (R) or thin till veneers (Mx) overlying bedrock. The extent of potential pit areas within the Local Study Area is reduced when the detailed terrain mapping is compared to the mapping completed by Ontario Geological Survey (2018). The reduction in extent of these potential pit areas is partly due to the more detailed scale of mapping completed, but mainly due to the field data collected by Golder (2010), KGS (2019a), and WSP Canada Inc. which indicate that many of the areas previously thought to be composed of sand and gravel are composed of coarse fragment-free silt, clay, and fine sand which is more typical of glaciolacustrine deposition. Areas with no field verification should be ground-truthed where there may be interaction with the proposed development to confirm the presence or absence of potential aggregate resources. The areas mapped as bedrock by the Ontario Geological Survey (2018) were refined based on the detailed terrain mapping which used stereo aerial photographs and Light Detection and Ranging data.

Potential pit areas have been identified in the following areas:

- Alternative 4, SG-01, veneers of glaciofluvial sediments overlying till have been mapped, but have not been field verified. Additional areas of glaciofluvial sediments generally considered to be less than 1 m in thickness have been identified approximately 500 m northeast of SG-01 (field verified) and 1.7 km west of SG-01 at the edge of the Local Study Area (non-verified);
- Alternative 1, SG-20. Two areas mapped as blankets of glaciofluvial sediments overlying till. These areas have not been field verified;
- Alternative 1, the two northerly segments of SG-06. Ridges (eskers) of glaciofluvial sediment. An additional area of hummocky glaciofluvial sediments has also been identified adjacent to the Ogoki River and approximately 1.8 km west of the SG-06. None of these areas have been field verified;

- Alternative 1, SG-07. Blankets of glaciofluvial sediments overlying till. This area has not been field verified;
- Alternative 4, several areas in SG-05, south and west of Winslow Lake. An additional area not within a proposed pit area has also been identified north of Winslow Lake. Undulating to gently sloping glaciofluvial sediments which have not been field verified;
- Alternative 1 and 4, northwest and west of SG-09. Veneers and blankets of glaciofluvial sediments overlying glaciolacustrine sediments or till. This area has not been field verified and is currently not identified as a potential pit by AECOM Canada Ltd.;
- Alternative 1 and 4, southwest of SG-09. Thick undulating glaciofluvial sediments which have not been field verified and are currently not identified as a potential pit by AECOM Canada Ltd.;
- Alternative 4, south of the Albany River in SG-11, and north of the Albany River in SG-12 (southeast and north sections). Mainly undulating to gently sloping and terraced glaciofluvial sediments the majority of which have not been field verified;
- Alternative 1, various areas identified within SG-15 and the southern areas of SG-16 south of the Wabassi River. Additional areas of glaciofluvial sediments not within the SG-15 and SG-16 boundaries have also been identified in this area. The thickness of glaciofluvial sediments ranges from thick, undulating, and ridged deposits to veneers and blankets overlying till, glaciolacustrine sediments, or bedrock. Please note only a few of the areas identified have been field verified;
- Alternative 4, SG-18 on the south shore of Mink Lake. Gently sloping to moderately sloping and undulating glaciofluvial sediments (field verified). West of Mink Lake, the glaciofluvial sediments are thought to be thinner (less than 1 m in thickness) and overlying till (non-verified);
- Alternative 1, near the community of Marten Falls First Nation, which has one of the most extensive ridges of glaciofluvial sediments within the Local Study Area. This area is currently being used by the community as a sand resource and is currently not being considered as a pit resource for the Project. A small area of glaciofluvial blankets overlying till has also been mapped in this area at the end of the proposed alignment;
- Alternative 1, approximately 1 km east of Painter Lake, an area of undulating to ridged glaciofluvial sediments. There are additional small areas of thick glaciofluvial sediments between approximately 1.8 and 2.6 km northeast of Painter Lake. One of the areas is crossed by the proposed alignment, with another approximately 210 m northeast of the proposed alignment. None of these areas have been field verified and are currently not being considered as pit resources for the Project;

- Alternative 1 and 4, the southern areas of SG-19 near the Buffaloskin River (Oji-Cree translation, *Majih Waayaan Ih Ziibih*). Ridges of glaciofluvial sediments have been identified in addition to blankets and veneers of glaciofluvial material overlying till. These areas have not been field verified;
- Alternative 4, SG-03 north of Patience Lake (Oji-Cree translation, *Bakihda'hawgan*) and a small area between the southwest edge of BR-05 and the lake have been mapped as undulating to hummocky glaciofluvial sediments. These areas have not been field verified. A small area of glaciofluvial veneers and blankets overlying bedrock have also been mapped at the east edge of Alternative 4 west quarry area west of Patience Lake. This area was identified during the field program;
- Alternative 4, immediately south of BR-02, approximately 2.0 km northwest of Painter Lake Road. Veneers of glaciofluvial sediment overlying till (field verified); and
- Alternative 4, south of the Ogoki River on the east side of the Local Study Area, veneers of glaciofluvial sediments overlying till. This area has not been field verified.

Potential quarries have been identified in the following areas:

- Alternative 4, BR-02 and BR-03, with additional areas of bedrock exposed at the western edge of the Local Study Area between BR-02 and BR-03;
- Alternative 4, Alt 4 W south and north of the Ogoki River, and BR-05, areas of exposed bedrock have been mapped in these areas, surrounded by thin veneers and veneers of till overlying bedrock;
- Alternative 1, BR-04, bedrock mapped at the surface in some of this area, with veneers of till overlying bedrock or veneers of organic soil overlying till veneers mapped elsewhere in this area;
- Alternative 4, BR-07 and BR-08, small areas of bedrock have been mapped in these areas;
- Alternative 4, BR-12, thin veneers and veneers of till overlying bedrock have been mapped in this area;
- Alternative 1, BR-13 south of the Wabassi River, bedrock mapped at the surface in some of this area, with veneers of till overlying bedrock mapped elsewhere in this area;
- Alternative 1, BR-14 north of Oxtoby Lake, bedrock mapped at the surface in some of this area, with veneers of till overlying bedrock mapped elsewhere in this area; and
- Alternative 1 and 4, BR-15 and BR-16, bedrock mapped at the surface in some of these two areas, with thin veneers and veneers of till overlying bedrock mapped elsewhere in these areas.

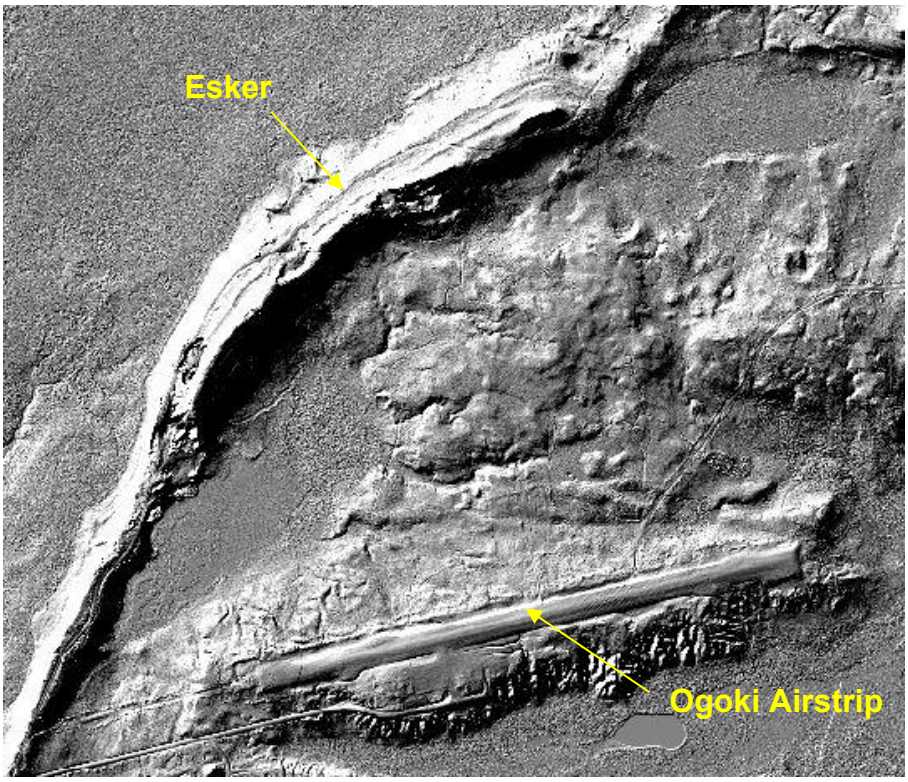
5.5.2. Eskers

Previous mapping (Ontario Geological Survey, 2018) identified several eskers within the Local Study Area. Eskers are low ridges composed of glaciofluvial sand and gravel formed by deposition from meltwater running through a channel beneath or within glacier ice (Howes and Kenk, 1997). They are potential sources of aggregate material. The detailed terrain mapping has identified several areas within the Local Study Area where ridged glaciofluvial sediments have been identified (**Figure B-3a** to **B-3g**; **Attachment B**). The extent of eskers identified within the detailed terrain mapping is less than that mapped by the Ontario Geological Survey (2018). Some of the eskers previously identified by the Ontario Geological Survey (2018) have been reassigned as glaciolacustrine materials based on field data collected by Golder (2010), KGS (2019a), and WSP Canada Inc. which indicate the surficial materials in these areas are finer grained with little sand and gravel. Areas where eskers have been identified include (but are not limited to):

- Alternative 1, SG-06 south of the Ogoki River;
- Alternative 1, SG-15 south and southwest of Maxey Lake and SG-16;
- Alternative 1 and 4, SG-19 approximately 25 km northwest of Marten Falls; and
- Alternative 1, near the community of Marten Falls First Nation, which has one of the most extensive ridges of glaciofluvial sediments within the Local Study Area (**Figure B-4g**, **Attachment B**, **Figure 5-12**).

Areas mapped as eskers by the Ontario Geological Survey (2018), but with no field verification, have been left as eskers as there was no field evidence to update to a ridged landform composed of non-aggregate material (i.e., glaciolacustrine silt and clay). It is recommended these areas be ground-truthed where there may be interaction with the proposed development to confirm the presence or absence of potential aggregate resources.

Figure 5-12: Esker Near the Community of Marten Falls First Nation



5.5.3. Organic Soils

Areas of organic accumulation are shown on **Figures B-4a** to **B-4g**; **Attachment B** and include terrain units mapped as organic (O) in the detailed terrain mapping or any terrain unit that had organic material mapped as a subdominant component (second decile is "O"). The Local Study Area has extensive areas of very poorly drained organic soils. Thinner organic soils are more common at the southern end of the Project, where they accumulate in the depressions and level areas between till capped bedrock undulations or exposed bedrock outcrops. Thicker organic soils are located on both Alternative 1 and 4 north of Winslow Lake. The most extensive organic soils are located along the western part of Alternative 1 which includes areas Maxey Lake, the Wabassi River, and Oxtoby Lake; Alternative 4 which includes Trebell Lake and the Wabassi River; and Alternative 1 and 4 which includes the Alder River (Oji-Cree translation, *Wadobii Wih Ziibih*), Gittins Lake (*Kamaashkiikosih Nowih Zaakaihgan*), the Buffaloskin River, and the *jiigaakodigweyaa wih zaagaihgan*.

5.5.4. Permafrost and Permafrost Degradation

Permafrost is defined as a state of the ground, whether soil or rock, which remains at or below 0°C for long periods of time (Heginbottom et al., 1995). Thermokarst is associated with permafrost degradation and is characterized by surface depressions that have formed by the thawing of ice-rich permafrost and the subsequent subsidence of the soil (Howes and Kenk, 1997).

As discussed in **Section 5.4.4**, the Regional Study Area is located within an area of Canada that is considered to be unfrozen (Heginbottom et al., 1995). However, the north end of the Regional Study Area is approximately 12 km south of an area mapped as having isolated patches of permafrost (i.e., less than 10% of the land area), with less than 10% ground ice content in the upper 10 to 20 m of the ground (Heginbottom et al., 1995). Low resolution soil mapping (NRCan, 2021) identifies potential Cryosolic soils approximately 2 to 3 km west of the western boundary of the Regional Study Area in the Albany Provincial Park area, and the predictive surficial geology mapping completed by the Ontario Geological Survey (2018b) identified peat palsas in the northern part of the Regional Study Area. Therefore, it is possible there may be isolated patches of permafrost within the Local Study Area.

As mentioned in **Section 5.4.4**, KGS Group (2019a) noted temperatures below 0°C at the bottom of 12 hand augers or boreholes. Two of the boreholes, TH19-08 and TH19-17, are located within proposed pit areas SG-12 and SG-19, respectively. It is recommended further investigations be completed in these two areas to determine the extent of potential permafrost. In addition, two areas of potential permafrost or permafrost degradation were identified during terrain mapping at the western edge of the Local Study Area approximately 630 m southwest of SG-16 (Alternative 1). Frozen ground was not encountered in any of the field inspections completed during the terrain and soil field programs in 2022. The area identified in the terrain mapping, as well as areas identified with temperatures below freezing in the KGS Group (2019a) boreholes and hand augers are shown on **Figure B-4a** to **B-4g**; **Attachment B**.

5.5.5. Steep Slopes and Colluvium

Figure B-4a to **B-4g**, **Attachment B** shows the distribution of steep slopes and areas mapped as colluvium (C) within the Local Study Area. The steep slopes have been identified based on a minimum slope grade of 50% which equates to a 2:1 ratio. The areas mapped as colluvium have been included as many of these areas have steeper slopes and the identification of these potentially unstable or unstable slopes may affect construction and maintenance activities. Many of the areas identified as steep slopes are associated with veneers and thin veneers of till overlying bedrock at the southern end of the Project (e.g., near BR-02 and Colpitts Creek, Alternative 1).

Other steep slope areas are located adjacent to meandering rivers where the outer bank of the meander bends is eroded by the rivers or streams. Colluvium is commonly also associated with these steep riverbank areas as erosion at the toe of the slope results in small landslides and slumps. Four areas of colluvium not adjacent to watercourses were also mapped in the Local Study Area and details are provided in **Section 5.4.3**.

5.6. Soils

NRCan (2021b) published a low-resolution map of soil great groups in Ontario. Gleysols and Eutric Brunisols are mapped in the southwest part of the Project area for approximately the first 30 km. North of the Ogoki River, the majority of the central part of the Project area is mapped as Mesisols, with an Organic Cryosol map unit occurring around Albany River Provincial Park. The northwest part of the Regional Study Area and the area extending east to the community of Marten Falls First Nation are dominated by Fibrisols.

Based on site information on the Great Lakes Forestry Centre soil monolith collection (NRCan, 2021b), Gray Luvisols are to be expected on the finer textured till and glaciolacustrine sediments, and Dystric Brunisols and Humo-Ferric Podzols have likely formed on eskers and other coarse glaciofluvial deposits.

Much of the Local Study Area is characterized by subdued topography and level organic areas. Over half of the Local Study Area has been mapped as Organic soil map units. Very minor areas of steeper slopes associated with bedrock outcrops or colluvium are present scattered throughout the study areas.

5.6.1. Soil Mapping and Characteristics

Soil materials in the Local Study Area vary from coarser sands to very fine heavy clay textures. From field data (**Attachment C – Abbreviation Key and Detailed Terrain and Soil Field Data**), over half of the textures recorded in soil inspections were noted to be moderately to very fine textured, with relatively few being recorded as coarser sandier textures. Mineral soils in the Local Study Area were dominantly classified as Luvisolic, with Brunisolic soils the second most common soil Great Group. Brunisolic soils were dominantly classified as Eutric based on pH values being greater than 5.5.

Table 5-4 provides a summary of characteristics for each soil map unit, **Attachment B**, **Figures B-3a** to **B-3g** provides soil maps, and **Attachment D – Soil Map Unit Descriptions and Representative Site Descriptions** provides detailed representative profile descriptions with accompanying photos for each soil map unit.

Soil materials in the Local Study Area vary from coarser sands to very fine heavy clay textures. From field data, over half of the textures recorded in soil inspections were noted to be moderately to very fine textured with relatively few being recorded as coarser sandier textures. Mineral soils in the Local Study Area were dominantly classified as Luvisolic, with Brunisolic soils the second most common soil Great Group. Brunisolic soils were dominantly classified as Eutric based on pH values being greater than 5.5. **Table 5-4** provides the distribution of each soil map unit in the Local Study Area and Construction Disturbance Area. Soil map unit descriptions are located in **Attachment D**.

Table 5-4: Soil Map Unit Characteristics

Soil Map Unit Symbol	Associated Surficial Material and Texture Class	Representative Soil Texture[a]		Soil Types[a]		Dominant Drainage Class[a]	Representative Description	Local Study Area		Construction Disturbance Area	
		Surface (Upper Lift)	Subsurface (Lower Lift)[b]	Major	Significant / Minor			Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
C1	Moderately fine textured colluvium, potentially over moderately fine textured second parent material	CL	CL	O.R	GL.R	m	Orthic Regosol composed of moderately fine colluvium potentially overlying moderately fine / fine textured second parent material. Drainage and textures of material may vary based on location.	74.8	<0.1	5.7	<0.1
F1	Medium textured fluvial material	L	L	R.G	-	p	Rego Gleysol developed on medium textured fluvial material. Soils may be underlain by a second parent material, generally of a fine (C, SiC) texture.	2,323.2	1.2	119.0	1.0
GF1	Very coarse textured glaciofluvial material	LS	S	E.DYB	O.DYB E.EB	r	Eluviated Dystric Brunisol developed on very coarse textured glaciofluvial material. Contains inclusions of eluviated Brunisols with lower pH levels (i.e., Dystric Brunisols). Map unit contains inclusions of various drainage conditions, ranging	1,715.2	0.9	855.3	6.7
GF2	Very coarse textured glaciofluvial material	LS	S	O.G	R.G	p	Orthic Gleysol developed on very coarse textured glaciofluvial material. Contains inclusions of less developed Rego Gleysols.	142.4	0.1	9.0	0.1
GF3	Very coarse glaciofluvial material over moderately fine to fine textured second parent material	LS	LS	BR.GL	GLE.EB E.EB	w	Brunisolic Gray Luvisol developed on very coarse textured glaciofluvial material. The parent material at depth is fine to moderately fine textured till or glaciolacustrine sediment. May contain soils with a lesser amount of pedogenic development (i.e., Brunisolic) with similar surficial material textures. Contains inclusions of imperfectly drained (i.e., gleyed) subgroups.	353.9	0.2	88.5	0.7
GF4	Very coarse glaciofluvial material over fine textured second parent material	LS	LS	R.G	-	p	Rego Gleysol formed on very coarse glaciofluvial sediment overlying fine textured till.	139.7	0.1	2.9	<0.1
GF5	Very coarse to medium textured glaciofluvial over bedrock	LS	LFS	E.EB	O.EB GL.EB	w	Orthic Eutric Brunisol formed on very coarse to medium textured glaciofluvial material, underlain by consolidated bedrock. Map unit may contain isolated pockets of imperfectly drained soils.	90.0	<0.1	7.2	0.1
GL1	Medium textured glaciolacustrine material	SiL	SiCL	E.EB	BR.GL O.GL	m	Eluviated Eutric Brunisol developed on medium textured glaciolacustrine material. May include soils with a greater amount of pedogenic development (i.e., Luvisolic) where surficial material textures are similar.	1,395.8	0.7	584.3	4.6
GL2	Medium textured glaciolacustrine material	SiL	SiCL	GLE.EB	-	i	Gleyed Eluviated Eutric Brunisol developed on medium textured glaciolacustrine material.	183.0	0.1	63.1	0.5
GL3	Moderately fine to fine textured glaciolacustrine	vfSL	HC	O.GL	GL.GL O.R	m	Orthic Gray Luvisol developed on moderately fine to fine textured glaciolacustrine material. Inclusions of less developed soils (i.e., Regosols) and imperfectly drained (i.e., gleyed) subgroups are present.	1,730.6	0.9	790.1	6.2

Soil Map Unit Symbol	Associated Surficial Material and Texture Class	Representative Soil Texture[a]		Soil Types[a]		Dominant Drainage Class[a]	Representative Description	Local Study Area		Construction Disturbance Area	
		Surface (Upper Lift)	Subsurface (Lower Lift)[b]	Major	Significant / Minor			Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
GL4	Moderately fine to fine textured glaciolacustrine	SL	C	GL.GL	-	i	Gleyed Gray Luvisol developed on moderately fine to fine glaciolacustrine material.	1,319.7	0.7	115.0	0.9
GL5	Medium textured glaciolacustrine material	SiL	SiL	R.G	-	p	Rego Gleysol developed on medium textured glaciolacustrine material. Map unit composed of soils that are poorly drained.	691.8	0.3	61.9	0.5
GL6	Moderately Fine to Fine Glaciolacustrine material	SiC	SiC	O.G	O.LG R.G	p	Orthic Gleysol formed on moderately fine to fine textured glaciolacustrine material. Map unit composed of soils that are poorly drained	562.2	0.3	62.5	0.5
GL7	Medium to fine textured glaciolacustrine over a second parent material	L	C	O.GL	GL.GL	m	Orthic Gray Luvisol formed on moderately fine to fine textured glaciolacustrine material. Profile underlain by second parent material of various textures and depositional sources. Map unit includes drainages ranging from rapid to well drained.	883.2	0.4	97.7	0.8
GL8	Medium to fine textured glaciolacustrine over a second parent material	SiCL	SiC	O.LG	O.G GL.R GL.GL	p	Orthic Luvic Gleysol formed on moderately fine to fine textured glaciolacustrine material. Profile underlain by second parent material of various textures and depositional sources or by bedrock. Map unit contains imperfectly drained soils.	793.4	0.4	56.1	0.4
L1	Moderately fine to fine textured lacustrine material over a second parent material	SiL	CL	R.G	GL.R	p	Rego Gleysol formed on moderately fine to fine textured lacustrine material, underlain by a second parent material. Map unit contains soils that are imperfectly drained.	70.5	<0.1	2.4	<0.1
L2	Moderately fine to fine textured lacustrine material	SiCL	SiC	O.R	-	m	Orthic Regosol developed on moderately fine to fine textured lacustrine material. Map unit contains soils that are well drained.	23.0	<0.1	0.6	<0.1
L3	Moderately fine to fine textured lacustrine material	SL	SL	R.G	GL.R	p	Rego Gleysol developed on moderately fine to fine textured lacustrine material. Map unit contains soils that are imperfectly drained.	190.1	0.1	5.1	<0.1
M1	Moderately fine to very fine textured till	L	C	O.GL	O.EB BR.GL O.R	m	Orthic Gray Luvisol developed on moderately fine to very fine textured till. Soils with less pedogenic development (i.e., Brunisols) have been included in this map unit if surficial material textures are similar. Bedrock identified beneath till blankets or deeper is not considered here.	19,352.1	9.8	858.1	6.8
M2	Moderately fine to medium textured till	SiL	CL	GL.GL	-	i	Gleyed Gray Luvisol developed on moderately fine textured till.	1,473.8	0.7	10.9	0.1
M3	Moderately fine to fine textured till	L	CL	O.G	R.G GL.GL	p	Orthic Gleysol formed on moderately fine to fine textured till material. Has inclusions of moderately coarse textured (SL) textured parent material. Has imperfectly drained (i.e., gleyed) subgroup inclusions.	12,093.8	6.1	276.5	2.2
M4	Very coarse to moderately coarse textured till over bedrock	LS	LS	O.HFP	E.DYB	r	Orthic Humo-Ferric Podzol formed on moderately coarse till material. May include less developed profiles (i.e., Brunisols)	1,179.9	0.6	357.0	2.8

Soil Map Unit Symbol	Associated Surficial Material and Texture Class	Representative Soil Texture[a]		Soil Types[a]		Dominant Drainage Class[a]	Representative Description	Local Study Area		Construction Disturbance Area	
		Surface (Upper Lift)	Subsurface (Lower Lift)[b]	Major	Significant / Minor			Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
M5	Moderately fine to very fine textured till over bedrock	HC	HC	O.GL	GL.GL O.R	w	Orthic Gray Luvisol on moderately fine to very fine textured till material. Contains inclusions of imperfectly drained (i.e., gleyed subgroup) soils. Map unit may contain inclusions of moderately coarse (SL) to medium (L) textured layers of parent materials.	11,668.5	5.9	1,547.0	12.2
M6	Moderately fine to fine textured till over bedrock	SiC	SiC	O.G	GL.GL	p	Orthic Gleysol formed on fine textured till material, underlain by bedrock. Has imperfectly drained (i.e., gleyed) subgroup inclusions.	1,800.9	0.9	417.6	3.3
M7	Medium textured till	CL	C	O.GL	O.EB BR.GL	w	Orthic Gray Luvisol developed on medium textured till. Soils with less pedogenic development (i.e., Brunisols) have been included in this map unit if surficial material textures are similar.	2,673.7	1.4	103.9	0.8
M8	Medium textured till over bedrock	CL	C	O.GL	O.EB BR.GL	w	Orthic Gray Luvisol developed on medium textured till underlain by bedrock. Soils with less pedogenic development (i.e., Brunisols) have been included in this map unit if surficial material textures are similar.	3,427.1	1.7	223.0	1.8
M9	Medium textured till	SiCL	SiL	R.HG	O.LG GL.GL	p	Orthic Gleysol formed on fine textured till material, underlain by bedrock. Has imperfectly drained (i.e., gleyed) subgroup inclusions.	601.1	0.3	18.5	0.1
O1	Deep Peat (>100 cm)	N/A	N/A	TY.F	ME.F TY.M FI.M (T.M THU.M TFI.M TME.F TME.H T.H THU.F T.F).	v	Organic soils, with O horizon(s) Thicker than 100 cm. May include Terric profiles, with peat depth 100-160 cm. Typic profiles predominantly composed of fibric material with lower prevalence of mesic material. Terric profiles more often characterized by mesic peat.	45,917.3	23.2	851.1	6.7
O2	Shallow Peat (<100 cm) over mineral material	N/A	N/A	T.M	TFI.M THU.M T.H THU.F T.F	v	Terric Organic profiles with veneers of organic material (less than 100 cm). Field results show majority of organic soils with terric layers and peat veneers are mesic in composition, with lower amounts of humic and fibric material.	76,069.6	38.4	3,956.2	31.2
R1	Consolidated Bedrock	N/A	N/A	N/A	N/A	x	Consolidated bedrock at surface. Little to no soil development.	1,497.2	0.8	1,075.9	8.5
ZDL	Anthropogenic	N/A	N/A	N/A	N/A	N/A	Contains evidence of human disturbance	64.2	<0.1	1.9	<0.1
ZWA	Water	N/A	N/A	N/A	N/A	N/A	Waterbody	7,458.1	3.8	41.2	0.3
Total[c]								**197,959.8**	**100**	**12,665.3**	**100**

Notes:
(a) Soil code descriptions can be found in **Attachment C.**
(b) Second Parent material texture is not represented by the Lower Lift representative texture.
(c) Numbers may not add up due to rounding.
cm = centimetre; ha = hectare; % = percent, - = not present, N/A = not applicable.

5.6.2. Soil Chemistry and Physical Characteristics

Soil samples were collected at seventeen field inspection locations. Of these seventeen sites, fifty-seven samples were collected from representative soil types in the Local Study Area and submitted to Bureau Veritas Laboratories for analyses. Chemical lab results from Bureau Veritas Laboratories are provided in **Attachment E**.

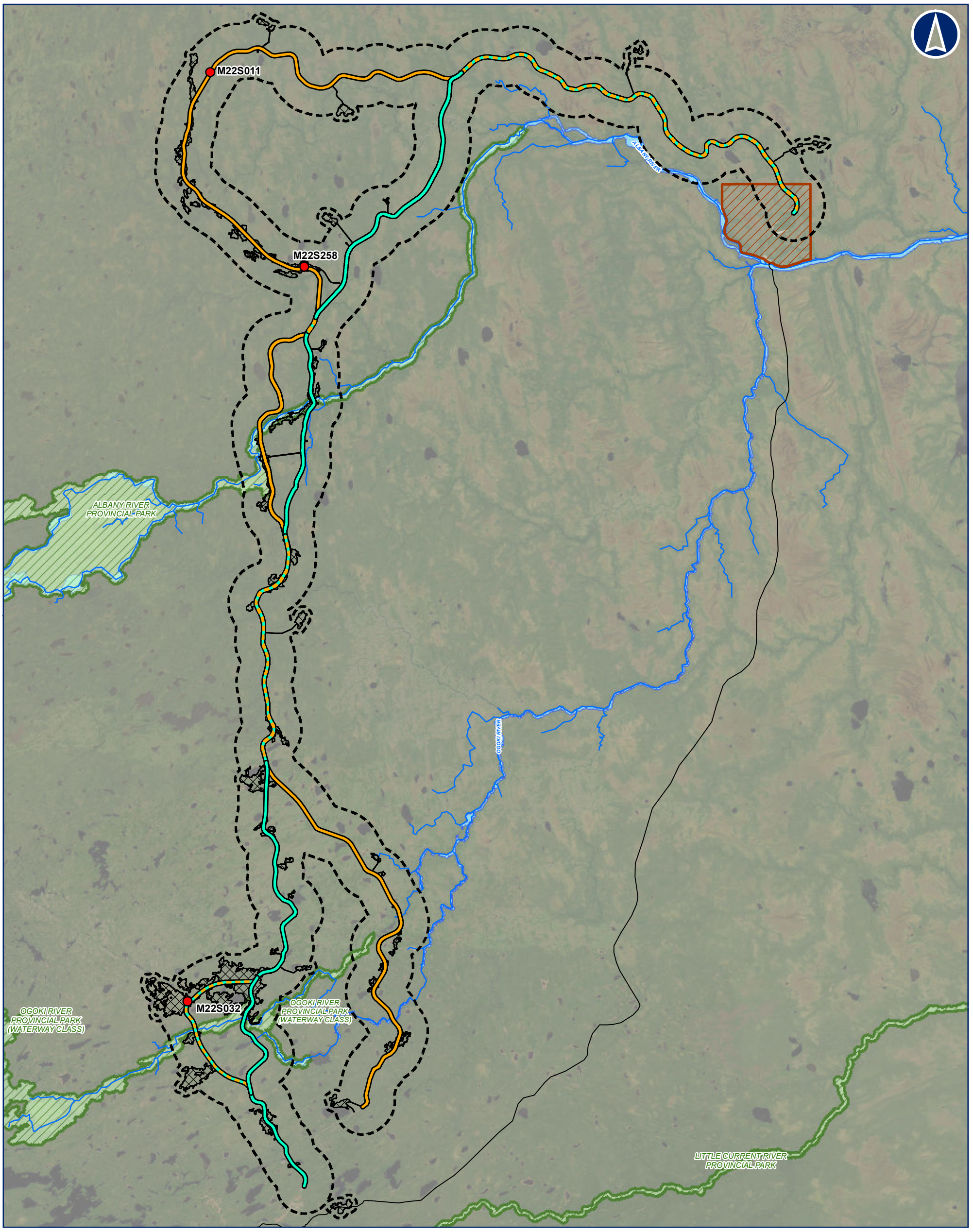
Select samples were submitted for Polyaromatic Hydrocarbon and radionuclide analyses. All analyzed samples were measured to contain less than 0.02 milligrams per kilogram (mg/kg) polycyclic aromatics, and <0.08 mg/kg field preserved volatiles. All samples submitted for radionuclide analysis were measured to contain less than 1.0 becquerels per gram. Detailed analytical results can be found in **Attachment E**.

Metals analyses were completed on a limited number of samples by the geochemistry discipline using SGS Laboratories (WSP, 2024b). Three samples have concentrations of metals higher than the guidelines:

- M22S258-GEOCHEM exceeds the criteria for chromium and nickel (within the SG-15 aggregate area);
- M22S011-GEOCHEM exceeds the criteria for arsenic (approximately 2 km east of aggregate area SG-17); and
- M22S032-GEOCHEM exceeds the criteria for chromium (within the BR-05 aggregate area).

The location of these sites is provided in **Figure 5-13**.

Attachment F – Metals Concentrations Compared to the Canadian Council of Ministers of the Environment Soil Quality Guidelines shows these results compared with Canadian Council of Ministers of the Environment (CCME, 2014) guidelines and criteria.



Legend

- FIELD SITES WITH METAL CONCENTRATIONS HIGHER THAN GUIDELINES

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- WATERBODY
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

LOCATION OF FIELD SITES WITH METAL CONCENTRATIONS HIGHER THAN GUIDELINES

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026	1:400,000 * when printed 11"x17"
Rev:0	

Figure 5-13

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Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_GEN_011_GIS_MetalConcentrations_RevA.mxd
Date Saved: 2/18/2026 4:28:03 PM User Name: gld_rduval

5.6.3. Reclamation Suitability

Fifty-one soil samples were compared against the Northern Forest Region suitability criteria. These samples combined to create sixteen soil profiles. Over 60% (32 / 51) of the soil samples submitted for laboratory analyses and used in reclamation suitability rating calculations were rated as poor for reclamation suitability. The most limiting rating of all horizon samples for a soil profile is assigned to the whole profile, so of the 16 profiles, 1 was rated as good, 1 rated as fair, 11 rated as poor, and 3 rated as unsuitable. It should be noted that poor, and even unsuitable ratings assigned do not mean the material cannot be used for reclamation and vegetative regrowth, but that it may require careful planning, good management, and possible soil amendments to change the rating to a more suitable category.

Limiting factors contributing to the poor ratings are fine and very fine textures (clay and heavy clay, respectively), or low pH values (less than 4.2), usually in the upper lift, and high calcium carbonate equivalent percentage (usually in the lower lift). Unsuitable ratings were assigned to two profiles for low pH values (less than 3.45), and to one profile for a high coarse fragment content (75% fine gravel). **Attachment G – Reclamation Suitability Calculations** provides more detail about the rating system, chemical results, and ratings.

Fine and very fine textured soils (clays) are typically not suitable for use in reclamation because they are difficult to handle, have low permeability which can cause drainage problems, have low load bearing capacity, and seeds and roots may have difficulty emerging through these soils (Joshi, 2017; Alberta Environment and Water, 2012). Soils with low pH (acidic soils) have decreased availability of plant nutrients such as phosphorus, calcium, molybdenum, and can contain toxic levels of some elements such as aluminum and manganese (Läuchli and Grattan, 2012). High pH values (associated with high calcium carbonate equivalent percentage) can limit the availability of plant nutrients such as iron, phosphorous, and zinc and create imbalances in calcium, manganese, and potassium (Läuchli and Grattan, 2012).

Low pH values in the upper lift of the soil do not appear to have inhibited existing vegetative growth; however, given the current low and high pH in the upper and lower lifts, respectively, land capability to support vegetation and subsequent ecosystems would depend on measures taken to mitigate the potential effects on soil quality such as proper soil salvage and careful placement techniques (Naeth et al., 2021). The same is true for drastic differences in texture from the upper lift and lower lift.

Based on the soil mapping within the Local Study Area, approximately 8% of the soils were assigned an unsuitable rating, and approximately 22.5% were assigned a poor suitability rating (**Table 5-5)**. The spatial distribution of soil reclamation suitability ratings in the Local Study Area is displayed on **Figure 5-14**.

Table 5-5: Soil Reclamation Suitability Ratings in the Local Study Area and Construction Disturbance Area

Reclamation Suitability Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Good	2,323.2	1.2	119.0	0.9
Fair	4,386.0	2.2	738.8	5.8
Poor	44,619.4	22.5	4,291.9	33.9
Unsuitable	15,624.8	7.9	1,589.3	12.5
Not Rated[(a)]	131,006.4	66.2	5,926.3	46.8
Total[(b)]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
(a) Rock (R), water (N), and Organic (O1, O2) were not rated.
Numbers may not add up due to rounding.
ha = hectare; % = percent.

ALBANY RIVER PROVINCIAL PARK

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

LITTLE CURRENT RIVER PROVINCIAL PARK

Marten Falls First Nation

Map Location

Legend

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

RECLAMATION SUITABILITY RATINGS
- UNSUITABLE
- POOR
- FAIR
- GOOD
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
Detailed Soil Mapping by WSP 2024.

Data Source:
Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

RECLAMATION SUITABILITY IN THE EXISTING CONDITIONS LOCAL STUDY AREA

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026 | 1:400,000 * when printed 11"x17"

Rev:0

Figure 5-14

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Date Saved: 2/18/2026 4:55:29 PM User Name: gld_rduval

5.6.4. Soil Sensitivities

5.6.4.1. Wind Erosion Risk

Soil wind erosion risk in the Local Study Area is dominantly moderate (20.3%). Ratings were not assigned to 66.2% of the Local Study Area because these are areas of open water, rock, anthropogenic materials, or Organic soils ("Not rated" in **Table 5-6**). A slightly higher percentage (10.5%) of the Construction Disturbance Area has been rated as being at a high risk for wind erosion (compared to 1.9% of the existing conditions Local Study Area). This is likely due to the Construction Disturbance Area being in areas suspected of having sand and gravel aggregate resources which would have a high risk of being eroded by wind. The spatial distribution of wind erosion risk ratings is displayed on **Figure 5-15**.

Table 5-6: Wind Erosion Risk Ratings in the Local Study Area and Construction Disturbance Area

Wind Erosion Risk Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Low	23,129.5	11.7	2,484.8	19.6
Moderate	40,098.6	20.3	2,922.6	23.1
High	3,725.2	1.9	1,331.6	10.5
Not rated	131,006.4	66.2	5,926.3	46.8
Total[(a)]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
(a) Numbers may not add up due to rounding.
ha = hectare; % = percent.

ALBANY RIVER PROVINCIAL PARK

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

LITTLE CURRENT RIVER PROVINCIAL PARK

Legend

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- CONSTRUCTION DEVELOPMENT AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL WIND EROSION POTENTIAL
- LOW
- MODERATE
- HIGH
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL WIND EROSION RISK IN THE EXISTING CONDITIONS LOCAL STUDY AREA

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 5-15

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Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_GEN_007_GIS_SoilWindErosion_RevA.mxd
Date Saved: 2/18/2026 4:55:02 PM User Name: gld_rduval

5.6.4.2. Water Erosion Risk

The existing conditions Local Study Area is mostly subdued surface expressions, and although some slopes are relatively steep, 28% of the existing conditions Local Study Area was assigned very low or low water erosion risk ratings (**Table 5-7**). If the areas that are not rated are excluded, this is over 80% of the existing conditions Local Study Area. This is the same within the Construction Disturbance Area. Water erosion risk was not calculated (not rated) for the areas of open water, rock, anthropogenic materials, or Organic soils which comprise 66.2% of the Local Study Area. The spatial distribution of water erosion risk ratings is displayed on **Figure 5-16.**

Table 5-7: Water Erosion Risk Ratings in the Local Study Area and Construction Disturbance Area

Water Erosion Risk Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Very Low	35,309.4	17.8	4,097.1	32.3
Low	20,166.5	10.2	1,371.4	10.8
Moderate	8,416.4	4.3	951.8	7.5
High	1,799.8	0.9	195.7	1.5
Severe	1,261.2	0.6	120.4	1.0
Not rated	131,006.4	66.2	5,928.7	46.8
Total[(a)]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
(a) Numbers may not add up due to rounding.
ha = hectare; % = percent.

ALBANY RIVER PROVINCIAL PARK

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

LITTLE CURRENT RIVER PROVINCIAL PARK

Legend

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

WaterErosionRating_UL
- VERY LOW (<6 t/ha)
- LOW (6-11 t/ha)
- MODERATE (11-22 t/ha)
- HIGH (22-33 t/ha)
- SEVERE (>33 t/ha)
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL WATER EROSION RISK IN THE EXISTING CONDITIONS LOCAL STUDY AREA

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 5-16

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Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_GEN_008_GIS_SoilWaterErosion_RevA.mxd
Date Saved: 2/18/2026 5:14:15 PM User Name: gld_rduval

5.6.4.3. Soil Sensitivity to Acidification

Acidification sensitivity potentials were assigned to the soil map units within the existing conditions Local Study Area (**Table 5-8; Figure 5-17**). Lab analyses for pH and cation exchange capacity showed soils in the Local Study Area were generally associated with low cation exchange capacity and low pH values, especially in the upper horizons of the soil profile.

Since there is a variety of soil textures (even within a profile), development, and drainage, sensitivity to acidification tended to vary, even within texture classes, however there is a correlation between finer textured soil (silty clay, silty clay loam, heavy clay, and clay loam) and low sensitivity to acidification (60%), and coarser textured soils (silt loam, very fine sandy loam, sandy loam, loam, and loamy sand) having a high or moderate sensitivity to acidification (70%).

Since few bogs were mapped in the existing conditions Local Study Area, the organic soils mapped (soil map units O1 and O2) were rated as having low sensitivity to acidic inputs.

Table 5-8: Acidification Sensitivity Ratings in the Local Study Area and Construction Disturbance Area

Sensitivity to Acidification Rating	Associated Soil Map Units[(a)]	Local Study Area		Construction Disturbance Area	
		Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Low	GL8, M1, M5, M6, M7, M8, GF5, C1, O1, O2	153,805.1	77.7	7,423.0	58.6
Moderate	L1, L3, M2, O1, O2	12,120.0	6.1	740.3	5.8
High	GL1, GL2, GL3, GL4, GL5, GL6, GL7, L2, M3, M4, M9, GF1, GF2, GF3, GF4	23,015.1	11.6	3,383.0	26.7
Not Applicable	R1, ZWA, ZDR	9,019.5	4.6	1,119.0	8.8
Total[(b)]		**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
(a) Soil Map Unit Descriptions can be found in **Section 5.7.1**.
(b) Numbers may not add up due to rounding.
ha = hectare; % = percent.

ALBANY RIVER PROVINCIAL PARK

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

LITTLE CURRENT RIVER PROVINCIAL PARK

Marten Falls First Nation

Map Location

Legend

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

COMPACTING RATINGS
- LOW
- MODERATE
- HIGH
- NOT RATED

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL SENSITIVITY TO ACIDIFICATION IN THE EXISTING CONDITIONS LOCAL STUDY AREA

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 5-17

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Date Saved: 2/18/2026 5:27:21 PM User Name: gld_rduval

5.6.4.4. Compaction Risk

Since soil compaction risk is assigned based mainly on soil texture and soil drainage, the Local Study Area has a relatively even distribution of soils that are at a low, moderate, or high risk for compaction (**Table 5-9**). Areas of Organic soils have not been rated but would likely be at a high risk for compaction as mentioned in **Section 4.3.1**. Open water, rock, and previously disturbed areas in the Local Study Area were also not rated for compaction risk. **Figure 5-18** shows the spatial extent of compaction risk ratings assigned.

Table 5-9: Soil Compaction Risk Ratings in the Local Study Area and Construction Disturbance Area

Soil Compaction Risk Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Low	27,914.8	14.1	3,712.3	29.3
Moderate	19,163.6	9.7	2,023.3	16.0
High	19,874.9	10.0	1,003.4	7.9
Not rated	131,006.4	66.2	5,926.3	46.8
Total[(a)]	**197,959.8**	**100.0**	**12,665.3**	**100.0**

Notes:
(a) Numbers may not add up due to rounding.
ha = hectare; % = percent.

ALBANY RIVER PROVINCIAL PARK

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)

LITTLE CURRENT RIVER PROVINCIAL PARK

Marten Falls First Nation

Map Location

Legend

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- WATERCOURSE
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

COMPACTING RATINGS
- LOW
- MODERATE
- HIGH
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
Detailed Soil Mapping by WSP 2024.

Data Source:
Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL COMPACTION RISK IN THE EXISTING CONDITIONS LOCAL STUDY AREA

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026 | 1:400,000 * when printed 11"x17"

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Figure 5-18

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Date Saved: 2/18/2026 5:05:50 PM User Name: gld_rduval

6. Selection of the Preferred Route

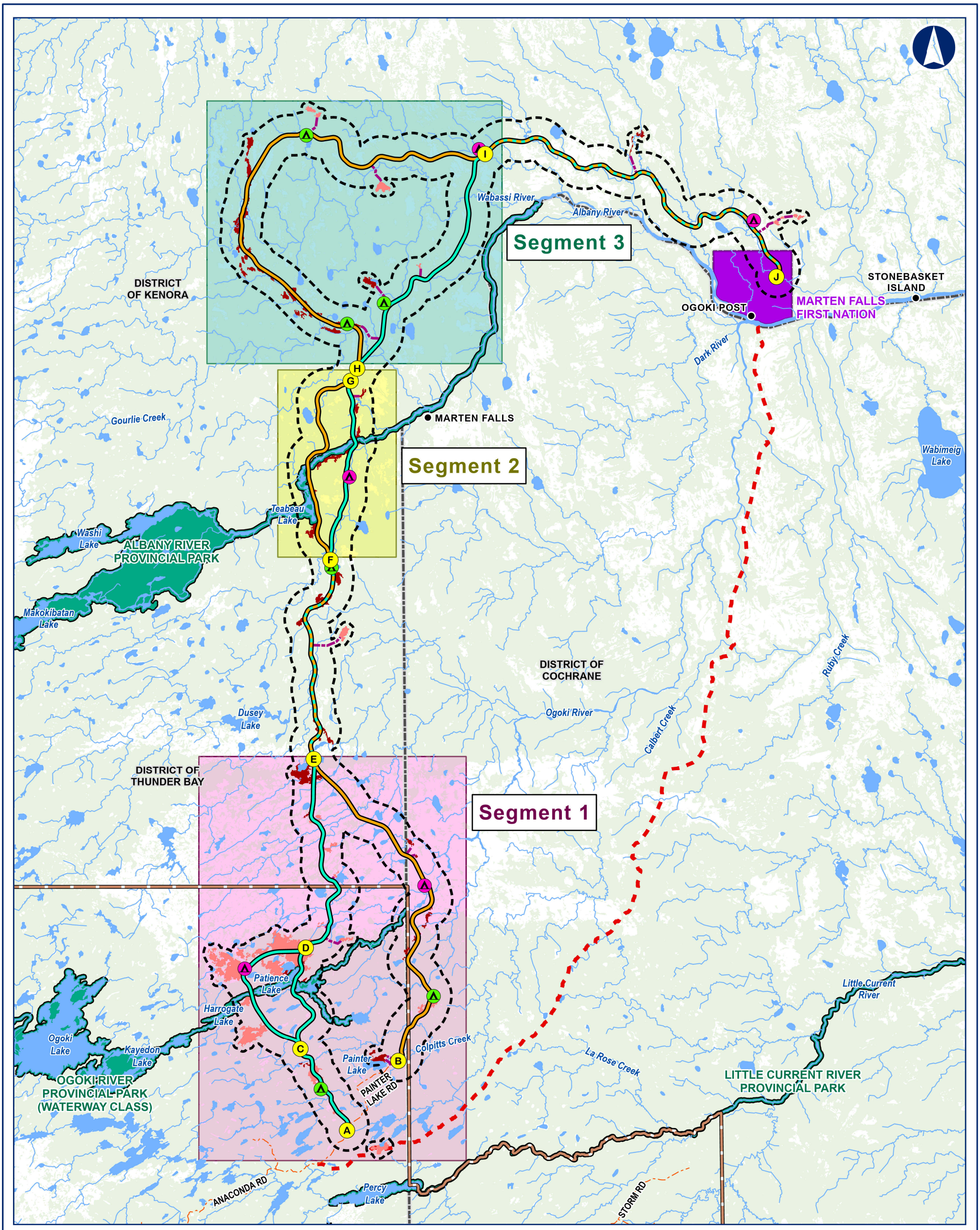
Following the collection of existing condition information on the two alternative route alignments described in **Section 4**, the Project Team undertook an exercise to select a Preferred Route. The methodology and detailed results of this exercise are described in the *Environmental Assessment / Impact Statement Report* and are summarized at a high level below. The Preferred Route includes the footprint of any ancillary features such as pits and quarries, temporary access roads, and worker camps associated with the construction of that route. The Effects Assessment will be completed using the identified Preferred Route.

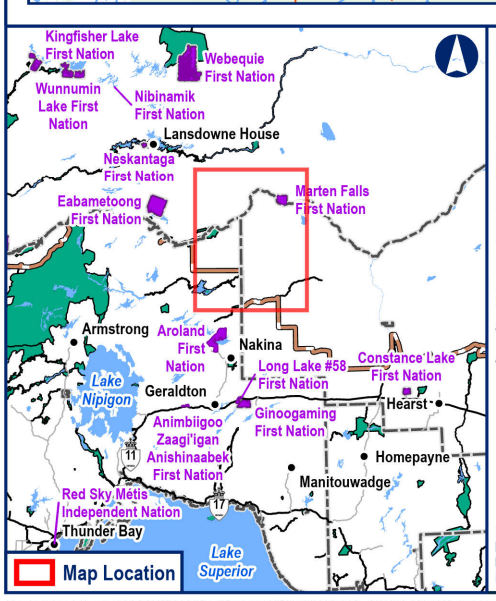
6.1. Alternative Segments and Routes Within Each Segment

To simplify the evaluation of the alternatives, the alternatives were divided into three separate segments based on their geographical locations, as presented in **Figure 6-1**. The segments were also determined so that any alternative route in one segment could connect with any alternative route in the next segment, allowing for decisions to be made based on the environment in each segment, and not based on the whole. This approach considers the variable environmental conditions within the Project area, allowing for flexibility to avoid sensitive natural features encountered within the Construction Disturbance Area for each segment instead of requiring decision makers to balance trade offs of one long route versus the other.

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

Route Alternatives and Segments





Legend

- Segment Node
- Project Study Area
- Segment 1
- Segment 2
- Segment 3

Construction Disturbance Area

Route Alternatives (100 m Right-of-Way)

- Alternative 1
- Alternative 4

Potential Camp Site

- 50 Persons (108 m x 150 m)
- 200 Persons (108 m x 150 m)
- Approximate Access Road to Potential Construction Camp (10 m Width)

Potential Aggregate Source

- Bedrock
- Sand and gravel
- Approximate Access Road to Potential Aggregate Site (10 m Width)

General Features

- Resource / Recreation Road
- MFFN Existing Winter Access Road
- Watercourse
- Waterbody
- First Nation Reserve
- District Municipal Boundary
- Far North Boundary
- Provincial Park

Data Source:
Base Data: Provided by MNRF 2023; Route Infrastructure - Provided by AECOM 2021. Contains Information licensed under the Government Licence Ontario.

Notes:
First Nation Reserves of MFFN CAR Neighboring Indigenous Communities are shown within the inset extent.

0 5 10 20
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 6-1

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Date Saved: 2026-01-21 6:05 AM User Name: paige.crossman

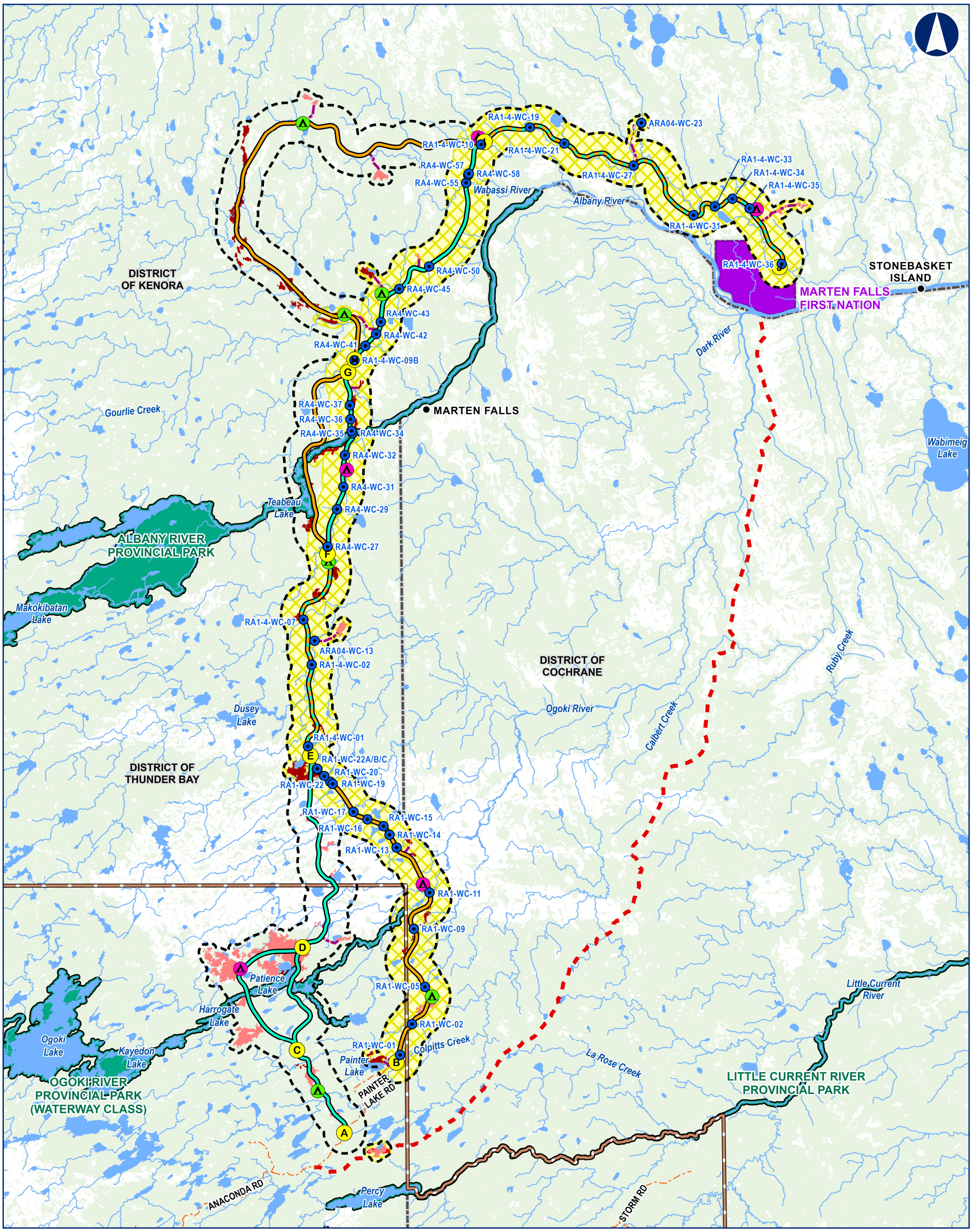
6.2. Preferred Route

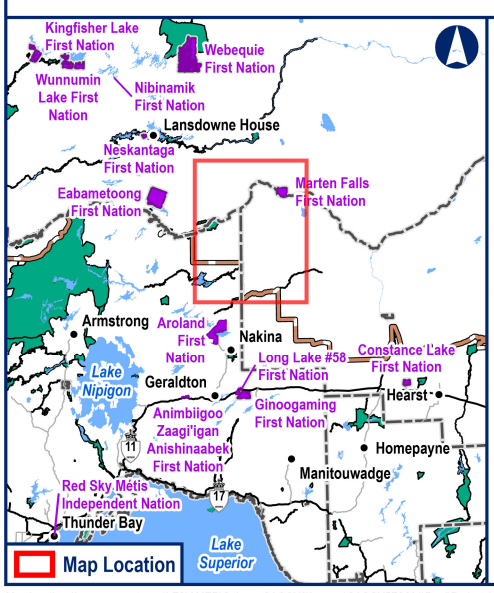
The selection of the Preferred Route within each segment involved a thorough analysis of technical, economic, natural, social, and cultural factors. The route alternative evaluation took into account the potential effects and standard or known mitigation approaches to determine the net positive or negative effects of each alternative and was completed using the reasoned argument (trade-off) method. The reasoned argument method qualitatively compares the advantages and disadvantages of each alternative, including the relative significance of the potential net effects.

Following the completion of the steps outlined previously, and direction from the community of Marten Falls First Nation, Aroland First Nation, and input from the public and regulators, the Proponent identified a Preferred Route alignment for each segment.

- Segment 1 – Ogoki Crossing: Alternative 1;
- Segment 2 – Albany Crossing: Alternative 4; and
- Segment 3 – North of the Albany: Alternative 4.

The combination of Segments 1, 2, and 3 creates the final Preferred Route (**Figure 6-2**).





Legend

- Water Crossing
- Segment Node
- Project Study Area
- Final Route Recommendation

Construction Disturbance Area

Route Alternatives (100 m Right-of-Way)

- Alternative 1
- Alternative 4

N/A

- Alternative 1 and Alternative 4

Potential Camp Site

- 50 Persons (108 m x 150 m)
- 200 Persons (108 m x 150 m)

Potential Aggregate Source

- Bedrock
- Sand and gravel
- Approximate Access Road to Potential Aggregate Site (10 m Width)

General Features

- Resource / Recreation Road
- MFFN Existing Winter Access Road
- Watercourse
- Waterbody
- First Nation Reserve
- District Municipal Boundary
- Far North Boundary
- Provincial Park

Data Source:
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Notes:
First Nation Reserves of MFFN CAR Neighboring Indigenous Communities are shown within the inset extent.

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

Final Route Recommendation

0 5 10 20
Kilometres
Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 6-2

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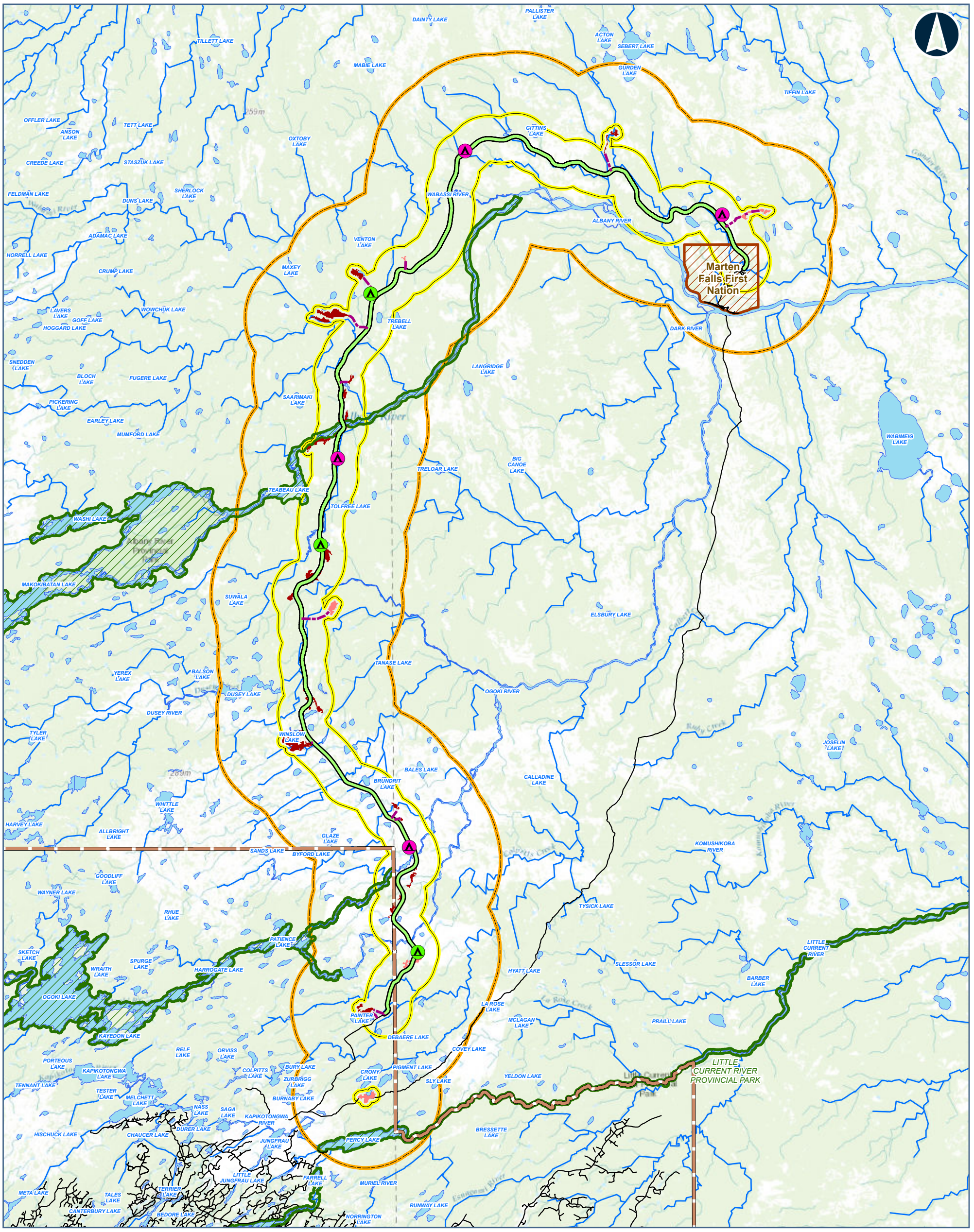
Map location: \\na.aecomnet.com\LFS\AMER\Calgary-CACGY3\Legacy\CACGY5FS001\Prod\Projects\60593122\900-CAD_GIS\920-929 (GIS-Graphics)\Design\01_Reports_2024\Route Recommendation\PRJ_MFCAR_Final Route Recommendation_60593122.aprx Figure: MAP_Fig6-2_MFCAR_PerferredRouteWatercrossings_60593122
Date Saved: 2026-01-22 9:07 AM User Name: paige.crossman

7. Residual Effects Assessment

Effects assessment results are provided for the Preferred Route, for each temporal phase of the Project as described in **Section 4.2.1**. This includes the potential effects (positive and negative), mitigation and enhancement measures, residual effects, and indirect effects.

7.1. Summary of the Existing Conditions Within the Effects Study Areas

Existing conditions were established for physiography, terrain, and soils within the effects assessment Construction Disturbance Area, Local Study Area, and Regional Study Area for the Preferred Route (**Figure 7-1**). These data have been used to establish a description of the existing conditions for the effects assessment.



LEGEND

CONSTRUCTION DISTURBANCE AREA

POTENTIAL CAMP SITE (SIZE)

- 50 PERSONS
- 200 PERSONS
- PREFERRED ROUTE
- APPROXIMATE ACCESS ROAD TO POTENTIAL CONSTRUCTIONS CAMP
- APPROXIMATE ACCESS ROAD TO POTENTIAL AGGREGATE SITE

POTENTIAL AGGREGATE SOURCE

- BEDROCK
- SAND AND GRAVEL

- FAR NORTH BOUNDARY
- ROAD
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- WATERBODY
- WATERCOURSE
- PHYSIOGRAPHY, TERRAIN, AND SOILS RSA
- PHYSIOGRAPHY, TERRAIN, AND SOILS LSA

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World Topographic Map: Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

PHYSIOGRAPHY,TERRAIN AND SOILS EFFECTS ASSESSMENT STUDY AREAS

0 2.75 5.5 11 16.5 22
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Jan, 2026	1:480,000 * when printed 11"x17"
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Figure 7-1

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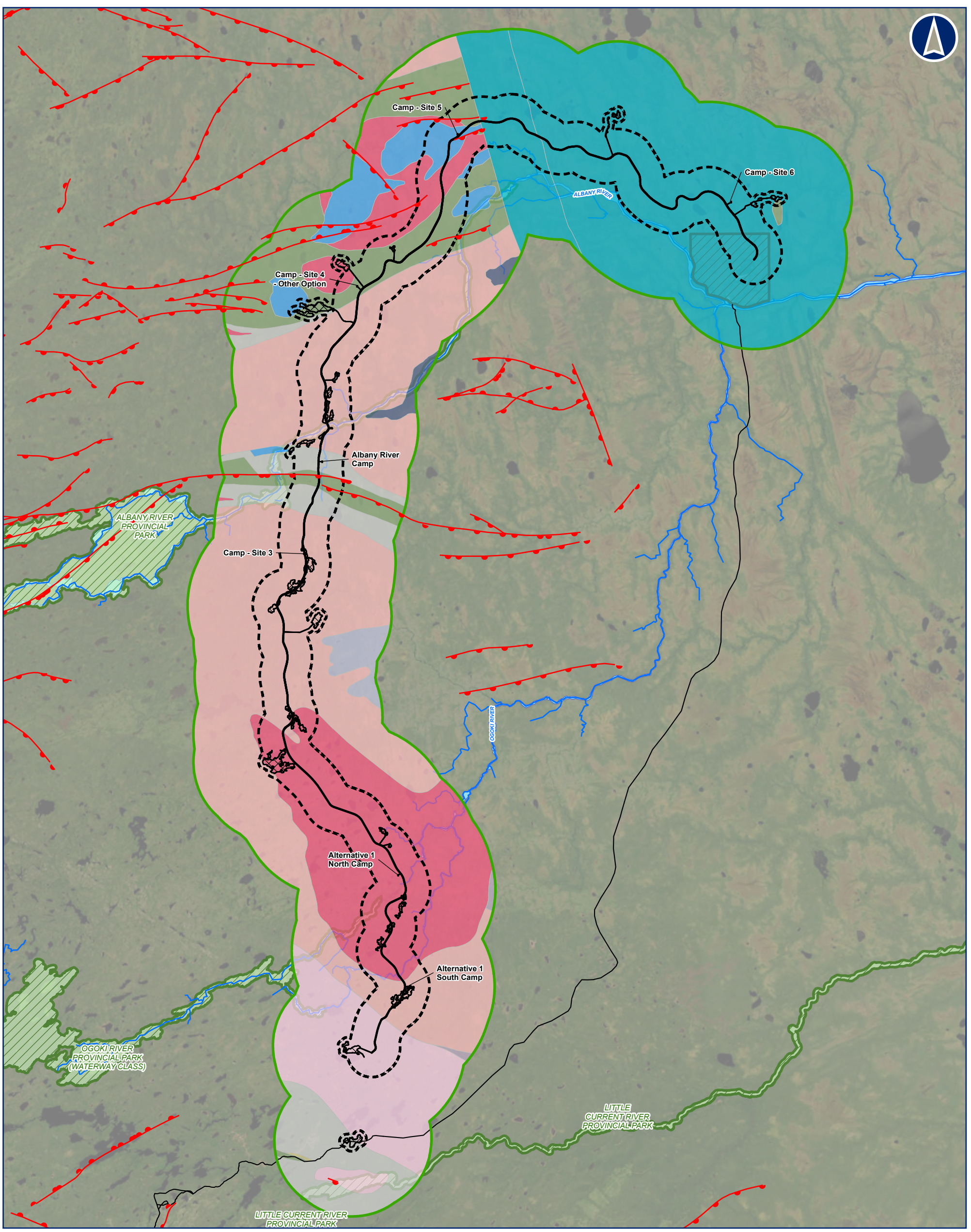
Date Saved: 1/12/2026 2:36 PM User Name: gld_rduval

7.1.1. Physiography and Bedrock Geology

The majority of the effects assessment Regional Study Area is within the Severn Upland physiographic subregion; the area east of approximately Gittins Lake is in the Hudson Bay Lowland physiographic subregion (Bostock, 1970). A description of the Severn Upland and the Hudson Bay Lowland is provided in **Section 5.1**.

Figure 7-2 displays 1:250,000 scale bedrock geology mapping for the effects assessment Regional Study Area. **Section 5.1** provides a description of the bedrock in the Regional Study Area.



Legend

- PREFERRED ROUTE
- FAULT
- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA

BEDROCK GEOLOGY

- SHALE, LIMESTONE, DOLOSTONE, SILTSTONE (PALEOZOIC)
- MASSIVE TO FOLIATED GRANODIORITE TO GRANITE (NEO-TO MESOARCHEAN)
- MUSCOVITE-BIOTITE AND CORDIERITE-BIOTITE GRANITE, GRANODIORITE-TONALITE (NEO-TO MESOARCHEAN)
- TONALITE TO GRANODIORITE-FOLIATED TO MASSIVE (NEO-TO MESOARCHEAN)
- GABBRO, ANORTHOSITE, ULTRAMAFIC ROCKS (NEO-TO MESOARCHEAN)
- METAVOLCANIC ROCKS, MINOR METASEDIMENTARY ROCKS, MAFIC GNEISSES OF UNCERTAIN PROTOLITH, GRANITIC GNEISSES (NEO-TO MESOARCHEAN)
- WACKE, SILTSTONE, ARKOSE, ARGILLITE, SLATE, MUDSTONE, MARBLE, CHERT, IRON FORMATION, MINOR METAVOLCANIC ROCKS, CONGLOMERATE, ARENITE, PARAGNEISS, MIGMATITES (NEO-TO MESOARCHEAN)
- WACKE, SILTSTONE, ARKOSE OR ARGILLITE (FROM LOWLANDS) (NEO-TO MESOARCHEAN)
- PARAGNEISS AND MIGMATITES (NEO-TO MESOARCHEAN)
- RHYOLITIC, RHYODACITIC, DACITIC AND ANDESITIC FLOWS, TUFFS AND BRECCIAS, CHERT, IRON FORMATION, MINOR METASEDIMENTARY AND INTRUSIVE ROCKS; RELATED MIGMATITES (NEO-TO MESOARCHEAN)
- BASALTIC AND ANDESITIC FLOWS, TUFFS AND BRECCIAS, CHERT, IRON FORMATION, MINOR METASEDIMENTARY AND INTRUSIVE ROCKS, RELATED MIGMATITES (NEO-TO MESOARCHEAN)

Notes:

1. Ontario Geological Survey. 2011. 1:250,000 scale Bedrock Geology of Ontario. Ontario Geological Survey, Miscellaneous Release – Data 126, Revision 1. Available at: http://www.geologyontario.mndm.gov.on.ca/ogsearth.html

Data Source:

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

BEDROCK GEOLOGY IN THE EFFECTS ASSESSMENT REGIONAL STUDY AREA

0 2.5 5 10 15 20
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026 | 1:450,000 * when printed 11"x17"

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Figure 7-2

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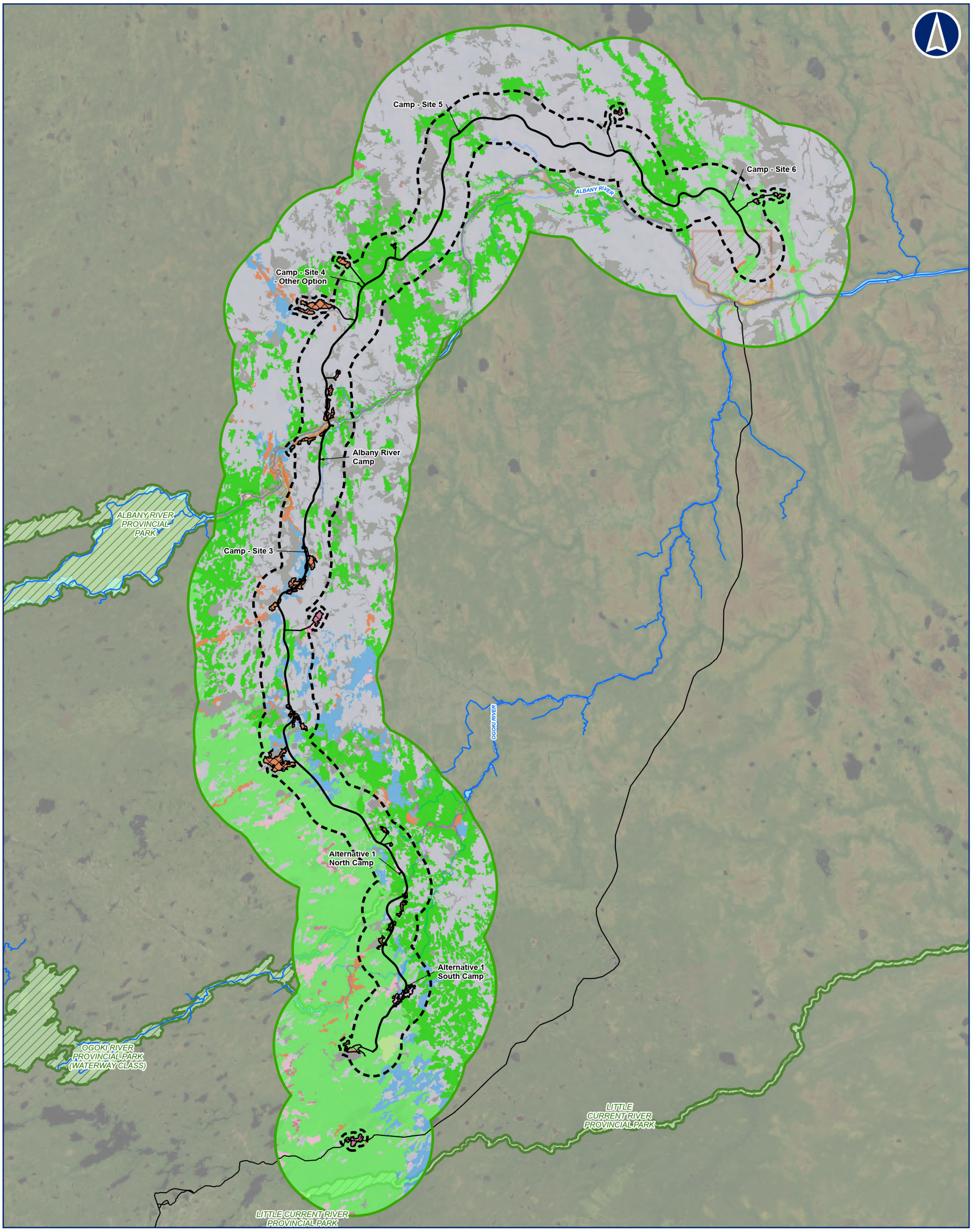
Map location: \\corp.pbwan.net\ca\CACALK00\CALIM\GISActive\2022\21455151\Mapping\Products\007_CumulativeEffects\21455151_EF_GEN_002_GIS\21455151_EF_GEN_002_GIS.aprx
Date Saved: 2/11/2026 6:42 PM User Name: INGU06951

7.1.2. Regional Surficial Geology

Section 5.2 provides a description of the existing surficial materials in the effects assessment Regional Study Area based on the predictive surficial geology mapping by the Ontario Geological Survey (2018). The southern part of the Regional Study Area is dominated by till, and organic soils (bogs and fens) dominate the north. Full details are provided in **Section 5.2** and the Ontario Geological Survey (2018) predictive mapping is shown in **Figure 7-3.**



Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- WATERBODY
- FAR NORTH BOUNDARY
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SURFICIAL GEOLOGY

- ORGANIC DEPOSITS (FEN)
- ORGANIC DEPOSITS (BOG)
- FLUVIAL DEPOSITS (RECENT)
- FLUVIAL DEPOSITS (ABANDONED)
- MARINE BEACH AND NEAR-SHORE DEPOSITS
- GLACIOLACUSTRINE BASIN DEPOSITS
- GLACIOFLUVIAL ICE-CONTACT DEPOSITS
- CLAYEY-SILT TO CLAY TILL
- SANDY SILT TO SILT TILL
- SILTY SAND TO SAND TILL
- THIN SEDIMENT OVER BEDROCK
- BEDROCK (PRECAMBRIAN)

Notes:

1. Barnett, P.J., K.H. Yeung, and J.D. McCallum. 2013a. Surficial geology of the Fort Hope area northeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3724, scale 1:100 000.
2. Barnett, P.J., K.H. Yeung, and J.D. McCallum. 2013b. Surficial geology of the Fort Hope area southeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3736, scale 1:100 000.
3. Barnett, P.J., K.H. Yeung, and J.D. McCallum. 2013c. Surficial geology of the Nakina area northeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3744, scale 1:100 000.
4. Gao, C. and K.H. Yeung. 2018. Surficial geology of the Ogoki area northwest, northern Ontario. Ontario Geological Survey, Preliminary Map P.3725, scale 1:100 000.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL GEOLOGY IN EFFECTS ASSESSMENT REGIONAL STUDY AREA

0 2.5 5 10 15 20
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026 | 1:450,000 * when printed 11"x17"

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Figure 7-3

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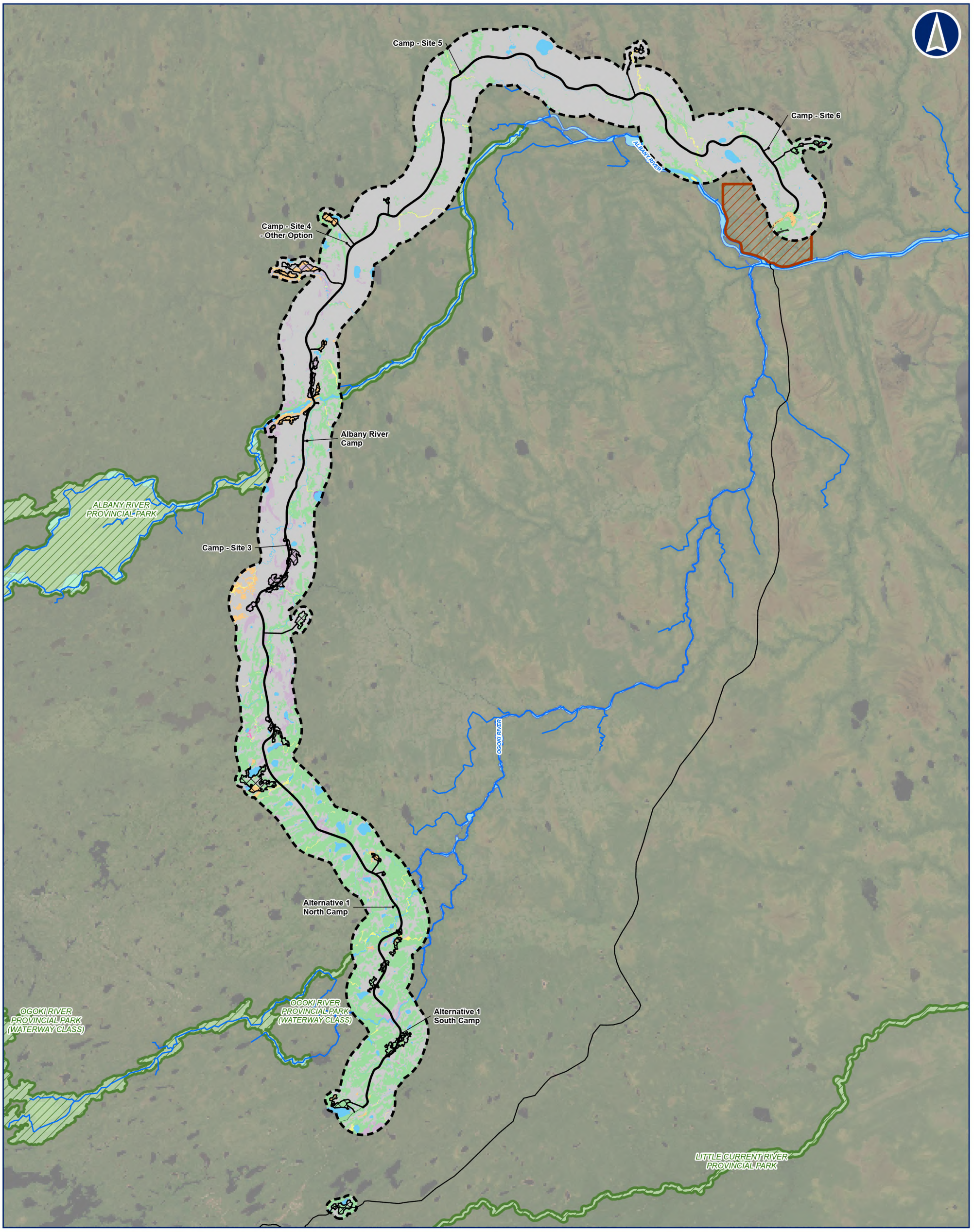
7.1.3. Surficial Materials in the Construction Disturbance Area and Effects Assessment Local Study Area

Results from the desktop review and field assessment components identified 10 surficial material types in the Construction Disturbance Area and the effects assessment Local Study Area, which are described in **Section 5.4.1**. These surficial materials are listed in **Table 7-1** with associated area and proportion (percentage) of each material mapped. An overview of the spatial distribution of the dominant materials mapped in the Construction Disturbance Area and effects assessment Local Study Area is shown on **Figure 7-4**, and a larger scale, more detailed display of dominant surficial materials, geomorphological processes, and field inspection locations is shown on **Figures H-1a** to **H-1m**, **Attachment H – Effects Assessment Detailed Mapping Figures**. Detailed terrain mapping is also provided as a Google Earth (.kml) attachment. Three surficial materials (organic, till, and glaciolacustrine) account for over 85% of the surficial materials in the Construction Disturbance Area; just over 43.5% of this is represented by organic soils (peatlands).

Table 7-1: Surficial Materials in the Effects Assessment Local Study Area and Construction Disturbance Area

Surficial Material	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Anthropogenic (A)	57.1	<0.1	1.7	<0.1
Colluvium (C)	58.9	0.1	5.7	0.1
Fluvial (F)	1,039.5	0.9	28.9	0.6
Glaciofluvial (FG)	1,730.3	1.5	577.1	12.3
Lacustrine (L)	63.1	0.1	2.6	0.1
Glaciolacustrine (LG)	4,070.2	3.5	702.3	14.9
Moraine (till) (M)	31,291.8	27.0	1,265.1	26.9
Open Water (N)	5,007.7	4.3	23.5	0.5
Organic (O)	72,266.0	62.3	2,047.3	43.6
Bedrock (R)	374.3	0.3	46.0	1.0
Total[(a)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Numbers may not add up due to rounding.
< = less than; ha = hectare; % = percent.



Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

DOMINANT SURFICIAL MATERIAL

- ANTHROPOGENIC - A
- BEDROCK - R
- COLLUVIUM - C
- FLUVIAL - F
- GLACIOFLUVIAL MATERIAL - FG
- GLACIOLACUSTRINE - LG
- LACUSTRINE - L
- MORAINAL/TILL - M
- ORGANIC - O
- WATERBODY - N

Notes:

Detailed Terrain Mapping by WSP 2024.

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Aerial photography provided by:
Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, AAFC, NRCan

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

DISTRIBUTION OF DOMINANT SURFICIAL MATERIAL OVERVIEW

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 7-4

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7.1.4. Drainage

Drainage in the Construction Disturbance Area and effects assessment Local Study Area ranges from very poorly drained organics to very rapidly drained bedrock outcrops. **Table 7-2** summarizes the dominant drainage mapped in the Construction Disturbance Area and effects assessment Local Study Area and the extent of the dominant drainage in each terrain polygon is shown on **Figures H-2a** to **H-2f**, **Attachment H**.

Approximately 66% of the effects assessment Local Study Area is very poorly drained, with a further 10% poorly or imperfectly drained. Approximately 21% is inferred to be well drained (moderately well, well, rapidly, or very rapidly drained). In the Construction Disturbance Area, approximately 45% of the area is inferred to be very poorly drained, with approximately 8% imperfectly or poorly drained. Just over 46% of the Construction Disturbance Area is inferred to be well drained (moderately well, well, rapidly, or very rapidly drained). The Construction Disturbance Area likely has a larger area of well drained soils than the effects assessment Local Study Area as the Preferred Route and associated features were chosen on upland, where mineral soil and rock is generally more common.

Table 7-2: Drainage in the Effects Assessment Local Study Area and Construction Disturbance Area

Drainage	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Very rapid (x)	45.9	<0.1	15.3	0.3
Rapid (r)	421.2	0.4	255.8	5.4
Well (w)	13,536.3	11.7	1,287.9	27.4
Moderately well (m)	9,869.3	8.5	621.6	13.2
Imperfect (i)	6,784.1	5.9	265.4	5.6
Poor (p)	5,389.9	4.6	112.4	2.4
Very Poor (v)	76,148.9	65.7	2,121.6	45.1
Null (open water or anthropogenic)	3,763.4	3.2	20.3	0.4
Total[(a)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Numbers may not add up due to rounding
(b) Drainage summary data are based only on the dominant drainage assigned in each terrain polygon. Non-dominant drainage (if assigned) can be found in the .kml file provided in **Attachment H.**
< = less than; ha = hectare; % = percent.

7.1.5. Terrain Stability

Terrain stability in the Construction Disturbance Area and effects assessment Local Study Area is mainly stable, meaning landslide initiation following vegetation removal or construction is unlikely. Approximately 99.5% of the Construction Disturbance Area and 96.7% of the effects assessment Local Study Area is regarded as stable (Classes I, II, and III). These areas are expected to have negligible to low likelihood of landslide initiation following vegetation and soil disturbance.

Potentially unstable terrain (Class IV) with a moderate likelihood of landslide initiation, and unstable terrain (Class V), with a high likelihood of landslide initiation, each account for less than 0.1% of the effects assessment Local Study Area. In the Construction Disturbance Area, potentially unstable terrain accounts for 0.1% of the area and less than 0.1% is inferred to be unstable terrain. Potentially unstable terrain includes areas of till, colluvium, glaciofluvial, or glaciolacustrine deposits with steeper slopes that may show signs of slow and shallow failure, gullying, or seepage. Terrain mapping in these areas suggests the slopes range from 5% to 60% grade. Unstable terrain has evidence of rapid mass movements (e.g., landslides) or slow mass movement (e.g., slumps) and is mapped as colluvium. It should be noted that only some of the areas mapped as potentially unstable or unstable terrain were field checked.

Terrain units classified as open water or anthropogenic were not rated for stability and comprise approximately 3.2% of the effects assessment Local Study Area and 0.4% of the Construction Disturbance Area.

Table 7-3 lists each stability class and the associated area and proportion (percentage) of the effects assessment Local Study Area and Construction Disturbance Area of each stability class.

Table 7-3: Terrain Stability Classes in the Construction Disturbance Area and Effects Assessment Local Study Area

Terrain Stability Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Stable (I)	10,5586.6	91.1	3,960.9	84.3
Generally stable (II)	6,211.7	5.4	594.1	12.6
Moderately stable (III)	333.4	0.3	119.9	2.6
Potentially unstable (IV)	38.0	<0.1	2.7	0.1
Unstable (V)	26.0	<0.1	2.3	<0.1
Null (open water or anthropogenic)	3,763.4	3.2	20.2	0.4
Total[(a)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Adapted from British Columbia Ministry of Environment (1999).
(b) Numbers may not add up due to rounding.
< = less than; ha = hectare; % = percent.

7.1.6. Geohazards

A description and discussion of the following geohazards in relation to the Project is provided in **Section 5.4**:

- Seismic / ground shaking from earthquakes;
- Liquefaction (a granular material transforming from a solid to a liquid state;
- Landslides and slumps;
- Permafrost degradation (e.g., thermokarst subsidence);
- Isostatic rise;
- Inundation (flooding);
- Karst associated with limestone and dolomitic bedrock; and
- Soil erosion.

Within the effects assessment Local Study Area, 24 landslides or slumps are noted, and five instances of potential permafrost. The landslides and slumps are found scattered throughout the effects assessment Local Study Area and are dominantly associated with steeper slopes, and the banks of fluvial systems. The potential permafrost locations are mainly found in the northeastern 24 km of the route, northwest of Ogoki, with two locations documented, one in the SG-12 pit area and another in the SG-19 pit area. The landslides and slumps associated with colluvial materials and commonly steep slopes, as well as the potential permafrost locations in the effects assessment Local Study Area are displayed on **Figures H-1a** to **H-1m**, as well as **Figures H-3a** to **H-3f** in **Attachment H**.

7.1.7. Special Geologic and Geomorphic Features

The following "special" geologic and geomorphic features have been identified (if present) and are displayed in **Figures H-3a** to **H-3f** in **Attachment H**:

- Eskers;
- Potential pits and quarries;
- Organic soils;
- Permafrost and permafrost degradation areas; and
- Steep slopes and colluvium.

A detailed description and discussion of each of these features is provided in **Section 5.5.**

Eleven polygons are mapped as eskers (FGr) in the effects assessment Local Study Area. Details on the location of the 11 esker ridges are as follows.

- Two are located at the southern tip of the effects assessment Local Study Area adjacent to Colpitts Creek;
- Three are within the SG-06 pit area;
- One is located within the Albany River, west of the Albany River crossing;
- Two are in the SG-19 pit area;
- One esker fragment is located adjacent to the south end of the SG-19 area; and
- Two of the largest esker polygons identified are outside the Construction Disturbance Area near the Ogoki Post airport.

Potential pits and quarries are associated with areas mapped as glaciofluvial (FG) material or bedrock (R), respectively (**Table 7-1**, **Figure H-3a** to **H-3f**). Eleven potential pit areas (SG-05, SG-06, SG-07, SG-09, SG-11, SG-12, SG-15, SG-18, SG-19, SG-20, and the glaciofluvial sediments at Ogoki Post) were identified within the effects assessment Local Study Area, and four areas (BF-04, BR-12, BR-15, and BR-16) for quarries.

Organic material is the dominant surficial material mapped in both the effects assessment Local Study Area and Construction Disturbance Area (**Section 7.1.4**, **Table 7-1**). Permafrost and permafrost degradation and steep slopes and colluvium in the effects assessment Local Study Area are discussed in **Section 5.4.3** and **Section 5.5.4**.

7.1.8. Soils

7.1.8.1. Soil Mapping and Characteristics

Table 7-4 provides the associated area and proportion (percentage) of each soil map unit in the effects assessment Local Study Area and Construction Disturbance Area. Soil map unit descriptions and characterization are provided in **Attachment D** and **Section 5.6.1**, respectively. Most (over 65%) of the soils in the effects assessment Local Study Area are organic (**Table 7-4**). Mineral soil material textures in the effects assessment Local Study Area vary from coarser sands to very fine heavy clay. From field data (**Attachment C**), over half of the textures recorded in soil inspections were noted to be moderately to very fine textured with less than a quarter of soil horizons being recorded as coarser sandier textures. Mineral soils in the effects assessment Local Study Area were dominantly classified as Luvisolic with Brunisolic soils the second most common soil Great Group. Brunisolic soils were dominantly classified as Eutric Brunisols based on pH values being greater than 5.5.

A summary of characteristics for each soil map unit is provided in **Table 5-4**. The soil maps are provided in **Attachment H**, **Figures H-4a** to **H-4f**. **Attachment D** provides detailed representative profile descriptions with accompanying photos for each soil map unit.

Table 7-4: Soil Map Units in the Effects Assessment Local Study Area and Construction Disturbance Area

Soil Map Unit Symbol[(a)]	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
C1	60.3	0.1	5.4	0.1
F1	1,068.3	0.9	33.4	0.7
GF1	1,331.2	1.1	519.2	11.1
GF2	128.4	0.1	8.9	<0.1
GF3	127.9	0.1	42.7	0.9
GF4	95.9	0.1	<0.1	<0.1
GF5	44.1	<0.1	5.7	0.1
GL1	484.7	0.4	239.4	5.1
GL2	81.4	0.1	15.9	0.3
GL3	820.5	0.7	225.3	4.8
GL4	423.1	0.4	63.7	1.4
GL5	304.0	0.3	12.6	0.3
GL6	263.8	0.2	8.8	0.2
GL7	622.5	0.5	45.6	1.0
GL8	666.9	0.6	54.0	1.2
L1	14.0	<0.1	0.5	<0.1

Soil Map Unit Symbol[a]	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
L2	1.0	<0.1	0.3	<0.1
L3	31.8	<0.1	1.1	<0.1
M1	13,330.8	11.5	571.4	12.2
M2	933.4	0.8	4.6	0.1
M3	7,613.9	6.6	141.2	3.0
M4	27.7	<0.1	-	-
M5	4,135.4	3.6	327.4	7.0
M6	302.1	0.3	11.1	0.2
M7	1,349.8	1.2	54.2	1.2
M8	1,427.7	1.2	144.3	3.1
M9	124.5	0.1	5.2	0.1
O1	29,452.1	25.4	466.9	9.9
O2	46,681.9	40.3	1,654.7	35.2
R1	45.9	<0.1	15.3	0.3
ZDL	45.9	<0.1	1.7	<0.1
ZWA	3,907.0	3.4	19.5	0.4
Total[b]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Soil Map Unit descriptions can be found in **Section 5.7.1**.
(b) Numbers may not add up due to rounding.
< = less than; ha = hectare; % = percent, - = not present

7.1.8.2. Soil Chemistry and Physical Characterization

Soil samples were collected from the following eight field site inspection locations in the effects assessment Local Study Area:

- M22C008;
- M22C022;
- M22K040;
- M22L016;
- M22S055;
- M22S127;
- M22S258; and
- M22SAD1.

From these eight sites, 29 samples (27 mineral samples and two organic samples) were collected as representative soil types in the effects assessment Local Study Area and were submitted to Bureau Veritas Laboratories for analyses. Chemical lab results from Bureau Veritas Laboratories are provided in **Attachment E**.

Metals analyses were completed on a limited number of samples by the geochemistry discipline using SGS Laboratories (WSP, 2024b). One sample within the Construction Disturbance Area has concentrations of metals higher than the guidelines:

- M22S258-GEOCHEM exceeds the criteria for chromium and nickel and is within the SG-15 pit area.

The location of this site is provided in **Figure 7-5**.

Attachment F shows these results compared with Canadian Council of Ministers of the Environment (CCME, 2014) guidelines and criteria.

Camp - Site 5
Camp - Site 6
ALBANY RIVER
Camp - Site 4
- Other Option
M22S258
Albany River
Camp
ALBANY RIVER
PROVINCIAL PARK
Camp - Site 3
OGOKI RIVER
Alternative 1
North Camp
OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)
Alternative 1
South Camp
OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)
LITTLE CURRENT RIVER
PROVINCIAL PARK

Legend

- FIELD SITES WITH METAL CONCENTRATIONS HIGHER THAN GUIDELINES
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

Notes:

Detailed Terrain Mapping by WSP 2024.

Data Source:

Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, AAFC, NRCan

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

LOCATION OF FIELD SITES WITH METAL CONCENTRATIONS HIGHER THAN GUIDELINES

0 5 10
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure 7-5

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7.1.8.3. Reclamation Suitability

Section 5.6.3 provides a summary of the soil samples compared against the Northern Forest Region suitability criteria (Alberta Soils Advisory Committee, 1987) and the reclamation suitability categories assigned to each sample. Of the 18 profiles submitted for analyses, eight are located within the effects assessment Local Study Area and include soil sampled from the sites listed in **Section 7.1.8.2**.

Details about limiting factors contributing to poor and unsuitable ratings are provided in **Section 5.6.3**. Details about the rating system, chemical results, and rating calculations are provided in **Attachment G**.

Based on the soil mapping within the effects assessment Local Study Area, approximately 20% of the soils were assigned a Poor reclamation suitability rating, and approximately 8% were assigned an unsuitable suitability rating (**Table 7-5**). As mentioned in **Section 5.6.3**, it should be noted that poor, and even unsuitable assigned ratings do not mean the material cannot be used for reclamation and vegetative regrowth, but that it may require careful planning, good management, and possible soil amendments to change the rating to a more suitable category.

Table 7-5: Soil Reclamation Suitability Ratings in the Effects Assessment Local Study Area and Construction Disturbance Area

Reclamation Suitability Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Good	1,068.3	0.9	33.4	0.7
Fair	1,963.8	1.7	278.6	5.9
Poor	23,458.1	20.2	1,517.8	32.3
Unsuitable	9,324.8	8.0	712.1	15.2
Not Rated[(a)]	80,144.0	69.1	2,158.2	45.9
Total[(b)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Rock (R), water (N), and Organic (O1, O2) were not rated.
(b) Numbers may not add up due to rounding.
ha = hectare; % = percent.

The spatial distribution of soil reclamation suitability ratings in the effects assessment Local Study Area is displayed in **Figure 7-6**.

Camp - Site 5

Camp - Site 6

Camp - Site 4
- Other Option

Albany River
Camp

ALBANY RIVER
PROVINCIAL PARK

Camp - Site 3

Alternative 1
North Camp

OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

Alternative 1
South Camp

LITTLE CURRENT RIVER
PROVINCIAL PARK

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

RECLAMATION SUITABILITY RATINGS

- UNSUITABLE
- POOR
- FAIR
- GOOD
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

RECLAMATION SUITABILITY IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA

0 5 10
Kilometres

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Figure 7-6

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7.1.8.4. Soil Sensitivities

7.1.8.4.1. Soil Wind Erosion Risk

Of the soils that were rated, soil wind erosion risk in the effects assessment Local Study Area is dominantly moderate (**Table 7-6)**. Ratings were not assigned to 69.1% of the effects assessment Local Study Area and nearly half (45.9%) of the Construction Disturbance Area because these are areas of open water, rock, anthropogenic materials, or Organic soils ("Not rated" in **Table 7-6**). A higher percentage (12.4%) of the Construction Disturbance Area has been rated as being at a high risk for wind erosion (compared to 1.5% of the effects assessment Local Study Area). This is likely due to the Construction Disturbance Area being in areas suspected of having sand and gravel aggregate resources which would have a higher risk of being eroded by wind. The spatial distribution of wind erosion risk ratings in the effects assessment Local Study Area is displayed on **Figure 7-7**. Details and discussion about the wind erosion risk ratings are provided in **Section 5.6.4.1**.

Table 7-6: Wind Erosion Risk Ratings in the Effects Assessment Local Study Area and Construction Disturbance Area

Wind Erosion Risk Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Low	9,906.7	8.5	624.9	13.3
Moderate	24,123.6	20.8	1,335.1	28.4
High	1,784.7	1.5	582.1	12.4
Not rated	80,144.0	69.1	2,158.2	45.9
Total[(a)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Numbers may not add up due to rounding.
ha = hectare; % = percent.

Camp - Site 5

Camp - Site 6

Camp - Site 4
- Other Option

Albany River
Camp

ALBANY RIVER
PROVINCIAL PARK

Alternative 1
North Camp

OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

Alternative 1
South Camp

OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

LITTLE CURRENT RIVER
PROVINCIAL PARK

Marten Falls
First Nation

Map Location

Legend

- WATERCOURSE
- CONSTRUCTION DEVELOPMENT AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL WIND EROSION POTENTIAL

- LOW
- MODERATE
- HIGH
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL WIND EROSION RISK IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA

0 5 10
Kilometres

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Figure 7-7

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7.1.8.4.2. Soil Water Erosion Risk

The effects assessment Local Study Area is mostly characterized by subdued surface expressions, and although some slopes are relatively steep, approximately 24.4% of the effects assessment Local Study Area was assigned very low or low water erosion risk ratings (**Table 7-7**). Excluding the areas that were not rated, this is approximately 78.9% of the effects assessment Local Study Area. This is the same within the Construction Disturbance Area, with approximately 76.3% assigned a very low or low water erosion risk rating when areas not rated are excluded. Ratings were not assigned to areas mapped as open water, rock, anthropogenic materials, or Organic soils, and in total these account for approximately 69.1% of the effects assessment Local Study Area. The spatial distribution of water erosion risk ratings in the effects assessment Local Study Area is displayed on **Figure 7-8**.

Table 7-7: Water Erosion Risk Ratings in the Effects Assessment Local Study Area and Construction Disturbance Area

Water Erosion Risk Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Very Low	15,490.5	13.4	1,287.8	27.4
Low	12,782.0	11.0	651.0	13.9
Moderate	5,616.3	4.8	463.7	9.9
High	1,080.5	0.9	50.5	1.1
Severe	845.7	0.7	88.9	1.9
Not rated[(a)]	80,144.0	69.1	2,158.2	45.9
Total[(b)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Areas of water, bedrock, anthropogenic materials, or organic soils were not rated.
(b) Numbers may not add up due to rounding.
ha = hectare; % = percent.

Camp - Site 5

Camp - Site 6

Camp - Site 4
- Other Option

Albany River
Camp

ALBANY RIVER
PROVINCIAL PARK

Alternative 1
North Camp

OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

Alternative 1
South Camp

OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)

LITTLE CURRENT RIVER
PROVINCIAL PARK

Marten Falls
First Nation

Map Location

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL WATER EROSION POTENTIAL

- VERY LOW
- LOW
- MODERATE
- HIGH
- SEVERE
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL WATER EROSION RISK IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA

0 5 10
Kilometres

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Figure 7-8

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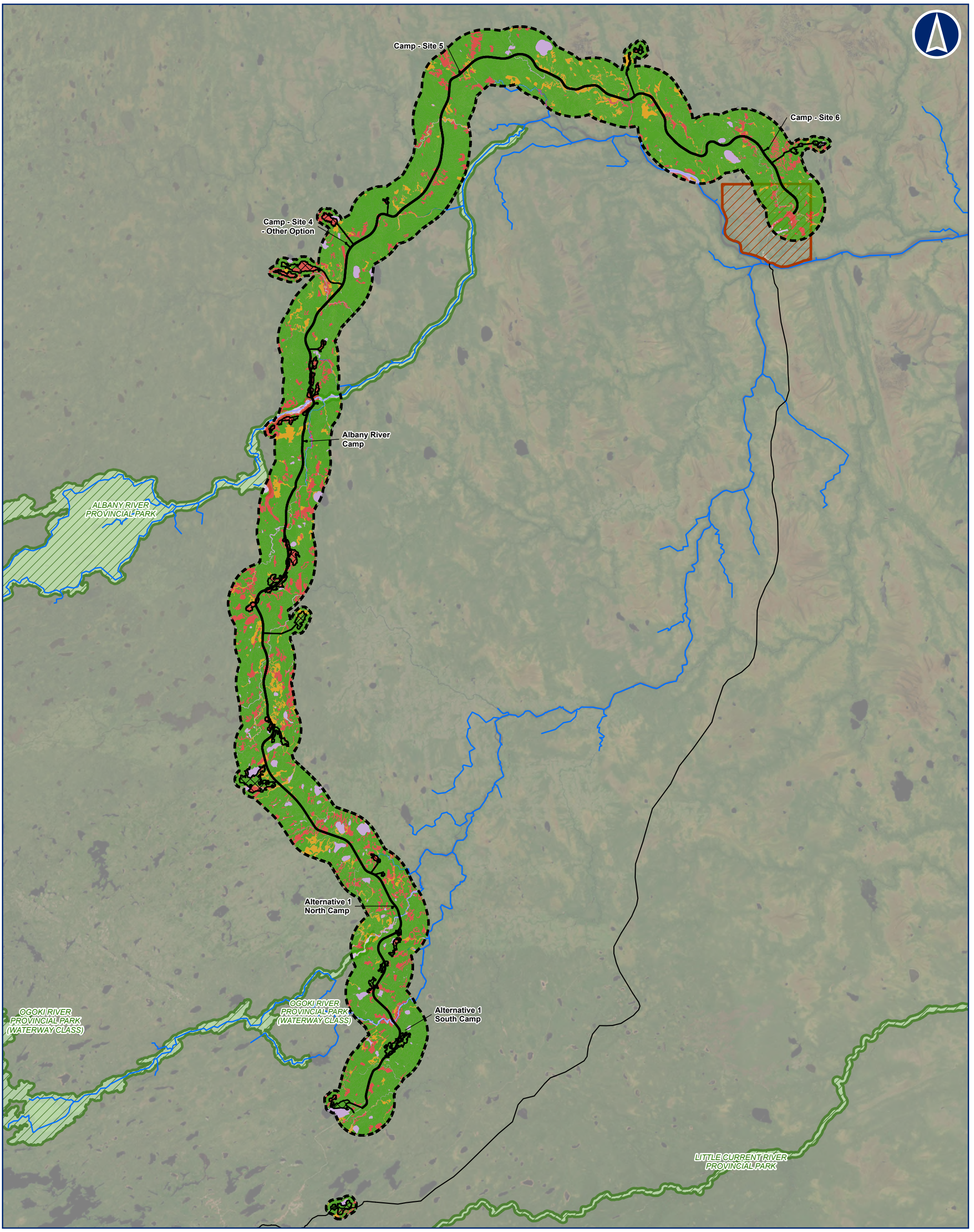
7.1.8.4.3. Soil Sensitivity to Acidification

Soil sensitivity to acidification is assigned based on a soil's cation exchange capacity and pH, therefore although there is some correlation with texture (**Section 4.3**), acidification sensitivity varies in the effects assessment Local Study Area (**Table 7-8, Figure 7-8)**. There is a higher proportion of soils having a high sensitivity to acidification in the effects assessment Construction Disturbance Area than the effects assessment Local Study Area, as the Construction Disturbance Area has targeted potential sand and gravel resources typically consisting of low pH coarse textured soil.

Table 7-8: Acidification Sensitivity Ratings in the Effects Assessment Local Study Area and Construction Disturbance Area

Sensitivity to Acidification Rating	Associated Soil Map Units[(a)]	Local Study Area		Construction Disturbance Area	
		Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Low	GL8, M1, M5, M6, M7, M8, GF5, C1, O1, O2	93,508.3	80.6	3,157.4	67.2
Moderate	L1, L3, M2, O1, O2	5,990.3	5.2	177.3	3.8
High	GL1, GL2, GL3, GL4, GL5, GL6, GL7, L2, M3, M4, M9, GF1, GF2, GF3, GF4	12,450.4	10.7	1,328.9	28.3
Not Applicable	R1, ZWA, ZDR	4,010.0	3.5	36.6	0.8
Total[(b)]		**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Soil Map Unit Descriptions can be found in **Section 5.7.1**.
(b) Numbers may not add up due to rounding.
ha = hectare; % = percent.



Legend

- WATERCOURSE
- CONSTRUCTION DEVELOPMENT AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL SENSITIVITY TO ACIDIFICATION

- LOW
- MODERATE
- HIGH
- N/A

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL SENSITIVITY TO ACIDIFICATION IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA

0 5 10
Kilometres

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Figure 7-9

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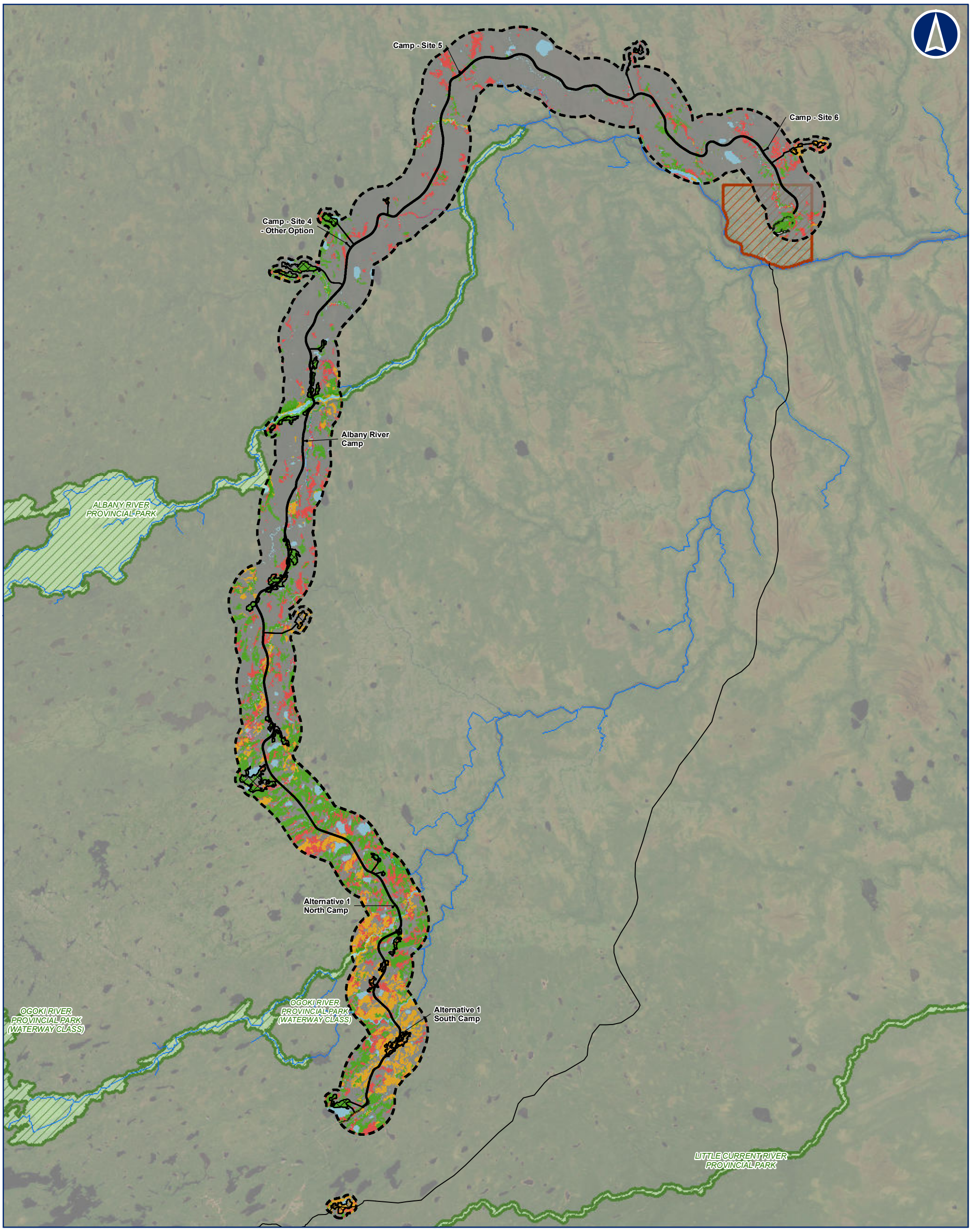
7.1.8.4.4. Soil Compaction Risk

Soil compaction risk is assigned based mainly on soil texture and soil drainage, and therefore the effects assessment Local Study Area has a relatively even distribution of soils that are at a low, moderate, or high risk for compaction (**Table 7-9**). Areas of Organic soils have not been rated but would likely be at a high risk for compaction as mentioned in **Section 4.3.1.5.4**. Open water, bedrock, and previously disturbed areas (i.e., anthropogenic) in the effects assessment Local Study Area were also not rated for compaction risk. **Figure 7-10** shows the spatial extent of compaction risk ratings assigned in the effects assessment Local Study Area.

Table 7-9: Soil Compaction Risk Ratings in the Effects Assessment Local Study Area and Construction Disturbance Area

Soil Compaction Risk Class	Local Study Area		Construction Disturbance Area	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)
Low	17,160.9	14.8	1,703.6	36.2
Moderate	7,542.2	6.5	566.8	12.1
High	11,111.9	9.6	271.6	5.8
Not rated	80,144.0	69.1	2,158.2	45.9
Total[(a)]	**115,959.0**	**100.0**	**4,700.2**	**100.0**

Notes:
(a) Numbers may not add up due to rounding.
ha = hectare; % = percent.



Legend

- WATERCOURSE
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

COMPACTING RATINGS

- LOW
- MODERATE
- HIGH
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)
- NOT RATED (ORGANIC)
- NOT RATED (ROCK)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL COMPACTION RISK IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA

0 5 10
Kilometres

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Figure 7-10

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7.2. Project–Environment Interactions

Measurement indicators are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in indicators representing Project–environment interactions are used to predict overall effects on Valued Components. Three measurement indicators were identified and used for the physiography, terrain, and soils assessment:

- **Quantity and distribution of terrain units**—refers to the amount (area in ha) of each terrain unit and the way each unit is distributed on the landscape. Terrain quantity and distribution are linked to the soil map unit measurement indicator, but terrain focuses on the underlying parent material (i.e., material in which soils form). Metrics of terrain unit quantity and distribution include surficial material, topography, permafrost potential, and slope stability;
- **Quantity and distribution of soil map units**—refers to the amount (area in ha) of each soil map unit and the way each soil map unit is distributed on the landscape. The soil map unit quantity and distribution are linked to the terrain quantity and distribution, but soil map units focus on the mineral and organic material. Metrics of soil map unit quantity and distribution include soil classification, coarse fragment content, and soil texture; and
- **Soil quality (i.e., productivity, reclamation suitability)**—refers to the productivity of the soil as a growth medium on the landscape. Productivity is typically reduced in human-altered environments due to changes in physical properties of soils (e.g., removal of soil and compaction). Metrics used to evaluate soil quality include soil chemistry, soil suitability for reclamation, erosion sensitivity, sensitivity to acidification (i.e., measure of susceptibility to chemical changes after experiencing acid inputs), and sensitivity to compaction.

The analysis of Project–environment interactions for physiography, terrain, and soils that are likely to have a potential effect is provided in **Table 7-10.**

Table 7-10: Project–Environment Interactions

Project Phase	Project Activities	Indicator	Description of Project–Environment Interaction
Construction	■ Clearing the right-of-way (e.g., remove and dispose of trees, shrubs, fallen timber, and surface litter, strip organic materials, grub) ■ Blasting rock (e.g., remove rock at quarries, and as required, at specific locations in association with road and bridge construction) ■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning) ■ Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, watercourse bank grading to improve approaches if required) ■ Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels) ■ Mobilization of equipment, supplies, and personnel (e.g., haulage of materials, solid and liquid waste management, fuel storage, and hazardous materials handling, sewage and effluent treatment and water storage and effluent monitoring for temporary construction camps)	■ Quantity (area in ha) and distribution of terrain units, which includes surficial materials, topography, and slope stability ■ Quantity (area in ha) and distribution of soil map units ■ Soil quality (i.e., productivity, reclamation suitability)	The overall effects due to Project–environment interaction during the Construction Phase can be summarized as follows: ■ Changes to terrain quantity and distribution from Project activities ■ Changes to terrain quantity and distribution (esker landforms) from Project activities ■ Changes to terrain quantity and distribution (slope stability) from Project activities ■ Changes to soil quantity and distribution from Project activities ■ Changes to soil quality (compaction and admixing) from Project activities ■ Changes to soil quality from contamination due to potential leaks or spills of deleterious or hazardous substances from Project activities ■ Changes to soil quality from the transport and deposition of air contaminant emissions (e.g., potential acid inputs) and particulate matter (dust) from Project activities
Operation and Maintenance	■ Operate the Preferred Route ■ Maintain the Preferred Route[(a)]	■ Quantity (area in ha) and distribution of terrain units, which includes surficial materials, topography, and slope stability ■ Quantity (area in ha) and distribution of soil map units ■ Soil quality (i.e., productivity, reclamation suitability)	■ Changes to terrain quantity and distribution from Project activities ■ Changes to terrain quantity and distribution (esker landforms) from Project activities ■ Changes to terrain quantity and distribution (slope stability) from Project activities ■ Changes to soil quantity and distribution from Project activities ■ Changes to soil quality (compaction and admixing) from Project activities ■ Changes to soil quality from contamination due to potential leaks or spills of deleterious or hazardous substances from Project activities ■ Changes to soil quality from the transport and deposition of air contaminant emissions (e.g., potential acid inputs) and particulate matter (dust) from Project activities

Notes:
(a) Includes general maintenance activities (e.g., grading, erosion control, excavation at pits / quarries and processing aggregate, dust suppression), seasonal maintenance activities (e.g., clear vegetation on road shoulders, snow clearing and bridge and culvert maintenance, ditch maintenance), and special maintenance activities (e.g., slope failures and road settlement / break-up).
ha = hectares.

7.3. Assessing Residual Effects

This section presents the potential changes, mitigation and enhancement measures, and predicted residual Project effects for the physiography, terrain, and soils Valued Component. The residual effects analysis considers the Project activity and environmental interaction that is expected to result in effects on physiography, terrain, and soils after implementing mitigation. A summary of the potential changes, mitigation measures, and residual effects are presented in **Table 7-10.** Residual effects are brought forward for characterization into **Section 7.3.1** and into the cumulative effects assessment in **Section 8.**

7.3.1. Potential Effects, Mitigation and Predicted Residual Effects

7.3.1.1. Construction Phase

7.3.1.1.1. Changes to Terrain Quantity and Distribution

Potential Effects

The Project will have a direct effect on terrain in the Construction Disturbance Area during the Construction Phase due to clearing, earth moving, excavation at pits and / or blasting at quarry sites and other road construction activities. Although excavation at pits and quarries is still anticipated as part of road maintenance activities during the Operation and Maintenance Phase, for the purposes of the assessment it is assumed that all pit and quarry sites will reach their maximum footprint extent during the Construction Phase. Alteration of terrain conditions (i.e., quantity and distribution) within the Construction Disturbance Area may change surface expression, surficial material thickness, or associated soil drainage, and could potentially influence the ability of terrain and soil to support the establishment of plant species and vegetation communities and associated wildlife habitat and species. Indigenous Knowledge from Marten Falls First Nation noted generalized concerns related to the potential for overall landscape disturbances and how these changes might affect their usage of the land (Dillon, 2026a; Marten Falls First Nation, 2019). Marten Falls First Nation also noted that they are concerned about how development will affect their connection to the land, including concerns related to the effects of blasting on cultural / spiritual sites. In particular, community members have noted beliefs that the development will alter the natural landscape, thereby impacting the beauty, tranquility, silence, and special places of Marten Falls First Nation's traditional territory (Marten Falls First Nation, 2023).

Mitigation Measures

Mitigation measures that will be implemented during the Construction Phase, wherever and whenever possible are:

- Limit the Project footprint (Construction Disturbance Area) to the extent practicable;
- Minimize areas of vegetation clearing and soil disturbance and optimize the use of existing cleared areas for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way);
- Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control, reclamation procedures, best management practices, and guidelines / policies);
- Minimize stripping and grading of terrain between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and limit to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be stabilized;
- Regrade areas with erosional gullies to conform to the local landform to maintain drainage patterns during decommissioning of temporary infrastructure;
- Strip the overburden from bedrock quarry areas before blasting, or excavating and will be managed in accordance with the *On-Site and Excess Soil Management Regulation* under the Ontario *Environmental Protection Act*; and
- All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act.*

Identification of Predicted Residual Effects

Reclamation and / or rehabilitation of temporary disturbances is predicted to reverse changes to temporarily disturbed terrain units to sustain productive soils, which would support the establishment and succession of vegetation communities with similar function to baseline ecosystems. Rehabilitation in reference to pits and quarries is defined as "*the treatment of land from which aggregate has been excavated so that the use or condition of the land is restored to its former use or condition or is changed to another use or condition that is or will be compatible with the use of adjacent land"* (Government of Ontario, 1990). The establishment of reclaimed terrain is predicted to occur through the decommissioning activities for temporary infrastructure at the end of the Construction Phase. The terrain will be reclaimed by regrading the terrain to blend with existing topography and landforms. In a study conducted in central Alberta, Macyk (1986) suggested reconstructed soils are composites of the original soil units and the resultant soil properties are largely controlled by surficial material characteristics (terrain) and material handling procedures. Irreversible

residual effects from the Project will remain in 84.6% of the Construction Disturbance Area, associated with the areas of permanent disturbance; this change will be brought forward into the Residual Effects Analysis.

For the Operations and Maintenance Phase, it is assumed that activities associated with maintaining the Community Access Road mentioned previously will continue through the Operations and Maintenance Phase; however, no new disturbances outside the Construction Disturbance Area, and in turn, changes to terrain quantity and distribution, are anticipated.

7.3.1.1.2. Changes to Terrain Quantity and Distribution (Esker Landforms)

Potential Effects

Project activities such as constructing the Community Access Road, sand and gravel pit creation and aggregate extraction have the potential to change or remove esker landforms during the Construction Phase. Although excavation at pits and quarries is still anticipated as part of road maintenance activities during the Operation and Maintenance Phase, for the purposes of the assessment it is assumed that all pit and quarry sites will reach their maximum footprint extent during the Construction Phase. Because sand and gravel resources are rare in the effects assessment Local Study Area, the Construction Disturbance Area has been developed to target and include potential esker landforms as a potential aggregate (pit) resource. Indigenous Knowledge from Marten Falls First Nation and Aroland First Nation noted generalized concerns related to the potential for overall landscape disturbances and how these changes might affect their usage of the land (Dillon, 2026a; Dillon, 2026b; Marten Falls First Nation, 2019).

Mitigation Measures

Mitigation and enhancement measures that will be implemented to reduce changes to esker landforms during the Construction Phase include:

- Minimize or avoid the use of eskers or similar geological features for aggregate resources by using bedrock quarries or other sand and gravel resources whenever possible;
- Confirm suitable aggregate material in ridged landforms prior to extraction; and
- All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act.*

Identification of Predicted Residual Effects

Within the effects assessment Local Study Area, eleven polygons were mapped and identified as eskers **Section 7.1.7**). Of those eleven eskers, five have been identified as potential sand and gravel resources within the Construction Disturbance Area (SG-06, SG-19) and would be permanently disturbed to support road construction, operations, and maintenance. Approximately 45% of the esker features identified in the effects assessment Local Study Area will be permanently disturbed, and therefore this effect will be carried forward to the Residual Effects Assessment.

For the Operations and Maintenance Phase, it is assumed that activities associated with maintaining the Community Access Road mentioned previously will continue through the Operations and Maintenance Phase; however, no new disturbances outside the Construction Disturbance Area, and in turn, changes to esker landforms, are anticipated.

7.3.1.1.3. Changes To Quantity and Distribution of Terrain Units (Slope Stability)

Potential Effects

Project activities such as land clearing, site preparation, pit and quarry development, and earth works during the Construction Phase have the potential to cause slope instability and increased probability of failure on slopes, especially those adjacent to watercourses or waterbodies. Although excavation at pits and quarries is still anticipated as part of road maintenance activities during the Operation and Maintenance Phase, for the purposes of the assessment it is assumed that all pit and quarry sites will reach their maximum footprint extent during the Construction Phase.

Mitigation Measures

Mitigation and enhancement measures that will be implemented during the Construction Phase to reduce changes to terrain stability include:

- Avoid or minimize the amount of area for construction facilities that are considered to have terrain that is either unstable or potentially unstable and design slopes for long-term stability. Stabilize slopes, if required;
- Have construction activities occur under frozen or dry conditions as much as possible;
- Avoid construction on highly saturated soil where practicable or use suitable ground equipment to avoid potentially increasing slope instability;
- Regrade areas with erosional gullies to conform to the local landform to maintain drainage patterns;

- Minimize any exposed mineral soil between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and limit to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be left at a stable angle;
- Pit and quarry rehabilitation plans will address final slopes for pit and quarry areas to help to ensure slopes are stable and suitable for reclamation;
- Use low road grades and proper drainage to reduce potential terrain instability, where feasible; and
- Implement progressive reclamation and revegetation of disturbed areas no longer required for construction.

Identification of Predicted Residual Effects

Terrain in the effects assessment Local Study Area is generally stable (**Section 7.1.5**) with only 64 ha of terrain identified as being potentially unstable or unstable. Details on unstable terrain can be found in **Section 5.5.3** and these areas can be found on **Figures H-3a** to **H-3f** in **Attachment H**. Although surficial materials in large portions of the effects assessment Local Study Area have higher potential to be prone to failures, topography in the effects assessment Local Study Area is generally level, with very few areas of slopes steep enough to fail. The potentially unstable or unstable areas were identified almost exclusively adjacent to erosional slopes of watercourses, waterbodies, and peatlands (fens). The implementation of environmental design features, mitigation, and monitoring is expected to avoid adverse residual changes to slope stability potential increased probability of failures; and therefore, this effect was not carried forward to the residual effects assessment.

7.3.1.1.4. Changes to Quantity and Distribution of Soils

Potential Effects

The Project will have direct changes to soil in the Construction Disturbance Area during construction due to clearing, earth moving, pit and quarry development (including excavation and blasting), and other construction activities. Although excavation and blasting at pits and quarries is still anticipated as part of road maintenance activities during the Operation and Maintenance Phase, for the purposes of the assessment it is assumed that all pit and quarry sites will reach their maximum footprint extent during the Construction Phase. Changes to soil conditions (i.e., quantity and distribution) within the Construction Disturbance Area may adversely affect the soils ability to sustain ecosystems. Project activities may affect soil quantity and distribution through an increase in potential soil loss through wind or water erosion, or an alteration of soil map unit distribution.

Mitigation Measures

Mitigation measures that will be implemented during the Construction Phase to reduce changes to soil quantity and distribution wherever and whenever possible are:

- Limit the Project footprint (Construction Disturbance Area) to the extent practicable;
- Minimize areas of vegetation clearing and soil disturbance and optimize the use of cleared area for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way);
- Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control (based on the Ontario Ministry of Transportation's *Erosion and Sediment Control Guide)*, reclamation procedures, best management practices and guidelines / policies);
- Select erosion and sediment control products that correspond with the nature and duration of the Project as recommended in the Project-specific Soil Management Plan;
- Regularly inspect and maintain erosion and sediment control structures (e.g., sediment fences, rip rap or other sediment control structures) during all Project phases and modify measures as necessary. If control measures are not functioning properly, no further work will occur until the problem is resolved;
- Limit duration of soil exposure; phase activities whenever possible, and restore disturbed areas as soon as possible (i.e., implement appropriate erosion and sediment control, and progressive reclamation and revegetation of disturbed areas no longer required);
- Control potential erosion by utilizing an effective road design (including use of engineered culverts and bridges);
- Selectively cut vegetation and restrict clearing and grubbing within areas with steep slopes or soils prone to risk of erosion;
- Do not include mineral soil in the debris piles during clearing;
- Have construction activities occur under frozen or dry conditions as much as possible;
- Use clearing equipment appropriate to the nature of work being conducted that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, and brushes), where feasible. For example, avoid using large machinery when hand tools or smaller scale machinery could be used;
- Regrade areas with vehicle ruts and erosion gullies to conform to the local landform to maintain drainage patterns;

- To the extent practicable, avoid work in sensitive areas (i.e., erosive soils, wetland features, and fish habitats) during periods that may result in high flow volumes and / or increased erosion and sedimentation (e.g., spring freshet) and confirm that soil stockpiles are setback at least 100 m from watercourses;
- Minimize stripping and grading of terrain between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and limit to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be left at a stable angle;
- Use low road grades and proper drainage to reduce soil erosion, where feasible;
- Install and regularly maintain mitigation measures prior to the commencement of any site clearing, grubbing, excavation, filling, or grading works, prior to and after runoff events;
- Where soils are prone to wind erosion, apply tackifier, cover, and seed, apply water or pack the topsoil stockpiles and windrows with approved equipment, especially during periods of high erosion potential (i.e., summer and fall);
- When practicable, consider pre-fabrication (e.g., parts of structures) at an approved off-site location to minimize on-site construction effects;
- Minimize steepness and length of slopes of disturbed areas and stockpiled soils;
- Avoid placing soil stockpiles near waterbodies or drainage features (i.e., a minimum distance of 100 m from watercourses);
- All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act*;
- Manage soil in accordance with the *Best Management Practices for Aggregate Pit and Quarry Rehabilitation in Ontario* (Madeh et al., 2021); and
- Manage any excess construction soil in accordance with the *On-Site and Excess Soil Management Regulation* under the Ontario *Environmental Protection Act*.

Identification of Predicted Residual Effects

Soils in the effects assessment Local Study Area are dominantly rated as having a low or moderate risk of wind erosion because of the finer soil textures noted (**Section 7.1.8.4.1**), and dominantly have Very Low, Low, or Moderate susceptibility to water erosion because of the subdued landscape and lack of steep slopes (**Section 7.1.8.4.2**). A higher proportion of soils with high wind erosion risk (approximately 11% more) were noted in the Construction Disturbance Area than in the effects assessment Local Study Area. This is due to the of the inclusion of sand and gravel resources which are associated with coarser textured soils prone to wind erosion. However, with environmental design features, mitigation, and monitoring, changes in soil distribution are anticipated to be minimized.

Reclamation and rehabilitation are predicted to reverse effects on temporarily disturbed soil map units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project. Rehabilitation in reference to pits and quarries is defined as "*the treatment of land from which aggregate has been excavated so that the use or condition of the land is restored to its former use or condition or is changed to another use or condition that is or will be compatible with the use of adjacent land"* (Government of Ontario, 1990). The establishment of reclaimed soil in temporary components of the Project is predicted to occur well into the Operation and Maintenance Phase, particularly for mature forest types. Irreversible residual effects from the Project will remain in 84.3% of the Construction Disturbance Area, and 3.4% of the effects assessment Local Study Area associated with the areas of permanent disturbance; this change will be brought forward into the Residual Effects Analysis.

For the Operations and Maintenance Phase, it is assumed that activities associated with maintaining the Community Access Road mentioned previously will continue through the Operations and Maintenance Phase; however, no new disturbances outside the Construction Disturbance Area, and in turn, changes to the distribution of soils, are anticipated.

7.3.1.1.5. Changes To Soil Quality from Compaction and Admixing

Potential Effects

For the effects assessment, existing soil quality has been described by categorizing soil based on its suitability for reclamation which takes chemical and physical characteristics of soil into consideration. These include pH, salinity, sodicity, base saturation, stoniness or coarse fragment content, texture, moisture content, and calcium carbonate equivalent (**Section 4.3.1.4**). These characteristics typically change through the soil profile and require that during land clearing and site preparation, benefits of stripping the topsoil separately from the subsoil are considered. Site clearing, earth moving, excavation, pit and quarry development, and other construction activities can cause admixing and compaction which may change the quality of soil.

Mitigation Measures

Mitigation that will be implemented during the Construction Phase to reduce changes to soil quality include:

- Limit the Project footprint (Construction Disturbance Area) to the extent practicable;
- Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control (based on the Ontario Ministry of Transportation's *Erosion and Sediment Control Guide)*, reclamation procedures, best management practices and guidelines / policies);

- Use clearing equipment appropriate to the nature of work being conducted that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, and brushes), where feasible. For example, avoid using large machinery when hand tools or smaller scale machinery could be used;
- Have construction activities occur under frozen or dry conditions as much as possible;
- Use low pressure or rubber tracked vehicles for the early phase of the construction season and only higher-pressure equipment when the ground surface is strong enough to prevent compaction and rutting;
- Avoid construction activities on highly saturated soil (primarily during or immediately after rain events or during freshet) where practicable or use suitable ground equipment to prevent unnecessary soil damage through rutting, for example. Crews should be prepared to stop work in these conditions;
- Regrade areas with vehicle ruts and erosion gullies to conform to the local landform to maintain drainage patterns; and
- De-compact subsoils, temporary access trails and soils damaged during wet weather.

Identification of Predicted Residual Effects

Soil compaction can occur during site clearing, contouring, and excavation if heavy equipment passes over soils that are sensitive to compaction. Generally, well-drained, coarse- and medium-textured soils (i.e., loams, sandy loam, loamy sand, loam) are less prone to compaction than fine-textured soils (i.e., silty clay loam, silty clay, clay loam, and clay). However, sensitivity to compaction can change based on soil moisture conditions (Lewis et al., 1989). Soils within the effects assessment Local Study Area generally have Low susceptibility to compaction; however, soils in level or low-lying areas that are under higher moisture conditions (e.g., Gleysols) have a High susceptibility to compaction, and soils with moderately fine to very fine textures (e.g., the L1, L4, M5 soil map units) are generally rated as having a Moderate susceptibility to compaction (**Section 7.1.8.4.4**).

Admixing of the topsoil (i.e., upper soil horizon or upper lift) with subsoil (i.e., lower soil horizons or lower lift) can occur during site clearing, contouring, and excavation if there is not a clear division (e.g., colour, texture, structural change) between topsoil and subsoil horizons. Admixing can reduce organic matter and carbon content in topsoil materials by incorporating subsoil materials with lower organic matter content, which can alter microbiological activity and composition and increase the rate of organic matter decomposition due to soil aeration (Wick et al., 2009). When soil has been stripped in horizons and stockpiled during disturbance, admixing of horizons can be an issue, but can be mitigated with careful placement techniques (Naeth et al., 2021).

Some soils in the effects assessment Local Study Area, particularly the soil map units associated with glaciolacustrine material (e.g., GL3, GL4, GL7) had different textures in the topsoil and subsoil, so admixing in these soils would result in textural changes in the topsoil material. Most other soil map units had generally uniform textures throughout the soil profile, and therefore, it is not anticipated that admixing would result in textural changes in topsoil material. However, the seed bank, soil organic matter, and surface organic horizons would be diluted if topsoil and subsoil materials were mixed, leading to a decrease in soil quality.

Reclamation and proper soil handling and management is predicted to reverse changes on temporarily disturbed soil map units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project. The establishment of reclaimed soil in temporary components of the Project is predicted to occur well into the Operations and Maintenance Phase, particularly for mature forest types.

Project activities could result in a measurable minor change to soil quality within the Construction Disturbance Area relative to existing conditions; however, the effect is expected to be localized and with the effective implementation of mitigation measures, no residual adverse effects are predicted, and this effect was not carried forward to the Residual Effects Assessment.

7.3.1.2. Construction Phase and Operation and Maintenance Phase

7.3.1.2.1. Changes to Soil Quality from Contamination due to Potential Leaks or Spills of Deleterious or Hazardous Substances

Potential Effects

There is the potential for accidental spills of fuels and other materials resulting in the release of deleterious substances and soil contamination during the Construction and Operation and Maintenance Phases. These can occur from malfunctions of equipment such as hydraulic and fluid leaks, spills during equipment or vehicle refuelling, or from vehicle accidents.

Mitigation Measures

Mitigation measures that will be implemented during the Construction and Operation and Maintenance Phases to reduce changes to soil quality from contamination include:

- Develop and implement a Spill Prevention and Emergency Response Plan, in the event of a spill;
- Adhere to Standard Operating Procedures for fuel handling;

- Construction and operation and maintenance machinery will arrive on site in a clean condition, free from leaks;
- Crews will always keep a spill response kit on site during the work;
- Contain and clean up spills immediately in accordance with provincial regulatory requirements and the Spill Prevention and Emergency Response Plan;
- Transport fuel and hazardous materials in approved containers in licensed vehicles; and
- Require crews using the Community Access Road to report spills to the Ontario Spills Action Centre at 1-800-268-6060.

Community members from Marten Falls First Nation proposed a number of mitigation measures related to pollution control that were outlined within the Marten Falls First Nation *Indigenous Knowledge Land Use and Occupancy Study* (Marten Falls First Nation, 2023) including:

- Provide and make sure holding bats are readily available, so there is less chance of spillage;
- Provide adequate lighting at fuelling stations and monitoring so that people clean up after any spills;
- Provide various pit stops along the Community Access Road where drivers can check their tanks and valves; and
- Provide barriers along the sides of bridges to prevent other chemicals from spilling into waterways beneath them.

Identification of Predicted Residual Effects

The wash-off of fluids from accidental spills and leaks may result in an increase to the concentrations of chemical constituents to soils. However, leaks, or spills are considered avoidable with good planning, adequate design, and proper emergency response. Further to this, the frequency, spatial extent and severity of accidental spills or leaks during the Construction and the Operation and Maintenance Phases of the Project are anticipated to be minimized with the effective implementation of the mitigation and enhancement measures. However, it is recognized that, even with the best planning and the implementation of mitigation measures, the potential exists for accidents and malfunctions. As such, measurable changes (i.e., residual effects) to soil quality in the form of increase to the concentrations of chemical constituents could occur in the event of the wash-off from accidental spills or leaks. This effect is carried forward to the residual effects assessment.

7.3.1.2.2. Changes to Soil Quality from the Transport and Deposition of Air Contaminant Emissions (e.g., Potential Acid Inputs) and Particulate Matter (Dust)

Potential Effects

Deposition of air contaminant emissions associated with Project activities are expected to occur from the combustion of fossil fuels and emission of criteria air contaminants. Criteria air contaminants include particulate matter less than 2.5 micrometres (µm) in diameter ($PM_{2.5}$) and 10 µm in diameter (PM_{10}), total suspended particulates, carbon monoxide, sulphur dioxide, and nitrogen dioxides.

Construction activities such as land clearing, site preparation, site traffic, blasting of rock, burning of non-hazardous waste materials (e.g., food waste), and handling of rock and aggregate materials from pit and quarry operations would generate criteria air contaminant and fugitive dust emissions, which can contain constituents such as metals. Accumulation of dust (i.e., total suspended particulate deposition) and associated constituents, such as metals, may result in changes to the chemical content of soil within affected areas. Changes to the chemical content of soil can alter soil pH and affect soil productivity. At a mine the Northwest Territories, dust generated from a high-traffic, 28 km haul road was found to change soil pH rapidly (i.e., exponentially) within 250 m with smaller changes from 250 m to 1 km away (Chen et al., 2017). Operation and maintenance activities, such as the operation of sand and gravel pits and quarries are also anticipated to result in emission of criteria air contaminants and fugitive dust through the operation of equipment, combustion of fossil fuels and excavation and blasting activities.

Dillon (2024b) notes that acid deposition occurs when emission activities release airborne compounds containing sulphur and nitrogen to the atmosphere where they transform into secondary pollutants (e.g., sulphuric acid, ammonium nitrate, and nitric acid). Acid deposition may have an adverse effect on waterbodies, vegetation, and cause soil nutrient imbalances. Depending on the local airshed (i.e., heavy industry sources), the buffering capacity of the ecosystem or vulnerability to acid deposition may change. The Project location is considered a pristine environment, where heavy anthropogenic sources of emissions are not present (Dillon, 2026b). Air particulate emissions can change soil quality by altering soil pH, nutrient content, and the composition of soil organisms (Rusek and Marshall 2000; Jung et al., 2011; Chen et al., 2017). Air particulates may also affect cation and anion exchange in soil, decomposition rate of organic matter, and nutrient cycling (John et al., 2009; Jung et al., 2011). Deposition of sulphur dioxide and nitrogen dioxides could lead to acidification of soils (Holowaychuck and Fessenden, 1987; Bobbink et al., 1998).

Mitigation Measures

Mitigation measures that will be implemented during the Construction and Operation and Maintenance Phases to reduce changes to soil from emissions and deposition include those listed in the Air Quality and Greenhouse Gas Existing Conditions and Effects Assessment Technical Support Document (Dillon 2026b).

Identification of Predicted Residual Effects

The potential for the Project to contribute to acid deposition was qualitatively assessed by Dillon (2026b) for the Construction and Operation and Maintenance Phases. The Alberta Environment and Parks Alberta Acid Deposition Management Framework (Alberta Government, 2022) was referenced to establish a method to determine the Project's potential to contribute to acid deposition. Dillon (2026b) found that the potential total acidifying emissions of the Project for both the Construction and Operations and Maintenance Phases were found to be well below the threshold recommended in the Alberta Acid Deposition Management Framework and modelling was not considered to be required. Because of this, no residual effect on soil quality is anticipated due to transport and deposition of air contaminant emissions (acid deposition).

Particulate concentrations (Total Suspended Particulate Matter, Particulate matter 10 micrometres or less in diameter, and Particulate matter 2.5 micrometers or less in diameter) could potentially exceed Ambient Air Quality Criteria during Construction, and during Operations, are expected to exceed or be equal to 50% of 24-hr and/or annual criteria (Dillon 2024b). However, there is no predicted change to soil quality anticipated. Based on results from the Geochemical Characterization study (WSP, 2024b), all geochemical samples analyzed for the Project were classified as non-potentially acid generating. In addition, no salt is planned to be used as part of any project activity, so soil salinization from salt in dust production from Construction or Operations and Maintenance phases is not anticipated. No residual effect is expected on soil quality from particulate matter during the Construction or Operations and Maintenance Phases.

Project design and mitigation policies and procedures are anticipated to limit fugitive dust emissions from the Project. Several mitigation measures would be applied to minimize dust deposition, such as watering the access roads and pits and quarries during dry conditions and establishing and enforcing speed limits on access roads to reduce dust production. With the effective implementation of mitigation measures, no residual adverse effects are predicted for the Construction and Operation and Maintenance Phases, and this effect was not carried forward to the Residual Effects Assessment.

7.3.2. Summary of Potential Effects, Mitigation and Enhancement Measures, and Identification of Residual Effects

Table 7-11 provides a summary of the potential effects due to Project–environment interactions during construction and operation of the Project, mitigation and enhancement measures, identification of residual effects identified in previous sections.

Table 7-11: Summary of Potential Effects, Mitigation and Enhancement Measures and Predicted Residual Effects on Physiography, Terrain, and Soils

Valued Component	Project Activities	Project Phase	Description of Project Environmental Interaction	Mitigation and Enhancement Measures	Predicted Residual Effect
Physiography, Terrain, and Soils	■ Blasting rock (e.g., remove rock at quarries, and as required, at specific locations in association with road and bridge construction) ■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning) ■ Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, watercourse bank grading to improve approaches if required) ■ Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels)	Construction	Changes to terrain quantity / distribution from Project activities	■ Limit the Project footprint (Construction Disturbance Area) to the extent practicable; ■ Minimize areas of vegetation clearing and soil disturbance and optimize the use of existing cleared areas for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way); ■ Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control (based on the Ontario Ministry of Transportation's *Erosion and Sediment Control Guide*), reclamation procedures, best management practices and guidelines / policies); ■ Minimize stripping and grading of terrain between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and will be limited to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be stabilized; ■ Regrade areas with erosional gullies to conform to the local landform to maintain drainage patterns during decommissioning of temporary infrastructure; ■ Strip the overburden from bedrock quarry areas before blasting, or excavating and manage in accordance with the *On-Site and Excess Soil Management Regulation* under the Ontario *Environmental Protection Act*; and ■ All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act.*	Residual change to terrain quantity / distribution from Project construction
	■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning)	Construction	Changes to terrain quantity and distribution (esker landforms) from Project activities	■ Minimize or avoid the use of eskers or similar geological features for aggregate resources by using bedrock quarries or other sand and gravel resources whenever possible; ■ Confirm suitable aggregate material in ridged landforms prior to extraction; and ■ All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act.*	Residual change to esker landforms from Project construction
	■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning) ■ Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, watercourse bank grading to improve approaches if required) ■ Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels)	Construction	Changes to terrain quantity and distribution (slope stability) from Project activities	■ Avoid or minimize the amount of area for construction and subsequent operation facilities that are considered to have terrain that is either unstable or potentially unstable and design slopes for long-term stability. Stabilize slopes, if required; ■ Have construction activities occur under frozen or dry conditions as much as possible; ■ Avoid construction on highly saturated soil where practicable or use suitable ground equipment to avoid potentially increasing slope instability; ■ Regrade areas with erosional gullies to conform to the local landform to maintain drainage patterns; ■ Any exposed mineral soil between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, will be kept to an absolute minimum and will be limited to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be left at a stable angle; ■ Use low road grades and proper drainage to reduce potential terrain instability, where feasible; and ■ Implement progressive reclamation and revegetation of disturbed areas no longer required for construction.	No residual effect anticipated

Valued Component	Project Activities	Project Phase	Description of Project Environmental Interaction	Mitigation and Enhancement Measures	Predicted Residual Effect
	■ Clearing of the right-of-way (e.g., remove and dispose of trees, shrubs, fallen timber, and surface litter, strip organic materials, grub) ■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning) ■ Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, watercourse bank grading to improve approaches if required) ■ Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels)	Construction	Changes to soil quantity and distribution from Project activities	■ Limit the Project footprint (Construction Disturbance Area) to the extent practicable; ■ Minimize areas of vegetation clearing and soil disturbance and optimize the use of cleared area for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way); ■ Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control (based on the Ontario Ministry of Transportation's *Erosion and Sediment Control* Guide), reclamation procedures, best management practices and guidelines / policies); ■ Select erosion and sediment control products that correspond with the nature and duration of the Project as recommended in the Soil Management Plan; ■ Regularly inspect and maintain erosion and sediment control structures (e.g., sediment fences, rip rap or other sediment control structures) during all Project phases and modify measures as necessary. If control measures are not functioning properly, no further work will occur until the problem is resolved; ■ Limit duration of soil exposure; phase activities whenever possible, and restore disturbed areas as soon as possible (i.e., implement appropriate erosion and sediment control, and progressive reclamation and revegetation of disturbed areas no longer required); ■ Control potential erosion by utilizing an effective road design (including use of engineered culverts and bridges); ■ Selectively cut vegetation and restrict clearing and grubbing within areas with steep slopes or soils prone to risk of erosion; ■ Do not include mineral soil in the debris piles during clearing; ■ Have construction activities occur under frozen or dry conditions as much as possible; ■ Use clearing equipment appropriate to the nature of work being conducted that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, and brushes), where feasible. For example, avoid using large machinery when hand tools or smaller scale machinery could be used; ■ Regrade areas with vehicle ruts and erosion gullies to conform to the local landform to maintain drainage patterns; ■ To the extent practicable, avoid work in sensitive areas (i.e., erosive soils, wetland features, and fish habitats) during periods that may result in high flow volumes and / or increased erosion and sedimentation (e.g., spring freshet); ■ Stripping and grading of terrain between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, will be kept to an absolute minimum and will be limited to that required to address engineering issues and safety concerns, such as the re ■ oval of hazards. If stripping or grading occurs within such areas, the site will be left at a stable angle; ■ Use low road grades and proper drainage to reduce soil erosion, where feasible; ■ Install and regularly maintain mitigation measures prior to the commencement of any site clearing, grubbing, excavation, filling, or grading works, prior to and after runoff events; ■ Where soils are prone to wind erosion, apply tackifier, cover, and seed, apply water or pack the topsoil stockpiles and windrows with approved equipment, especially during periods of high erosion potential (i.e., summer and fall); ■ When practicable, consider pre-fabrication (e.g., parts of structures) at an approved off-site location to minimize on-site construction effects;	Residual change to soil quantity and distribution from Project construction

Valued Component	Project Activities	Project Phase	Description of Project Environmental Interaction	Mitigation and Enhancement Measures	Predicted Residual Effect
				■ Minimize steepness and length of slopes of disturbed areas and stockpiled soils; ■ Avoid placing soil stockpiles near waterbodies or drainage features (i.e., a minimum distance of 100 m from a watercourse); ■ All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act*; ■ Manage soil in accordance with the *Best Management Practices for Aggregate Pit and Quarry Rehabilitation in Ontario* (Madeh et al., 2021); and ■ Manage any excess construction soil in accordance with the *On-Site and Excess Soil Management Regulation* under the Ontario *Environmental Protection Act*.	
	■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning) ■ Constructing bridges and installing culverts (e.g., surface water management and erosion control, dewatering of the watercourses to create ice bridges, alteration of natural drainage systems, watercourse bank grading to improve approaches if required) ■ Constructing, operating, and decommissioning temporary infrastructure (e.g., remove temporary culverts and bridges, remediate channels)	Construction	Changes to soil quality (compaction and admixing) from Project activities	■ Limit the Project footprint (Construction Disturbance Area) to the extent practicable; ■ Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control (based on the Ontario Ministry of Transportation's *Erosion and Sediment Control Guide*), reclamation procedures, best management practices and guidelines / policies); ■ Use clearing equipment appropriate to the nature of work being conducted that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, and brushes), where feasible. For example, avoid using large machinery when hand tools or smaller scale machinery could be used; ■ Have construction activities occur under frozen or dry conditions as much as possible; ■ Use low pressure or rubber tracked vehicles for the early phase of the Community Access Road construction season and only higher-pressure equipment when the ground surface is strong enough to prevent compaction and rutting; ■ Avoid construction activities on highly saturated soil (primarily during or immediately after rain events or during freshet) where practicable or suitable ground equipment will be utilized to prevent unnecessary soil damage through rutting, for example. Crews should be prepared to stop work in these conditions; ■ Regrade areas with vehicle ruts and erosion gullies to conform to the local landform to maintain drainage patterns; and ■ De-compact subsoils, temporary access trails and soils damaged during wet weather.	No residual effect anticipated
	■ Mobilization of equipment, supplies, and personnel (e.g., haulage of materials, solid and liquid waste management, fuel storage, and hazardous materials handling, sewage and effluent treatment and water storage and effluent monitoring for temporary construction camps)	Construction	Changes to soil quality from contamination due to potential leaks or spills of deleterious or hazardous substances from Project activities	■ Develop and implement a Spill Prevention and Emergency Response Plan, in the event of a spill; ■ Adhere to Standard Operating Procedures for fuel handling; ■ Construction machinery will arrive on site in a clean condition, free from leaks; ■ Construction crews will always keep a spill response kit on site during the work; ■ Contain and clean up spills immediately in accordance with provincial regulatory requirements and the Spill Prevention and Emergency Response Plan; ■ Transport fuel and hazardous materials in approved containers in licensed vehicles; and ■ Require construction crews and drivers of vehicles using the Community Access Road system to report spills to the Ontario Spills Action Centre at 1-800-268-6060; ■ Provide and make sure holding bats are readily available, so there is less chance of spillage; ■ Provide adequate lighting at fuelling stations and monitoring so that people clean up after any spills; ■ Provide various pit stops along the Community Access Road where drivers can check their tanks and valves; and ■ Provide barriers along the sides of bridges to prevent other chemicals from spilling into waterways beneath them.	Residual change to soil quality from contamination due to potential leaks or spills or deleterious or hazardous substances during Project activities

Valued Component	Project Activities	Project Phase	Description of Project Environmental Interaction	Mitigation and Enhancement Measures	Predicted Residual Effect
	■ Operate the Preferred Route ■ Maintain the Preferred Route[(a)]	Operation and Maintenance		■ Implement a Spill Prevention and Emergency Response Plan, in the event of a spill; ■ Adhere to Standard Operating Procedures for fuel handling; ■ Operations and maintenance machinery will arrive on site in a clean condition, free from leaks; ■ Maintenance crews will always keep a spill response kit on site during the work; ■ Contain and clean up spills immediately in accordance with provincial regulatory requirements and the Spill Prevention and Emergency Response Plan; ■ Transport fuel and hazardous materials in approved containers in licensed vehicles; ■ Require maintenance crews and drivers of vehicles using the Community Access Road system to report spills to the Ontario Spills Action Centre at 1-800-268-6060; ■ Provide and make sure holding bats are readily available, so there is less chance of spillage; ■ Provide adequate lighting at fuelling stations and monitoring so that people clean up after any spills; ■ Provide various pit stops along the Community Access Road where drivers can check their tanks and valves; and ■ Provide barriers along the sides of bridges to prevent other chemicals from spilling into waterways beneath them.	Residual change to soil quality from contamination due to potential leaks or spills or deleterious or hazardous substances during Project activities
	■ Constructing the Community Access Road (e.g., overburden excavation and removal, excavation of granular material at pits, remove unsuitable soil, place and compact rock and granular material, trim and shape the road, stockpiling of mineral soil and leaf litter [organic material], and soil handling and replacement from stockpiles at decommissioning) ■ Blasting rock (e.g., remove rock at quarries, and as required, at specific locations in association with road and bridge construction) ■ Mobilization of equipment, supplies, and personnel (e.g., haulage of materials, solid and liquid waste management, fuel storage, and hazardous materials handling, sewage and effluent treatment and water storage and effluent monitoring for temporary construction camps)	Construction	Changes to soil quality from the transport and deposition of air contaminant emissions (e.g., potential acid inputs) and particulate matter (dust) from Project activities	■ Mitigation measures that will be implemented during the Construction and Operation and Maintenance Phases to reduce changes to soil from emissions and deposition include those listed in the Air Quality and Greenhouse Gas Existing Conditions and Effects Assessment Technical Support Document (Dillon 2026b).	No residual effect anticipated
	■ Blasting rock (e.g., remove rock at quarries) ■ Mobilization of equipment, supplies, and personnel (e.g., haulage of materials, solid and liquid waste management, fuel storage)	Operation and Maintenance		■ Mitigation measures that will be implemented during the Construction and Operation and Maintenance Phases to reduce changes to soil from emissions and deposition include those listed in the Air Quality and Greenhouse Gas Existing Conditions and Effects Assessment Technical Support Document (Dillon 2026b).	No residual effect anticipated

Notes:
(a) Includes general maintenance activities (e.g., grading, erosion control, excavation at pits / quarries and processing aggregate, dust suppression), seasonal maintenance activities (e.g., clear vegetation on road shoulders, snow clearing and bridge and culvert maintenance, ditch maintenance), and special maintenance activities (e.g., slope failures and road settlement / break-up).
(b) Various mitigation and enhancement measures have been included from the Marten Falls First Nation Community Access Road Preferred Route Selection and Preliminary Environmental Work Project Proposal (Marten Falls First Nation Chief and Council 2017).
m = metre.

7.4. Characterization of Predicted Residual Effects

The characterization of predicted residual effects considers the predicted effect on physiography, terrain, and soils after implementing mitigation (**Table 7-11**) and was structured using separate subsections for each of the physiography, terrain, and soils measurement indicators in the Construction Disturbance Area. The characterization of residual effects assumes that all temporary disturbances that are decommissioned and / or abandoned, will be reclaimed so that physiography, terrain, and soils can support the establishment of plant species and vegetation communities and associated wildlife habitat and species over time.

Residual effects resulting from the Project have been assessed using the assumption that physiography, terrain, and soils in the entire Construction Disturbance Area would be altered (**Section 4.2.3**). Assuming effective implementation of all mitigation and enhancement measures presented in **Table 7-11,** residual effects as a result of the Project are predicted for physiography, terrain, and soils and are included in the characterization of predicted residual effects and cumulative effects assessment. Predicted residual effects are characterized according to the effect characteristics of context, direction, magnitude, geographic extent, duration, frequency, reversibility, and likelihood (**Section 4.4.2.4**). A description of the predicted residual effects of the Project on physiography, terrain, and soils and prediction confidence is presented below and summarized in **Section 7.4.3.**

7.4.1. Quantity and Distribution of Terrain Units

7.4.1.1. Changes to Terrain Quantity and Distribution from Construction Activities

In the Existing Conditions section, surficial material (i.e., terrain units) distribution and slope stability were identified (**Section 7.1.3**). The organic terrain unit comprises the largest proportion (43.6%) of the Construction Disturbance Area with till (26.9%), glaciolacustrine (14.9%), and glaciofluvial (12.3%) materials comprising the next largest areas in the Construction Disturbance Area. It has been assumed the entire Construction Disturbance Area footprint will be disturbed to take a conservative approach to the assessment. It has also been assumed no areas of open water will be removed or added, and exposed bedrock areas used in quarry activities will change to anthropogenic disturbance. The area of anthropogenic disturbance increases from 1.7 ha in the existing conditions, to 4,674.2 ha after construction and represents 99.5% of the Construction Disturbance Area and 4% of the effects assessment Local Study Area (**Table 7-12**). All natural terrain units in the Construction Development Area would change to disturbance (Anthropogenic) terrain units, except for water, which is assumed to remain unchanged. Approximately 699.7 ha of the Construction Disturbance Area are to be temporarily disturbed and will be reclaimed during the Construction Phase, resulting in 84.6% of the Construction Disturbance Area being permanently disturbed, or 3.4% of the effects assessment Local Study Area.

Although it has been assumed all pits and quarries will be permanently disturbed for this characterization all pits and quarries are required to be rehabilitated as per the *Aggregate Resources Act*.

Table 7-12: Change in Terrain Map Unit Areas in the Effects Assessment Local Study Area from Construction Activities

Terrain Map Unit	Existing Conditions[a]		Project Effect		Decommissioned (Reclaimed) Area[b]		Residual Effect (Area Lost / Gained)[b]	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)	Area (ha)	Percentage of Local Study Area (%)	Area (ha)	Percentage of Terrain Lost or Gained in the Local Study Area (%)
Anthropogenic (A)	57.1	<0.1	4,676.8	99.5	0	0	3,994.3	3.4
Colluvium (C)	58.9	0.1	0.0	0.0	0.9	<0.1	-4.5	-<0.1
Fluvial (F)	1,039.5	0.9	0.0	0.0	2.1	<0.1	-31.4	-<0.1
Glaciofluvial (FG)	1,730.3	1.5	0.0	0.0	2.0	<0.1	-574.6	-0.5
Lacustrine (L)	63.1	0.1	0.0	0.0	0.0	0.0	-1.9	-<0.1
Glaciolacustrine (LG)	4,070.2	3.5	0.0	0.0	39.7	<0.1	-656.6	-0.6
Moraine (till) (M)	31,291.8	27.0	0.0	0.0	133.7	0.1	-1,094.7	-1.1
Open Water (N)	5,007.7	4.3	23.5	0.5	0.0	0.0	0.0	0.0
Organic (O)	72,266.0	62.3	0.0	0.0	522.4	0.5	-1,599.3	-1.8
Bedrock (R)	374.3	0.3	0.0	0.0	0.0	0.0	-15.3	-<0.1
Total Terrain Unit Area	115,959.0	100.0	4,700.2	100.0	699.7	0.6	-3,977.4	-3.4

Notes:
(a) Existing conditions areas for terrain units reflect the incorporation of deciles. Deciles are used to indicate the proportion of more than one terrain type within a terrain unit when they cannot be delineated separately due to scale (e.g., 70% till, 30% bedrock).
(b) These numbers reflect a permanent disturbance of all pits and quarries to be conservative, however all pits and quarries will be rehabilitated as per the *Aggregate Resources Act*.
ha = hectare; % = percent; - = negative; < = less than.

Residual effects from Project-related changes in natural terrain units during the Construction Phase would be direct effects, of certain likelihood, and negative in direction. Effects would be expected to be confined to the Construction Disturbance Area and continuous from the start of the Construction Phase. The magnitude and geographic extent of effects are assumed to be the entire extent of the Construction Disturbance Area to be conservative, even though some of the Construction Disturbance Area is likely to remain undisturbed and / or is expected to be reclaimed during decommissioning in the Construction Phase.

Effects associated with permanent features of the Project (e.g., the Community Access Road) are irreversible. The effects from disturbance on terrain units not covered by permanent features are reversible following decommissioning and reclamation. The removal of geomorphic characteristics of natural terrain units cannot be recovered, but over time, these units are expected to provide functional substrates for soils and the establishment of early seral vegetation communities (i.e., young vegetation communities that occupy reclaimed areas). It should be noted that in the effects assessment Local Study Area, quarry (bedrock) and sand and gravel (pit) resources are not readily available. The Construction Disturbance Area has targeted these potential resource areas resulting in a much higher proportion of bedrock outcrops and sand and gravel resources (e.g., eskers) being negatively affected by the Project.

Project activities and components would alter terrain conditions (i.e., quantity and distribution), which could subsequently adversely affect soil productivity and the types of ecosystems that can be re-established on the landscape through reclamation. Project activities that would affect terrain quantity and distribution include land clearing and site preparation for infrastructure and facilities during Construction, hauling and deposition of aggregate (e.g., bedrock, sand, and gravel), and other materials during Construction, and removal of infrastructure and facilities and associated reclamation and revegetation of non-permanent Project components through decommissioning and reclamation activities at the end of the Construction Phase. As this residual effect is of negligible magnitude and certain to occur, the effect was carried forward into the cumulative effects assessment.

7.4.1.2. Changes to Terrain Quantity and Distribution (Esker Landforms) from Construction Activities

In the effects assessment Local Study Area, five of the eleven polygons (45%) identified as eskers would be permanently disturbed or destroyed as they are associated with sand and gravel resources within the Construction Disturbance Area (aggregate pits SG-06 and SG-19 [**Figure H-3a** and **H-3e**, respectively]). Although the sand and gravel pits are required to be rehabilitated based on the *Aggregate Resources Act*, it is not feasible to recreate an esker landform as the material forming the landform is to be used as an aggregate resource. Therefore, all five esker polygons are considered to be permanently disturbed or destroyed.

Although sand and gravel resources are rare in the effects assessment Local Study Area, and knowledge from Marten Falls First Nation and Aroland First Nation noted generalized concerns related to the potential for overall landscape disturbances and how these changes might affect their usage of the land (Dillon, 2026a; Marten Falls First Nation, 2019), fewer than half of these landforms are predicted to be disturbed.

As this residual effect is of medium magnitude and certain to occur, the effect was carried forward into the cumulative effects assessment.

7.4.2. Quantity and Distribution of Soil Map Units

7.4.2.1. Changes to Quantity and Distribution of Soils from Construction Activities

The existing conditions soil map units were assessed against the Construction Disturbance Area Project effect which assumed 100% of the Construction Disturbance Area would be disturbed. The O2 soil map unit (peatlands) comprises the largest proportion (35.2%) of the Construction Disturbance Area, followed by the M1, GF1, and O1 soil map units (

Table 7-13). During the Project, the amount of soil disturbance increases to 4,665.5 ha from 1.7 ha in the existing conditions and represents 99.3% of the Construction Disturbance Area. This area includes 4,608.4 ha of new disturbance plus the 1.7 ha of existing disturbance in the existing conditions. All natural soil units in the Construction Disturbance Area change to disturbance units (ZDL), except for water (ZWA), which is assumed to remain unchanged in available area and bedrock (R1) which is considered to be a non-soil and would remain unchanged in available soil area.

Table 7-13: Change in Soil Map Unit Areas in the Effects Assessment Local Study Area from Project Activities

Soil Map Unit[a]	Existing Conditions		Project Effect		Decommissioned (Reclaimed) Area[b]		Residual Effect (Area Lost / Gained)[a]	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)	Area (ha)	Percentage of Local Study Area (%)	Area (ha)	Percentage of Soil Map Units Lost or Gained in the Local Study Area (%)
C1	60.3	0.1	0.0	0.0	0.9	<0.1	-4.5	-<0.1
F1	1,068.3	0.9	0.0	0.0	2.1	<0.1	-31.4	-<0.1
GF1	1,331.2	1.1	0.0	0.0	2.0	<0.1	-517.4	-0.4
GF2	128.4	0.1	0.0	0.0	0.0	<0.1	-8.9	-<0.1
GF3	127.9	0.1	0.0	0.0	0.0	<0.1	-42.7	-<0.1
GF4	95.9	0.1	0.0	0.0	0.0	<0.1	-0.0	-<0.1
GF5	44.1	<0.1	0.0	0.0	0.0	<0.1	-5.7	0.4
GL1	484.7	0.4	0.0	0.0	5.3	<0.1	-234.1	-0.2
GL2	81.4	0.1	0.0	0.0	2.0	<0.1	-13.8	-0.1
GL3	820.5	0.7	0.0	0.0	10.3	<0.1	-215.0	-<0.1
GL4	423.1	0.4	0.0	0.0	2.1	<0.1	-61.6	-<0.1
GL5	304.0	0.3	0.0	0.0	0.6	<0.1	-12.0	0.2
GL6	263.8	0.2	0.0	0.0	2.2	<0.1	-6.6	-<0.1
GL7	622.5	0.5	0.0	0.0	6.5	<0.1	-39.0	0.2
GL8	666.9	0.6	0.0	0.0	10.2	<0.1	-43.9	0.1
L1	14.0	<0.1	0.0	0.0	0.0	<0.1	-0.5	-<0.1
L2	1.0	<0.1	0.0	0.0	0.0	<0.1	-0.3	-<0.1
L3	31.8	<0.1	0.0	0.0	0.0	<0.1	-1.1	-<0.1
M1	13,330.8	11.5	0.0	0.0	65.6	0.1	-505.8	-0.4
M2	933.4	0.8	0.0	0.0	1.9	<0.1	-2.8	-<0.1

Soil Map Unit[a]	Existing Conditions		Project Effect		Decommissioned (Reclaimed) Area[b]		Residual Effect (Area Lost / Gained)[a]	
	Area (ha)	Percentage (%)	Area (ha)	Percentage (%)	Area (ha)	Percentage of Local Study Area (%)	Area (ha)	Percentage of Soil Map Units Lost or Gained in the Local Study Area (%)
M3	7,613.9	6.6	0.0	0.0	28.2	<0.1	-113.0	-0.1
M4	27.7	<0.1	0.0	0.0	0.0	0.0	0.0	0.0
M5	4,135.4	3.6	0.0	0.0	15.1	<0.1	-312.2	-0.3
M6	302.1	0.3	0.0	0.0	0.0	<0.1	-11.1	-<0.1
M7	1,349.8	1.2	0.0	0.0	8.8	<0.1	-45.4	-<0.1
M8	1,427.7	1.2	0.0	0.0	13.3	<0.1	-131.0	0.1
M9	124.5	0.1	0.0	0.0	1.3	<0.1	-4.0	-<0.1
O1	29,452.1	25.4	0.0	0.0	146.7	0.3	-320.2	-0.3
O2	46,681.9	40.3	0.0	0.0	375.7	1.1	-1,279.0	-1.1
R1	45.9	<0.1	15.3	0.3	0.0	0.0	0.0	0.0
ZDL	57.1	<0.1	4,665.5	99.3	0.0	0.0	3,994.3	3.4
ZWA	3,907.0	3.4	19.4	0.4	0.0	0.0	0.0	0.0
Total soil map unit Area	**115,959.0**	100.0	4,700.2	100.0	700.8	0.6	-3,962.1	-3.4

Notes:
(a) Soil Map Unit Descriptions can be found in **Section 5.7.1**.
(b) These numbers reflect a permanent disturbance of all pits and quarries to be conservative, however all pits and quarries will be rehabilitated as per the *Aggregate Resources Act*.

ha = hectare; % = percent; - = negative; < = less than.

Residual effects from Project-related changes in the quantity and distribution of soil map units would be direct effects, of certain likelihood, and negative in direction. Effects would be expected to be confined to the residual effects Construction Disturbance Area and continuous from the start of Construction through to the decommissioning and reclamation activities in the Construction Phase. The magnitude and geographic extent of effects are assumed to be the entire extent of the residual effects Construction Disturbance Area to be conservative, even though some of the residual effects Construction Disturbance Area is likely to remain undisturbed and / or is expected to be reclaimed during decommissioning in the Construction Phase.

Effects associated with permanent features of the Project (e.g., the Community Access Road itself) are irreversible. The effects from disturbance on soil map units not covered by permanent features are reversible following decommissioning and reclamation activities within the Construction Phase. Natural soils form from complex interactions between terrain, weather, and other factors and may take thousands of years to develop. For example, Canadian soils began forming about 17,000 years ago (Pennock, 2021). Disturbed soils can be reclaimed with appropriate mixing of materials, and over time (long term), support similar ecosystem functions as natural soils. Studies have shown that reconstructed soils can perform similarly in function to natural soils and can support equivalent plant communities (Holl, 2002; Séré et al., 2008). Therefore, the conversion of natural soils to disturbed soils is predicted to be reversible in temporarily disturbance areas. Reclamation is predicted to reverse effects on disturbed soil map units and provide productive soils to support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project. The establishment of reclaimed soils and associated vegetation ecosystems is predicted to occur well into the Operation and Maintenance Phase, particularly for mature forest types (e.g., forests more than 60 years of age).

The Project footprint would be limited to the extent practicable to minimize changes in quantity and distribution of soil units. Vegetation clearing and soil disturbance would also be limited to the minimum area required and work in areas containing soils sensitive to loss (e.g., by erosion) would be scheduled during non-sensitive times of the year (e.g., outside of spring freshet), to the extent practicable. Progressive reclamation and revegetation would be completed as facilities are removed and areas are no longer required for the Project to avoid prolonged soil exposure and potential soil loss. As this residual effect is of negligible magnitude and certain to occur, the effect was carried forward into the cumulative effects assessment.

7.4.2.2. Residual Changes to Soil Quality from Accidental Fuel Spills and Leaks during the Construction and Operation and Maintenance Phases

Accidental spills and leaks from pit and quarry aggregate extraction and processing, the transportation, storage, and handling of hazardous materials during the construction, and the operation of vehicles and equipment during the Construction and Operation and Maintenance Phases, could occur, and, if occurring in high enough volumes, could change the chemical constituents and affect soil quality.

The residual effect will be direct because the relevant Project activities are expected to directly affect soils. The residual effect was assessed as negative in direction because accidental spills and leaks may result in an increase to the concentrations of chemical constituents in receiving waterbodies. The residual effect was characterized as low magnitude because potential volumes / loads to soils are expected to be minor. The residual effect is expected to be short-term in duration, given that spills and leaks will be contained and cleaned up as soon as possible following incidents. The residual effect was assessed to be infrequent (i.e., limited to upset conditions that are not part of the normal or typical operation of the Project). The residual effect is predicted to be reversible as the soil quality is expected to return to existing conditions upon implementation spill mitigation measures. The geographic extent of the residual effect is expected to be limited to the residual effects Construction Disturbance Area, because any increases to the concentrations of chemical constituents are anticipated to be limited to the area of the spill. The likelihood of occurrence of the effect was assessed as possible (the effect may occur, but is not likely), given that the implementation of the detailed Spill Prevention and Emergency Response Plan, which will be developed with consideration for applicable regulations and guidelines for spill management and clean-up, is expected to minimize opportunities for the wash-off of spills and leaks from relevant Project activities to enter nearby waterbodies.

As this residual effect is of negligible magnitude, infrequent and possible to occur, the effect was not carried forward into the cumulative effects assessment.

7.4.3. Prediction Confidence and Uncertainty

Scientific inference is associated with uncertainty, and prediction confidence (i.e., the level of confidence in assessment results) depends on the level of uncertainty and the way this uncertainty is addressed. Primary factors affecting confidence in the predictions made in the physiography, terrain, and soils assessment include:

- Availability of baseline field data;
- Availability and accuracy of baseline data (e.g., surficial geology maps, soil maps, Digital Elevation Model resolution, stereo imagery quality);
- Level of understanding of the interactions in terms of the effects they are likely to have on physiography, terrain, and soils;

- Level of certainty associated with the effectiveness of proposed mitigations, where applicable; and
- Level of understanding of baseline physiography, terrain, and soils conditions and range of natural variation.

Uncertainty was managed by:

- Reviewing historical data, previous baseline studies and conducting relevant baseline studies in the residual effects Local Study Area;
- Completing quality assurance and quality control of baseline data;
- Inferring that terrain and soil types would be present in delineated mapped areas where they were not directly observed;
- Using the best available land cover and surficial geology / soil data for mapping terrain and soil in the residual effects Local Study Area, and using that information to aid in extrapolating terrain and soil map units;
- Using data to make inferences about potential changes to physiography, terrain, and soils from Project effects;
- Using the assumption that the entire residual effects Construction Disturbance Area would be disturbed to increase confidence that effects are not underestimated; and
- Comparing assessment results to relevant published scientific literature.

Overall, there is a moderate to high degree of confidence in predictions related to the changes to physiography, terrain, and soils. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential effects. There is some residual uncertainty regarding the quantity and distribution of reclaimed terrain and soils units, and the level of soil productivity for revegetation during and after decommissioning. Additional studies for permafrost along with potential detailed design changes, if necessary, are suggested. Monitoring is proposed to be used to address residual uncertainty by evaluating the progress of reclamation activities. Different approaches and methods would be implemented, if necessary, to establish a trajectory towards the successful regeneration and succession of vegetation ecosystems that are functionally similar to natural plant communities in the region.

Overall, the level of uncertainty was considered to be moderate because there were limited baseline data available, the Project-related effects are mostly understood, and the level of certainty associated with the effectiveness of proposed mitigations is moderate to high.

7.4.4. Summary

Table 7-14 provides a summary of the predicted residual effects and their associated effects characteristics for physiography, terrain, and soils.

Table 7-14 Characterization of Predicted Residual Effects for Physiography, Terrain, and Soils Valued Component

Valued Component	Predicted Residual Effect	Context	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Uncertainty	Direct / Indirect
Physiography, Terrain, and Soils	Changes to terrain quantity and distribution	The total area of permanent loss of terrain (3.4% of the Local Study Area) is low when taking community access and industrial supply needs into consideration.	Negative	Negligible - 3,977.4ha of natural terrain units under existing conditions permanently disturbed (3.4% of the Local Study Area)	Construction Disturbance Area	■ Long term: natural terrain units covered by permanent features (e.g., Marten Falls First Nation Community Access Road) ■ Medium-term for temporarily disturbed (reclaimed) terrain units	Infrequent	■ Irreversible: natural terrain map units covered by permanent features (e.g., Marten Falls First Nation Community Access Road)	Certain	Moderate	Direct
	Changes to esker landforms	Eleven natural esker landforms were mapped in the Local Study Area. Approximately 45% of these will be permanently disturbed.	Negative	Medium – Five of the 11 natural esker landforms will be permanently disturbed within the Local Study Area	Construction Disturbance Area	■ Long term	Infrequent	■ Irreversible	Certain	Moderate	Direct
	Changes to soil quantity and distribution	The total area of permanent loss of soil map units (3.4% of the Local Study Area) is low when taking community access and industrial supply needs into consideration. The resilience and adaptive capacity of reclaimed soils are high.	Negative	Negligible - 3,962.1ha of natural soil map units under existing conditions permanently disturbed (3.4% of the Local Study Area)	Construction Disturbance Area	■ Long term: soil map units covered by permanent features (e.g., Marten Falls First Nation Community Access Road) ■ Medium-term for temporarily disturbed (reclaimed)soil map units	Infrequent	■ Irreversible: soil map units covered by permanent features (e.g., Marten Falls First Nation Community Access Road) ■ Reversible: for reclaimed (temporary) soil map units	Certain	Moderate	Direct
	Changes to soil quality from accidental spills and leaks during all Project phases	Accidental spills and leaks will be confined to the Construction Disturbance Area and with mitigation, will not have any residual effects.	Negative	Negligible	Construction Disturbance Area	■ Short-term	Infrequent	■ Reversible	Possible	Moderate	Direct

ha = hectare; % = percent.

8. Cumulative Effects Assessment

The *Canadian Environmental Assessment Act, 2012* (Government of Canada, 2019) requires that each Environmental Assessment of a project take into account any cumulative environmental effects that are likely to result from the project in combination with the environmental effects of other physical activities that have been or will be carried out.

This section presents the assessment of potential cumulative effects completed as part of the Project. The effects of present and reasonably foreseeable activities in the effects assessment Study Area and Valued Components identified for the Project were assessed and results are described in the following sections.

The cumulative effects assessment builds on the results of the effects assessment described in **Section 7** and will consider the incremental changes that are predicted to have a likely residual adverse effect on a Valued Component.

8.1. Cumulative Effects Scoping

8.1.1. Valued Components with Residual Effects

The results of the effects assessment completed in **Section 7** which have been carried forward for assessment of cumulative effects are described in **Table 8-1.**

Table 8-1: Valued Components and Residual Effects

Valued Component	Residual Effect
Physiography, Terrain, and Soils	Residual changes to terrain quantity and distribution from construction activities
	Residual changes to terrain quantity and distribution (esker landforms) from construction activities
	Residual changes to quantity and distribution of soils from construction activities

8.1.2. Spatial and Temporal Boundaries

The spatial boundary for the cumulative effects assessment corresponds to the geographic extent that the likely residual adverse effects of the Project are predicted to occur. The study area used in the cumulative effects assessment is the physiography, terrain, and soils Regional Study Area which is an 11 km buffer on either side of the Project centreline (**Table 8-2**).

Temporal boundaries for the cumulative effects assessment correspond to the duration that the likely residual adverse effects of the Project are predicted to occur. There are currently no plans to decommission the Community Access Road as there is no expected / known end date for its need. Therefore, future suspension, decommissioning, and eventual abandonment of the Community Access Road are not considered in this Report. These will be considered if, and when, a decommissioning or abandonment application is made for the Community Access Road. As a result, this assessment is limited to identifying and assessing cumulative effects during the Project Construction and Operations and Maintenance Phases (**Table 8-2**).

The Project is planned to occur in two phases:

- **Construction Phase**—The time from start of construction, including site preparation activities, to start of operations and maintenance of the Community Access Road. Decommissioning of construction works is included in the Construction Phase. The Construction Phase is anticipated to take approximately three to ten years to complete; and
- **Operation and Maintenance Phase**—The Operations and Maintenance Phase starts once construction activities are complete and lasts for the life of the Project. The Operation and Maintenance Phase of the Project is considered to be permanent based on the expected timeline for when major refurbishment of road components (e.g., bridges) is anticipated.

Table 8-2: Spatial and Temporal Boundaries

Valued Component	Spatial Boundary	Temporal Boundary
Physiography, Terrain, and Soils	Regional Study Area - 11 km buffer on either side of the Project centreline	■ Construction ■ Operation and Maintenance

km = kilometre.

8.1.3. Physical Activities Inclusion List

To determine the spatial boundaries of potential cumulative effects, four related projects within the physiography, terrain and soils effects assessment Regional Study Area were considered for the cumulative effects assessment (**Table 8-3**, **Figure 8-1**).

The proposed Northern Road Link would be a new all-season multi-use gravel road to be constructed between the Marten Falls First Nation Community Access Road and the Webequie Supply Road in northwestern Ontario (**Table 8-4**). The construction schedule is not finalized; however, the expectation is for the Northern Road Link to begin construction during the construction of the northern portion of Community Access Road.

The Anaconda and Painter Lake road upgrades will be completed to allow construction of the Project as they are required for heavy vehicles accessing the Project route during the Community Access Road Construction and Operation and Maintenance phases. The potential scope of work is expected to include roadway widening, culvert and bridge replacements / rehabilitations to accommodate higher weight vehicles, and road base improvements. These upgrades would be completed in advance of the Community Access Road Construction phase. The forestry road upgrades are in the planning and design study phase.

The Rapid Lynx Broadband project involves laying heavily armored fibre-optic cable approximately 1 m underground, with some aerial sections. Construction and installation began in 2020, with sections of Phase 1 construction having already been completed, including the section near the Project. It is assumed the installation of fibre-optic cable does not require permanent disturbance.

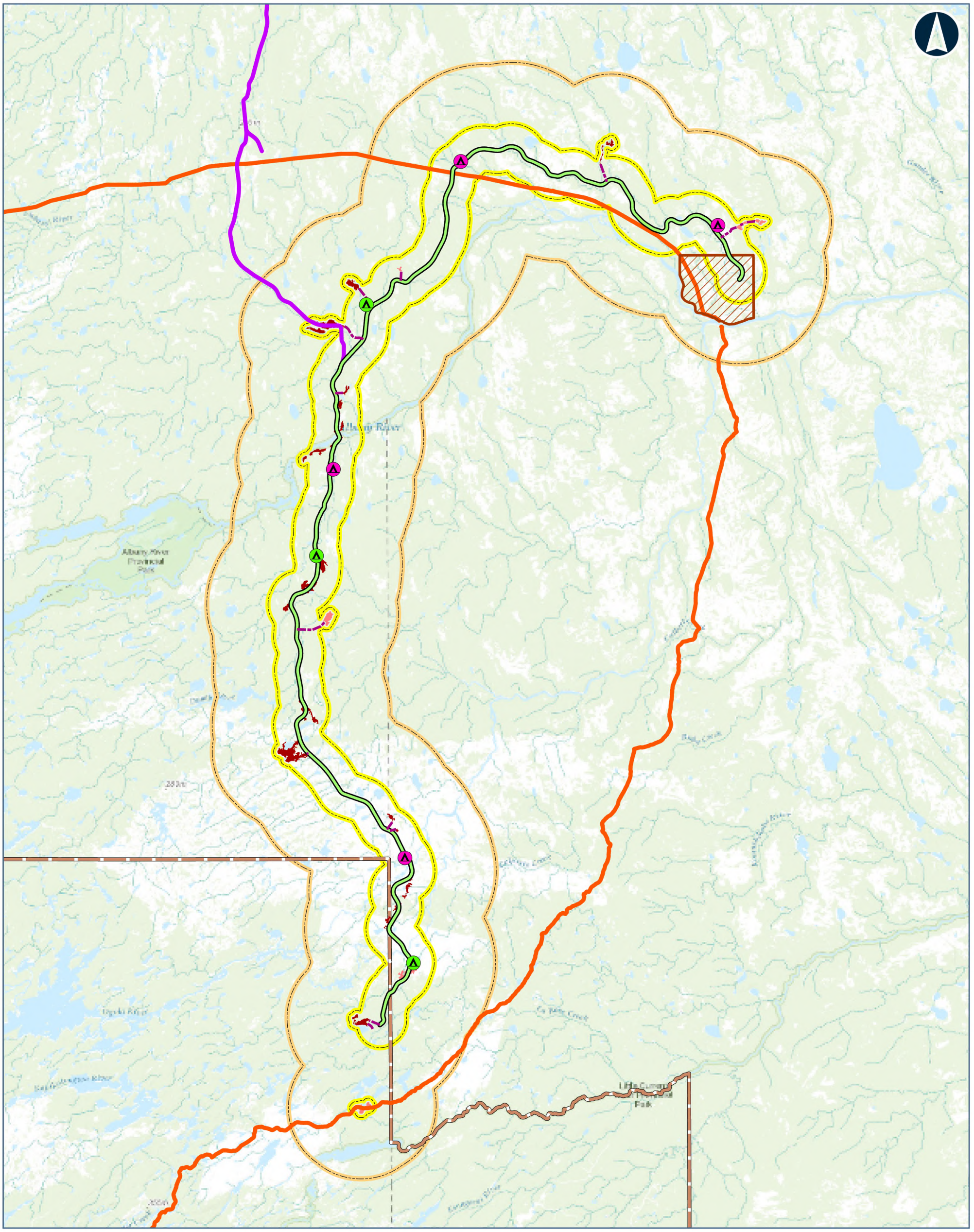
The Winter Road Realignment Project provides funding to remote northern communities to support upgrades to existing winter roads, including the installation of water crossing infrastructure, such as pre-engineered bridges and culverts, and repairs to existing structures. Although the Project applies to multiple routes totalling approximately 3,200 km of winter roads in Ontario, it is treated as a single program-level initiative. It is assumed that any upgrades or realignment work as part of the Winter Road Realignment Project will not require permanent disturbance.

Table 8-3: Project and Physical Activity Inclusion List for Physiography, Terrain and Soils

Project	Identified in *Tailored Impact Statement Guidelines* (Yes / No)	Location	Status	Distance (km) and Direction from the Project	Developer / Company	Project Start Date	Project Duration	Project Completion Date	Assumed Temporal Overlap with Community Access Road Activities (Y / N)	Project Description	Physiography, Terrain and Soils Valued Components Temporal Overlap with Project (Y / N)	Physiography, Terrain and Soils Valued Components Spatial Overlap with Project (Y / N)	Included in Cumulative Effects Assessment (Y / N)
Northern Road Link	Yes	Between the Community Access Road and Webequie Supply Road, northwestern Ontario	Impact Assessment ongoing	0 (adjacent or overlapping)	Webequie First Nation Marten Falls First Nation	October 28, 2020	Unknown	Unknown	Yes – construction and operation will overlap with Community Access Road construction (expected for Northern Road Link to begin construction during construction of northern portion of Community Access Road).	■ Marten Falls First Nation and Webequie First Nation are proposing to build, operate and maintain a multi-use road and associated infrastructure between the Community Access Road that has been proposed by Marten Falls First Nation and the supply road that has been proposed by Webequie First Nation. ■ *Terms of Reference* for the preparation of an Environmental Assessment were approved March 3, 2023.	Yes	Local Study Area – Yes Regional Study Area – Yes	Yes
Anaconda and Painter Lake Road Upgrades	Yes	James Bay Lowlands	Unknown	0 (adjacent or overlapping)	In discussions: Ministry of Transportation, Ontario and Aroland First Nation	Not Started	2-5 years	Unknown	Yes – operation expected to overlap with Community Access Road construction and operation	■ Upgrades to existing road will be required for heavy vehicles accessing the Community Access Road route during construction and operation and maintenance. ■ Currently discussions on prepotency and scope of work are underway. ■ Potential scope of work is expected to include roadway widening, culvert and bridge replacements / rehabilitations to accommodate higher weight vehicles, and road base improvements. ■ This project will be completed prior to the start of the	Yes	Local Study Area – Yes Regional Study Area – Yes	Yes

Project	Identified in *Tailored Impact Statement Guidelines* (Yes / No)	Location	Status	Distance (km) and Direction from the Project	Developer / Company	Project Start Date	Project Duration	Project Completion Date	Assumed Temporal Overlap with Community Access Road Activities (Y / N)	Project Description	Physiography, Terrain and Soils Valued Components Temporal Overlap with Project (Y / N)	Physiography, Terrain and Soils Valued Components Spatial Overlap with Project (Y / N)	Included in Cumulative Effects Assessment (Y / N)
										construction of the Community Access Road and therefore the upgrades to these roads is not expected to overlap with the construction of the Community Access Road.			
Rapid Lynx Broadband	Yes	Matawa First Nation communities	Phase 1:Complete Phase 2: Ongoing	Phase 1 – 0 (adjacent or overlapping) Phase 2 – 57.69	Rapid Lynx	February 2020	Unknown	Unknown	Yes – operations of Phase 1 and operations and construction of Phase 2 expected to overlap with Community Access Road Construction and Operation and Maintenance Phases	■ Approximately 810 km of fibre optic cables, providing reliable high-speed internet service to five Matawa First Nation communities: Eabametoong, Marten Falls, Neskantage, Nibinamik and Webequie with an interconnection at Aroland.	Yes	Local Study Area – Yes Regional Study Area – Yes	Yes
Winter Road Realignment Project	No	Various	Ongoing	0	Ministry of Northern Economic Development and Growth	2025	Unknown	Unknown	Yes – construction and operations will overlap with Community Access Road construction (expected to occur concurrently)	■ Funding to remote northern communities for projects involving installation of water crossing infrastructure, such as pre-engineered bridges and culverts, and repairs to existing structures. ■ Funding for approximately 3,200 km of winter roads in Northern Ontario.	Yes	Local Study Area – Yes Regional Study Area – Yes	No, the winter roads are included in the landcover for existing conditions.

km = kilometre



LEGEND

CONSTRUCTION DISTURBANCE AREA

POTENTIAL CAMP SITE (SIZE)

- 50 PERSONS
- 200 PERSONS
- PREFERRED ROUTE
- APPROXIMATE ACCESS ROAD TO POTENTIAL AGGREGATE SITE
- APPROXIMATE ACCESS ROAD TO POTENTIAL CONSTRUCTION CAMP
- BEDROCK
- SAND AND GRAVEL
- LOCAL STUDY AREA (3 KM)
- REGIONAL STUDY AREA (11 KM)
- FAR NORTH BOUNDARY
- FIRST NATION COMMUNITY

PHYSICAL ACTIVITIY PROJECT INCLUSION

- NORTHERN ROAD LINK
- RAPID LYNX BROADBAND PROJECT

Notes:

None

Data Source:

Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, AAFC, NRCan
World Topographic Map: Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

Physical Activities Inclusions in the Physiography Terrain and Soils Effects Assessment Regional Study Area

0 2.75 5.5 11 16.5 22
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026	1:480,000 * when printed 11"x17"
Rev:0	

Figure 8-1

Contains information provided by Ontario Ministry of the Environment, Conservation and Parks or by Ontario Ministry of Natural Resources and Forestry (Copyright: King's Printer of Ontario 2023), through a Sensitive Data License Agreement. This drawing has been prepared for use of AECOM client and may not be reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM express written consent. The use of Sensitive Data in this drawing does not constitute an endorsement by the Ministry for this drawing or by AECOM of the Sensitive Data.

Map location: S:\Clients\MartenFalls_FirstNation\Northern_Ontario\99_PROJ\21455151\40_PROD\0017_Vegetation_EC_Reporting\21455151-0017-RT-0000.aprx
Date Saved: 2/12/2026 1:09 PM User Name: gld_rduval

8.1.4. Summary of Outcome

The predicted residual effect identified in **Table 8-1** is applicable to the physiography, terrain, and soils Valued Component. Three of the four projects identified within **Table 8-3** have the potential for residual effects to overlap with the spatial and temporal boundaries of the physiography, terrain, and soils Valued Component (**Table 8-2**); therefore, these three projects have been considered for the cumulative effects assessment (**Section 8.2**). **Table 8-4** summarizes the outcome of the cumulative effects scoping.

Table 8-4: Summary of Outcome

Past, Existing and Future Physical Activities / Projects	Valued Component Carried Forward	Results of Scoping
Northern Road Link	Physiography, Terrain and Soils	■ Both the Marten Falls First Nation Community Access Road Project and the Northern Road Link project have the potential for residual effects on the quantity and distribution of terrain units, terrain quantity and distribution (esker landforms), and quantity and distribution of soil units of the physiography, terrain and soils Valued Component through the continued alteration of the landscape (terrain and soils) and loss of esker landforms for use as sand and gravel resources for the development of the Northern Road Link project. ■ The residual effects from the project may overlap temporally during the Construction and Operation and Maintenance Phases. Spatially, residual effects from the Northern Road Link project may overlap with the residual effects from the Marten Falls First Nation Community Access Road Project within the Local Study Area and Regional Study Area.
Anaconda and Painter Lake Road Upgrades	Physiography, Terrain and Soils	■ Both the Marten Falls First Nation Community Access Road Project and the Anaconda and Painter Lake road upgrades have the potential for residual effects quantity and distribution of terrain units, terrain quantity and distribution (esker landforms), and quantity and distribution of soil units of the physiography, terrain and soils Valued Component through the continued alteration of the landscape (terrain and soils) and loss of esker landforms for use as sand and gravel resources for the development of the Anaconda and Painter Lake road upgrades project ■ The residual effects from the project may overlap temporally during the Construction and Operation and Maintenance Phases. Spatially, residual effects from the Anaconda and Painter Lake Road Upgrades project may overlap with the residual effects from the Marten Falls First Nation Community Access Road Project within the Local and Regional Study Areas.
Rapid Lynx Broadband	Physiography, Terrain and Soils	■ No potential for residual effects on the quantity and distribution of terrain and soil units, and terrain quantity and distribution (esker landforms) of the physiography, terrain and soils Valued Component are expected from the Rapid Lynx Broadband project. ■ The project may overlap the Marten Falls First Nation Community Access Road Project temporally and spatially within the Local and Regional Study Areas; however, it is assumed this is a buried facility which will be reclaimed and no sand and gravel resources will be needed for the construction of this project, so will not result in any loss of esker landforms.

8.2. Cumulative Effects Assessment

8.2.1. Changes to Terrain Quantity and Distribution from Construction Activities

8.2.1.1. Potential Cumulative Effects

As discussed in **Section 8.1**, the construction of the Northern Road Link, and the Anaconda and Painter Lake road upgrade projects along with the Project, have the potential for cumulative effects on the quantity and distribution of terrain through the physical alteration and removal of terrain from Construction activities. As described in **Section 7.3.1.1.1**, Project activities such as clearing, earth moving, excavation at pits and / or blasting at quarry sites and other road construction activities have the potential to change the terrain.

The potential for cumulative effects on the quantity and distribution of terrain will depend on:

- the area of the proposed final permanent disturbance; and
- the strategies prescribed to these projects with respect to mitigating or minimising changes to terrain.

Cumulative effects related to potential changes to the quantity and distribution of terrain through the physical alteration of the landscape for the Northern Road Link may begin during the Construction Phase and continue through the Operation and Maintenance Phase of the Project. The Anaconda and Painter Lake road upgrades are expected to be concluded before the initiation of the Project but may overlap during the Construction Phase of the Project, depending on the timing of the projects.

8.2.1.2. Mitigation Measures

No additional mitigation measures are proposed for changes to terrain quantity and distribution due to construction activities cumulative effects. It is anticipated that mitigation measures will be, or have been, implemented to limit changes to the quantity and distribution of terrain during the construction of the Northern Road Link, and Anaconda and Painter Lake road upgrade projects and that these mitigation measures will be similar to those implemented for the Project (**Section 7.3.1.1.1**).

8.2.1.3. Characterization of Predicted Cumulative Effects

Changes in the terrain quantity and distribution through Project construction will be minimized by effective implementation of the mitigation measures.

Based on provincial surficial geology mapping (Barnett et al. 1991) the type (i.e. surficial material), extent and distribution of terrain units within the Regional Study Area are similar to those mapped within the Local Study Area, so distribution of terrain is not expected to be affected by the construction of additional projects in the Regional Study Area.

The Project is predicted to permanently disturb 0.9% of terrain within the Regional Study Area. The permanent disturbance area of the Northern Road Link, and the Anaconda and Painter Lake road upgrades projects within the Physiography, Terrain, and Soils Regional Study Area is assumed to be 811.2 ha which is based on a 200 m wide corridor centered on each project's centreline (0.2% of the Regional Study Area). It is assumed that the road design for the Northern Road Link and the Anaconda and Painter Lake road upgrades will be similar to that proposed for the Project and ultimately include pits and quarries, and other construction infrastructure, but these are unknown at this time. It is expected that the Northern Road Link, and the Anaconda and Painter Lake road upgrades would follow similar mitigations as outlined for the Project in **Section 7.3.1.1.1** and **Section 8.2.1.2** which primarily includes minimizing the project footprint. As a result, the effects from each project on the quantity and distribution of terrain units from construction activities are expected to be minimized and have limited potential for cumulative effects on the quantity and distribution of terrain units. As a result, the incremental changes related to this interaction from these other projects are within the residual effects predicted for the Project (i.e., negligible magnitude and long term / irreversible for terrain units). The cumulative effects summary is provided in **Section 8.2.5**.

8.2.2. Changes to Terrain Quantity and Distribution (Esker Landforms) From Construction Activities

8.2.2.1. Potential Cumulative Effects

As discussed in **Section 8.1**, the construction of the Northern Road Link, and the Anaconda and Painter Lake road upgrade projects, along with the Project, have the potential for cumulative effects on the quantity and distribution of esker landforms through the physical alteration and removal of these landforms for the excavation of sand and gravel material. As described in **Section 7.3.1.1.2**, Project activities such as sand and gravel pit creation and aggregate extraction have the potential to change or remove esker landforms.

The potential for cumulative effects on the quantity and distribution of esker landforms will depend on:

- The quantity of sand and gravel material required for road construction and / or road upgrades for the overlapping projects;
- The accessibility of alternative (non-esker) sand and gravel resources; and / or
- The strategies prescribed to these projects with respect to mitigating or minimizing changes to the quantity and distribution of esker landforms.

Cumulative effects related to potential changes to the quantity and distribution of esker landforms through the physical alteration and removal of these landforms for the Northern Road Link project may begin during the Community Access Road Construction Phase and continue through the Operation and Maintenance Phase. The Anaconda and Painter Lake road upgrades are expected to be concluded before the initiation of the Construction Phase of the Community Access Road but may overlap, depending on the timing of the projects.

8.2.2.2. Mitigation Measures

It is anticipated that mitigation measures will be, or have been, implemented to limit the development of esker landforms for sand and gravel extraction during the construction of the Northern Road Link, and Anaconda and Painter Lake road upgrade projects and that these mitigation measures will be similar to those implemented for the Project. Mitigation for the use of eskers for sand and gravel extraction would be expected to be followed including minimizing or avoiding the development of eskers as borrow pits by using bedrock quarries or other sand and gravel resources wherever possible, and confirming there is suitable aggregate material in the ridged esker landforms before extraction commences.

8.2.2.3. Characterization of Predicted Cumulative Effects

Changes in the terrain quantity and distribution of esker landforms through the creation of sand and gravel pits and aggregate extraction will be minimized by effective implementation of the mitigation measures. However, cumulative changes from the physical alteration of eskers have the potential to occur if the esker landforms contained within the Regional Study Area of the Project are used as sources of road building materials (sand and gravel resources) for the Northern Road Link and Anaconda and Painter Lake road upgrades.

Based on provincial surficial geology line features which identify eskers (Barnett et al., 1991) in combination with detailed terrain mapping completed by WSP (**Section 5.4.1**), an additional 5 eskers are noted to be within the Regional Study Area, but outside the Local Study Area.

The Project is predicted to reduce the number of eskers in the Regional Study Area from 16 to 11 which is a 31% reduction in the number of eskers in the Regional Study Area. Although the alignments for the Northern Road Link and the Anaconda and Painter Lake road upgrades projects have been provided to WSP, the alignments do not appear to identify pits and quarries, so it is unknown if eskers within the Regional Study Area will be used for construction. It is expected that the Northern Road Link, the Anaconda and Painter Lake road upgrades would follow similar mitigations as outlined for the Project in **Section 7.3.1.1.2** and **Section 8.2.1.2**, which primarily include minimizing or avoiding the development of eskers as borrow pits by identifying alternative sources of aggregate such

as bedrock quarries or sand and gravel glaciofluvial deposits that are not esker landforms. As a result, the effects from each project on terrain quantity and distribution of esker landforms from physical alterations would be expected to be minimized and have limited potential for cumulative effects on the quantity and distribution of esker landforms. As a result, the incremental changes related to this interaction from these other projects are within the residual effects predicted for the Project (**Section 7.4.1.2**) (i.e., medium magnitude and long term / irreversible for eskers used as borrow sources). The cumulative effects summary is provided in **Section 8.2.5**.

8.2.3. Changes to Quantity and Distribution of Soils from Construction Activities

8.2.3.1. Potential Cumulative Effects

As discussed in **Section 8.1**, the construction of the Northern Road Link, and the Anaconda and Painter Lake road upgrade projects along with the Project, have the potential for cumulative effects on the quantity and distribution of soil through the physical alteration and removal of soil from Construction activities.

As described in **Section 7.3.1.1.4**, Project activities such as clearing, earth moving, excavation at pits and / or blasting at quarry sites and other road construction activities have the potential to change the soil.

The potential for cumulative effects on the quantity and distribution of soil will depend on:

- the area of the proposed permanent disturbance; and
- the strategies prescribed to these projects with respect to mitigating or minimising changes to terrain.

Cumulative effects related to potential changes to the quantity and distribution of soil through the physical alteration of the landscape for the Northern Road Link may begin during the Community Access Road Construction Phase and continue through the Operation and Maintenance Phase. The Anaconda and Painter Lake road upgrades are expected to be concluded before the initiation of the Community Access Road Construction Phase but may overlap, depending on the timing of the projects.

8.2.3.2. Mitigation Measures

It is anticipated that mitigation measures will be, or have been, implemented to limit changes to the quantity and distribution of soil during the construction of the Northern Road Link, and Anaconda and Painter Lake road upgrade projects and that these mitigation measures will be similar to those implemented for the Project.

8.2.3.3. Characterization of Predicted Cumulative Effects

Changes in the soil quantity and distribution through project construction will be minimized by effective implementation of the mitigation measures.

No soil mapping for the Regional Study Area is available, so it is not possible to describe the extent and distribution of soil map units within the Regional Study Area or determine if they are similar to those mapped within the Local Study Area. Although it is not possible to characterize the cumulative effect on the distribution of soil units, there is a general correlation of soil type with surficial material type. Given the surficial geology within the Regional Study Area is similar to that in the Local Study Area, the distribution of soil units is not expected to be affected by the construction of additional projects in the Regional Study Area.

The Project is predicted to permanently disturb 0.9% of soil within the Regional Study Area. The Northern Road Link, and the Anaconda and Painter Lake road upgrades projects permanent disturbance area within the Project Regional Study Area is assumed to be 811.2 ha which is based on a 200 m wide corridor centered on each project's centreline (0.2% of the Regional Study Area). It is assumed the project description (e.g., road design) for the Northern Road Link and the Anaconda and Painter Lake road upgrades will be similar to that proposed for the Project and ultimately include pits and quarries, and other construction infrastructure, but these are unknown at this time. It is expected that the Northern Road Link, and the Anaconda and Painter Lake road upgrades would follow similar mitigations as outlined for the Project in **Section 7.3.1.1.4** and **Section 8.2.3.2** which primarily includes minimizing the project footprint. As a result, the effects from each project on the quantity and distribution of soil units from construction activities are expected to be minimized and have limited potential for cumulative effects on the quantity and distribution of terrain units. As a result, the incremental changes related to this interaction from these other projects are within the residual effects predicted for the Project (i.e., negligible magnitude and long term / irreversible for soil units).

The cumulative effects summary is provided in **Section 8.2.5**.

8.2.4. Prediction Confidence and Uncertainty

Within a cumulative effects assessment, there is inherently a level of uncertainty due to the level of information available regarding other projects, including reasonably foreseeable developments. However, this uncertainty is managed by making conservative assumptions regarding these projects' design or activities. Although footprints for the Northern Road Link and Anaconda and Painter Lake road upgrades projects have been provided to WSP, they appear to be a buffered linear feature with no identification of project components associated with infrastructure or construction development such as pits, quarries, camps and access roads.

Therefore, the extent of permanent disturbance of terrain and soils, as well as whether esker landforms are planned to be used for the construction of these projects is unknown. The mitigation measures for these types of projects are assumed to be similar to the mitigation measures proposed for the Project (**Section 7.3.1.2.2** and **Section 8.2.1.2**) to reduce permanent disturbance areas, as well as effects on esker landforms, but this is also unknown information. While there is a reasonable understanding of esker landforms in the Local Study Area, the data available at the Regional level are at a coarser scale (i.e., less detailed). Therefore, the effect on eskers at a Regional scale after effects to eskers potentially included in the Project as well as the Northern Road Link and Anaconda and Painter Lake road upgrades projects is uncertain.

Overall, the level of uncertainty associated with the predictions of the cumulative effects assessment was considered to be moderate for cumulative effects on terrain and soil quantity and distribution, and quantity and distribution of terrain (esker landforms). These levels of uncertainty were assigned based on the Project-related effects being mostly understood, a level of certainty associated with the effectiveness of proposed mitigations, and conservative assumptions being applied. There is still uncertainty about extent of permanent disturbance and the use of eskers for construction sources for the Northern Road Link and Anaconda and Painter Lake road upgrades projects and the effect on eskers at a Regional scale which reduces prediction confidence.

8.2.5. Summary

The summary of the characterization of predicted cumulative effects for physiography, terrain and soils Valued Component is provided in **Table 8-5**.

Table 8-5: Characterization of Predicted Cumulative Effects for Physiography, Terrain and Soils

Predicted Cumulative Effect	Context	Magnitude	Direction	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Uncertainty
Changes to terrain quantity and distribution from Project activities	The total area of permanent loss of terrain (1.1% of the Regional Study Area) is low when taking the Project, and the three additional projects into consideration	Negligible	Negative	Regional Study Area	Long term	Infrequent	Irreversible	Certain	Moderate
Changes to terrain quantity and distribution (esker landforms) from Project activities	Sixteen natural esker landforms were mapped in the Regional Study Area. Approximately 31% of these will be permanently disturbed.	Medium	Negative	Regional Study Area	Long term	Infrequent	Irreversible	Possible	Moderate
Changes to soil quantity and distribution from Project activities	The total area of permanent loss of soil map units (1.1% of the Regional Study Area) is low when taking the Project, and the three additional projects into consideration. The resilience and adaptive capacity of reclaimed soils are high.	Negligible	Negative	Regional Study Area	Long term	Infrequent	Irreversible	Certain	Moderate

9. Monitoring Programs and Future Commitments

A monitoring program verifies the accuracy of the effects assessment and evaluates the effectiveness of mitigation measures. Monitoring programs also include future commitments related to mitigating residual effects and addressing uncertainty. A Project-specific Environmental Monitoring Program will be developed and implemented that includes the monitoring commitments related to physiography, terrain, and soil Valued Components presented in this section.

9.1. Construction Monitoring Program

During detailed design, a Project-specific Soil Management Plan will be developed which could include the following:

- Slope stability monitoring during land clearing, site preparation, and construction of facilities, especially road components adjacent to rivers, creeks, and streams;
- Monitoring for admixing of soil, compaction, and erosion during clearing, contouring, and excavation activities;
- Monitoring of transportation of soil and stockpiling activities for signs of erosion;
- Monitoring of erosion and sedimentation control measures to avoid and minimize sediment mobilization from disturbed areas to drainages, wetlands, or watercourses;
- Monitoring of soil stockpiles and the Construction Disturbance Area for invasive species such as weeds. If invasive species are identified within the Construction Disturbance Area, a response plan will be prepared;
- Monitoring and managing reclamation concerns pertaining to soil erosion, revegetation, and slope stability; and
- Monitoring of aggregate rehabilitation to fully assess the effectiveness of rehabilitation and detect any unintended effects.

9.2. Operations Monitoring Program

Inspections and maintenance of roadside ditches and culverts will be conducted as appropriate to limit the risk of road wash-out or sediment release to the environment. The frequency of these inspections will likely vary depending on weather events, amount of traffic, season, etc.

A program will be conducted to verify that erosion and sediment control measures have been successful (e.g., bank restoration and revegetation) and that the stability of each waterbody crossing is maintained (i.e., the channel has not washed out).

The post-construction monitoring will occur within one full growing season after the completion of construction, but timing may be extended if needed.

9.3. Future Commitments

All mitigation measures outlined in **Section 7** will be adhered to. Mitigation measures are summarized in **Table 7-11**. The effectiveness of mitigation measures will be evaluated during construction and operations and will be modified or enhanced as necessary through adaptive management.

Table 9-1: Summary of Future Commitments

Valued Component	Commitment	Phase	Section Reference
Physiography, Terrain, and Soils	The Soil Management Plan will be developed and followed for Construction and Operations and Maintenance Phases.	Detailed design	**Section 7.3.2**
	Permitted pits and quarries developed for the construction, operation, and maintenance of the Community Access Road will follow the progressive and final rehabilitation requirements outlined in the approved site plans (Government of Ontario 2020) under the *Aggregate Resources Act*.	Detailed design	**Section 7.3.2**
	Develop and implement a geochemical testing and monitoring program to assess the potential for acid rock drainage from any soils, or bedrock, which will be exposed during aggregate extraction.	Detailed design	**Section 7.3.2**
	Develop and implement a Spill Prevention and Emergency Response Plan.	Detailed design	**Section 7.3.2**
	Develop and implement a Blasting and Communication Management Plan.	Detailed design	**Section 7.3.2**
	Work with the Ministry of Transportation, and the Northern Road Link and Webequie Supply Road Project Teams to develop a coordinated approach to permafrost assessment.	Detailed design	**Section 5.5.4**
	Develop and follow recommendations outlined in a Permafrost Management Plan.	Detailed design	**Section 2.1.1**

9.4. Future Permits and Approvals

To facilitate the construction of the Community Access Road, including construction activities and temporary infrastructure, permits and approvals from provincial, federal government and other jurisdictional agencies will need to be acquired.

The pits and quarries that are proposed through the Project will be subject to permitting requirements outlined within the *Aggregate Resources Act* and its regulations. For a permit to be issued, additional studies, mitigation plans, consultation and monitoring commitments may be required. In addition to permitting requirements under *the Aggregate Resources Act*, permitting and approvals under other pieces of legislation may also be required for pit and quarry development, including:

- Ontario *Planning Act;*
- Ontario *Water Resources Act;*
- Ontario *Environmental Protection Act;*
- Ontario *Endangered Species Act*; and
- Federal *Species at Risk Act.*

10. Summary and Recommendations

The potential effects summary and recommendations for the physiography, terrain, and soils Valued Component is provided in **Table 10-1**. Through the permitting stage of the Project, a Project-specific Environmental Protection Plan, and Environmental Monitoring Plan will be developed and implemented that includes an implementation plan for the mitigation and monitoring commitments presented in **Table 10-1**.

The mitigations presented in **Table 10-1** for the physiography, terrain, and soils Valued Component also include those for cumulative effects.

Table 10-1: Potential Effects Summary and Recommendations

ID	Valued Component	Environmental Concern and Potential Effect	Project Phase	Mitigation, Protection, Monitoring, and Study Commitments to be Carried Forward to Detailed Design	Mitigation, Protection, Monitoring, and Study Commitments to be Carried Forward to Construction / Operation
PTS-01	Physiography, Terrain, and Soils	Changes to terrain quantity / distribution from Project activities	■ Construction	■ Limit the Project footprint (Construction Disturbance Area) to the extent practicable; and ■ Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control [based on the Ontario Ministry of Transportation's Erosion and Sediment Control Guide], reclamation procedures, best management practices and guidelines / policies).	■ Minimize areas of vegetation clearing and soil disturbance and optimize the use of existing cleared areas for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way); ■ Minimize the stripping and grading of terrain between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and will be limited to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be stabilized; ■ Regrade areas with erosional gullies to conform to the local landform to maintain drainage patterns during decommissioning of temporary infrastructure; ■ Strip overburden from bedrock quarry areas before drilling, blasting, or excavating and manage in accordance with the *On-Site and Excess Soil Management Regulation* under the Ontario *Environmental Protection Act*; and ■ All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act*.
PTS-02		Changes to terrain quantity and distribution (esker landforms) from Project activities	■ Construction	■ Confirm suitable aggregate material in ridged landforms prior to extraction; and ■ The use of eskers or similar geological features for aggregate resources will be minimized or avoided by using bedrock quarries or other sand and gravel resources whenever possible.	■ Confirm suitable aggregate material in ridged landforms prior to extraction; and ■ All pits and quarries will be rehabilitated during their operational lifetime and once extraction is finished as per the Ontario Ministry of Natural Resources *Aggregate Resources Act*.
PTS-03		Changes to terrain quantity and distribution (slope stability) from Project activities	■ Construction	■ Avoid or minimize the amount of area for construction and subsequent operation facilities that are considered to have terrain that is either unstable or potentially unstable and design slopes for long-term stability; and ■ The potential effect of Class IV and V terrain to infrastructure planning within the Construction Disturbance Area will be further assessed as part of the detailed design.	■ Have construction activities occur under frozen or dry conditions as much as possible; ■ Avoid construction on highly saturated soil where practicable or use suitable ground equipment to avoid potentially increasing slope instability; ■ Regrade areas with erosional gullies to conform to the local landform to maintain drainage patterns; ■ Minimize any exposed mineral soil between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and will be limited to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be left at a stable angle; ■ Use low road grades and proper drainage to reduce potential terrain instability, where feasible; and ■ Implement progressive reclamation and revegetation of disturbed areas no longer required for construction.
PTS-04		Changes to soil quantity and distribution from Project activities	■ Construction	■ Limit the Project footprint (Construction Disturbance Area) to the extent practicable; ■ Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control [based on the Ontario Ministry of Transportation's Erosion and Sediment Control Guide], reclamation procedures, best management practices and guidelines / policies;	■ Minimize areas of vegetation clearing and soil disturbance and optimize the use of cleared area for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way); ■ Regularly inspect and maintain erosion and sediment control structures (e.g., sediment fences, rip rap or other sediment control structures) during all Project phases and modify measures as necessary. If control measures are not functioning properly, no further work will occur until the problem is resolved;

ID	Valued Component	Environmental Concern and Potential Effect	Project Phase	Mitigation, Protection, Monitoring, and Study Commitments to be Carried Forward to Detailed Design	Mitigation, Protection, Monitoring, and Study Commitments to be Carried Forward to Construction / Operation
				■ Select erosion and sediment control products that correspond with the nature and duration of the Project as recommended in the Soil Management Plan; ■ Control potential erosion by utilizing an effective road design (including use of engineered culverts and bridges); ■ To the extent practicable, avoid work in sensitive areas (i.e., erosive soils, wetland features, and fish habitats) during periods that may result in high flow volumes and / or increased erosion and sedimentation (e.g., spring freshet); ■ Use low road grades and proper drainage to reduce soil erosion, where feasible; ■ When practicable, consider pre-fabrication (e.g., parts of structures) at an approved off-site location to minimize on-site construction effects; ■ Avoid placing soil stockpiles near waterbodies or drainage features (i.e., a minimum distance of 100 m from watercourses); ■ Manage soil in accordance with the Best Management Practices for Aggregate Pit and Quarry Rehabilitation in Ontario (Madeh et al., 2021); and ■ Manage any excess construction soil in accordance with the On-Site and Excess Soil Management Regulation under the *Ontario Environmental Protection Act*.	■ Limit duration of soil exposure; phase activities whenever possible, and restore disturbed areas as soon as possible (i.e., implement appropriate erosion and sediment control, and progressive reclamation and revegetation of disturbed areas no longer required); ■ Selectively cut vegetation and restrict clearing and grubbing within areas with steep slopes or soils prone to risk of erosion; ■ Do not include mineral soil in the debris piles during clearing; ■ Have construction activities occur under frozen or dry conditions as much as possible; ■ Use clearing equipment appropriate to the nature of work being conducted that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, and brushes), where feasible. For example, avoid using large machinery when hand tools or smaller scale machinery could be used; ■ Regrade areas with vehicle ruts and erosion gullies to conform to the local landform to maintain drainage patterns; ■ Minimize stripping and grading of terrain between the height of land (drainage divide) and the watercourse, or within 100 m of a watercourse crossing, whichever is less, and will be limited to that required to address engineering issues and safety concerns, such as the removal of hazards. If stripping or grading occurs within such areas, the site will be left at a stable angle; ■ Install and regularly maintain mitigation measures prior to the commencement of any site clearing, grubbing, excavation, filling, or grading works, prior to and after runoff events; ■ Where soils are prone to wind erosion, apply tackifier, cover, and seed, apply water or pack the topsoil stockpiles and windrows with approved equipment, especially during periods of high erosion potential (i.e., summer and fall); ■ Minimize steepness and length of slopes of disturbed areas and stockpiled soils;
PTS-05		Changes to soil quality (compaction and admixing) from Project activities	■ Construction	■ Limit the Project footprint (Construction Disturbance Area) to the extent practicable; and ■ Develop and implement a Project-specific Soil Management Plan (e.g., soil stripping and handling recommendations, erosion and sediment control [based on the Ontario Ministry of Transportation's Erosion and Sediment Control Guide], reclamation procedures, best management practices and guidelines / policies).	■ Minimize areas of vegetation clearing and soil disturbance and optimize the use of cleared area for Project activity (i.e., site clearing will be kept to a minimum within the Community Access Road right-of-way); ■ Use clearing equipment appropriate to the nature of work being conducted that minimizes surface disturbance, soil compaction, and topsoil loss (e.g., equipment with low ground pressure tracks or tires, blade shoes, and brushes), where feasible. For example, avoid using large machinery when hand tools or smaller scale machinery could be used; ■ Have construction activities occur under frozen or dry conditions as much as possible; ■ Use low pressure or rubber tracked vehicles for the early phase of the Community Access Road construction season and only higher-pressure equipment when the ground surface is strong enough to prevent compaction and rutting; ■ Avoid construction activities on highly saturated soil (primarily during or immediately after rain events or during freshet) where practicable or use suitable ground equipment to prevent unnecessary soil damage through rutting, for example. Crews should be prepared to stop work in these conditions; ■ Regrade areas with vehicle ruts and erosion gullies to conform to the local landform to maintain drainage patterns; and ■ De-compact subsoils, temporary access trails and soils damaged during wet weather.

ID	Valued Component	Environmental Concern and Potential Effect	Project Phase	Mitigation, Protection, Monitoring, and Study Commitments to be Carried Forward to Detailed Design	Mitigation, Protection, Monitoring, and Study Commitments to be Carried Forward to Construction / Operation
PTS-06		Changes to soil quality from contamination due to potential leaks or spills of deleterious or hazardous substances from Project activities	■ Construction ■ Operations and Maintenance	■ Develop and implement a Spill Prevention and Emergency Response Plan, in the event of a spill; ■ Provide and make sure holding bats are readily available, so there is less chance of spillage; ■ Provide adequate lighting at fuelling stations and monitoring so that people clean up after any spills; and ■ Provide various pit stops along the Community Access Road where drivers can check their tanks and valves.	■ Adhere to Standard Operating Procedures for fuel handling; ■ Construction machinery will arrive on site in a clean condition, free from leaks; ■ Construction crews will always keep a spill response kit on site during the work; ■ Contain and clean up spills immediately in accordance with provincial regulatory requirements and the Spill Prevention and Emergency Response Plan; ■ Transport fuel and hazardous materials in approved containers in licensed vehicles; ■ Require construction crews and drivers of vehicles using the Community Access Road system to report spills to the Ontario Spills Action Centre at 1-800-268-6060; and ■ Provide barriers along the sides of bridges to prevent other chemicals from spilling into waterways beneath them.
PTS-07		Changes to soil quality from the transport and deposition of air contaminant emissions (e.g., potential acid inputs) and particulate matter (dust) from Project activities	■ Construction ■ Operations and Maintenance	■ Minimize areas of vegetation clearing and soil disturbance and optimize the use of cleared areas for Project activities (i.e., site clearing and maintenance activities will be kept to a minimum within the Community Access Road right-of-way); while maintaining safe traffic and pedestrian flows, and follow best practices for design speeds and expected vehicle traffic Optimize access roads to reduce fuel consumption and emissions from equipment.	■ Mitigation measures that will be implemented during the Construction and Operation and Maintenance Phases to reduce changes to soil from emissions and deposition include those listed in the Air Quality and Greenhouse Gas Existing Conditions and Effects Assessment Technical Support Document (Dillon 2026b).

m = metre.

11. References

AECOM Canada Ltd. (AECOM). (2020a) Marten Falls First Nation Proposed Terms of Reference Marten Falls Community Access Road - Environmental Assessment, Appendix B: Consultation & Engagement Plan to Support the Environmental Assessment / Impact Statement

AECOM Canada Ltd. (AECOM). (2020b). Marten Falls First Nation. Record of Consultation Report. *Community Access Road / March 2019 to July 2020*. Retrieved from: https://www.martenfallsaccessroad.ca/wp-content/uploads/2020/09/RPT_Appendix-C_2020-09-09-REDACTED-Record-of-Consultation_60593122-1.pdf

Alberta Environment and Water. (2012). Best Management Practices for Conservation of Reclamation Materials in the Mineable Oil Sands Region of Alberta. Prepared by MacKenzie, D. for the Terrestrial Subgroup, Best Management Practices Task Group of the Reclamation Working Group of the Cumulative Environmental Management Association, Fort McMurray, AB. March 9, 2011.

Alberta Government. (2022). Alberta Acid Deposition Management Framework. Retrieved from: https://open.alberta.ca/publications/alberta-acid-deposition-managementframework

Alberta Soils Advisory Committee. (1987). Soil Quality Criteria Relative to Disturbance and Reclamation (Revised). Prepared by the Soil Quality Criteria Working Group, Soil Reclamation Subcommittee, Alberta Soils Advisory Committee. Alberta Agriculture Food and Rural Development. March 1987. Edmonton, AB. 46 pp.

Archibald, D.J., W.B. Wiltshire, D.M. Morris, and B.D. Batchelor. (1997). Forest management guidelines for the protection of the physical environment. Version 1. Report MNR #51032. Ontario Ministry of Natural Resources.

Attawapiskat First Nation. (2015). Attawapiskat First Nation Community Based Land Use Plan.

Barnett, P.J., A.P. Henry and D. Babuin. (1991). Quaternary geology of Ontario, East-Central sheet. Ontario Geological Survey, Map 2555, scale 1,000,000.

Barnett, P.J. (1992). Quaternary Geology of Ontario. In, P.C. Thurston, H.R. Williams, R.H. Sutcliff and G.M. Stott (eds.). Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 2, pp. 1011-1088.

Barnett, P.J., K.H. Yeung, and J.D. McCallum. (2013a). Surficial geology of the Fort Hope area northeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3724, scale 1:100 000.

Barnett, P.J., K.H. Yeung, and J.D. McCallum. (2013b). Surficial geology of the Fort Hope area southeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3736, scale 1:100 000.

Barnett, P.J., K.H. Yeung, and J.D. McCallum. (2013c). Surficial geology of the Nakina area northeast, northern Ontario. Ontario Geological Survey, Preliminary Map P.3744, scale 1:100 000.

Bates, L. and J.A. Jackson (eds). (1987). Glossary of Geology. 3rd edition, American Geological Institute, Alexandria, 788 pp.

Bobbink R., M. Hornung, and J.G.M. Roelofs. (1998). The effects of air-borne nitrogen pollutants on the Species diversity in natural and semi-natural European vegetation. Journal of Ecology 86(5):717-738.

Bostock, H.H. (1970). Physiography of Canada. Geological Survey of Canada, Map 1254A, scale 1:5,000,000.

British Columbia Ministry of Environment. (1999). Mapping and Assessing Terrain Stability Guidebook, 2nd Edition. Available at: https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/terrain/zipped/terrain.pdf

British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development. (1999). Hazard Assessment Keys for Evaluating Site Sensitivity to Soil Degrading Process Guidebook. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/silviculture/silviculture-surveys/hazardassesskeys-web.pdf. Accessed April 2023.

British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment. (2010). Field Manual for Describing Terrestrial Ecosystems. 2nd ed. Forest Science Program, Victoria, B.C. Land Manag. Handb. No. 25. Available at: https://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh25/Lmh25_ed2_(2010).pdf

Brown, R.J.E. (1968). Occurrence of permafrost in Canadian peatlands. Proceedings: Third International Peat Congress held in Quebec, Canada, 18-23 August 1968, pp. 174-181.

Canadian institutes of Health Research. (2022, August 19). *Gender-Based Analysis Plus.* Retrieved from Government of Canada: https://cihr-irsc.gc.ca/e/50968.html

Canadian Council of Ministers of the Environment (CCME). (2014). Soil Quality Guidelines for the Protection of Environmental and Human Health; Chapter PDF. Accessed May, 2023. Available at http://st-ts.ccme.ca/en/index.html.

Cannon, K.R. and S. Landsburg. (1990). Soil compaction and pipeline construction. A literature review. NOVA Corporation of Alberta, Calgary, Alberta.

Chen W.J., S.G. Leblanc, H.P. White, C. Prevost, B. Milakovic, C. Rock, G. Sharam, H. O'Keefe, L. Corey, B. Croft, A. Gunn, S. van der Wielen, A. Football, B. Tracz, J.S. Pellissey, and J. Boulanger. (2017). Does dust from Arctic mines affect caribou forage? Journal of Environmental Protection. 8, 258-276.

Chiefs of Ontario. (n.d.). *Traditional Knowledge*. Retrieved from Chiefs of Ontario: http://www.chiefs-of-ontario.org/priorities/environment/traditional-knowledge/.

Coote, D.R., and W.W. Pettapiece. (1989). Wind Erosion Risk, Alberta. Land Resource Research Centre, Research Branch, Agriculture Canada. Publication 5255/B. Contribution Number 87-08.

Dillon Consulting Limited (Dillon). (2021). *Aboriginal and Treaty Rights and Interests Study Plan.*

Dillon Consulting Limited (Dillon). (2026a). *Marten Falls Community Access Road: Aboriginal and / or Treaty Rights and Interests Existing Conditions Report.*

Dillon Consulting Limited (Dillon). (2026b). Air Quality and Greenhouse Gas Existing Conditions and Effects Assessment Technical Support Document. Volume 1 - Air Quality.

Dredge, L.A. and L.D. Dyke. (2020). Landscapes and Landforms of the Hudson Bay Lowlands. In, O. Slaymaker and N. Catto (eds.). Landscapes and Landforms of Eastern Canada. World Geomorphological Landscapes

Dredge, L.A. and W.R. Cowan. (1989). Quaternary geology of the southwestern Canadian Shield. In, R.J. Fulton (ed.). Quaternary Geology of Canada and Greenland. Geological Survey of Canada, Geology of Canada, no. 1, p. 214-249.

Dyke, A.S. and V.K. Prest. (1987). Late Wisconsinan and Holocene history of the Laurentide Ice Sheet. Géographie Physique et Quaternaire. 41: 237-263.

Environmental Systems Research Institute (ESRI). (2018). Soil Erosion Toolbox V1. Python Script Tool available to download at: Soil Erosion Toolbox V1 - Overview (arcgis.com)

Expert Committee on Soil Survey. (1982). The Canada Soil Information System (CanSIS): Manual for Describing Soils in the Field, 1982 Revised. Land Resource Research Institute, Research Branch, Agriculture Canada, Ottawa. LRRI Contribution no 82-52. 166 pp.

Ford, D. C. (1998). Principal features of evaporite karst in Canada, Fourth international conference on geomorphology, karst geomorphology, Italy 1997. Suppl. Geogr. Fis. Dinam. Quat. III, T.4 (1998), 11-19.

Fyon, A. (2020). Canada (Ontario) Beneath Our Feet. Ontario: The Geology of Isostatic Rebound - Rising Land (web page with map). Accessed May 5, 2023 at https://www.ontariobeneathourfeet.com/rising-land-isostatic-rebound.

Gao, C. and K.H. Yeung. (2018). Surficial geology of the Ogoki area northwest, northern Ontario. Ontario Geological Survey, Preliminary Map P.3725, scale 1:100 000.

Garvin, T., & Northern Forestry Centre (Canada). (2001). *A Guide to Conducting a Traditional Knowledge and Land Use Study.* Northern Forestry Centre.

Golder. (2010). 2010 Geology and Terrain Unit Geotechnical Data Report. Canada Chrome Proposed Infrastructure Corridor. Prepared for Canada Chrome Corporation.

Golder. (2013, September). Cliffs Chromite Project Environmental Assessment. Terrestrial Vegetation and Soil Technical Supporting Document Part 2: Integrated Transportation System. Prepared for Cliffs.

Golder. (2021). Physiography, Terrain and Soils Study Plan. Prepared for Marten Falls First Nation: All Season Community Access Road. May 2021.

Government of Canada. (2019, August 28). *Impact Assessment Act (S.C. 2019, c. 28, s. 1)*. Retrieved from Justice Laws Website: https://laws.justice.gc.ca/eng/acts/I-2.75/index.html

Government of Manitoba. (2007). Manual for Describing Soils in the Field (Revised 2007). Available at: https://www.gov.mb.ca/agriculture/soil/soil-survey/pubs/manual_for_describing_soils_in_the_field.pdf.

Government of Ontario. (1990). Aggregate Resources Act, R.S.O. 1990, c.A.8. Last amended June 1, 2021. Peterborough ON: Ministry of Natural Resources. https://www.ontario.ca/laws/statute/90a08

Government of Ontario. (2020). Aggregate Resources of Ontario: Site Plan Standards. Ministry of Natural Resources and Forestry. Canada. Retrieved

from https://coilink.org/20.500.12592/z205f7n on 16 Dec 2025. COI: 20.500.12592/z205f7n.

Government of Ontario. (2021). Find Pits and Quarries (interactive web page). Accessed May 19, 2021 at https://www.ontario.ca/page/find-pits-and-quarries.

Halchuk, S., T.I. Allen, G.C. Rogers, and J. Adams. (2015). Seismic Hazard Earthquake Epicentre File (SHEEF2010) used in the Fifth Generation Seismic Hazard Maps of Canada; Geological Survey of Canada, Open File 7724. doi:10.4095/296908.

Hausenbuiller R.L. (1972). Soil Science Principles and Practices. Wm. C. Brown Company. ISBN 0-697-05851-4.

Heginbottom, J.A., M.-A. Dubreuil and P. Harker. (1995). *Permafrost – Canada. National Atlas of Canada MCR 4177.* Scale 1:7,500,000.

Henton, J.A., M.R. Craymer, R. Ferland, H. Dragert, S. Mazzotti and D.L. Forbes. (2006). Crustal Motion and Deformation Monitoring of the Canadian Landmass. Geomatica, 60, 2, 173-191.

Holl K.D. (2002). Long-term vegetation recovery on reclaimed coal surface mines in the eastern USA. Journal of Applied Ecology. 39, 960-970. Available at https://doi.org/10.1046/j.1365-2664.2002.00767.x

Holowaychuk N. and R.J.Fessenden. (1987). Soil Sensitivity to Acid Deposition and the Potential of Soils and Geology in Alberta to Reduce the Acidity of Acidic Inputs. Alberta Research Council. Earth Sciences Report 87-1. Edmonton, AB. 38 pp.

Howes, D.E. and E. Kenk (1997). Terrain Classification System for British Columbia, Version 2 (1990). B.C. Ministry of Environment, MOE Manual 10. Victoria BC.

Impact Assessment Agency of Canada (IAAC). (2020, February 24). *Marten Falls Community Access Road Project Tailored Impact Statement Guidelines.* Retrieved from https://iaac-aeic.gc.ca/050/documents/p80184/133937E.pdf

Impact Assessment Agency of Canada (IAAC). (2021, July). *Glossary of Terms*. Retrieved from Canada.ca: https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/glossary-of-terms.html

Impact Assessment Agency of Canada (IAAC). (2021, September 17). *Guidance: Gender-Based Analysis Plus in Impact Assessment.* Retrieved from Government of Canada: https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/gender-based-analysis.html

Impact Assessment Agency of Canada (IAAC). (2022). *Impact Assessment Agency of Canada (IAAC). Physiography, Terrain and Soils and Vegetation and Peatlands Work Plan Comments*.

John R., P. Ahmad, K. Gadgil, and S. Sharma. (2009). Heavy metal toxicity: effect on plant growth, biochemical parameters and metal accumulation by Brassica juncea L. International Journal of Plant Production 3(3):65-76.

Joshi, R. (2017). Physical constraints of fine textured heavy soils and their management – A review. Agricultural Research Communication Centre, Agricultural Reviews, 38(2): 216-222, Online ISSN: 0976-1539.

Jung K., Y.S. Ok, and S.X. Chang. (2011). Sulfate adsorption properties of acid-sensitive soils in the Athabasca oil sand region in Alberta, Canada. Chemosphere 84(4):457-463.

KGS Group. (2019a). MFFN Testhole Logs & Lab Testing Data – KGS Sept-Oct 2019.

KGS Group. (2019b). Environmental Assessment and Preliminary Design Services for Marten Falls Community Access Road 3-Day Helicopter Reconnaissance – Phase 1 – Final (letter to AECOM).

KGS Group. (2020a). Environmental Assessment and Preliminary Design Services for Marten Falls Community Access Road Geotechnical Report Excluding Appendices (Draft Rev A).

KGS Group. (2020b). Environmental Assessment and Preliminary Design Services for Marten Fall Community Access Road Aggregate Resources Report.

Kim, P. J. (2019, July 25). Social Determinants of Health Inequities in Indigenous Canadians through a Life Course Approach to Colonialism and the Residential School Systems. *Health Equity*(3.1), 378-381. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6657289/

Kolaj, M., S.C. Halchuk, and J. Adams. (2023). Sixth-generation seismic hazard model of Canada: grid values of mean hazard to be used with the 2020 National Building Code of Canada. version 1.0, Geological Survey of Canada, Open File, 8950, https://doi.org/10.4095/331497

Lamontagne, M., S. Halchuk, J.F. Cassidy, and G.C. Rogers. (2018). Significant Canadian earthquakes 1600–2017, Geological Survey of Canada, Open File 8285, 1 .zip file. https://doi.org/10.4095/311183.

Läuchli, A. and S.R. Grattan. (2012). Soil pH Extremes (Chapter). Plant Stress Physiology (pp. 194-209). CAB International.

Lewis T. and W.W. Carr, Timber Harvesting Subcommittee, Interpretation Working Group. (1989). Developing Timber Harvesting Prescriptions to Minimize Site Degradation-Interior Sites, Land Management Handbook, Field Guide Insert, British Columbia Ministry of Forests, Victoria, B.C. 31 pp.

Macyk, T.M. (1986). Characterization and variability of soils reconstructed after surface mining in Central Alberta. Alberta Land Conservation and Reclamation Council Report RRTAC#86-2. p. 146.

Madeh, P., D. Carnegie, and L. Weissling. (2021). Best Management Practices for Aggregate Pit and Quarry Rehabilitation in Ontario. Ontario Society of Professional Engineers. Available at: https://ospe.on.ca/wp-content/uploads/2021/04/Best-Management-Practices-for-Aggregate-Pit-and-Quarry-Rehab-in-Ont..pdf

Mapping System Working Group. (1981). A Soil Mapping System for Canada: Revised. Land Resource Research Institute. Contribution Number 142. Research Branch. Agriculture Canada. Ottawa. 94 pp.

Marten Falls First Nation Chief and Council. (2017). Marten Falls First Nation All-Season Community Access Road Preferred Route Selection and Preliminary Environmental Work Project Proposal. Marten Falls First Nation Band Office, Ogoki, Ontario.

Marten Falls First Nation. (2019). Indigenous Knowledge obtained by Four Rivers Environmental Services Group.

Marten Falls First Nation. (2020) Community Based Land Use Plan.

Marten Falls First Nation. (2022). Public Information Centre (PIC) #4 Meeting on November 2, 2022.

Marten Falls First Nation. (2023). *Marten Falls First Nation Indigenous Knowledge Land Use and Occupancy Study for the Northern Access Roads.*

Ministry of the Environment, Conservation and Parks (MECP). (2022). *Physiography, Terrain and Soils and Vegetation and Peatlands Work Plan Comments*.

Ministry of Transportation, Ontario (MTO). (2002). Standard Practice for Aggregate Resource Evaluation. Soils and Aggregate Section, Materials Engineering and Research Office, Ministry of Transportation, Ontario.

Mushkegowuk Council. (2022). Meeting with Mushkegowuk Council on May 18, 2022.

Naeth, M.A., P.M. Rutherford, and A.M. Jobson. (2021). Soil Reclamation and Remediation of Disturbed Lands, In M.Krzic, F.L. Walley, A. Diochon, M.C. Paré, & R.E. Farrell (Eds.), Digging into Canadian soils: An introduction to soil science (pp. 463–517). Pinawa, MB: Canadian Society of Soil Science. https://openpress.usask.ca/soilscience/chapter/soil-health-and-management/

Natural Resources Canada (NRCan). (2021a). Earthquake Magnitude Scales. Earthquakes Canada. Accessed May 3, 2023, at https://earthquakescanada.nrcan.gc.ca/info-gen/scales-echelles/magnitude-en.php

Natural Resources Canada (NRCan). (2021b). Forest soils of Ontario - Soil monolith collection at GLFC (web page with soil map of Ontario). Accessed May 21, 2021 at https://cfs.nrcan.gc.ca/projects/101.

Natural Resources Canada (NRCan). (2022). Passive Control Networks, Geodetic References Systems. Accessed 3 May, 2023, at https://webapp.csrs-scrs.nrcan-rncan.gc.ca/geod/data-donnees/passive-passif.php?locale=en&_gl=1*nz3dje*_ga*MTg3MTgyMjIyNS4xNjY0NTc1MzU4*_ga_C2N57Y7DX5*MTY4MzEyMzkwMS4xMS4xLjE2ODMxMjUxNzguMC4wLjA.

Natural Resources Canada (NRCan). (2023). Earthquakes Canada, GSC, Earthquake Search (Online Bulletin), accessed 6 June 2024 from Search the Earthquake Database (nrcan.gc.ca) https://earthquakescanada.nrcan.gc.ca/stndon/NEDB-BNDS/bulletin-en.php.Ontario Geological Survey (Ontario Geological Survey). 1997. Quaternary geology, seamless coverage of the province of Ontario. Ontario Geological Survey, Data Set 14. Scale 1:1,000,000.

Ontario Geological Survey (OGS). (1997). Quaternary geology, seamless coverage of the province of Ontario. Ontario Geological Survey, Data Set 14.

Ontario Geological Survey (OGS). (2011). 1:250,000 scale Bedrock Geology of Ontario. Ontario Geological Survey, Miscellaneous Release – Data 126, Revision 1. Available at: http://www.geologyontario.mndm.gov.on.ca/ogsearth.html

Ontario Geological Survey (OGS). (2018). Far North Predictive Mapping. Available at: https://www.geologyontario.mndm.gov.on.ca/ogsearth.html#nont

Ontario Geological Survey (OGS). (2021). Aggregate Resources of Ontario (ARO-2020). Ontario Geological Survey, Aggregate Resources of Ontario, database, updated June 2021. Available at: https://www.geologyontario.mndm.gov.on.ca/mndmaccess/mndm_dir.asp?type=pub&id=ARO

O'Rourke, M.J. and X. Liu. (1999). Response of buried pipelines subject to earthquake effects: Multidisciplinary Center for Earthquake Engineering Research Monograph Series MCEER-99-MN03.

O'Rourke, M.J. and X. Liu. (2012). Seismic Design of Buried and Offshore Pipelines. Multidisciplinary Center for Earthquake Engineering Research. Monograph Series MCEER-12-MN04.

Panagos P. and C. Ballabio. (2017). Global Rainfall Erosivity Dataset. European Soil Data Centre (ESDAC) Joint Research Centre. Available to download at: Global Rainfall Erosivity - ESDAC - European Commission (europa.eu)

Parker, S. (1994). Dictionary of Earth Science. Published by McGraw-Hill.

Pennock, D. (2021). Soil genesis, In M. Krzic, F.L. Walley, A. Diochon, M.C. Paré, and R.E. Farrell (Eds.), Digging into Canadian soils: An introduction to soil science (pp. 463–517). Pinawa, MB: Canadian Society of Soil Science. https://openpress.usask.ca/soilscience/chapter/soil-health-and-management/

Rusek A. and V.G. Marshall. (2000). Impacts of airborne pollutants on soil fauna. Annual Review of Ecology and Systematics 31: 395-423.

Séré G., C. Schwartz, S. Ouvrard, C. Sauvage, J,-C. Renat, and J.-L. Morel. (2008). Soil construction: A step for ecological reclamation of derelict lands. Journal of Soils and Sediments, 8: 130. Available at https://doi.org/10.1065/jss2008.03.277

Soil Classification Working Group. (1998). The Canadian System of Soil Classification, 3rd ed. Agriculture and Agri-Food Canada Publication 1646, 187 pp.

Thurston, P.C. (1991). Geology of Ontario: Introduction. In, P.C. Thurston, H.R. Williams, R.H. Sutcliff and G.M. Stott (eds.). Geology of Ontario, Ontario Geological Survey, Special Volume 4, Part 1, p. 3-25.

Turchenek, L.W., S.A. Abboud, and U. Dowey. (1998). Critical Loads for Organic (Peat) Soils in Alberta. Prepared for the Target Loading Subgroup and Clean Air Strategic Alliance by Alberta Research Council and AGRA Earth and Environmental Limited. Edmonton, AB.

Veillette, J.J. (1994). Evolution and paleohydrology of the glacial lakes Barlow and Ojibway. Quaternary Science Reviews. 13: 945-971.

Wald, D.J., V. Quitoriano, T.H. Heaton, and Kanamori, H. (1999). Relationship between Peak Ground Acceleration, Peak Ground Velocity, and Modified Mercalli Intensity in California: Earthquake Spectra, v. 15, no. 3, p. 557-564.

Wall, G.J., D.R. Coote, E.A. Pringle and I.J. Shelton (editors). (2002). RUSLEFAC — Revised Universal Soil Loss Equation for Application in Canada: A Handbook for Estimating Soil Loss from Water Erosion in Canada. Research Branch, Agriculture and Agri-Food Canada. Ottawa. Contribution No. AAFC/AAC2244E. 117 pp

Wick, A.F., P.D. Stahl, L.J. Ingram, and L. Vicklund. (2009). Soil Aggregation and Organic Carbon in Short-Term Stockpiles. Soil Use and Management. 25:311-319

WSP Canada Inc. (WSP). (2026a). Vegetation Technical Support Document: Existing Conditions and Effects Assessment.

WSP Canada Inc. (WSP). (2026b). Groundwater Technical Support Document: Existing Conditions and Effects Assessment, Attachment B (Geochemical Characterization Technical Support Document)

Women and Gender Equality Canada. (2022, June). *Gender-based Analysis Plus.* Retrieved from Government of Canada: https://women-gender-equality.canada.ca/en/gender-based-analysis-plus/what-gender-based-analysis-plus.html

Youd, T.L., I.M. Idriss, R.D. Andrus, I. Arango, G. Castro, J.T. Christian, R. Dobry, W.D. Finn, Jr. L.F. Harder, M.W. Hynes, K. Ishihara, J.P. Koester, S.S.C. Liao, W.F. Marcuson III, G.R. Martin, J.K. Mitchell, Y. Moriwaki, M.S. Power, P.K. Robertson, R.B. Seed, and K.H. Stokoe II. (2001). Liquefaction resistance of soils summary report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils. Journal of Geotechnical and Geoenvironmental Engineering, v. 127, no. 10, p. 817-833.

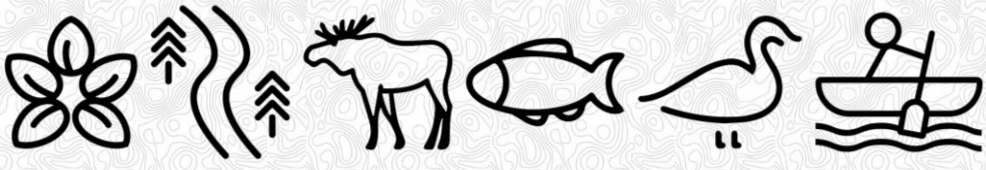
Attachment A – Draft Study Plan, Workplan and Regulator Comments

MARTEN FALLS FIRST NATION
ALL SEASON COMMUNITY ACCESS ROAD

FINAL

Physiography, Terrain and Soils Study Plan

May 2021



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Revision History

Rev #	Date	Revision Description
Draft	June 2020	Submitted “Study Plan- Physiography, Geology Geochemistry, Terrain and Soils DRAFT FOR DISCUSSION” to the Agency.
Final	May 2021	Revised to address federal and provincial agency comments.

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Appendices

Appendix A. Preliminary List of Data Sources
Appendix B Agency Comments on the Draft Study Plan

Acronyms

AP ..... Acid-Generation Potential
AECOM ..... AECOM Canada Ltd.
CALA ..... Canadian Association for Laboratory Accreditation
CAR ..... Community Access Road
EA ..... Environmental Assessment
IA ..... Impact Assessment
IAAC ..... Impact Assessment Agency of Canada
IS ..... Impact Statement
km ..... Kilometre
LSA ..... Local Study Area
MECP ..... Ontario Ministry of the Environment, Conservation and Parks
MFFN ..... Marten Falls First Nation
OGS ..... Ontario Geological Survey
PAG ..... Potentially Acid Generating
PDA ..... Project Development Area
PTTW ..... Permit To Take Water
ROW ..... Right-of-way
RSA ..... Regional Study Area
SARA ..... Species at Risk
TISG ..... Tailored Impact Statement Guidelines
ToR ..... Terms of Reference
VC ..... Valued Component

1. Introduction

The Proponent of the Community Access Road (CAR or the Project) is Marten Falls First Nation (MFFN), a remote First Nation community in northern Ontario located at the junction of the Albany and Ogoki rivers, approximately 430 kilometres (km) from Thunder Bay, Ontario. The MFFN community is proposing an all-season Community Access Road that will connect the MFFN community to Ontario's provincial highway network (Highway 643) to the south via the existing Painter Lake Road. MFFN, as the Proponent of the Project, has formed a MFFN CAR Project Team that includes MFFN CAR Community Member Advisors and MFFN CAR Project Consultants who act with input, guidance and direction from the MFFN Chief and Council/

This document outlines the study plan for the Physiography Terrain and Soils discipline to support a co-ordinated Impact Assessment (IA) required for Project review by the Impact Assessment Agency of Canada (the Agency) under the federal *Impact Assessment Act* (IAA) and Environmental Assessment (EA) required for Project review by the Ontario Ministry of the Environment, Conservation and Parks (MECP) under the Ontario *Environmental Assessment Act*.

1.1 Federal and Provincial Terminology

The study plans have been prepared using federal terminology, however, the respective provincial terminology has been provided in **Table 1-1** for reference. The terms can be used interchangeably.

Table 1-1: Equivalent Federal and Provincial Terms

Provincial Term	Federal Term
Criteria	Valued Component
Impact Management Measure	Mitigation Measure
Net Effects	Residual Effects
Record of Consultation	Record of Engagement

1.2 Project Study Plans

The Physiography, Geology, Terrain and Soils Study Plan focuses on valued components associated with physical geography, including the location, spatial extent and composition of surficial landforms. Studying these landforms will help the Project avoid sensitive landform features such as eskers, beach ridges, bedrock outcrops and wetlands, unfavourable soils due to poor quality or poor geotechnical properties and unfavourable slopes (i.e., areas prone to slope failure). This Study Plan will also provide insight on potential pit and quarry areas and ongoing geological modifying processes, such as permafrost degradation, landslides and slumps.

This Study Plan is one of a group of study plans created for the Project. **Table 1-2** includes the study plans for each environmental[1] discipline currently planned for the Project and the valued components (VCs) covered by the study plans where applicable.

Table 1-2: Project Study Plans and Valued Components

Environmental Discipline	Study Plan Name	Valued Component(s)
Aboriginal and Treaty Rights and Interests	■ Aboriginal and Treaty Rights and Interests Study Plan	■ Indigenous Current Use of Lands and Resources for Traditional Purposes ■ Cultural Continuity (ability to practice and transmit cultural traditions)
Atmospheric Environment	■ Atmospheric Environment and Greenhouse Gases Study Plan	■ Air Quality ■ Greenhouse Gas Emissions
Climate Change	■ Climate Adaptation and Resiliency Study Plan	■ Climate Change
Acoustic and Vibration Environment	■ Acoustic and Vibration Environment Study Plan	■ Noise ■ Vibration
Physiography, Geology, Terrain and Soils	■ Physiography, Terrain and Soils Study Plan	■ Physiography, Terrain and Soils
Surface Water	■ Surface Water Study Plan	■ Surface Water
Groundwater and Geochemistry	■ Groundwater and Geochemistry Study Plan	■ Groundwater
Vegetation	■ Vegetation Study Plan	■ Wetland and Riparian Ecosystems ■ Upland Ecosystems ■ Designated Areas (Areas of Natural and Scientific Interest, Environmentally Significant Areas, Significant Woodlands, Critical Landform / Vegetation Associations)

1. *The use of the term environment in this document is inclusive of the components of the environment that are included in the Ontario Environmental Assessment Act definition, which includes a general description of the social, cultural, built and natural environments.*

Environmental Discipline	Study Plan Name	Valued Component(s)
		■ Traditional Use Plants and SAR Plant Populations (including species with special conservation status or rarity in the province)
	■ Peatlands Study Plan	■ Peatland Ecosystems (bogs and fens)
Wildlife	■ Wildlife Study Plan	■ Bats (including SAR-bats such as: Little Brown Myotis [*Myotis lucifugus*], Northern Myotis [*Myotis septentrionalis*] and Tricolored Bat [*Perimyotis subflavus*]) ■ Fur Bearers (proxy VC[2] American Marten [*Martes americana*], Beaver [*Castor canadensis*] and Wolverine [*Gulo gulo*]) ■ Amphibians and Reptiles ■ Pollinating Insects
	■ Ungulates (Moose and Caribou) Study Plan	■ Moose (*Alces alces*) ■ Caribou, boreal population (*Rangifer tarandus*)
	■ Bird Study Plan	■ Forest Birds (proxy VC of Red-eyed Vireo [*Vireo olivaceus*] for deciduous forest, Ovenbird [*Seirus aurocapilla*] for mixedwood forest, Dark-eyed Junco [*Junco hyemalis*] for coniferous forest and disturbed forest ■ Raptors (proxy VC of Osprey [*Pandion haliaetus*] for diurnal raptors and Boreal Owl [*Aegolius funereus*] for nocturnal raptors ■ Shorebirds (proxy VC of Wilson's Snipe [*Gallingo delicata*]) ■ Waterfowl (proxy VC of Mallard [*Anas platyrhynchos*]) ■ Bog / Fen Birds and Other Wetland Birds (proxy VC of Palm Warbler [*Setophaga palmarum*] for bogs, Common Yellowthroat [*Geothlypis trichas*] for fens; and Northern Waterthrush [*Parkesia noveboracensis*] for swamps . ■ SAR birds: Canada Warbler (*Cardellina canadensis*), Chimney Swift (*Chaetura pelagica*), Common Nighthawk (*Chordeiles minor*), Eastern Whip-poor-will (*Antrostomus vociferous*), Eastern Wood-Pewee (*Contopus virens*), Evening Grosbeak (*Coccothraustes vespertinus*), Olive-sided Flycatcher (*Contopus cooperi*), Bald Eagle (*Haliaeetus leucocephalus)*, Peregrine Falcon (*Falco peregrinus*), Short-eared Owl (*Asio flammeus)*, Bank Swallow (*Riparia riparia*), Barn Swallow (*Hirundo rustica*), Black Tern (*Childonias niger*), Rusty Blackbird (*Euphagus carolinus*), Yellow Rail (*Coturnicops noveboracensis*)

[2] *A proxy VC is used when looking at the effects of one species that represents many others.*

Environmental Discipline	Study Plan Name	Valued Component(s)
Fish and Fish Habitat	■ Fish and Fish Habitat Study Plan	■ Lake Sturgeon (*Acipenser fulvescens*) ■ Walleye (*Sander vitreus*) ■ Brook Trout (*Salvelinus fontinalis*) ■ Northern Pike (*Esox lucius*) ■ Lake Whitefish (*Coregonus clupeaformis*) ■ Chain Pickerel (*Esox niger*) ■ Yellow Perch (*Perca flavescens*) ■ Cisco (*Coregonus artedii*) ■ Burbot (*Lota lota*) ■ Longnose Sucker (*Catostomus catostomus*) ■ White Sucker (*Catostomus commersonii*) ■ Forage / Prey Species (including species such as Lake Chub [*Couesius plumbeus*]) ■ Lower Trophic Organisms (e.g., benthic invertebrates)
Social	■ Social Study Plan	■ Housing and Accommodation ■ Community Service and Infrastructure ■ Transportation ■ Community Well-being ■ Populations and Demographics
Economy	■ Economic Study Plan	■ Regional Economy ■ Labour Force and Employment ■ Government Finances
Land and Resource Use	■ Land and Resource Use Study Plan	■ Land Use Compatibility ■ Parks and Protected Areas ■ Extractive Industry ■ Forestry Industry ■ Energy and Linear Infrastructure ■ Recreation and Tourism
Human Health and Community Safety	■ Human Health and Community Safety Study Plan	■ Public Safety ■ Public Health ■ Diet ■ Environmental Factors Influencing Health
Visual Aesthetics	■ Visual Aesthetics Study Plan	■ Visual Contrast / Character ■ Visibility ■ Visual Sensitivity
Archaeological and Cultural Heritage	■ Cultural Heritage Study Plan	■ Archaeological Sites and Resources ■ Built Heritage Resources and Cultural Heritage Landscapes

It should be noted that while there is not a consultation study plan, the Project has developed the *Consultation and Engagement Plan to Support the Environmental Assessment / Impact Statement* (AECOM 2020) (referred to as the Impact Statement [IS] / EA Consultation Plan).

2. Purpose and Objectives

The key objectives of conducting an IA / EA are to describe the existing environment, gather sufficient information to predict Project-related effects (positive and negative, direct and indirect) of the Project and alternatives on the environment, determine measures needed to avoid or minimize adverse Project effects, and enhance beneficial Project effects where feasible, and to undertake consultation and engagement throughout. The purpose of this Study Plan is to explain:

- A baseline[3] study methodology that will result in a comprehensive description of the existing environment potentially impacted by the Project;
- How efficient and transparent data management and analysis will be undertaken;
- Effects assessment scoping inputs specific to Physiography, Terrain and Soils that will allow for potential effects of the Project on the existing environment to be appropriately assessed in the IS / EA Report; and
- How the study plan aligns with federal and provincial requirements and guidance, including the Agency's Tailored Impact Statement Guidelines (TISG), dated February 24, 2020 (the Agency 2020c), for this Project and applicable provincial agency comments on the Draft Terms of Reference (ToR)[4].

As required by the IAA and referenced in TISG Section 7.3, work plans will also be developed for disciplines as required. It is anticipated the work plans will include further details on how to action the study plans; for example they would contain such information as location of sampling sites, scheduling, and sequencing.

For the purposes of establishing appropriate context, the study plan begins with background and relevant information on:

- Study plan related discussions with the Agency, the MECP and applicable agencies to date (**Section 3**);
- The approach to Project consultation and engagement (**Section 4**);
- How Indigenous Knowledge will be collected and used in the IA / EA (**Section 5**); and
- The spatial and temporal boundaries that will be used for the IA / EA (**Section 6**).

3. *Baseline refers to the current conditions of the environment potentially impacted by the Project. Baseline conditions serve as a reference against which changes due the Project are measured.*
4. *If necessary, the Study Plan will be updated to reflect the approved ToR if approval is obtained.*

2.1 Approach to Handling Confidential Information

2.1.1 Indigenous Knowledge

Permission from the Indigenous community will be sought before including Indigenous Knowledge in the IS / EA Report, regardless of the source of the Indigenous Knowledge. Sensitive and / or confidential information will be specifically collected through the Indigenous Knowledge Program to inform the IS / EA Report, and its use and publication will be governed by Indigenous community-specific Indigenous Knowledge Sharing Agreements. Sensitive and / or confidential information collected through Indigenous Knowledge Sharing Agreements will be protected from public or third-party disclosure and will be established between the Proponent and Indigenous communities participating in the Indigenous Knowledge Program prior to the sharing and use of any sensitive information. Instances where Indigenous Knowledge sharing has taken place during consultation activities (e.g., meetings) will be recorded in the Record of Consultation and Engagement, including where Indigenous Knowledge was incorporated into Project decisions and into the IS / EA Report (i.e., specifics will not be included in the Record of Consultation and Engagement given the potential sensitivity and / or confidentiality of the information shared).

3. Study Plan Technical Discussions

To facilitate the development of satisfactory study plans and eventually a satisfactory IS / EA Report, MFFN previously submitted draft study plans in an effort to hold technical discussions with the Agency, the MECP and applicable agencies. However, no discussions have occurred to date on the Physiography, Terrain and Soils Study Plan.

4. IS / EA Report Consultation and Engagement Process

4.1 Interested Persons and Government Agencies

The Proponent will provide Project notices and advise of opportunities for consultation and engagement with interested persons[5] which includes, at a minimum, members of the public outlined in the *Public Participation Plan for the Marten Falls Community Access Road Project Impact Assessment* (The Agency 2020) (referred to as the Public Participation Plan). This will include the opportunity to provide input on the existing environment, VCs, effects assessment methods, effects assessment results, and mitigation and follow-up program measures as applicable. A variety of activities will be offered so that members of the public are informed of the IS / EA Report as it progresses and are aware of the opportunities and means to provide their input. The study plans have recognized public and agency input received on the Project to date. Government agencies and interested persons will have the opportunity to comment on components of the study plans throughout the IS / EA Report consultation and engagement process. The Project's approach to handling confidential and sensitive information is outlined in **Section 2.1**.

4.2 Indigenous Communities

The Proponent will provide Project notices and opportunities for consultation and engagement with Indigenous communities identified in **Table 4-1**, which is inclusive of all Indigenous communities identified in the *Indigenous Partnership and Engagement Plan for the Marten Falls Community Access Road Project Impact Assessment* (The Agency 2020a) (referred to as the Indigenous Engagement and Partnership Plan).

Indigenous communities will be provided the opportunity to be involved at critical decision-making points throughout the IS / EA Report so that the Proponent can consider and incorporate, where appropriate Indigenous Knowledge and Indigenous land and resource use information into the Project as it pertains to the existing environment, VCs, effects assessment methods, effects assessment results, and mitigation and follow-up program measures. A variety of activities will be offered so that Indigenous communities are

5. *Interested persons, as defined in the IS / EA Consultation Plan, are individuals and groups (e.g., associations, non-governmental organizations, industry and academia) who could have an interest in the Project, including but not limited to communities in the region, those with commercial interests (e.g., forestry, trappers, outfitters, other mineral tenure holders in the area) and recreational users or those with recreational interest (e.g., campers, hunters and environmental groups).*

informed of the IS / EA Report as it progresses and are aware of the opportunities, means and timelines to provide their input. The study plans have recognized Indigenous community input received on the Project to date. Indigenous communities will have the opportunity to comment on components of the study plans throughout the IS / EA Report consultation and engagement process.

Table 4-1: Identified Neighbouring Indigenous Communities, including their Provincial Territorial Organizations and / or Tribal Council Affiliations

Tribal Council Affiliation	Indigenous Community or Organization
Matawa First Nations Management *(Nishnawbe Aski Nation)*	■ **Marten Falls First Nation** (Proponent and potentially affected Indigenous community) ■ Aroland First Nation ■ Constance Lake First Nation ■ Eabametoong First Nation ■ Ginoogaming First Nation ■ Neskantaga First Nation ■ Nibinamik First Nation ■ Webequie First Nation
Matawa First Nation and the Union of Ontario Indians / Nishnawbe Aski Nation	■ Long Lake #58 First Nation**
Mushkegowuk Council *(Nishnawbe Aski Nation)*	■ Attawapiskat First Nation ■ Fort Albany First Nation ■ Kashechewan First Nation
Shibogama First Nations Council *(Nishnawbe Aski Nation)*	■ Kasabonika Lake First Nation ■ Kingfisher Lake First Nation ■ Wapekeka First Nation ■ Wawakapewin First Nation ■ Wunnumin Lake First Nation
Independent First Nations Alliance *(Nishnawbe Aski Nation)*	■ Kitchenuhmaykoosib Inninuwug First Nation
Independent First Nations *(Nishnawbe Aski Nation)*	■ Mishkeegogamang First Nation ■ Weenusk First Nation
Nokiiwin Tribal Council	■ Animbiigoo Zaagi'igan Anishinaabek First Nation (AZA)*
Métis Nation of Ontario	■ Métis Nation of Ontario; Region 2*
Independent Métis Nation	■ Red Sky Independent Métis Nation*

*Notes: * Indigenous communities or organizations identified by MECP who should be consulted on the basis that they may be interested in the Community Access Road.*
*** MECP indicated in a letter to MFFN that Long Lake #58 First Nation was moved from interest-based to rights-based.*

4.3 Consideration of Identity and Gender-Based Analysis Plus in Engagement

To fulfill requirements of the IAA, the Consultation and Engagement Program will consider a diverse range of perspectives from interested persons and interested Indigenous communities and their members identified in the Agency's Indigenous Engagement and Partnership Plan and the Public Participation Plan. This will include at a minimum providing ongoing opportunities for engagement to:

- **Neighbouring Indigenous communities, including relevant subpopulations:**
  - Women;
  - Youth; and
  - Elders.
- **Non-Indigenous communities including:**
  - Women;
  - Youth; and
  - Activity-based subgroups (e.g., recreationalists, snowmobilers, tourism establishment operators).

The Proponent will also consult and engage with other subpopulations identified by communities during consultation and engagement. The information from these activities and any additional identity groups identified by communities through consultation and engagement will be considered by applicable environmental disciplines for the purposes of data collection and considering disproportionate effects.

During consultation and engagement, these aforementioned groups will be consulted and engaged with on targeted input**.**

When feedback is received from interested persons and Indigenous communities, issues, comments and questions will be tracked, which is consistent with the process described in the IS / EA Consultation Plan. Specific to Gender-Based Analysis Plus objectives, this will include efforts to engage with diverse populations. It is expected this will include activities specific to subgroups and tabulation of consultation and engagement participation with respect to identity factors. This will provide summary statistics to demonstrate the diversity achieved in consultation and engagement.

5. Consideration of Indigenous Knowledge in the IS / EA Report

The following provides a general description of how Indigenous Knowledge will be considered in the IA / EA process. The extent to which Indigenous Knowledge is considered by each specific VC will vary depending on the nature of the VC, the potential for Project effects on the VC and whether Indigenous knowledge that relates to a VC is provided / obtained. As such, not all aspects of the general approach described below may apply to all VCs / study plans.

There are two concurrent and complementary avenues for Indigenous communities and groups to be engaged with and provide input on the Project: the Indigenous Knowledge Program and the Consultation and Engagement Program. Both programs serve to support the collection of Indigenous perspectives, values, and input on the Project, including Aboriginal and Treaty Rights and how they may be impacted by the Project, to be integrated throughout the IA / EA process. However, the Indigenous Knowledge Program specifically aims to solicit and incorporate information that is considered sensitive and may have confidentiality requirements, including Indigenous Knowledge and information on Indigenous land and resource use. Indigenous Knowledge Sharing Agreements will be established between the Proponent and Indigenous communities participating in the Indigenous Knowledge Program prior to the sharing and use of any sensitive information.

All Indigenous communities and groups identified by the MECP and the Agency through the Indigenous Engagement and Partnership Plan have the opportunity to participate in the Indigenous Knowledge Program. The Indigenous Knowledge Program provides interested Indigenous communities an opportunity to: share existing Indigenous Knowledge and information on Indigenous land and resource use and cultural values that may be relevant to the Project, and / or complete Project-specific studies to collect and share Indigenous Knowledge and information on Indigenous land and resource use and cultural values. The Indigenous Knowledge Program includes opportunities for Indigenous communities and groups to meet with the Proponent to discuss the program, ask questions, and share concerns and interests. In support of this, the Proponent has created an Indigenous Knowledge Program Guidance Document (the Guidance Document) that provides:

- An overview of the Indigenous Knowledge Program and information on how Indigenous Knowledge, Indigenous land and resource use and cultural values and practices can be collected and / or shared;

- Information on how Indigenous Knowledge and information on Indigenous land and resource use and cultural values and practices may be used in the planning and design processes; and
- A suite of guidance materials that were developed based on the information requirements of both the federal and provincial assessment processes, including question guides to support the collection of information on historical and current community context, Indigenous Knowledge that may be relevant to the various technical disciplines; information on Indigenous land and resource use, cultural values and practices and associated spatial data; and perspective on potential Project-related effects and associated mitigation and / or enhancement measures.

The Guidance Document will also support participating Indigenous communities in providing Project-specific information in a manner that facilitates meaningful incorporation into the IS / EA Report.

The IS / EA Consultation Plan outlines the process for obtaining information and feedback about the Project from Indigenous communities (i.e., the Consultation and Engagement Program). All Indigenous communities identified by the MECP and the Agency have the opportunity to participate in the Consultation and Engagement Program through community-specific meetings, Public Information Centres, web conferences, and other formats. All Indigenous communities identified by the MECP and the Agency will be provided information related to the Project and invited to participate at various points throughout the IA / EA process.

There are also opportunities for technical teams to engage with Indigenous communities to solicit perspectives and information relevant to the Project, including information related to collection of existing information and the development of the IS / EA Report. The Proponent also invites feedback and inputs throughout the Project via the Project website and ongoing communications with the Proponent.

The Indigenous Knowledge and Consultation and Engagement programs are designed to be complementary and provide multiple opportunities for communities to offer feedback and information, including perspectives on Aboriginal and Treaty Rights and interests and how these may be impacted by the proposed Project. Relevant information collected through both the Indigenous Knowledge and Consultation and Engagement programs, including potential effect pathways on Aboriginal and Treaty Rights and interests, will be shared with each of the relevant disciplines throughout the IA / EA to: guide and inform VCs; support characterization of the existing environment; identify the potential effects of the Project on VCs; help identify mitigation measures and potential monitoring programs; and ultimately guide Project planning. The nature of how the Indigenous Knowledge becomes integrated into the IS / EA Report will be dictated by the specific information provided by each Indigenous community and the parameters set out in

the Indigenous Knowledge Sharing Agreements. A description of how Indigenous Knowledge was considered in the IA / EA and in each of the technical discipline areas will be included in the IS / EA Report.

It is also important to note that information collected through the various activities (e.g., field studies and programs, effects assessments) of each discipline area (e.g., wildlife, vegetation, cultural heritage) will be shared with the Indigenous Knowledge Program leads. This will support the establishment of the existing environment and the effects assessment for the Aboriginal and Treaty Rights and Interests environmental discipline, as well as the identification of potential mitigation measures and monitoring programs, given the interrelated nature of Indigenous peoples and other environmental disciplines.

The Proponent will strive to respectfully collaborate with Indigenous communities on how Indigenous Knowledge and information on Indigenous land and resource use and cultural values will become part of the IS / EA Report, and how potential effects to Aboriginal and Treaty Rights and interests will be assessed. It is expected that measures to support this may include but are not limited to: engaging Indigenous communities to solicit information on Indigenous Knowledge and Indigenous land and resource use and cultural values to inform baseline conditions, providing Indigenous communities with draft sections of the IS / EA Report to illustrate how Indigenous Knowledge and information on Indigenous land and resource use and cultural values has been integrated and to confirm it has been presented appropriately, and completing collaborative working sessions with Indigenous communities for the effects assessment on Aboriginal and Treaty Rights and Interests. Further information on how potential effects on Indigenous rights will be assessed is provided in the Aboriginal and Treaty Rights and Interests Study Plan.

6. Assessment Boundaries

6.1 Temporal Boundaries: Project Phases

Project phases, which are temporal boundaries, are developed to establish the timeframes within which potential effects of the Project will be considered in the IS / EA Report. The Project is planned to occur in two phases, which are briefly described below and shown in **Figure 6-1**.

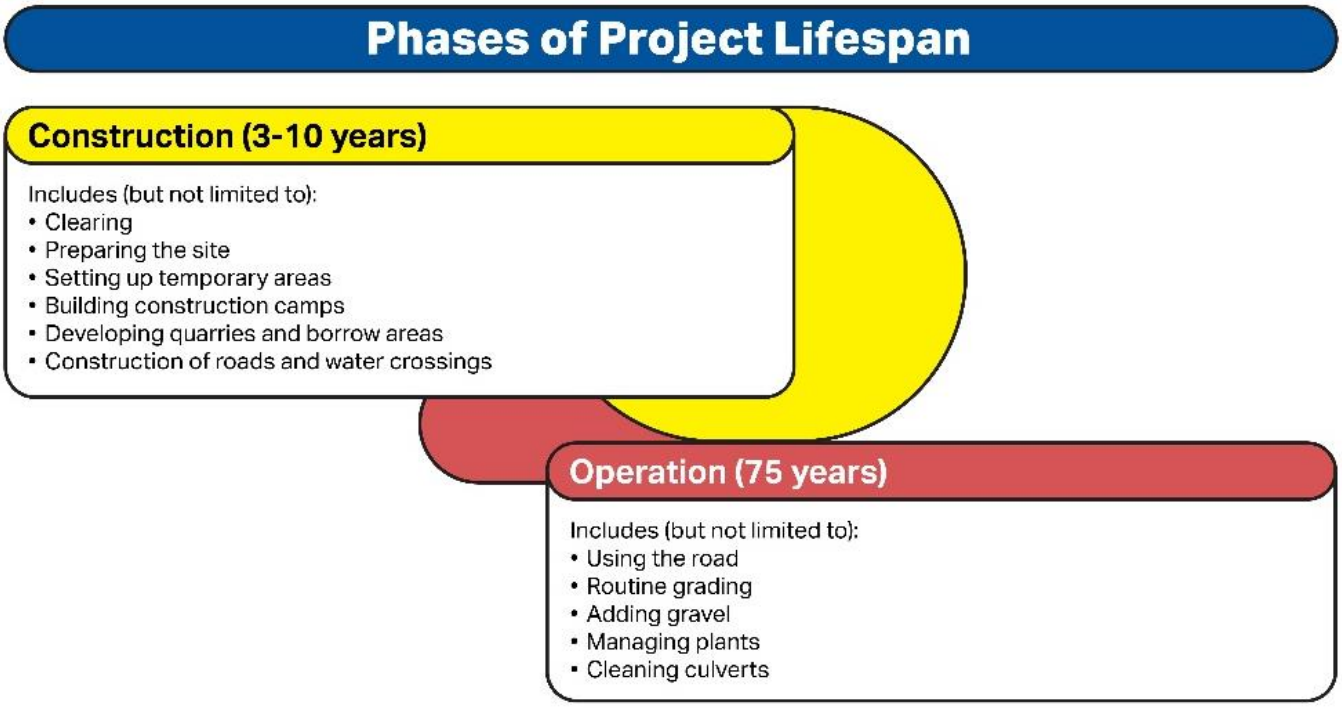
- **Construction Phase:**
  The time from start of construction, including site preparation activities, to the start of operations and maintenance of the CAR. Decommissioning of construction works is included in the construction phase. The construction phase is anticipated to take approximately 3 to 10 years to complete.
- **Operations and Maintenance Phase:**
  The operations and maintenance phase starts once construction activities are complete and lasts for the life of the Project. The operations and maintenance phase of the Project is considered to be 75 years based on the expected timeline for when major refurbishment of road components (e.g., bridges), is anticipated.

There are currently no plans to decommission the CAR as there is no expected / known end date for its need. Therefore, future suspension, decommissioning and eventual abandonment of the CAR will not be considered in the IS / EA Report. It will be considered if and when a decommissioning or abandonment application is made for the road.

In determining the temporal boundaries, in particular the long operations and maintenance phase, consideration was given to the long-term effects on the well-being of present and future generations (Sustainability Principle #2[6]). The final temporal boundaries to be used in the IS / EA Report will be based on regulatory agency guidance, professional judgement and input received through the Project consultation process.

6. *Sustainability Principles #2 is one of four sustainability principles included in Section 25 of the Project's TISG as further elaborated on Section 9.7.*

Figure 6-1: Project Schedule



6.2 Spatial Boundaries: Study Areas

6.2.1 General Information

Study areas identify the geographic extents within which potential effects of the Project are likely to occur and will be considered in the IS / EA Report. The existing conditions and potential effects are documented for three study areas selected for the Project:

- **Project Development Area (PDA):** area of direct disturbance;
- **Local Study Area (LSA):** the area where most of the direct effects of the Project are likely to occur; and
- **Regional Study Area (RSA):** the area where indirect effects of the Project are likely to occur.

The PDA encompasses the 100 metre-wide CAR right-of-way (ROW), temporary construction access roads, work areas, worker camps, and pits, quarries and associated access roads. The preliminary LSA

currently being considered within the scope of the ongoing provincial regulatory review process generally includes the area within 2.5 km of the centreline of Alternative 1 and Alternative 4. The preliminary study area generally allows for the documentation of existing conditions and prediction of potential environmental effects for the Project. A 5 km wide study area also allows for route refinements during development of Project design (e.g., adjustment of the alignment to avoid sensitive features).

The specific location of Project components, including the roadway, quarries, pits and temporary infrastructure, are not yet known and will be included in the IS / EA Report. While most of the Project components are expected to be located within the preliminary 5 km wide study area, benefits (e.g., reduced environmental disturbance, avoidance of sensitive features, technical considerations, concerns received through consultation) for locating Project components on lands outside of the 5 km wide study area may become known during the IA / EA process. If the need to locate Project components outside the 5 km wide study area is determined to be required or of benefit to the Project, the study area would be adjusted.

The study area for each environmental discipline may vary from the above-described general study area based on the potential for the Project to directly or indirectly affect each environmental discipline; therefore, discipline-specific LSAs and RSAs have been defined for the Project. In defining the final LSAs and RSAs, each environmental discipline will consider:

- Location and other characteristics of the environmental discipline relative to the Project;
- The anticipated extent of the potential Project effects;
- Federal, provincial, regional, and local government administrative boundaries;
- Indigenous groups listed in **Table 4-1**;
- Community knowledge and Indigenous Knowledge;
- Current or traditional land and resource use by Indigenous communities;
- Exercise of Aboriginal and Treaty Rights of Indigenous peoples, including cultural and spiritual practices; and
- Physical, ecological, technical, social, health, economic and cultural considerations.

The study areas included in this document are preliminary, covering the extent to which readily available information suggests the Project may have noticeable effects on the environment. The size, nature and location of past, present and reasonably foreseeable projects will be taken into consideration in the development of the cumulative effects assessment study area(s). The appropriate study area(s) to assess cumulative effects are dependent on the VCs predicted to have direct residual adverse effects as a result of the Project, and therefore, cannot be defined until the IS / EA Report has sufficiently advanced.

As further detailed in **Section 4**, the Proponent will continue to provide opportunities for neighbouring Indigenous communities and interested persons to provide input and inform the effects assessment, including the LSAs and RSAs.

6.2.1.1 Physiography, Terrain and Soils Study Areas

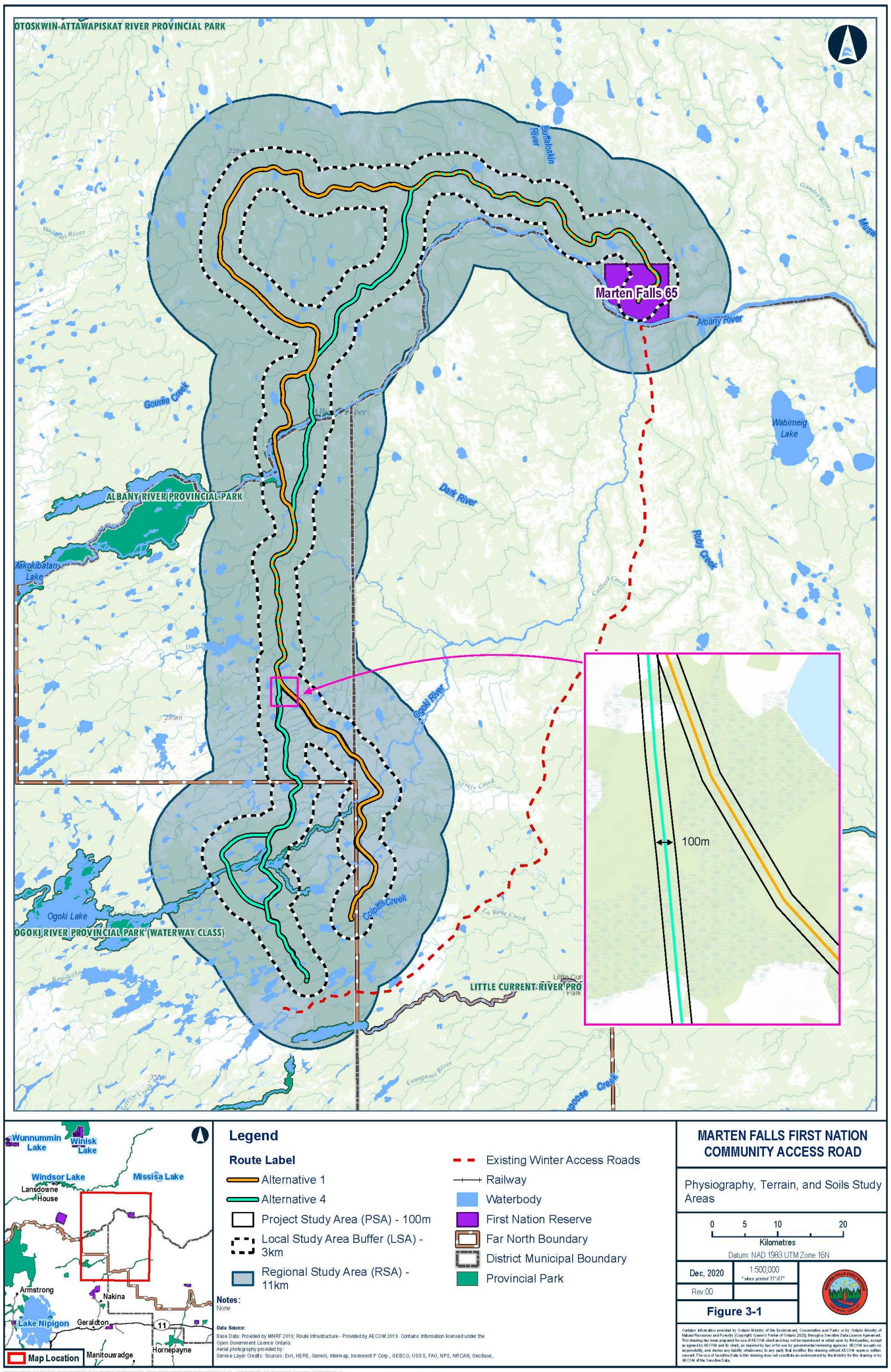
The LSA and RSA boundaries for Physiography, Terrain and Soils are detailed in **Table 6-1** with the LSA and RSA boundaries being shown on **Figure 6-2.**

Table 6-1: Physiography, Terrain and Soils Study Areas

Study Area	Geographic Extent	Rationale
Local Study Area	■ 3 km buffer on either side of the centreline of Alternative 1 and Alternative 4.	■ Designed to address the area where direct effects of the Project are likely to occur beyond the Project Development Area.
Regional Study Area	■ 11 km buffer on either side of the centreline of Alternative 1 and Alternative 4	■ Using a boundary of 11 km on either side of the Project centreline will allow for assessment of cumulative and indirect effects of the Project on the broader landscape, while remaining representative of the types of physiography, terrain and soils found within the RSA.

The LSA and the RSA align with the Vegetation Study Plan because changes to physiography, terrain and soils are expected to have a strong measurable effect on vegetation composition and forest productivity.

Figure 6-2: Physiography, Terrain and Soils Local and Regional Study Areas



7. Baseline Study Design

Baseline conditions are used as a reference point for identifying environmental changes, and for qualitative and quantitative assessments of effects to physiography, terrain and soils. This section outlines the proposed desktop assessment, detailed terrain mapping and field data collection proposed to complete a comprehensive Physiography, Terrain and Soils baseline study designed in support of the IA / EA for the Project.

In addition to the Physiography, Terrain and Soils baseline study, the TISG (The Agency, 2020c) for the Project also requires the identification of any geological hazards that exist in areas planned for Project facilities and infrastructure. Therefore, this section also outlines the desktop analysis and field survey proposed to complete a geological hazard assessment. The geological hazard assessment will characterize the geological conditions within the Physiography, Terrain and Soils RSA and identify potential geological hazards. The results of the geological hazard assessment will support the assessment of effects of the environment on the Project and will provide critical information to support selection and design the preferred CAR alignment, minimizing road alignment through areas with known or suspect geological hazards (e.g., permafrost degradation, landslides and slumps). Due to the association between the geological hazard assessment and the Physiography, Terrain and Soils Baseline study, the geological hazard assessment is captured as part of this Study Plan.

7.1 Desktop Assessment

7.1.1 Physiography, Terrain and Soils

A desktop review of existing information sources will be completed to identify information gaps that will need to be addressed through further study. A preliminary list of applicable information sources has been included in Appendix A. The desktop assessment will be focused on lands within the RSA for Route Alternatives 1 and 4. The desktop review will focus on published information obtained from all local or interested First Nation communities (including Marten Falls), the Ontario Ministry of the Environment, Conservation and Parks (MECP), Ministry of Transportation Ontario (MTO) Foundation Library (GEOCRES), and Ministry of Natural Resources and Forestry (MNRF), Ontario Geological Survey (OGS)

and the Geological Survey of Canada (GSC) to develop a conceptual understanding of the local physiography, terrain and soil conditions. The desktop assessment will include the following tasks:

- A review of available high-resolution imagery, including digital stereo aerial photography, satellite imagery and Google Earth imagery, and previous studies pertaining to the Project or conducted within the RSA that may provide additional physiography, terrain and soil data relevant to the Project. If any data are referenced, justification for utilizing these data (i.e., spatial and temporal relevance), detailed descriptions, and specific data sources will be provided in the baseline report.
- Conducting a review of relevant mining claims in Canada Chrome Corporation (Ontario Assessment File Database, #20000007482, Ministry of Energy, Northern Development and Mines).
- A review of documents pertaining to mineral aggregate deposits in Ontario, including, but not limited to, the Mineral aggregates in Ontario Report, prepared by the Ontario Aggregate Resources Corporation in 2002
- Conducting an online search for regional terrain polygon mapping and soil quality studies.
- Conducting a search for regional permafrost mapping.
- Discussion with other discipline leads to identify locations along the proposed CAR that may have ecological receptors that are sensitive or vulnerable to acidification.
- Preparation of a report summarizing the findings and data gaps noted during the desktop review.

If any surrogate data are referenced, justification for utilizing these data (i.e., spatial and temporal relevance), detailed descriptions, and specific data sources will be provided in the baseline report. Note that site-specific data will also be collected, as described below. The Project will not be solely relying on surrogate data from reference sites.

7.1.2 Geology and Geological Hazards

A desktop review of existing information sources will be completed to characterize the geological environment and identify geological hazards within the RSA. A preliminary list of applicable information sources has been included in Appendix A. The geology desktop assessment will be focused on lands within the Terrain, Soils and Physiography RSA for Route Alternatives 1 and 4, as the geological characterization will be used to support the assessment of effects to the Terrain, Soils and Physiography VC. The desktop review will focus on published information obtained from Ontario Geological Survey (OGS) and the

Geological Survey of Canada (GSC) to develop a conceptual understanding of the local geological conditions. The desktop assessment will include the following tasks:

- Conducting a search for and review of surficial, bedrock and structural geological maps from within the RSA using publicly available data from online geological mapping or provincial databases, such as the OGS and the GSC.
- Conducting an online search of federal websites for information regarding the earthquake and seismic history for the Project area. This information will be used to identify potential geological hazards that exist in the areas planned for the Project facilities and infrastructure.
- Conducting a search for known or potential areas within the RSA where karst related natural hazards may be present.

7.2 Summary of Previous Field Studies

Previous geotechnical investigations were completed in 2009-2010 for a proposed Infrastructure Corridor that was commissioned by Canada Chrome Corporation (Golder 2010). The extensive auger hole and borehole subsurface investigations along the Canada Chrome alignment mostly overlap Alternative 1 and portions of the Alternative 4 routes, as shown on **Figure 6-2**. The investigations included auger holes up to 6 m total depth, boreholes with a total depth of up to about 8 m and water crossing boreholes extending 3 m into bedrock. The auger holes and borehole logs confirmed the regional surficial geology mapping of the area penetrating peat, silt, clay and sand mixtures at surface to depth. At the two (2) river crossings near the southern end of the Alternative 1 route, the boreholes penetrated granitic bedrock at an elevation of between approximately 233.2 and 233.3 meters above sea level (0.6 m to 4.2 m below ground surface). These investigations provide valuable information on sub-surface conditions in the area.

In 2019, KGS completed a preliminary geotechnical investigation along Alternatives 1 and 4. The field investigations were focused on geological features which could be potential pits and quarries along the CAR. Field activities included:

- Developing helicopter access;
- Peat probing;
- Hand auguring;
- Test hole drilling; and
- Visual assessment of select major water crossings (crossings of >10 m +/- in width).
- Site walkover of potential bedrock quarry sites

Results from these field investigations will be used to inform the development of the desktop portion of the assessment and the planning of the field studies proposed in **Section 7.3**.

7.3 Terrain Mapping

Because much of the existing published surficial geology and terrain mapping available from government agencies such as the OGS and GSC is at small scales ranging from 1:50,000 to 1:250,000, detailed terrain mapping will be completed at a scale of between 1:2,000 and 1:5,000 for the PDA and LSA. The value of this detailed mapping is that it provides information on the following:

- Location and spatial extent of soil parent materials (e.g., till, bedrock, glaciofluvial and organic) within the PDA and LSA;
- Location and spatial extent of sensitive landform features such as eskers, beach ridges, bedrock outcrops and wetlands;
- Location and spatial extent of potential pit and quarry materials;
- Location and spatial extent of soils (from a soil quality perspective);
- Location and spatial extent of unfavourable slopes;
- Location of unfavourable soils (e.g., muskeg);
- Thickness of overburden materials / depth to bedrock, including thickness of organic materials and underlying soil parent material;
- Drainage of soil materials (e.g., are the materials well drained or poorly drained mineral materials, or are they very poorly drained organic accumulations); and
- Ongoing geological modifying processes such as permafrost degradation, landslides and slumps.

This mapping will allow for the proper establishment of sampling plots for a variety of disciplines, including soils and vegetation.

The requirements outlined in the TISG suggest the need for historical analysis in relation to both permafrost and landsliding. As a result, digital aerial photography from the early 1950s and the most recent publicly available imagery will be obtained for selected areas for historical analysis and mapping purposes. The mapping of terrain units will be completed on the most recent stereo imagery while the imagery from the

early 1950s and Google Earth imagery will be used to look for historical trends. Relatively homogeneous terrain units will be delineated on the basis of:

- Soil parent materials (e.g., till, outwash, organic and bedrock)
- Overburden thickness / depth to bedrock
- Topography / landforms (e.g., undulating, planar, depressional and ridged (eskers, beach ridges)
- Slope
- Drainage (e.g., well, imperfect and poor) and
- Geological modifying processes (e.g., permafrost degradation, landsliding, groundwater seepage)

The detailed mapping will be completed by a group of experienced terrain scientists with experience in northern Ontario. The mapping will be completed in a digital mapping environment known as "*Softcopy*", the same mapping software tools being used to complete the vegetation mapping. Softcopy combines ArcGIS and PurVIEW software to allow mappers the ability to zoom into the digital stereo imagery in 3D at scales ranging from 1:5,000 to 1:1,000 and to incorporate any previously collected field data, including hand auger, peat probe and test hole drilling data, surficial geology and bedrock geology mapping. This then allows for the better delineation of critical landscape features such as areas of permafrost degradation, landslides, areas of peat deposits in excess of 2 m, or areas of poorly drained mineral soils. This approach has been used for other projects in northern Ontario, including De Beers Victor diamond mine west of Attawapiskat, Ontario.

This mapping will be supported by a reconnaissance field program where soils and terrain data will be collected to address the requirements of the IS / EA Report, especially to meet soil requirements for soil quality, erosion and reclamation planning.

A series of final 1:5,000 scale map figures will be produced for the PDA while map figures at 1:10,000 scale will be produced from the new mapping for the LSA and from existing mapping for the RSA. These figures will adhere to GIS and map production standards.

7.4 Field Study Methods

7.4.1 Physiography, Terrain and Soils

Information on the regional physiography, terrain and soil components of the PDA and LSA will be primarily obtained through the desktop assessment and previous studies (KGS 2019). However, as identified in **Section 7.3**, detailed terrain mapping will be completed and will be supported by a reconnaissance field program specifically aimed at collecting data to address the soils component of the IS / EA Report and to verify the initial terrain mapping. Additional site-specific data obtained from field programs from other disciplines, such as geotechnical, hydrogeological and vegetation, will also be incorporated and used to refine the preliminary mapping and existing knowledge.

The Physiography, Terrain and Soils field program will be completed in conjunction with the Vegetation field program. This will allow for the consistent collection of field data to establish correlations between soil / terrain conditions and vegetation communities (e.g., ecosites[7]) in the field. The soil / terrain plot will be established within the larger vegetation plot with the overall plot location being agreed to by both the soil / terrain specialist and the vegetation ecologist. The soil / terrain specialist and the vegetation ecologist will work co-operatively to determine critical ecological parameters including soil moisture and soil nutrient regime which are two key drivers in classifying ecosites.

The field program will use a combination of plot types, including both ground plots and visual plots. The ground plots are more detailed with full soil pits being completed and data collected to address both soils and vegetation needs. The visual plots are less intensive but will also collect sufficient data to help in the final mapping process. It is anticipated that the visual plots will be completed both on the ground (e.g., while walking from one ground plot to another) and in the air from the helicopter. The ground plots and some visuals will be established along transects running out from pre-cut helicopter landing pads. Based on access, it is anticipated that there will be between 50 and 60 ground plots and between 150 to 180 visuals.

Field plot locations will be identified during the initial terrain mapping by both the soil / terrain specialist and vegetation ecologist. The purpose of these field sites for soils and terrain will be to verify / confirm the soil parent materials, depth to bedrock, topography, slope, drainage and presence / absence of ongoing geological modifying processes such as permafrost degradation, landsliding, seepage and high water

7. *An ecosite is defined as a distinctive kind of land with specific soil and physical characteristics that differ from other kinds of land in its ability to produce a distinctive kind and amount of vegetation and its ability to respond similarly to management actions and natural disturbances.*

tables. And as part of the program, soil pits will be dug to a depth of approximately 0.75 m cm and augured to a depth of approximately 2 m or until bedrock is encountered. Individual soil profiles will be described to the subgroup level according to the Canadian System of Soil Classification, Third Edition (Soil Classification Working Group. 1998), Field Manual for Describing Soils in Ontario (University of Guelph 2003) and The Canada Soil Information System (CanSIS) (Expert Committee on Soil Survey 1982). No provincial standards or guidelines are available for soil sampling protocols in non-productive or non-agricultural areas of Ontario.

7.4.2 Soil Quality Sampling

As part of the sampling program, baseline soil quality data will be collected from proposed pit and quarry areas and disturbed areas along the CAR. Sampling locations will be focused on landforms of interest and areas undergoing terrain investigations, including areas near watercourses. Soil samples will be placed in laboratory-supplied sample jars prepared in advance with the appropriate preservatives, sealed, labelled and stored prior to being transported to a CALA certified laboratory. Soil samples will be submitted for analysis of the following parameters:

- Total metals, including:
  - Aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorus, potassium, selenium, silicon, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium and zinc
  - Mercury and methylmercury
- Alkalinity;
- pH;
- Total organic carbon;
- Anions (chloride, bromide, fluoride and sulphate);
- Nutrients (nitrate, nitrite);
- Volatile organic compounds (VOCs);
- Poly-aromatic hydrocarbons (PAHs); and / or
- Radionuclide parameters.

The above suite of analytical parameters will be used to establish baseline soil quality and identify contaminants of potential concern associated with Project work, including placement of fill material (general

parameters, anions, metals and radionuclides), blasting residual (nutrients), hydrocarbons and solvents (VOCs and PAHs) and permeant infrastructure, such as bridges, piles and culverts (metals). Radionuclide parameters will only be collected once from each surficial geological unit.

For the purposes of this study, it is assumed that two samples from 30 individual locations (60 samples total) will be sufficient to assess baseline soil conditions within the PDA, but outside the CAR ROW. Multiple samples will be collected from each lithology at spatially separated locations to allow for a more robust and representative dataset. Samples will typically be collected on the downgradient side of the ROW within the upper 1 m using a shovel or hand auger. The scope of the analytical program will be refined following completion of the desktop study. Prior to field work, a plan map showing the regionally mapped surficial geology units and the proposed sampling locations will be created to help ensure that samples are collected from all surficial geological units and proposed key areas, such as quarries and camps.

7.4.3 Geological Hazard Assessment

Geological hazards in the RSA will be identified during the desktop assessment through discussions with Indigenous communities, or from the detailed terrain mapping within the LSA and PDA. Further assessment and field truthing will be conducted under the terrain / soils field program (**Section 7.4.1.1**) and in other discipline work plans, as required, based on the professional judgement of MFFN CAR Project Consultants. This information will be used when selecting and designing the preferred CAR alignment with the overall goal of minimizing road alignment through areas with known or suspected geological hazards. Geological hazards will include but not limited to:

- Seismic (e.g., earthquakes)
- Liquefaction
- Landsliding / Slumping
- Permafrost degradation (e.g., thermokarst subsidence)
- Isostatic rise
- Inundation / flooding
- Karst
- Soil erosion

8. Data Management

8.1 Data Management

Data management including quality assurance / quality control (QA / QC) will be employed to minimize potential for data entry and analysis errors, prepare data sets for analysis and limit sensitive data distribution in accordance to established agreements. Field sheets, Laboratory Certificates of Analysis and original electronic data files provided by the laboratory will be archived as reference materials for the Project.

8.2 Analysis and Reporting

Upon completion of the Physiography, Terrain and Soils desktop study, a report will be produced that outlines the results initial data review, including the identification of data gaps that will need to be addressed in the mapping and field reconnaissance programs. This summary will be used to guide the mapping and subsequent field investigations, as required.

The results from detailed mapping and field investigation programs will be summarized in a baseline report in support of the IS / EA Report for the Project. The baseline report will include:

- A detailed summary of previous relevant investigations including, but not limited to, the studies referenced in **Section 7.2**.
- A series of map figures depicting the bedrock geology accompanied by detailed description of the bedrock geology, including lithologic descriptions for mapped geologic units within the RSA.
- A series of map figures depicting the surficial geology within the LSA accompanied by detailed description of each surficial material type, including texture (e.g., sand, silt, clay), type (rounded, subrounded, subangular, angular) and percent coarse fragment, thickness and associated topographic conditions. Maps will show the location of field sampling sites. A smaller scale map will be provided that shows the surficial geology within the RSA based on published data.
- A discussion of geological hazards including permafrost degradation, and isostatic rebound. This discussion will include a series of smaller-scale maps that depict particular features such as fault lines, karst, etc.

- A series of map figures depicting “special” geologic and geomorphic features within the LSA that may affect construction and maintenance activities. These include features such as eskers, potential pits and quarries, areas of organic soils, areas of permafrost, areas showing evidence of active permafrost degradation (e.g., thermokarst), areas of steep slopes and other potential hazards.
- A series of map figures depicting soil units within the LSA accompanied by detailed descriptions of each soil group (e.g., data on soil texture, consistency, presence/absence of mottling, depth to water table) and associated topographic conditions. Maps will show the location of soil sampling sites. No soils mapping will be completed for the RSA.
- A series of map figures depicting soil drainage within the LSA accompanied by a detailed description of each soil drainage class and implications for construction and maintenance activities. Maps will show the location of soil sampling sites.
- A series of map figures depicting soil erosion within the LSA accompanied by a discussion of soil erosion and mitigation techniques.

Soil quality results will be compared against applicable federal (Canadian Council of Ministries of the Environment [CCME]) and Ontario Soil Quality Guidelines. All map figures will show spatial boundaries of the Project and will illustrate the CAR, access roads, camp and laydown areas, MFFN community, and other features where appropriate.

9. Effects Assessment

The following sections provide discipline-specific input and considerations as they pertain to the methodology for effects assessment. The Project is in the early stage of the IS / EA Report preparation and it is expected that the effects assessment methodology will be refined iteratively based on regulatory agency guidance, professional judgment and input received through the Project consultation and engagement process.

9.1 Project-Environment Interactions

The Project activities that may result in changes to the environment are described within the identified temporal and spatial boundaries. This includes identification of both direct and indirect changes by comparing the existing setting to the conditions anticipated to occur as a result of the Project. For each environmental discipline, the likely Project-environment interactions will be identified based on professional judgment, activities listed in TISG Section 3.2 as well as projects of similar magnitude and / or location.

A preliminary analysis of Project-environment interactions for the Physiography, Terrain and Soils is provided in **Table 9-1** and will be confirmed during the IS / EA process to identify the Project-environment interactions that are likely to have a potential effect, and to identify measures to avoid or minimize potential negative effects and enhance benefits.

Table 9-1: Project – Environment Interactions

Project Phases	Project Activities	Physiography, Terrain and Soils
Construction Phase	*Mobilization of Equipment and Supplies*	
	Temporary Construction Staging Areas[1]	**X**
	Temporary Access Roads and Trails[1]	**X**
	Temporary Construction Camps[1]	**X**
	ROW Clearing and Grubbing	**X**
	Brush and Timber Disposal	
	Quarries and Pits[1]	**X**
	Drilling / Blasting / Aggregate Production	**X**
	Road Construction (stripping, subgrade excavation, embankment fill placement, grading, ditching)	**X**
	Bridge and Culvert Installation (approach embankments, foundations, substructures, superstructures, traffic protection, erosion controls)	**X**
	Construction Site Restoration	**X**

Project Phases	Project Activities	Physiography, Terrain and Soils
Construction Phase: Decommissioning	*Quarries and Pits*	**X**
	Temporary Camps, Roads / Trails and Staging Areas	**X**
Operations Phase	*Road Usage*	
	Maintenance[2]	**X**

Notes: 1. Includes construction and use of
2. Includes General Maintenance (e.g., grading, erosion control, quarrying, borrow pits), Seasonal Maintenance (e.g., snow clearing, bridge and culvert maintenance), and Special Maintenance (e.g., slope failures, road settlement / break-up.).

9.2 Valued Components and Indicators

VCs are the environmental, health, social, economic or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous peoples, federal authorities and interested parties (the Agency 2020b). Indicators represent the resource, feature, or issue related to the VC that, if changed, may demonstrate an effect on the environment. The indicators and rationale for selection and measurement of potential effects, to be used to assess and evaluate the alternative routes in the IS / EA Report are provided in **Table 9-2.** The table includes both quantitative and qualitative indicators. The final list of VCs and indicators to be used in the IS / EA Report will be based on regulatory agency guidance, professional judgement and input received through the Project consultation and engagement process.

Table 9-2: Physiography, Terrain and Soils Indicators

Valued Component	Indicator	Rationale for Selection
Physiography, Terrain and Soils	■ Degradation of physical or chemical characteristics of terrain, and soils, including permafrost.	■ Important for geotechnical stability of civil infrastructure (e.g., roads), protection of human health, and protection of aquatic and terrestrial habitat associated with natural hazards (e.g., slope failures).

The Physiography, Terrain and Soil VC has been determined through consideration of the following factors listed in the TISG[8]:

- VC presence in the study area;

8. The TISG also states that information from ongoing and completed regional assessments in the proposed area of the Project should be used to inform VCs for the Project. In February 2020 a regional assessment of the Ring of Fire region commenced; however, it is not sufficiently advanced at this time to inform the Project VCs. The VCs will be consulted and engaged on early in the IA/ EA process and finalized taking into consideration the input received. Therefore, only information relevant to the Project that arises from the regional assessment of the Ring of Fire within an appropriate timeline will inform the VCs for the Project.

- the relationship of the Physiography, Terrain and Soil VC to other disciplines (e.g., vegetation, climate change, etc.);
- the extent to which the VC is linked to the interests or exercise of Aboriginal and Treaty Rights of Indigenous peoples, and whether an Indigenous group has requested the VC;
- the extent to which the effects (real or perceived) of the Project and related activities have the potential to interact with the VC;
- the extent to which the VC may be under cumulative stress from other past, existing or future undertakings in combination with other human activities and natural processes;
- the extent to which the VC is linked to federal, provincial, territorial or municipal government priorities (e.g., legislation, programs, policies);
- the possibility that adverse or positive effects on the VC would be of particular concern to Indigenous groups, the public, or federal, provincial, territorial, municipal or Indigenous governments; and
- whether the potential effects of the Project on the VC can be measured and / or monitored or would be better ascertained through the analysis of a proxy VC.

The indicators have been determined for VCs of the Physiography, Terrain and Soils through additional consideration of the following:

- any other relevant and credible source, such as scientific or academic publications or input from the public; and
- review of existing available mapping, reports and other information.

Inputs received to date from Indigenous communities, agencies and interested persons through the Consultation and Engagement Program, including inputs received on the Draft ToR, have also been used to inform the selection of the VCs and indicators for Physiography, Terrain and Soils.

Geology is not considered a stand-alone VC in the IS / EA, but rather a supporting technical discipline to other VCs. This considers that the characterization of the geological environment will be used to support the assessment of Project-related effects to other identified VCs and their indicators, including Physiography, Terrain and Soils. The identification of geological hazards will also support the assessment of effects of the environment on the Project.

9.3 Potential Effects

A direct effect occurs through the direct interaction of an activity with an environmental discipline. The Project-environment interactions currently anticipated, based upon preliminary analysis, to result in direct effects to the Physiography, Terrain and Soils discipline have been identified in **Table 9.1**. The potential direct effects resulting from the Project-environment interactions will be confirmed during the IS / EA process and will be based on input received through the Indigenous Knowledge Program and Consultation and Engagement Program, regulatory agency guidance, and professional judgement.

An indirect effect occurs when a change to one environmental discipline resulting from a Project activity causes a change to another environmental discipline (e.g., changes in vegetation could indirectly affect wildlife). **Table 9-3** provides a preliminary identification of how changes to physiography, terrain and soils may result in indirect effects to other environmental disciplines.

9.4 Methods for Predicting Future Conditions

Modelling is a common approach to predicting future conditions for many disciplines / components of an IA / EA. However, modelling is not planned for the Physiography, Terrain and Soils baseline report or effects assessment.

9.5 Mitigation and Enhancement Measures

Once potential effects have been identified, the effects assessment will explore technically and economically feasible mitigation measures to avoid or minimize the identified negative effects and enhancement measures to increase positive effects beyond those that are already inherent to the design. These measures will consist of industry-standard practices, federal and provincial standard specifications, regulator-mandated measures, best management practices, Indigenous and community recommendations and recommendations from industry and environmental professionals based on expertise, scientific publications, experience and judgement.

It is important that mitigation and enhancement measures are achievable, measurable and verifiable, and monitored for compliance and effectiveness during all temporal phases as part of the Project follow-up monitoring plan. Required environmental monitoring will verify the potential environmental effects predicted in the IS / EA Report, evaluate the effectiveness of mitigation and enhancement measures, and identify the process the Proponent will follow if mitigation and enhancement measures are not effective.

Table 9-3: Potential Discipline Interactions

Discipline and Associated Valued Components	Aboriginal Treaty Rights and Interests	Atmospheric Environment	Acoustic and Vibration Environment	Physiography, Geology Terrain and Soils	Surface Water	Groundwater	Vegetation	Wildlife	Fish and Fish Habitat	Social	Economy	Land and Resource Use	Human Health and Community Safety	Visual Aesthetics	Archaeological and Cultural Heritage
Physiography, Geology, Terrain and Soils ■ **Physiography, Terrain and Soils**	X	-	-		X	X	X	X	X	-	X	X	X	X	-

Notes: X = Potential pathway for indirect effect as a result of the Project.
- = No pathway for indirect effect is anticipated as a result of the Project.

9.6 Residual Effects

Residual effects are the effects remaining after the application of mitigation measures. The IS / EA Report will describe in detail the potential adverse and positive residual effects in relation to each temporal phase of the Project (e.g., construction, operation). Residual effects will be described using criteria to quantify or qualify adverse and positive effects, taking into account any important contextual factors. The residual effects will therefore be described in terms of the direction, magnitude, geographic extent, duration, frequency, likelihood, and whether effects are reversible or irreversible[9]. Ecological and socio-economic context may also be relevant when describing a residual effect. Context relates to the existing setting, its level of disturbance and resilience to adverse effects. Context can also relate to timing as it applies to assessing the worst-case scenario (e.g., effect during migratory or calving season for wildlife). Where appropriate, information regarding residual effects will be disaggregated by sex, gender, age and other community relevant identify factors to identify disproportionate residual effects for diverse subgroups.

9.6.1 Magnitude

For magnitude, environmental discipline-specific definitions are required and are proposed below in **Tables 9-4 and 9-5** for Physiography and Terrain, and Soils, respectively.

Table 9-4: Physiography and Terrain Magnitude Definition

Magnitude Level	Definition	Rationale
Negligible	■ There is little to no variation in predicted topographical changes (<1 m), all changes are above the seasonal water table, topographical changes are more than 10 m away from water crossings. (i.e., similar to existing conditions).	■ Topographical changes are minor and largely indiscernible, therefore no effect on existing drainage surface water flow, and remains protective of ecological and human life (i.e., migration barriers and slope failures).
Low	■ There is a small topographical variation predicted (between 1 and 10 m), all changes are above the seasonal water table, topographical changes are more than 10 m away from water crossings.	■ Temporary effect or permanent change to topography is discernable but doesn't alter existing surface water flow and remains protective of ecological and human life (i.e., migration barriers and slope failures).

9. *TISG Section 13.1 identifies additional effects characteristics for certain disciplines (e.g., wetlands, birds, terrestrial wildlife, species at risk). These additional effects characteristics are described in the respective discipline-specific study plans.*

Magnitude Level	Definition	Rationale
Medium	■ There is modest topographical variation predicted (between 10 and 20 m), changes occur below the seasonal water table, topographical changes are between 3 and 10 m away from water crossings.	■ Temporary effect or permanent change to topography is discernable, alters existing surface water drainage, acts as a modest barrier to ecological migration, and increases the likelihood of slope failure. However, ecological and human health impacts can be mitigated through planning and implementation of engineering controls.
High	■ There is a large topographical variation predicted (>20 m), changes occur below the seasonal water table, changes are less than 3 m from water crossings.	■ Temporary effect or permanent change to topography is discernable, and can potentially impair surface water drainage, ecological and human health. Effects can be limited, but not completely removed, through mitigation planning and implementation of engineering controls.

Table 9-5: Soils Magnitude Definition

Magnitude Level	Definition	Rationale
Negligible	■ There is little to no variation predicted in soil concentrations which remain within the range of natural variability.	■ Soil quality shows no discernable change, therefore no effect on ecological life or human health (e.g., potable water use, physical contact).
Low	■ There is a small variation predicted in soil concentrations that is less than double current concentrations, but concentrations remain below applicable provincial / federal soil quality criteria.	■ Temporary effect or permanent change to soil quality is minor and is inferred to remain protective of ecological life and human health.
Medium	■ There is a moderate variation predicted in measurable parameters, concentrations are less than five (5) times current concentrations and are below the applicable provincial/federal soil quality criteria, or predicted concentrations are less than 10 times current concentrations.	■ Temporary effect or permanent change to soil quality is moderate but is inferred to remain protective of ecological life and human health.
High	■ There is a large variation predicted in measurable parameters, concentrations exceed applicable provincial / federal soil quality criteria and are greater than 10 times current concentrations.	■ Temporary effect or permanent change to soil quality can potentially impair ecological life or human health.

Professional judgement and / or risk assessment may be required to assess impacts where no provincial or federal soil standard exists or when non-threshold parameters such as arsenic, chromium and lead are involved.

9.7 Consideration of Sustainability Principles

The following provides a generic description of how sustainability principles will be considered in the preparation of the IS / EA Report. The extent to which sustainability principles apply to a specific VC will vary depending on the nature of the VC and the potential for Project effects on the VC.

The sustainability assessment for the Project will be undertaken on the preferred alternative and will characterize the Project's contribution to sustainability incorporating the requirements set out in Section 25 of the TISG.

One aspect of the sustainability assessment is describing the process in selecting the preferred alternative to the Project and how the sustainability principles were considered. The effects assessment approach for the Project has included the consideration of the sustainability principles outlined in the Project TISG and the Agency's guidance on sustainability. The sustainability principles that have been considered include:

1. Consider the interconnectedness and interdependence of human-ecological systems;
2. Consider the well-being of present and future generations;
3. Consider positive effects and reduce adverse effects of the Project; and
4. Apply the precautionary principle by considering uncertainty and risk of irreversible harm.

The interconnectedness and interdependence of human-ecological systems will be considered through the assessment of potential indirect effects of each alternative. An indirect effect occurs when a change to one environmental discipline resulting from a Project activity causes a change to another environmental discipline (e.g., changes in vegetation could indirectly affect wildlife). A preliminary assessment of indirect effects has been included in **Section 9.3**.

The well-being of present and future generations will be considered in the effects assessment through the application of the long-term operations phase temporal boundary of 75 years (**Section 6.1**) and through the effects characteristics description of duration and reversibility for each residual effect predicted.

The consideration of positive effects and reducing adverse effects of the Project is fundamental to the effects assessment methodology through the identification of mitigation measures to reduce potential adverse effects and the identification of the preferred alternative through the evaluation of advantages (e.g., positive effects) and disadvantages (e.g., adverse effects).

The effects assessment will apply the precautionary principle by clearly describing and documenting all uncertainties and assumptions underpinning the analysis and identifying information sources. The effects

assessment will consider risk of irreversible harm through the effects characteristics description of reversibility for each residual effect predicted and will describe any uncertainty associated with the assessment of residual effects.

The scope of the sustainability assessment will be defined by issues of importance identified by Indigenous communities and interested persons through consultation and engagement activities, while also ensuring to be inclusive of the diversity of views expressed. The selection of VCs that will be the focus of the sustainability assessment will be aligned with the issues of importance identified by Indigenous communities and interested persons, as well as residual effects identified through the effects assessment process. The sustainability assessment will describe how the planning and design of the Project, in all phases including follow-up monitoring, considered the sustainability principles.

9.8 Consideration of Identity and Gender-Based Analysis Plus in Effects Assessment

The Proponent recognizes that communities and sub-populations within those communities may be impacted differently by the Project with respect to VCs and indicators. As such, the Project aims to collect baseline information for the purpose of assessing differential effects and establishing relevant mitigation measures, as further elaborated on in **Section 4.3**. Gender-Based Analysis Plus will not be limited to community feedback, when offered or discussed in secondary texts, additional sub-population information as is applicable to the relevant assessment will be incorporated.

9.9 Follow-up Programs

A follow-up program verifies the accuracy of the effects assessment and evaluates the effectiveness of mitigation measures. Identification of follow-up programs for the Project are not described in this Study Plan as the information needed to determine environmental monitoring requirements is dependent on the outcome of the effects assessment and consultation with Indigenous communities, agencies and interested persons. Therefore, the Proponent will include information on follow-up programs, that address the requirements outlined in Section 26 of the TISG and in the IS / EA Report, and will identify the compliance and effects monitoring activities to be undertaken during all phases of the Project, as required.

10. Assumptions

Existing condition values for soil quality will be based on one soil sampling program because soil quality is not subject to seasonal or inter-annual variability. It is assumed that two samples from 30 individual locations (60 samples total) is sufficient to assess baseline soil conditions within the PDA, but outside the CAR ROW. If additional landforms / surface soils are encountered, additional soil samples will be required to characterize all soil types.

11. Concordance with Federal and Provincial Guidance

This section provides the best information currently available on how federal and provincial requirements identified for the Project to date will be addressed. The final concordance with federal and provincial requirements will be included in the IS / EA Report, and will be based on regulatory agency guidance, professional judgement and input received through the Project consultation and engagement process.

Table 11-1: Study Plan Federal Concordance – Conformance with Requirements

ID	Federal TISG Reference	Requirement / Comment / Concern	Response	Study Plan Reference
1	TISG Section 1.1, page 4	■ The Guidelines correspond to factors to be considered in the impact assessment. These factors are listed in subsection 22(1) of IAAC and prescribe that the impact assessment of a designated project must take into account any change to the designated project that may be caused by the environment;	■ The potential effects of the project on the environment will be assessed in accordance with applicable standards and guidance.	■ No reference
2	TISG Section 2.3, pages 6-7	■ The description should focus on aspects of the Project and its setting that are important in order to understand the potential environmental, health, social and economic effects and impacts of the Project. The following information must be included and, where appropriate, located on map(s): – geographic co-ordinates (i.e., longitude/latitude using international standard representation in degrees, minutes, seconds) for the beginning and end points of the proposed road; – current land and/or aquatic uses within the study areas; – distance of the project components to any federal lands and the location of any federal lands within the study areas; – all waterbodies and their location on a map; – navigable waterways; – the environmental significance and value of the geographical setting in which the Project will take place and the study areas; – environmentally sensitive areas, such as national, provincial, territorial and regional parks, UNESCO World Heritage Sites, geological heritage sites, ecological reserves, ecologically and biologically sensitive areas, wetlands, and habitats of federally or provincially listed species at risk and other sensitive areas; – Dedicated Protected Areas3 and any other areas of ecological and social significance identified by the community during the community-based land use planning processes with the Province of Ontario (e.g., Enhanced Management Areas; see Section 6.1 for requirements related to confidentiality); – lands subject to conservation agreements; – current mineral development proposals, and areas of early and advanced mineral exploration in the study areas; – current areas of aggregate extraction; – description and locations of all potable drinking water sources (i.e., municipal or private), including spring water sources ; – description of local communities and Indigenous groups that is culturally relevant and gender sensitive; – if the information is not confidential, provide a description and location of Indigenous traditional territories and/or consultation areas, Treaty and/or Title lands, Indian Reserve lands, Indigenous harvesting regions (with permission of Indigenous groups), Métis settlements; and – culturally important features of the landscape.	■ The information related to landscape features, sensitive or protected areas and select others listed in the TISG will be illustrated on maps and / or described within the IS / EA Report, where appropriate. ■ Land use will be assessed so that appropriate soil quality standards are applied to the soil quality data collected.	■ Section 6 ■ Section 7 ■ Section 8
3	TISG Section 3.1, page 11	■ The Impact Statement must describe all project components including but not limited to: – borrow pits, gravel or aggregate pits and quarries (footprint, geographic location, ownership, and development plans including pit phases and lifespan), including their location in relation to upland habitats and the presence of rare, limited and/or significant habitat (e.g., federal, provincial, or Indigenous protected and conserved areas, ANSIs (Areas of Natural and Scientific Interest), Ramsar sites critical habitat identified under the Species at Risk Act, etc.;	■ Potential quarry and pit areas will be identified on a map in the baseline report. Areas of ecological sensitivity will be identified in other discipline Study Plans	■ Section 8.2
4	TISG Section 5.1, page 22	■ Any proposed mitigation measures are to be clearly linked, to the extent possible, to valued components in the Impact Statement as well as to specific project components or activities, as well as comments raised during engagement activities	■ Mitigation measures will be included in the IS / EA Report.	■ No reference
5	TISG Section 7.1, page 30	■ The Impact Statement must establish appropriate study area boundaries to describe the baseline conditions. The study area boundaries need to encompass the spatial boundaries of the Project, including any associated project components or activities, and the anticipated boundaries of the Project effects, including all potentially impacted local communities, municipalities and Indigenous groups. Considerations in assigning appropriate study areas or boundaries would include, but not be limited to: – areas potentially effected by changes to water quality and quantity or changes in flow in the watershed and hydrologically connected waters; – areas potentially effected by airborne emissions or odours; – areas determined by dispersion and deposition modelling;	■ The Study Areas are defined and described in this Study Plan.	■ Section 6.2

ID	Federal TISG Reference	Requirement / Comment / Concern	Response	Study Plan Reference
		– areas within the range of vision, light and sound and the locations and characteristics of the most sensitive receptors; – species habitat areas, usage timing and migratory patterns; – emergency planning and emergency response zones; – the geographic extent of local and regional services; – any impacted local communities, including municipalities; – all potentially impacted Indigenous groups; – areas of known Indigenous land, cultural, spiritual and resource use; and – existing effected infrastructure.		
6	TISG Section 7.1, page 30	■ If the baseline data have been extrapolated or otherwise manipulated to depict environmental, health, social and / or economic conditions within the study area, modelling methods must be described and must include assumptions, calculations of margins of error and other relevant statistical information. ■ Models that are developed should be validated using field data from the appropriate local and regional study areas. Ensure baseline data are representative of project site conditions. If surrogate data from reference sites are used rather than site-specific surveys, the proponent should demonstrate that the data are representative of project site conditions.	■ A limited amount of modelling may be required during the effects assessment; however, modelling is not planned for the baseline report. ■ If any surrogate data are used to supplement the data collected as part of the field studies (Section 7.3), it will be demonstrated that those data are representative of project site conditions.	■ Section 7.3 ■ Section 9.4
7	TISG Section 7.1, page 31	■ Where baseline data are available in geographic information system (GIS) format, this information is to be provided to the Agency as electronic geospatial data file(s) compliant with the ISO 19115 standard. This would support the Government of Canada's commitment to Open Science and Data and would facilitate the sharing of information with the public through the Canadian Impact Assessment Registry Internet Site and the Government's Open Science and Data Platform. The Agency intends to make the geospatial data files available to the public under the terms of the Open Government License – Canada.	■ Complete data sets from all field sites will be provided. They will be in the form of complete and quality assured relational databases, with precisely georeferenced site information, precise observation / visit information and with observations and measurements in un-summarized form. Databases and GIS files will be accompanied by detailed metadata that meets ISO 19115 standards (or equivalent). Documentation and digital files will be provided for all results of analyses that allow for a clear understanding of the methods and a replication of the results.	■ No reference
8	TISG Section 7.2, page 32	■ The Impact Statement must provide detailed descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental, health, social and economic condition that is described, in order to corroborate the validity and accuracy of the baseline information collected.	■ Descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental condition will be provided in the IS / EA Report and are summarized in this Study Plan.	■ Section 7
9	TISG Section 7.2, page 33	■ Baseline data must be collected in a manner that enables reliable analysis, extrapolations and predictions. Resulting data should be suitable for analyses to estimate pre-project baseline conditions, derive predictions of impacts, and evaluate and compare post-project conditions and at scales of within and across the Project, Local and Regional Assessment areas. Modelling methods, error estimates and assumptions should be reported (as per section 7.1). Modelling and simulations should be used early in the planning phase to estimate the necessary sampling intensity and to quantitatively evaluate the effectiveness of design options. Ethical guidelines and relevant cultural protocols governing research, data collection and confidentiality must be adhered to.	■ Descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental condition will be provided in the IS / EA Report and are summarized in this Study Plan. ■ A limited amount of modelling may be required during the effects assessment; however, modelling is not planned for the baseline report.	■ Section 7
10	TISG Section 7.2, page 33	■ With regard to field studies, survey work must be planned to include multiple sampling locations and multiple visits to each location to support all required assessment analyses. Existing data should be considered as a limited augmentation of this new data. See the "Establishing Baseline Conditions" (sections 8.5, 8.9, 8.10, 8.11) in this Tailored Impact Statement Guidelines for recommendations on survey design and methodology. Surveys and analyses should be conducted by qualified experts. Baseline data must be collected in a manner that enables reliable analysis, extrapolations and predictions. Resulting data should be suitable for analyses to estimate pre-project baseline conditions, derive predictions of impacts, and evaluate and compare post-project conditions and at scales of within and across the Project, Local and Regional Assessment areas. Modelling methods, error estimates and assumptions should be reported (as per section 7.1). Modelling and simulations should be used early in the planning phase to estimate the necessary sampling intensity and to quantitatively evaluate the effectiveness of design options. Ethical guidelines and relevant cultural protocols governing research, data collection and confidentiality must be adhered to.	■ Descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental condition will be provided in the IS / EA Report and are summarized in this Study Plan	■ Section 7

ID	Federal TISG Reference	Requirement / Comment / Concern	Response	Study Plan Reference
11	TISG Section 7.2, pages 31-33	■ Information sources and data collection methods used for describing the baseline environmental, health, social and economic setting may consist of the following sources of information. For specific sources of baseline information, see Appendix 1. – Federal government (e.g., Environment and Climate Change Canada, Health Canada, Indigenous Services Canada, Statistics Canada, Women and Gender Equality Canada); – Ontario provincial government (e.g., Ministry of Environment, Conservation, and Parks, Ministry of Natural Resources and Forestry; – Bird Conservation Region plans; – academic institutions; – field studies, including site-specific survey methods; – database searches, including: – federal, provincial, territorial, municipal and local data banks; – Breeding Bird Atlas - Ontario (2001-2005) – monitoring program databases protected areas, watershed or coastal management plans; – natural resource management plans; – species recovery and restoration plans; – field measurements to gather data on ambient or background levels for air, water, soil and sediment quality, light levels or acoustic environment (soundscape); – land cover data, including: • terrestrial ecosystem mapping products; • forest cover maps; • remote sensing resources; • important habitats and features to include: ▪ water bodies, wetlands, watercourses; ▪ riparian habitat; ▪ river banks or other eroded habitats; ▪ artificial water sources; ▪ forest, tree patches, solitary trees (especially old decaying trees); ▪ forest edges and tree rows; ▪ ridges, including eskers; ▪ caves and mines; ▪ cliffs, rock outcrops, exposed bedrock, talus, and other karst topography; ▪ buildings, bridges, and other anthropogenic features, including linear features; ▪ sources of artificial lighting attracting insects; ▪ critical habitat; and ▪ any other habitat features known to be important in the area. – Published literature, such as peer reviewed journals, reports by think tanks, non-government organizations and government reports; – environmental assessment documentation, including monitoring reports, from prior projects in the area and similar projects outside the area; – regional studies, project assessments and strategic assessments; – renewable harvest data; – Indigenous knowledge, including oral histories and knowledge gathered by spending time on the land with knowledge holders; – community based monitoring and studies conducted by Indigenous communities; – expert, community, public and Indigenous engagement and consultation activities, including workshops, meetings, open houses, surveys; – qualitative information gathered from interviews, focus groups or observation; – census data; – baseline human health risk assessments; – community and regional economic profiles; – community well-being studies; and – statistical surveys, as applicable.	■ Descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental condition will be provided in the IS / EA Report and are summarized in this Study Plan.	■ Section 7

ID	Federal TISG Reference	Requirement / Comment / Concern	Response	Study Plan Reference
12	TISG Section 7.3, page 34	■ The list of valued components must be informed, validated and finalized through engagement with the public, Indigenous groups, lifecycle regulators, jurisdictions, federal authorities, and other interested parties. The Impact Statement must describe valued components, processes, and interactions that are identified to be of concern or that the Agency considers likely to be impacted by the Project and are included in the Guidelines.	■ Information on the VCs will be collected from the public and indigenous communities as outlined in the Consultation and Engagement Plan and the Aboriginal and Treaty Rights and Interests Study Plan. The IS / EA Report will include an assessment of the effects of the project on the VC.	■ Section 4 ■ Section 5
13	TISG Section 7.3, page 35	■ The valued components must be described in sufficient detail to allow the reviewer to understand their importance and to assess the potential adverse and positive environmental, health, social and economic effects and impacts arising from the Project activities.	■ The baseline report describes the valued components. The IS / EA Report will include further details and descriptions of the VCs, their importance and predicted effects (adverse and positive) as a result of the project.	■ Section 8.1
14	TISG Section 7.3, page 35	■ For each of the valued components that will be assessed in the Impact Statement, the proponent must create a study plan and a work plan to be validated by the Agency. Upon receipt of a study plan, the Agency may request that the proponent present and discuss the study plan at technical meetings, which will be scheduled during the impact statement phase.	■ This Study Plan will be reviewed by relevant federal and provincial agencies. A work plan will be developed for the valued components and validated by the Agency as required.	■ Section 7
15	TISG Section 7.3, pages 34-35	■ In selecting a valued component to be included, the following factors should be considered: – valued component presence in the study area; " – "the extent to which the valued component is linked to the interests or exercise of Aboriginal and Treaty rights of Indigenous peoples, and whether an Indigenous group has requested the valued component; – "the extent to which the effects (real or perceived) of the Project and related activities have the potential to interact with the valued component; – "the extent to which the valued component may be under cumulative stress from other past, existing or future undertakings in combination with other human activities and natural processes; – "the extent to which the valued component is linked to federal, provincial, territorial or municipal government priorities (e.g., legislation, programs, policies); – "the extent to which the valued component is being addressed through any ongoing or completed regional assessment processes; – "the possibility that adverse or positive effects on the valued component would be of particular concern to Indigenous groups, the public, or federal, provincial, territorial, municipal or Indigenous governments; and – whether the potential effects of the Project on the valued component can be measured and/or monitored or would be better ascertained through the analysis of a proxy valued component.	■ The valued components were selected in consideration of the factors listed in this comment.	■ Section 9.2
16	TISG Section 7.4.1, page 36	■ For valued components establish three study area spatial boundaries to assess impacts to each valued component: 1) Project Study Area: defined as the project footprint for each alternative route; " 2) Local Study Area: defined for each valued component – see below; 3) Regional Study Area: defined for each valued component – see below ■ Provide a rationale for boundaries of the project study area, local study area, and regional study area for each valued component and indicate how the above objectives were met in establishing the boundaries.	■ Geographic extent, and the extent rationale, of the Project, Local, and Regional Study Areas for this VC is provided in this Study Plan.	■ Section 6.2
17	TISG Section 7.4.1, pages 35-36	■ The Impact Statement must describe the spatial boundaries, including project, local and regional study areas, for each valued component included in assessing the potential adverse and positive environmental, health, social and economic effects of the Project and provide a rationale for each boundary. Spatial boundaries are defined taking into account the appropriate scale and spatial extent of potential effects and impacts of the Project; community knowledge and Indigenous knowledge; current or traditional land and resource use by Indigenous groups; exercise of Aboriginal and Treaty rights of Indigenous peoples, including cultural and spiritual practices; and physical, ecological, technical, social, health, economic and cultural considerations. The size, nature and location of past, present and foreseeable future projects and activities are factors that should be included in the definition of spatial boundaries. It should be noted that in some cases, spatial boundaries might extend to areas outside of Canada. These transboundary spatial boundaries should be identified where transboundary effects are expected.	■ Geographic extent, and the extent rationale, of the Project, Local, and Regional Study Areas for this VC is provided in this Study Plan.	■ Section 6.2
18	TISG Section 7.4.2, page 37	■ The temporal boundaries of the impact assessment span all phases of the Project determined to be within the impact assessment. If potential effects are predicted after project decommissioning or abandonment, this should be taken into consideration in defining specific boundaries. In order to assess a project's contribution to sustainability, consideration should be given to the long-term effects on the well-being of present and future generations. When defining temporal boundaries, the proponent should consider how elements of environmental, health, social and economic well-being that local communities, including municipalities, and Indigenous groups identify as being valuable could change over time.	■ The effects assessment will be conducted across all phases of the project.	■ Section 6.1

ID	Federal TISG Reference	Requirement / Comment / Concern	Response	Study Plan Reference
19	TISG Section 8.3, pages 40-41	■ The Impact Statement must: – describe the bedrock geology and lithological units, including a summary table of geologic descriptions, mineralization styles (if applicable) supported by geological maps and cross-sections at appropriate scale (normally 1:50 000). Provide in the table an inferred risk rating (i.e., low, medium, high) for acid rock drainage and metal leaching potential based on the desk-top review of bedrock geology and mineralization; – provide written description and maps of the current location of eskers and other post-glacial deposits on a map; – identify any geological hazards that exist in the areas planned for the project facilities and infrastructure, including: • history of seismic activity in the area, including induced earthquakes, and secondary effects such as the risk of, landslides and liquefaction; • evidence of active faults; • isostatic rise or subsidence; and • history of landslides, slope erosion and the potential for ground and rock instability/landslides, and subsidence during and following project activities. – provide a characterization of the geochemical composition of all expected construction materials (i.e., eskers, quarries, etc.), in order to predict metal leaching and acid rock drainage including oxidation of primary sulphides and secondary soluble sulphate minerals.	■ The Physiography, Terrain and Soils baseline report will include a geological characterization and geological hazard assessment that meets the requirements of the TISG. A geochemical characterization of construction materials will be completed and is discussed in greater detail in the Groundwater and Geochemistry Study Plan.	■ Section 7.1 ■ Section 7.2 ■ Section 8.1 ■ Section 9.6
20	TISG Section 8.4, pages 41-42	■ "The Impact Statement must: – describe the landforms, soils and sediments within the local and regional project areas, including sediment stratigraphy; surficial geology maps and cross-sections of appropriate scale; – describe the soils and sediment within the local and regional project areas and their suitability for sourcing construction material; – describe the geomorphology, topography and geotechnical characteristics of areas proposed for construction of major project components, including the presence and distribution of eskers and permafrost, if applicable; – identify any areas of ground instability; – provide maps depicting soil depth by horizon and soil order within the project site area to support soil salvage and reclamation efforts, and to outline potential for soil erosion; – describe the suitability of topsoil and overburden for use in the reclamation of disturbed areas including an assessment of the acid generating potential of overburden to be use – describe the historical land use and the potential for contamination of soils and sediments and describe any known or suspected soil contamination with the study area that could be re-suspended, released or otherwise disturbed as a result of the Project; and – identify ecosystems that are sensitive or vulnerable to acidification resulting from the deposition of atmospheric contaminants – provide written description and maps of ecozones, ecoregions, and ecodistricts as per Ontario or Canada's Ecological Landscape Classification; – provide written description and maps of the current location of eskers and other post-glacial deposits on a map; – describe permafrost conditions including distribution of frozen and unfrozen ground, if applicable; and – describe the potential for thaw settlement and terrain instability associated with ground thawing in permafrost areas, if applicable.	■ The desktop and field studies will incorporate all of the comments and summarize the results as part of the baseline works and the IS / EA Report.	■ Section 7 ■ Section 8
21	TISG Section 8.6, page 46	■ The Impact Statement must describe the structural geology of the hydrogeological environment, including major faults, fracture density and orientation with respect to groundwater flow directions;	■ Publicly available geological data obtained through the desktop study will be included on relevant Project Plan maps.	■ Section 7.1
22	TISG Section 8.9, page 54	– use the Ontario Ministry of Natural Resources and Forestry's Far North Land cover (version 1.4 or later, as available) and augmentation with fire history, digital elevation models, surficial geology and other data sources	■ This source will be used in the IS / EA Report where applicable.	■ Appendix A
23	TISG Section 13, pages 80-83	■ This section of the TISG describes the methodology for the effects assessment, including definitions of scope, severity, and irreversibility.	■ The IS / EA Report will include a description of the methodology of the effects assessment, some of which is also summarized in this Study Plan.	■ Section 9
24	TISG Section 14.3, page 88	■ The Impact statement must describe any changes to eskers and similar geological features as a result of the Project;	■ Changes in topography will be assessed as part of the IA / EA. The locations of key geological features will be identified during the desktop review and ground-truthed during the field studies.	■ Section 7.1 ■ Section 7.3

ID	Federal TISG Reference	Requirement / Comment / Concern	Response	Study Plan Reference
25	TISG Section 14.3, page 88	■ The Impact statement must describe any changes to permafrost conditions as a result of the Project;	■ Permafrost will be considered in the assessment as part of the IA / EA. The presence of frozen and unfrozen ground will be identified during the desktop review and ground-truthed during the field studies.	■ Section 7.1 ■ Section 7.3
26	TISG Section 14.3, Page 88	■ The Impact Statement must provide an overall description of changes related to landscape disturbance including fragmentation of habitats and project effects on areas of ground instability;	■ Changes in topography will be assessed as part of the IA / EA, including subsequent effects on habitat fragmentation and geohazards.	■ No reference
27	TISG Section 14.3, page 88	■ The Impact statement must describe any contaminants of concern (e.g., arsenic, chromium, mercury) potentially associated with the Project (including from spills or accidental discharges) that may affect soil, sediment, wetlands, and surface and groundwater (including substances used during summer and winter maintenance activities);	■ The contaminants of concern for soil will be presented in IS / EA Report and soil samples will be analyzed for contaminant of concern parameters (including arsenic, chromium, mercury and methlymercury) as part of the baseline studies. The contaminants of concern for water will be described in the Groundwater and Geochemistry and Surface Water Study Plans. Accidents and malfunctions will be assessed in the IS / EA Report. Potential changes to surface and groundwater (quality and quantity), including effects on other VCs, will be assessed as part of the IA / EA.	■ Section 7.4 ■ Groundwater and Geochemistry Study Plan ■ Surface Water Study Plan
28	TISG Section 14.3, page 88	■ The Impact statement must describe how hydrological or drainage changes may disturb soils, wetlands, peatlands or muskeg and result in the release of mercury or methylmercury from disturbed soils, which may affect water and groundwater quality, fish, wildlife and human health;	■ Changes in topography will be assessed as part of the IA / EA, including changes in surface water drainage and the subsequent effects on other VCs will be assessed in the IA / EA. ■ Mercury and methylmercury soil sampling will also be completed to determine the presence of mercury within the LSA and allow for risk assessment and mitigation planning, as required. In addition, the Surface Water and Groundwater and Geochemistry Study Plans include water quality sampling for mercury and methylmercury parameters.	■ Section 7.4 ■ Surface Water Study Plan ■ Groundwater and Geochemistry Study Plan
29	TISG Section 14.3, page 89	– describe the historical land use and the potential for contamination of soils and sediments and potential for loss of soil fertility. Describe any known or suspected soil contamination within the study area that could be re-suspended, released or otherwise disturbed as a result of the Project;	■ Soil quality data will be collected at any known or potential areas of contamination as part of the baseline soil sampling program.	■ Section 7.4
30	TISG Section 20, page 119-128	■ Section 20 of the TISG describes the requirements around mitigation and enhancement measures that must be considered in the Impact Statement.	■ Mitigation measures will be informed by best management practices, applicable resource management and / or recovery plan, Indigenous input, and industry standards.	■ Section 9.5
31	TISG Section 21, pages 129-130	■ Section 21 of the TISG describes the requirements and guidance associated with determining residual effects.	■ Residual effects will be assessed in the IA / EA.	■ Section 9.6
32	TISG Section 22, pages 131-133	■ Section 22 of the TISG describes the guidance around conducting cumulative effects assessment for the project.	■ Cumulative effects assessment will be conducted as part of the IA / EA.	■ Effects Assessment Methodologies
33	TISG Section 23.2, page 136	■ Identify any areas of potential wind or water erosion, slumps and slope instability, geologic hazards, including but not limited to those caused by geologic movements;	■ These areas will be identified during the desktop study. If geological hazards in the RSA are identified during the desktop assessment the areas will be flagged to the Geotechnical and Project design teams. Further assessment and field truthing will be conducted under other discipline work plans, as required, based on the professional judgement of the geotechnical team. The Project design team will use this information when selecting and designing the preferred CAR alignment with the overall goal of minimizing road alignment through areas with known or suspect geological hazards.	■ Section 7.1 ■ Section 7.4.3
34	TISG Section 25, pages 139-140	■ Section 25 of the TISG provides guidance on how to demonstrate the Project's contributions to sustainability.	■ The IS / EA Report will include discussion on how the project contributes to sustainability.	■ Section 9.7
35	TISG Section 26, Page 141	■ Section 26 of the TISG includes a description of the considerations for developing a follow-up program for environmental, health, social or economic effects, as applicable.	■ The IS / EA Report will include descriptions of follow-up programs, as required by VC.	■ Section 9.9

Table 11-2: Study Plan Provincial Concordance – Conformance with Requirements

ID	Comment from Regulatory Agency	Comment Type	Requirement / Comment / Concern	Response	Study Plan Reference
1	MECP	■ Completeness Review Memorandum compiled from MECP emails and August 2019 meetings with MECP and ENDM	■ Study areas are missing and lack clarity – maps show study area for 4 routes even though only 2 (or 1?) routes are proposed to be assessed; no indication of local and regional study areas for each environmental component (e.g., groundwater, surface water, caribou, etc.).	■ The Study Areas are defined and described in the Study Plan.	■ Section 6
2	MECP	■ Email from Agni Papageorgiou & Sasha McLeod, Special Project Officer Environmental Assessment Services Section, Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ #17 Section 8 Page 54 – Consultation on Assessment Methodology - MFFN acknowledges that the proposed methodology will be open to input during the draft ToR review, but also says a more detailed method will be presented in the EA. Page 47 indicates the effects assessment criteria will be developed during the EA. While it is appropriate to defer some detailed work planning to the EA phase, the ToR should include commitments for how technical reviewers, and other interested persons, will be consulted during the development of specific evaluation methodologies or technical work plans. It is strongly recommended that those opportunities for review occur prior to the completion of studies (e.g., prior to the submission of a draft or final EA document).It is not clear whether MFFN plans to consult on the more detailed methodology and criteria during the EA phase or if the ToR phase is the main opportunity to provide input. – Please indicate how consultation on the ToR has informed the preliminary criteria and indicators. Please clarify when MFFN will consult and provide opportunity for input on the detailed assessment method, including criteria and indicators (and work plans as MECP has proposed), with agencies, communities and stakeholders during the EA phase in order to finalize the methodologies before EA studies get advanced.	■ The Study Plan meets this requirement. ■ As identified in Section 4.2 of the Study Plan, the Proponent will provide opportunities for consultation and engagement with Indigenous communities identified in Table 4-1, which is inclusive of all Indigenous communities identified in the Indigenous Partnership and Engagement Plan for the Marten Falls Community Access Road Project Impact Assessment (IAAC 2020a). ■ Further information on how Indigenous Knowledge will be considered in the IS / EA Report has been included in Section 5 of the Study Plan. Section 5 of the Study Plan provides further details on the two concurrent and complementary avenues for Indigenous communities and groups to be engaged with and provide input on the Project: the Indigenous Knowledge Program and the Consultation and Engagement Program.	■ Section 4 ■ Section 5
3	MECP	■ Email from Agni Papageorgiou & Sasha McLeod, Special Project Officer Environmental Assessment Services Section, Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ #21 Section 10.2.4 Page 73Technical Work Plans – – Page 73 states that MECP has indicated it will not be commenting on work plans associated with field work until the ToR is finalized. This statement does not reflect MECP's guidance to the project team. MECP's guidance, which is documented on page 69 of the RoC, is that the ToR is the mechanism to seek technical review of work plans and that discipline- specific work plans should be included with the ToR. As well, discussions that MECP has had with the project team to date are considered pre-consultation, since it is the ToR that sets out what work is to be done during the EA phase.Please revise the statement on page 73 to state: "MFFN provided MECP and MNRF work plans associated with field work planned during 2019 for review, however MECP advised this is considered-consultation and that discipline-specific work plans should be appended to the ToR to allow full technical review. "As the draft ToR did not include detailed discipline-specific work plans, the other option the ministry strongly recommends is to include commitments to develop work plans at the outset of the EA phase, including opportunities for technical review.	■ The Study Plan meets this requirement.	■ No reference
4	MECP	■ Email from Agni Papageorgiou & Sasha McLeod, Special Project Officer Environmental, MECP Assessment Services Section, Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ Assessment Methods – – For the most part, section 7.2 provides a description of potential environmental effects for each discipline. However, this section also includes assessment methodologies for some subsections (7.2.1 and 7.2.2 AERMOD modelling, quantitative noise assessment) while the majority do not (7.2.3 – 12). The level of detail in the ToR about assessment methods should be consistent for all environmental components. – It is strongly recommended to include commitments to develop work plans at the outset of the EA phase, including opportunities for technical review by agencies and others. The work plans should include assessment methodology appropriate for each environmental component. The ToR could include a high level summary table for each environmental discipline listing data collection and assessment methods, with a commitment to develop the work plans at the outset of the EA phase to provide more details. Consider where the information about air and noise modelling is best placed.	■ The Study Plan meets this requirement.	■ Section 7 ■ Section 8

ID	Comment from Regulatory Agency	Comment Type	Requirement / Comment / Concern	Response	Study Plan Reference
5	MECP	■ Email from Agni Papageorgiou & Sasha McLeod, Special Project Officer Environmental, MECP Assessment Services Section, Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ #16 Section 8 Page 54, Work Plans – Section 8 describes the approach that will be taken to evaluate alternative methods during the EA, including proposed criteria and indicators (presented in Appendix A). The information presented is high level and does not provide an opportunity for technical review of the methodologies that will be applied to evaluate those specific criteria and indicators.It is strongly recommended to include commitments to develop work plans at the outset of the EA phase, including opportunities for technical review by agencies and others.	■ The Study Plan meets this requirement.	■ Section 9
6	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ In Section 9, the proponent indicated that environmental commitments and monitoring plans will be developed and included in the EA. Based on the absence of baseline groundwater quality and quantity monitoring information and the potential environmental risks associated with quarry material geochemistry, the following plans will be required in addition to the groundwater effect management/mitigation measures and compliance/effects monitoring plans: – Draft Baseline Groundwater Work Plan (description of baseline groundwater quality and quantity field programs); and – Aggregate Material Geochemical Management Plan (testing, results interpretation, storage, handling and mitigation measures for materials that are likely to result in acid rock drainage and/or metal leaching [ARD/ML])."	■ This Study Plan outlines the proposed desktop assessment and field sampling program that will be conducted to assess the likelihood of ML / ARD impacts on surface water or groundwater quality within the Project area.	■ Section 7.4.2
7	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ #2 Draft Terms of Reference (Nov. 2019), Section 7.1 Description of the Environment; Table 7-1: – Environmental Disciplines to be Considered during the Environmental Assessment, p. 22. Table 7-1 includes a list of environmental disciplines that will be considered during the EA. 'Geochemistry' was not included in the list for the Natural (Physical and Biophysical Environment. The consultant has committed to classification of bedrock quarry source materials, where "Samples of the bedrock will be obtained, and photographs of the feature will be taken in an effort to assess the suitability for quarry development." (p. 26).Considering the extent of wetland areas and number of water crossings associated with the project, additional baseline data are required on the geochemistry of aggregate rock source (i.e., quarry) materials/blasted rockfill. Acid Rock Drainage and Metal Leaching (ARD/ML) from potential aggregate rock source materials must be determined prior to quarry selection and development along the proposed route, and prior to use in construction. ARD/ML sample analysis must be completed during the EA, and a commitment must be made in the Terms of Reference for inclusion of the 'Geochemistry' discipline in Table 7-1. Table 7-1: Environmental Disciplines to be Considered during the Environmental Assessment in the Terms of Reference must include 'Geochemistry' in the discipline list for the Natural (Physical and Biophysical Environment. Baseline geochemistry investigations must be completed during the EA, with results and interpretation provided in the EA and applicable MECP Permit To Take Water (PTTW) and Environmental Compliance Approval (ECA) applications. These geochemistry investigations must include Acid Rock Drainage and Metal Leaching (ARD/ML) testing of representative samples from proposed aggregate rock source (i.e., quarry) material locations. The sample selection, collection, analytical testing and interpretation of results should be undertaken according to the following international guidelines:· Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, MEND (Mine Environment Neutral Drainage Program) Report 1.20.1, December 2009 [http://mend-nedem.org/wp-content/uploads/1.20.1_PredictionManual.p df] Rock Drainage at Mine sites in British Columbia, British Columbia Ministry of Energy and Mines, August 1998 [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral- exploration-mining/documents/permitting/ml- ard_guidelines.pdf]	■ The Study Plan meets this requirement.	■ Section 7.4.2

ID	Comment from Regulatory Agency	Comment Type	Requirement / Comment / Concern	Response	Study Plan Reference
8	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ Subsection 7.1.4.3 pg 25-26 – Provides an overview of soils and overburden stratigraphy along the proposed road corridor route. It is noted that the central portion of the proposed route follows the general path of a series of mining claims by Canada Chrome Corporation, that include extensive (~400 m spacing) overburden exploration boreholes drilled in 2010 (refer to the Ontario Assessment File Database, #20000007482, Ministry of Energy, Northern Development and Mines).The proponent is encouraged to access the associated borehole logs and geotechnical studies to provide additional baseline information on soil stratigraphy for the EA and supporting documents for MECP Permit to Take Water (PTTW) and ECA applications [http://www.geologyontario.mndm.gov.on.ca/mn dmfiles/afri/data/records/20000007482.html].Additional baseline data for soil stratigraphy in support of the EA and applicable MECP PTTW and ECA applications may be obtained from Ontario Assessment File #20000007482, Ministry of Energy, Northern Development and Mines [http://www.geologyontario.mndm.gov.on.ca/m ndmfiles/afri/data/records/20000007482.html]."	■ Publicly available online databases will be reviewed as part of this desktop assessment and results will be included in the baseline report.	■ Section 7.1
9	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ Considering the extent of wetland areas and number of water crossings associated with the project, additional baseline data are required on the geochemistry of aggregate rock source (i.e., quarry) materials/blasted rockfill. Acid Rock Drainage and Metal Leaching (ARD / ML) from potential aggregate rock source materials must be determined prior to quarry selection and development along the proposed route, and prior to use in construction.	■ This issue is now addressed in the Groundwater and Geochemistry Study Plan. This includes the proposed desktop assessment and field sampling program that will be conducted to assess the likelihood of ML / ARD impacts on surface water or groundwater quality within the Project area. ■ Groundwater monitoring is discussed in the Groundwater and Geochemistry Study Plan.	■ Section 7.4.2 ■ Groundwater and Geochemistry Study Plan
10	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ ARD / ML sample analysis must be completed during the EA, and a commitment must be made in the Terms of Reference for inclusion of the 'Geochemistry' discipline in Table 7-1. Table 7-1: Environmental Disciplines to be Considered during the Environmental Assessment in the Terms of Reference must include 'Geochemistry' in the discipline list for the Natural (Physical and Biophysical Environment.	■ This issue is now addressed in the Groundwater and Geochemistry Study Plan. This includes the proposed desktop assessment and field sampling program that will be conducted to assess the likelihood of ML / ARD impacts on surface water or groundwater quality within the Project area. ■ Groundwater monitoring is discussed in the Groundwater and Geochemistry Study Plan.	■ Section 7.4.2 ■ Groundwater and Geochemistry Study Plan
11	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ #7 Draft Terms of Reference (Nov. 2019), Section 7.2 Potential Environmental Effects; Subsection 7.2.5 Groundwater, p. 50.Subsection 7.2.5 – Provides an overview of potential effects on groundwater resources associated with the project.This section must include potential groundwater quality effects associated with use of quarried aggregate rock source materials that have acid rock drainage and/or metal leaching (ARD / ML) potential.This section must also include potential groundwater quality effects from construction camp sewage systems.Subsection 7.1.4.5 Groundwater of the Terms of Reference must be edited to include the following effects:· Use of quarried aggregate rock source materials during construction has the potential to result in groundwater and surface water quality effects from acid rock drainage and/or metal leaching (ARD / ML).· Groundwater quality may be affected by discharge from construction camp sewage systems.	■ This issue is now addressed in the Groundwater and Geochemistry Study Plan. This includes the proposed desktop assessment and field sampling program that will be conducted to assess the likelihood of ML / ARD impacts on surface water or groundwater quality within the Project area. ■ Groundwater monitoring is discussed in the Groundwater and Geochemistry Study Plan.	■ Section 7.4.2 ■ Groundwater and Geochemistry Study Plan

ID	Comment from Regulatory Agency	Comment Type	Requirement / Comment / Concern	Response	Study Plan Reference
12	MECP	■ Email from Shannon Heggie, Hydrogeologist - Groundwater Unit, Technical Support Section, Northern Region, Drinking Water and Environmental Compliance Division Ministry of the Environment, Conservation and Parks with comments of the Draft ToR	■ #15 Draft Terms of Reference (Nov. 2019), Appendix A – Draft Criteria & Indicators for Alternatives Evaluation, p. A- 1. – In Appendix A, it is recommended that the following data source is used for additional baseline soil and overburden stratigraphy data along the proposed road corridor route: Ontario Assessment File Database, #20000007482, Ministry of Energy, Northern Development and Mines, [http://www.geologyontario.mndm.gov.on.ca/mn dmfiles /afri/data/records/20000007482.html]. Include the following source of information in Appendix A – Draft Criteria & Indicators for Alternatives Evaluation of the Terms of Reference: Ontario Assessment File Database, #20000007482, Ministry of Energy, Northern Development and Mines, [http://www.geologyontario.mndm.gov.on.ca/m ndmfiles/afri/data/records/20000007482.html].	■ Conducting a review of relevant mining claims in Canada Chrome Corporation (Ontario Assessment File Database, #20000007482, Ministry of Energy, Northern Development and Mines).	■ Section 7.1
13	MNRF	■ Letter received from Dave Barker, Resources Management Supervisor, Nipigon District, MNRF on the Draft Terms of Reference	■ Sec 7.1.4.3 pg. 25 – There doesn't appear to be soil sampling planned to identify baseline metals information. Having baseline information will provide data in the event of accidental release of contaminants during construction from the use of equipment and machinery (as noted in section 7.2.3). When conducting the geotechnical analysis on mineral and peat material, collect samples for analysis to be done. Soil samples could also be collected as part of the ELC/vegetation surveys (7.1.4.6).	■ The soil sampling program is outlined in Section in 7.3.3 and includes analysis of metals, as well as numerous other parameters.	■ Section 7.3.3
14	MNRF	■ Letter received from Dave Barker, Resources Management Supervisor, Nipigon District, MNRF on the Draft Terms of Reference	■ Sec. 7.2.3 – Physiology, Geology, Terrain and Soils pg. 42 Appendix A – The proponent acknowledges the importance of identifying and securing the aggregate materials that will be required for road construction and maintenance. MNRF shares the view that the availability of suitable and sufficient amounts of aggregate for the project will be a major consideration in route selection and overall feasibility. The rationale is to be transparent on the quantity and sources of aggregate at the ToR stage because of the wetland dominated landscape with limited sources. The associated potential effects in obtaining sufficient volume to construct and maintain the proposed road because it is possible that sources will need to be accessed beyond the defined local study area resulting in additional roads. Although potential aggregate sources (fig 7.2 pg 26) is provided, detailed information about the type and volume of aggregate needed to implement the project and that exists in the project area will need to be presented, along with an assessment of environmental impacts of new aggregate extraction operations that are proposed and how these will be mitigated. The assessment approach to evaluating potential effects for aggregates is weak (see Appendix A) because it appears to be included in the general local geology criteria with no mention of indicators that are sensitive to ecological changes at the project, local and regional levels. For example, attention should be given to developing criterion and indicators that reflect the potential ecological and hydrologic effects associated with construction and maintenance of the proposed road.	■ The Groundwater and Geochemistry Study will identify potential quarry and pit areas and conduct sampling activities to develop a baseline for existing conditions and to assess the potential for ML / ARD or elevated soil concentration issues. This information will be using in conjunction with data from other disciplines to assess the risk on ecological habitats in the quarry and pit areas and construction areas.	■ Section 7 ■ Section 9 ■ Groundwater and Geochemistry Study Plan
15	MNRF	■ Letter received from Dave Barker, Resources Management Supervisor, Nipigon District, MNRF on the Draft Terms of Reference	■ Draft Criteria and Indicators for Alternatives Evaluation Appendix A Available resources to help inform the draft criteria and indicators include research publications and expert knowledge on topics such as stressor-effects pathways, cumulative effects, and associated environmental components and indicators. ■ Contacting researchers such as Rob Mackereth (MNRF) who has published research on these topics and related subjects is encouraged. ■ Rempel, R.S., et al. 2016. Support for development of a long-term environmental monitoring strategy for the Ring of Fire area. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Information Report IR-08. 34 p. + append. Catalogue-natural-resource-scientific-and-technical-publications ■ While no specifics are provided in this submission, MNRF welcomes a discussion with MECP and ENDM to explore what (if any) role this project could play in advancing baseline information and long-term environmental monitoring for the Ring of Fire in partnership with First Nations communities.	■ Data sources are being reviewed for their appropriateness and will be included in Study Plans where applicable. Information on specific data sources and their relevance to the Project will be included in the IS / EA reports.	■ Section 7 ■ Appendix A

12. References

AECOM Canada Ltd., 2020:

Marten Falls First Nation Proposed Terms of Reference Marten Falls Community Access Road – Environmental Assessment, Appendix B: Consultation & Engagement Plan to Support the Environmental Assessment / Impact Statement.

Expert Committee on Soil Survey, 1982:

The Canada Soil Information System (CanSIS): Manual for Describing Soils in the Field, 1982 Revised. Land Resource Research Institute, Research Branch, Agriculture Canada, Ottawa. LRRI Contribution no 82-52. 166 pp.

Impact Assessment Agency of Canada, 2019:

Impact Assessment Act. https://laws-lois.justice.gc.ca/eng/acts/I-2.75/

Golder Associates Inc., 2010:

2010 Geology and Terrain Unit Geotechnical Data Report, Canada Chrome Proposed Infrastructure Corridor, 093-81042, December 27, 2010.

Impact Assessment Agency of Canada, 2020:

Public Participation Plan for the Marten Falls Community Access Road Project Impact Assessment. https://iaac-aeic.gc.ca/050/documents/p80184/133934E.pdf

Impact Assessment Agency of Canada, 2020a:

Indigenous Partnership and Engagement Plan for the Marten Falls Community Access Road Project Impact Assessment. https://iaac-aeic.gc.ca/050/documents/p80184/133936E.pdf

Impact Assessment Agency of Canada, 2020b;

Glossary of Terms for the impact assessment of designated projects under the IAA. https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/glossary-of-terms.html

Impact Assessment Agency of Canada, 2020c:

Tailored Impact Statement Guidelines for the Marten Falls Community Access Road Project. https://iaac-aeic.gc.ca/050/documents/p80184/133937E.pdf

KGS Group Inc., 2019:
Environmental Assessment and Preliminary Design Services for Marten Falls Community Access Road 3-Day Helicopter Reconnaissance – Phase 1 – Final, December 11, 2019.

Ontario Geological Survey, 1984:
Aggregate Resources Inventory of the Hearst Area, Cochrane District; Ontario, Geological Survey, Aggregate Resources Inventory Paper 71, 51 p., 6 tables, 6 maps, scale 1:50 000.

Ontario Government, 1990a:
Environmental Assessment Act. https://www.ontario.ca/laws/statute/90e18

Ministry of Energy, Northern Development and Mines, 2017a:
Quaternary Geology. https://www.mndm.gov.on.ca/en/mines-and minerals/applications/ogsearth/quaternary-geology

Ministry of Energy, Northern Development and Mines, 2017b:
Bedrock Geology. https://www.mndm.gov.on.ca/en/mines-and minerals/applications/ogsearth/bedrock-geology

Price, W.A., 1997:
Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report.

Price, W.A., 2009:
Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report

Soil Classification Working Group, 1998:
The Canadian System of Soil Classification, 3rd ed. Agriculture and Agri-Food Canada Publication 1646, 187 pp.

University of Guelph, 2003:
Field Manual for Describing Soils in Ontario. ASIN : B00JGZIHL4 1.20.1. Version CANMET – Mining and Mineral Sciences Laboratories, Smithers, BC.

Appendix A

Preliminary List of Data Sources

Golder Associates Inc., 2010:
2010 Geology and Terrain Unit Geotechnical Data Report, Canada Chrome Proposed Infrastructure Corridor, 093-81042, December 27, 2010.

KGS Group Inc., 2019:
Environmental Assessment and Preliminary Design Services for Marten Falls Community Access Road 3-Day Helicopter Reconnaissance – Phase 1 – Final, December 11, 2019.

Ministry of Energy, Northern Development and Mines, 2017:
Bedrock Geology. https://www.mndm.gov.on.ca/en/mines-and minerals/applications/ogsearth/bedrock-geology

Ministry of Energy, Northern Development and Mines, 2017:
Quaternary Geology. https://www.mndm.gov.on.ca/en/mines-and minerals/applications/ogsearth/quaternary-geology

Ministry of Energy, Northern Development and Mines:
Canada Chrome Corporation mining claims (Ontario Assessment File Database, #20000007482).

Ontario Aggregate Resources Corporation, 2002:
The *Mineral aggregates in Ontario Report*.

Ontario Geological Survey, 1984:
Aggregate Resources Inventory of the Hearst Area, Cochrane District; Ontario, Geological Survey, Aggregate Resources Inventory Paper 71, 51 p., 6 tables, 6 maps, scale 1:50 000.

Price, W.A., 1997:
Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report.

Price, W.A., 2009:
Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report

Appendix B

Agency Comments on the Draft Study Plan

Draft Study Plan Comments – Federal

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
General Comment	■ **General Comment**	■ Sections 5, 6, 7, 13, 19.2 and 25	■ The Agency	■ In addition to the required actions detailed below, other required actions to be addressed in the update to this study plan are detailed in a separate table titled "2020-07-02 - IAAC to MFFN- General Comments on MFCAR Draft Study Plans". The Agency has provided these other required actions to highlight common sections of the Tailored Impact Statement Guidelines (Guidelines) where requirements were not met in the draft study plans submitted to the Agency. These additional actions must be addressed in the updated study plans.		■ We have reviewed the relevant comments and incorporated where appropriate. Please refer to the General Comments Table Response submitted separately to the Agency for specific responses.	■ Various Sections
GE-01	■ **Section 3: Spatial Boundaries: Study Areas** – "The PSA encompasses the 100 m wide CAR right-of-way (ROW), temporary construction access roads, work areas, worker camps, and long-term aggregate sources and associated access roads. The LSA currently being considered within the scope of the ongoing regulatory review process generally includes the area within 2.5 km of the centreline of Alternative 1 and Alternative 4."	■ **Section 7.4.1** – "The Impact Statement must describe the spatial boundaries, including project, local and regional study areas, for each valued component included in assessing the potential adverse and positive environmental, health, social and economic effects of the Project and provide a rationale for each boundary… – For valued components establish three study area spatial boundaries to assess impacts to each valued component: 1) Project Study Area: defined as the project footprint for each alternative route; …"	■ The Agency	■ The description of the study areas is unclear, in particular the description of the Project Study Area. ■ From the description provided in the study plan, it seems that only the Local Study Area and the Regional Study Area will encompass the route alternatives under consideration. ■ The study plan does not clearly describe how baseline data will be collected for the route alternatives under consideration.	■ Update the study plan to clarify the spatial boundaries of the study areas, in particular of the Project Study Area, for all route alternatives under consideration. ■ Update the study plan to provide a map showing the study areas for all route alternatives under consideration.	■ A map of the study areas in included.	■ Table 6-1 in Section 6.2.
GE-02	■ **Figure 3-1**	■ Editorial	■ The Agency	■ The legend of the map provided in Figure 3-1 is incomplete, as several colors used in the map are not featured in the legend. ■ A clear understanding of the map is important for validation of appropriateness of the sampling locations.	■ Update the legend of the map provided in Figure 3-1 to indicate what all various coloured areas represent. Several colors used in the map are not featured in the legend.	■ The study area plan map is updated.	■ Figure 6-2 in Section 6.2

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
GE-03	■ **Section 4: Baseline Study Design** – "This study plan focuses on the additional studies that are anticipated to be required to gather information beyond what is currently available through existing information sources, including those as described in Section 7.2 'Sources of baseline information' in IAAC's Tailored Impact Statement (TISG) for this Project"	■ **Section 8.4** – "The Impact Statement must: … • describe the geomorphology, topography and geotechnical characteristics of areas proposed for construction of major project components, including the presence and distribution of eskers and permafrost, if applicable; … • provide maps depicting soil depth by horizon and soil order within the project site area to support soil salvage and reclamation efforts, and to outline potential for soil erosion; … • describe the historical land use and the potential for contamination of soils and sediments and describe any known or suspected soil contamination with the study area that could be re-suspended, released or otherwise disturbed as a result of the Project; and • identify ecosystems that are sensitive or vulnerable to acidification resulting from the deposition of atmospheric contaminants; … • provide written description and maps of the current location of eskers and other post-glacial deposits on a map; • describe permafrost conditions including distribution of frozen and unfrozen ground, if applicable; and • describe the potential for thaw settlement and terrain instability associated with ground thawing in permafrost areas, if applicable."	■ The Agency	■ It is unclear if the requirements in Section 8.4 of the Guidelines will be met. Proposed methodologies for many of the relevant requirements in Section 8.4 of the Guidelines are not included in the study plan	■ Update the study plan to provide information to demonstrate the proposed approaches and methods to be used to meet the requirements of Section 8.4 of the Guidelines.	■ The Study Plan is updated to include the relevant requirements of Section 8.4 of the Guidelines.	■ Section 7.1 ■ Section 8.1

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
GE-04	■ **Section 4.1: Desktop Assessment** – "Due to the large Project area, the study will be largely based on previous investigations and published existing data / information in the area." ■ **Section 7: Conformance with Federal and Provincial Guidance** – "The summary report will provide detailed descriptions of specific data sources and data collection methods associated with physiology, geology, geochemistry, terrain and soils."	■ **Section 7.1** – "…Ensure baseline data are representative of project site conditions. If surrogate data from reference sites are used rather than site-specific surveys, the proponent should demonstrate that the data are representative of project site conditions…" ■ **Section 7.2** – "…The Impact Statement must provide detailed descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental, health, social and economic condition that is described, in order to corroborate the validity and accuracy of the baseline information collected.."	■ The Agency	■ It is assumed that the previous investigations referenced in Section 4.1 of the study plan are the 2009-2010 geotechnical investigations commissioned by Canada Chrome Corporation and the 2019 KGS geotechnical investigations. ■ It is unclear what published existing data and information in the area will be used.	■ Demonstrate that the reports are representative of all of the terrain units and settings encountered by the Project. ■ Provide details about the published existing data and information that will be used to characterize the baseline conditions, as required in Section 7.2 of the Guidelines. ■ If surrogate data sources from reference sites are used rather than site-specific surveys, provide detail to demonstrate that the data are representative of project site conditions and clarify how potential gaps in the spatial coverage of the data will be addressed. ■ Ensure that a clear map showing all proposed route alternatives, along with the borehole and auger data used for each alternative, is provided in the Impact Statement. Ensure that in composite the existing and new data meet the requirements of the Guidelines	■ The Study Plan is updated to indicate if any surrogate data are referenced, justification for utilizing these data (i.e., spatial and temporal relevance with respect to the Project RSA), detailed descriptions, and specific data sources will be provided in the baseline report. Note that site-specific data will also be collected, as described below. The Project will not be solely relying on surrogate data from reference sites. ■ The map showing the proposed routes is included (Figure 6-2).	■ Section 7.1 ■ Figure 6-2
GE-05	■ **Section 4.3.1: Geochemistry (ML/ARD)** – "We have assumed that half of the samples will be collected at surface (bedrock outcrop hand samples) and the remainder will be collected from geotechnical drill core. The depth of the drill core samples will be shallower than the proposed depths of quarry / blasting operations to make certain that samples are representative of blast / fill material"	■ **Section 3.2.2** – The Impact Statement must describe the anticipated activities during the operation phase of the Project, including: … • characterization and management of borrow material, including overburden, and aggregate (storage, handling and transport of the volumes generated, mineralogical characterization, potential for metal leaching and acid rock drainage);…" ■ **Section 8.3** – "The Impact Statement must: … • provide a characterization of the geochemical composition of all	■ The Agency	■ Caution is recommended when sampling surface outcrop samples as they can be weathered and not indicative of the actual reactivity of the rock. It is recommended that the depth distribution of samples (including those at surface) reflect the approximate distribution of the main volume of material to be quarried at depth.	■ Provide details to demonstrate that the samples collected at each location will be compositionally and spatially representative of material to be disturbed.	■ The Study Plan is updated to describe that approximately 25% of the samples will be collected near surface (<0.4 m below grade) and bedrock outcrop hand samples. Care will be taken to collect fresh outcrop samples and not exposed/weathered bedrock samples. The remainder of the samples will be collected from geotechnical drill core. The depth of the drill core samples will be shallower than the proposed depths of quarry / blasting operations to make certain that samples are representative of blast / fill material.	■ Section 7.4.2

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
		expected construction materials (i.e., eskers, quarries, etc.), in order to predict metal leaching and acid rock drainage including oxidation of primary sulphides and secondary soluble sulphate minerals..”					
GE-06	■ **Section 4.3.1: Geochemistry (ML/ARD)** – “Mineralogy and Rietveld X-ray Diffraction: To determine the mineralogical composition of the rock samples.”	■ **Section 8.3** – “The Impact Statement must: … • provide a characterization of the geochemical composition of all expected construction materials (i.e., eskers, quarries, etc.), in order to predict metal leaching and acid rock drainage including oxidation of primary sulphides and secondary soluble sulphate minerals..” ■ **Section 14.2** – “…If the proponent undertakes quarrying activities to extract aggregate material that may results in effects on groundwater and surface water levels (i.e., quarrying below the water table), the Impact Statement must: … • describe the methods used to predict acid rock drainage and/or metal leaching for construction materials, including sample collection and laboratory testing;…”	■ The Agency	■ As the material to be sampled and tested likely contains low sulphide mineral concentrations, it is recommended that the proponent utilizes QEMSCAN rather than Rietveld XRD, as it has a much lower detection limit. It is possible that Rietveld XRD will not detect any sulphide minerals and is thus not of value for this project.	■ Revise the study plan to provide details to demonstrate that using QEMSCAN rather than Rietveld XRD will be considered, as it has a much lower detection limit for sulphide minerals.	■ Based on the level of this study at this time, XRD is considered sufficient and will allow for more samples to be collected due to the relative cost per analysis (~$250 for XRD and ~$1000 for QEMSCAN). In the future, we can use QEMSCAN for targeted locations as specified/requested by the professional geochemist. ■ No changes to the text were made.	■ N/A
GE-07	■ **4.3.2 Soil Sampling** – (…) Soil samples will be submitted for analysis of the following parameters: • Total metals (including mercury, arsenic and chromium); • Alkalinity; • pH; • Total organic carbon; • Anions (chloride, bromide, fluoride and sulphate);	■ **Section 9** – “…The proponent should refer to Health Canada guidance documents such that best practices are followed in the collection of baseline information to assess real and perceived project-related impacts to human health due to changes in air quality, noise, drinking and recreational water quality, country foods and/or multiple pathways of exposure to	■ The Agency	■ The study plan proposes to test soil samples for various parameters such as total metals, PAHs, VOCs to determine baseline levels of contaminants. However, the study plan does not explain how soil contaminants of potential concerns (COPCs) were screened for inclusion in the assessment.	■ Provide details to demonstrate the methods used to screen the proposed COPCs into the soil quality assessment and to explain the rationale for the proposed methods. ■ Describe interconnections and clarify how predicted changes in soil contaminant levels will be incorporated in the exposure pathway analysis for the human health effect assessment	■ As Project emissions of concern will be determined primarily based on the outcomes of the Air Quality Study, it is not possible at this time to screen soils for COPCs. If Air Quality Study outcomes suggest a potential for significant deposition of air emissions of concern onto local soils, then the soil contact pathway will be considered for evaluation in a HHRA. This may necessitate a need for a surface soil survey in the areas	■ Section 7.3.3 provides rational for the list of soil parameters that will be analyzed for during the baseline studies.

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
	• Nutrients (nitrate, nitrite); • Volatile organic compounds (VOCs); • Poly-aromatic hydrocarbons (PAHs); and/or • Radionuclide parameters. ■ **Table 6.1: Physiography, Geology, Geochemistry, Terrain, and Soils indicators** – Indicator: Physiography, Terrain and Soils – Expression of Change: Degradation of physical or chemical characteristics of permafrost, terrain or topography (e.g., natural hazards) and soils. – Rationale for selection: Important for geotechnical stability of civil infrastructure (e.g., roads), protection of human health, and protection of aquatic and terrestrial habitat associated with natural hazards (e.g., slope failures).	contaminants. The proponent should provide a detailed rationale/explanation for any deviation from recommended baseline characterization approaches and methods, including from Health Canada's guidance, or when determining such characterization is not warranted." ■ **Section 16.1** – "…With respect to biophysical determinants of health, the Impact Statement must: … • describe and quantify the health risk from exposure to COPCs (e.g., arsenic, chromium, mercury) via consumption of country foods and differential risk for vulnerable subgroups; … • if a Human Health Risk Assessment is required, the assessment must identify all potential contaminant exposure pathways for contaminants of concern to adequately characterize potential biophysical risks to human health. A multimedia Human Health Risk Assessment may need to be considered and conducted for any contaminant of potential concern with an identified risk and multiple pathways;…"		■ Additionally, it is not clear how soil quality data will be used in the prediction of human health risks (e.g., from consumption of country foods).	proposed in the human health and community safety study plan. ■ Consult Section 7 of Health Canada's Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment.	predicted to receive the greatest potential deposition of air emissions, to generate baseline soil concentrations of the emissions of concern. Soil data may not be used at all in an assessment of country food consumption, should that exposure pathway be deemed necessary to assess in a HHRA. Ideally, country food item tissue data would provide the concentrations of COPCs in the harvested food items of interest. Soil data are only relevant towards estimating COPC levels in country food items if the foods are harvested from the same locations that are expected to incur soil impacts due to air emissions, and are only relevant for food items that are in direct contact with soil (such as plants, berries). Soil data are typically irrelevant to any assessment of fish or game animal country food items (due to reasons such as animal home ranges and foraging behaviours, locations where harvesting occurs relative to areas where soil impacts are predicted). The noted HC guidance will be consulted should there be a need to assess human exposure pathways related to soil and/or country foods.	
GE-08	■ **Section 4.3.2: Soil Sampling** – "As part of the ML/ARD sampling program, a single soil sampling event will be conducted to collect baseline soil quality data from proposed borrow source areas and disturbed areas…. For the purposes of this study, it is assumed that two samples from 30 individual locations (60 samples total) will be sufficient to	■ **Section 4.4** – "…The determination of alternative means must be conducted in accordance with the Impact Assessment Agency of Canada's policy and guidance documents (2)…" ■ **Section 8.4** – "The Impact Statement must:	■ The Agency	■ According to Agency guidance on alternatives, a proponent is expected to select one or multiple preferred alternatives that become the focus of the impact assessment. Where multiple alternatives are brought forward, a more detailed assessment of the alternatives is required.	■ Provide details to demonstrate that landforms, soils and sediments within both the local and regional study areas, including sediment stratigraphy; surficial geology maps and cross-sections of appropriate scale, will be described in the Impact Statement. ■ Provide details to demonstrate that a description of the 60 (total)	■ The baseline studies will provide details on landforms (e.g., eskers), soils and sediments within both the local and regional study areas. Surficial geology maps will be field-truthed at sampling locations. Cross-sections will not be completed at the baseline stage, but will be included at key locations in future reporting (e.g., Impact Statement).	■ Section 7.4.3 ■ Section 8.1

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	assess baseline soil conditions within the Project disturbance footprint, but outside the CAR ROW. Samples will typically be collected on the downgradient side of the ROW within the upper 1 m using a shovel or hand auger"	• describe the landforms, soils and sediments within the local and regional project areas, including sediment stratigraphy; surficial geology maps and cross-sections of appropriate scale;…" • (2) https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/guidance-need-for-purpose-of-alternatives-to-and-alternative-means.html		■ It is unclear if the landforms, soils and sediments within the local and regional project areas will be described, as per the requirement in Section 8.4 of the Guidelines. ■ In addition, the study plan does not clearly present the criteria used for the selection of the 30 sampling locations.	samples planned to be collected (i.e., type of material such as clay, silt, sand, etc.) will be included in the Impact Statement. ■ Ensure that all route alternatives under consideration, as well as the location of all other project components, particularly the aggregates sources (short-term and long-term), are determined prior to the baseline data collection and are scoped in the study plan. If a preferred alternative has not been identified before baseline studies start, then baseline data collection must be carried out for all route alternatives under consideration. ■ Update the study plan to provide a map with the proposed location of the 30 sampling sites for the baseline data collection. Provide sufficient detail to demonstrate how the 30 locations represent all alternative project components.	■ For the purposes of this study, it is assumed that two samples from 30 individual locations (60 samples total) will be sufficient to assess baseline soil conditions within the Project disturbance footprint, but outside the CAR ROW. Multiple samples will be collected from each lithology at spatially separated locations to allow for a more robust and representative dataset. Samples will typically be collected on the downgradient side of the ROW within the upper 1 m using a shovel or hand auger. If multiple landforms / surface soils are present at any station, additional soil samples will be collected to ensure multiple samples of each soil type are collected. The scope and budget of the analytical program will be refined following completions of the desktop study. Prior to field work, a plan map showing the regionally mapped surficial geology units and the proposed sampling locations will be created to ensure that samples are collected from all surficial geological units.	
GE-09	■ **Section 4.3.2: Soil Sampling** – "samples will be submitted for analysis of the following parameters: • Total metals (including mercury, arsenic and chromium); Alkalinity; pH; Total organic carbon; Anions (chloride, bromide, fluoride and sulphate); Nutrients (nitrate, nitrite); Volatile organic compounds (VOCs); • Poly-aromatic hydrocarbons (PAHs); and/or Radionuclide parameters. – The above suite of analytical parameters will be used to establish baseline soil quality and	■ **Section 8.4** – "The Impact Statement must: … • describe the suitability of topsoil and overburden for use in the reclamation of disturbed areas including an assessment of the acid generating potential of overburden to be used;…"	■ The Agency	■ It is recommended that soil is subjected to the same ABA test method as described in Section 4.3.1 of the study plan, to suitably confirm the ARD potential of the soil and overburden and plan for appropriate use and/or management	■ Update the study plan to describe considerations to using the same ABA test methods proposed in Section 4.3.1 of the study plan as part of the assessment of the acid generating potential of the soil and overburden.	■ Soil sampling proposed for geochemical testing to support the development of a geochemical characterization of soil and overburden is discussed in the Groundwater and Geochemistry Study Plan. These samples will be focused on proposed quarry and pit areas. ■ The soil samples collected as part of Section 7.4.3 in this Study Plan are intended to characterize generic soil quality and will be spatially distributed across the proposed CAR. Locations will not be focused on proposed quarry / pit areas. However, there will be some areas where soil sampling for both generic and geochemistry analysis will be conducted.	■ Section 7.4.2 ■ Section 7.4.3

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
	identify contaminants of potential concern associated with Project work, including placement of fill material (general parameters, anions, metals and radionuclides), blasting residual (nutrients), acid rock drainage and buffering capabilities (metals and alkalinity), metal leaching (metals and general parameters), hydrocarbons and solvents (VOCs and PAHs) and permanent infrastructure, such as bridges, piles and culverts (metals). Radionuclide parameters will only be collected once from each area."						
GE-10	■ **Section 6: Effects Assessment Scoping**	■ Section 14.3 – "The Impact Statement must: … • describe any changes to permafrost conditions as a result of the Project; • describe any changes to eskers and similar geological features as a result of the Project; • describe any contaminants of concern (e.g., arsenic, chromium, mercury) potentially associated with the Project (including from spills or accidental discharges) that may affect soil, sediment, wetlands, and surface and groundwater (including substances used during summer and winter maintenance activities); … • describe the historical land use and the potential for contamination of soils and sediments and potential for loss of soil fertility. Describe any known or suspected soil contamination within the study area that could be re-suspended, released or otherwise disturbed as a result of the Project; …"	■ The Agency	■ It is unclear how the requirements in Section 14.3 of the Guidelines will be met. ■ Methodologies for many of the relevant requirements in Section 14.3 of the Guidelines are not included in the effects assessment section of the study plan. ■ The effects assessment must consider the effects of each of the project components and physical activities, in all phases, and be based on a comparison to the proposed baseline work.	■ Provide detail in the study plan to describe the approaches and methods to be used to meet the requirements identified in Section 14.3 of the Guidelines.	■ Available high-resolution imagery and regional surficial geological, terrain polygon, permafrost maps will be searched for and reviewed as part of the desktop study and ground-truthed during the field program (during soil and rock sampling). ■ A review of the provincially known / registered contaminated sites database will be conducted to determine proximal contaminated sites with potential pre-existing soil quality issues. ■ The baseline report will include the descriptions of the findings and present the location of key geological features and known contaminated sites.	■ Section 7.1 ■ Section 8.1

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
GE-11	■ **Section 6.1: Indicators and Expression of Change** ■ **Table 6-1 Physiography, Geology, Geochemistry, Terrain and Soils Indicators** – [Indicator – Physiography, Terrain and Soils] "Expression of Change: Degradation of physical or chemical characteristics of permafrost, terrain or topography (e.g., natural hazards) and soils. Rationale for Selection: Important for geotechnical stability of civil infrastructure (e.g., roads), protection of human health, and protection of aquatic and terrestrial habitat associated with natural hazards (e.g., slope failures)."	■ **Section 8.3** – "The Impact Statement must: … • identify any geological hazards that exist in the areas planned for the project facilities and infrastructure, including: • history of seismic activity in the area, including induced earthquakes, and secondary effects such as the risk of, landslides and liquefaction; • evidence of active faults; • isostatic rise or subsidence; and • history of landslides, slope erosion and the potential for ground and rock instability/ landslides, and subsidence during and following project activities.." ■ **Section 8.4** – "The Impact Statement must: … • identify any areas of ground instability; …"	■ The Agency	■ The study plan only describes geological or natural hazards and ground stability in Table 6-1. It is unclear how the requirements in Section 8.3 of the Guidelines regarding the data required to identify the geological hazards will be met. ■ It is also unclear how the requirements in Section 8.4 of the Guidelines regarding ground instability will be met.	■ Revise the study plan to provide details to demonstrate that all requirements in Section 8.3 of the Guidelines related to the identification of geological hazards will be met. ■ Provide details to demonstrate how areas of ground instability will be identified, as required in Section 8.4 of the Guidelines.	■ As part of the desktop study, an online search for information regarding the earthquake and natural disaster history for the Project area will be conducted. This information will be used to identify potential geological hazards that exist in the areas planned for the Project facilities and infrastructure. ■ Added a field study section (Section 7.4.4) the outlines the steps taken if any geological hazards are identified during the desktop assessment. In summary, the areas will be flagged to the Geotechnical and Project design teams so additional assessment and field truthing can be conducted, as required, based on the professional judgement of the geotechnical team. Any field study's will be completed under other disciplines (e.g., geotechnical). The Project design team will use this information when selecting and designing the preferred CAR alignment with the overall goal of minimizing road alignment through areas with known or suspect geological hazards.	■ Section 7.1 ■ Section 7.4.4
GE-12	■ **Section 6.3: Magnitude of Effect Table 6-3 Geochemistry Magnitude Definition** – "Laboratory testing indicates that all rock types disturbed by the Project is non-ML, where non-ML is defined as: • Predicted water quality results (dissolved metals) do not exceed applicable water quality standards or are similar to proximal baseline surface water quality results."	■ **Section 8.3** – "The Impact Statement must: • describe the bedrock geology and lithological units, including a summary table of geologic descriptions, mineralization styles (if applicable) supported by geological maps and cross-sections at appropriate scale (normally 1:50 000). Provide in the table an inferred risk rating (i.e., low, medium, high) for acid rock drainage and metal leaching potential based on the desk-top review of bedrock geology and mineralization;…"	■ The Agency	■ It is unclear what is meant by "predicted water quality results". It is unclear if the study plan refers to the laboratory leach test results or water quality modelling. Caution is recommended in comparing laboratory leach test results with water quality standards as laboratory leach tests do not reflect actual site conditions.	■ Update the study plan to clarify what is meant by "predicted water quality results". Provide details to demonstrate how the requirement in Section 8.3 of the Guidelines related to inferred risk rating for ARD and ML will be met.	■ Baseline geochemistry has been moved to the Groundwater and Geochemistry Study Plan. The Groundwater and Geochemistry Study Plan is updated to change the wording to shake flask extraction. We agree that caution should be used when comparing laboratory shake flask extraction results with water quality standards. However, future studies will consider geochemical modelling, laboratory kinetic testing and field-scale testing to mimic site conditions.	■ Section 7.4.2 of the Groundwater and Geochemistry Study Plan

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
GE-13	■ **Section 6.3 Magnitude of Effect** – "The residual effects will therefore be described in terms of the magnitude, geographic extent, timing, duration, frequency, social and ecological context, likelihood, and whether effects are reversible or irreversible. For magnitude, VC-specific definitions are required and are proposed below in Table 6-2 for Physiography, Geology, Geochemistry, Terrain and Soils. Tables 6-3 and 6-4 provide details of the definitions of geochemistry magnitude and soils magnitude, respectively."	■ **Section 14.2** – …"If the proponent undertakes quarrying activities to extract aggregate material that may results in effects on groundwater and surface water levels (i.e., quarrying below the water table), the Impact Statement must: … • With respect to potential effects on water quality resulting from acid rock drainage and/or metal leaching, the Impact Statement must: provide estimates of the potential for aggregate extraction activities (i.e., eskers and quarries) and rock exposed in permanent rock cuts to be sources of acid rock drainage or metal leaching; … • provide an acid rock drainage assessment and mitigation plan that describes the confirmatory monitoring of construction materials and potential mitigation strategies to prevent or control acid rock drainage and metal leaching during construction, operation, decommissioning and abandonment; and • describe contingency plans, monitoring during operation, decommissioning and abandonment, and maintenance plans."	■ The Agency	■ Any risk associated with rock cuts that will be exposed along the road alignment, and at aggregate source sites, must be clearly identified and effects must be assessed, if applicable, in both the testing program and the mitigation, contingency, and monitoring plans. ■ The study plan is proposing a phased approach to the development of an ARD/ML monitoring and mitigation plan, which would be based on the results of the proposed geochemical characterization program. ■ Details are needed on how the phased approach to developing an ARD/ML monitoring and mitigation plan would be scoped to minimize risk posed by exposed rock along the road alignment and at aggregate source sites.	■ Update the study plan to provide details to demonstrate that the geochemical characterization program summary report will identify if an ARD/ML monitoring and mitigation plan will be proposed, and if so, will provide a description of its scope and a timeline for its development and appropriate implementation.	■ Geochemistry has been moved to the Groundwater and Geochemistry Study Plan. The Groundwater and Geochemistry Study Plan has been updated accordingly.	■ Section 7.4.2 of the Groundwater and Geochemistry Study Plan
GE-14	■ **Table 6-4: Soils Magnitude Definition** – **Negligible** • "Definition: There is little to no variation predicted in soil concentrations which remain within the range of natural variability.	■ **Section 21** – "…Proponents must describe the extent to which residual effects are adverse. Where relevant, or where best practice or evidence-based thresholds exist, effects should be described using criteria to quantify adverse effects. This includes criteria such as whether the effects	■ The Agency	■ The medium and high soils magnitude criteria are defined using the threshold of a 10-fold increase above baseline conditions. It is unclear when this threshold is applied (e.g., only when no applicable soil quality criterion exists). No explanation is provided on how the proposed judgement criteria	■ Update the study plan to include in the definitions for magnitude criteria that are relevant to the protection of human health. ■ Describe the approach that will be used to ensure that these criteria are appropriate for the human health impact assessment.	■ The Study Plan is updated.	■ Table 9-5 ■ Table 9-6 ■ Section 9.6

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
	• Rationale: Soil quality shows no discernable change, therefore no effect on ecological life or human health (e.g., potable water use, physical contact). – **Low** • Definition: There is a small variation predicted in soil concentrations that is less than double current concentrations, but concentrations remain below applicable soil quality criteria. • Rationale: Temporary effect or permanent change to soil quality is minor and remains protective of ecological life and human health. – **Medium** • Definition: There is a moderate variation predicted in soil concentrations that is less than five (5) times current concentrations, but concentrations are below the applicable soil quality criteria or less than 10 times current concentrations. • Rationale: Temporary effect or permanent change to soil quality is moderate but remains protective of ecological life and human health. – **High** • Definition: There is a large variation predicted in measurable parameters, concentrations exceed applicable soil quality criteria and are greater than 10 times current concentrations. • Rationale: Temporary effect or permanent change to soil quality can potentially impair ecological life or human health.”	are high or low in magnitude, the geographical extent, timing, frequency, duration and reversibility of the effects, taking into account any important contextual factors. Where the potential for human health effects exist due to exposure to a particular contaminant at any level (e.g., non-threshold air pollutants, including particulate matter and nitrogen dioxide, and water pollutants, such as but not limited to arsenic and lead) mitigation measures should aim to reduce the residual effects to as low as reasonably achievable.. – The Impact Statement must: • characterize the residual effects using criteria most appropriate for the effect; • characterize residual effects for human health using human health-related criteria most appropriate for the carcinogenic and non-carcinogenic health effects of non-threshold contaminants;… • provide the rationale for the choice of criteria used to determine the extent to which the predicted effects are adverse. The information provided must be clear and sufficient to enable the Agency, review panel, technical and regulatory agencies, Indigenous groups, and the public to review the proponent’s analysis of effects;…”		were developed or how they are relevant to the protection of human health. ■ Furthermore, the study plan assumes that soil quality remains protective of human health as long as contaminant levels are below applicable criteria. However, there is no evidence of a health effect threshold at the population level upon exposure to certain soil contaminants, such as arsenic, chromium and lead. Although these contaminants are provided as examples of non-threshold contaminants in water (Section 21 of the Guidelines), their toxicological characteristics are applicable to other environmental media, including soils. The characterization of potential health impacts should acknowledge that health risks exist below criteria levels along the continuum of concentrations for these non-threshold pollutants/contaminants. ■ Additionally, it is unclear in Table 6.3 which “applicable water quality standards” will be used to justify that the proposed geochemistry magnitude criteria are protective of human health.			
				■ Health Canada encourages the proponent to use all available technologies to reduce their emissions as low as reasonably achievable (ALARA) and beyond those required to achieve applicable thresholds (i.e., Canadian Council of Ministers of the Environment’s (CCME (3)) Soil Quality Guidelines for the Protection of Environmental and Human Health and Ontario Soil, Groundwater and Sediment Standards (4) in order to reduce the burden of soil and sediment pollution. ■ (3) CCME, 2014. Soil Quality Guidelines for the Protection of Environmental and Human Health. Available at : http://st-ts.ccme.ca/en/index.html?chems=all&chapters=4&pdf=1		■ Thank you for your comment. Data will be reviewed and relevant information will be incorporated into the IS / EA where appropriate	■ N/A

Comment # / Ref #	Study Plan Section	TISG Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Response	Study Plan Reference
	■ **Table 6-3: Geochemistry Magnitude Definition** – "(…) Minor incremental effects to surface water, groundwater and/or drinking water quality are anticipated to be discernable, but water quality remains protective of ecological life and human health for all time periods and life stages."			(4) Ontario Soil, Groundwater and Sediment Standards. Available at: https://www.ontario.ca/page/soil-groundwater-and-sediment-standards-use-under-part-xv1-environmental-protection-act.			

Draft Study Plan Comments – Provincial

Comment ID	Study Plan Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Final Response	Study Plan Reference
1	■ N/A	■ MECP, Environmental Assessment Branch	■ Please review EAB comments on the Wildlife, Ungulates, Vegetation, Groundwater and Climate Change work plans that may apply to this work plan		■ No comments are applicable to this Study Plan.	■ N/A
2	■ List of Acronyms	■ MECP, Environmental Assessment Branch	■ Minor typo in MFFN – Martin Falls First Nation.	■ Correct typo.	■ Corrected.	■ Abbreviations
3	■ Page 4, Figure 3-1	■ MECP, Environmental Assessment Branch	■ Figure 3-1 is titled “Physiography, Geology, Geochemistry, Terrain and Soils Local and Regional Study Areas” but it does not include the study areas. It is also missing a legend, which is necessary to explain what all the colours are.	■ Please include a map of the local and regional study areas and include a legend on Figure 3-1.	■ The figure has been updated. Note that this study plan is now titled "Physiography, Terrain and Soils", and the figure has been updated to reflect this change.	■ Figure 6-2
1	■ Pg. 6 / s. 4.3 – Field Study Methods	■ MECP, Species At Risk Branch (Northern Species at Risk Specialist comments)	■ Insufficient details are provided describing the proposed test hole drilling program (e.g., dates, locations, duration at each site, etc.) and overburden and bedrock sample collection (e.g., dates, locations, duration at each site, methods for sample collection, etc.). Details must be provided in the draft Work Plan to ensure an appropriate review of potential impact to species at risk (e.g., removal of trees within bat habitat during maternity period, sensory disturbance to caribou during the nursery period, etc.).	■ Update the draft Work Plan to describe, in detail, the methodology for the proposed test hole drilling program. ■ If, for whatever reason, these details cannot be provided in the draft Work Plan, they must be provided to MECP-SARB at SAROntario@ontario.ca prior to the activities being undertaken and with sufficient time for MECP-SARB to review (i.e., minimum of 4 weeks).	■ The overburden and bedrock sample collection are now included in the Groundwater and Geochemistry Study Plan. ■ The proposed field work program will be refined upon completion of the desktop studies for the Physiography, Terrain and Soils and Groundwater and Geochemistry Study Plans and related Study Plans (e.g., surface water).	■ Groundwater and Geochemistry Study Plan
1	■ p. 6/Section 4.3.1 Geochemistry (ML/ARD)	■ MECP, Hydrogeologist Comments	■ The consultant provided the sampling frequency based on estimated tonnage for geochemistry samples, according to the guidance materials in Table 8.2, Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, MEND Report 1.20.1, Dec. 2009. The consultant further stated that, “…geological units associated with high potential of sulphide mineralization will be sampled more intensively”. ■ The baseline geochemistry report must provide more information on geochemistry sample selection (e.g., location, dimensions, volume, geologic unit, mineralogy, sulphide classification and percentage, weathering, etc.). As stated in the Dec. 2009 MEND report (Section 8.4), compositing of material is not recommended, and “…should be avoided for samples taken: at different times; over wide distances; and from different geologic units and waste or wall material with significant variability in physical, mineralogical, geochemical, weathering or leaching properties.”	■ The baseline geochemistry report must provide additional information on the methodology for selection of geochemical samples (e.g., location, dimensions, volume, geologic unit, mineralogy, sulphide classification and percentage, weathering, etc.). Compositing of material for geochemistry samples is not recommended.	■ Baseline geochemistry is now captured as part of Groundwater and Geochemistry Study Plan. ■ Prior to sample submission, key information including location, dimensions, volume, geologic unit, mineralogy, sulphide classification and percentage and weathering will be recorded. The number of samples that will be submitted for geochemical testing is dependent on the volume, location and geological and geochemical composition of material that will be disturbed or moved during construction. The preliminary Project description will be used to estimate borrow source excavation and blasting volumes. Information on expected volume and locations of disturbances and the different geological units encountered in the overburden and bedrock during field investigations will be used to determine the number and distribution of the samples submitted for ARD / ML characterization. This information will be summarized in a table as part of the baseline study report.	■ Groundwater and Geochemistry Study Plan

Comment ID	Study Plan Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Final Response	Study Plan Reference
2	■ p. 12/Table 6-3: Geochemistry Magnitude Definition; and p. 7/Section 4.3.1 Geochemistry (ML/ARD)	■ MECP, Hydrogeologist Comments	■ Based on Table 6-3, the consultant has stated that "moderate" or "high" magnitude geochemical test results would prompt further assessment by a qualified professional geochemist and implementation of impact management measures listed on page 7. Considering the permanent nature of the road base materials and in order to remain protective of ecological life and human health over the long-term, it is recommended that "low" magnitude geochemical test results would require blending of materials if "uncertain" (NPR between 1-2) or potential metal leaching rock types exceed 10%. Management measures associated with ARD/ML geochemical test results must be assessed by a qualified professional geochemist prior to implementation.	■ "Low" magnitude geochemical test results should require the following management measure: blending of materials if "uncertain" (NPR between 1-2) or potential metal leaching rock types exceed 10%. Management measures associated with ARD/ML geochemical test results must be assessed by a qualified professional geochemist prior to implementation.	■ Geochemistry is now captured as part of Groundwater and Geochemistry Study Plan. Geochemistry and geology have been removed as a VC, and the geochemical test results will be used to support the assessment of the groundwater and surface water VCs as it relates to the groundwater and surface water quality indicators. The need for a ML / ARD Management Plan will be determined following the assessment of field data and completion of the baseline report.	■ Section 7.4.2 ■ ■ Groundwater and Geochemistry Study Plan
3	■ p. 12/Table 6-3: Geochemistry Magnitude Definition	■ MECP, Hydrogeologist Comments	■ The Rationale column in Table 6-3 for "negligible", "low" and "medium" magnitude geochemical test results states that "water quality remains protective of ecological life and human health for all time periods and life stages". If this is accurate, then it is assumed that all water quality results will meet or remain below the more stringent of applicable provincial or federal standards/guidelines. However, the Definition column for the "low" and "medium" magnitude levels states that the predicted water quality results will exceed the applicable water quality criteria. Clarification is required.	■ Remove the following statement from the Table 6-3 Rationale column for the "low" and "medium" magnitude categories: "…water quality remains protective of ecological life and human health for all time periods and life stages."	■ Geochemistry is now captured as part of Groundwater and Geochemistry Study Plan. Geochemistry and geology have been removed as a VC for assessment, and the geochemical test results will be used to support the assessment of the groundwater and surface water VCs as it relates to the groundwater and surface water quality indicators.	■ Table 95 and Section 9.6, ■ ■ Groundwater and Geochemistry Study Plan
1	■ N/A	■ MTO, Transportation Infrastructure Management Division Comments	■ Attached with these comments, MTO has provided a guidance document for assessing aggregate deposits that was prepared by MTO's materials engineering office. A page at the end of this pdf lists MTO's laboratory testing regiment for gravel and bedrock deposits. This could be a supplementary guidance document for the Marten Falls work plan should they wish to use it. – Standard Practice for Aggregate Resource Evaluation, MTO, 2002 – Provincial Pavement Engineering Investigation Guidelines, v. 1.1, MTO, 2013		■ The Study Plan is updated to include the review of the Standard Practice for Aggregate Resource Evaluation to the desktop assessment. The provincial pavement engineering guidelines is more suited to the Geotechnical Work plan.	■ Section 7.1
1	■ 4.3.1 – page 7 paragraph 3	■ MTO, NWR Aggregate Supervisor Comments	■ Concerned with assumption that ML/ARD testing may be done on bedrock samples obtained from geotechnical drill core. If drill core is tested for geotechnical purposes (i.e., Micro Deval, relative density/absorption, freeze-thaw, flat & elongates) then there might not be enough drill core left for ML/ARD testing purposes as geotechnical tests are mostly destructive tests.	■ Generally, NWR aggregate quarry testing includes two 15 metre drill cores. Perhaps a third separate core can be taken for ML/ARD testing.	■ Geochemistry is now captured as part of Groundwater and Geochemistry Study Plan. ■ Geochemical static testing requires ~500 g sample and based on our experience it is expected that these samples can be collected from the geotechnical core. If additional ARD / ML characterization is required the samples will be collected from residue core or residual samples from geotechnical testing. If additional ARD/ML testing is required and there is insufficient existing core then samples of the same rock type with the same geochemical data would be collected from other boreholes. If there are still insufficient core then additional boreholes may be required.	■ Section 7.4.2

Comment ID	Study Plan Section	Agency / Regulatory Body Comments Received From	Comment / Context	Action Item	Final Response	Study Plan Reference
2	■ 4.3.1 – page 7 paragraph 3	■ MTO, NWR Aggregate Supervisor Comments	■ "The depth of the drill core samples will be shallower than the proposed depths of the quarry/blasting operations to make certain that the samples are representative of the blast/fill material" ■ For the sentence above to be true, a significant amount of geotechnical and design component will need to be completed to know the actual depth that they want to test for ML/ARD.	■ Start Geotech & Design prior to completion of Environmental Assessment or perform deeper cores (i.e., 15 metres) and have a geologist confirm that the entire core run is homogenous lithology or catalogue each different lithology and test each distinct unit for ML/ARD separately.	■ Geochemistry is now captured as part of Groundwater and Geochemistry Study Plan. Text revised to match current text in that study plan. ■ The Study Plan is updated to indicate: *The depth of the drill core samples will shallower than the proposed depths of quarry / blasting operations, if known, to make certain that samples are representative of blast / fill material~~.~~ Additional bedrock samples may be required based on initial ML / ARD results and on the homogeneity of the geology encountered throughout the entire length of each borehole.*	■ Section 7.4.2, ■ ■ Groundwater and Geochemistry Study Plan
3	■ 4.2 – page 5	■ MTO, NWR Aggregate Supervisor Comments	■ Section indicates preliminary geotechnical investigations including peat augering, hand augering, and test hole drilling were carried out. However, a summary of this information was not included in the report.	■ Include a brief summary of soils encountered and any laboratory testing from this investigation, including any engineering recommendations for embankment and road structure construction (realize this may be outside the scope of this report).	■ This is out of scope for this report. A summary will be provided in the Baseline Report.	■ Section 8.1
4	■ 4.3 – page 6	■ MTO, NWR Aggregate Supervisor Comments	■ Section discusses next step in field study methods, which are primarily focused on investigation geological features that could be developed as aggregate sources.	■ Use the information from the previous investigation discussed in Section 4.2 as a basis for developing borehole plan. Strongly consider expanding geotechnical investigation to sample subgrade material, in order to provide preliminary recommendations on embankment and road construction. The MTO's Provincial Pavement Engineering Guidelines could be used as a tool to help scope this drilling program.	■ The Physiography, Terrain and Soils work plan will map potential quarry and pit materials within the 6 km wide LSA, however the mapping and field assessment will not provide data necessary to comment on the suitability of the materials for road construction. Determination of whether or the identified aggregate materials are suitable for road construction will be conducted by other disciplines (e.g., geotechnical engineering). ■ Field plots will be established within a number of potential source areas with data collected on soil texture, percent coarse fragments, type of coarse fragments (e.g., rounded, angular, etc.) and possible thickness (e.g., 1 - 3 m, > 3 m). To better assess the potential of these sources, samples are usually taken for laboratory analysis and boreholes or GPR data are collected to assess the thickness of the overall deposit. These samples could be collected during the Geotechnical field investigations and data can then be compared to Provincial standards for road building material to determine its potential for road construction.	N/A
1	■ Pg 3 / Sec 3.	■ ENDM, Regional Land Use Geologist & Land Use Planning and Policy Co-ordinator Comments	■ "A 5 km wide study area also allows for route refinements during development of Project design…"	■ Specify that the 5 km study area is considered the Regional Study Area	■ The physiography, terrain and soils local and regional study areas have been updated to align with the Vegetation Study Plan.	■ Section 6.2
2	■ Pg 4 / Sec 3.	■ ENDM, Regional Land Use Geologist & Land Use Planning and Policy Co-ordinator Comments	■ No reference to bedrock geology base map.	■ Add a reference somewhere for the bedrock geology base map used.	■ The Study Plan has been updated accordingly.	■ Figure 6-2
3	■ Pg 10 / Sec 6.1.	■ ENDM, Regional Land Use Geologist & Land Use Planning and Policy Co-ordinator Comments	■ Physiography, Terrain and Soils – Rationale for Selection	■ Perhaps also add "karst" as an example of another potential natural hazard, as there is some potential for karst formation in that area associated with the limestone bedrock.	■ The Study Plan has been updated accordingly.	■ Section 7.1; 7.4.4

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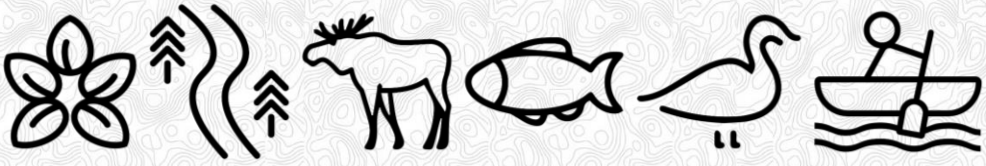

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FINAL

Physiography, Terrain and Soils and Vegetation and Peatlands Field Logistics Work Plan

September 2021

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Revision History

Rev #	Date	Revision Description

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Acronyms

Agency, the ... Impact Assessment Agency of Canada
CAR ..... Community Access Road
EA ..... Environmental Assessment
HaSEP ..... Health and Safety and Environmental Protection Plan
IA ..... Impact Assessment
IAA ..... *Impact Assessment Act*
IS ..... Impact Statement
JSEA ..... Job Safety and Environmental Analysis
MECP ..... Ontario Ministry of the Environment, Conservation and Parks
MFFN ..... Marten Falls First Nation
SAR ..... Species at Risk
VC ..... Valued Component

1. Introduction

The Proponent of the Community Access Road (CAR or the Project) is Marten Falls First Nation (MFFN), a remote First Nation community in northern Ontario located at the junction of the Albany and Ogoki rivers, approximately 430 kilometres from Thunder Bay, Ontario. The MFFN community is proposing an all-season CAR that will connect the MFFN community to Ontario's provincial highway network (Highway 643) to the south via the existing Painter Lake Road. MFFN, as the Proponent of the Project, has formed a MFFN CAR Project Team that includes MFFN CAR Community Member Advisors and MFFN CAR Project Consultants who act with input, guidance, and direction from the MFFN Chief and Council.

This document outlines the work plan to implement the field studies for the valued component (VC) wetland and riparian ecosystems, upland ecosystems, designated areas, traditional use plants and species at risk (SAR) plant populations, peatland ecosystems, and physiography, terrain and soils, recognizing the results of these field surveys will be used to support a coordinated Impact Assessment (IA) required for Project review by the Impact Assessment Agency of Canada (the Agency) under the federal *Impact Assessment Act* (IAA), and an Environmental Assessment (EA) required for Project review by the Ontario Ministry of the Environment, Conservation and Parks (MECP) under the Ontario *Environmental Assessment Act*. The Physiography, Terrain and Soils, and Vegetation and Peatlands Work Plans have been combined as these components are highly integrated throughout the Project, including both mapping and field inventory programs.

The Physiography, Terrain and Soils, and Vegetation and Peatlands Work Plan describes the proposed methods and schedule to complete the field programs and considers both the Agency's Tailored Impact Statement Guidelines for the Marten Falls Community Access Road Project (IAAC 2020), and the comments received on the Draft Terms of Reference (AECOM 2020).

2. Overview and Approach

The approach and associated study areas for the Physiography, Terrain and Soils, and Vegetation and Peatlands field programs are defined in the respective Study Plans (MFFN CAR 2021a,b). These considerations were developed based on discussions with both federal and provincial regulators. A brief description of the proposed methodology and staffing plan to complete the Physiography, Terrain and Soils and Vegetation and Peatlands field programs are described below, with the understanding that the technical content is limited to supplementary information not previously included in the Physiography, Terrain and Soils and Vegetation and Peatlands Study Plans.

Additional soils fieldwork will likely be required after the EA has been submitted and a final preferred route has been selected. The soils fieldwork will be in support of soil salvage, management, and reclamation in the disturbance footprint.

2.1 Methodology

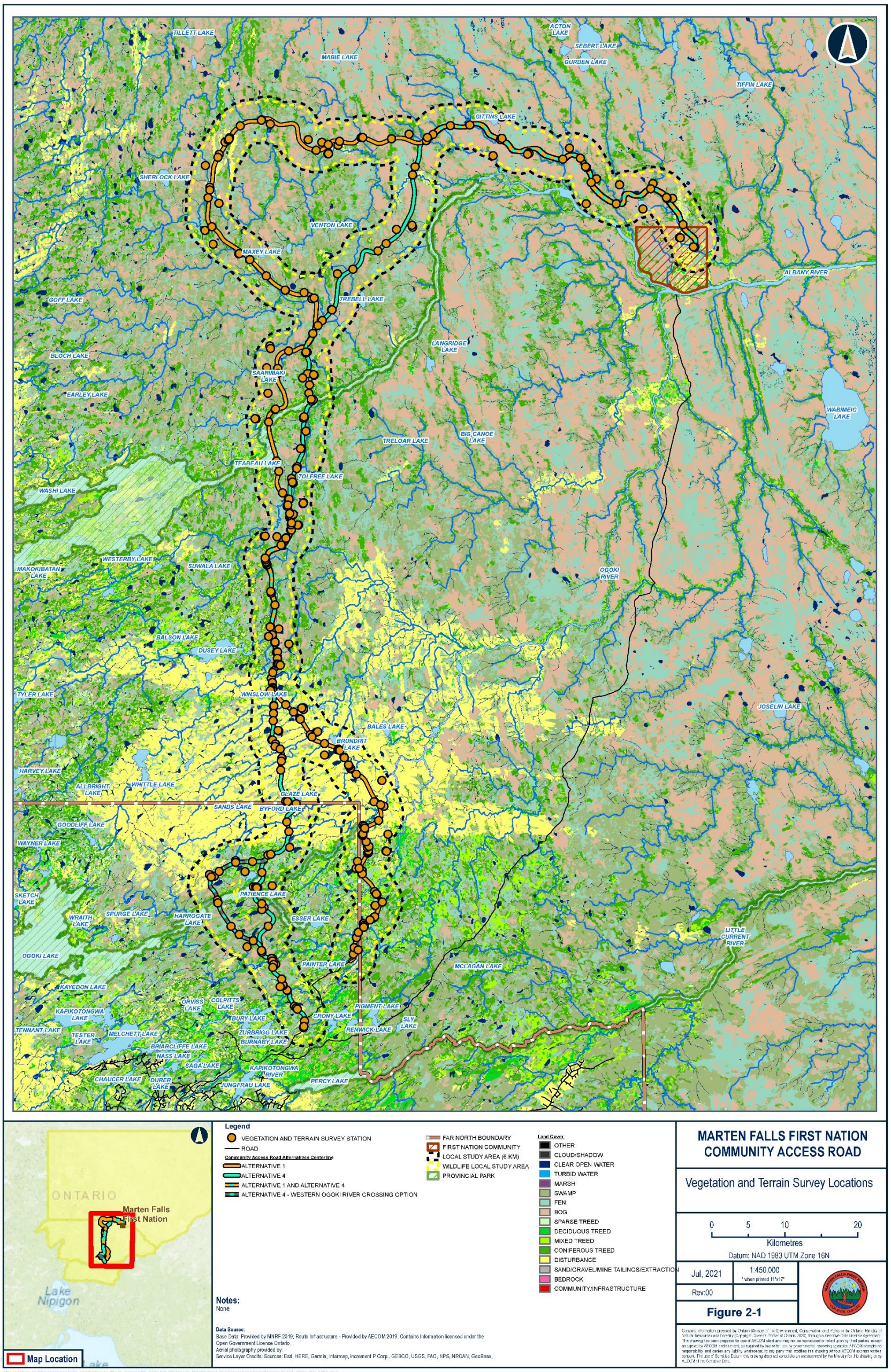
The proposed methodology for the Physiography, Terrain and Soils, and Vegetation and Peatlands field programs are described in **Table 2-1,** and the corresponding survey locations are shown in **Figure 2-1**.

Table 2-1: Methodology for Physiography, Terrain and Soils and Vegetation and Peatlands Field Studies

Physiography, Terrain and Soils	
Permits to Conduct Field Study	■ MECP Letter of Authorization to Conduct Research in a Provincial Park or Conservation Reserve; valid from June 1, 2021 to December 31, 2022 ■ MECP Letter of Authorization to Conduct Research in a Provincial Park or Conservation Reserve; valid from May 1, 2022 to December 31, 2023
Field Study Methods	■ Soil and terrain inventory – Field survey locations were selected based on desktop pre-typing of vegetation ecosites, as well as review of stereoscopic air photos in gap areas where desktop pre-typing had not yet been completed ■ Geological Hazard Assessment (where appropriate) ■ Soil sample collection at 30 sites for soil quality and reclamation suitability ■ Geochemistry sample collection at the 30 sites identified for soil sample collection
Lab Analysis Methods	■ Details of analyses required listed in Study Plan ■ Additional analyses potentially required to support soil salvage and reclamation include: – Particle Size Distribution – Saturation Percentage

Physiography, Terrain and Soils	
	– Electrical Conductivity – Soluble Cations *Based on guidelines from Soil Quality Criteria Relative to Disturbance and Reclamation (AAFRD 1987) ■ Samples assumed to be submitted to SGS Laboratories ■ A list of analyses required for the geochemistry portion of the program is found in the Geochemistry Study Plan.
Vegetation and Peatlands	
Permits to Conduct Field Study	■ MECP Letter of Authorization to Conduct Research in a Provincial Park or Conservation Reserve; valid from June 01, 2021 to December 31, 2022
Field Study Methods	■ Vegetation Community Surveys-ground based and aerial – Field survey locations were selected based on desktop pre-typing of vegetation ecosites, as well as provincial landcover mapping in gap areas where desktop pre-typing had not yet been completed ■ Up to 75 stations will overlap with wildlife field study survey locations and be assessed through photo interpretation at the desktop level. Detailed survey locations are described in the Wildlife Work Plan and Bird Work Plan ■ Peatland Composition Survey – ground based ■ Functional Assessments (for peatland, wetland and riparian ecosystems) ■ Botanical Inventory ■ Traditional Use Plants and Species at Risk Plant Surveys ■ Invasive Plant Survey
Lab Analysis Methods	■ Taxonomic identification of Sphagnum mosses (where required)

Figure 2-1: VC Survey Locations for Physiography, Terrain and Soils and Vegetation and Peatlands Field Programs



2.2 Program Staffing

The proposed staff participating in the Physiography, Terrain and Soils and Vegetation and Peatlands field programs are outlined in **Table 2-2**.

Table 2-2: Personnel Qualifications

Name	Title	Project Role	Credentials	Years of Experience*
Anne Sommerville	Senior Terrain Scientist	Physiography, Terrain and Soils Component Lead	Ph.D, P.Ag.	20
Christiane Brouwer	Soil/Terrain Scientist	Soil / Terrain Field Lead	B.Sc., P.Ag	16
Joe Fitzpatrick	Soil/Terrain Scientist	Soil / Terrain Field Crew Member	B.Sc., P.Ag	25
Claire Kisko	Soil Scientist	Soil / Terrain Field Crew Member	B.Sc., AIT	5
David Brown	Soil Scientist	Soil / Terrain Field Crew Member	B.Sc.	10
Amber Sabourin	Ecologist	Vegetation Component Lead	H.B.Sc (Env)	11
Andrew Stewart	Ecologist	Peatlands Component Lead	B.Sc.	11
Erin Greenaway	Senior Ecologist	Natural Sciences Lead, Senior Adviser, Vegetation Senior Reviewer	B.Sc.	23
Heather Melcher	Senior Ecologist	Principal, Vegetation Senior Reviewer	M.Sc.	25
Luke Owens	Wildlife Biologist	Vegetation and Peatlands Field Lead	B.A.	15
Judah Berkan	Junior Biologist	Vegetation and Peatlands Field Crew Member	B. Sc.	2
Jessica Tratnik	Junior Biologist	Vegetation and Peatlands Field Crew Member	B.A.Sc.	4

*Note: * Experience as of March 2021*

Please note that the staffing for the Physiography, Terrain and Soils and Vegetation and Peatlands field programs may also rely on additional members from the MFFN CAR Project Consultant Team and / or members from local Indigenous communities. It is anticipated that one Indigenous individual will be teamed with each soil / terrain scientist in the field.

3. Discipline Specific-Schedule

The proposed schedule for the Physiography, Terrain and Soils and Vegetation and Peatlands field programs are presented below in **Table 3-1**.

Table 3-1: Program Schedule

Task / Program	Start Date (MM/YR)	Approximate Duration	Targeted VC Interaction
■ Physiography, Terrain and Soils	■ Spring/summer 2022	■ 8 days (plus travel to and from site)	■ Physiography, Terrain and Soils
■ Vegetation ■ Peatlands	■ September 2021 (round 1) ■ May/June 2022 (round 2)	■ two rounds of 7 field days (plus travel to and from site)	■ Wetland and Riparian Ecosystems ■ Upland Ecosystems ■ Traditional Use Plants and SAR Plant Populations ■ Designated Areas ■ Peatland Ecosystems

Prior to field programs commencing, the following groups from the Project Contact List will be notified:

- Indigenous Community Key Contacts
- Tribal Councils, Provincial Territorial Organizations and Métis Nation of Ontario
- Other Indigenous Persons Identified for Consultation (including MFFN community members)
- Businesses
- Tourism Operators
- Community and Interest Groups and Non-Governmental Organizations
- Interested Parties / Potential Stakeholders – Unaffiliated
- Government Review Team
- Non-Government Review Team agency representatives
- Forest Management Companies
- Mining Claim Holders
- Emergency Medical Services and Law Enforcement
- Neighbouring Projects and their Contacts
- Other Agency Representatives (elected Members of Parliament and Provincial Parliament of Ontario)

4. Health and Safety

4.1 General

Golder is committed to the health and safety of employees, clients, contractors and the public, with the understanding that all work performed by Golder is subject to strict health and safety policies and applicable federal, provincial, and municipal acts and regulations. Golder has internal Work Safe Practices for aerial work, remote work, cold weather work, and working around water. All field crew members will be expected to review these protocols prior to commencing surveys. In addition, the Golder survey teams will develop a project specific Health and Safety and Environmental Protection Plan (HaSEP) prior to conducting field work. The Project's HaSEP will be reviewed and discussed with all field crew members (including pilot and Indigenous crew members) prior to the survey's commencement.

The aerial / helicopter support for the Project will be designed and scheduled according to Golder's and the client's health and safety policies, procedures, and training. Restrictions on aircraft type and pilot proficiency will apply. Prior to daily take-off, the pilot will provide an aircraft orientation and safety briefing to all members of the survey team. The briefing will include identifying hazards, emergency response plans and procedures, and general helicopter protocol (including how to exit and enter an aircraft). As part of these briefings, hazards specific to the day's task will also be identified, discussed, and documented on a job safety and environmental analysis (JSEA) form, with a plan for all crew members to sign the JSEA. Field surveys will only occur when weather conditions allow safe aircraft operations, recognizing that (1) field crew members have the right to refuse substandard actions or conditions if the worker feels that these actions / conditions are imminently dangerous to their safety or to the safety of others and (2) field crew members should rely on pilot judgement as well as their own experienced and comfort level to determine if flights should occur or be prematurely terminated.

As part of each field day, field crew members will pack extra food, water, and clothing in case of aircraft mechanical trouble and unexpected delays. In addition, each field crews will carry a survival and first aid kit for emergency situations (supplementary to the aircraft emergency survival kit). Daily check-in times with a designated contact will be pre-determined as part of the HaSEP, noting that satellite phones or satellite communication devices (e.g., Garmin inReach) will be used in areas where cell phone coverage is not reliable.

4.2 COVID-19

All COVID-19 related risk mitigation and recovery measures have been established in line with government protocols and AECOM corporate measures. Field crews will employ preventative COVID-19 actions including daily screening questionnaires and the use of Personal Protective Equipment such as gloves, masks, regular disinfection and social distancing.

Members of the field crews are not to attend site, or must remove themselves from site, if they fit any of the following criteria:

- They have symptoms associated with COVID-19 (e.g., fever, cough, sore throat, shortness of breath, sneezing / running nose or loss of sense of smell);
- They have been confirmed for COVID-19 or are awaiting the results from being tested for COVID-19;
- They have been in close-contact with a known or suspected case of COVID-19 in the past 14 days; and / or
- They have returned, or been in contact with someone who has returned, from overseas in the past 14 days.

When working in the community, field crews will strictly adhere to the COVID-19 preventative measures as described above. Where community access is required to facilitate a field survey, entry will be discussed with the community in advance. As needed, a negative COVID-19 test will be presented prior to entering Indigenous communities.

Field crews will have access to an adequate supply of sanitizer, and, as part of this, the crew members will regularly sanitize their hands. Further to this: field crews will minimize use of shared tools and equipment, as practical (including the use of hand tools, electronic devices, pens, clipboards, and notepads); all work surfaces and equipment used in the course of work will be adequately cleaned and disinfected at the end of the work shift or more frequently when visibly soiled or used repeatedly; and cloth or surgical masks (as a minimum) will be worn by field crews at all times during the course of work and in transit to the work site in line with government direction.

For all workers, regardless of specific exposure risks, it is always a good practice to:

- Frequently wash your hands with soap and water for at least 20 seconds, noting that, when soap and running water are unavailable, use of an alcohol-based hand rub with at least 60% alcohol is suggested.

- Avoid touching your eyes, nose, or mouth with unwashed hands.
- Avoid close contact with people who are sick.
- Cover your mouth and nose with your bent elbow or tissue when you cough or sneeze, and immediately dispose of the used tissue.
- Stay home if you are sick.

5. References

AAFRD (Alberta Agriculture, Food and Rural Development). 1987. Soil Quality Criteria Relative to Disturbance. Alberta Agriculture, Food and Rural Development Conservation and Development Branch, Edmonton, AB.

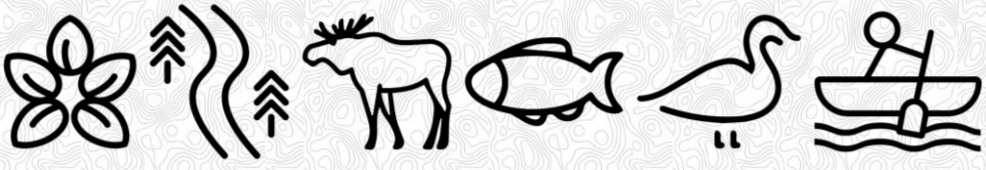
AECOM Canada Ltd., 2020:
Marten Falls First Nation Proposed Terms of Reference Marten Falls Community Access Road – Environmental Assessment, Appendix B: Consultation & Engagement Plan to Support the Environmental Assessment / Impact Statement.

Impact Assessment Agency of Canada, 2020:
Tailored Impact Statement Guidelines for the Marten Falls Community Access Road Project. https://iaac-aeic.gc.ca/050/documents/p80184/133937E.pdf

Marten Falls First Nation Community Access Road Project (MFFN CAR), 2021a:
Physiography, Terrain and Soils Study Plan

Marten Falls First Nation Community Access Road Project (MFFN CAR), 2021b:
Vegetation Study Plan

Phone: 1-800-764-9114 **Email:** info@martenfallsaccessroad.ca **Web:** http://www.martenfallsaccessroad.ca



Comments on Marten Falls Community Access Road Project (Project) revised Groundwater and Geochemistry Study Plan and Physiography, Geology, Terrain and Soils Study Plan – October 1, 2021

It is essential that the Impact Statement for the Marten Falls Community Access Road Project (the Project) address all requirements outlined in the Tailored Impact Statement Guidelines (the Guidelines), and that the study plans outline a clear approach to achieving these requirements. The Impact Assessment Agency of Canada (the Agency) has highlighted sections of the Guidelines where requirements were not met in the draft study plans submitted to the Agency. Note that this is not an exhaustive list of Guidelines requirements and the Guidelines should be reviewed in its entirety, including the sections identified below.

General Comments from the Impact Assessment Agency of Canada on the Marten Falls Community Access Road Draft Study Plans – July 2, 2020					
#	**Tailored Impact Statement Guidelines Section[1]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Agency comments**
GC-01	**Section 5 - Public Participation and views (including 5.1, 5.2)**	Provide a clear description in the study plans of how public engagement opportunities have been and/or will be integrated into the impact statement phase. This must include detail on how the public will have opportunities to provide input to contribute to the development of the Impact Statement, as required in Section 5 of the Guidelines. Describe what engagement with the members of the public listed in the Public Participation Plan has been done in the development of the study plans, and/or any planned engagement with members of the public on the proposed study plans.	Section 4: describes how the Proponent will provide Project notices and opportunities with members of the public listed in the Public Partnership Plan. This will also include the opportunity to provide input on the existing environment, VCs, effects assessment methods, effects assessment results, and mitigation and follow-up program measures as applicable. A variety of activities will be offered so that members of the public are informed of the IS / EA Report as it progresses and are aware of the opportunities and means to provide their input. The study plans have recognized public and agency input received on the Project to date.	**Section 4.1** "A variety of activities will be offered so that members of the public are informed of the IS / EA Report as it progresses and are aware of the opportunities and means to provide their input."	Section 4.1 of the study plan mentions that "*a variety of activities will be offered*", however, no details on the likely engagement activities are provided. As required by Sections 5 and 6 of the Guidelines, the Impact Statement must provide a record of engagement that describes all efforts taken to seek the views of local communities and other stakeholders with respect to the Project, including on the study plans. This record of engagement is to include all engagement activities undertaken prior to the submission of the Impact Statement, including prior to and during the planning phase, and in the preparation of the Impact Statement. Provide details on the timeline for public engagement relative to the project workplan, including engagement relative to the schedule for baseline work, and in consideration of the project team's timeline for the development of the Impact Statement. Demonstrate in the Impact Statement how comments provided by members of the public on physiography, geology, terrain and soils and groundwater and geochemistry were taken into consideration. Comments provided to the Agency are available on the Canadian Impact Assessment Registry Internet site at: https://iaac-aeic.gc.ca/050/evaluations/proj/80184/contributions
GC-02	**Section 6 - Description of Engagement with Indigenous Groups (including 6.1, 6.2, 6.3)**	Provide a clear description in the study plans of how all Indigenous groups listed in the Indigenous Engagement and Partnership Plan will have opportunities to provide Indigenous knowledge, including the validation of how information they provided was applied. The study plan should include a description of the proposed methods for data collection, management of confidentiality, and information storage. This should also include a methodology for tracking information that has been approved by the group, to demonstrate that the guidance outlined in Section 6.2 of the Guidelines has been incorporated into the study plans. Describe what engagement with all the Indigenous groups listed in the Indigenous	In Section 4.2 it is noted that the Proponent will provide Project notices and opportunities for consultation and engagement with Indigenous communities identified in the Indigenous Partnership and Engagement Plan. A variety of activities will be offered so that Indigenous communities are informed of the IS / EA Report as it progresses and are aware of the opportunities, means and timelines to provide their input. Section 2.1.1 outlines the approach to handling confidential information, by means of permission from Indigenous communities to include Indigenous Knowledge in the IS / EA Report, regardless of the source of the Indigenous Knowledge. The study plans have recognized Indigenous community input received on the Project to date.	**Section 4.2** "…A variety of activities will be offered so that Indigenous communities are informed of the IS / EA Report as it progresses and are aware of the opportunities, means and timelines to provide their input…" "…Indigenous communities will have the opportunity to comment on components of the study plans throughout the IS / EA Report consultation and engagement process…"	Section 4.2 of the study plan states that "*a variety of activities will be offered*", however, no details on the planned engagement activities are provided. Section 4.2 of the study plan also states that "*Indigenous communities will have the opportunity to comment on components of the study plans throughout the IS / EA Report consultation and engagement process*", however, it is unclear on which components of the study plans the project team plans to engage. It is also unclear whether Indigenous groups will be provided with a meaningful opportunity to provide input on a preliminary approach/method for baseline data collection, as required in Section 6 of the Guidelines, or if engagement will take place after the baseline data collection is complete. Provide details on the timeline for Indigenous engagement on the Physiography, Geology, Terrain and Soils Study Plan and the Groundwater and Geochemistry Study Plan including engagement relative to the schedule for baseline work, and spatial and temporal boundaries determinations, and particularly in relation to collection of

[1] Refer to complete sections of the Guidelines for more context.

General Comments from the Impact Assessment Agency of Canada on the Marten Falls Community Access Road Draft Study Plans – July 2, 2020					
#	**Tailored Impact Statement Guidelines Section[1]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Agency comments**
		Engagement and Partnership Plan has been done in the development of the study plans, and/or any planned engagement with Indigenous groups on the proposed study plans, particularly in relation to collection of Indigenous knowledge (i.e. develop the work plan in collaboration with those Indigenous groups that would need to provide knowledge).			Indigenous knowledge, and in consideration of the project team's timeline for the development of the Impact Statement. Demonstrate in the Impact Statement that comments provided by Indigenous groups on physiography, geology, terrain and soils and groundwater and geochemistry taken into consideration. Comments provided to the Agency are available on the Canadian Impact Assessment Registry Internet site at: https://iaac-aeic.gc.ca/050/evaluations/proj/80184/contributions
GC-03	**Section 6.2 - Analysis and response to questions, comments, and issues raised**	Revise the study plans to include an approach to handling confidential information that demonstrates adherence to the guidance provided in Section 6.2 of the Guidelines.	Section 2.1.1: Section has been updated to include information regarding both confidentiality and permission information on all collected Indigenous Knowledge, regardless of the source. This section also includes how information regarding the Indigenous Knowledge Sharing Agreements will be established by the Proponent and Indigenous community participating in the Program.	**Section 2.1.1** "…Sensitive and / or confidential information collected through Indigenous Knowledge Sharing Agreements will be protected from public or third-party disclosure and will be established between the Proponent and Indigenous communities participating in the Indigenous Knowledge Program prior to the sharing and use of any sensitive information. Instances where Indigenous Knowledge sharing has taken place during consultation activities (e.g., meetings) will be recorded in the Record of Consultation and Engagement, including where Indigenous Knowledge was incorporated into Project decisions and into the IS / EA Report (i.e., specifics will not be included in the Record of Consultation and Engagement given the potential sensitivity and / or confidentiality of the information shared)…"	As required in Section 6 of the Guidelines, describe the confidential information provided by each Indigenous group. Present the content in sufficient detail to support understanding of the potential effects and impacts on rights, while also protecting confidential/sensitive specifics and respecting stipulations in the confidentiality agreements (e.g, use buffer areas instead of specific locations, etc.). Provide to the Agency, in the form of a letter from the Indigenous group that shared confidential information, a letter confirming that: • the Indigenous group that provided confidential information is satisfied with the way the Impact Statement was informed; • the Indigenous group that provided confidential information is satisfied with the way the issue was solved or addressed.
GC-04	**Study plans spatial boundaries**	Describe the approach to be implemented to demonstrate how the definitions of the proposed study area boundaries: • encompass the anticipated boundaries of the Project's effects, including all potentially impacted local communities, municipalities and all Indigenous groups listed in the Indigenous Engagement and Partnership Plan; and • take into account community knowledge and Indigenous knowledge; current or traditional land and resource use by Indigenous groups; exercise of Aboriginal and Treaty rights of Indigenous peoples, including cultural and spiritual practices; physical, ecological, technical,	Section 6.2: General information on study areas for the Project, including a detailed list of what was considered to develop the discipline-specific local and region study areas, is included in each study plan. Each study area has been proposed taking into consideration community knowledge and Indigenous Knowledge, current or traditional land and resource use by Indigenous communities, and the exercise of Aboriginal and Treaty Rights of Indigenous peoples, including cultural and spiritual practices, physical, ecological, technical, social, health, economic and cultural considerations available at this time. The proposed discipline-specific study areas are preliminary. The proposed study areas will be consulted and engaged on early in the IA / EA process. In addition, the Indigenous Knowledge Program provides additional opportunities for community knowledge and Indigenous Knowledge, current or traditional land and resource use by Indigenous communities, and the exercise of Aboriginal and	**Section 6.2.1** **"**The preliminary LSA currently being considered within the scope of the ongoing provincial regulatory review process generally includes the area within 2.5 km of the centreline of Alternative 1 and Alternative 4"	As required in Section 7 of the Guidelines, demonstrate how a Local Study Area of approximately one kilometre from the centerline would be appropriate to assess effects on groundwater and geochemistry. It is unclear if the proposed groundwater survey locations are representative of drinking water sources used by Indigenous groups and whether Indigenous input was incorporated in the development of the proposed study methods/locations. As required in Section 7 of the Guidelines, provide details to demonstrate that the physiography, geology, terrain and soils and the groundwater and geochemistry Regional Study Areas encompass the anticipated boundaries of the Project's effects, including all potentially impacted local communities, municipalities and all Indigenous groups listed in the Indigenous Engagement and Partnership Plan. Note that the Regional Study Area must encompass the spatial boundary of cumulative effects. As required in Section 7.4.1 of the Guidelines, provide information regarding how the following were/will be taken into account in

General Comments from the Impact Assessment Agency of Canada on the Marten Falls Community Access Road Draft Study Plans – July 2, 2020					
#	**Tailored Impact Statement Guidelines Section[1]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Agency comments**
		social, health, economic and cultural considerations; and the size, nature and location of past, present and foreseeable future projects and activities.	Treaty Rights of Indigenous peoples to be shared in greater detail.		defining the spatial boundaries: community knowledge and Indigenous knowledge; current and traditional land and resource use by Indigenous groups; exercise of Aboriginal and Treaty rights, including cultural and spiritual practices; physical, ecological, technical, social, health, economic and cultural considerations; and the size, nature and location of past, present and reasonably foreseeable future projects and activities. Provide the above information in a way that allows those who provided the knowledge to the proponent and the Agency to see their input reflected in the Impact Statement. It is not sufficient to state that "input from participants will be/was taken into account".
GC-06		Provide further details in the study plans on how GBA+ has been integrated into all aspects of data collection methodology, as per Section 7.1 of the Guidelines, and into the assessment of effects and impacts, as mentioned in Sections 13, 20, 21, and others, related to effects assessments of the Guidelines	Section 4.3 has been updated to include the consideration of Identity and Gender-Based Analysis Plus (GBA+) including both Indigenous communities and their relevant subpopulations and non-Indigenous communities and their subpopulations. During consultation and engagement activities these groups (and any others defined during consultation) will be engaged with on targeted input.	**Section 4.3**	Describe how GBA+ has been or will be applied to the consideration of engagement activities. Identify specific methods targeted to specific subgroups. Provide detail on how GBA+ has been integrated into all aspects of data collection methodology, as per Section 7.1 of the Guidelines, and into the assessment of effects and impacts, as mentioned in Sections 13, 20, 21, and others, related to effects assessments of the Guidelines. It is not sufficient to mention that Gender-Based Analysis Plus will be applied to the assessment. Clear descriptions of how GBA+ was integrated (including to which variables, method, and how it influenced results' interpretation) are needed in the Impact Statement.
GC-07	**Section 13 - Effects Assessment (including 13.1, 13.2)**	Provide details to demonstrate how the Project's potential effects will be considered, as per the requirements in Sections 13 to 19 of the Guidelines. Ensure that the effects assessment considers the effects of each of the project components and physical activities, in all phases, and that it is based on a comparison to the proposed baseline work. Provide detail on how engagement with all Indigenous groups listed in the Indigenous Engagement and Partnership Plan and the public will inform the effects assessment and the selection of mitigation measures and follow-up program measures.	Project environmental interaction are separated into Project phases, and Project activities for each environmental discipline in their VC-specific study plan listed as Table 9-1. Information collected through the various activities (e.g., field studies and programs, effects assessments) of each discipline area (e.g., wildlife, vegetation, cultural heritage) will be shared with the Indigenous Knowledge Program leads. This will support the establishment of the existing environment and the effects assessment for the Aboriginal and Treaty Rights and Interests environmental discipline, as well as the identification of potential mitigation measures and monitoring programs.	**Throughout the study plan, Section 9**	As required in Sections 7 and 13 of the Guidelines, ensure that the effects assessment considers the effects of each of the project components (including but not limited to all alternative routes brought forward in the Impact Statement, all aggregates sources, access roads, etc.) and physical activities, in all phases, and that the assessment is based on a comparison to the data and information gathered during the proposed baseline work. Clarify the level of information that will be shared with, and explained to, the Indigenous Knowledge Program leads and whether study plans will be made available to all Indigenous groups listed in the Indigenous Engagement and Partnership Plan.
GC-09	**Section 19.2 - Impacts on the Exercise of Aboriginal and Treaty Rights**	Describe an approach for identifying the potentially impacted rights of Indigenous peoples of Canada that are recognized and affirmed by section 35 of the *Constitution Act, 1982*, and for integrating the potential impacts on those rights into the collection of	All study plans reference how potential effects on Indigenous rights will be assessed in the Aboriginal and Treaty Rights and Interests Study Plan. Impacts on Rights considerations are explained in the rationale for defining a Local Study Area and Regional Study Area for Aboriginal and Treaty Rights and Interests	**Section 5, and Section 6.2.2 in the Aboriginal and Treaty Rights and Interests Study Plan**	Feedback will be provided in the Federal Review Team's comments package on the Aboriginal and Treaty Rights and Interests Study Plan.

General Comments from the Impact Assessment Agency of Canada on the Marten Falls Community Access Road Draft Study Plans – July 2, 2020					
#	**Tailored Impact Statement Guidelines Section[1]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Agency comments**
		baseline information and the effects assessment.	VCs. Further information for this is listed in Section 6.2.2 in the Aboriginal and Treaty Rights and Interests Study Plan.		
GC-10	**Section 20 - Mitigation and enhancement measures**	Provide detail on the approach to meeting the requirements of Section 20 of the Guidelines regarding the identification of mitigation and enhancement measures.	Section 9: Approach to mitigation and enhancement measures, specifically noting that once potential effects have been identified, the effects assessment will explore technically and economically feasible mitigation measures to avoid or minimize the identified negative effects and enhancement measures to increase positive effects.	**Section 9.5** "Once potential effects have been identified, the effects assessment will explore technically and economically feasible mitigation measures to avoid or minimize the identified negative effects and enhancement measures to increase positive effects beyond those that are already inherent to the design"	Ensure that the Impact Statement provides a description of the method or approach followed to meet the requirements of Section 20 of the Guidelines.
GC-11	**Section 25 – Description of the Project's contribution to sustainability**	Provide detail on the approach to meeting the requirements of Section 25 of the Guidelines regarding the description of the Project's contribution to sustainability.	Section 9: the sustainability assessment for the Project will be undertaken on the preferred alternative and will characterize the Project's contribution to sustainability incorporating the requirements set out in Section 25 of the TISG.	**Section 9.7**	Ensure that the Impact Statement provides a description of the method or approach followed to meet the requirements of Section 25 of the Guidelines.

Response to Previous Comments from the Impact Assessment Agency of Canada on the Marten Falls Community Access draft Groundwater Study Plan – June 05, 2020						
#	**Draft Study Plan Section**	**Tailored Impact Statement Guidelines Section[2]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Federal Review Team comments on Response**
GW-01	**Table 3-1: Groundwater Study Areas** Local Study Area (LSA): 2.0 km Regional Study Area (RSA): 5.0 km Rationale: Potential effects (s) to groundwater are considered to be localized and limited to the alignment and area immediately surrounding the alignment within the zone of influence (ZOI) that may be affected by Project construction activities. **4.1 Desktop Assessment** "…The desktop review will focus on published information obtained from Marten Falls First Nation… The report will include detailed information on registered water well locations and depths (including borehole logs, if available) and a figure showing domestic and public water well locations within two kilometres of the Project works." **4.2.1 Study Area Reconnaissance & Determination of Key Groundwater Monitoring Locations** "The groundwater baseline study will include … • Areas within two kilometres of the developed Marten Falls First Nation communities, particularly with potential dewatering and other effects to existing structures, infrastructure and/or local well supplies; • Areas within close proximity (two kilometres) to other existing groundwater users (e.g. registered and unregistered water supply wells); **4.2.1.1 Water Well Locations** "…A door-to-door water well survey will be completed within	**Section 6** "…The proponent must engage with all Indigenous groups that may be impacted by the Project. The *Indigenous Engagement and Partnership Plan*, issued by the Agency, is available to assist the proponent in further developing or refining their engagement strategy and supporting ongoing trust and relationship-building. In addition to the requirements set out in section 6.1, 6.2 and 6.3, the proponent must provide Indigenous groups with an opportunity to: • provide Indigenous knowledge during baseline data collection; • comment on the list of valued components and indicators;…" **Section 7.4.1** "…Spatial boundaries are defined taking into account the appropriate scale and spatial extent of potential effects and impacts of the Project; community knowledge and Indigenous knowledge; current or traditional land and resource use by Indigenous groups; exercise of Aboriginal and Treaty rights of Indigenous peoples, including cultural and spiritual practices; and physical, ecological, technical, social, health, economic and cultural considerations…" **Section 8.6** "…The Impact Statement must:… • identify all springs and any other potable surface water resources within the local and regional project areas and describe their current use, potential for future use, and whether their consumption has Indigenous cultural importance;	Provide details to demonstrate the approach that will be used to identify all domestic, communal, or municipal water wells within the local and regional project areas as per the Guidelines. Clarify the inconsistency between the geographic extent of the Regional Study Area mentioned in the Desktop Assessment report and the geographic extent of the Regional Study Area shown in Table 3-1. Describe in the study plan how Indigenous groups will have opportunities to provide Indigenous knowledge on the groundwater study plan and validate the baseline data collected. All Indigenous groups listed in the IEPP must be provided opportunities to: • provide Indigenous knowledge during baseline data collection; • comment on the list of valued components and indicators; • inform the effects assessment and review its conclusions; and • inform the development of mitigation measures and follow-up programs.	Section 4 was updated to clarify that government agencies, first nation communities and any interested persons will have the opportunity to comment on components of the study plans throughout the IS / EA Report consultation and engagement process. The LSA was refined and edits to the text were made in Section 6.2. Revised text to include springs in Section 7.2.1.1 and Section 8.2.2. Any spring water samples will be samples for the same parameters and at the same frequency as groundwater. Sections 7.2.1.1 and 8.2.2 were updated to include water levels and hydrostratigraphic units. Section 7.1 and 7.2.1.1 outline the approach used to identify all domestic, communal, or municipal water wells / springs within the local and regional project area.	**Section 4** **Section 6.2** **Section 7.1** **Section 7.2.1.1** **Section 8.2.2**	This comment has been partially addressed. See also comments GC-01 and GC-02 above.

[2] Refer to complete sections of the Guidelines for more context

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	Marten Falls and any outpost camps within two kilometres of the proposed CAR, associated borrow source areas, associated roads and construction lay down areas to identify unregistered water supply wells and to verify the locations of registered wells."	• describe the surface water quality baseline characterization program, including sampling site selection, monitoring duration and frequency, sampling protocol, and analytical protocol, including quality assurance and quality control measures;… identify all domestic, communal, or municipal water wells within the local and regional project areas, including their screened hydrostratigraphic unit and piezometric level; describe their current use, potential for future use, and whether their consumption has any Indigenous cultural importance;…"				
GW-02	**Section 4.1 Desktop Assessment** The desktop assessment will include the following tasks: A review of previous studies pertaining to the Project or conducted within the RSA that may provide additional hydrogeological, geological, hydrological, geochemical or biological data relevant to the Project. A desktop review of available reports and other pertinent information from within the RSA, if any; **Section 7 Conformance with Federal and Provincial Guidance** "The desktop assessment and/or the baseline groundwater report will provide detailed descriptions of specific data sources and data collection methods associated with groundwater."	**Section 7.1** "…Ensure baseline data is representative of project site conditions. If surrogate data from reference sites are used rather than site-specific surveys, the proponent should demonstrate that the data are representative of project site conditions..." **Section 7.2** "…The Impact Statement must provide detailed descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental, health, social and economic condition that is described, in order to corroborate the validity and accuracy of the baseline information collected…. If using existing data sources, the Impact Statement must provide justification to show that the data sources are relevant in spatial and temporal coverage to the Project…"	Provide details to demonstrate that existing data sources are relevant in spatial and temporal coverage to the Project.	Revised text in Section 7.1. Site Specific baseline data will be collected. Surrogate data from other sites will not be used in place of site-specific baseline data for the Project area, but may be used to supplement site specific data if the data are from nearby sites within the region.	**Section 7.1.1**	This comment has been addressed.
GW-03	***5.2.2 Data Analysis and Reporting*** ***"***Upon completion of the two-year groundwater monitoring program, water quality and quantity data will be analyzed and the findings	**Section 9** "…To understand the community and Indigenous context and baseline health profile, the proponent must:…	Clarify whether any water wells that may be used as drinking water sources will be identified as drinking water sources in the baseline study and how water quality data will be	The drinking water sources (groundwater or surface water) will be identified during the desktop assessment and / or the field water well /spring surveys. Any water wells that have potential to provide drinking water will be treated as drinking water sources.	**Section 7.2.1.1** **Section 8.2.2**	This comment has been addressed.

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	will be presented in a hydrogeology baseline report… The hydrogeology baseline report will include:… • Plan maps showing: o The Project location and key features (i.e. the selected CAR, aggregate borrow source area, access roads, camp and laydown areas, the Marten Falls First Nation community and registered and unregister water wells); o Project study areas, encompassing the spatial boundaries of the Project, including any associated project components and the anticipated boundaries of the Project effects that may potentially effected local communities, municipalities and Indigenous groups; o Bedrock and surficial geology, including major structural features (e.g. faults); o Groundwater monitoring locations and inferred groundwater flow directions" • Groundwater quality results will be compared to applicable guidelines and standards for aquatic life and drinking water uses, including the Canadian drinking water quality guidelines, Ontario drinking water quality guidelines and the Ontario Groundwater Standards;"	• describe drinking water sources which may be effected by the Project, including surface and/or groundwater (permanent, seasonal, periodic or temporary), their distance from project activities and approximate wellhead capture zones;…" **Section 16.1** "…With respect to biophysical determinants of health, the Impact Statement must:… • identify predicted effects of the Project on the quality and quantity of ground or surface water used for domestic uses based on the most stringent guideline values of the following criteria; Canadian Drinking Water Quality Guidelines (CDWQG), Ontario Drinking Water Quality Standards (ODWQS), or Ontario Soil, Groundwater and Sediment Standards (SGSS);…"	used for the health effects assessment. Provide detail to demonstrate that the potable groundwater contaminant levels will be compared to the most stringent guideline values, as per Section 16.1 of the Guidelines.	Water quality results will be compared against all applicable criteria for all suitable uses (drinking water, aquatic life, wildlife, etc.). Exceedances from all criteria will be flagged in the baseline and future reports, which includes the most stringent criteria.		
GW-04	***5.2.2 Data Analysis and Reporting*** ***"***The hydrogeology baseline report will include: • ***Tables summarizing data such as:*** • Water well owners, water levels, reported yield and uses (domestic,	**Section 14.2** "…With respect to potential project effects on the physical hydrogeological system, the Impact Statement must: • provide a project-specific water use assessment identifying and describing the quantity and quality of water resources	Update the study plan to ensure that measured or inferred available drawdown with water well information are included, as required in Section 14.2 of the Guidelines.	Revised updated section 8.2.2 to specifically include "inferred available drawdown".		This comment has been addressed.

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	communal, municipal, commercial/industrial);"	potentially affected by the Project, including: o any withdrawal of groundwater or surface water; o changes to the groundwater recharge/discharge areas; o temporal and spatial changes in groundwater quantity, quality and flow (e.g., long-term changes in water levels), including how these changes may relate to domestic, communal or municipal water supply wells; o the flow or volume of water available in the water bodies; and how any waste waters or dewatering water would be managed and where it would be discharged..."				
GW-05	***6.2 Methods for Predicting Future Conditions*** ***"No modelling is proposed as part of the study plan for groundwater. There will be some analytical calculations and analysis software packages (e.g., AQTESOLV) required for the estimation of K values."***	**Section 14.2** "…With respect to potential project effects on the physical hydrogeological system, the Impact Statement must: • provide a project-specific water use assessment identifying and describing the quantity and quality of water resources potentially affected by the Project, including: o any withdrawal of groundwater or surface water; o changes to the groundwater recharge/discharge areas; o temporal and spatial changes in groundwater quantity, quality and flow (e.g., long-term changes in water levels), including how these changes may relate to domestic, communal or municipal water supply wells; o the flow or volume of water available in the water bodies; • how any waste waters or dewatering water would be	Provide details about the methods that will be used to quantify the magnitude of the effects to groundwater quantity in a manner that meets the requirements of the Guidelines.	Analytical calculations and analysis software packages (e.g., AQTESOLVE) will be utilized for the estimation of hydraulic conductivity (K) values. Numerical models will use field derived aquifer properties to estimate CAR construction related zones of influence / drawdown cones to assess for potential interference for ecological systems or drinking water sources. In addition, a water balance model approach will be utilized to evaluate the impact of groundwater extraction on valued ecosystem components (receptors). The need for a more comprehensive groundwater model will be elevated following completion of project design.		This comment has been addressed.

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		managed and where it would be discharged..."				
GW-06	***6.3 Magnitude of Effect*** **Table 6-2: Groundwater Quality Magnitude Definition** **"Negligible** Definition: There is little to no variation predicted in measurable parameters and is within the range of natural variation. Rationale: Monitoring wells show no discernable change to water quality, therefore no effect on ecological life or potable use. **Low** Definition: There is a small variation predicted in measurable parameters, that are outside the range of natural variation and below the applicable water quality criteria or within 20% of existing condition values**.** Rationale: Temporary effect or permanent change to water quality is discernable but remains protective of ecological life and potable water sources. **Medium** Definition: There is a modest variation predicted in measurable parameters, that is significantly different from existing conditions and is below the applicable water quality criteria or is between 20% to 50% of existing condition values. Rationale: Temporary effect or permanent change to water quality is significant but remains protective of ecological life and potable water sources. **High** Definition: There is a large variation predicted in measurable parameters, exceeds applicable water quality criteria, or is greater than 50% of existing condition values. Rationale: Temporary effect or permanent change to water	**Section 21** "…Proponents must describe the extent to which residual effects are adverse. Where relevant, or where best practice or evidence-based thresholds exist, effects should be described using criteria to quantify adverse effects. This includes criteria such as whether the effects are high or low in magnitude, the geographical extent, timing, frequency, duration and reversibility of the effects, taking into account any important contextual factors. Where the potential for human health effects exist due to exposure to a particular contaminant at any level (e.g., non-threshold air pollutants, including particulate matter and nitrogen dioxide, and water pollutants, such as but not limited to arsenic and lead) mitigation measures should aim to reduce the residual effects to as low as reasonably achievable. In addition, effects should be characterized using language most appropriate for the effect (for example, impacts on the exercise of Aboriginal and Treaty rights and social effects may be described differently from biophysical effects)…" "…The Impact Statement must: • characterize the residual effects using criteria most appropriate for the effect; • characterize residual effects for human health using human health-related criteria most appropriate for the carcinogenic and non-carcinogenic health effects of non-threshold contaminants;" • provide the rationale for the choice of criteria used to determine the extent to which the predicted effects are adverse. The information provided must be clear and sufficient to enable the Agency, review panel,	Update the study plan to include, in the definitions for magnitude, criteria that are relevant to the protection of human health. Describe the approach that will be used to ensure that these criteria are appropriate for the human health impact assessment.	The percentage division values for water quality and quantity were selected using professional judgement. Water quality and quantity undergo natural seasonal fluctuations, therefore it is extremely challenging to state whether changes are natural or Project induced at less than 20% change. Once baseline data are collected, we will have a better idea of the range of natural seasonal variation and can adjust the approach as needed. The CDWQG's do state concentrations for a few parameters (arsenic, lead, haloaceteic acids, and vinyl chloride) should be ALARA (as low as reasonably achievable). That being said, they still undergo natural seasonal variation and it is extremely challenging to state whether changes are natural or Project induced at less than 20% change.	**Table 9-4 Groundwater Quantity Magnitude Definition** **Table 9-5 Groundwater Quality Magnitude Definition**	This comment was not addressed. The magnitude of residual effects continues to be determined partly based on the percentage deviation (e.g., between 20% and 50%) from the baseline condition (Table 9-5, pdf p.58 and 59). These threshold values appear to be arbitrary and are not justified for use in the evaluation of non-threshold contaminants. In addition, it appears that if baseline levels are already above the water quality criteria, then the magnitude of residual effects will be determined based solely on variation from baseline conditions. An explanation is still not provided on how the proposed judgement criteria are developed or whether they are adequate to protect human health. Update the study plan to provide clarification on how the proposed definitions for the magnitude of residual effects criteria are relevant to the protection of the health of project-impacted groundwater consumers. Consider aligning the residual effects magnitude definitions for groundwater quality with those for surface water quality.

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	quality is discernable and can potentially impair ecological or potable uses of water."	technical and regulatory agencies, Indigenous groups, and the public to review the proponent's analysis of effects;…"				
GW-07	**Section 7 Conformance with Federal and Provincial Guidance** "…. will be included in future reporting (effects assessment), but will not be included as part of the baseline works."	**Section 14.2**	Provide more detail on the methodology of the effects assessment, and how the requirements described in Section 14.2 of the Guidelines will be met. Provide detail on how engagement with Indigenous groups and the public will inform the effects assessment, as well as the selection of mitigation and follow up program measures.	Additional wording added.	**Section 4** **Section 9**	This comment was partially addressed. See general comments GC-01, GC-02 and GC-07 above.

New comments based on the Groundwater and Geochemistry Study Plan submitted on June, 2021.				
#	**Study Plan Section**	**Tailored Impact Statement Guidelines Section**	**Context**	**Required Action for the Proponent**
GW-08	**Footnote 7, Section 9.2** "In February 2020 a regional assessment of the Ring of Fire region commenced; however, it is not sufficiently advanced at this time to inform the Project VCs. The VCs will be consulted and engaged on early in the IA/EA process and finalized taking into consideration the input received. Therefore, only information relevant to the Project that arises from the regional assessment of the Ring of Fire within an appropriate timeline will inform the VCs for the Project."	**Editorial comment**	The statement in the footnote 7 in Section 9.2 "*In February 2020 a regional assessment of the Ring of Fire region commenced; however, it is not sufficiently advanced at this time to inform the Project VCs."* is inaccurate, as the Regional Assessment in the Ring of Fire area has not yet begun.	Replace the text in footnote 7 with "*In February 2020, the Minister of Environment and Climate Change determined that a regional assessment will be conducted in an area centred on the Ring of Fire mineral deposits in northern Ontario. Relevant information available in relation to the Regional Assessment in the Ring of Fire area would be considered in the impact assessment of the Project."*
GW-09	**Section 10 Assumptions** "Existing condition values for groundwater quantity will be based on the seasonal range of groundwater levels collected three times per year (spring, summer and fall) over a period of two (2) years at all monitoring stations."		NRCan recommends that existing condition values for groundwater quantity be based on the seasonal range of groundwater levels collected **continuously at instrumented monitoring stations, and** three times per year (spring, summer and fall) at the **remaining** monitoring stations, over a period of two years.	

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GE-01	**Section 3: Spatial Boundaries: Study Areas** "The PSA encompasses the 100 m wide CAR right-of-way (ROW), temporary construction access roads, work areas, worker camps, and long-term aggregate sources and associated access roads. The LSA currently being considered within the scope of the ongoing regulatory review process generally includes the area within 2.5 km of the centreline of Alternative 1 and Alternative 4."	**Section 7.4.1** "…The Impact Statement must describe the spatial boundaries, including project, local and regional study areas, for each valued component included in assessing the potential adverse and positive environmental, health, social and economic effects of the Project and provide a rationale for each boundary… For valued components establish three study area spatial boundaries to assess impacts to each valued component: Project Study Area: defined as the project footprint for each alternative route; …"	Update the study plan to clarify the spatial boundaries of the study areas, in particular of the Project Study Area, for all route alternatives under consideration. Update the study plan to provide a map showing the study areas for all route alternatives under consideration.	A map of the study areas in included.	Table 6-Section 6.2	This comment has been addressed.
GE-02	**Figure 3-1**	**Editorial**	Update the legend of the map provided in Figure 3-1 to indicate what all various coloured areas represent. Several colors used in the map are not featured in the legend.	The study area plan map is updated.	Figure 6-2 Section 6.2	This comment has been addressed. However, the original Figure 3-1 also showed auger and borehole sampling locations taken to date. This information has been removed in Figure 6-2 in the revised study plan. Ensure that maps that identify all sampling locations used for each field study are provided to the Federal Review Team for validation in the study plans or in the work plans in advance of conducting field studies.
GE-03	**Section 4: Baseline Study Design** "This study plan focuses on the additional studies that are anticipated to be required to gather information beyond what is currently available through existing information sources, including those as described in Section 7.2 'Sources of baseline information' in IAAC's Tailored Impact Statement (TISG) for this Project"	**Section 8.4** "…The Impact Statement must: … - describe the geomorphology, topography and geotechnical characteristics of areas proposed for construction of major project components, including the presence and distribution of eskers and permafrost, if applicable; … - provide maps depicting soil depth by horizon and soil order within the project site area to support soil salvage and reclamation efforts, and to outline potential for soil erosion; … - describe the historical land use and the potential for contamination of soils and sediments and describe any known or suspected soil contamination with the study area that could be re-suspended, released or otherwise disturbed as a result of the Project; and - identify ecosystems that are sensitive or vulnerable to acidification resulting from the deposition of atmospheric contaminants; …	Update the study plan to provide information to demonstrate the proposed approaches and methods to be used to meet the requirements of Section 8.4 of the Guidelines.	The Study Plan is updated to include the relevant requirements of Section 8.4 of the Guidelines.	Section 7.1 Section 8.1	This comment was partially addressed. While more information was provided in the revised study plan, the following aspects of Section 8.4 of the Guidelines still appear to be missing: - describe the historical land use and the potential for contamination of soils and sediments and describe any known or suspected soil contamination with the study area that could be re-suspended, released or otherwise disturbed as a result of the Project; - identify ecosystems that are sensitive or vulnerable to acidification resulting from the deposition of atmospheric contaminants - describe permafrost conditions including distribution of frozen and unfrozen ground, if applicable; and describe the potential for thaw settlement and terrain instability associated with ground thawing in permafrost areas, if applicable." Ensure that the Impact Statement includes the information required by Section 8.4 of the Guidelines.

[3] Refer to complete sections of the Guidelines for more context

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		- provide written description and maps of the current location of eskers and other post-glacial deposits on a map; - describe permafrost conditions including distribution of frozen and unfrozen ground, if applicable; and - describe the potential for thaw settlement and terrain instability associated with ground thawing in permafrost areas, if applicable…"				
GE-04	**Section 4.1: Desktop Assessment** "Due to the large Project area, the study will be largely based on previous investigations and published existing data / information in the area." **Section 7: Conformance with Federal and Provincial Guidance** "The summary report will provide detailed descriptions of specific data sources and data collection methods associated with physiology, geology, geochemistry, terrain and soils."	**Section 7.1** "…Ensure baseline data is representative of project site conditions. If surrogate data from reference sites are used rather than site-specific surveys, the proponent should demonstrate that the data are representative of project site conditions…" **Section 7.2** "…The Impact Statement must provide detailed descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental, health, social and economic condition that is described, in order to corroborate the validity and accuracy of the baseline information collected..."	Demonstrate that the reports are representative of all of the terrain units and settings encountered by the Project. Provide details about the published existing data and information that will be used to characterize the baseline conditions, as required in Section 7.2 of the Guidelines. If surrogate data sources from reference sites are used rather than site-specific surveys, provide detail to demonstrate that the data are representative of project site conditions and clarify how potential gaps in the spatial coverage of the data will be addressed. Ensure that a clear map showing all proposed route alternatives, along with the borehole and auger data used for each alternative, is provided in the Impact Statement. Ensure that in composite the existing and new data meet the requirements of the Guidelines.	The Study Plan is updated to indicate if any surrogate data are referenced, justification for utilizing these data (i.e., spatial and temporal relevance with respect to the Project RSA), detailed descriptions, and specific data sources will be provided in the baseline report. Note that site-specific data will also be collected, as described below. The Project will not be solely relying on surrogate data from reference sites. The map showing the proposed routes is included (Figure 6-2).	Section 7.1 Figure 6-2	This comment was addressed.
GE-05	**Section 4.3.1: Geochemistry (ML/ARD)** "We have assumed that half of the samples will be collected at surface (bedrock outcrop hand samples) and the remainder will be collected from geotechnical drill core. The depth of the drill core samples will be shallower than the proposed depths of quarry / blasting operations to make certain that samples are representative of blast / fill material"	**Section 3.2.2.** "…The Impact Statement must describe the anticipated activities during the operation phase of the Project, including: … - characterization and management of borrow material, including overburden, and aggregate (storage, handling and transport of the volumes generated, mineralogical characterization, potential for metal leaching and acid rock drainage);…" **Section 8.3**	Provide details to demonstrate that the samples collected at each location will be compositionally and spatially representative of material to be disturbed.	The Study Plan is updated to describe that approximately 25% of the samples will be collected near surface (<0.4 m below grade) and bedrock outcrop hand samples. Care will be taken to collect fresh outcrop samples and not exposed/weathered bedrock samples. The remainder of the samples will be collected from geotechnical drill core. The depth of the drill core	Section 7.4.2	This comment was addressed.

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		"…The Impact Statement must: … provide a characterization of the geochemical composition of all expected construction materials (i.e., eskers, quarries, etc.), in order to predict metal leaching and acid rock drainage including oxidation of primary sulphides and secondary soluble sulphate minerals..."		samples will be shallower than the proposed depths of quarry / blasting operations to make certain that samples are representative of blast / fill material.		
GE-06	**Section 4.3.1: Geochemistry (ML/ARD)** "Mineralogy and Rietveld X-ray Diffraction: To determine the mineralogical composition of the rock samples."	**Section 8.3** "…The Impact Statement must: … - provide a characterization of the geochemical composition of all expected construction materials (i.e., eskers, quarries, etc.), in order to predict metal leaching and acid rock drainage including oxidation of primary sulphides and secondary soluble sulphate minerals..." **Section 14.2** "…If the proponent undertakes quarrying activities to extract aggregate material that may results in effects on groundwater and surface water levels (i.e., quarrying below the water table), the Impact Statement must: … describe the methods used to predict acid rock drainage and/or metal leaching for construction materials, including sample collection and laboratory testing;…"	Revise the study plan to provide details to demonstrate that using QEMSCAN rather than Rietveld XRD will be considered, as it has a much lower detection limit for sulphide minerals.	Based on the level of this study at this time, XRD is considered sufficient and will allow for more samples to be collected due to the relative cost per analysis (~$250 for XRD and ~$1000 for QEMSCAN). In the future, we can use QEMSCAN for targeted locations as specified/requested by the professional geochemist. No changes to the text were made.	N/A	Natural Resources Canada has indicated that the costs for QEMSCAN have dropped significantly and should be comparable to XRD, should the proponent wish to explore this methodology further.
GE-07	**4.3.2 Soil Sampling** (…) Soil samples will be submitted for analysis of the following parameters: • Total metals (including mercury, arsenic and chromium); • Alkalinity; • pH; • Total organic carbon; • Anions (chloride, bromide, fluoride and sulphate); • Nutrients (nitrate, nitrite); • Volatile organic compounds (VOCs); • Poly-aromatic hydrocarbons (PAHs); and/or • Radionuclide parameters. **Table 6.1: Physiography, Geology, Geochemistry, Terrain, and Soils indicators** Indicator: Physiography, Terrain and Soils	**Section 9** "…The proponent should refer to Health Canada guidance documents such that best practices are followed in the collection of baseline information to assess real and perceived project-related impacts to human health due to changes in air quality, noise, drinking and recreational water quality, country foods and/or multiple pathways of exposure to contaminants. The proponent should provide a detailed rationale/explanation for any deviation from recommended baseline characterization approaches and methods, including from Health Canada's guidance, or when determining such characterization is not warranted." **Section 16.1** "…With respect to biophysical determinants of health, the Impact Statement must: … - describe and quantify the health risk from exposure to COPCs (e.g., arsenic, chromium, mercury) via consumption of country foods and differential risk for vulnerable subgroups; …	Provide details to demonstrate the methods used to screen the proposed COPCs into the soil quality assessment and to explain the rationale for the proposed methods. Describe interconnections and clarify how predicted changes in soil contaminant levels will be incorporated in the exposure pathway analysis for the human health effect assessment proposed in the human health and community safety study plan. Consult Section 7 of Health Canada's Guidance for Evaluating Human Health Impacts in Environmental Assessment: Human Health Risk Assessment.	As Project emissions of concern will be determined primarily based on the outcomes of the Air Quality Study, it is not possible at this time to screen soils for COPCs. If Air Quality Study outcomes suggest a potential for significant deposition of air emissions of concern onto local soils, then the soil contact pathway will be considered for evaluation in a HHRA. This may necessitate a need for a surface soil survey in the areas predicted to receive the greatest potential deposition of air emissions, to generate baseline soil concentrations of the emissions of concern. Soil data may not be used at all in an assessment of country food consumption, should that exposure pathway be deemed necessary to assess in a	Section 7.3.3 provides rational for the list of soil parameters that will be analyzed for during the baseline studies.	This comment was partially addressed. It is unclear how 'significance' of air contaminants deposition onto soils will be determined in the Air Quality study, how areas expected to receive the greatest potential of deposition of air emissions will be determined and how baseline soil samples will be taken. Include in the Impact Statement additional information to clarify which criteria will be used to assess significance of air contaminants deposition onto soils as a pre-requisite for a human health risk assessment.

Federal Review Team comments on the Marten Falls Community Access Road Project Draft Physiography, Geology, Geochemistry, Terrain and Soils Environment Study Plan Study Plan – September 18, 2020						
#	**Draft Study Plan Section**	**Tailored Impact Statement Guidelines Section[3]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Federal Review Team comments on Response**
	Expression of Change: Degradation of physical or chemical characteristics of permafrost, terrain or topography (e.g., natural hazards) and soils. Rationale for selection: Important for geotechnical stability of civil infrastructure (e.g., roads), protection of human health, and protection of aquatic and terrestrial habitat associated with natural hazards (e.g., slope failures).	if a Human Health Risk Assessment is required, the assessment must identify all potential contaminant exposure pathways for contaminants of concern to adequately characterize potential biophysical risks to human health. A multimedia Human Health Risk Assessment may need to be considered and conducted for any contaminant of potential concern with an identified risk and multiple pathways;…"		HHRA. Ideally, country food item tissue data would provide the concentrations of COPCs in the harvested food items of interest. Soil data are only relevant towards estimating COPC levels in country food items if the foods are harvested from the same locations that are expected to incur soil impacts due to air emissions, and are only relevant for food items that are in direct contact with soil (such as plants, berries). Soil data are typically irrelevant to any assessment of fish or game animal country food items (due to reasons such as animal home ranges and foraging behaviours, locations where harvesting occurs relative to areas where soil impacts are predicted). The noted HC guidance will be consulted should there be a need to assess human exposure pathways related to soil and/or country foods.		
GE-08	**Section 4.3.2: Soil Sampling** "As part of the ML/ARD sampling program, a single soil sampling event will be conducted to collect baseline soil quality data from proposed borrow source areas and disturbed areas…. For the purposes of this study, it is assumed that two samples from 30 individual locations (60 samples total) will be sufficient to assess baseline soil conditions within the Project disturbance footprint, but outside the CAR ROW. Samples will typically be collected on the downgradient side of the ROW within the upper 1 m using a shovel or hand auger"	**Section 4.4** "…The determination of alternative means must be conducted in accordance with the Impact Assessment Agency of Canada's policy and guidance documents[4]…" **Section 8.4** "…The Impact Statement must: describe the landforms, soils and sediments within the local and regional project areas, including sediment stratigraphy; surficial geology maps and cross-sections of appropriate scale;…"	Provide details to demonstrate that landforms, soils and sediments within both the local and regional study areas, including sediment stratigraphy; surficial geology maps and cross-sections of appropriate scale, will be described in the Impact Statement. Provide details to demonstrate that a description of the 60 (total) samples planned to be collected (i.e. type of material such as clay, silt, sand, etc.) will be included in the Impact Statement. Ensure that all route alternatives under consideration, as well as	The baseline studies will provide details on landforms (e.g., eskers), soils and sediments within both the local and regional study areas. Surficial geology maps will be field-truthed at sampling locations. Cross-sections will not be completed at the baseline stage, but will be included at key locations in future reporting (e.g., Impact Statement). For the purposes of this study, it is assumed that two samples from 30 individual locations (60 samples total)	Section 7.4.3 Section 8.1	This comment was partially addressed. Ensure that all route alternatives under consideration, as well as the location of all other project components, particularly the aggregates sources (short-term and long-term), are determined prior to the baseline data collection and are scoped in the study plan. If a preferred alternative has not been identified before baseline studies start, then baseline data collection must be carried out for all route alternatives under consideration.

[4] https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/guidance-need-for-purpose-of-alternatives-to-and-alternative-means.html

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			the location of all other project components, particularly the aggregates sources (short-term and long-term), are determined prior to the baseline data collection and are scoped in the study plan. If a preferred alternative has not been identified before baseline studies start, then baseline data collection must be carried out for all route alternatives under consideration. Update the study plan to provide a map with the proposed location of the 30 sampling sites for the baseline data collection. Provide sufficient detail to demonstrate how the 30 locations represent all alternative project components.	will be sufficient to assess baseline soil conditions within the Project disturbance footprint, but outside the CAR ROW. Multiple samples will be collected from each lithology at spatially separated locations to allow for a more robust and representative dataset. Samples will typically be collected on the downgradient side of the ROW within the upper 1 m using a shovel or hand auger. If multiple landforms / surface soils are present at any station, additional soil samples will be collected to ensure multiple samples of each soil type are collected. The scope and budget of the analytical program will be refined following completions of the desktop study. Prior to field work, a plan map showing the regionally mapped surficial geology units and the proposed sampling locations will be created to ensure that samples are collected from all surficial geological units.		
GE-09	**Section 4.3.2: Soil Sampling** “samples will be submitted for analysis of the following parameters: Total metals (including mercury, arsenic and chromium); Alkalinity; pH; Total organic carbon; Anions (chloride, bromide, fluoride and sulphate); Nutrients (nitrate, nitrite); Volatile organic compounds (VOCs); • Poly-aromatic hydrocarbons (PAHs); and/or Radionuclide parameters. The above suite of analytical parameters will be used to establish baseline soil quality and identify contaminants of potential concern associated with Project work, including placement of fill material	**Section 8.4** “The Impact Statement must: … describe the suitability of topsoil and overburden for use in the reclamation of disturbed areas including an assessment of the acid generating potential of overburden to be used;…”	Update the study plan to describe considerations to using the same ABA test methods proposed in Section 4.3.1 of the study plan as part of the assessment of the acid generating potential of the soil and overburden.	Soil sampling proposed for geochemical testing to support the development of a geochemical characterization of soil and overburden is discussed in the Groundwater and Geochemistry Study Plan. These samples will be focused on proposed quarry and pit areas. The soil samples collected as part of Section 7.4.3 in this Study Plan are intended to characterize generic soil quality and will be spatially distributed across the proposed CAR. Locations will not be focused on proposed quarry / pit areas. However,	Section 7.4.2 Section 7.4.3	This comment was addressed.

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	(general parameters, anions, metals and radionuclides), blasting residual (nutrients), acid rock drainage and buffering capabilities (metals and alkalinity), metal leaching (metals and general parameters), hydrocarbons and solvents (VOCs and PAHs) and permeant infrastructure, such as bridges, piles and culverts (metals). Radionuclide parameters will only be collected once from each area."			there will be some areas where soil sampling for both generic and geochemistry analysis will be conducted.		
GE-10	**Section 6: Effects Assessment Scoping**	**Section 14.3** "…The Impact Statement must: … - describe any changes to permafrost conditions as a result of the Project; - describe any changes to eskers and similar geological features as a result of the Project; - describe any contaminants of concern (e.g., arsenic, chromium, mercury) potentially associated with the Project (including from spills or accidental discharges) that may affect soil, sediment, wetlands, and surface and ground water (including substances used during summer and winter maintenance activities); … - describe the historical land use and the potential for contamination of soils and sediments and potential for loss of soil fertility. Describe any known or suspected soil contamination within the study area that could be re-suspended, released or otherwise disturbed as a result of the Project; …"	Provide detail in the study plan to describe the approaches and methods to be used to meet the requirements identified in Section 14.3 of the Guidelines.	Available high-resolution imagery and regional surficial geological, terrain polygon, permafrost maps will be searched for and reviewed as part of the desktop study and ground-truthed during the field program (during soil and rock sampling). A review of the provincially known / registered contaminated sites database will be conducted to determine proximal contaminated sites with potential pre-existing soil quality issues. The baseline report will include the descriptions of the findings and present the location of key geological features and known contaminated sites.	Section 7.1 Section 8.1	This comment was partially addressed. The revised Physiography, Geology, Terrain and Soils Study Plan provides a description of the contaminants of concerns potentially associated with the Project. However, changes to permafrost conditions (aside from its general degradation), and changes to eskers as a result of the Project are not described. Furthermore, the revised study plan does not describe how historical land use and its potential for contamination of soil will be studied/determined. Ensure that the Impact Statement includes the information required by Section 14.3 of the Guidelines**.**
GE-11	**Section 6.1: Indicators and Expression of Change** **Table 6-1 Physiography, Geology, Geochemistry, Terrain and Soils Indictors** [Indicator – Physiography, Terrain and Soils] "Expression of Change Degradation of physical or chemical characteristics of permafrost, terrain or topography (e.g., natural hazards) and soils. Rationale for Selection	**Section 8.3** "…The Impact Statement must: … • identify any geological hazards that exist in the areas planned for the project facilities and infrastructure, including: o history of seismic activity in the area, including induced earthquakes, and secondary effects such as the risk of, landslides and liquefaction; o evidence of active faults; o isostatic rise or subsidence; and o history of landslides, slope erosion and the potential for ground and rock instability/landslides, and subsidence during and following project	Revise the study plan to provide details to demonstrate that all requirements in Section 8.3 of the Guidelines related to the identification of geological hazards will be met. Provide details to demonstrate how areas of ground instability will be identified, as required in Section 8.4 of the Guidelines.	As part of the desktop study, an online search for information regarding the earthquake and natural disaster history for the Project area will be conducted. This information will be used to identify potential geological hazards that exist in the areas planned for the Project facilities and infrastructure. Added a field study section (Section 7.4.4) the outlines the steps taken if any	Section 7.1 Section 7.4.4	This comment was addressed.

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	Important for geotechnical stability of civil infrastructure (e.g., roads), protection of human health, and protection of aquatic and terrestrial habitat associated with natural hazards (e.g., slope failures)."	activities..." **Section 8.4** "…The Impact Statement must: … identify any areas of ground instability; …"		geological hazards are identified during the desktop assessment. In summary, the areas will be flagged to the Geotechnical and Project design teams so additional assessment and field truthing can be conducted, as required, based on the professional judgement of the geotechnical team. Any field study's will be completed under other disciplines (e.g., geotechnical). The Project design team will use this information when selecting and designing the preferred CAR alignment with the overall goal of minimizing road alignment through areas with known or suspect geological hazards.		
GE-12	**Section 6.3: Magnitude of Effect Table 6-3 Geochemistry Magnitude Definition** **"**Laboratory testing indicates that all rock types disturbed by the Project is non-ML, where non-ML is defined as: Predicted water quality results (dissolved metals) do not exceed applicable water quality standards or are similar to proximal baseline surface water quality results."	**Section 8.3** "…The Impact Statement must: describe the bedrock geology and lithological units, including a summary table of geologic descriptions, mineralization styles (if applicable) supported by geological maps and cross-sections at appropriate scale (normally 1:50 000). Provide in the table an inferred risk rating (i.e., low, medium, high) for acid rock drainage and metal leaching potential based on the desk-top review of bedrock geology and mineralization;…"	Update the study plan to clarify what is meant by "predicted water quality results". Provide details to demonstrate how the requirement in Section 8.3 of the Guidelines related to inferred risk rating for ARD and ML will be met.	Baseline geochemistry has been moved to the Groundwater and Geochemistry Study Plan. The Groundwater and Geochemistry Study Plan is updated to change the wording to shake flask extraction. We agree that caution should be used when comparing laboratory shake flask extraction results with water quality standards. However, future studies will consider geochemical modelling, laboratory kinetic testing and field-scale testing to mimic site conditions.	Section 7.4.2 of the Groundwater and Geochemistry Study Plan	This comment was addressed.
GE-13	**Section 6.3 Magnitude of Effect** "The residual effects will therefore be described in terms of the magnitude, geographic extent, timing, duration, frequency, social and ecological context, likelihood, and whether effects are reversible or irreversible. For magnitude, VC-specific definitions are required and are proposed below in Table 6-2 for Physiography, Geology, Geochemistry, Terrain and Soils. Tables 6-3 and 6-4 provide details	**Section 14.2** …"If the proponent undertakes quarrying activities to extract aggregate material that may results in effects on groundwater and surface water levels (i.e., quarrying below the water table), the Impact Statement must: … • With respect to potential effects on water quality resulting from acid rock drainage and/or metal leaching, the Impact Statement must: provide estimates of the potential for aggregate extraction	Update the study plan to provide details to demonstrate that the geochemical characterization program summary report will identify if an ARD/ML monitoring and mitigation plan will be proposed, and if so, will provide a description of its scope and a timeline for its development and appropriate implementation.	Geochemistry has been moved to the Groundwater and Geochemistry Study Plan. The Groundwater and Geochemistry Study Plan has been updated accordingly.	Section 7.4.2 of the Groundwater and Geochemistry Study Plan	This comment was addressed.

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#	**Draft Study Plan Section**	**Tailored Impact Statement Guidelines Section[3]**	**Required Action for Proponent**	**Proponent Response**	**Final Study Plan Section Reference**	**Federal Review Team comments on Response**
	of the definitions of geochemistry magnitude and soils magnitude, respectively.“	activities (i.e., eskers and quarries) and rock exposed in permanent rock cuts to be sources of acid rock drainage or metal leaching; … • provide an acid rock drainage assessment and mitigation plan that describes the confirmatory monitoring of construction materials and potential mitigation strategies to prevent or control acid rock drainage and metal leaching during construction, operation, decommissioning and abandonment; and describe contingency plans, monitoring during operation, decommissioning and abandonment, and maintenance plans…”				
GE-14	**Table 6-4: Soils Magnitude Definition** **Negligible** “Definition: There is little to no variation predicted in soil concentrations which remain within the range of natural variability. Rationale: Soil quality shows no discernable change, therefore no effect on ecological life or human health (e.g., potable water use, physical contact). **Low** Definition: There is a small variation predicted in soil concentrations that is less than double current concentrations, but concentrations remain below applicable soil quality criteria. Rationale: Temporary effect or permanent change to soil quality is minor and remains protective of ecological life and human health. **Medium** Definition: There is a moderate variation predicted in soil concentrations that is less than five (5) times current concentrations, but concentrations are below the	**Section 21** “…Proponents must describe the extent to which residual effects are adverse. Where relevant, or where best practice or evidence-based thresholds exist, effects should be described using criteria to quantify adverse effects. This includes criteria such as whether the effects are high or low in magnitude, the geographical extent, timing, frequency, duration and reversibility of the effects, taking into account any important contextual factors. Where the potential for human health effects exist due to exposure to a particular contaminant at any level (e.g., non-threshold air pollutants, including particulate matter and nitrogen dioxide, and water pollutants, such as but not limited to arsenic and lead) mitigation measures should aim to reduce the residual effects to as low as reasonably achievable... The Impact Statement must: • characterize the residual effects using criteria most appropriate for the effect; • characterize residual effects for human health using human health-related criteria most appropriate for the carcinogenic and non-carcinogenic health effects of non-threshold contaminants;…	Update the study plan to include in the definitions for magnitude criteria that are relevant to the protection of human health. Describe the approach that will be used to ensure that these criteria are appropriate for the human health impact assessment. Health Canada encourages the proponent to use all available technologies to reduce their emissions as low as reasonably achievable (ALARA) and beyond those required to achieve applicable thresholds (i.e., Canadian Council of Ministers of the Environment’s (CCME[5]) Soil Quality Guidelines for the Protection of Environmental and Human Health and Ontario Soil, Groundwater and Sediment Standards[6]) in order to reduce the burden of soil and sediment pollution.	The Study Plan is updated.	Table 9-5 Table 9-6 Section 9.6	This comment was not addressed. The definitions for the magnitude of residual effects criteria remain unchanged (Table 9-5), despite the new statement that “professional judgement and / or risk assessment may be required to assess impacts where no provincial or federal soil standard exists or when non-threshold parameters such as arsenic, chromium and lead are involved”. The chosen thresholds of increase above baseline conditions still appear arbitrary and no evidence is provided to support the rationale that the definitions are relevant to the protection of human health. Update the study plan to clarify how the thresholds of increase from baseline conditions were derived for residual effects magnitude criteria definitions, and how they are relevant to the protection of human health. Health Canada recommends the use of all available technologies to reduce their emissions as low as reasonably achievable (ALARA) and beyond those required to achieve applicable thresholds (i.e., Canadian Council of Ministers of the Environment’s (CCME[7]) Soil Quality Guidelines for the Protection of Environmental and Human Health and Ontario Soil, Groundwater and Sediment Standards[8]) in order to reduce the burden of soil and sediment pollution.

[5] CCME, 2014. Soil Quality Guidelines for the Protection of Environmental and Human Health. Available at : http://st-ts.ccme.ca/en/index.html?chems=all&chapters=4&pdf=1
[6] Ontario Soil, Groundwater and Sediment Standards. Available at: https://www.ontario.ca/page/soil-ground-water-and-sediment-standards-use-under-part-xv1-environmental-protection-act.

[7] CCME, 2014. Soil Quality Guidelines for the Protection of Environmental and Human Health. Available at : http://st-ts.ccme.ca/en/index.html?chems=all&chapters=4&pdf=1
[8] Ontario Soil, Groundwater and Sediment Standards. Available at: https://www.ontario.ca/page/soil-ground-water-and-sediment-standards-use-under-part-xv1-environmental-protection-act.

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	applicable soil quality criteria **or** less than 10 times current concentrations. Rationale: Temporary effect or permanent change to soil quality is moderate but remains protective of ecological life and human health. **High** Definition: There is a large variation predicted in measurable parameters, concentrations exceed applicable soil quality criteria and are greater than 10 times current concentrations. Rationale: Temporary effect or permanent change to soil quality can potentially impair ecological life or human health." **Table 6-3: Geochemistry Magnitude Definition** "(…) Minor incremental effects to surface water, groundwater and/or drinking water quality are anticipated to be discernable, but water quality remains protective of ecological life and human health for all time periods and life stages."	provide the rationale for the choice of criteria used to determine the extent to which the predicted effects are adverse. The information provided must be clear and sufficient to enable the Agency, review panel, technical and regulatory agencies, Indigenous groups, and the public to review the proponent's analysis of effects;…"				

New comments based on the Physiography, Geology, Terrain and Soils Study Plan submitted in June, 2021.				
#	**Study Plan Section**	**Tailored Impact Statement Guidelines Section**	**Context**	**Required Action for the Proponent**
GE-15	**Section 7.2 Summary of Previous Field Studies** **“**In 2019, KGS completed a preliminary geotechnical investigation along Alternatives 1 and 4. The field investigations were focused on geological features which could be potential pits and quarries along the CAR.”	**Section 3** “…The Impact Statement must describe all project components including but not limited to: • borrow pits, gravel or aggregate pits and quarries (footprint, geographic location, ownership, and development plans including pit phases and lifespan), including their location in relation to upland habitats and the presence of rare, limited and/or significant habitat (e.g., federal, provincial, or Indigenous protected and conserved areas, ANSIs (Areas of Natural and Scientific Interest), Ramsar sites, critical habitat identified under the Species at Risk Act, etc.; • waste rock, overburden, topsoil, gravel and rock storage and stock piles (footprint, locations, volumes, development plans and design criteria); • aggregate extraction and production (crushing/screening) facilities (footprint, technology, location)…” **Section 7.2** “…The Impact Statement must provide detailed descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental, health, social and economic condition that is described, in order to corroborate the validity and accuracy of the baseline information collected…”	Potential location and description of project components, including but not limited to borrow pits, gravel or aggregate pits, quarries and access roads is not provided in the study plan.	Update the study plan or the work plan to provide a map of the 2019 KGS sampling location and identify “the geological features which could be potential pits and quarries along the CAR”. See general comment GC-07 above. Update the study plan to provide detail on how engagement with all Indigenous groups listed in the Indigenous Engagement and Partnership Plan and the public will inform the effects assessment and the selection of the location of project components, including but not limited to road alternative, borrow pits, gravel or aggregate pits, quarries, camps and access roads.
GE-16	**Section 7.4.2 Soil Quality Sampling** “Prior to field work, a plan map showing the regionally mapped surficial geology units and the proposed sampling locations will be created to help ensure that samples are collected from all surficial geological units and proposed key areas, such as quarries and camps.”	**Section 7.2** “…The Impact Statement must provide detailed descriptions of specific data sources, data collection, sampling, survey and research protocols and methods followed for each baseline environmental, health, social and economic condition that is described, in order to corroborate the validity and accuracy of the baseline information collected…”	Similar to comment GE-15, the potential locations of “proposed key areas, such as quarries and camps” is not clearly presented in the study plan and the map provided in the Physiography, Terrain and Soils and Vegetation and Peatlands Field Logistics Work Plan does not identify proposed key areas.	Prior to field work, share with the Federal Review Team the map with the proposed sampling locations and proposed key areas, such as quarries and camps.
GE-17	**Section 9.2 Valued Components and Indicators** **Table 9-2: Physiography, Terrain and Soils Indicators**	**Section 7.1** “…The information describing the existing baseline conditions may be provided as a stand-alone chapter in the Impact Statement or integrated into clearly defined sections for relevant valued components, including effects assessment of each valued component and valued component interactions, identification of mitigation measures, residual effects analysis and cumulative effects assessment...” **Section 8.4** **(**entire section)	Table 9-2: Physiography, Terrain and Soils Indicators in Section 9.2 of the Study Plan only includes one valued component with one indicator to cover all requirements of Section 8.4 of the Guidelines. It unclear how all the requirements of Section 8.4 of the Guidelines will be met. Section 8.4 of the Guidelines requires the determination of the presence and distribution of eskers, however, eskers are not mentioned as valued components and no indicator is proposed for the assessment.	Update the study plan to include appropriate valued components and indicators to meet all requirements of Section 8.4 of the Guidelines, including but not limited to the distribution of eskers within the Local Study Area.
GE-18	**Section 9.4 Methods for Predicting Future Conditions** “Modelling is a common approach to predicting future conditions for many disciplines / components of an IA / EA. However, modelling		Section 9.4 of the Physiography, Terrain and Soils Study Plan states that “Modelling is a common approach to predicting future conditions for many disciplines / components of an IA / EA. However, modelling is not	Update the study plan to clarify how future conditions will be predicted to assess potential effects of the Project on Physiography, Geology, Terrain and Soils.

New comments based on the Physiography, Geology, Terrain and Soils Study Plan submitted in June, 2021.				
#	**Study Plan Section**	**Tailored Impact Statement Guidelines Section**	**Context**	**Required Action for the Proponent**
	is not planned for the Physiography, Terrain and Soils baseline report or effects assessment."		planned for the Physiography, Geology, Terrain and Soils baseline report or effects assessment" and does not provide any further information.	
GE-19	**Section 7.4.2: Soil Quality Sampling** "Soil samples will be submitted for analysis of the following parameters: • Total metals, including: − Aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorus, potassium, selenium, silicon, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium and zinc − Mercury and methylmercury • Alkalinity; • pH; • Total organic carbon; • Anions (chloride, bromide, fluoride and sulphate); • Nutrients (nitrate, nitrite); • Volatile organic compounds (VOCs); • Poly-aromatic hydrocarbons (PAHs); and / or • Radionuclide parameters."	**Section 8.4** "…The Impact Statement must describe the historical land use and the potential for contamination of soils and sediments and describe any known or suspected soil contamination with the study area that could be re-suspended, released or otherwise disturbed as a result of the Project…"	The study plan indicates that as part of the sampling program, baseline soil quality data will be collected from proposed pit and quarry areas and disturbed areas along the CAR. Sampling locations will be focused on landforms of interest and areas undergoing terrain investigations, including areas near watercourses. Soil samples will be submitted for analysis of the parameters listed in Section 7.4.2 and the scope of the analytical program will be refined following completion of the desktop study. The study plan does not indicate whether the list of parameters to be sampled will be expanded to any parameters of concern in addition to those listed in Section 7.4.2 that may be identified during the desktop review of historical land use and potential soil contamination.	Expand the list of soil parameters to be sampled to include any additional parameters not listed in Section 7.4.2 that may be identified during the desktop assessment of historical land use and other existing studies, including the registered contaminated sites database. Include in the Impact Statement a description of the outcome of the desktop assessment of historical land use and indicate whether expanding the list of soil parameters was required.
GE-20	**Section 9.6.1 Magnitude** "Professional judgement and / or risk assessment may be required to assess impacts where no provincial or federal soil standard exists or when non-threshold parameters such as arsenic, chromium and lead are involved."	**Section 8.4** "…The Impact Statement must describe the historical land use and the potential for contamination of soils and sediments and describe any known or suspected soil contamination with the study area that could be re-suspended, released or otherwise disturbed as a result of the Project…"	There are the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for arsenic, total and hexavalent chromium, and lead. It is therefore unclear under what circumstances professional judgement or risk assessment may be required to assess impacts.	Update the study plan to clarify and validate with the Federal Review Team the circumstances under which the relevant provincial and federal soil standards would not be applied and professional judgement or risk assessment may be required to assess impacts.
GE-21	**Footnote 8, Section 9.2** "In February 2020 a regional assessment of the Ring of Fire region commenced; however, it is not sufficiently advanced at this time to inform the Project VCs. The VCs will be consulted and engaged on early in the IA/EA process and finalized taking into consideration the input received. Therefore, only information relevant to the Project that arises from the regional assessment of the Ring of Fire within an appropriate timeline will inform the VCs for the Project."	**Editorial comment**	The statement in the footnote 8 in Section 9.2 "*In February 2020 a regional assessment of the Ring of Fire region commenced; however, it is not sufficiently advanced at this time to inform the Project VCs."* is inaccurate, as the Regional Assessment in the Ring of Fire area has not yet begun.	Replace the text in footnote 8 with "*In February 2020, the Minister of Environment and Climate Change determined that a regional assessment will be conducted in an area centred on the Ring of Fire mineral deposits in northern Ontario. Relevant information available in relation to the Regional Assessment in the Ring of Fire area would be considered in the impact assessment of the Project."*

Attachment B – Existing Conditions Detailed Mapping Figures

M22L010
M22L012
M22L011
M22S172
M22S171
M22S170
SG-01
SG-01
SG-01
BR-03
M22S176
BR-03
M22S060
M22S059
Colpitts Creek
Colpitts Creek
M22L014
M22L015
M22L013
BR-02
M22S181
M22S180
M22S030
M22S029
M22S028
SG-20
SG-20
BR-01

Legend

ROAD
WATERCOURSE
CONSTRUCTION DISTURBANCE AREA
LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
ALTERNATIVE 4
ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL
ANTHROPOGENIC
BEDROCK
COLLUVIUM
FLUVIAL
GLACIOFLUVIAL
GLACIOLACUSTRINE
MORAINAL (<0.2 METRES)
MORAINAL (0.2 - 1 METRES)
MORAINAL (1 - 3 METRES)
MORAINAL (> 3 METRES)
LACUSTRINE
ORGANIC
WATERBODY

GEOPROCESSESS
SLOW MASS MOVEMENTS - DEBRIS SLIDE (Fs)
SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
SURFACE SEEPAGE (L)
MEANDERING CHANNEL (M)
RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
INUNDATION (U)
GULLY EROSION (V)

SOIL INSPECTION LOCATIONS
GROUND PLOT
VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
Base Data: Provided by MNRF 2019; Route Infrastructure - Provided by AECOM 2019. Contains Information licensed under the Open Government Licence Ontario.
Aerial photography provided by:
Service Layer Credits: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

Feb, 2026 | 1:50,000 * when printed 11"x17"

Rev:0

Figure B-1a

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Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_SOIL_001_GIS_SurficialMaterialGeoprocess_RevA.mxd
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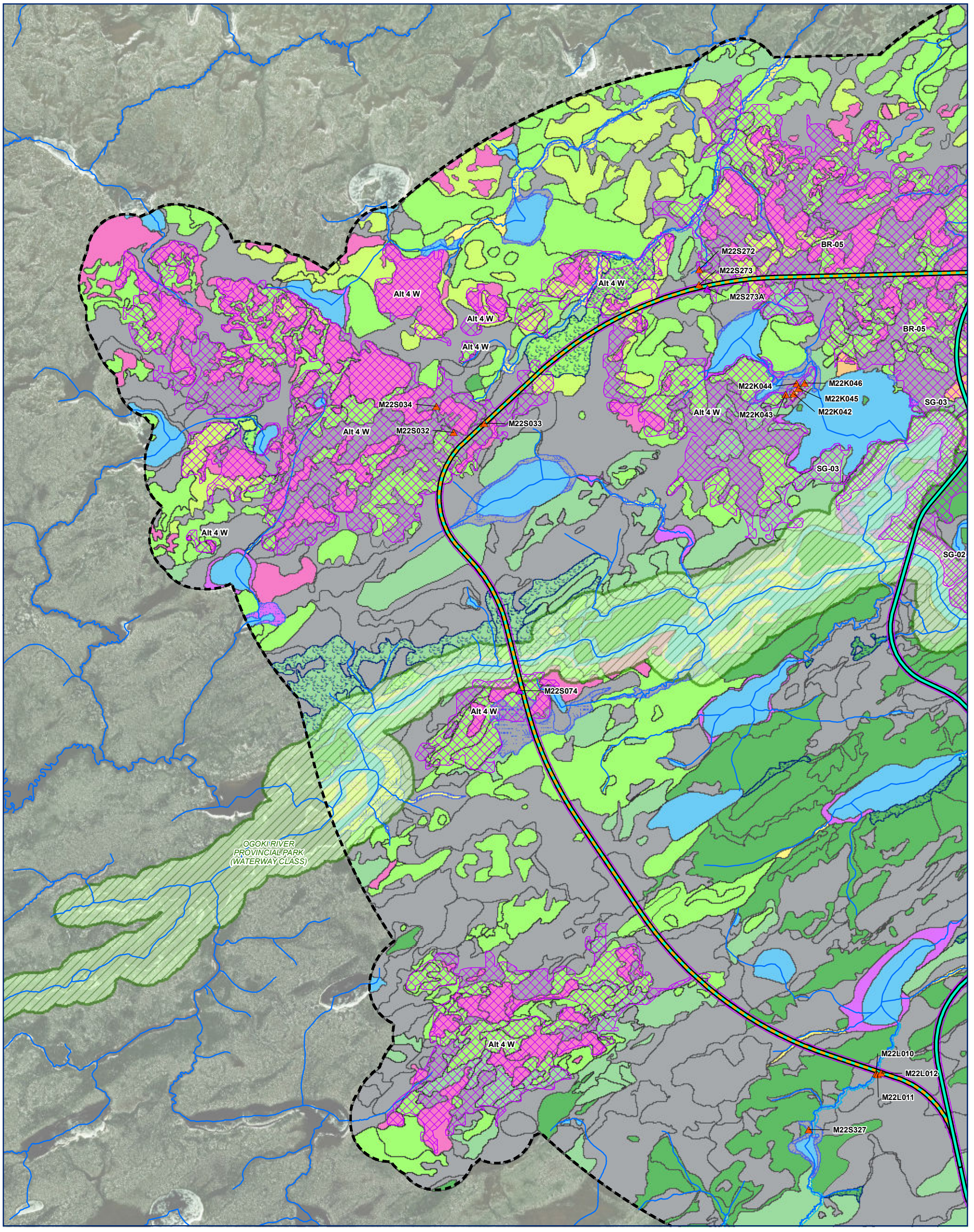

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- BEDROCK
- FLUVIAL
- GLACIOFLUVIAL
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- IRREGULARLY SINUOUS CHANNEL (I)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1b

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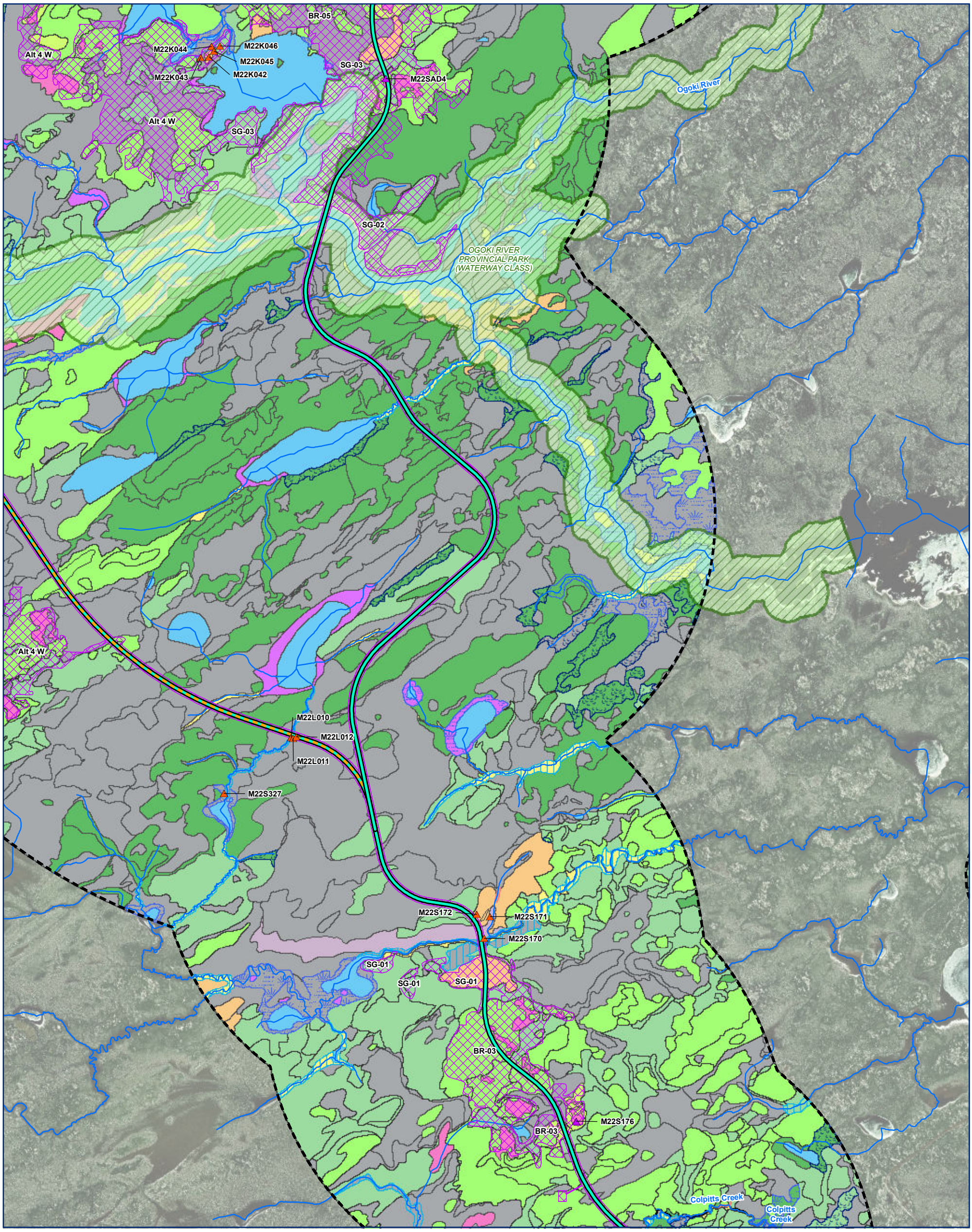

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SLOW MASS MOVEMENTS - DEBRIS SLIDE (Fs)
- IRREGULARLY SINUOUS CHANNEL (I)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1c

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M22K048
M22K047
M22K049
BR-09
BR-09
M22SAD8
BR-08
BR-08
M22S164
M22S165
M22K050
M22K051
M22K055
M22K056
M22K053
M22K054
M22K052
BR-07
BR-07
BR-07
BR-06
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
BR-05
M22S272
M22S273
M2S273A
BR-05
Alt 4 W
M22K044
M22K046
M22K045
M22K043
M22K042
SG-03
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
M22SAD4

Marten Falls First Nation

Map Location

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- BEDROCK
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1d

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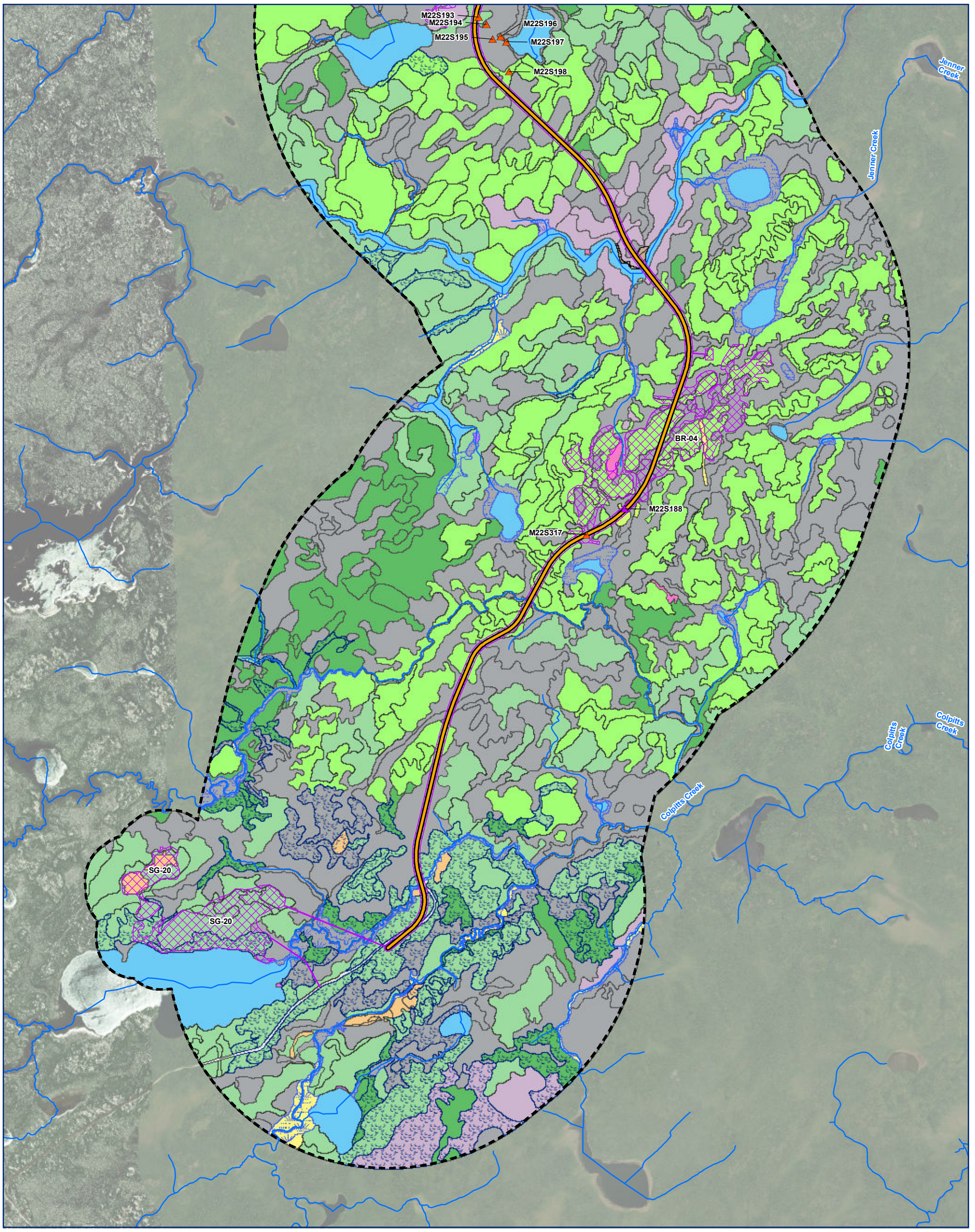

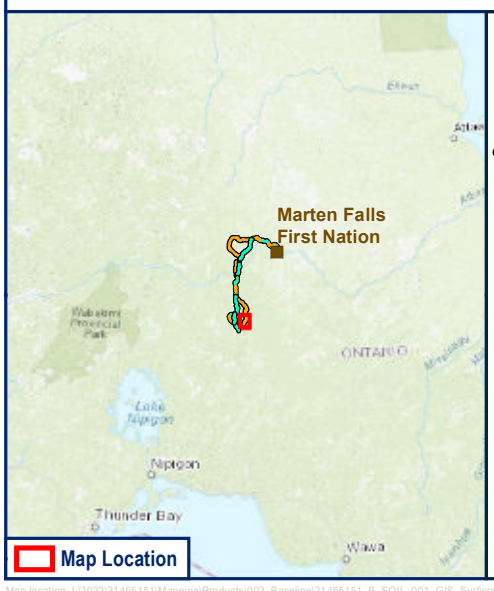

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1

DOMINANT SURFICIAL MATERIAL
- ANTHROPOGENIC
- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS
- SURFACE SEEPAGE (L)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1e

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SG-07
SG-07
SG-06
SG-06
SG-06
SG-06
M22K061
M22K058
M22K057
M22K059
M22K060
SG-06
M22S193
M22S194
M22S196
M22S195
M22S197
M22S198
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
Ogoki River
Jenner Creek
Jenner Creek
Jenner Creek
Jenner Creek
Jenner Creek
Marten Falls First Nation
ONTARIO
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1

DOMINANT SURFICIAL MATERIAL
- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS
- KETTLED (H)
- SURFACE SEEPAGE (L)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS
- GROUND PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1f

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M22S215
M22S219
M22S218
SG-07
SG-07
M22K050
M22K051

Marten Falls First Nation
Map Location

Legend

ROAD
WATERCOURSE
CONSTRUCTION DISTURBANCE AREA
LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
ALTERNATIVE 1
ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL
COLLUVIUM
FLUVIAL
GLACIOFLUVIAL
GLACIOLACUSTRINE
MORAINAL (<0.2 METRES)
MORAINAL (0.2 - 1 METRES)
MORAINAL (1 - 3 METRES)
MORAINAL (> 3 METRES)
ORGANIC
WATERBODY

GEOPROCESSESS
SURFACE SEEPAGE (L)
MEANDERING CHANNEL (M)
RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
INUNDATION (U)

SOIL INSPECTION LOCATIONS
GROUND PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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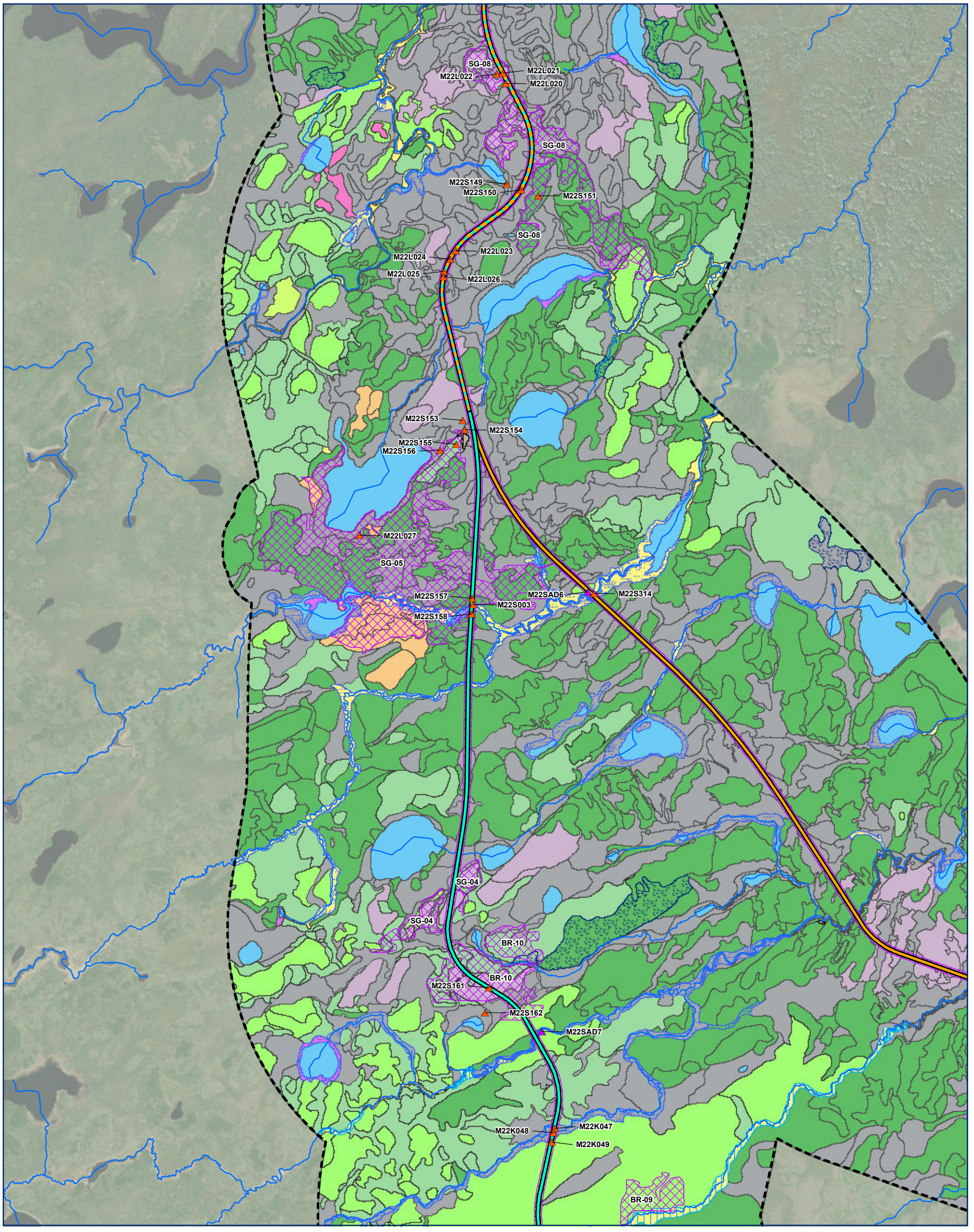

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SLOW MASS MOVEMENTS - DEBRIS SLIDE (Fs)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1h

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SG-10
M22S239
SG-09
SG-09
M22L009
M22L008
M22L007
BR-11
M22L016
M22L019
M22L017
M22L018
SG-08

Legend

ROAD
WATERCOURSE
CONSTRUCTION DISTURBANCE AREA
LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL
BEDROCK
COLLUVIUM
FLUVIAL
GLACIOFLUVIAL
GLACIOLACUSTRINE
MORAINAL (0.2 - 1 METRES)
MORAINAL (1 - 3 METRES)
MORAINAL (> 3 METRES)
LACUSTRINE
ORGANIC
WATERBODY

GEOPROCESSESS
KETTLED (H)
SURFACE SEEPAGE (L)
MEANDERING CHANNEL (M)
RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
INUNDATION (U)
GULLY EROSION (V)

SOIL INSPECTION LOCATIONS
GROUND PLOT
VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1i

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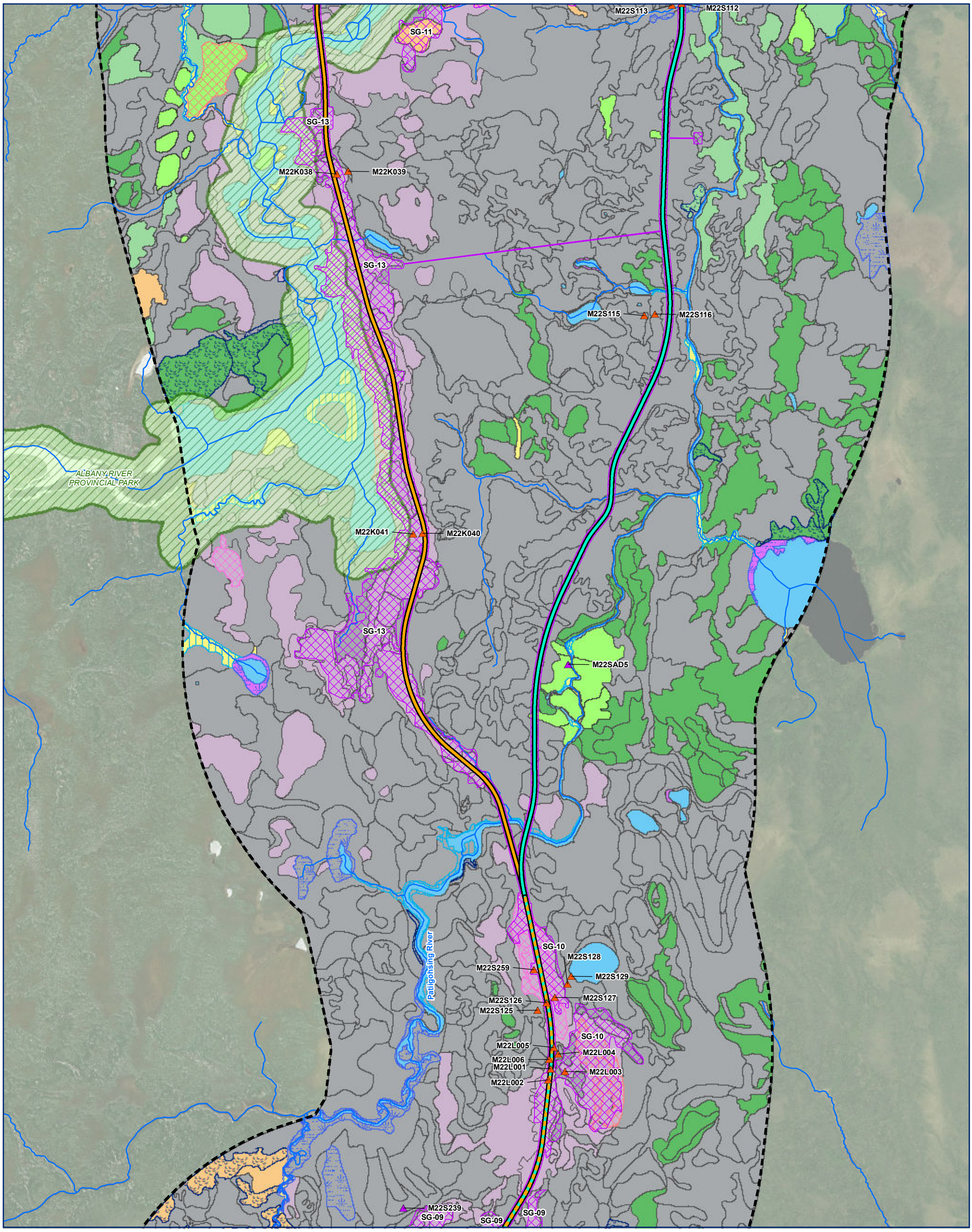

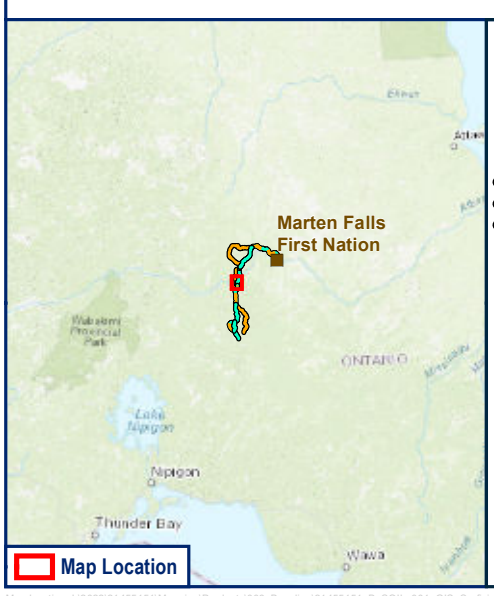

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1j

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M22K031
M22K029
M22K030
SG-12
M22K032
M22K033
SG-12
M22S105
M22S081
SG-12
M22K036
M22K035
M22K037
SG-12
SG-12
SG-11
ALBANY RIVER PROVINCIAL PARK
M22S041
M22S042
SG-11
SG-11
M22S114
M22S113
M22S112
SG-13

Marten Falls First Nation
ONTARIO
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)
- PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS

- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1k

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SG-16
SG-16
SG-16
SG-16
SG-15
SG-15
SG-15
SG-15
SG-15
SG-15
SG-15
SG-15
SG-15
M22K017
M22K016
M22K018
M22K019
M22K020
M22K024
M22K022
M22K021
M22K023
M22S258
M22K026
M22K027
M22SAD3
M22K028
M22K025
Gourlie Creek

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1

DOMINANT SURFICIAL MATERIAL

- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- CHANNELED BY MELTWATER - (E)
- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1l

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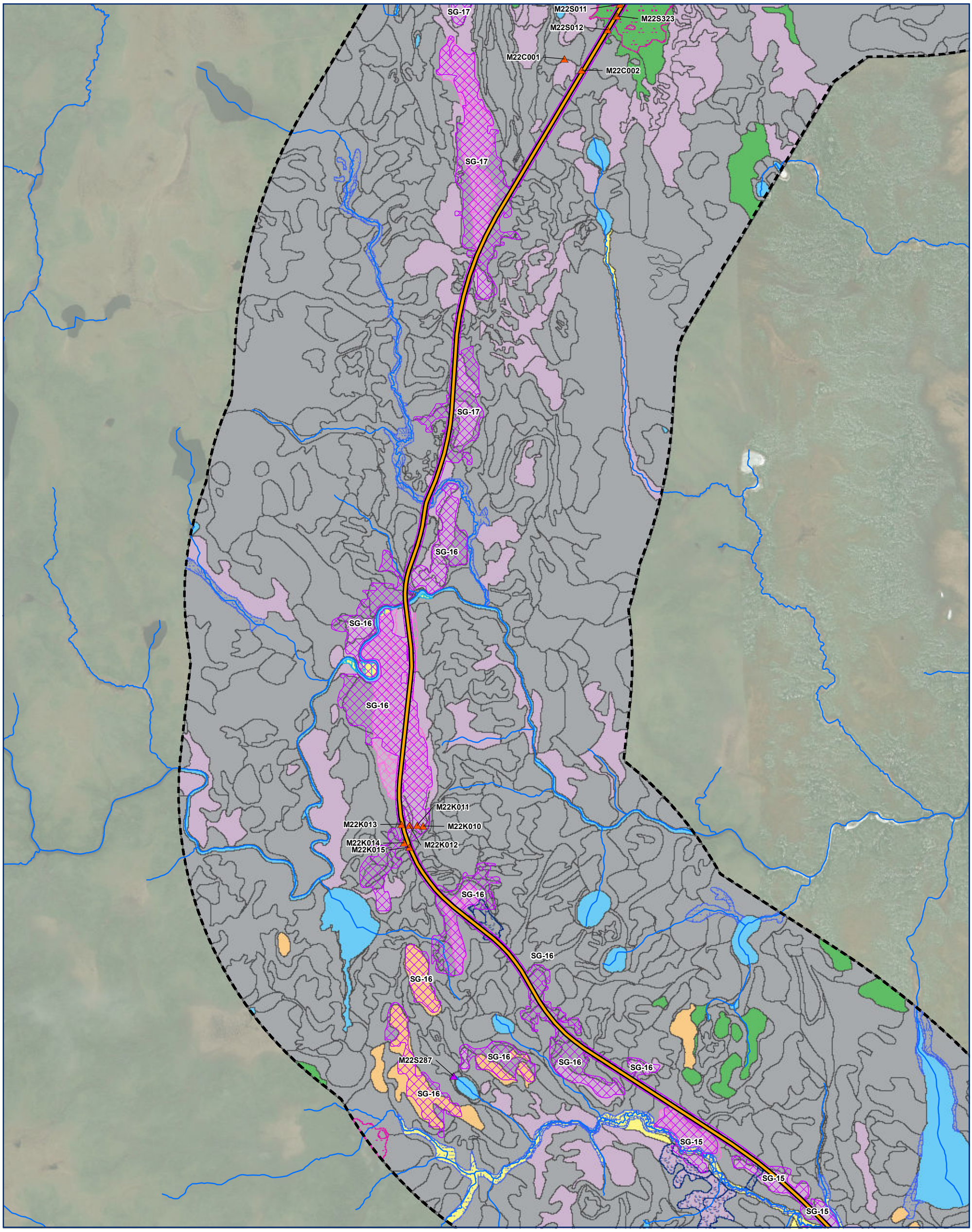

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1

DOMINANT SURFICIAL MATERIAL

- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)
- PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1m

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BR-14
M22K004
BR-14
M22K002
M22K005
M22K001
M22K006
M22K003
M22S283
SG-17
M22S011
M22S323
M22S012
M22C001
M22C002
SG-17
SG-17

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1

DOMINANT SURFICIAL MATERIAL
- BEDROCK
- FLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS
- KETTLED (H)
- INUNDATION (U)
- PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS
- GROUND PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1n

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M22S045
M22S046
M22S044
M22S010
M22C004
M22C003
M22S008
M22S009
M22S310
M22SAD9
BR-13

Legend

ROAD
WATERCOURSE
CONSTRUCTION DISTURBANCE AREA
LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
ALTERNATIVE 1

DOMINANT SURFICIAL MATERIAL
BEDROCK
FLUVIAL
MORAINAL (0.2 - 1 METRES)
MORAINAL (1 - 3 METRES)
MORAINAL (> 3 METRES)
LACUSTRINE
ORGANIC
WATERBODY

GEOPROCESSESS
SURFACE SEEPAGE (L)
MEANDERING CHANNEL (M)
INUNDATION (U)
PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS
GROUND PLOT
VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1o

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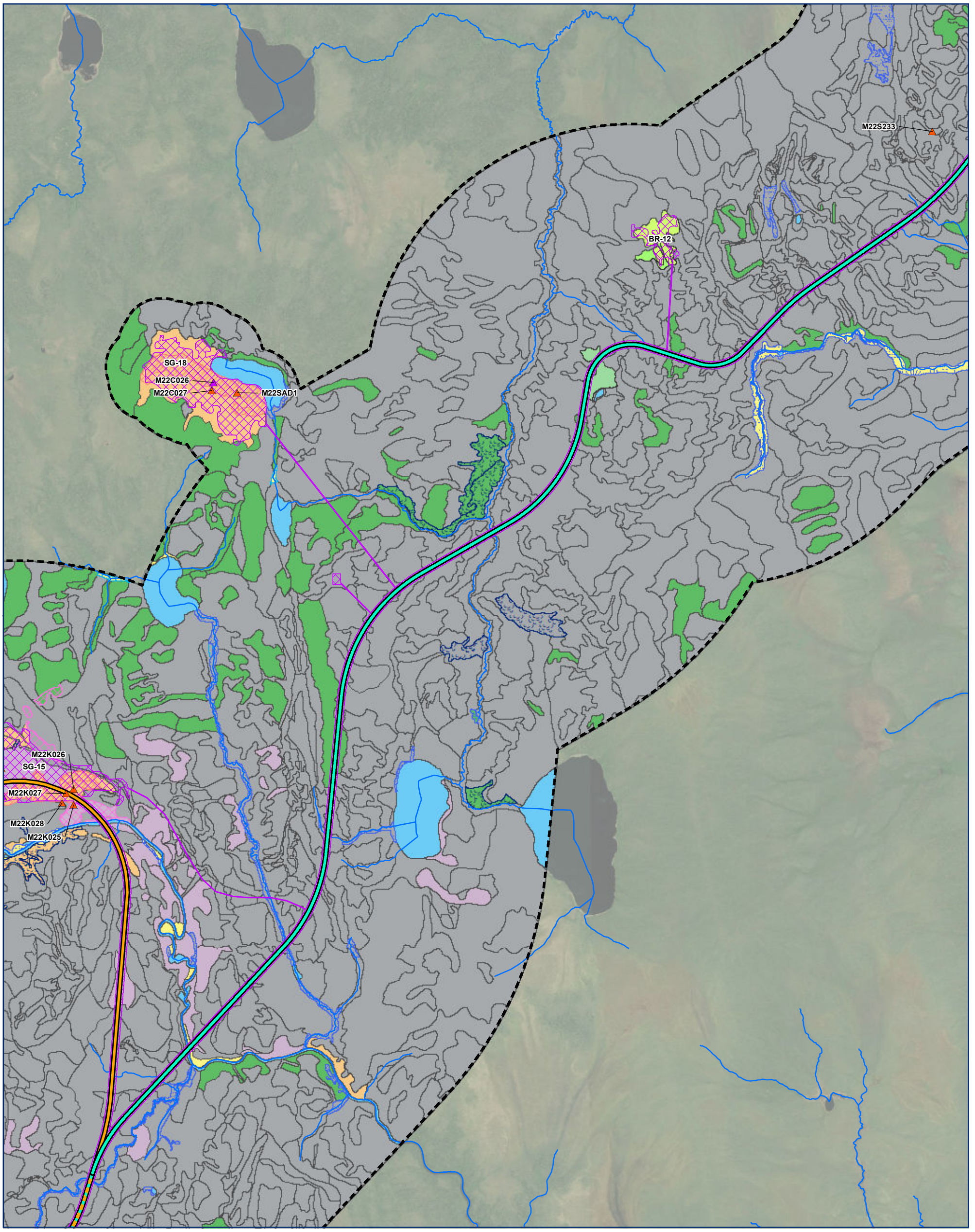

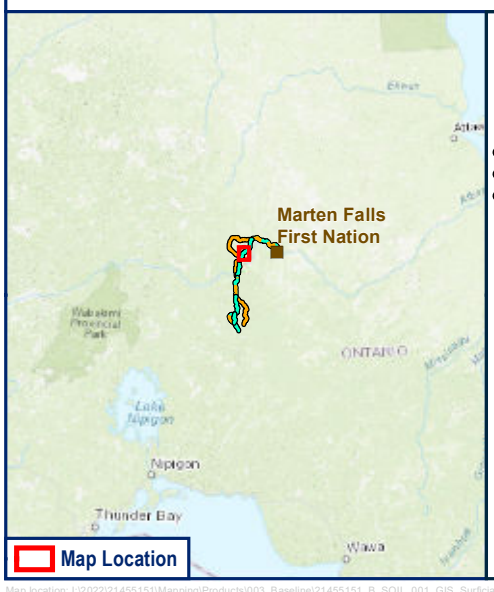

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1p

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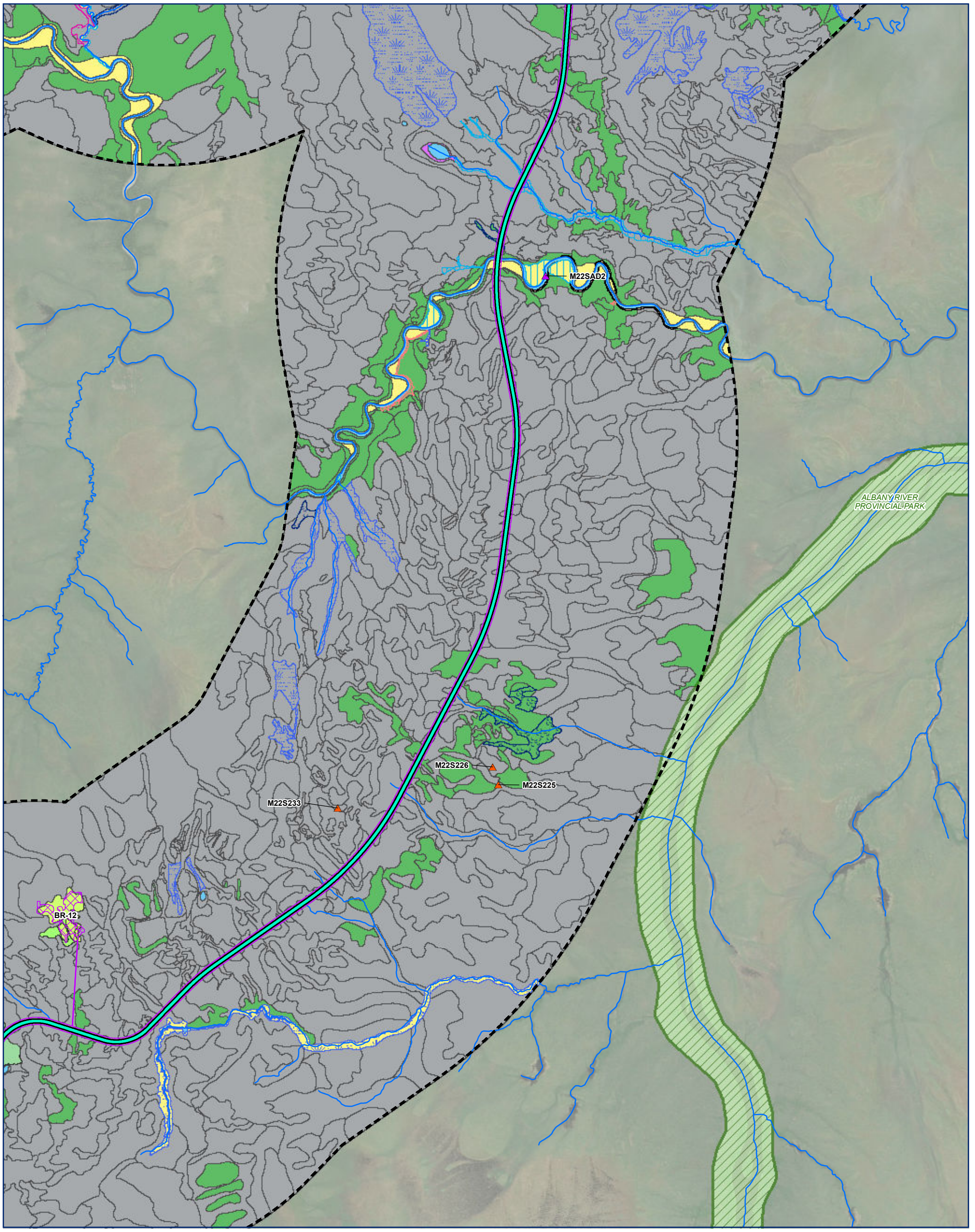

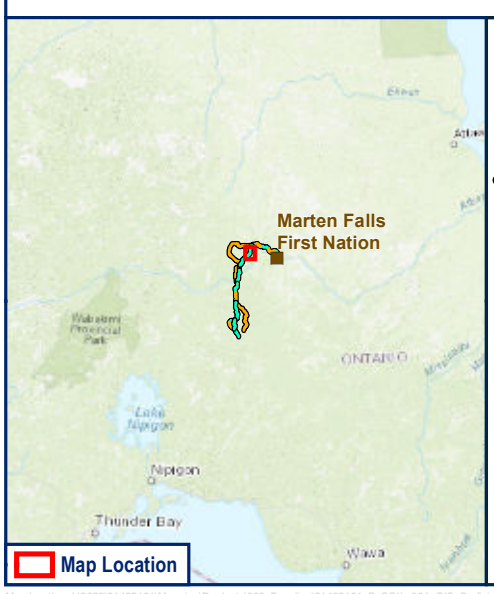

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL
- COLLUVIUM
- FLUVIAL
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)
- PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1q

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Alder River

M22C006
M22C005
M22C009
M22C010
M22C008
M22K007
M22K009
M22K008
M22C007
M22SAD2

ALBANY RIVER PROVINCIAL PARK

Marten Falls First Nation

Map Location

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1r

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M22C011
M22C012
M22C013
M22C014
Wabassi River
Wabassi River
ALBANY RIVER PROVINCIAL PARK

Marten Falls First Nation
Map Location

Legend

ROAD
WATERCOURSE
CONSTRUCTION DISTURBANCE AREA
LOCAL STUDY AREA
PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL
FLUVIAL
GLACIOLACUSTRINE
MORAINAL (> 3 METRES)
ORGANIC
WATERBODY

GEOPROCESSESS
SURFACE SEEPAGE (L)
INUNDATION (U)
GULLY EROSION (V)
PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS
GROUND PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

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Figure B-1s

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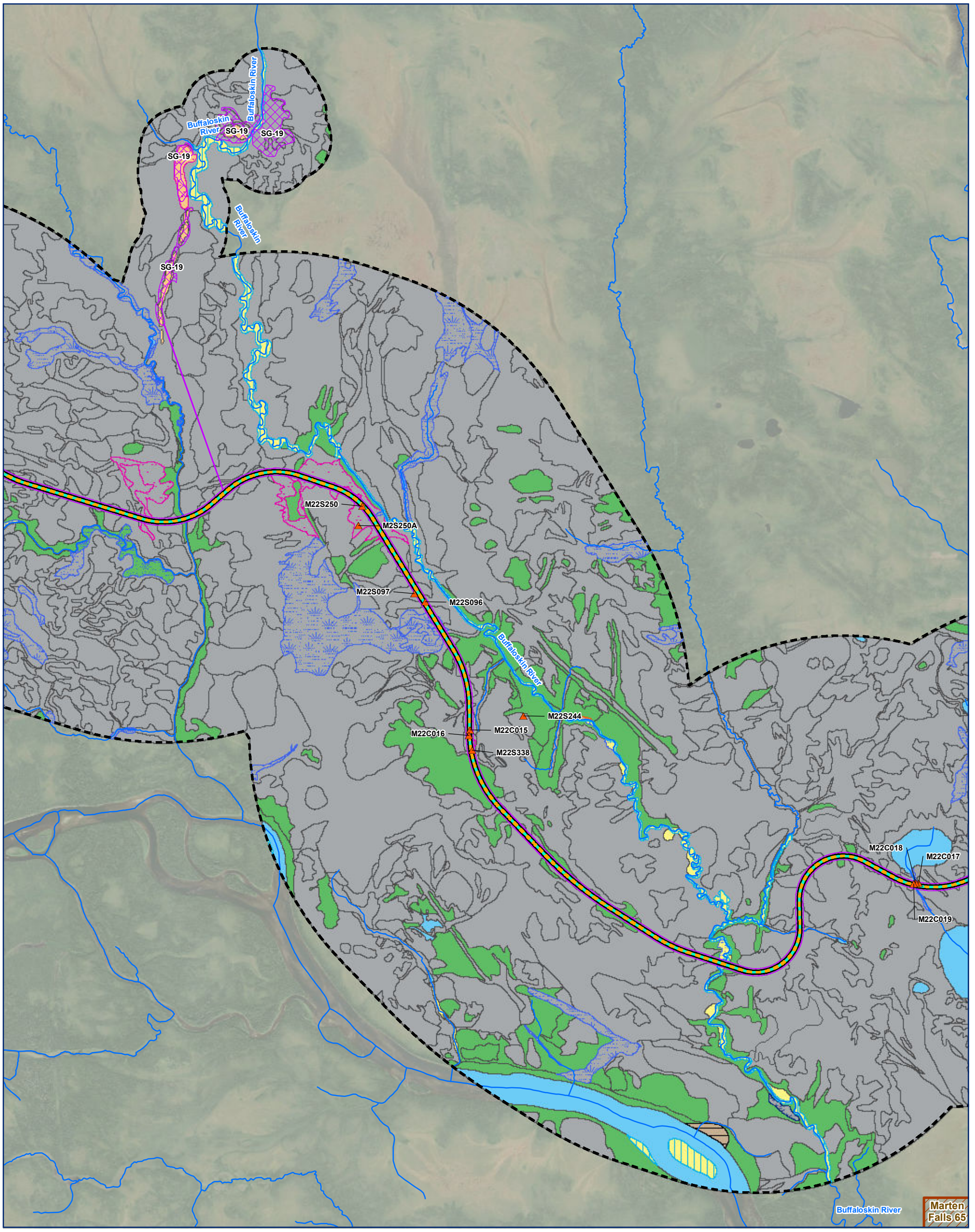

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Ru)
- INUNDATION (U)
- PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS

- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1t

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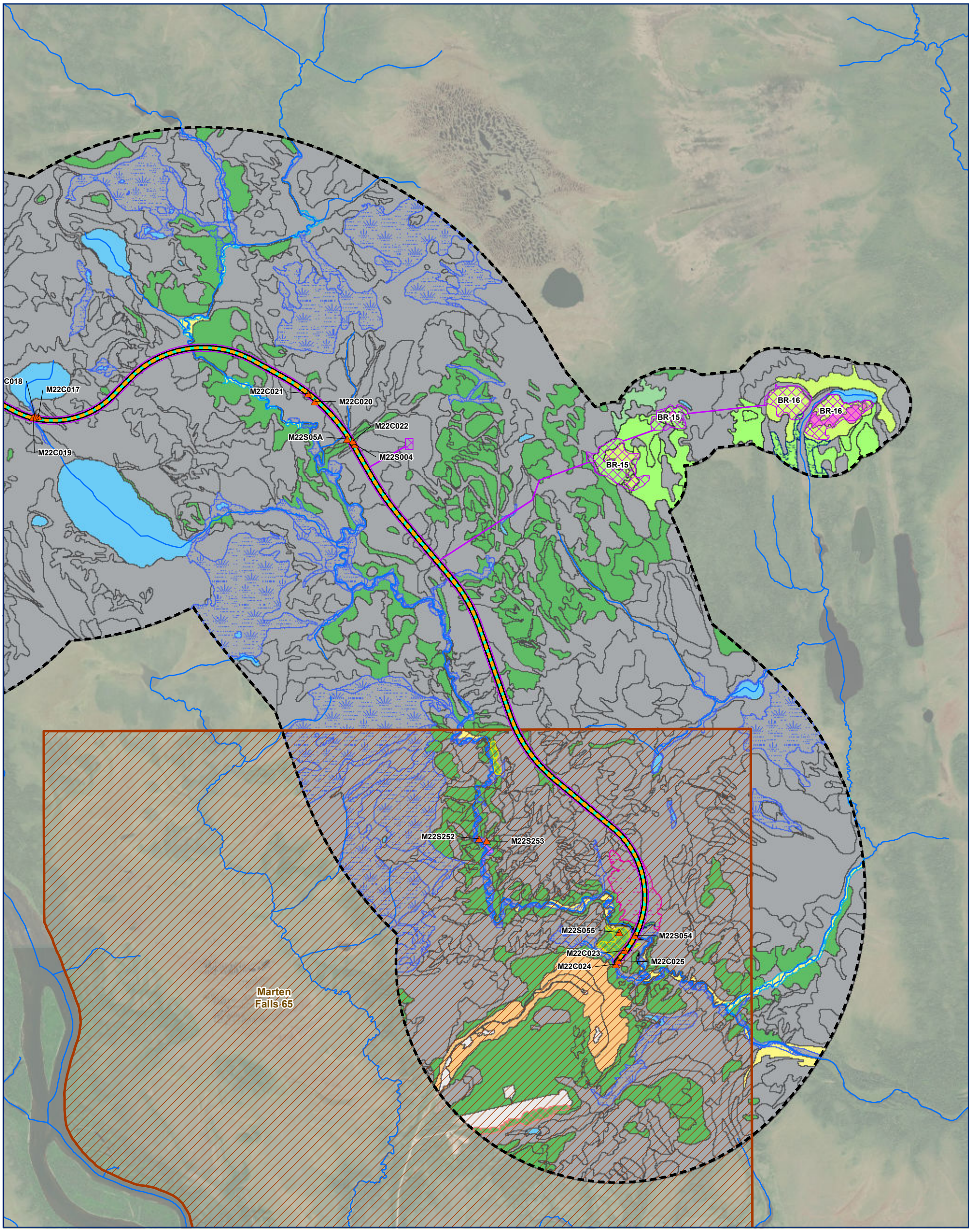

Legend

- ROAD
- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1 AND ALTERNATIVE 4

DOMINANT SURFICIAL MATERIAL

- ANTHROPOGENIC
- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- CHANNELED BY MELTWATER - (E)
- SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)
- PERMAFROST PROCESSES (X)

SOIL INSPECTION LOCATIONS

- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 1 2
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-1u

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Terrain Symbol Legend

Surficial Material

A	Anthropogenic
C	Colluvium
D	Weathered Bedrock (in situ)
F	Fluvial
FG	Glaciofluvial
L	Lacustrine
LG	Glaciolacustrine
M	Morainal/Till
N	Waterbody
O	Organic
R	Bedrock

Texture

a	Blocks
b	Boulders
c	Clay
d	Mixed fragments
e	Fibric organic
g	Gravel
h	Humic organic
k	Cobble
m	Mud
p	Pebbles
r	Rubble
s	Sand
u	Mesic organic
x	Angular fragments
y	Shells
z	Silt

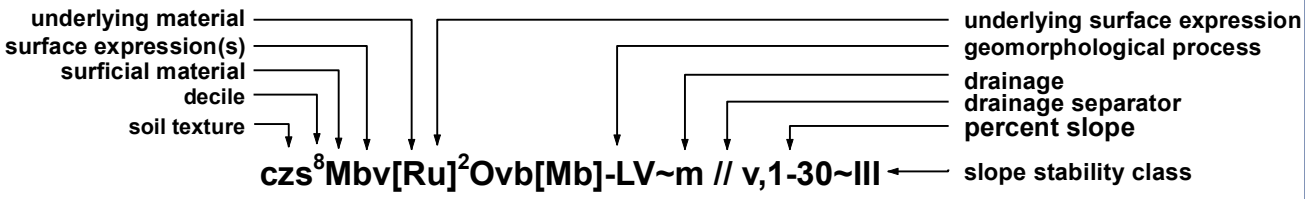
Terrain Stability Classification

Terrain Stability Class	Interpretation
I	No significant stability problems exist
II	Very low likelihood of landslide initiation following land clearing or road/pipeline construction
III	Low likelihood of landslide initiation following land clearing or road/pipeline construction
IV	Moderate likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing potentially unstable terrain)
V	High likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing unstable terrain)

Drainage Code Separator

,	no intermediate classes
-	all intermediate classes
/	first drainage dominant
//	first drainage significantly dominant

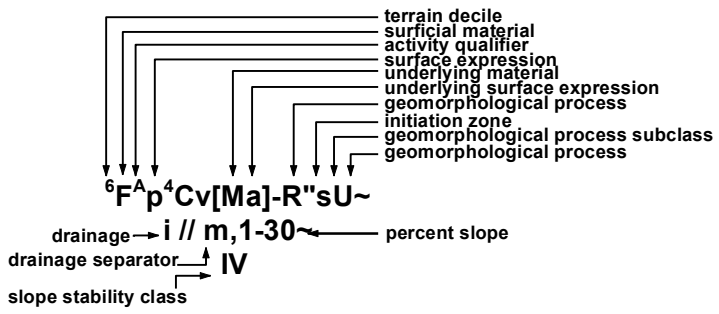
Terrain Polygon Label (used for kmz file)



Drainage

r	rapid
w	well
m	moderately well
i	imperfect
p	poor
v	very poor
x	very rapid

Complex Label



Surface Expression

a	Moderate Slope
b	Blanket (1 - 3 m)
d	Depression(s)
f	Fan(s)
h	Hummock(s)
j	Gentle Slope
k	Moderately Steep Slope
m	Rolling
p	Plain (> 3 m)
r	Ridge(s)
s	Steep Slope
t	Terrace(s)
u	Undulating
v	Veneer (0.2 - 1 m)
x	Thin Veneer (< 0.2 m)

Geomorphological Process Subclasses

Mass Movement Processes

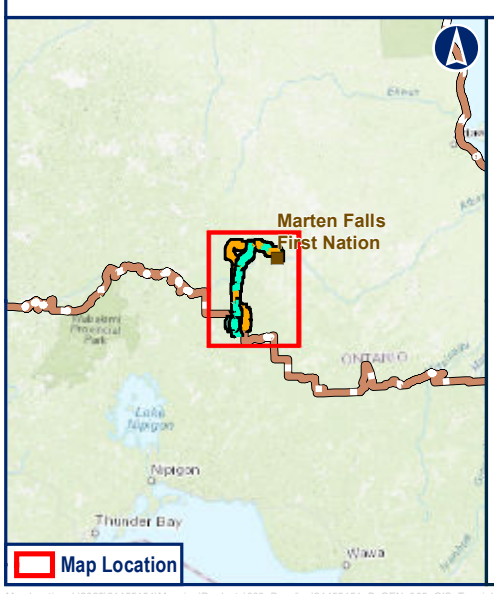
s	Debris slide
u	Slump in surficial material

Qualifiers

A	Active
I	Intermittant

Geomorphological Process

V	Gully Erosion
W	Washing
B	Braiding Channel
I	Irregularly Sinuous Channel
M	Meandering Channel
F	Slow Mass Movements
R	Rapid Mass Movements
X	Permafrost Processes
E	Channelled by Meltwater
H	Kettled
U	Inundated
L	Surface Seepage



Notes:
1. THIS DRAWING MUST BE READ IN CONJUNCTION WITH WSP INC REPORT.

Data Source:
1. Terrain Symbol Legend Annotated List from Howes & Kenk (1997).
2. Terrain Stability Classification Adapted from APEGBC (2002 and Ministry of Forests (1999)).

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

TERRAIN LEGEND

Feb, 2026

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Figure B-1

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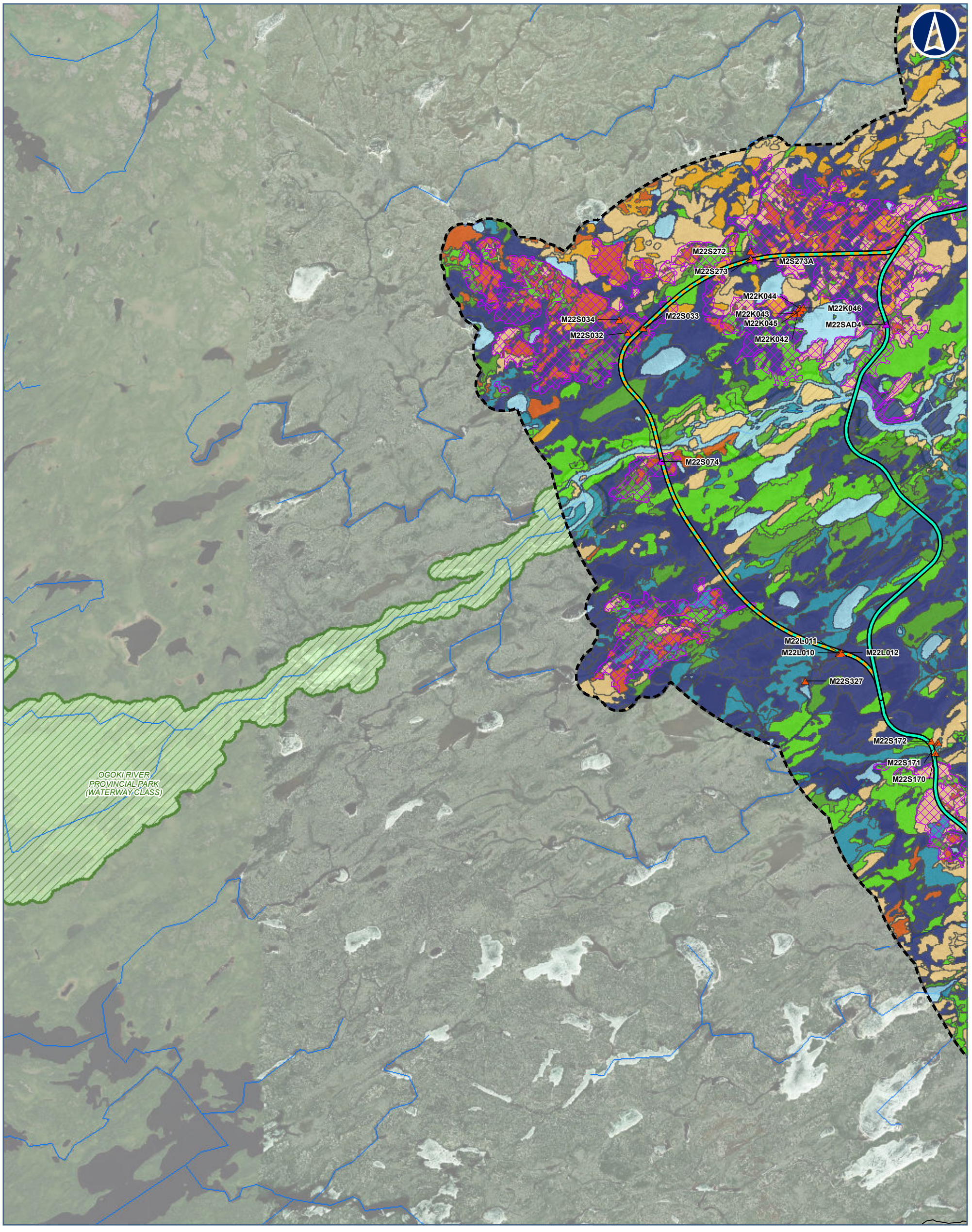

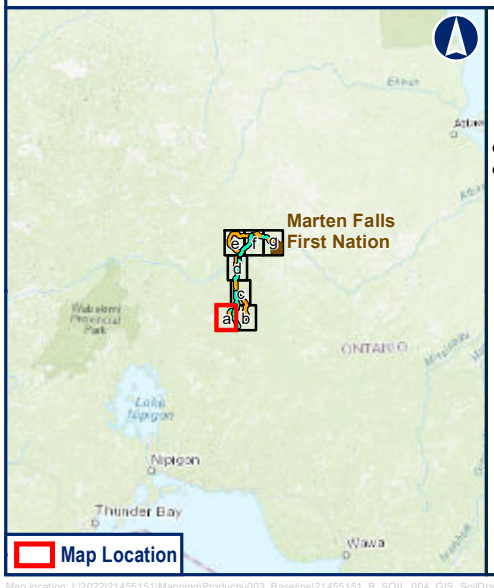

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-2a

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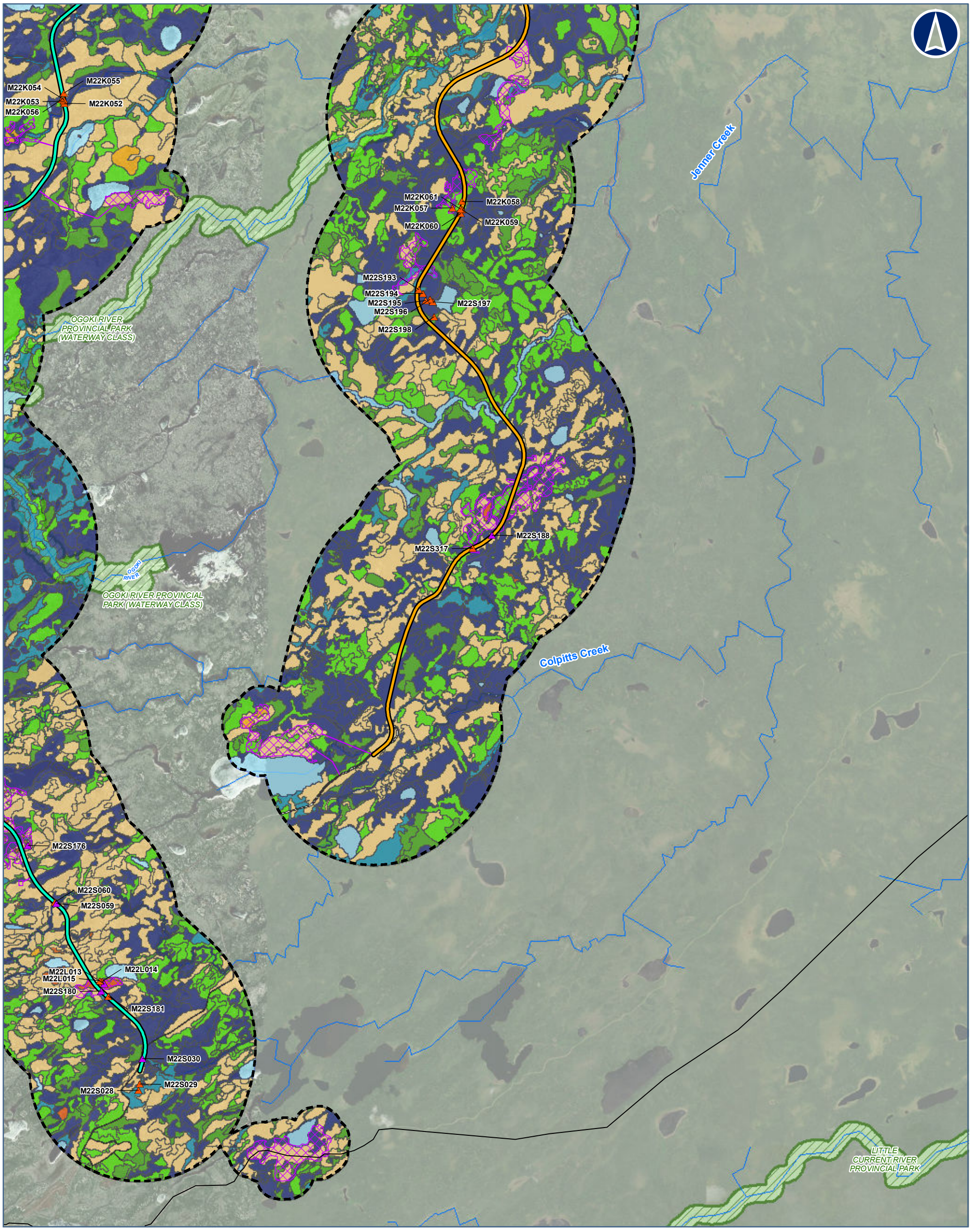

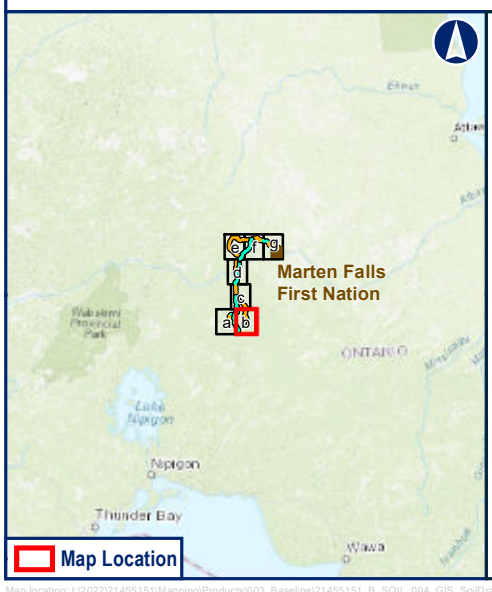

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL DRAINAGE
- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-2b

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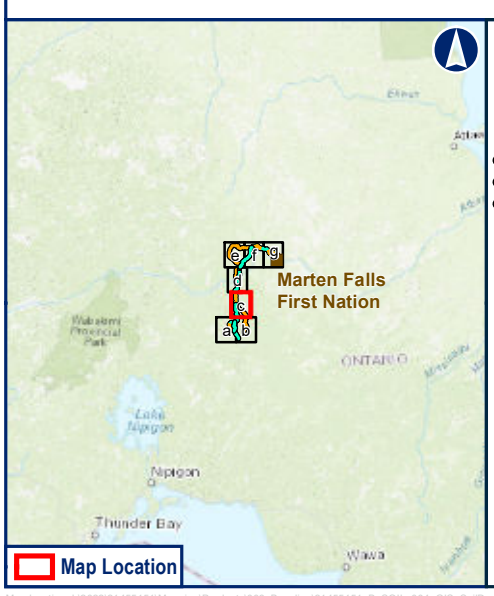
OGOKI RIVER



Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-2c

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M22K035
M22K037
M22K034
M22S042
M22S041
M22S114
M22S112
M22S113
M22K038
ALBANY RIVER
M22K039
M22S115
M22S116
ALBANY RIVER PROVINCIAL PARK
M22K040
M22K041
M22SAD5
M22S259
M22S129
M22S127
M22S125
M22S128
M22S126
M22L004
M22L005
M22L001
M22L003
M22L006
M22L002
M22S239
M22L009
M22L007
M22L008

Marten Falls First Nation

Map Location

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-2d

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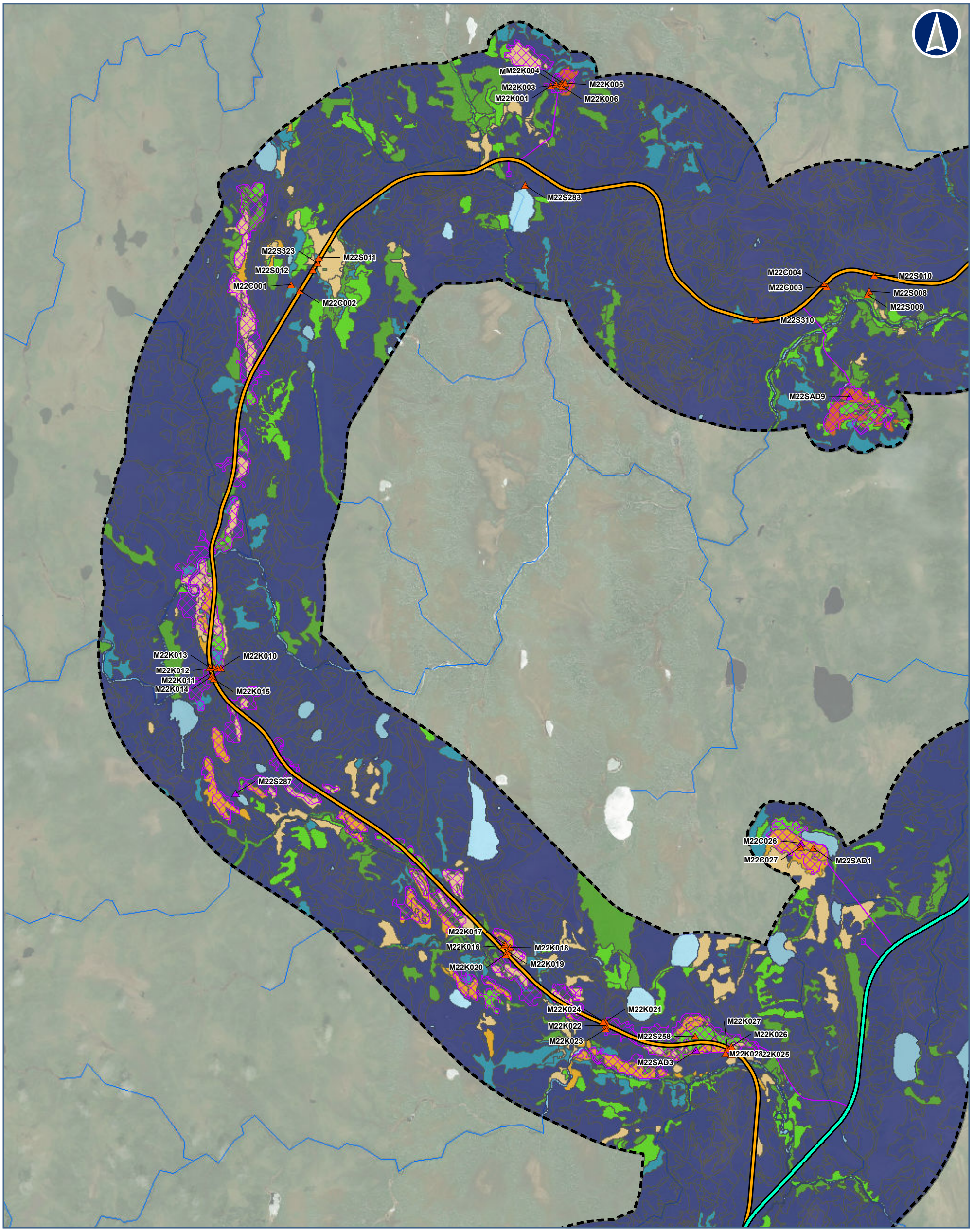

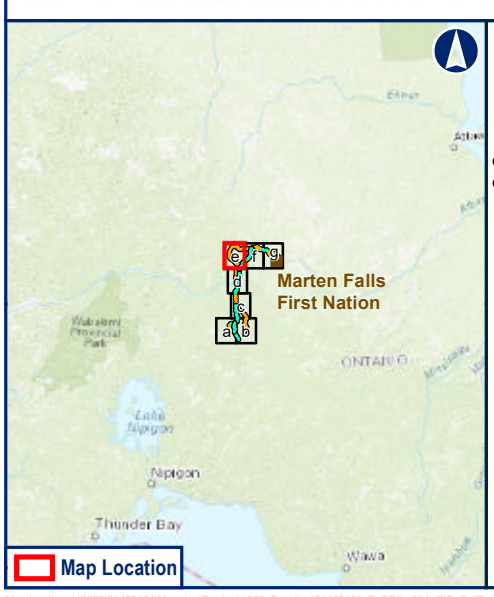

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY

SOIL DRAINAGE
- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-2e

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Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_SOIL_004_GIS_SoilDrainage_RevA.mxd
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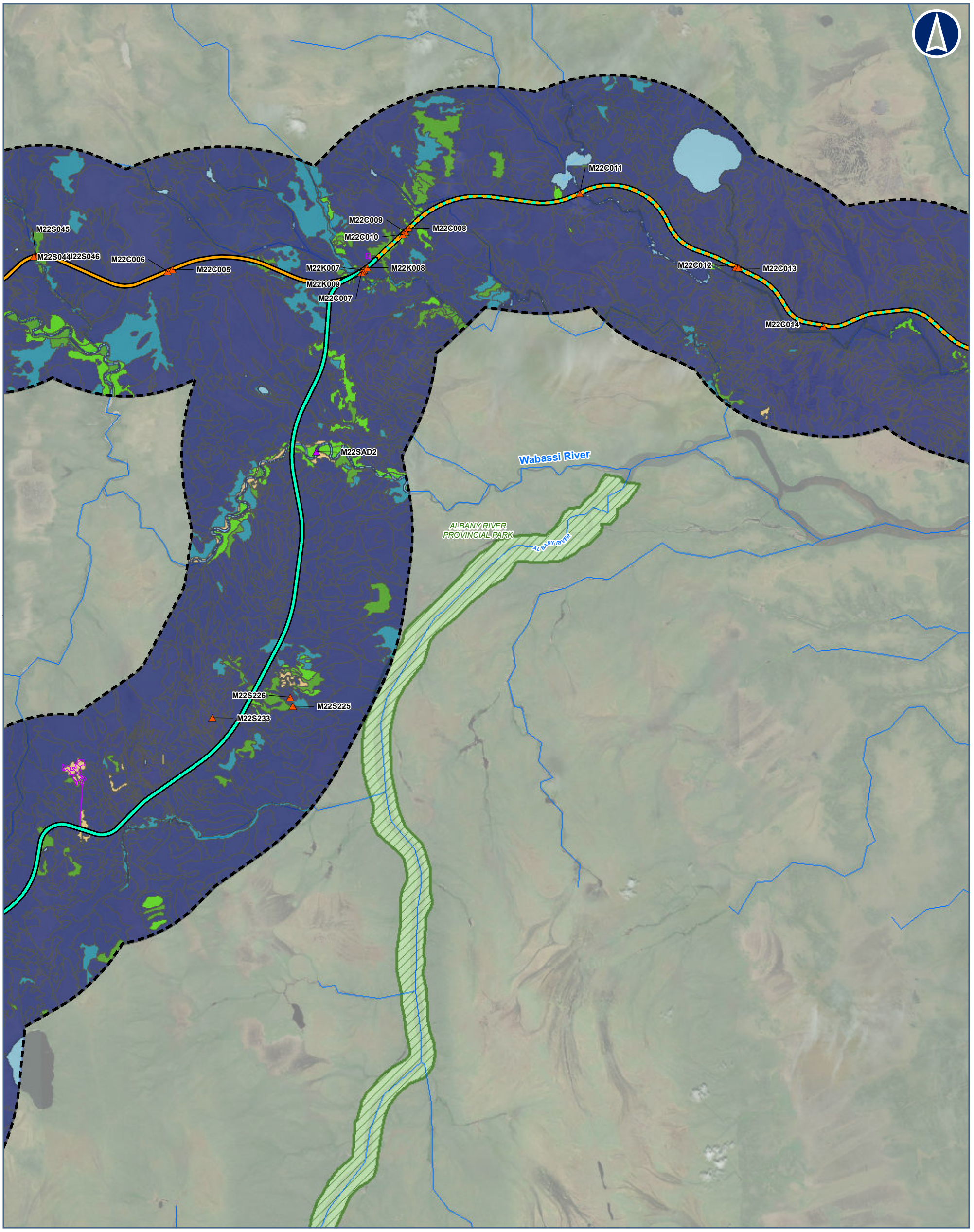

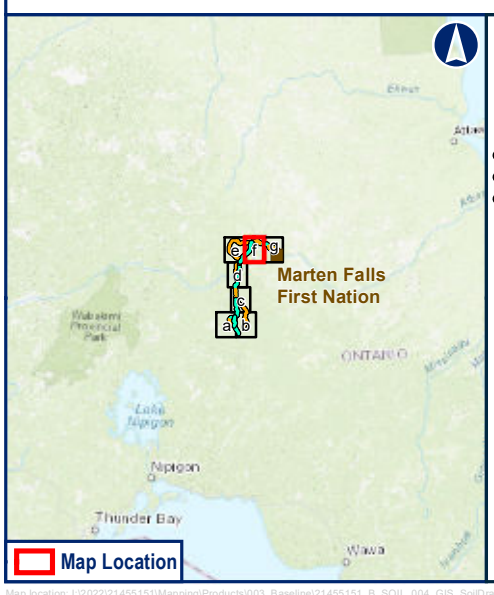

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

Data Source:
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Aerial photography provided by:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-2f

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Map location: I:\2022\21455151\Mapping\Products\003_Baseline\21455151_B_SOIL_004_GIS_SoilDrainage_RevA.mxd
Date Saved: 2/18/2026 5:49:06 PM User Name: gld_rduval

M2S250A
M22S250
M22S096
M22S097
M22S244
M22C015
M22C016
M22S338
M22C021
M22C020
M22C022
M22C018
M22C017
M22S004
M22C019
M22S05A
Buffaloskin River
M22S252
M22S253
M22S054
M22S055
M22C024
M22C023
M22C025
ALBANY RIVER
GOOSE RIVER

Marten Falls First Nation
ONTARIO
Lake Nipigon
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS
- GROUND PLOT

- FIRST NATION COMMUNITY

SOIL DRAINAGE
- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)

Notes:
Detailed Soil Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Rev:0

Figure B-2g

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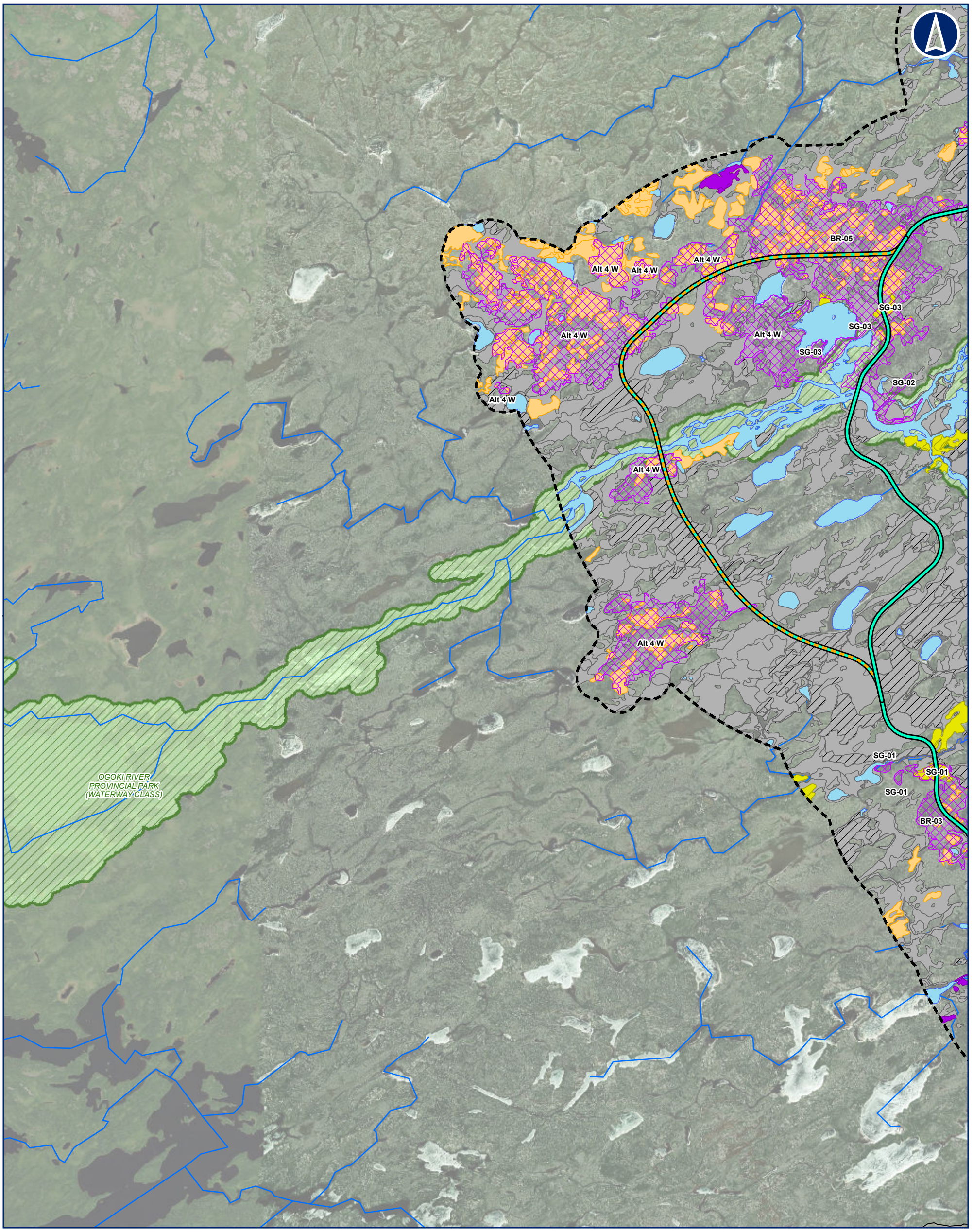

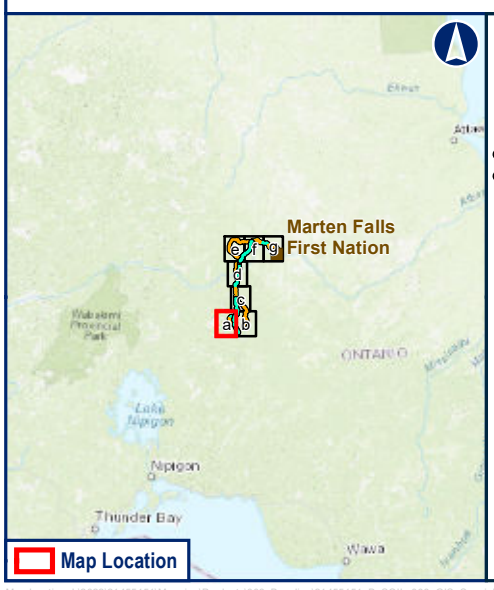

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-3a

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BR-07
BR-07
BR-06
SG-06
SG-06
SG-06
SG-06
BR-04
SG-20
SG-20
BR-03
BR-03
BR-02
BR-01
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
OGOKI RIVER
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
Jenner Creek
Jenner Creek
Jenner Creek
Jenner Creek
Colpitts Creek
Colpitts Creek
Colpitts Creek
LITTLE CURRENT RIVER PROVINCIAL PARK

Marten Falls First Nation

Map Location

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-3b

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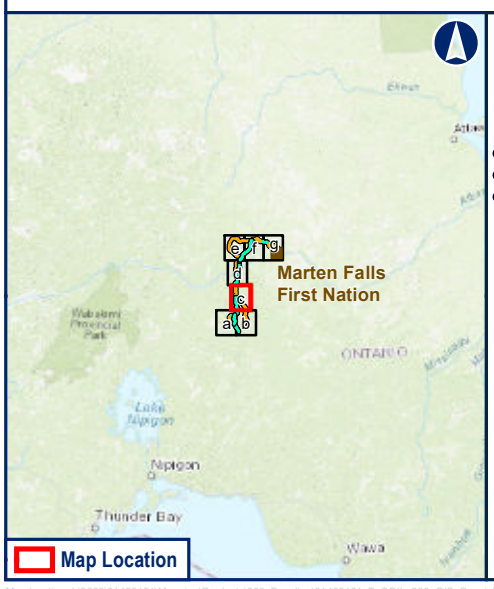
BR-11
SG-08
SG-08
SG-05
SG-04
SG-04
BR-10
BR-10
BR-09
BR-09
BR-08
BR-08
SG-07
SG-07
OGOKI RIVER



Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- FIRST NATION COMMUNITY

- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-3c

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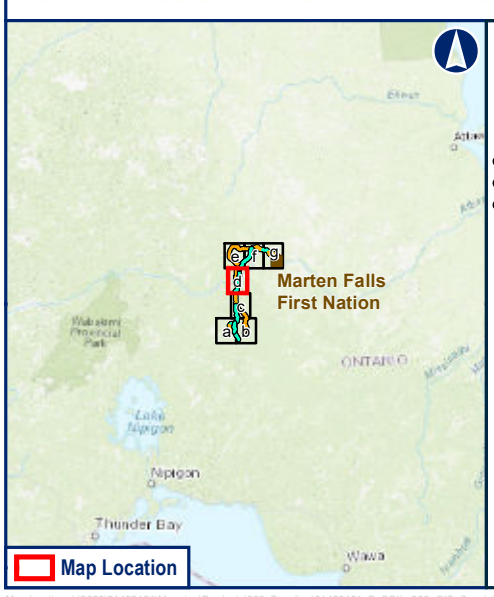
SG-12
SG-12
SG-12
SG-12
SG-12
SG-11
SG-11
ALBANY RIVER
ALBANY RIVER PROVINCIAL PARK
SG-13
SG-10
SG-10
SG-09
SG-09
BR-11



Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PERMAFROST
- POTENTIAL PITS
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-3d

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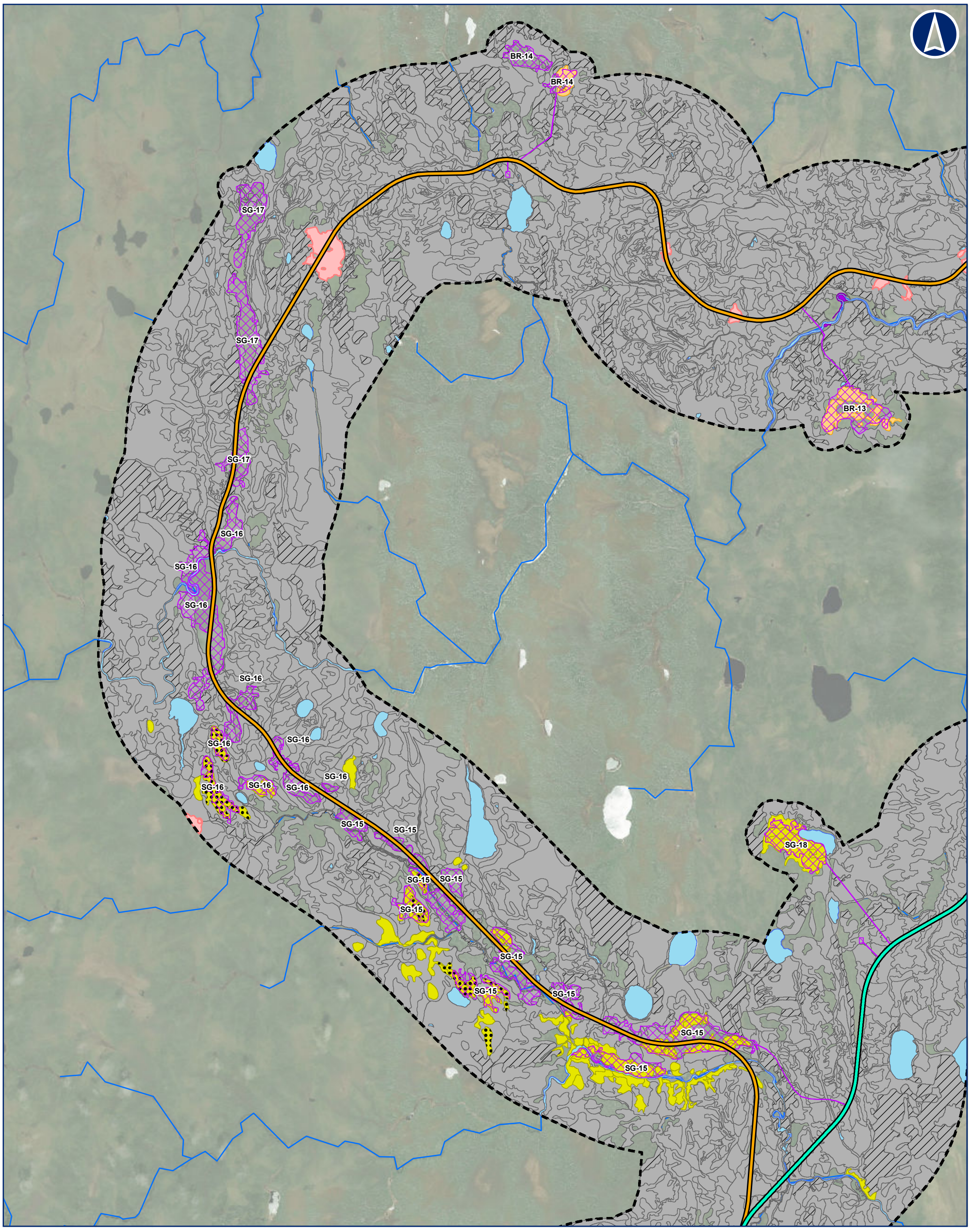

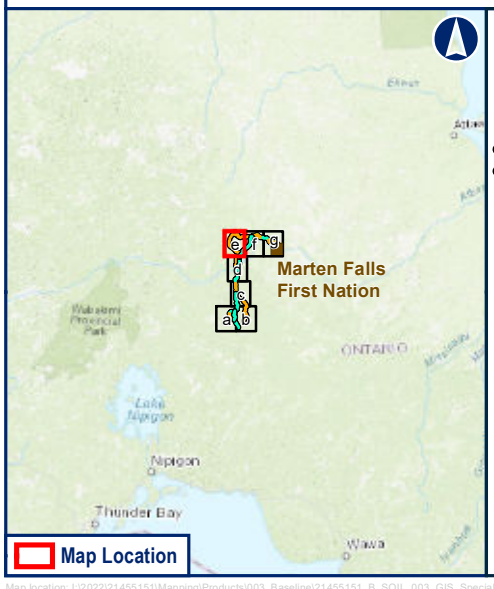

Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- FIRST NATION COMMUNITY
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PERMAFROST
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-3e

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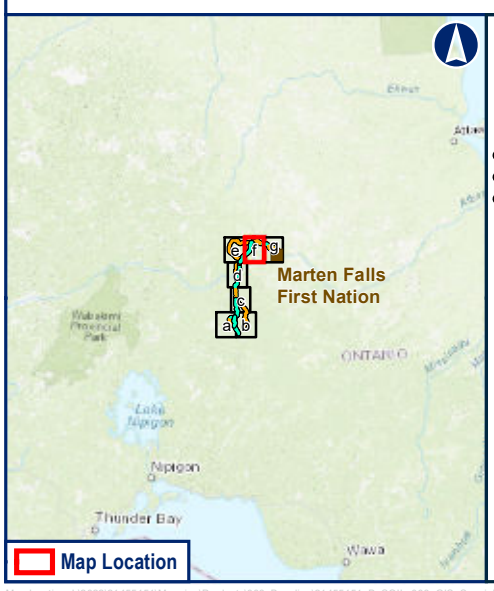
Wabassi River

ALBANY RIVER PROVINCIAL PARK

ALBANY RIVER

BR-12



Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PERMAFROST
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-3f

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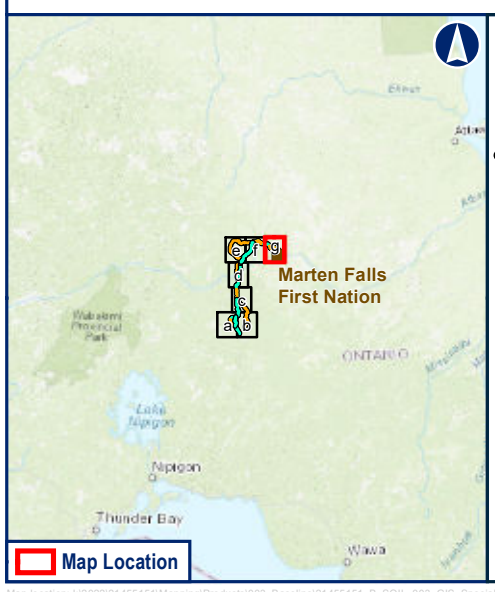
Buffaloskin River
SG-19
SG-19
SG-19
Buffaloskin River
BR-16
BR-16
BR-15
BR-15
Marten Falls 65
ALBANY RIVER
OGOKI RIVER



Legend

- WATERCOURSE
- CONSTRUCTION DISTURBANCE AREA
- LOCAL STUDY AREA
- WATERBODY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1 AND ALTERNATIVE 4
- FIRST NATION COMMUNITY
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PERMAFROST
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-3g

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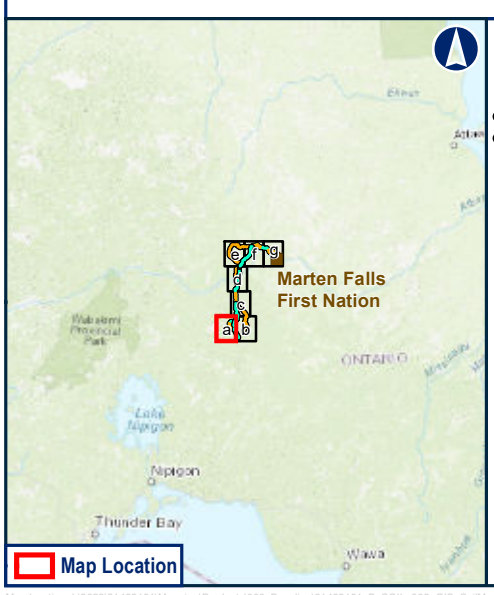
M22K043
M22K045
M22SAD4
M22S034
M22S033
M22S032
M22K042
M22S074
M22L011
M22L010
M22L012
M22S327
M22S172
M22S171
M22S170
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)



Legend

WATERCOURSE
LOCAL STUDY AREA
COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
ALTERNATIVE 4
ALTERNATIVE 1 AND ALTERNATIVE 4
SOIL INSPECTION LOCATIONS
GROUND PLOT
VISUAL PLOT
FIRST NATION COMMUNITY
PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)

COLLUVIUM (C1)
FLUVIAL (F1)
FLUVIAL (F2)
FLUVIAL (F3)
GLACIOFLUVIAL (GF1)
GLACIOFLUVIAL (GF3)
GLACIOFLUVIAL (GF4)
GLACIOFLUVIAL (GF5)
GLACIOLACUSTRINE (GL7)
LACUSTRINE (L1)
LACUSTRINE (L2)
LACUSTRINE (L3)
MORAINAL (M1)
MORAINAL (M2)
MORAINAL (M3)
MORAINAL (M4)
MORAINAL (M5)
MORAINAL (M6)
MORAINAL (M7)
MORAINAL (M8)
MORAINAL (M9)
ORGANIC (O1)
ORGANIC (O2)
BEDROCK (R1)
WATERBODY (ZWA)

Notes:
Detailed Soil Mapping by WSP 2024.

Data Source:
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Aerial photography provided by:
Service Layer Credits: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-4a

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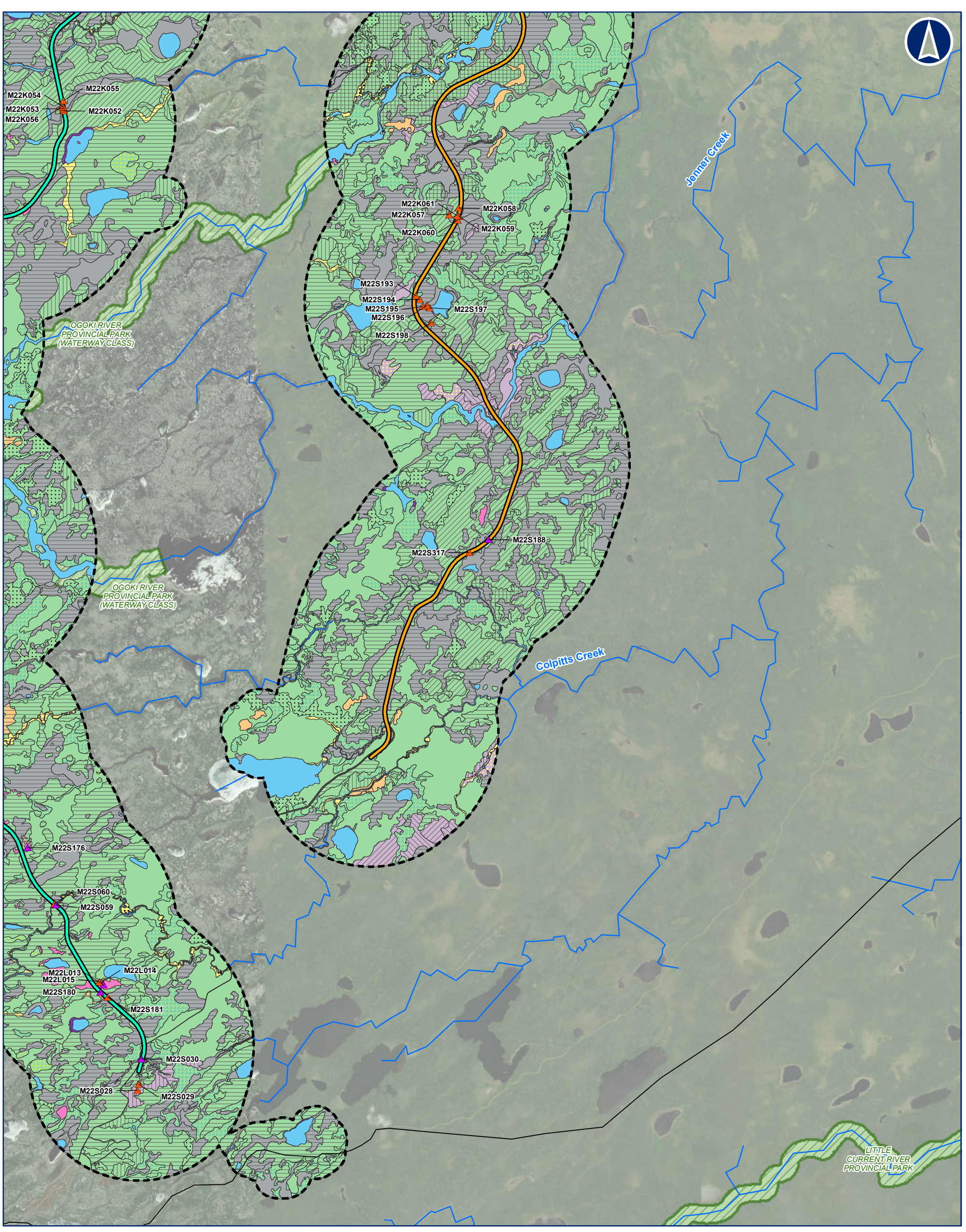

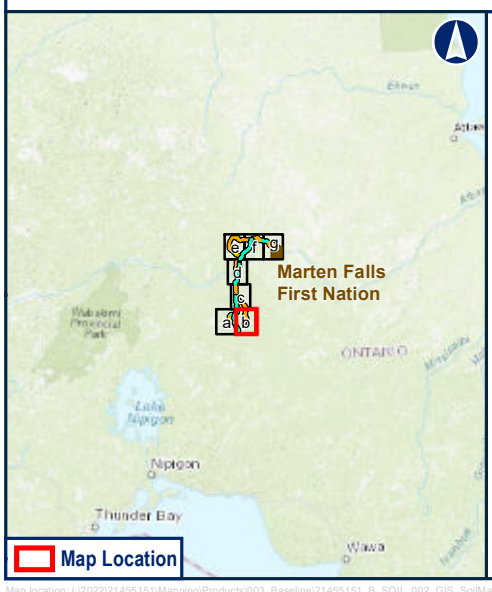

Legend

- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

SOIL MAPPING UNITS (SMU)

- COLLUVIUM (C1)
- FLUVIAL (F1)
- FLUVIAL (F2)
- FLUVIAL (F3)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF3)
- GLACIOFLUVIAL (GF4)
- GLACIOLACUSTRINE (GL1)
- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
- GLACIOLACUSTRINE (GL5)
- GLACIOLACUSTRINE (GL6)
- GLACIOLACUSTRINE (GL8)
- GLACIOLACUSTRINE (GL9)
- LACUSTRINE (L1)
- LACUSTRINE (L2)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M2)
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- MORAINAL (M4)
- MORAINAL (M5)
- MORAINAL (M6)
- MORAINAL (M7)
- MORAINAL (M8)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- DISTRUBED LAND (ZDL)
- WATERBODY (ZWA)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-4b

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M22L026
M22S153
M22S154
M22S156
M22S155
M22L027
M22S157
M22S314
M22SAD6
M22S003
M22S158
M22S161
M22SAD7
M22S162
M22S215
M22S219
M22S218
M22K048
M22K047
M22K049
M22SAD8
M22S165
M22K051
M22S164
M22K050

Map Location

Legend

- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

SOIL MAPPING UNITS (SMU)

- COLLUVIUM (C1)
- FLUVIAL (F1)
- FLUVIAL (F2)
- FLUVIAL (F3)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF4)
- GLACIOLACUSTRINE (GL1)
- GLACIOLACUSTRINE (GL2)
- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
- GLACIOLACUSTRINE (GL5)
- GLACIOLACUSTRINE (GL6)
- GLACIOLACUSTRINE (GL8)
- GLACIOLACUSTRINE (GL9)
- LACUSTRINE (L1)
- LACUSTRINE (L2)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M2)
- MORAINAL (M3)
- MORAINAL (M4)
- MORAINAL (M5)
- MORAINAL (M6)
- MORAINAL (M7)
- MORAINAL (M8)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- WATERBODY (ZWA)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-4c

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M22K037
M22K034
M22S041
M22S042
M22S114
M22S112
M22S113
M22K038
M22K039
ALBANY RIVER PROVINCIAL PARK
M22S115
M22S116
M22K040
M22K041
M22SAD5
M22S259
M22S129
M22S127
M22S128
M22S125
M22L004
M22S126
M22L005
M22L001
M22L003
M22L006
M22L002
M22S239
M22L009
M22L007
M22L008

Legend

- WATERCOURSE
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE
- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)
- COLLUVIUM (C1)
- FLUVIAL (F1)
- FLUVIAL (F2)
- FLUVIAL (F3)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF3)
- GLACIOFLUVIAL (GF4)
- GLACIOFLUVIAL (GF5)
- GLACIOLACUSTRINE (GL1)
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- GLACIOLACUSTRINE (GL5)
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- GLACIOLACUSTRINE (GL8)
- GLACIOLACUSTRINE (GL9)
- LACUSTRINE (L2)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- WATERBODY (ZWA)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure B-4d

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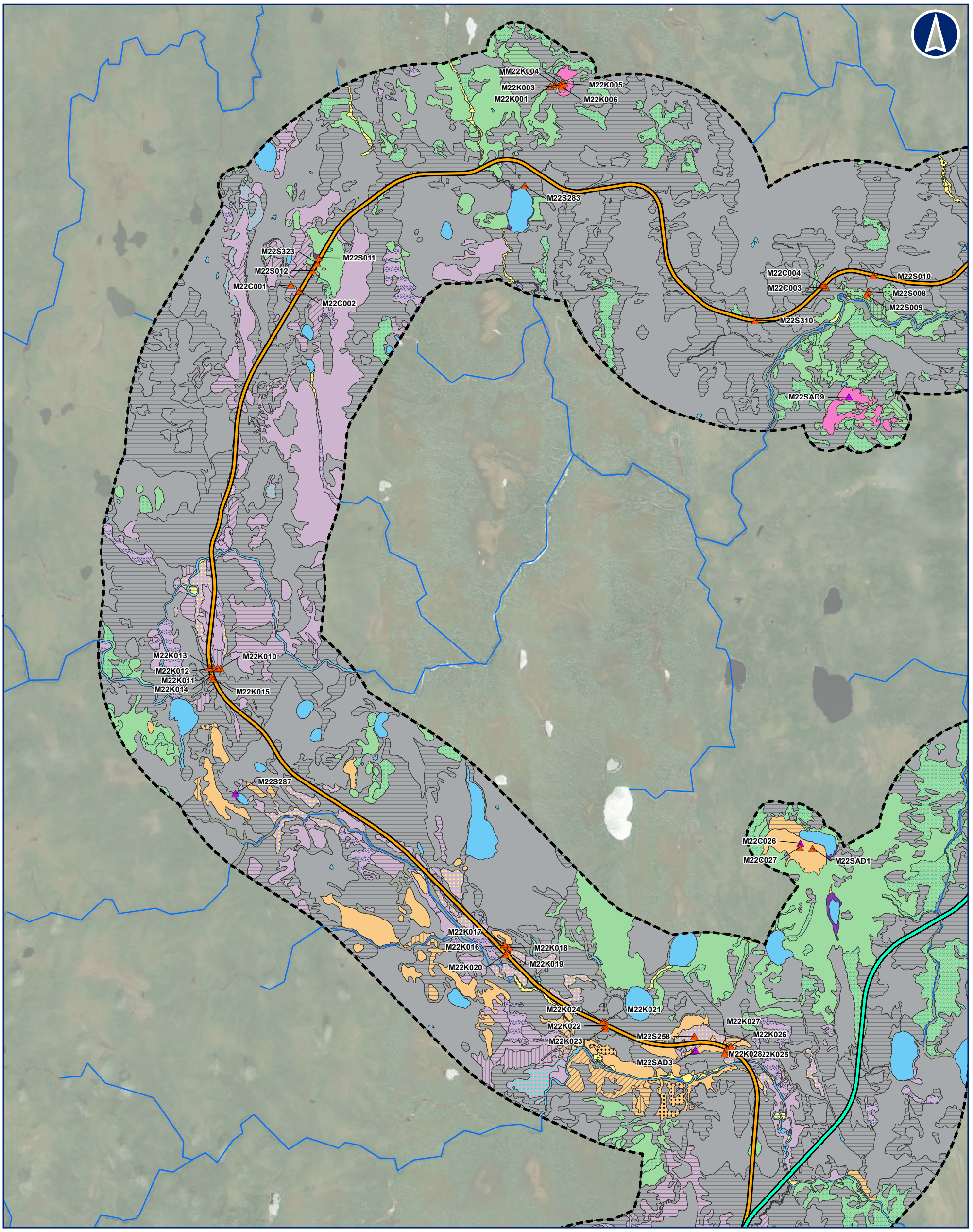

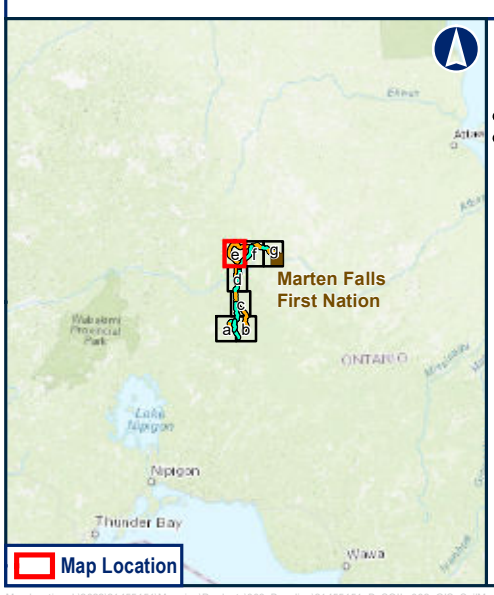

Legend

- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

SOIL MAPPING UNITS (SMU)

- FLUVIAL (F1)
- FLUVIAL (F2)
- FLUVIAL (F3)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF3)
- GLACIOFLUVIAL (GF4)
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- GLACIOLACUSTRINE (GL1)
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- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
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- GLACIOLACUSTRINE (GL8)
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- LACUSTRINE (L2)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M2)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M7)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- WATERBODY (ZWA)

Notes:
Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 — 2.25 — 4.5
Kilometres

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Figure B-4e

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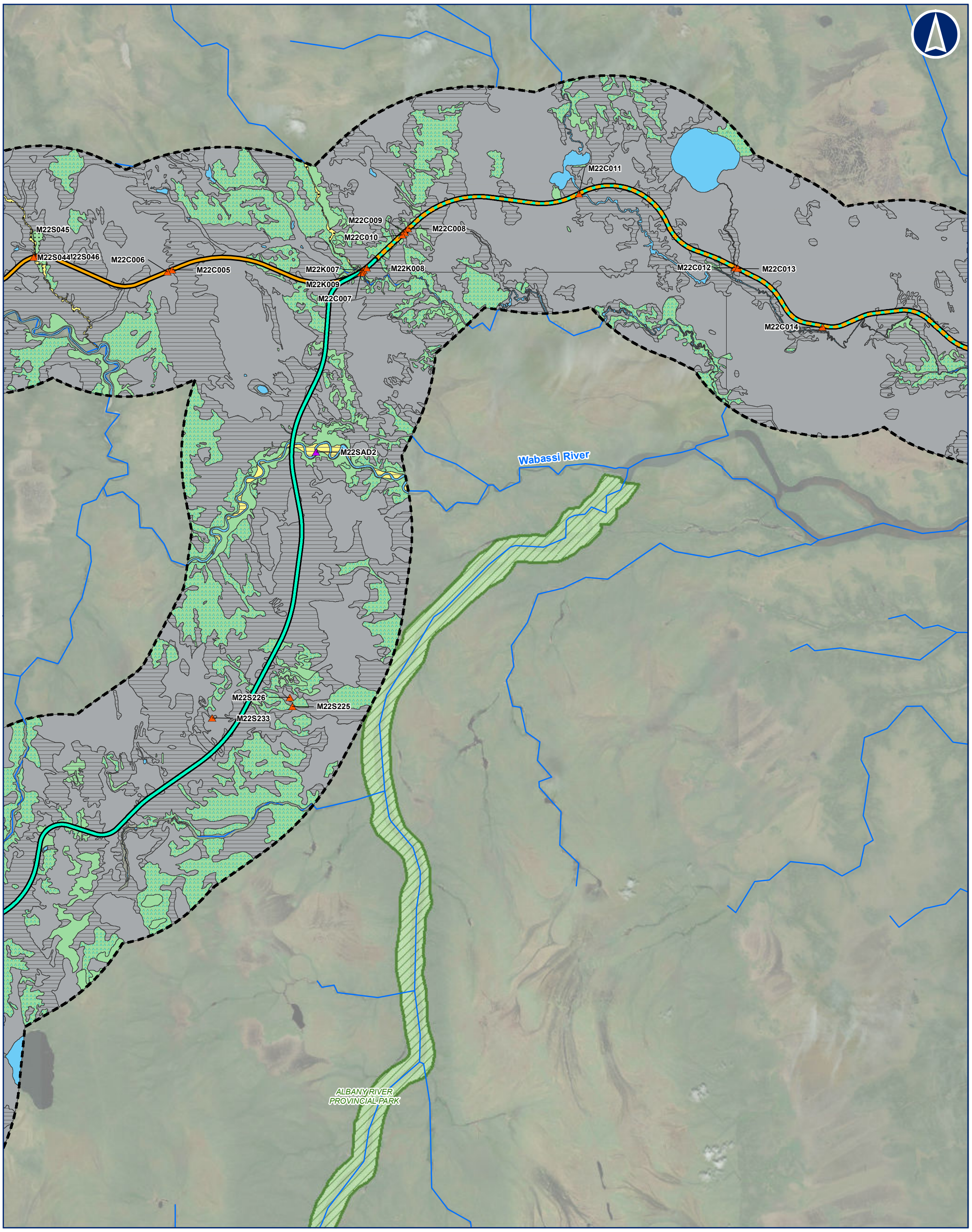

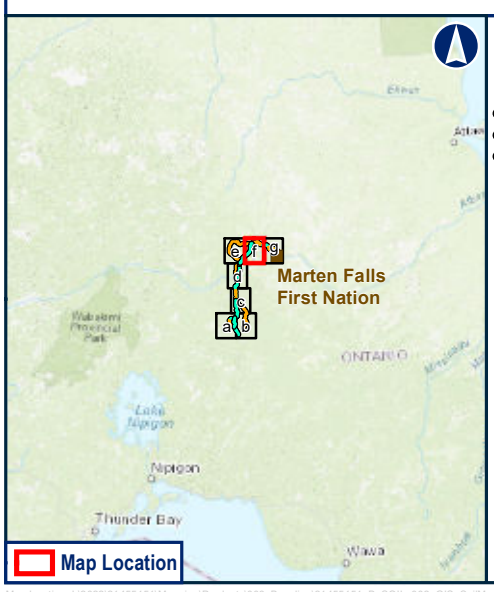

Legend

- WATERCOURSE
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1
- ALTERNATIVE 4
- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)

- COLLUVIUM (C1)
- FLUVIAL (F1)
- FLUVIAL (F2)
- FLUVIAL (F3)
- MORAINAL (M1)
- MORAINAL (M2)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- WATERBODY (ZWA)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 — 2.25 — 4.5
Kilometres

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Figure B-4f

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M22C020
M22C022
M22C018
M22C017
M22S004
M22C019
M22S05A
Buffaloskin River
M22S252
M22S253
M22S054
M22S055
M22C024
M22C023
M22C025

Marten Falls First Nation

Map Location

Legend

- WATERCOURSE
- LOCAL STUDY AREA

COMMUNITY ACCESS ROAD ALTERNATIVES CENTERLINE

- ALTERNATIVE 1 AND ALTERNATIVE 4

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- FIRST NATION COMMUNITY

SOIL MAPPING UNITS (SMU)

- COLLUVIUM (C1)
- FLUVIAL (F1)
- FLUVIAL (F2)
- FLUVIAL (F3)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF3)
- LACUSTRINE (L2)
- MORAINAL (M1)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- DISTRUBED LAND (ZDL)
- WATERBODY (ZWA)

Notes:

Detailed Soil Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EXISTING CONDITIONS LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure B-4g

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Attachment C – Abbreviation Key and Detailed Terrain and Soil Field Data

Soil and Terrain Abbreviation Key and Detailed Field Data

Table C-1: Moisture Regime

Code	Class	Description
0	Very Xeric	Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after precipitation
1	Xeric	Water moved very rapidly in relation to supply; soil is moist for brief periods following precipitation
2	Subxeric	Water removed rapidly in relation to supply; soil is moist for short periods following precipitation
3	Submesic	Water removed readily in relation to supply; water available for moderately short periods following precipitation
4	Mesic	Water removed somewhat slowly in relation to supply. Soil may remain moist for a significant period of the year.
5	Subhygric	Water removed slowly; soils are wet for a significant part of the growing season. Possible mottling below 20 cm.
6	Hygric	Water removed slowly; soils are wet for most of the growing season. Soils are often gleyed.
7	Subhydric	Water removed slowly; water table at or near the surface for most of the year.
8	Hydric	Water removed very slowly; water table at or above the surface all year.

Adapted from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

Table C-2: Nutrient Regime

Code	Description
A	Very Poor
B	Poor
C	Medium
D	Rich

Adapted from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

Table C-3: Slope Position

Code	Description
DP	Depression
LV	Level
LW	Lower Slope
MD	Middle Slope
UP	Upper Slope
TO	Toe Slope
CR	Crest

Adapted from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

Table C-4: Terrain Surface Texture

Code	Description
c	Clay
d	Mixed fragments
e	Fibric organic
g	Gravel
h	Humic organic
p	Pebbles
s	Sand
u	Mesic organic
z	Silt

Adapted from: Terrain Classification System for British Columbia (Howes and Kenk 1997)

Table C-5: Surficial Material

Code	Description
F	Fluvial
L	Lacustrine
FG	Glaciofluvial
LG	Glaciolacustrine
M	Morainal/Till
C	Colluvium
O	Organic
R	Bedrock

Adapted from: Terrain Classification System for British Columbia (Howes and Kenk 1997)

Table C-6: Surface and Subsurface Expression

Code	Name	Description
a	Moderate Slope	Unidirectional slopes between 27 and 50%
b	Blanket	A layer of unconsolidated material greater than 1m thick
f	Fan	Relatively smooth sector of a cone with a slope gradient from apex to toe up to and including 26%
h	Hummocks (s)	Steep sided hillock and hollows with multidirectional slopes dominantly between 26 to 70%. Local relief is greater than 1m.
j	Gentle Slopes	Unidirectional slopes between 7 – 26%
p	Plain (>m 3 m)	Level of very gentle sloping, unidirectional surface between 0 – 5%
r	Ridges	Elongate hillocks with slopes dominantly between 26 – 70%
u	Undulating	Gently sloping hillock and hollows with multidirectional slopes generally up to 26%
v	Veneer	Surficial material is less than 1 m thick
w	Mantel of Variable Thickness	A layer of discontinuous layer of surficial material of variables thickness (between 0 – 3 m). Generally, too thin to mask prominent irregularities in the underlying material

Adapted from: Terrain Classification System for British Columbia (Howes and Kenk 1997)

Table C-7: Soil Drainage

Code	Description
x	Very rapidly drained – water is removed from the soil very rapidly in relation to supply, soils are typically fragmental or skeletal, or shallow, or both.
r	Rapidly drained– water is removed from the soil rapidly in relation to supply
w	Well drained – water is removed from the soil somewhat slowly in relation to supply because of imperviousness or lack of gradient.
m	Moderately well drained – Water is removed from the soil somewhat slowly in relation to supply because of imperviousness or lack of gradient.
i	Imperfectly drained – water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season.
p	Poorly drained – water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen.
v	Vey poorly drained - Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen

Codes from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

Table C-8: Soil Subgroup Classification

Code	Description
BR.GL	Brunisolic Gray Luvisol
D.GL	Dark Gray Luvisol
E.DYB	Eluviated Dystric Brunisol
E. EB	Eluviated Eutric Brunisol
FI.M	Fibric Mesisol
GL.EB	Gleyed Eutric Brunisol
GL.GL	Gleyed Gray Luvisol
GL.R	Gleyed Regosol
GLCU.R	Gleyed Cumulic Regosol
GLD.GL	Gleyed Dark Gray Luvisol
GLE.EB	Gleyed Eluviated Eutric Brunisol
HI.FO	Histic Folisol
HU.M	Humic Mesisol
ME.F	Mesic Fibrisol
ME.H	Mesic Humisol
O.EB	Orthic Eutric Brunisol
O.G	Orthic Gleysol
O.GL	Orthic Gray Luvisol
O.HFP	Orthic Humo-Ferric Podzol
O.LG	Orthic Luvic Gleysol
O.R	Orthic Regosol
PZ.GL	Podzolic Gray Luvisol
R.G	Rego Gleysol
R.HG	Rego Humic Gleysol
SZ.GL	Solonetzic Gray Luvisol
T.F	Terric Fibrisol
T.H	Terric Humisol
T.M	Terric Mesisol
TFI.M	Terric Fibric Mesisol
THU.F	Terric Humic Fibrisol
THU.M	Terric Humic Mesisol
TME.F	Terric Mesic Fibrisol
TME.H	Terric Mesic Humisol
TY.F	Typic Fibrisol
TY.H	Typic Humisol
TY.M	Typic Mesisol

Defined in The Canadian System of Soil Classification (Soil Classification Working Group 1998)

Table C-9: Soil Texture

Code	Description
C	Clay
CL	Clay loam
fS	Fine Sand
fSL	Fine sandy loam
HC	Heavy Clay
L	Loam
LfS	Loamy Fine Sand
LS	Loamy Sand
S	Sand
SC	Sandy Clay
SCL	Sandy clay loam
Si	Silt
SiC	Silty Clay
SiCL	Silty clay loam
SiL	Silty Loam
SL	Sandy Loam
vfSL	Very Fine Sandy loam

Codes from: Manual for Describing Soils in the Field (Government of Manitoba 2007).

Table C-10: Soil Structure

Code	Description
ABK	Angular Blocky
GR	Granular
MA	Massive
PL	Platy
PR	Prismatic
SBK	Subangular Blocky
SGR	Single Grained

Codes from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

Table C-11: Consistence

Code	Description
FM	Firm
FR	Friable
LO	Loose
PL	Pliable

Codes from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

Table C-12: Soil Mottling

Abundance		Size		Contrast	
Code	Description	Code	Description	Code	Description
C	Common	C	Coarse	D	Distinct
F	Few	F	Fine	F	Faint
M	Many	M	Medium	P	Prominent

Codes from: Field Manual for Describing Terrestrial Ecosystems (British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment 2010)

References

British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment. 2010. Field Manual for Describing Terrestrial Ecosystems. 2nd ed. Forest Science Program, Victoria, B.C. Land Manag. Handb. No. 25. Available at: https://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh25/Lmh25_ed2_(2010).pdf

Government of Manitoba. 2007. Manual for Describing Soils in the Field (Revised 2007). Available at: https://www.gov.mb.ca/agriculture/soil/soil-survey/pubs/manual_for_describing_soils_in_the_field.pdf.

Howes, D. E. and E. Kenk. 1997. Terrain Classification System for British Columbia, Version 2. B.C. Ministry of Environment. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/terclass_system_1997.pdf

Soil Classification Working Group. 1998. The Canadian System of Soil Classification, 3rd ed. Agriculture and Agri-Food Canada Publication 1646, 187 pp.

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22C001	Ground	2022	513126	5740235	228	–	7	B	0	–	LV	Pad not cleared yet so added this in. Can land and shut down here.	e	O	b	zc	LG	p	NA	v	–	–	T.F	Om	120-140	–	–	–	–	–	–	–
																								Of	0-120	–	–	–	–	–	–	–
																								Cg	140-160	10Y4/1	SIC	–	FM	0	–	–
M22C002	Ground	2022	513359	5740083	230	–	7	C	0	–	LV	Decomposed wood in profile but mainly mesic.	u	O	b	c	LG	p	NA	v	–	–	TY.M	Om	10-190	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Cg	190-200	5GY5/1	C	/MA		0	–	–
M22C003	Ground	2022	527699	5740187	189	–	7	C	0	–	LV	–	u	O	v	sz	F	b	NA	v	0	–	THU.M	Oh	40-75	–	–	–	–	–	–	–	–
																								Om	0-40	–	–	–	–	–	–	–
																								Cg	75-120	5Y3/2	L	–	FR	0	–	Yes
M22C004	Ground	2022	527623	5740240	204	–	5	B	0	–	LV	Could be GL.R but with seepage at 40 and >30 cm organic, sphagnum hummocks in some areas, black spruce and the occasional larch, bumped to poor and Gleysol	zc	M	p	–	–		NA	p	42	–	R.G	F	32-20	–	–	–	–	–	–	–
																								H	20-0	–	–	–	–	–	–	–
																								Cg	0-21	10YR4/4	CL	–	FR	5	–	Yes
																								Ckg1	21-32	10YR5/3	CL	–	FR	15	–	Yes
																								Ckg2	32-90	2.5Y6/2	SiCL	–	FR	2	–	Yes
M22C005	Ground	2022	535701	5740657	193	–	7	B	0	–	LV	–	u	O	v	c	M	p	NA	v	–	–	T.M	Om	17-55	–	–	–	–	–	–	–
																								Of	0-17	–	–	–	–	–	–	–
																								Cg	55-100	10YR4/3	C	–	FM	2	–	–
M22C006	Ground	2022	535570	5740602	188	–	7	B	0	–	LV	Some carbonate concretions in Cg but matrix not carbonated.	u	O	b	zc	LG	v	NA	v	60	–	T.M	Oh	140-150	–	–	–	–	–	–	–
																								Om	10-140	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Cg	155-165	N4/1	SIC	/MA	FM	0	–	–
M22C007	Ground	2022	540853	5740572	182	✓	7	C	0	–	LV	–	cz	F	b	–	M	p	U, M	p	–	–	R.G	Of	20-0	–	–	–	–	–	–	–
																								Cg	0-60	5Y3/2	SICL	/MA	–	0	–	–
M22C008	Ground	2022	542126	5741785	202	✓	4	B	0	–	CR	–	gcz	M	p	–	–	–	NA	m	–	–	PZ.GL	L	10-3	–	–	–	–	–	–	–	–
																								H	3-0	–	–	–	–	–	–	–
																								Ae	0-6	10YR6/2	VFSL	C/PL	FR	1	–	Yes
																								Bfj	6-10	5YR3/4	CL	F/GR	FR	0	–	Yes

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								Bt	10-33	7.5YR4/4	CL	F/SBK	FM	4	–	Yes
																								Ck	33-80	10YR5/4	CL	/MA	FM	10	–	Yes
M22C009	Ground	2022	542043	5741678	198	✓	4	C	3	90	LW	–	zc	M	p	–	–	–	NA	M	–	–	O.GL	F	11-0	–	–	–	–	–	–	–
																								Ae	0-10	10YR6/3	L	F/PL	FR	3	–	–
																								Bt	10-18	7.5YR3/3	CL	F/SBK	FR	3	–	–
																								Ck	18-100	7.5YR4/4	CL	/MA		5	–	–
M22C010	Ground	2022	541973	5741606	193	✓	7	B	0	–	LV	–	u	O	v	szc	M	p	NA	v	–	–	T.M	Om	15-80	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–
																								Cg	80-100	10YR5/3	CL	/MA	FM	3	–	–
M22C011	Ground	2022	546784	5742728	172	✓	7	C	0	–	LV	Likely organic on other side of creek so did just 1 point here. Heli landed at point. Veg mostly Care urticulata and Lari lar.	u	O	b	zc	LG	v	NA	v	–	–	T.M	Om	10-125	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Cg	125-140	N4/1	CL	–	–	0	–	–
M22C012	Ground	2022	551039	5740721	173	✓	7	B	0	–	LV	–	eu	O	b	szc	M	p	NA	v	–	–	FI.M	Om	45-170	–	–	–	–	–	–	–
																								Of	0-45	–	–	–	–	–	–	–
																								Ckg	170-180	5Y5/1	CL	/MA	FR	2	–	–
M22C013	Ground	2022	551111	5740692	175	✓	7	C	0	–	LV	–	eu	O	b	zc	M	p	NA	v	–	–	T.M	Om	45-135	–	–	–	–	–	–	–
																								Of	0-45	–	–	–	–	–	–	–
																								Ckg	135-160	10Y4/1	SICL	–	FM	2	–	–
M22C014	Ground	2022	553420	5739104	175	✓	7	C	0	–	LV	Taller trees but same terrain poly as north. Lots of blueberries on the way in. Ckg quite fine sand and silt texture.	u	O	b	zs	LG	p	NA	v	–	–	TY.M	Om	25-165	–	–	–	–	–	–	–
																								Of	0-25	–	–	–	–	–	–	–
																								Ckg	165-175	10Y4/1	VFSL	–	FM	0	–	–
M22C015	Ground	2022	563440	5735153	168	✓	7	C	0	–	LV	–	ue	O	b	zc	M	p	NA	v	60	–	TY.F	Om	135-200	–	–	–	–	–	–	–
																								Of	0-135	–	–	–	–	–	–	–
																								Ckg	200-210	10Y4/1	SICL	–	FM	2	–	–
M22C016	Ground	2022	563430	5735076	165	✓	7	B	0	–	LV	Thought frozen, but three steps out and able to auger, so must have been a log at 100.	e	O	b	zc	M	p	NA	v	–	–	ME.F	Om	130-175	–	–	–	–	–	–	–
																								Of	0-130	–	–	–	–	–	–	–
																								Ckg	175-185	10Y4/1	SICL	/MA	FM	1	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22C017	Ground	2022	569549	5733065	164	✓	7	B	0	–	LV	Thought mineral from mapping but thick peat.	u	O	b	szc	LG	p	NA	v	–	–	T.M	Om	20-150	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Cg	150-170	10Y4/1	CL	/MA	FM	1	–	–
M22C018	Ground	2022	569505	5733069	164		7	D	0	–	DP	Creek channel. Still peat. Chalky concretions in Ckg but no coarse fragments. Unsure of mineral material because so few stones.	u	O	b	szc	LG	b	NA	v	–	–	TY.M	Om	0-170	–	–	–	–	–	–	–
																								Ckg	170-185	10Y4/1	CL	/MA	–	0	–	–
M22C019	Ground	2022	569480	5733058	167	✓	7	C	0	–	LV	Herd of about 10 caribou north of sites on the south side of lake at mouth of drainage.	eu	O	b	zc	LG	p	NA	v	–	–	T.M	Om	30-125	–	–	–	–	–	–	–
																								Of	0-30	–	–	–	–	–	–	–
																								Ckg	125-140	10YR4/1	CL	/MA	FM	1	–	–
M22C020	Ground	2022	573313	5733271	169	✓	7	B	0	0	LV	–	u	O	v	szc	M	p	NA	v	–	–	T.M	Oh	60-75	–	–	–	–	–	–	–
																								Om	20-60	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Ckg	65-100	10YR7/3	SIL	–	FM	1	C/M/D	–
M22C021	Ground	2022	573220	5733379	162	✓	7	C	0	–	LV	–	eu	O	b	zc	M	p	NA	v	–	–	T.M	Om	10-125	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Ckg	125-140	10YR4/1	SICL	/MA	FM	1	–	–
M22C022	Ground	2022	573830	5732734	162	✓	4	B	4	250	MD	In pad area but think just veg disturbed and not soil.	zc	M	r	–	–	–	NA	w	–	–	O.EB	F	6-0	–	–	–	–	–	–	–
																								Ae	0-1	10YR7/2	SL	–	LO	0	–	–
																								Bm	1-30	10YR5/6	CL	F/SBK	FR	3	–	Yes
																								Ck	30-100	10YR5/4	CL	/MA	FR	4	–	Yes
M22C023	Ground	2022	577531	5725801	168	✓	4	C	2	280	MD	–	zc	M	u	–	–	–	NA	w	–	–	BR.GL	L	4-3	–	–	–	–	–	–	–
																								F	3-0	–	–	–	–	–	–	–
																								Ae	0-5	10YR5/2	L	F/PL	LO	4	–	–
																								Bm	5-18	10YR4/4	CL	F/SBK	FM	5	–	–
																								Bt	18-45	5YR4/4	C	F/SBK	FM	10	–	–
																								Ck	45-80	10YR5/3	CL	–	FM	12	–	–
M22C024	Ground	2022	577410	5725616	157	✓	6	C	0	–	LV	Interesting site - was previously a peatland, but recent fluvial activity has deposited half a metre	sg	F	v	h	O	b	U	i	35	–	GLCU.R	F	2-0	–	–	–			–	–
																								C	0-25	–	–	–	LO	100	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
												of fluvial sediment over 1.5 m of peat. Unsure how to classify this, but the terrain call is not a mistake.												Cgj	25-50	2.5Y3/2	LS	–	–	50	–	–
																								Om	50-200	–	–	–	–	–	–	–
																								IICg	200-220	10YR4/1	LS	/SGR	FR	15	–	–
M22C025	Ground	2022	577445	5725661	163	✓	3	B	2	1	LV	Added this site based on exposed sand and gravel at road cut. Unsure of extent, but potential aggregate here.	zds	FG	b	–	M	p	NA	w	–	–	E.EB	F	3-0	–	–	–	–	–	–	–
																								Ae	0-6	10YR6/2	LS	–	LO	10	–	–
																								Bm	6-21	7.5YR4/6	LFS	/SGR	LO	40	–	–
																								BC	21-27	10YR6/4	LFS	/SGR	LO	10	–	–
																								Ck1	27-40	10YR7/2	FSL	/MA	LO	5	–	–
																								Ck2	40-58	10YR4/3	CS	/SGR	LO	20	–	–
																								Ck3	58-100	10YR7/2	LFS	/SGR	LO	3	–	–
M22C026	Visual	2022	527007	5725038	230	✓	–	–	30	350	MD	Visual, so limited horizon info collected. BC horizon gets coarser with depth.	s	FG	a	–	–	–	V	r	–	–	E.EB	F	8-0	–	–	–	–	–	–	–
																								Ae	0-5	–	S	–	–	0	–	–
																								Bm	5-20	–	S	/SGR	LO	2	–	–
																								BC	20-100	–	CS	/SGR	LO	5	–	–
																								Ck	100-120	–	S	/SGR	–	5	–	–
M22C027	Ground	2022	526982	5724930	239	✓	3	C	2	0	MD	More gravel and cobbles than on eroded slopes down to lake, but a bit finer textures with less sand. Think still FG, but unsure how thick.	zds	FG	u	–	–	–	NA	w	–	–	E.DYB	F	3-0	–	–	–	–		–	–
																								Ae	0-7	10YR7/2	LS	/SGR	–	20	–	–
																								Bm	7-26	7.5YR4/6	L	M/SBK	LO	4	–	–
																								BC	26-38	7.5YR5/6	SL	/MA	LO	25	–	–
																								Ck	38-90	10YR6/3	FSL	/SGR	LO	25	–	–
M22K001	Ground	2022	520196	5745652	229	–	7	A	0	–	LV	–	ue	O	b	szc	M	p	NA	v	–	–	T.F	Om	90-105	–	–	–	–	–	–	–
																								Of	0-90	–	–	–	–	–	–	–
																								Ckg	105-120	10YR4/2	C	/MA	FM	5	F/F/P	
M22K002	Ground	2022	520330	5745699	227	–	7	B	2	180	LW	–	eu	O	b	–	M	p	NA	v	20	–	TY.M	Om	15-180	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22K003	Ground	2022	520436	5745685	234	–	6	B	2	340	LW	–	zsc	M	u	–	–	–	NA	p	-	–	O.G	Of	25-0	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								Bg	0-20	10YR6/3	SL	M/PL	FM	10	F/M/P	–
																								Ckg	20-120	10YR5/4	C	/MA	FM	5	–	–
M22K004	Ground	2022	520499	5745735	226	–	7	B	0	–	LV	–	ue	O	p	–	–	–	NA	v	–	–	TY.F	Om	160-180	–	–	–	–	–	–	–
																								Of	0-160	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22K005	Ground	2022	520574	5745725	231	–	7	B	1	210	MD	–	szc	M	u	–	–	–	NA	p	–	–	R.G	Of	35-10	–	–	–	–	–	–	–
																								Oh	10-0	–	–	–	–	–	–	–
																								Ckg	0-100	10YR5/3	C	/MA	FM	5	F/M/P	–
M22K006	Ground	2022	520497	5745634	231	–	7	B	7	70	MD	–	e	O	v	–	R	u	NA	v	–	28	THU.F	Of	26-12	–	–	–	–	–	–	–
																								Oh	12-0	–	–	–	–	–	–	–
																								Cg	0-2	10YR5/3	C	/MA	FM	5	F/M/P	–
																								R	2-3	–	–	–	–	–	–	–
M22K007	Ground	2022	540918	5740645	182	✓	7	B	0	–	LV	–	e	O	v	zsc	M	p	NA	v	–	–	T.F	Of	0-60	–	–	–	–	–	–	–
																								Ckg	60-120	10YR5/3	CL	/MA	FM	5	C/M/P	–
M22K008	Ground	2022	541000	5740707	181	✓	7	B	0	–	LV	–	hue	O	b	szc	M	p	NA	v	–	–	TME.F	Oh	90-110	–	–	–	–	–	–	–
																								Om	50-90	–	–	–	–	–	–	–
																								Of	0-50	–	–	–	–	–	–	–
																								Ck	110-120	10YR5/4	C	/MA	FM	5	F/M/P	–
M22K009	Ground	2022	540878	5740604	183	✓	5	B	9	270	LW	–	zsc	M	u	–	–	–	NA	m	–	–	O.GL	L	7-5	–	–	–	–	–	–	–
																								F	5-0	–	–	–	–	–	–	–
																								Ae	0-15	7.5YR6/2	L	M/PL	FR	2	–	–
																								Bt	15-55	7.5YR5/4	C	F/SBK	FM	5	–	–
																								Ckgj	55-100	7.5YR4/4	CL	/MA	FM	5	C/M/D	–
M22K010	Ground	2022	511204	5729795	235	–	7	B	0	–	LV	–	he	O	v	szc	LG	p	NA	v	–	–	THU.F	Oh	60-100	–	–	–	–	–	–	–
																								Of	0-60	–	–	–	–	–	–	–
																								Ckg	100-120	2.5Y6/2	SIC	/MA	FM	0	–	–
M22K011	Ground	2022	511121	5729803	237	–	6	C	3	140	LW	–	cz	LG	u	–	–	–	NA	p	–	–	R.G	Of	10-0	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								Ckg	0-110	2.5Y6/3	SIL	/MA	FR	0	F/F/P	–
M22K012	Ground	2022	511018	5729806	240	–	7	D	2	100	TO	–	h	O	v	–	–	–	NA	v	–	–	T.H	Oh	15-45	–	–	–	–	–	–	–
																								Om	0-15	–	–	–	–	–	–	–
																								Bg	45-65	2.5Y3/2	SIL	/MA	FR	0	–	–
																								Ckg	65-110	2.5Y6/3	SIL	/MA	FR	0	F/C/D	–
M22K013	Ground	2022	510907	5729821	237	–	7	B	0	-	LV	–	e	O	v	–	–	–	NA	v	–	–	T.F	Of	0-60	–	–	–	–	–	–	–
																								Cg	60-80	10YR4/4	SIC	/MA	FM	0	–	–
																								Ckg	80-120	2.5Y6/3	SIL	/MA	FR	0	–	–
M22K014	Ground	2022	510946	5729569	236	–	7	B	0	-	LV	–	he	O	v	–	–	–	NA	v	–	–	THU.F	Oh	55-85	–	–	–	–	–	–	–
																								Of	0-55	–	–	–	–	–	–	–
																								Cg	0-35	10Y3/1	SIC	/MA	FM	0	–	–
M22K015	Ground	2022	511017	5729506	232	–	7	B	0	-	LV	Water table at surface in between hummocks.	u	O	b	–	–	–	NA	v	–	–	TY.M	Om	0-175	–	–	–	–	–	–	–
																								Cg	175-190	10Y3/1	SIC	/MA	FM	0	–	–
M22K016	Ground	2022	518923	5722252	224	–	4	C	4	60	MD	–	cz	LG	b	–	–	–	NA	w	–	–	O.GL	L	7-6	–	–	–	–	–	–	–
																								F	6-2	–	–	–	–	–	–	–
																								H	2-0	–	–	–	–	–	–	–
																								Ae	0-16	10R6/2	SL	M/PL	FR	0	–	–
																								Bt	16-40	10YR4/4	SCL	M/SBK	FM	0	–	–
																								Ck	40-100	10YR6/4	SIL	/MA	FR	0	–	–
M22K017	Ground	2022	518938	5722291	222	–	3	C	4	110	UP	–	zs	FG	u	–	–	–	NA	r	–	–	E.EB	F	5-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR6/1	LS	/SGR	LO	0	–	–
																								Bm	4-33	7.5YR4/6	SL	/SGR	LO	0	–	–
																								Ck	33-110	2.5Y6/3	LS	/SGR	LO	0	–	–
M22K018	Ground	2022	519086	5722196	224	–	7	B	0	–	LV	Unsure of surface expression for GF material. Plain call chosen based on observations made at M22K018 and mapping calls of thick deposit (though mapping called GL).	hu	O	b	–	–	–	NA	v	–	–	THU.M	Oh	70-120	–	–	–	–	–	–	–
																								Om	0-70	–	–	–	–	–	–	–
																								Cg	120-135	10Y5/1	LS	/SGR	LO	5	–	–
M22K019	Ground	2022	519018	5722090	229	–	3	C	15	240	MD	–	zs	FG	u	–	–	–	NA	r	–	–	E.EB	L	5-4	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								F	4-1	–	–	–	–	–	–	–
																								H	1-0	–	–	–	–	–	–	–
																								Ae	0-11	10YR6/2	LS	/SGR	LO	5	–	–
																								Bm	11-46	7.5YR5/8	LS	/SGR	LO	5	–	–
																								Ck	46-110	2.5Y6/3	LS	/SGR	LO	0	–	–
M22K020	Ground	2022	518957	5722004	225	–	3	B	6	240	MD	–	dzs	F	f	–	–	–	V	r	–	–	E.EB	Of	4-1	–	–	–	–	–	–	–
																								Oh	1-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR6/1	LS	/SGR	LO	5	–	–
																								Bm	4-36	7.5YR5/8	LS	/SGR	LO	15	–	–
																								Ck	36-110	10YR5/3	SL	/SGR	LO	15	–	–
M22K021	Ground	2022	521681	5720184	215	✓	7	B	0	–	LV	–	he	O	v	dzc	M	p	NA	v	–	–	THU.F	Oh	40-70	–	–	–	–	–	–	–
																								Of	0-40	–	–	–	–	–	–	–
																								Ckg	70-120	2.5Y5/3	C	/MA	FM	5	C/M/P	–
M22K022	Ground	2022	521686	5720069	211	✓	7	B	0	–	LV	Organic veneer over LG veneer over Till (plain?).	he	O	v	zc	LG	v	NA	v	–	–	THU.F	Oh	55-70	–	–	–	–	–	–	–
																								Of	0-55	–	–	–	–	–	–	–
																								Cg	70-110	10YR5/3	SIC	/MA	FM	0	C/F/P	–
																								IICkg	110-120	2.5Y6/3	C	/MA	FM	5	C/M/P	–
M22K023	Ground	2022	521684	5719991	217	✓	7	B	0	–	LV	–	he	O	b	zc	LG	v	NA	v	110	–	THU.F	Oh	60-105	–	–	–	–	–	–	–
																								Of	0-60	–	–	–	–	–	–	–
																								Cg	105-120	10Y3/1	SIC	/MA	FM	0	–	–
M22K024	Ground	2022	521619	5720181	211	✓	7	D	0	–	LV	–	h	O	b	czs	F	p	M	v	30	–	TY.H	Oh	0-165	–	–	–	–	–	–	–
																								Ckg	165-190	10Y6/1	SL	/MA	FR	15	–	–
M22K025	Ground	2022	525104	5719287	217	✓	5	C	3	280	MD	Coarse fragments encountered at base of pit, used to assign till underlying material.	cz	LG	B	–	M	u	NA	w	–	–	BR.GL	L	6-5	–	–	–	–	–	–	–
																								Fm	5-2	–	–	–	–	–	–	–
																								H	2-0	–	–	–	–	–	–	–
																								Ae	0-5	10YR6/2	SL	M/PL	LO	0	–	–
																								Bm	5-17	10YR4/6	L	VF/SBK	FR	0	–	–

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																								Bt	17-42	7.5YR4/3	SIC	M/SBK	FR	0	–	–
																								BCk	42-57	10YR5/3	SICL	/MA	FM	0	–	–
																								Ck	57-120	2.5Y7/3	SIL	/MA	FR	0	–	–
M22K026	Ground	2022	525102	5719506	226	✓	5	D	12	140	MD	No evidence of slumping apparent.	zs	FG	v	zc	M	u	NA	w	–	–	BR.GL	L	4-3	–	–	–	–	–	–	–
																								F	3-1	–	–	–	–	–	–	–
																								H	1-0	–	–	–	–	–	–	–
																								Ae	0-6	10YR6/2	LS	/SGR	LO	0	–	–
																								Bm	6-24	7.5YR4/6	LS	/SGR	LO	0	–	–
																								IIBt	24-80	10YR5/4	CL	M/SBK	FM	5	–	–
																								IICk	80-100	10YR6/3	SIC	/MA	LO	2	–	–
M22K027	Ground	2022	524999	5719447	231	✓	4	C	8	120	UP	–	zs	FG	u	–	–	–	NA	r	–	–	E.EB	L	4-3	–	–	–	–	–	–	–
																								F	3-1	–	–	–	–	–	–	–
																								H	1-0	–	–	–	–	–	–	–
																								Ae	0-4	7.5YR6/4	SL	/SGR	LO	0	–	–
																								Bfj	4-14	5YR4/6	SL	/SGR	LO	0	–	–
																								Bm	14-35	7.5YR4/6	SL	/SGR	LO	0	–	–
																								BC	35-80	2.5Y6/4	LS	/SGR	LO	0	–	–
																								Ck	80-100	2.5Y6/2	LS	/SGR	LO	0	–	–
M22K028	Ground	2022	524947	5719314	211	✓	7	B	0	–	LV	–	hue	O	b	zs	FG	p	NA	v	–	–	TFI.M	Oh	120-140	–	–	–	–	–	–	–
																								Om	50-120	–	–	–	–	–	–	–
																								Of	0-50	–	–	–	–	–	–	–
																								Ckg	140-170	10Y4/1	SL	/MA	FR	5	–	–
M22K029	Ground	2022	522196	5711750	220	✓	7	B	0	–	LV	–	u	O	b	zc	LG	p	NA	v	–	–	TY.M	Om	10-180	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Ckg	180-200	10Y4/1	SIC	/MA	FM	0	–	–
M22K030	Ground	2022	522270	5711727	217	✓	7	D	0	–	LV	Mineral could be deeper, but assuming it's within 3 m.	eu	O	B	–	LG	p	NA	v	–	–	TY.M	Of	150-220	–	–	–	–	–	–	–
																								Om	0-150	–	–	–	–	–	–	–

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M22K031	Ground	2022	522200	5711815	213	✓	8	D	0	–	LV	–	u	O	v	czs	F	b	M, U	v	–	–	T.M	Om	0-100	–	–	–	–	–	–	–
																								Cg	100-120	10YR3/2	SL	/MA	FR	2	–	–
M22K032	Ground	2022	520533	5709447	223	–	7	B	0	–	LV	–	heu	O	b	szc	M	p	NA	v	–	–	TY.M	Oh	160-170	–	–	–	–	–	–	–
																								Om	55-160	–	–	–	–	–	–	–
																								Of	0-55	–	–	–	–	–	–	–
																								Ckg	170-200	10Y4/1	C	/MA	FM	5	–	–
M22K033	Ground	2022	520563	5709423	215		8	D	0	–	LV	–	u	O	v	s	F	b	M, U	v	–	–	T.M	Om	0-85	–	–	–	–	–	–	–
																								Cg	85-100	10YR5/2	CS	/SGR	LO	2	–	–
M22K034	Ground	2022	525034	5706289	219	✓	7	B	0	–	LV	–	u	O	v	c	LG	p	NA	v	–	–	T.M	Om	0-90	–	–	–	–	–	–	–
																								Ckg	90-120	10Y5/1	HC	/MA	FR	0	–	–
M22K035	Ground	2022	525061	5706388	222	✓	7	C	0	–	LV	–	u	O	b	c	LG	p	NA	v	–	–	T.M	Om	0-150	–	–	–	–	–	–	–
																								Ckg	150-165	10Y5/1	HC	/MA	FM	0	–	–
M22K036	Ground	2022	524968	5706456	223	✓	5	C	2	50	MD	Seemed wetter in Bt but then relatively dry at depth. Ae discontinuous and full of mychorrizhal fungi.	cz	LG	p	–	–	–	NA	m	–	–	O.GL	F	6-1	–	–	–	–	–	–	–
																								H	1-0	–	–	–	–	–	–	–
																								Ae	0-3	7.5YR5/2	SICL	F/GR	FR	0	–	–
																								Bt	3-31	10YR4/3	SIC	M/SBK	FM	0	–	–
																								Ck	31-100	2.5Y6/4	SICL	/MA	FR	0	–	–
M22K037	Ground	2022	524918	5706326	217	✓	4	C	3	90	MD	–	zs	LG	p	–	–	–	NA	w	–	–	E.EB	F	6-0	–	–	–	–	–	–	–
																								Ae	0-7	10YR6/3	VFSL	F/PL	FR	0	–	–
																								Bm	7-28	10YR5/6	VFSL	F/PL	FR	0	–	–
																								Ck1	28-55	2.5Y6/3	SIL	F/PL	LO	0	–	–
																								Ck2	55-100	2.5Y6/2	LFS	/SGR	LO	0	–	–
M22K038	Ground	2022	519477	5700331	225	–	4	C	3	65	MD	Lots of blow down, so profile is a bit disturbed.	cz	LG	p	–	–	–	NA	w	–	–	E.EB	L	5-4	–	–	–	–	–	–	–
																								F	4-0	–	–	–	–	–	–	–
																								Ae	0-2	10YR7/2	SIL	F/PL	FR	0	–	–
																								Bm	2-13	10YR4/4	SICL	F/SBK	FR	0	–	–

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																								Ck	13-110	2.5Y6/3	SICL	/MA	FR	0	–	–
M22K039	Ground	2022	519627	5700368	214	–	7	D	0	–	LV	–	u	O	v	cz	LG	p	NA	v	45	–	T.M	Om	0-90	–	–	–	–	–	–	–
																								Cg	90-120	5Y5/2	SIL	/MA	FR	0	–	–
M22K040	Ground	2022	520639	5695443	224	✓	5	C	6	100	MD	Similar pit and texture to M22K038	csz	LG	j	–	–	–	NA	m	–	–	E.EB	F	8-0	–	–	–	–	–	–	–
																								Ae	0-8	10YR6/2	SIL	F/PL	FR	0	–	Yes
																								Bm	8-18	10YR4/4	SICL	F/PL	FR	0	–	Yes
																								Ck	18-120	2.5Y6/3	SIL	M/PL	FR	0	–	Yes
M22K041	Ground	2022	520514	5695433	232	✓	4	C	2	270	MD	–	cz	LG	p	–	–	–	NA	w	–	–	O.GL	F	7-2	–	–	–	–	–	–	–
																								H	2-0	–	–	–	–	–	–	–
																								Ae	0-5	10YR7/1	SICL	F/PL	FR	0	–	–
																								Bt	5-26	10YR4/3	HC	M/SBK	FM	0	–	–
																								Ck	15-100	2.5Y6/3	SICL	/MA	FR	1	–	–
M22K042	Ground	2022	516044	5640262	276	–	6	B	2	20	UP	Bedrock outcrops noted to the south. Likely FGvb	gzs	FG	b	–	R	p	NA	i	–	–	GL.EB	F	9-0	–	–	–	–	–	–	–
																								Bm	0-16	10YR4/3	L	F/SBK	LO	5	–	Yes
																								Ck1	16-35	2.5Y6/3	L	/MA	FR	5	–	Yes
																								Ck2	35-45	2.5Y5/3	SL	/MA	FR	75	–	Yes
																								Ck3	45-85	2.5Y6/3	SL	/MA	FR	5	–	–
																								Ckg	85-110	2.5Y6/3	SL	/MA	FR	5	C/M/P	–
M22K043	Ground	2022	515930	5640252	270	–	7	C	0	–	LV	–	hu	O	b	zsc	M	v	NA	v	–	–	THU.M	Oh	85-105	–	–	–	–	–	–	–	–
																								Om	0-85	–	–	–	–	–	–	–
																								Ckg	105-120	10Y4/1	SCL	/MA	FM	2	–	–
M22K044	Ground	2022	516080	5640402	270	–	7	B	0	–	LV	–	ue	O	b	sz	L	b	NA	v	–	–	FI.M	Om	70-210	–	–	–	–	–	–	–	–
																								Of	0-70	–	–	–	–	–	–	–
																								Cg	210-220	10Y5/1	SIL	/MA	FR	0	–	–
M22K045	Ground	2022	516111	5640339	269	–	7	B	0	–	LV	Material could be FG or beach Lacustrine since it's in a saddle between two lakes. Veg looks similar to organic site to north.	ue	O	b	csz	M	b	NA	v	–	–	TME.F	Om	90-140	–	–	–	–	–	–	–	–
																								Of	0-90	–	–	–	–	–	–	–
																								Ckg	140-160	10Y5/1	L	/MA	FR	5	–	–

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M22K046	Ground	2022	516191	5640411	277	–	5	C	2	60	MD	–	zc	M	b	–	R	u	NA	i	90	–	GL.GL	L	6-4	–	–	–	–	–	–	–
																								F	4-0	–	–	–	–	–	–	–
																								Ae	0-4	7.5YR5/2	L	M/PL	FR	5	–	–
																								AB	4-16	7.5YR4/3	CL	M/SBK	FR	15	–	–
																								Bt	16-36	7.5YR3/3	HC	M/SBK	FM	5	–	–
																								Ck	36-90	2.5Y6/3	SIC	/MA	FM	5	–	–
																								Ckg	90-110	2.5YR6/3	SICL	/MA	FM	5	M/M/P	–
M22K047	Ground	2022	521105	5656044	238	–	7	D	0	0	LV	Unsure of underlying material but likely mineral within 3 m.	u	O	b	–	M	b	NA	v	–	0	TY.M	Om	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22K048	Ground	2022	521084	5655985	240	–	7	D	0	–	LV	–	u	O	b	zc	M	b	NA	v	–	–	TY.M	Om	0-180	–	–	–	–	–	–	–
																								Ckg	185-200	10Y4/1	C	/MA	FM	3	–	–
M22K049	Ground	2022	521063	5655859	241	–	5	C	2	10	MD	Bedrock outcrops within 10-15 m of pit. Area previously burned.	cdz	M	B	–	R	u	NA	m	110	–	O.GL	F	4-0	–	–	–	–	–	–	–
																								Ae	0-3	7.5YR5/3	CL	M/PL	FR	3	–	–
																								Bt	3-25	7.5YR4/3	C	M/SBK	FM	10	–	–
																								BCk	25-70	10YR4/3	CL	/MA	FM	15	–	–
																								Ck	70-120	2.5Y6/3	L	/MA	FR	40	–	–
M22K050	Ground	2022	523050	5649777	246	–	8	D	0	–	LV	Landed on top of point. Water level above soil surface (20 cm) blocked by beaver dam.	u	O	v	zsc	M	p	M, U	v	–	–	T.M	Oh	65-80	–	–	–	–	–	–	–
																								Om	15-65	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–
																								Cg	80-100	10YR2/1	CL	/MA	FR	2	–	–
M22K051	Ground	2022	523050	5649735	247	–	5	C	2	10	MD	–	czd	M	b	–	R	u	NA	m	–	–	O.GL	L	2-1	–	–	–	–	–	–	–
																								F	1-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR4/2	HC	F/GR	FR	5	–	Yes
																								Bt	4-16	7.5YR3/2	HC	M/SBK	FM	2	–	Yes
																								BCk	16-37	10YR5/3	C	F/SBK	FM	2	–	Yes
																								Ck	37-120	2.5Y6/3	L	/MA	FR	65	–	Yes
M22K052	Ground	2022	522042	5645995	248	–	7	D	0	–	LV		u	O	v	uz	F	b		v	–	–	T.M	Om	0-55	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
												Organics buried throughout the Cg. No mottles but wet and peaty. Could be cumulic Rego but no distinct layers that could be pulled out as buried organic layers. Peat thickness varies. Likely some RG in this polygon. Could be hydric for SMR but no water here now.							U, M					Cg	55-120	10YR2/2	SIL	/MA	FR	1	–	–
M22K053	Ground	2022	522026	5646051	251	–	7	B	0	–	LV	–	ue	O	b	–	M	p	NA	v	–	–	ME.F	Om	100-220	–	–	–	–	–	–	–
																								Of	0-100	–	–	–	–	–	–	–
																								Cg	220-225	–	–	–	–	–	–	–
M22K054	Ground	2022	522026	5646095	250	–	7	C	0	0	LV	–	ue	O	b	csz	M	p	NA	v	–	–	FI.M	Om	170-215	–	–	–	–	–	–	–
																								Of	80-170	–	–	–	–	–	–	–
																								Om	0-80	–	–	–	–	–	–	–
																								Cg	215-220	10Y4/1	L	/MA	FR	2	–	–
M22K055	Ground	2022	522028	5646272	257	–	4	C	2	150	MD	Bedrock outcrops observed throughout area.	czd	M	v	–	R	u	NA	w	–	–	O.GL	L	3-2	–	–	–	–	–	–	–
																								F	2-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR5/3	CL	M/GR	FR	2	–	–
																								Bt	4-24	7.5YR4/3	C	M/ABK	FM	7	–	–
																								Ck	24-60	2.5Y6/3	L	/MA	FR	55	–	–
M22K056	Ground	2022	521972	5646099	251	–	4	C	2	90	LW	–	cdz	M	b	–	R	u	NA	m	90	–	O.GL	F	5-3	–	–	–	–	–	–	–
																								H	3-0	–	–	–	–	–	–	–
																								Ae	0-3	10YR5/3	CL	F/GR	FR	5	–	–
																								Bt	3-19	10YR4/3	C	M/SBK	FM	5	–	–
																								BCk	19-39	2.5Y5/3	CL	M/SBK	FM	15	–	–
																								Ck	39-120	2.5Y6/2	L	/MA	FR	45	–	–
M22K057	Ground	2022	532616	5643147	253	✓	7	C	0	–	LV	–	hu	O	b	zc	M	b	NA	v	–	–	T.M	Oh	140-155	–	–	–	–	–	–	–
																								Om	0-140	–	–	–	–	–	–	–
																								Ckg	155-170	10Y5/1	C	/MA	FM	2	–	–
M22K058	Ground	2022	532868	5643324	254	✓	4	C	2	270	MD	–	szd	M	b	–	R	u	NA	m	–	–	O.GL	L	4-3	–	–	–	–	–	–	–
																								F	3-1	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								H	1-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR6/3	CL	F/SBK	FR	2	–	–
																								Bt	4-18	7.5YR4/3	C	M/SBK	FM	5	–	–
																								BCk	18-25	10YR5/3	SCL	/MA	FM	5	–	–
																								Ck	25-105	2.5Y6/2	SL	/MA	FR	55	–	–
M22K059	Ground	2022	532880	5643100	248	✓	7	C	0	–	LV	–	u	O	v	szd	M	b	NA	v	–	–	T.M	Om	0-80	–	–	–	–	–	–	–
																								Ckg	80-110	2.5Y6/2	SL	/MA	FR	45	–	–
M22K060	Ground	2022	532846	5642998	244	✓	7	B	0	–	LV	–	eu	O	p	–	–	–	NA	v	–	–	ME.F	Om	170-220	–	–	–	–	–	–	–
																								Of	70-170	–	–	–	–	–	–	–
																								Om	15-70	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–
																										–	–	–	–	–	–	–
M22K061	Ground	2022	532833	5643112	247	✓	7	C	0	–	LV	–	u	O	v	zc	M	b	NA	v	–	–	T.M	Oh	60-75	–	–	–	–	–	–	–
																								Om	0-60	–	–	–	–	–	–	–
																								Cg	75-100	10YR4/4	C	/MA	FM	2	–	–
M22L001	Ground	2022	522383	5688151	236	✓	4	C	2	340	MD	–	sz	LG	p	–	–	–	NA	w	–	–	O.GL	L	8-7	–	–	–	–	–	–	–
																								F	7-3	–	–	–	–	–	–	–
																								H	3-0	–	–	–	–	–	–	–
																								Ae	0-1	10YR7/2	FSL	/SGR	LO	0	–	–
																								Bt	1-30	10YR3/3	CL	M/SBK	FR	0	–	–
																								Ck	30-110	10YR7/4	SIL	/MA	FR	0	–	–
M22L002	Ground	2022	522350	5688002	242	✓	4	C	3	45	MD	–	czs	LG	u	–	–	–	NA	w	–	–	E.EB	L	5-4	–	–	–	–	–	–	–
																								F	4-2	–	–	–	–	–	–	–
																								H	2-0	–	–	–	–	–	–	–
																								Ae	0-2	7.5YR7/1	FSL	F/SBK	LO	0	–	–
																								Bm	2-9	10YR5/6	FSL	F/SBK	LO	0	–	–
																								Ck	9-110	10YR7/2	FSL	/MA	FR	0	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22L003	Ground	2022	522579	5688117	235	✓	5	C	1	–	LV	–	scz	LG	p	–	–	–	NA	I	–	–	GL.GL	F	15-0	–	–	–	–	–	–	–
																								Ae	0-15	10YR6/3	SL	M/PL	FR	0	–	–
																								Bt	15-32	10YR3/3	C	M/SBK	FM	0	–	–
																								Ckgj	32-90	10YR5/3	SICL	/MA	FM	0	–	–
M22L004	Ground	2022	522488	5688353	225	✓	8	B	0	–	LV	–	eu	O	b	c	LG	p	NA	v	50	–	TFI.M	Om	50-120	–	–	–	–	–	–	–
																								Of	0-50	–	–	–	–	–	–	–
																								Cg	120-150	10Y4/1	C	/MA	FM	0	–	–
M22L005	Ground	2022	522426	5688445	230	✓	4	C	0	–	LV	–	zc	LG	p	–	–	–	NA	m	–	–	BR.GL	F	8-0	–	–	–	–	–	–	–
																								Ae	0-6	7.5YR4/3	L	F/SBK	FR	0	–	–
																								Bt	6-20	10YR5/2	CL	M/SBK	FR	0	–	–
																								C	20-33	10YR3/3	C	F/SBK	FM	0	–	–
																								Ck	33-100	10YR5/3	SICL	–	FM	0	–	–
M22L006	Ground	2022	522363	5688281	225	✓	7	C	0	–	LV	–	eu	O	v	zc	LG	p	NA	v	30	–	T.M	Om	20-75	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Cg	75-100	2.5Y5/2	SIC	/MA	FM	0	–	–
M22L007	Ground	2022	518948	5682746	228	✓	7	C	0	–	LV	–	e	O	v	sz	LG	p	NA	p	0	–	R.G	Of	50-0	–	–	–	–	–	–	–
																								Ckg1	0-30	2.5Y3/1	SIC	/MA	FM	0	–	–
																								Ckg2	30-80	2.5Y7/2	SIL	/MA	FM	0	–	–
M22L008	Ground	2022	518881	5682815	226	✓	7	B	0	–	LV	–	eu	O	b	zc	LG	p	NA	v	40	–	TY.M	Om	40-200	–	–	–	–	–	–	–
																								Of	0-40	–	–	–	–	–	–	–
																								Ckg	200-220	2.5Y3/1	SIC	/MA	FM	0	–	–
M22L009	Ground	2022	518742	5682896	237	✓	5	C	2	160	LV	–	sz	LG	u	–	–	–	NA	m	-	–	O.GL	F	7-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR5/2	SL	F/PL	LO	0	–	–
																								Bt	4-20	10YR4/2	C	F/SBK	FR	0	–	–
																								Ck	20-110	2.5Y6/3	FSL	/MA	FR	0	–	–
M22L010	Ground	2022	517164	5630998	270	–	7	D	0	–	LV	Site on creek edge	eu	O	p	–	–	–	M	v	40	–	TY.M	Om	20-220	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22L011	Ground	2022	517186	5630988	271	–	7	C	0	–	LV	–	eh	O	b	–	M	p	NA	v	70	–	TY.M	Om	30-220	–	–	–	–	–	–	–
																								Of	0-30	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22L012	Ground	2022	517231	5631008	276	–	7	C	0	–	LV	Little recovery	eh	O	b	–	M	p	NA	v	30	–	TY.M	Oh	30-220	–	–	–	–	–	–	–
																								Of	0-30	–	–	–	–	–	–	–
																										–	–	–	–	–	–	–
M22L013	Visual	2022	523128	5622010	299	–	–	–	12	0	UP	Outcrop	–	R	u	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22L014	Ground	2022	523067	5622076	287	–	6	B	13	0	MD	Little soil on outcrop. Classification to be checked.	se	O	w	–	R	u	NA	p	–	16	HI.FO	Of	13-3	–	–	–	–	–	–	–
																								Oh	3-0	–	–	–	–	–	–	–
																								C	0-3	10YR3/1	CSL	/SGR	LO	10	–	–
																								R	23+	–	–	–	–	–	–	–
M22L015	Ground	2022	523015	5622096	282	–	3	B	30	10	MD	MbR in downsloping cleft in between solid exposed bedrock faces	zds	M	b	–	R	a	NA	r	–	–	O.HFP	Of	9-0	–	–	–	–	–	–	–
																								Ae	0-9	10YR7/1	LS	/SGR	LO	4	–	–
																								Bf	9-43	5YR4/3	LS	/SGR	LO	5	–	Yes
																								Bf2	43-110	5YR2.5/2	SL	/SGR	LO	16	–	–
M22L016	Ground	2022	520047	5672474	243	✓	5	C	0	–	LV	Gleyed Dark Grey Luvisol. Sampled for nuc and voc	dzs	M	p	–	–	–	NA	i	–	–	GLD.GL	Of	10-0	–	–	–	–	–	–	Yes
																								Ahe	0-9	2.5Y2.5/1	C	F/SBK	LO	0	–	Yes
																								BA	9-14	10YR4/2	C	M/SBK	FM	2	–	Yes
																								Bt	14-29	10YR4/3	HC	F/SBK	FM	2	–	Yes
																								Ckgj	29-110	2.5Y6/3	SL	/MA	FR	17	F/M/D	Yes
M22L017	Ground	2022	520087	5672488	241	✓	7	B	0	–	LV	–	eu	O	v	dsc	M	p	NA	v	20	–	T.M	Om	15-100	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–
																								Ckg	100-120	2.5Y5/2	SCL	/MA	–	15	–	–
M22L018	Ground	2022	520084	5672381	235	✓	7	C	999	–	LV	–	ue	O	b	sc	M		NA	v	70	99	TY.F	Om	70-180	–	–	–	–	–	–	–
																								Of	0-70	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								Ckg	180-220	10Y6/1	SCL	/MA	FM	10	–	–
M22L019	Ground	2022	520030	5672343	237	✓	7	C	0	–	LV	Possibly till from 180	eu	O	b	c	LG	p	NA	v	50	–	TFI.M	Om	50-150	–	–	–	–	–	–	–
																								Of	0-50	–	–	–	–	–	–	–
																								Cg	150-180	10Y6/1	C	/MA	FM	0	–	–
M22L020	Ground	2022	520436	5670290	242	✓	8	B	0	–	LV	–	u	O	b	c	LG	p	NA	V	–	40	TY.M	Om	20-170	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Cg	170-200	10Y5/1	C	/MA	FM	0	–	–
M22L021	Ground	2022	520398	5670434	245	✓	5	C	1	275	MD	–	sc	LG	v	dsc	M	p	NA	m	–	–	O.GL	L	4-3	–	–	–	–	–	–	–
																								F	3-2	–	–	–	–	–	–	–
																								H	2-0	–	–	–	–	–	–	–
																								Ae	0-4	10YR6/3	L	M/PL	FR	0	–	–
																								Bt	4-32	10YR3/6	C	F/SBK	FR	0	–	–
																								Ckgj	32-60	10YR6/3	CL	/MA	FR	0	C/F/F	–
																								IICkgj	60-120	10YR5/4	SCL	/MA	FR	10	C/F/F	–
M22L022	Ground	2022	520317	5670418	245	✓	7	B	0	–	LV	–	u	O	v	c	LG	p	NA	v	–	–	T.M	Om	0-60	–	–	–	–	–	–	–
																								Cg	60-100	10Y4/1	C	/MA	FM	0	–	–
M22L023	Ground	2022	519758	5668005	238	✓	7	C	0	–	LV	–	eu	O	b		LG	b	NA	v	50	–	TY.M	Om	50-220	–	–	–	–	–	–	–
																								Of	0-50	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22L024	Ground	2022	519682	5667894	235	✓	7	B	0	–	LV	–	eu	O	b		LG	b	NA	v	50	–	TY.M	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22L025	Ground	2022	519596	5667728	238	✓	7	C	0	–	LV	–	eh	O	v	c	M	b	NA	v	50	–	T.M	Oh	70-90	–	–	–	–	–	–	–
																								Om	0-70	–	–	–	–	–	–	–
																								C	90-105	10Y5/1	C	–	FM	15	F/M/D	–
M22L026	Ground	2022	519588	5667656	243	✓	7	C	0	–	LV	–	hu	O	v	dsc	M	p	NA	v	40		THU.M	Oh	35-65	–	–	–	–	–	–	–
																								Om	0-35	–	–	–	–	–	–	–
																								Cg	65-100	2.5Y5/2	SCL	/MA	FR	11	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22L027	Ground	2022	518442	5664129	242	✓	7	C	0	–	LV	–	eu	O	v	sc	M	p	NA	v	60	–	T.M	Om	10-50	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Ckg	50-100	5Y7/2	CL	/MA	FR	5	F/F/P	–
M22S003	Ground	2022	519992	5663187	233	✓	5	C	1	–	LV	Along river but no signs of fluvial action despite proximity to river.	dzc	F	v	–	M	p	NA	p	–	–	R.G	Om	32-0	–	–	–	–	–	–	–
																								Cg	0-70	10YR5/1	SIC	/MA	PL	25	C/F/D	–
M22S004	Ground	2022	573862	5732688	160	✓	7	C	0	–	LV	–	eu	O	v	c	M	p	U	v	–	–	TFI.M	Om	20-55	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Ckg	55-120	2.5Y6/1	C	/MA	–	2	–	–
M22S008	Ground	2022	528853	5740056	205	–	7	B	0	–	LV	Geochem sample taken. Till rather than LG based on sandier matrix and clasts.	u	O	v	csz	M	p	NA	v	–	–	T.M	Oh	50-60	–	–	–	–	–	–	–
																								Om	5-50	–	–	–	–	–	–	–
																								Of	0-5	–	–	–	–	–	–	–
																								Ckg	60-155	N6/1	SICL	–	–	5	–	–
M22S009	Ground	2022	528808	5739966	195	–	6	B	0	–	LV	Seepage measured from surface.	csz	M	p	–	–	–	NA	p	110	–	O.G	Om	35-0	–	–	–	–	–	–	–
																								Bg	0-19	10YR5/1	SIL	–	–	5	–	–
																								Ckg	19-100	10YR6/2	SICL	–	–	5	–	–
M22S010	Ground	2022	528989	5740488	204	–	7	B	0	–	LV	1 or 2 small pebbles in C. Subangular. Still feel LG rather than M.	u	O	b	szc	LG	b	NA	v	–	–	TY.M	Om	10-200	–	–	–	–	–	–	–
																								Of	0-10	–	–	–	–	–	–	–
																								Ckg	–	N6/1	SIC	–	–	–	–	–
M22S011	Ground	2022	513878	5740980	234	–	6	C	0	–	LV	Beaver impacted. Standing water everywhere. Seems like till but think depositions of lacustrine. Can't pull soil up from depth - wet sand.	czs	L	b	–	M	p	U	p	–	–	R.G	–	–	–	–	–	–	–	–	–
																								Ah	0-28	10YR3/2	SL	–	–	0	–	Yes
																								Cg1	28-55	2.5Y4/4	C	/MA	FR	2	–	Yes
																								Cg2	55-120	7.5YR3/4	L	/SGR	–	3	–	Yes
M22S012	Ground	2022	513714	5740635	239	–	6	C	0	–	LV	Soil frozen to 60 cm. Two veg types - taller stands of black spruce and low stands of black spruce with taller larch. Don't see much soil development but also not much for gleying. Based on thick peat, vegetation, and lack of profile development, assume drainage is poor.	szc	M	p	–	–	–	L	p	33	–	R.G	F	31-0	–	–	–	–	–	–	–
																								Bg	0-30	7.5YR3/3	CL	/MA	–	5	–	–
																								Ckg	30-90	10YR4/4	CL	/MA	–	5	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
												Seepage may not be the right call - think water table high here in general.																					
M22S028	Ground	2022	524057	5619112	265	–	5	C	2	–	LV	Peaty but no mottling or low chroma	szc	LG	b	–	R	p	NA	m	73	–	D.GL	O	17-0	–	–	–	–	–	–	Yes
																								Ahe	0-14	10YR4/1	CL	F/SBK	FR	0	–	Yes
																								Bt	14-39	10YR5/3	HC	M/SBK	FM	0	–	Yes
																								C	39-145	10YR7/3	C	/MA	FM	0	–	Yes
																								R	145+	–	–	–	–	–	–	–
M22S029	Ground	2022	524098	5619281	267	–	6	C	2	–	LV	–	scz	LG	b	–	R	p	NA	p	110	–	O.LG	Om	11-0	–	–	–	–	–	–	–
																								Ahe	0-7	10YR4/1	SICL	F/SBK	FR	0	–	–
																								Btgk	7-32	10YR5/2	SIC	M/SBK	FR	0	C/F/P	–
																								Ckg	32-125	10YR6/2	SICL	–	FR	0	C/M/P	–
																								R	125+	–	–	–	–	–	–	–
M22S030	Visual	2022	524170	5619975	262	–	6	C	0	0	DP	Poor to very poor drainage. Close to upland, so thinking not thick lacustrine deposit, overlying till. Rego humic gleysol.	scz	F	v	c	F	v	U	p	–	–	R.HG	Of	15-0	–	–	–	–	–	–	–
																								Ah	0-35	2.5Y2.5/1	SIC	–	–	–	–	–
																								Cg	35-41	2.5Y4/2	SIC	/MA	–	–	–	–
																								Ahb	41-60	5Y2.5/1	SICL	–	–	–	–	–
																								Ckg	60-85	10YR5/4	C	–	–	–	–	–
M22S032	Ground	2022	511407	5639735	289	–	7	B	0	–	LV	–	u	O	v	gs	M	x	NA	v	–	80	TFI.M	Om	55-75	–	–	–	–	–	–	Yes
																								Of	35-55	–	–	–	–	–	–	Yes
																								Om	15-35	–	–	–	–	–	–	Yes
																								Of	0-15	–	–	–	–	–	–	–
																								Cg	75-80	–	LS	–		50	–	–
																								R	80-81	–	–	–	–	–	–	–
M22S033	Ground	2022	511825	5639861	287	–	7	B	0	–	LV	Frozen at 40 cm.	e	O	v	zds	M	x	NA	v	–	70	T.M	Om	30-75	–	–	–	–	–	–	–
																								Of	0-3	–	–	–	–	–	–	–
																								Cg	75-85	–	LS	–	–	45	–	–
																								R	85-86	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22S034	Ground	2022	511172	5640091	293	–	7	B	0	–	LV	Bedrock at 80 cm	u	O	v	–	R	p	NA	v	–	80	T.M	Om	40-80	–	–	–	–	–	–	–
																								Om	0-40	–	–	–	–	–	–	–
																								R	80-81	–	–	–	–	–	–	–
M22S041	Ground	2022	520161	5703787	215	–	7	C	0	–	LV	Silt from 90 to 120	uz	O	v	cz	LG	p	U	p	–	–	T.M	L	41-31	–	–	–	–	–	–	–
																								Om	31-13	–	–	–	–	–	–	–
																								Om	5-0	–	–	–	–	–	–	–
																								Cg	13-5	10YR5/1	SIL	/MA	–	0	M/F/P	–
																								IICg	0-64	10BG4/1	C	/MA	–	0	M/C/P	–
																								IICkg	64-89	10Y6/1	SI	/MA	–	0	–	–
M22S042	Ground	2022	520217	5703842	226	–	7	C	1	–	LV	–	h	O	b	z	LG	b	NA	v	–	–	FI.H	Om	90-110	–	–	–	–	–	–	–	–
																								Oh	40-90	–	–	–	–	–	–	–
																								Of	0-40	–	–	–	–	–	–	–
																								Ckg	110-130	2.5Y7/3	SI	/MA	–	0	–	–
M22S044	Ground	2022	531928	5741000	200	–	6	C	0	–	TO	Potentially rich nutrient regime but no veg yet, just bare soil. Prominent mottles, so Gleysol but note cumulic effects due to frequent flooding from creek.	csz	F	p	–	–	–	U	p	–	–	R.G	L	4-0	–	–	–	–	–	–	–
																								Cg1	0-90	2.5Y4/2	L	/MA	–	1	M/C/P	Yes
																								Cg2	90-120	5Y3/1	L	–	–	0	–	Yes
M22S045	Ground	2022	531996	5741017	216	–	6	B	1	250	LV	This could be lower water table in late summer. No prominent mottling but comes across as anGleysol based on peaty horizons, landscape, vegetation (sphagnum)	sz	M	p	–	–	–	NA	p	25	–	R.HG	F	29-7	–	–	–	–	–	–	–
																								H	7-0	–	–	–	–	–	–	–
																								Ah	0-10	10YR2/2	SICL	–	–	2	–	–
																								Ckg	10-80	2.5Y5/3	SIL	–	–	4	–	–
M22S046	Ground	2022	532156	5741020	204	–	7	B	0	–	LV	Peat frozen at 30 cm. Didn't expect to have such thick peat. Till under LG at 155.	u	O	b	c	LG	v	NA	v	–	–	TME.H	Oh	80-125	–	–	–	–	–	–	–
																								Om	55-80	–	–	–	–	–	–	–
																								Of	0-55	–	–	–	–	–	–	–
																								Cg	125-155	5Y3/2	C	–	–	0	–	–
																								IICkg	155-170	5Y5/2	SICL	–	–	5	–	–
M22S054	Ground	2022	577669	5726003	157	✓	5	C	3	48	LW	Think this may be colluvial or fluvial. Thin, discontinuous layer of buried organic at 29 cm.	szc	C	v	szc	M	p	Ru	i	60	–	GL.R	F	2-0	–	–	–	–	–	–	–
																								Ck	0-29	10YR4/4	CL	/MA	FR	3	–	–

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												Carbonated to surface. Slumps on bank behind us.												IICk	29-60	10YR5/4	CL	/MA	FM	3	–	–
																								IICkgj	60-120	10YR5/4	CL	/MA	–	8	–	–
M22S055	Ground	2022	577460	5726044	163	✓	5	C	0	–	LV	Adjacent to Rabbit Hill Creek. Seepage present at 55 cm. Thought I was in till at 60 cm but then gravel layer at 90 so may be all fluvial. Geochem sample taken.	cz	M	p	–	–	–	L	i	–	–	GL.GL	F	5-0	–	–	–	–	–	–	–
																								Ae	0-3	–	SIL	F/PL	FR	3	–	Yes
																								Bt	3-17	7.5YR4/4	CL	F/SBK	FR	8	–	Yes
																								Ckgj	17-80	–	SIC	/MA	–	1	F/F/F	Yes
																								IICkgj	80-120	10YR5/4	SICL	/MA	–	20	–	Yes
M22S059	Visual	2022	521825	5624204	253	–	–	–	0	–	LV	At edge of flooded area. Mainly organic with silty clay texture. Undifferentiated organic.	h	O	b	zc	LG	p	U	v	–	–	T.H	Oh	70-100	–	–	–	–	–	–	–
																								Oh	16-70	–	–	–	–	–	–	–
																								F	0-16	–	–	–	–	–	–	–
																								Cg	100-110	–	SiC					
M22S05A	Ground	2022	573755	5732760	164	✓	8	C	0	–	LV	Temporary flooding	uh	O	b	zc	M	p	NA	v	–	–	ME.H	Oh	70-110	–	–	–	–	–	–	–
																								Om	40-70	–	–	–	–	–	–	–
																								Oh	20-40	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Ckg	110-115	5YR6/1	SIC	/MA	FM	3	M/C/P	
M22S060	Ground	2022	521785	5624233	257	–	7	B	2	135	MD	–	e	O	b	zc	LG	p	NA	v	–	–	T.F	Om	105-110	–	–	–	–	–	–	–
																								Of	0-105	–	–	–	–	–	–	–
																								Ah	110-115	5Y2.5/1	SIC	–	–	–	–	–
																								Ckg	115-220	2.5Y7/4	SIC	–	–	–	–	–
M22S074	Visual	2022	512310	5636219	324	–	–	–	0	–	CR	–		R	u	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S081	Ground	2022	524692	5708677	203	✓	7	D	0	–	LV	–	e	O	b	zc	LG	p	U	v	–	99	T.F	Of	0-150	–	–	–	–	–	–	–
																								Ckg	150-200	10G5/1	SIC	/MA	–	–	–	–
M22S096	Ground	2022	562829	5736895	178	✓	7	B	0	–	LV	LG overlying till plain with 2% coarse frags. Check for borehole data to confirm till. Perhaps all LG.	u	O	v	zc	LG	v	NA	v	–	–	T.M	Om	0-90	–	–	–	–	–	–	–
																								Ckg	90-140	N6/1	SIC	–	PL	0	C/M/P	–
																								IICkg	140-200	N6/1	SIC	–	FM	2	C/M/P	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22S097	Ground	2022	562681	5737005	166	✓	7	C	0	–	LV	Terrain call likely Op.	eu	O	p	–	–	–	NA	v	–	–	ME.F	Om	120-220	–	–	–	–	–	–	–
																								Of	0-120	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S105	Ground	2022	524632	5708680	219	✓	6	B	1	–	LV	–	zc	LG	p	–	–	–	NA	p	–	–	O.G	L	18-0	–	–	–	–	–	–	–
																								Bg1	0-12	10YR5/3	SIC	M/SBK	FM	0	–	–
																								Bg2	12-38	10YR4/3	SIC	F/SBK	FM	0	–	–
																								Ckg1	38-78	10YR6/2	SIC	/MA	FM	0	–	–
																								Ckg2	78-105	10YR7/2	SIC	/MA	FM	0	–	–
M22S112	Ground	2022	524166	5702650	204	✓	7	D	0	–	LV	Surface mineral is a fluvial deposit of organic and mineral.	czu	F	v	zc	LG	p	U	v	5	–	R.G	Om	55-80	–	–	–	–	–	–	–
																								Om	10-40	–	–	–	–	–	–	–
																								Cg1	0-10	10YR5/1	SIL	/MA	–	–	–	–
																								Cg2	40-55	10YR5/1	SIL	/MA	–	–	–	–
																								IICkg	80-120	N6/1	SIC	/MA	–	–	–	–
M22S113	Ground	2022	524035	5702628	215	✓	7	B	0	–	LV	–	u	O	v	c	LG	p	NA	v	–	–	HU.M	Oh	45-65	–	–	–	–	–	–	–
																								Om	20-45	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Ckg	65-110	10YR6/2	C	/MA		0	–	–
M22S114	Ground	2022	524145	5702795	228	✓	7	C	0	–	LV	–	e	O	v	zc	LG	p	NA	v	25	–	T.F	Om	60-70	–	–	–	–	–	–	–
																								Of	0-60	–	–	–	–	–	–	–
																								Cg	70-120	2.5Y5/1	SIC	/MA	–	–	–	–
M22S115	Ground	2022	523660	5698403	220	✓	7	B	1	–	LV	–	e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S116	Ground	2022	523801	5698426	221	✓	7	C	1	135	LV	–	e	O	v	scz	M	p	NA	v	–	–	THU.F	Oh	60-80	–	–	–	–	–	–	–
																								Of	0-60	–	–	–	–	–	–	–
																								Ckg	–	2.5Y6/1	SIL	/MA		5	–	–
M22S125	Ground	2022	522205	5688949	229	✓	7	C	0	–	LV	–	u	O	b	c	LG	p	NA	v	–	–	TY.M	Om	15-205	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–

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																								Cg	205-220	5GY4/1	C	/MA	–	0	–	–
M22S126	Ground	2022	522329	5689053	236	✓	4	C	3	260	MD	–	sz	LG	p	–	–	–	NA	w	–	–	O.GL	F	9-0	–	–	–	–	–	–	–
																								Ae	0-5	10YR4/3	SIL	M/PL	FR	0	–	–
																								Bt	5-26	7.5YR3/3	SICL	F/ABK	FM	0	–	–
																								Ck	26-120	2.5Y5/4	VFSL	/MA	FR	0	–	–
M22S127	Ground	2022	522440	5689124	232	✓	4	C	2	60	MD	Very fine sand in texture. No signs of gleying but seepage at 43 cm. Called MW because think spring seepage and not reflective of drainage.	sz	LG	p	–	–	–	NA	m	43	–	O.GL	F	6-0	–	–	–	–	–	–	–
																								Ae	0-5	10YR4/3	SIL	C/PL	FR	0	–	Yes
																								Bt	5-12	7.5YR3/3	SiL	F/SBK	FR	0	–	Yes
																								Ck	12-120	2.5Y5/4	SiL	/MA	FR	0	–	Yes
M22S128	Ground	2022	522612	5689307	232	✓	7	D	0	–	LV	Pockets of Om, but mainly var8ng levels of decomposition in Of horizons. Need to add numbers to different Of	e	O	b	–	LG	p	NA	v	–	–	TY.F	Om	200-230	–	–	–	–	–	–	–
																								Of2	90-200	–	–	–	–	–	–	–
																								Of1	0-90	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S129	Ground	2022	522664	5689414	229	✓	7	B	0	–	LV	–	e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S149	Ground	2022	520452	5668918	236	✓	8	B	0	–	LV	–	e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S150	Ground	2022	520644	5668838	238	✓	7	C	0	–	LV	–	u	O	b	zc	LG	p	NA	v	–	–	TY.M	Om	0-170	–	–	–	–	–	–	–
																								Ckg	170-170	N6/1	SIC	/MA	–	0	–	–
M22S151	Ground	2022	520884	5668758	243	✓	4	B	3	270	MD	–	cz	M	u	–	–	–	NA	i	–	–	GL.R	L	14-0	–	–	–	–	–	–	–
																								Ck	0-25	10YR5/3	SIC	F/SBK	FM	2	–	–
																								Ckgj	25-110	2.5Y6/3	SIL	/MA	FR	5	–	–
M22S153	Ground	2022	519852	5665695	244	✓	7	B	999	–	LV	–	e	O	b	–	M	b	NA	v	–	–	–	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S154	Ground	2022	519882	5665568	246	✓	7	B	0	–	LV	–	eu	O	b	–	M	b	NA	v	–	–	FI.M	Of	100-220	–	–	–	–	–	–	–
																								Om	50-100	–	–	–	–	–	–	–
																								Of	0-50	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22S155	Ground	2022	519761	5665369	249	✓	5	C	0	–	LV	–	scz	M	b	–	R	p	NA	p	30	–	O.G	Om	17-0	–	–	–	–	–	–	–
																								Bg	0-29	10YR5/1	SIC	–	PL	5	–	–
																								Ckg	29-120	10YR6/2	SIC	–		5	–	–
M22S156	Ground	2022	519542	5665283	240	✓	7	B	0	–	LV	–	u	O	p	–	–	–	–	v	–	–	TY.F	Oco	180-220	–	–	–	–	–	–	–
																								Of	0-180	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S157	Ground	2022	519980	5663269	242	✓	5	C	2	180	MD	–	dzc	M	b	–	M	p	U	p	15	–	O.G	L	8-0	–	–	–	–	–	–	–
																								Bg	0-25	10YR5/1	SIC	F/SBK	–	19	–	–
																								Ckg	25-120	10YR7/1	SIC	/MA	–	20	–	–
M22S158	Ground	2022	519974	5663057	244	✓	4	C	2	330	MD	Unsure of PM. Not till. Depositions of clay and sand. Lake relatively near by. Structure at surface is granular, with depth turns into pseudo coarse, strong sub angular blocky.	zc	L	v	zs	LG	v	NA	m	–	–	O.R	F	4-0	–	–	–	–	–	–	–
																								C1	0-16	10YR4/4	SICL	M/SBK	–	0	–	–
																								C2	16-43	7.5YR3/3	SIC	F/SBK	–	0	–	–
																								IICk1	43-80	10YR4/4	SICL	/MA	–	0	–	–
																								IICk2	80-120	2.5Y5/4	FS	/MA	–	1	–	–
M22S161	Ground	2022	520210	5657962	248	–	4	C	2	250	MD		c	LG	v	szc	M	u	NA	m	–	–	SZ.GL	L	2-0	–	–	–	–	–	–	–
																								Bm	0-14	10YR4/4	HC	F/GR	FR	0	–	Yes
																								Btnj	14-27	10YR4/3	HC	M/PR	FR	–	–	Yes
																								Bm2	27-44	10YR4/4		VF/SBK	FR	0	–	Yes
																								Ck	44-65	10YR6/3	HC	/MA	FR	0	–	Yes
																								IICkg	65-110	2.5Y6/2	L	/MA	FR	20	–	Yes
M22S162	Ground	2022	520156	5657621	246	–	7	D	0	99	LV		e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S164	Ground	2022	521660	5650022	250	–	8	C	0	–	LV		e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S165	Ground	2022	521800	5650039	258	–	4	C	1	185	LV	Upper portion of pit is wet and sticky and difficult to dig. Moved point due to lack of time.	zc	LG	v	psz	M	v	NA	m	35	–	O.R	F	3-0	–	–	–	–	–	–	–
																								Ck1	0-13	10YR4/4	SIC	M/SBK	–	0	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
												Think saturated soil in pit is product of snow ,let and soil thaw rather than drainage, however don't think drainage is well. No profile development noted. Carbonates in upper two horizons is weak but confirmed present.												Ck2	13-29	7.5YR3/3	SIC	F/SBK	–	0	–	–
																								Ck3	29-80	2.5Y5/4	SI	/MA	–	0	–	–
																								IICk	80-120	2.5Y5/4	SCL	–	–	10	–	–
M22S170	Ground	2022	519788	5628264	271	–	7	B	0.5	–	LV	–	h	O	v	szc	LG	p	NA	v	–	–	T.H	Oh	5-55	–	–	–	–	–	–	–
																								Of	0-5	–	–	–	–	–	–	–
																								Cg	55-60	10YR6/1	SICL	–	FR	0	C/M/P	–
M22S171	Ground	2022	519865	5628562	277	–	5	C	2	–	LV	seepage from organic layer. Bedrock at 40 cm below mineral surface.	szc	LG	v	–	R	u	NA	p	–	40	O.LG	Om	20-0	–	–	–	–	–	–	–
																								Ahe	0-9	10YR4/1	LS	/SGR	LO	0	–	–
																								Bt	9-21	7.5YR4/3	C	M/SBK	PL	0	–	–
																								Ckg	21-40	10YR5/1	C	–	PL	0	C/M/P	–
																								R	40+	–	–	–	–	–	–	–
M22S172	Ground	2022	519684	5628589	286	–	4	C	3	0	MD	–	ps	FG	v	csz	M	b	NA	i	32	–	GLE.EB	L	9-6	–	–	–	–	–	–	–
																								F	6-3	–	–	–	–	–	–	–
																								H	3-0	–	–	–	–	–	–	–
																								Ahe	0-7	10YR5/1	LS	/SGR	LO	20	–	–
																								Bm	7-25	7.5YR4/4	LS	/SGR	LO	25	–	–
																								IIBC	25-40	7.5YR5/3	SCL	/MA	LO	10	–	–
																								IICkgj	40-120	10YR6/1	SICL	/MA	–	5	–	–
M22S176	Visual	2022	521042	5625774	291	–	0	A	3	125	MD	Non soil - confirmed bedrock.	–	R	u	–	–	–	NA	–	–	–	–	S	5-0	–	–	–	–	–	–	–
																								R	–	–	–	–	–	–	–	–
M22S180	Visual	2022	523040	5621814	290	–	6	B	4	180	MD	Peaty phase	zs	FG	v	sc	M	b	–	p	22	–	R.G	Of	28-20	–	–	–	–	–	–	–
																								Om	20-0	–	–	–	–	–	–	–
																								Cg	0-55	–	LS	/MA	–	30	–	–
																								IICkg	55-110	2.5Y6/2	SC	/MA	–	12	–	–
M22S181	Ground	2022	523243	5621672	272	–	–	–	1	–	LV	0-15 cm Of, 15-30 cm Om, 30-65 cm Oh, Cg. O over M, no idea thickness of till although	h	O	v	zc	M	p	–	v	–	–	T.H	Om	15-30	–	–	–	–		–	–
																								Oh	15-65	–	–	–	–		–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
												bedrock ridge within 300-400 m. Assume at least a blanket.												Of	0-15	–	–	–	–	–	–	–
																								Cg	65-70	2.5Y2.5/1	SIC	/MA	–	3	–	–
M22S188	Visual	2022	533689	5634227	322	✓	–	–	4	–	CR	–	–	R	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S193	Ground	2022	531702	5640920	258	✓	5	C	1	–	LV	2% gravel sr	zc	M	b	–	R	u	NA	p	15	–	O.G	L	10-0	–	–	–	–	–	–	–
																								Bg	0-34	10YR5/1	SIC	F/SBK	PL	2	–	–
																								Ckg	34-120	10YR7/2	SIC	/MA	PL	2	C/M/D	–
M22S194	Ground	2022	531806	5640821	256	✓	7	B	0	–	LV	–	u	O	b	scz	M	b	NA	v	–	–	T.H	Oh	35-120	–	–	–	–	–	–	–	–
																								Om	20-35	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Ckg	120-220	10YR7/2	SIC	/MA	PL	3	–	–
M22S195	Ground	2022	531891	5640619	251	✓	7	B	0	–	LV	–	u	O	b	–	M	b	NA	v	–	–	TY.M	Om	20-220	–	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S196	Ground	2022	532002	5640659	251	✓	8	D	0	–	LV	See notes from 197	e	O	b	–	M	b	U	v	0	–	TY.F	Of	0-220	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S197	Ground	2022	532078	5640586	248	✓	8	D	0	–	LV	Organic may go to 3 m but not far from where land rises slightly.	e	O	b	–	L	p	U	v	0	–	TY.F	Of	0-220	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S198	Ground	2022	532117	5640181	256	✓	6	B	1	315	MD	–	zc	M	v	zs	M	v	L	p	20	–	O.LG	Of	13-4	–	–	–	–	–	–	–	–
																								Oh	4-0	–	–	–	–	–	–	–
																								Aegj	0-8	10YR7/2	SIL	F/PL	–	0	F/F/F	–
																								Btgj	8-48	10YR5/4	SIC	VF/SBK	–	5	F/F/F	–
																								Ckg	48-65	2.5Y7/2	SIC	/MA	–	7	–	–
																								IICkg	65-105	5Y6/2	SL	–	–	2	–	–
M22S215	Ground	2022	528918	5657196	235	–	8	D	0	–	LV	–	h	O	v	scz	F	b	U	v		–	T.H	Oh	0-50	–	–	–	–	–	–	–
																								Ah	50-62	2.5Y2.5/1	CL	–	–	2	–	–
																								Ckg	62-120	2.5Y6/1	SICL	–	–	2	M/F/P	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
M22S218	Ground	2022	528936	5657166	239	–	6	C	1	–	LV	–	szc	M	p	–	–	–	NA	p	–	–	O.LG	L	23-0	–	–	–	–	–	–	–
																								Ahe	0-7	2.5Y4/1	L	F/	FR	2	–	–
																								Aeg	7-19	2.5Y5/2	SL	F/PL	FR	2	–	–
																								Btg	19-37	2.5Y5/2	SICL	M/SBK	FR	2	C/F/P	–
																								Ckg	37-100	2.5Y6/3	CL	/MA	–	2	M/C/P	–
M22S219	Ground	2022	528999	5657109	251	–	5	C	2	240	MD	Frozen below LFH	scz	M	u	–	–	–	NA	p	–	–	GLD.GL	L	14-0	–	–	–	–	–	–	–
																								Ahe	0-14	10YR4/1	L	F/PL	FR	2	–	–
																								AB	14-20	2.5Y5/2	SIL	F/SBK	FR	2	–	–
																								Btgj	20-32	10YR5/3	SICL	M/SBK	FR	2	F/F/D	–
																								Ckgj	32-40	2.5Y5/3	SICL	–	–	2	F/F/D	–
M22S225	Ground	2022	538982	5728769	198	–	7	D	0	–	LV	–	u	O	b	zc	M	p	NA	v	–	–	TFI.M	Of	80-105	–	–	–	–	–	–	–
																								Om	0-80	–	–	–	–	–	–	–
																								Ckg	105-120	10Y4/1	SCL	–	–	3	–	–
M22S226	Ground	2022	538906	5729011	195	–	7	B	0	–	LV	Sundew at site	e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S233	Ground	2022	536795	5728453	200	–	7	B	0	–	LV	–	e	O	b	c	LG	p	NA	v	–	–	T.F	Oh	110-120	–	–	–	–	–	–	–
																								Of	0-110	–	–	–	–	–	–	–
																								Cg	120-130	N6/1	C	/MA	–	–	–	–
M22S239	Visual	2022	520383	5686260	247	–	–	–	0	–	LV	No classification or von post assigned due to visual air call.	–	O	p	–	–	–	–	v	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S244	Ground	2022	564171	5735343	174	–	7	C	0	–	LV	–	u	O	b	c	LG	p	NA	v	–	–	FI.M	Oh	90-100	–	–	–	–	–	–	–
																								Om	40-90	–	–	–	–	–	–	–
																								Of	0-40	–	–	–	–	–	–	–
																								Ckg	100-120	5Y5/1	SIC	–	FR	0	–	–
M22S250	Ground	2022	561976	5738197	179	–	7	B	0	–	LV	Think this should be split out from south portion of polygon.	u	O	b	scz	M	p	NA	v	–	–	T.M	Om	80-120	–	–	–	–	–	–	–
																								Om	25-80	–	–	–	–	–	–	–
																								Of	0-25	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								Ckg	120-180	5Y4/1	SICL	–	–	3	–	–
M22S252	Ground	2022	575550	5727321	158	–	6	C	0	–	LV	Beaver impacted area	zc	L	v	s	F	b	U	p	–	–	R.G	L	2-0	–	–	–	–	–	–	–
																								Ah	0-8	10YR3/3	SIL	/MA	–	0	–	–
																								Cg	8-100	10YR4/3	CL	/MA	FR	0	M/M/P	–
																								IICg	100-120	10YR4/3	S	/SGR	–	0	–	–
M22S253	Ground	2022	575655	5727292	159	–	6	B	1	–	LV	–	zc	M	u	–	–	–	NA	p	–	–	O.G	L	8-0	–	–	–	–	–	–	–
																								Bg	0-27	10YR5/2	CL	F/SBK	–	2	–	–
																								Ckg	27-100	10YR6/2	SIC	/MA	–	5	–	–
M22S258	Ground	2022	524118	5719784	2362	✓	4	C	–	10	MD	Transitional horizon between Bt and Ck (possibly additional Ck horizon as it is carbonated). Varves/layers of clay and silt but frozen. Difficult to dig and auger. On higher elevation and so LG perhaps over till. Or eroded LG? Unsure of underlying parent material. South side of feature with gullies has sand. Up to crest is LG	cz	LG	b	–	M	p	NA	m	–	–	O.GL	F	6-0	–	–	–	–	–	–	Yes
																								Ae	0-5	10YR6/1	VFSL	C/PL	–	0	–	Yes
																								Bt	5-36	7.5YR3/3	HC	M/SBK	–	0	–	Yes
																								Ck	36-120	2.5Y5/4	SiC	/MA	–	0	–	Yes
M22S259	Ground	2022	522157	5689503	240	–	4	C	4	246	MD	Interesting because different depositions with texture and carbonation. Walked through a significant depression filled with water to the east	zc	LG	v	sz	LG	p	NA	w	–	–	O.GL	F	8-0	–	–	–	–	–	–	–
																								Ae	0-6	10YR4/4	SIL	–	FR	0	–	–
																								Bt	6-26	7.5YR4/3	SICL	F/SBK	FM	0	–	–
																								Ck1	26-41	10YR5/4	SICL	/MA	FR	0	–	–
																								C	41-80	7.5YR3/3	SIC	/MA	FM	0	–	–
																								Ck2	80-120	10YR5/4	SIL	/MA	FR	0	–	–
M22S272	Ground	2022	514757	5641958	275	–	7	D	0	–	LV	–	e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S273	Ground	2022	514750	5641747	273	–	7	C	0	–	LV	–	e	O	p	–	–	–	NA	v	–	–	ME.F	Of	160-220	–	–	–	–	–	–	–
																								Om	90-160	–	–	–	–	–	–	–
																								Of	0-90	–	–	–	–	–	–	–
																										–	–	–	–	–	–	–
M22S283	Ground	2022	519489	5742945	213	–	8	C	0	–	LV		e	O	b	–	L	p	U	v	–	–	ME.F	Of	70-150	–	–	–	–	–	–	–

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
												Oxbow lake. Pushed auger without bit to 155. Mineral inhole at end.												Om	30-70	–	–	–	–	–	–	–
																								Of	0-30	–	–	–	–	–	–	–
																								C	150-155	10YR3/2	SIL	–	–	–	–	–
M22S287	Visual	2022	511618	5726392	239	–	8		0	–	LV	–	–	O	p	–	–	–	–	v	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S310	Ground	2022	525774	5739273	210	–	7	B	0	–	LV	Called plain since still Of at 220 cm. Likely is at least another 80 cm .	e	O	p	–	–	–	NA	v	–	–	TY.F	Of	0-220	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S314	Ground	2022	521642	5663338	232	–	6	D	0	–	LV	Between two Beaver dams	cz	F	p	–	–	–	U	p	–	–	R.G	–	–	–	–	–	–	–	–	–	–
																								Cg	0-200	2.5Y3/1	SIL	–	–	0	–	–
M22S317	Ground	2022	533169	5633872	263	–	7	C	0	–	LV	Suspect most of this polygon is organic. Likely poor borrow source. Obv south to lake.	u	O	b	–	M	v	NA	v	–	–	TY.M	Om	15-160	–	–	–	–	–	–	–	–
																								Of	0-15	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S323	Ground	2022	513840	5740820	243	–	4	B	2	38	MD	Soil frozen.	scz	M	p	–	–	–	NA	w	–	–	O.GL	F	10-0	–	–	–	–	–	–	–	–
																								Ae	0-11	7.5YR4/4	SIL	–	–	3	–	–
																								Bt	11-35	7.5YR4/3	CL	M/SBK	–	3	–	–
																								Ck	35-120	10YR5/4	SICL	/MA	–	3	–	–
M22S327	Ground	2022	516246	5630236	270	–	8	D	0	-	LV	About 20 cm standing water. Couldn't't pull peat up from depth but some humic in side of auger. May be close to mineral.	e	O	b	–	L	p	NA	v	–	–	TY.F	Oh	140-245	–	–	–	–	–	–	–	–
																								Of	0-140	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22S338	Ground	2022	563469	5734877	169	–	4	B	2	0	UP	–	szc	M	u	–	–	–	NA	m	–	–	O.GL	L	10-0	–	–	–	–	–	–	–	–
																								Ae	0-5	10YR6/1	SL	M/PL	FR	2	–	–
																								Bt	5-31	5Y4/4	CL	F/SBK	FR	2	–	–
																								BCk	31-46	7.5YR5/3	CL	/MA	FR	2	–	–
																								Ck	46-120	10YR6/2	SIC	/MA	–	2	–	–
M22SAD1	Ground	2022	527330	5724899	245	✓	3	C	25	348	MD	At old exploration camp. Large aggregate area. Gullied FGhr. Burn layer in LFH.	ps	FG	h	–	–	–	NA	r	–	–	E.DYB	F	9-0	–	–	–	–	–	–	–	–
																								Ae	0-7	7.5YR5/2	LS	/SGR	–	5	–	Yes
																								Bm	7-25	5YR3/4	S	/SGR	–	7	–	Yes

Site ID	Plot Type	Year Surveyed	Easting	Northing	Elevation	In Effects Assessment LSA	Moisture Regime	Nutrient Regime	Slope Gradient (%)	Site Aspect (degree)	Slope Position	Field Notes	Terrain Surface Texture	Surficial Material	Surface Expression	Terrain Subsurface Texture	Subsurface Material	Subsurface Expression	Geomorphological Processes	Soil Drainage	Seepage Depth (cm)	Rooting Depth (cm)	Soil Classification	Soil Horizon	Horizon Depth (cm)	Horizon Colour	Soil Texture	Soil Structure	Consistence	Coarse Fragment Content (%)	Soil Mottling (Abundance/Size/Contrast)	Soil Sampled
																								Ck1	25-45	7.5YR2.5/2	S	/SGR	–	35	–	Yes
																								Ck2	45-120	2.5Y4/3	CS	/SGR	–	20	–	Yes
M22SAD2	Visual	2022	539624	5735697	177	–	–	–	60	180	MD	Likely Regosol but soil not classified as this was a terrain air call.	–	C	b	–	M	k	Rs	–	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22SAD3	Visual	2022	524139	5719402	225	–	–	–	30	120	MD	Side of gully. Strange because long, shallow, inclined slope at north side is LG.	s	FG	a	–	–	–	V	r	–	–	E.EB	F	6-0	–	–	–	–	–	–	–
																								Ahe	0-6	10YR3/2	S	–	–	0	–	–
																								Bm	6-22	7.5YR4/4	S	–	–	0	–	–
																								BC	22-50	10YR4/4	S	–	–	0	–	–
																								Ck	50-100	2.5Y5/2	S		LO	0	–	–
M22SAD4	Visual	2022	518450	5639963	307	–	–	–	0	–	CR		–	R	u	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22SAD5	Visual	2022	522620	5693660	244	–	–	–	0	–	CR		–	R	u	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22SAD6	Visual	2022	521558	5663359	251	–	–	–	0	–	CR		–	R	u	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22SAD7	Visual	2022	520928	5657365	253	–	–	–	2	–	CR	Exposure near PDA. No bedrock noted in centerline PDA area.	–	R	u	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22SAD8	Visual	2022	521867	5651203	251	–	–	–	6	60	MD		–	R	u	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M22SAD9	Visual	2022	528324	5737190	239	–	–	–	3	–	CR		–	R	u	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
																								–	–	–	–	–	–	–	–	–
M2S250A	Ground	2022	561920	5737934	171	–	7	C	0	–	LV	Frozen from 15 to 60 cm	eu	O	v	szc	M	p	NA	v	–	–	TFI.M	Of	70-100	–	–	–	–	–	–	–
																								Om	20-70	–	–	–	–	–	–	–
																								Of	0-20	–	–	–	–	–	–	–
																								Ckg	100-120	2.5Y5/2	SICL	/MA	–	5	–	–
M2S273A	Visual	2022	514866	5641696	278	–	–	–	0	–	LV	Augered pit to check bedrock depth. Bedrock at 85. Drainage in mapping needs to be updated. This is poorly drained for terrain even though soils is VP. Not a lot of topography. Till texture loam or SCL. 60 cm peat over mineral.	e	O	v	czs	M	v	–	v	–	–	T.F	–	–	–	–	–	–	–	–	–	–

Attachment D – Soil Map Unit Descriptions and Representative Site Descriptions

General Notes:

1. UTM = Universal Transverse Mercator.
2. Appendix C provides detailed profile horizon data and abbreviation code definitions
3. Appendix E provides laboratory result for sampled soil horizons

Table D-1: Representative Site Descriptions – for Soil Map Units GL1 and GL2

Subgroup Classification	Eluviated Eutric Brunisol			Gleyed Eluviated Eutric Brunisol		
Representative Map Unit(s)	GL1			GL2		
Representative Site	M22K040			Not Sampled		
Survey Date	2022			2022		
Location	520639 E; 5695443 N; UTM Zone 16, NAD83			520639 E; 5695443 N; UTM Zone 16, NAD83		
Surface Expression	Gentle slopes (j)			Plain (p)		
Slope Position	Mid			Lower, Level		
Slope Gradient (%)	6			0		
Drainage	Moderately Well (m)			Imperfect (i)		
Mottles	Absent			Present		
Associated Terrain Unit	LGj-m			LGp-i		
Parent Material	Medium textured glaciolacustrine material on gentle slopes			Medium textured glaciolacustrine plain		
Example Profile (M22K040)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragment (%)
	F	8 to 0	-	-	-	-
	Ae	0 to 8	Silt Loam	10YR 6/2	Fine Platy	0
	Bm	8 to 18	Silty Clay Loam	10YR 6/4	Fine Platy	0
	Ck	18 to 120	Silt Loam	2.5Y 6/3	Medium Platy	0

Photo 1: Inspection Site M22K040 - a well to moderately well drained Eluviated Eutric Brunisol

Table D-2: Representative Site Description – GL3

Subgroup Classification	Orthic Gray Luvisol					
Representative Map Unit(s)	GL3					
Site Inspection ID	M22S258					
Survey Date	2022					
Location	524118 E; 5719784 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Mid					
Slope Gradient (%)	2					
Drainage	Moderately Well (m)					
Mottles	Absent					
Associated Terrain Unit	LGb/Mp-m					
Parent Material	Moderately fine to fine textured glaciolacustrine blanket overlying till plain					
Example Profile (M22S258)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	6 to 0	-	-	-	-
	Ae	0 to 5	Very Fine Sandy Loam	10YR 6/1	Coarse Platy	0
	Bt	5 to 36	Heavy Clay	7.5YR 3/3	Medium Subangular Blocky	0
	Ck	36 to 120	Silty Clay	2.5Y 5/4	Massive	0

Photo 2: Inspection Site M22S258 - a moderately well drained Orthic Gray Luvisol

Photo 3:Inspection Site M22S258 - Soil horizons and structures displayed for the Orthic Gray Luvisol

Table D-3: Representative Site Description – GL4

Subgroup Classification	Gleyed Gray Luvisol					
Representative Map Unit(s)	GL4					
Site Inspection ID	M22L003					
Survey Date	2022					
Location	522579 E; 5688117 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	1					
Drainage	Imperfectly (i)					
Mottles	Present					
Associated Terrain Unit	LGp-i					
Parent Material	Moderately fine to fine textured glaciolacustrine plain					
Example Profile (M22L003)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	15 to 0	-	-	-	-
	Ae	0 to 15	Sandy Loam	10YR 6/3	Medium Platy	0
	Bt	15 to 32	Clay	10YR 3/3	Medium Subangular Blocky	0
	Ckgj	32 to 90	Silty Clay Loam	10YR 5/3	Massive	0

Photo 4: Inspection Site M22L003 - Soil horizons and structures displayed for the Gleyed Gray Luvisol

Photo 5: Inspection Site M22L003 - An imperfectly drained Gleyed Gray Luvisol

Table D-4: Representative Site Description – GL5

Subgroup Classification	Rego Gleysol					
Representative Map Unit(s)	GL5					
Site Inspection ID	M22K011					
Survey Date	2022					
Location	511121 E; 5729803 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Lower					
Slope Gradient (%)	3					
Drainage	Poor (p)					
Mottles	Present					
Associated Terrain Unit	LGu-p					
Parent Material	Medium textured glaciolacustrine undulating					
Example Profile (M22K011)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Of	10 to 0	-	-	-	-
	Ckg	0 to 110	Silt Loam	2.5Y 6/3	Massive	0

Photo 6: Inspection Site M22K011 - a poorly drained Rego Gleysol

Photo 7: Inspection Site M22K011 - soil horizon representation of Rego Gleysol

Table D-5: Representative Site Description – GL6

Subgroup Classification	Orthic Gleysol					
Representative Map Unit(s)	GL6					
Site Inspection ID	M22S105					
Survey Date	2022					
Location	524632 E; 5708680 N; UTM Zone 16, NAD83					
Surficial Material	Glaciolacustrine (LG)					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	1					
Drainage	Poor (p)					
Mottles	Absent					
Parent Material Texture	Moderately fine to fine					
Example Profile (M22S105)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	18 to 0	-	-	-	-
	Bg1	0 to 12	Silty Clay	10YR 5/3	Medium Subangular Blocky	0
	Bg2	12 to 38	Silty Clay	10YR 4/3	Fine Subangular Blocky	0
	Ckg1	38 to 78	Silty Clay	10YR 6/2	Massive	0
	Ckg2	78 to 105	Silty Clay	10YR 7/2	Massive	0

Photo 8: Inspection Site M22S105 - a poorly drained Orthic Gleysol

Table D-6: Representative Site Description – GL7

Subgroup Classification	Orthic Gray Luvisol					
Representative Map Unit(s)	GL7					
Site Inspection ID	M22L021					
Survey Date	2022					
Location	520398 E; 5670434 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Mid Slope					
Slope Gradient (%)	2					
Drainage	Moderately Well (m)					
Mottles	Present					
Associated Terrain Unit	LGv/Mp-m					
Parent Material	Medium to fine textured glaciolacustrine veneer overlying a second parent material plain					
Example Profile (M22S021)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	4 to 3	-	-	-	-
	F	3 to 2	-	-	-	-
	H	2 to 0	-	-	-	-
	Ae	0 to 4	Loam	10YR 6/3	Medium Platy	0
	Bt	4 to 32	Clay	10YR 3/6	Fine Subangular Blocky	0
	Ckgj	32 to 60	Clay Loam	10YR 6/3	Massive	0
	IICKgi	60 to 120	Sandy Clay Loam	10YR 5/4	Massive	10

No site photos available

Table D-7: Representative Site Description – GL8

Subgroup Classification	Orthic Luvic Gleysol					
Representative Map Unit(s)	GL8					
Site Inspection ID	M22S029					
Survey Date	2022					
Location	524098 E; 5619281 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	2					
Drainage	Poor (p)					
Mottles	Present					
Associated Terrain Unit	LGb/Rp-p					
Parent Material	Medium to fine texture glaciolacustrine blanket overlying second parent material					
Example Profile (M22S029)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Om	11 to 0	-	-	-	-
	Ahe	0 to 7	Silty Clay Loam	10YR 4/1	Fine Subangular Blocky	0
	Btgjk	7 to 32	Silty Clay	10YR 5/1	Medium Subangular Blocky	0
	Ckg	32 to 125	Silty Clay Loam	10YR 6/2	Massive	0
	R	125		-	-	-

Photo 9: Inspection Site M22S029 - A poorly drained Orthic Luvic Gleysol

Table D-8: Representative Site Description – L1

Subgroup Classification	Rego Gleysol					
Representative Map Unit(s)	L1					
Site Inspection ID	M22S252					
Survey Date	2022					
Location	575550E; 5727321 UTM Zone 16, NAD83					
Surface Expression	Blanket (b)					
Slope Position	Level					
Slope Gradient (%)	0					
Drainage	Poor (p)					
Mottles	Present					
Associated Terrain Unit	Lv/Fb-p					
Parent Material	Moderately fine to fine textured lacustrine veneer overlying a fluvial blanket					
Example Profile (M22S252)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	2 to 0	-	-	-	-
	Ah	0 to 8	Silt Loam	10YR 3/3	Massive	0
	Cg	8 to 100	Clay Loam	10YR 4/3	Massive	0
	IICg	100 to 120	Sand	10YR 4/3	Single Grained	0

Photo 10: Inspection Site M22S252 - Soil horizons and mottles displayed for the Rego Gleysol

Table D-9: Representative Site Description – for Soil Map Units L2

Subgroup Classification	Orthic Regosol			Orthic Regosol		
Representative Map Unit(s)	L2					
Site Inspection ID	M22S158					
Survey Date	2022					
Location	51997 E; 5663057 N; UTM Zone 16, NAD83					
Surface Expression	Veneer (v)					
Slope Position	Mid					
Slope Gradient (%)	2					
Drainage	Moderately Well (m)					
Mottles	Absent					
Associated Terrain Unit	Lv/LGv-m					
Parent Material	Moderately fine to fine textured lacustrine veneers overlying a glaciolacustrine veneer			Moderately fine to fine textured lacustrine veneers overlying a glaciolacustrine veneer		
Example Profile (M22S158)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	4 to 0	-	-	-	-
	C1	0 to 16	Silty Clay Loam	10YR 4/4	Medium Subangular Blocky	0
	C2	15 to 43	Silty Clay	7.5YR 3/3	Fine Subangular Blocky	0
	IICk1	43 to 80	Silty Clay Loam	10YR 4/4	Massive	0
	IICk2	80 to 120	Fine Sand	2.5Y 5/4	Massive	1

Photo 11: Inspection Site M22S158 - A moderately well drained Orthic Regosol

Photo 12: Inspection Site M22S158 - Soil horizons and depositional differences in materials displayed for the Orthic Regosol

Table D-10: Representative Site Description – L3

Subgroup Classification	Rego Gleysol					
Representative Map Unit(s)	L3					
Site Inspection ID	M22S011					
Survey Date	2022					
Location	513878E; 5740980 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	0					
Drainage	Poor (p)					
Mottles	Present					
Associated Terrain Unit	Lb/Mp-p					
Parent Material	Moderately fine to fine textured lacustrine blanket overlying a till plain					
Example Profile (M22S011)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Ah	0 to 28	Sandy Loam	10YR 3/2	-	0
	Cg1	28 to 55	Clay	10YR 4/4	Massive	5
	Cg2	55 to 120	Loam	10YR 3/4	Single Grained	5

Photo 13: Inspection Site M22S011 – A poorly drained Rego Gleysol featuring inundation as a geomorphological process

Photo 14: Inspection Site M22S011 – Mottling in soil profile of Rego Gleysol

Table D-11: Representative Site Description – M1

Subgroup Classification	Orthic Gray Luvisol					
Representative Map Unit(s)	M1					
Site Inspection ID	M22K009					
Survey Date	2022					
Location	540868 E; 5740604 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Lower					
Slope Gradient (%)	9					
Drainage	Moderately Well (m)					
Mottles	Present					
Associated Terrain Unit	Mu-m					
Parent Material	Moderately fine to very fine textured undulating till					
Example Profile (M22K009)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	7 to 5	-	-	-	-
	F	5 to 0	-	-	-	-
	Ae	0 to 15	Loam	7.5YR 6/2	Medium Platy	5
	Bt	15 to 55	Clay	7.5YR 5/4	Fine Subangular Blocky	5
	Ckgj	55 to 100	Clay Loam	7.5YR 4/4	Massive	5

Photo 15: Inspection Site M22K009 - a moderately well drained Orthic Gray Luvisol

Photo 16: Inspection Site M22K009 - Soil horizons and structures displayed for the Orthic Gray Luvisol

Table D-12: Representative Site Description – M2 and M9

Subgroup Classification	Rego Humic Gleysol (peaty phase)					
Representative Map Unit(s)	M2			M9		
Site Inspection ID	M22S045					
Survey Date	2022					
Location	516111 E; 5640339 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	0					
Drainage	Poor (p)					
Mottles	Not present, soil colour reduced					
Associated Terrain Unit	Mp-p			Mv/Ru-p		
Parent Material	Medium textured till plain			Medium textured till veneer overlying bedrock		
Example Profile (M22S045)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	29 to 7	-	-	-	-
	H	7 to 0	-	-	-	-
	Ah	0 to 10	Silty Clay Loam	10YR 2/2	Massive	2
	Ckg	10-80	Silt Loam	2.5Y 5/3	Massive	4

Photo 17: Inspection Site M22S045 - soil horizons of a Rego Humic Gleysol

Table D-13: Representative Site Description – M3

Subgroup Classification	Orthic Gleysol					
Representative Map Unit(s)	M3					
Site Inspection ID	M22S009					
Survey Date	2022					
Location	528808 E; 5739966 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	0					
Drainage	Poor (p)					
Mottles	Absent					
Associated Terrain Unit	Mp-p					
Parent Material	Moderately fine to fine textured till plain					
Example Profile (M22S009)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Om	35 to 0	-	-	-	-
	Bg	0 to 19	SiL	10YR 5/1	-	5
	Ckg	19 to 100	SICL	10YR 6/2	-	5

Photo 18:Inspection Site M22S009 - a poorly drained Orthic Gleysol

Photo 19:Inspection Site M22K009 - Example of coarse fragments found in till material

Table D-14: Representative Site Description – for Soil Map Unit M4

Subgroup Classification	Orthic Dystric Brunisol					
Representative Map Unit(s)	M4					
Site Inspection ID	M22L015					
Survey Date	2022					
Location	523015 E; 5622096 N; UTM Zone 16, NAD83					
Surface Expression	Moderate Slope (a)					
Slope Position	Mid					
Slope Gradient (%)	30					
Drainage	Rapid (r)					
Mottles	Absent					
Associated Terrain Unit	Mb/Ra-r					
Parent Material	Very coarse to moderately coarse textured till blanket overlying moderately sloped bedrock					
Example Profile (M22L015)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Of	9 to 0	-	-	-	-
	Ae	0 to 9	Loamy Sand	10YR 7/1	Single Grained	4
	Bf1	9 to 43	Loamy Sand	5YR 4/3	Single Grained	5
	Bf2	43 to 110	Sandy Loam	5YR 2.5/2	Single Grained	16

Note: Minor component (Orthic Humo-Ferric Podzol) of map unit represented in example profile

No site photos available

Table D-15: Representative Site Description – M5

Subgroup Classification	Orthic Gray Luvisol					
Representative Map Unit(s)	M5					
Site Inspection ID	M22K051					
Survey Date	2022					
Location	523050 E; 5649735 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Mid					
Slope Gradient (%)	2					
Drainage	Well (w)					
Mottles	Absent					
Associated Terrain Unit	Mb/Ru-w					
Parent Material	Moderately fine to very fine textured till blanket over undulating bedrock					
Example Profile (M22K051)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	2 to 1	-	-	-	-
	F	1 to 0	-	-	-	-
	Ae	0 to 4	Heavy Clay	10YR 4/2	Fine Granular	5
	Bt	4 to 16	Heavy Clay	7.5YR 3/2	Medium Subangular Blocky	2
	BCk	16 to 37	Clay	10YR 5/3	Fine Subangular Blocky	2
	Ck	37 to 120	Loam	2.5Y 6/3	Massive	65

Photo 20: Inspection Site M22K051- a well drained Orthic Gray Luvisol

Photo 21: Inspection Site M22K051 - soil structure and horizons of Orthic Gray Luvisol

Table D-16: Representative Site Description – for Soil Map Units M6

Subgroup Classification	Orthic Gleysol					
Representative Map Unit(s)	M6					
Site Inspection ID	M22S155					
Survey Date	2022					
Location	519761 E; 5665369 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	0					
Drainage	Poor (p)					
Mottles	Absent					
Associated Terrain Unit	Mb/Rp-p					
Parent Material	Fine textured till blanket overlying bedrock plain				Medium textured till blanket overlying bedrock plain	
Example Profile (M22S155)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Om	17 to 0	-	-	-	-
	Bg	0 to 29	Silty Clay	10YR5/1	-	5
	Ckg	20 to 120	Silty Clay	10YR 6/2	-	5

Photo 22: Inspection Site M22S155 - a poorly drained Orthic Gleysol

Table D-17: Representative Site Description – for Soil Map Units M7 and M8

Subgroup Classification	Orthic Gray Luvisol					
Representative Map Unit(s)	M7				M8	
Site Inspection ID	Not Sampled				M22K055	
Survey Date	2022					
Location	522028 E; 5646272 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Mid					
Slope Gradient (%)	2					
Drainage	Well (w)					
Mottles	Absent					
Associated Terrain Unit	Mu-w				Mv/Ru-w	
Parent Material	Medium textured undulating till				Medium textured till veneer overlying undulating bedrock	
Example Profile (M22K055)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	3 to 2	-	-	-	-
	F	2 to 0	-	-	-	-
	Ae	0 to 4	Clay Loam	10YR 5/3	Medium Granular	2
	Bt	4 to 24	Clay	7.5YR 4/3	Medium Angular Blocky	7
	Ck	24 to 60	Loam	2.5Y 6/3	Massive	55
	R	-	-	-	-	-

Photo 23:Inspection Site M22K055 - a well drained Orthic Gray Luvisol

Photo 24:Inspection Site M22K055 - soil structure and horizons of Orthic Gray Luvisol

Table D-18: Representative Site Description – for Soil Map Units GF1 and GF2

Subgroup Classification	Eluviated Dystric Brunisol			Orthic Gleysol		
Representative Map Unit(s)	GF1			GF2		
Site Inspection ID	M22SAD1			Not Sampled		
Survey Date	2022					
Location	527330 E; 5724898 N; UTM Zone 16, NAD83					
Surface Expression	Hummocky					
Slope Position	Mid			Lower		
Slope Gradient (%)	25					
Drainage	Rapid (r)			Poor (p)		
Mottles	Absent			Present		
Associated Terrain Unit	FGh-r			FGp-p		
Parent Material	Very coarse textured hummocky glaciofluvial material					
Example Profile (M22SAD1)*	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	9 to 0	-	-	-	-
	Ae	0 to 7	Loamy Sand	7.5YR 5/2	Single Grained	5
	Bm	7 to 25	Sand	5YR 3/4	Single Grained	7
	Ck1	25 to 45	Sand	7.5YR 2.5/2	Single Grained	35
	Ck2	45 to 120	Coarse Sand	2.5Y 4/3	Single Grained	20

* = represents only the GF1 unit as the GF2 unit was mapped, but not sampled.

Photo 25: Inspection Site M22SAD1 - a rapidly drained Eluviated Dystric Brunisol

Photo 26: Inspection Site M22SAD1 – soil structure and horizons of Eluviated Dystric Brunisol

Table D-19: Representative Site Description – GF3

Subgroup Classification	Brunisolic Gray Luvisol					
Representative Map Unit(s)	GF3					
Site Inspection ID	M22K026					
Survey Date	2022					
Location	519684 E; 5628589 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Mid					
Slope Gradient (%)	3					
Drainage	Well (w)					
Mottles	Absent					
Associated Terrain Unit	FGv/Mu-w					
Parent Material	Very coarse textured glaciofluvial veneer overlying moderately fine to fine textured undulating moraine (till)					
Example Profile (M22K026)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	4 to 3	-	-	-	-
	F	3 to 1	-	-	-	-
	H	1 to 0	-	-	-	-
	Ae	0 to 6	Loamy Sand	10YR 6/2	Single Grained	0
	Bm	6 to 24	Loamy Sand	7.5YR 4/6	Single Grained	0
	IIBt	24 to 80	Clay Loam	10YR 5/4	-	5
	IICk	80 to 100	Silty Clay	10YR 6/3	-	2

Photo 27: Inspection Site M22K026 – soil structure and horizons of Brunisolic Gray Luvisol

Table D-20: Representative Site Description – GF4

Subgroup Classification	Rego Gleysol					
Representative Map Unit(s)	GF4					
Site Inspection ID	M22S180					
Survey Date	2022					
Location	523040 E; 5621814 N; UTM Zone 16, NAD83					
Surface Expression	Blanket (b)					
Slope Position	Mid					
Slope Gradient (%)	4					
Drainage	Poor (p)					
Mottles	-					
Associated Terrain Unit	FGv/Mb-p					
Parent Material	Coarse textured glaciofluvial veneer overlying blanket of fine textured second parent material					
Example Profile (M22S180)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	Of	28 to 20	-	-	-	-
	Om	20 to 0	-	-	-	-
	Cg	0 to 55	Loamy Sand	-	Massive	30
	IICkg	55 to 110	Sandy Clay	2.5YR 6/2	Massive	12

No photos available

Table D-21: Representative Site Description – GF5

Subgroup Classification	Eluviated Eutric Brunisol					
Representative Map Unit(s)	GF5					
Site Inspection ID	M22C025 (modified)					
Survey Date	2022					
Location	577445 E; 5725661 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Level					
Slope Gradient (%)	2					
Drainage	Well (w)					
Mottles	Absent					
Associated Terrain Unit	FGb/Rp-w					
Parent Material	Very coarse textured glaciofluvial veneer overlying bedrock					
Example Profile (M22C025)*	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	3 to 0	-	-	-	-
	Ae	0 to 6	Loamy Sand	10YR 6/2	-	10
	Bm	6 to 21	Loamy Fine Sand	7.5YR 4/6	Single Grained	40
	BC	21 to 27	Loamy Fine Sand	10YR 6/4	Single Grained	10
	Ck1	27 to 40	Fine Sandy Loam	10YR 7/2	Massive	5
	Ck2	40 to 58	Coarse Sand	10YR 4/3	Single Grained	20
	Ck3	58 to 100	Loamy Fine Sand	10YR 7/4	Single Grained	3

*= M22C025 was not found over bedrock but was used to represent the soil of a typical GF5 profile.

Photo 28: Inspection Site M22C025 - a well drained Eluviated Eutric Brunisol

Photo 29: Inspection Site M22C025 - Soil horizons and structure of Eluviated Eutric Brunisol

Table D-22: Representative Site Description – for Soil Map Units F1

Subgroup Classification	Rego Gleysol					
Representative Map Unit(s)	F1					
Site Inspection ID	M22S044					
Survey Date	2022					
Location	531927 E; 5740999 N; UTM Zone 16, NAD83					
Surface Expression	Plain (p)					
Slope Position	Toe					
Slope Gradient (%)	0					
Drainage	Poor (p)					
Mottles	Present		Absent		Absent	
Associated Terrain Unit	Fp-p					
Parent Material	Medium textured fluvial plain					
Example Profile (M22S044)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	L	4 to 0	-	-	-	-
	Cg1	0 to 90	Loam	2.5Y 4/2	Massive	1
	Cg2	90 to 120	Loam	5Y 3/1	Massive	0

Photo 30: Inspection Site M22S044 – Recently deposited material from fluvial processes

Photo 31: Inspection Site M22S044 – Cg1 horizon displaying prominent mottling and high water table in soil pit visible at the top of the photo.

Photo 32: Inspection Site M22S044 – Cg2 horizon displaying reduced colour

Table D-23: Representative Site Description – for Soil Map Unit C1

Subgroup Classification	Orthic Regosol			Gleyed Regosol		
Representative Map Unit(s)	C1					
Site Inspection ID	M22S054					
Survey Date	2022					
Location	577669 E; 5726003 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Various					
Slope Gradient (%)	5 - 70					
Drainage	Various					
Mottles	Present					
Associated Terrain Unit	Various					
Parent Material	Moderately fine textured colluvial veneer overlying moderately fine textured morainal (till) plain, but varies throughout Local Study Area					
Example Profile (M22S054)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	F	2 to 0	-	-	-	-
	Ck	0 to 29	Clay Loam	10YR 5/4	Massive	3
	IICk	29 to 60	Clay Loam	10YR 5/4	Massive	3
	IICkgj	60 to 120	Clay Loam	10YR 5/4	Massive	8

Photo 33: Inspection Site M22S054 – an imperfectly drained Gleyed Regosol developed on colluvium overlying till

Photo 34: Inspection site M22S054 - soil horizons of Gleyed Regosol showing buried organic material found at 29 cm between the Ck and IICk horizons.

Table D-24: Representative Site Description – R1

Subgroup Classification	Bedrock					
Representative Map Unit(s)	R1					
Site Inspection ID	M22S176					
Survey Date	2022					
Location	521042 E; 5674774 N; UTM Zone 16, NAD83					
Surface Expression	Undulating (u)					
Slope Position	Middle					
Slope Gradient (%)	3					
Drainage	Very Rapid (x)					
Mottles	Absent					
Associated Terrain Unit	Ru					
Parent Material	Undulating bedrock					
Example Profile (M22S176)	Horizon	Depth (cm)	Texture	Colour	Structure	Coarse Fragments (%)
	R	-	-	-	-	-

Photo 35: Inspection site M22S176 - very rapidly draining consolidated bedrock

Table D-25: Representative Site Description – for Soil Map Units O1 and O2

Subgroup Classification	Typic Fibrisol	Terric Mesisol
Representative Map Unit(s)	O1	O2
Site Inspection ID	M22C015	
Survey Date	2022	
Location	527699 E; 5740187 N; UTM Zone 16, NAD83	
Surface Expression	Blanket (b)	Veneer (v)
Slope Position	Lower	
Slope Gradient (%)	0	
Drainage	Very Poor (vp)	
Mottles	-	
Associated Terrain Unit	Ob/Mp-v	Ov/LG-v
Parent Material	Organic Blanket (between 100 cm and 300 cm in thickness) overlying till	Organic veneer (<100 cm in thickness) overlying glaciolacustrine material

Example Profile (M22C015)	Horizon	Depth (cm)	Texture	Colour	Coarse Fragments (%)
	Of	0 to 135	-	-	-
	Om	135-200	-	-	-
	Ckg	200-210+	Silty Clay Loam	10Y4/1	2

Photo 36: Inspection site M22C001 – Profile of a typical organic profile with 140 cm of peat accumulation overlying a reduced (in colour) silty clay glaciolacustrine material

Attachment E – Soil Laboratory Data

Your P.O. #: 21455151
Your Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO

Attention: Christiane Brouwer

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Your C.O.C. #: 1 of 4, 159589, 159558, 159559, 159560

Report Date: 2022/07/15
Report #: R3200810
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BUREAU VERITAS JOB #: C239961
Received: 2022/06/08, 08:30

Sample Matrix: Soil
Samples Received: 31

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Cation/EC Ratio	1	N/A	2022/06/19		Auto Calc
Cation/EC Ratio	27	N/A	2022/06/20		Auto Calc
Cation Exchange Capacity (1)	28	2022/06/15	2022/06/20		Auto Calc
Chloride (Soluble)	1	2022/06/18	2022/06/19	AB SOP-00033 / AB SOP-00020	SM 23-4500-Cl-E m
Chloride (Soluble)	12	2022/06/19	2022/06/19	AB SOP-00033 / AB SOP-00020	SM 23-4500-Cl-E m
Chloride (Soluble)	15	2022/06/19	2022/06/20	AB SOP-00033 / AB SOP-00020	SM 23-4500-Cl-E m
Conductivity @25C (Soluble)	13	2022/06/19	2022/06/19	AB SOP-00033 / AB SOP-00004	SM 23 2510 B m
Conductivity @25C (Soluble)	15	2022/06/19	2022/06/20	AB SOP-00033 / AB SOP-00004	SM 23 2510 B m
Sum of Cations, Anions	1	N/A	2022/06/19		Auto Calc
Sum of Cations, Anions	27	N/A	2022/06/20		Auto Calc
Moisture	10	N/A	2022/06/16	AB SOP-00002	CCME PHC-CWS m
Moisture	18	N/A	2022/06/17	AB SOP-00002	CCME PHC-CWS m
Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	3	2022/06/18	2022/06/18	AB SOP-00091	SM 23 4500 NO3m
Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	11	2022/06/18	2022/06/19	AB SOP-00091	SM 23 4500 NO3m
Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	1	2022/06/19	2022/06/19	AB SOP-00091	SM 23 4500 NO3m
Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	16	2022/06/19	2022/06/20	AB SOP-00091	SM 23 4500 NO3m
Nitrate-N (soluble)	31	2022/06/15	2022/06/20		Auto Calc
pH @25C (1:2 Calcium Chloride Extract)	12	2022/06/18	2022/06/18	AB SOP-00033 / AB SOP-00006	SM 23 4500 H+B m
pH @25C (1:2 Calcium Chloride Extract)	16	2022/06/19	2022/06/19	AB SOP-00033 / AB SOP-00006	SM 23 4500 H+B m
Particle Size by Sieve (75 micron)	27	N/A	2022/06/18		Auto Calc
Particle Size by Sieve (75 micron)	1	N/A	2022/06/20		Auto Calc
Particle Size by Sieve	27	N/A	2022/06/18	AB SOP-00022	ASTM D6913-17 m
Particle Size by Sieve	1	N/A	2022/06/20	AB SOP-00022	ASTM D6913-17 m

Your P.O. #: 21455151
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EDMONTON, AB
CANADA T5P 4C3

Your C.O.C. #: 1 of 4, 159589, 159558, 159559, 159560

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CERTIFICATE OF ANALYSIS – REVISED REPORT

BUREAU VERITAS JOB #: C239961
Received: 2022/06/08, 08:30

Sample Matrix: Soil
Samples Received: 31

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Sodium Adsorption Ratio	1	N/A	2022/06/19		Auto Calc
Sodium Adsorption Ratio	27	N/A	2022/06/20		Auto Calc
Soluble Ions	1	2022/06/18	2022/06/19	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Soluble Ions	12	2022/06/19	2022/06/19	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Soluble Ions	15	2022/06/19	2022/06/20	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Soluble Paste	14	2022/06/18	2022/06/18	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Paste	1	2022/06/18	2022/06/19	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Paste	16	2022/06/19	2022/06/19	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Ions Calculation	28	N/A	2022/06/17		Auto Calc
Total Organic Carbon LECO Method	31	N/A	2022/06/22	CAL SOP-00243	LECO 203-821-498 m
Texture by Hydrometer	17	N/A	2022/07/13	AB SOP-00030	Carter 2nd ed 55.3 m
Texture by Hydrometer	6	N/A	2022/07/15	AB SOP-00030	Carter 2nd ed 55.3 m
Texture Class	17	N/A	2022/07/13		Auto Calc
Texture Class	6	N/A	2022/07/15		Auto Calc
Theoretical Gypsum Requirement (2)	1	N/A	2022/06/19		Auto Calc
Theoretical Gypsum Requirement (2)	27	N/A	2022/06/20		Auto Calc

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or

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Your P.O. #: 21455151
Your Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO

Attention: Christiane Brouwer

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Your C.O.C. #: 1 of 4, 159589, 159558, 159559, 159560

Report Date: 2022/07/15
Report #: R3200810
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BUREAU VERITAS JOB #: C239961
Received: 2022/06/08, 08:30

implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Sample(s) analyzed using accredited methodologies and have been subjected to Bureau Veritas's standard validation process for the submitted matrix however this is not accredited for this matrix.

(2) TGR calculation is based on a theoretical SAR of 4. Salt Contamination and Assessment and remediation guideline 2001 recommended SAR is ranging 4-8. TGR is reported in tonnes/ha.

Encryption Key

Janelle Kochan
Key Account Specialist
15 Jul 2022 19:04:35

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Cynny Hagen, Key Account Specialist
Email: Cynny.HAGEN@bureauveritas.com
Phone# (403)735-2273

==========

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS304			AUS305		
Sampling Date		2022/06/06			2022/06/06		
COC Number		159589			159589		
	UNITS	M22S161BM0-14-220606	RDL	QC Batch	M22S161BTNJ14-27-220606	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.17	N/A	A610666	0.18	N/A	A610666
Cation Sum	meq/L	1.1	N/A	A610666	5.9	N/A	A610666
Cation/EC Ratio	N/A	10	0.10	A610669	11	0.10	A610669
Soluble Nitrate (N)	mg/L	0.38	0.20	A610735	0.38	0.20	A610735
Calculated Calcium (Ca)	mg/kg	3.5	0.79	A610630	41	0.87	A610630
Calculated Magnesium (Mg)	mg/kg	1.0	0.53	A610630	7.7	0.58	A610630
Calculated Sodium (Na)	mg/kg	6.3	1.3	A610630	16	1.5	A610630
Calculated Potassium (K)	mg/kg	1.8	0.69	A610630	0.94	0.75	A610630
Calculated Chloride (Cl)	mg/kg	<5.3	5.3	A610630	<5.8	5.8	A610630
Calculated Sulphate (SO4)	mg/kg	4.3	2.6	A610630	4.9	2.9	A610630
Elements							
Cation exchange capacity	cmol+/Kg	16	10	A610725	28	10	A610725
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	<10	10	A615170	<10	10	A614879
Soluble Conductivity	dS/m	0.11	0.020	A615090	0.53	0.020	A615110
Soluble (CaCl2) pH	pH	5.49	N/A	A614648	6.92	N/A	A613560
Sodium Adsorption Ratio	N/A	1.1	0.10	A610668	0.77	0.10	A610668
Soluble Calcium (Ca)	mg/L	6.6	1.5	A615115	71	1.5	A615162
Soluble Nitrite (N)	mg/L	<0.20	0.20	A615164	<0.20	0.20	A614740
Soluble Magnesium (Mg)	mg/L	1.9	1.0	A615115	13	1.0	A615162
Soluble Sodium (Na)	mg/L	12	2.5	A615115	27	2.5	A615162
Soluble Potassium (K)	mg/L	3.5	1.3	A615115	1.6	1.3	A615162
Saturation %	%	53	N/A	A614646	58	N/A	A613550
Soluble Sulphate (SO4)	mg/L	8.1	5.0	A615115	8.5	5.0	A615162
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A610667	<0.20	0.20	A610667
Physical Properties							
Grain Size	N/A	FINE	N/A	A609766	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	A614511	<0.20	0.20	A614511
Sieve - #200 (>0.075mm)	%	2.0	0.20	A614511	2.6	0.20	A614511
Sieve - Pan	%	98	0.20	A614511	97	0.20	A614511

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS306		AUS307		
Sampling Date		2022/06/06		2022/06/06		
COC Number		159589		159589		
	UNITS	M22161BC27-44-220606	RDL	M22S161CK44-65-220606	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.20	N/A	0.018	N/A	A610666
Cation Sum	meq/L	2.2	N/A	2.1	N/A	A610666
Cation/EC Ratio	N/A	10	0.10	9.8	0.10	A610669
Soluble Nitrate (N)	mg/L	0.22	0.20	<0.20	0.20	A610735
Calculated Calcium (Ca)	mg/kg	13	0.80	11	0.73	A610630
Calculated Magnesium (Mg)	mg/kg	2.4	0.53	1.8	0.49	A610630
Calculated Sodium (Na)	mg/kg	8.2	1.3	6.9	1.2	A610630
Calculated Potassium (K)	mg/kg	<0.69	0.69	<0.64	0.64	A610630
Calculated Chloride (Cl)	mg/kg	<5.3	5.3	<4.9	4.9	A610630
Calculated Sulphate (SO4)	mg/kg	3.6	2.7	<2.5	2.5	A610630
Elements						
Cation exchange capacity	cmol+/Kg	38	10	25	10	A610725
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A615434
Soluble Conductivity	dS/m	0.22	0.020	0.21	0.020	A615524
Soluble (CaCl2) pH	pH	7.10	N/A	7.70	N/A	A614042
Sodium Adsorption Ratio	N/A	0.76	0.10	0.71	0.10	A610668
Soluble Calcium (Ca)	mg/L	24	1.5	23	1.5	A615500
Soluble Nitrite (N)	mg/L	0.55	0.20	0.26	0.20	A615203
Soluble Magnesium (Mg)	mg/L	4.5	1.0	3.7	1.0	A615500
Soluble Sodium (Na)	mg/L	15	2.5	14	2.5	A615500
Soluble Potassium (K)	mg/L	<1.3	1.3	<1.3	1.3	A615500
Saturation %	%	53	N/A	49	N/A	A614038
Soluble Sulphate (SO4)	mg/L	6.8	5.0	<5.0	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A610667
Physical Properties						
Grain Size	N/A	FINE	N/A	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	<0.20	0.20	A614511
Sieve - #200 (>0.075mm)	%	0.68	0.20	0.72	0.20	A614511
Sieve - Pan	%	99	0.20	99	0.20	A614511

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS308			AUS309		
Sampling Date		2022/06/06			2022/05/28		
COC Number		159589			159589		
	UNITS	M22S16111CKG-65-110-220606	RDL	QC Batch	M22S028AHE0-14-220528	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	8.4	N/A	A610666	0.25	N/A	A610666
Cation Sum	meq/L	9.3	N/A	A610666	1.7	N/A	A610666
Cation/EC Ratio	N/A	9.6	0.10	A610669	11	0.10	A610669
Soluble Nitrate (N)	mg/L	0.47	0.20	A610735	<0.20	0.20	A610735
Calculated Calcium (Ca)	mg/kg	31	0.35	A610630	13	1.2	A610630
Calculated Magnesium (Mg)	mg/kg	4.1	0.23	A610630	3.4	0.79	A610630
Calculated Sodium (Na)	mg/kg	5.9	0.58	A610630	9.4	2.0	A610630
Calculated Potassium (K)	mg/kg	0.43	0.30	A610630	1.2	1.0	A610630
Calculated Chloride (Cl)	mg/kg	69	2.3	A610630	<7.9	7.9	A610630
Calculated Sulphate (SO4)	mg/kg	<1.2	1.2	A610630	9.5	4.0	A610630
Elements							
Cation exchange capacity	cmol+/Kg	13	10	A610725	64	10	A610725
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	300	10	A614879	<10	10	A615434
Soluble Conductivity	dS/m	0.97	0.020	A615110	0.16	0.020	A615524
Soluble (CaCl2) pH	pH	7.70	N/A	A613560	6.56	N/A	A614042
Sodium Adsorption Ratio	N/A	0.55	0.10	A610668	0.68	0.10	A610668
Soluble Calcium (Ca)	mg/L	130	1.5	A615162	16	1.5	A615500
Soluble Nitrite (N)	mg/L	<0.20	0.20	A614740	<0.20	0.20	A615203
Soluble Magnesium (Mg)	mg/L	18	1.0	A615162	4.3	1.0	A615500
Soluble Sodium (Na)	mg/L	25	2.5	A615162	12	2.5	A615500
Soluble Potassium (K)	mg/L	1.9	1.3	A615162	1.5	1.3	A615500
Saturation %	%	23	N/A	A613550	79	N/A	A614038
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	A615162	12	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A610667	<0.20	0.20	A610667
Physical Properties							
Grain Size	N/A	FINE	N/A	A609766	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	22	0.20	A614511	0.86	0.20	A614511
Sieve - #200 (>0.075mm)	%	45	0.20	A614511	2.9	0.20	A614511
Sieve - Pan	%	55	0.20	A614511	97	0.20	A614511

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS310			AUS311		
Sampling Date		2022/05/28			2022/05/28		
COC Number		159589			159589		
	UNITS	M22S028017-0-220528	RDL	QC Batch	M22S028BT14-39-220528	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.76	N/A	A610666	0.33	N/A	A610666
Cation Sum	meq/L	1.9	N/A	A610666	1.9	N/A	A610666
Cation/EC Ratio	N/A	7.2	0.10	A610669	12	0.10	A610669
Soluble Nitrate (N)	mg/L	0.22	0.20	A610735	1.8	0.20	A610735
Calculated Calcium (Ca)	mg/kg	45	6.6	A610630	7.2	0.63	A610739
Calculated Magnesium (Mg)	mg/kg	16	4.4	A610630	1.8	0.42	A610739
Calculated Sodium (Na)	mg/kg	31	11	A610630	6.0	1.1	A610739
Calculated Potassium (K)	mg/kg	100	5.7	A610630	1.0	0.55	A610739
Calculated Chloride (Cl)	mg/kg	55	44	A610630	<4.2	4.2	A610739
Calculated Sulphate (SO4)	mg/kg	83	22	A610630	3.7	2.1	A610739
Elements							
Cation exchange capacity	cmol+/Kg	37	10	A610725	26	10	A610725
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	12	10	A615434	<10	10	A614879
Soluble Conductivity	dS/m	0.26	0.020	A615524	0.15	0.020	A615110
Soluble (CaCl2) pH	pH	3.72 (1)	N/A	A614042	6.91	N/A	A613560
Sodium Adsorption Ratio	N/A	0.48	0.10	A610668	0.79	0.10	A610668
Soluble Calcium (Ca)	mg/L	10	1.5	A615500	17	1.5	A615162
Soluble Nitrite (N)	mg/L	<0.20	0.20	A615203	0.23	0.20	A614740
Soluble Magnesium (Mg)	mg/L	3.6	1.0	A615500	4.3	1.0	A615162
Soluble Sodium (Na)	mg/L	7.0	2.5	A615500	14	2.5	A615162
Soluble Potassium (K)	mg/L	23	1.3	A615500	2.5	1.3	A615162
Saturation %	%	440	N/A	A614038	42	N/A	A613550
Soluble Sulphate (SO4)	mg/L	19	5.0	A615500	8.8	5.0	A615162
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A610667	<0.20	0.20	A610667
Physical Properties							
Grain Size	N/A	COARSE	N/A	A609766	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	11	0.20	A614511	0.27	0.20	A614511
Sieve - #200 (>0.075mm)	%	59	0.20	A614511	9.8	0.20	A614511
Sieve - Pan	%	41	0.20	A614511	90	0.20	A614511

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Sample pH value outside pH calibration range 4 to 10, verified using pH 1.68 buffer

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Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS312		AUS343		
Sampling Date		2022/05/28		2022/06/04		
COC Number		159589		159558		
	UNITS	M22S028C39-145-220528	RDL	M22S258AE0-6-220604	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.075	N/A	0.28	N/A	A610666
Cation Sum	meq/L	2.0	N/A	1.2	N/A	A610666
Cation/EC Ratio	N/A	9.6	0.10	9.3	0.10	A610669
Soluble Nitrate (N)	mg/L	0.83	0.20	0.39	0.20	A610735
Calculated Calcium (Ca)	mg/kg	6.9	0.54	3.1	0.51	A610739
Calculated Magnesium (Mg)	mg/kg	1.3	0.36	0.80	0.34	A610739
Calculated Sodium (Na)	mg/kg	6.5	0.90	3.2	0.86	A610739
Calculated Potassium (K)	mg/kg	<0.47	0.47	1.3	0.45	A610739
Calculated Chloride (Cl)	mg/kg	<3.6	3.6	<3.4	3.4	A610739
Calculated Sulphate (SO4)	mg/kg	<1.8	1.8	3.8	1.7	A610739
Elements						
Cation exchange capacity	cmol+/Kg	16	10	<10	10	A610725
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A615434
Soluble Conductivity	dS/m	0.21	0.020	0.13	0.020	A615524
Soluble (CaCl2) pH	pH	7.24	N/A	4.50	N/A	A614042
Sodium Adsorption Ratio	N/A	1.0	0.10	0.71	0.10	A610668
Soluble Calcium (Ca)	mg/L	19	1.5	9.0	1.5	A615500
Soluble Nitrite (N)	mg/L	0.22	0.20	0.26	0.20	A615203
Soluble Magnesium (Mg)	mg/L	3.6	1.0	2.3	1.0	A615500
Soluble Sodium (Na)	mg/L	18	2.5	9.2	2.5	A615500
Soluble Potassium (K)	mg/L	<1.3	1.3	3.9	1.3	A615500
Saturation %	%	36	N/A	34	N/A	A614038
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	11	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A610667
Physical Properties						
Grain Size	N/A	FINE	N/A	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	0.85	0.20	2.0	0.20	A614511
Sieve - #200 (>0.075mm)	%	6.3	0.20	23	0.20	A614511
Sieve - Pan	%	94	0.20	77	0.20	A614511

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS344			AUS345		
Sampling Date		2022/06/04			2022/06/04		
COC Number		159558			159558		
	UNITS	M22S258BT5-36-220604	RDL	QC Batch	M22S258CK36-120-220604	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.024	N/A	A610734	0.0000	N/A	A610734
Cation Sum	meq/L	1.0	N/A	A610734	1.9	N/A	A610734
Cation/EC Ratio	N/A	18	0.10	A610722	10	0.10	A610722
Soluble Nitrate (N)	mg/L	0.33	0.20	A610735	<0.20	0.20	A610735
Calculated Calcium (Ca)	mg/kg	4.2	0.86	A610739	7.9	0.55	A610739
Calculated Magnesium (Mg)	mg/kg	1.9	0.57	A610739	0.74	0.37	A610739
Calculated Sodium (Na)	mg/kg	4.2	1.4	A610739	5.5	0.92	A610739
Calculated Potassium (K)	mg/kg	1.3	0.74	A610739	<0.48	0.48	A610739
Calculated Chloride (Cl)	mg/kg	<5.7	5.7	A610739	<3.7	3.7	A610739
Calculated Sulphate (SO4)	mg/kg	<2.9	2.9	A610739	<1.8	1.8	A610739
Elements							
Cation exchange capacity	cmol+/Kg	28	10	A610725	16	10	A610725
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	<10	10	A615434	<10	10	A615434
Soluble Conductivity	dS/m	0.056	0.020	A615524	0.18	0.020	A615524
Soluble (CaCl2) pH	pH	5.46	N/A	A614042	7.17	N/A	A614042
Sodium Adsorption Ratio	N/A	0.57	0.10	A610736	0.82	0.10	A610736
Soluble Calcium (Ca)	mg/L	7.3	1.5	A615500	22	1.5	A615500
Soluble Nitrite (N)	mg/L	<0.20	0.20	A615203	<0.20	0.20	A615203
Soluble Magnesium (Mg)	mg/L	3.4	1.0	A615500	2.0	1.0	A615500
Soluble Sodium (Na)	mg/L	7.4	2.5	A615500	15	2.5	A615500
Soluble Potassium (K)	mg/L	2.3	1.3	A615500	<1.3	1.3	A615500
Saturation %	%	57	N/A	A614038	37	N/A	A614038
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	A615500	<5.0	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A610742	<0.20	0.20	A610742
Physical Properties							
Grain Size	N/A	FINE	N/A	A609766	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	A614511	<0.20	0.20	A614608
Sieve - #200 (>0.075mm)	%	0.88	0.20	A614511	0.29	0.20	A614608
Sieve - Pan	%	99	0.20	A614511	100	0.20	A614608

RDL = Reportable Detection Limit
N/A = Not Applicable

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RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS346			AUS347		
Sampling Date		2022/06/02			2022/06/02		
COC Number		159558			159558		
	UNITS	M22S127AE0-5-220602	RDL	QC Batch	M22S127BT5-12-220602	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.74	N/A	A610734	0.28	N/A	A610734
Cation Sum	meq/L	1.5	N/A	A610734	1.9	N/A	A610734
Cation/EC Ratio	N/A	9.5	0.10	A610722	12	0.10	A610722
Soluble Nitrate (N)	mg/L	0.41	0.20	A610735	0.52	0.20	A610735
Calculated Calcium (Ca)	mg/kg	4.2	0.58	A610739	7.2	0.64	A610739
Calculated Magnesium (Mg)	mg/kg	1.5	0.39	A610739	2.8	0.43	A610739
Calculated Sodium (Na)	mg/kg	5.1	0.97	A610739	4.8	1.1	A610739
Calculated Potassium (K)	mg/kg	0.85	0.50	A610739	1.1	0.56	A610739
Calculated Chloride (Cl)	mg/kg	7.2	3.9	A610739	<4.3	4.3	A610739
Calculated Sulphate (SO4)	mg/kg	3.5	1.9	A610739	5.0	2.1	A610739
Elements							
Cation exchange capacity	cmol+/Kg	11	10	A610725	14	10	A610725
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	18	10	A614879	<10	10	A615434
Soluble Conductivity	dS/m	0.16	0.020	A615110	0.17	0.020	A615524
Soluble (CaCl2) pH	pH	5.84	N/A	A613560	6.13	N/A	A614042
Sodium Adsorption Ratio	N/A	0.88	0.10	A610736	0.58	0.10	A610736
Soluble Calcium (Ca)	mg/L	11	1.5	A615162	17	1.5	A615500
Soluble Nitrite (N)	mg/L	<0.20	0.20	A614740	<0.20	0.20	A615203
Soluble Magnesium (Mg)	mg/L	3.8	1.0	A615162	6.5	1.0	A615500
Soluble Sodium (Na)	mg/L	13	2.5	A615162	11	2.5	A615500
Soluble Potassium (K)	mg/L	2.2	1.3	A615162	2.7	1.3	A615500
Saturation %	%	39	N/A	A613550	43	N/A	A614038
Soluble Sulphate (SO4)	mg/L	9.0	5.0	A615162	12	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A610742	<0.20	0.20	A610742
Physical Properties							
Grain Size	N/A	FINE	N/A	A609766	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	A614608	0.79	0.20	A614700
Sieve - #200 (>0.075mm)	%	2.4	0.20	A614608	1.8	0.20	A614700
Sieve - Pan	%	98	0.20	A614608	98	0.20	A614700

RDL = Reportable Detection Limit
N/A = Not Applicable

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RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS348		AUS349		
Sampling Date		2022/06/02		2022/06/03		
COC Number		159558		159558		
	UNITS	M22S127CK12-120-220602	RDL	M22SAD1AE0-7-220603	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.041	N/A	0.37	N/A	A610734
Cation Sum	meq/L	1.9	N/A	1.3	N/A	A610734
Cation/EC Ratio	N/A	10	0.10	8.9	0.10	A610722
Soluble Nitrate (N)	mg/L	0.58	0.20	<0.20	0.20	A610735
Calculated Calcium (Ca)	mg/kg	6.0	0.46	2.7	0.53	A610739
Calculated Magnesium (Mg)	mg/kg	1.0	0.31	0.68	0.35	A610739
Calculated Sodium (Na)	mg/kg	4.5	0.76	2.4	0.88	A610739
Calculated Potassium (K)	mg/kg	<0.40	0.40	1.8	0.46	A610739
Calculated Chloride (Cl)	mg/kg	<3.1	3.1	<3.5	3.5	A610739
Calculated Sulphate (SO4)	mg/kg	<1.5	1.5	6.2	1.8	A610739
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	<10	10	A610725
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A614879
Soluble Conductivity	dS/m	0.18	0.020	0.15	0.020	A615110
Soluble (CaCl2) pH	pH	7.60	N/A	3.45 (1)	N/A	A613560
Sodium Adsorption Ratio	N/A	0.81	0.10	0.57	0.10	A610736
Soluble Calcium (Ca)	mg/L	20	1.5	7.6	1.5	A615162
Soluble Nitrite (N)	mg/L	<0.20	0.20	<0.20	0.20	A614740
Soluble Magnesium (Mg)	mg/L	3.3	1.0	1.9	1.0	A615162
Soluble Sodium (Na)	mg/L	15	2.5	6.8	2.5	A615162
Soluble Potassium (K)	mg/L	<1.3	1.3	5.2	1.3	A615162
Saturation %	%	31	N/A	35	N/A	A613550
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	18	5.0	A615162
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A610742
Physical Properties						
Grain Size	N/A	FINE	N/A	COARSE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	4.0	0.20	A614608
Sieve - #200 (>0.075mm)	%	0.21	0.20	74	0.20	A614608
Sieve - Pan	%	100	0.20	26	0.20	A614608

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Sample pH value outside pH calibration range 4 to 10, verified using pH 1.68 buffer

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS350		AUS351		
Sampling Date		2022/06/03		2022/06/03		
COC Number		159558		159558		
	UNITS	M22SAD1BM7-25-220603	RDL	M22SAD1CK2-45-120-220603	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.0000	N/A	0.38	N/A	A610734
Cation Sum	meq/L	0.37	N/A	2.4	N/A	A610734
Cation/EC Ratio	N/A	7.3	0.10	11	0.10	A610722
Soluble Nitrate (N)	mg/L	<0.20	0.20	0.54	0.20	A610735
Calculated Calcium (Ca)	mg/kg	<0.44	0.44	8.7	0.40	A610739
Calculated Magnesium (Mg)	mg/kg	<0.29	0.29	0.83	0.26	A610739
Calculated Sodium (Na)	mg/kg	2.1	0.74	2.8	0.66	A610739
Calculated Potassium (K)	mg/kg	<0.38	0.38	0.51	0.34	A610739
Calculated Chloride (Cl)	mg/kg	<2.9	2.9	3.2	2.6	A610739
Calculated Sulphate (SO4)	mg/kg	<1.5	1.5	<1.3	1.3	A610739
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	<10	10	A610725
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	12	10	A614879
Soluble Conductivity	dS/m	0.051	0.020	0.22	0.020	A615110
Soluble (CaCl2) pH	pH	4.21	N/A	7.91	N/A	A613560
Sodium Adsorption Ratio	N/A	NC	0.10	0.48	0.10	A610736
Soluble Calcium (Ca)	mg/L	<1.5	1.5	33	1.5	A615162
Soluble Nitrite (N)	mg/L	<0.20	0.20	<0.20	0.20	A614740
Soluble Magnesium (Mg)	mg/L	<1.0	1.0	3.1	1.0	A615162
Soluble Sodium (Na)	mg/L	7.2	2.5	11	2.5	A615162
Soluble Potassium (K)	mg/L	<1.3	1.3	1.9	1.3	A615162
Saturation %	%	29	N/A	26	N/A	A613550
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	<5.0	5.0	A615162
Theoretical Gypsum Requirement	tonnes/ha	NC	0.20	<0.20	0.20	A610742
Physical Properties						
Grain Size	N/A	COARSE	N/A	COARSE	N/A	A609766
Sieve - #10 (>2.00mm)	%	2.0	0.20	3.6	0.20	A614608
Sieve - #200 (>0.075mm)	%	90	0.20	96	0.20	A614608
Sieve - Pan	%	10	0.20	4.1	0.20	A614608

RDL = Reportable Detection Limit
N/A = Not Applicable

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RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS365		AUS366		
Sampling Date		2022/06/01		2022/06/01		
COC Number		159559		159559		
	UNITS	M22S044-CG-0-90-220601	RDL	M22S044-IICG-90-120-220601	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.28	N/A	2.3	N/A	A610734
Cation Sum	meq/L	1.2	N/A	3.3	N/A	A610734
Cation/EC Ratio	N/A	9.6	0.10	7.5	0.10	A610722
Soluble Nitrate (N)	mg/L	0.43	0.20	0.58	0.20	A610735
Calculated Calcium (Ca)	mg/kg	3.5	0.65	10	0.49	A610739
Calculated Magnesium (Mg)	mg/kg	0.83	0.43	2.3	0.33	A610739
Calculated Sodium (Na)	mg/kg	6.6	1.1	7.9	0.81	A610739
Calculated Potassium (K)	mg/kg	<0.56	0.56	0.59	0.42	A610739
Calculated Chloride (Cl)	mg/kg	<4.3	4.3	20	3.3	A610739
Calculated Sulphate (SO4)	mg/kg	5.1	2.2	7.7	1.6	A610739
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	<10	10	A610725
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	62	10	A615434
Soluble Conductivity	dS/m	0.13	0.020	0.44	0.020	A615524
Soluble (CaCl2) pH	pH	6.06	N/A	5.65	N/A	A614042
Sodium Adsorption Ratio	N/A	1.3	0.10	1.0	0.10	A610736
Soluble Calcium (Ca)	mg/L	8.2	1.5	31	1.5	A615500
Soluble Nitrite (N)	mg/L	<0.20	0.20	<0.20	0.20	A615203
Soluble Magnesium (Mg)	mg/L	1.9	1.0	7.1	1.0	A615500
Soluble Sodium (Na)	mg/L	15	2.5	24	2.5	A615500
Soluble Potassium (K)	mg/L	<1.3	1.3	1.8	1.3	A615500
Saturation %	%	43	N/A	33	N/A	A614038
Soluble Sulphate (SO4)	mg/L	12	5.0	24	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A610742
Physical Properties						
Grain Size	N/A	FINE	N/A	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	0.43	0.20	A614608
Sieve - #200 (>0.075mm)	%	27	0.20	23	0.20	A614608
Sieve - Pan	%	73	0.20	77	0.20	A614608

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS367		AUS368		AUS369		
Sampling Date		2022/05/29		2022/05/29		2022/05/29		
COC Number		159559		159559		159559		
	UNITS	M22S011-AH-220529	RDL	M22S011-CG1-220529	RDL	M22S011-CG2-55-120-220529	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	0.42	N/A	0.33	N/A	0.31	N/A	A610734
Cation Sum	meq/L	1.0	N/A	0.65	N/A	0.78	N/A	A610734
Cation/EC Ratio	N/A	8.2	0.10	9.1	0.10	8.7	0.10	A610722
Soluble Nitrate (N)	mg/L	2.0	0.20	2.8	0.20	0.71	0.20	A610735
Calculated Calcium (Ca)	mg/kg	6.4	1.2	0.82	0.59	1.3	0.77	A610739
Calculated Magnesium (Mg)	mg/kg	1.0	0.81	<0.40	0.40	<0.51	0.51	A610739
Calculated Sodium (Na)	mg/kg	7.8	2.0	4.4	0.99	7.3	1.3	A610739
Calculated Potassium (K)	mg/kg	1.9	1.1	0.62	0.51	0.73	0.67	A610739
Calculated Chloride (Cl)	mg/kg	<8.1	8.1	<4.0	4.0	<5.1	5.1	A610739
Calculated Sulphate (SO4)	mg/kg	16	4.0	2.6	2.0	6.5	2.6	A610739
Elements								
Cation exchange capacity	cmol+/Kg	11	10	<10	10	<10	10	A610725
Soluble Parameters								
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	<10	10	A614879
Soluble Conductivity	dS/m	0.12	0.020	0.072	0.020	0.090	0.020	A615110
Soluble (CaCl2) pH	pH	4.61	N/A	4.62	N/A	5.20	N/A	A613560
Sodium Adsorption Ratio	N/A	0.83	0.10	2.1	0.10	2.5	0.10	A610736
Soluble Calcium (Ca)	mg/L	8.0	1.5	2.1	1.5	2.5	1.5	A615162
Soluble Nitrite (N)	mg/L	<0.20	0.20	<0.20	0.20	<0.20	0.20	A614740
Soluble Magnesium (Mg)	mg/L	1.3	1.0	<1.0	1.0	<1.0	1.0	A615162
Soluble Sodium (Na)	mg/L	9.6	2.5	11	2.5	14	2.5	A615162
Soluble Potassium (K)	mg/L	2.4	1.3	1.6	1.3	1.4	1.3	A615162
Saturation %	%	81	N/A	40	N/A	51	N/A	A613550
Soluble Sulphate (SO4)	mg/L	20	5.0	6.6	5.0	13	5.0	A615162
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	<0.20	0.20	A610742
Physical Properties								
Grain Size	N/A	FINE	N/A	COARSE	N/A	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	0.29	0.20	<0.20	0.20	2.6	0.20	A614608
Sieve - #200 (>0.075mm)	%	14	0.20	79	0.20	12	0.20	A614608
Sieve - Pan	%	86	0.20	21	0.20	88	0.20	A614608

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS370		AUS371	AUS372		
Sampling Date		2022/06/04		2022/05/31	2022/05/31		
COC Number		159559		159559	159559		
	UNITS	M22S258 F6-0-220604	QC Batch	M22S032-0F/0M-220531	M22S032-0M/0F-220531	RDL	QC Batch
Calculated Parameters							
Soluble Nitrate (N)	mg/L	<0.20	A610735	0.43	0.56	0.20	A610735
Soluble Parameters							
Soluble Nitrite (N)	mg/L	<0.20	A615203	<0.20	<0.20	0.20	A614740
Saturation %	%	170	A614038	470	420	N/A	A613550

RDL = Reportable Detection Limit
N/A = Not Applicable

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RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS379			AUS380		
Sampling Date		2022/05/28			2022/05/28		
COC Number		159560			159560		
	UNITS	M22S055AE0-3-220528	RDL	QC Batch	M22S055BT3-17-220528	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.77	N/A	A610734	0.11	N/A	A610734
Cation Sum	meq/L	1.9	N/A	A610734	1.2	N/A	A610734
Cation/EC Ratio	N/A	9.9	0.10	A610722	10	0.10	A610722
Soluble Nitrate (N)	mg/L	<0.20	0.20	A610735	<0.20	0.20	A610735
Calculated Calcium (Ca)	mg/kg	4.5	0.46	A610739	1.9	0.50	A610739
Calculated Magnesium (Mg)	mg/kg	1.3	0.31	A610739	0.64	0.33	A610739
Calculated Sodium (Na)	mg/kg	5.2	0.77	A610739	4.4	0.83	A610739
Calculated Potassium (K)	mg/kg	1.4	0.40	A610739	1.1	0.43	A610739
Calculated Chloride (Cl)	mg/kg	3.3	3.1	A610739	<3.3	3.3	A610739
Calculated Sulphate (SO4)	mg/kg	6.9	1.5	A610739	1.7	1.7	A610739
Elements							
Cation exchange capacity	cmol+/Kg	<10	10	A610725	<10	10	A610725
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	11	10	A615434	<10	10	A614879
Soluble Conductivity	dS/m	0.20	0.020	A615524	0.11	0.020	A615110
Soluble (CaCl2) pH	pH	4.59	N/A	A614042	4.30	N/A	A613560
Sodium Adsorption Ratio	N/A	1.0	0.10	A610736	1.2	0.10	A610736
Soluble Calcium (Ca)	mg/L	14	1.5	A615500	5.8	1.5	A615162
Soluble Nitrite (N)	mg/L	<0.20	0.20	A615203	<0.20	0.20	A614740
Soluble Magnesium (Mg)	mg/L	4.1	1.0	A615500	1.9	1.0	A615162
Soluble Sodium (Na)	mg/L	17	2.5	A615500	13	2.5	A615162
Soluble Potassium (K)	mg/L	4.4	1.3	A615500	3.4	1.3	A615162
Saturation %	%	31	N/A	A614038	33	N/A	A613550
Soluble Sulphate (SO4)	mg/L	22	5.0	A615500	5.2	5.0	A615162
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A610742	<0.20	0.20	A610742
Physical Properties							
Grain Size	N/A	FINE	N/A	A609766	FINE	N/A	A609766
Sieve - #10 (>2.00mm)	%	0.69	0.20	A614608	<0.20	0.20	A614608
Sieve - #200 (>0.075mm)	%	23	0.20	A614608	12	0.20	A614608
Sieve - Pan	%	77	0.20	A614608	88	0.20	A614608

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N/A = Not Applicable

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		AUS381		AUS382		AUS383		
Sampling Date		2022/05/28		2022/05/28		2022/06/03		
COC Number		159560		159560		159560		
	UNITS	M22S055CKGJ17-80-220528	RDL	MM22S055IICKGJ80-100-220528	RDL	M22SAD1CK125-45-220603	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	0.51	N/A	1.4	N/A	0.79	N/A	A610734
Cation Sum	meq/L	2.2	N/A	3.6	N/A	2.3	N/A	A610734
Cation/EC Ratio	N/A	9.9	0.10	8.9	0.10	10	0.10	A610722
Soluble Nitrate (N)	mg/L	0.63	0.20	<0.20	0.20	3.6	0.20	A610735
Calculated Calcium (Ca)	mg/kg	9.1	0.54	19	0.57	9.6	0.47	A610739
Calculated Magnesium (Mg)	mg/kg	1.5	0.36	2.5	0.38	1.3	0.31	A610739
Calculated Sodium (Na)	mg/kg	5.0	0.91	4.9	0.96	2.9	0.78	A610739
Calculated Potassium (K)	mg/kg	0.50	0.47	<0.50	0.50	0.66	0.41	A610739
Calculated Chloride (Cl)	mg/kg	3.7	3.6	19	3.8	3.4	3.1	A610739
Calculated Sulphate (SO4)	mg/kg	2.7	1.8	<1.9	1.9	3.4	1.6	A610739
Elements								
Cation exchange capacity	cmol+/Kg	15	10	15	10	15	10	A610725
Soluble Parameters								
Soluble Chloride (Cl)	mg/L	10	10	50	10	11	10	A615434
Soluble Conductivity	dS/m	0.23	0.020	0.40	0.020	0.23	0.020	A615524
Soluble (CaCl2) pH	pH	7.70	N/A	7.21	N/A	7.44	N/A	A614042
Sodium Adsorption Ratio	N/A	0.67	0.10	0.45	0.10	0.42	0.10	A610736
Soluble Calcium (Ca)	mg/L	25	1.5	50	1.5	31	1.5	A615500
Soluble Nitrite (N)	mg/L	0.28	0.20	0.24	0.20	<0.20	0.20	A615203
Soluble Magnesium (Mg)	mg/L	4.1	1.0	6.6	1.0	4.2	1.0	A615500
Soluble Sodium (Na)	mg/L	14	2.5	13	2.5	9.4	2.5	A615500
Soluble Potassium (K)	mg/L	1.4	1.3	<1.3	1.3	2.1	1.3	A615500
Saturation %	%	36	N/A	38	N/A	31	N/A	A614038
Soluble Sulphate (SO4)	mg/L	7.4	5.0	<5.0	5.0	11	5.0	A615500
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	<0.20	0.20	A610742
Physical Properties								
Grain Size	N/A	FINE	N/A	FINE	N/A	COARSE	N/A	A609766
Sieve - #10 (>2.00mm)	%	<0.20	0.20	16	0.20	45	0.20	A614608
Sieve - #200 (>0.075mm)	%	7.9	0.20	23	0.20	93	0.20	A614608
Sieve - Pan	%	92	0.20	77	0.20	7.3	0.20	A614608

RDL = Reportable Detection Limit
N/A = Not Applicable

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PHYSICAL TESTING (SOIL)

Bureau Veritas ID		AUS304		AUS305		
Sampling Date		2022/06/06		2022/06/06		
COC Number		159589		159589		
	UNITS	M22S161BM0-14-220606	QC Batch	M22S161BTNJ14-27-220606	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	17	A645642	9.9	2.0	A642740
% silt by hydrometer	%	17	A645642	15	2.0	A642740
Clay Content	%	66	A645642	75	2.0	A642740
Texture	N/A	HEAVY CLAY	A633908	HEAVY CLAY	N/A	A633908
Moisture	%	27	A612517	23	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS306			AUS307		
Sampling Date		2022/06/06			2022/06/06		
COC Number		159589			159589		
	UNITS	M22161BC27-44-220606	RDL	QC Batch	M22S161CK44-65-220606	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%				8.3	2.0	A645642
% silt by hydrometer	%				17	2.0	A645642
Clay Content	%				75	2.0	A645642
Texture	N/A				HEAVY CLAY	N/A	A633908
Moisture	%	29	0.30	A612517	28	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS308			AUS309	AUS310		
Sampling Date		2022/06/06			2022/05/28	2022/05/28		
COC Number		159589			159589	159589		
	UNITS	M22S16111CKG-65-110-220606	RDL	QC Batch	M22S028AHE0-14-220528	M22S028017-0-220528	RDL	QC Batch
Physical Properties								
% sand by hydrometer	%	48	2.0	A642740				
% silt by hydrometer	%	37	2.0	A642740				
Clay Content	%	15	2.0	A642740				
Texture	N/A	LOAM	N/A	A633908				
Moisture	%	11	0.30	A612517	55	73	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

PHYSICAL TESTING (SOIL)

Bureau Veritas ID		AUS311		AUS312	AUS343		
Sampling Date		2022/05/28		2022/05/28	2022/06/04		
COC Number		159589		159589	159558		
	UNITS	M22S028BT14-39-220528	QC Batch	M22S028C39-145-220528	M22S258AE0-6-220604	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	18	A645642	25	45	2.0	A642740
% silt by hydrometer	%	20	A645642	28	43	2.0	A642740
Clay Content	%	62	A645642	47	12	2.0	A642740
Texture	N/A	HEAVY CLAY	A633908	CLAY	LOAM	N/A	A633908
Moisture	%	22	A612158	27	26	0.30	A612534

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS344		AUS345	AUS346		
Sampling Date		2022/06/04		2022/06/04	2022/06/02		
COC Number		159558		159558	159558		
	UNITS	M22S258BT5-36-220604	QC Batch	M22S258CK36-120-220604	M22S127AE0-5-220602	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	7.7	A645642	7.7	17	2.0	A642740
% silt by hydrometer	%	9.5	A645642	50	61	2.0	A642740
Clay Content	%	83	A645642	43	22	2.0	A642740
Texture	N/A	HEAVY CLAY	A633908	SILTY CLAY	SILT LOAM	N/A	A633908
Moisture	%	32	A612534	22	25	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS347		AUS348		
Sampling Date		2022/06/02		2022/06/02		
COC Number		159558		159558		
	UNITS	M22S127BT5-12-220602	QC Batch	M22S127CK12-120-220602	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	18	A642740	11	2.0	A642740
% silt by hydrometer	%	58	A642740	78	2.0	A642740
Clay Content	%	23	A642740	11	2.0	A642740
Texture	N/A	SILT LOAM	A633908	SILT LOAM	N/A	A633908
Moisture	%	24	A612534	17	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

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PHYSICAL TESTING (SOIL)

Bureau Veritas ID		AUS349		AUS350	AUS351		
Sampling Date		2022/06/03		2022/06/03	2022/06/03		
COC Number		159558		159558	159558		
	UNITS	M22SAD1AE0-7-220603	QC Batch	M22SAD1BM7-25-220603	M22SAD1CK2-45-120-220603	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	83	A642740	93	96	2.0	A642740
% silt by hydrometer	%	12	A642740	<2.0	2.3	2.0	A642740
Clay Content	%	5.0	A642740	5.7	2.2	2.0	A642740
Texture	N/A	LOAMY SAND	A634693	SAND	SAND	N/A	A634693
Moisture	%	13	A612534	7.5	9.5	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS365		AUS366		
Sampling Date		2022/06/01		2022/06/01		
COC Number		159559		159559		
	UNITS	M22S044-CG-0-90-220601	QC Batch	M22S044-IICG-90-120-220601	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	46	A642740	52	2.0	A642740
% silt by hydrometer	%	43	A642740	35	2.0	A642740
Clay Content	%	11	A642740	13	2.0	A642740
Texture	N/A	LOAM	A634693	LOAM	N/A	A634693
Moisture	%	26	A612534	25	0.30	A612158

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS367			AUS368	AUS369		
Sampling Date		2022/05/29			2022/05/29	2022/05/29		
COC Number		159559			159559	159559		
	UNITS	M22S011-AH-220529	RDL	QC Batch	M22S011-CG1-220529	M22S011-CG2-55-120-220529	RDL	QC Batch
Physical Properties								
% sand by hydrometer	%				82	32	2.0	A645642
% silt by hydrometer	%				5.5	24	2.0	A645642
Clay Content	%				12	43	2.0	A645642
Texture	N/A				SANDY LOAM	CLAY	N/A	A634693
Moisture	%	56	0.30	A612158	20	29	0.30	A612534

RDL = Reportable Detection Limit
N/A = Not Applicable

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PHYSICAL TESTING (SOIL)

Bureau Veritas ID		AUS379			AUS380		
Sampling Date		2022/05/28			2022/05/28		
COC Number		159560			159560		
	UNITS	M22S055AE0-3-220528	RDL	QC Batch	M22S055BT3-17-220528	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	38	2.0	A642740			
% silt by hydrometer	%	40	2.0	A642740			
Clay Content	%	22	2.0	A642740			
Texture	N/A	LOAM	N/A	A634693			
Moisture	%	23	0.30	A612517	23	0.30	A612517

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		AUS381		AUS382		AUS383		
Sampling Date		2022/05/28		2022/05/28		2022/06/03		
COC Number		159560		159560		159560		
	UNITS	M22S055CKGJ17-80-220528	QC Batch	MM22S055IICKGJ80-100-220528	QC Batch	M22SAD1CK125-45-220603	RDL	QC Batch
Physical Properties								
% sand by hydrometer	%	18	A642740	25	A642740	91	2.0	A642740
% silt by hydrometer	%	32	A642740	30	A642740	4.3	2.0	A642740
Clay Content	%	51	A642740	45	A642740	4.3	2.0	A642740
Texture	N/A	CLAY	A634693	CLAY	A634693	SAND	N/A	A634693
Moisture	%	18	A612534	12	A612517	14	0.30	A612534

RDL = Reportable Detection Limit
N/A = Not Applicable

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MISCELLANEOUS (SOIL)

Bureau Veritas ID		AUS304	AUS305		AUS306		
Sampling Date		2022/06/06	2022/06/06		2022/06/06		
COC Number		159589	159589		159589		
	UNITS	M22S161BM0-14-220606	M22S161BTNJ14-27-220606	QC Batch	M22161BC27-44-220606	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	2.0	0.92	A617736	1.0	0.050	A617680
RDL = Reportable Detection Limit							

Bureau Veritas ID		AUS307		AUS308	AUS309		
Sampling Date		2022/06/06		2022/06/06	2022/05/28		
COC Number		159589		159589	159589		
	UNITS	M22S161CK44-65-220606	QC Batch	M22S16111CKG-65-110-220606	M22S028AHE0-14-220528	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	0.28	A617680	0.11	10	0.050	A617736
RDL = Reportable Detection Limit							

Bureau Veritas ID		AUS310	AUS311	AUS312		
Sampling Date		2022/05/28	2022/05/28	2022/05/28		
COC Number		159589	159589	159589		
	UNITS	M22S028017-0-220528	M22S028BT14-39-220528	M22S028C39-145-220528	RDL	QC Batch
Misc. Inorganics						
Total Organic Carbon (C)	%	48	1.4	0.38	0.050	A617680
RDL = Reportable Detection Limit						

Bureau Veritas ID		AUS343		AUS344		
Sampling Date		2022/06/04		2022/06/04		
COC Number		159558		159558		
	UNITS	M22S258AE0-6-220604	QC Batch	M22S258BT5-36-220604	RDL	QC Batch
Misc. Inorganics						
Total Organic Carbon (C)	%	1.1	A617680	0.73	0.050	A617736
RDL = Reportable Detection Limit						

Bureau Veritas ID		AUS345	AUS346	AUS347		
Sampling Date		2022/06/04	2022/06/02	2022/06/02		
COC Number		159558	159558	159558		
	UNITS	M22S258CK36-120-220604	M22S127AE0-5-220602	M22S127BT5-12-220602	RDL	QC Batch
Misc. Inorganics						
Total Organic Carbon (C)	%	0.20	1.2	1.6	0.050	A617680
RDL = Reportable Detection Limit						

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MISCELLANEOUS (SOIL)

Bureau Veritas ID		AUS348	AUS349		AUS350		
Sampling Date		2022/06/02	2022/06/03		2022/06/03		
COC Number		159558	159558		159558		
	UNITS	M22S127CK12-120-220602	M22SAD1AE0-7-220603	QC Batch	M22SAD1BM7-25-220603	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	0.17	0.86	A617680	0.29	0.050	A617736
RDL = Reportable Detection Limit							

Bureau Veritas ID		AUS351	AUS365		AUS366		
Sampling Date		2022/06/03	2022/06/01		2022/06/01		
COC Number		159558	159559		159559		
	UNITS	M22SAD1CK2-45-120-220603	M22S044-CG-0-90-220601	QC Batch	M22S044-IICG-90-120-220601	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	0.58	1.5	A617680	0.89	0.050	A617736
RDL = Reportable Detection Limit							

Bureau Veritas ID		AUS367		AUS368	AUS369		
Sampling Date		2022/05/29		2022/05/29	2022/05/29		
COC Number		159559		159559	159559		
	UNITS	M22S011-AH-220529	QC Batch	M22S011-CG1-220529	M22S011-CG2-55-120-220529	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	7.8	A617736	0.75	2.1	0.050	A617680
RDL = Reportable Detection Limit							

Bureau Veritas ID		AUS370		AUS371		
Sampling Date		2022/06/04		2022/05/31		
COC Number		159559		159559		
	UNITS	M22S258 F6-0-220604	QC Batch	M22S032-0F/0M-220531	RDL	QC Batch
Misc. Inorganics						
Total Organic Carbon (C)	%	23	A617680	29	0.050	A617736
RDL = Reportable Detection Limit						

Bureau Veritas ID		AUS372	AUS379		AUS380		
Sampling Date		2022/05/31	2022/05/28		2022/05/28		
COC Number		159559	159560		159560		
	UNITS	M22S032-0M/0F-220531	M22S055AE0-3-220528	QC Batch	M22S055BT3-17-220528	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	33	1.4	A617680	1.1	0.050	A617736
RDL = Reportable Detection Limit							

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MISCELLANEOUS (SOIL)

Bureau Veritas ID		AUS381		AUS382	AUS383		
Sampling Date		2022/05/28		2022/05/28	2022/06/03		
COC Number		159560		159560	159560		
	UNITS	M22S055CKGJ17-80-220528	QC Batch	MM22S055IICKGJ80-100-220528	M22SAD1CK125-45-220603	RDL	QC Batch
Misc. Inorganics							
Total Organic Carbon (C)	%	0.57	A617736	0.45	1.5	0.050	A617680
RDL = Reportable Detection Limit							

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	0.6°C
Package 2	-2.2°C

Version #2: Additional Texture analysis has been added as per request from client 20220706

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A612158	MGH	Method Blank	Moisture	2022/06/17	<0.30		%	
A612158	MGH	RPD [AUS311-01]	Moisture	2022/06/17	0		%	20
A612517	RIL	Method Blank	Moisture	2022/06/17	<0.30		%	
A612517	RIL	RPD [AUS380-01]	Moisture	2022/06/17	5.8		%	20
A612534	ETS	Method Blank	Moisture	2022/06/16	<0.30		%	
A612534	ETS	RPD	Moisture	2022/06/16	1.0		%	20
A613550	NQU	QC Standard	Saturation %	2022/06/18		100	%	75 - 125
A613550	NQU	RPD [AUS369-01]	Saturation %	2022/06/18	1.2		%	12
A613560	STB	QC Standard	Soluble (CaCl2) pH	2022/06/18		100	%	97 - 103
A613560	STB	Spiked Blank	Soluble (CaCl2) pH	2022/06/18		100	%	97 - 103
A613560	STB	RPD [AUS369-01]	Soluble (CaCl2) pH	2022/06/18	3.3		%	N/A
A614038	NQU	QC Standard	Saturation %	2022/06/19		98	%	75 - 125
A614038	NQU	RPD [AUS365-01]	Saturation %	2022/06/19	4.2		%	12
A614042	STB	QC Standard	Soluble (CaCl2) pH	2022/06/19		99	%	97 - 103
A614042	STB	Spiked Blank	Soluble (CaCl2) pH	2022/06/19		100	%	97 - 103
A614042	STB	RPD [AUS365-01]	Soluble (CaCl2) pH	2022/06/19	1.0		%	N/A
A614511	NMG	QC Standard	Sieve - #200 (>0.075mm)	2022/06/18		97	%	75 - 125
			Sieve - Pan	2022/06/18		101	%	75 - 125
A614511	NMG	RPD	Sieve - #10 (>2.00mm)	2022/06/18	108 (1)		%	30
			Sieve - #200 (>0.075mm)	2022/06/18	59 (1)		%	30
			Sieve - Pan	2022/06/18	39 (1)		%	30
A614608	NMG	QC Standard	Sieve - #200 (>0.075mm)	2022/06/18		98	%	75 - 125
			Sieve - Pan	2022/06/18		101	%	75 - 125
A614608	NMG	RPD	Sieve - #10 (>2.00mm)	2022/06/18	NC		%	30
			Sieve - #200 (>0.075mm)	2022/06/18	5.5		%	30
			Sieve - Pan	2022/06/18	2.0		%	30
A614646	NQU	QC Standard	Saturation %	2022/06/19		102	%	75 - 125
A614646	NQU	RPD [AUS304-01]	Saturation %	2022/06/19	2.9		%	12
A614646	NQU	RPD	Saturation %	2022/06/19	2.8		%	12
A614648	STB	QC Standard	Soluble (CaCl2) pH	2022/06/19		99	%	97 - 103
A614648	STB	Spiked Blank	Soluble (CaCl2) pH	2022/06/19		100	%	97 - 103
A614648	STB	RPD	Soluble (CaCl2) pH	2022/06/19	0.11		%	N/A
A614700	BL7	QC Standard	Sieve - #200 (>0.075mm)	2022/06/20		99	%	75 - 125
			Sieve - Pan	2022/06/20		100	%	75 - 125
A614700	BL7	RPD	Sieve - #10 (>2.00mm)	2022/06/20	NC		%	30
			Sieve - #200 (>0.075mm)	2022/06/20	20		%	30
			Sieve - Pan	2022/06/20	1.3		%	30
A614740	ACR	Matrix Spike [AUS369-01]	Soluble Nitrite (N)	2022/06/19		90	%	75 - 125
A614740	ACR	Spiked Blank	Soluble Nitrite (N)	2022/06/18		95	%	80 - 120
A614740	ACR	Method Blank	Soluble Nitrite (N)	2022/06/19	<0.20		mg/L	
A614740	ACR	RPD [AUS369-01]	Soluble Nitrite (N)	2022/06/19	NC		%	30
A614879	AFI	Matrix Spike [AUS380-01]	Soluble Chloride (Cl)	2022/06/19		113	%	75 - 125
A614879	AFI	QC Standard	Soluble Chloride (Cl)	2022/06/19		119	%	75 - 125
A614879	AFI	Spiked Blank	Soluble Chloride (Cl)	2022/06/19		108	%	80 - 120
A614879	AFI	Method Blank	Soluble Chloride (Cl)	2022/06/19	<10		mg/L	
A614879	AFI	RPD [AUS369-01]	Soluble Chloride (Cl)	2022/06/19	NC		%	30
A615090	EH2	QC Standard	Soluble Conductivity	2022/06/19		106	%	75 - 125
A615090	EH2	Spiked Blank	Soluble Conductivity	2022/06/19		100	%	90 - 110
A615090	EH2	Method Blank	Soluble Conductivity	2022/06/19	<0.020		dS/m	
A615090	EH2	RPD	Soluble Conductivity	2022/06/19	0.78		%	20
A615110	EH2	QC Standard	Soluble Conductivity	2022/06/19		103	%	75 - 125
A615110	EH2	Spiked Blank	Soluble Conductivity	2022/06/19		99	%	90 - 110

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A615110	EH2	Method Blank	Soluble Conductivity	2022/06/19	<0.020		dS/m	
A615110	EH2	RPD [AUS369-01]	Soluble Conductivity	2022/06/19	5.6		%	20
A615115	MPU	Matrix Spike	Soluble Calcium (Ca)	2022/06/19		91	%	75 - 125
			Soluble Magnesium (Mg)	2022/06/19		89	%	75 - 125
			Soluble Sodium (Na)	2022/06/19		87	%	75 - 125
			Soluble Potassium (K)	2022/06/19		92	%	75 - 125
A615115	MPU	QC Standard	Soluble Calcium (Ca)	2022/06/19		105	%	75 - 125
			Soluble Magnesium (Mg)	2022/06/19		107	%	75 - 125
			Soluble Sodium (Na)	2022/06/19		101	%	75 - 125
			Soluble Potassium (K)	2022/06/19		101	%	75 - 125
			Soluble Sulphate (SO4)	2022/06/19		111	%	75 - 125
A615115	MPU	Spiked Blank	Soluble Calcium (Ca)	2022/06/19		95	%	80 - 120
			Soluble Magnesium (Mg)	2022/06/19		100	%	80 - 120
			Soluble Sodium (Na)	2022/06/19		91	%	80 - 120
			Soluble Potassium (K)	2022/06/19		94	%	80 - 120
A615115	MPU	Method Blank	Soluble Calcium (Ca)	2022/06/19	<1.5		mg/L	
			Soluble Magnesium (Mg)	2022/06/19	<1.0		mg/L	
			Soluble Sodium (Na)	2022/06/19	<2.5		mg/L	
			Soluble Potassium (K)	2022/06/19	<1.3		mg/L	
			Soluble Sulphate (SO4)	2022/06/19	<5.0		mg/L	
A615115	MPU	RPD	Soluble Calcium (Ca)	2022/06/19	7.6		%	30
			Soluble Magnesium (Mg)	2022/06/19	3.7		%	30
			Soluble Sodium (Na)	2022/06/19	2.9		%	30
			Soluble Potassium (K)	2022/06/19	7.7		%	30
			Soluble Sulphate (SO4)	2022/06/19	0.71		%	30
A615162	MPU	Matrix Spike [AUS369-01]	Soluble Calcium (Ca)	2022/06/19		104	%	75 - 125
			Soluble Magnesium (Mg)	2022/06/19		104	%	75 - 125
			Soluble Sodium (Na)	2022/06/19		103	%	75 - 125
			Soluble Potassium (K)	2022/06/19		104	%	75 - 125
A615162	MPU	QC Standard	Soluble Calcium (Ca)	2022/06/19		101	%	75 - 125
			Soluble Magnesium (Mg)	2022/06/19		100	%	75 - 125
			Soluble Sodium (Na)	2022/06/19		99	%	75 - 125
			Soluble Potassium (K)	2022/06/19		118	%	75 - 125
			Soluble Sulphate (SO4)	2022/06/19		95	%	75 - 125
A615162	MPU	Spiked Blank	Soluble Calcium (Ca)	2022/06/19		96	%	80 - 120
			Soluble Magnesium (Mg)	2022/06/19		97	%	80 - 120
			Soluble Sodium (Na)	2022/06/19		95	%	80 - 120
			Soluble Potassium (K)	2022/06/19		96	%	80 - 120
A615162	MPU	Method Blank	Soluble Calcium (Ca)	2022/06/19	<1.5		mg/L	
			Soluble Magnesium (Mg)	2022/06/19	<1.0		mg/L	
			Soluble Sodium (Na)	2022/06/19	<2.5		mg/L	
			Soluble Potassium (K)	2022/06/19	<1.3		mg/L	
			Soluble Sulphate (SO4)	2022/06/19	<5.0		mg/L	
A615162	MPU	RPD [AUS369-01]	Soluble Calcium (Ca)	2022/06/19	2.4		%	30
			Soluble Magnesium (Mg)	2022/06/19	NC		%	30
			Soluble Sodium (Na)	2022/06/19	8.7		%	30
			Soluble Potassium (K)	2022/06/19	3.6		%	30
			Soluble Sulphate (SO4)	2022/06/19	2.5		%	30
A615164	ACR	Matrix Spike [AUS304-01]	Soluble Nitrite (N)	2022/06/19		97	%	75 - 125
A615164	ACR	Spiked Blank	Soluble Nitrite (N)	2022/06/19		98	%	80 - 120
A615164	ACR	Method Blank	Soluble Nitrite (N)	2022/06/19	<0.20		mg/L	
A615164	ACR	RPD [AUS304-01]	Soluble Nitrite (N)	2022/06/19	NC		%	30

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A615170	AFI	Matrix Spike	Soluble Chloride (Cl)	2022/06/19		111	%	75 - 125
A615170	AFI	QC Standard	Soluble Chloride (Cl)	2022/06/19		103	%	75 - 125
A615170	AFI	Spiked Blank	Soluble Chloride (Cl)	2022/06/19		111	%	80 - 120
A615170	AFI	Method Blank	Soluble Chloride (Cl)	2022/06/19	<10		mg/L	
A615170	AFI	RPD	Soluble Chloride (Cl)	2022/06/19	2.1		%	30
A615203	ACR	Matrix Spike [AUS365-01]	Soluble Nitrite (N)	2022/06/20		97	%	75 - 125
A615203	ACR	Spiked Blank	Soluble Nitrite (N)	2022/06/20		90	%	80 - 120
A615203	ACR	Method Blank	Soluble Nitrite (N)	2022/06/20	<0.20		mg/L	
A615203	ACR	RPD [AUS365-01]	Soluble Nitrite (N)	2022/06/20	NC		%	30
A615434	CTU	Matrix Spike [AUS365-01]	Soluble Chloride (Cl)	2022/06/20		89	%	75 - 125
A615434	CTU	QC Standard	Soluble Chloride (Cl)	2022/06/20		103	%	75 - 125
A615434	CTU	Spiked Blank	Soluble Chloride (Cl)	2022/06/20		97	%	80 - 120
A615434	CTU	Method Blank	Soluble Chloride (Cl)	2022/06/20	<10		mg/L	
A615434	CTU	RPD [AUS365-01]	Soluble Chloride (Cl)	2022/06/20	NC		%	30
A615500	PL	Matrix Spike [AUS365-01]	Soluble Calcium (Ca)	2022/06/20		99	%	75 - 125
			Soluble Magnesium (Mg)	2022/06/20		103	%	75 - 125
			Soluble Sodium (Na)	2022/06/20		94	%	75 - 125
			Soluble Potassium (K)	2022/06/20		98	%	75 - 125
A615500	PL	QC Standard	Soluble Calcium (Ca)	2022/06/20		102	%	75 - 125
			Soluble Magnesium (Mg)	2022/06/20		106	%	75 - 125
			Soluble Sodium (Na)	2022/06/20		96	%	75 - 125
			Soluble Potassium (K)	2022/06/20		104	%	75 - 125
			Soluble Sulphate (SO4)	2022/06/20		102	%	75 - 125
A615500	PL	Spiked Blank	Soluble Calcium (Ca)	2022/06/20		99	%	80 - 120
			Soluble Magnesium (Mg)	2022/06/20		103	%	80 - 120
			Soluble Sodium (Na)	2022/06/20		94	%	80 - 120
			Soluble Potassium (K)	2022/06/20		98	%	80 - 120
A615500	PL	Method Blank	Soluble Calcium (Ca)	2022/06/20	<1.5		mg/L	
			Soluble Magnesium (Mg)	2022/06/20	<1.0		mg/L	
			Soluble Sodium (Na)	2022/06/20	<2.5		mg/L	
			Soluble Potassium (K)	2022/06/20	<1.3		mg/L	
			Soluble Sulphate (SO4)	2022/06/20	<5.0		mg/L	
A615500	PL	RPD [AUS365-01]	Soluble Calcium (Ca)	2022/06/20	2.0		%	30
			Soluble Magnesium (Mg)	2022/06/20	0.27		%	30
			Soluble Sodium (Na)	2022/06/20	4.0		%	30
			Soluble Potassium (K)	2022/06/20	NC		%	30
			Soluble Sulphate (SO4)	2022/06/20	5.8		%	30
A615524	LZ3	QC Standard	Soluble Conductivity	2022/06/20		108	%	75 - 125
A615524	LZ3	Spiked Blank	Soluble Conductivity	2022/06/20		100	%	90 - 110
A615524	LZ3	Method Blank	Soluble Conductivity	2022/06/20	<0.020		dS/m	
A615524	LZ3	RPD [AUS365-01]	Soluble Conductivity	2022/06/20	4.6		%	20
A617680	PL	QC Standard	Total Organic Carbon (C)	2022/06/22		105	%	75 - 125
A617680	PL	Spiked Blank	Total Organic Carbon (C)	2022/06/22		101	%	80 - 120
A617680	PL	Method Blank	Total Organic Carbon (C)	2022/06/22	<0.050		%	
A617680	PL	RPD [AUS368-01]	Total Organic Carbon (C)	2022/06/22	6.7		%	35
A617736	PL	QC Standard	Total Organic Carbon (C)	2022/06/22		102	%	75 - 125
A617736	PL	Spiked Blank	Total Organic Carbon (C)	2022/06/22		99	%	80 - 120
A617736	PL	Method Blank	Total Organic Carbon (C)	2022/06/22	<0.050		%	
A617736	PL	RPD [AUS344-01]	Total Organic Carbon (C)	2022/06/22	4.9		%	35
A642740	BL7	QC Standard	% sand by hydrometer	2022/07/13		102	%	75 - 125
			% silt by hydrometer	2022/07/13		108	%	75 - 125
			Clay Content	2022/07/13		90	%	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A642740	BL7	RPD [AUS345-01]	% sand by hydrometer	2022/07/13	15		%	30
			% silt by hydrometer	2022/07/13	6.5		%	30
			Clay Content	2022/07/13	4.3		%	30
A645642	BL7	QC Standard	% sand by hydrometer	2022/07/15		102	%	75 - 125
			% silt by hydrometer	2022/07/15		101	%	75 - 125
			Clay Content	2022/07/15		97	%	75 - 125
A645642	BL7	RPD	% sand by hydrometer	2022/07/15	5.0		%	30
			% silt by hydrometer	2022/07/15	4.9		%	30
			Clay Content	2022/07/15	4.8		%	30

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

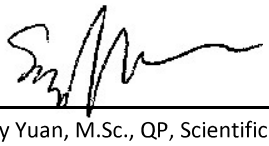
Bureau Veritas Job #: C239961
Report Date: 2022/07/15

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: MARTEN FALLS, NORTHERN ONTARIO
Your P.O. #: 21455151
Sampler Initials: CB

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics



Sandy Yuan, M.Sc., QP, Scientific Specialist

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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Automated Statchk

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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4/6

BUREAU VERITAS

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/6

CHAIN OF CUSTODY RECORD 159589

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: GOLDER WSP	Company Name:	Quotation #:	☑ Regular TAT (5-7 days) Most analyses
Contact Name:	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:	Project #:	Rush TAT (Surcharges will be applied)
Phone: Fax:	Phone: Fax:	Site Location:	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Email:	Email:	Site #:	Date Required:
		Site Location Province:	Rush Confirmation #:
		Sampled By:	

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES' DRINKING WATER CHAIN OF CUSTODY

Regulation 153	Other Regulations
☐ Table 1 ☐ Res/Park ☐ Med/ Fine	☐ CCME ☐ Sanitary Sewer Bylaw
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ MISA ☐ Storm Sewer Bylaw
☐ Table 3 ☐ Agri/ Other	☐ PWQO Region
☐ Table _____	☐ Other (Specify)
FOR RSC (PLEASE CIRCLE) Y / N	☐ REG 558 (MIN. 3 DAY TAT REQUIRED)
	☐ REG 406 Table _____

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

Analysis Requested

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	HOLD- DO NOT ANALYZE
1	M225161BM0-14-220606												
2	M225161Btnj14-27-220606												
3	M225161BC27-44-220606												
4	M225161Ck44-65-220606												
5	M225161IICkg-65-110-220606												
6	M225028Ahe0-14-220528												
7	M225028017-0-220528												
8	M225028BtA39-220528												
9	M225028C39-145-220528												
10													

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
		15, 17, 17

COOLING MEDIA PRESENT: Y / N

COMMENTS

Rec'd In Thunder Bay

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
LYNDON SCHOLER	2022/06/07		Bramwell Bramwell	2022/06/07	13:24
			Franklin Franklin	2022/06/08	08:30

08-Jun-22 08:30
Cynny Hagen
C239961
CGE INS-0249

seal:yes intact:yes 0.7/1.2/0.5
ice:yes Temp(°C): -2.1/-2.3/-2.3

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COC-1004 (06/19)

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BUREAU VERITAS

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CAM FCD-01191/6

CHAIN OF CUSTODY RECORD 159558

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: GOLDER WSP	Company Name:	Quotation #:	☐ Regular TAT (5-7 days) Most analyses
Contact Name:	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:	Project #:	Rush TAT (Surcharges will be applied)
Phone: Fax:	Phone: Fax:	Site Location:	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Email:	Email:	Site #:	Date Required:
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES' DRINKING WATER CHAIN OF CUSTODY		Site Location Province:	Rush Confirmation #:
		Sampled By:	

Regulation 153	Other Regulations
☐ Table 1 ☐ Res/Park ☐ Med/ Fine	☐ CCME ☐ Sanitary Sewer Bylaw
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ MISA ☐ Storm Sewer Bylaw
☐ Table 3 ☐ Agri/ Other	☐ PWQO Region
☐ Table ____	☐ Other (Specify)
FOR RSC (PLEASE CIRCLE) Y / N	☐ REG 558 (MIN. 3 DAY TAT REQUIRED)
	☐ REG 406 Table

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

LABORATORY USE ONLY

CUSTODY SEAL Y / N: Present / Intact

COOLER TEMPERATURES

COOLING MEDIA PRESENT: Y / N

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	HOLD- DO NOT ANALYZE	COMMENTS
1	M225258Ae0-6-220604													
2	M225258Bt5-36-220604													
3	M225258CK36-120-220604													Rec'd In Thunder Bay
4	M225127Ae0-5-220602													
5	M225127Bt5-12-220602													
6	M225127CK12-120-220602													
7	M225ADIAe0-7-220603													
8	M225ADIBn7-25-220603													
9	M225ADICK2-45-120-220603													
10														

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
LYNDON SCHOLER	2022/06/07	13:00	See page 1		

08-Jun-22 08:30
Cynny Hagen
C239961
CGE INS-0249

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CHAIN OF CUSTODY RECORD 159559 Page 3 of 4

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: GOLDER WSP	Company Name:	Quotation #:	☐ Regular TAT (5-7 days) Most analyses
Contact Name:	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:	Project #:	Rush TAT (Surcharges will be applied)
		Site Location:	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Phone: Fax:	Phone: Fax:	Site #:	
Email:	Email:	Site Location Province:	Date Required:
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES' DRINKING WATER CHAIN OF CUSTODY		Sampled By:	Rush Confirmation #:

Regulation 153
☐ Table 1 ☐ Res/Park ☐ Med/ Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/ Other
☐ Table ____
FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations
☐ CCME ☐ Sanitary Sewer Bylaw
☐ MISA ☐ Storm Sewer Bylaw
☐ PWQO Region
☐ Other (Specify)
☐ REG 558 (MIN. 3 DAY TAT REQUIRED)
☐ REG 406 Table

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

LABORATORY USE ONLY
CUSTODY SEAL Y / N (Present / Intact)
COOLER TEMPERATURES
COOLING MEDIA PRESENT: Y / N

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	HOLD- DO NOT ANALYZE	COMMENTS
1	M225044-Cg-0-90-220601													
2	M225044-IICg-90-120-220601													
3	M225011-Ah-220529													Rec'd In Thunder Bay
4	M225011-Cg1-220529													
5	M225011-Cg2-55-120-220529													
6	M225258 F6-0-220604													
7	M225032-OF10m-220531													
8	M225032-Om/OF-220531													
9														
10														

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
LYNDON SCHOLER	2022/06/07		See page1		

08-Jun-22 08:30
Cynny Hagen
C239961
CGE INS-0249

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COC-1004 (06/19)

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BUREAU VERITAS

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CHAIN OF CUSTODY RECORD 159560 Page 4 of 4

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: GOLDER WSP	Company Name:	Quotation #:	☐ Regular TAT (5-7 days) Most analyses
Contact Name:	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:	Project #:	Rush TAT (Surcharges will be applied)
		Site Location:	☐ 1 Day ☐ 2 Days ☐ 3-4 Days
Phone: Fax:	Phone: Fax:	Site #:	
Email:	Email:	Site Location Province:	Date Required:
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES' DRINKING WATER CHAIN OF CUSTODY		Sampled By:	Rush Confirmation #:

Regulation 153: ☐ Table 1 ☐ Res/Park ☐ Med/ Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/ Other ☐ Table ____ FOR RSC (PLEASE CIRCLE) Y / N

Other Regulations: ☐ CCME ☐ Sanitary Sewer Bylaw ☐ MISA ☐ Storm Sewer Bylaw ☐ PWQO Region ____ ☐ Other (Specify) ☐ REG 558 (MIN. 3 DAY TAT REQUIRED) ☐ REG 406 Table ____

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

LABORATORY USE ONLY: CUSTODY SEAL Y / N (Present / Intact) — COOLER TEMPERATURES — COOLING MEDIA PRESENT: Y / N

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	HOLD- DO NOT ANALYZE	COMMENTS
1	M225055 Ae 0-3-220528													
2	M225055 Bt 3-17-220528													
3	M225055 CKgj 17-80-220528													Rec'd In Thunder Bay
4	M225055 TiCKgj 80-100-220528													
5	M225ADI CK 125-45-220603													
6														
7														
8														
9														
10														

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
LYNDON SCHOLER	2022/06/07	13:00	See page 1		

08-Jun-22 08:30
Cynny Hagen
C239961
CGE INS-0249

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COC-1004 (06/19)

BUREAU VERITAS

eCOC: W49389

Expected TAT: Standard TAT
Expected Arrival: 2022/06/09
Submitted By:
Submitted To: Calgary ENV: 4000 19th St NE

Invoice Information

Attn: ACCOUNTS PAYABLE
GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON , AB , T5P 4C3
Email to:
gld.canadaaccountspayableinvoices@wsp.com

Report Information

Attn: Christiane Brouwer
GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON , AB , T5P 4C3
Email to:
christiane_brouwer@golder.com

Project Information

Quote #:	C20106
PO/AFE#:	21455151
Project #:	21455151
Site Location:	Marten Falls, Northern Ontario

Analytical Summary

A: Standard TAT

Client Sample ID	Clnt Ref	Sampling Date/Time	Matrix	#Cont	SOIL SALINITY 4	Cation Exchange Capacity	Moisture	Nitrate-N (soluble)	Particle Size by Sieve	Particle Size by Sieve (75 micron)	Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	Soluble Paste	Total Organic Carbon LECO Method	Set Number
M22S161Bm0-14-220606	1	2022/06/06	SOIL	1	A	A	A	A	A	A	A		A	1
M22S161Btnj14-27-220606	2	2022/06/06	SOIL	1	A	A	A	A	A	A	A		A	1
M22S161BC27-44-220606	3	2022/06/06	SOIL	1	A	A	A	A	A	A	A		A	1
M22S161Ck44-65-220606	4	2022/06/06	SOIL	1	A	A	A	A	A	A	A		A	1
M22S161IICkg-65-110-220606	5	2022/06/06	SOIL	1	A	A	A	A	A	A	A		A	1
M22S028Ahe0-14-220528	6	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22S017-0-220528	7	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22S028Bt14-39-220528	8	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22S028C39-145-220528	9	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22S258Ae0-6-220604	10	2022/06/04	SOIL	1	A	A	A	A	A	A	A		A	1
M22S258Bt5-36-220604	11	2022/06/04	SOIL	1	A	A	A	A	A	A	A		A	1
M22S258Ck-12-120-220604	12	2022/06/04	SOIL	1	A	A	A	A	A	A	A		A	1
M22S127Ae0-5-220602	13	2022/06/02	SOIL	1	A	A	A	A	A	A	A		A	1
M22S127Bt5-12-220602	14	2022/06/02	SOIL	1	A	A	A	A	A	A	A		A	1
M22S127Ck12-120-220602	15	2022/06/02	SOIL	1	A	A	A	A	A	A	A		A	1
M22SAD1Ae0-7-220603	16	2022/06/03	SOIL	1	A	A	A	A	A	A	A		A	1
M22SAD1Bm7-25-220603	17	2022/06/03	SOIL	1	A	A	A	A	A	A	A		A	1
M22SAD1Ck2-45-120-220603	18	2022/06/03	SOIL	1	A	A	A	A	A	A	A		A	1
M22S044-Cg-0-90-220601	19	2022/06/01	SOIL	1	A	A	A	A	A	A	A		A	1
M22S044-IICg-90-120-220601	20	2022/06/01	SOIL	1	A	A	A	A	A	A	A		A	1
M22S011-Ah-220529	21	2022/05/29	SOIL	1	A	A	A	A	A	A	A		A	1
M22S011-Cg1-220529	22	2022/05/29	SOIL	1	A	A	A	A	A	A	A		A	1
M22S011-Cg2-55-120-220529	23	2022/05/29	SOIL	1	A	A	A	A	A	A	A		A	1
M22S258F6-0-220604	24	2022/06/04	SOIL	1				A			A	A	A	2
M22S032-OF/OM-220531	25	2022/05/31	SOIL	1				A			A	A	A	2
M22S032-OM/OF-220531	26	2022/05/31	SOIL	1				A			A	A	A	2
M22055Ae0-3-220528	27	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22055Bt3-17-220528	28	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22055Ckgj17-80-220528	29	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22055IICkgj80-100-220528	30	2022/05/28	SOIL	1	A	A	A	A	A	A	A		A	1
M22AD1Ck125-45-220603	31	2022/06/03	SOIL	1	A	A	A	A	A	A	A		A	1

Deadlines are estimates only and are subject to change. Please refer to your Job Confirmation report for final due dates.

Your P.O. #: 21455151
Your Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your C.O.C. #: 55004

Attention: Christiane Brouwer

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/11/18
Report #: R3265728
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C284514
Received: 2022/10/07, 02:56

Sample Matrix: Soil
Samples Received: 32

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Cation/EC Ratio	24	N/A	2022/11/09		Auto Calc
Cation Exchange Capacity (2)	20	2022/10/26	2022/11/09		Auto Calc
Cation Exchange Capacity (2)	4	2022/10/26	2022/11/10		Auto Calc
Chloride (Soluble)	24	2022/11/08	2022/11/09	AB SOP-00033 / AB SOP-00020	SM 23-4500-Cl-E m
Conductivity @25C (Soluble)	20	2022/11/08	2022/11/09	AB SOP-00033 / AB SOP-00004	SM 23 2510 B m
Conductivity @25C (Soluble)	4	2022/11/09	2022/11/09	AB SOP-00033 / AB SOP-00004	SM 23 2510 B m
Sum of Cations, Anions	24	N/A	2022/11/09		Auto Calc
Moisture	2	N/A	2022/10/29	AB SOP-00002	CCME PHC-CWS m
Nitrite-N and Nitrate-N (soluble)	14	2022/11/08	2022/11/09	AB SOP-00033 / AB SOP-00023	SM 23 4110 B m
Nitrite-N and Nitrate-N (soluble)	10	2022/11/08	2022/11/10	AB SOP-00033 / AB SOP-00023	SM 23 4110 B m
Benzo[a]pyrene Equivalency	2	N/A	2022/10/30		Auto Calc
PAH in Soil by GC/MS	2	2022/10/28	2022/10/30	AB SOP-00036 / AB SOP-00003	EPA 3540C/8270E m
pH @25C (1:2 Calcium Chloride Extract)	24	2022/11/08	2022/11/08	AB SOP-00033 / AB SOP-00006	SM 23 4500 H+B m
Sodium Adsorption Ratio	24	N/A	2022/11/09		Auto Calc
Soluble Ions	24	2022/11/08	2022/11/09	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Soluble Paste	24	2022/11/08	2022/11/08	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Ions Calculation	24	N/A	2022/11/08		Auto Calc
Total Organic Carbon LECO Method	6	N/A	2022/11/09	CAL SOP-00243	LECO 203-821-498 m
Texture by Hydrometer	23	N/A	2022/11/09	AB SOP-00030	Carter 2nd ed 55.3 m
Texture by Hydrometer	1	N/A	2022/11/10	AB SOP-00030	Carter 2nd ed 55.3 m
Texture Class	22	N/A	2022/11/09		Auto Calc
Texture Class	2	N/A	2022/11/10		Auto Calc
Theoretical Gypsum Requirement (3)	24	N/A	2022/11/09		Auto Calc
VOCs in Soil by HS GC/MS (Std List) (4)	1	N/A	2022/10/28	AB SOP-00056	EPA 5021a/8260d m
VOCs in Soil by HS GC/MS (Std List) (4)	1	N/A	2022/10/31	AB SOP-00056	EPA 5021a/8260d m

Your P.O. #: 21455151
Your Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your C.O.C. #: 55004

Attention: Christiane Brouwer

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/11/18
Report #: R3265728
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C284514
Received: 2022/10/07, 02:56

Sample Matrix: Soil
Samples Received: 32

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Radionuclides by Gamma Spectrometry (1)	2	N/A	2022/11/16	BQL SOP-00007	Gamma Spectrometry
Radionuclides by Gamma Spectrometry (1)	4	N/A	2022/11/17	BQL SOP-00007	Gamma Spectrometry

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Kitimat, 6790 Kitimat Rd., Unit 4, Mississauga, Ontario, L5N 5L9
(2) Sample(s) analyzed using accredited methodologies and have been subjected to Bureau Veritas's standard validation process for the submitted matrix however this is not accredited for this matrix.
(3) TGR calculation is based on a theoretical SAR of 4. Salt Contamination and Assessment and remediation guideline 2001 recommended SAR is ranging 4-8. TGR is reported in tonnes/ha.
(4) No lab extraction date is given for F1BTEX & VOC samples that are field preserved with methanol. Extraction date is date sampled unless otherwise stated.

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Your P.O. #: 21455151
Your Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your C.O.C. #: 55004

Attention: Christiane Brouwer

GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON, AB
CANADA T5P 4C3

Report Date: 2022/11/18
Report #: R3265728
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C284514
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Please direct all questions regarding this Certificate of Analysis to:
Cynny Hagen, Key Account Soecialist
Email: Cynny.HAGEN@bureauveritas.com
Phone# (403)735-2273

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Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Scott Cantwell, General Manager responsible for Alberta Environmental laboratory operations.

Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO700		BFO701		
Sampling Date		2022/09/30		2022/09/30		
COC Number		55004		55004		
	UNITS	M22C003Cg75-120-220930	RDL	M22C004Bg0-21-220930	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	2.9	N/A	0.61	N/A	A775320
Cation Sum	meq/L	3.7	N/A	4.0	N/A	A775320
Cation/EC Ratio	N/A	10	0.10	14	0.10	A775309
Calculated Calcium (Ca)	mg/kg	34	1.0	18	0.44	A775327
Calculated Magnesium (Mg)	mg/kg	6.5	0.68	2.8	0.29	A775327
Calculated Sodium (Na)	mg/kg	5.8	1.7	1.4	0.74	A775327
Calculated Potassium (K)	mg/kg	2.1	0.89	0.47	0.38	A775327
Calculated Chloride (Cl)	mg/kg	20	6.8	3.0	2.9	A775327
Calculated Sulphate (SO4)	mg/kg	22	3.4	2.5	1.5	A775327
Elements						
Cation exchange capacity	cmol+/Kg	17	10	15	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	30	10	10	10	A792375
Soluble Conductivity	dS/m	0.36	0.020	0.28	0.020	A792223
Soluble (CaCl2) pH	pH	6.04	N/A	7.16	N/A	A790533
Sodium Adsorption Ratio	N/A	0.29	0.10	0.15	0.10	A775322
Soluble Calcium (Ca)	mg/L	50	1.5	59	1.5	A791791
Soluble Nitrite (N)	mg/L	0.22	0.20	0.94	0.20	A792187
Soluble Magnesium (Mg)	mg/L	9.5	1.0	9.3	1.0	A791791
Soluble Nitrate (N)	mg/L	19	0.20	1.1	0.20	A792187
Soluble Sodium (Na)	mg/L	8.5	2.5	4.8	2.5	A791791
Soluble Potassium (K)	mg/L	3.1	1.3	1.6	1.3	A791791
Saturation %	%	68	N/A	29	N/A	A790531
Soluble Sulphate (SO4)	mg/L	32	5.0	8.4	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO702			BFO703		
Sampling Date		2022/09/30			2022/10/01		
COC Number		55004			55004		
	UNITS	M22C004Ckg121-32-220930	RDL	QC Batch	M22C008Ae0-6-221001	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	2.8	N/A	A775320	0.0000	N/A	A775320
Cation Sum	meq/L	5.9	N/A	A775320	1.1	N/A	A775320
Cation/EC Ratio	N/A	11	0.10	A775309	17	0.10	A775309
Calculated Calcium (Ca)	mg/kg	29	0.46	A775327	2.4	0.51	A775327
Calculated Magnesium (Mg)	mg/kg	3.7	0.31	A775327	0.51	0.34	A775327
Calculated Sodium (Na)	mg/kg	1.3	0.77	A775327	1.3	0.86	A775327
Calculated Potassium (K)	mg/kg	0.98	0.40	A775327	<0.44	0.44	A775327
Calculated Chloride (Cl)	mg/kg	28	3.1	A775327	<3.4	3.4	A775327
Calculated Sulphate (SO4)	mg/kg	2.5	1.5	A775327	<1.7	1.7	A775327
Elements							
Cation exchange capacity	cmol+/Kg	<10	10	A775311	<10	10	A775311
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	90	10	A792363	<10	10	A792375
Soluble Conductivity	dS/m	0.55	0.020	A793185	0.067	0.020	A792223
Soluble (CaCl2) pH	pH	7.50	N/A	A790909	3.30 (1)	N/A	A790533
Sodium Adsorption Ratio	N/A	0.11	0.10	A775322	0.35	0.10	A775322
Soluble Calcium (Ca)	mg/L	93	1.5	A791910	6.9	1.5	A791791
Soluble Nitrite (N)	mg/L	0.39	0.20	A791998	<0.20	0.20	A792187
Soluble Magnesium (Mg)	mg/L	12	1.0	A791910	1.5	1.0	A791791
Soluble Nitrate (N)	mg/L	0.26	0.20	A791998	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	4.4	2.5	A791910	3.9	2.5	A791791
Soluble Potassium (K)	mg/L	3.2	1.3	A791910	<1.3	1.3	A791791
Saturation %	%	31	N/A	A790903	34	N/A	A790531
Soluble Sulphate (SO4)	mg/L	8.2	5.0	A791910	<5.0	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A775141	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Sample pH value outside pH calibration range 4 to 10, verified using pH 1.68 buffer

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO704		BFO705		
Sampling Date		2022/10/01		2022/10/01		
COC Number		55004		55004		
	UNITS	M22C008Bfj6-10-221001	RDL	M22C008Bt10-33-221001	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.0000	N/A	0.17	N/A	A775320
Cation Sum	meq/L	0.70	N/A	4.1	N/A	A775320
Cation/EC Ratio	N/A	13	0.10	12	0.10	A775309
Calculated Calcium (Ca)	mg/kg	3.1	0.75	19	0.49	A775327
Calculated Magnesium (Mg)	mg/kg	0.61	0.50	3.8	0.33	A775327
Calculated Sodium (Na)	mg/kg	<1.3	1.3	1.3	0.81	A775327
Calculated Potassium (K)	mg/kg	1.4	0.65	<0.42	0.42	A775327
Calculated Chloride (Cl)	mg/kg	<5.0	5.0	<3.3	3.3	A775327
Calculated Sulphate (SO4)	mg/kg	<2.5	2.5	2.2	1.6	A775327
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	13	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A792375
Soluble Conductivity	dS/m	0.055	0.020	0.34	0.020	A792223
Soluble (CaCl2) pH	pH	3.96 (1)	N/A	6.73	N/A	A790533
Sodium Adsorption Ratio	N/A	0.25	0.10	0.13	0.10	A775322
Soluble Calcium (Ca)	mg/L	6.1	1.5	60	1.5	A791791
Soluble Nitrite (N)	mg/L	<0.20	0.20	0.42	0.20	A792187
Soluble Magnesium (Mg)	mg/L	1.2	1.0	12	1.0	A791791
Soluble Nitrate (N)	mg/L	<0.20	0.20	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	2.5	2.5	4.1	2.5	A791791
Soluble Potassium (K)	mg/L	2.7	1.3	<1.3	1.3	A791791
Saturation %	%	50	N/A	33	N/A	A790531
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	6.9	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Sample pH value outside pH calibration range 4 to 10, verified using pH 1.68 buffer

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO706			BFO707		
Sampling Date		2022/10/01			2022/10/02		
COC Number		55004			55004		
	UNITS	M22C008Ck33-100-221001	RDL	QC Batch	M22C022Bm1-30-221002	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.87	N/A	A775320	0.19	N/A	A775320
Cation Sum	meq/L	3.9	N/A	A775320	4.9	N/A	A775320
Cation/EC Ratio	N/A	11	0.10	A775309	14	0.10	A775309
Calculated Calcium (Ca)	mg/kg	23	0.56	A775327	28	0.57	A775325
Calculated Magnesium (Mg)	mg/kg	3.0	0.37	A775327	4.7	0.38	A775325
Calculated Sodium (Na)	mg/kg	1.5	0.93	A775327	1.1	0.95	A775325
Calculated Potassium (K)	mg/kg	<0.48	0.48	A775327	0.58	0.49	A775325
Calculated Chloride (Cl)	mg/kg	8.8	3.7	A775327	<3.8	3.8	A775325
Calculated Sulphate (SO4)	mg/kg	2.5	1.9	A775327	3.4	1.9	A775325
Elements							
Cation exchange capacity	cmol+/Kg	10	10	A775311	12	10	A775311
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	24	10	A792363	<10	10	A792375
Soluble Conductivity	dS/m	0.36	0.020	A793185	0.35	0.020	A792223
Soluble (CaCl2) pH	pH	7.51	N/A	A790909	5.98	N/A	A790533
Sodium Adsorption Ratio	N/A	0.13	0.10	A775322	<0.10	0.10	A774579
Soluble Calcium (Ca)	mg/L	61	1.5	A791910	74	1.5	A791791
Soluble Nitrite (N)	mg/L	0.38	0.20	A791998	<0.20	0.20	A792187
Soluble Magnesium (Mg)	mg/L	8.0	1.0	A791910	12	1.0	A791791
Soluble Nitrate (N)	mg/L	0.50	0.20	A791998	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	4.0	2.5	A791910	3.0	2.5	A791791
Soluble Potassium (K)	mg/L	<1.3	1.3	A791910	1.5	1.3	A791791
Saturation %	%	37	N/A	A790903	38	N/A	A790531
Soluble Sulphate (SO4)	mg/L	6.7	5.0	A791910	9.1	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A775141	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO708		BFO709		
Sampling Date		2022/10/02		2022/10/03		
COC Number		55004		55004		
	UNITS	M22C022Ck30-100-221002	RDL	M22K040Ae0-8-221003	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	1.7	N/A	0.47	N/A	A775320
Cation Sum	meq/L	4.6	N/A	1.9	N/A	A775320
Cation/EC Ratio	N/A	12	0.10	14	0.10	A775309
Calculated Calcium (Ca)	mg/kg	22	0.48	11	0.56	A774580
Calculated Magnesium (Mg)	mg/kg	3.3	0.32	1.7	0.38	A774580
Calculated Sodium (Na)	mg/kg	1.9	0.80	<0.94	0.94	A774580
Calculated Potassium (K)	mg/kg	0.62	0.42	0.85	0.49	A774580
Calculated Chloride (Cl)	mg/kg	17	3.2	<3.8	3.8	A774580
Calculated Sulphate (SO4)	mg/kg	2.6	1.6	8.4	1.9	A774580
Elements						
Cation exchange capacity	cmol+/Kg	11	10	<10	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	54	10	<10	10	A792375
Soluble Conductivity	dS/m	0.37	0.020	0.13	0.020	A792223
Soluble (CaCl2) pH	pH	7.38	N/A	4.51	N/A	A790533
Sodium Adsorption Ratio	N/A	0.18	0.10	<0.10	0.10	A774579
Soluble Calcium (Ca)	mg/L	69	1.5	29	1.5	A791791
Soluble Nitrite (N)	mg/L	0.60	0.20	<0.20	0.20	A792187
Soluble Magnesium (Mg)	mg/L	10	1.0	4.4	1.0	A791791
Soluble Nitrate (N)	mg/L	<0.20	0.20	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	6.0	2.5	<2.5	2.5	A791791
Soluble Potassium (K)	mg/L	1.9	1.3	2.3	1.3	A791791
Saturation %	%	32	N/A	38	N/A	A790531
Soluble Sulphate (SO4)	mg/L	8.3	5.0	22	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	NC	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO710		BFO711		
Sampling Date		2022/10/03		2022/10/03		
COC Number		55004		55004		
	UNITS	M22K040Bm8-18-221003	RDL	M22K040Ck18-120-221003	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.28	N/A	0.064	N/A	A775320
Cation Sum	meq/L	2.2	N/A	2.9	N/A	A775320
Cation/EC Ratio	N/A	16	0.10	13	0.10	A775309
Calculated Calcium (Ca)	mg/kg	12	0.60	13	0.43	A774580
Calculated Magnesium (Mg)	mg/kg	2.4	0.40	2.0	0.29	A774580
Calculated Sodium (Na)	mg/kg	1.4	1.0	1.2	0.72	A774580
Calculated Potassium (K)	mg/kg	0.59	0.52	<0.37	0.37	A774580
Calculated Chloride (Cl)	mg/kg	<4.0	4.0	<2.9	2.9	A774580
Calculated Sulphate (SO4)	mg/kg	5.5	2.0	<1.4	1.4	A774580
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	<10	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A792375
Soluble Conductivity	dS/m	0.14	0.020	0.23	0.020	A792223
Soluble (CaCl2) pH	pH	4.97	N/A	7.03	N/A	A790533
Sodium Adsorption Ratio	N/A	0.15	0.10	0.16	0.10	A774579
Soluble Calcium (Ca)	mg/L	31	1.5	44	1.5	A791791
Soluble Nitrite (N)	mg/L	<0.20	0.20	0.48	0.20	A792187
Soluble Magnesium (Mg)	mg/L	5.9	1.0	6.9	1.0	A791791
Soluble Nitrate (N)	mg/L	<0.20	0.20	0.42	0.20	A792187
Soluble Sodium (Na)	mg/L	3.5	2.5	4.3	2.5	A791791
Soluble Potassium (K)	mg/L	1.5	1.3	<1.3	1.3	A791791
Saturation %	%	40	N/A	29	N/A	A790531
Soluble Sulphate (SO4)	mg/L	14	5.0	<5.0	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO712		BFO713		
Sampling Date		2022/10/04		2022/10/04		
COC Number		55004		55004		
	UNITS	M22K042Bm0-16-221004	RDL	M22K042Ck116-35-221004	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.29	N/A	0.27	N/A	A775320
Cation Sum	meq/L	3.8	N/A	3.6	N/A	A775320
Cation/EC Ratio	N/A	14	0.10	12	0.10	A775309
Calculated Calcium (Ca)	mg/kg	16	0.43	12	0.31	A774580
Calculated Magnesium (Mg)	mg/kg	2.9	0.29	1.4	0.21	A774580
Calculated Sodium (Na)	mg/kg	1.2	0.72	0.88	0.51	A774580
Calculated Potassium (K)	mg/kg	<0.37	0.37	<0.27	0.27	A774580
Calculated Chloride (Cl)	mg/kg	<2.9	2.9	<2.1	2.1	A774580
Calculated Sulphate (SO4)	mg/kg	3.5	1.4	2.1	1.0	A774580
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	<10	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A792375
Soluble Conductivity	dS/m	0.27	0.020	0.29	0.020	A792223
Soluble (CaCl2) pH	pH	6.81	N/A	7.13	N/A	A790533
Sodium Adsorption Ratio	N/A	0.13	0.10	0.14	0.10	A774579
Soluble Calcium (Ca)	mg/L	56	1.5	57	1.5	A791791
Soluble Nitrite (N)	mg/L	0.48	0.20	0.86	0.20	A792187
Soluble Magnesium (Mg)	mg/L	10	1.0	6.9	1.0	A791791
Soluble Nitrate (N)	mg/L	<0.20	0.20	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	4.0	2.5	4.3	2.5	A791791
Soluble Potassium (K)	mg/L	<1.3	1.3	<1.3	1.3	A791791
Saturation %	%	29	N/A	21	N/A	A790531
Soluble Sulphate (SO4)	mg/L	12	5.0	10	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO714		BFO715		
Sampling Date		2022/10/04		2022/10/05		
COC Number		55004		55004		
	UNITS	M22K042Ck235-45-221004	RDL	M22K051Ae0-4-221005	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	1.2	N/A	0.28	N/A	A775320
Cation Sum	meq/L	4.3	N/A	2.8	N/A	A775320
Cation/EC Ratio	N/A	13	0.10	13	0.10	A775309
Calculated Calcium (Ca)	mg/kg	12	0.28	24	0.91	A774580
Calculated Magnesium (Mg)	mg/kg	1.6	0.18	4.5	0.61	A774580
Calculated Sodium (Na)	mg/kg	1.3	0.46	2.0	1.5	A774580
Calculated Potassium (K)	mg/kg	<0.24	0.24	1.3	0.79	A774580
Calculated Chloride (Cl)	mg/kg	6.1	1.8	<6.1	6.1	A774580
Calculated Sulphate (SO4)	mg/kg	1.3	0.92	8.1	3.0	A774580
Elements						
Cation exchange capacity	cmol+/Kg	<10	10	26	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	33	10	<10	10	A792375
Soluble Conductivity	dS/m	0.32	0.020	0.21	0.020	A792223
Soluble (CaCl2) pH	pH	7.45	N/A	6.12	N/A	A790533
Sodium Adsorption Ratio	N/A	0.21	0.10	0.13	0.10	A774579
Soluble Calcium (Ca)	mg/L	67	1.5	39	1.5	A791791
Soluble Nitrite (N)	mg/L	1.2	0.20	<0.20	0.20	A792187
Soluble Magnesium (Mg)	mg/L	8.5	1.0	7.4	1.0	A791791
Soluble Nitrate (N)	mg/L	<0.20	0.20	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	7.0	2.5	3.3	2.5	A791791
Soluble Potassium (K)	mg/L	<1.3	1.3	2.2	1.3	A791791
Saturation %	%	18	N/A	61	N/A	A790531
Soluble Sulphate (SO4)	mg/L	7.0	5.0	13	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO716		BFO717		
Sampling Date		2022/10/05		2022/10/05		
COC Number		55004		55004		
	UNITS	M22K051Bt4-16-221005	RDL	M22K051BCk16-37-221005	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.26	N/A	13	N/A	A775320
Cation Sum	meq/L	2.3	N/A	16	N/A	A775320
Cation/EC Ratio	N/A	14	0.10	11	0.10	A775309
Calculated Calcium (Ca)	mg/kg	18	0.83	45	0.54	A774580
Calculated Magnesium (Mg)	mg/kg	3.2	0.55	19	0.36	A774580
Calculated Sodium (Na)	mg/kg	2.4	1.4	48	0.91	A774580
Calculated Potassium (K)	mg/kg	<0.72	0.72	2.6	0.47	A774580
Calculated Chloride (Cl)	mg/kg	<5.5	5.5	32	3.6	A774580
Calculated Sulphate (SO4)	mg/kg	5.5	2.8	180	1.8	A774580
Elements						
Cation exchange capacity	cmol+/Kg	34	10	15	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	89	10	A792375
Soluble Conductivity	dS/m	0.17	0.020	1.5	0.020	A792223
Soluble (CaCl2) pH	pH	6.42	N/A	7.36	N/A	A790533
Sodium Adsorption Ratio	N/A	0.18	0.10	2.5	0.10	A774579
Soluble Calcium (Ca)	mg/L	33	1.5	120	1.5	A791791
Soluble Nitrite (N)	mg/L	0.52	0.20	0.76	0.20	A792187
Soluble Magnesium (Mg)	mg/L	5.8	1.0	52	1.0	A791791
Soluble Nitrate (N)	mg/L	0.22	0.20	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	4.3	2.5	130	2.5	A791791
Soluble Potassium (K)	mg/L	<1.3	1.3	7.3	1.3	A791791
Saturation %	%	55	N/A	36	N/A	A790531
Soluble Sulphate (SO4)	mg/L	9.9	5.0	510	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
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Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO718			BFO719		
Sampling Date		2022/10/05			2022/10/05		
COC Number		55004			55004		
	UNITS	M22K051Ck37-120-221005	RDL	QC Batch	M22L016Ahe0-9-221005	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	0.84	N/A	A775320	1.1	N/A	A775320
Cation Sum	meq/L	3.9	N/A	A775320	3.0	N/A	A775320
Cation/EC Ratio	N/A	13	0.10	A775309	12	0.10	A775309
Calculated Calcium (Ca)	mg/kg	9.9	0.30	A774580	61	2.0	A774580
Calculated Magnesium (Mg)	mg/kg	1.7	0.20	A774580	9.7	1.3	A774580
Calculated Sodium (Na)	mg/kg	1.5	0.49	A774580	<3.3	3.3	A774580
Calculated Potassium (K)	mg/kg	2.3	0.26	A774580	2.0	1.7	A774580
Calculated Chloride (Cl)	mg/kg	4.2	2.0	A774580	24	13	A774580
Calculated Sulphate (SO4)	mg/kg	1.4	0.99	A774580	38	6.6	A774580
Elements							
Cation exchange capacity	cmol+/Kg	33	10	A775311	120	10	A775311
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	21	10	A792363	18	10	A792375
Soluble Conductivity	dS/m	0.31	0.020	A793185	0.25	0.020	A792223
Soluble (CaCl2) pH	pH	7.62	N/A	A790909	6.43 (1)	N/A	A790533
Sodium Adsorption Ratio	N/A	0.26	0.10	A774579	<0.10	0.10	A774579
Soluble Calcium (Ca)	mg/L	50	1.5	A791910	47	1.5	A791791
Soluble Nitrite (N)	mg/L	0.69	0.20	A791998	0.25	0.20	A792187
Soluble Magnesium (Mg)	mg/L	8.7	1.0	A791910	7.4	1.0	A791791
Soluble Nitrate (N)	mg/L	0.54	0.20	A791998	<0.20	0.20	A792187
Soluble Sodium (Na)	mg/L	7.7	2.5	A791910	<2.5	2.5	A791791
Soluble Potassium (K)	mg/L	12	1.3	A791910	1.5	1.3	A791791
Saturation %	%	20	N/A	A790903	130	N/A	A790531
Soluble Sulphate (SO4)	mg/L	7.2	5.0	A791910	29	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A775141	NC	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) pH was done on a 10:1 Calcium Chloride to soil ratio due to the matrix of the sample.

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Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO720		BFO721		
Sampling Date		2022/10/05		2022/10/05		
COC Number		55004		55004		
	UNITS	M22L016BA9-14-221005	RDL	M22L016Bt14-29-221005	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.22	N/A	0.17	N/A	A775320
Cation Sum	meq/L	2.4	N/A	1.4	N/A	A775320
Cation/EC Ratio	N/A	13	0.10	12	0.10	A775309
Calculated Calcium (Ca)	mg/kg	15	0.67	11	0.86	A774580
Calculated Magnesium (Mg)	mg/kg	3.0	0.45	2.0	0.58	A774580
Calculated Sodium (Na)	mg/kg	1.8	1.1	2.3	1.4	A774580
Calculated Potassium (K)	mg/kg	<0.58	0.58	<0.75	0.75	A774580
Calculated Chloride (Cl)	mg/kg	<4.5	4.5	<5.8	5.8	A774580
Calculated Sulphate (SO4)	mg/kg	3.5	2.2	3.3	2.9	A774580
Elements						
Cation exchange capacity	cmol+/Kg	27	10	32	10	A775311
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	<10	10	<10	10	A792375
Soluble Conductivity	dS/m	0.19	0.020	0.11	0.020	A792223
Soluble (CaCl2) pH	pH	6.40	N/A	6.74	N/A	A790533
Sodium Adsorption Ratio	N/A	0.16	0.10	0.23	0.10	A774579
Soluble Calcium (Ca)	mg/L	34	1.5	18	1.5	A791791
Soluble Nitrite (N)	mg/L	0.51	0.20	0.52	0.20	A792187
Soluble Magnesium (Mg)	mg/L	6.7	1.0	3.4	1.0	A791791
Soluble Nitrate (N)	mg/L	0.31	0.20	0.21	0.20	A792187
Soluble Sodium (Na)	mg/L	3.9	2.5	4.1	2.5	A791791
Soluble Potassium (K)	mg/L	<1.3	1.3	<1.3	1.3	A791791
Saturation %	%	45	N/A	58	N/A	A790531
Soluble Sulphate (SO4)	mg/L	7.9	5.0	5.6	5.0	A791791
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO722			BFO723		
Sampling Date		2022/10/05			2022/10/05		
COC Number		55004			55004		
	UNITS	M22L016Ckgj29-110-221005	RDL	QC Batch	M22K051-Radionuclides	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	1.1	N/A	A775320			
Cation Sum	meq/L	3.3	N/A	A775320			
Cation/EC Ratio	N/A	10	0.10	A775309			
Calculated Calcium (Ca)	mg/kg	8.0	0.26	A774580			
Calculated Magnesium (Mg)	mg/kg	1.4	0.17	A774580			
Calculated Sodium (Na)	mg/kg	1.4	0.43	A774580			
Calculated Potassium (K)	mg/kg	<0.23	0.23	A774580			
Calculated Chloride (Cl)	mg/kg	6.2	1.7	A774580			
Calculated Sulphate (SO4)	mg/kg	<0.87	0.87	A774580			
Elements							
Cation exchange capacity	cmol+/Kg	31	10	A775311			
RADIONUCLIDE							
Actinium-228	Bq/g				<0.20	0.20	A801716
Gross Gamma	Bq/g				<1.0	1.0	A801716
Lead-210	Bq/g				<0.20	0.20	A801716
Lead-212	Bq/g				<0.10	0.10	A801716
Potassium-40	Bq/g				<1.0	1.0	A801716
Radium 226	Bq/g				<0.15	0.15	A801716
Radium-228	Bq/g				<0.20	0.20	A801716
Thorium-228	Bq/g				<0.20	0.20	A801716
Thorium-230	Bq/g				<1.0	1.0	A801716
Thorium-234	Bq/g				<0.20	0.20	A801716
Uranium-235	Bq/g				<0.20	0.20	A801716
Soluble Parameters							
Soluble Chloride (Cl)	mg/L	36	10	A792375			
Soluble Conductivity	dS/m	0.33	0.020	A792223			
Soluble (CaCl2) pH	pH	7.14	N/A	A790533			
Sodium Adsorption Ratio	N/A	0.30	0.10	A774579			
Soluble Calcium (Ca)	mg/L	46	1.5	A791791			
Soluble Nitrite (N)	mg/L	0.66	0.20	A792187			
Soluble Magnesium (Mg)	mg/L	8.1	1.0	A791791			

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO722			BFO723		
Sampling Date		2022/10/05			2022/10/05		
COC Number		55004			55004		
	UNITS	M22L016Ckgj29-110-221005	RDL	QC Batch	M22K051-Radionuclides	RDL	QC Batch
Soluble Nitrate (N)	mg/L	0.69	0.20	A792187			
Soluble Sodium (Na)	mg/L	8.3	2.5	A791791			
Soluble Potassium (K)	mg/L	<1.3	1.3	A791791			
Saturation %	%	17	N/A	A790531			
Soluble Sulphate (SO4)	mg/L	<5.0	5.0	A791791			
Theoretical Gypsum Requirement	tonnes/ha	<0.20	0.20	A775141			

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO724	BFO725	BFO726		
Sampling Date		2022/10/02	2022/10/01	2022/10/04		
COC Number		55004	55004	55004		
	UNITS	M22C022-Radionuclides	M22C008-Radionuclides	M22K042-Radionuclides	RDL	QC Batch
RADIONUCLIDE						
Actinium-228	Bq/g	<0.20	<0.20	<0.20	0.20	A801716
Gross Gamma	Bq/g	<1.0	<1.0	<1.0	1.0	A801716
Lead-210	Bq/g	<0.20	<0.20	<0.20	0.20	A801716
Lead-212	Bq/g	<0.10	<0.10	<0.10	0.10	A801716
Potassium-40	Bq/g	<1.0	<1.0	<1.0	1.0	A801716
Radium 226	Bq/g	<0.15	<0.15	<0.15	0.15	A801716
Radium-228	Bq/g	<0.20	<0.20	<0.20	0.20	A801716
Thorium-228	Bq/g	<0.20	<0.20	<0.20	0.20	A801716
Thorium-230	Bq/g	<1.0	<1.0	<1.0	1.0	A801716
Thorium-234	Bq/g	<0.20	<0.20	<0.20	0.20	A801716
Uranium-235	Bq/g	<0.20	<0.20	<0.20	0.20	A801716

RDL = Reportable Detection Limit

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RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO727			BFO730		
Sampling Date		2022/10/03			2022/09/29		
COC Number		55004			55004		
	UNITS	M22K040-Radionuclide	RDL	QC Batch	M22C004Ckg232-90-220930	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L				2.0	N/A	A775320
Cation Sum	meq/L				4.8	N/A	A775320
Cation/EC Ratio	N/A				13	0.10	A774540
Calculated Calcium (Ca)	mg/kg				16	0.41	A774580
Calculated Magnesium (Mg)	mg/kg				2.4	0.28	A774580
Calculated Sodium (Na)	mg/kg				1.8	0.69	A774580
Calculated Potassium (K)	mg/kg				11	0.36	A774580
Calculated Chloride (Cl)	mg/kg				18	2.8	A774580
Calculated Sulphate (SO4)	mg/kg				1.9	1.4	A774580
Elements							
Cation exchange capacity	cmol+/Kg				<10	10	A775311
RADIONUCLIDE							
Actinium-228	Bq/g	<0.20	0.20	A801716			
Gross Gamma	Bq/g	<1.0	1.0	A801716			
Lead-210	Bq/g	<0.20	0.20	A801716			
Lead-212	Bq/g	<0.10	0.10	A801716			
Potassium-40	Bq/g	<1.0	1.0	A801716			
Radium 226	Bq/g	<0.15	0.15	A801716			
Radium-228	Bq/g	<0.20	0.20	A801716			
Thorium-228	Bq/g	<0.20	0.20	A801716			
Thorium-230	Bq/g	<1.0	1.0	A801716			
Thorium-234	Bq/g	<0.20	0.20	A801716			
Uranium-235	Bq/g	<0.20	0.20	A801716			
Soluble Parameters							
Soluble Chloride (Cl)	mg/L				64	10	A792363
Soluble Conductivity	dS/m				0.36	0.020	A793185
Soluble (CaCl2) pH	pH				7.56	N/A	A790909
Sodium Adsorption Ratio	N/A				0.21	0.10	A774579
Soluble Calcium (Ca)	mg/L				56	1.5	A791910
Soluble Nitrite (N)	mg/L				0.47	0.20	A791998
Soluble Magnesium (Mg)	mg/L				8.6	1.0	A791910

RDL = Reportable Detection Limit
N/A = Not Applicable

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RESULTS OF CHEMICAL ANALYSES OF SOIL

Bureau Veritas ID		BFO727			BFO730		
Sampling Date		2022/10/03			2022/09/29		
COC Number		55004			55004		
	UNITS	M22K040-Radionuclide	RDL	QC Batch	M22C004Ckg232-90-220930	RDL	QC Batch
Soluble Nitrate (N)	mg/L				0.47	0.20	A791998
Soluble Sodium (Na)	mg/L				6.4	2.5	A791910
Soluble Potassium (K)	mg/L				38	1.3	A791910
Saturation %	%				28	N/A	A790903
Soluble Sulphate (SO4)	mg/L				7.0	5.0	A791910
Theoretical Gypsum Requirement	tonnes/ha				<0.20	0.20	A775141

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO731		
Sampling Date				
COC Number		55004		
	UNITS	M22L0160F10-0-221005	RDL	QC Batch
RADIONUCLIDE				
Actinium-228	Bq/g	<0.20	0.20	A801716
Gross Gamma	Bq/g	<1.0	1.0	A801716
Lead-210	Bq/g	<0.20	0.20	A801716
Lead-212	Bq/g	<0.10	0.10	A801716
Potassium-40	Bq/g	<1.0	1.0	A801716
Radium 226	Bq/g	<0.15	0.15	A801716
Radium-228	Bq/g	<0.20	0.20	A801716
Thorium-228	Bq/g	<0.20	0.20	A801716
Thorium-230	Bq/g	<1.0	1.0	A801716
Thorium-234	Bq/g	<0.20	0.20	A801716
Uranium-235	Bq/g	<0.20	0.20	A801716

RDL = Reportable Detection Limit

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PHYSICAL TESTING (SOIL)

Bureau Veritas ID		BFO700	BFO701		BFO702		
Sampling Date		2022/09/30	2022/09/30		2022/09/30		
COC Number		55004	55004		55004		
	UNITS	M22C003Cg75-120-220930	M22C004Bg0-21-220930	QC Batch	M22C004Ckg121-32-220930	RDL	QC Batch
Physical Properties							
% sand by hydrometer	%	24	27	A790786	30	2.0	A791603
% silt by hydrometer	%	50	36	A790786	39	2.0	A791603
Clay Content	%	26	37	A790786	31	2.0	A791603
Texture	N/A	LOAM	CLAY LOAM	A774801	CLAY LOAM	N/A	A774801

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO703	BFO704	BFO705		
Sampling Date		2022/10/01	2022/10/01	2022/10/01		
COC Number		55004	55004	55004		
	UNITS	M22C008Ae0-6-221001	M22C008Bfj6-10-221001	M22C008Bt10-33-221001	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	43	39	27	2.0	A790786
% silt by hydrometer	%	43	30	35	2.0	A790786
Clay Content	%	15	31	38	2.0	A790786
Texture	N/A	LOAM	CLAY LOAM	CLAY LOAM	N/A	A774801

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO706		BFO707		
Sampling Date		2022/10/01		2022/10/02		
COC Number		55004		55004		
	UNITS	M22C008Ck33-100-221001	QC Batch	M22C022Bm1-30-221002	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	31	A791603	29	2.0	A790786
% silt by hydrometer	%	36	A791603	37	2.0	A790786
Clay Content	%	33	A791603	34	2.0	A790786
Texture	N/A	CLAY LOAM	A774801	CLAY LOAM	N/A	A774801

RDL = Reportable Detection Limit
N/A = Not Applicable

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PHYSICAL TESTING (SOIL)

Bureau Veritas ID		BFO708	BFO709	BFO710		
Sampling Date		2022/10/02	2022/10/03	2022/10/03		
COC Number		55004	55004	55004		
	UNITS	M22C022Ck30-100-221002	M22K040Ae0-8-221003	M22K040Bm8-18-221003	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	33	22	12	2.0	A790786
% silt by hydrometer	%	36	60	59	2.0	A790786
Clay Content	%	31	18	28	2.0	A790786
Texture	N/A	CLAY LOAM	SILT LOAM	SLTY CL LO	N/A	A775328

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO711	BFO712	BFO713		
Sampling Date		2022/10/03	2022/10/04	2022/10/04		
COC Number		55004	55004	55004		
	UNITS	M22K040Ck18-120-221003	M22K042Bm0-16-221004	M22K042Ck116-35-221004	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	8.7	37	44	2.0	A790786
% silt by hydrometer	%	68	36	38	2.0	A790786
Clay Content	%	23	26	18	2.0	A790786
Texture	N/A	SILT LOAM	LOAM	LOAM	N/A	A775328

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO714	BFO715	BFO716		
Sampling Date		2022/10/04	2022/10/05	2022/10/05		
COC Number		55004	55004	55004		
	UNITS	M22K042Ck235-45-221004	M22K051Ae0-4-221005	M22K051Bt4-16-221005	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	54	11	7.1	2.0	A790786
% silt by hydrometer	%	32	25	15	2.0	A790786
Clay Content	%	14	64	78	2.0	A790786
Texture	N/A	SANDY LOAM	HEAVY CLAY	HEAVY CLAY	N/A	A775328

RDL = Reportable Detection Limit
N/A = Not Applicable

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Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

PHYSICAL TESTING (SOIL)

Bureau Veritas ID		BFO717		BFO718		BFO719		
Sampling Date		2022/10/05		2022/10/05		2022/10/05		
COC Number		55004		55004		55004		
	UNITS	M22K051BCk16-37-221005	QC Batch	M22K051Ck37-120-221005	QC Batch	M22L016Ahe0-9-221005	RDL	QC Batch
Physical Properties								
% sand by hydrometer	%	17	A790786	40	A790214	34	2.0	A790786
% silt by hydrometer	%	29	A790786	42	A790214	24	2.0	A790786
Clay Content	%	54	A790786	19	A790214	42	2.0	A790786
Texture	N/A	CLAY	A775328	LOAM	A775328	CLAY	N/A	A775328

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO720	BFO721	BFO722		
Sampling Date		2022/10/05	2022/10/05	2022/10/05		
COC Number		55004	55004	55004		
	UNITS	M22L016BA9-14-221005	M22L016Bt14-29-221005	M22L016Ckgj29-110-221005	RDL	QC Batch
Physical Properties						
% sand by hydrometer	%	21	14	59	2.0	A790786
% silt by hydrometer	%	22	15	32	2.0	A790786
Clay Content	%	57	71	9.3	2.0	A790786
Texture	N/A	CLAY	HEAVY CLAY	SANDY LOAM	N/A	A775328

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas ID		BFO728	BFO729			BFO730		
Sampling Date		2022/10/05	2022/10/05			2022/09/29		
COC Number		55004	55004			55004		
	UNITS	M22L016-221005-PAH	M22K051-PAH	RDL	QC Batch	M22C004Ckg232-90-220930	RDL	QC Batch
Physical Properties								
% sand by hydrometer	%					16	2.0	A791603
% silt by hydrometer	%					54	2.0	A791603
Clay Content	%					30	2.0	A791603
Texture	N/A					SLTY CL LO	N/A	A775774
Moisture	%	55	29	0.30	A777704			

RDL = Reportable Detection Limit
N/A = Not Applicable

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SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Bureau Veritas ID		BFO728		BFO729		
Sampling Date		2022/10/05		2022/10/05		
COC Number		55004		55004		
	UNITS	M22L016-221005-PAH	RDL	M22K051-PAH	RDL	QC Batch
Polycyclic Aromatics						
Acenaphthene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
B[a]P TPE Total Potency Equivalents	mg/kg	<0.014	0.014	<0.0071	0.0071	A773925
Acenaphthylene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Acridine	mg/kg	<0.020 (1)	0.020	<0.010	0.010	A777877
Anthracene	mg/kg	<0.0080 (1)	0.0080	<0.0040	0.0040	A777877
Benzo(a)anthracene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Benzo(b&j)fluoranthene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Benzo(k)fluoranthene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Benzo(g,h,i)perylene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Benzo(c)phenanthrene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Benzo(a)pyrene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Benzo(e)pyrene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Chrysene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Dibenz(a,h)anthracene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Fluoranthene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Fluorene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Indeno(1,2,3-cd)pyrene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
1-Methylnaphthalene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
2-Methylnaphthalene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Naphthalene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Phenanthrene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Perylene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Pyrene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A777877
Quinoline	mg/kg	<0.020 (1)	0.020	<0.010	0.010	A777877
Surrogate Recovery (%)						
D10-ANTHRACENE (sur.)	%	84		101		A777877
D8-ACENAPHTHYLENE (sur.)	%	87		102		A777877
D8-NAPHTHALENE (sur.)	%	86		99		A777877
TERPHENYL-D14 (sur.)	%	88		105		A777877

RDL = Reportable Detection Limit
(1) Detection limits raised due to high moisture content, sample contains => 50% moisture.

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VOLATILE ORGANICS BY GC-MS (SOIL)

Bureau Veritas ID		BFO728		BFO729		
Sampling Date		2022/10/05		2022/10/05		
COC Number		55004		55004		
	UNITS	M22L016-221005-PAH	RDL	M22K051-PAH	RDL	QC Batch
Field Preserved Volatiles						
Benzene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A775085
Bromodichloromethane	mg/kg	<0.062 (1)	0.062	<0.030	0.030	A775085
Bromoform	mg/kg	<0.10 (1)	0.10	<0.050	0.050	A775085
Bromomethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Carbon tetrachloride	mg/kg	<0.0010 (1)	0.0010	<0.00050	0.00050	A775085
Chlorobenzene	mg/kg	<0.010 (1)	0.010	<0.0050	0.0050	A775085
Dibromochloromethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Chloroethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Chloroform	mg/kg	<0.021 (1)	0.021	<0.010	0.010	A775085
Chloromethane	mg/kg	<0.062 (1)	0.062	<0.030	0.030	A775085
1,2-dibromoethane	mg/kg	<0.0041 (1)	0.0041	<0.0020	0.0020	A775085
1,2-dichlorobenzene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,3-dichlorobenzene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,4-dichlorobenzene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,1-dichloroethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,2-dichloroethane	mg/kg	<0.0041 (1)	0.0041	<0.0020	0.0020	A775085
1,1-dichloroethene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
cis-1,2-dichloroethene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
trans-1,2-dichloroethene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Dichloromethane	mg/kg	<0.062 (1)	0.062	<0.030	0.030	A775085
1,2-dichloropropane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
cis-1,3-dichloropropene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
trans-1,3-dichloropropene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Ethylbenzene	mg/kg	<0.021 (1)	0.021	<0.010	0.010	A775085
Methyl methacrylate	mg/kg	<0.083 (1)	0.083	<0.040	0.040	A775085
Methyl-tert-butylether (MTBE)	mg/kg	<0.062 (1)	0.062	<0.030	0.030	A775085
Styrene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,1,1,2-tetrachloroethane	mg/kg	<0.10 (1)	0.10	<0.050	0.050	A775085
1,1,2,2-tetrachloroethane	mg/kg	<0.10 (1)	0.10	<0.050	0.050	A775085
Tetrachloroethene	mg/kg	<0.021 (1)	0.021	<0.010	0.010	A775085
Toluene	mg/kg	<0.10 (1)	0.10	<0.050	0.050	A775085

RDL = Reportable Detection Limit
(1) Detection limits raised based on sample weight used for analysis.

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VOLATILE ORGANICS BY GC-MS (SOIL)

Bureau Veritas ID		BFO728		BFO729		
Sampling Date		2022/10/05		2022/10/05		
COC Number		55004		55004		
	UNITS	M22L016-221005-PAH	RDL	M22K051-PAH	RDL	QC Batch
1,2,3-trichlorobenzene	mg/kg	<0.083 (1)	0.083	<0.040	0.040	A775085
1,2,4-trichlorobenzene	mg/kg	<0.083 (1)	0.083	<0.040	0.040	A775085
1,3,5-trichlorobenzene	mg/kg	<0.083 (1)	0.083	<0.040	0.040	A775085
1,1,1-trichloroethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,1,2-trichloroethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Trichloroethene	mg/kg	<0.021 (1)	0.021	<0.010	0.010	A775085
Trichlorofluoromethane	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
1,2,4-trimethylbenzene	mg/kg	<1.0 (1)	1.0	<0.50	0.50	A775085
1,3,5-trimethylbenzene	mg/kg	<1.0 (1)	1.0	<0.50	0.50	A775085
Vinyl chloride	mg/kg	<0.00060 (1)	0.00060	<0.00030	0.00030	A775085
Xylenes (Total)	mg/kg	<0.083	0.083	<0.040	0.040	A775085
m & p-Xylene	mg/kg	<0.083 (1)	0.083	<0.040	0.040	A775085
o-Xylene	mg/kg	<0.041 (1)	0.041	<0.020	0.020	A775085
Surrogate Recovery (%)						
1,4-Difluorobenzene (sur.)	%	102		97		A775085
4-Bromofluorobenzene (sur.)	%	109		104		A775085
D10-o-Xylene (sur.)	%	138		117		A775085
D4-1,2-Dichloroethane (sur.)	%	109		111		A775085

RDL = Reportable Detection Limit
(1) Detection limits raised based on sample weight used for analysis.

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MISCELLANEOUS (SOIL)

Bureau Veritas ID		BFO703	BFO707	BFO709		
Sampling Date		2022/10/01	2022/10/02	2022/10/03		
COC Number		55004	55004	55004		
	UNITS	M22C008Ae0-6-221001	M22C022Bm1-30-221002	M22K040Ae0-8-221003	RDL	QC Batch
Misc. Inorganics						
Total Organic Carbon (C)	%	0.65	1.7	1.3	0.050	A790650
RDL = Reportable Detection Limit						

Bureau Veritas ID		BFO712	BFO715	BFO719		
Sampling Date		2022/10/04	2022/10/05	2022/10/05		
COC Number		55004	55004	55004		
	UNITS	M22K042Bm0-16-221004	M22K051Ae0-4-221005	M22L016Ahe0-9-221005	RDL	QC Batch
Misc. Inorganics						
Total Organic Carbon (C)	%	0.71	4.6	22	0.050	A790650
RDL = Reportable Detection Limit						

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.0°C
Package 2	5.0°C

Sample BFO700 [M22C003Cg75-120-220930] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO701 [M22C004Bg0-21-220930] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO702 [M22C004Ckg121-32-220930] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO703 [M22C008Ae0-6-221001] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Total Organic Carbon LECO Method. Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO704 [M22C008Bfj6-10-221001] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO705 [M22C008Bt10-33-221001] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO706 [M22C008Ck33-100-221001] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO707 [M22C022Bm1-30-221002] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Total Organic Carbon LECO Method. Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO708 [M22C022Ck30-100-221002] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO709 [M22K040Ae0-8-221003] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Total Organic Carbon LECO Method. Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method

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specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO710 [M22K040Bm8-18-221003] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). SLTY CL LO = SILTY CLAY LOAM Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO711 [M22K040Ck18-120-221003] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO712 [M22K042Bm0-16-221004] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Total Organic Carbon LECO Method. Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO713 [M22K042Ck116-35-221004] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO714 [M22K042Ck235-45-221004] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO715 [M22K051Ae0-4-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Total Organic Carbon LECO Method. Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO716 [M22K051Bt4-16-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO717 [M22K051BCk16-37-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO718 [M22K051Ck37-120-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer.

Sample BFO719 [M22L016Ahe0-9-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Total Organic Carbon LECO Method. Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO720 [M22L016BA9-14-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold

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time for Nitrite-N and Nitrate-N (soluble).

Sample BFO721 [M22L016Bt14-29-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO722 [M22L016Ckgj29-110-221005] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble).

Sample BFO728 [M22L016-221005-PAH] : Sample was analyzed past method specified hold time for PAH in Soil by GC/MS.

Sample BFO729 [M22K051-PAH] : Sample was analyzed past method specified hold time for PAH in Soil by GC/MS.

Sample BFO730 [M22C004Ckg232-90-220930] : Sample was analyzed past method specified hold time for pH @25C (1:2 Calcium Chloride Extract). Sample was analyzed past method specified hold time for Texture by Hydrometer. Sample was analyzed past method specified hold time for Chloride (Soluble). Sample was analyzed past method specified hold time for Conductivity @25C (Soluble). Sample was analyzed past method specified hold time for Nitrite-N and Nitrate-N (soluble). SLTY CL LO = SILTY CLAY LOAM

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A775085	YPA	Matrix Spike	1,4-Difluorobenzene (sur.)	2022/10/28		97	%	50 - 140
			4-Bromofluorobenzene (sur.)	2022/10/28		104	%	50 - 140
			D10-o-Xylene (sur.)	2022/10/28		113	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2022/10/28		98	%	50 - 140
			Benzene	2022/10/28		82	%	50 - 140
			Bromodichloromethane	2022/10/28		92	%	50 - 140
			Bromoform	2022/10/28		109	%	50 - 140
			Bromomethane	2022/10/28		94	%	50 - 140
			Carbon tetrachloride	2022/10/28		75	%	50 - 140
			Chlorobenzene	2022/10/28		91	%	50 - 140
			Dibromochloromethane	2022/10/28		101	%	50 - 140
			Chloroethane	2022/10/28		117	%	50 - 140
			Chloroform	2022/10/28		84	%	50 - 140
			Chloromethane	2022/10/28		99	%	50 - 140
			1,2-dibromoethane	2022/10/28		104	%	50 - 140
			1,2-dichlorobenzene	2022/10/28		96	%	50 - 140
			1,3-dichlorobenzene	2022/10/28		87	%	50 - 140
			1,4-dichlorobenzene	2022/10/28		90	%	50 - 140
			1,1-dichloroethane	2022/10/28		86	%	50 - 140
			1,2-dichloroethane	2022/10/28		90	%	50 - 140
			1,1-dichloroethene	2022/10/28		87	%	50 - 140
			cis-1,2-dichloroethene	2022/10/28		85	%	50 - 140
			trans-1,2-dichloroethene	2022/10/28		81	%	50 - 140
			Dichloromethane	2022/10/28		85	%	50 - 140
			1,2-dichloropropane	2022/10/28		92	%	50 - 140
			cis-1,3-dichloropropene	2022/10/28		93	%	50 - 140
			trans-1,3-dichloropropene	2022/10/28		92	%	50 - 140
			Ethylbenzene	2022/10/28		83	%	50 - 140
			Methyl methacrylate	2022/10/28		106	%	50 - 140
			Methyl-tert-butylether (MTBE)	2022/10/28		82	%	50 - 140
			Styrene	2022/10/28		94	%	50 - 140
			1,1,1,2-tetrachloroethane	2022/10/28		90	%	50 - 140
			1,1,2,2-tetrachloroethane	2022/10/28		114	%	50 - 140
			Tetrachloroethene	2022/10/28		82	%	50 - 140
			Toluene	2022/10/28		85	%	50 - 140
			1,2,3-trichlorobenzene	2022/10/28		97	%	50 - 140
			1,2,4-trichlorobenzene	2022/10/28		90	%	50 - 140
			1,3,5-trichlorobenzene	2022/10/28		83	%	50 - 140
			1,1,1-trichloroethane	2022/10/28		79	%	50 - 140
			1,1,2-trichloroethane	2022/10/28		93	%	50 - 140
			Trichloroethene	2022/10/28		84	%	50 - 140
			Trichlorofluoromethane	2022/10/28		77	%	50 - 140
			1,2,4-trimethylbenzene	2022/10/28		84	%	50 - 140
			1,3,5-trimethylbenzene	2022/10/28		83	%	50 - 140
			Vinyl chloride	2022/10/28		90	%	50 - 140
			m & p-Xylene	2022/10/28		84	%	50 - 140
			o-Xylene	2022/10/28		90	%	50 - 140
A775085	YPA	Spiked Blank	1,4-Difluorobenzene (sur.)	2022/10/28		98	%	50 - 140
			4-Bromofluorobenzene (sur.)	2022/10/28		105	%	50 - 140
			D10-o-Xylene (sur.)	2022/10/28		114	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2022/10/28		97	%	50 - 140
			Benzene	2022/10/28		76	%	60 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Bromodichloromethane	2022/10/28		86	%	60 - 130
			Bromoform	2022/10/28		101	%	60 - 130
			Bromomethane	2022/10/28		100	%	60 - 130
			Carbon tetrachloride	2022/10/28		71	%	60 - 130
			Chlorobenzene	2022/10/28		85	%	60 - 130
			Dibromochloromethane	2022/10/28		94	%	60 - 130
			Chloroethane	2022/10/28		92	%	60 - 130
			Chloroform	2022/10/28		79	%	60 - 130
			Chloromethane	2022/10/28		90	%	60 - 130
			1,2-dibromoethane	2022/10/28		97	%	60 - 130
			1,2-dichlorobenzene	2022/10/28		91	%	60 - 130
			1,3-dichlorobenzene	2022/10/28		83	%	60 - 130
			1,4-dichlorobenzene	2022/10/28		85	%	60 - 130
			1,1-dichloroethane	2022/10/28		82	%	60 - 130
			1,2-dichloroethane	2022/10/28		84	%	60 - 130
			1,1-dichloroethene	2022/10/28		82	%	60 - 130
			cis-1,2-dichloroethene	2022/10/28		81	%	60 - 130
			trans-1,2-dichloroethene	2022/10/28		76	%	60 - 130
			Dichloromethane	2022/10/28		80	%	60 - 130
			1,2-dichloropropane	2022/10/28		85	%	60 - 130
			cis-1,3-dichloropropene	2022/10/28		86	%	60 - 130
			trans-1,3-dichloropropene	2022/10/28		83	%	60 - 130
			Ethylbenzene	2022/10/28		79	%	60 - 130
			Methyl methacrylate	2022/10/28		97	%	60 - 130
			Methyl-tert-butylether (MTBE)	2022/10/28		81	%	60 - 130
			Styrene	2022/10/28		88	%	60 - 130
			1,1,1,2-tetrachloroethane	2022/10/28		84	%	60 - 130
			1,1,2,2-tetrachloroethane	2022/10/28		109	%	60 - 130
			Tetrachloroethene	2022/10/28		78	%	60 - 130
			Toluene	2022/10/28		81	%	60 - 130
			1,2,3-trichlorobenzene	2022/10/28		96	%	60 - 130
			1,2,4-trichlorobenzene	2022/10/28		87	%	60 - 130
			1,3,5-trichlorobenzene	2022/10/28		82	%	60 - 130
			1,1,1-trichloroethane	2022/10/28		74	%	60 - 130
			1,1,2-trichloroethane	2022/10/28		85	%	60 - 130
			Trichloroethene	2022/10/28		79	%	60 - 130
			Trichlorofluoromethane	2022/10/28		69	%	60 - 130
			1,2,4-trimethylbenzene	2022/10/28		80	%	60 - 130
			1,3,5-trimethylbenzene	2022/10/28		79	%	60 - 130
			Vinyl chloride	2022/10/28		84	%	60 - 130
			m & p-Xylene	2022/10/28		79	%	60 - 130
			o-Xylene	2022/10/28		84	%	60 - 130
A775085	YPA	Method Blank	1,4-Difluorobenzene (sur.)	2022/10/28		97	%	50 - 140
			4-Bromofluorobenzene (sur.)	2022/10/28		102	%	50 - 140
			D10-o-Xylene (sur.)	2022/10/28		106	%	50 - 140
			D4-1,2-Dichloroethane (sur.)	2022/10/28		110	%	50 - 140
			Benzene	2022/10/28	<0.0050		mg/kg	
			Bromodichloromethane	2022/10/28	<0.030		mg/kg	
			Bromoform	2022/10/28	<0.050		mg/kg	
			Bromomethane	2022/10/28	<0.020		mg/kg	
			Carbon tetrachloride	2022/10/28	<0.00050		mg/kg	
			Chlorobenzene	2022/10/28	<0.0050		mg/kg	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dibromochloromethane	2022/10/28	<0.020		mg/kg	
			Chloroethane	2022/10/28	<0.020		mg/kg	
			Chloroform	2022/10/28	<0.010		mg/kg	
			Chloromethane	2022/10/28	<0.030		mg/kg	
			1,2-dibromoethane	2022/10/28	<0.0020		mg/kg	
			1,2-dichlorobenzene	2022/10/28	<0.020		mg/kg	
			1,3-dichlorobenzene	2022/10/28	<0.020		mg/kg	
			1,4-dichlorobenzene	2022/10/28	<0.020		mg/kg	
			1,1-dichloroethane	2022/10/28	<0.020		mg/kg	
			1,2-dichloroethane	2022/10/28	<0.0020		mg/kg	
			1,1-dichloroethene	2022/10/28	<0.020		mg/kg	
			cis-1,2-dichloroethene	2022/10/28	<0.020		mg/kg	
			trans-1,2-dichloroethene	2022/10/28	<0.020		mg/kg	
			Dichloromethane	2022/10/28	<0.030		mg/kg	
			1,2-dichloropropane	2022/10/28	<0.020		mg/kg	
			cis-1,3-dichloropropene	2022/10/28	<0.020		mg/kg	
			trans-1,3-dichloropropene	2022/10/28	<0.020		mg/kg	
			Ethylbenzene	2022/10/28	<0.010		mg/kg	
			Methyl methacrylate	2022/10/28	<0.040		mg/kg	
			Methyl-tert-butylether (MTBE)	2022/10/28	<0.030		mg/kg	
			Styrene	2022/10/28	<0.020		mg/kg	
			1,1,1,2-tetrachloroethane	2022/10/28	<0.050		mg/kg	
			1,1,2,2-tetrachloroethane	2022/10/28	<0.050		mg/kg	
			Tetrachloroethene	2022/10/28	<0.010		mg/kg	
			Toluene	2022/10/28	<0.050		mg/kg	
			1,2,3-trichlorobenzene	2022/10/28	<0.040		mg/kg	
			1,2,4-trichlorobenzene	2022/10/28	<0.040		mg/kg	
			1,3,5-trichlorobenzene	2022/10/28	<0.040		mg/kg	
			1,1,1-trichloroethane	2022/10/28	<0.020		mg/kg	
			1,1,2-trichloroethane	2022/10/28	<0.020		mg/kg	
			Trichloroethene	2022/10/28	<0.010		mg/kg	
			Trichlorofluoromethane	2022/10/28	<0.020		mg/kg	
			1,2,4-trimethylbenzene	2022/10/28	<0.50		mg/kg	
			1,3,5-trimethylbenzene	2022/10/28	<0.50		mg/kg	
			Vinyl chloride	2022/10/28	<0.00030		mg/kg	
			Xylenes (Total)	2022/10/28	<0.040		mg/kg	
			m & p-Xylene	2022/10/28	<0.040		mg/kg	
			o-Xylene	2022/10/28	<0.020		mg/kg	
A775085	YPA	RPD	Bromodichloromethane	2022/10/31	NC		%	50
			Bromoform	2022/10/31	NC		%	50
			Bromomethane	2022/10/31	NC		%	50
			Carbon tetrachloride	2022/10/31	NC		%	50
			Chlorobenzene	2022/10/31	NC		%	50
			Dibromochloromethane	2022/10/31	NC		%	50
			Chloroethane	2022/10/31	NC		%	50
			Chloroform	2022/10/31	NC		%	50
			Chloromethane	2022/10/31	NC		%	50
			1,2-dibromoethane	2022/10/31	NC		%	50
			1,2-dichlorobenzene	2022/10/31	NC		%	50
			1,3-dichlorobenzene	2022/10/31	NC		%	50
			1,4-dichlorobenzene	2022/10/31	NC		%	50
			1,1-dichloroethane	2022/10/31	NC		%	50

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-dichloroethane	2022/10/31	NC		%	50
			1,1-dichloroethene	2022/10/31	NC		%	50
			cis-1,2-dichloroethene	2022/10/31	NC		%	50
			trans-1,2-dichloroethene	2022/10/31	NC		%	50
			Dichloromethane	2022/10/31	NC		%	50
			1,2-dichloropropane	2022/10/31	NC		%	50
			cis-1,3-dichloropropene	2022/10/31	NC		%	50
			trans-1,3-dichloropropene	2022/10/31	NC		%	50
			Methyl methacrylate	2022/10/31	NC		%	50
			Methyl-tert-butylether (MTBE)	2022/10/31	NC		%	50
			Styrene	2022/10/31	NC		%	50
			1,1,1,2-tetrachloroethane	2022/10/31	NC		%	50
			1,1,2,2-tetrachloroethane	2022/10/31	NC		%	50
			Tetrachloroethene	2022/10/31	NC		%	50
			1,2,3-trichlorobenzene	2022/10/31	NC		%	50
			1,2,4-trichlorobenzene	2022/10/31	NC		%	50
			1,3,5-trichlorobenzene	2022/10/31	NC		%	50
			1,1,1-trichloroethane	2022/10/31	NC		%	50
			1,1,2-trichloroethane	2022/10/31	NC		%	50
			Trichloroethene	2022/10/31	NC		%	50
			Trichlorofluoromethane	2022/10/31	NC		%	50
			1,2,4-trimethylbenzene	2022/10/31	NC		%	50
			1,3,5-trimethylbenzene	2022/10/31	NC		%	50
			Vinyl chloride	2022/10/31	NC		%	50
A777704	KLG	Method Blank	Moisture	2022/10/29	<0.30		%	
A777704	KLG	RPD	Moisture	2022/10/29	8.1		%	20
A777877	JC7	Matrix Spike	D10-ANTHRACENE (sur.)	2022/10/30		101	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2022/10/30		103	%	50 - 130
			D8-NAPHTHALENE (sur.)	2022/10/30		100	%	50 - 130
			TERPHENYL-D14 (sur.)	2022/10/30		103	%	50 - 130
			Acenaphthene	2022/10/30		83	%	50 - 130
			Acenaphthylene	2022/10/30		90	%	50 - 130
			Acridine	2022/10/30		66	%	50 - 130
			Anthracene	2022/10/30		87	%	50 - 130
			Benzo(a)anthracene	2022/10/30		89	%	50 - 130
			Benzo(b&j)fluoranthene	2022/10/30		86	%	50 - 130
			Benzo(k)fluoranthene	2022/10/30		85	%	50 - 130
			Benzo(g,h,i)perylene	2022/10/30		84	%	50 - 130
			Benzo(c)phenanthrene	2022/10/30		94	%	50 - 130
			Benzo(a)pyrene	2022/10/30		88	%	50 - 130
			Benzo(e)pyrene	2022/10/30		82	%	50 - 130
			Chrysene	2022/10/30		89	%	50 - 130
			Dibenz(a,h)anthracene	2022/10/30		89	%	50 - 130
			Fluoranthene	2022/10/30		86	%	50 - 130
			Fluorene	2022/10/30		92	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2022/10/30		86	%	50 - 130
			1-Methylnaphthalene	2022/10/30		76	%	50 - 130
			2-Methylnaphthalene	2022/10/30		95	%	50 - 130
			Naphthalene	2022/10/30		83	%	50 - 130
			Phenanthrene	2022/10/30		89	%	50 - 130
			Perylene	2022/10/30		78	%	50 - 130
			Pyrene	2022/10/30		86	%	50 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Quinoline	2022/10/30		78	%	50 - 130
A777877	JC7	Spiked Blank	D10-ANTHRACENE (sur.)	2022/10/30		108	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2022/10/30		107	%	50 - 130
			D8-NAPHTHALENE (sur.)	2022/10/30		119	%	50 - 130
			TERPHENYL-D14 (sur.)	2022/10/30		100	%	50 - 130
			Acenaphthene	2022/10/30		81	%	50 - 130
			Acenaphthylene	2022/10/30		93	%	50 - 130
			Acridine	2022/10/30		70	%	50 - 130
			Anthracene	2022/10/30		90	%	50 - 130
			Benzo(a)anthracene	2022/10/30		89	%	50 - 130
			Benzo(b&j)fluoranthene	2022/10/30		86	%	50 - 130
			Benzo(k)fluoranthene	2022/10/30		86	%	50 - 130
			Benzo(g,h,i)perylene	2022/10/30		89	%	50 - 130
			Benzo(c)phenanthrene	2022/10/30		92	%	50 - 130
			Benzo(a)pyrene	2022/10/30		92	%	50 - 130
			Benzo(e)pyrene	2022/10/30		83	%	50 - 130
			Chrysene	2022/10/30		85	%	50 - 130
			Dibenz(a,h)anthracene	2022/10/30		92	%	50 - 130
			Fluoranthene	2022/10/30		90	%	50 - 130
			Fluorene	2022/10/30		86	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2022/10/30		93	%	50 - 130
			1-Methylnaphthalene	2022/10/30		82	%	50 - 130
			2-Methylnaphthalene	2022/10/30		100	%	50 - 130
			Naphthalene	2022/10/30		100	%	50 - 130
			Phenanthrene	2022/10/30		91	%	50 - 130
			Perylene	2022/10/30		81	%	50 - 130
			Pyrene	2022/10/30		89	%	50 - 130
			Quinoline	2022/10/30		81	%	50 - 130
A777877	JC7	Method Blank	D10-ANTHRACENE (sur.)	2022/10/30		105	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2022/10/30		107	%	50 - 130
			D8-NAPHTHALENE (sur.)	2022/10/30		102	%	50 - 130
			TERPHENYL-D14 (sur.)	2022/10/30		105	%	50 - 130
			Acenaphthene	2022/10/30	<0.0050		mg/kg	
			Acenaphthylene	2022/10/30	<0.0050		mg/kg	
			Acridine	2022/10/30	<0.010		mg/kg	
			Anthracene	2022/10/30	<0.0040		mg/kg	
			Benzo(a)anthracene	2022/10/30	<0.0050		mg/kg	
			Benzo(b&j)fluoranthene	2022/10/30	<0.0050		mg/kg	
			Benzo(k)fluoranthene	2022/10/30	<0.0050		mg/kg	
			Benzo(g,h,i)perylene	2022/10/30	<0.0050		mg/kg	
			Benzo(c)phenanthrene	2022/10/30	<0.0050		mg/kg	
			Benzo(a)pyrene	2022/10/30	<0.0050		mg/kg	
			Benzo(e)pyrene	2022/10/30	<0.0050		mg/kg	
			Chrysene	2022/10/30	<0.0050		mg/kg	
			Dibenz(a,h)anthracene	2022/10/30	<0.0050		mg/kg	
			Fluoranthene	2022/10/30	<0.0050		mg/kg	
			Fluorene	2022/10/30	<0.0050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2022/10/30	<0.0050		mg/kg	
			1-Methylnaphthalene	2022/10/30	<0.0050		mg/kg	
			2-Methylnaphthalene	2022/10/30	<0.0050		mg/kg	
			Naphthalene	2022/10/30	<0.0050		mg/kg	
			Phenanthrene	2022/10/30	<0.0050		mg/kg	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Perylene	2022/10/30	<0.0050		mg/kg	
			Pyrene	2022/10/30	<0.0050		mg/kg	
			Quinoline	2022/10/30	<0.010		mg/kg	
A777877	JC7	RPD	Acenaphthene	2022/10/30	NC		%	50
			Acenaphthylene	2022/10/30	NC		%	50
			Acridine	2022/10/30	NC		%	50
			Anthracene	2022/10/30	NC		%	50
			Benzo(a)anthracene	2022/10/30	NC		%	50
			Benzo(b&j)fluoranthene	2022/10/30	27		%	50
			Benzo(k)fluoranthene	2022/10/30	NC		%	50
			Benzo(g,h,i)perylene	2022/10/30	30		%	50
			Benzo(c)phenanthrene	2022/10/30	NC		%	50
			Benzo(a)pyrene	2022/10/30	NC		%	50
			Benzo(e)pyrene	2022/10/30	NC		%	50
			Chrysene	2022/10/30	NC		%	50
			Dibenz(a,h)anthracene	2022/10/30	NC		%	50
			Fluoranthene	2022/10/30	NC		%	50
			Fluorene	2022/10/30	NC		%	50
			Indeno(1,2,3-cd)pyrene	2022/10/30	42		%	50
			1-Methylnaphthalene	2022/10/30	NC		%	50
			2-Methylnaphthalene	2022/10/30	NC		%	50
			Naphthalene	2022/10/30	NC		%	50
			Phenanthrene	2022/10/30	NC		%	50
			Perylene	2022/10/30	16		%	50
			Pyrene	2022/10/30	NC		%	50
			Quinoline	2022/10/30	NC		%	50
A790214	EH2	QC Standard	% sand by hydrometer	2022/11/10		96	%	75 - 125
			% silt by hydrometer	2022/11/10		105	%	75 - 125
			Clay Content	2022/11/10		102	%	75 - 125
A790214	EH2	RPD	% sand by hydrometer	2022/11/10	0.43		%	30
			% silt by hydrometer	2022/11/10	1.1		%	30
			Clay Content	2022/11/10	0.21		%	30
A790531	HTA	QC Standard	Saturation %	2022/11/08		102	%	75 - 125
A790531	HTA	RPD [BFO705-01]	Saturation %	2022/11/08	3.1		%	12
A790531	HTA	RPD [BFO708-01]	Saturation %	2022/11/08	6.0		%	12
A790533	DPL	QC Standard	Soluble (CaCl2) pH	2022/11/08		98	%	97 - 103
A790533	DPL	Spiked Blank	Soluble (CaCl2) pH	2022/11/08		100	%	97 - 103
A790533	DPL	RPD [BFO705-01]	Soluble (CaCl2) pH	2022/11/08	0.19		%	N/A
A790650	PL	QC Standard	Total Organic Carbon (C)	2022/11/09		100	%	75 - 125
A790650	PL	Spiked Blank	Total Organic Carbon (C)	2022/11/09		99	%	80 - 120
A790650	PL	Method Blank	Total Organic Carbon (C)	2022/11/09	<0.050		%	
A790650	PL	RPD	Total Organic Carbon (C)	2022/11/09	0.55		%	35
A790786	SJA	QC Standard	% sand by hydrometer	2022/11/09		97	%	75 - 125
			% silt by hydrometer	2022/11/09		109	%	75 - 125
			Clay Content	2022/11/09		97	%	75 - 125
A790786	SJA	RPD [BFO705-01]	% sand by hydrometer	2022/11/09	1.3		%	30
			% silt by hydrometer	2022/11/09	5.4		%	30
			Clay Content	2022/11/09	3.8		%	30
A790903	HTA	QC Standard	Saturation %	2022/11/08		101	%	75 - 125
A790903	HTA	RPD [BFO718-01]	Saturation %	2022/11/08	7.9		%	12
A790909	SFU	QC Standard	Soluble (CaCl2) pH	2022/11/08		98	%	97 - 103
A790909	SFU	Spiked Blank	Soluble (CaCl2) pH	2022/11/08		100	%	97 - 103

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A790909	SFU	RPD [BFO718-01]	Soluble (CaCl2) pH	2022/11/08	0.17		%	N/A
A791603	RDL	QC Standard	% sand by hydrometer	2022/11/09		100	%	75 - 125
			% silt by hydrometer	2022/11/09		105	%	75 - 125
			Clay Content	2022/11/09		96	%	75 - 125
A791603	RDL	RPD	% sand by hydrometer	2022/11/09	6.1		%	30
			% silt by hydrometer	2022/11/09	21		%	30
			Clay Content	2022/11/09	4.0		%	30
A791791	PL	Matrix Spike [BFO707-01]	Soluble Calcium (Ca)	2022/11/09		98	%	75 - 125
			Soluble Magnesium (Mg)	2022/11/09		96	%	75 - 125
			Soluble Sodium (Na)	2022/11/09		98	%	75 - 125
			Soluble Potassium (K)	2022/11/09		97	%	75 - 125
A791791	PL	QC Standard	Soluble Calcium (Ca)	2022/11/09		86	%	75 - 125
			Soluble Magnesium (Mg)	2022/11/09		86	%	75 - 125
			Soluble Sodium (Na)	2022/11/09		91	%	75 - 125
			Soluble Potassium (K)	2022/11/09		104	%	75 - 125
			Soluble Sulphate (SO4)	2022/11/09		84	%	75 - 125
A791791	PL	Spiked Blank	Soluble Calcium (Ca)	2022/11/09		100	%	80 - 120
			Soluble Magnesium (Mg)	2022/11/09		97	%	80 - 120
			Soluble Sodium (Na)	2022/11/09		99	%	80 - 120
			Soluble Potassium (K)	2022/11/09		98	%	80 - 120
A791791	PL	Method Blank	Soluble Calcium (Ca)	2022/11/09	<1.5		mg/L	
			Soluble Magnesium (Mg)	2022/11/09	<1.0		mg/L	
			Soluble Sodium (Na)	2022/11/09	<2.5		mg/L	
			Soluble Potassium (K)	2022/11/09	<1.3		mg/L	
			Soluble Sulphate (SO4)	2022/11/09	<5.0		mg/L	
A791791	PL	RPD [BFO705-01]	Soluble Calcium (Ca)	2022/11/09	0.42		%	30
			Soluble Magnesium (Mg)	2022/11/09	2.7		%	30
			Soluble Sodium (Na)	2022/11/09	2.7		%	30
			Soluble Potassium (K)	2022/11/09	NC		%	30
			Soluble Sulphate (SO4)	2022/11/09	17		%	30
A791910	PL	Matrix Spike	Soluble Calcium (Ca)	2022/11/09		89	%	75 - 125
			Soluble Magnesium (Mg)	2022/11/09		87	%	75 - 125
			Soluble Sodium (Na)	2022/11/09		NC	%	75 - 125
			Soluble Potassium (K)	2022/11/09		95	%	75 - 125
A791910	PL	QC Standard	Soluble Calcium (Ca)	2022/11/09		96	%	75 - 125
			Soluble Magnesium (Mg)	2022/11/09		97	%	75 - 125
			Soluble Sodium (Na)	2022/11/09		100	%	75 - 125
			Soluble Potassium (K)	2022/11/09		97	%	75 - 125
			Soluble Sulphate (SO4)	2022/11/09		92	%	75 - 125
A791910	PL	Spiked Blank	Soluble Calcium (Ca)	2022/11/09		97	%	80 - 120
			Soluble Magnesium (Mg)	2022/11/09		95	%	80 - 120
			Soluble Sodium (Na)	2022/11/09		96	%	80 - 120
			Soluble Potassium (K)	2022/11/09		95	%	80 - 120
A791910	PL	Method Blank	Soluble Calcium (Ca)	2022/11/09	<1.5		mg/L	
			Soluble Magnesium (Mg)	2022/11/09	<1.0		mg/L	
			Soluble Sodium (Na)	2022/11/09	<2.5		mg/L	
			Soluble Potassium (K)	2022/11/09	<1.3		mg/L	
			Soluble Sulphate (SO4)	2022/11/09	<5.0		mg/L	
A791910	PL	RPD [BFO718-01]	Soluble Calcium (Ca)	2022/11/09	0.36		%	30
			Soluble Magnesium (Mg)	2022/11/09	2.7		%	30
			Soluble Sodium (Na)	2022/11/09	0.13		%	30
			Soluble Potassium (K)	2022/11/09	7.4		%	30

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Soluble Sulphate (SO4)	2022/11/09	11		%	30
A791998	HTA	Matrix Spike [BFO718-01]	Soluble Nitrite (N)	2022/11/09		108	%	75 - 125
			Soluble Nitrate (N)	2022/11/09		108	%	75 - 125
A791998	HTA	Spiked Blank	Soluble Nitrite (N)	2022/11/09		100	%	80 - 120
			Soluble Nitrate (N)	2022/11/09		103	%	80 - 120
A791998	HTA	Method Blank	Soluble Nitrite (N)	2022/11/09	<0.20		mg/L	
			Soluble Nitrate (N)	2022/11/09	<0.20		mg/L	
A791998	HTA	RPD [BFO718-01]	Soluble Nitrite (N)	2022/11/09	NC		%	30
			Soluble Nitrate (N)	2022/11/09	NC		%	30
A792187	JLD	Matrix Spike [BFO705-01]	Soluble Nitrite (N)	2022/11/09		108	%	75 - 125
			Soluble Nitrate (N)	2022/11/09		110	%	75 - 125
A792187	JLD	Spiked Blank	Soluble Nitrite (N)	2022/11/09		104	%	80 - 120
			Soluble Nitrate (N)	2022/11/09		104	%	80 - 120
A792187	JLD	Method Blank	Soluble Nitrite (N)	2022/11/09	<0.20		mg/L	
			Soluble Nitrate (N)	2022/11/09	<0.20		mg/L	
A792187	JLD	RPD [BFO705-01]	Soluble Nitrite (N)	2022/11/09	13		%	30
			Soluble Nitrate (N)	2022/11/09	NC		%	30
A792223	ZI	QC Standard	Soluble Conductivity	2022/11/09		99	%	75 - 125
A792223	ZI	Spiked Blank	Soluble Conductivity	2022/11/09		101	%	90 - 110
A792223	ZI	Method Blank	Soluble Conductivity	2022/11/09	<0.020		dS/m	
A792223	ZI	RPD [BFO705-01]	Soluble Conductivity	2022/11/09	1.3		%	20
A792363	ZI	Matrix Spike	Soluble Chloride (Cl)	2022/11/09		104	%	75 - 125
A792363	ZI	QC Standard	Soluble Chloride (Cl)	2022/11/09		92	%	75 - 125
A792363	ZI	Spiked Blank	Soluble Chloride (Cl)	2022/11/09		102	%	80 - 120
A792363	ZI	Method Blank	Soluble Chloride (Cl)	2022/11/09	<10		mg/L	
A792363	ZI	RPD [BFO718-01]	Soluble Chloride (Cl)	2022/11/09	NC		%	30
A792375	ZI	Matrix Spike [BFO707-01]	Soluble Chloride (Cl)	2022/11/09		104	%	75 - 125
A792375	ZI	QC Standard	Soluble Chloride (Cl)	2022/11/09		91	%	75 - 125
A792375	ZI	Spiked Blank	Soluble Chloride (Cl)	2022/11/09		102	%	80 - 120
A792375	ZI	Method Blank	Soluble Chloride (Cl)	2022/11/09	<10		mg/L	
A792375	ZI	RPD [BFO705-01]	Soluble Chloride (Cl)	2022/11/09	NC		%	30
A793185	EBO	QC Standard	Soluble Conductivity	2022/11/09		102	%	75 - 125
A793185	EBO	Spiked Blank	Soluble Conductivity	2022/11/09		99	%	90 - 110
A793185	EBO	Method Blank	Soluble Conductivity	2022/11/09	<0.020		dS/m	
A793185	EBO	RPD [BFO718-01]	Soluble Conductivity	2022/11/09	4.9		%	20
A801716	éFK	QC Standard	Actinium-228	2022/11/16		105	%	N/A
			Gross Gamma	2022/11/16		103	%	N/A
			Lead-210	2022/11/16		100	%	74 - 126
			Lead-212	2022/11/16		109	%	74 - 126
			Potassium-40	2022/11/16		104	%	74 - 126
			Radium 226	2022/11/16		100	%	74 - 126
			Radium-228	2022/11/16		105	%	74 - 126
			Thorium-228	2022/11/16		109	%	74 - 126
			Thorium-230	2022/11/16		102	%	74 - 126
			Thorium-234	2022/11/16		94	%	74 - 126
			Uranium-235	2022/11/16		87	%	74 - 126
A801716	éFK	Method Blank	Actinium-228	2022/11/16	<0.20		Bq/g	
			Gross Gamma	2022/11/16	<1.0		Bq/g	
			Lead-210	2022/11/16	<0.20		Bq/g	
			Lead-212	2022/11/16	<0.10		Bq/g	
			Potassium-40	2022/11/16	<1.0		Bq/g	
			Radium 226	2022/11/16	<0.15		Bq/g	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Radium-228	2022/11/16	<0.20		Bq/g	
			Thorium-228	2022/11/16	<0.20		Bq/g	
			Thorium-230	2022/11/16	<1.0		Bq/g	
			Thorium-234	2022/11/16	<0.20		Bq/g	
			Uranium-235	2022/11/16	<0.20		Bq/g	
A801716	éFK	RPD [BFO725-01]	Actinium-228	2022/11/17	NC		%	N/A
			Gross Gamma	2022/11/17	NC		%	N/A
			Lead-210	2022/11/17	NC		%	N/A
			Lead-212	2022/11/17	NC		%	N/A
			Potassium-40	2022/11/17	NC		%	N/A
			Radium 226	2022/11/17	NC		%	N/A
			Radium-228	2022/11/17	NC		%	N/A
			Thorium-228	2022/11/17	NC		%	N/A
			Thorium-230	2022/11/17	NC		%	N/A
			Thorium-234	2022/11/17	NC		%	N/A
			Uranium-235	2022/11/17	NC		%	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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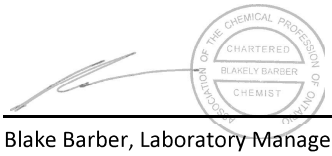
Bureau Veritas Job #: C284514
Report Date: 2022/11/18

GOLDER ASSOCIATES LTD
Client Project #: 21455151
Site Location: Marten Falls, Northern Ontario
Your P.O. #: 21455151
Sampler Initials: CB

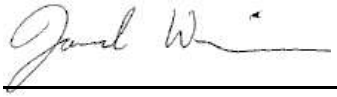
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Blake Barber, Laboratory Manager

Janet Gao, B.Sc., QP, Supervisor, Organics



Jared Wiseman, B.Sc., P.Chem., QP, Senior Analyst, Organics

Suwan (Sze Yeung) Fock, B.Sc., Scientific Specialist

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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Custody Tracking Form

eCOC Number
W55064

Please use this form for custody tracking when submitting the work instructions via eCOC (electronic Chain of Custody). Please ensure your form **has a barcode or a Bureau Veritas eCOC confirmation number** in the top right hand side. This number links your electronic submission to your samples. This form should be **placed in the cooler with your samples.**

Relinquished By				Received By			
		Date		Sherine Bramwell	Sbramwell	Date	2022/10/07
		Time (24 HR)				Time (24 HR)	14:56
		Date		Nick Bath		Date	2022/10/08
		Time (24 HR)				Time (24 HR)	09:30
		Date				Date	
		Time (24 HR)				Time (24 HR)	

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Triage Information

Sampled By (Print)	# of Coolers/Pkgs				
		Rush ☐	Immediate Test ☐	Food Residue ☐	
		Micro ☐		Food Chemistry ☐	

***** Laboratory Use Only *****

Received At

Labeled By

Verified By

Lab Comments:

Rec'd In Thunder Bay

Custody Seal		Cooling Media	Temperature °C		
Present (Y/N)	Intact (Y/N)	Present (Y/N)	1	2	3
N	N/A	Y	7	5	6
Y	Y	Y	6	6	5

Drinking Water Metals Preservation Check Done (Circle) **YES** **NO**

Job# C284514

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eCOC: W55004

Project Information:	C284514
Job Received:	2022/10/08 09:30
Expected TAT:	Standard TAT
Expected Arrival:	2022/10/09 12:00
Submitted By:	Christiane Brouwer
Submitted To:	Calgary ENV: 4000 19th St NE

Invoice Information

Attn: ACCOUNTS PAYABLE
GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON , AB , T5P 4C3
Email to:
gld.canadaaccountspayableinvoices@wsp.com

Report Information

Attn: Christiane Brouwer
GOLDER ASSOCIATES LTD
16820-107 AVE
EDMONTON , AB , T5P 4C3
Email to:
christiane_brouwer@golder.com

Project Information

Quote #:	C20106
PO/AFE#:	21455151
Project #:	21455151
Site Location:	Marten Falls, Northern Ontario

Analytical Summary

A: Standard TAT
M: Manually added test

Client Sample ID	Clnt Ref	Sampling Date/Time	Matrix	#Cont	SOIL SALINITY 4	Benzo[a]pyrene Equivalency	Cation Exchange Capacity	Moisture	Nitrate-N (soluble)	NORM Group Analysis	PAH in Soil by GC/MS	Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	TEXT	Total Organic Carbon LECO Method	Set Number
M22C003Cg75-120-220930	1	2022/09/30	SOIL	1	A		A		A			A	M		1
M22C004Bg0-21-220930	2	2022/09/30	SOIL	1	A		A		A			A	M		1
M22C004Ckg121-32-220930	3	2022/09/30	SOIL	1	A		A		A			A	M		1
M22C008Ae0-6-221001	4	2022/10/01	SOIL	1	A		A		A			A	M	A	2
M22C008Bfj6-10-221001	5	2022/10/01	SOIL	1	A		A		A			A	M		1
M22C008Bt10-33-221001	6	2022/10/01	SOIL	1	A		A		A			A	M		1
M22C008Ck33-100-221001	7	2022/10/01	SOIL	1	A		A		A			A	M		1
M22C022Bm1-30-221002	8	2022/10/02	SOIL	1	A		A		A			A	M	A	2
M22C022Ck30-100-221002	9	2022/10/02	SOIL	1	A		A		A			A	M		1
M22K040Ae0-8-221003	10	2022/10/03	SOIL	1	A		A		A			A	M	A	2
M22K040Bm8-18-221003	11	2022/10/03	SOIL	1	A		A		A			A	M		1
M22K040Ck18-120-221003	12	2022/10/03	SOIL	1	A		A		A			A	M		1
M22K042Bm0-16-221004	13	2022/10/04	SOIL	1	A		A		A			A	M	A	2
M22K042Ck116-35-221004	14	2022/10/04	SOIL	1	A		A		A			A	M		1
M22K042Ck235-45-221004	15	2022/10/04	SOIL	1	A		A		A			A	M		1
M22K051Ae0-4-221005	16	2022/10/05	SOIL	1	A		A		A			A	M	A	2
M22K051Bt4-16-221005	17	2022/10/05	SOIL	1	A		A		A			A	M		1
M22K051BCk16-37-221005	18	2022/10/05	SOIL	1	A		A		A			A	M		1
M22K051Ck37-120-221005	19	2022/10/05	SOIL	1	A		A		A			A	M		1
M22L016Ahe0-9-221005	20	2022/10/05	SOIL	1	A		A		A			A	M	A	2
M22L016BA9-14-221005	21	2022/10/05	SOIL	1	A		A		A			A	M		1
M22L016Bt14-29-221005	22	2022/10/05	SOIL	1	A		A		A			A	M		1
M22L016Ckgj29-110-221005	23	2022/10/05	SOIL	1	A		A		A			A	M		1
M22K051-Radionuclides	24	2022/10/05	SOIL	1						A					3
M22C022-Radionuclides	25	2022/10/02	SOIL	1						A					3
M22C008-Radionuclides	26	2022/10/01	SOIL	1						A					3
M22K042-Radionuclides	27	2022/10/04	SOIL	1						A					3
M22K040-Radionuclide	28	2022/10/03	SOIL	1						A					3
M22L016-221005-PAH	29	2022/10/05	SOIL	2		A		A			A				4
M22L016-221005-VOC	30	2022/10/05	SOIL	1				A							5
M22K051-PAH	31	2022/10/05	SOIL	1		A		A			A				4

eCOC: W55004

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Submitted To: Calgary ENV: 4000 19th St NE

A: Standard TAT
M: Manually added test

Client Sample ID	Clnt Ref	Sampling Date/Time	Matrix	#Cont	SOIL SALINITY 4	Benzo[a]pyrene Equivalency	Cation Exchange Capacity	Moisture	Nitrate-N (soluble)	NORM Group Analysis	PAH in Soil by GC/MS	Soluble NO2 (N);Soluble NO2 (N) + NO3(N)	TEXT	Total Organic Carbon LECO Method	Set Number
M22K051-VOC	32	2022/10/05	SOIL	1				A							5
M22C004Ckg232-90-220930	33	2022/09/29	SOIL	1	A		A		A			A	M		1

A: Standard TAT

Client Sample ID	Clnt Ref	Sampling Date/Time	Matrix	#Cont	VOCs in Soil by HS GC/MS (Std List)	Set Number
M22C003Cg75-120-220930	1	2022/09/30	SOIL	1		1
M22C004Bg0-21-220930	2	2022/09/30	SOIL	1		1
M22C004Ckg121-32-220930	3	2022/09/30	SOIL	1		1
M22C008Ae0-6-221001	4	2022/10/01	SOIL	1		2
M22C008Bfj6-10-221001	5	2022/10/01	SOIL	1		1
M22C008Bt10-33-221001	6	2022/10/01	SOIL	1		1
M22C008Ck33-100-221001	7	2022/10/01	SOIL	1		1
M22C022Bm1-30-221002	8	2022/10/02	SOIL	1		2
M22C022Ck30-100-221002	9	2022/10/02	SOIL	1		1
M22K040Ae0-8-221003	10	2022/10/03	SOIL	1		2
M22K040Bm8-18-221003	11	2022/10/03	SOIL	1		1
M22K040Ck18-120-221003	12	2022/10/03	SOIL	1		1
M22K042Bm0-16-221004	13	2022/10/04	SOIL	1		2
M22K042Ck116-35-221004	14	2022/10/04	SOIL	1		1
M22K042Ck235-45-221004	15	2022/10/04	SOIL	1		1
M22K051Ae0-4-221005	16	2022/10/05	SOIL	1		2
M22K051Bt4-16-221005	17	2022/10/05	SOIL	1		1
M22K051BCk16-37-221005	18	2022/10/05	SOIL	1		1
M22K051Ck37-120-221005	19	2022/10/05	SOIL	1		1
M22L016Ahe0-9-221005	20	2022/10/05	SOIL	1		2
M22L016BA9-14-221005	21	2022/10/05	SOIL	1		1
M22L016Bt14-29-221005	22	2022/10/05	SOIL	1		1
M22L016Ckgj29-110-221005	23	2022/10/05	SOIL	1		1
M22K051-Radionuclides	24	2022/10/05	SOIL	1		3
M22C022-Radionuclides	25	2022/10/02	SOIL	1		3
M22C008-Radionuclides	26	2022/10/01	SOIL	1		3

eCOC: W55004

Project Information:	C284514
Job Received:	2022/10/08 09:30
Expected TAT:	Standard TAT
Expected Arrival:	2022/10/09 12:00
Submitted By:	Christiane Brouwer
Submitted To:	Calgary ENV: 4000 19th St NE

A: Standard TAT

Client Sample ID	Clnt Ref	Sampling Date/Time	Matrix	#Cont	VOCs in Soil by HS GC/MS (Std List)	Set Number
M22K042-Radionuclides	27	2022/10/04	SOIL	1		3
M22K040-Radionuclide	28	2022/10/03	SOIL	1		3
M22L016-221005-PAH	29	2022/10/05	SOIL	2		4
M22L016-221005-VOC	30	2022/10/05	SOIL	1	A	5
M22K051-PAH	31	2022/10/05	SOIL	1		4
M22K051-VOC	32	2022/10/05	SOIL	1	A	5
M22C004Ckg232-90-220930	33	2022/09/29	SOIL	1		1

Deadlines are estimates only and are subject to change. Please refer to your Job Confirmation report for final due dates.

Submission Information

# of Samples: 33

Sample Set Listing

Set 1 (18 samples)	Set 2 (6 samples)	Set 3 (5 samples)	Set 4 (2 samples)	Set 5 (2 samples)
M22C003Cg75-120-220930	M22C008Ae0-6-221001	M22K051-Radionuclides	M22L016-221005-PAH	M22L016-221005-VOC
M22C004Bg0-21-220930	M22C022Bm1-30-221002	M22C022-Radionuclides	M22K051-PAH	M22K051-VOC
M22C004Ckg121-32-220930	M22K040Ae0-8-221003	M22C008-Radionuclides		
M22C008Bfj6-10-221001	M22K042Bm0-16-221004	M22K042-Radionuclides		
M22C008Bt10-33-221001	M22K051Ae0-4-221005	M22K040-Radionuclide		
M22C008Ck33-100-221001	M22L016Ahe0-9-221005			
M22C022Ck30-100-221002				
M22K040Bm8-18-221003				
M22K040Ck18-120-221003				
M22K042Ck116-35-221004				
M22K042Ck235-45-221004				
M22K051Bt4-16-221005				
M22K051BCk16-37-221005				
M22K051Ck37-120-221005				
M22L016BA9-14-221005				
M22L016Bt14-29-221005				
M22L016Ckgj29-110-221005				
M22C004Ckg232-90-220930				

Attachment F – Metals Concentrations Compared to the Canadian Council of Ministers of the Environment Soil Quality Guidelines

Marten Falls Community Access Road Project Metals Analysis Results Compared to the CCME Soil Quality Guidelines for the Protection of Environmental and Human Health (Residential/parkland criteria)												
Sample ID		M22S258-GEOCHEM	M22S011-GEOCHEM	M22S044-GEOCHEM	M22S283-GEOCHEM	M22S028-GEOCHEM	M22S055-GEOCHEM	M22S161-GEOCHEM	M22S032-GEOCHEM	M22S154-GEOCHEM	M22S096-GEOCHEM	CCME Soil Quality Criteria
Analysis	**Units**											
Mercury	ug/g	0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.06	0.07	< 0.05	7
Silver	µg/g	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	20
Arsenic	µg/g	11	30	5.7	3.3	5.7	3.6	3.8	2.0	1.1	3.4	12
Aluminum	µg/g	33000	19000	11000	4700	20000	21000	22000	15000	1400	14000	no data
Barium	µg/g	140	54	61	27	91	100	120	69	25	96	500
Beryllium	µg/g	1.0	0.40	0.22	0.12	0.61	0.79	0.80	0.19	0.06	0.50	4
Calcium	µg/g	51000	2800	4200	5000	91000	100000	100000	22000	21000	110000	no data
Cadmium	µg/g	0.08	0.08	0.21	0.20	0.09	0.07	0.06	0.27	0.13	0.12	10
Cobalt	µg/g	21	8.0	8.5	1.6	13	12	14	9.7	1.3	9.2	50
Chromium	µg/g	83	43	26	11	50	51	59	69	2.2	41	64
Copper	µg/g	39	10	5.0	4.3	22	24	29	20	4.3	20	63
Iron	µg/g	44000	25000	22000	5100	29000	30000	35000	29000	3900	25000	no data
Lithium	µg/g	30	17	10	2	19	22	25	17	< 2	17	no data
Manganese	µg/g	820	450	1800	56	560	510	540	360	160	580	no data
Molybdenum	µg/g	0.3	0.6	0.8	0.4	0.8	0.2	0.2	0.8	0.2	1.4	10
Nickel	µg/g	50	24	12	6.4	31	31	36	28	1.8	24	45
Lead	µg/g	13	7.2	5.1	3.6	9.2	8.6	9.6	5.9	1.2	6.2	140
Antimony	µg/g	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	20
Selenium	µg/g	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	1
Tin	µg/g	< 2	< 2	< 2	4	< 2	< 2	< 2	< 2	< 2	< 2	50
Thallium	µg/g	0.24	0.13	0.09	0.02	0.16	0.17	0.19	0.21	< 0.02	0.13	1
Uranium	µg/g	0.82	0.41	0.68	0.32	0.65	0.62	0.65	1.7	0.085	0.80	23
Vanadium	µg/g	77	42	29	9	51	53	57	47	2	41	130
Zinc	µg/g	81	72	63	18	51	51	58	54	14	54	250

Concentration within guidelines

Concentration exceeds guidelines

Criteria from CCME (2014)

No Data = Not listed in CCME guidelines

Attachment G – Reclamation Suitability Calculations

Reclamation Suitability Calculations for Samples from The Marten Falls Community Access Road Project (Soil Quality Criteria Working Group 1987)												
Sample ID	Horizon	Depth	pH	EC topsoil (dS/m)	SAR	Saturation (%)	Texture	Moist Consistency	CaCO3 Equivalent (%)	Coarse Fragments (%)	Final Rating	Limiting Factors
M22S011-Ah-220529	Ah	0-28	4.61	0.12	0.83	81.00	Sandy Loam	-	-	0	Poor	High saturation %, Fine texture
M22S011-Cg1-220529	Cg1	28-55	4.62	0.072	2.1	40.00	Sandy loam	Firm	-	2		
M22S011-Cg2-55-120-220529	Cg2	55-120	5.2	0.09	2.5	51.00	Clay	-	-	3		
M22S028Ahe0-14-220528	Ahe	0-14	6.56	0.16	0.68	79.00	Clay Loam	Friable	-	0	Poor	Fine texture
M22S028Bt14-39-220528	Bt	14-39	6.91	0.15	0.79	42.00	Heavy clay	Firm	-	0		
M22S028C39-145-220528	C	39-145	7.24	0.21	1	36.00	Clay	Firm	-	0		
M22S044-Cg-0-90-220601	Cg	0-90	6.06	0.13	1.3	43.00	Loam	-	-	1	Good	N/A
M22S044-IICg-90-120-220601	IICg	90-120	5.65	0.44	1	33.00	Loam	-	-	0		
M22S055Ae0-3-220528	Ae	0-3	4.59	0.2	1	33.00	Loam	Friable	-	3	Poor	Low pH, Fine texture
M22S055Bt3-17-220528	Bt	3-17	4.3	0.11	1.2	33.00	Clay loam	Friable	-	8		
M22S055Ckgj17-80-220528	Ckgj	17-80	7.7	0.23	0.67	36.00	Clay	-	-	1		
M22S055IICkgj80-100-220528	IICkgj	80-100	7.21	0.4	0.45	31.00	Clay	-	-	20		
M22S127Ae0-5-220602	Ae	0-5	5.84	0.16	0.88	39.00	Silt loam	Friable	-	0	Poor	Low pH
M22S127Bt5-12-220602	Bt	5-12	6.13	0.17	0.58	43.00	Silt Loam	Friable	-	0		
M22S127Ck12-120-220602	Ck	12-120	7.6	0.18	0.81	31.00	Silt Loam	Friable	-	0		
M22S161Bm0-14-220606	Bm	0-14	5.49	0.11	1.1	53.00	Heavy clay	Friable	-	0	Poor	Fine Texture
M22S161Btnj14-27-220606	Btnj	14-27	6.92	0.53	0.77	58.00	Heavy clay	Friable	-	0		
M22161BC27-44-220606	BC	27-44	7.1	0.22	0.76	53.00	Heavy clay	Friable	-	0		
M22S161Ck44-65-220606	Ck	44-65	7.7	0.21	0.71	49.00	Heavy clay	Friable	-	0		
M22S161IICkg-65-110-220606	IICkg	65-110	7.7	0.97	0.55	23.00	Loam	Friable	-	20		
M22S258Ae0-5-220604	Ae	0-5	4.50	0.130	0.71	34.0	Silt loam	-	-	0	Poor	Low pH, Fine texture
M22S258Bt5-36-220604	Bt	5-36	5.46	0.056	0.57	57.00	Heavy clay	-	-	0		

Reclamation Suitability Calculations for Samples from The Marten Falls Community Access Road Project (Soil Quality Criteria Working Group 1987)												
Sample ID	Horizon	Depth	pH	EC topsoil (dS/m)	SAR	Saturation (%)	Texture	Moist Consistency	CaCO3 Equivalent (%)	Coarse Fragments (%)	Final Rating	Limiting Factors
M22S258Ck36-120-220604	Ck	36-110	7.17	0.18	0.82	37.00	Silty clay	-	-	0		
M22SAD1Ae0-7-220603	Ae	0-7	3.45	0.15	0.57	35.00	Loamy sand	-	-	5	Unsuitable	Low pH, coarse texture, high coarse fragment content
M22SAD1Bm7-25-220603	Bm	7-25	4.21	0.051	-	29.00	Sand	-	-	7		
M22SAD1Ck125-45-220603	Ck1	25-45	7.44	0.23	0.42	31.00	Sand	-	-	35		
M22SAD1Ck2-45-120-220603	Ck2	45-120	7.91	0.22	0.48	26.00	Sand	-	-	20		
M22L016Ahe0-9-221005	Ahe	0-9	6.43	0.25	0.1	130.0	Clay	Loose	3.5	0	Poor	Fine texture, Low saturation %, High CaCO3 equivalent, High coarse fragment content
M22L016BA9-14-221005	BA	9-14	6.4	0.19	0.16	45	Clay	Firm	1.2	2		
M22L016Bt14-29-221005	Bt	14-29	6.74	0.11	0.23	58	Heavy clay	Firm	1.3	2		
M22L016Ckgj29-110-221005	Ckgj	29-110	7.14	0.33	0.3	17	Sandy loam	Friable	25	17		
M22K051Ae0-4-221005	Ae	0-4	6.12	0.21	0.13	61	Heavy clay	Friable	1.1	5	Poor	High pH, Fine texture, High CaCO3 equivalent, High coarse fragment content
M22K051Bt4-16-221005	Bt	4-16	6.42	0.17	0.18	55	Heavy clay	Firm	1.2	2		
M22K051BCk16-37-221005	BCk	16-37	7.36	1.5	2.5	36	Clay	Firm	30	2		
M22K051Ck37-120-221005	Ck	37-120	7.62	0.31	0.26	20	Loam	Friable	26	65		
M22K042Bm0-16-221004	Bm	0-16	6.81	0.27	0.13	29	Loam	Loose	0.63	5	Unsuitable	High coarse fragment content, low saturation %, High CaCO equivalant
M22K042Ck116-35-221004	Ck1	16-35	7.13	0.29	0.14	21	Loam	Friable	-	5		
M22K042Ck235-45-221004	Ck2	35-45	7.45	0.32	0.21	18	Sandy loam	Friable	29	75		
M22K040Ae0-8-221003	Ae	0-8	4.51	0.130	0.1	38.0	Silt loam	Friable	0.62	0	Poor	High CaCO3 equivalent
M22K040Bm8-18-221003	Bm	8-18	4.97	0.14	0.15	40	Silty clay loam	Friable	0.79	0		
M22K040Ck18-120-221003	Ck	18-120	7.03	0.23	0.16	29	Silt loam	Friable	35	0		
M22C022Bm1-30-221002	Bm	1-30	5.98	0.35	0.1	38	Clay loam	Friable	3.3	3	Poor	High CaCO3 equivalent
M22C022Ck30-100-221002	Ck	30-100	7.38	0.37	0.18	32	Clay loam	Friable	29	4		
M22C008Ae0-6-221001	Ae	0-6	3.30	0.067	0.35	34	Loam	Firm	0.6	1	Unsuitable	Low pH, High CaCO3 equivilant

Reclamation Suitability Calculations for Samples from The Marten Falls Community Access Road Project (Soil Quality Criteria Working Group 1987)												
Sample ID	Horizon	Depth	pH	EC topsoil (dS/m)	SAR	Saturation (%)	Texture	Moist Consistency	CaCO3 Equivalent (%)	Coarse Fragments (%)	Final Rating	Limiting Factors
M22C008Bfj6-10-221001	Bfj	6-10	3.96	0.055	0.25	50	Clay loam	Firm	0.92	0		
M22C008Bt10-33-221001	Bt	10-33	6.73	0.34	0.13	33	Clay loam	Friable	3.3	4		
M22C008C33-80-221001	Ck	33-100	7.51	0.36	0.13	37	Clay loam	Friable	28	10		
M22C003Cg75-120-220930	Cg	75-120	6.04	0.36	0.29	68	Loam	Friable	1.1	0	Fair	high saturation %
M22C004Bg0-21-220930	Bg	0-21	7.16	0.28	0.15	29	Clay loam	Friable	14	5	Poor	High CaCO3 equivalent
M22C004Ckg121-32-220930	Ckg1	21-32	7.5	0.55	0.11	31	Clay loam	Friable	31	15		
M22C004Ckg232-90-220930	Ckg2	32-90	7.56	0.02	0.21	28	Silty clay loam	Friable	38	2		

Note:

Good
Fair
Poor
Unsuitable
- = no data

Attachment H – Effects Assessment Detailed Mapping Figures

SG-20

SG-20

COLPITTS CREEK

PAINTER LAKE ROAD

M22L015

M22L014

M22L013

M22S180

M22S181

M22S030

M22S029

M22S028

BR-01

MARTEN FALLS WINTER ROAD

Marten Falls First Nation

ONTARIO

Nipigon

Thunder Bay

Wawa

Map Location

Legend

ROAD

LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA

ACCESS ROAD

LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

ANTHROPOGENIC

FLUVIAL

GLACIOFLUVIAL

GLACIOLACUSTRINE

MORAINAL (0.2 - 1 METRES)

MORAINAL (1 - 3 METRES)

MORAINAL (> 3 METRES)

LACUSTRINE

ORGANIC

WATERBODY

GEOPROCESSESS

SURFACE SEEPAGE (L)

INUNDATION (U)

SOIL INSPECTION LOCATIONS

GROUND PLOT

VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-1a

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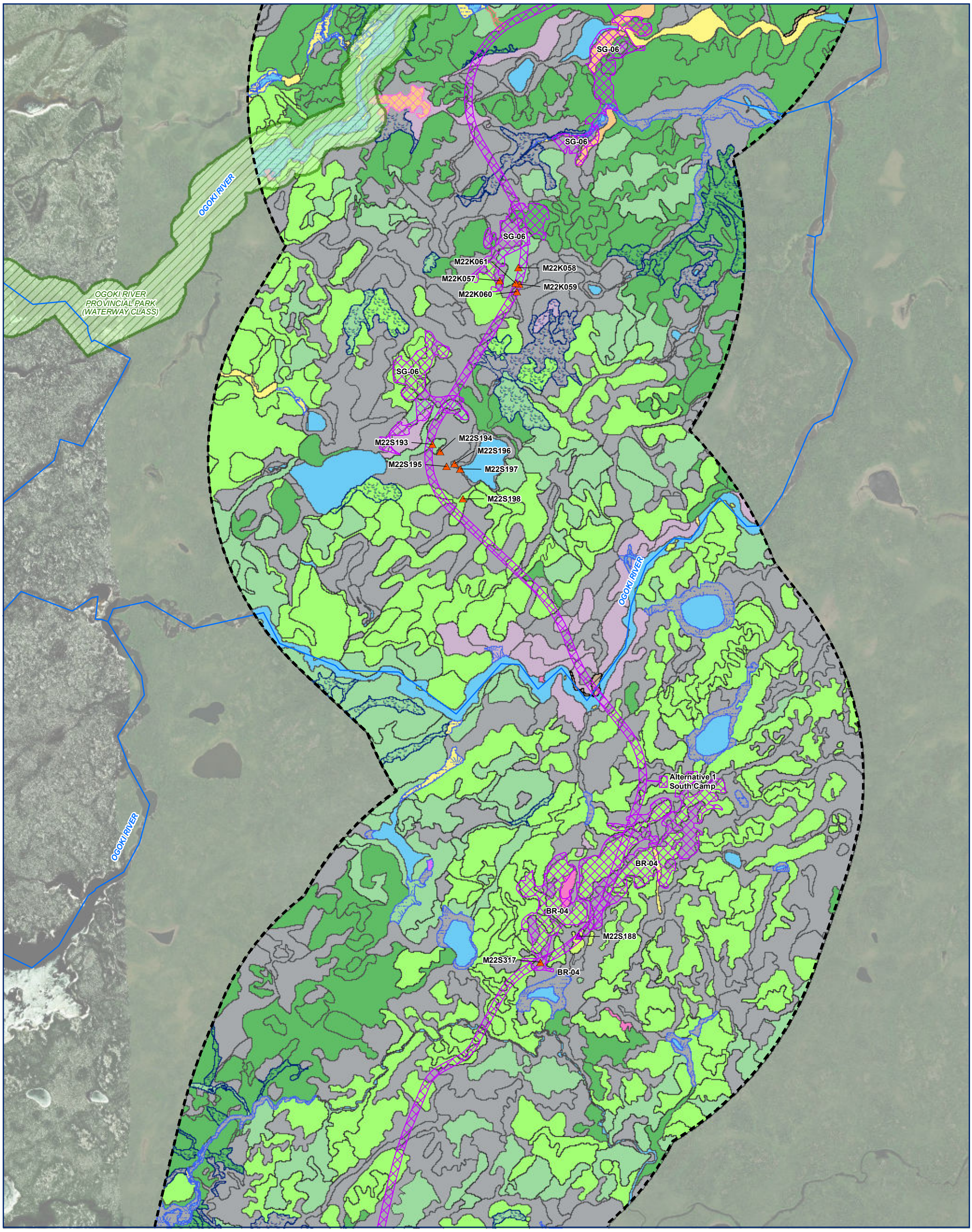

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- KETTLED (H)
- SURFACE SEEPAGE (L)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-1b

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M22S215
M22S219
M22S218
SG-07
SG-07
Alternative 1
North Camp
OGOKI RIVER
SG-06
OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)
SG-06
OGOKI RIVER

Marten Falls
First Nation
ONTARIO
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1c

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SG-08
M22L021
M22L022
M22L020
SG-08
M22S149
M22S150
M22S151
SG-08
SG-08
M22L024
M22L023
M22L025
M22L026
M22S153
M22S154
M22S155
M22S156
WINSLOW LAKE
M22L027
SG-05
M22S157
M22S003
M22S158
M22SAD6
M22S314
M22S161
M22S162
M22SAD7
M22K048
M22K047
M22K049

Legend

ROAD
LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
ACCESS ROAD
LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL
BEDROCK
COLLUVIUM
FLUVIAL
GLACIOFLUVIAL
GLACIOLACUSTRINE
MORAINAL (<0.2 METRES)
MORAINAL (0.2 - 1 METRES)
MORAINAL (1 - 3 METRES)
MORAINAL (> 3 METRES)
LACUSTRINE
ORGANIC
WATERBODY

GEOPROCESSESS
SLOW MASS MOVEMENTS - DEBRIS SLIDE (Fs)
SURFACE SEEPAGE (L)
MEANDERING CHANNEL (M)
RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
INUNDATION (U)

SOIL INSPECTION LOCATIONS
GROUND PLOT
VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1d

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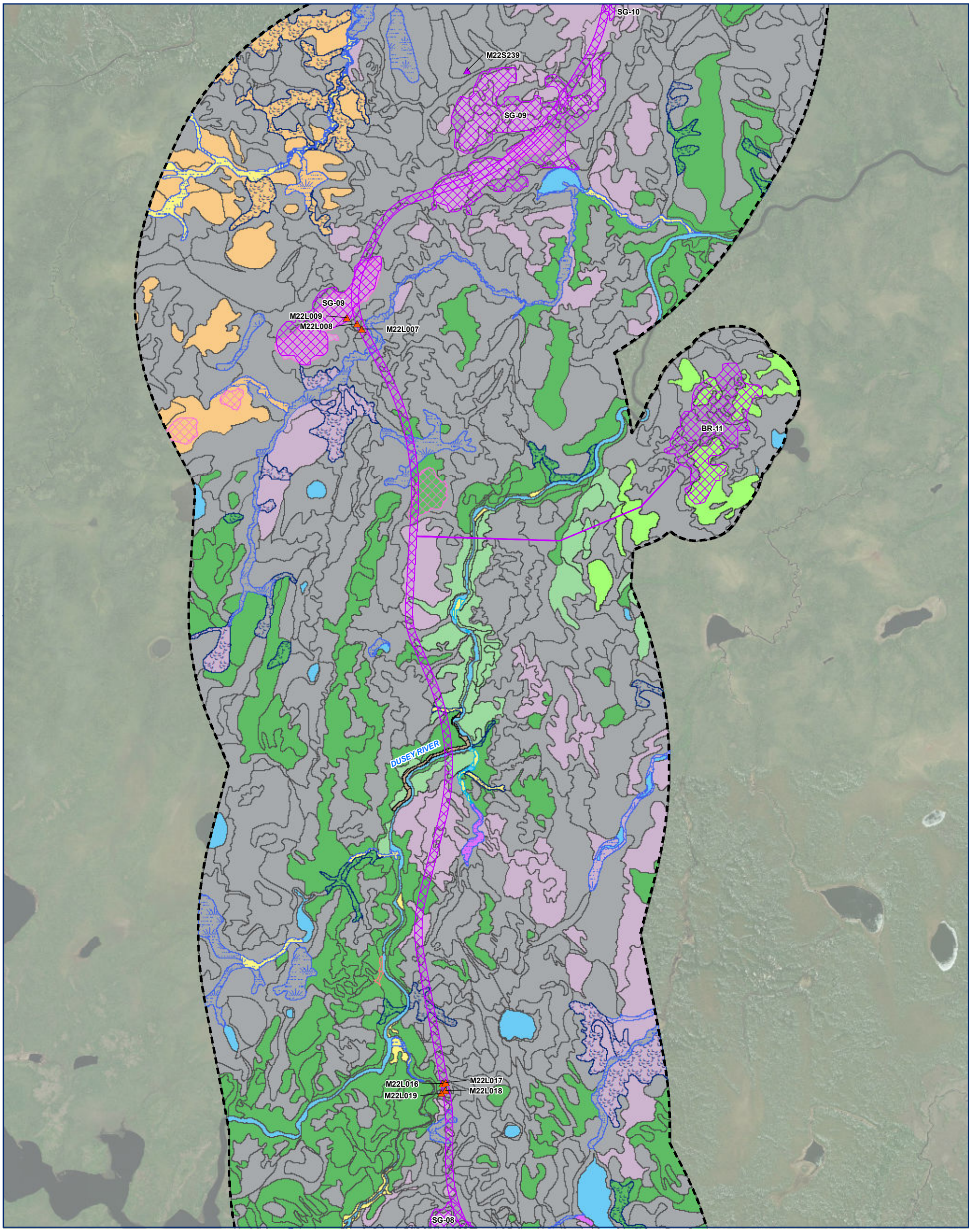

Legend

- ROAD
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL
- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS
- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1e

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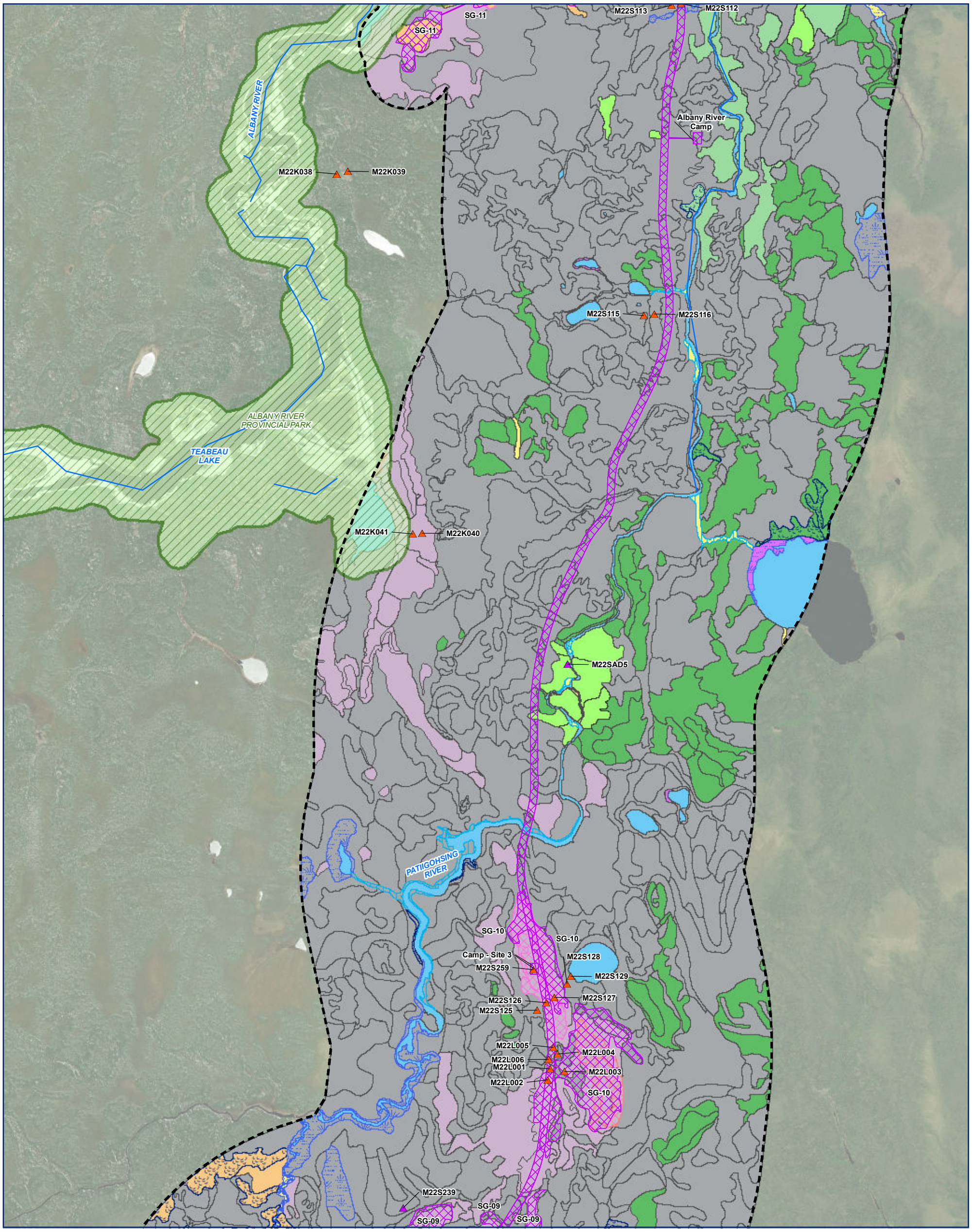

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- KETTLED (H)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1f

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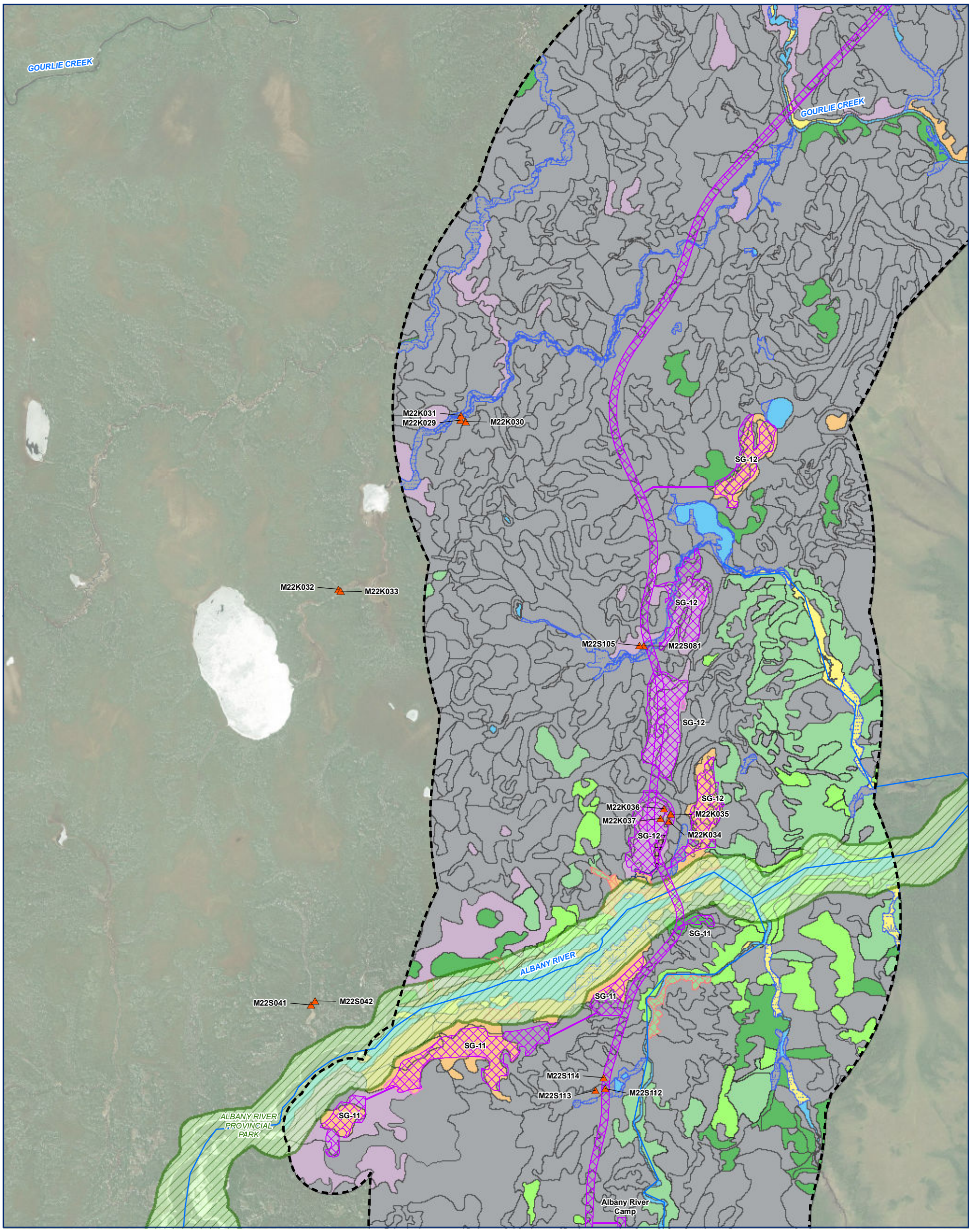

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS
- SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
- KETTLED (H)
- SURFACE SEEPAGE (L)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS
- GROUND PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1g

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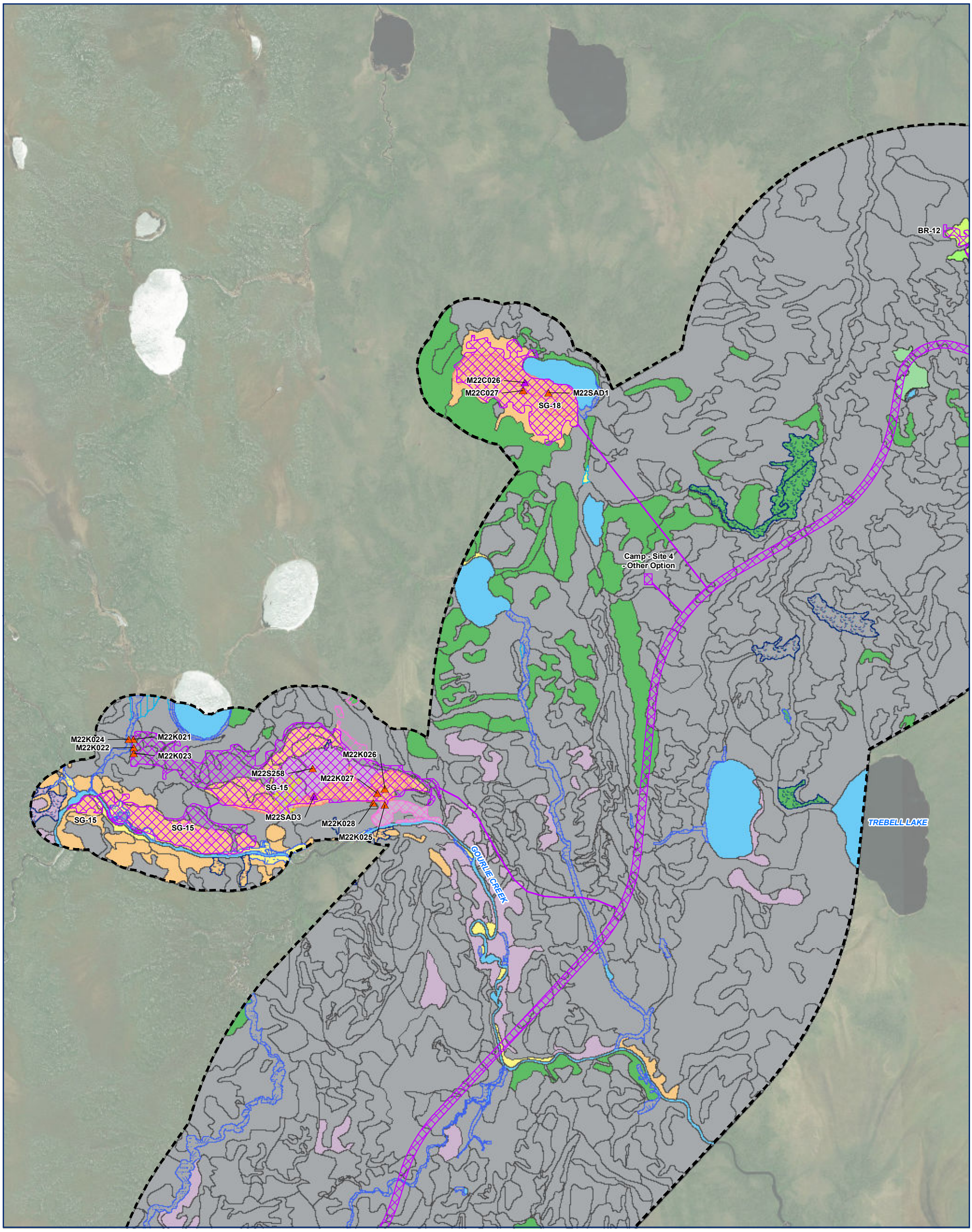

Legend

ROAD
LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
ACCESS ROAD
LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL
FLUVIAL
GLACIOFLUVIAL
GLACIOLACUSTRINE
MORAINAL (<0.2 METRES)
MORAINAL (0.2 - 1 METRES)
MORAINAL (1 - 3 METRES)
MORAINAL (> 3 METRES)
ORGANIC
WATERBODY

GEOPROCESSESS
CHANNELED BY MELTWATER - (E)
KETTLED (H)
SURFACE SEEPAGE (L)
MEANDERING CHANNEL (M)
INUNDATION (U)
GULLY EROSION (V)

SOIL INSPECTION LOCATIONS
GROUND PLOT
VISUAL PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1h

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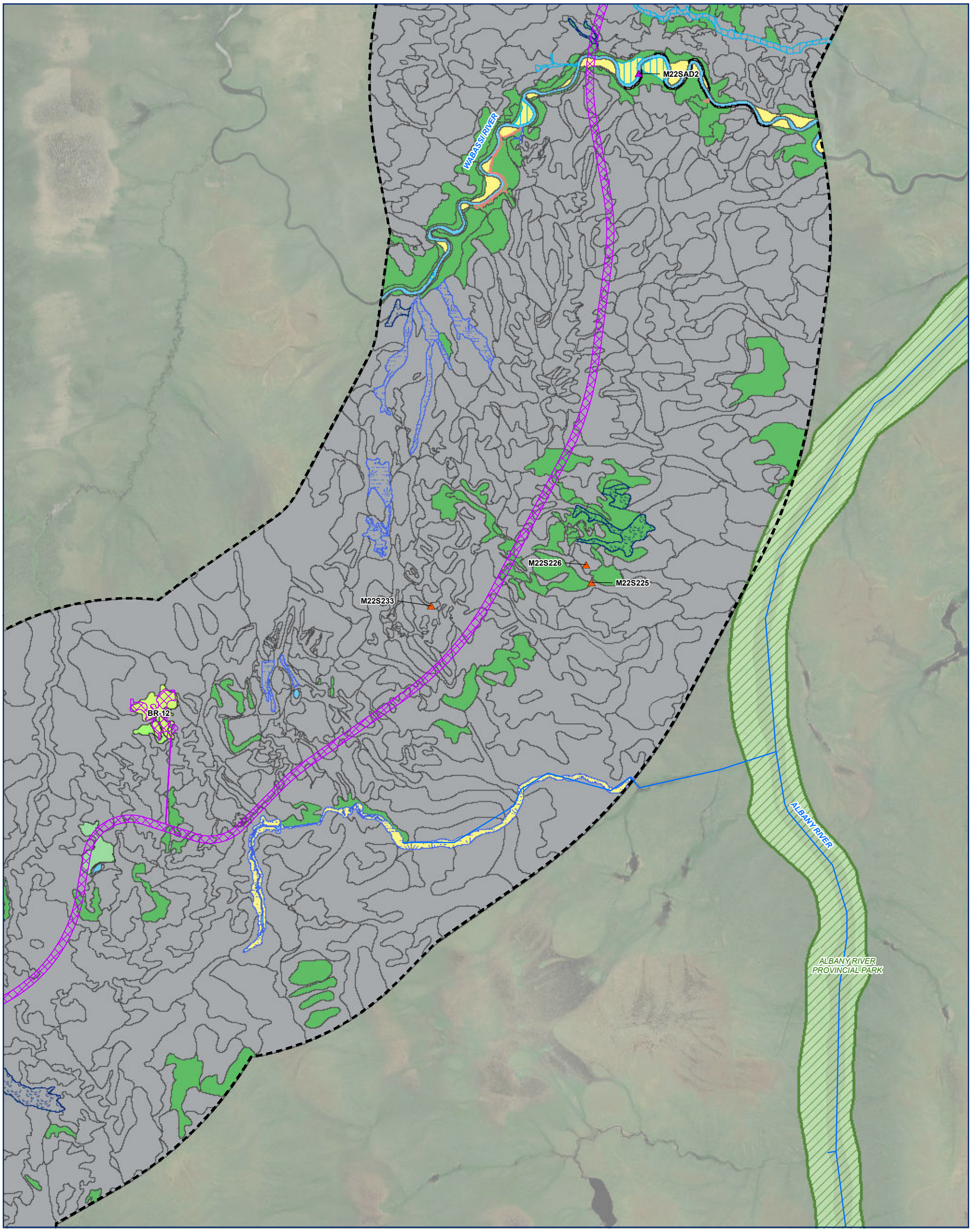

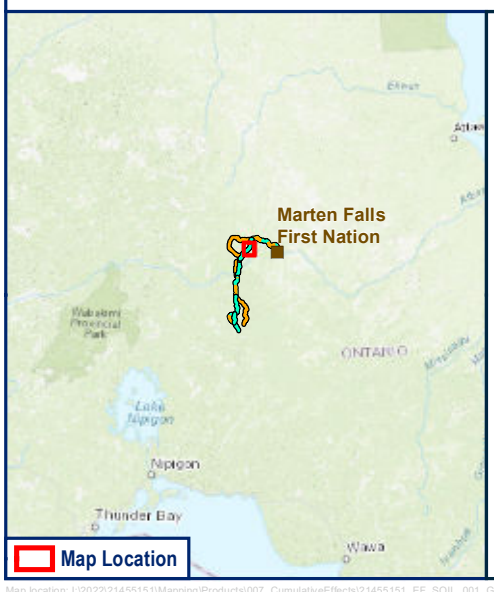

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

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Figure H-1i

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ALDER RIVER

M22C009
M22C008
M22C010

Camp - Site 5

M22C006
M22C005

M22K007
M22K008
M22K009
M22C007

M22SAD2

WABASSI RIVER

ALBANY RIVER PROVINCIAL PARK

ALBANY RIVER

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- COLLUVIUM
- FLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-1j

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GITTINS LAKE

M22C011

M22C012

M22C013

M22C014

WABASSI RIVER

ALBANY RIVER

ALBANY RIVER PROVINCIAL PARK

ALBANY RIVER

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- FLUVIAL
- GLACIOLACUSTRINE
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS

- SURFACE SEEPAGE (L)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-1k

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SG-19
SG-19
SG-19
SG-19
BUFFALOSKIN RIVER
M22S250
M2S250A
M22S097
M22S096
M22S244
M22C016
M22C015
M22S338
M22C018
M22C017
M22C019
JIIGAAKODIGWEYAA WIH ZAAGAIHAN
ALBANY RIVER
Marten Falls 65

Marten Falls First Nation
ONTARIO
Wabakimi Provincial Park
Lake Nipigon
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- MORAINAL (> 3 METRES)
- ORGANIC
- WATERBODY

GEOPROCESSESS
- SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Ru)
- INUNDATION (U)

SOIL INSPECTION LOCATIONS
- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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Aerial photography provided by:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-1l

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JOJAB (JOSEPH) LAKE

JIIGAAKODIGWEYAA WIH ZAAGAIHAN

M22C018
M22C017
M22C019
M22C021
M22C020
M22C022
M22S05A
M22S004
Camp - Site 6
BR-15
BR-16
BR-16
BR-15

M22S252
M22S253
M22S055
M22S054
M22C023
M22C025
M22C024

Marten Falls 65

ALBANY RIVER

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

DOMINANT SURFICIAL MATERIAL

- ANTHROPOGENIC
- BEDROCK
- COLLUVIUM
- FLUVIAL
- GLACIOFLUVIAL
- MORAINAL (<0.2 METRES)
- MORAINAL (0.2 - 1 METRES)
- MORAINAL (1 - 3 METRES)
- MORAINAL (> 3 METRES)
- LACUSTRINE
- ORGANIC
- WATERBODY

GEOPROCESSESS

- CHANNELED BY MELTWATER - (E)
- SLOW MASS MOVEMENTS - SLUMP IN SURFICIAL MATERIAL (Fu)
- SURFACE SEEPAGE (L)
- MEANDERING CHANNEL (M)
- RAPID MASS MOVEMENTS - DEBRIS SLIDE (Rs)
- INUNDATION (U)
- GULLY EROSION (V)

SOIL INSPECTION LOCATIONS

- GROUND PLOT

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SURFICIAL MATERIALS AND GEOMORPHOLOGICAL PROCESSES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DISTURBANCE AREA

0 0.75 1.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-1m

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Terrain Symbol Legend

Surficial Material

A	Anthropogenic
C	Colluvium
D	Weathered Bedrock (in situ)
F	Fluvial
FG	Glaciofluvial
L	Lacustrine
LG	Glaciolacustrine
M	Morainal/Till
N	Waterbody
O	Organic
R	Bedrock

Texture

a	Blocks
b	Boulders
c	Clay
d	Mixed fragments
e	Fibric organic
g	Gravel
h	Humic organic
k	Cobble
m	Mud
p	Pebbles
r	Rubble
s	Sand
u	Mesic organic
x	Angular fragments
y	Shells
z	Silt

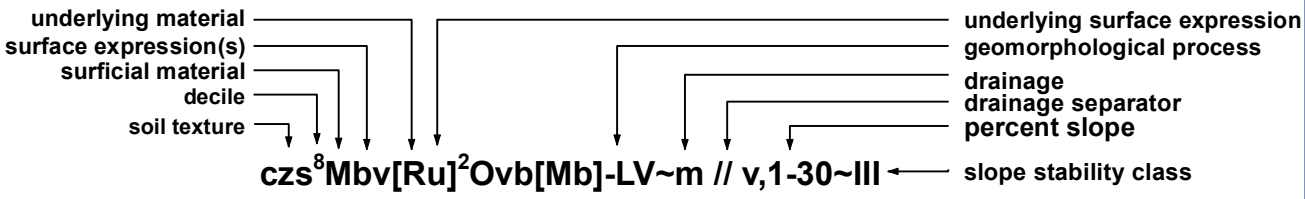
Terrain Stability Classification

Terrain Stability Class	Interpretation
I	No significant stability problems exist
II	Very low likelihood of landslide initiation following land clearing or road/pipeline construction
III	Low likelihood of landslide initiation following land clearing or road/pipeline construction
IV	Moderate likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing potentially unstable terrain)
V	High likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing unstable terrain)

Drainage Code Separator

,	no intermediate classes
-	all intermediate classes
/	first drainage dominant
//	first drainage significantly dominant

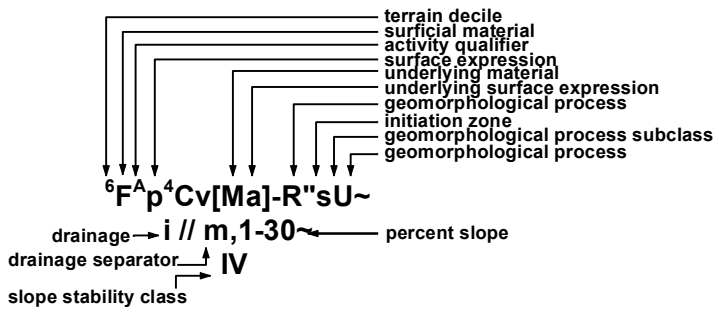
Terrain Polygon Label (used for kmz file)



Drainage

r	rapid
w	well
m	moderately well
i	imperfect
p	poor
v	very poor
x	very rapid

Complex Label



Surface Expression

a	Moderate Slope
b	Blanket (1 - 3 m)
d	Depression(s)
f	Fan(s)
h	Hummock(s)
j	Gentle Slope
k	Moderately Steep Slope
m	Rolling
p	Plain (> 3 m)
r	Ridge(s)
s	Steep Slope
t	Terrace(s)
u	Undulating
v	Veneer (0.2 - 1 m)
x	Thin Veneer (< 0.2 m)

Geomorphological Process Subclasses

Mass Movement Processes

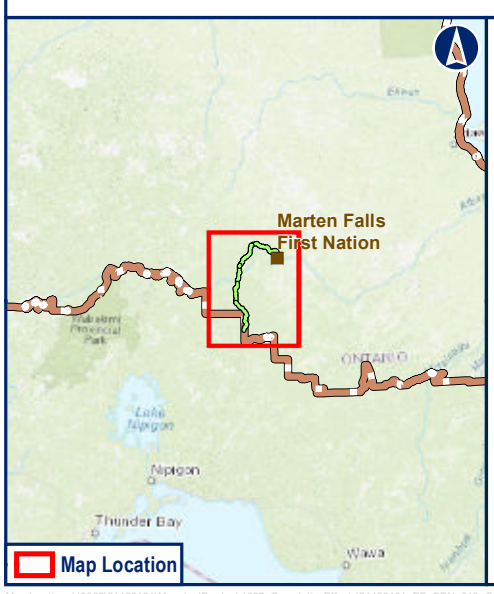
s	Debris slide
u	Slump in surficial material

Qualifiers

A	Active
I	Intermittant

Geomorphological Process

V	Gully Erosion
W	Washing
B	Braiding Channel
I	Irregularly Sinuous Channel
M	Meandering Channel
F	Slow Mass Movements
R	Rapid Mass Movements
X	Permafrost Processes
E	Channelled by Meltwater
H	Kettled
U	Inundated
L	Surface Seepage



Notes:
1. THIS DRAWING MUST BE READ IN CONJUNCTION WITH WSP INC REPORT.

Data Source:
1. Terrain Symbol Legend Annotated List from Howes & Kenk (1997).
2. Terrain Stability Classification Adapted from APEGBC (2002 and Ministry of Forests (1999)).

MARTEN FALLS FIRST NATION
COMMUNITY ACCESS ROAD

TERRAIN LEGEND

Feb, 2026

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Figure H-1

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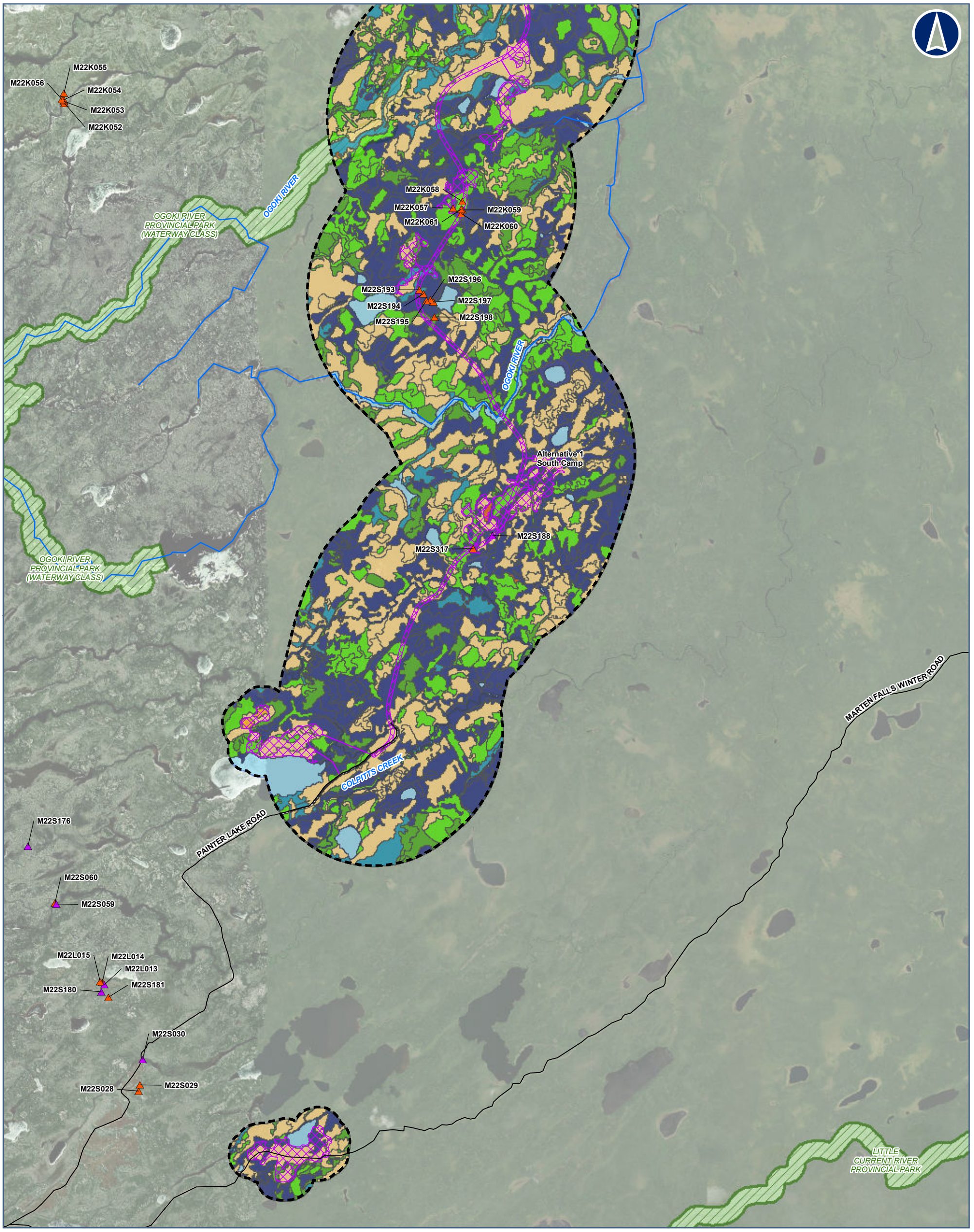

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-2a

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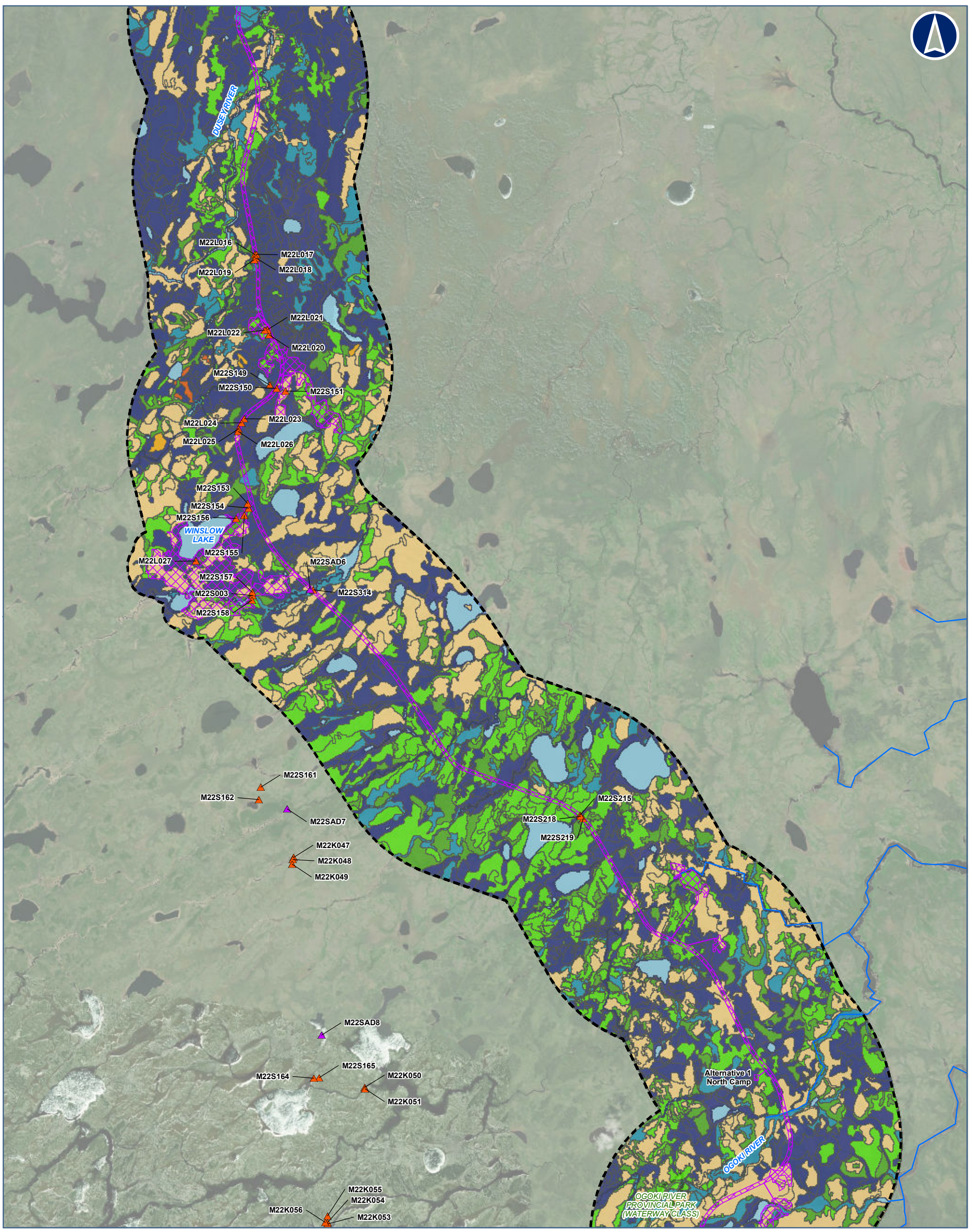

Legend

- WATERCOURSE
- LOCAL STUDY AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

SOIL DRAINAGE
- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (OPEN WATER)

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-2b

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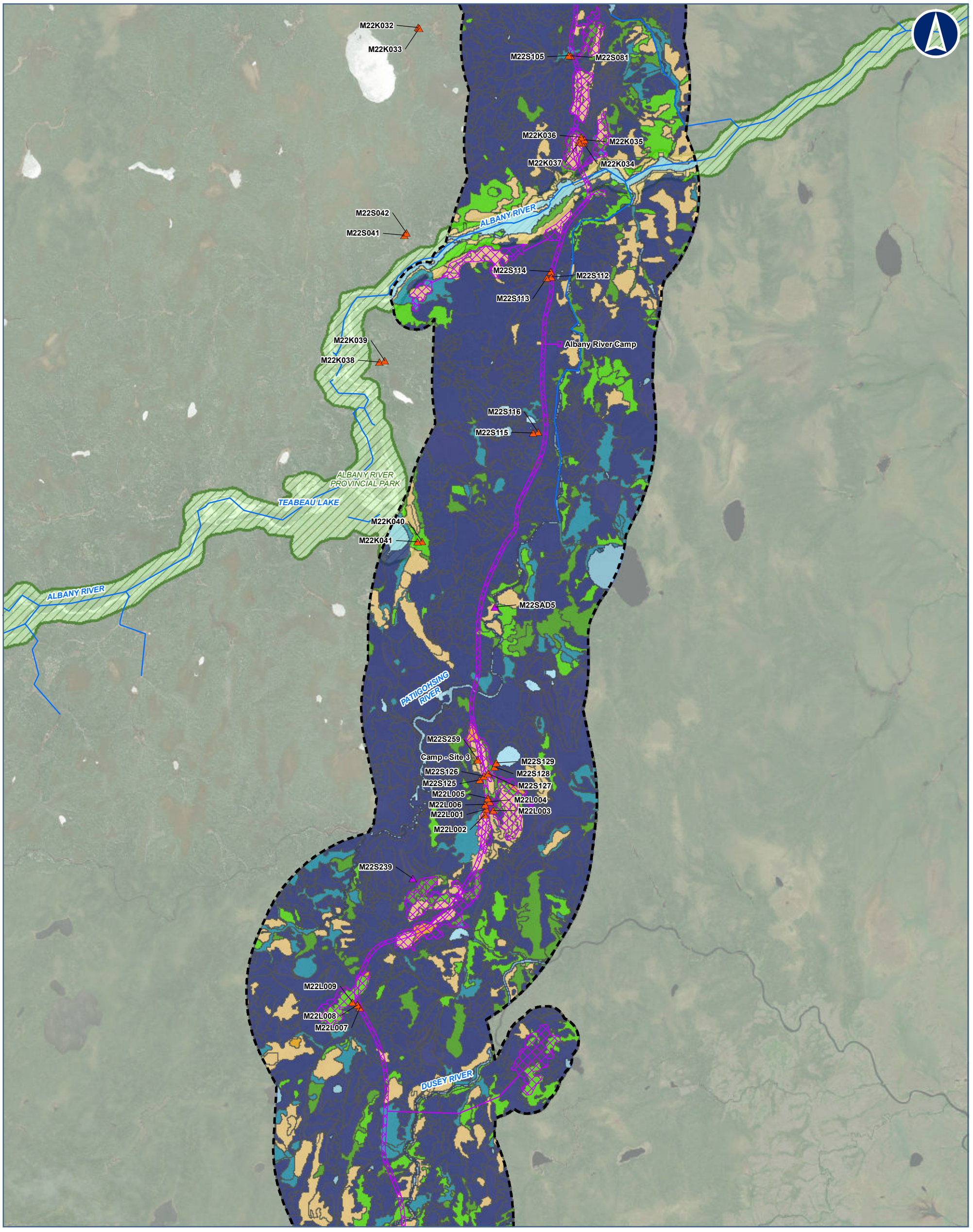

Legend

- WATERCOURSE
- LOCAL STUDY AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

SOIL DRAINAGE
- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (OPEN WATER)

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-2c

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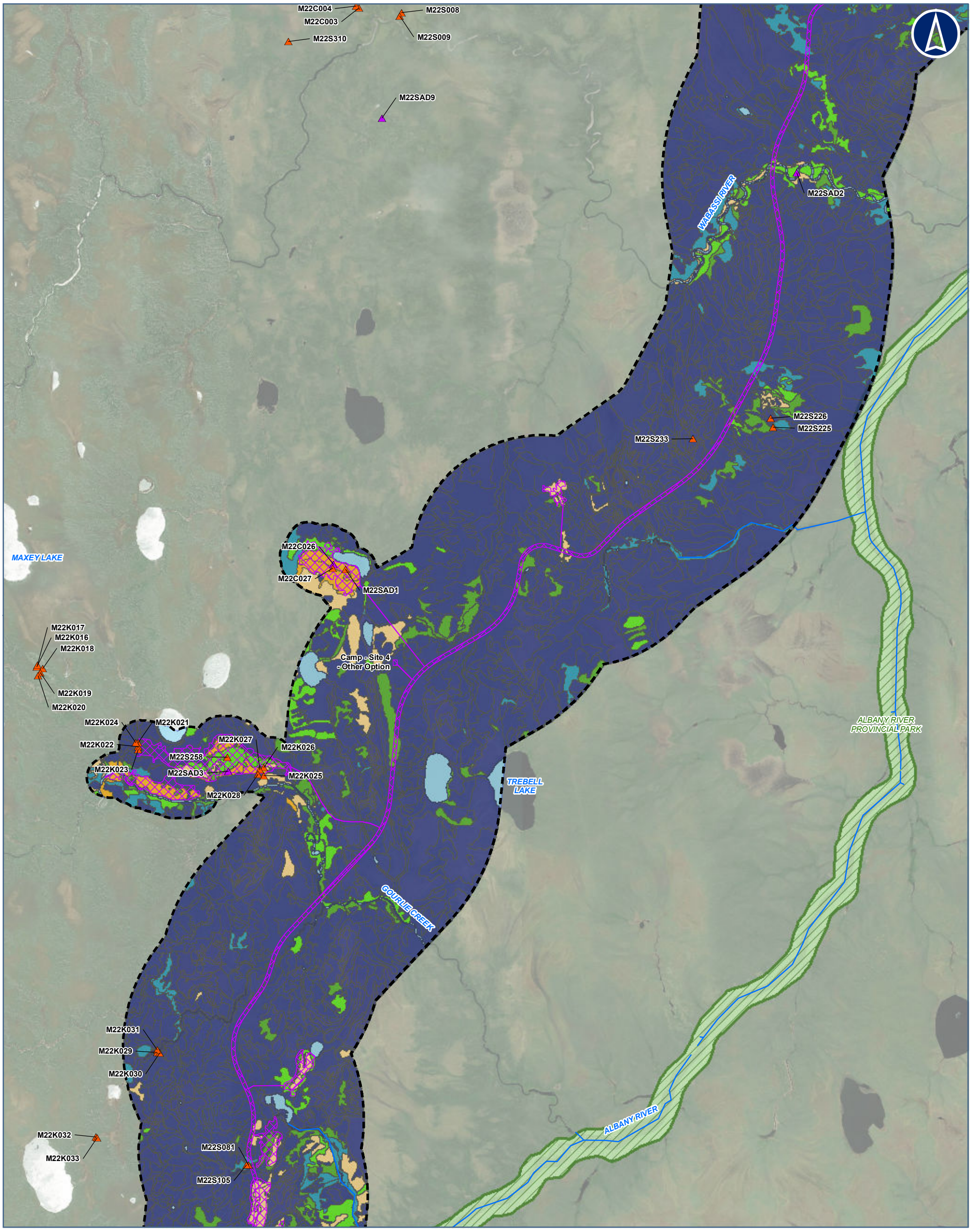

Legend

- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- NOT RATED (OPEN WATER)

Notes:

Detailed Terrain Mapping by WSP 2024.

Data Source:

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-2d

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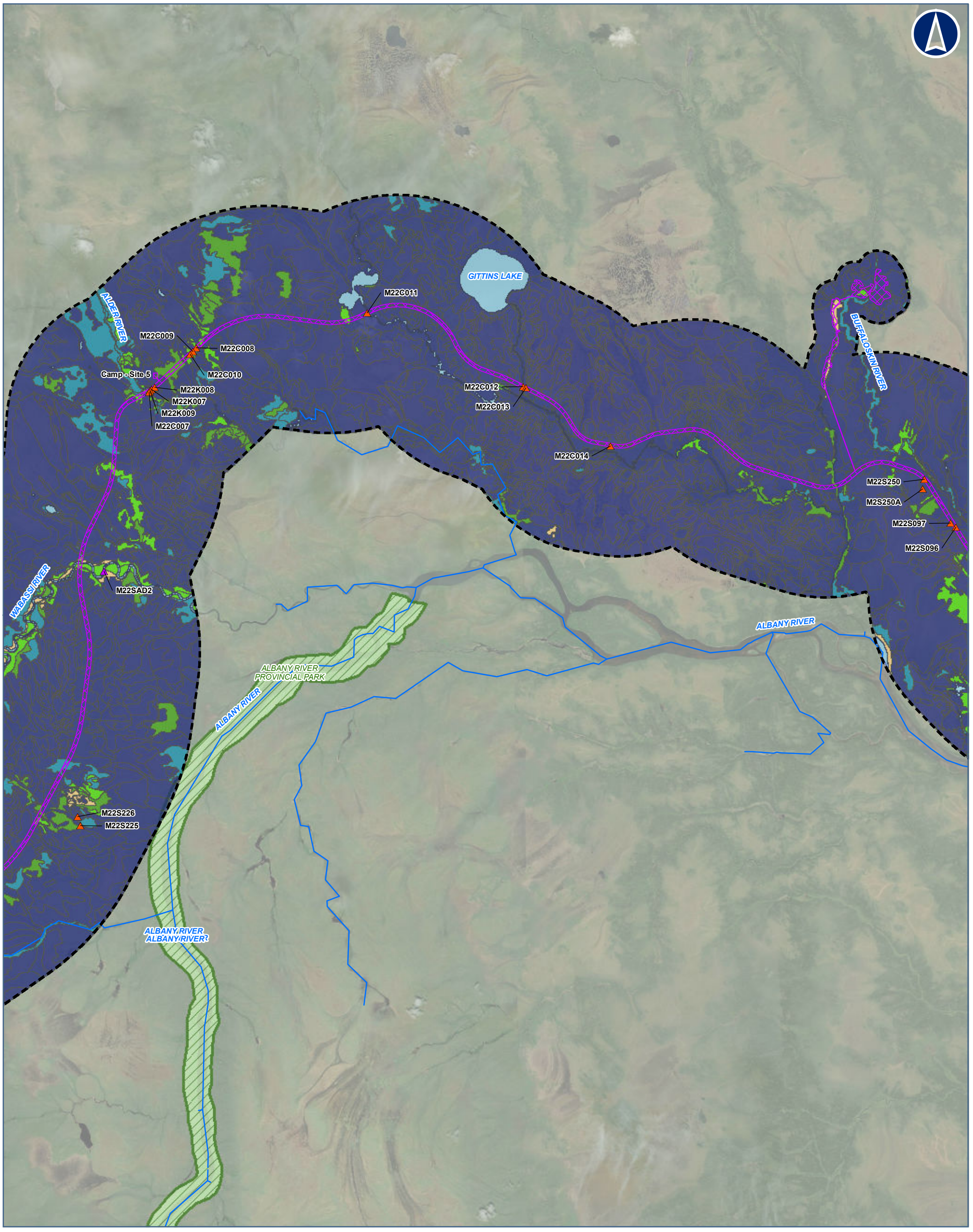

Legend

- WATERCOURSE
- LOCAL STUDY AREA

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

SOIL DRAINAGE

- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- NOT RATED (OPEN WATER)

Notes:

Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-2e

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Date Saved: 2/13/2026 12:30:45 PM User Name: gld_rduval

BUFFALO SKIN RIVER
M22S250
M2S250A
M22S097
M22S096
M22C015
M22C016
M22S338
M22S244
JOJAB (JOSEPH) LAKE
M22C018
M22C017
M22C019
M22C021
M22C020
M22S05A
M22C022
Camp - Site 6
M22S004
JIIGAAKODIGWEYAA WIH ZAAGAIHAN
ALBANY RIVER
M22S252
M22S253
M22S055
M22S054
M22C025
M22C024
M22C023
Marten Falls 65
ALBANY RIVER
OGOKI RIVER
MARTEN FALLS WINTER ROAD

Marten Falls First Nation
Map Location
Wabakimi Provincial Park
ONTARIO
Lake Nipigon
Nipigon
Thunder Bay
Wawa

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT

- FIRST NATION COMMUNITY

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- LEGEND Construction_Development_Area_R06

SOIL DRAINAGE
- VERY POOR
- POOR
- IMPERFECT
- MODERATELY WELL
- WELL
- RAPID
- VERY RAPID
- NOT RATED (ANTHROPOGENIC)
- NOT RATED (OPEN WATER)

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL DRAINAGE IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-2f

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SG-06
SG-06
SG-06
SG-06
OGOKI RIVER
OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)
OGOKI RIVER
Alternative 1
South Camp
BR-04
OGOKI RIVER
PROVINCIAL PARK
(WATERWAY CLASS)
SG-20
SG-20
COLPITTS CREEK
PAINTER LAKE ROAD
MARTEN FALLS WINTER ROAD
BR-01
LITTLE
CURRENT RIVER
PROVINCIAL PARK

Marten Falls
First Nation
Wabakimi
Provincial
Park
ONTARIO
Lake
Nipigon
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- ROAD
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure H-3a

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DUSEY RIVER
SG-08
SG-08
SG-08
WINSLOW LAKE
SG-05
SG-07
SG-07
Alternative 1
North Camp
OGOKI RIVER
SG-06
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
SG-06

Marten Falls First Nation
ONTARIO
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-3b

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SG-12
SG-12
TH19-08
SG-12
SG-12
SG-11
ALBANY RIVER
SG-11
SG-11
SG-11
Albany River Camp
TEABEAU LAKE
ALBANY RIVER PROVINCIAL PARK
ALBANY RIVER
PATIIGOHSING RIVER
SG-10
Camp - Site 3
SG-10
SG-09
SG-09
BR-11
DUSEY RIVER

Marten Falls First Nation

Map Location

Legend

- BOREHOLE
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-3c

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WABASSI RIVER
BR-12
MAXEY LAKE
SG-18
Camp - Site 4
- Other Option
ALBANY RIVER
PROVINCIAL PARK
SG-15
SG-15
SG-15
TREBELL
LAKE
GOURLIE CREEK
SG-12
SG-12
SG-12
TH19-08
ALBANY RIVER

Marten Falls
First Nation
ONTARIO
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- BOREHOLE
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure H-3d

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GITTINS LAKE
ALDER RIVER
Camp - Site 5
SG-19
TH19-17
SG-19
SG-19
SG-19
BUFFALOSKIN RIVER
WABASSI RIVER
ALBANY RIVER
ALBANY RIVER
PROVINCIAL PARK
ALBANY RIVER
ALBANY RIVER
ALBANY RIVER

Marten Falls
First Nation
ONTARIO
Nipigon
Thunder Bay
Wawa
Map Location

Legend

- BOREHOLE
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

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Service Layer Credits: Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community

MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-3e

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SG-19
SG-19
TH19-17
SG-19
SG-19
BUFFALO SKIN RIVER
JOJAB (JOSEPH) LAKE
BR-16
BR-16
BR-15
BR-15
Camp - Site 6
JIIGAAKODIGWEYAA WIH ZAAGAIHAN
ALBANY RIVER
Marten Falls 65
ALBANY RIVER
OGOKI RIVER
MARTEN FALLS WINTER ROAD

Marten Falls First Nation
Map Location

Legend

- BOREHOLE
- ROAD
- LOCAL STUDY AREA
- CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA
- FIRST NATION COMMUNITY
- ESKER
- DOMINANTLY ORGANIC SOIL
- PARTIALLY ORGANIC SOIL
- POTENTIAL PITS
- QUARRIES
- STEEP SLOPE
- WATERBODY

Notes:
Detailed Terrain Mapping by WSP 2024.

Data Source:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

"SPECIAL" GEOLOGIC AND GEOMORPHIC FEATURES IN THE EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2.25 4.5
Kilometres

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Figure H-3f

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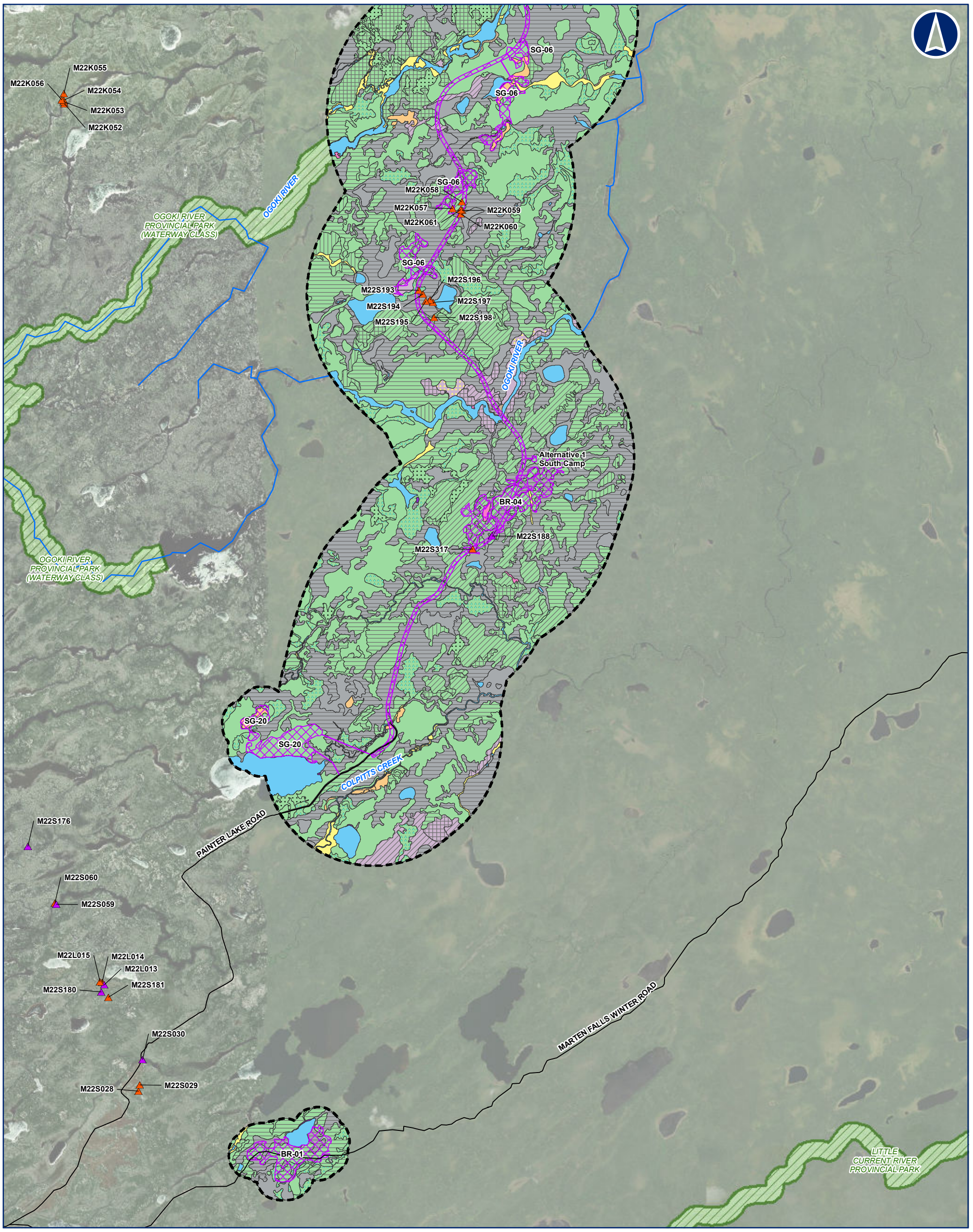

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)
- COLLUVIUM (C1)
- FLUVIAL (F1)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF3)
- GLACIOLACUSTRINE (GL1)
- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
- GLACIOLACUSTRINE (GL6)
- GLACIOLACUSTRINE (GL7)
- GLACIOLACUSTRINE (GL8)
- LACUSTRINE (L1)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M2)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M6)
- MORAINAL (M7)
- MORAINAL (M8)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- DISTRUBED LAND (ZDL)
- WATERBODY (ZWA)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2 4
Kilometres

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Figure H-4a

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Map location: I:\2022\21455151\Mapping\Products\007_CumulativeEffects\21455151_EF_SOIL_004_GIS_SoilMapUnits_RevA.mxd
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DUSEY RIVER
M22L016
M22L017
M22L019
M22L018
SG-08
M22L021
M22L022
M22L020
SG-08
M22S149
M22S150
M22S151
M22L024
M22L023
M22L025
M22L026
M22S153
M22S154
M22S156
WINSLOW LAKE
M22S155
M22L027
M22SAD6
SG-05
M22S157
M22S003
M22S314
M22S158
M22S161
M22S162
M22SAD7
M22K047
M22K048
M22K049
M22S215
M22S218
M22S219
SG-07
SG-07
M22SAD8
M22S165
M22S164
M22K050
M22K051
Alternative 1 North Camp
OGOKI RIVER
SG-06
OGOKI RIVER PROVINCIAL PARK (WATERWAY CLASS)
SG-06
M22K055
M22K054
M22K056
M22K053

Marten Falls First Nation
a
b
c
d
e
f
Wabakimi Provincial Park
ONTARIO
Lake Nipigon
Nipigon
Thunder Bay
Wawa

Legend

- WATERCOURSE
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)
- COLLUVIUM (C1)
- FLUVIAL (F1)
- GLACIOFLUVIAL (GF1)
- GLACIOLACUSTRINE (GL1)
- GLACIOLACUSTRINE (GL2)
- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
- GLACIOLACUSTRINE (GL5)
- GLACIOLACUSTRINE (GL6)
- GLACIOLACUSTRINE (GL7)
- GLACIOLACUSTRINE (GL8)
- LACUSTRINE (L1)
- LACUSTRINE (L2)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M2)
- MORAINAL (M3)
- MORAINAL (M4)
- MORAINAL (M5)
- MORAINAL (M6)
- MORAINAL (M7)
- MORAINAL (M8)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- WATERBODY (ZWA)

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2 4
Kilometres
Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-4b

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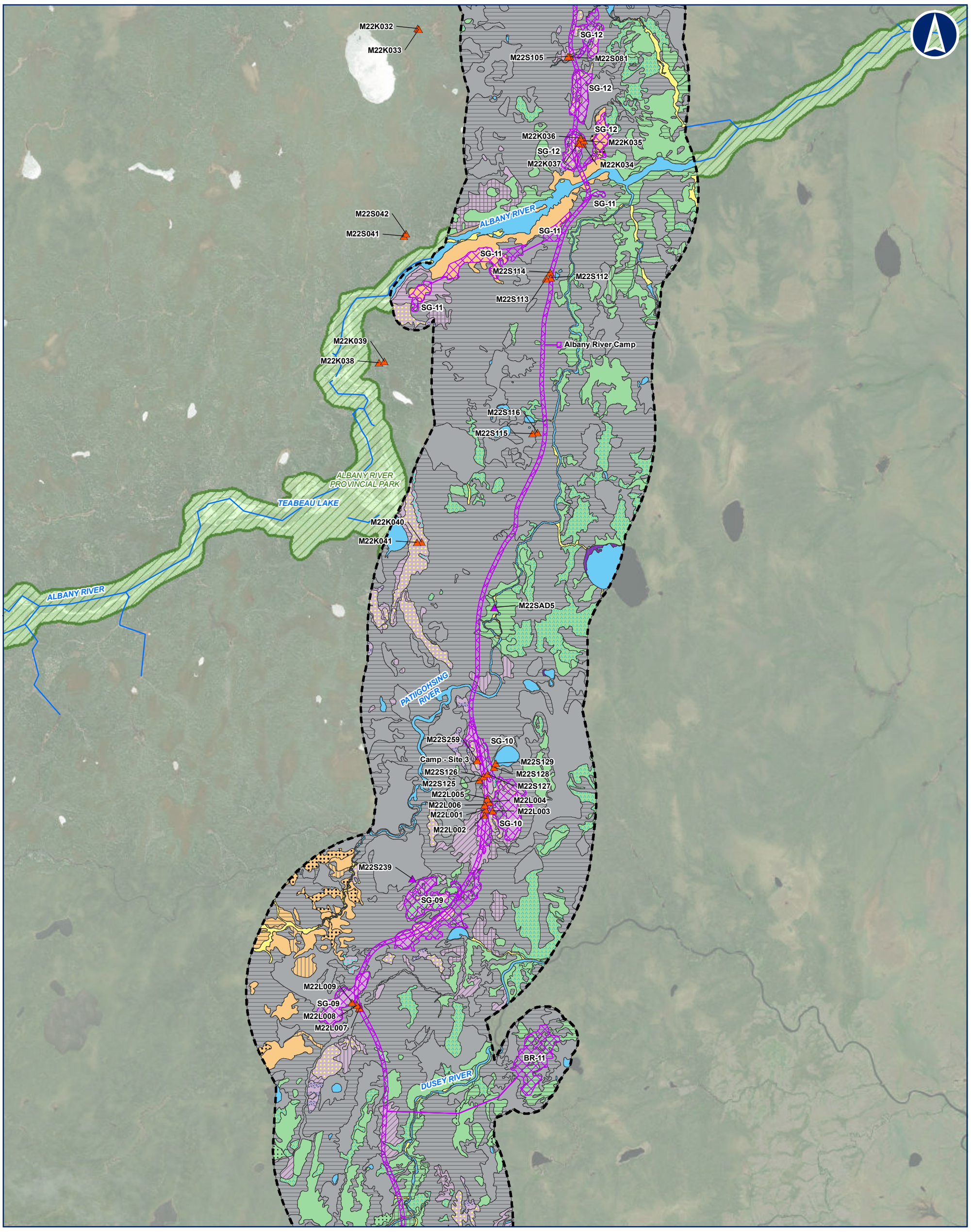

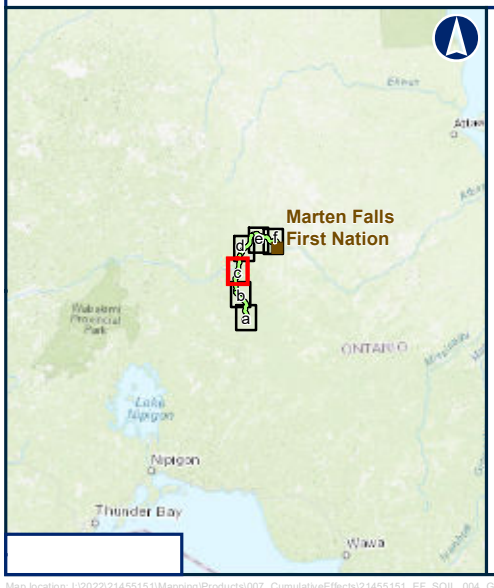

Legend

- WATERCOURSE
- LOCAL STUDY AREA
- FIRST NATION COMMUNITY
- PROVINCIAL PARK

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

SOIL MAPPING UNITS (SMU)

- COLLUVIUM (C1)
- FLUVIAL (F1)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF3)
- GLACIOFLUVIAL (GF4)
- GLACIOLACUSTRINE (GL1)
- GLACIOLACUSTRINE (GL2)
- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
- GLACIOLACUSTRINE (GL5)
- GLACIOLACUSTRINE (GL6)
- GLACIOLACUSTRINE (GL7)
- GLACIOLACUSTRINE (GL8)
- LACUSTRINE (L1)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M2)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M6)
- MORAINAL (M7)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- WATERBODY (ZWA)

Notes:

Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2 4
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-4c

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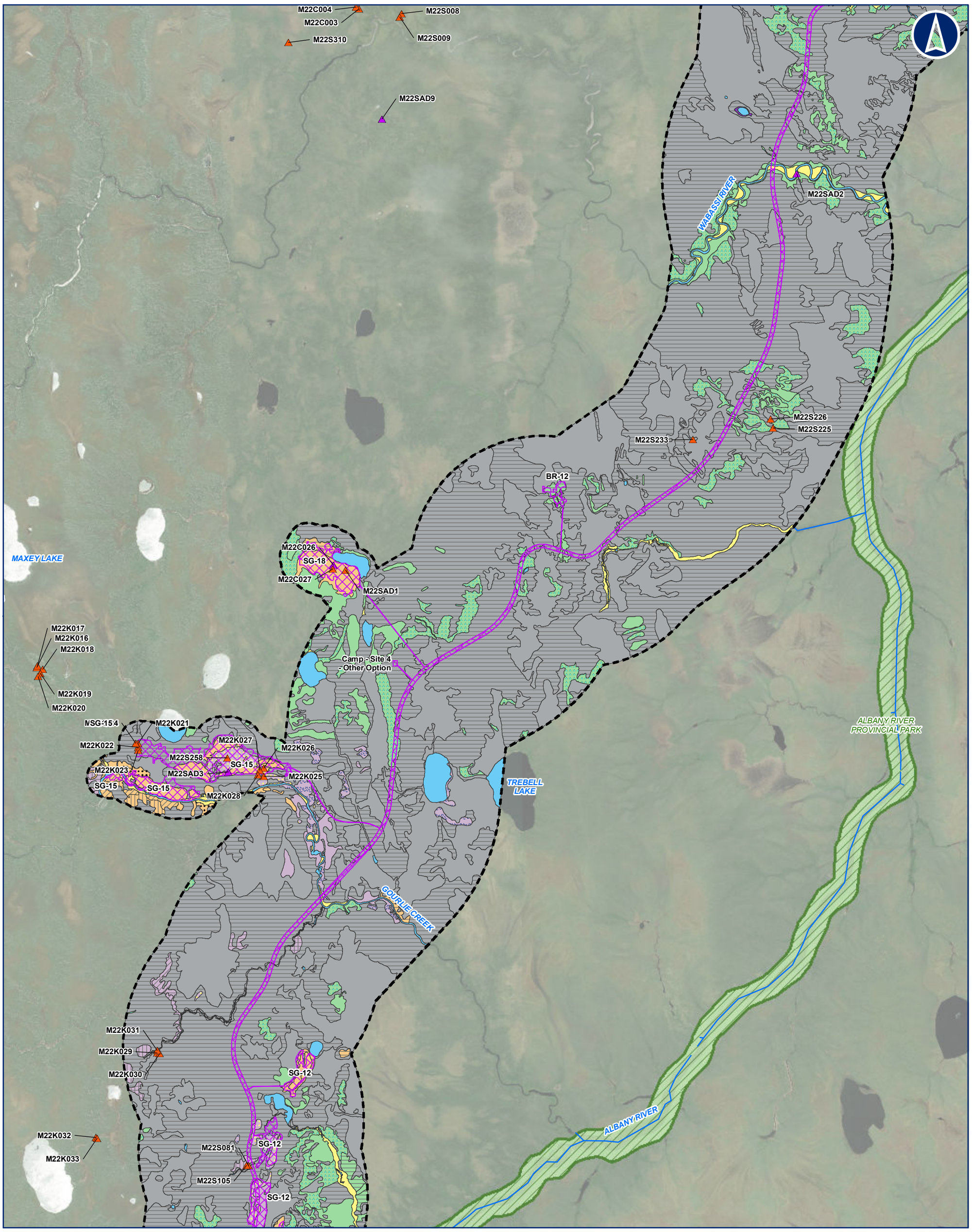

Legend

- WATERCOURSE
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)
- COLLUVIUM (C1)
- FLUVIAL (F1)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF3)
- GLACIOFLUVIAL (GF4)
- GLACIOFLUVIAL (GF5)
- GLACIOLACUSTRINE (GL1)
- GLACIOLACUSTRINE (GL3)
- GLACIOLACUSTRINE (GL4)
- GLACIOLACUSTRINE (GL5)
- GLACIOLACUSTRINE (GL6)
- GLACIOLACUSTRINE (GL7)
- GLACIOLACUSTRINE (GL8)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- WATERBODY (ZWA)

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2 4
Kilometres

Datum: NAD 1983 CSRS UTM Zone 16N

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Figure H-4d

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GITTINS LAKE
M22C011
M22C009
M22C008
M22C010
Camp - Site 5
M22K008
M22K007
M22K009
M22C007
M22C012
M22C013
M22C014
SG-19
SG-19
SG-19
SG-19
BUFFALOSKIN RIVER
M22S250
M2S250A
M22S097
M22S096
ALDER RIVER
WABASSI RIVER
M22SAD2
ALBANY RIVER
ALBANY RIVER PROVINCIAL PARK
ALBANY RIVER
M22S226
M22S225
ALBANY RIVER
ALBANY RIVER?

Marten Falls First Nation
ONTARIO
Lake Nipigon
Nipigon
Thunder Bay
Wawa

Legend

- WATERCOURSE
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA

- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA

SOIL INSPECTION LOCATIONS

- GROUND PLOT
- VISUAL PLOT

- FIRST NATION COMMUNITY
- PROVINCIAL PARK

SOIL MAPPING UNITS (SMU)

- COLLUVIUM (C1)
- FLUVIAL (F1)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF3)
- LACUSTRINE (L3)
- MORAINAL (M1)
- MORAINAL (M3)
- ORGANIC (O1)
- ORGANIC (O2)
- WATERBODY (ZWA)

Notes:
Detailed Terrain Mapping by WSP 2024.

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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2 4
Kilometres

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Figure H-4e

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SG-19
SG-19
SG-19
SG-19
BUFFALOSKIN RIVER
M2S250A
M22S250
M22S097
M22S096
M22C015
M22S244
M22C016
M22S338
JOJAB (JOSEPH) LAKE
M22C018
M22C017
M22C019
M22C021
M22C022
M22C020
M22S05A
Camp - Site 6
M22S004
JIIGAAKODIGWEYAA WIH ZAAGAIHAN
BR-16
BR-15
BR-15
BR-16
ALBANY RIVER
M22S252
M22S253
M22S055
M22S054
M22C025
M22C023
M22C024
Marten Falls 65
ALBANY RIVER
OGOKI RIVER
MARTEN FALLS WINTER ROAD

Marten Falls First Nation
ONTARIO
Lake Nipigon
Nipigon
Thunder Bay
Wawa

Legend

- ROAD
- WATERCOURSE
- LOCAL STUDY AREA

CONSTRUCTION DISTURBANCE AREA
- ACCESS ROAD
- CONSTRUCTION DISTURBANCE AREA

SOIL INSPECTION LOCATIONS
- GROUND PLOT
- FIRST NATION COMMUNITY

SOIL MAPPING UNITS (SMU)
- COLLUVIUM (C1)
- FLUVIAL (F1)
- GLACIOFLUVIAL (GF1)
- GLACIOFLUVIAL (GF2)
- GLACIOFLUVIAL (GF3)
- LACUSTRINE (L1)
- MORAINAL (M1)
- MORAINAL (M3)
- MORAINAL (M5)
- MORAINAL (M9)
- ORGANIC (O1)
- ORGANIC (O2)
- BEDROCK (R1)
- DISTRUBED LAND (ZDL)
- WATERBODY (ZWA)

Notes:
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MARTEN FALLS FIRST NATION COMMUNITY ACCESS ROAD

SOIL MAP UNITS IN THE MARTEN FALLS COMMUNITY ACCESS ROAD EFFECTS ASSESSMENT LOCAL STUDY AREA AND CONSTRUCTION DEVELOPMENT AREA

0 2 4
Kilometres

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Figure H-4f

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