Supportive Documentation for Terms of Reference

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WEBEQUIE SUPPLY ROAD: TERRAIN ANALYSIS, POTENTIAL AGGREGATE SOURCES & IDENTIFICATION OF ROUTE ALTERNATIVES

Note: This report should be read in conjunction with Terms of Reference Section 5.4 - Development of Routing Sub-Alternatives within Preferred Supply Road Corridor.

DRAFT REPORT

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1 INTRODUCTION

Webequie First Nation, located approximately 500 km north of Thunder Bay, is developing an all-season road between the community of Webequie and the proposed Ring of Fire mining development around Esker Camp just to the east of the Mukutei River, known as the Webequie First Nation Supply Road Project (Figure 1). The Webequie Supply Road will offer year-round movement between the community and future mine sites and will facilitate economic opportunities for the community.

Preliminary corridor alternatives were identified and a preferred corridor was selected by the community based on engagement with the community as a whole, youth representatives, elders, and the Webequie land use planning committee. The preferred corridor, selected by the community, is approximately 107 km in length (extending about 51 km toward the south-southeast from Webequie before turning east for about 56 km toward Esker Camp), and 2 km in width. It is within this preferred corridor that the road route is to be selected.

As part of the Environmental Assessment and Preliminary Engineering Services for Webequie First Nation's Supply Road Project, J.D. Mollard and Associates (2010) Limited was sub-contracted by SNC Lavalin to conduct terrain mapping within the proposed community corridor to facilitate identification of potential aggregate sources, characterization of stream crossings, mapping of several competing route alternatives, and identification of an optimal route based on terrain and engineering considerations. This report provides the results of these studies.

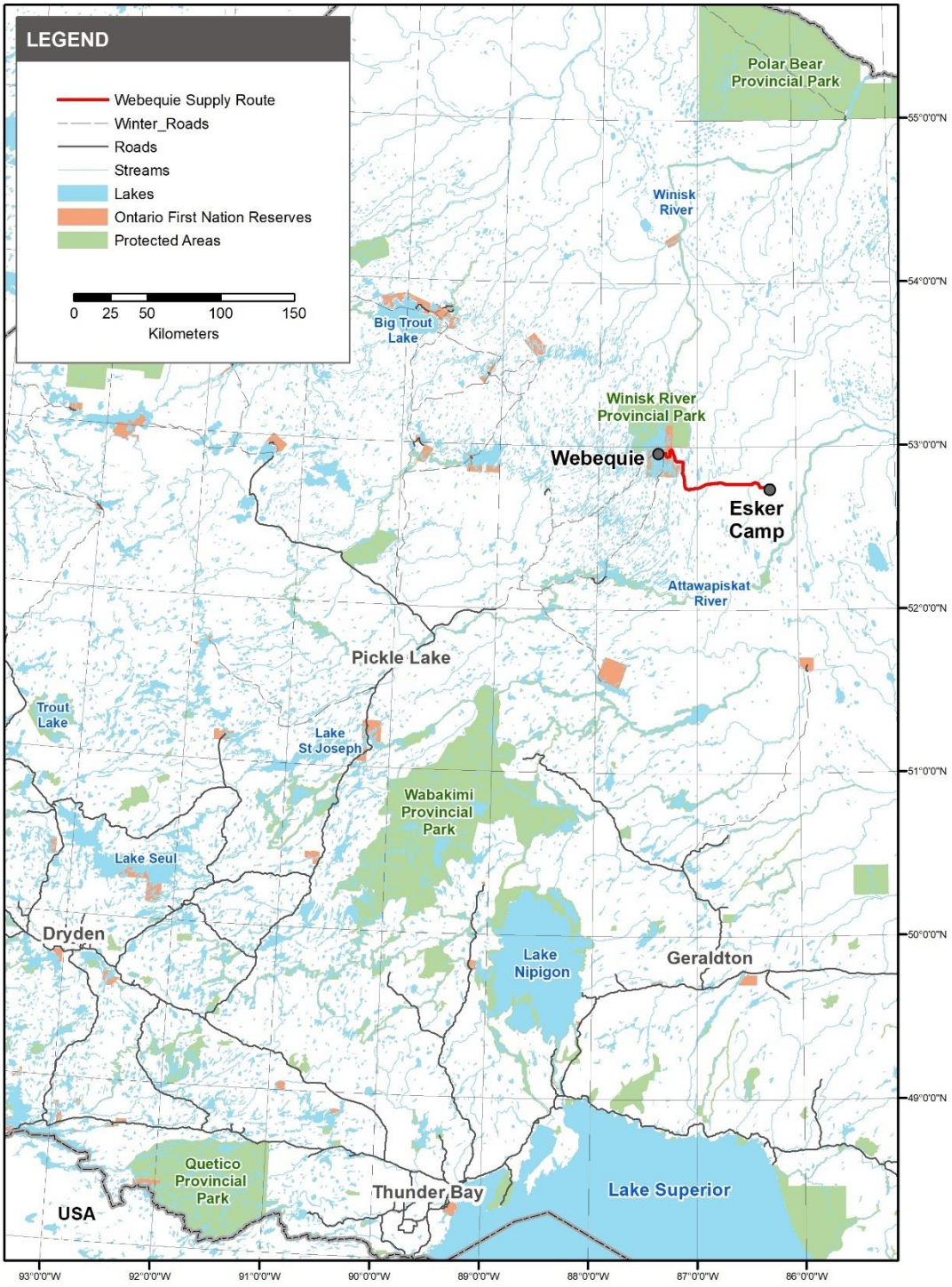


Figure 1: Location of the Webequie First Nation Supply Road Project.

2 DATA SOURCES

Terrain analysis was conducted using aerial and satellite imagery and digital elevation data. The primary source of desktop information for terrain mapping was high-resolution orthoimagery (20 cm resolution) and LiDAR elevation data (1 m resolution) acquired within the 2-km wide corridor for the project in October 2018. Satellite imagery available through ESRI World Imagery Basemap and Google Earth offered supplemental imagery at high-resolution. Air photo interpretation was also conducted at select locations using 1954 black & white photos at 1:60,000 scale, which when viewed stereoscopically provide 3-D perspectives to evaluate terrain and topographic conditions. These multiple sources of imagery assist with the terrain unit classification, particularly with resolving the wetlands and permafrost-affected terrain.

- Black & White air photos. Scale: 1:60,000. Year: 1954.
- ESRI World Imagery Basemap. Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
- Google Earth Pro V7.3.2.5491.
- Orthoimagery captured with LiDAR data. 20 cm resolution. October, 2018.

Elevation data covering the 2-km wide route corridor was provided by LiDAR (light detection and ranging) and processed at a spatial resolution of 1 m. Using the LiDAR data, shaded-relief and slope rasters were generated in ArcGIS to assist with the interpretation terrain units.

- LiDAR (light detection and ranging)
- Shaded-relief and slope rasters

Information on the surficial and Quaternary geology was obtained from the following published maps.

- Ontario Geological Survey, 1997. Quaternary geology, seamless coverage of the province of Ontario: Ontario Geological Survey, Data Set 14.
- Barnett, P.J. *et al*., 2013. Surficial Geology of the Lansdowne House Area Northeast, Northern Ontario. 1:100,000. P3697.
- Barnett, P.J. *et al*., 2013. Surficial Geology of the Lansdowne House Area Northwest, Northern Ontario. 1:100,000. P3696.

Hydrological information was obtained from the following sources.

- Ontario Hydro Network – Waterbodies. Land Information Ontario (LIO) Warehouse.
- Ontario Wetlands: Ontario Ministry of Natural Resources.
- Provincial Land Cover (2000) Database: Ontario Ministry of Natural Resources.

Information from previous JDMA terrain studies, particularly the terrain units and legend, was obtained from the following reports:

- McFaulds Lake Project – Webequie to Esker Camp road route location: Report on mineral and organic terrain mapping in a 10 km radius around esker camp. 2010. J.D. Mollard and Associates (2010) Limited. September 23, 2010. Report No. 1675.
- McFaulds Lake Project – McFaulds Lake Peat Sampling Field Trip Report. J.D. Mollard and Associates (2010) Limited. September 17, 2010.

3 METHODOLOGY

3.1 TERRAIN MAPPING

Terrain mapping within the proposed route corridor involved the interpretation of remotely sensed imagery (air photos and satellite images) and digital elevation data, supplemented with surficial geology, hydrology, and land cover data, to characterize the landforms, surficial materials, topography, hydrology, *etc*. Geospatial data sources available for this study were compiled in a geographic information system (GIS) and terrain units were manually digitized over base layers of imagery (air photos and satellite) and elevation data (elevation, shaded-relief, and slope rasters).

Terrain units were mapped and classified according to a legend developed for this area based on a compilation of previous reports and existing mapping (JDMA, 2010). The route corridor crosses extensive organic terrains of various bogs and fens along the east-west section of the corridor west of Esker Camp and glacial terrains with mineral soils on the roughly north-south section leading to the community of Webequie. Mineral terrains include till with a discontinuous lacustrine clay veneer, glaciofluvial ice-contact, esker ridges, and alluvial floodplains. Organic terrains include bogs and fens with tremendous diversity and extent.

Following is a description of the terrain units mapped within the routing corridor.

MINERAL TERRAINS

TL (Till and glacial lake clay): silty till (T) on a N-S fluted plain with a mostly thin, discontinuous cover of soft, sticky plastic lacustrine (L) silty clay. Extensive cover over the N-S section of the route corridor with some areas of thin bog or fen cover.

ER (Esker ridge): the esker core near Esker Camp consists of thick sand over gravel, reaching a total depth of more than 20m, with a discontinuous cover of glacial-lake clay on sideslopes. The esker system is segmented, with mostly short gaps and three notable local expansions called “bulges” (esker fans and deltas), resulting in very large volumes of nearby granular material.

GF (Glaciofluvial): Ice-contact glaciofluvial deposits (kames and eskers) consisting of sorted granular material.

AF (Alluvial floodplain): Varying mineral-soil textures along small creek channels whose floodplains are discontinuous and around the periodically flooded perimeters of water bodies. Relatively thin peat over alluvium, stream-eroded till, and intermittently flooded mineral soil. Mostly narrow and subject to flooding. Some creek channels are linear, following abandoned flute depressions or ice-keel scour depressions.

ORGANIC TERRAINS

BOG TYPE TERRAINS

DB (Domed bog): Oval, lenticular, teardrop, balloon and irregular-outlined domed shapes; common occurrence; usually greater than 500m in longest dimension; notably convex surface with crest up to several metres higher than bog edges and the surrounding terrain. Multiple drainage lines (*e.g.,* watertracks) commonly radiate outward from the bog summit. Clusters of bog pools on DB are less common than they are on PB, also with smaller pools and smaller and less well-defined clusters. Peat depth may exceed 3m near the DB central area. Stratified Sphagnum-sedge-woody shrub peats with large Sphagnum lawn and black spruce areas at ground surface.

PB (Northern plateau bog): Typically large, slightly raised (0.5 to 1 m) bog above the surrounding terrain with steep edges -- thus plateau-like in appearance with a commonly irregular outline edge in plan. Numerous larger bog pools usually occur in larger clusters than observed on DB. Distinct pool clusters are also more common on PB than on DB, forming net (reticulate) patterns of narrow peaty ridges between large pools (NB), occasionally transitioning downslope to string bogs (SB) and then downslope to string (ribbed) fens. Includes flat bog, not raised above the surrounding surface with peat depth generally uniform and with less common net bog (NB). Light grey air photo tones result from extensive Sphagnum moss lawns with sparse black spruce trees and shrubs. Common stratified peat depths are 2 to 4 m, consisting of moderately decomposed Sphagnum peat over Sphagnum and sedge peats.

NB (Net bogs): component of northern plateau bogs (PB), located at one or more locations on flat-topped bog summits, includes minor string bog and string fen. The pattern consists of a network of reticulate narrow (2 to 3 m wide) peaty ridges about 1m high, separating numerous small to large bog pools having irregular and linear shapes (NB). Pools are occasionally aligned in parallel strings at right angles to surface-water runoff and to groundwater flow (SB). In this study, NB included SB in the terrain mapping. Pools vary from shallow to very deep.

TB (Treed bog): Areas of extensive tree cover developed on relatively thin organic material over mineral soils. Typically occur along the margins of streams and watercourses.

TK (Thermokarst bog, also called collapse scar bog, often associated with treed bog (TB)): Slightly raised perennially frozen peatland (permafrost-affected) with small, uniform-sized, roundish ground-ice-thawed collapse holes containing water or wet fen vegetation, called “collapse scars”. The resulting spotty speckled or mottled air photo pattern of whitish collapse holes is caused by subsidence upon melting of ground ice and possibly melting of palsas in a few places. This unit

tends to occur along the sloping margins of small and large creek drainages, and is also found as small isolated randomly distributed patches in neighbouring upland areas.

FEN TYPE TERRAINS

SF (String fen): on sloping terrain; narrow subparallel stringy peat ridges enclosing slit-like depressions with open water or wet fen vegetation (mostly sedge with shrubs and tamarack trees). Strings are aligned at right angles to the slope and in the direction of surface-water runoff and groundwater flow. SF areas are larger than ladder fens. String width becomes narrower and more closely spaced as slope gradient increases downslope. Peat depth is commonly over 2 m.

LF (Ladder fen): subtype of string fen, thus similar to string fens in appearance but smaller with narrower pools, often along the margin of domed and plateau bogs. Peat thickness is commonly 1 to 2 m.

CF (Channel fen): fens occupying generally well-defined longer and wider channels, including abandoned glacial meltwater channels, with and without small streams. Peat depth may exceed 2 m in some CF fens.

WF (Watertrack fen): A flowing pattern of narrow slightly concave surface runoff courses and groundwater seepage on slopes, radiating from the summits of domed and plateau bogs. WF may also originate from springs and seeps. Common peat depths of 1 to 2 m.

HF (Horizontal fen): broad, featureless gentle slopes. Commonly uniformly forested with trees, shrubs, coarse grasses and sedges. Commonly transitional to swamps (swamp-fens). Common peat thickness of 2 to 3 m.

Peat depths described in some of the terrain units are from the Canadian Wetland Classification System, University of Waterloo, Wetlands Research Centre, 1997. These depths are supported by soil probe data collected previously by JDMA from field sites south of the proposed corridor. Peat depths were also evaluated within the Webequie road corridor using ground penetrating radar in February 2019 as part of this study (See Section 3.2).

3.2 GROUND PENETRATING RADAR (GPR) SURVEYS

Ground penetrating radar (GPR) surveys were carried out at representative peatlands within the routing corridor to help characterize the depth and variability of the peat layer over bedrock or glacial sediment. GPR surveys were conducted from February 18-23, 2019.

Prior to the GPR field work, representative survey sites along the routing corridor were identified from the air photo terrain analysis and mapping work. At each survey site, two or more GPR transects were identified. Waypoints for equipment and personnel drop-off and transect start/stop points were provided to the GPR crew for location and navigation in the field. Access to each site was via helicopter, which brought in the survey crew, equipment, snowmobiles and fuel needed to conduct the surveys. There were three members of the GPR crew: Troy Zimmer and Jason Cosford, of JDMA, and Eric Jacob, of the Webequie First Nation community. A total of five (5) peatland areas were surveyed during the February 2019 field work (Figure 2). Sixteen (16) survey transects were collected in the field, capturing approximately 22 km of GPR profile data.

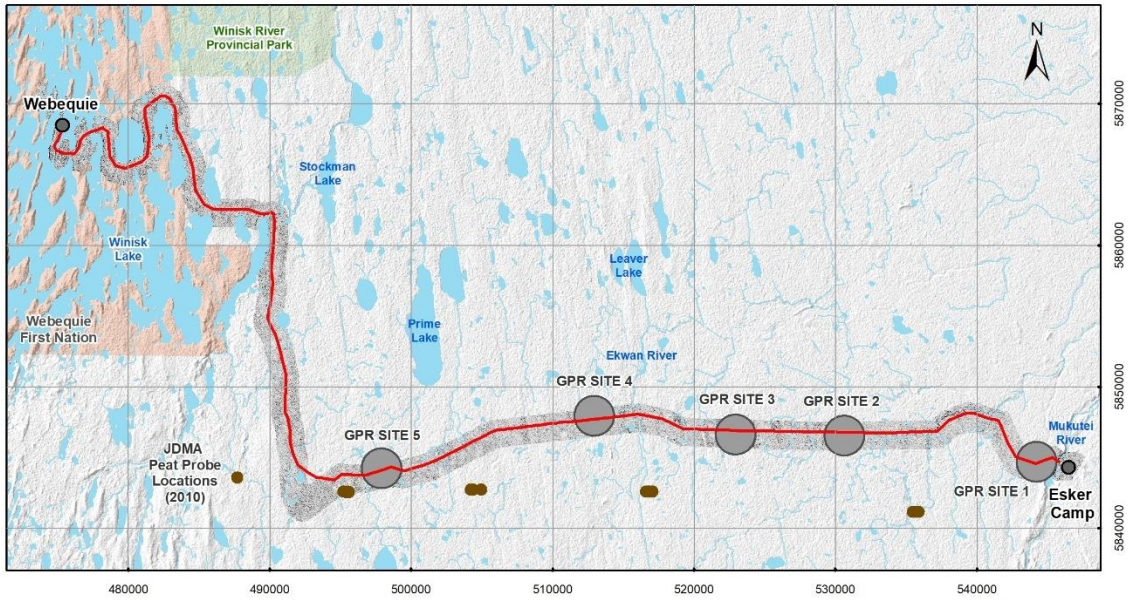


Figure 2. GPR and peat probe locations. Locations of the five peatland sites surveyed with GPR during the February 2019 field work (large grey circles) and peat probe locations from 2010 (small brown circles).

The field surveys were conducted used a Sensors & Software Noggin™ 100MHz GPR system mounted on custom skies and towed by snowmobile. A TopCon DGPS unit provided submeter geographic positioning for the GPR reflectance data as it was collected along each survey transect. The radar reflectance data for each survey transect was processed using Sensors & Software Ekko_Project v5.3 GPR software suite.

Figure 3. Field photographs of the GPR and peat probe. Left: Noggin 100MHz GPR system and ski mount being pulled by snowmobile at one of the GPR survey sites. Right: using a peat probe to try and measure depth to mineral soil / bedrock at the start of Transect 2-1.

The GPR survey crew attempted to use a hammer-style peat probe to measure actual peat depth at the first survey transect but were unable to push through the frozen peat to reach the top of the bedrock or glacial sediment. As a result, the processed GPR profiles assume a return radar wave velocity of 0.040 m/ns, a typical value cited in the literature for peatlands in northern Ontario. Because return wave velocity determines depth-below-surface measurements for features shown in the GPR profiles, it is recommended that sample peat depths be taken at points along selected survey transects during the summer so that the wave velocity and depths can be more accurately calculated and applied to the GPR profiles.

For each survey transect, the top of bedrock or glacial sediment was identified based on the distinctive reflectance pattern produced in the GPR profile when the radar pulse crosses the interface between the bottom of the water-saturated peat layers (with has relatively high dielectric values) into the much more dense, low-dielectric material below (Figure 4). The interpreted peat depths along each transect line are displayed as colour-coded depth points on the transect maps for each site (see Results, below). Since most survey transects cross several peatland terrain types (as interpreted by the air photo mapping work), statistics on the minimum, maximum and average peat depths for each terrain type were also compiled, for both individual transects and for the study sites as a whole.

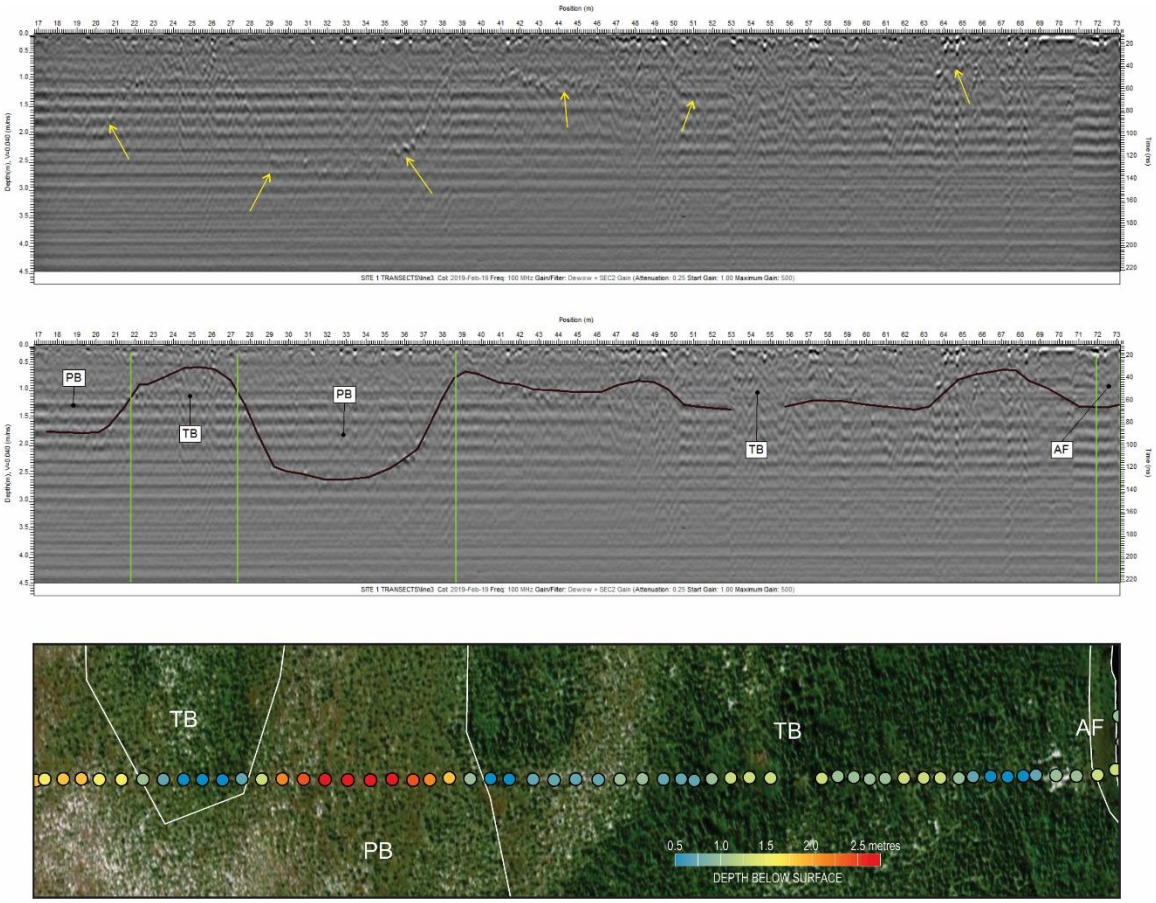


Figure 4. Portion of the GPR profile collected along a survey transect at SITE 1. TOP: GPR profile before interpretation; the reflector generated by the interface between the peat and the mineral soil / bedrock layers (indicated by the yellow arrows) shows up as a distinct white line within the profile stratigraphy. MIDDLE: Annotated profile with interpretation of the location of the peat / mineral interface (brown line); the interpretation polygon was used to generate the depth maps and statistics for each site, while the terrain type boundaries (in green) and terrain annotation was added to help with summarizing the statistical results. BOTTOM: The final colour-coded depth points (generated from the interpretation polyline), overlain on satellite orthoimagery and the terrain mapping datasets; the points represent the depth below surface (in metres) of the interpreted interface for every metre along the survey transect.

3.3 IDENTIFICATION OF ALTERNATIVE ROUTES

The selection of a final road route between Webequie First Nation and Esker Camp will rely on various social, culture, environmental, and engineering considerations. An initial road route provided by the community was used to establish a 2-km-wide corridor within which LiDAR data and orthoimagery were collected. In this study, the identification of route alternatives and the selection of an optimal route within the proposed route corridor from a terrain perspective follows the interpretation of terrain conditions and consideration of related engineering considerations. Terrain mapping characterized the landforms, surficial materials, topography, hydrology and groundwater conditions within the proposed corridor, which provided the basis for evaluating the favourability for route location and construction. Detailed engineering design, environmental, social and cultural factors will be considered by others in separate study components.

The following considerations served to guide the evaluation of all-weather road route alternatives in this study:

- Route length
- Surficial material (mineral vs organic soils)
- Bogs vs fens
- Topographic relief and slopes
- Ice-rich peat bogs and fens
- Extensive wetland & thermokarst-affected terrain
- Characteristics of river and stream crossings (width, approach slopes, *etc.)*
- Proximity to potential aggregate sources

Several route alternatives were identified with consideration to minimize the total route length, to follow routes that maximize terrain units of favourable constructability (*e.g.,* mineral soils), minimize units of poor constructability (*e.g.,* fens), minimize the number and widths of stream crossings, and minimize aggregate haul distances. While a shorter route is typically preferred, *ceteris paribus*, there can be environmental, engineering, social and economic advantages of an overall longer route that follows favourable terrain units and minimizes stream crossings. Terrain units with mineral soils are considered favourable for route construction, while those units with organic soils are considered unfavourable (Table 1). Bogs are preferred over fens because bogs typically have a lower water table and fewer open water areas. Treed bogs are considered more favourable than other bogs because the extensive tree cover hints at thinner organic cover with better drainage and roots anchored in mineral soils.

Table 1. Constructability Ranking

Constructability Ranking	Terrain units
Good	TL, ER, GF, AF*
Fair	TB, TK
Poor	DB, PB, NB, AF*
Very Poor	SF, CF, LF, HF, WF, AF*

*Alluvial floodplains exhibit various constructability rankings due to the variability observed in the imagery, ranging from mineral soils to aquatic vegetation.

3.4 WATER CROSSINGS

Surficial hydrology within the route corridor includes numerous streams, fens and bogs that will require various engineered water crossings. Overall, drainage of the area trends south to north, following the orientation of the fabric of glaciated landforms and ultimately draining into Hudson Bay. Stream crossings include both open water and flat alluvial floodplains. Many of the alluvial floodplains appear to feature extensive aquatic vegetation floating as a mat along the margins of the main open water channels. At these locations, the width of the water crossings should consider the area mapped as alluvial plain. Fens, particularly channel and ladder fens, having water tables at or near the surface and flowing groundwater gradients may also need to be treated as "water crossings" when considering engineering design options.

Stream crossings were characterized using the orthoimagery and LiDAR elevation data to describe the open water width, alluvial floodplain width, maximum slope, bank height, and terrain unit.

3.5 POTENTIAL AGGREGATE SOURCES

The road route corridor crosses an area of extensive wetlands and organic soils that limit prospects for potential aggregate sources. Aggregate prospects were identified while terrain mapping the route corridor. Air photo and satellite imagery, along with existing surficial geology maps, were used to identify granular landforms as potential sources of aggregate. Landforms created by meltwater processes during deglaciation are typically composed of sorted granular material. It is this relationship between landforms and materials that allows for granular prospects to be mapped by terrain analysis. Bedrock outcrops, with or without minimal overburden were identified and mapped as potential quarry sites.

The characteristics of the granular deposits and suitability and location of potential bedrock sources are as yet unproven. Field reconnaissance is required to describe and characterize the materials. At granular prospects, shallow test holes can be dug manually to a depth of a 30-60 cm to make an

initial assessment of material gradation and quality. At potential quarry sites, the lithology of rock and structural elements (fractures, bedding, foliation, *etc*.) visible at surface can be described to make an initial assessment of bedrock suitability for aggregate production. At the most promising sites drilling or deeper test pits would be required to fully assess the potential aggregate sources.

At the planning stage, the availability and distribution of construction material along a proposed route provides an important input to construction and maintenance cost estimates. Information compiled from the aggregate assessment will be provided regarding the material quality (gradation of granular material and lithology of bedrock), distance of source from the ROW, spacing along the ROW that can be used to optimize potential borrow sources, and potential access routes.

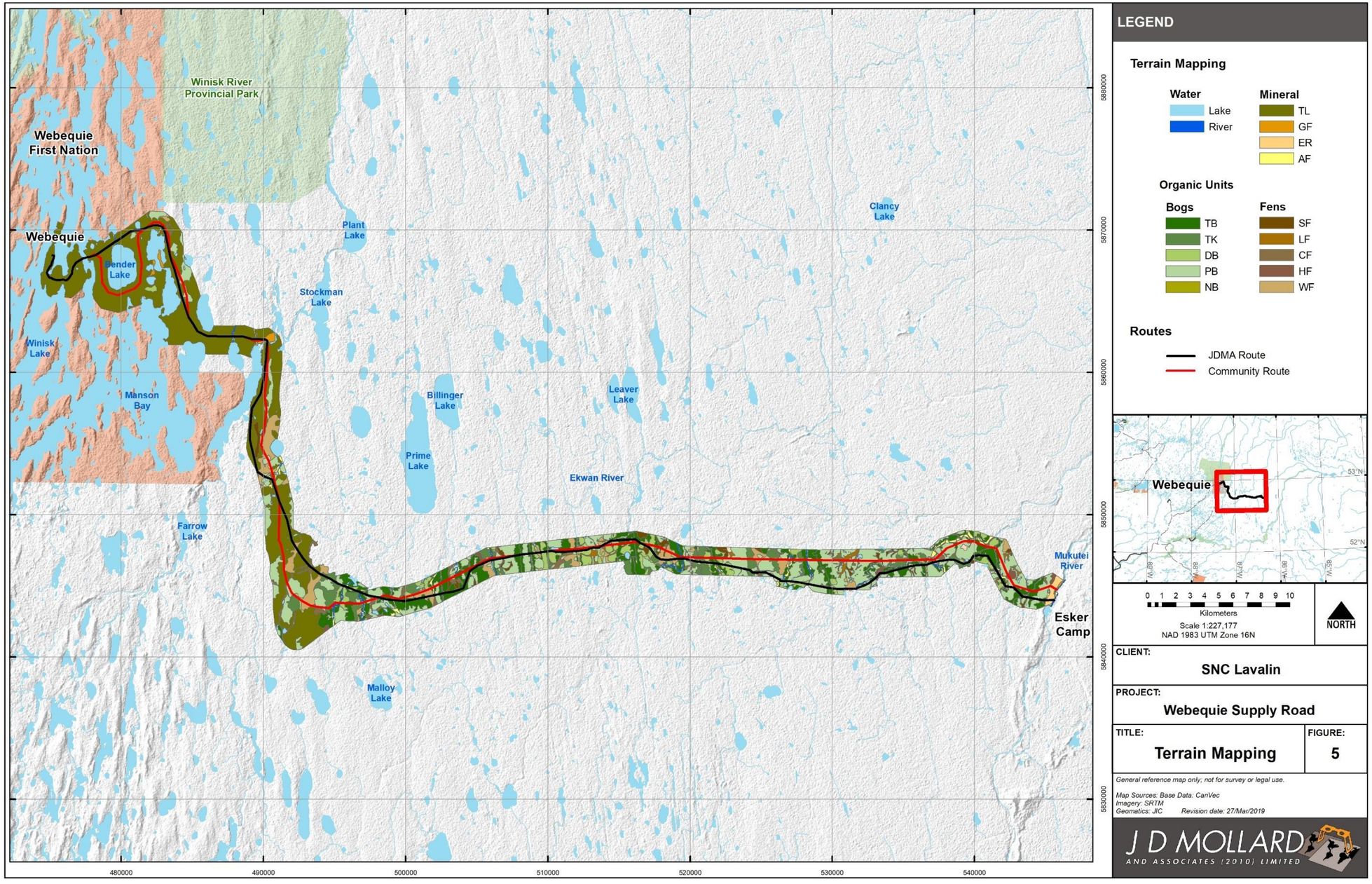
4 RESULTS

4.1 TERRAIN MAPPING

Terrain mapping was completed within the 2-km-wide corridor between the community of Webequie and the Mukutei River near Esker Camp (Figure 5). Large-scale maps are provided in Appendix 1. The total area mapped is 255.48 km^2, of which mineral terrains cover 87.12 km^2, organic terrains cover 133.33 km^2, and water (lakes and rivers) covers 35.03 km^2 (Table 2).

Table 2: Terrain units and area covered within the 2-km-wide Webequie Supply Road corridor

Terrain Units	Area (km^2)
Mineral Terrains	
TL	78.06
ER	0.95
GF	0.98
AF	7.13
Total Mineral Terrains	87.12
Organic Terrains	
Bogs	
DB	12.87
PB	51.32
TB	31.93
NB	0.22
TK	11.66
Total Bog Terrains	108.00
Fens	
SF	3.89
LF	1.72
CF	5.67
WF	12.84
HF	1.21
Total Fen Terrains	25.33
Total Organic Terrain	133.33
Water	
Lake	33.98
River	1.05
Total Water Terrains	35.03
Total	
Total	255.48



LEGEND

Terrain Mapping

Water	Mineral
Lake	TL
River	GF
	ER
	AF

Organic Units

Bogs	Fens
TB	SF
TK	LF
DB	CF
PB	HF
NB	WF

Routes

- JDMA Route
- Community Route

0 1 2 3 4 5 6 7 8 9 10
Kilometers
Scale 1:227,177
NAD 1983 UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

FIGURE: 5

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: SRTM
Geomatics: JIC *Revision date: 27/Mar/2019*

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4.2 GROUND PENETRATING RADAR

Figure 2 shows the locations where GPR surveys were conducted. Results are summarized below.

SITE 1

GPR SITE 1 is located on a long, narrow northern plateau bog near the eastern terminus of the proposed road route (Figure 6). The plateau bog is bordered to the east by a high esker ridge that overlooks the Muketei River and Noront's Esker Camp. The west border of the plateau bog is a series of narrow treed bogs draining into the small, unnamed creek to the west. GPR SITE 1 was considered one of two highest-priority sites for GPR data collection during the field program.

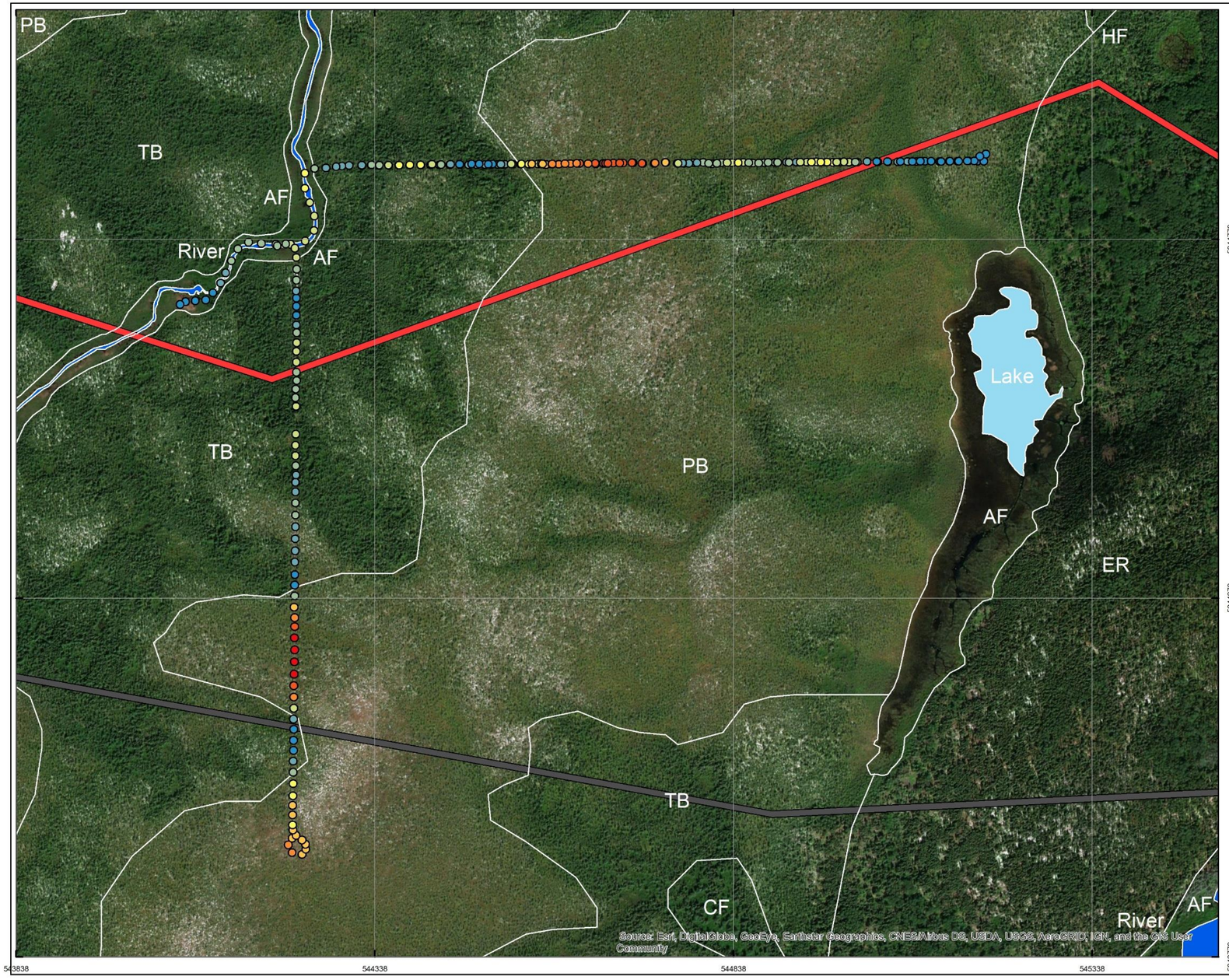
Two (2) GPR transects were surveyed at SITE 1, both taking advantage of existing seismic cut lines that allowed easy access through the dense forest on the treed bogs. Table 3a shows the average peat depth below for the two transects, along with the minimum and maximum depths observed and measure of standard deviation. Table 3b summarizes the average peat depth (and related statistics) for all transects in SITE 1.

Table 3a. GPR Site 1 – Summary of peat depth – by transect

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Transect 1-1				
Northern Plateau Bog (PB)	2.0 m	1.1 m	2.6 m	0.4
Treed Bog (TB)	1.0 m	0.6 m	2.6 m	0.2
Transect 1-2				
Northern Plateau Bog (PB)	1.3 m	0.5 m	2.3 m	0.6
Treed Bog (TB)	1.0 m	0.5 m	1.7 m	0.3

Table 3b. GPR Site 1 – Summary of peat depth – all transects

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Northern Plateau Bog (PB)	1.5 m	0.5 m	2.6 m	0.6
Treed Bog (TB)	1.0 m	0.5 m	1.7 m	0.3



LEGEND

Routes

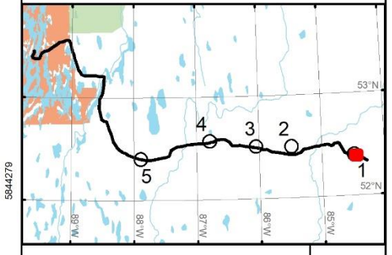
- JDMA Route
- Community Route

Interpreted Depth to Peat/Mineral Interface

Depth(m)

- < 0.75 m
- 0.75 - 1.0
- 1.0 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2.0
- 2.0 - 2.25
- 2.25 - 2.5
- > 2.5 m

0 100 200 300
Meters



Scale 1:5,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: GPR RESULTS SITE 1

FIGURE: 6

General reference map only; not for survey or legal use.

Map Sources: GPR Data: JDMA (c) 2019
Imagery: ESRI Base Imagery
Geomatics: TAZ Revision date: 28/Mar/2019

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SITE 2

GPR SITE 2 is located approximately 20 km west of SITE 1, on an extensive northern plateau bog dissected by a complex series of long, narrow ladder fens, watertrack fens, string fens, and channel fens (Figure 7). Several small ponds and areas of thermokarst are also scattered across the plateau. SITE 2 was considered the highest-priority site for GPR data collection during the field program.

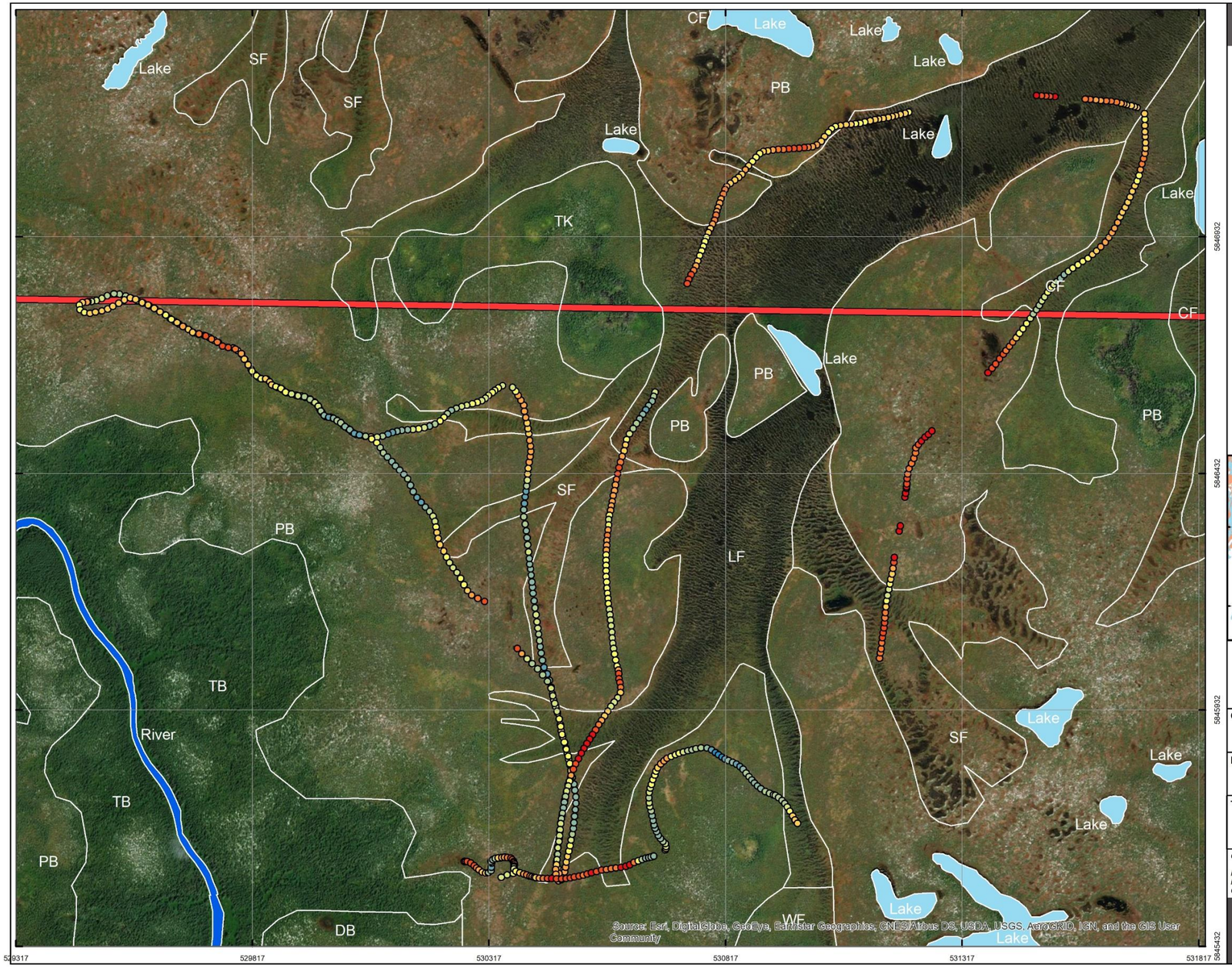
Four (4) GPR transects were surveyed at SITE 2, one running approximately west-east, two running approximately north-south, and the final one running northwest-southeast. Table 4a shows the average peat depth for each terrain type encountered, along with the minimum and maximum depths and measure of standard deviation. Table 4b summarizes the average depth, per terrain type, for all transects collected at SITE 2 combined.

Table 4a. GPR Site 2 Summary of peat depth – by transect

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Transect 2-1				
Northern Plateau Bog (PB)	2.6 m	1.4 m	3.8 m	0.7
Ladder Fen (LF)	3.3 m	2.4 m	3.9 m	0.5
Transect 2-2				
Northern Plateau Bog (PB)	3.6 m	2.2 m	5.0 m	0.6
String Fen (SF)	3.3 m	2.4 m	3.7 m	0.4
Channel Fen (F)	2.7 m	1.8 m	3.3 m	0.3
Transect 2-3				
Northern Plateau Bog (PB)	2.9 m	1.9 m	3.9 m	0.4
Ladder Fen (LF)	3.1 m	1.7 m	4.7 m	0.7
Channel Fen (F)	3.0 m	2.9 m	3.0 m	> 0.1
String Fen (SF)	3.5 m	3.3 m	3.6 m	0.1
Transect 2-4				
Northern Plateau Bog (PB)	2.5 m	1.6 m	3.8 m	0.6
Ladder Fen (LF)	2.3 m	1.8 m	3.0 m	0.4
String Fen (SF)	2.1 m	1.7 m	3.0 m	0.4

Table 4b. GPR Site 2 – Summary of peat depth – all transects

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Northern Plateau Bog (PB)	2.8 m	1.4 m	5.0 m	0.7
String Fen (SF)	2.6 m	1.7 m	3.7 m	0.7
Ladder Fen (LF)	3.0 m	1.7 m	4.7 m	0.7
Channel Fen (CF)	2.7 m	1.8 m	3.3 m	0.3



LEGEND

Routes

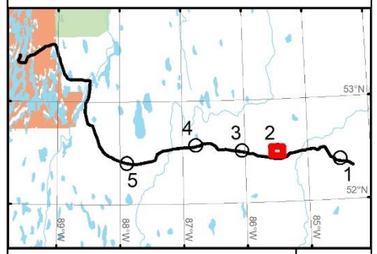
- JDMA Route
- Community Route

Interpreted Depth to Peat/Mineral Interface

Depth(m)

- < 1.5 m
- 1.5 - 1.75
- 1.75 - 2.0
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3.0
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- > 3.75 m

0 100 200 300 400
Meters



Scale 1:7,500
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT:
SNC Lavalin

PROJECT:
Webequie Supply Road

TITLE:
GPR RESULTS SITE 2

FIGURE:
7

General reference map only; not for survey or legal use.

Map Sources: GPR Data: JDMA (c) 2019
Imagery: ESRI Base Imagery
Geomatics: TAZ Revision date: 28/Mar/2019

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SITE 3

GPR SITE 3 is located approximately 7 km west of SITE 2. The area contains a mix of northern plateau and domed bogs with a few small, scattered areas of open water, treed bog and thin channels of string fen (Figure 8). SITE 3 is one of the widest (continuous) expanses of peatland within the proposed route corridor and so was considered high-priority for GPR data collection.

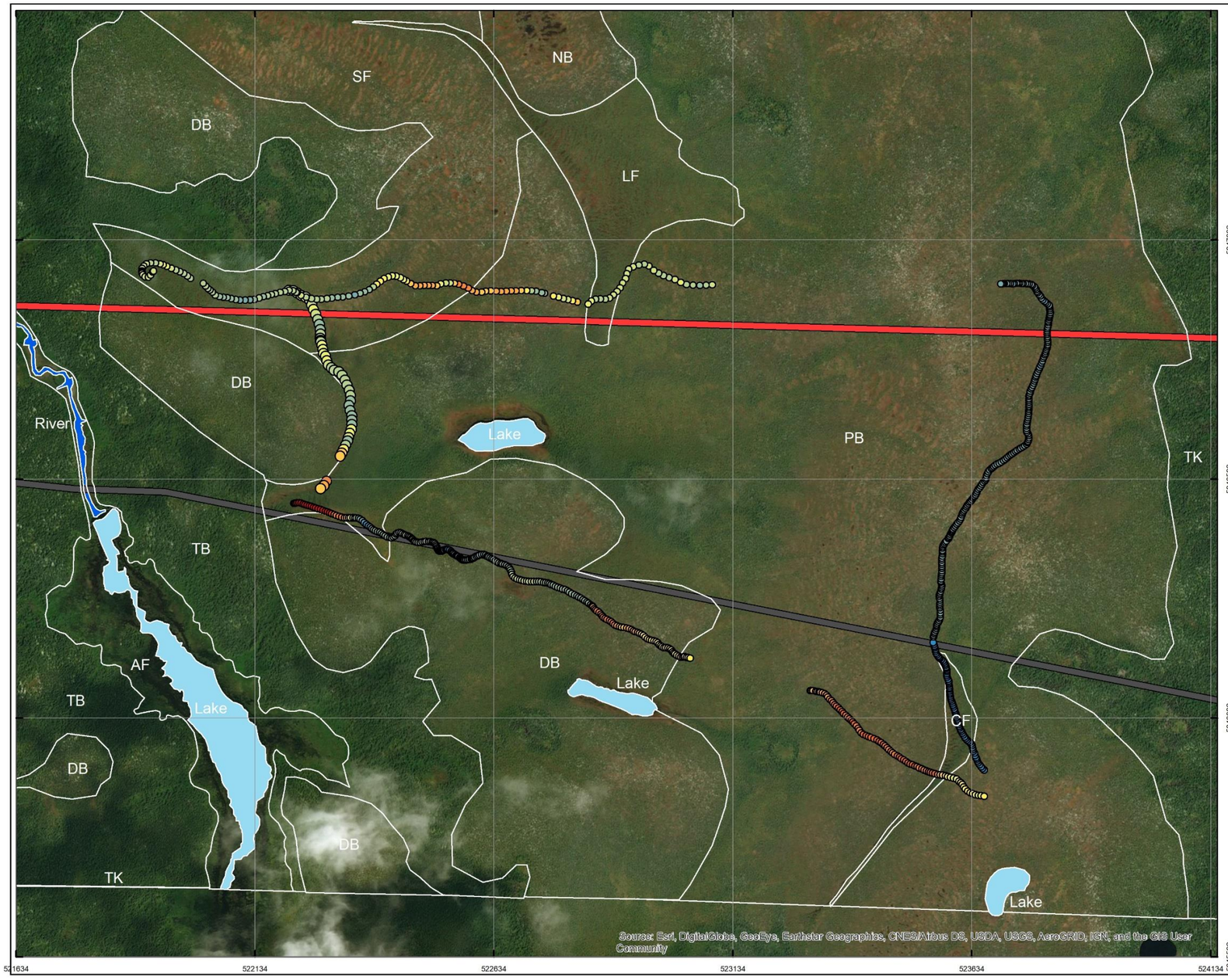
Four (4) GPR transects were surveyed at SITE 3, two running approximately west-east and two more running approximately north-south. Table 5a shows the average peat depth (along with minimum and maximum depths and measure of standard deviation), by terrain type, for each of the SITE 3 transects. Table 5b summarizes these statistics for all SITE 3 transects combined.

Table 5a. GPR Site 3 – Summary of peat depth – by transect

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Transect 3-1				
Northern Plateau Bog (PB)	3.3 m	1.2 m	4.3 m	0.8
Domed Bog (DB)	2.2 m	1.2 m	3.7 m	0.7
Channel Fen (CF)	3.0 m	2.8 m	3.2 m	0.2
Transect 3-2				
Northern Plateau Bog (PB)	1.5 m	1.2 m	1.7 m	0.1
Channel Fen (CF)	1.2 m	1.1m	1.3m	> 0.1
Transect 3-3				
Northern Plateau Bog (PB)	2.4 m	1.7 m	3.6 m	0.5
Ladder Fen (LF)	2.3 m	2.1 m	2.7 m	0.1
Transect 3-4				
Northern Plateau Bog (PB)	2.4 m	2.0 m	3.6 m	0.5
Domed Bog (DB)	2.4 m	1.9 m	3.1 m	0.4
Ladder Fen (LF)	2.3 m	1.8 m	2.6 m	0.2

Table 5b. GPR Site 3 – Summary of peat depth – all transects

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Northern Plateau Bog (PB)	2.2 m	1.2 m	4.3 m	0.9
Domed Bog (DB)	2.2 m	1.2 m	3.7 m	0.7
Ladder Fen (LF)	2.3 m	1.8 m	2.7 m	0.2
Channel Fen (CF)	1.3 m	1.2 m	3.2 m	0.4



LEGEND

Routes

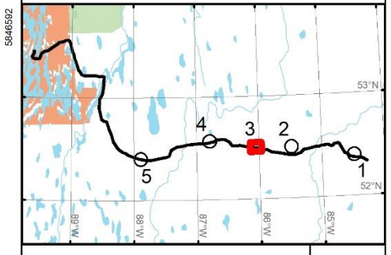
- JDMA Route
- Community Route

Interpreted Depth to Peat/Mineral Interface

Depth(m)

- < 1.25 m
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2.0
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3.0
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- 3.75 - 4.0
- 4.0 - 4.25
- > 4.25 m

0 100 200 300 400
Meters



Scale 1:7,500
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: GPR RESULTS SITE 3

FIGURE: 8

General reference map only; not for survey or legal use.

Map Sources: GPR Data: JDMA (c) 2019
Imagery: ESRI Base Imagery
Geomatics: TAZ Revision date: 28/Mar/2019

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SITE 4

GPR SITE 4 is located approximately 5 km east of the Ekwan River, and approximately 10 km west of SITE 3. The site is a complex mix of domed bogs and northern plateau bogs, with the different bog types separated by thin channels of ladder fen and string fen that radiate out from an extensive ladder fen on the southeast side of the site (Figure 9). A thin line of treed bog borders the site to the west.

Three (3) GPR transects were surveyed at SITE 4, all running approximately west-east across the survey site. Table 6a shows the average peat depth (along with minimum and maximum depths and measure of standard deviation), by terrain type, for each of the SITE 4 transects. Table 6b summarizes these statistics for all SITE 4 transects combined.

Table 6a. GPR Site 4 – Summary of peat depth – by transect

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Transect 4-1				
Domed Bog (DB)	1.0 m	0.7 m	1.3 m	0.2
Treed Bog (TB)	1.0 m	1.0 m	1.0 m	0.01
Transect 4-2				
Northern Plateau Bog (PB)	2.6 m	1.2 m	3.9 m	0.9
Domed Bog (DB)	1.8 m	1.3 m	2.0 m	0.3
Ladder Fen (LF)	1.9 m	1.0 m	3.7 m	0.7
Transect 4-3				
Northern Plateau Bog (PB)	2.6 m	1.5 m	3.6 m	0.5
Ladder Fen (LF)	1.9 m	1.1 m	3.3 m	0.5

Table 6b. GPR Site 4 – Summary of peat depth – all transects

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Northern Plateau Bog (PB)	2.6 m	1.2 m	3.9 m	0.8
Domed Bog (DB)	1.1 m	0.7 m	2.0 m	0.3
Treed Bog (TB)	1.0 m	1.0 m	1.0 m	> 0.1
Ladder Fen (LF)	1.9 m	1.0 m	3.7 m	0.6

LEGEND

Routes

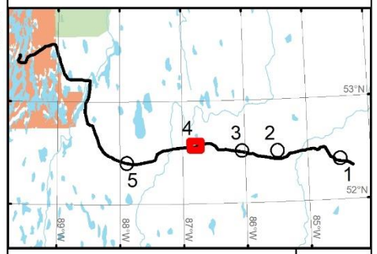
- JDMA Route
- Community Route

Interpreted Depth to Peat/Mineral Interface

Depth(m)

- < 1.25 m
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2.0
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3.0
- 3.0 - 3.25
- 3.25 - 3.5
- 3.5 - 3.75
- > 3.75 m

0 100 200 300 400
Meters



Scale 1:7,500
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT:
SNC Lavalin

PROJECT:
Webequie Supply Road

TITLE:
GPR RESULTS SITE 4

FIGURE:
9

General reference map only; not for survey or legal use.

Map Sources: GPR Data: JDMA (c) 2019
Imagery: ESRI Base Imagery
Geomatics: TAZ Revision date: 28/Mar/2019

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SITE 5

GPR SITE 5 is the western-most of the sites surveyed, located approximately 5 km west of the Ekwan River, and within a few kilometres of where the proposed route makes its main turn from north-south to east-west. SITE 5 consists of extensive areas of northern plateau bog dissected by bands of treed bog, channelized fens and open water (Figure 10). Areas of thermokarst terrain are also present along the edge of the treed bogs that border the site to the east.

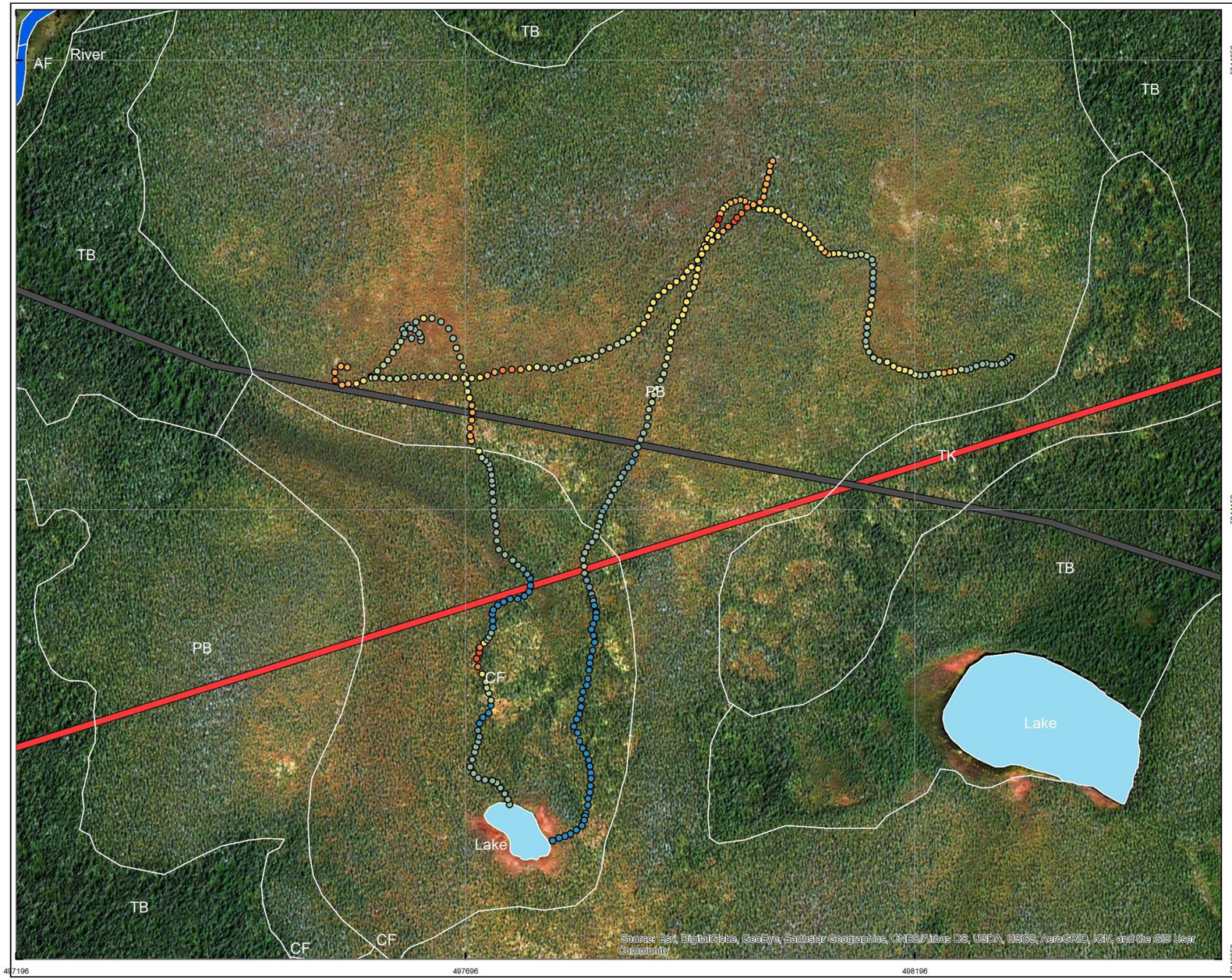
Three (3) GPR transects were surveyed at SITE 5, one running approximately west-east and the other two running approximately north-south. Table 7a shows the average peat depth (along with minimum and maximum depths and measure of standard deviation), by terrain type, for each of the SITE 5 transects. Table 7b summarizes these statistics for all SITE 5 transects combined.

Table 7a. GPR Site 5 – Summary of peat depth – by transect

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Transect 5-1				
Northern Plateau Bog (PB)	2.3 m	1.6 m	3.2 m	0.4 m
Transect 5-2				
Northern Plateau Bog (PB)	2.0 m	1.4 m	3.3 m	0.4
Channel Fen (CF)	1.2 m	1.0 m	1.8 m	0.2
Transect 5-3				
Channel Fen (CF)	1.7 m	1.2 m	3.1 m	0.5

Table 7b. GPR Site 5 – Summary of peat depth – all transects

Terrain Type	Avg Depth	Min Depth	Max Dept	STD DEV
Northern Plateau Bog (PB)	2.1 m	1.4 m	3.3 m	0.4
Channel Fen (CF)	1.6 m	1.0 m	3.1 m	0.5



LEGEND

Routes

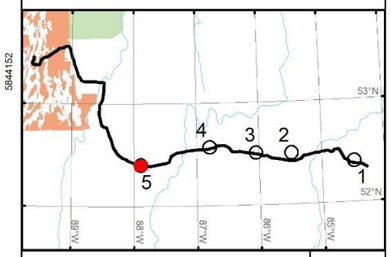
- JDMA Route
- Community Route

Interpreted Depth to Peat/Mineral Interface

Depth(m)

- < 1.25 metres
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2.0
- 2.0 - 2.25
- 2.25 - 2.5
- 2.5 - 2.75
- 2.75 - 3.0
- 3.0 - 3.25
- > 3.25 metres

0 100 200
Meters



Scale 1:4,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT:
SNC Lavalin

PROJECT:
Webequie Supply Road

TITLE:
GPR RESULTS SITE 5

FIGURE:
10

General reference map only; not for survey or legal use.

Map Sources: GPR Data: JDMA (c) 2019
Imagery: ESRI Base Imagery
Geomatics: TAZ Revision date: 28/Mar/2019

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Peat Thickness Summary

Peat thickness varied for each of the terrain units at the five GPR testing areas, with depths ranging from 0.5 m to 5.0 m (Tables 8a and 8b). Overall these observations suggest that, with the exception of treed bogs, peat thickness is similar in bogs and fens with common thicknesses of 1-3 m and maximum thicknesses up to 5 m. Peat thickness in treed bogs is generally less than 2 m.

Table 8a. Summaries of peat depths for terrain units at each of the five survey sites

	SITE 1			SITE 2			SITE 3			SITE 4			SITE 5		
TERRAIN TYPE	AVG Depth	MIN Depth	MAX Depth	AVG Depth	MIN Depth	MAX Depth	AVG Depth	MIN Depth	MAX Depth	AVG Depth	MIN Depth	MAX Depth	AVG Depth	MIN Depth	MAX Depth
Domed Bog (DB)	---	---	---	---	---	---	2.2 m	1.2 m	3.7 m	1.1 m	0.7 m	2.0 m	---	---	---
Plateau Bog (PB)	1.5 m	0.5 m	2.6 m	2.8 m	1.4 m	5.0 m	2.2 m	1.2 m	4.3 m	2.6 m	1.2 m	3.9 m	2.1 m	1.4 m	3.3 m
Treed Bog (TB)	1.0 m	0.5 m	1.7 m	---	---	---	---	---	---	1.0 m	1.0 m	1.0 m	---	---	---
String Fen (SF)	---	---	---	2.6 m	1.7 m	3.7 m	---	---	---	---	---	---	---	---	---
Ladder Fen (LF)	---	---	---	3.0 m	1.7 m	4.7 m	2.3 m	1.8 m	2.7 m	1.9 m	1.0 m	3.7 m	---	---	---
Channel Fen (CF)	---	---	---	2.7 m	1.8 m	3.3 m	1.3 m	1.2 m	3.2 m	---	---	---	1.6 m	1.0 m	3.1 m

The range of values observed for each of the terrain units at all of the testing locations is summarized in Table 8b. In 2010, JDMA conducted field work, including peat probing, outside of the Webequie route corridor to the south (see Figure 2), but within similar terrain units. At these sites of peat probing, peat thickness was observed between 1.0 and 4.7 m, which is consistent with the range of thicknesses observed with the GPR data.

Table 8b. Summary of peat depths for all five GPR survey sites. Note the last row shows the range of peat depths measured from peat probing in 2010.

Summary of peat depth ranges		
Terrain Type	**Min Depth**	**Max Depth**
Domed Bog (DB)	0.7 m	3.7 m
Plateau Bog (PB)	0.5 m	5.0 m
Treed Bog (TB)	0.5 m	1.0 m
String Fen (SF)	1.7 m	3.7 m
Ladder Fen (LF)	1.0 m	4.7 m
Channel Fen (CF)	1.0 m	3.3 m
Peat depths measured in 2010 (Figure 2)	1.0 m	4.7 m

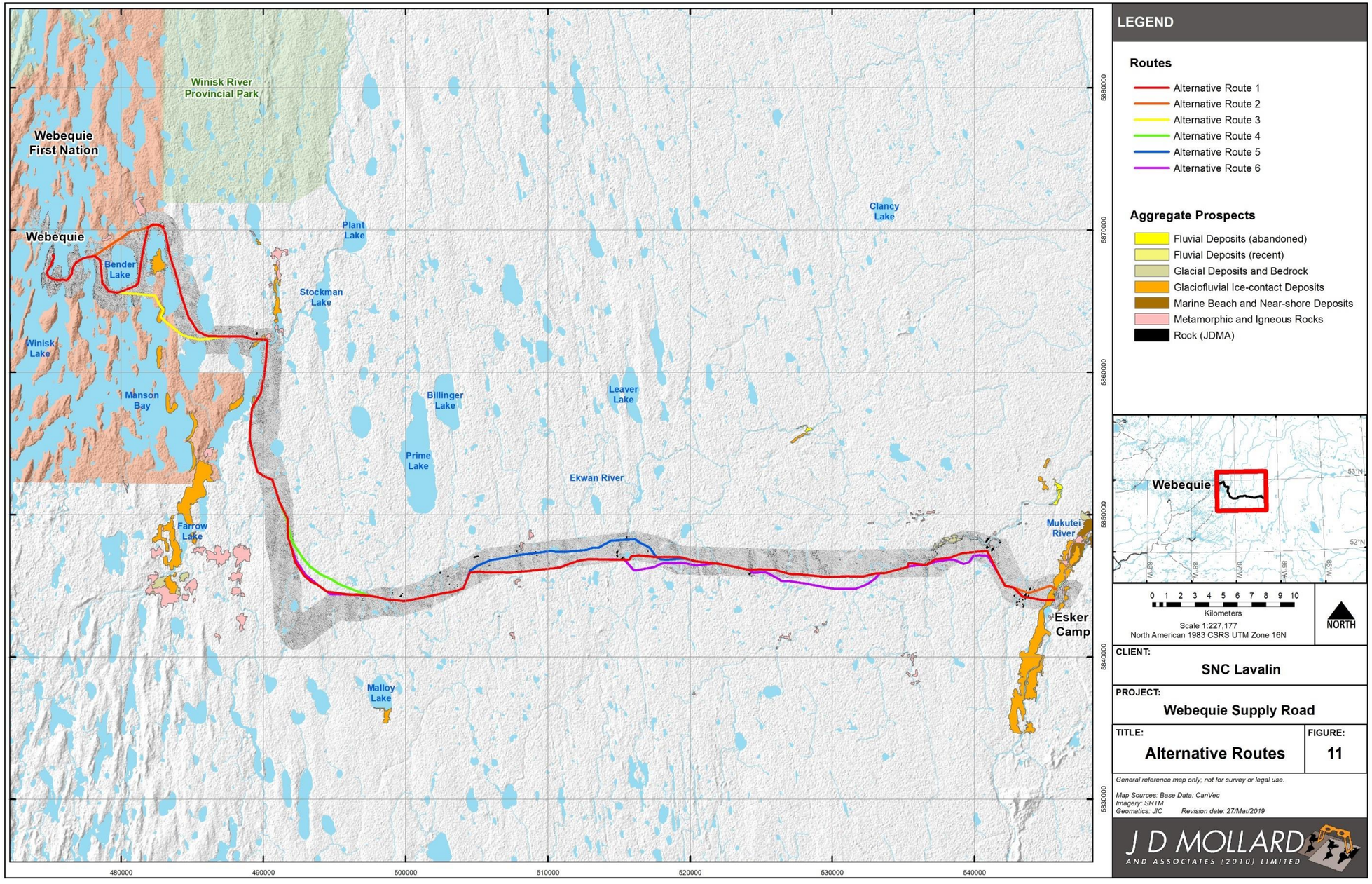
4.3 ROUTING

4.3.1 ROUTE ALTERNATIVES

A total of six alternative routes were mapped within the proposed corridor, each of which share various common segments and differ along other segments that offer advantages and disadvantages. An overview map of the routes is provided in Figure 11 and more detailed maps are included in Appendix 1. Table 9 provides a summary of lengths of route over each terrain unit. Routes 1, 2, and 3 differ only in the westernmost portions around Winisk Lake and Bender Lake in the approach to Webequie (Figure 11). Routes 1 and 2 diverge around Bender Lake, with Route 1 following a longer path around the south of the lake and Route 2 taking the shorter path to the north that requires a small channel crossing. The advantages of Route 1 are that it avoids a small stream crossing and provides access to the south side of Bender Lake, but at the disadvantage of a longer route. Nevertheless, the community has expressed preference for the route to follow south of Bender Lake. East of Bender Lake, these routes both pass around the northern end of a long embayment of Winisk Lake. Route 3 cuts across a narrow potion of this embayment of Winisk Lake and passes to the south of Bender Lake, which results in a much shorter route, but requires a channel crossing over the embayment.

Routes 4, 5, and 6 share the same path east from Webequie and along the main north-south segment (Figure 11). These routes differ mainly along the west-east segment that crosses the extensive organic terrains and in the point of crossing the Mukutei River. The challenge along this portion of the route corridor is minimizing routing across the extensive fens and water crossings. Among the most significant fens occurs just west of the Mukutei River tributary where multiple fens extend north-south nearly across the entire width of the corridor. Routes 4 and 5 avoid most of the fens by diverting to the south and following an alignment between two fens, while staying within the proposed route corridor. Route 5 diverts farther south, outside the proposed corridor, to limit these fen crossings. The southern path of this route also avoids other fens to the west before re-joining with Routes 4 and 5 (Figure 11).

Another difference in routes occurs along the section of the corridor crossed by multiple tributaries of the Ekwan River where there are extensive fens. Routes 4 and 6 divert to the south within the corridor while Route 5 follows a more central location (Figure 11).



LEGEND

Routes

- Alternative Route 1
- Alternative Route 2
- Alternative Route 3
- Alternative Route 4
- Alternative Route 5
- Alternative Route 6

Aggregate Prospects

- Fluvial Deposits (abandoned)
- Fluvial Deposits (recent)
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-contact Deposits
- Marine Beach and Near-shore Deposits
- Metamorphic and Igneous Rocks
- Rock (JDMA)

0 1 2 3 4 5 6 7 8 9 10
Kilometers
Scale 1:227,177
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: **SNC Lavalin**

PROJECT: **Webequie Supply Road**

TITLE: **Alternative Routes**

FIGURE: **11**

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: SRTM
Geomatics: JIC *Revision date: 27/Mar/2019*

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Table 9. Terrain unit length (km) on route alternatives.

Terrain Units	Route 1 Length (km)	Route 2 Length (km)	Route 3 Length (km)	Route 4 Length (km)	Route 5 Length (km)	Route 6 Length (km)
Mineral Terrains						
TL	44.78	39.88	37.48	44.36	44.78	44.51
ER	0.55	0.56	0.56	0.56	0.56	0.56
GF	0.61	0.65	0.65	0.65	0.65	0.65
AF	2.13	2.13	2.01	2.01	2.21	1.82
Organic Terrains						
Bogs						
DB	5.37	5.37	5.39	5.53	5.22	5.95
PB	15.09	15.35	15.33	15.61	14.99	14.25
TB	20.01	19.94	19.94	20.37	22.02	19.82
TK	6.33	6.33	6.33	5.34	5.46	7.87
Fens						
SF	0.38	0.38	0.38	0.38	0.53	0.61
LF	0.30	0.30	0.30	0.30	0.29	0.08
CF	2.18	2.11	2.09	2.19	2.00	1.87
WF	4.89	4.89	4.89	4.77	4.59	5.11
HF	0.34	0.34	0.34	0.34	0.56	0.49
Water Crossings						
Water	0.68	0.68	0.85	0.68	0.67	0.58
Total						
Total	103.63	98.89	96.52	102.98	104.52	104.18

4.3.2 Optimal Route from Terrain Analysis

An optimal route from a terrain perspective was identified by picking segments from the competing alternative routes that meet the major criteria of route length, terrain conditions, stream crossings, and proximity to aggregate sources (Figure 12 and Table 10). Appendix 1 provides enlarged maps of the route. The optimal route minimizes total length in two main locations. The first is in the area southwest of Prime Lake, where the corridor transitions from north-south to east-west at nearly a right angle. By crossing outside of the corridor to the north, the optimal route cuts the overall length without adding additional water crossings. The second key location is around Bender Lake, where the optimal route crosses the shorter path northward around the lake.

The optimal route minimizes the length of route crossing terrain units considered to have a poor constructability ranking (see Tables 1 and 11), in particular the various types of fens that feature organic soils and a water table at surface. Overall, this results in a route that is slightly south of the

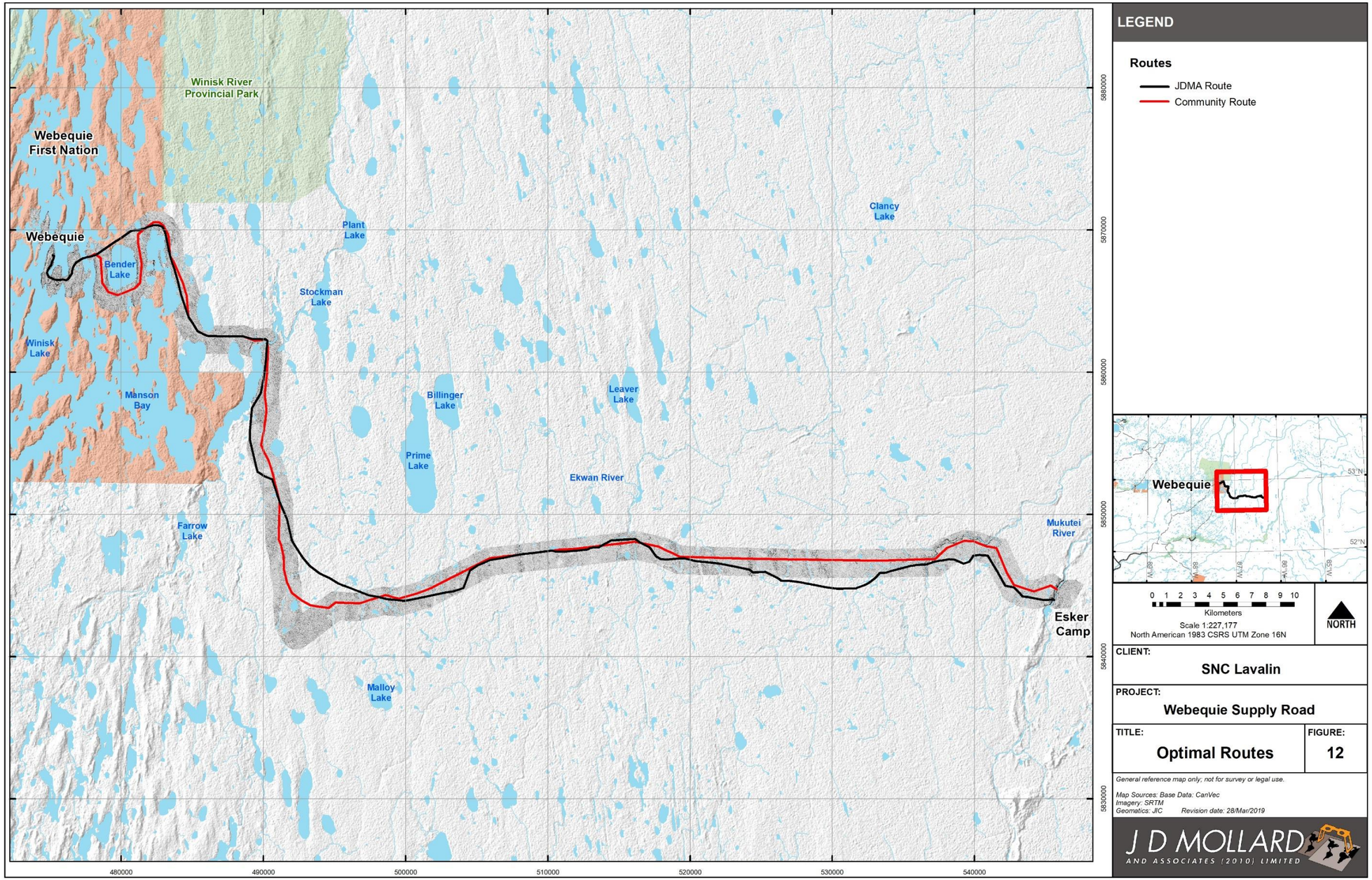
original community-selected route along the east-west extent and that lies outside of the 2-km-wide LiDAR corridor along a small portion of the route.

Table 10. Route length of terrain units on the optimal JDMA route and the community route.

Terrain Units	Optimal JDMA Route Length (km)	Community Route Length (km)
Mineral Terrains		
TL	39.33	41.13
ER	0.56	0.56
GF	0.61	0.69
AF	2.11	2.20
Organic Terrains		
Bogs		
DB	6.44	7.43
PB	13.89	22.94
TB	21.95	13.30
TK	4.94	4.95
Fens		
SF	0.77	1.20
LF	0.06	0.78
CF	1.76	2.49
WF	5.37	6.74
HF	0.71	0.54
Water Crossings		
Water	0.53	0.92
Total		
Total	99.04	105.88

Table 11. Length of constructability rankings on the optimal JDMA route and the community route.

Constructability Ranking	Optimal JDMA Route Length (km)	Community Route Length (km)
Good	40.50	42.39
Fair	26.89	18.26
Poor	20.83	31.18
Very Poor	10.29	13.13
Water Crossing	0.53	0.92
Total	99.04	105.88



LEGEND

Routes

- JDMA Route
- Community Route

0 1 2 3 4 5 6 7 8 9 10
Kilometers
Scale 1:227,177
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Optimal Routes

FIGURE: 12

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: SRTM
Geomatics: JIC *Revision date: 28/Mar/2019*

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4.4 WATER CROSSINGS

Water crossings, shown in Figure 13, were characterized by open water width, alluvial floodplain width, maximum slope, bank height, and adjacent terrain types. Table 12 summarizes crossings for the community route (C1 to C23) and Table 13 summarizes the result for the optimal JDMA route (J1 to J23). Appendix 2 provides a large-scale image, slope raster, and cross-sections for each of the water crossings along both the community and JDMA routes. Drainage across the east-west portion of the corridor, flows typically toward the north-northeast, draining northward into larger lakes like Prime Lake or Billinger Lake or into one of the larger river systems like the Ekwan River and the Mukutei River. Along the western portion of the corridor, which trends north-south and is covered largely by glacial terrains, the surficial drainage features fewer stream crossings than the east-west section of the corridor.

Most stream crossings exhibit relief of less than a few metres and cross flat alluvial floodplains that feature floating aquatic vegetation, have water tables near the surface, and are subject to flooding. The widest crossing, spanning approximately 250 m, is from Eastwood Island to the mainland (J23 and C23). Two of the most deeply incised stream crossings on both the optimal JDMA route and the community route, crossings 1 and 21 in both cases, appear to cut into glacial deposits (including glaciofluvial material) over bedrock. The Mukutei River (J1 and C1) crossing encounters the greatest bank heights of up to 20 m and slopes of up to 30 degrees on the west bank that consists of a large ice-contact glaciofluvial landform. The river crossing entering Stockman Lake (J21 and C21) spans a channel between two lakes and exhibits bank heights of up to 7.5 m and slopes of up to 23 degrees. The channel is cut through glacial sediment, with till on the south bank and glaciofluvial deposits on the north bank.

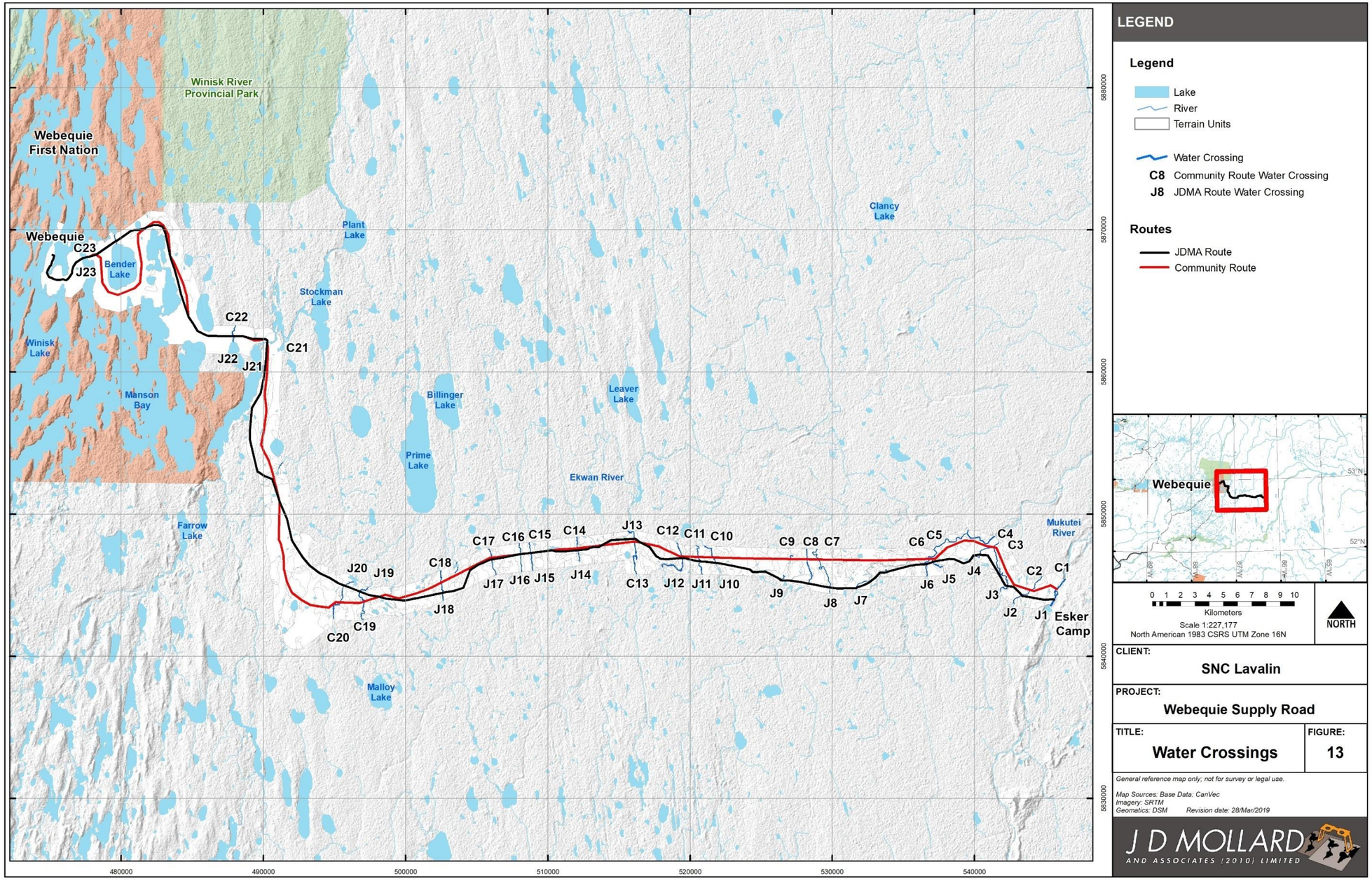
Table 12. Summary of water crossings along the community route

ID	Easting	Northing	Open Water Width	Alluvial Floodplain Width	Slope Max (degree)	Bank Height	Material
C1	545790	6844725	22	-	28	14	Esker: large steep slope
C2	544000	5844646	2.5	33	15	1	Treed Bog
C3	541370	5847665	28	49	11	2.5	Treed Bog
C4	541304	5847678	1.5	14	8	1	Treed Bog
C5	537013	5846847	5	53	26	4	Bog: Eroded valley
C6	536820	5846842	18	-	35	6	Till-Alluvial floodplain
C7	529066	5846800	16	-	28	3.5	Treed bog: channel
C8	528230	5846815	9	55	6	1	Treed-Plateau Bog
C9	527015	5846833	5	62	8	1	Treed Bog

C10	521566	5846956	8	48	8	1	Treed Bog
C11	520605	5846983	4.5	50	4	0.5	Thermokarst
C12	519420	5847015	12	108	6	0.5	Treed Bog
C13	516070	5848070	38	-	18	2.5	Treed Bog
C14	512045	5847600	30	200	6	0.5	Alluvial flood plain
C15	508765	5847270	8	100	9	1.5	Treed Bog
C16	508110	5847190	25	-	18	3.5	Treed Bog: channel
C17	506030	5846930	3	100	4	0.5	Bog-Fen: flat
C18	502472	5845167	12	62	12	2	Treed Bog
C19	497088	5843853	47	150	6	1	Treed Bog
C20	495405	5843792	3	41	8	1.5	Bog
C21	490280	5862110	44	54	23	7.5	Till-Glaciofluvial
C22	487910	5862520	15	102	14	1.5	Till
C23	477505	5868075	250	-	10	6	Till

Table 13. Summary of water crossings along the optimal JDMA Route

ID	Easting	Northing	Open Water Width	Alluvial Floodplain Width	Slope Max (degree)	Bank Height	Material
J1	545600	5843980	21	-	26	20	Esker: large steep slope
J2	543340	5844285	4	35	6	0.5	Treed Bog
J3	542295	5844955	10	145	6	0.5	Alluvial flood plain
J4	540430	5847145	1.5	100	11	1	Alluvial flood plain
J5	537080	5846650	3	50	16	4.5	Till-Bog: Eroded valley
J6	536645	5846490	21	200	26	7.5	Plateau Bog
J7	531690	5844820	4.5	32	-	-	Bog-Fen: flat
J8	529807	5844837	10	-	-	-	Treed Bog
J9	526262	5845452	2	140	-	-	Alluvial flood plain
J10	521777	5846572	7	29	7	-	Treed Bog
J11	520715	5846680	5	190	2	0.5	Alluvial flood plain
J12	519430	5846905	6	80	4	1.5	Treed Bog
J13	516050	5848263	13	-	22	3.5	Treed Bog
J14	512115	5847455	7.5	200	3	0.5	Alluvial flood plain
J15	508765	5847268	8	102	9	2.5	Alluvial flood plain
J16	508108	5847268	26	-	18	3.5	Treed Bog: channel
J17	506053	5846810	3	100	4	0.5	Fen-Bog: Flat
J18	502597	5844467	10	85	12	1	Treed Bog
J19	496850	5844530	15	42	8	1.5	Treed Bog
J20	495687	5844978	3	46	-	-	Treed Bog
J21	490280	5862110	44	54	23	7.5	Till-Glaciofluvial
J22	487910	5862520	15	102	14	1.5	Till
J23	477505	5868075	250	-	10	6	Till



LEGEND

Legend

- Lake
- River
- Terrain Units
- Water Crossing
- **C8** Community Route Water Crossing
- **J8** JDMA Route Water Crossing

Routes

- JDMA Route
- Community Route

0 1 2 3 4 5 6 7 8 9 10
Kilometers
Scale 1:227,177
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Water Crossings

FIGURE: 13

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: SRTM
Geomatics: DSM *Revision date: 28/Mar/2019*

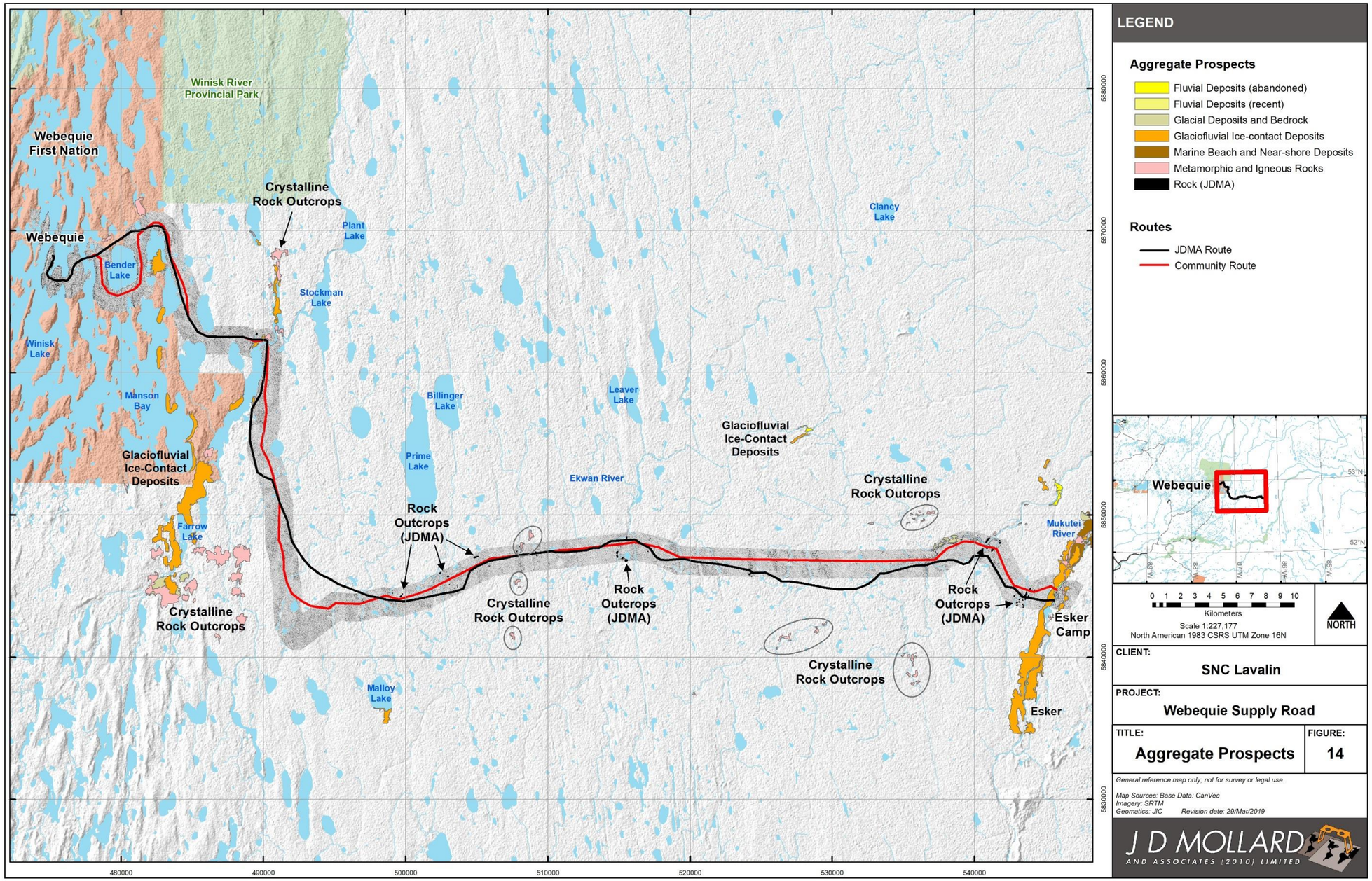
J D MOLLARD AND ASSOCIATES (2010) LIMITED

4.5 POTENTIAL AGGREGATE SOURCES

The Webequie Supply Road corridor crosses mostly glacial till along the north-south trending western section and extensive peatlands and organic soils along the east-west trending eastern section, which make identifying potential aggregate prospects a challenge. Potential aggregate sources are shown in Figure 14. Extensive, roughly north-south trending, ice-contact glaciofluvial systems are known to exist near the east and west ends of the proposed corridor and may provide a source of surficial granular material (Barnett *et al*., 2013, Surficial Maps P3696 and P3697). Near Esker Camp, on the west side of the Mukutei River, there is a large esker/ice-contact glaciofluvial deposit that trends north-northeast and is among the largest granular prospects in the region. The gradation of this feature needs to be field tested because despite being of glaciofluvial origin, discussions with people at Esker Camp suggest that the esker material is silty and lacks a significant coarse fraction. Near the western section of the route, there is an ice-contact glaciofluvial deposit that is most extensive to the west and north of Farrow Lake and that extends discontinuously northward along the eastern side of Manson Bay on Winisk Lake. In addition to these two large prospects, a smaller ice-contact glaciofluvial landform occurs within the corridor and extends northward west of Stockman Lake. Given that these are ice-contact glaciofluvial landforms, which are typically associated with granular material, and their proximity to the corridor, these landforms should be considered aggregate prospects and tested in the field to determine the material properties.

Bedrock outcrops scattered across the length of the corridor and in proximity to route alternatives offer potential quarry rock sources. The lithology of rock in the area is mapped as metamorphic and igneous. The largest outcrops occur south and east of Farrow Lake located west of the corridor. These areas likely provide the most surficial exposure to characterize the bedrock. Other bedrock outcrops are smaller and occur both inside and outside the corridor. While these smaller outcrops offer less exposure to characterize the bedrock, the bedrock will extend to great depth and lateral extent beyond the outcrop.

The characteristics of the granular deposits and suitability and location of potential bedrock sources are as yet unproven by field testing. Field reconnaissance is required to describe and characterize the material. Without drilling equipment, a simple initial field program is recommended where granular prospects are tested by digging shallow test holes to depths of 30-60 cm to assess the material gradation and quality. Where rock or quarry prospects are visited, the lithology and structural elements (fractures, bedding, foliation, *etc*.) visible at surface can be described.



LEGEND

Aggregate Prospects

- Fluvial Deposits (abandoned)
- Fluvial Deposits (recent)
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-contact Deposits
- Marine Beach and Near-shore Deposits
- Metamorphic and Igneous Rocks
- Rock (JDMA)

Routes

- JDMA Route
- Community Route

0 1 2 3 4 5 6 7 8 9 10
Kilometers
Scale 1:227,177
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Aggregate Prospects

FIGURE: 14

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: SRTM
Geomatics: JFC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED

5 SUMMARY

This study was undertaken as part of the Environmental Assessment and Preliminary Engineering Services for Webequie First Nation's Supply Road Project. J.D. Mollard and Associates (2010) Limited was sub-contracted by SNC Lavalin to conduct terrain mapping within the proposed community corridor to facilitate identification of potential aggregate sources, characterize stream crossings, map competing route alternatives, and identify an optimal route based on terrain and related engineering considerations.

Terrain studies focussed on a 2-km-wide routing corridor that was selected by community members based on engagement with the community as a whole, youth representatives, elders, and the Webequie land use planning committee. The corridor selected by the community is approximately 107 km in length (extending about 51 km toward the south-southeast from Webequie before turning east for about 56 km toward Esker Camp), and 2 km in width.

Six viable route alternatives were identified within the community-selected routing corridor and an optimal route was identified that provides a balance of length, terrain conditions for road construction and maintenance, stream crossings and proximity to potential aggregate sources. The optimal route is 99 km in length crossing approximately 67 km of terrain with fair to good constructability, 21 km of poor constructability, 10 km of very poor constructability and 0.5 km of water crossings.

Twenty-three stream crossings were identified on the optimal route with the majority having less than 3 m of relief and open water widths ranging from 3 to 250 m. The maximum crossing relief is 20 m at the Mutukei River. The widest crossing is 250 m from Eastwood Island to the mainland.

Peat thicknesses from ground penetrating radar surveys range from 0.5 to 5.0 m in bogs and from 1.0 to 4.7 m in fens. These depths are consistent with peat depths measured south of the corridor in 2010 but they have not been confirmed in the field. This is recommended in subsequent field studies.

A number of potential aggregate sources have been identified including glacial granular deposits and bedrock outcrops. Glacial granular sources are concentrated in large glaciofluvial deposits at the east and west ends of the study area. Bedrock outcrops are present within and outside of the routing corridor and are distributed across the study area. Field reconnaissance of these locations is required to better assess their potential.

Although an optimal route has been identified based on terrain and related engineering factors, selection of a final preferred route will require consideration of detailed engineering, social, cultural and environmental factors in additional studies.

REPORT SIGNATURE PAGE

J.D. Mollard and Associates (2010) Limited

Jason Cosford, Ph.D., P.Geo.

Lynden Penner, M.Sc., P.Eng., P.Geo.

Troy Zimmer, B.Sc., Hons. Dpl. (Bioscience), MCRSS

APPENDIX 1: Terrain Mapping

LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

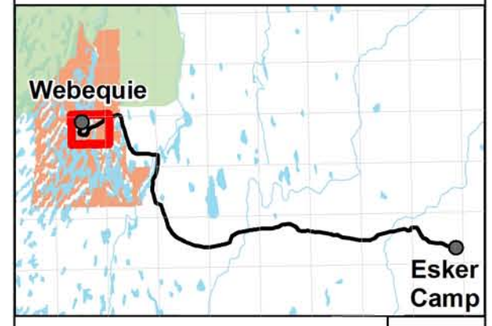
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

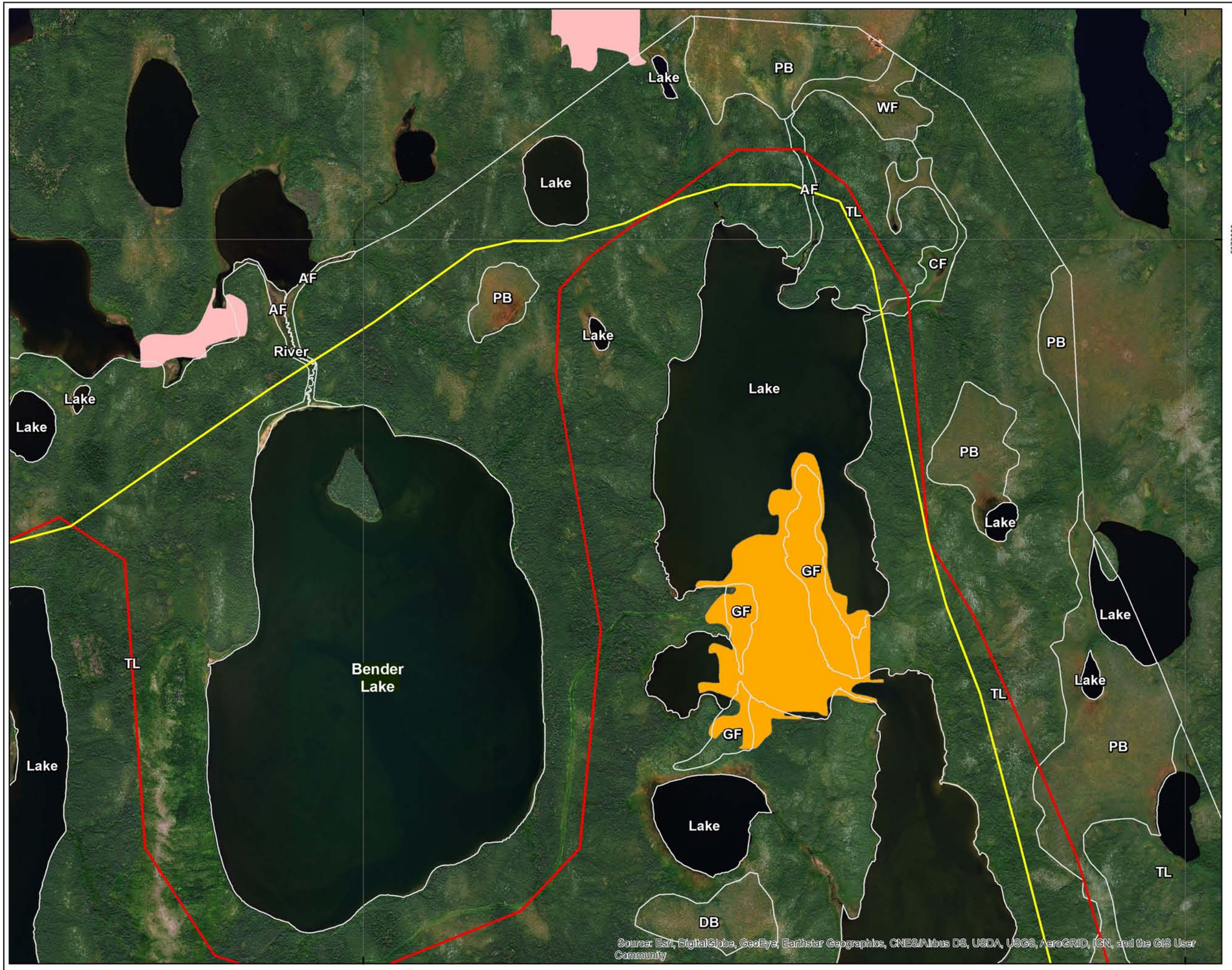
TITLE: Terrain Mapping

FIGURE: TM1

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

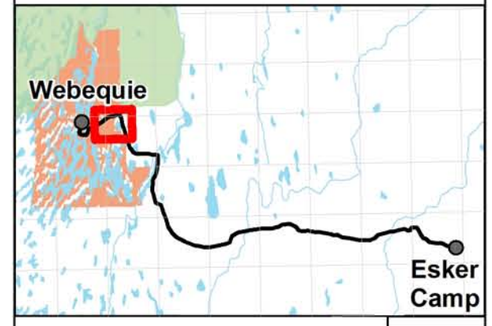
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

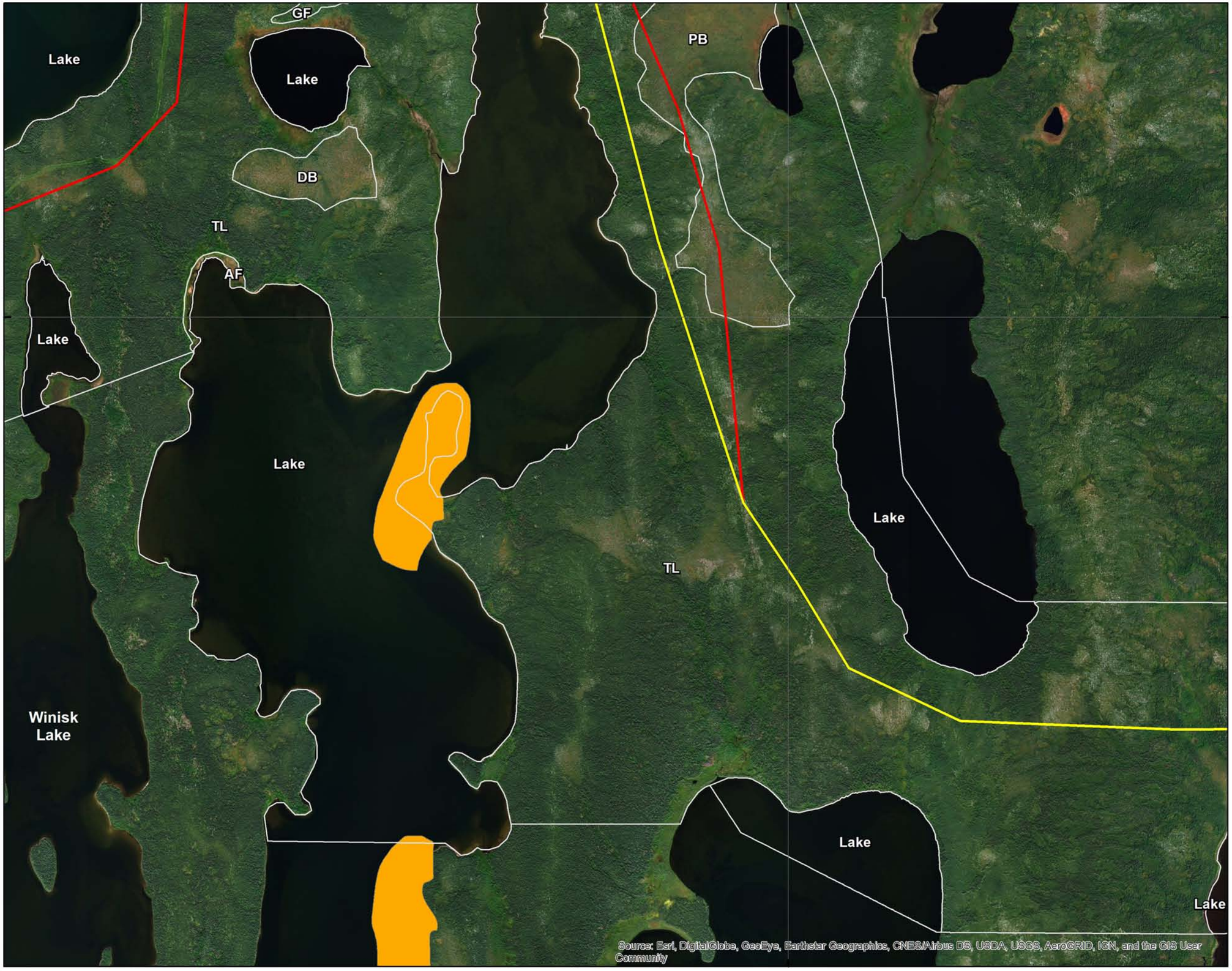
TITLE: Terrain Mapping

FIGURE: TM2

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

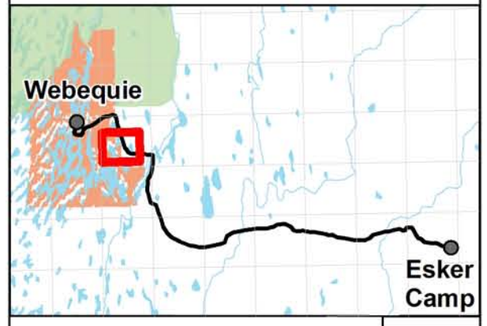
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

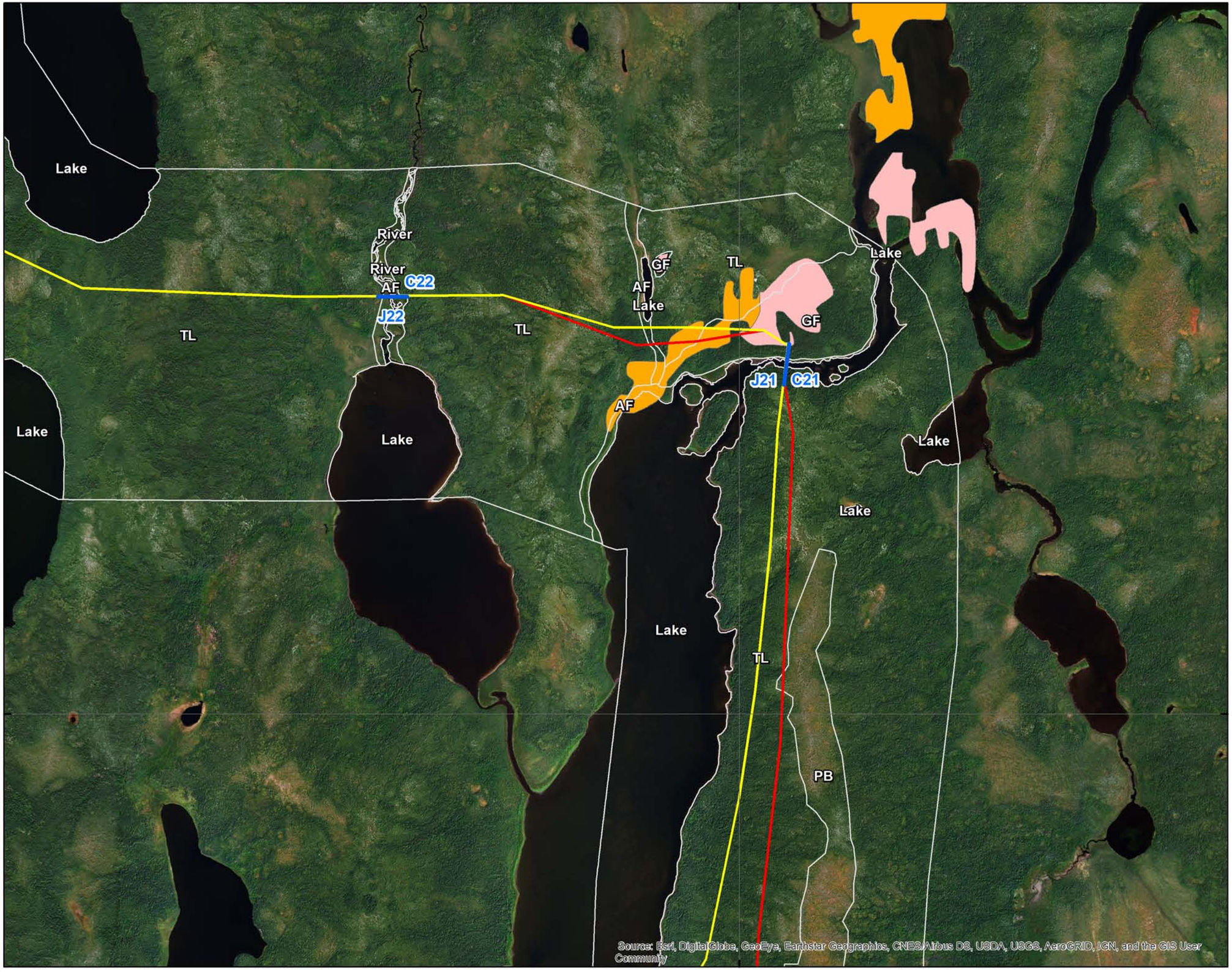
TITLE: Terrain Mapping

FIGURE: TM3

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

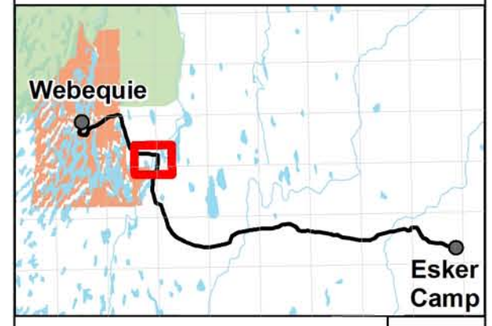
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

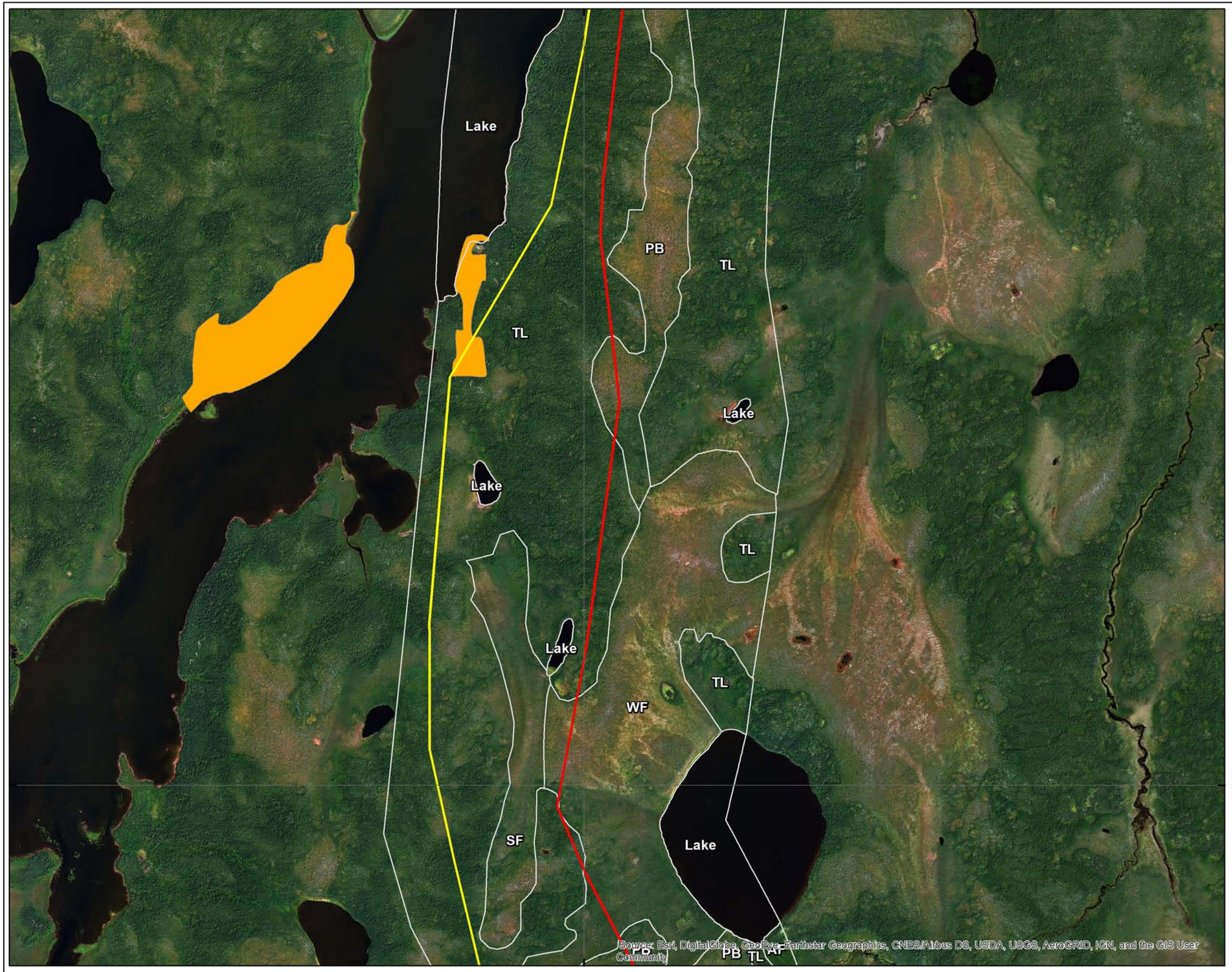
TITLE: Terrain Mapping

FIGURE: TM4

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

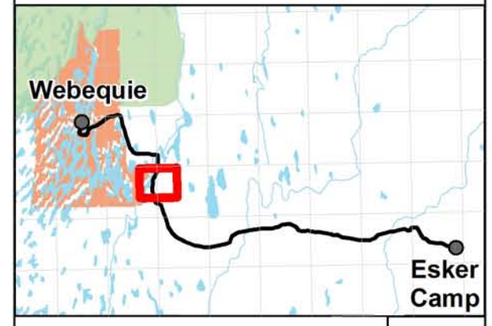
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial tilll	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

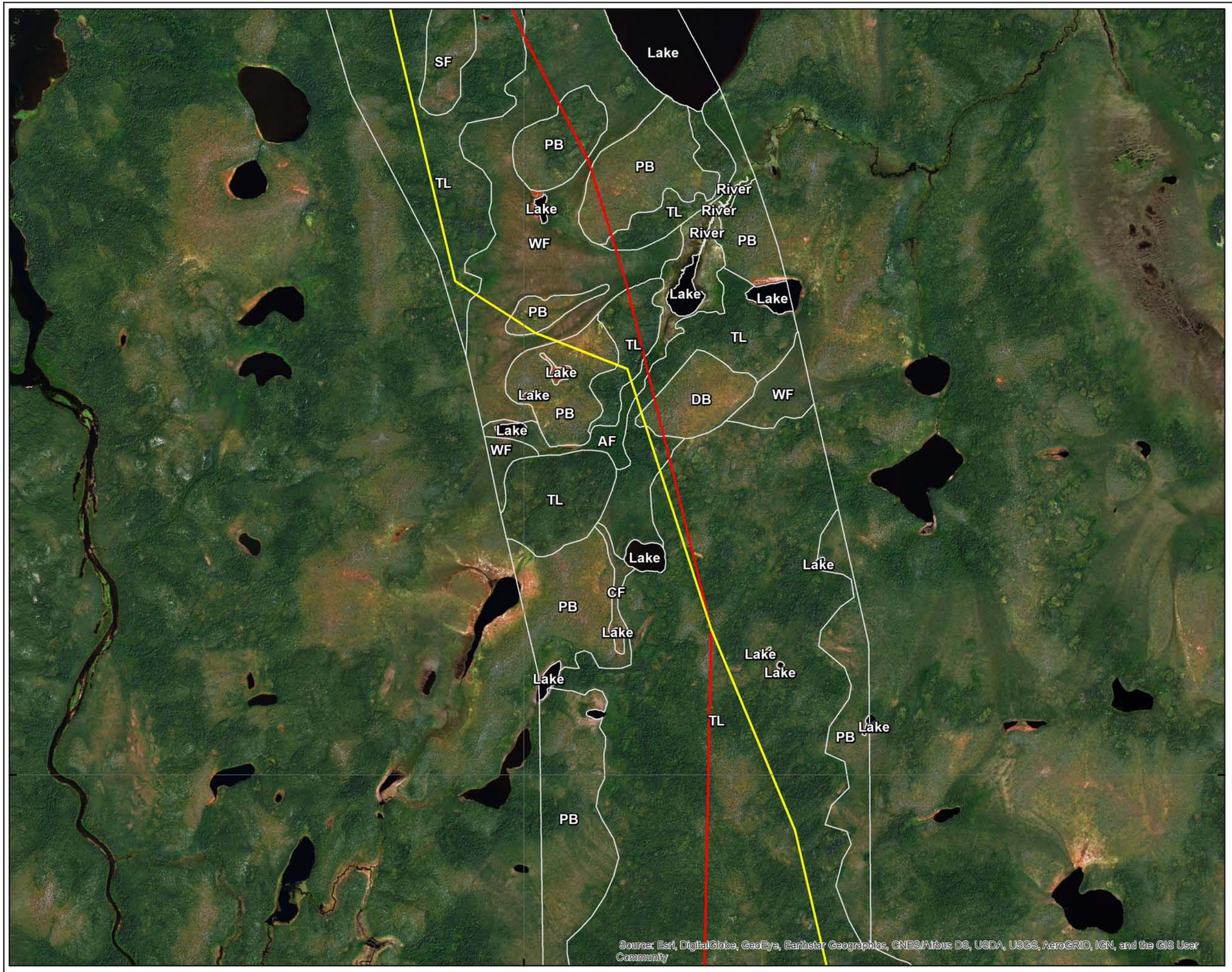
TITLE: Terrain Mapping

FIGURE: TM5

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

Mineral Terrains

TL: Glacial tilll
GF: Glaciofluvial
ER: Esker Ridge
AF: Alluvial Floodplain

Bog Terrains

TB: Treed Bog
TK: Thermokarst Bog
DB: Domed Bog
PB: Plateau Bog
NB: Net Bog

Fen Terrains

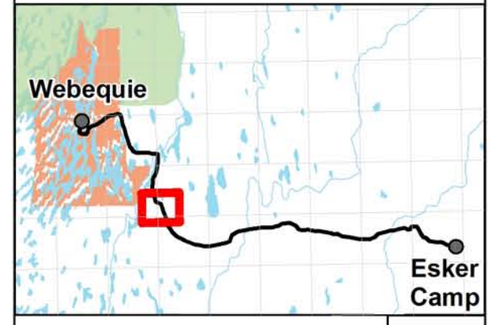
SF: String Fen
LF: Ladder Fen
CF: Channel Fen
HF: Horizontal Fen
WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

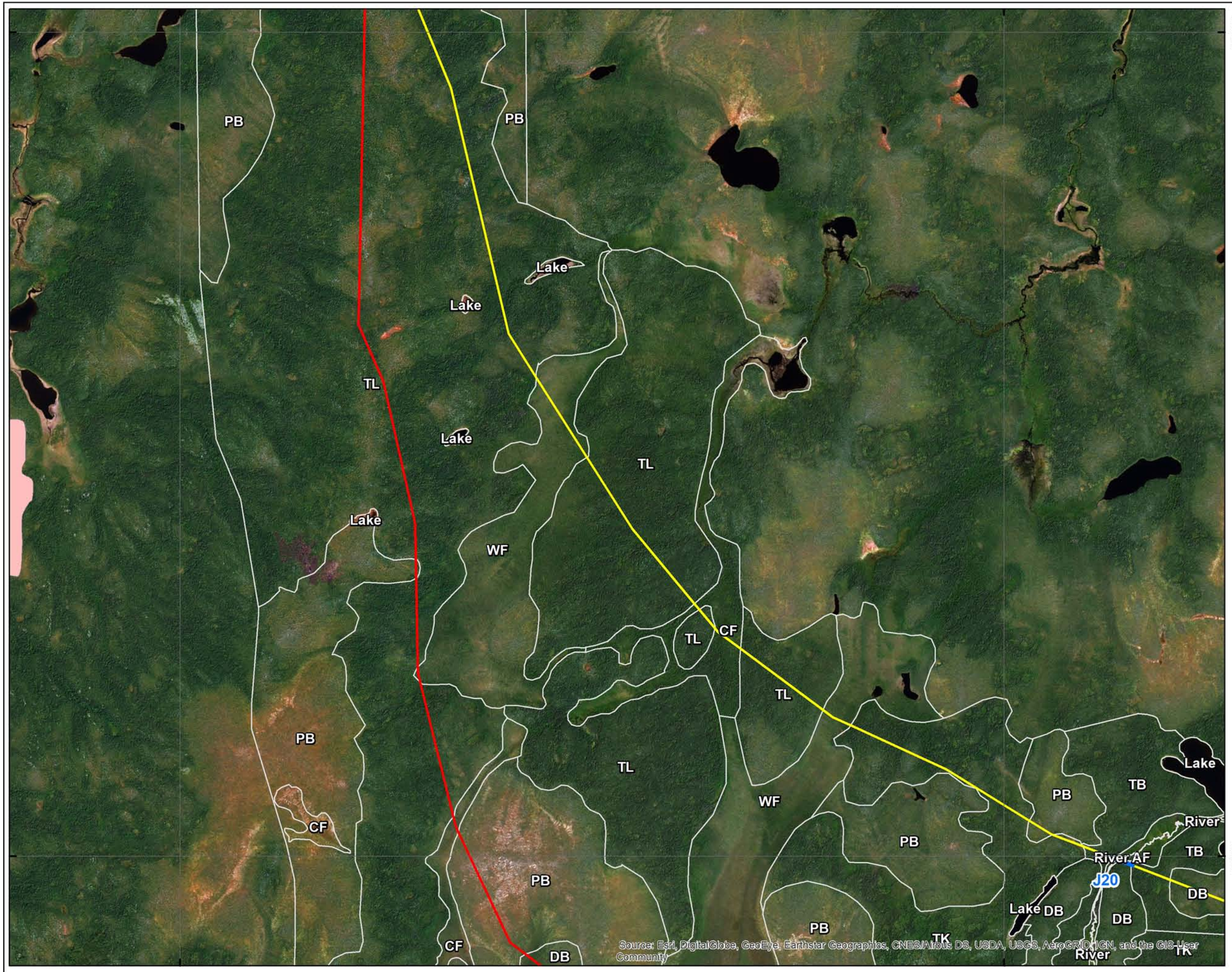
TITLE: Terrain Mapping

FIGURE: TM6

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

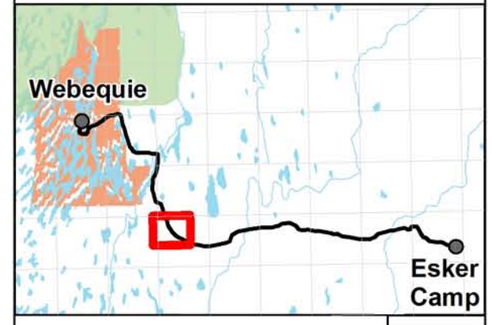
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial tilll	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

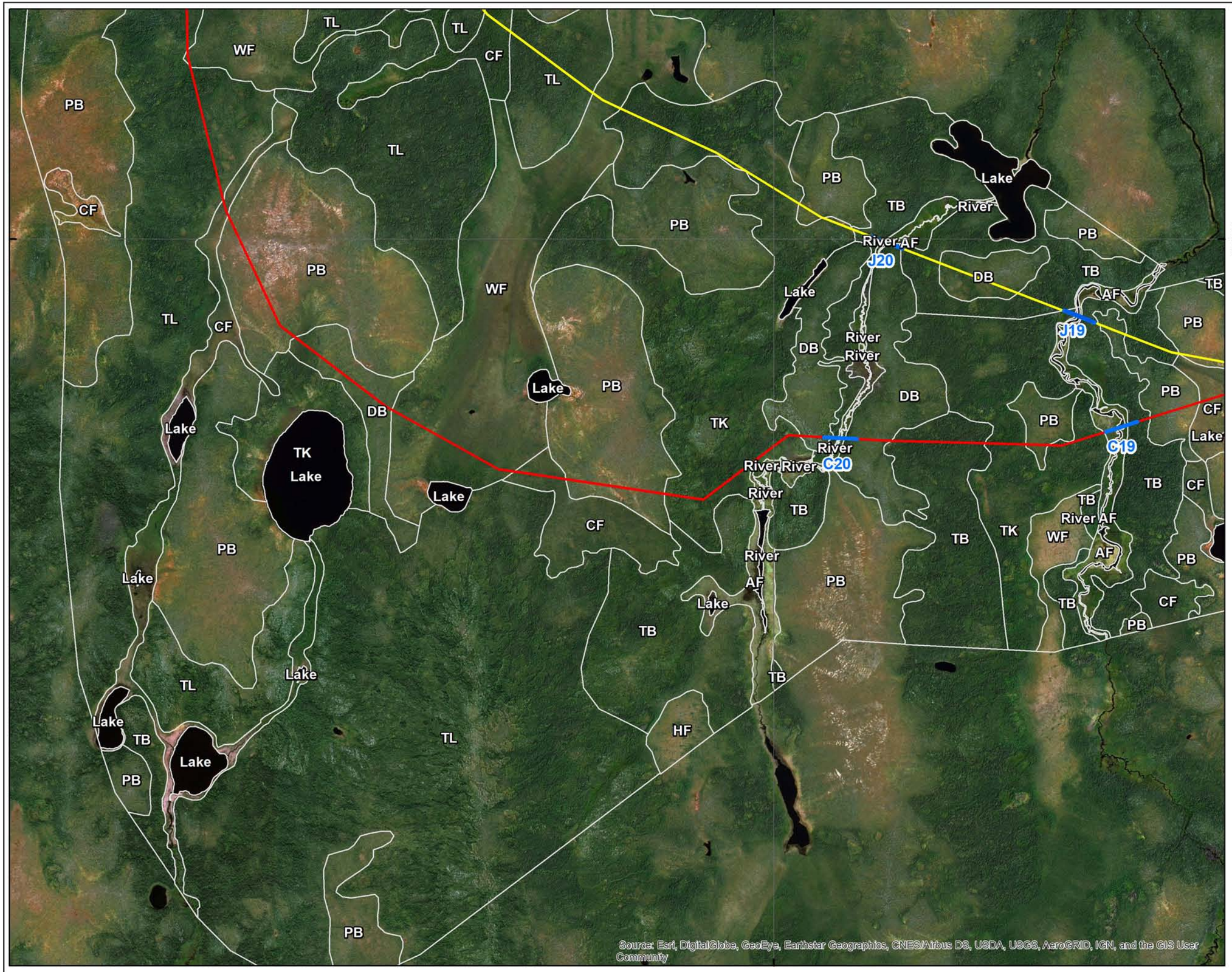
TITLE: Terrain Mapping

FIGURE: TM7

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

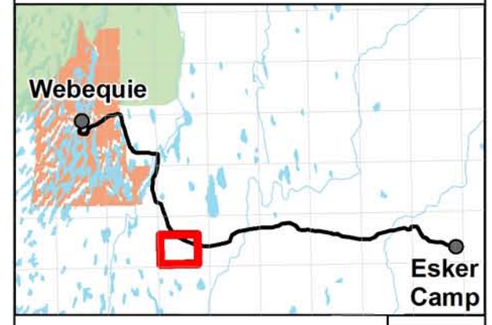
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
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North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

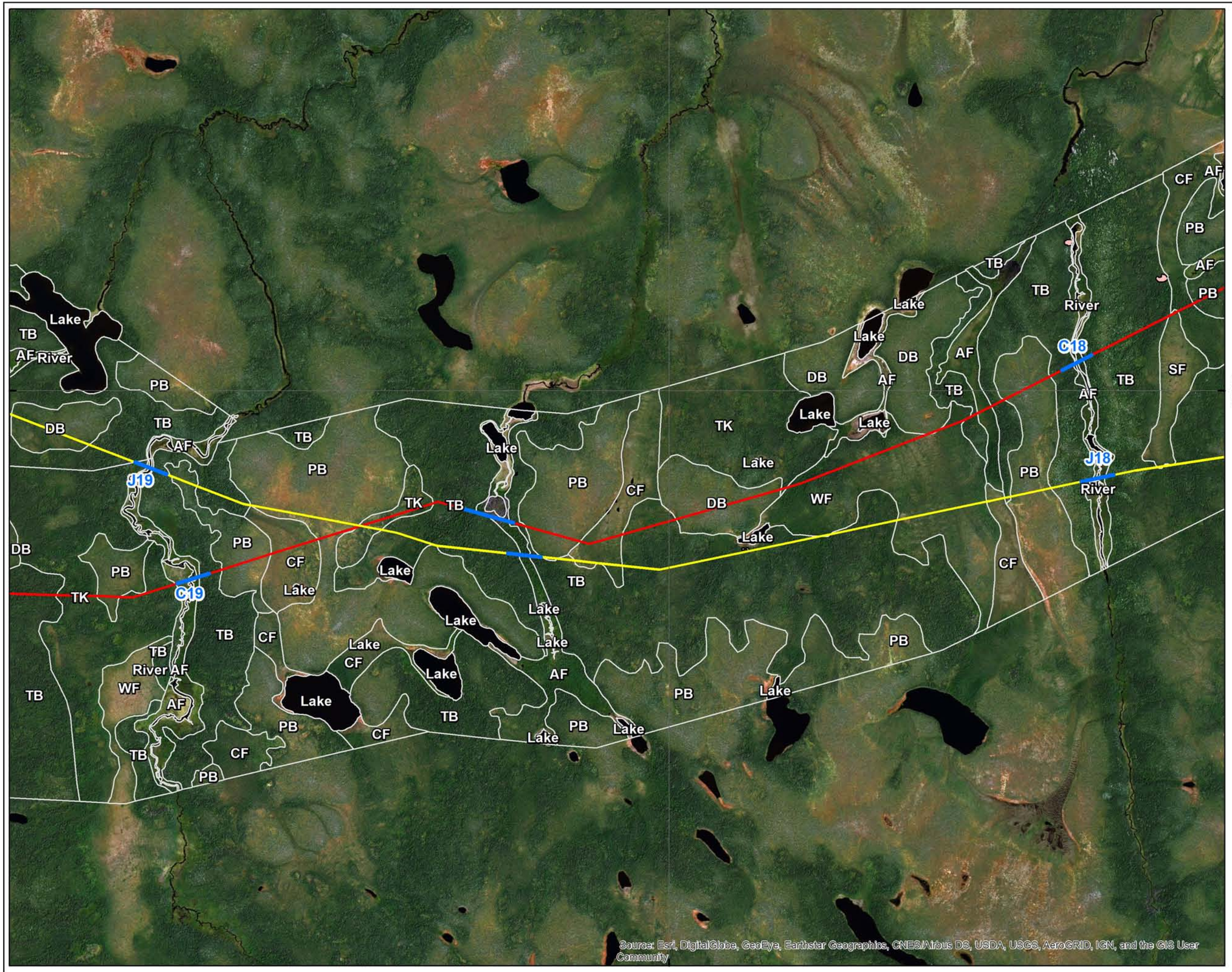
TITLE: Terrain Mapping

FIGURE: TM8

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

Mineral Terrains

TL: Glacial till
GF: Glaciofluvial
ER: Esker Ridge
AF: Alluvial Floodplain

Bog Terrains

TB: Treed Bog
TK: Thermokarst Bog
DB: Domed Bog
PB: Plateau Bog
NB: Net Bog

Fen Terrains

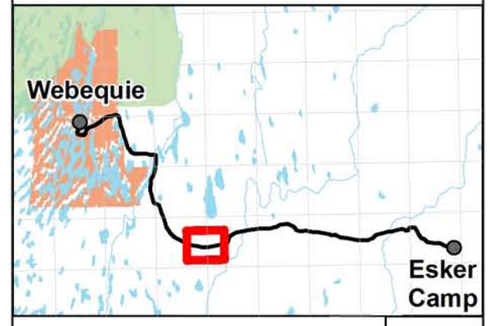
SF: String Fen
LF: Ladder Fen
CF: Channel Fen
HF: Horizontal Fen
WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: **SNC Lavalin**

PROJECT: **Webequie Supply Road**

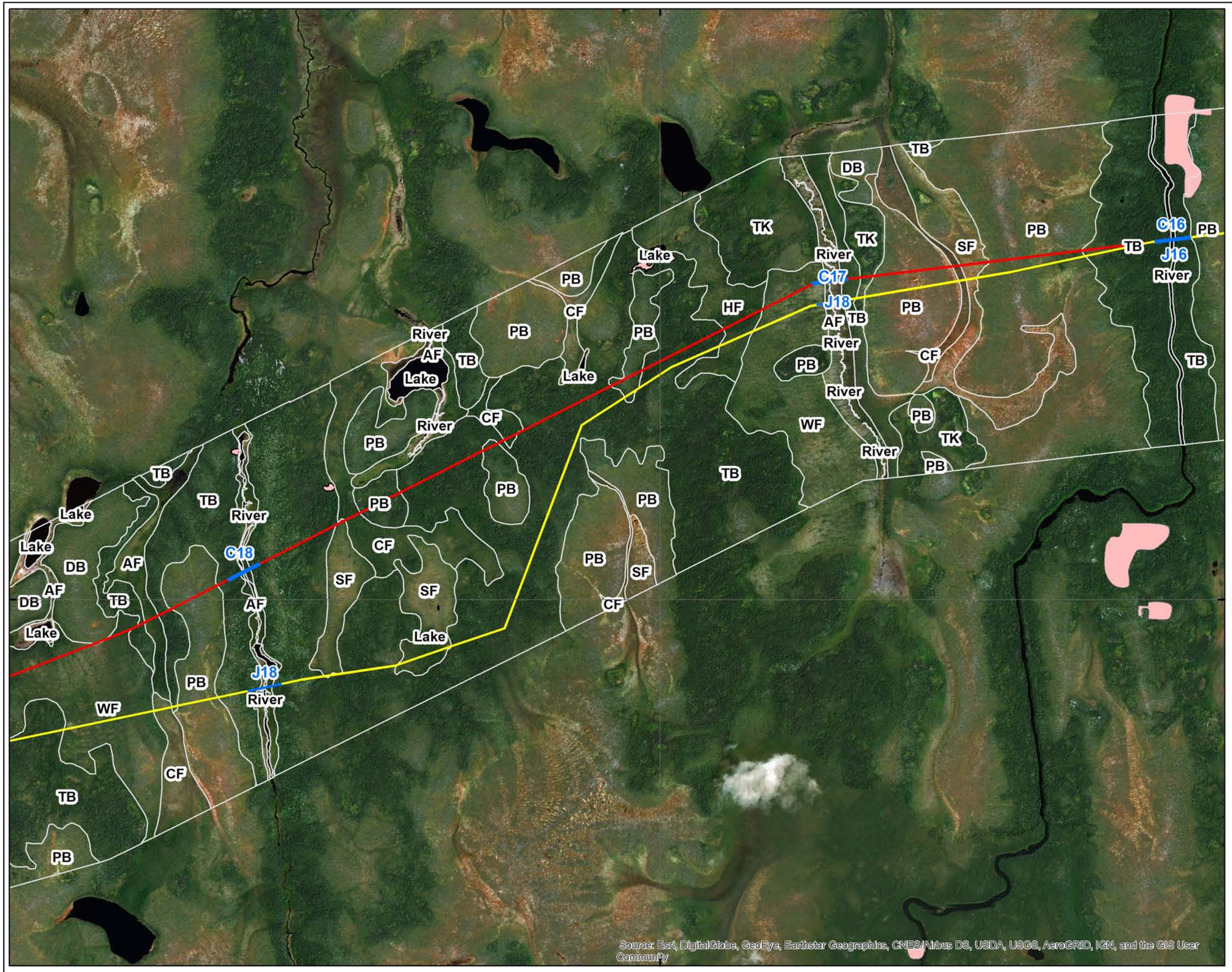
TITLE: **Terrain Mapping**

FIGURE: **TM9**

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

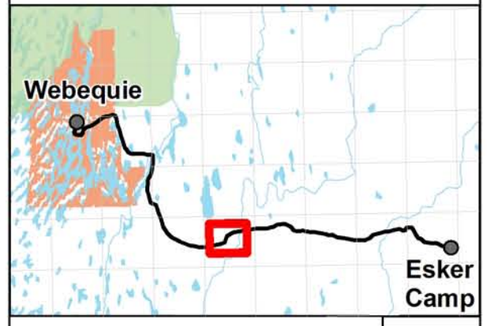
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



0 500 1,000
Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

FIGURE: TM10

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED

5850000

5845000

510000

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

Mineral Terrains

TL: Glacial tilll
GF: Glaciofluvial
ER: Esker Ridge
AF: Alluvial Floodplain

Bog Terrains

TB: Treed Bog
TK: Thermokarst Bog
DB: Domed Bog
PB: Plateau Bog
NB: Net Bog

Fen Terrains

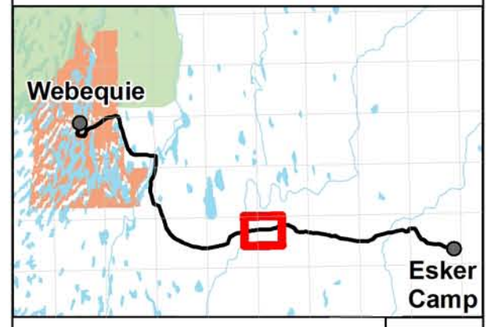
SF: String Fen
LF: Ladder Fen
CF: Channel Fen
HF: Horizontal Fen
WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

FIGURE: TM11

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED

LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

Mineral Terrains

TL: Glacial tilll
GF: Glaciofluvial
ER: Esker Ridge
AF: Alluvial Floodplain

Bog Terrains

TB: Treed Bog
TK: Thermokarst Bog
DB: Domed Bog
PB: Plateau Bog
NB: Net Bog

Fen Terrains

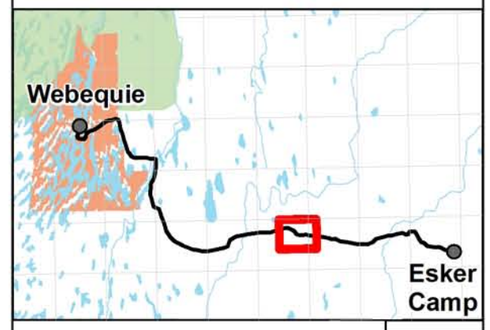
SF: String Fen
LF: Ladder Fen
CF: Channel Fen
HF: Horizontal Fen
WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

FIGURE: TM12

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED

LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

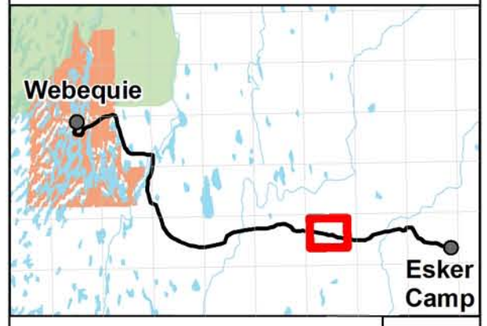
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



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Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

FIGURE: TM13

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED

LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 JDMA Route Water Crossing
- C23 Community Route Water Crossing

0 500 1,000
Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

FIGURE: TM14

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC Revision date: 29/Mar/2019

J D MOLLARD AND ASSOCIATES (2010) LIMITED

LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

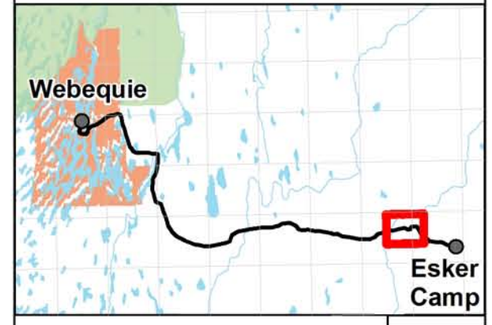
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



0 500 1,000
Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

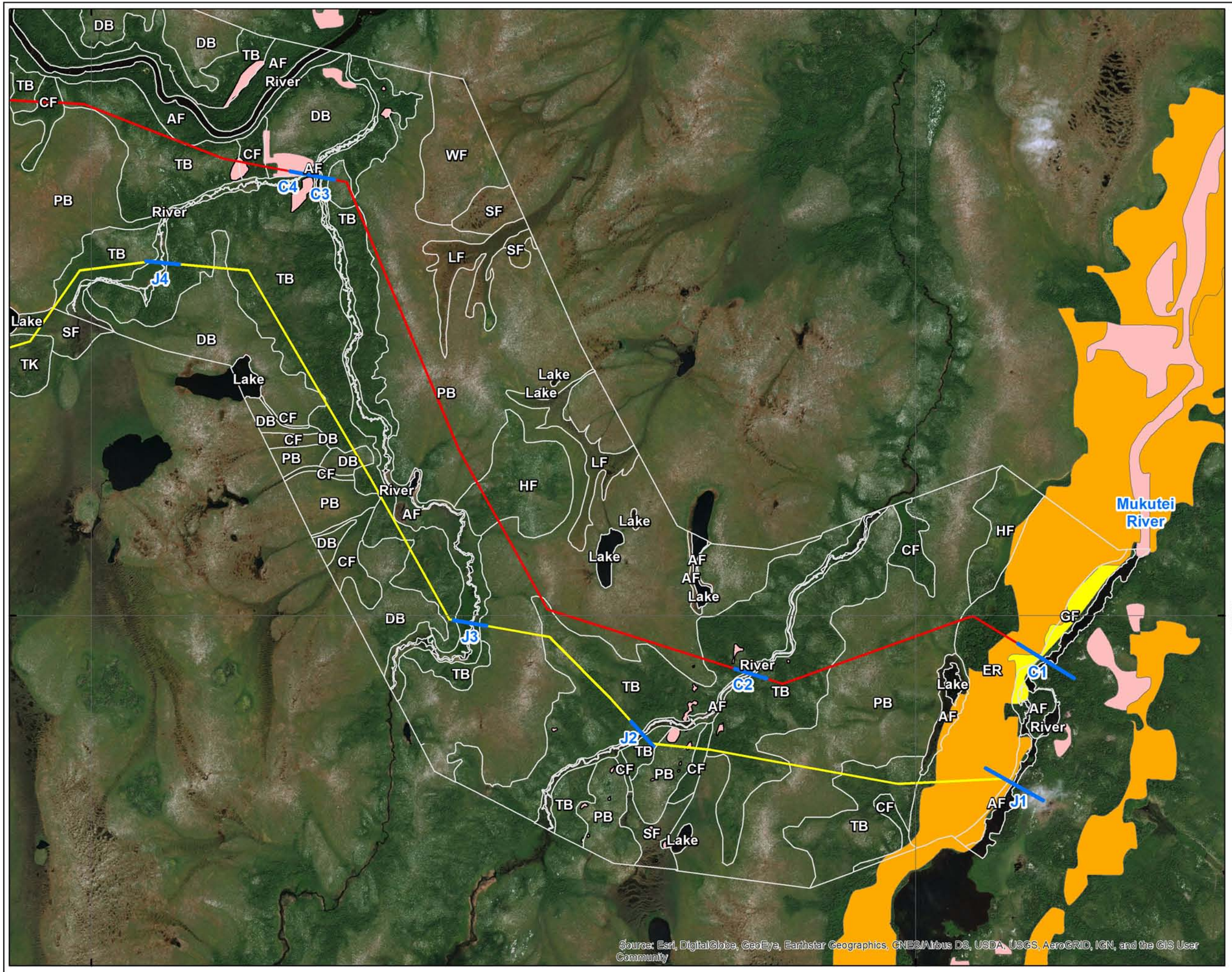
TITLE: Terrain Mapping

FIGURE: TM15

General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

J D MOLLARD AND ASSOCIATES (2010) LIMITED



LEGEND

Routes

- JDMA Route
- Community Route

Terrain Mapping

PB — Terrain Unit

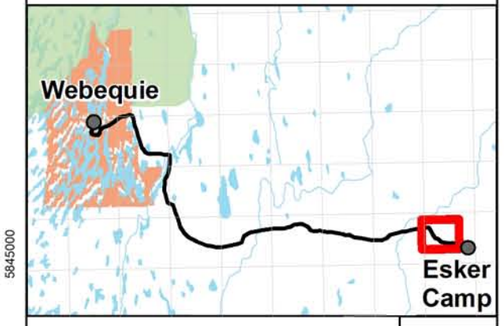
Mineral Terrains	Bog Terrains	Fen Terrains
TL: Glacial till	TB: Treed Bog	SF: String Fen
GF: Glaciofluvial	TK: Thermokarst Bog	LF: Ladder Fen
ER: Esker Ridge	DB: Domed Bog	CF: Channel Fen
AF: Alluvial Floodplain	PB: Plateau Bog	HF: Horizontal Fen
	NB: Net Bog	WF: Water Fen

Aggregate Prospects

- Fluvial Deposits
- Glacial Deposits and Bedrock
- Glaciofluvial Ice-Contact Deposits
- Crystalline Bedrock

Water Crossings

- J23 — JDMA Route Water Crossing
- C23 — Community Route Water Crossing



0 500 1,000
Meters
Scale 1:22,000
North American 1983 CSRS UTM Zone 16N

NORTH

CLIENT: SNC Lavalin

PROJECT: Webequie Supply Road

TITLE: Terrain Mapping

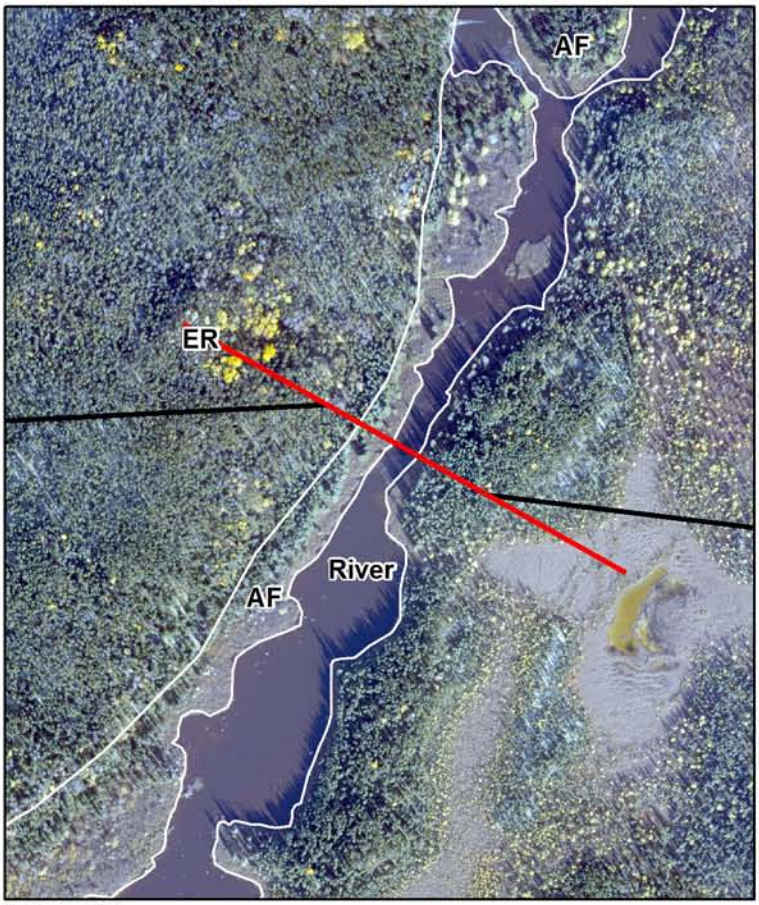
FIGURE: TM16

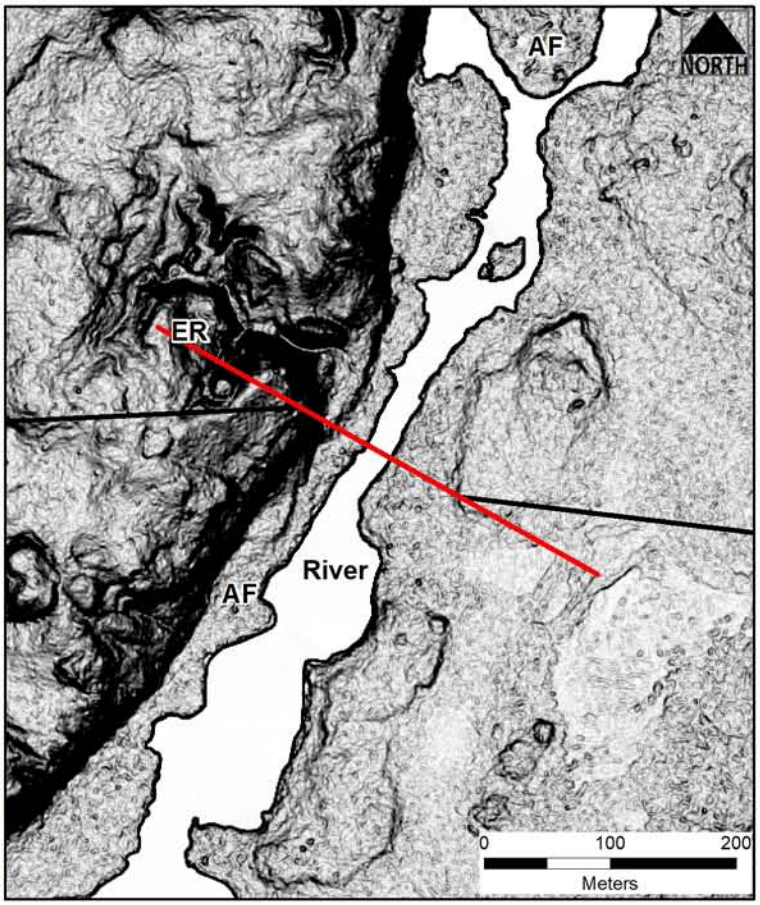
General reference map only; not for survey or legal use.

Map Sources: Base Data: CanVec
Imagery: ESRI
Geomatics: JIC *Revision date: 29/Mar/2019*

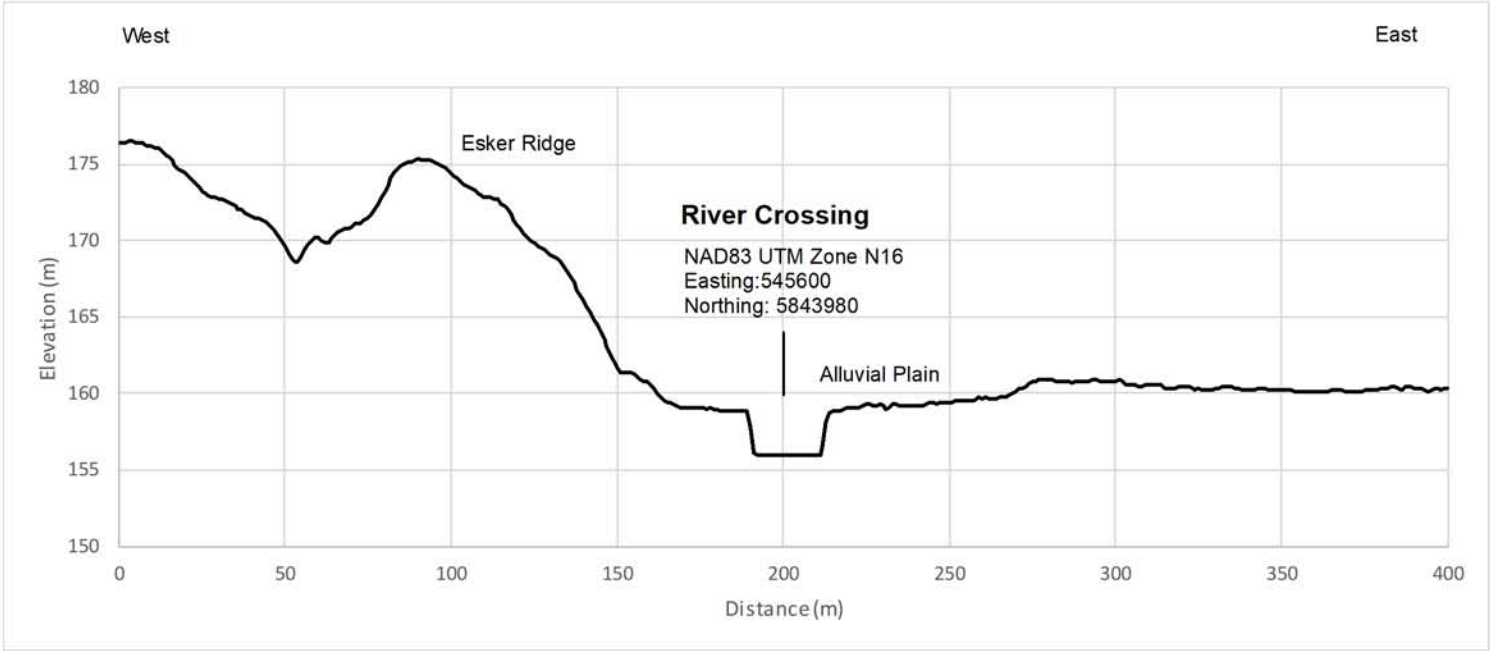
J D MOLLARD AND ASSOCIATES (2010) LIMITED

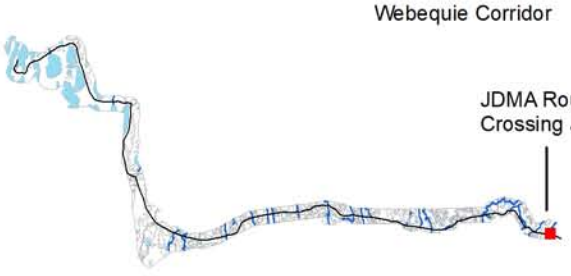
APPENDIX 2: Water Crossings





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

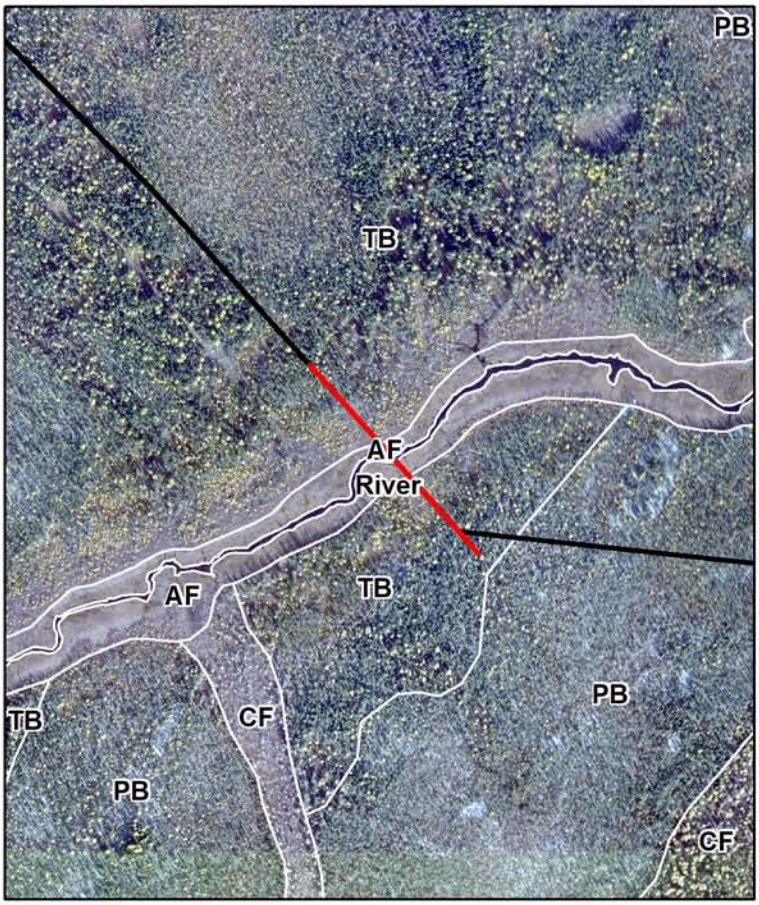
General reference map only; not for survey or legal use.

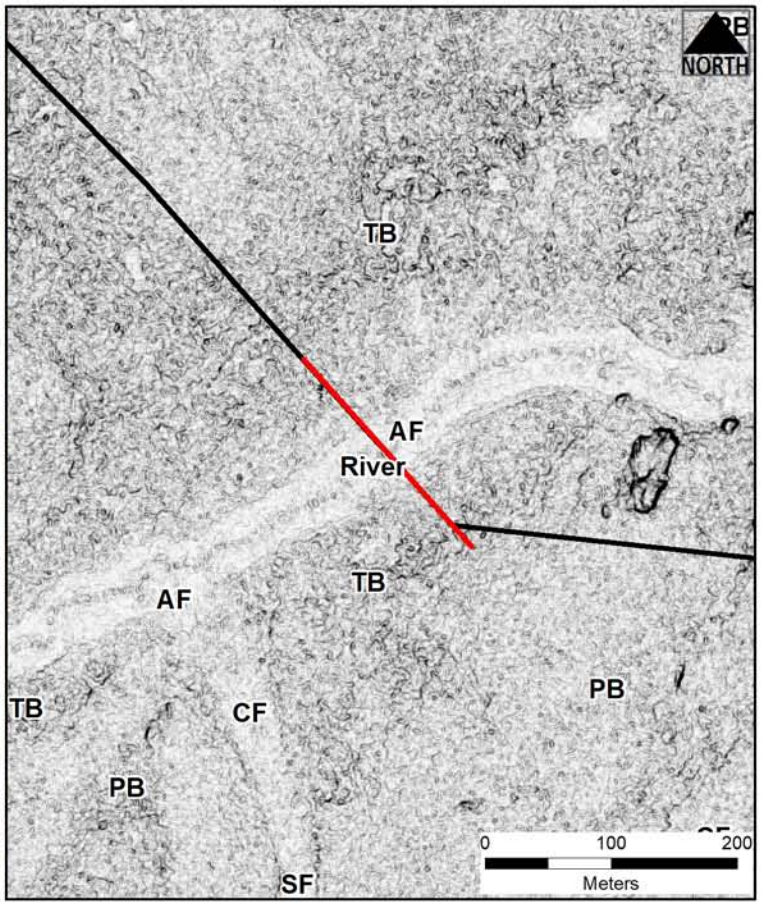
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

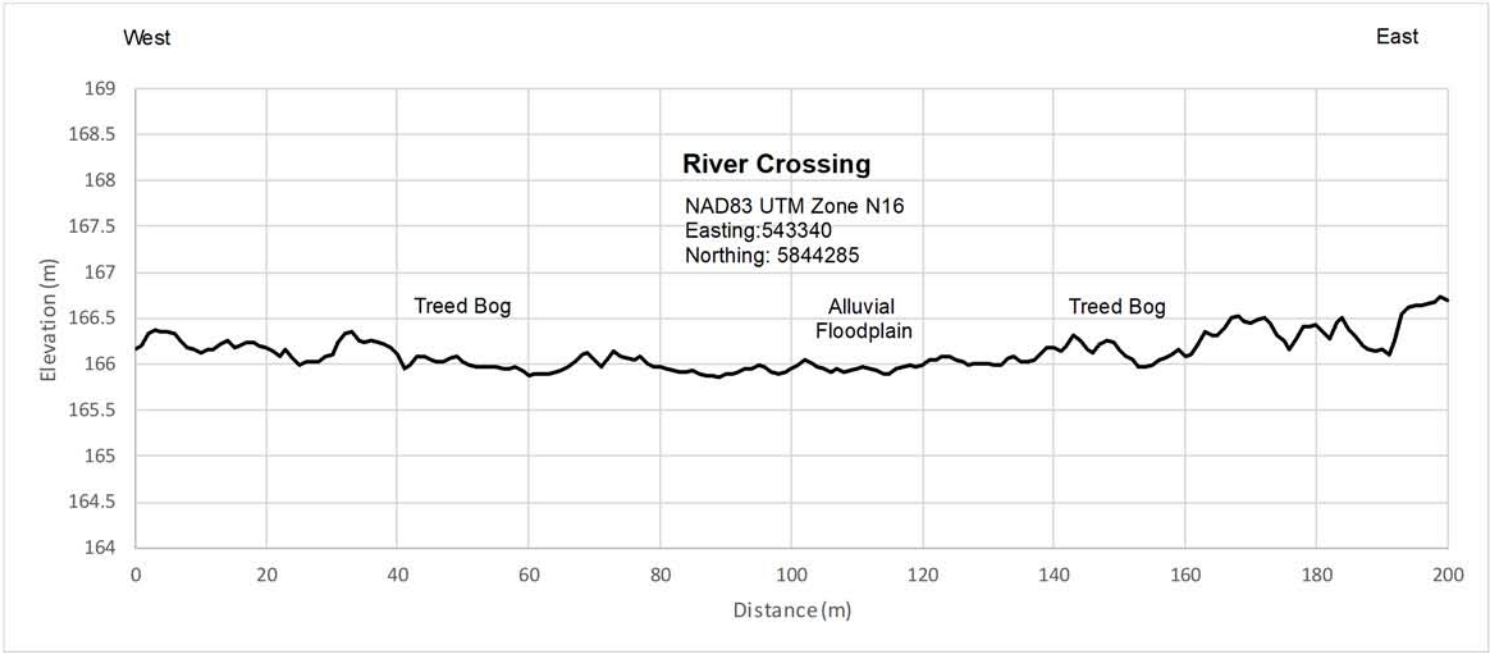
J1

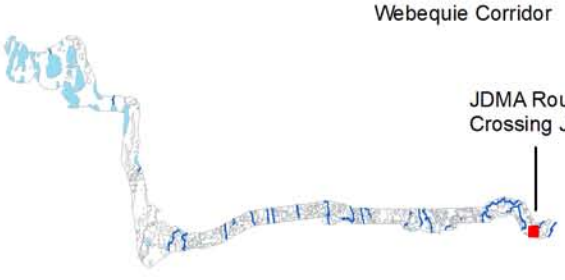
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

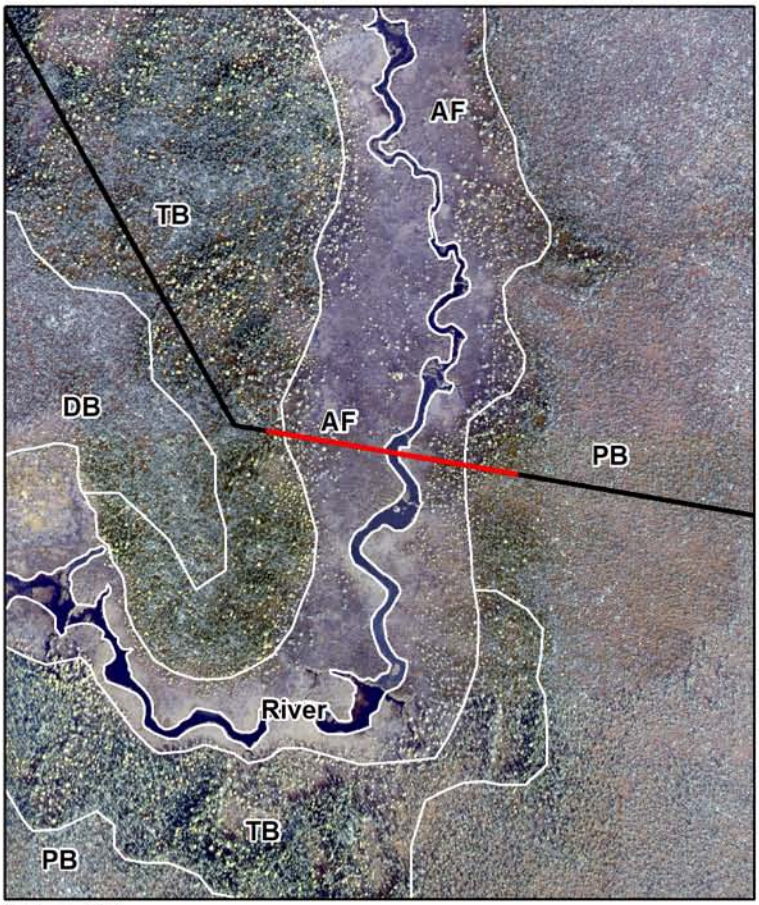
General reference map only; not for survey or legal use.

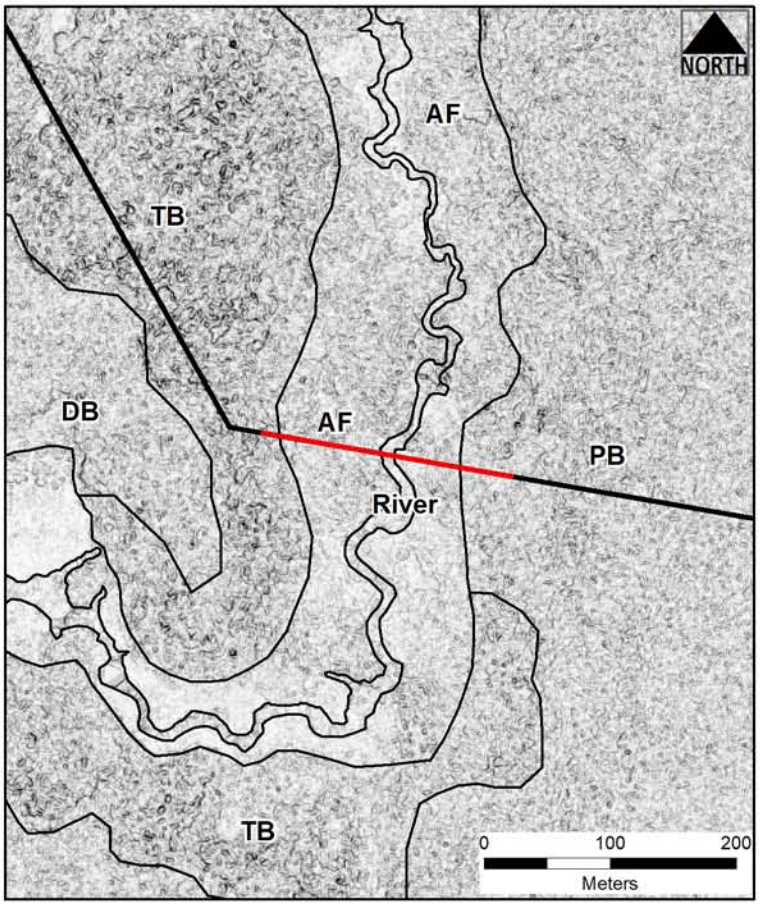
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

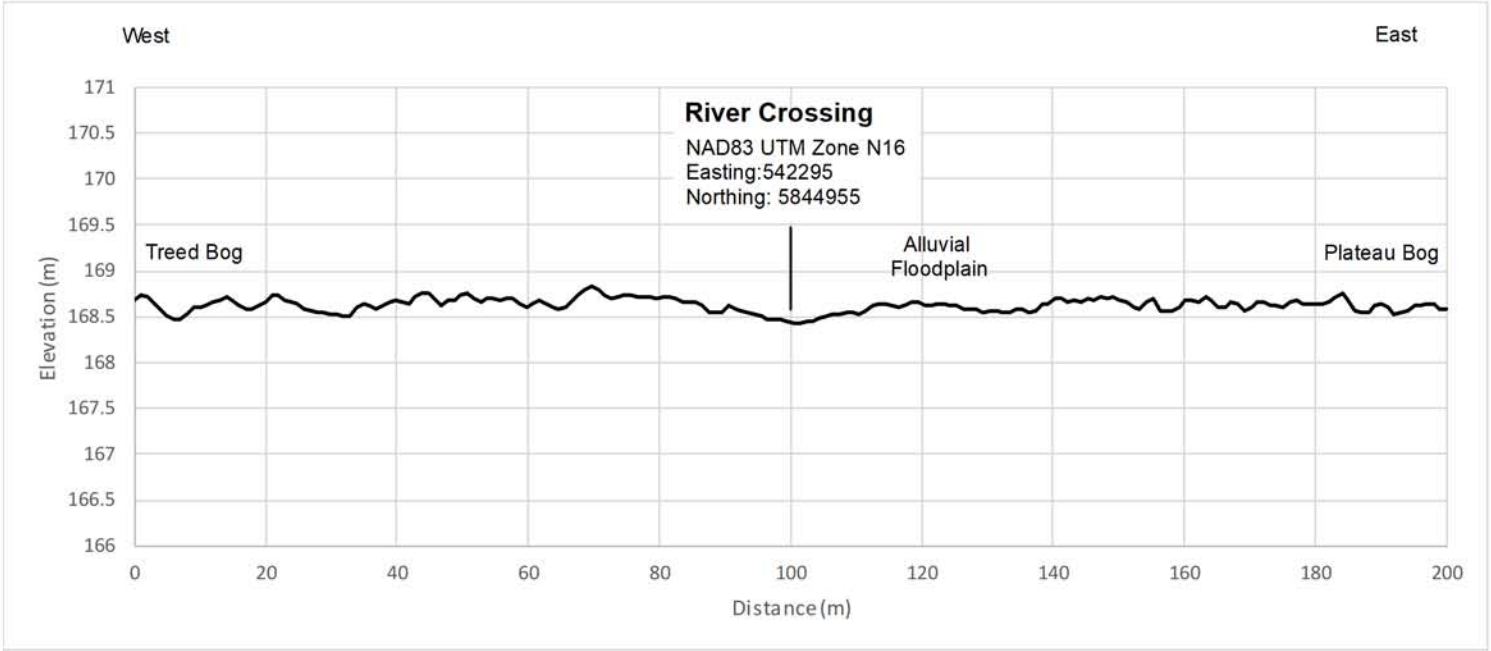
J2

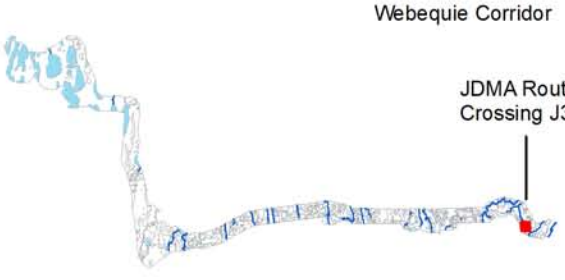
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

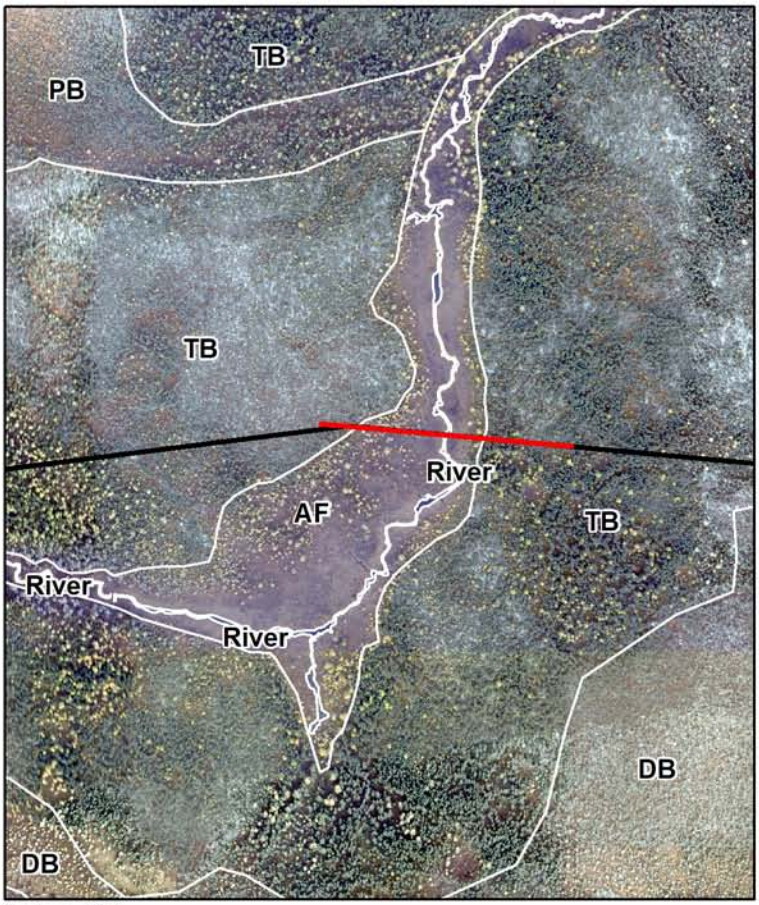
General reference map only; not for survey or legal use.

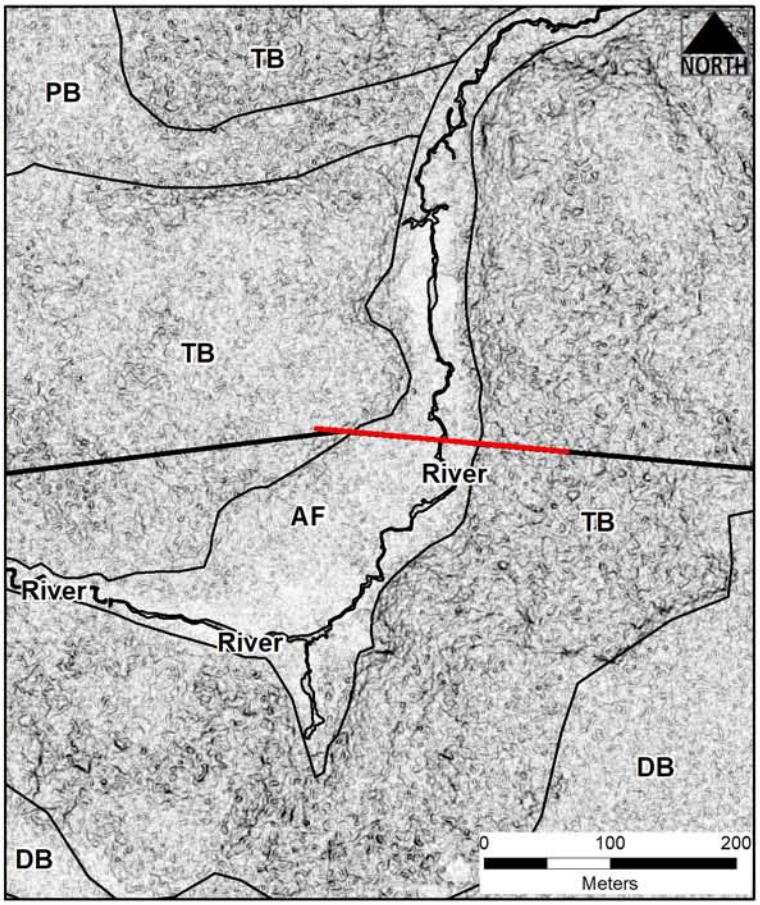
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

J3

J D MOLLARD AND ASSOCIATES (2010) LIMITED





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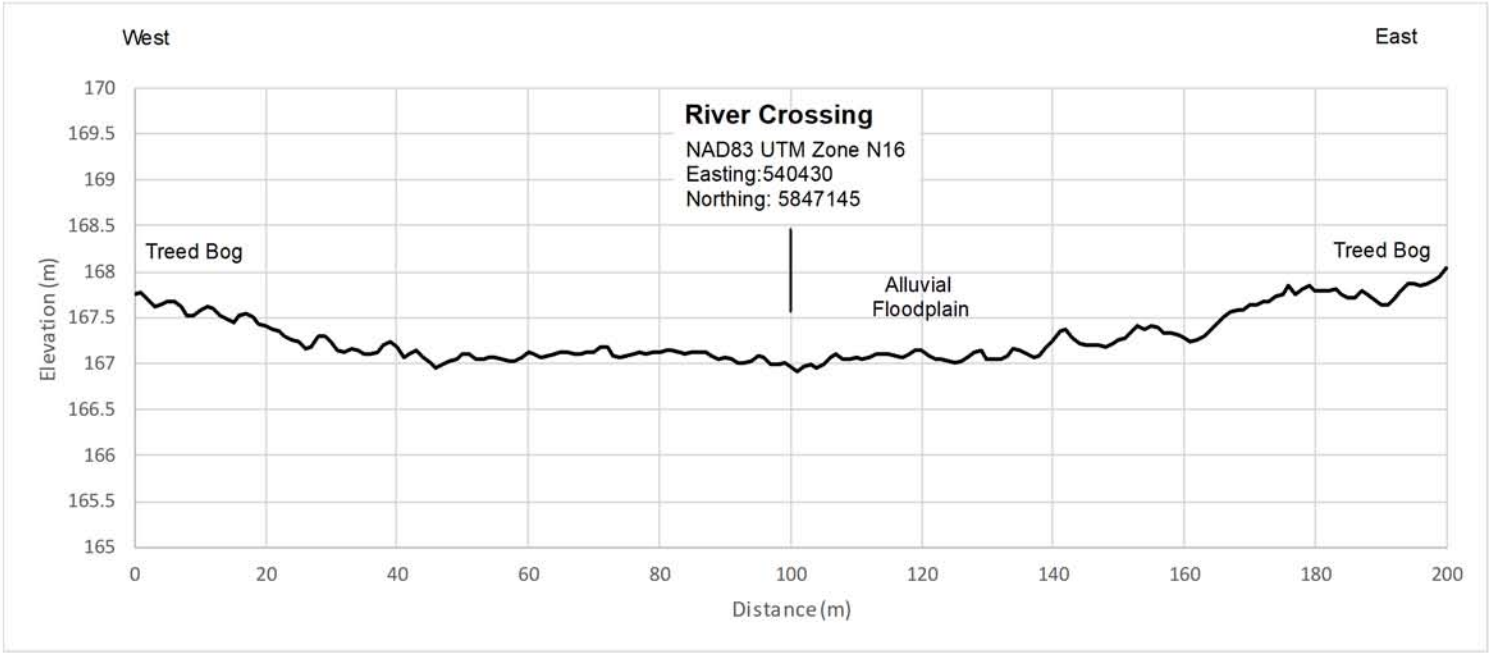
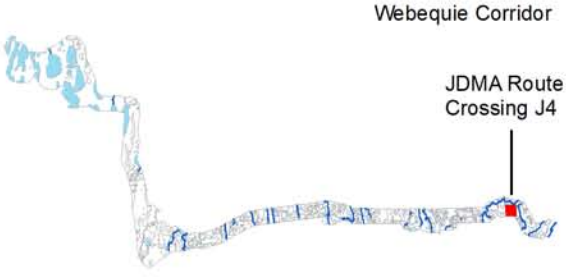




LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

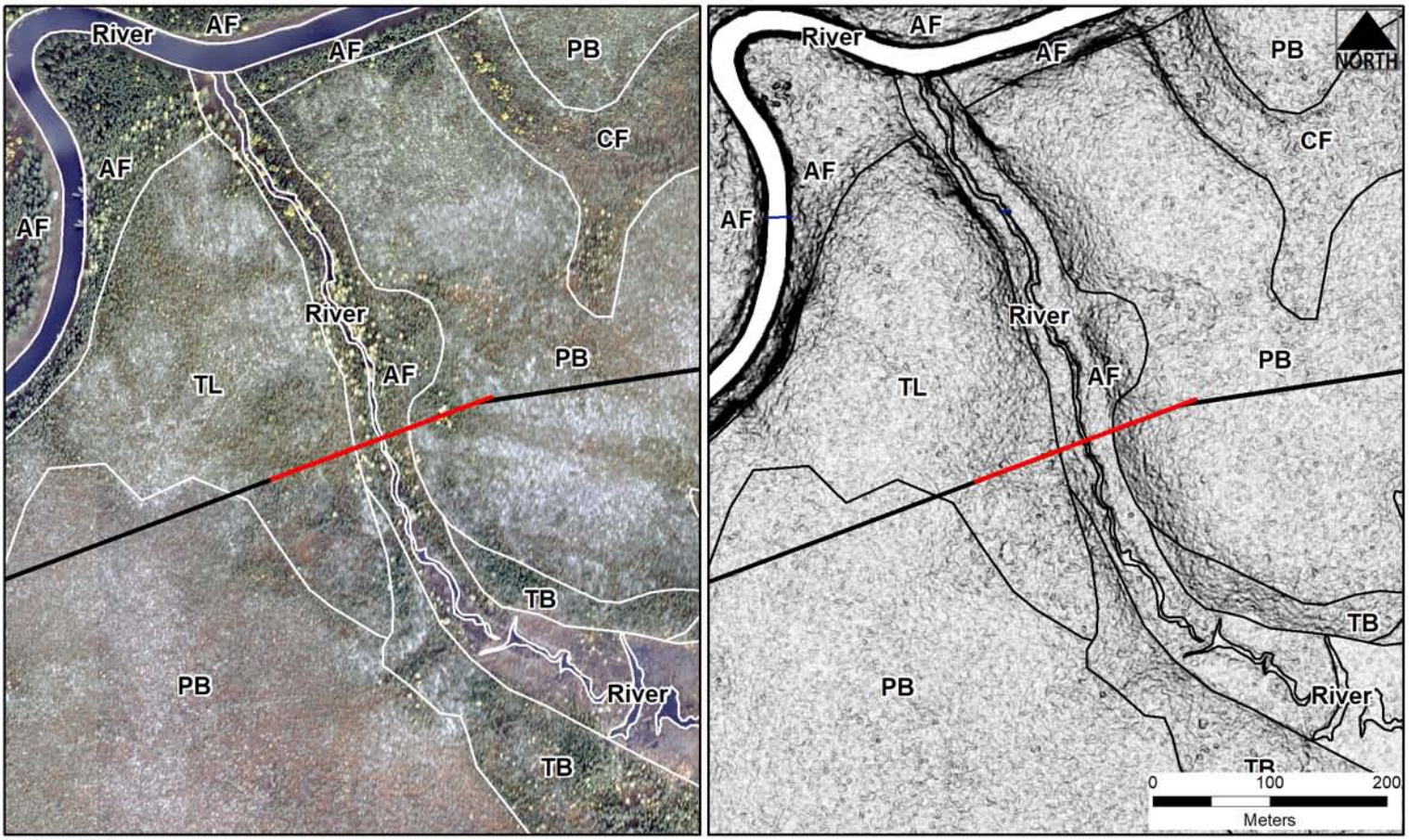
General reference map only; not for survey or legal use.

Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

J4

J D MOLLARD AND ASSOCIATES (2010) LIMITED



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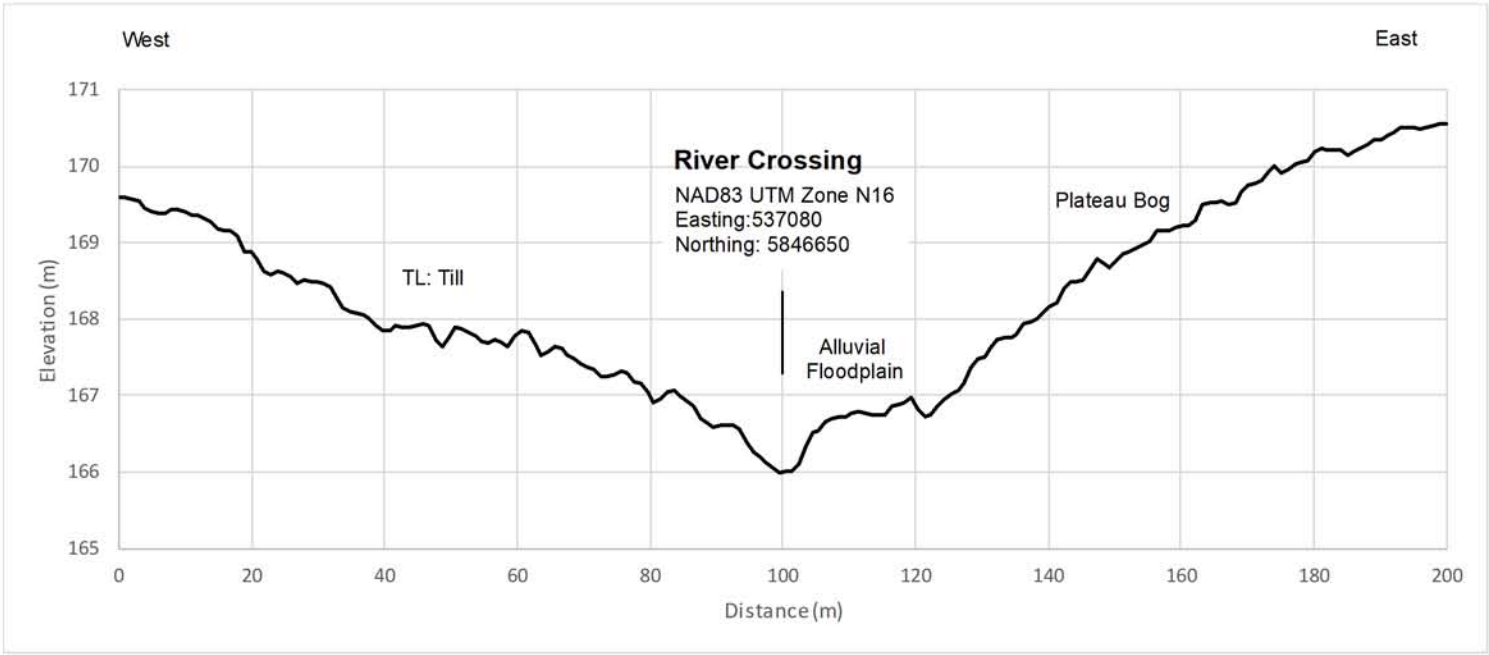
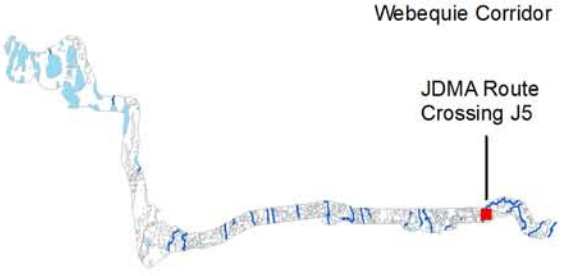




LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

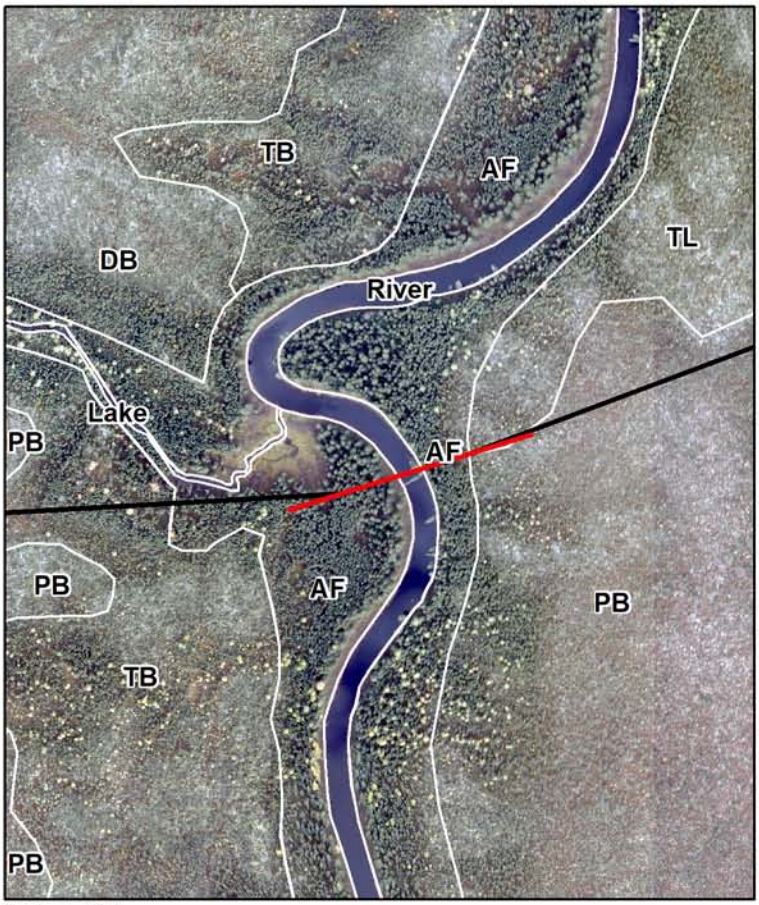
General reference map only; not for survey or legal use.

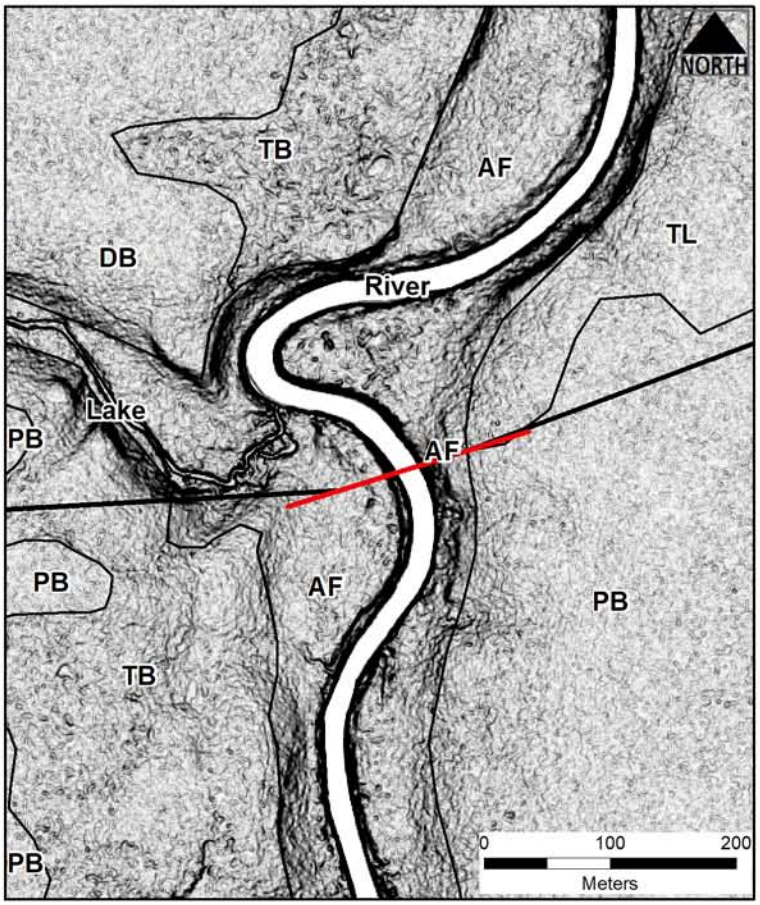
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 21/Mar/2019*

CROSSING:

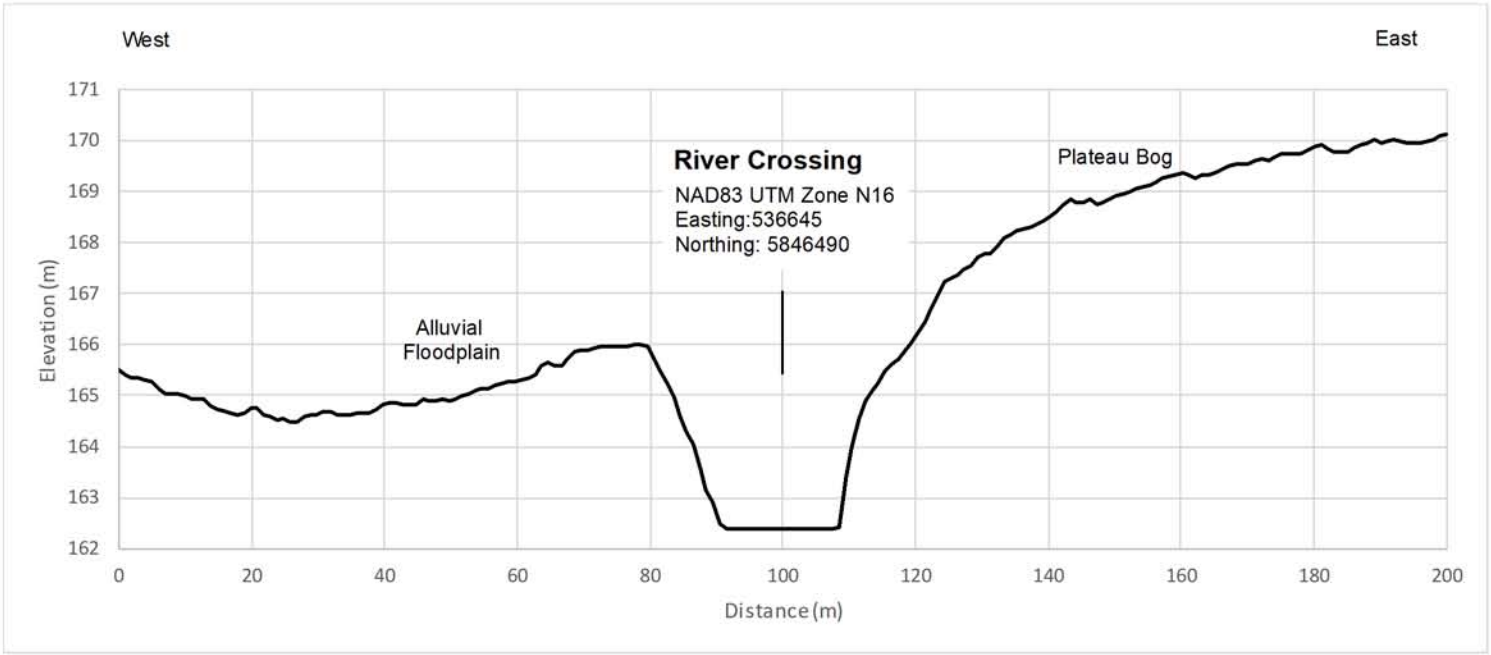
J5

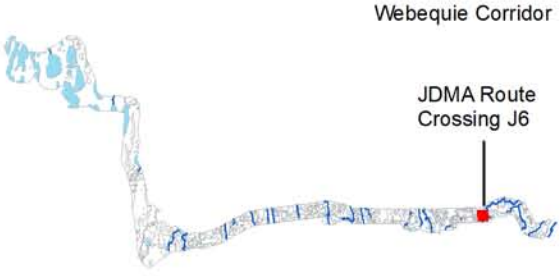
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

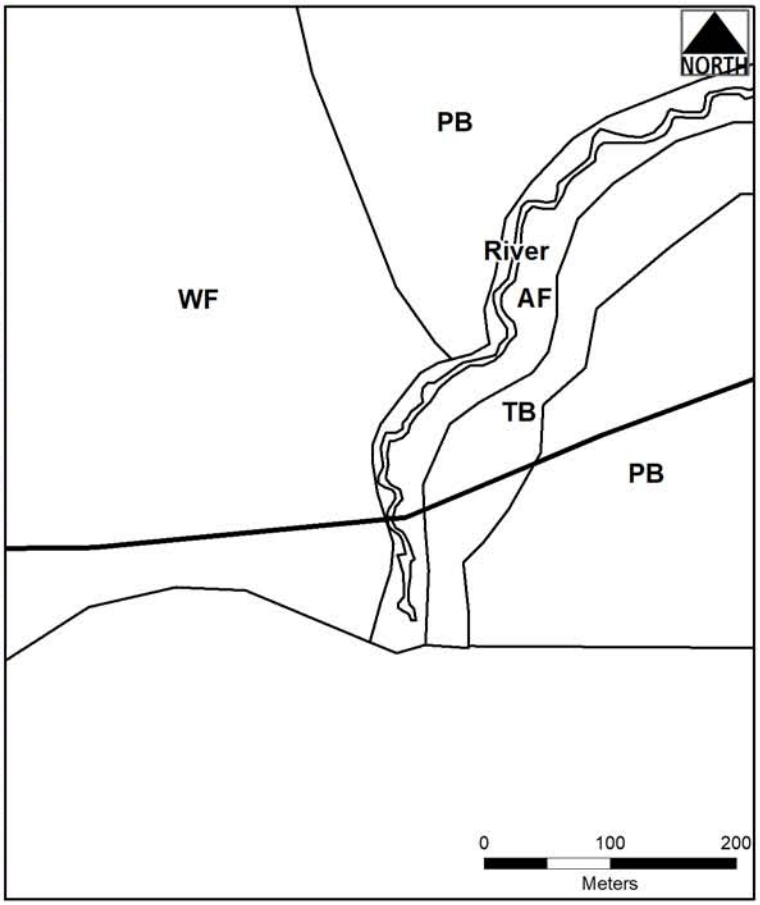
General reference map only; not for survey or legal use.

Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

J6

J D MOLLARD AND ASSOCIATES (2010) LIMITED

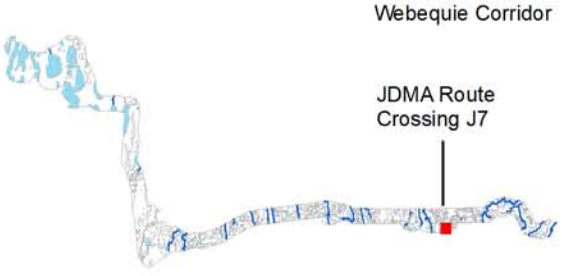


Chainages (Km)

River Crossing

NAD83 UTM Zone N16
Easting:531690
Northing: 5844820

No LiDAR Data



LEGEND:

JDMA Optimal (Feb, 2019)
Cross-Section

Slope (degrees)

High: 66.9
Low: 0

TITLE:

JDMA Route Crossings

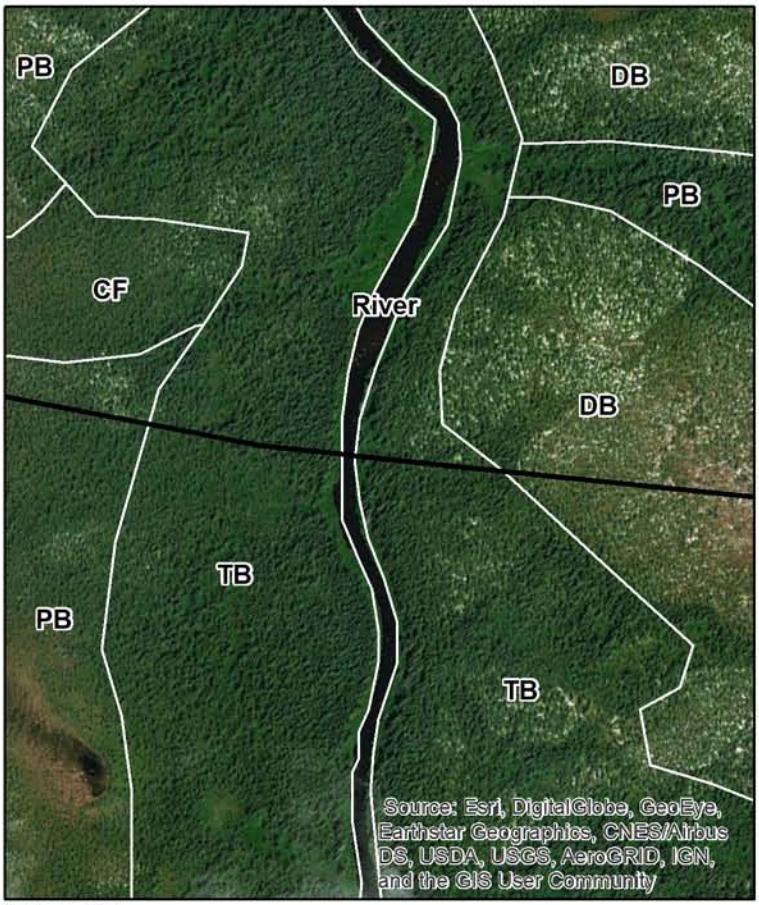
General reference map only; not for survey or legal use.

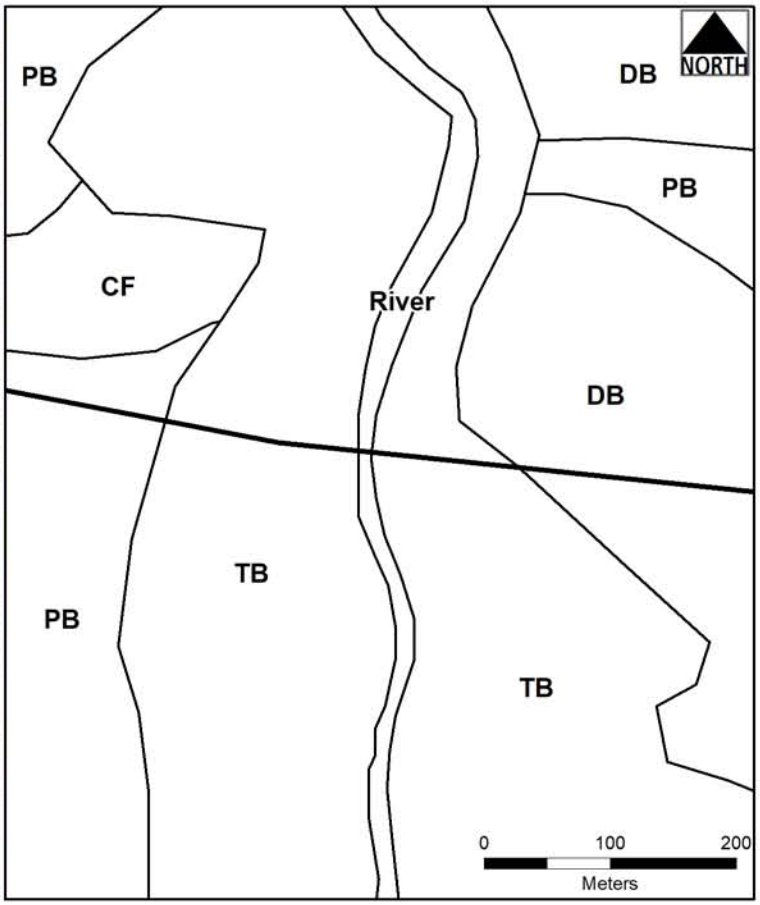
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

J7

J D MOLLARD AND ASSOCIATES (2010) LIMITED



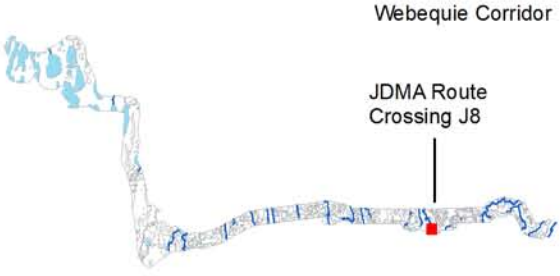


Chainages (Km)

River Crossing

NAD83 UTM Zone N16
Easting:529807
Northing: 5844837

No LiDAR Data



LEGEND:

JDMA Optimal (Feb, 2019)
Cross-Section

Slope (degrees)

High: 66.9
Low: 0

TITLE:

JDMA Route Crossings

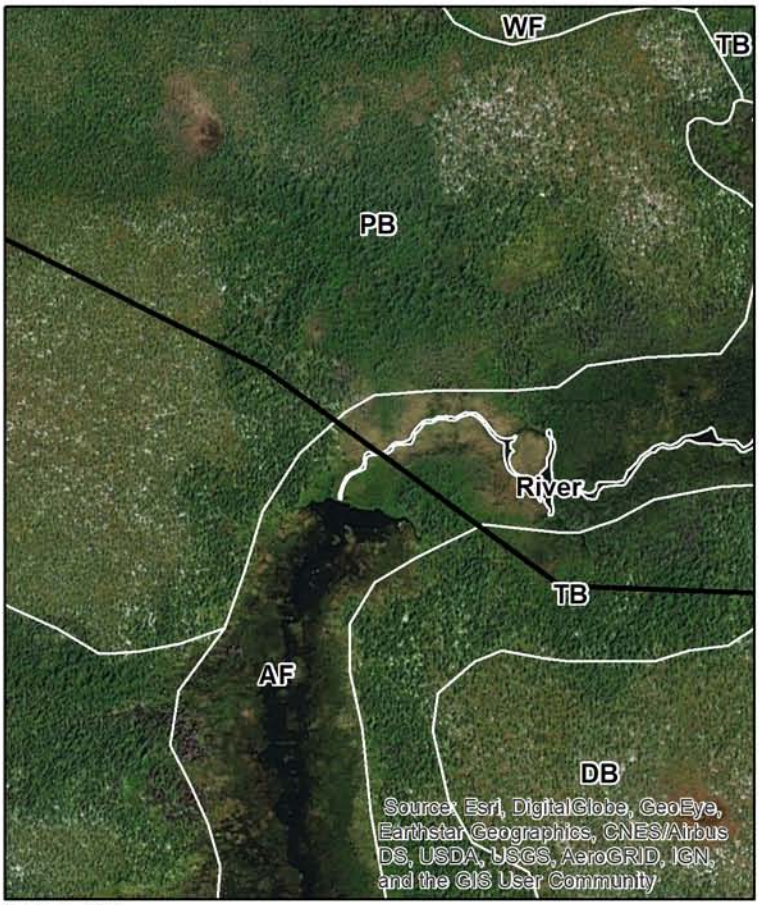
General reference map only; not for survey or legal use.

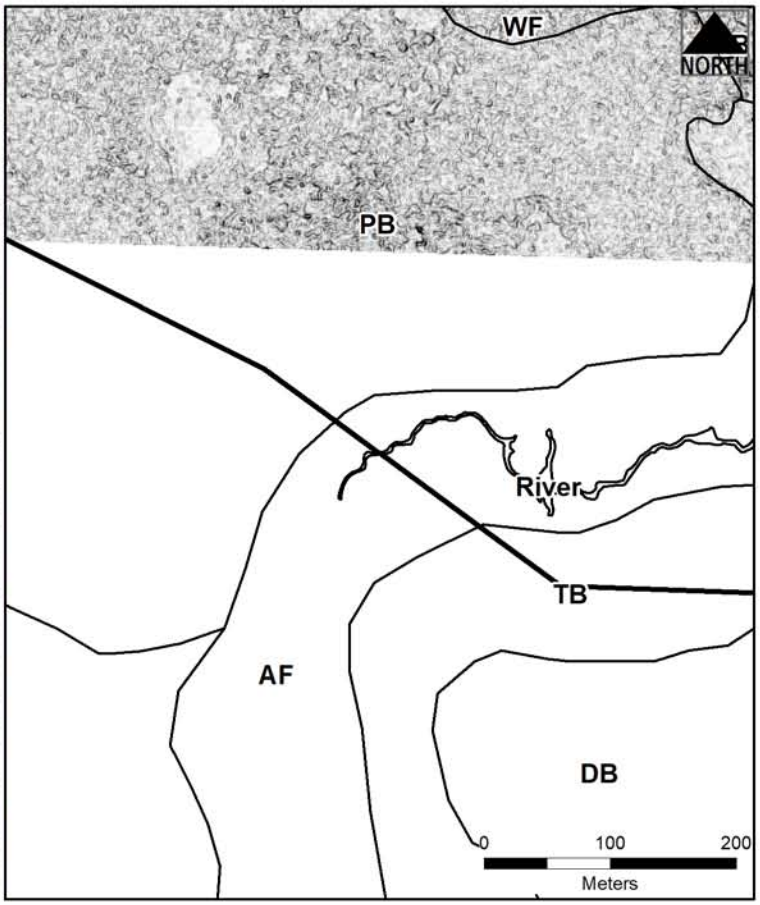
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

J8

J D MOLLARD AND ASSOCIATES (2010) LIMITED



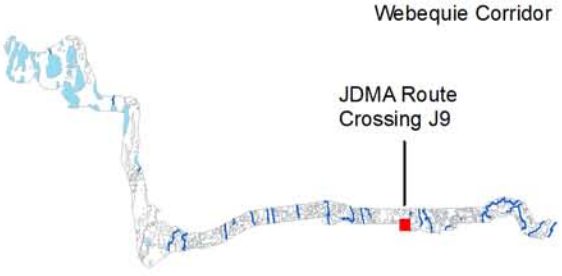


Chainages (Km)

River Crossing

NAD83 UTM Zone N16
Easting:526262
Northing: 5845452

No LiDAR Data



LEGEND:

JDMA Optimal (Feb, 2019)
Cross-Section

Slope (degrees)
High: 66.9
Low: 0

TITLE:

JDMA Route Crossings

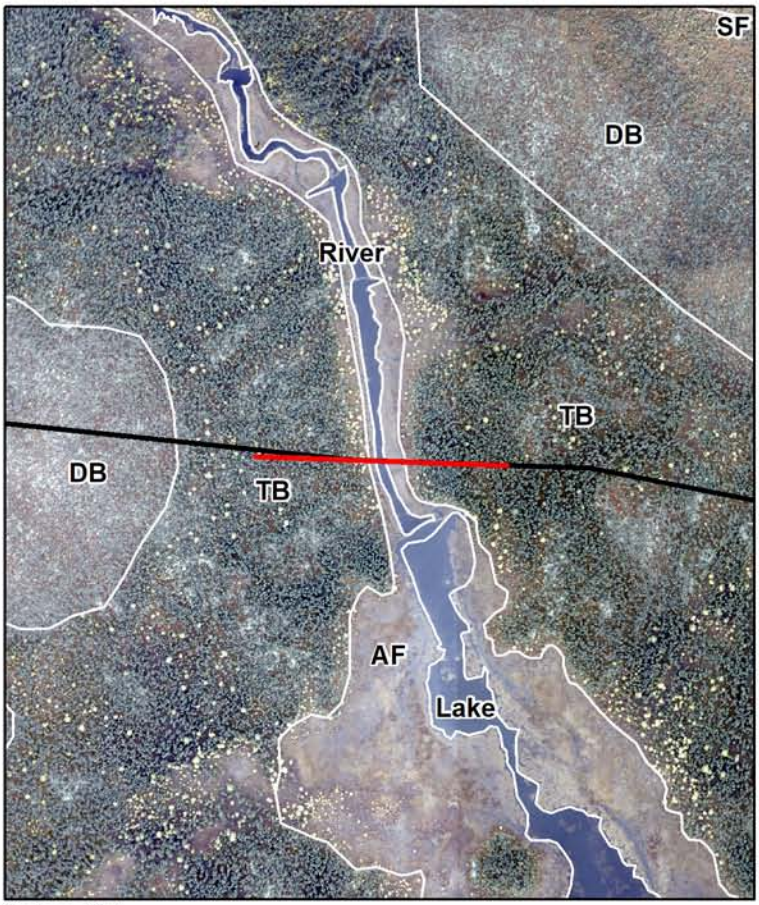
General reference map only; not for survey or legal use.

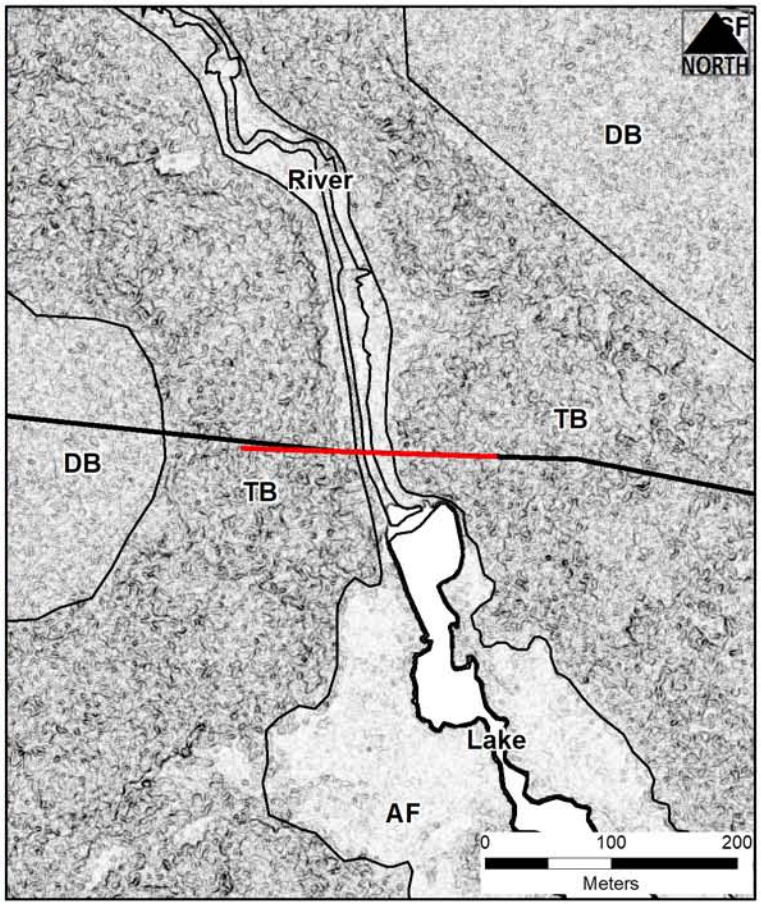
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

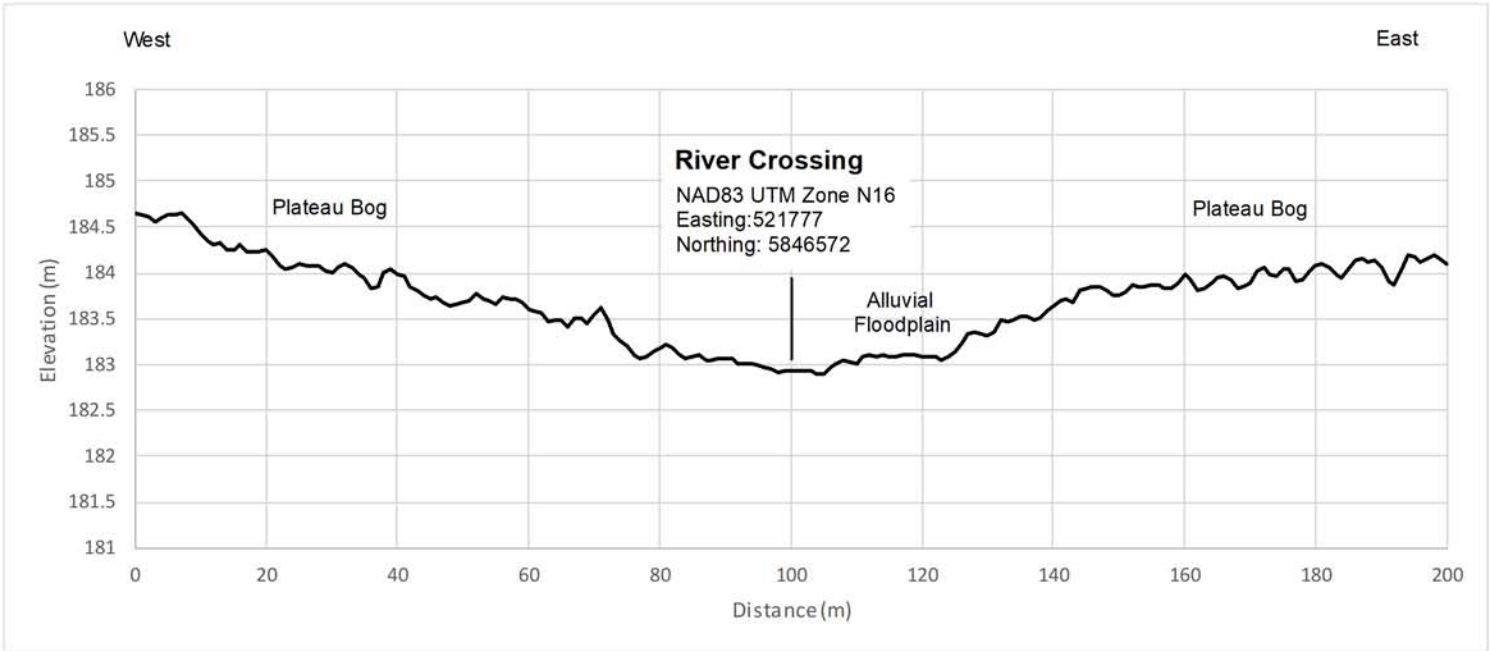
J9

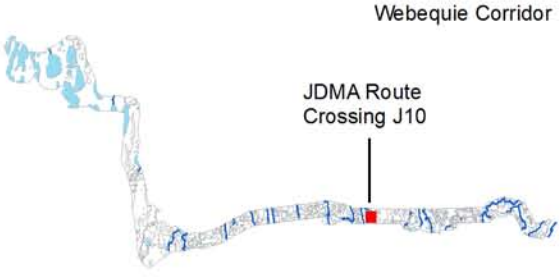
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

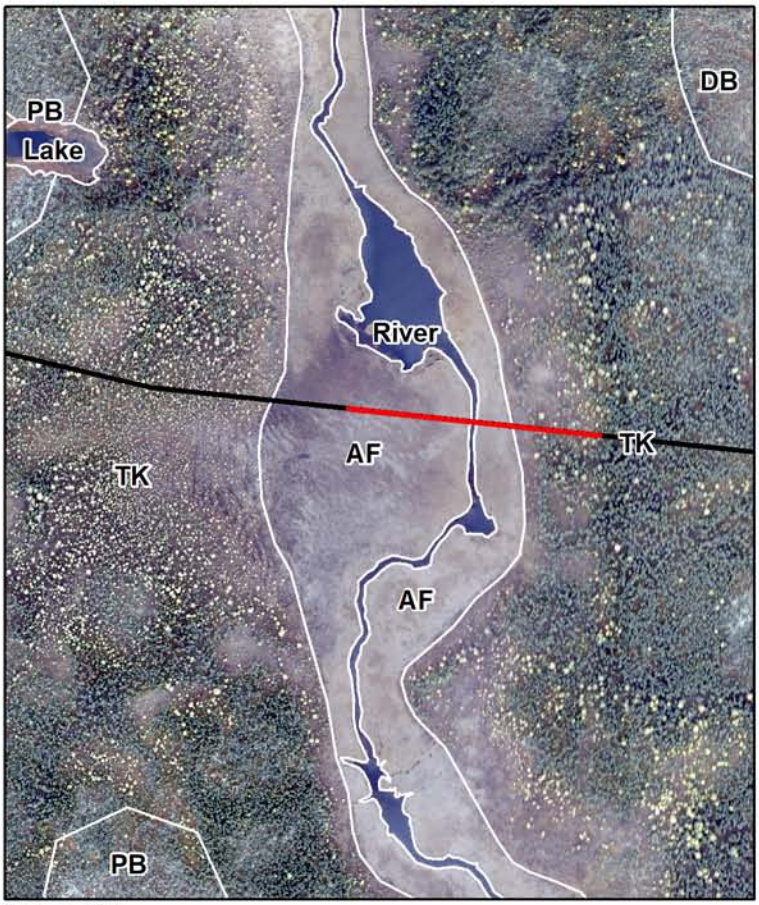
General reference map only; not for survey or legal use.

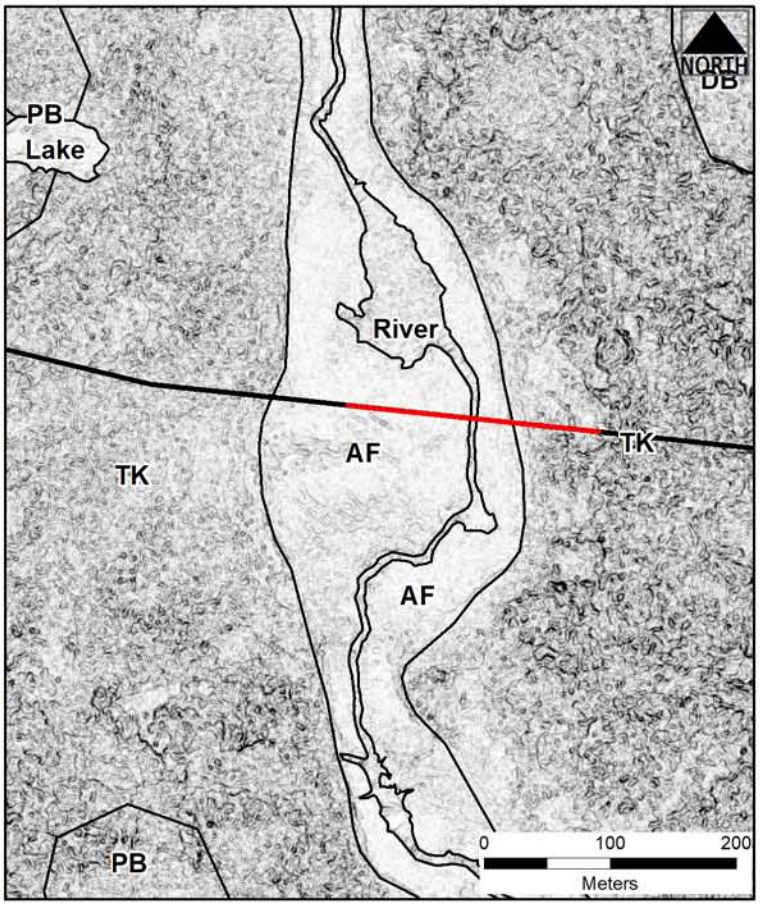
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

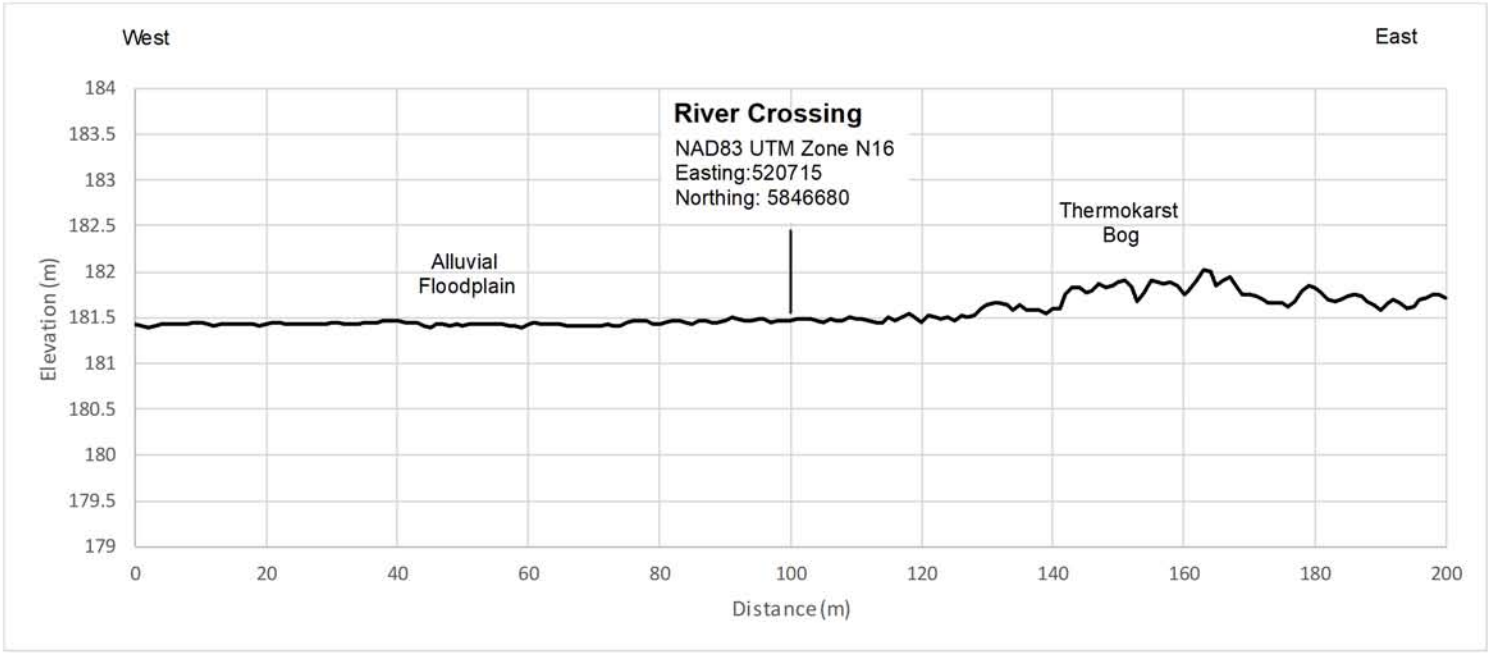
J10

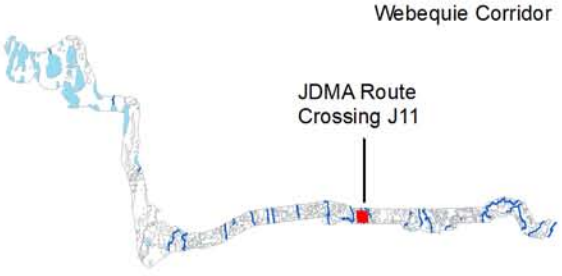
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

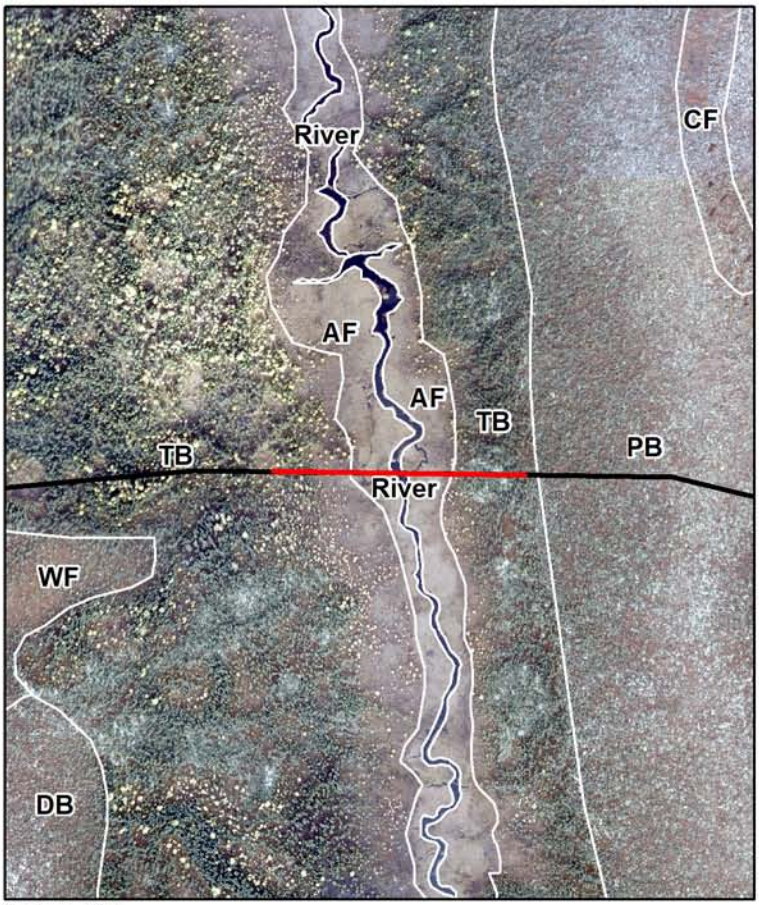
General reference map only; not for survey or legal use.

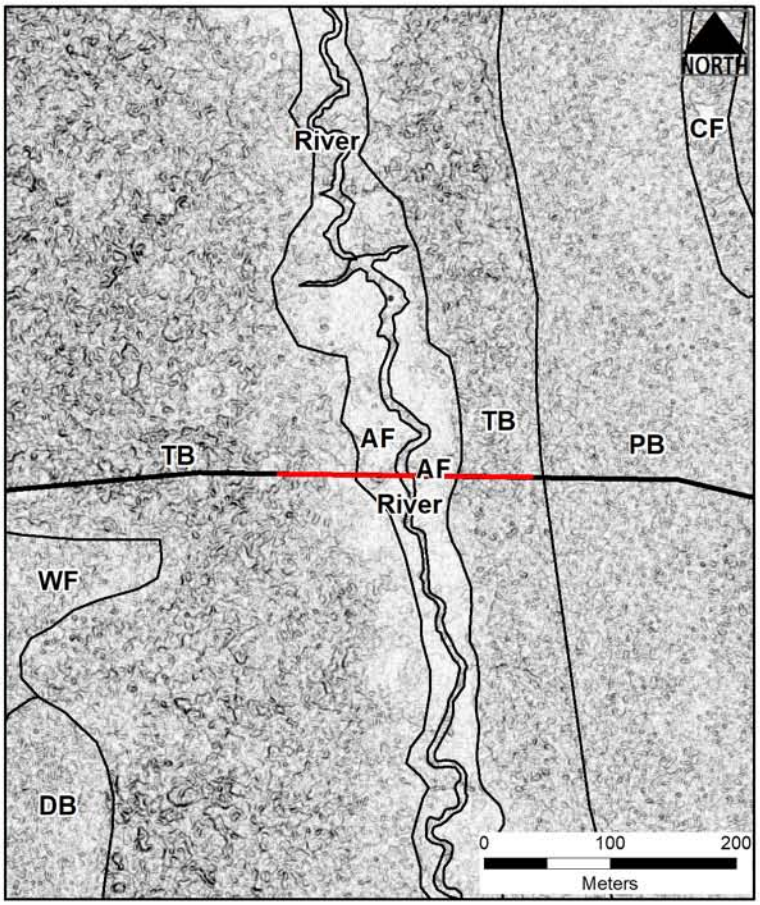
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

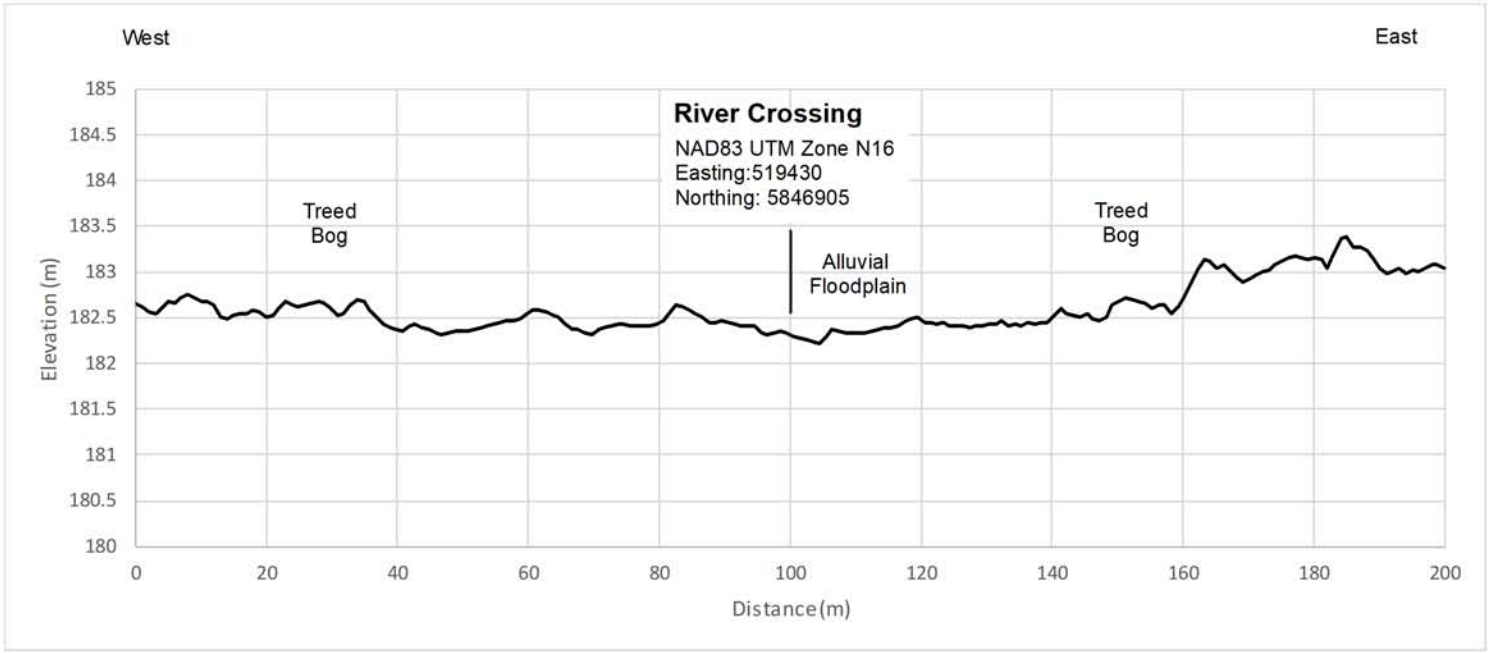
J11

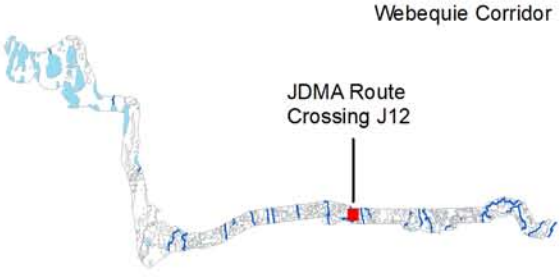
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

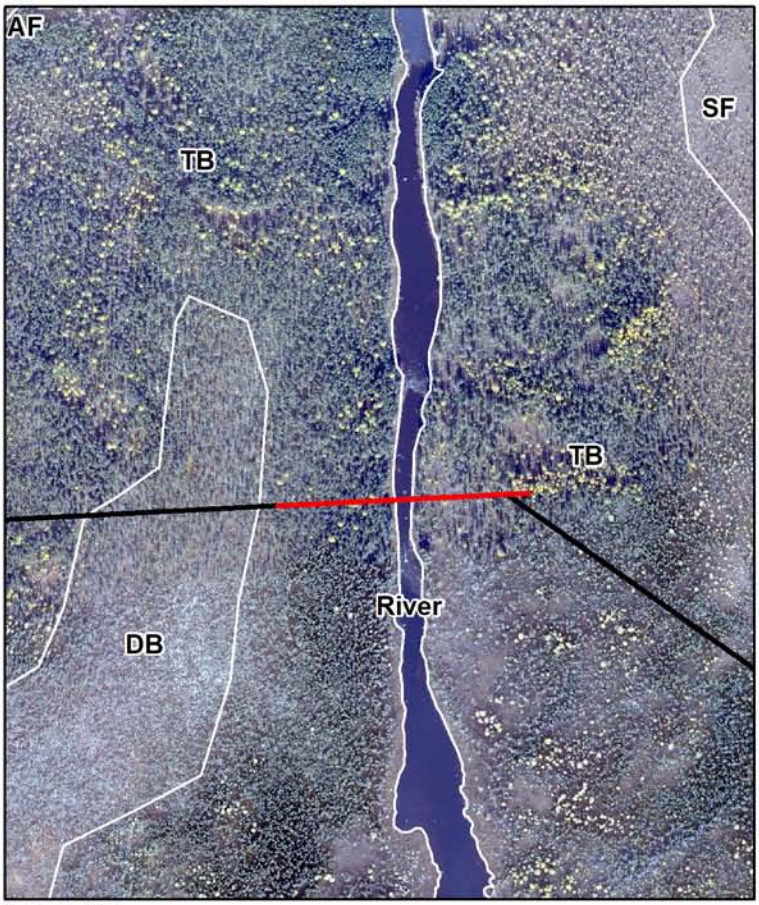
General reference map only; not for survey or legal use.

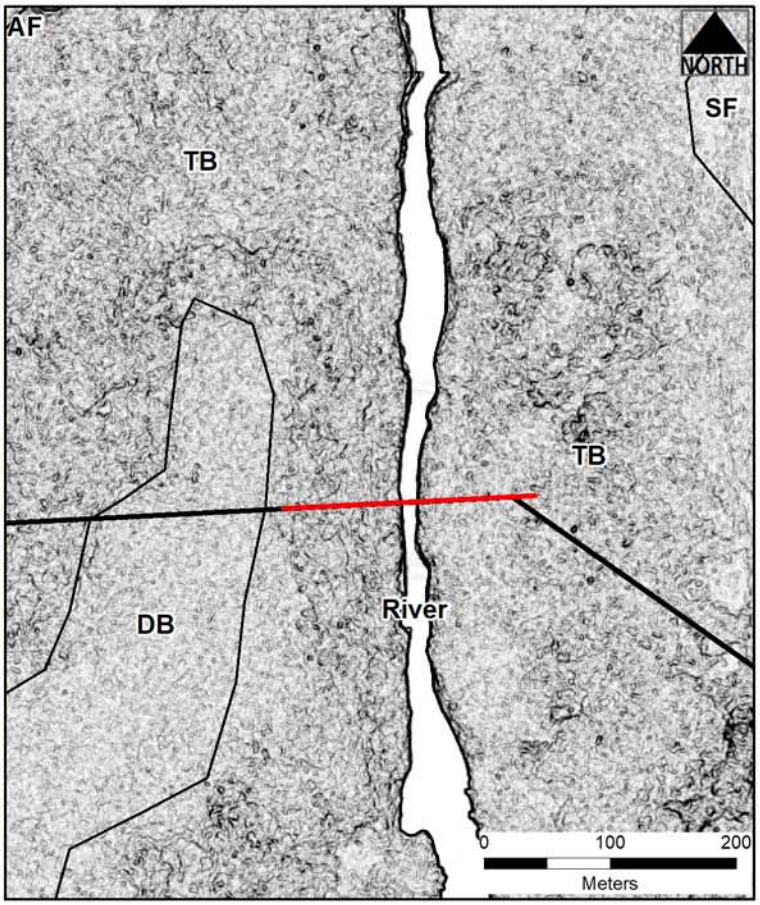
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

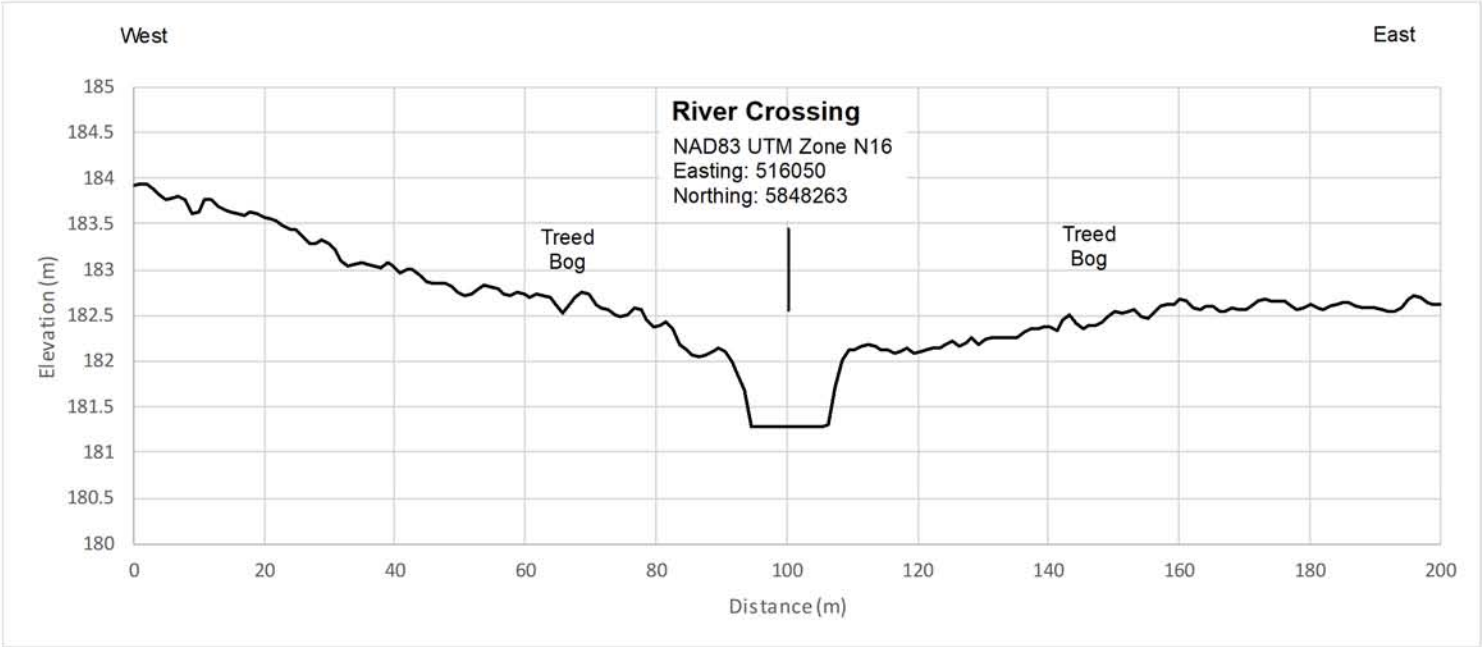
J12

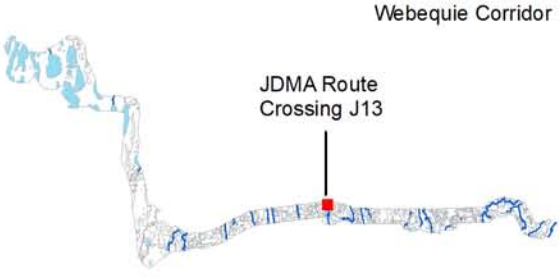
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

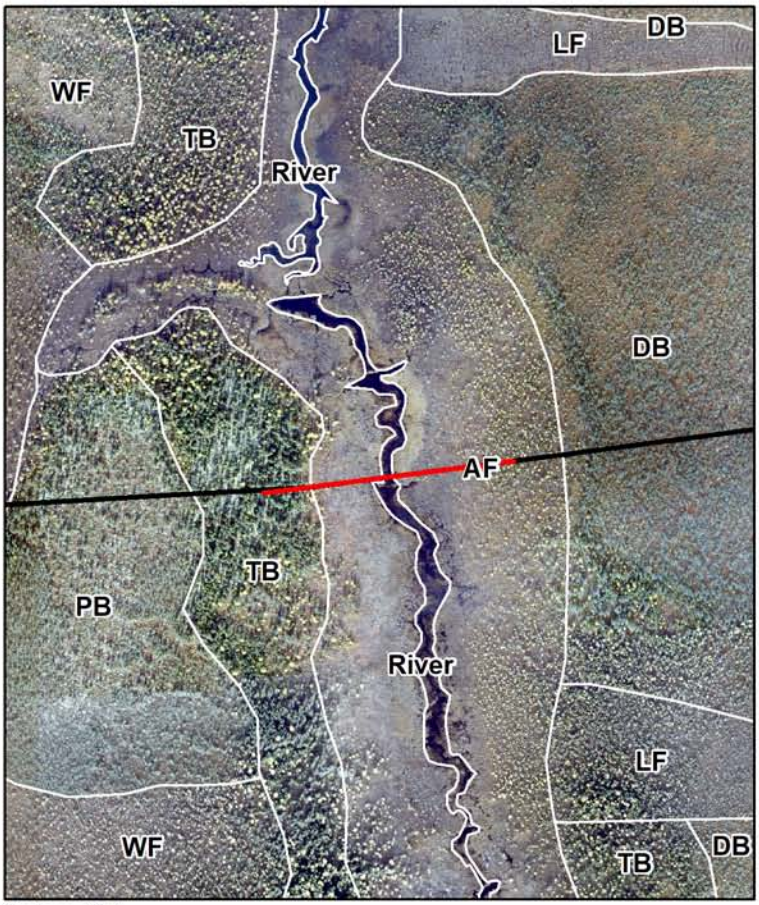
General reference map only; not for survey or legal use.

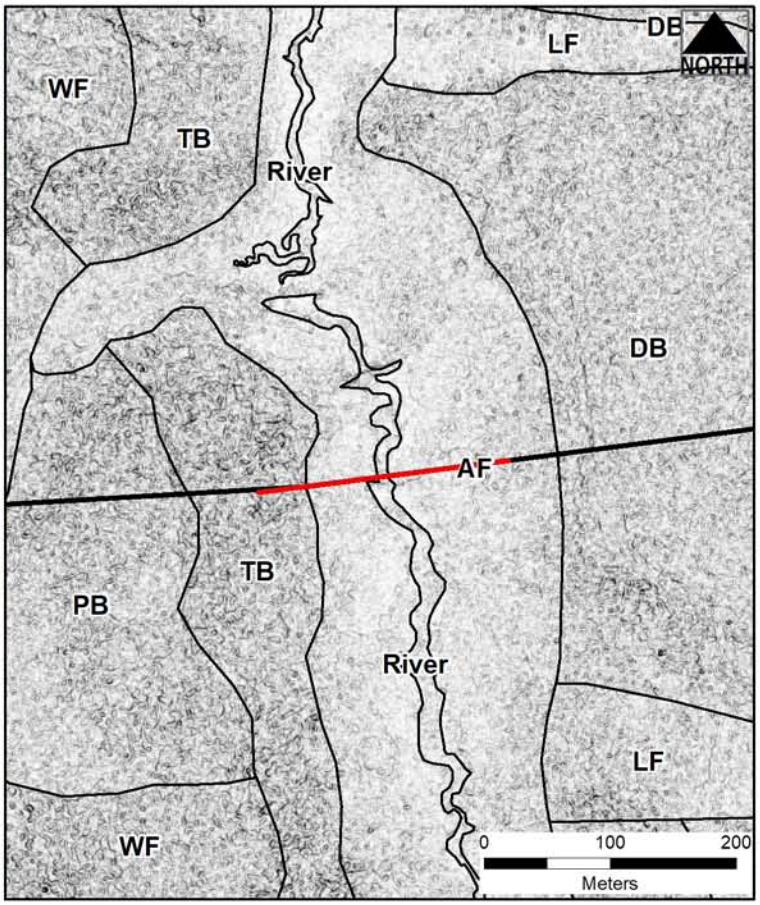
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

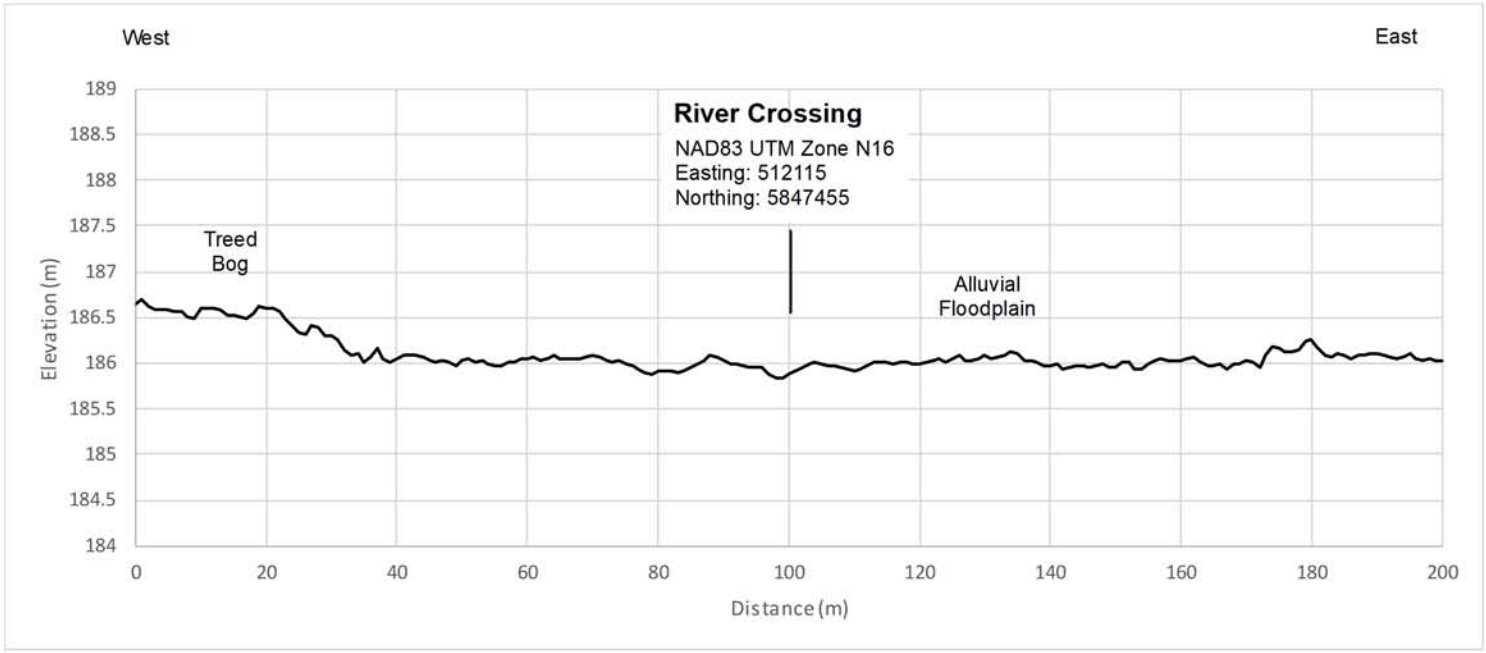
J13

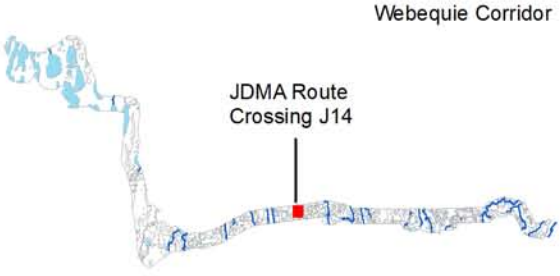
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

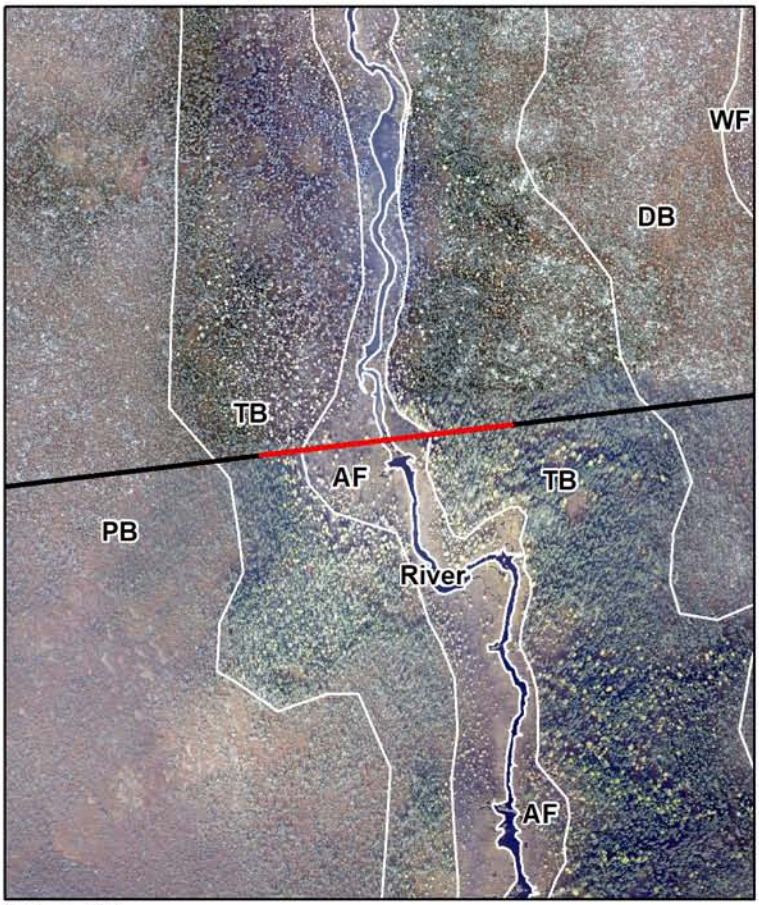
General reference map only; not for survey or legal use.

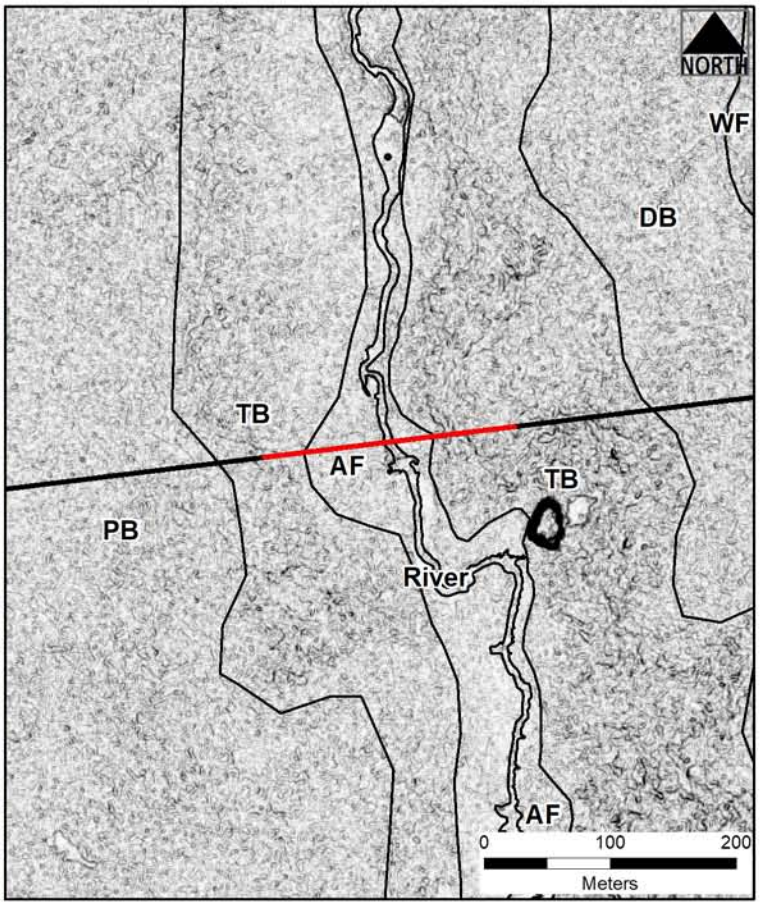
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

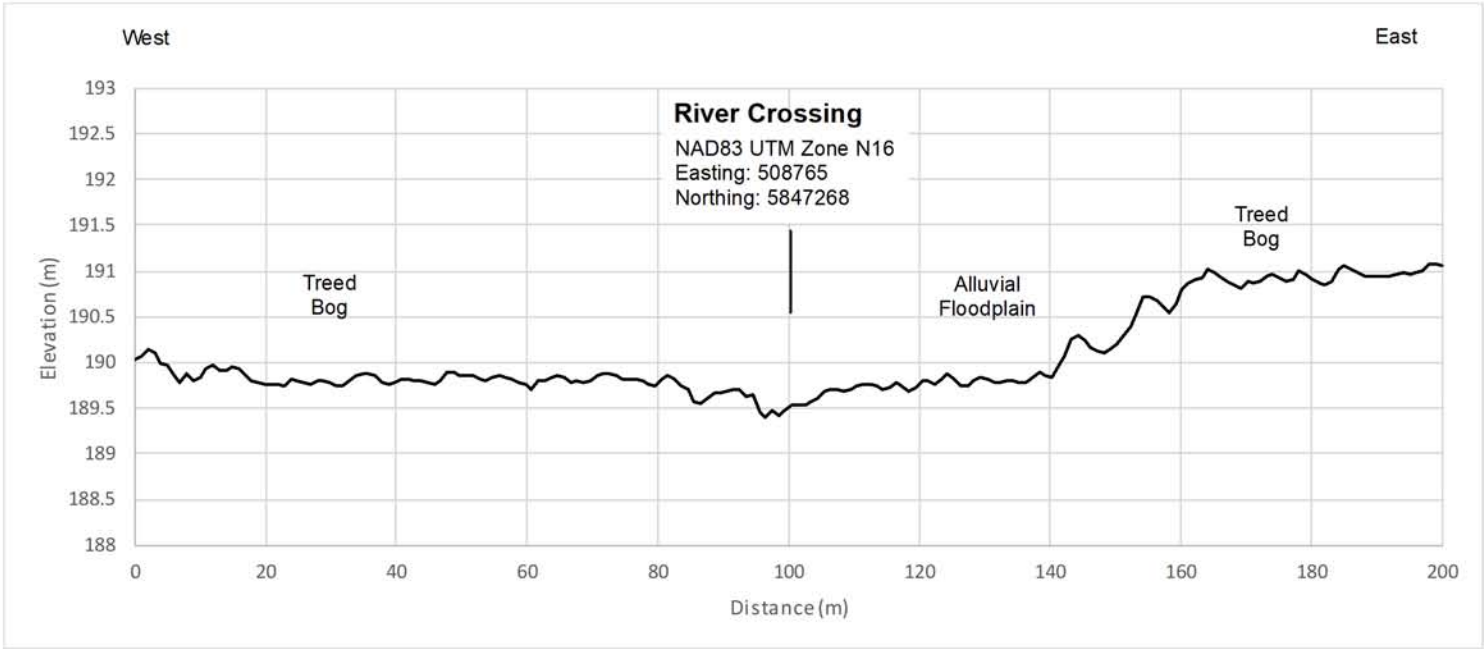
J14

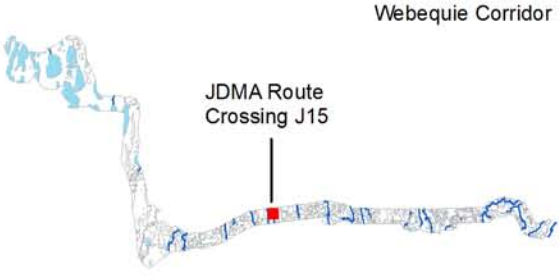
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

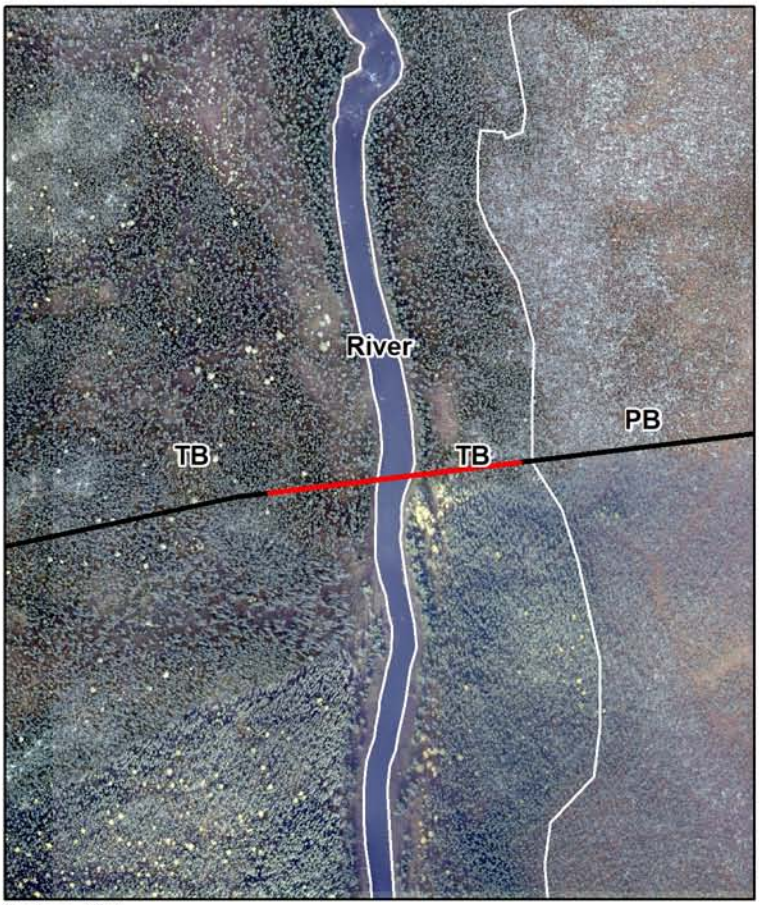
General reference map only; not for survey or legal use.

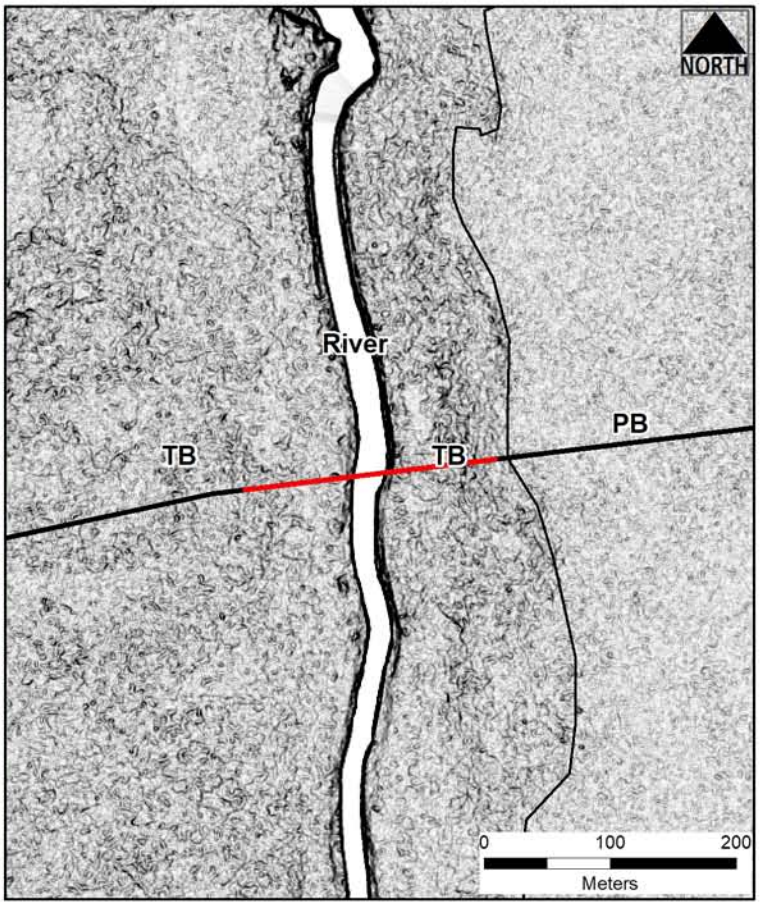
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

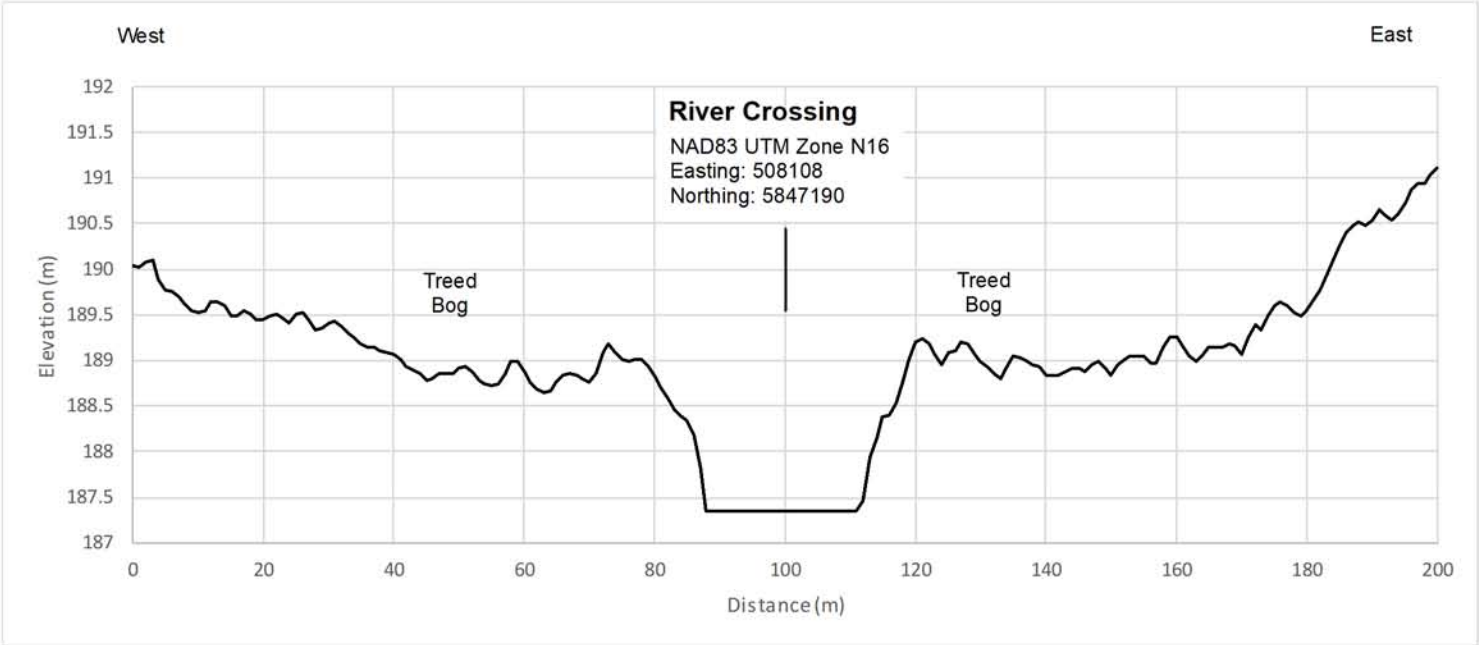
J15

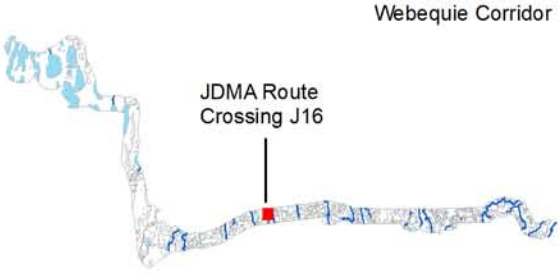
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

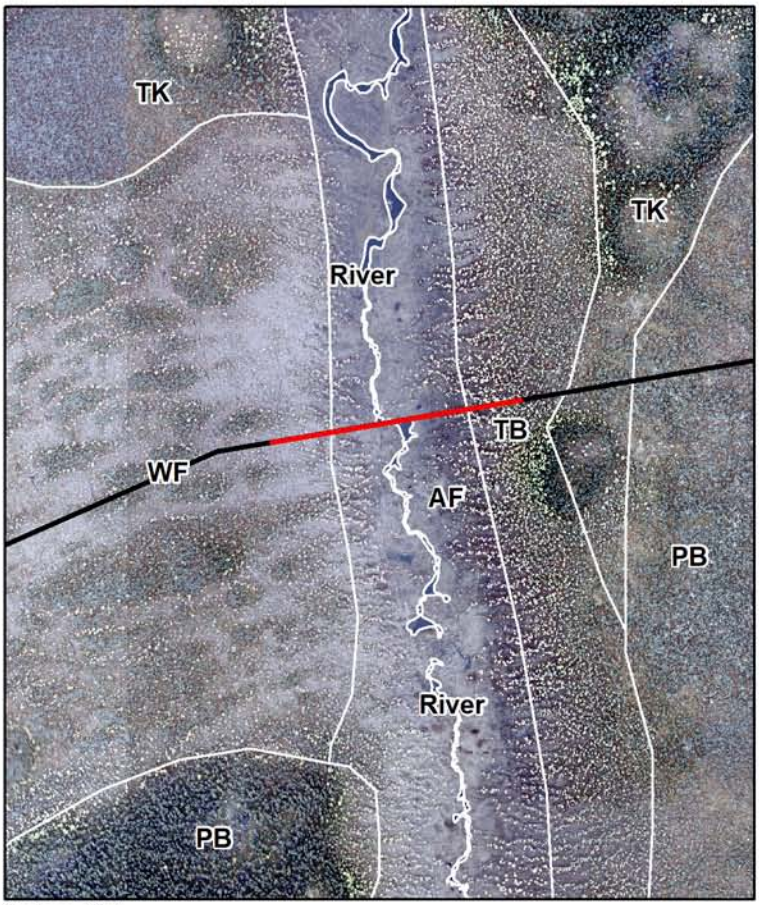
General reference map only; not for survey or legal use.

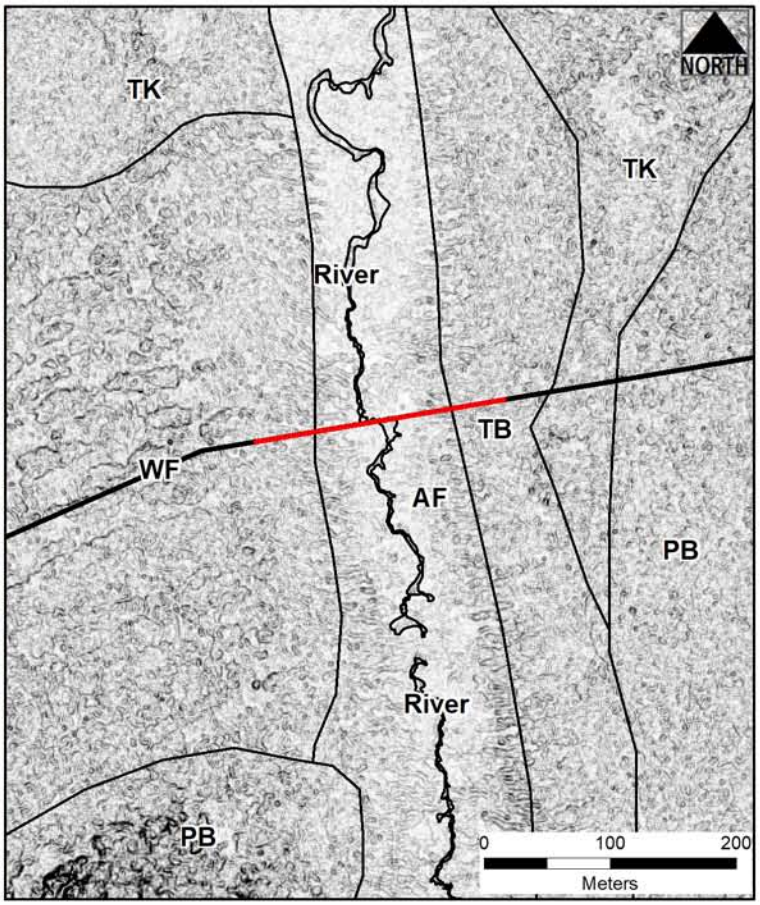
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

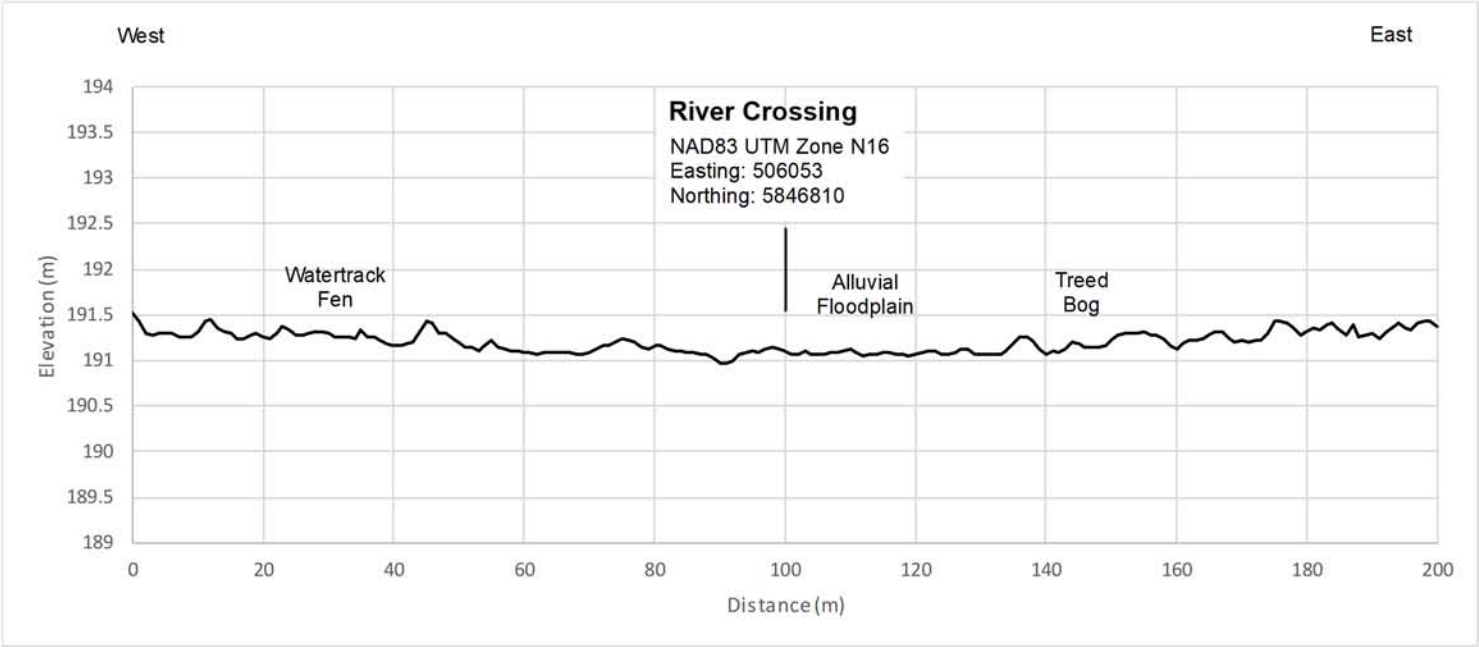
J16

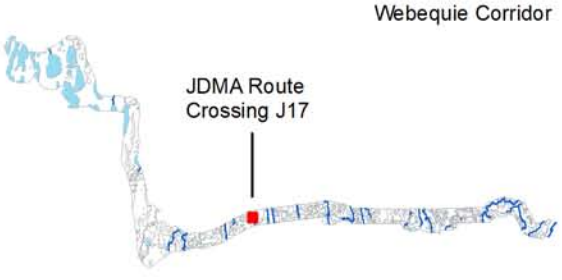
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

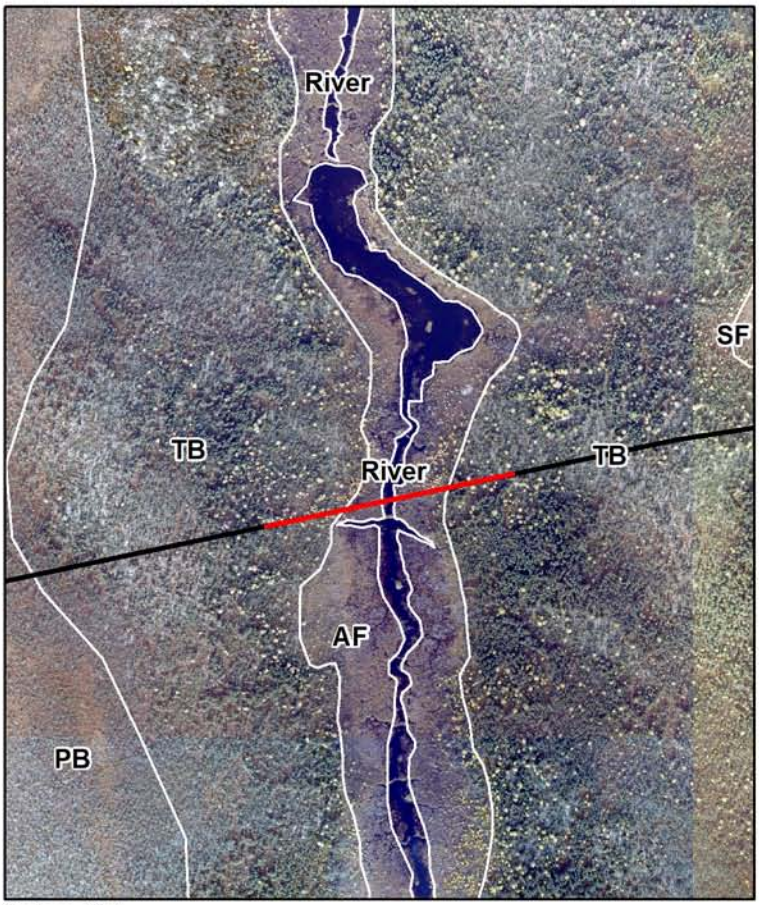
General reference map only; not for survey or legal use.

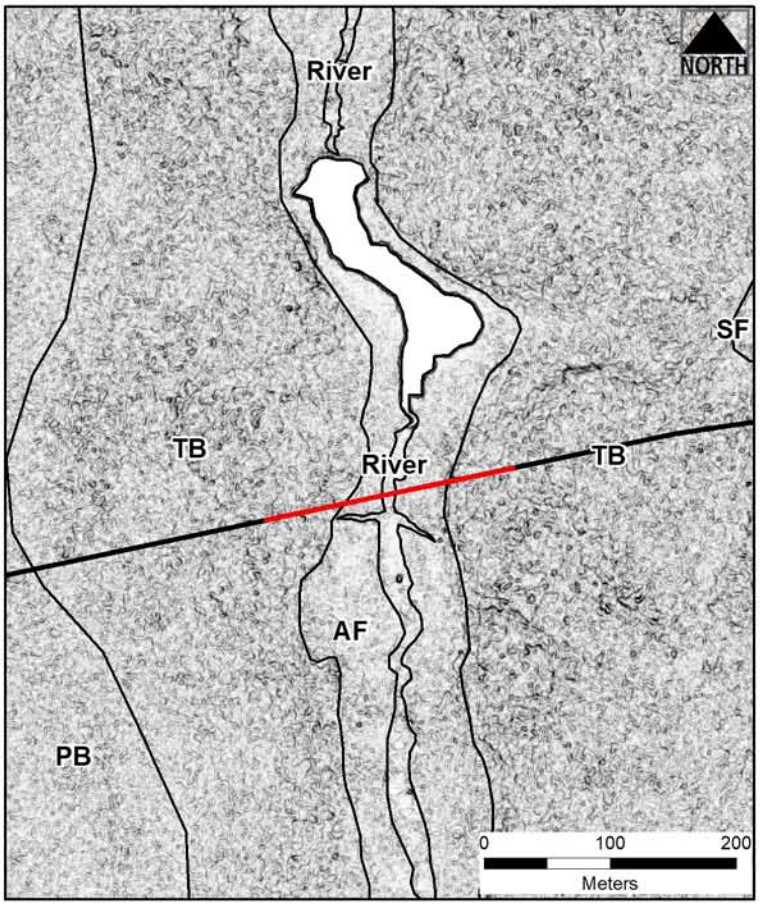
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

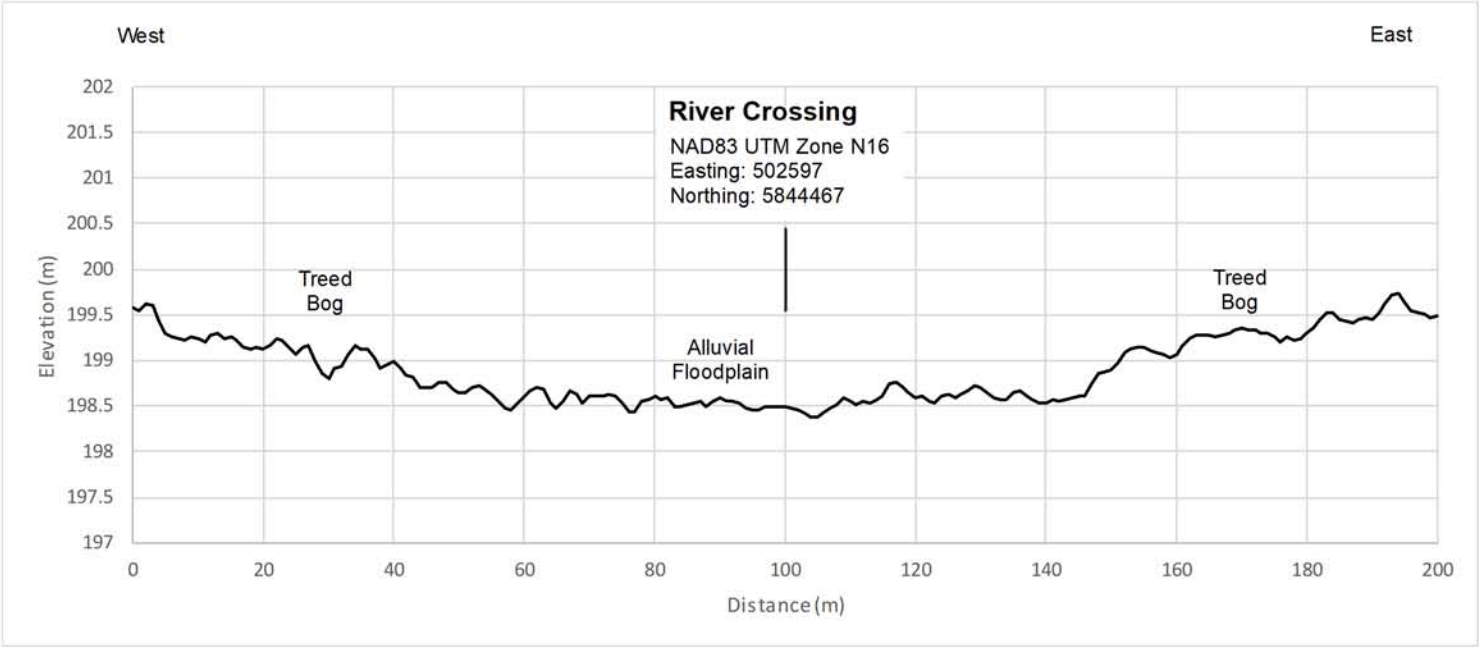
J17

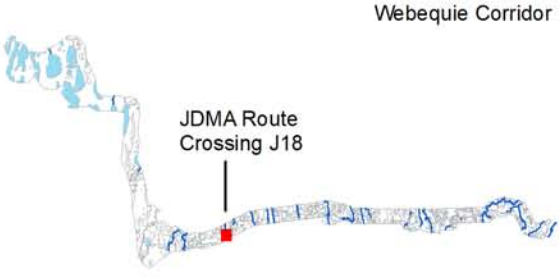
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

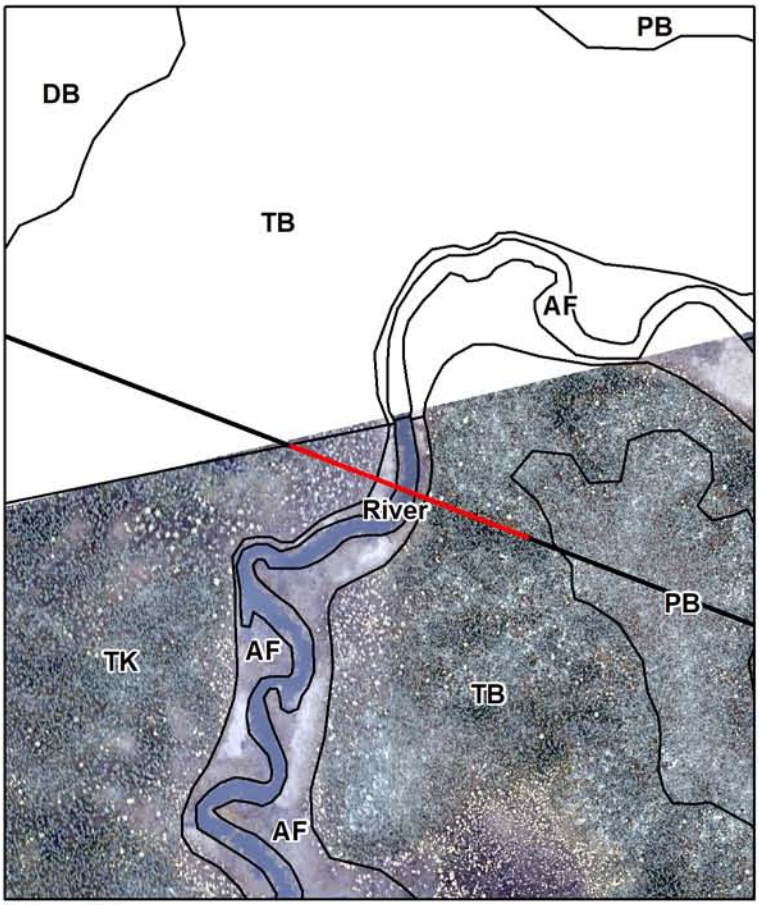
General reference map only; not for survey or legal use.

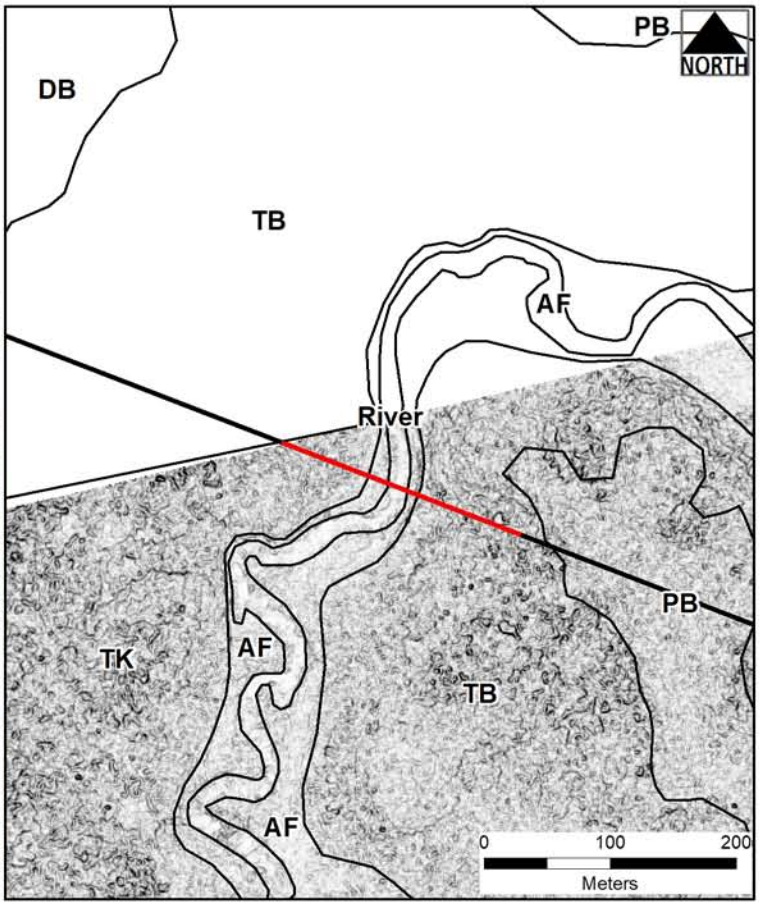
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

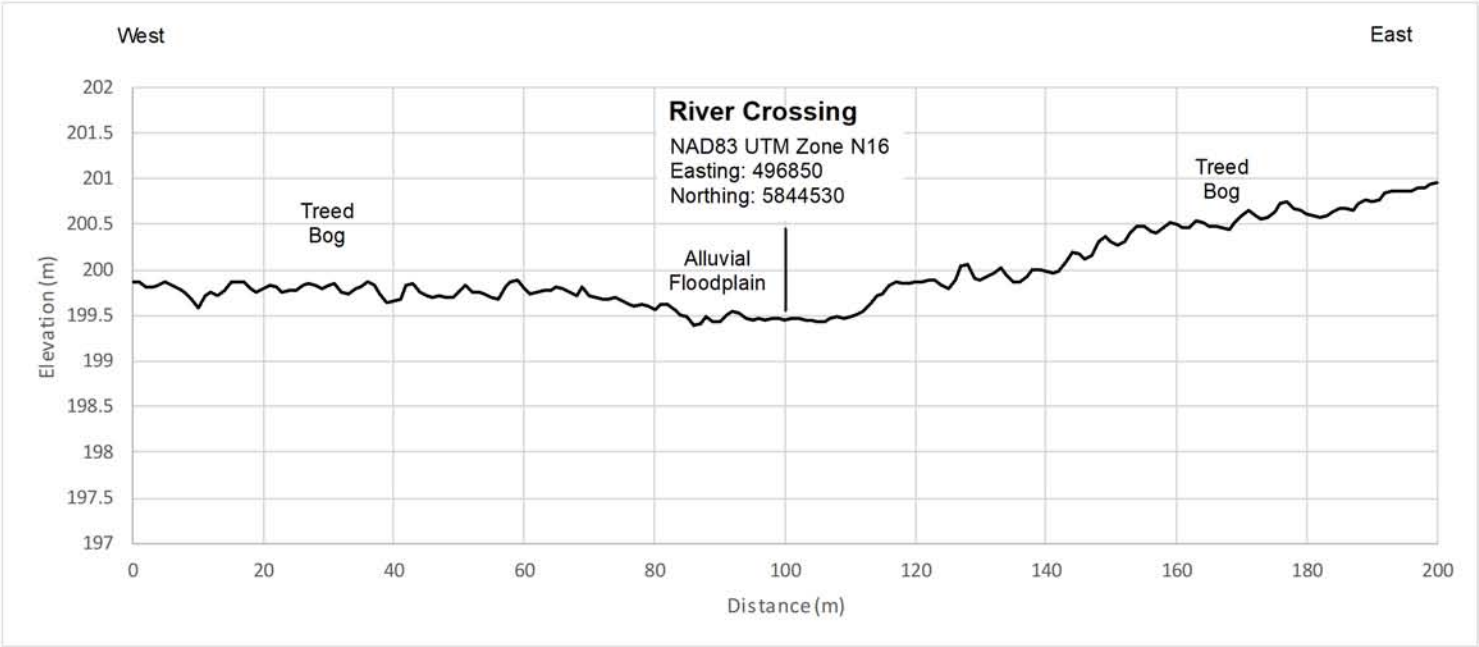
J18

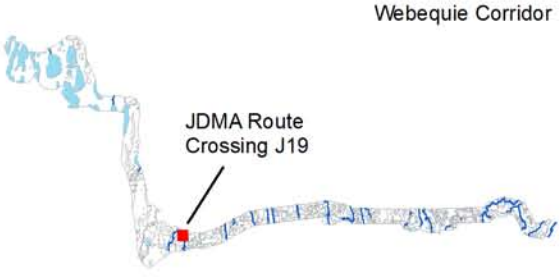
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

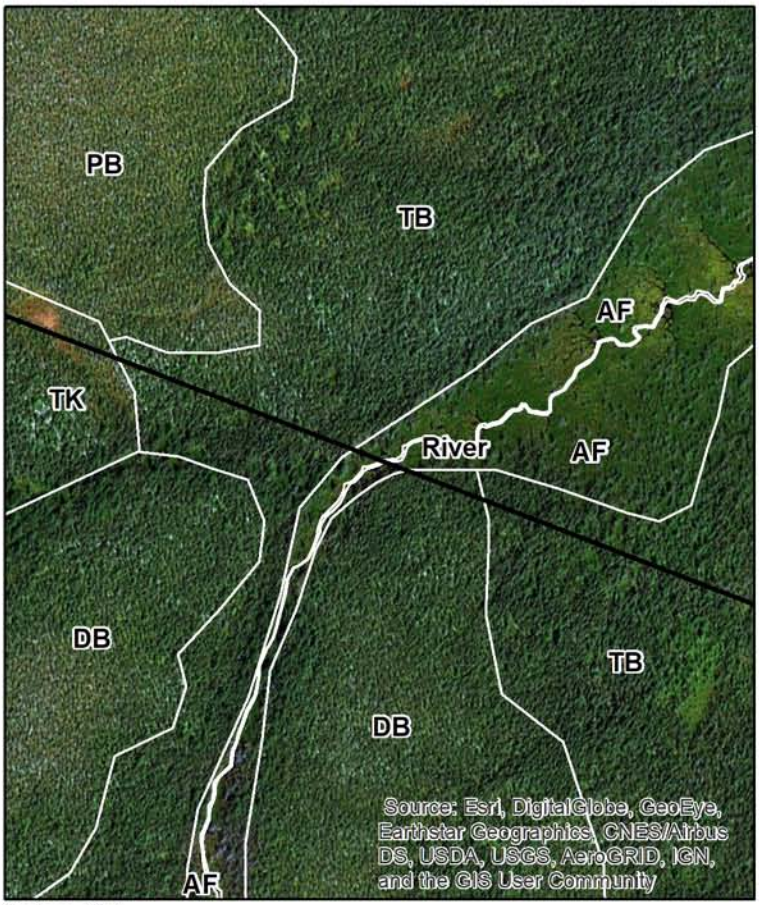
General reference map only; not for survey or legal use.

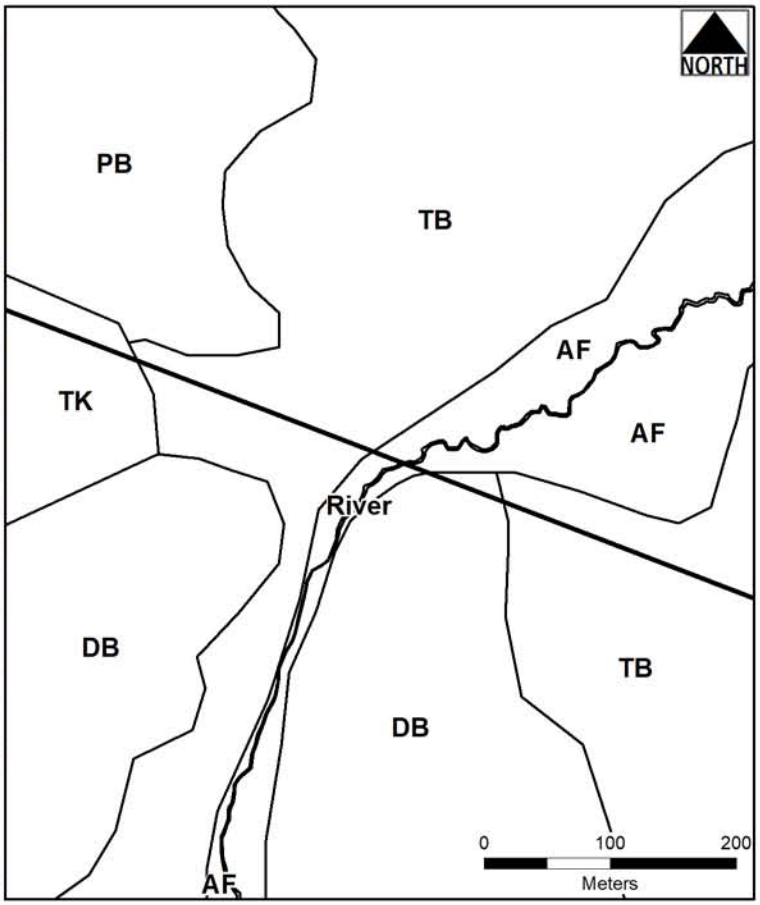
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

J19

J D MOLLARD AND ASSOCIATES (2010) LIMITED



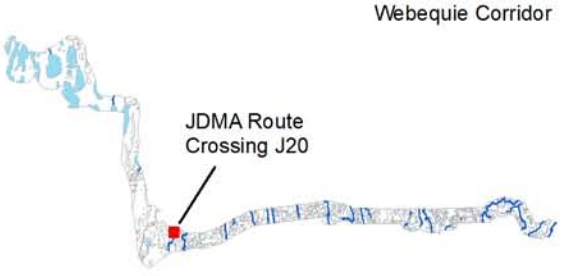


Chainages (Km)

River Crossing

NAD83 UTM Zone N16
Easting:495687
Northing: 5844978

No LiDAR Data



LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

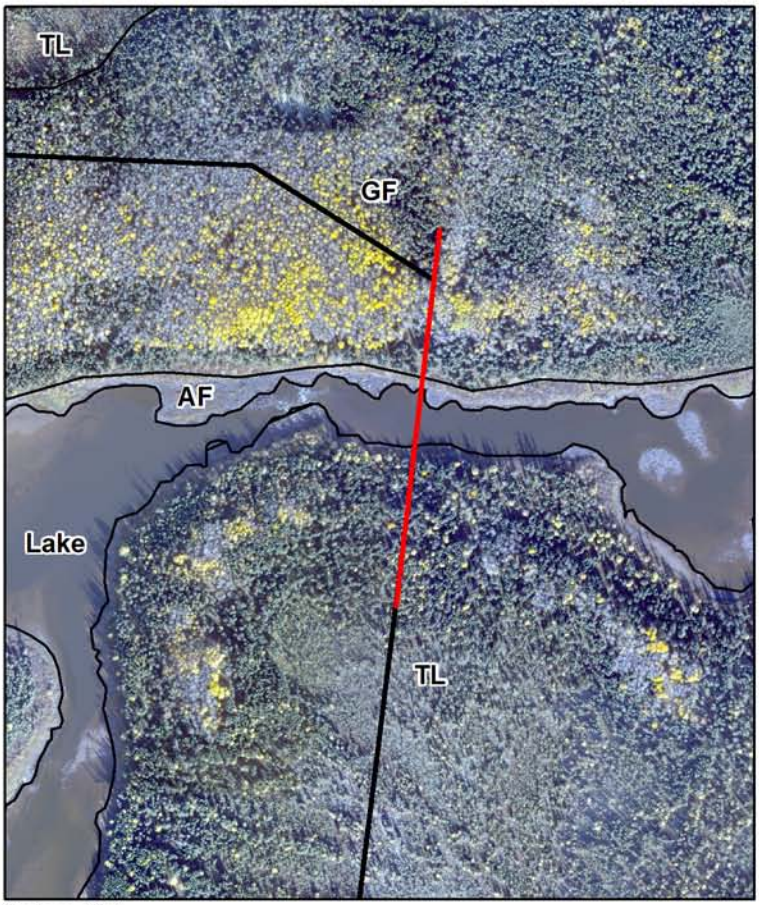
General reference map only; not for survey or legal use.

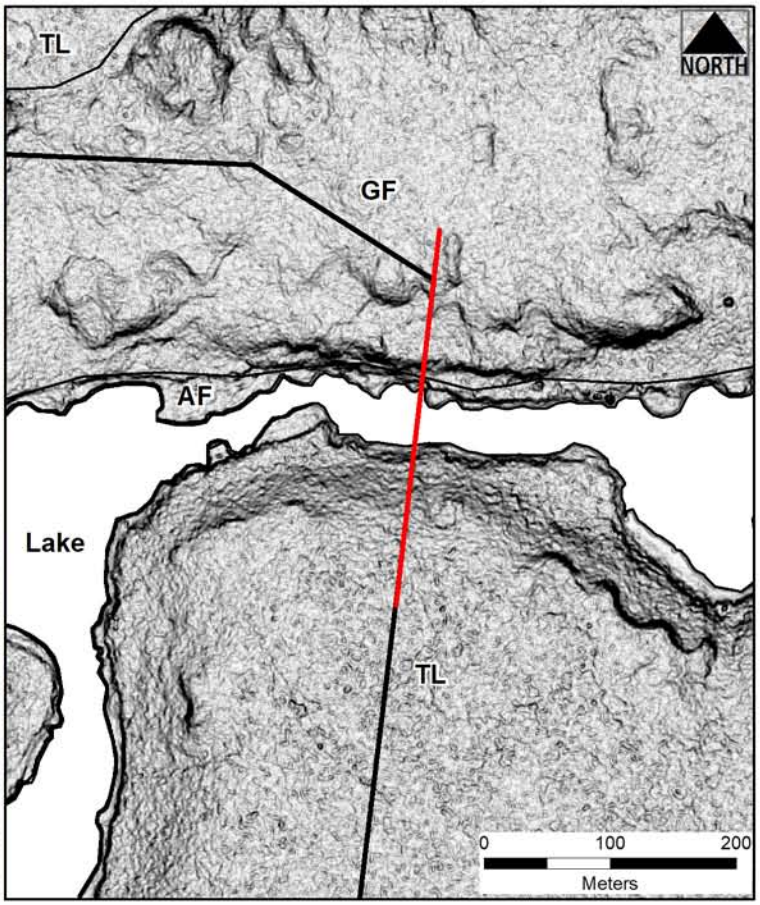
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

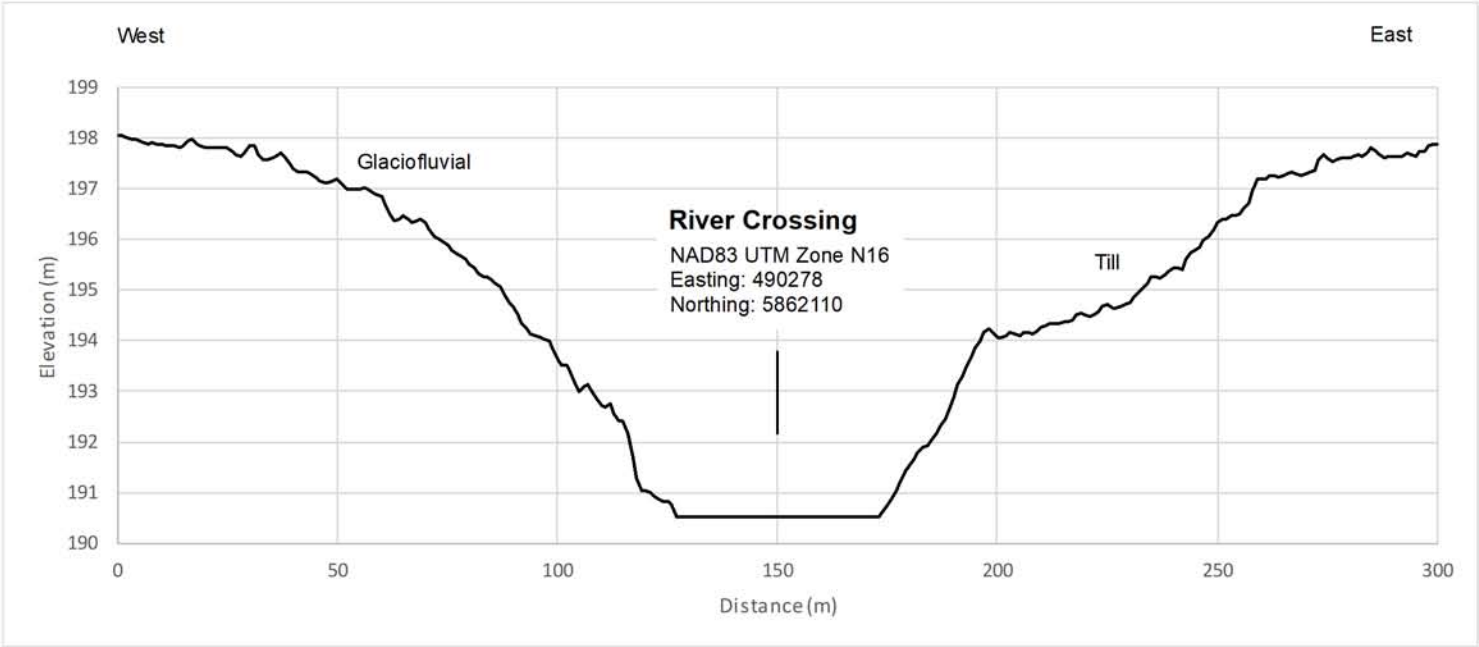
J20

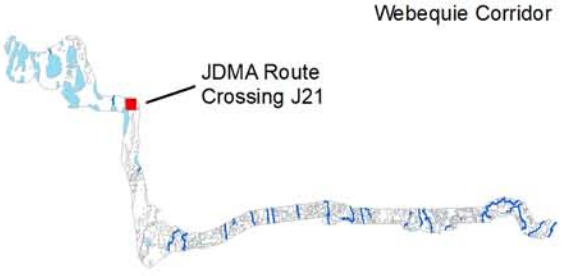
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

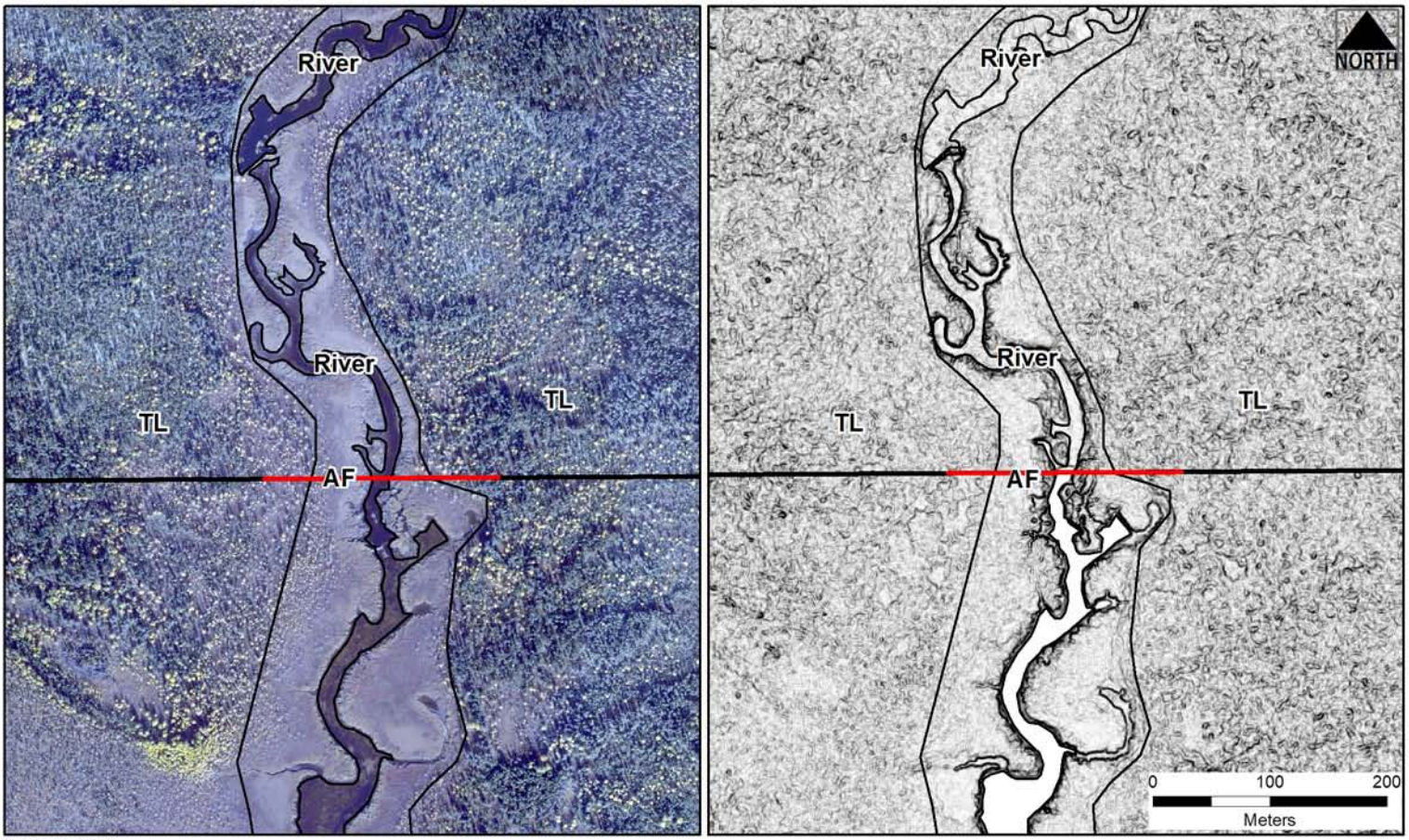
General reference map only; not for survey or legal use.

Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

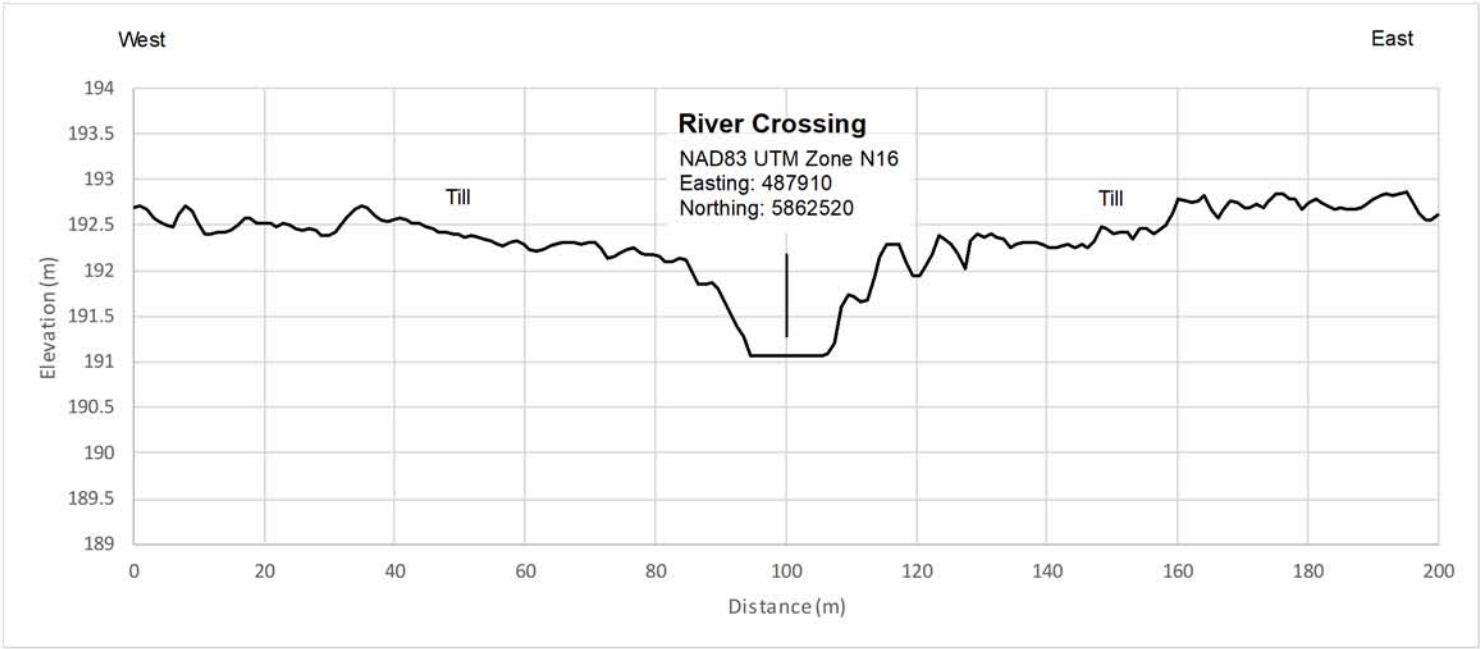
CROSSING:

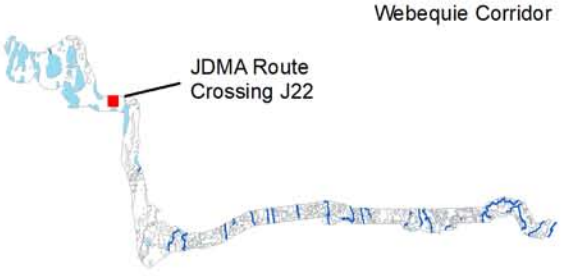
J21

J D MOLLARD AND ASSOCIATES (2010) LIMITED



Chainages (Km)





LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

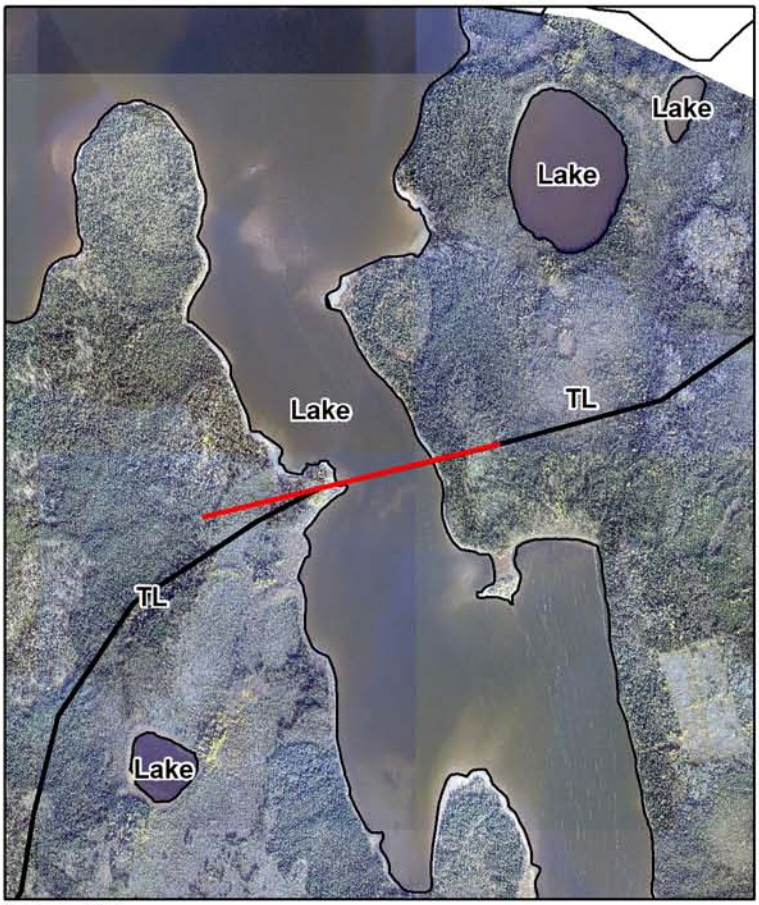
General reference map only; not for survey or legal use.

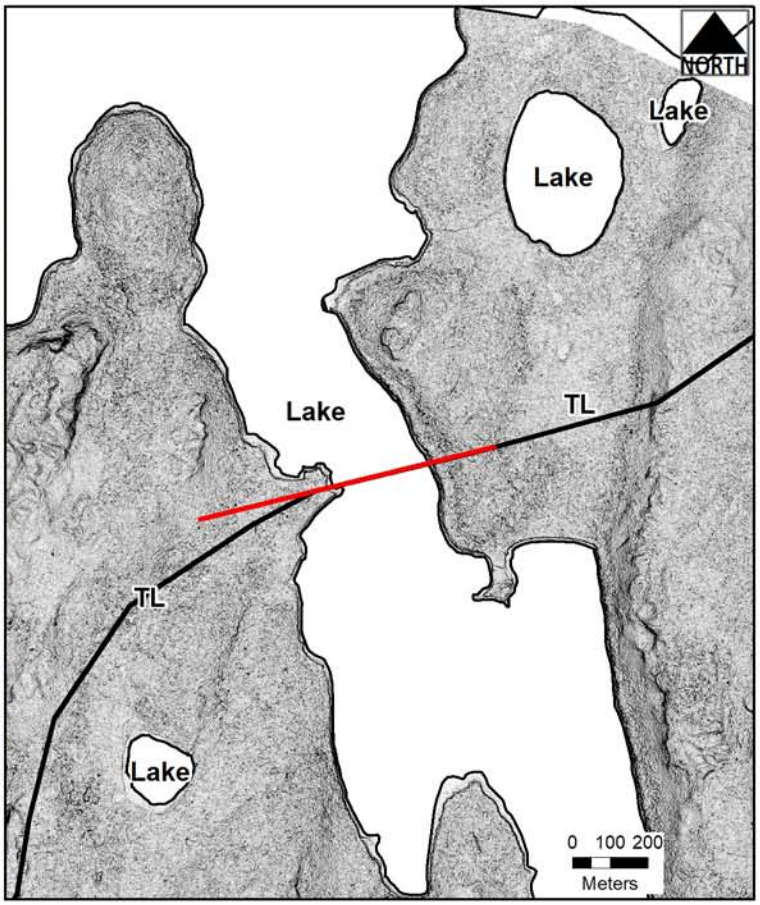
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

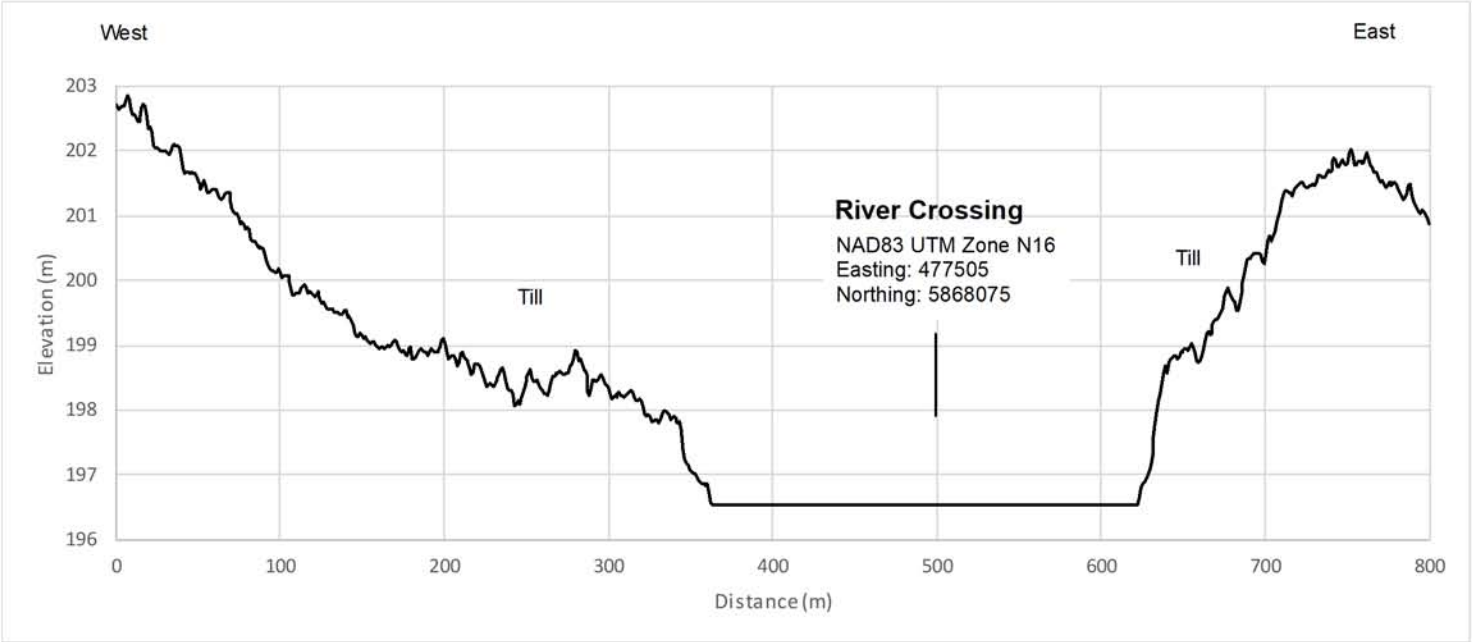
J22

J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)



LEGEND:

JDMA Optimal (Feb, 2019)

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

JDMA Route Crossings

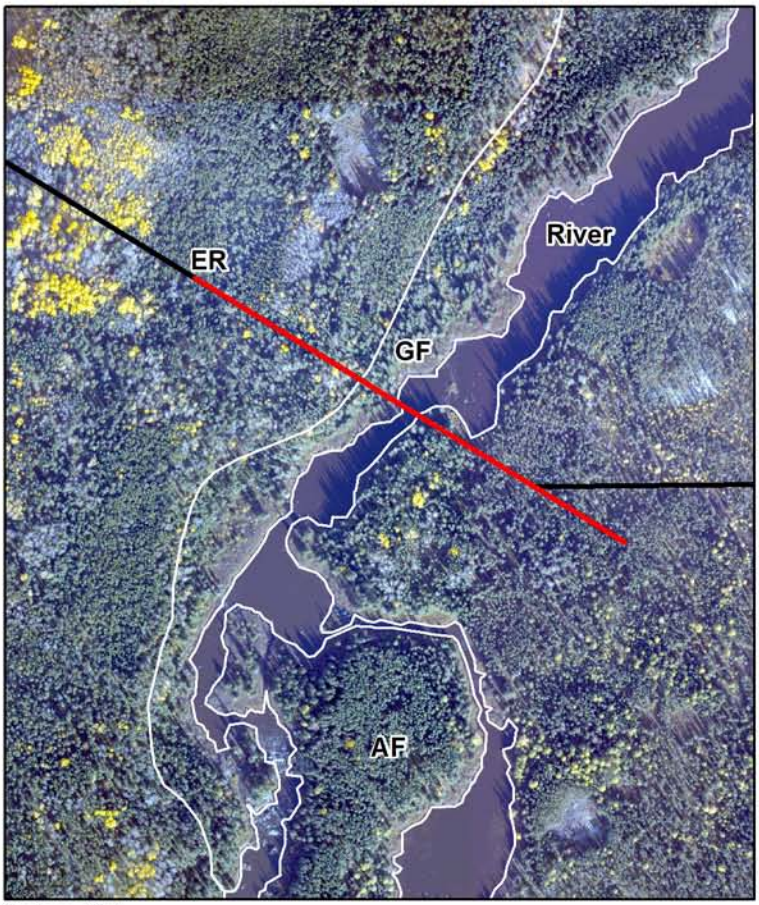
General reference map only; not for survey or legal use.

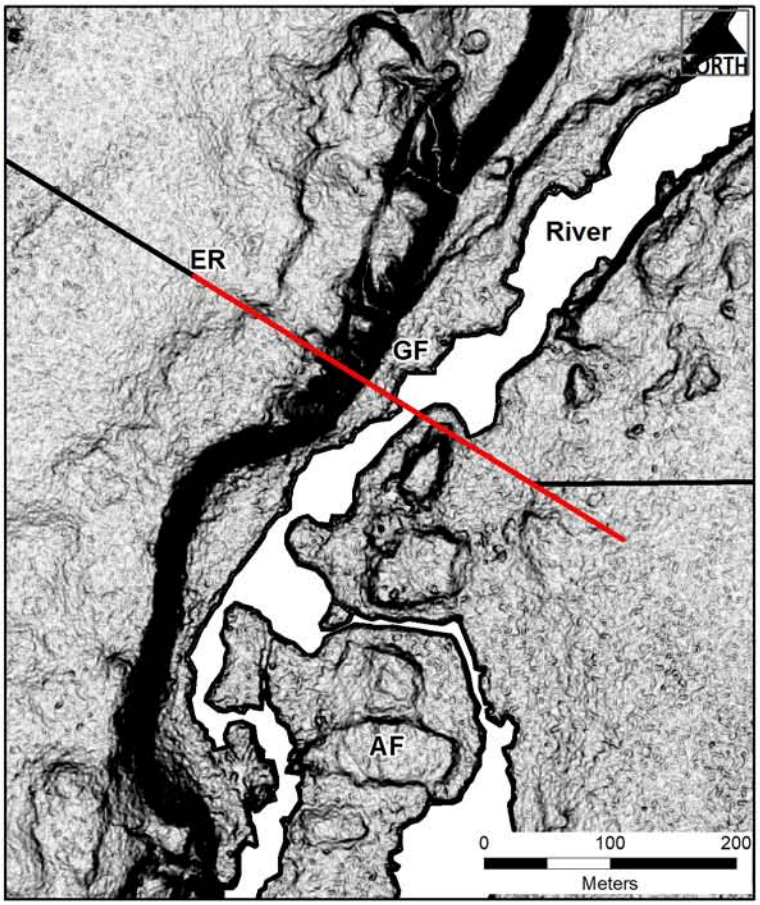
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

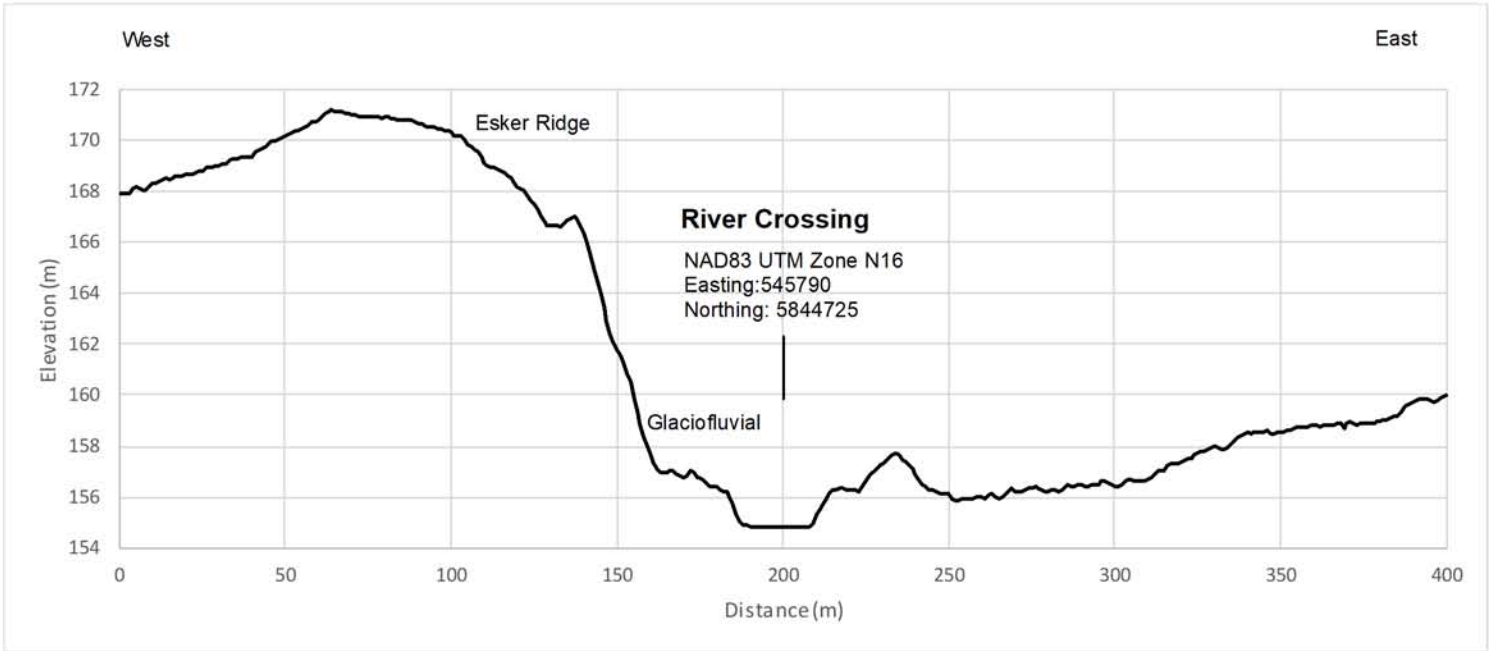
J23

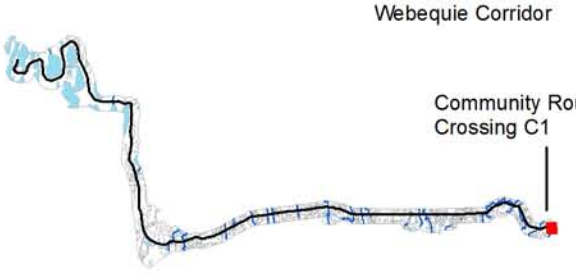
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

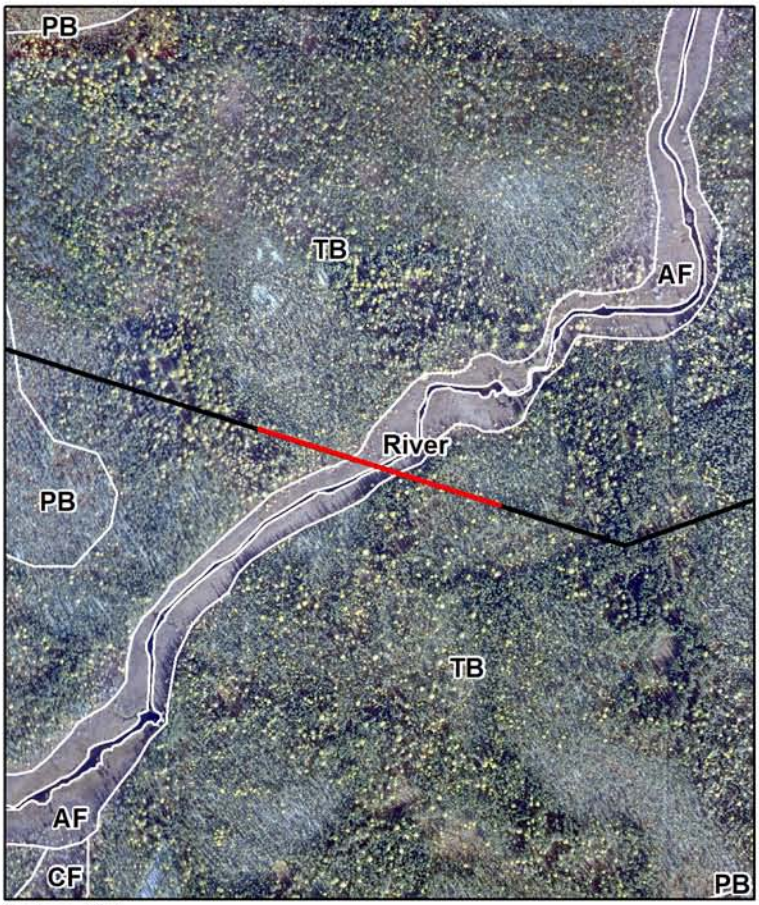
General reference map only; not for survey or legal use.

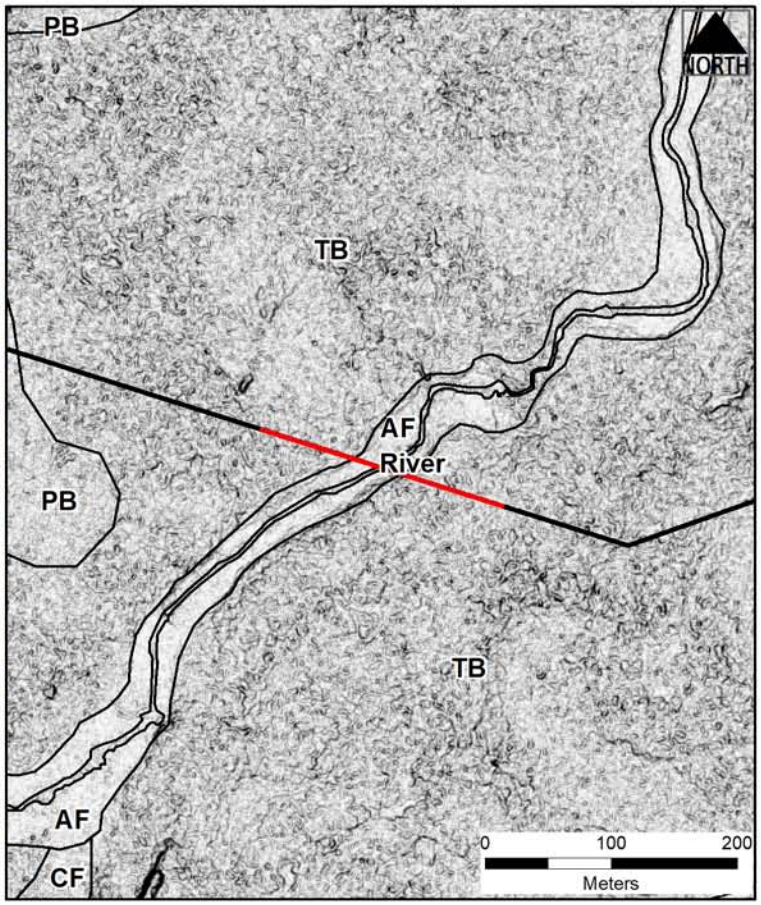
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

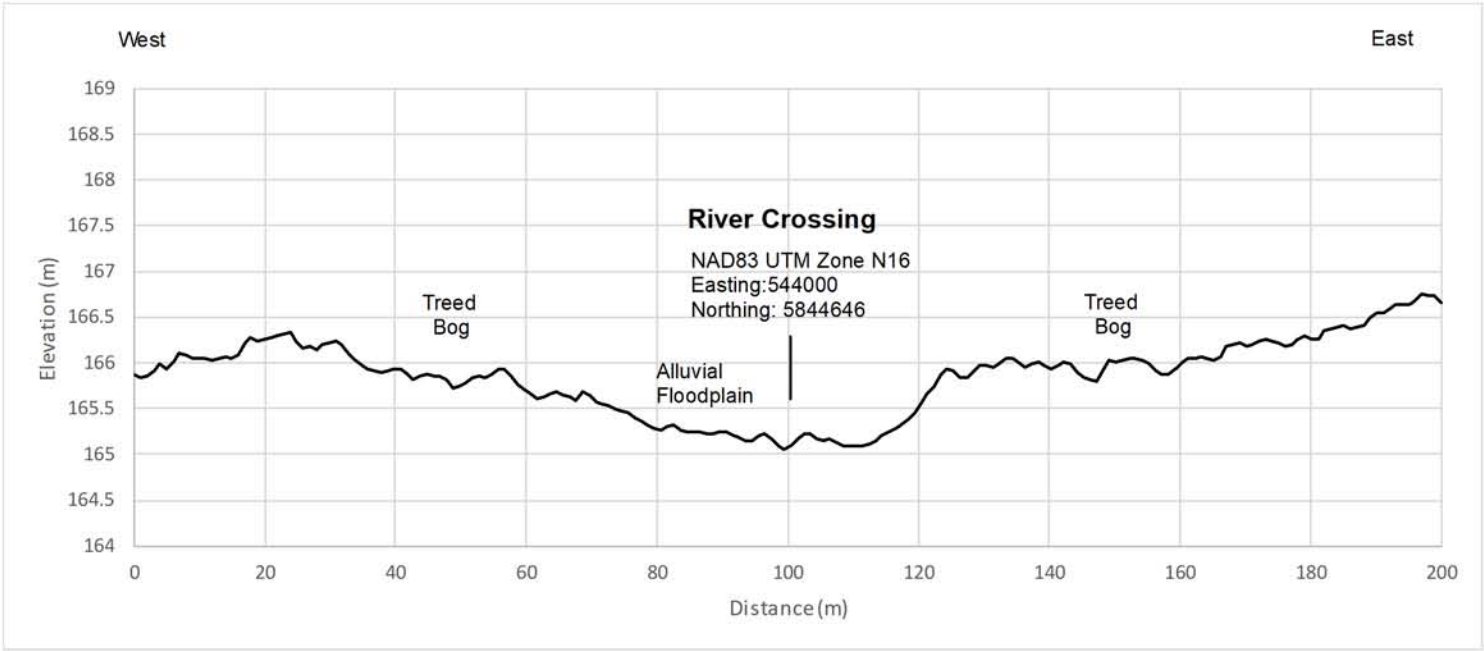
C1

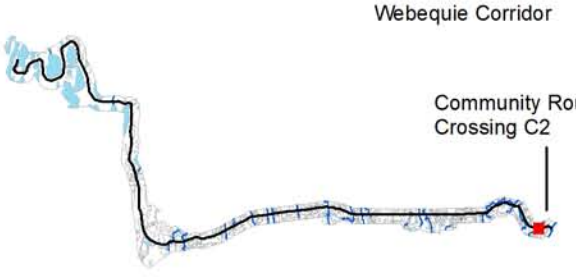
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

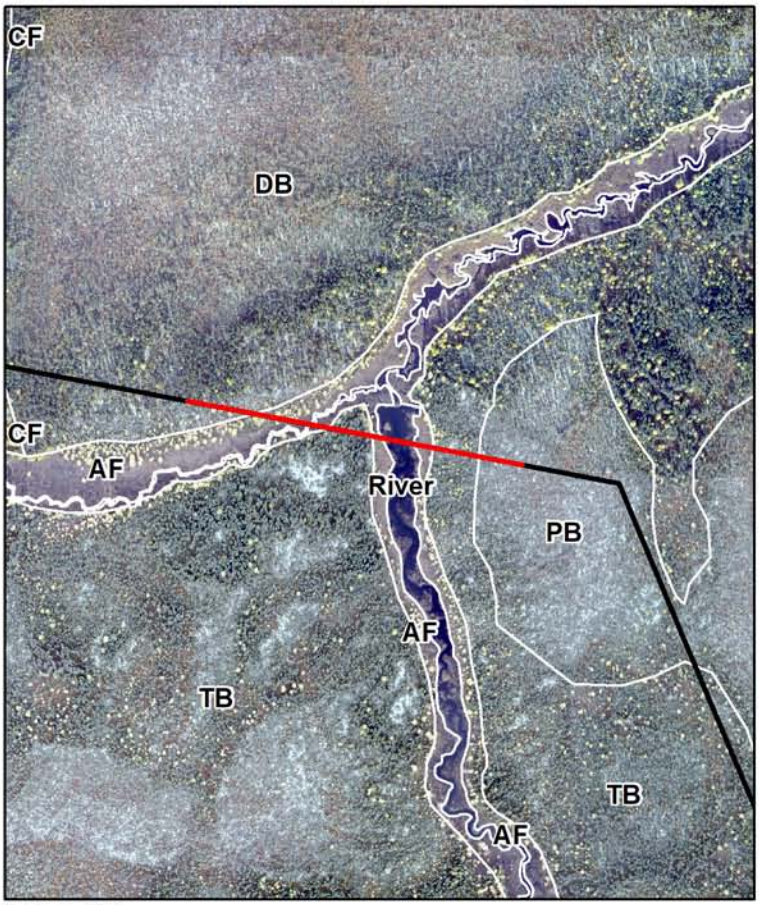
General reference map only; not for survey or legal use.

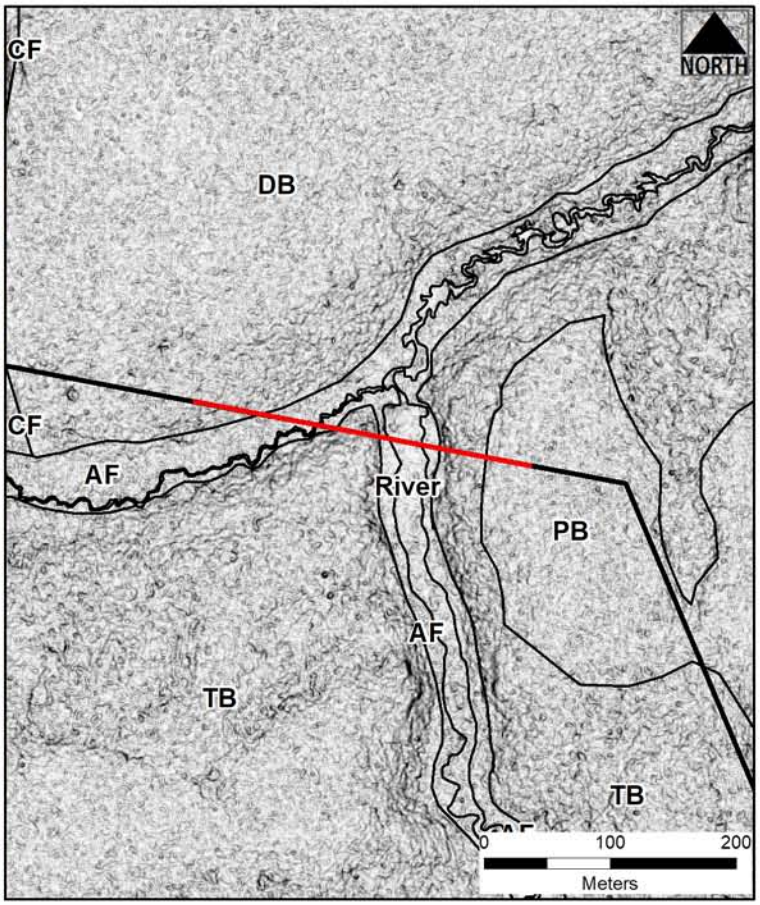
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

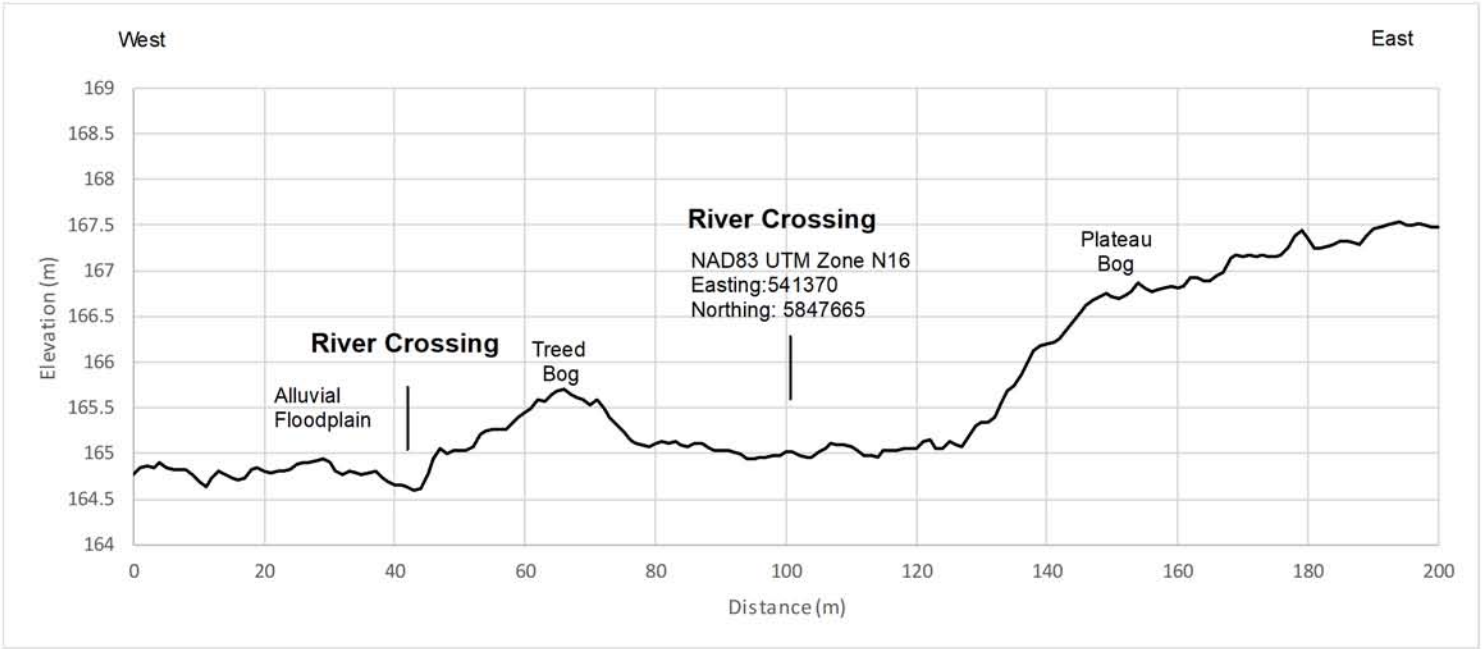
C2

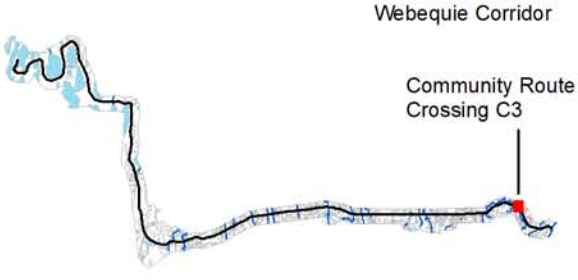
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

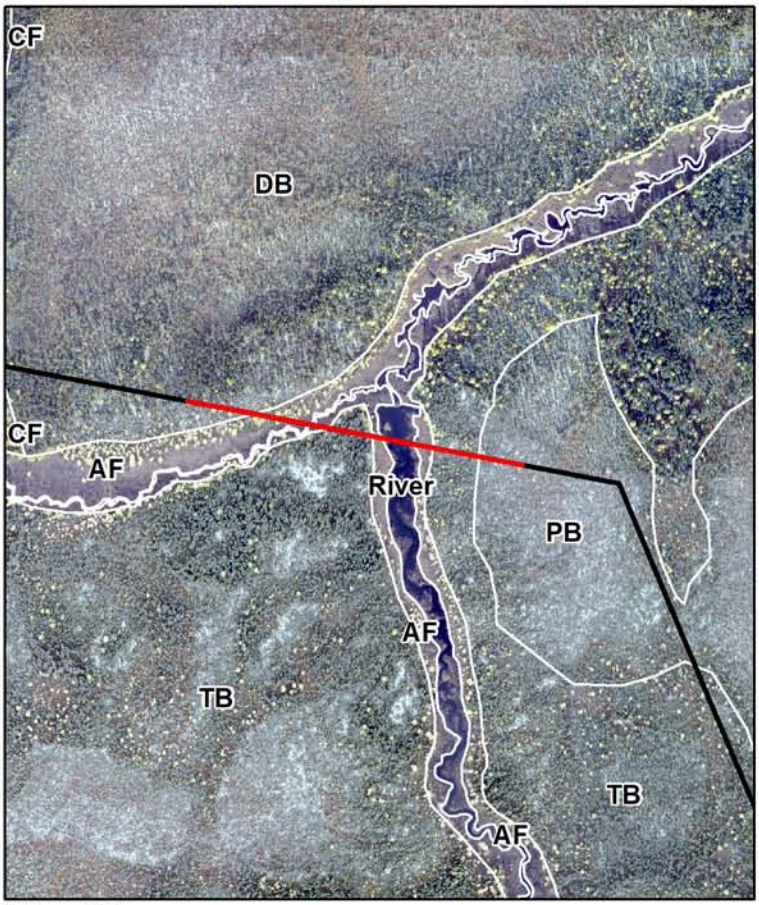
General reference map only; not for survey or legal use.

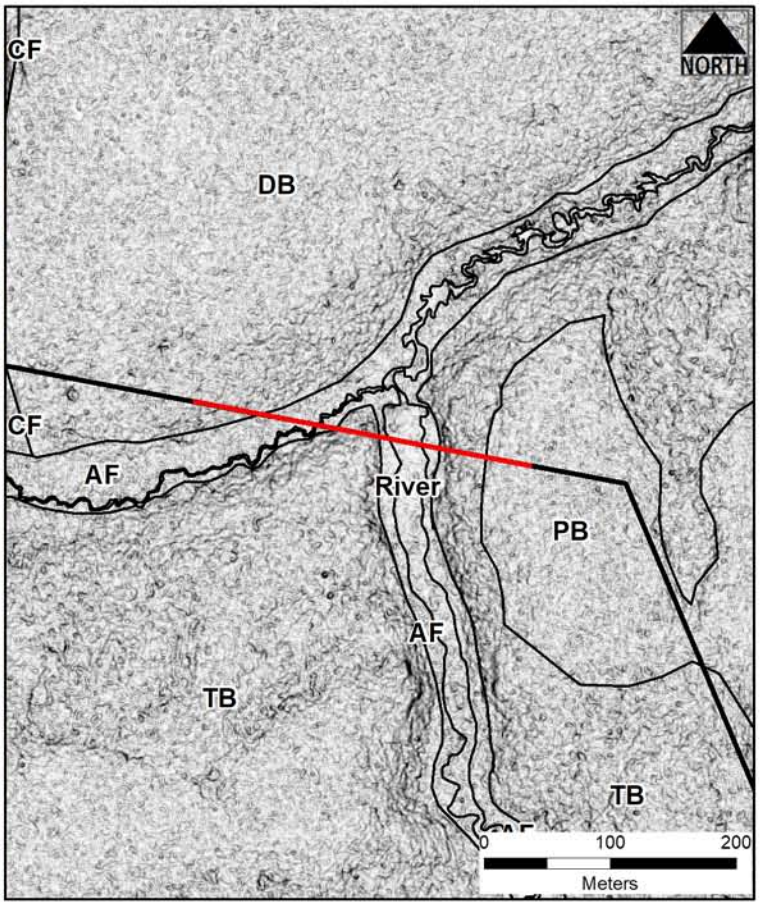
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

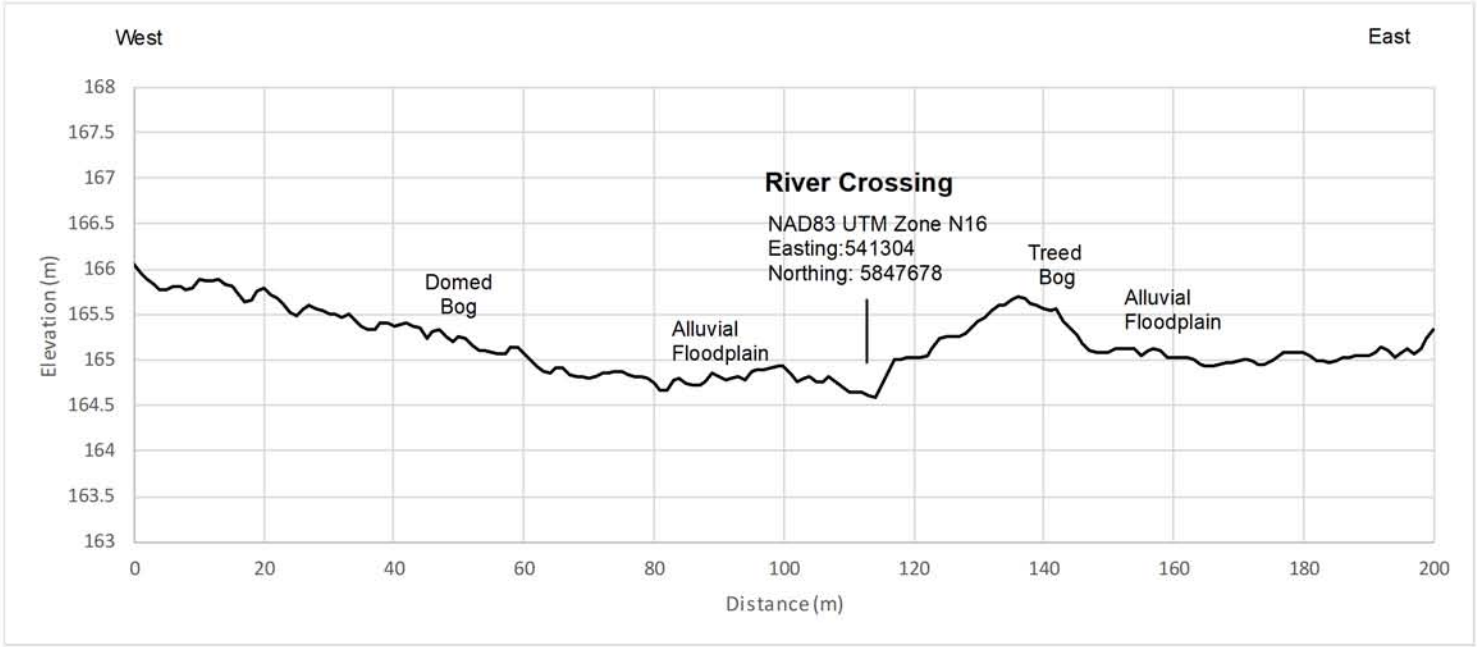
C3

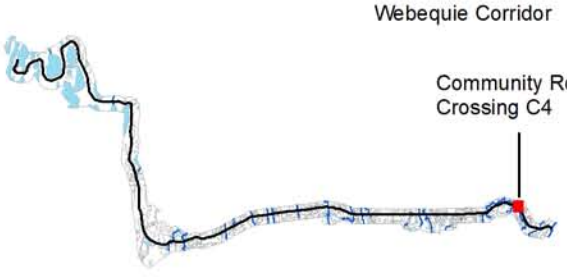
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

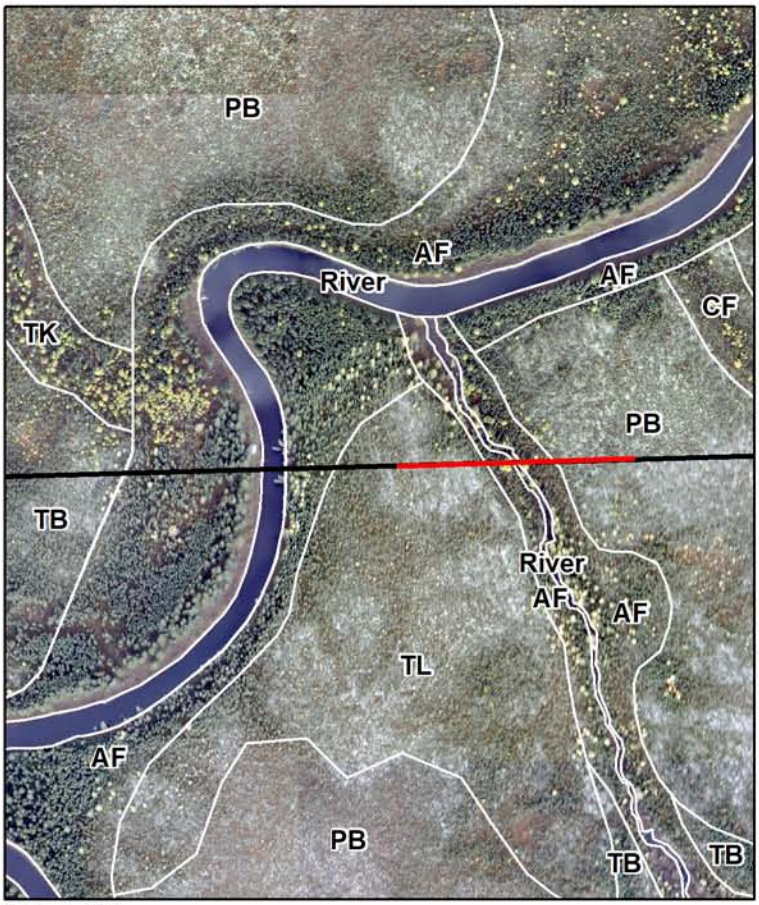
General reference map only; not for survey or legal use.

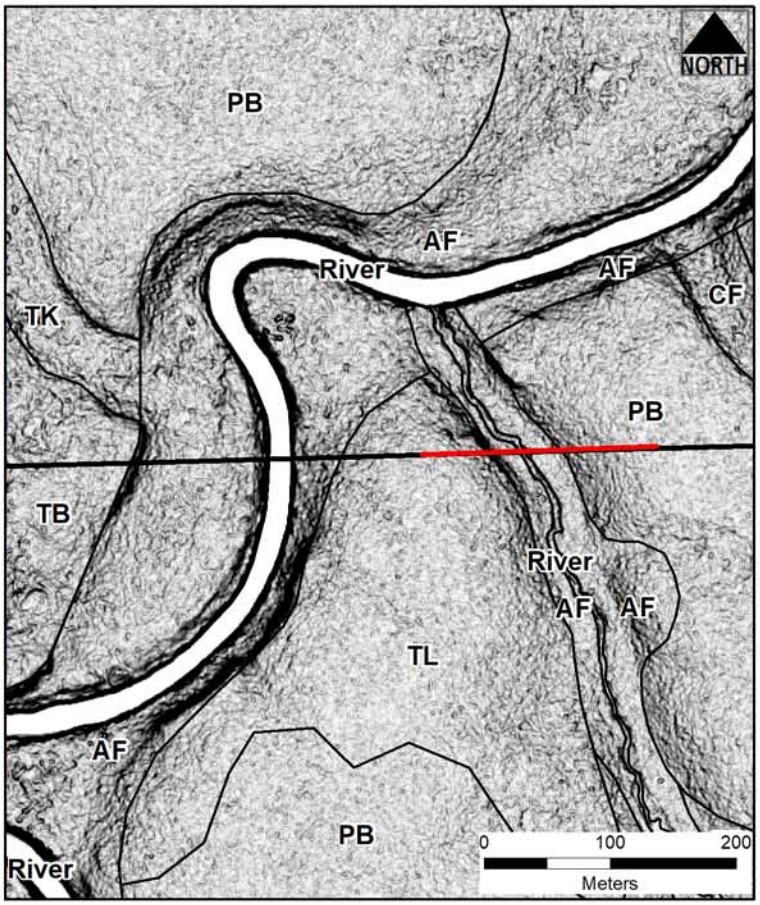
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 29/Mar/2019*

CROSSING:

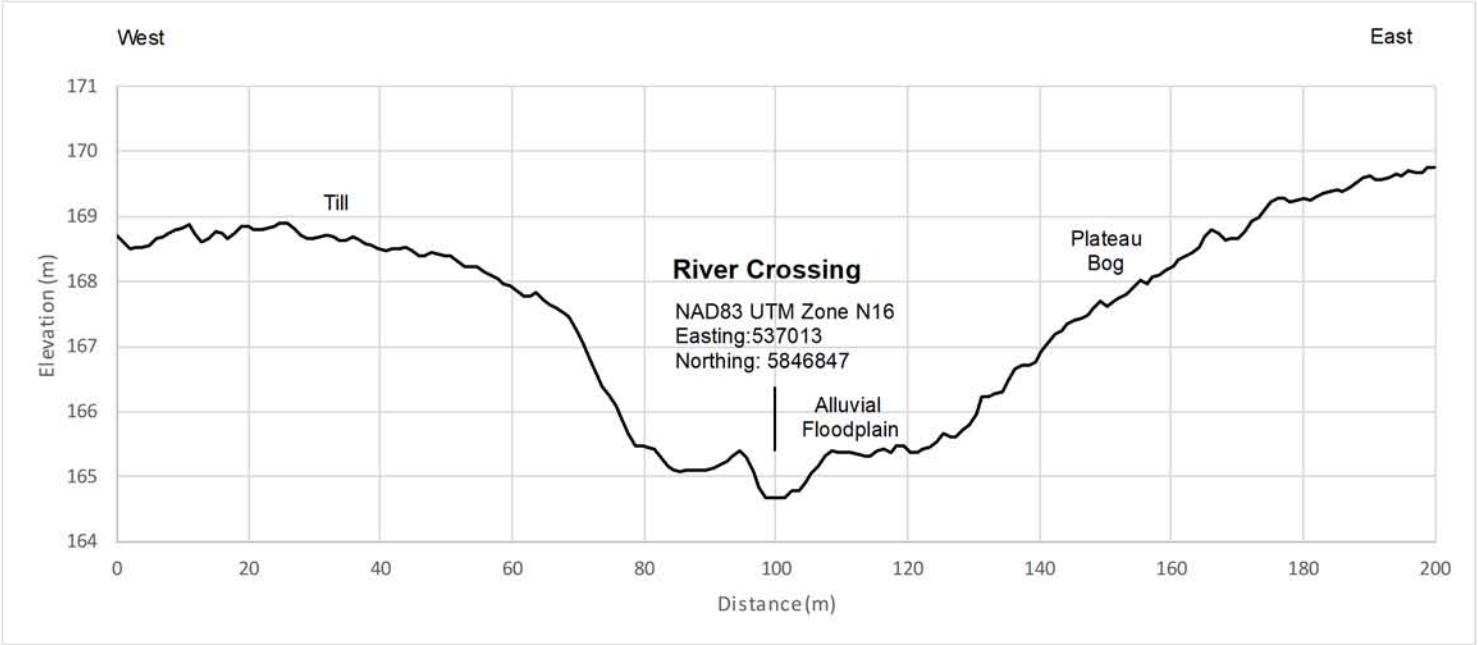
C4

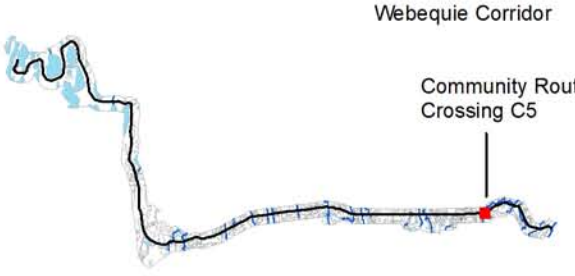
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

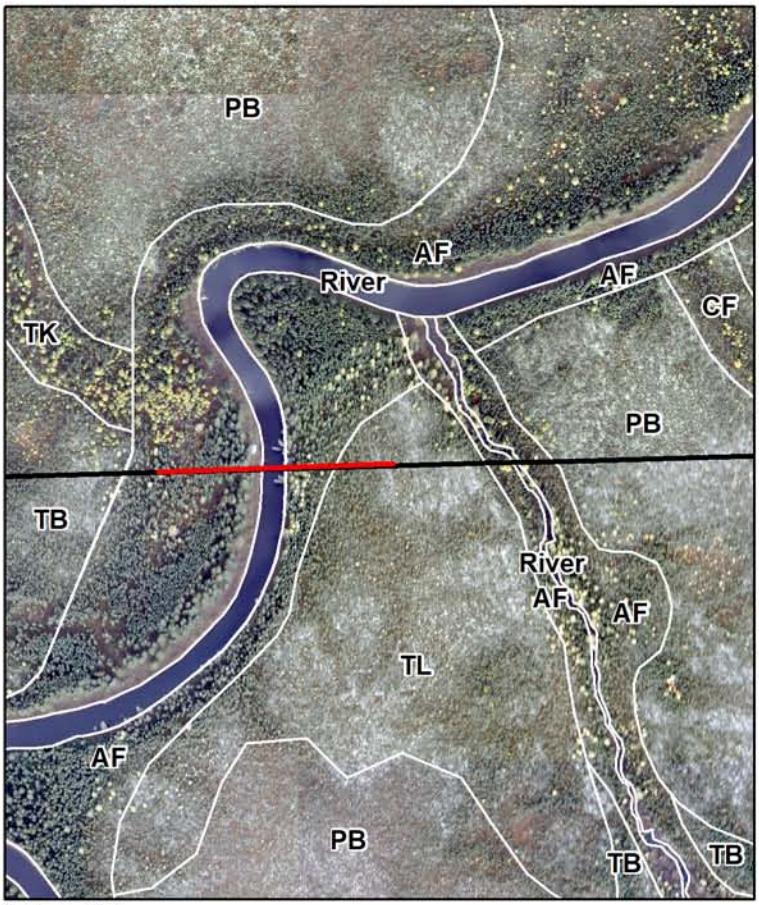
General reference map only; not for survey or legal use.

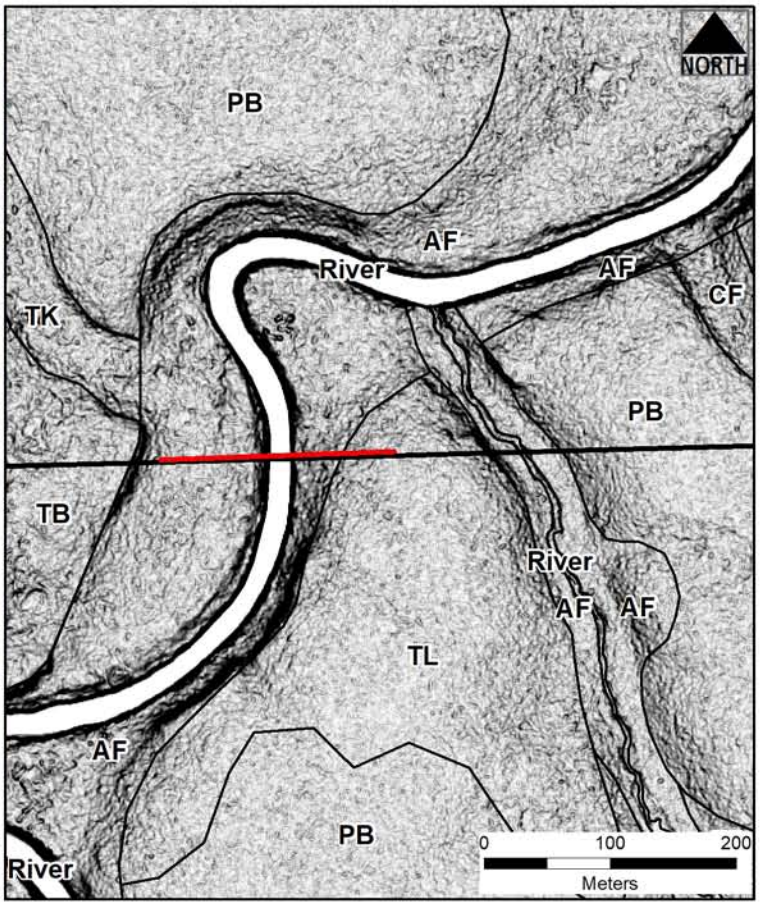
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

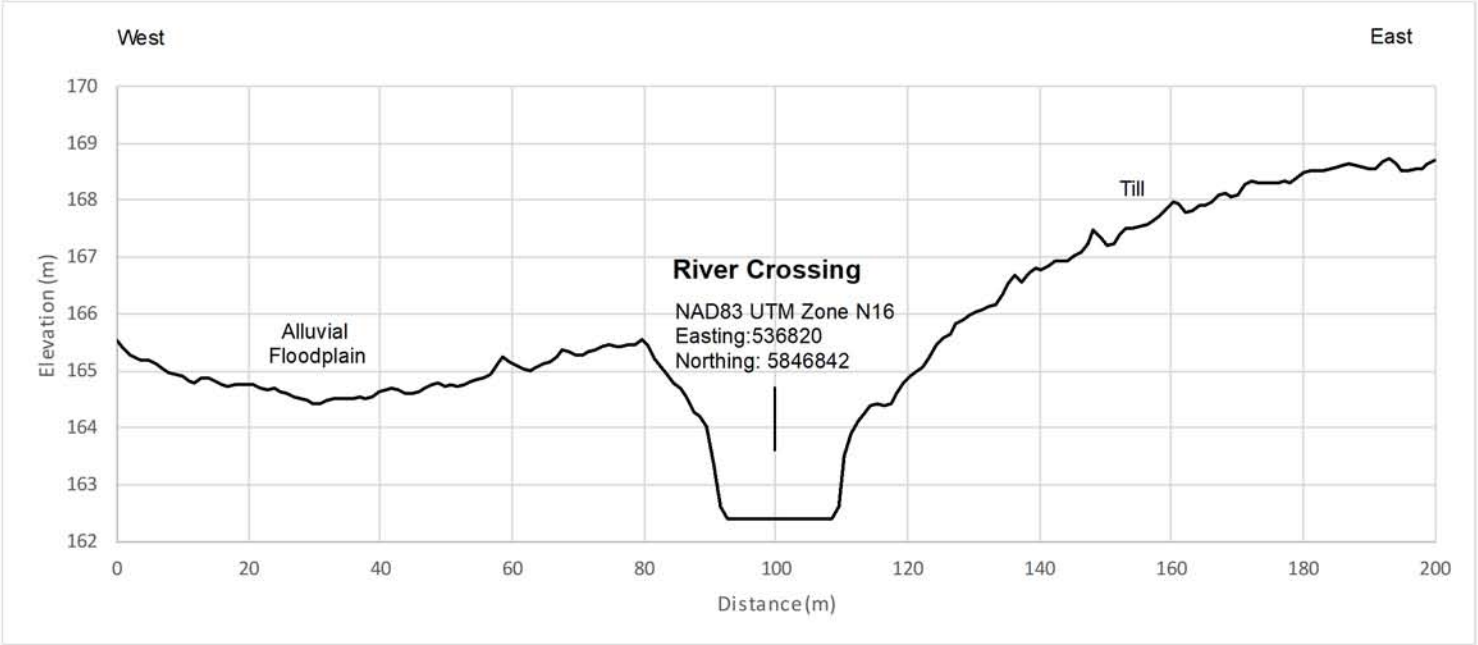
C5

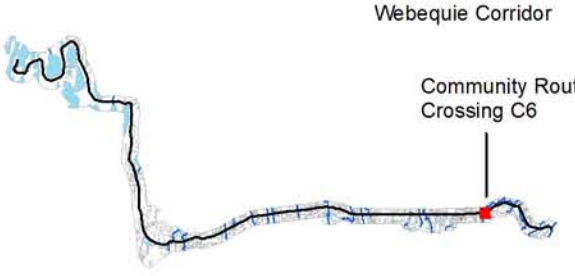
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

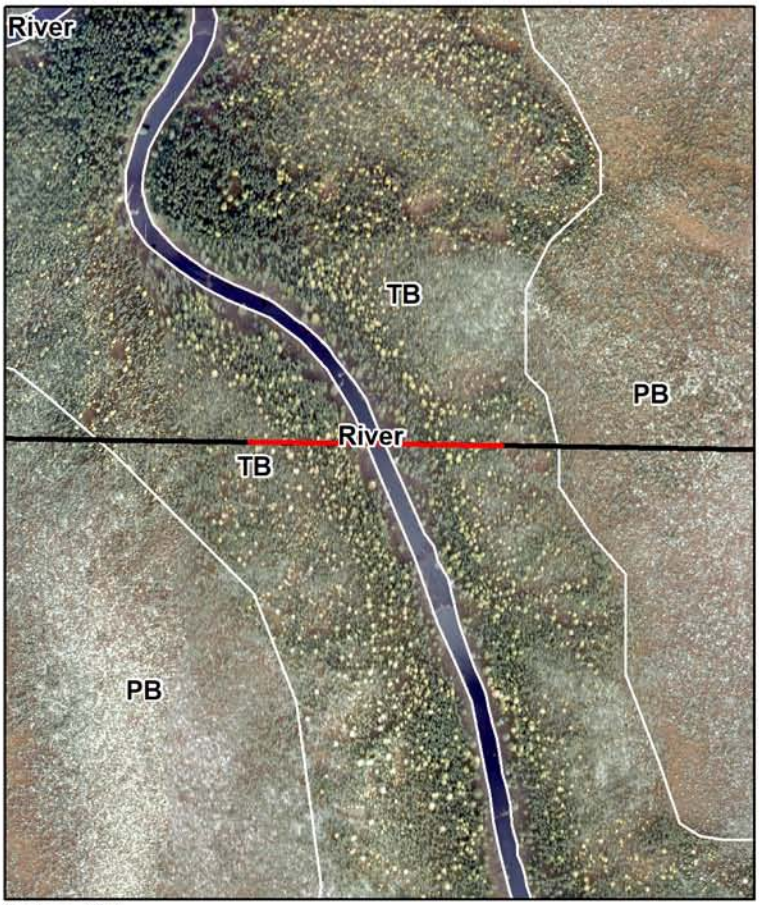
General reference map only; not for survey or legal use.

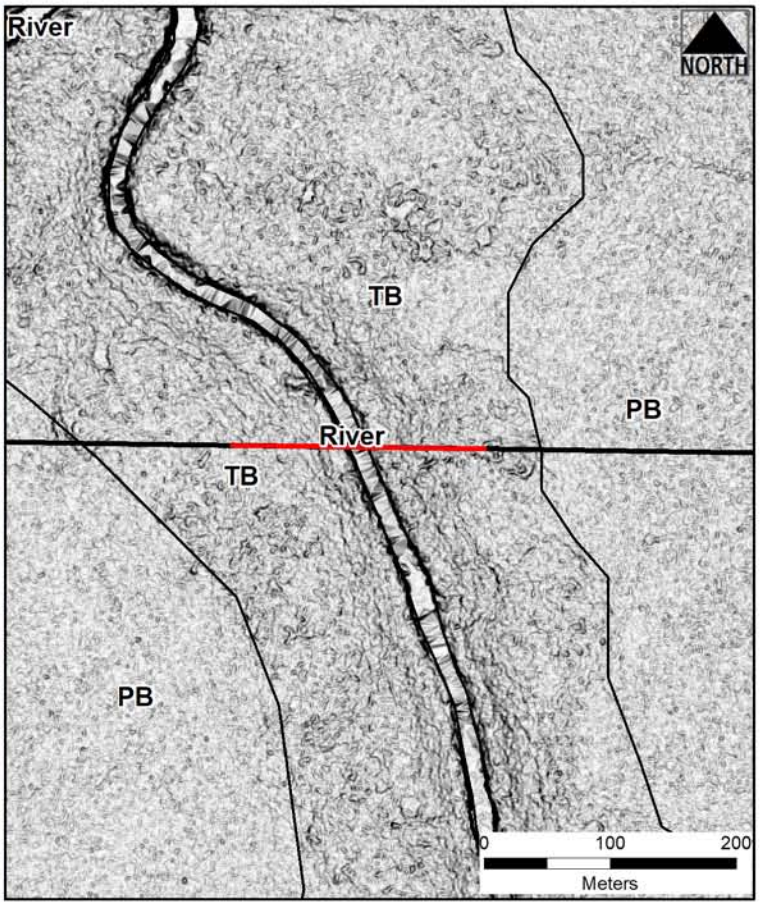
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

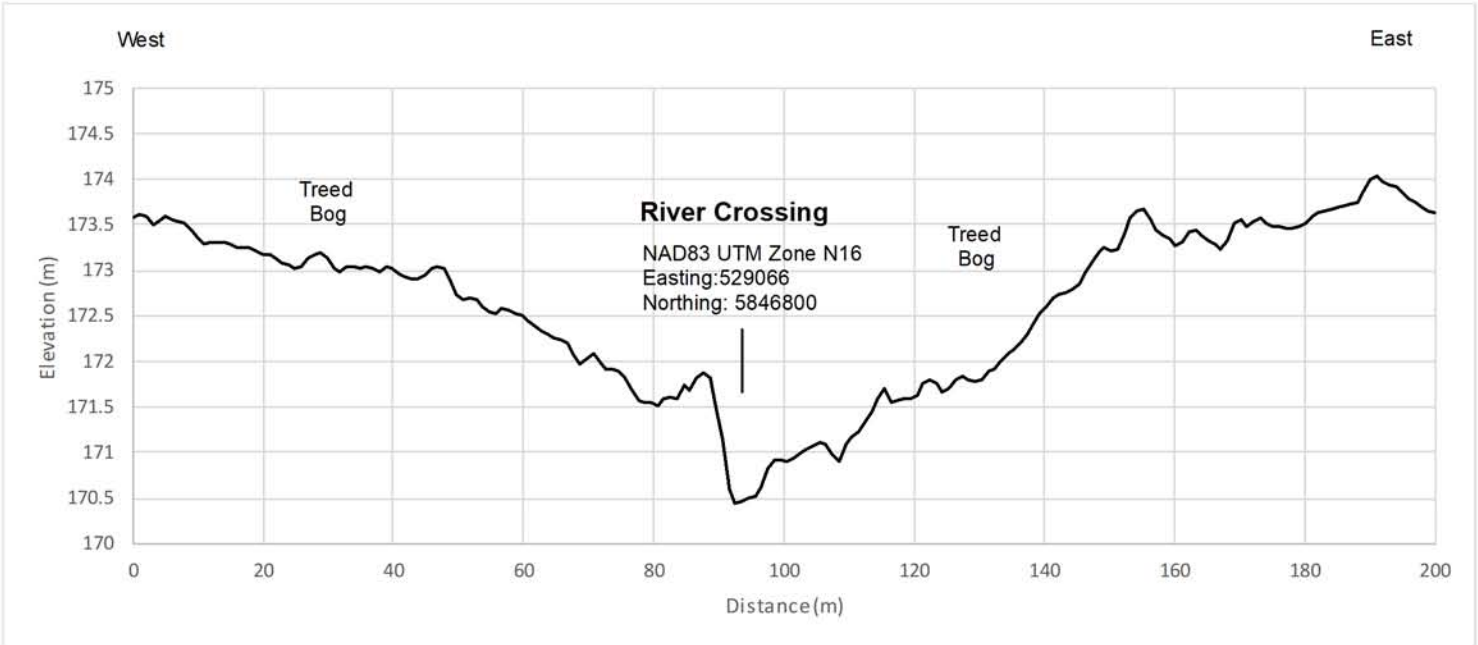
C6

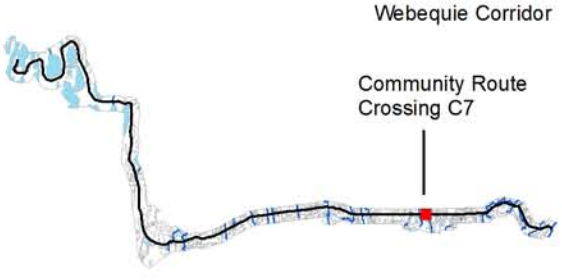
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

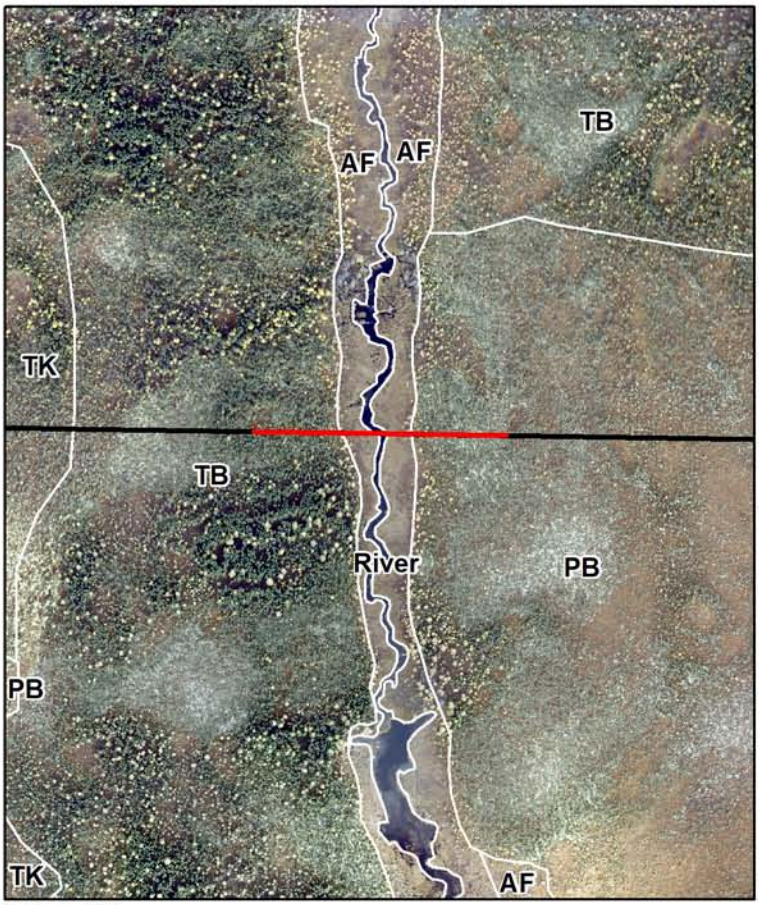
General reference map only; not for survey or legal use.

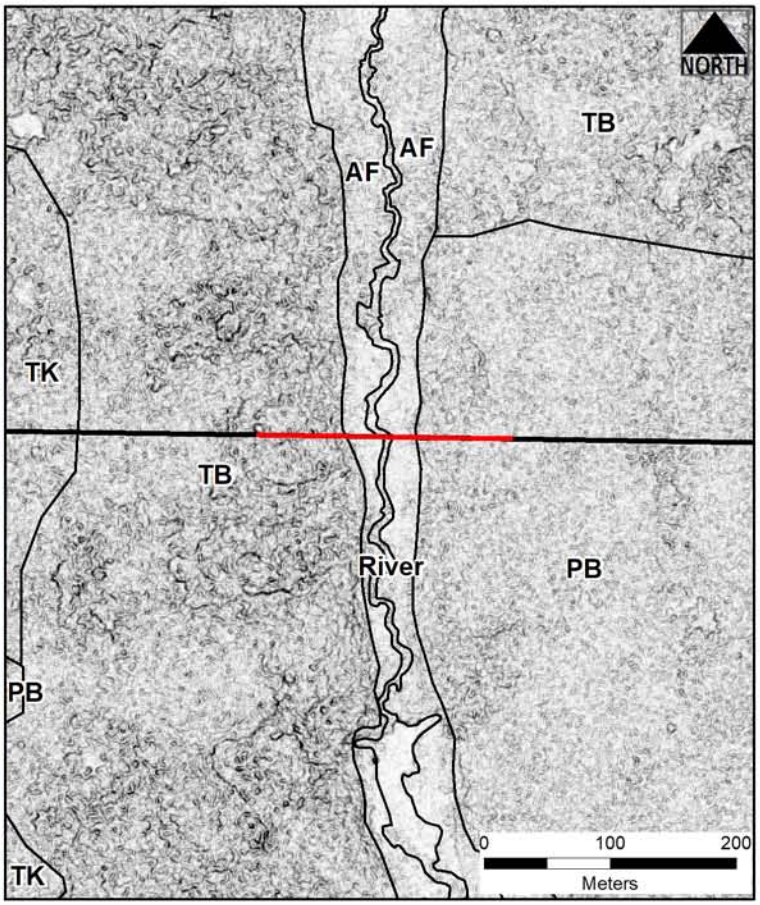
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

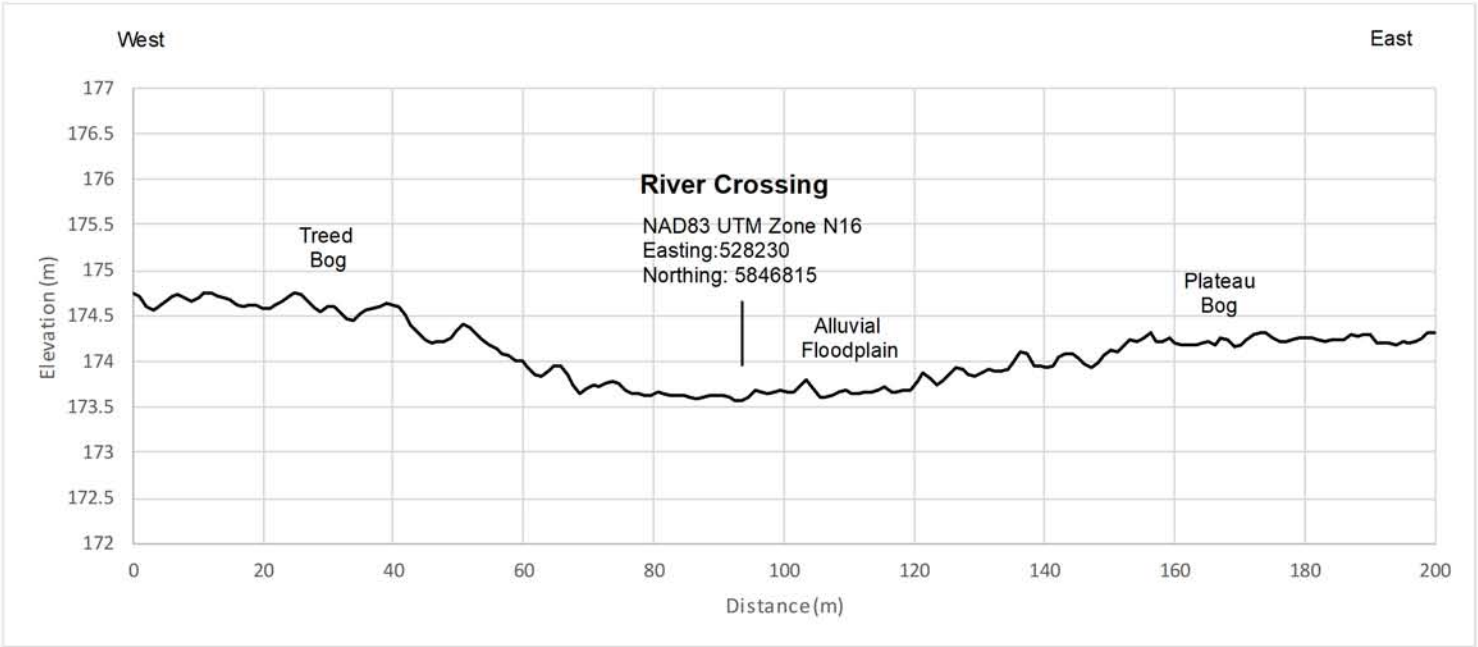
C7

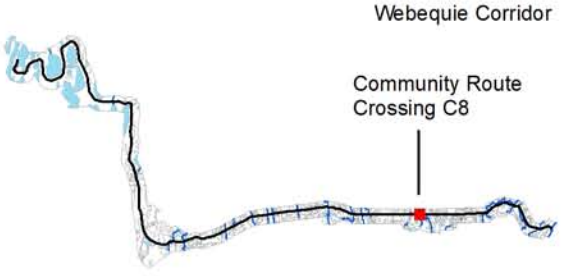
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

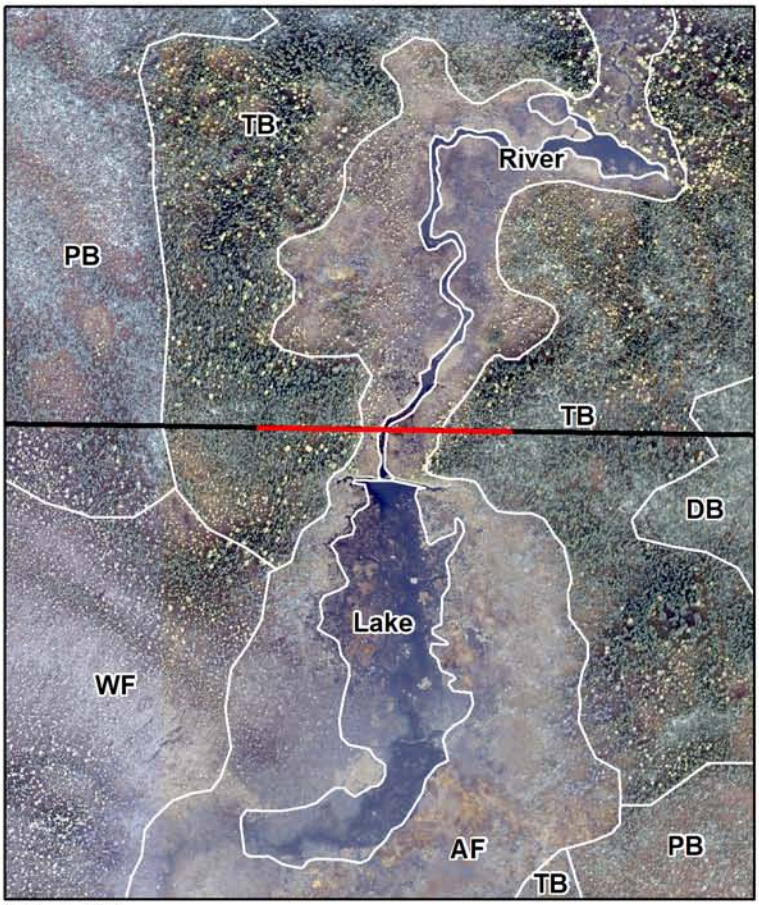
General reference map only; not for survey or legal use.

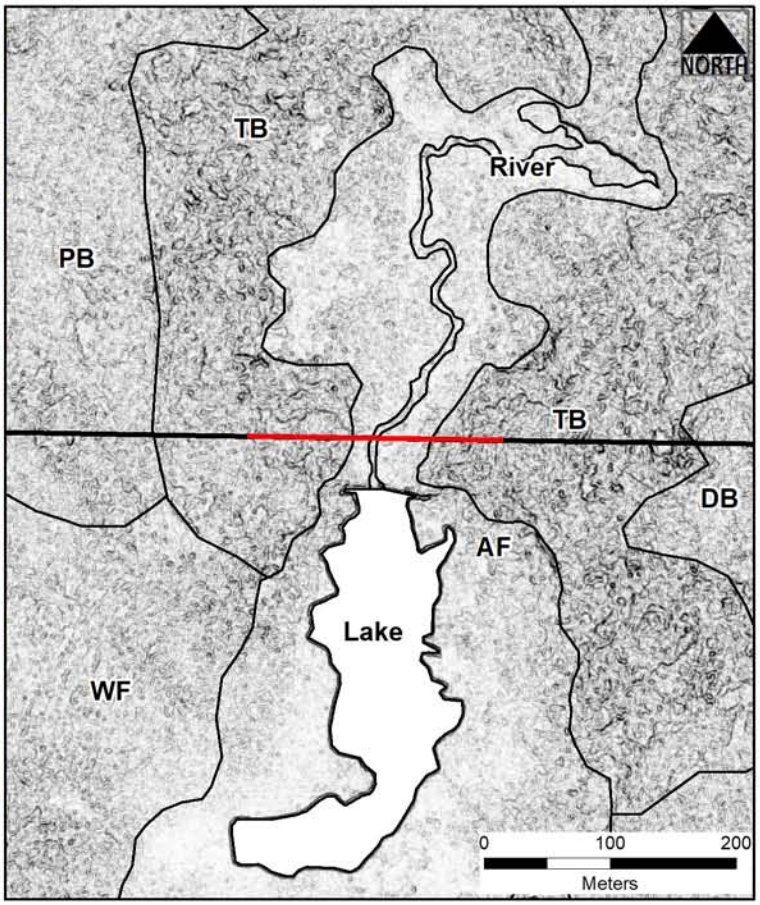
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

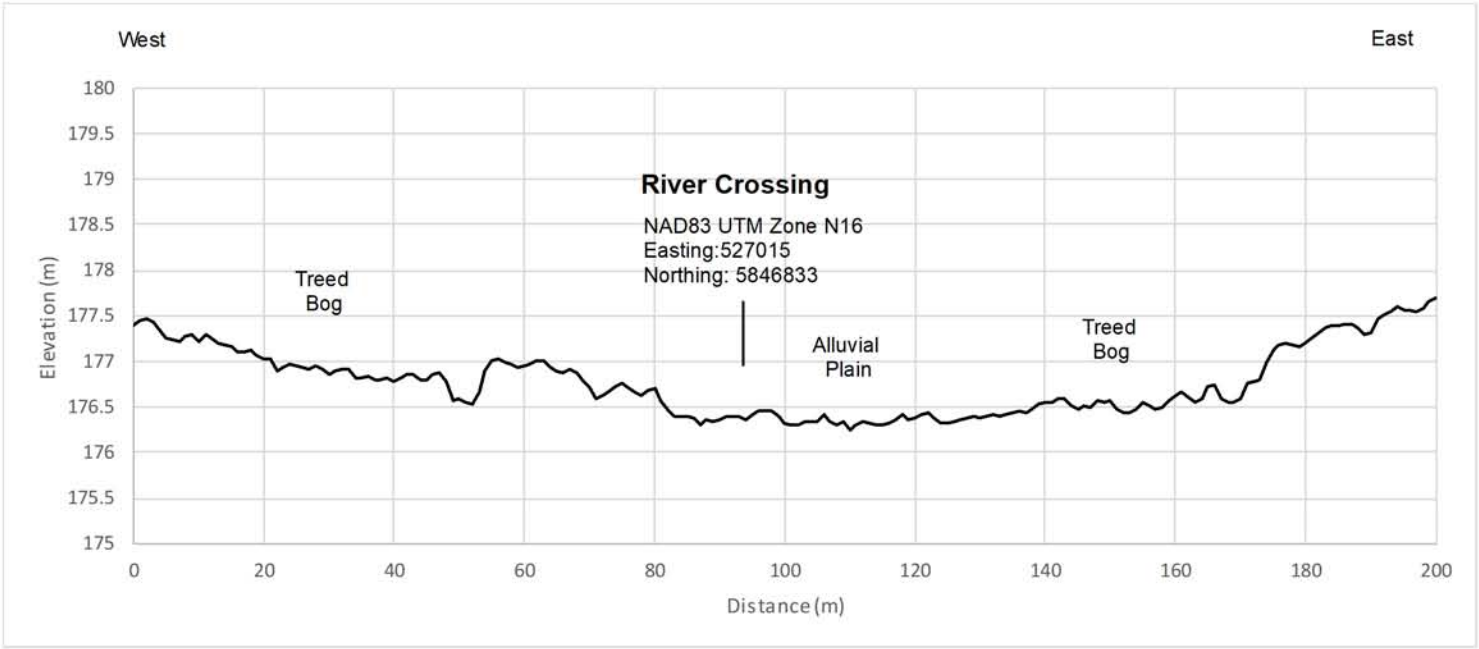
C8

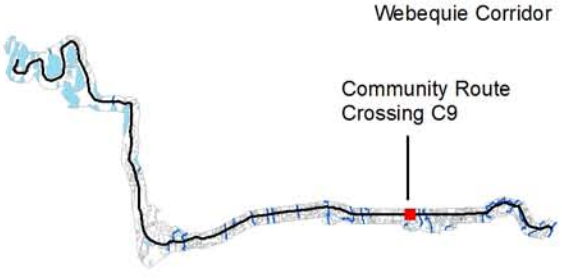
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

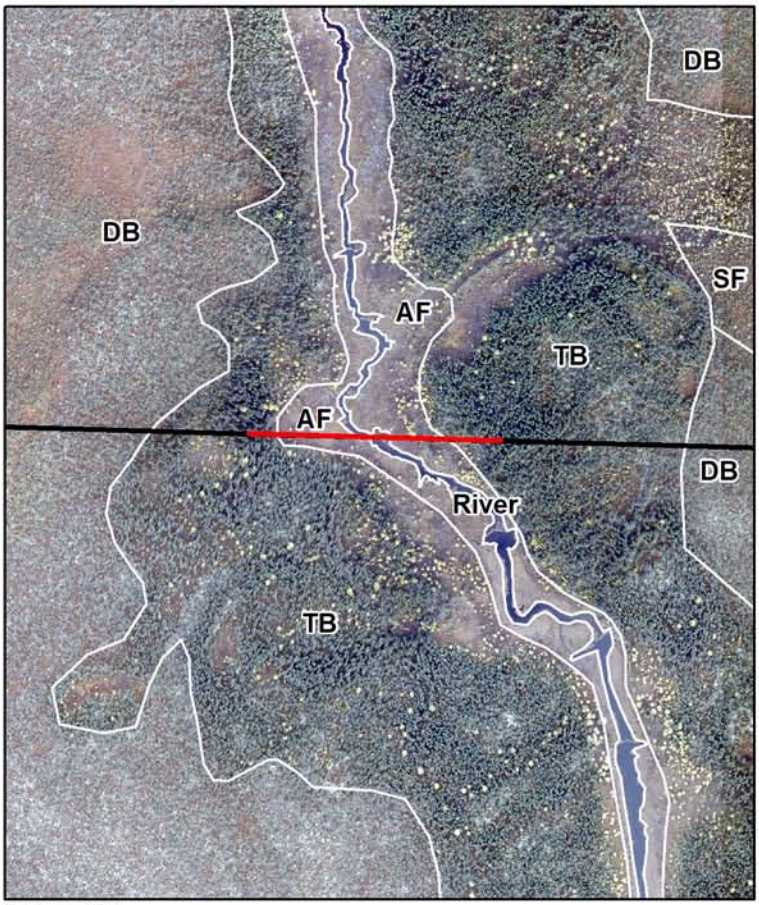
General reference map only; not for survey or legal use.

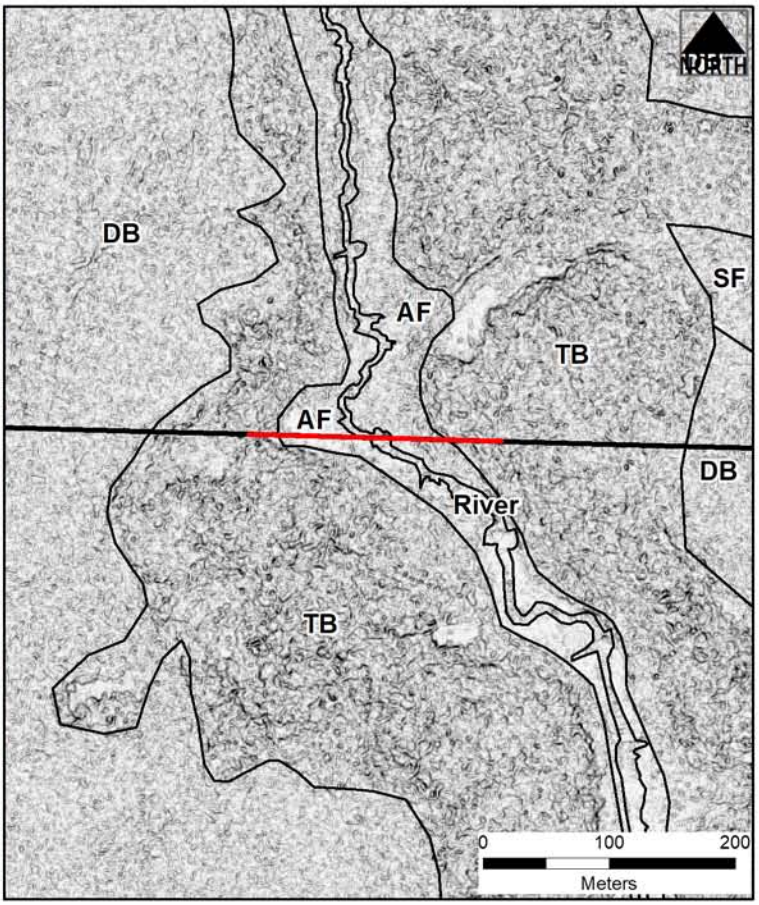
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

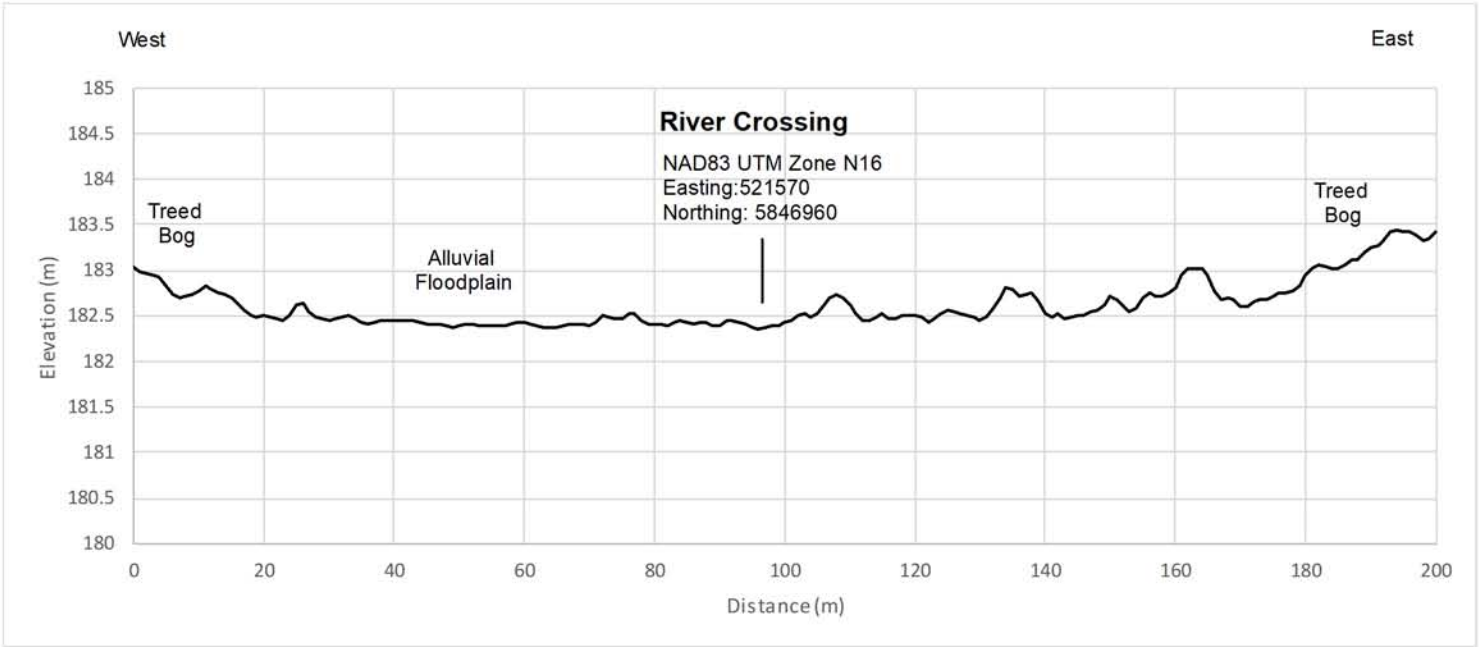
C9

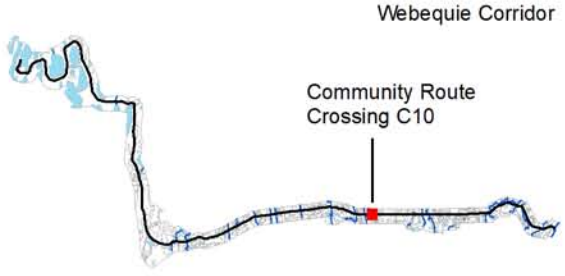
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

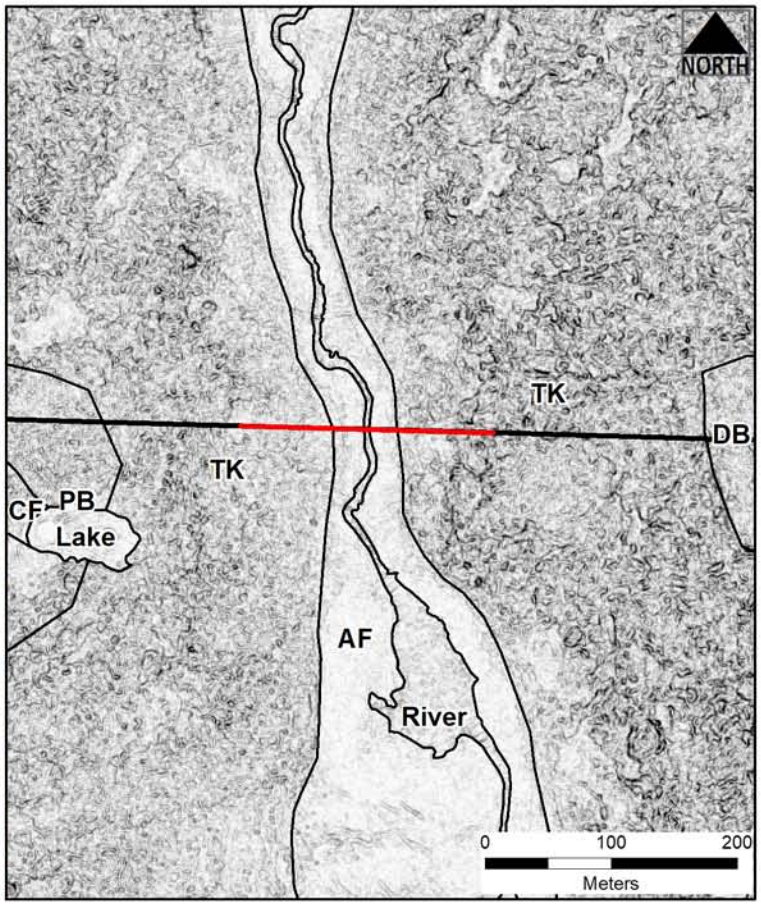
General reference map only; not for survey or legal use.

Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

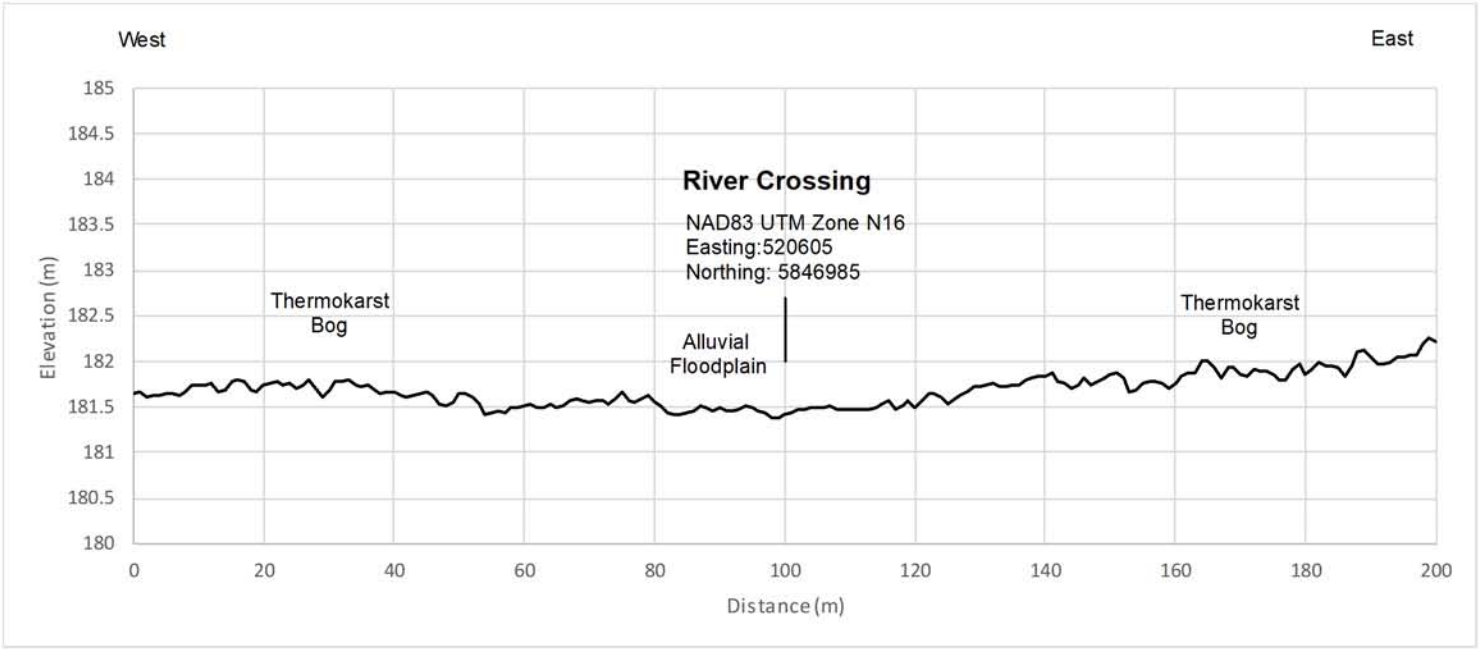
CROSSING:

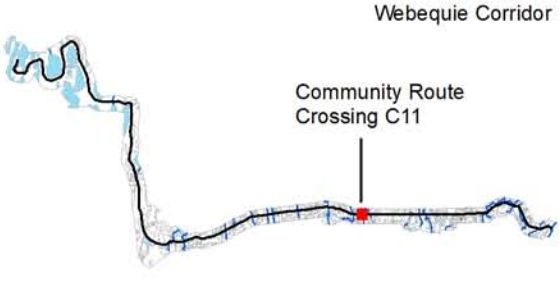
C10

J D MOLLARD AND ASSOCIATES (2010) LIMITED



Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

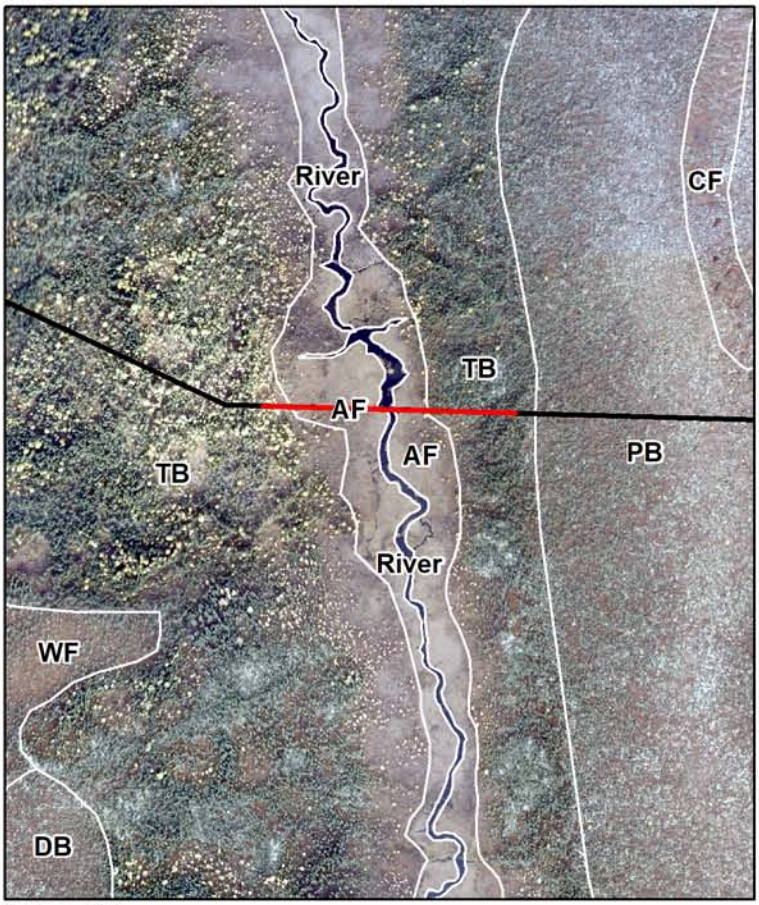
General reference map only; not for survey or legal use.

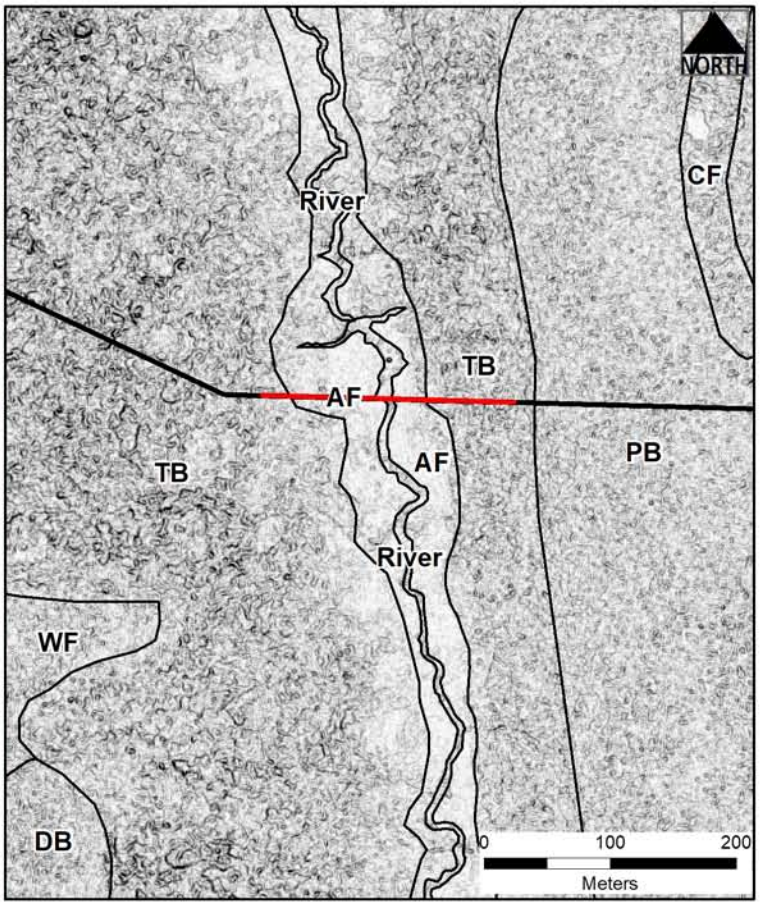
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

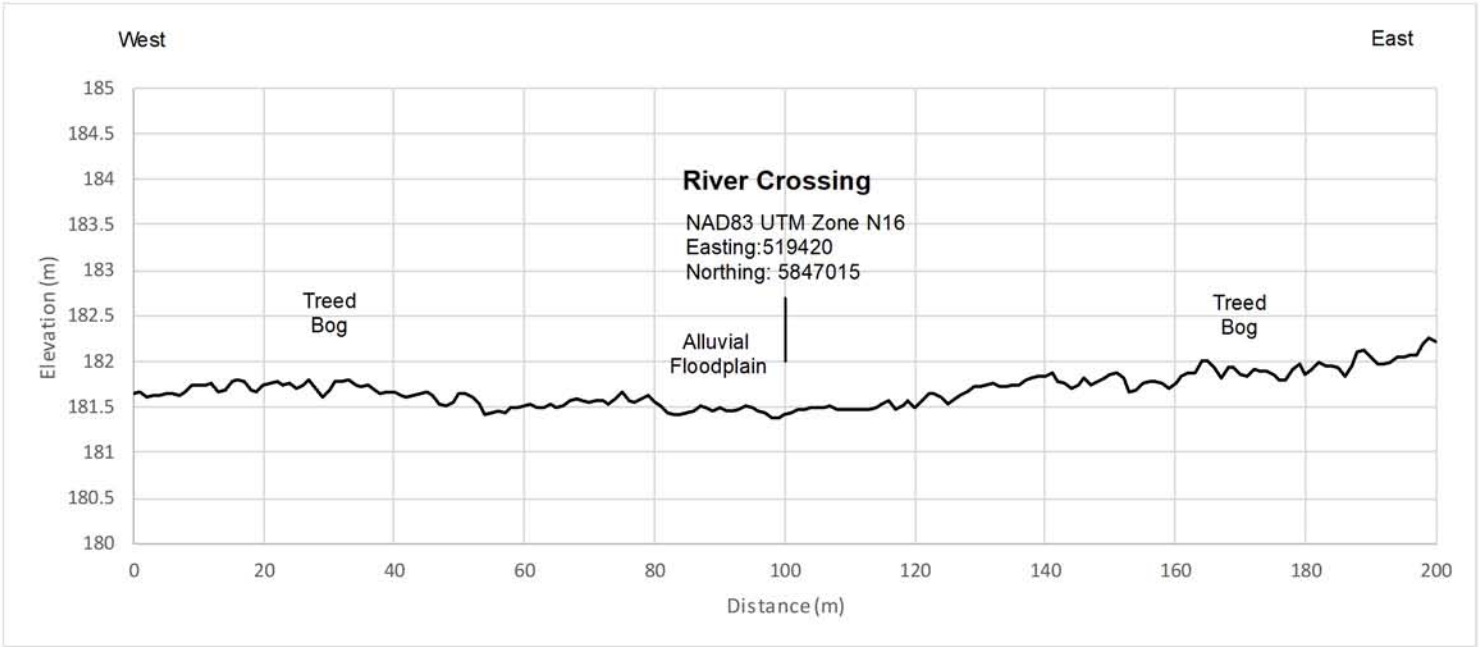
C11

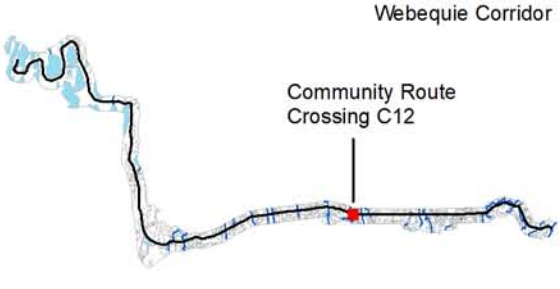
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

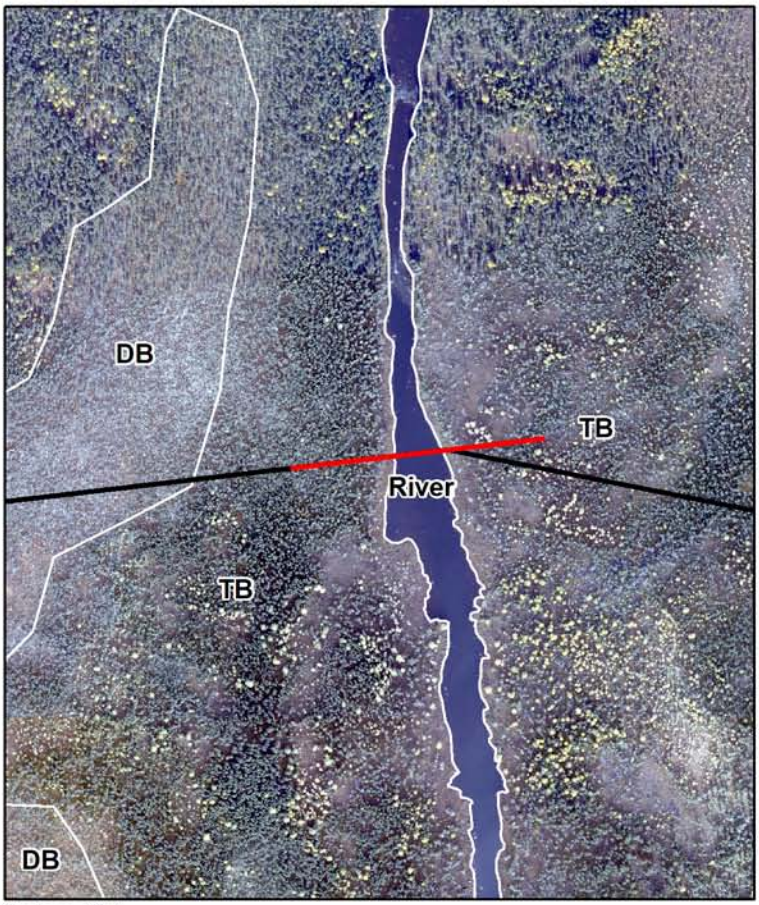
General reference map only; not for survey or legal use.

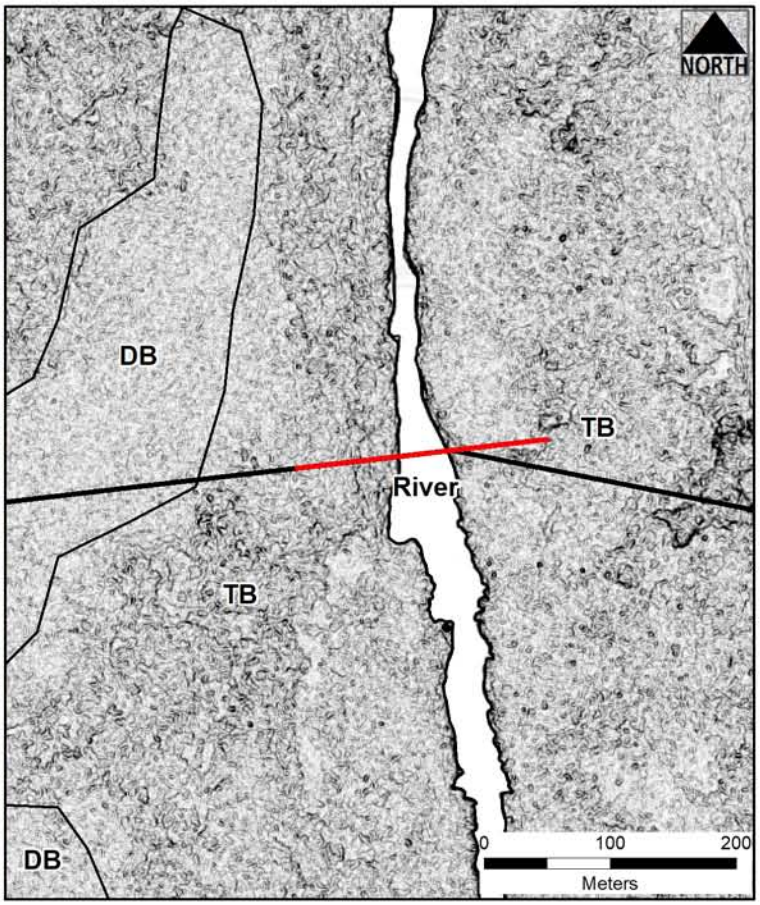
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

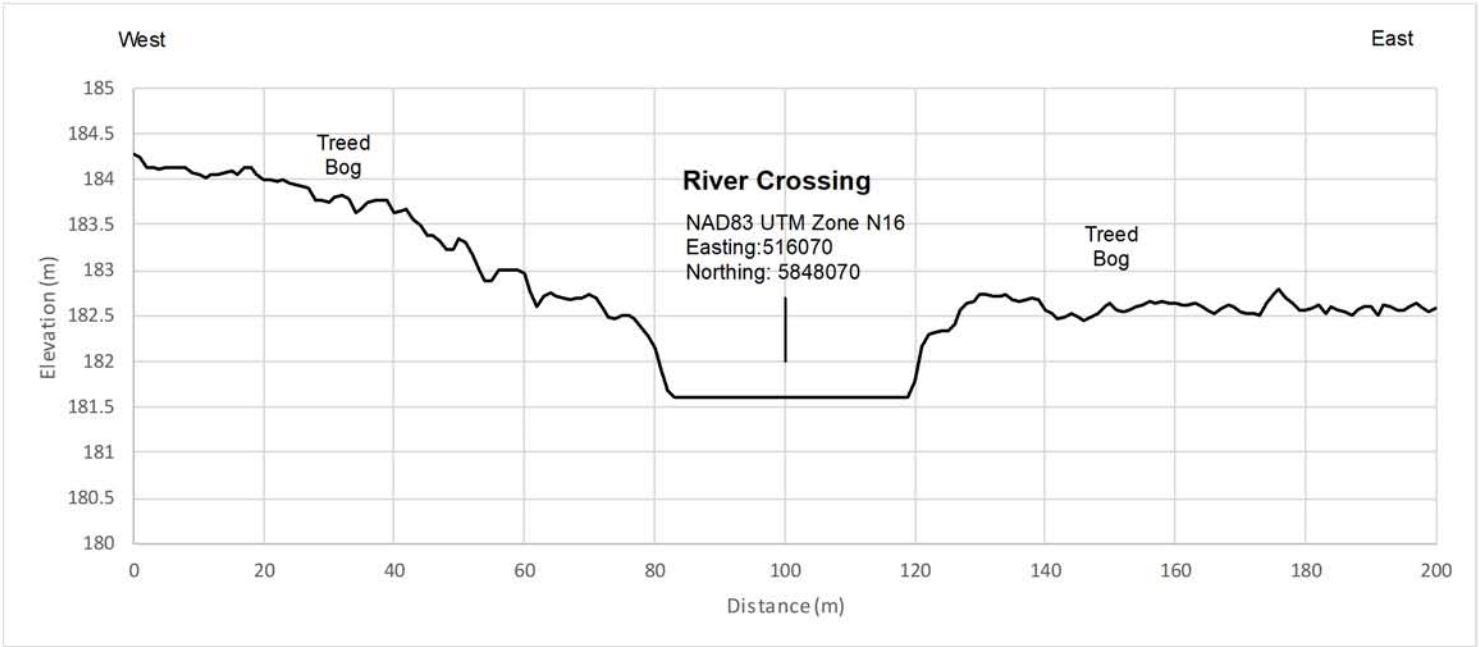
C12

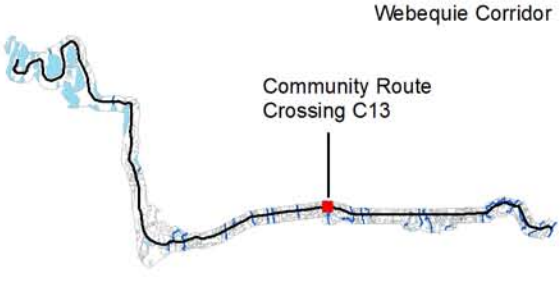
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

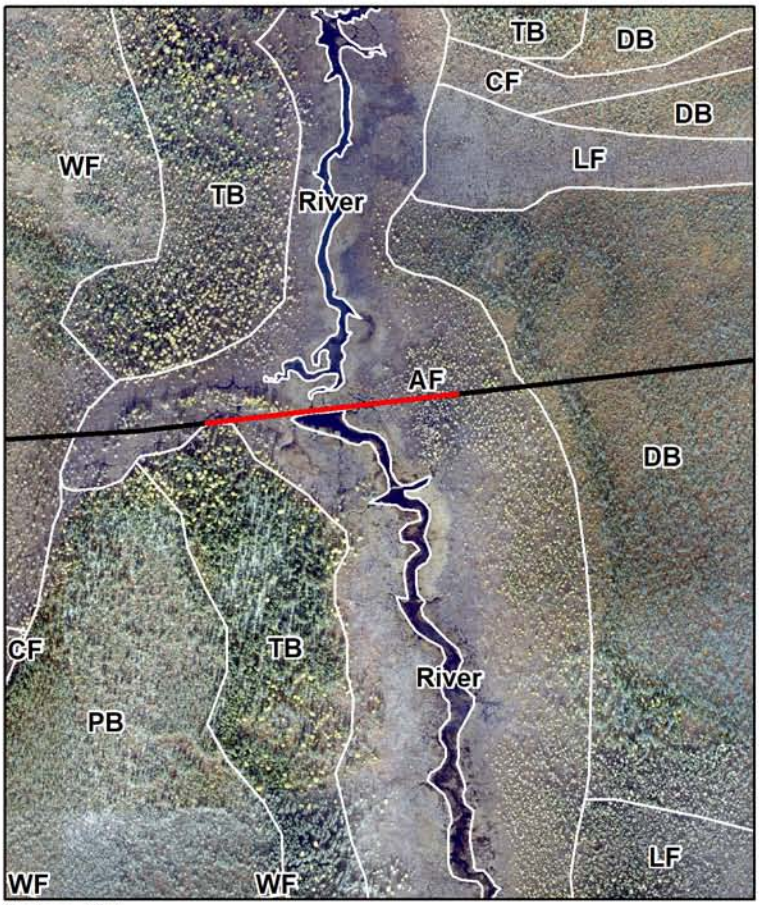
General reference map only; not for survey or legal use.

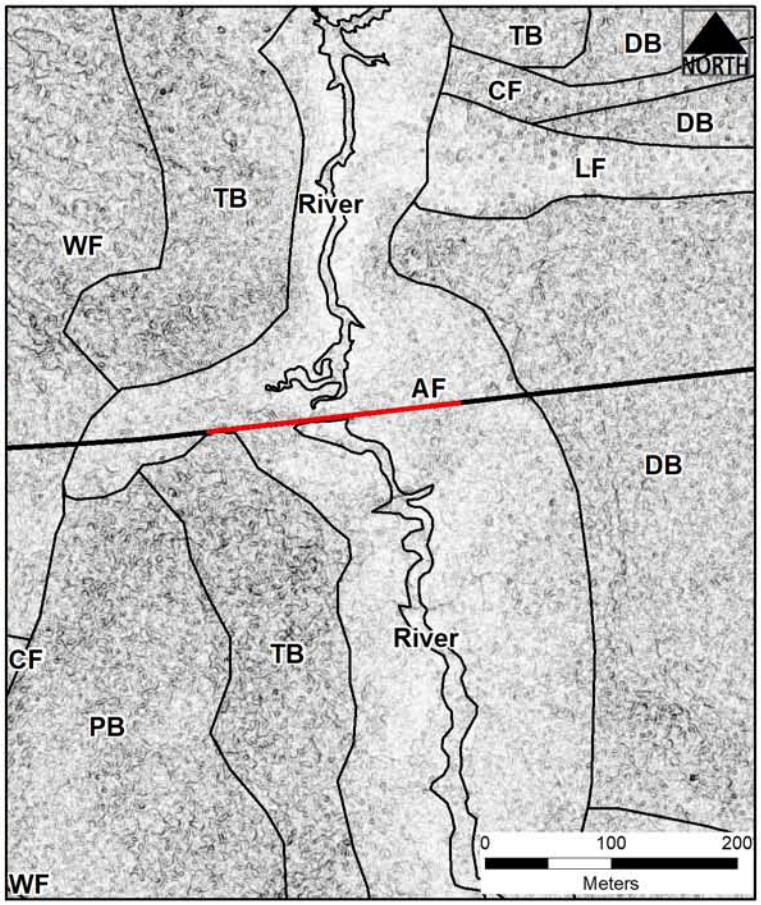
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

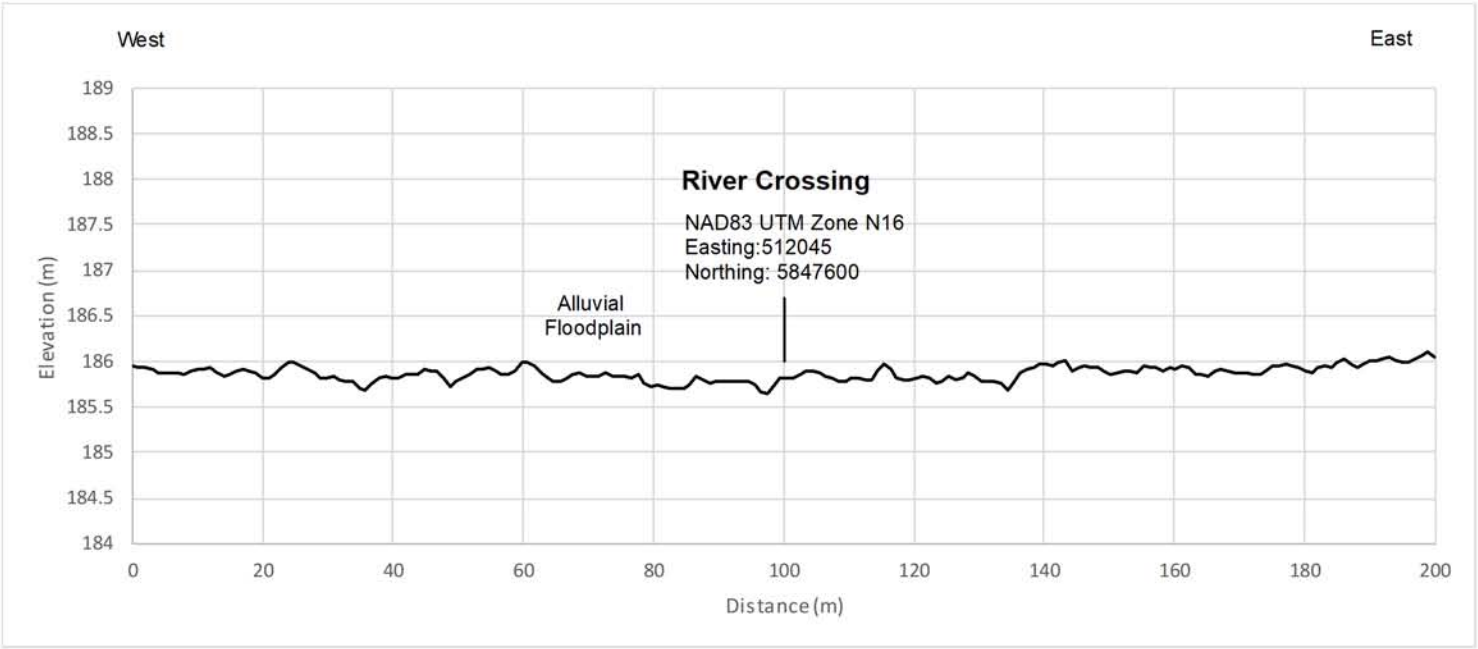
C13

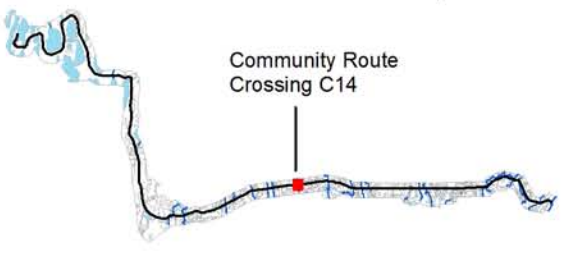
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

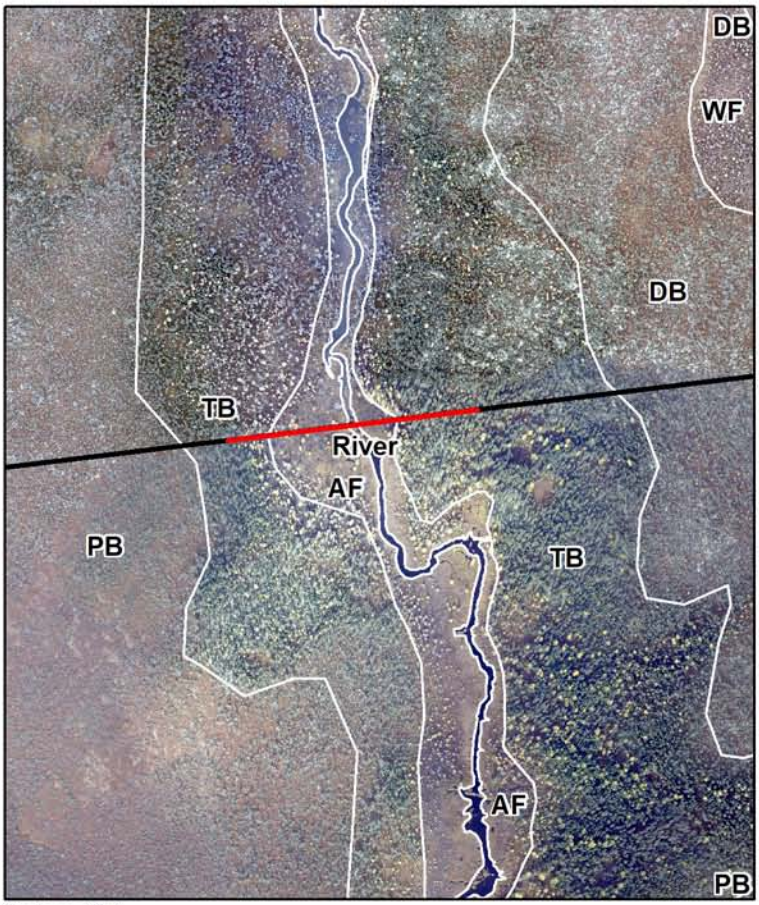
General reference map only; not for survey or legal use.

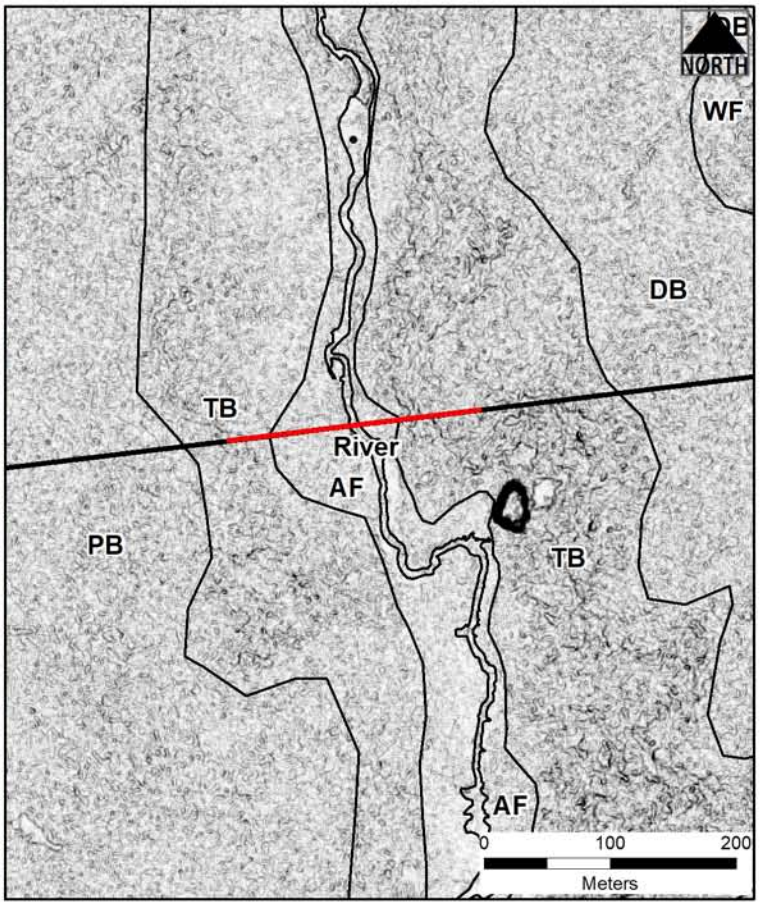
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

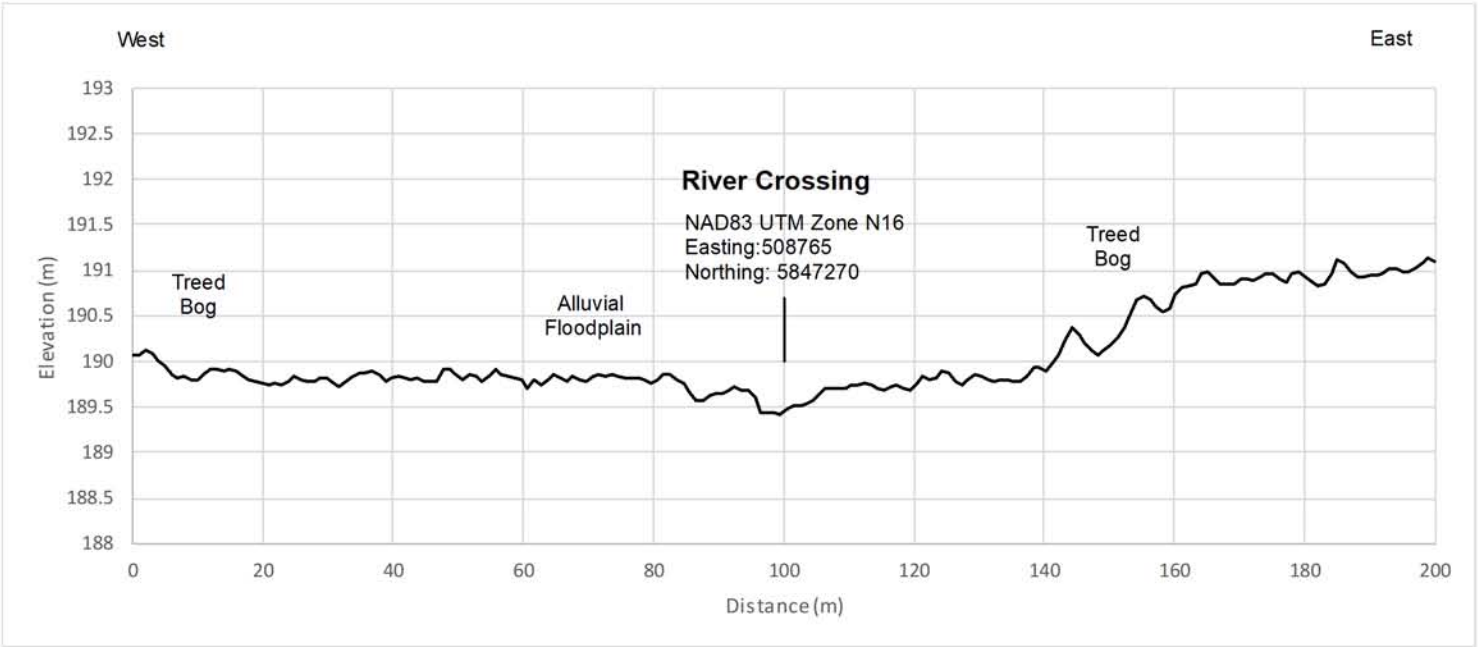
C14

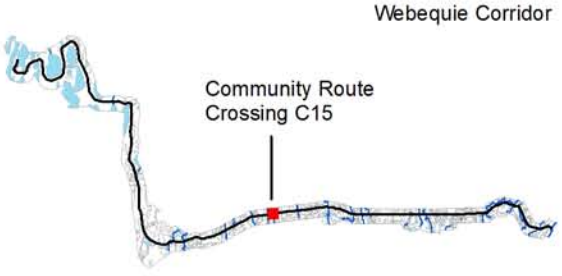
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

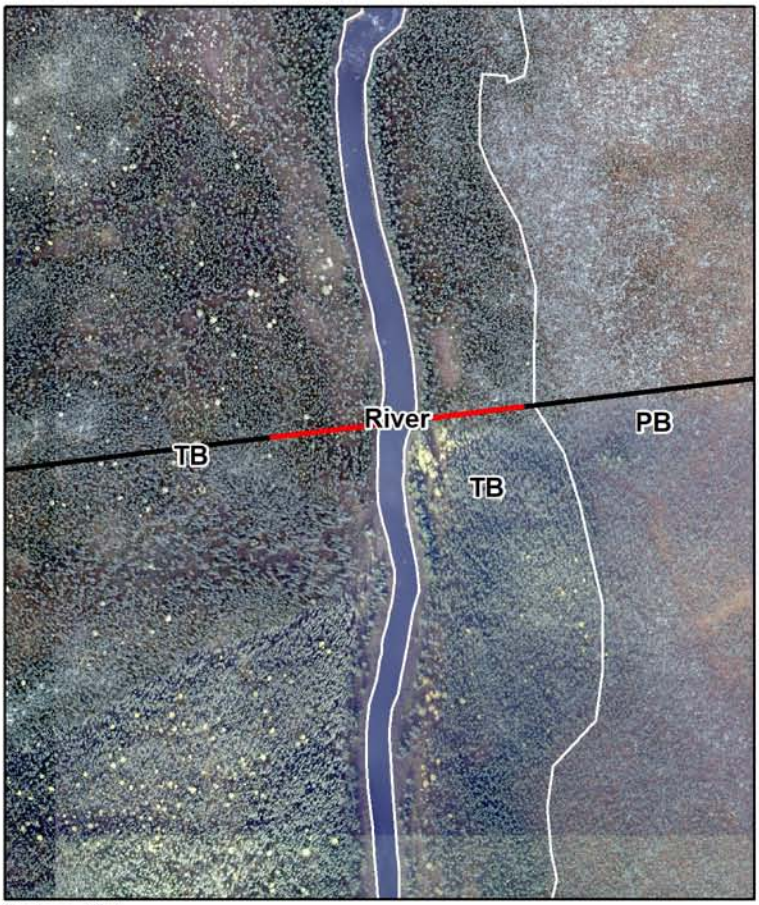
General reference map only; not for survey or legal use.

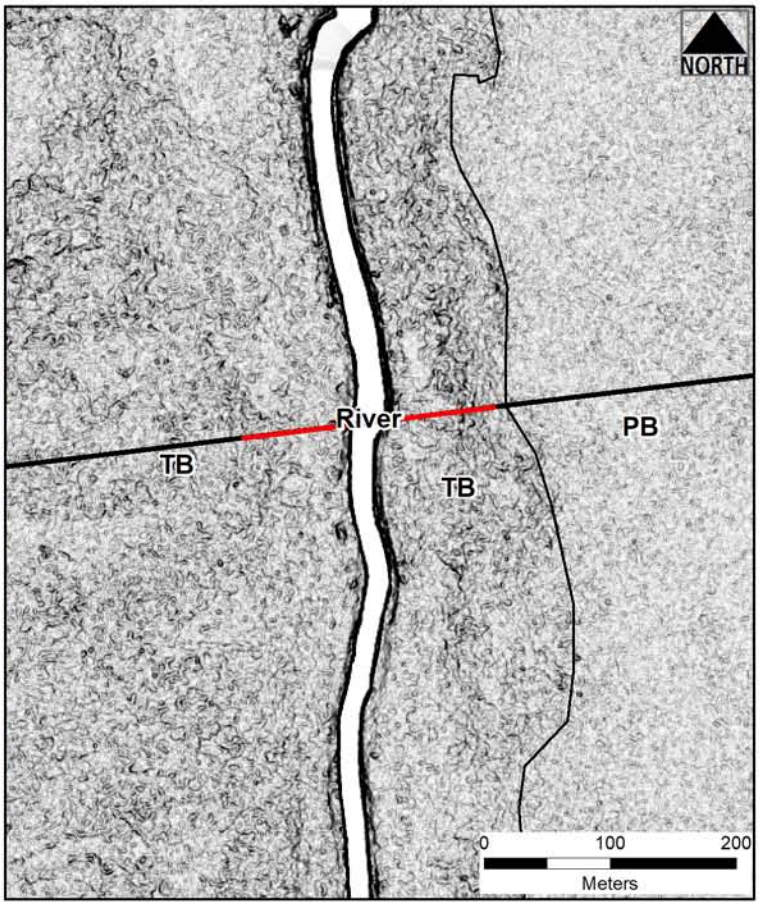
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

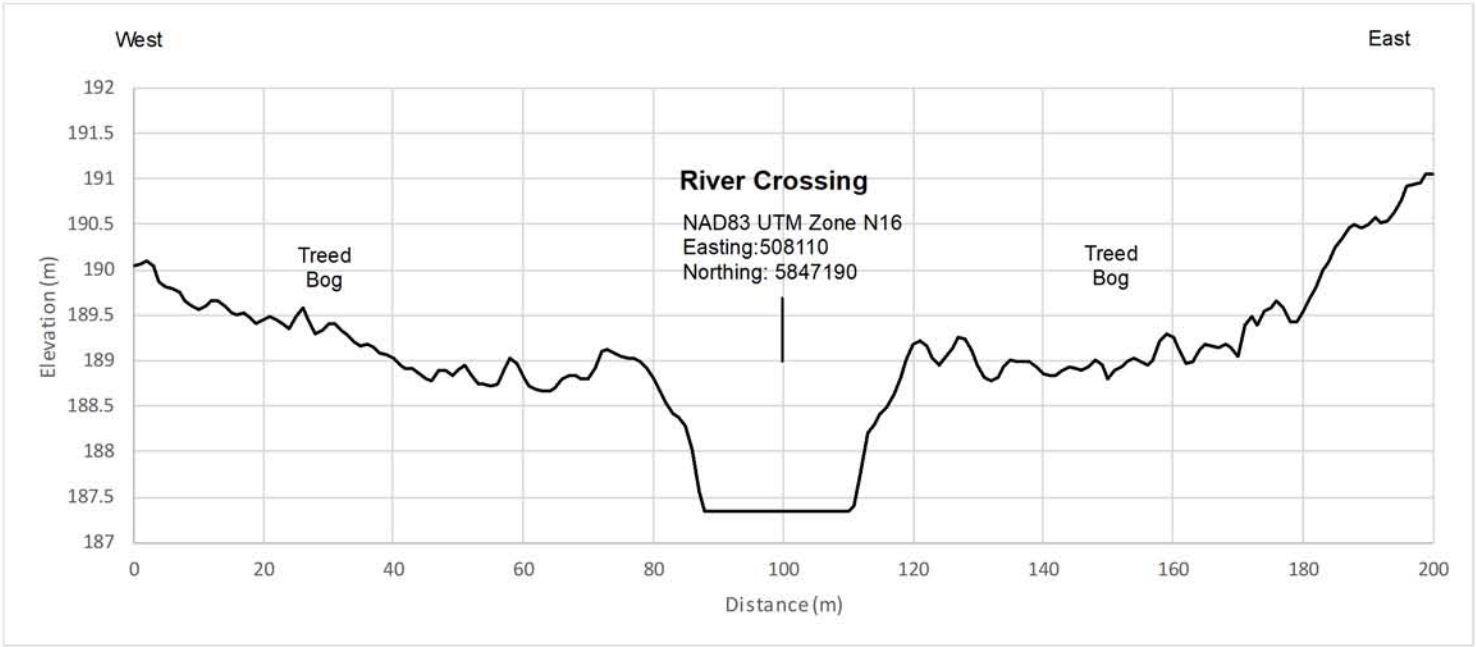
C15

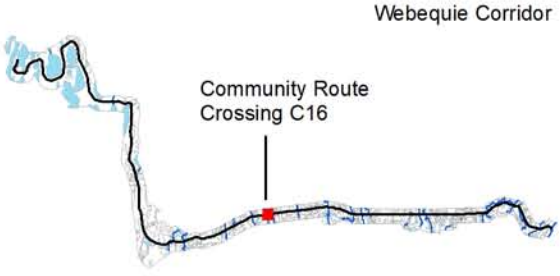
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

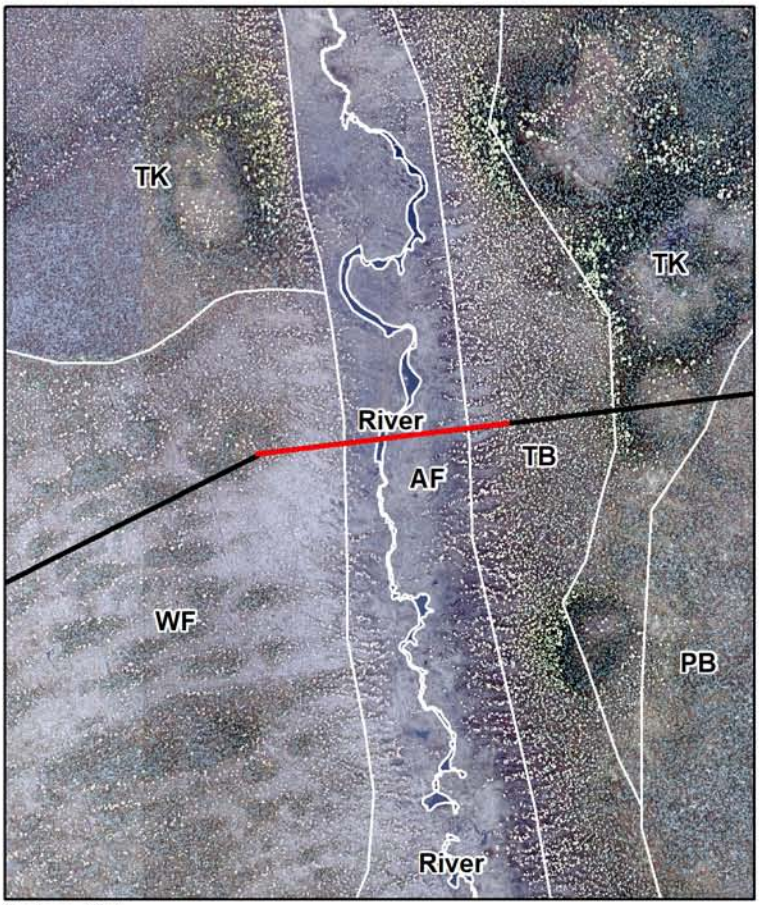
General reference map only; not for survey or legal use.

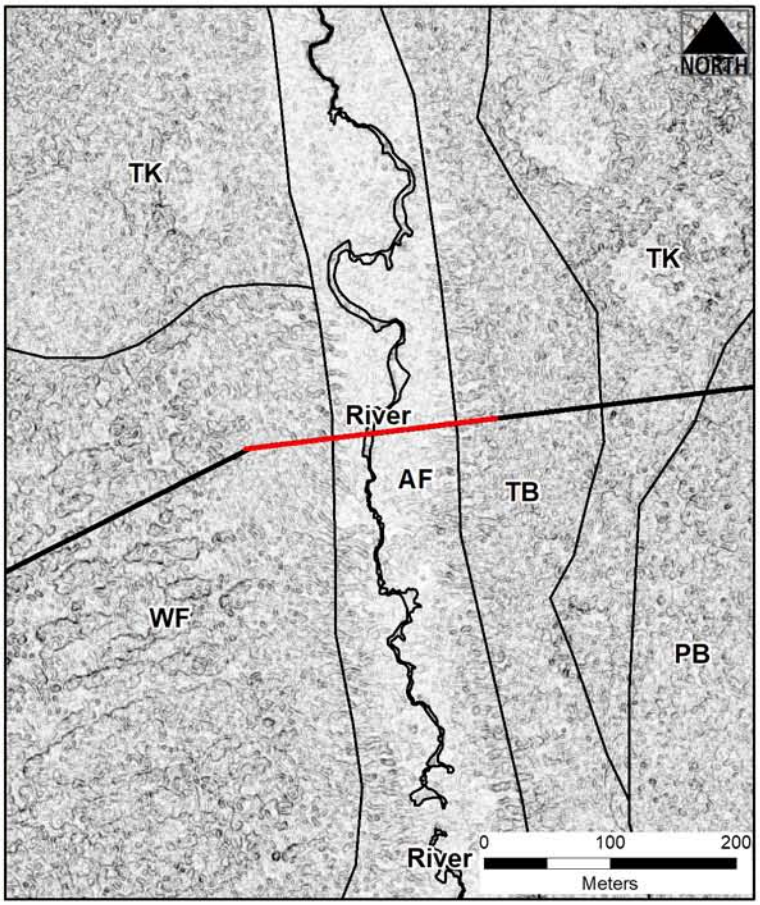
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

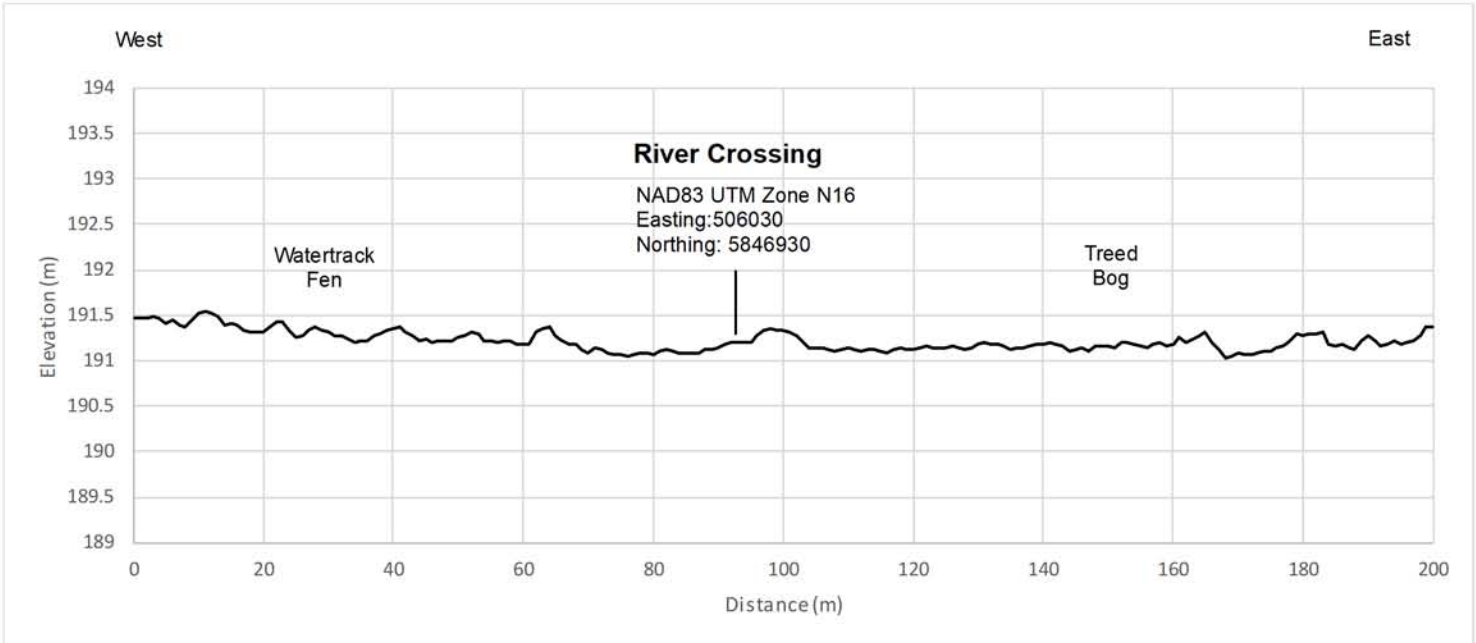
C16

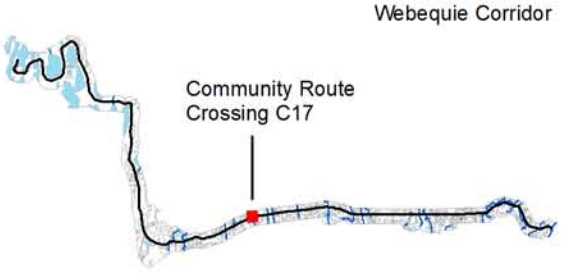
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

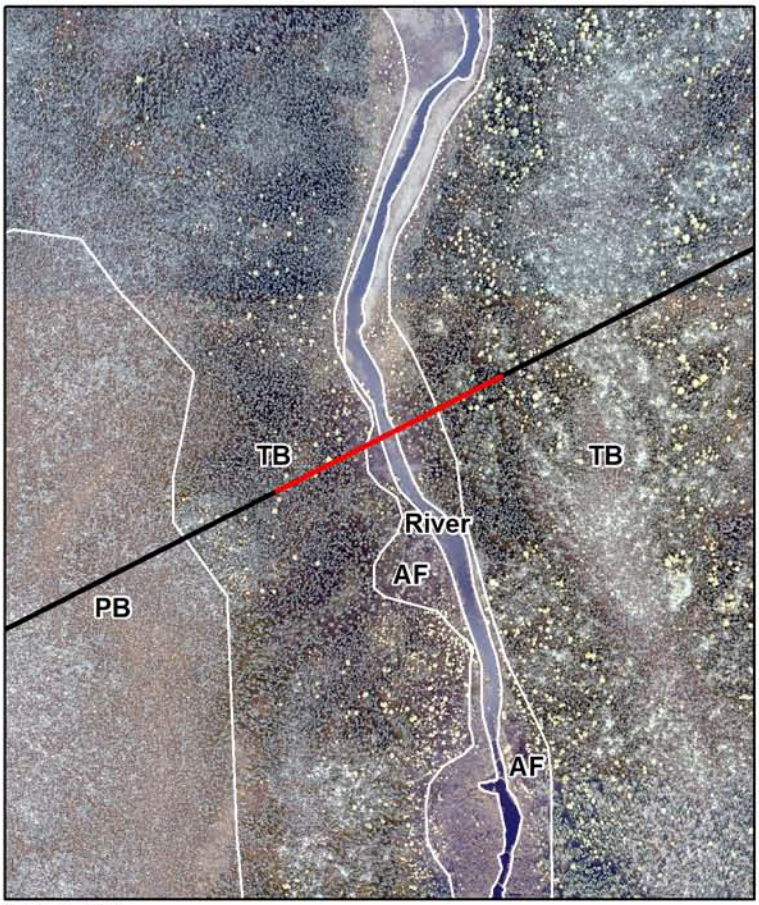
General reference map only; not for survey or legal use.

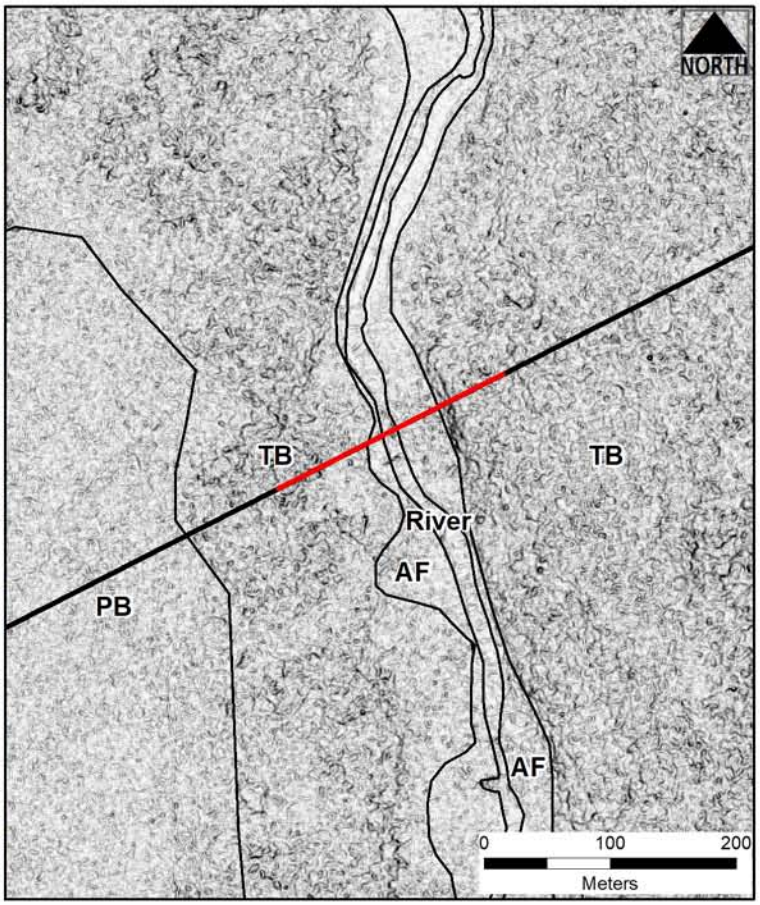
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

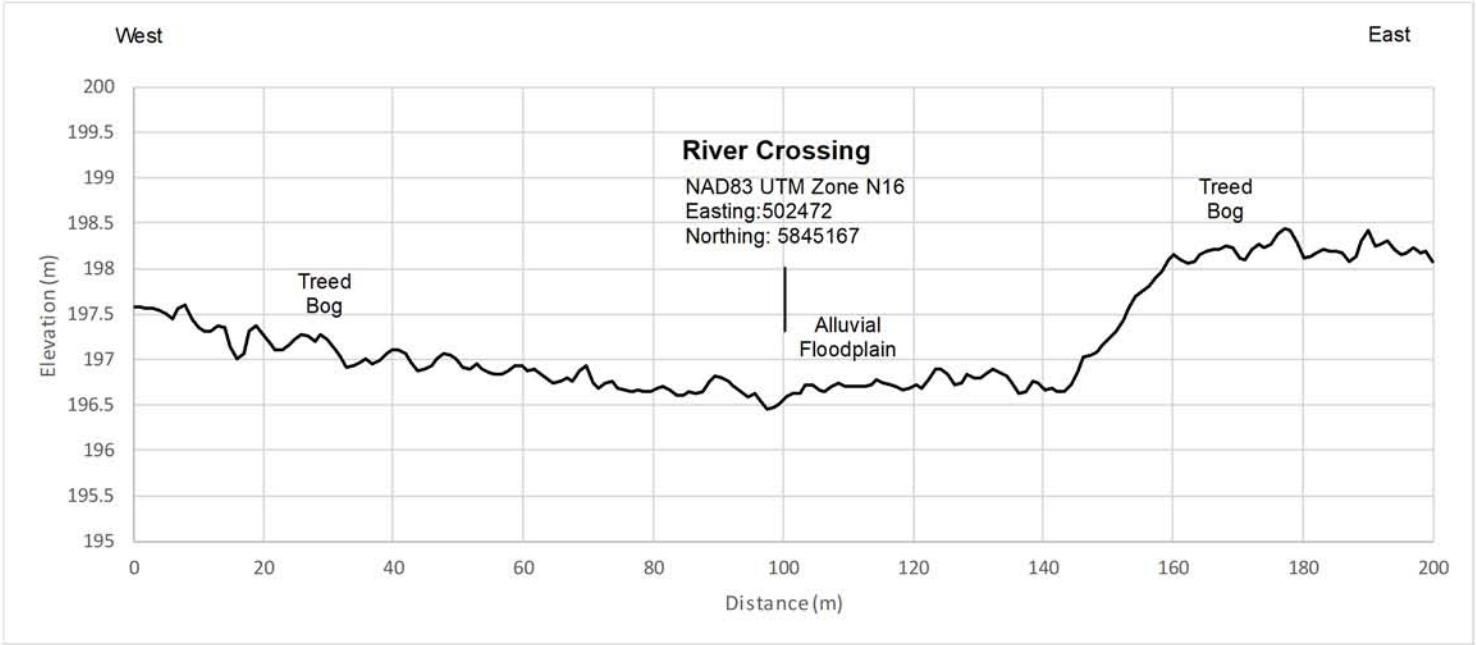
C17

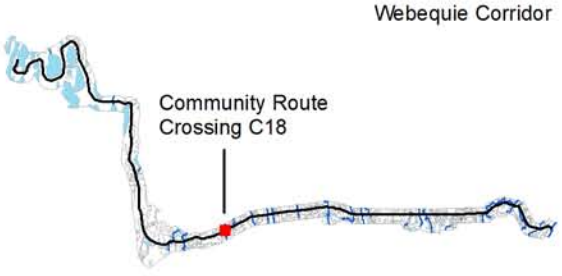
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

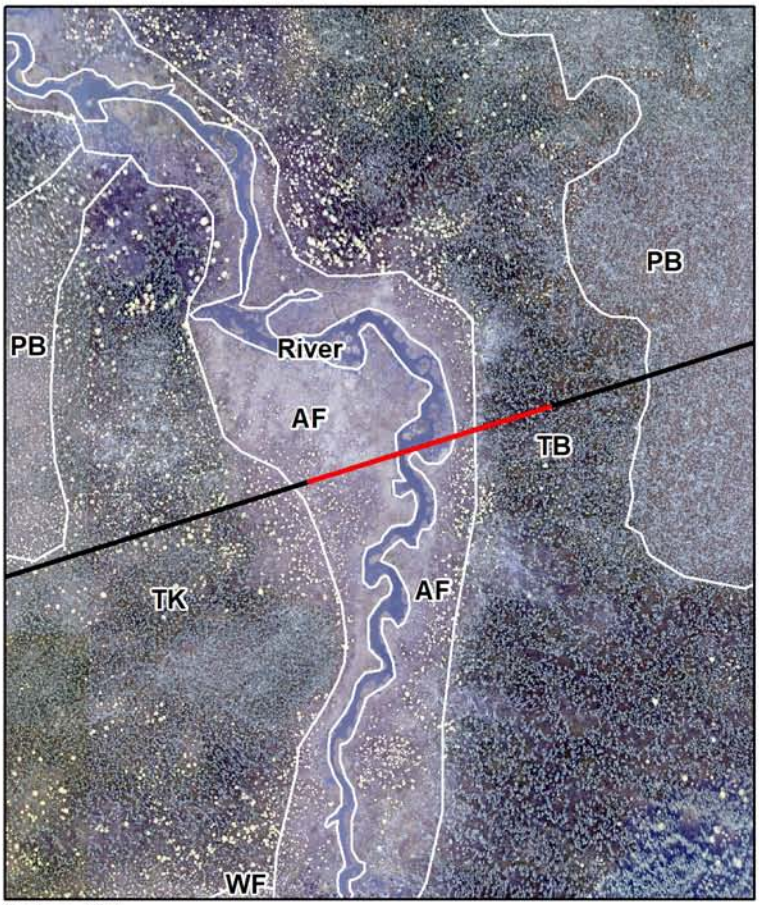
General reference map only; not for survey or legal use.

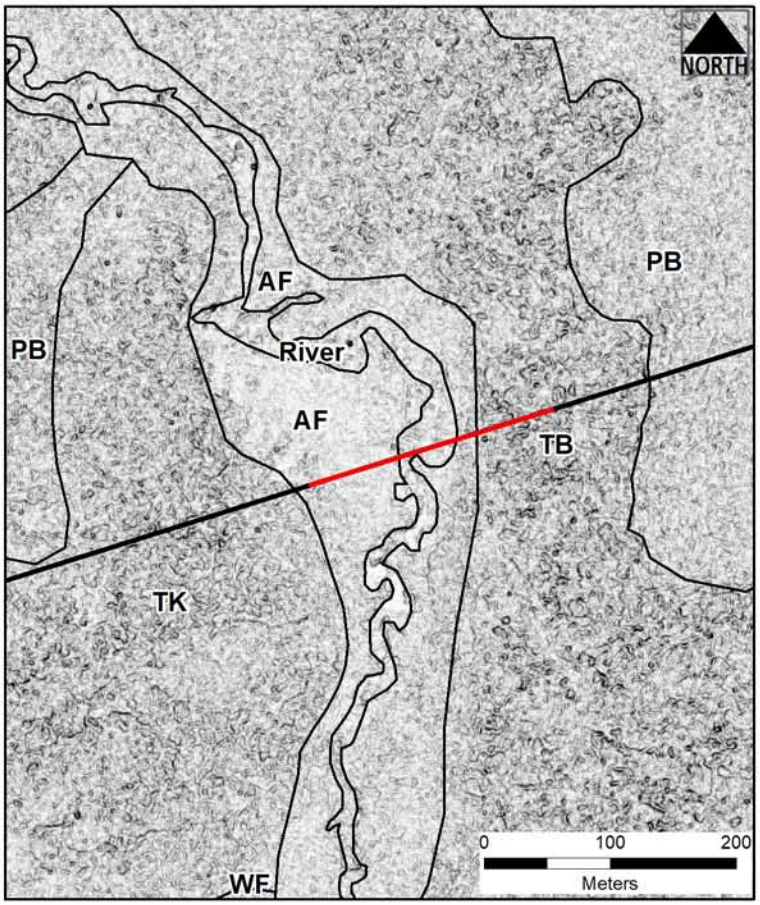
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

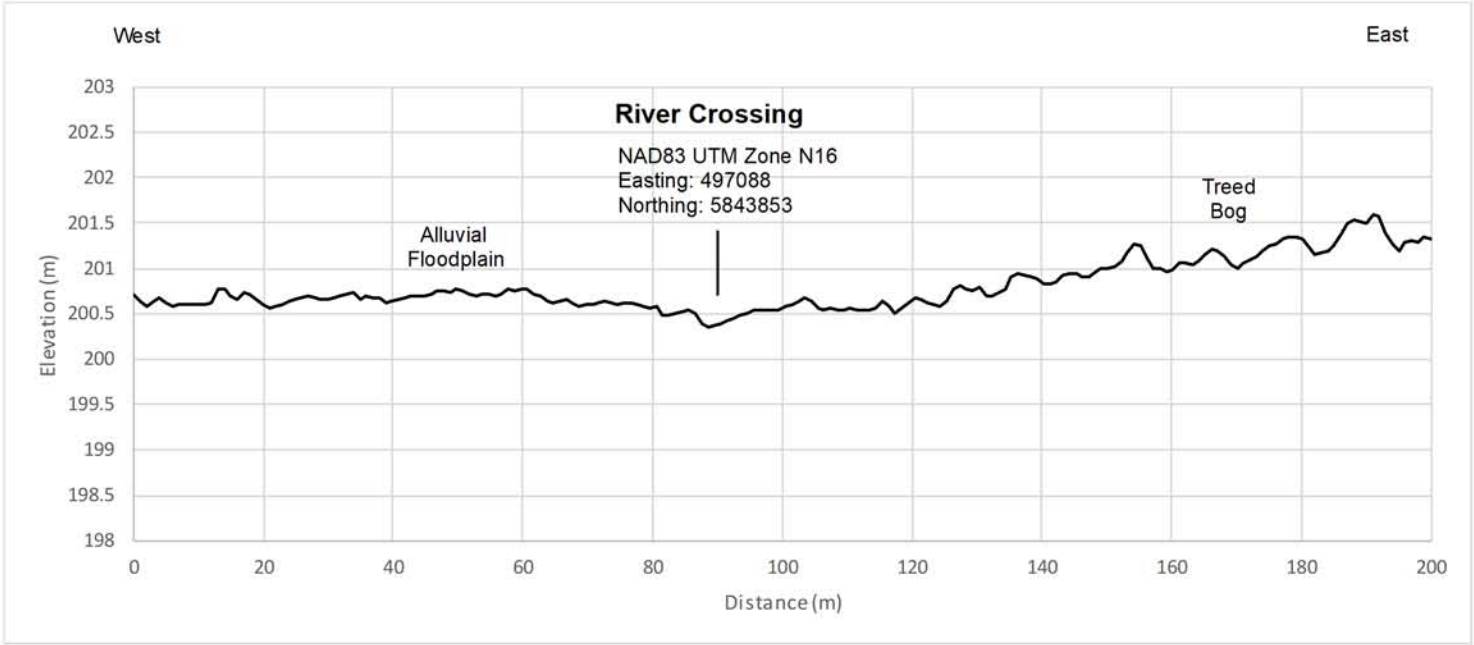
C18

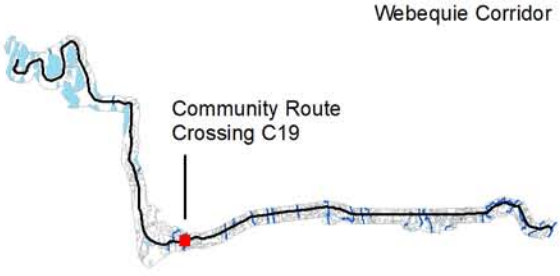
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

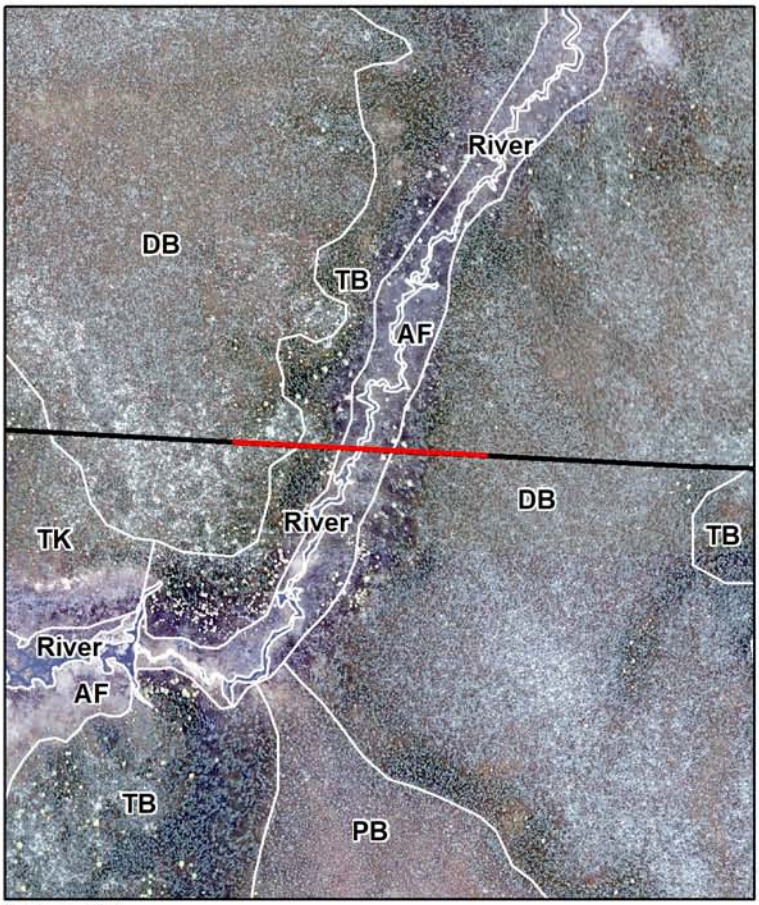
General reference map only; not for survey or legal use.

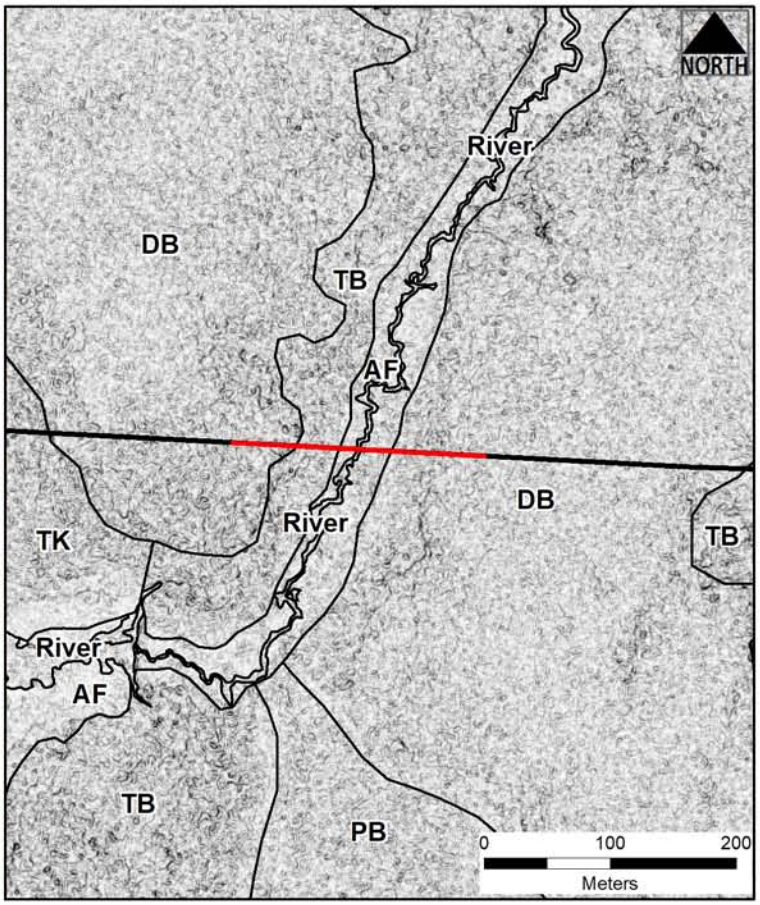
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

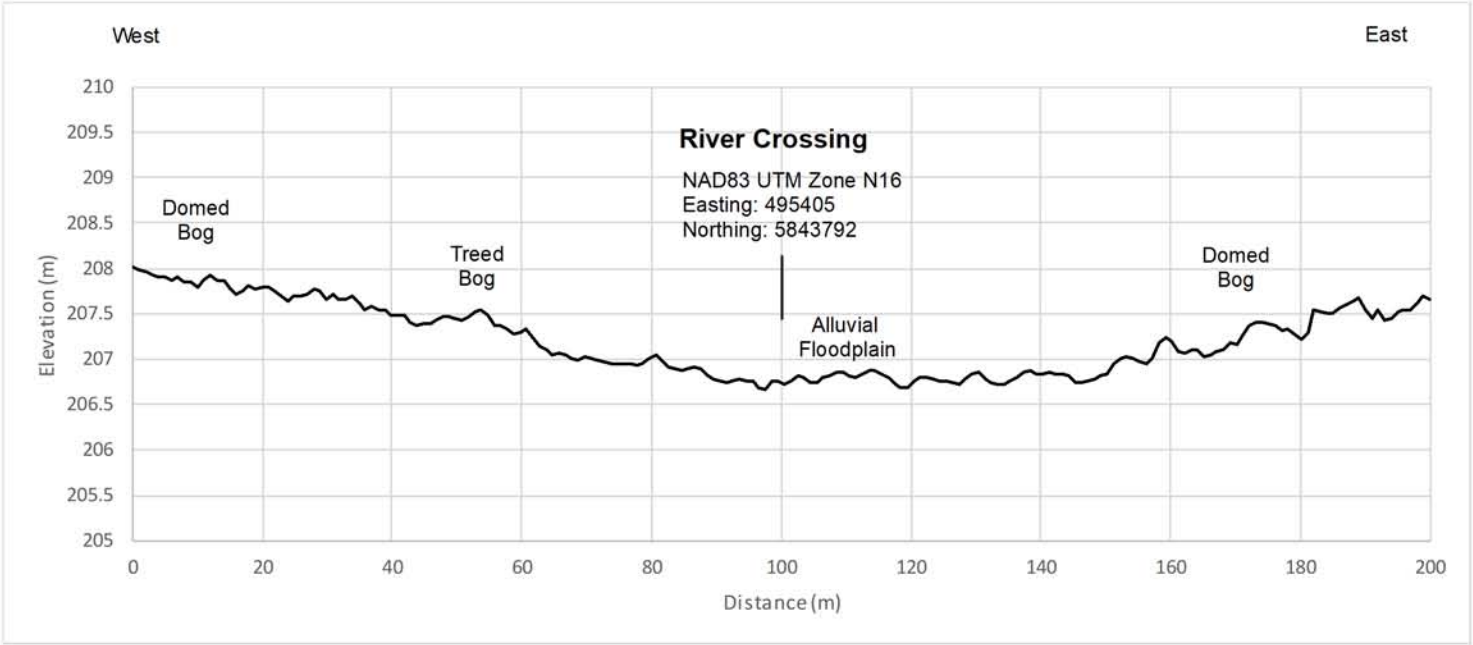
C19

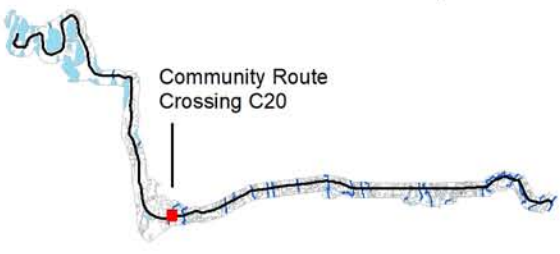
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

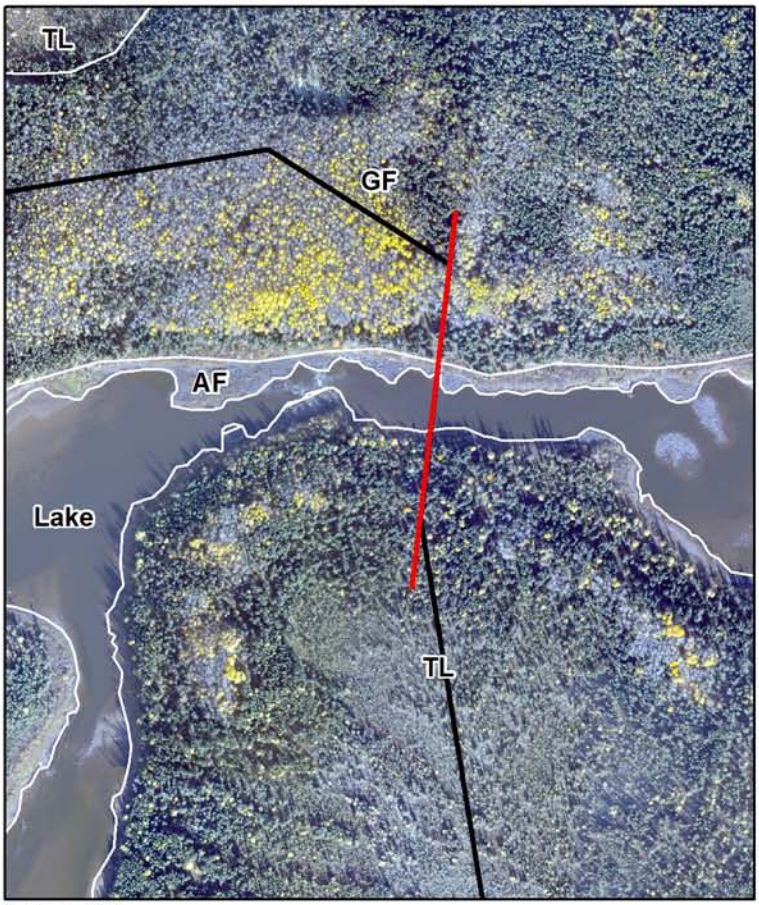
General reference map only; not for survey or legal use.

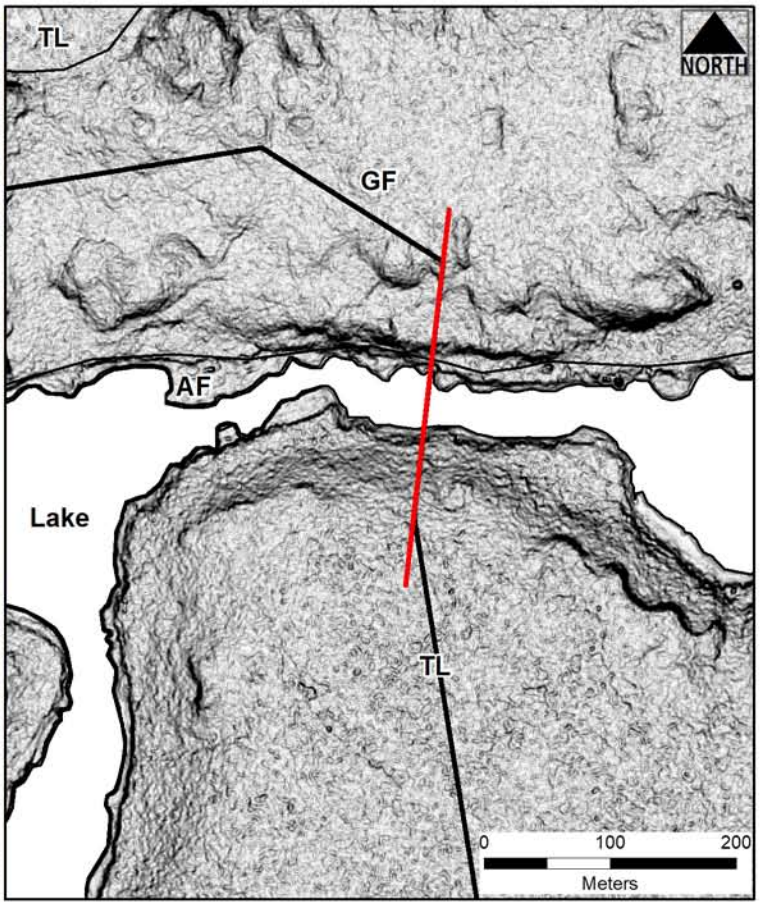
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

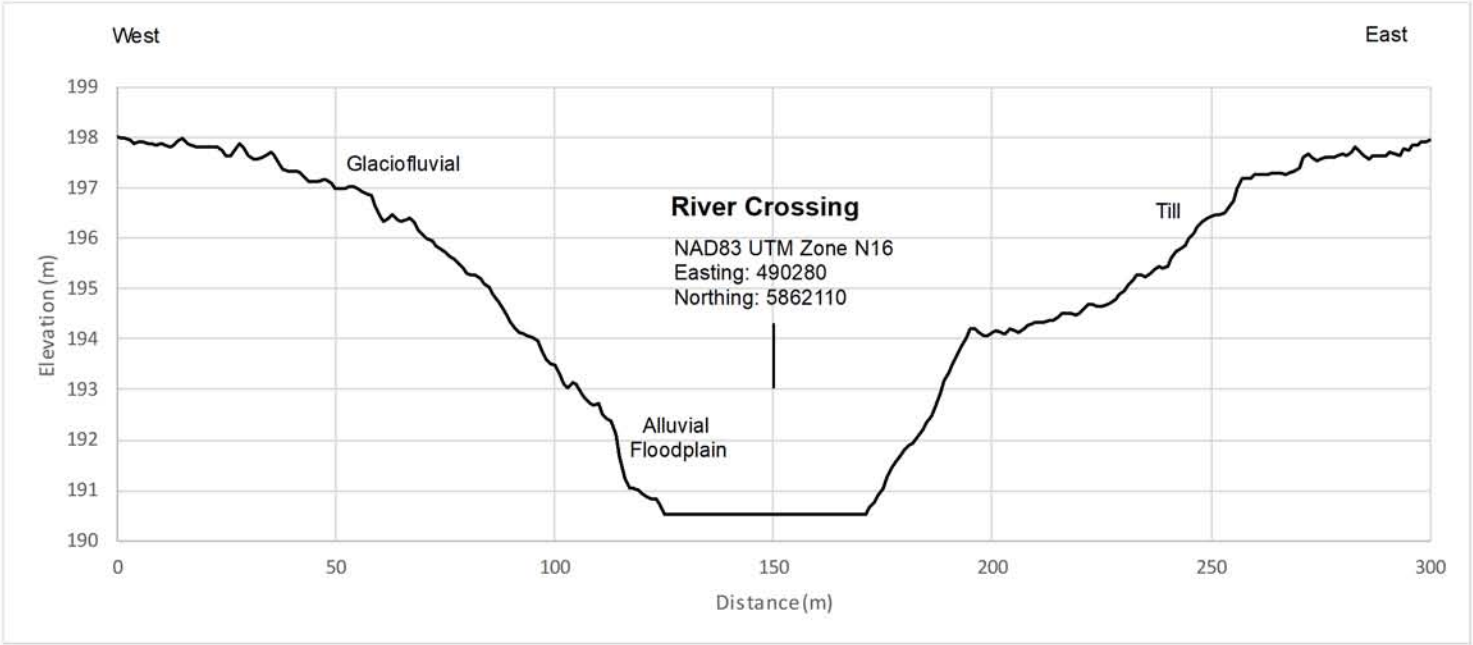
C20

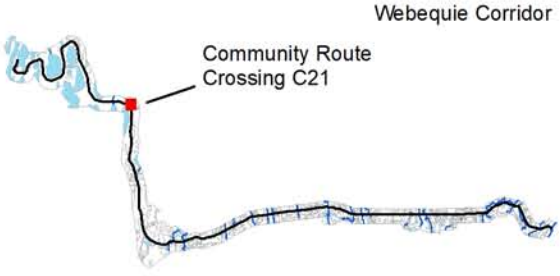
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

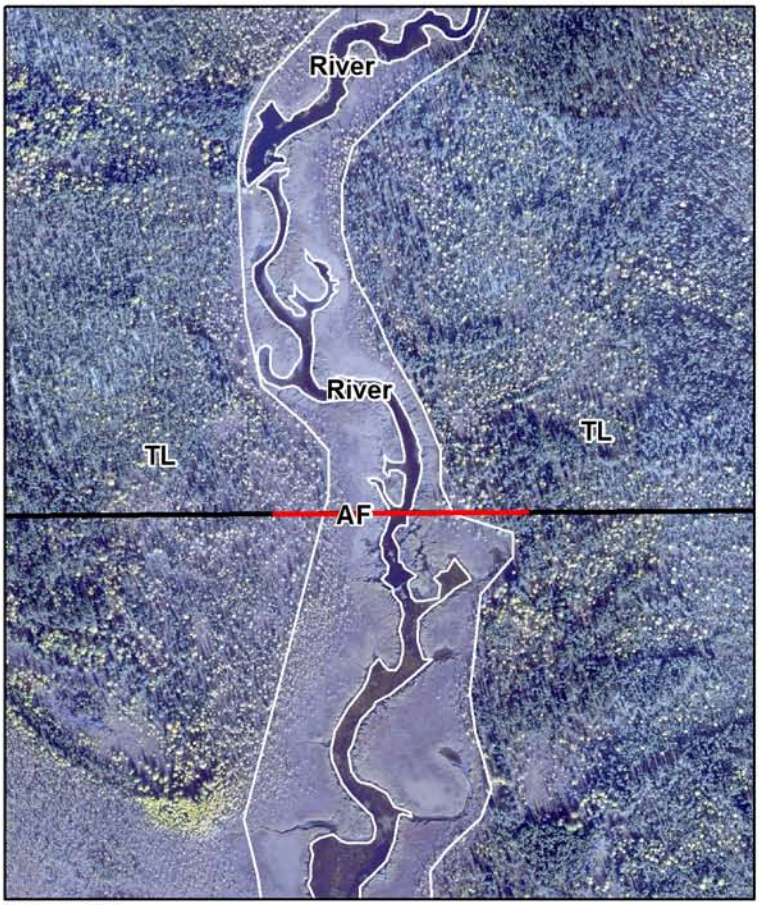
General reference map only; not for survey or legal use.

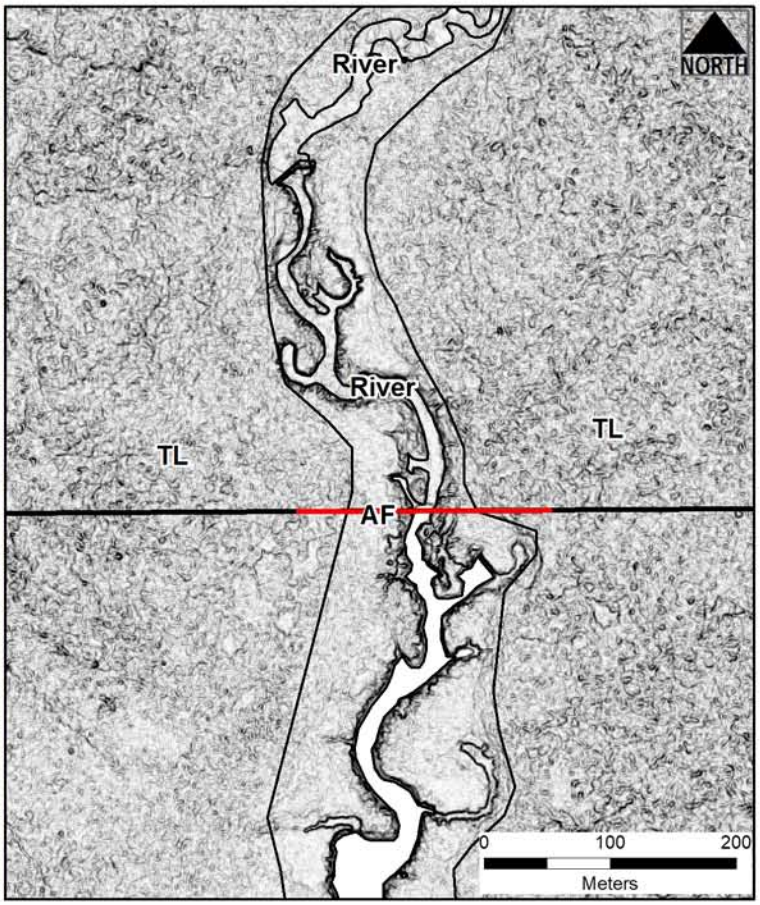
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

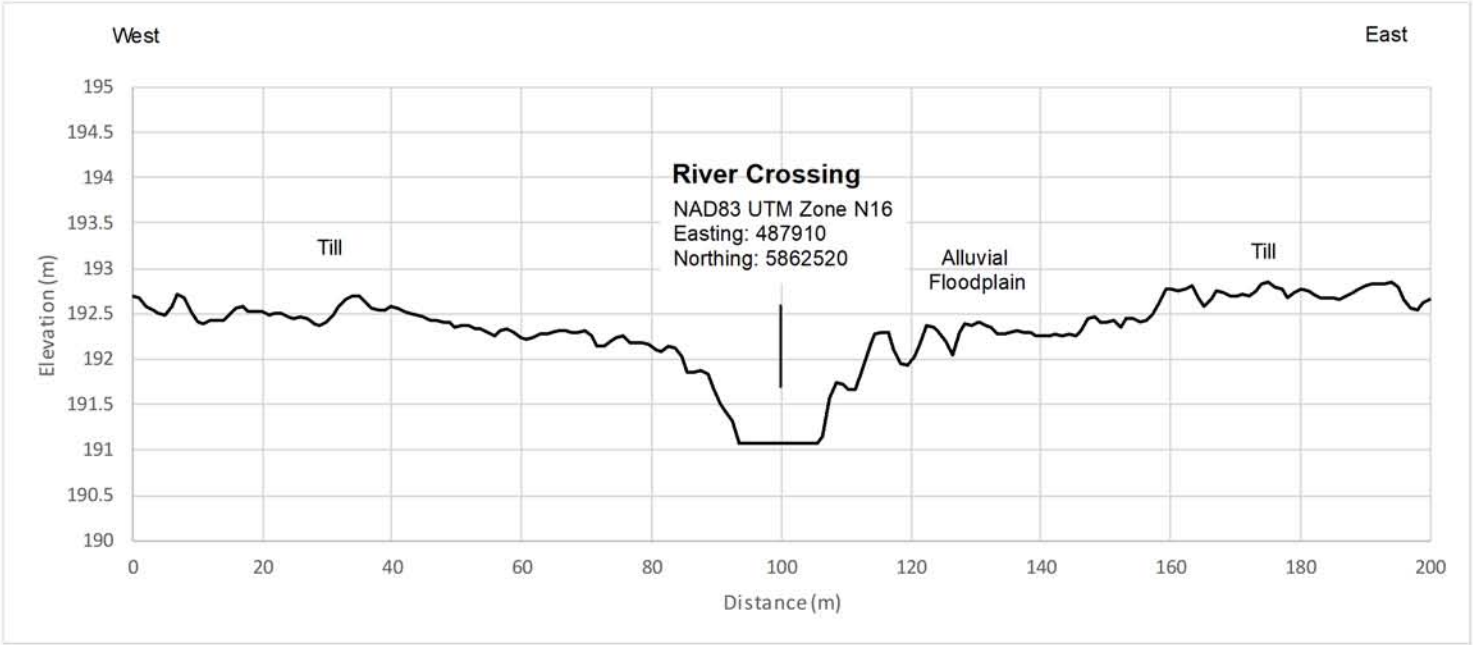
C21

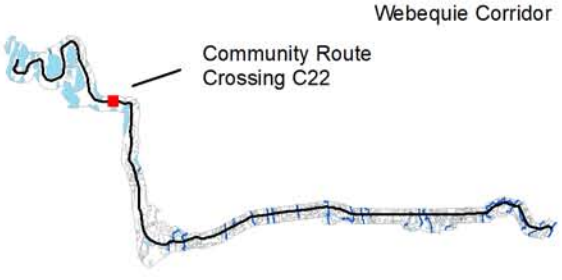
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Route

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

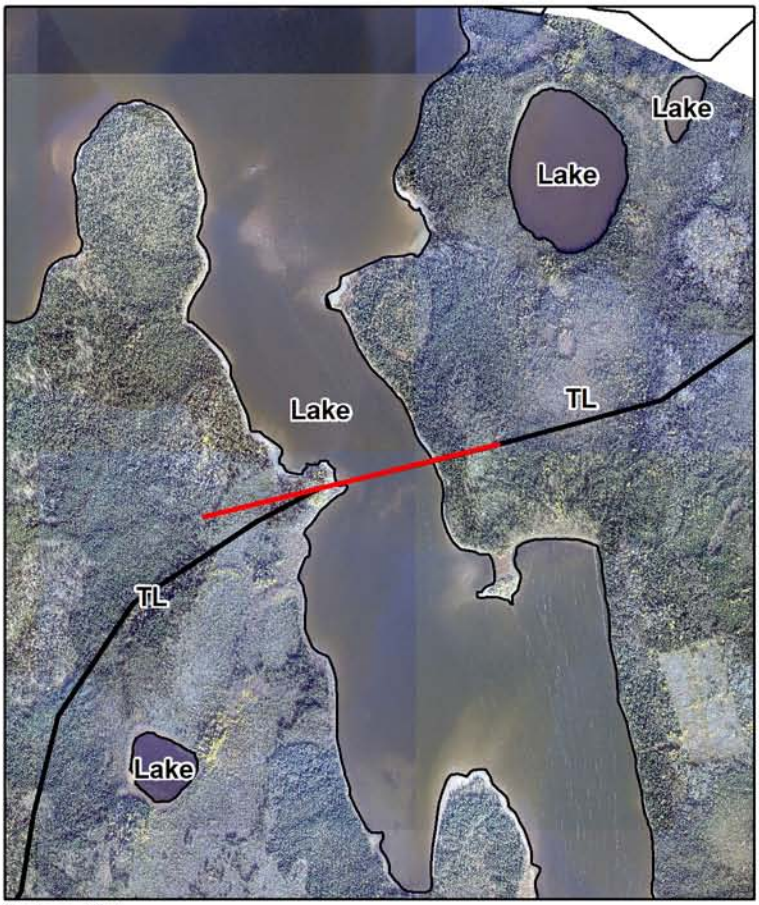
General reference map only; not for survey or legal use.

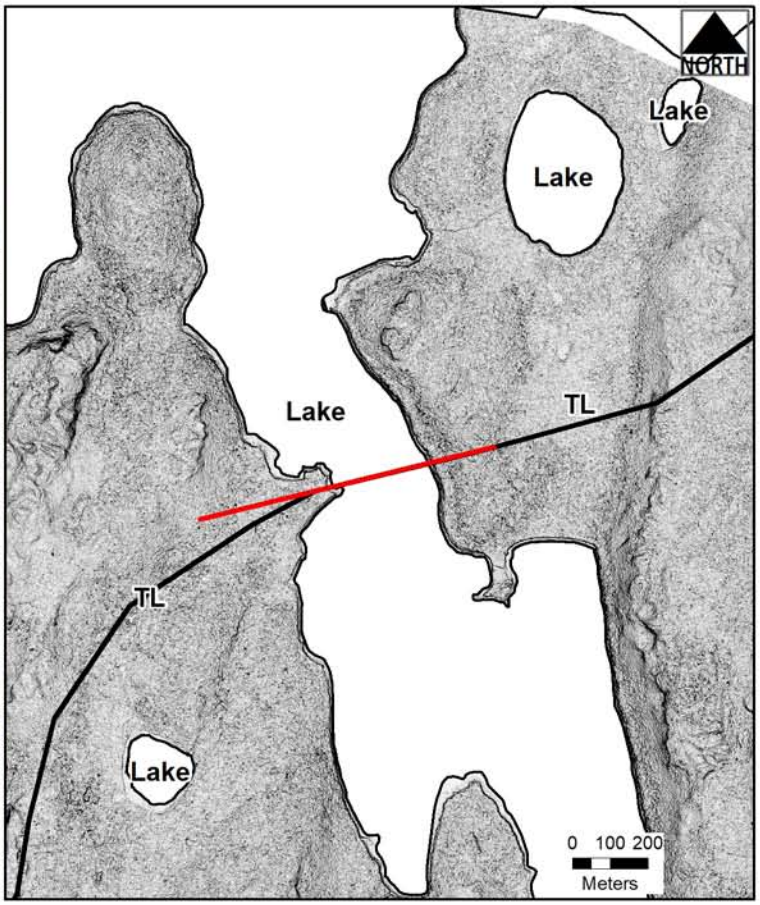
Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

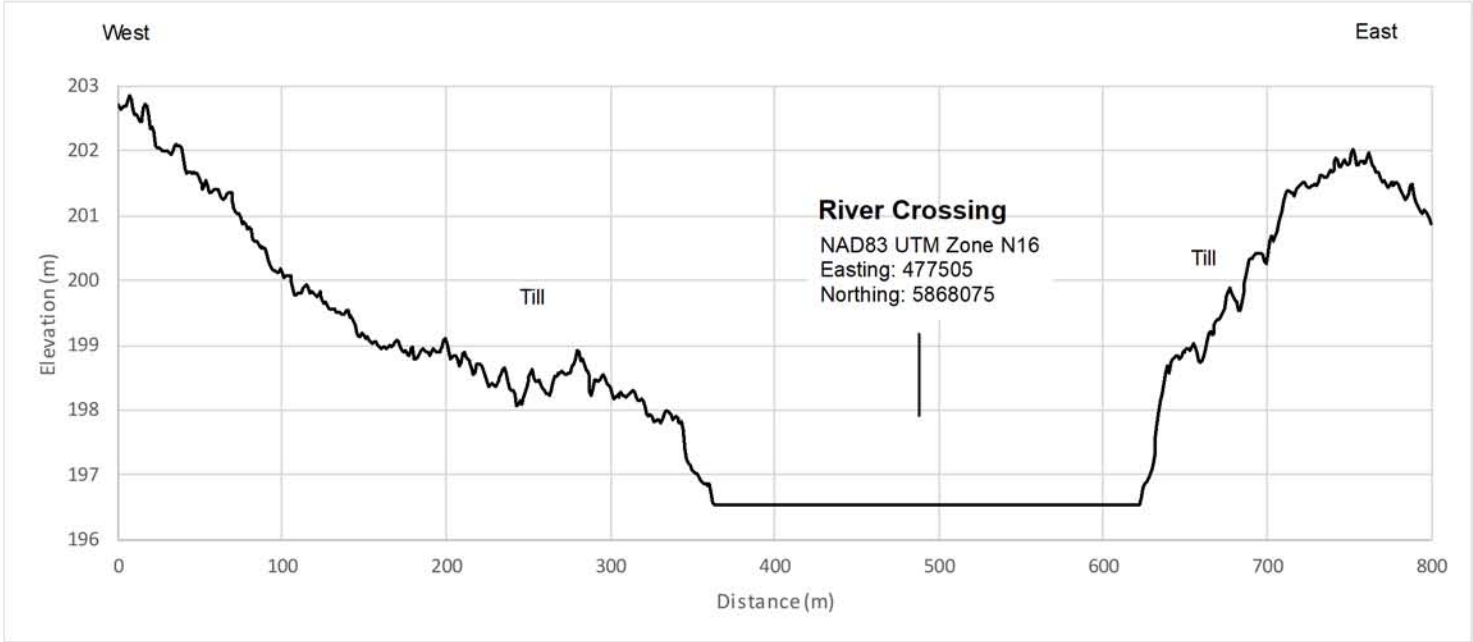
C22

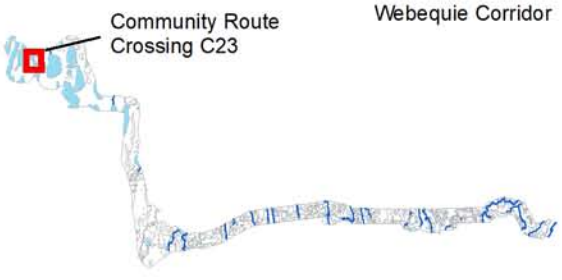
J D MOLLARD AND ASSOCIATES (2010) LIMITED





Chainages (Km)





LEGEND:

Community Preferred

Cross-Section

Slope (degrees)

High: 66.9

Low: 0

TITLE:

Community Route River Crossing

General reference map only; not for survey or legal use.

Map Sources:
Imagery: LiDAR slope raster
Geomatics: DSM *Revision date: 28/Mar/2019*

CROSSING:

C23

J D MOLLARD AND ASSOCIATES (2010) LIMITED