KAVIK-STANTEC INC.
PO Box 2320
Inuvik, NT
Canada X0E 0T0

Eli Nasogaluak
Environmental Assessment Coordinator
Environmental Impact Review Board
204-107 Mackenzie Road
P.O. Box 2121, Inuvik, NT X0E 0T0
eirb@jointsec.nt.ca

April 23, 2012 [VIA EMAIL]

Dear Mr. Nasogaluak:

Re: Inuvik to Tuktoyaktuk Highway – Preliminary Vegetation Map and Report

On behalf of the Government of Northwest Territories – Department of Transportation, Town of Inuvik and Hamlet of Tuktoyaktuk, KAVIK-STANTEC Inc. is pleased to submit the following documents related to vegetation characterization to the Environmental Impact Review Board during its consideration of the Inuvik to Tuktoyaktuk Highway Project (ITH):

- Preliminary Draft Vegetation Report
- Preliminary Vegetaton Classification Map (.shp file)

The preliminary report and map are being provided to assist with further planning and review of the ITH Project and as interim products to a final vegetation map and report to be submitted August 31, 2012.

The report is considered “preliminary”, as it does not incorporate, nor take into account results of additional field and desktop-based studies to be completed in May-July 2012. Additional desktop studies will include rare plant database review and mapping, and vegetation type sub-classification in support of selective wildlife habitat potential mapping. Field studies will include rare plant and vegetation type confirmation surveys.

Sincerely,

Erica Bonhomme
Senior Consultant, Stantec Consulting Ltd.
for KAVIK-STANTEC Inc.
erica.bonhomme@stantec.com

cc. Jim Stevens, DOT

Inuvik to Tuktoyaktuk Highway - Baseline Data Acquisition Program: Preliminary Vegetation Mapping

Preliminary Draft Report

April 18, 2012

Prepared for:
Government of the Northwest Territories – Department of Transportation
Yellowknife, NT

Prepared by:
KAVIK-STANTEC INC.

Inuvik, NT Project Number: 123510689

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Abbreviations

DOT ..... Department of Transportation
EIRB ..... Environmental Impact Review Board
EIS ..... Environmental Impact Statement
ENR ..... Environment and Natural Resources GNWT
EOSD ..... Earth Observation for Sustainable Development of Forests
IOL ..... Imperial Oil Limited
GIS ..... Geographic Information System
GNWT ..... Government of the Northwest Territories
MGP ..... Mackenzie Gas Project

1 INTRODUCTION

1.1 PROJECT BACKGROUND

The Government of the Northwest Territories (GNWT), Department of Transportation (DOT), the Town of Inuvik and the Hamlet of Tuktoyaktuk are proposing to construct a 140 km all-season highway to connect the Town of Inuvik with the Hamlet of Tuktoyaktuk (the project). The project is wholly within the Inuvialuit Settlement Region, with portions of the highway crossing Inuvialuit 7(1)(a), 7(1)(b) and Crown lands. The project is currently undergoing a substituted Panel review by the Environmental Impact Review Board. An Environmental Impact Statement (EIS) was submitted in May 2011. The EIS has undergone a conformity review by the EIRB and reviewers, where a number of deficiencies have been identified. The goal of the present report is to present additional information related to the identification of vegetation types located within a 1 km corridor centered on the project's proposed Alignments #1 and #3 as filed in the EIS and supplementary documents.

1.2 STUDY OBJECTIVES

The scope of the vegetation study includes the following tasks:

- Confirm the appropriateness of the vegetation classification system previously used in a portion of the study area
- Visually assign vegetation cover classifications to polygons mapped as part of terrain study
- Summarize the vegetation cover distribution along the highway alignment

The study will be completed in two parts:

(1) Preliminary vegetation cover classification and mapping based on desktop review

(2) Final vegetation cover classification and mapping based on desktop review and field verification

The present report summarizes the results of (1) – preliminary vegetation mapping based on desktop review only. This preliminary mapping has not been field verified.

2 METHODOLOGY

The following section describes the methodology used to complete preliminary vegetation cover mapping.

2.1 REVIEW OF EXISTING INFORMATION

The proposed alignment for the Inuvik to Tuktoyaktuk Highway crosses four Level IV Ecoregions (Ecosystem Classification Group. 2007, revised 2009): Mackenzie Delta High Subarctic, Sitidgi Plain High Subarctic, Caribou Hills Low Arctic, and Tuktoyaktuk Coastal Plain Low Arctic (Kiggiak-EBA. 2011). Specific classification and identification of vegetation communities or cover types in these areas has been produced as a satellite image classification product (Earth Observation for Sustainable Development of Forests (EOSD) initiative of the Canadian Forest Service (Wulder et al. 2004) and for Environmental Impact Statement for the Mackenzie Gas Project (IOL et al. 2004)) and as a field data and air photo interpretation based vegetation classification (Environmental Impact Statement (EIS) for the Mackenzie Gas Project (MGP) (IOL et al. 2004).

2.2 MAPPING METHODOLOGY

2.2.1 Review of Vegetation Classification

The largest, recent, small scale vegetation cover mapping product near or in the project area was completed for the Mackenzie Gas Project (MGP) Environmental Impact Statement (EIS) in 2004 (IOL et. al. 2004). Vegetation classification used for the MGP has been used as the classification for the highway alignment, for the following reasons:

- MGP mapping overlaps three of the four Level IV Ecoregions of the highway study area.
- MGP vegetation classification and mapping was conducted using stereo air photo interpretation of 1:20, 000 scale photos, a similar scale and type of imagery as is available for this study;
- MGP mapping and composition of the vegetation types was confirmed with a detailed field program;
- MGP vegetation classification was identified in the Environmental Impact Assessment for the Highway alignment as the likely community types to be found

There are many similarities in landscape and climate characteristics across the MGP project area and the proposed road route. Nine unique vegetation types from the MGP classification were identified though visual interpretation as appropriate to be used to map vegetation types within the present project area based on the experience of Kavik – Stantec staff that completed the air photo mapping and much of the field work for the tundra section of the MGP. Three MGP vegetation cover types are excluded as they are associated with the active Mackenzie River delta and not part of the highway study area.

2.2.2 Vegetation Mapping

Preliminary vegetation mapping was completed by reviewing terrain mapping product (KAVIK-STANTEC 2012) and the imagery in stereo (detailed below) and assigning a vegetation type to each polygon based on the dominant vegetation type observable in each polygon. The terrain polygons often contain more than one vegetation type. For this preliminary product one type was chosen as the most characteristic of the polygon. One exception is made for common upland vegetation, where the two most common vegetation types could be assigned to one polygon to represent areas where those two types were occurring as co-dominant in those polygons. This generalization allows for further subdivision if required, following field verification. The results of the preliminary vegetation mapping are being provided as electronic files suitable for viewing in a GIS environment.

Terrain mapping was completed to delineate and classify surficial geology, potentially ice-rich terrain features such as polygonal peat plateaus and terrain-related constraints (e.g. steep slopes, thaw slumps and seepage areas). Surface material, surface expression, drainage, slopes and geomorphic processes were mapped as small as 1 ha using digital 1:30,000 scale color photographs acquired in August of 2004 and 2005 as part of the Mackenzie Valley Airphoto Project (GNWT 2011). Terrain mapping and vegetation mapping were completed using GIS applications, specifically softcopy stereo (3D) vision systems. Elevation information used comes from the national and provincial digital elevation model (DEM) as well as from 1:50,000 scale digital base data available on the web portal of the Earth Sciences Sector (ESS) of Natural Resources Canada (NRCan).

Mapping was completed along the entire length of the two alternate highway alignments as well as along the proposed access to the borrow sources. A 1 km corridor was placed on the alignments to define a mapping corridor (resulting in a 500 m buffer on either side of the alignment). Mapping occurred at a representative scale ranging from 1:2,500 to 1:7,500. A total of 2,095 terrain polygons were delineated, resulting in an average polygon size of approximately 9 ha. Several polygons smaller than 1 ha in size were delineated, and most of these consist of critical landscape features such as water bodies, areas of ice-wedge polygons or areas characterized by active mass movements (e.g., thaw slumps).

2.2.3 Field Reconnaissance

Field reconnaissance will be completed in July 2012. The program will be designed to collect vegetation cover data used to confirm and or further refine the vegetation cover types as assigned during preliminary mapping, as well as conduct a rare plant survey.

2.2.4 Final Vegetation Cover Mapping

A final vegetation cover map atlas will be produced at a scale of 1:10,000, depicting vegetation cover classes and rare plant locations as appropriate, to be determined through discussion with the Department of Environment and Natural Resources.

3 RESULTS

3.1 Vegetation Classification

In the project region, topography is level to rolling, and elevation varies from close to sea level near Inuvik, Tuktoyaktuk and Husky Lakes, to 150 m near Parsons Lake. Vegetation grows on a veneer of unfrozen organic or granular substrate overlying permafrost. In wetter areas, sedges, cotton-grasses and sphagnum moss dominate high-centred and low-centred polygons. Drier areas support ericaceous shrubs. Riparian communities include wet sedge communities and taller shrubs. Larger creeks support outliers of black spruce (IOL et al. 2004).

The unique vegetation types from the MGP classification identified within the project area, as described in the MGP EIS, are in the following section. Three of the MGP vegetation cover types are excluded as they are associated with the active Mackenzie River delta and no part of the Highway alignment as associated with the Mackenzie delta.

3.1.1 Vegetation Type 1 – Dry Saxifrage Tundra

The dry saxifrage tundra vegetation type is found on dry, upland areas on the tundra of the Tuktoyaktuk Peninsula. It is often found on sparsely vegetated sites containing granular materials, where bare ground comprises a median percent cover of 20.8%. The surface cover includes ground birch, locoweed species, red bearberry, black crowberry, bog bilberry, mountain cranberry and willow species. The indicator species for this vegetation type are alpine holy grass and prickly saxifrage. Hair-cap moss is the most common bryophyte, and *Cetraria*, *Alectoria* and *Cladina* are frequent lichens. Other plants frequently found, but with low cover values are Yukon stitchwort – a rare species, blunt sedge, prostrate willow, and *Cladonia*, *Thamnolia* and *Stereocaulon* lichens. The dry saxifrage tundra vegetation type is characteristic of dry, warm soils in this ecological zone. It is common on crests and upper slopes with well-drained shallow soils with scarce organic material. These sites are associated with gravely deposits such as the hummocky glaciofluvial outwash, kames or eskers, or with weathered surfaces of poorly lithified sedimentary rocks. The nutrient regime in these sites is estimated to be poor to very poor with a moisture regime ranging from xeric to subxeric. The active layer depth is greater than 30 cm.

3.1.2 Vegetation Type 2 – Dwarf Shrub Heath

Dwarf shrub heath is the most common tundra vegetation type on the Tuktoyaktuk Peninsula. It is widespread throughout flat and rolling terrain, in thin organic soils on crests to mid-slope positions where water does not accumulate. Dwarf shrubs make up most of the shrub and ground cover layers. These include ground birch, mountain cranberry, northern Labrador tea, green alder, black crowberry, red bearberry, and bog bilberry. Cloudberry and sweet coltsfoot are also present. Arrow-leaved coltsfoot is an indicator species for this vegetation type. Common lichens are reindeer lichens and *Cetraria*, and peat moss is the most common bryophyte. *Peltigera* species are often associated with low cover values.

The dwarf shrub heath vegetation type is located on a variety of parent materials including glaciofluvial, morainal and colluvial. A veneer of peat is often present over mineral deposits, but is usually thinner than 50 cm. Sites are usually located in crest, upper to mid-slope positions but less commonly in depressions. Permafrost features such as thermokarst subsidence or frost boils are often present. Nutrient regime in these sites is estimated to be poor and the moisture regime ranges from mesic to hygric. The active layer depth ranges from 18 to 200 cm.

3.1.3 Vegetation Type 3 – Upland Shrub

Slopes on upland areas are frequently vegetated with an upland shrub vegetation type. The taller shrubs form a scattered to open canopy of ground birch, blue-green willow and green alder ranging from 0.5 to 1.5 m. Dwarf shrubs such as mountain cranberry, red bearberry and black crowberry comprise the ground cover layer. Additional species present in the ground cover layer include sweet coltsfoot and *Spiraea beauverdiana*, with bog bilberry found in lesser amounts. Indicator species of this vegetation type are Herriot's sagewort, arrow-leaved coltsfoot and bistort. Large-flowered lousewort is also an indicator for this vegetation type. Common lichens include reindeer lichens, *Cetraria* and club lichens.

The upland shrub vegetation type in the tundra occurs on morainal or lacustrine landforms with fine silty clay and loamy texture. Most sites have a hygric to subhydric moisture regime with moderate to poor drainage and fairly level to gently rolling topography. The upland shrub vegetation type also grows on coarse glaciofluvial sediments with coarse loamy sand to sandy loam parent material texture. There, this vegetation type is more common on the mid- to lower landscape positions where drainage is restricted by permafrost. Sites can have thermokarst subsidence or occasional but poorly developed ice-wedge polygons. A veneer of peat is often present over mineral deposits, but is usually thinner than 40 cm.

These sites have poor nutrients and a subhygric to hygric moisture regime. The active layer depth ranges from 25 to 67 cm.

3.1.4 Vegetation Type 4 – Cotton-Grass Tussock

The cotton-grass tussock vegetation type is found on lower slopes and lowlands where blanket flow of water at the permafrost surface creates hygric-subhydric soil moisture. Sheathed cotton-grass is the dominant species in this vegetation type. It forms dense tussocks along with two sedges, *Carex lugens* and *Carex consimilis*. In between the tussocks, sphagnum species thrive, whereas shrub species are less prominent because of the high moisture levels. Ground birch, mountain cranberry, northern Labrador tea, black crowberry and flat-leaved willow occur in the lower shrub layer. *Cladonia* and *Cetraria* lichen species are sometimes present. Cloudberry is also found in the ground cover layer. Other plants frequently found with low cover values are bog bilberry and *Dactylina* species. Leatherleaf (*Chamaedaphne calyculata*) is an indicator plant of this vegetation type.

The cotton-grass tussock vegetation type is located mostly within fine-textured morainal and lacustrine landscapes. Sites can be subject to inundation or permafrost, and demonstrate features such as thermokarst subsidence and frost heave. Micro-topography is often hummocky, with regional slopes less

than 10%.The nutrient regime in this vegetation type is typically considered to be poor with a moisture regime ranging from hygric to subhydric. The active layer depth ranges from 11 to 75 cm.

3.1.5 Vegetation Type 5 – High-centred Polygons

High-centred polygons are found localized in depression areas and flats on the Tuktoyaktuk Peninsula. They have large net-like patterns with high centres surrounded by water-filled troughs with ice bottoms. The centre of each polygon develops a dome of peat and is vegetated with upland species similar to the dwarf shrub heath vegetation type including northern Labrador tea, ground birch, mountain cranberry and black crowberry. Cloudberry and red bearberry are also common. Reindeer lichens are prominent and *Cetraria* and club lichens also occur on most sites. Species frequently found with low cover values in the wetter troughs and cracks are cotton-grasses, water sedge, *Carex consimilis*, *Carex rariflora* and *Carex lugens*.

In many high-centred polygons, a thick layer of strongly cryoturbated, mixed organic and mineral soil underlies surface peat deposits. The polygons are usually located in poorly drained areas that occupy low landscape positions such as depressions associated with thermokarst lakes or ponds, pingos, hollows or channel-like features. These sites occur in ice-rich, fine-grained soils with a silty clay loam to clay loam texture on the morainal landforms and small lacustrine basins. The nutrient regime in these sites is poor, and the moisture regime ranges from subhygric to hydric. The active layer depth ranges from 29 to 40 cm.

3.1.6 Vegetation Type 6 – Low-Centred Polygons

This vegetation type is localized in depression areas and drained lake basins on the Tuktoyaktuk Peninsula, typically adjacent to areas of standing water. Low-Centred Polygons often occur adjacent to high-centred polygons and are usually similar in pattern size. However, the centre of the polygons are depressed, often containing pond water and are covered with wetland vegetation such as sheathed cotton-grass, *Carex consimilis*, *Carex rotundata*, *Carex lugens* and *Carex rariflora*. Peat moss is the dominant moss in the wet centres. Leatherleaf is an indicative plant of this vegetation type; however, it has a low percent cover value and is not represented. The drier ridges are dominated by dwarf shrub heath vegetation, including ground birch, bog bilberry, northern Labrador tea, mountain cranberry, cloudberry and black crowberry. Flat-leaved willow and green alder are also present, along with bog rosemary and red bearberry at lower cover values. Common lichen species include reindeer lichens and *Cetraria*.

The middles of low-centred polygons are wet and are surrounded by soil ridges pushed up adjacent to ice wedges. The polygons are usually located in poorly-drained areas that occupy low landscape positions such as depressions associated with thermokarst lakes or ponds, pingos, hollows or channel-like features, and are often mixed with or near high-centred polygons. These sites occur in ice-rich, fine-grained soils with a silty clay loam to clay loam texture on the morainal landforms and small lacustrine basins. This vegetation type is nutrient poor and has a moisture regime ranging from subhygric to hydric. The active layer depth ranges from 11 to 50 cm.

3.1.7 Vegetation Type 7 – Riparian Shrub

The riparian shrub vegetation type is found along streams and drainage basins in the Tuktoyaktuk Peninsula. Taller shrubs form a closed canopy of flat-leaved willow, ground birch and green alder. Common ground cover species include mountain cranberry, northern Labrador tea, black crowberry and cloudberry, with sweet coltsfoot with lower cover values. Water sedge and marsh cinquefoil are common in areas with open water. The most common bryophyte is peat moss.

The riparian shrub vegetation type is most common on silty sand fluvial deposits associated with the small and beaded streams. Topography is subdued and concave, with slopes up to 5%. Soils are usually moderately well to poorly drained, with a shallow permafrost and water table near the surface. These sites have a poor to medium nutrient regime and the moisture regime ranges from hygric to hydric. The active layer depth ranges from 18 to 90 cm.

3.1.8 Vegetation Type 8 – Riparian Sedge – Cotton-Grass

The riparian sedge – cotton-grass vegetation type occurs on the perimeters of small lakes and ponds, and less commonly along small streams, in the Tuktoyaktuk Peninsula. The dominant vegetation is water sedge. Indicator species for this vegetation type include water horsetail and buck-bean. Peat moss is the most prominent nonvascular component.

The riparian sedge – cotton-grass vegetation type is most common on silty sand deposits associated with the small lakes and ponds. Topography is subdued with slopes up to 5%. Soils are usually imperfectly to very poorly drained, with a shallow active layer. These sites have a poor nutrient regime and the moisture regime ranges from subhydric to hydric. The active layer depth ranges from 15 to 45 cm.

3.1.9 Vegetation Type 13 – Riparian Black Spruce/Shrub

This vegetation type is the only forested tundra vegetation type, and is the northern limit of black spruce in the area. The average tree height on the survey plots is 9.1 m tall. The shrub layer is dominated by black spruce, flat-leaved willow and blue-green willow, and ground birch with lower cover values. The ground cover includes black crowberry, prickly rose, northern Labrador tea, mountain cranberry, and sweet coltsfoot. Dwarf scouring-rush and bog bilberry are also often present, but at lower cover values. Black spruce in the tree layer, and prickly rose in the ground cover layer are indicator species of this vegetation type.

This vegetation type is found exclusively along the floodplain and terraces of larger streams. Poorly developed soils on sandy to silty fluvial sediments show loamy sand to sandy texture with occasional gravely loamy sand sites. Sites are moderately well drained, transitioning to poor or very poor closer to the stream. The moisture regime is mesic and the soil nutrient regime range is poor. The active layer depth exceeds 100 cm.

3.2 Vegetation Mapping

The resulting preliminary vegetation mapping has been summarized by area and by linear length along Alignment #3 (Table 3.1 and 3.2). The dominant vegetation types are Vegetation Type 2 – Dwarf Shrub Heath and Vegetation Type 3 – Upland Shrub. These two types occur on very similar landscape types and in complexes with each other. The results from the mapping show that Dwarf Shrub Heath and Upland Shrub are intermixed in many of the polygons and as a result, these are summarized as one vegetation type. The air photo interpretation did not identify vegetation cover types that were sufficiently different from MGP vegetation types that they could not be classified using the existing nine MGP vegetation types. This excludes vegetation communities of small extent that may be associated with small features such as thaw slumps or persistent snow banks.

Table 3.1 Area of Vegetation types in the 1 km corridor (Alignment #3)

Vegetation Type	Area (ha)	% of total area
01 Dry Saxifrage Tundra	205.0	1.1
02 Dwarf Shrub Heath	5624.9	29.3
03 Dwarf Shrub Heath/Upland Shrub	6178.4	32.1
04 Cotton-Grass Tussock	442.7	2.3
05 High-Centred Polygons	2030.6	10.6
06 Low-Centred Polygons	155.9	0.8
07 Riparian Shrub	1031.8	5.4
08 Riparian Sedge - Cotton-Grass	247.6	1.3
13 Riparian Black Spruce/Shrub	32.9	0.2
Open Water	3270.8	17.0
Total	**19220.7**	**100.0**

Table 3.2 Linear summary of vegetation types crossed by Alignment #3

Vegetation Type	Length (km)	% of total length
01 Dry Saxifrage Tundra	0.5	0.4
02 Dwarf Shrub Heath	52.8	37.7
03 Dwarf Shrub Heath/Upland Shrub	55.8	39.9
04 Cotton-Grass Tussock	0.9	0.6
05 High-Centred Polygons	17.0	12.2
06 Low-Centred Polygons	0.2	0.2
07 Riparian Shrub	7.5	5.4
08 Riparian Sedge - Cotton-Grass	1.0	0.7
13 Riparian Black Spruce/Shrub	0.2	0.1
Open Water	0.0	0.0
Total	**135.9**	**100**

4 LIMITATIONS AND NEXT STEPS

This vegetation mapping product is a preliminary draft depicting vegetation types in the 1km proposed Alignment #3 corridor as determined based on digital stereo air photo interpretation and on vegetation types generated by and used in the Mackenzie Gas Project Environmental Impact Statement. The classifications and mapped distribution has not been field verified.

A field program to survey for rare plants and conduct vegetation type confirmation is planned for July 2012. A sample of the polygons will be visited to record a generalized site characterization. Data collected will include:

- GPS coordinates
- Site photos (minimum of 5 at each site)
- Slope position and aspect
- Depth to permafrost
- Permafrost features
- Surface expression
- Cover and density of tree and shrub stratum
- Cover and density of dominant vascular species
- Cover and density of the bryophyte and lichen groups (e.g., *Sphagnum, liverworts, Cladina*)
- Cover and density of litter, mineral and surface water

At rare plant survey sites all of the above is collected and those sites can also be used to confirm mapping. Additional information collected at rare plant survey sites will include:

- A complete list of vascular plants
- Collection of bryophytes and lichen samples stratified by microhabitat for later identification by specialists

The vegetation type confirmation survey data will be used to adjust and edit the preliminary mapping to further refine the vegetation typing. At this point the original terrain polygons may be split or edited for vegetation and habitat modeling specific needs. Wildlife habitat modeling requirements will be reviewed with the survey and modeling wildlife biologists to ensure the vegetation mapping will be sufficient to be used for their purposes.

The rare plant survey will target the Dry Saxifrage Tundra vegetation type that has been identified in the MGP EIS as having high potential for rare plants. For this project this vegetation type occurs frequently at the proposed granular resource extraction sites. All of these will be surveyed targeting the potential extraction area.

Preparation for the rare plant and vegetation confirmation survey will include:

- Development of a potential rare plant list (i.e. what to look for);
- Research on potential for plant Species at Risk;
- Research on ranking and rarity of bryophytes and lichens for the study area;
- Reviewing the latest information from ENR and other filed Environmental assessments on known rare plant locations in the project area

A Final Vegetation Map and Report will be available August 31, 2012.

5 REFERENCES

5.1 Literature Cited

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