WEBEQUIE SUPPLY ROAD (WSR) PROJECT

GEOLOGY, TERRAIN & SOILS STUDY PLAN SUMMARY

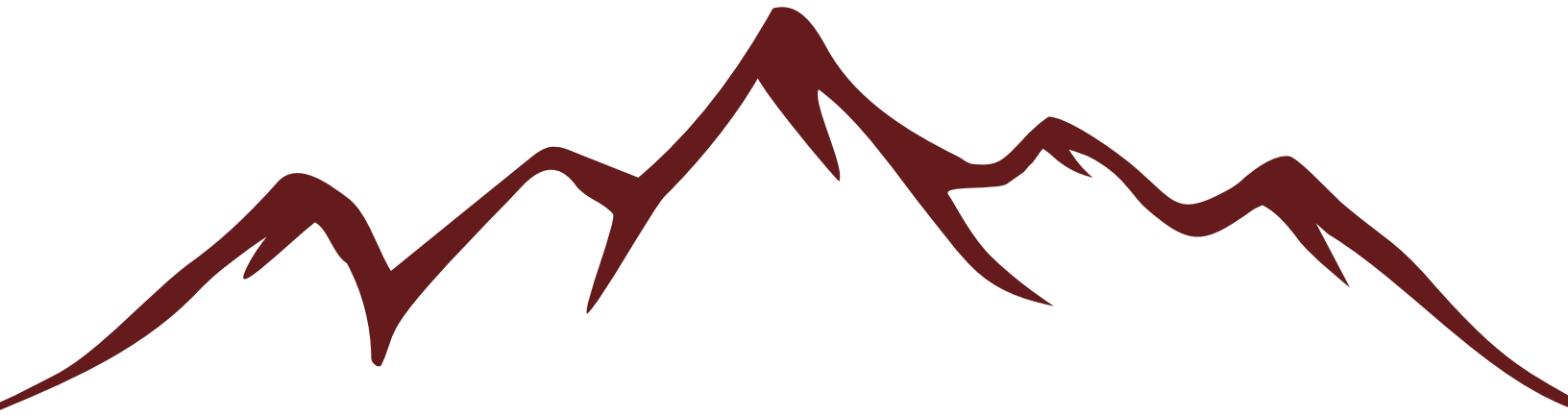
OBJECTIVES:

- Identify and consider the potential effects on fish and fish habitat as a result of the Project
- Identify and consider the potential effects on geology, terrain and soils as a result of the Project
- Provide recommendations for minimizing negative environmental, health, social and economic effects related to geology, terrain and soil effects during the construction and operation/maintenance of the Project

WHAT WILL BE ASSESSED AND HOW WILL THE ASSESSMENT BE DONE?

- **Terrain, Soils & Sediment -** Terrain (or topographical relief) is the elevation, slope, and orientation of the land surface. Soil is a mixture of minerals and organic matter that is a medium for plant growth, water storage, and a habitat for organisms. Sediment refers to soil and other matter that has been moved from an exposed surface and has settled at the bottom of the waterbody, gully, channel or other landscape feature.
- **Terrain Distribution** is the amount (or abundance) and distribution of terrain units (e.g., bog, mineral and fen types) in the landscape. This will be measured qualitatively as a change in overall representation of the terrain units in the project area and will be analyzed and assessed through mapping.
- **Soil Quality** refers to the physical, chemical, and biological characteristics of soil. This will be measured qualitatively in terms of changes to soil quality in the project area. Soil quality will be defined qualitatively by determining its potential for compaction, erosion, and mixing, as well as chemical influences from project activities, such as accidental spills of hazardous materials.

- **Soil Distribution** refers to the amount or abundance and spatial configuration of different types of soil. This will be measured qualitatively as a change in overall abundance and distribution of soil in the project area due to building and operating the road and will be analyzed and assessed by examining mapping.
- **Aggregate/Rock Sources** refers to aggregate and rock materials in the project area that may be used to construct and maintain the road. Among the potential aggregate and rock sources are sand and gravel deposits, and bedrock outcrops that may be blasted and crushed.
- **Geochemical Hazards** generally refers to the release of contaminants present in or originating from geological formations into the environment. The potential for increased acid rock drainage, metal leaching (see below) and other geochemical hazards due to building and operating the road will be assessed. Potential effects to the receiving environment will be qualified through various tests against relevant water quality guidelines.



- **Acid Rock Drainage** is a type of geochemical hazard caused by minerals containing sulphur encountering water and air to form sulphuric acid, which can leak into and damage the environment.
- **Metal Leaching** is a related geochemical hazard that happens due acid rock drainage. The sulphuric acid can leach (dissolve and carry) heavy metals from geological formations, causing the release of metal contaminants into the environment.
- **Geohazards** include landslides, sinkholes or other major geological depressions. Though no such geohazards have been observed to date in the project area, an assessment will determine potential increases in the likelihood of occurrence of, or the effect of these geohazards due to building and operating of the road will be assessed.

- **Permafrost** – The Project area is situated within a band of sporadic permafrost that is part of the Discontinuous Permafrost Zone of Canada's permafrost region. Permafrost conditions, including distribution of frozen and unfrozen ground, will be determined, and related potential permafrost effects, such as thaw weakening (see below), will be assessed.

- **Thaw Consolidation and Settlement -** Thaw settlement and terrain instability associated with ground thawing may occur in permafrost areas. When frozen ground thaws and water drains from it, the soil compacts into the empty spaces created; this is thaw consolidation. Ground settlement may occur due to thaw consolidation, causing the ground to "sink" slightly.

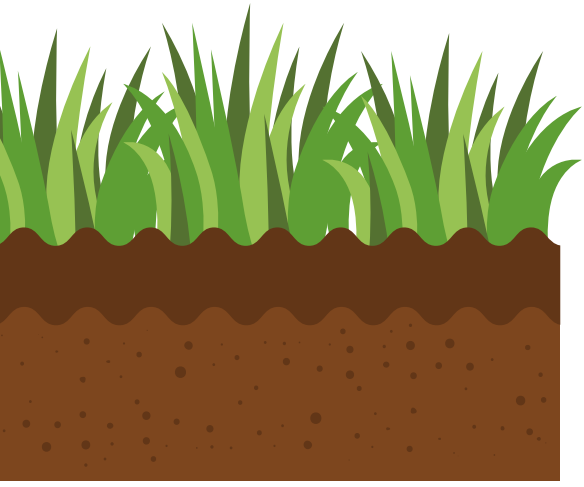
WHAT INFORMATION IS NEEDED AND HOW WILL IT BE COLLECTED?

- **Indigenous Knowledge** – Indigenous Knowledge from First Nation communities will be requested to help understand land use, areas of cultural importance, trends or changes in terrain and soil, and their perspectives on potential effects to terrain and soils that may result from the Project. The Project Team will ensure that the information is protected, kept confidential, and appropriately and respectfully integrated into the geology, terrain and soils assessment with the help of community knowledge holders and Elders.

- **Terrain Data and Information** is collected from existing published literature, mapping and from the results of field surveys, where applicable, and incorporated into a mapping of the collected data for evaluation, including information on eskers and other post-glacial deposits, geomorphology, topography, and geotechnical characteristics in project area, including the presence and distribution of eskers and permafrost and ground instability.

- **Soil Data and Information** is collected from existing published literature, mapping and from the results of field surveys.

- **Terrain and Soils Investigations** facilitate the identification of potential aggregate sources, characterization of stream crossings and mapping of route alternatives. The terrain analysis is conducted using aerial and satellite imagery and digital elevation data, including satellite imagery and light detection and ranging (LiDAR) data and background hydrological and land cover information.



- **Soils and Thickness Investigations –** To further supplement and expand on the terrain analysis and investigations, peat thickness information is collected within the preliminary preferred road corridor.

Reference: SNC-Lavalin. 2020. Webequie Supply Road-GEOLOGY, TERRAIN & SOILS STUDY PLAN

- **Aggregate Source Investigations -** Potential aggregate sources have been identified on a preliminary basis from existing surficial geology maps (i.e., Ontario Geological Survey) and from terrain analysis using aerial photography and LiDAR data for the corridor. Bedrock outcrops that are identified and mapped as potential quarry sites will be visited in the field, and the rock characteristics and structural elements (fractures, bedding, etc.,) will be described to assess suitability of deposits as sources for aggregate (gravel) and rock protection to protect shorelines and streambeds at bridge/culvert waterbody crossing sites.
- **Geotechnical Field Investigations -** The primary purpose of the geotechnical program is to assess ground conditions along the preliminary proposed road corridor and at waterbody crossing sites; identify potential aggregate sources; and provide design and construction recommendations to the engineering design team for the road, bridge/culvert foundations and supportive infrastructure (e.g., construction camps, access roads). Several boreholes have been advances in the Project area. Recovered soil and rock samples are logged, photographed and examined in the field. Geotechnical laboratory testing is performed on selected soil and rock samples.
- **Geochemical Investigation -** Geochemical field work includes soil and rock sampling and testing to provide an indication of the potential for acid rock drainage and metal leaching at aggregate pits/quarries and rock cuts, as well as locations where materials are generated and stockpiled.

WHAT ARE SOME OF THE POSSIBLE WAYS TO REDUCE POTENTIAL NEGATIVE EFFECTS OF THE PROJECT?

- Minimizing the area of disturbance (project footprint) to construct and operate the Project
- Design the road and associated infrastructure in accordance with engineering criteria related to permafrost and geologic hazards
- Design and implement erosion and sediment controls
- Apply best management practices for the proper salvage and storage of excess earth materials during construction and operations of the Project
- Restore terrain/topography at aggregate/rock source areas
- Use dust suppression techniques, such as watering during construction grading and excavation activities to minimize air quality effects
- Develop methods to address acid rock drainage and metal leaching through strategic temporary surface water flow management, including filtering and treatment measures, and ongoing monitoring of surface and groundwater, if drainage discharge is a concern
- Design the road drainage system with equalizer culverts along the proposed road alignment to maintain existing surface drainage patterns
- Use of state-of-the-art design and construction techniques, as applicable, to minimize loading/compaction, address effects on thaw-sensitive permafrost, and evenly distribute the weight of road using such methods as geogrids to reinforce and strengthen the underlying peat and weak soils

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GEOLOGY, TERRAIN & SOILS STUDY AREAS

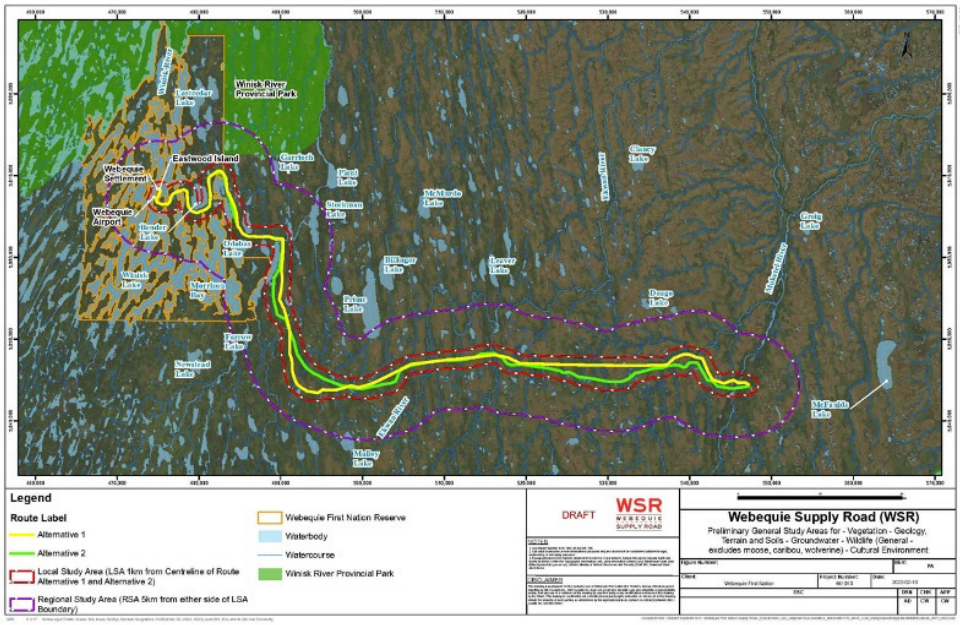


Figure 1 - Geology, Terrain & Soils Study Areas

Spatial boundaries define the geographic extent to consider potential project effects on geology, terrain and soils. As such, these boundaries define the study areas for the effects assessment. The study areas to be used in the assessment will be refined and validated with input and feedback from Indigenous communities, as well as guidance from federal and provincial regulators, and other stakeholders.

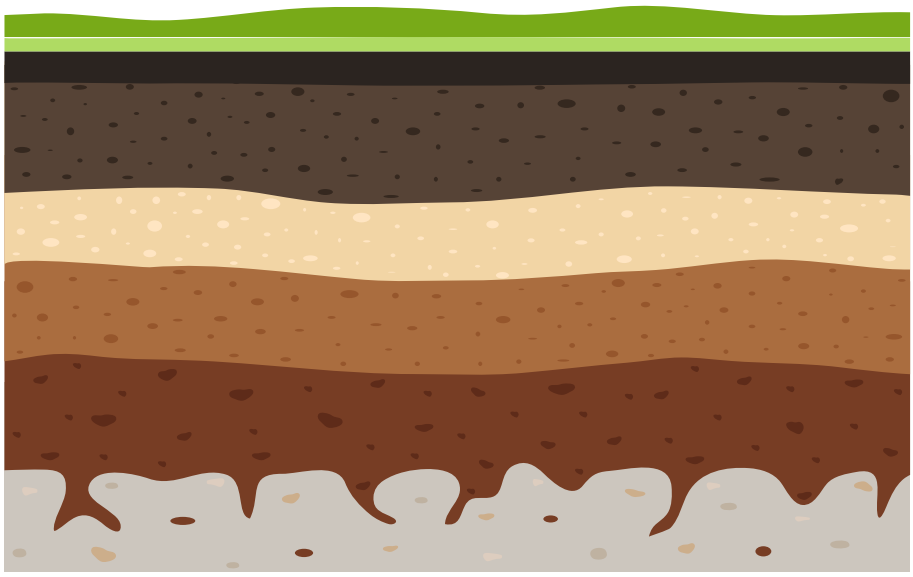
To capture the potential direct and indirect effects of the Project for each valued component, general study areas have been established (i.e., Project Footprint, Local Study Area and Regional Study Area). The proposed study areas identified for the geology, terrain and soils valued component are described below and presented in Figure 1.

- **Project Footprint (PF) -** The area of direct disturbance (i.e., the physical area required for Project construction and operation). The PF is defined as the 35 m right-of-way (ROW) width for the WSR and temporary or permanent areas needed to support the Project, including laydown/storage yards, construction camps, access roads and aggregate extraction sites.
- **Local Study Area (LSA) -** The area where largely direct, and indirect effects of the Project are likely to be measurable. The LSA for geology, terrain & soils is a 1 km buffer from either side of the centreline of the supply road Alternative 1 and Alternative 2, and 500 metres (m) from supportive infrastructure (camps, aggregate/rock source areas, access roads).
- **Regional Study Area (RSA) -** The area where potential, largely indirect and cumulative effects of the Project in the broader, regional context may occur. The RSA for geology, terrain & soils extends 5 kilometres (km) on either side of the LSA boundaries.

GEOLOGY, TERRAIN & SOILS STUDY AREAS

To determine Project effects to geology, terrain and soils, evaluation criteria and indicators are developed that represent the resource, feature or issue where measurable changes can be identified. Criteria, also known as valued components, are elements or conditions of the natural and human environment that may be affected by the Project and are of concern or value to the public, Indigenous peoples, federal/provincial authorities and interested parties. Indicators represent a resource, feature, or issue related to the criteria that, if changed, may demonstrate an effect on the environment. The table below identifies indicators for the proposed geology, terrain and soils valued component, also referred to as criteria (interchangeable term) based on the Ontario Environmental Assessment terminology.

Valued Component/Criteria	Indicators
Geology, Terrain and Soils	Terrain and Soil quality - Changes or degradation to physical, chemical and biological characteristics of permafrost, terrain or topography and soils Terrain and Soil Distribution - Changes or degradation to the amount and continuity of terrain units (e.g., eskers, etc.) in the landscape



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