APPENDIX A

YELLOWKNIFE GOLD PROJECT

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ECOLOGICAL LAND CLASSIFICATION FIELD REPORT

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Tyhee NWT Corp

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ECOLOGICAL LAND CLASSIFICATION- FIELD REPORT

TYHEE NWT CORP

YELLOWKNIFE GOLD PROJECT

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EXECUTIVE SUMMARY

Ecological land classification is a mapping process that involves the integration of site, soil and vegetation information. This information is used to organize ecological data into units that respond to disturbance in a consistent manner. This information is then used to development integrated and sustainable resource management plans.

The Yellowknife Gold Project (YGP) study area (~14,475 ha) is located within the Tazin Lake Upland Ecoregion of the Western Taiga Shield Ecozone. It is characterized by cool summers and cold winters and has a sub-humid, high boreal ecoclimate. Upland areas are dominated by bedrock exposes, while organic deposits cover lowlands. Dystric Brunisols are the dominant upland soils and Organic Cryosols are found in poorly drained, peat-filled depressions. Trembling aspen, jack pine, and white and black spruce dominate upland areas, while stands of tamarack and black spruce dominate poorly drained fens and bogs.

Baseline data was collected in July 2004. There were 91 field inspections completed in 12 ecosystem types resulting in a Terrestrial Ecosystem Mapping (TEM) sampling intensity level 5. Mapping at a 1:20,000 scale was completed using IKONOS imagery. Twenty-two ecosystem types were classified within the study area. Fourteen of these were naturally vegetated, three were classified as water, four were anthropogenic and one was cloud. Spruce-lichen (SL) was the dominant ecosystem type covering 33% of the YGP study area. Jack pine-lichen was second covering 19.5%. Treed bog was the most dominant wetland type covering 8.5% of the YGP study area. There were eight naturally vegetated ecosystem types of restricted distribution, each covering less than 1% of the YGP study area. Fifteen broad ecosystem units that correlated to the West Kitikmeot/Slave Study (WKSS) were assigned to each polygon. Dry Coniferous Woodland was the most abundant broad unit, with Burns second in abundance.

Complex polygons accounted for more than 35% of the polygons and over 50% of the area mapped. Spruce-lichen was the most common ecosystem that was complexed with one other unit. Treed bogs were the most common complexed with two other ecosystem types. This is due to the presence of small sedge and shrubby fens within the larger TB polygons. Coniferous stands accounted for close to 38% of the study area. The most abundant structural stage was young forest, with low/tall shrub woodland being the second most abundant. This is due to the fire history of the area, and the recent fire that affected the northeast portion of the study area.

The study area was mapped for potential rare plant habitat. A potential, rare plant habitat potential map was generated based on the abundance of rare plants potentially found within each ecosystem type. Each ecosystem rank was derived from a frequency histogram that correlated each ecosystem type with the number of rare plants potentially found within them. The following five ranks were assigned: very low (1 to 4 plants), low (5 to 9 plants), moderate (10 plants to 14 plants), high (15 plants to 19 plants) and very high (>20 plants). There is 15% of the study area ranked as either high or very high for rare plant habitat potential. The most common rank was moderate, covering 58% of the study area.

Confidence in the mapping and subsequent data analysis is moderate to high for most units, with the exception of the AM unit, which is low. Confidence in mapping structural stage, stand composition and broad ecosystem units is moderate. Confidence in mapping the rare plant habitat potential is moderate.

The project will have a direct effect on ~117 ha, the majority of which will be affected by the YGP infrastructure (88.2 ha) and ~28.9 ha associated with project roadways. Exploration, construction and site activities will require the clearing of vegetation, grading, cut and fill, extraction of borrow material and development of an all weather road. This will result in the potential impact to soil resources, and a direct loss of vegetation. As well, air emissions from the processing facility could affect vegetation health.

Based on proposed Project activities, the following impacts on vegetation have been identified: vegetation removal, alteration of soil properties, alternation of hydrology, change in water quality, air emissions**,** possible introduction of non-native or invasive **s**pecies, increased risk of spills, site maintenance activities, increased risk of fire due to human presence. At this stage in the project planning, it is difficult to identify impacts that may occur. It is not possible to determine the level of significance.

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1.0 INTRODUCTION

Ecological Land Classification (ELC), an ecological mapping process that involves the integration of site, soil and vegetation information, was undertaken as part of the integrated environmental baseline investigation conducted by EBA Engineering Consultants Ltd. (EBA) for Tyhee NWT Corp (Tyhee). Integrated and sustainable resource management requires an understanding of ecosystem dynamics and functioning, and ecosystem classification helps organize ecological data into units that respond to disturbance in a similar and predictable manner. Understanding past, present, and potential future development requires an understanding of environmental baseline conditions. This baseline provides a basis for long-term monitoring of the environment associated with future mining activities. The ELC is also a biophysical base for other resource components such as wildlife and biodiversity.

Despite its growth in many parts of Canada, ELC has been completed in only select areas of northern Canada and Alaska. Several ELC-related projects have been completed in the Northwest Territories (NWT). Larsen (1971) described the vegetation from Great Slave Lake north to Artillery Lake. He sampled high boreal forest, tundra and the forest-tundra transition zone, and classified a number of broad forest and tundra communities. Along the Mackenzie River, vegetation mapping was carried out at a scale of 1:125,000, including the mapping of several broad forest and tundra ecosystem units (Canada Forest Management Institute, 1974). Bradley *et al*. (1982) conducted an ecological land survey of the Lockhart River map area, an area that extends from Mackay Lake in the northwest to Selwyn Lake in the southeast. Based on field investigations, they described a range of ecological features, and classified and mapped Ecoregions and Subregions, Ecodistricts and basic structural vegetation types.

In recent years, new ELC work has been completed as part of the environmental assessments for development applications, particularly northeast of Yellowknife where diamond exploration and mining is underway. Table 1 provides a summary of ELC work that has occurred since 1995.

Table 1
Recent Ecological Land Classification Projects North of Yellowknife

Project	Description	Reference
Ekati Diamond Mine™ NWT Diamonds Project	• New description and classification of 12 detailed ecosystem units.	• BHP (1995)
Diavik Diamond Mine	• Broad mapping of landcover units using Landsat™. • Same methodology and units as Epp and Matthews (1999). • YGP study area vegetation mapping was also completed using 11 vegetation units separate from the landcover units described above.	• Golder Associates (1997a) • Golder Associates (1997b) • Diavik Associates (1997)
Ekati Diamond Mine™ Sable, Pigeon and Beartooth Mines	• 1:20,000 scale ecosystem mapping completed for the Ekati Diamond Mine™ area.	• BHP (2000)
Kennady Lake Diamond Project	• 1:20,000 scale Ecosystem mapping of 225 km^2 using the tundra units developed for Ekati Diamond Mine™. • One additional spruce unit added for a total of 13 ecosystem units. • Continued ecosystem mapping for Gahcho Kué.	• EBA and JWEL (2000) • AMEC and EBA (2004)
West Kitikmeot Slave Study Region Final Report (WKSS)	• Broad mapping of landcover units using Landsat™.	• Matthews and Epp (2001)
Snap Lake	• Mapping of vegetation classes using Landsat™. • Same methodology and units as Epp and Matthews (1999) plus four new vegetation units.	• De Beers (2001)
Tibbit to Contwoyto Winter Road	• 1:3,500 scale ecosystem mapping of the portages for the winter road corridor. • Used 18 ecosystem units adapted from the above studies.	• EBA (2002a, 2002b)

2.0 YELLOWKNIFE GOLD PROJECT STUDY AREA

The Yellowknife Gold Project study area (YGP) is ~ 14,475 ha and is located within the Tazin Lake Upland Ecoregion, Western Taiga Shield Ecozone. The Tazin Lake Upland is characterized by cool summers and very cold winters and has a subhumid, high boreal ecoclimate. Uplands are dominated by bedrock exposures, while lowlands are covered by organic deposits. Dystric Brunisols are the dominant upland soils formed on discontinuous veneers of sandy till. There are significant inclusions of Turbic Cryosols on permanently frozen sites and Organic Cryosols in poorly drained, peat-filled depressions (Environment Canada, 2000).

Vegetation of the Tazin Lake Upland is characterized by medium to tall, closed stands of trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*) and paper birch (*Betula papyrifera*). Jack pine (*Pinus banksiana*) dominates early successional stands, while white spruce (*Picea glauca*) and black spruce (*Picea mariana*) dominate the later successional stands. Poorly drained fens and bogs in this region are covered with low, open stands of tamarack (*Larix laricina*) and black spruce (Environment Canada, 2000).

3.0 ECOLOGICAL LAND CLASSIFICATION OBJECTIVES

The objectives of the Ecological Land Classification (ELC) are to complete the following tasks:

- define ecosystem types on the basis of field studies;
- map and characterize the landscape in the YGP study area using ecosystem units and satellite imagery;
- characterize the aerial extent of the proposed development footprint on the landscape; and
- identify key management issues related to ecosystem types and the proposed development.

4.0 METHODS

The ELC project methods are divided into four phases: preliminary ecosystem classification and sampling plan, field sampling, satellite imagery preparation, and ELC mapping. The methods and approach associated with each phase are discussed below.

4.1 Preliminary Classification and Sampling Plan

A literature review was completed of relevant ecosystem mapping in NWT at the initiation of the project. A list of potential ecosystem types was compiled prior to the field sampling based on the ecosystem units defined for the Tibbitt to Contwoyto winter road (EBA, 2002a). The ecosystem sampling plan was adapted from British Columbia's Terrestrial Ecosystem Mapping (TEM) system (Resources Inventory Committee [RIC] 1998a, 1998b) and other established ELC approaches (see Sims *et al.*, 1996). The TEM standard has also been recently adopted for several other ELC mapping exercises conducted as a part of environmental assessments in northern Canada.

A TEM Level 4 survey intensity was planned for the ELC sampling of the study area. This sampling intensity includes 15% to 25% polygon visitation with a plot ratio of 5% detailed full plots, 20% ground inspection form (GIF) plots and 75% visual plots. This ratio was considered appropriate for the ELC mapping scale and the diversity of ELC units thought to be present within the study area. Given the size of the study area, and a mapping scale of 1:20,000 (average polygon size of 20 ha), it was estimated that a maximum of 188 plots (25% sampling intensity) would be needed of the following types:

- 10 full plots;
- 38 GIF plots; and
- 140 visual plots.

The minimum number of plots required would be 113 at a 15% sampling intensity. Prior to field sampling, potential sampling locations were identified using NTS maps and local knowledge of the study area.

4.2 Field Sampling

Field data collection occurred from July 19 to 24, 2004, and followed the standards established in British Columbia for Describing Terrestrial Ecosystems in the Field (DTEIF) (Province of British Columbia, 1998) and for TEM (RIC, 1998a). All plot position coordinates were determined using global positioning system (GPS) with an expected accuracy of 6 m to 8 m. The ELC field crew consisted of a two-person team, which undertook a range of field measurements that are described below.

A total of 37 full plots and 54 visuals were completed for a total of 91 sample plots. A sampling ratio of 41:0:59 was achieved for full, GIF and visual plots in the field. The 91 plots sampled within 1,294 polygons (not including water), resulted in a 7% sampling intensity for the project. This meets the requirements for a TEM Level 5 survey. The final number of plots sampled was reduced from the pre-field planning target numbers (as mentioned in Section 4.1). This adjustment was due to difficulties in accessing potential sample locations. To make up for the difficulties in access, more full plots were

completed to ensure sufficient information was collected to adequately describe the ecosystem types.

In each of the full plots, the following site information was collected: plot number, date, UTM coordinates, elevation, exposure, aspect, slope, macro- and meso-site position, soil moisture, drainage and nutrient regime, ecosystem unit name, successional status, structural stage, and surface substrate (bedrock, rocks, mineral soil, wood, organic matter and water). Notes describing the plot-in-context and variability within the polygon were recorded. Photographs were taken at each plot.

All vascular plant species, and most bryophytes and lichens were identified in the full plots. Vegetation cover, density and distribution estimates were recorded. Vascular plant identification followed Porsild and Cody (1968, 1980). Bryophyte and lichen identification followed Vitt *et al*. (1988).

Visual plots involved recording brief point or area characteristics made from the air or ground, and were used to note the basic ecosystem unit, vegetation or other key features. The primary function of visual plots is to aid in the delineation of polygon labels and to confirm the placement of polygon boundaries during the photo interpretation and mapping phases of the work. No GIF plots were completed.

During the ELC field sampling, special features and other observations were recorded when encountered. These included observations of burn severity, wildlife, and signs of wildlife use. Evidence of recent burns was observed in the eastern section of the study area. Attempts were made to establish plots in unburned woodlands, recent burns and several post-fire seral stages to characterize vegetation succession.

Following field sampling, GPS data associated with the plot locations were prepared for use in the project's GIS software (ESRI 3.2 and Arc/Info® 8.1). The ELC plot data was digitally transcribed from field plot forms, into MS Access database, using VPRO, an ecological data entry and management tool (Province of British Columbia, 1999). The ELC plot data is provided in Appendix A.

4.3 Satellite Image Preparation

The imagery used for mapping was created from two ortho-rectified IKONOS scenes acquired between July 27, 2004, and August 2, 2004. There was significant cloud cover in several areas in the northeastern portion of the study area. The clouds were visually identified, removed and imagery was replaced with Landsat 7^{TM} imagery from August 11, 2001. IKONOS imagery has a resolution of 4 m in the multi-spectral bands and 1 m in the panchromatic band. The imagery was enhanced to increase visual interpretation using a linear transformation and several mosaics were produced highlighting different band combinations. Images produced include: 4 m true colour

image; 1 m pan-sharpened true colour image; 4 m false colour image (uses the near IR band to highlight vegetation); and 1m pan-sharpened false colour image.

4.4 ELC Mapping

Ecosystems were interpreted, mapped and labelled on-screen using ArcView® 3.2. Interpretation and labelling followed approaches defined by the RIC (1998a). To maintain a high level of consistency, the staff that completed the field sampling also attributed the polygons. Ecosystems were mapped at a nominal scale of 1:20,000. A quality assurance/quality control (QA/QC) review of the mapping was conducted concurrently with the line work. At the beginning of each day, 10% of the polygons that were previously mapped were revisited to ensure consistency from day to day. At the end of the mapping process, 10% of the polygons were audited for accuracy. Final ELC documents include ecosystem summaries, analysis of the ecosystem units within the study area and a map of the study area.

5.0 RESULTS OF FIELD SAMPLING AND MAPPING

Data collected in the field was used for ecosystem classification and mapping. Classification and mapping results for soils and vegetation are presented below.

5.1 Soils

A soil survey of the YGP study area was not completed as part of the baseline survey. The information contained in this report is based on a literature review of soils found in the region.

The YGP study area is described in the *Soils of Canada* as a strongly rolling plain comprised of igneous and metamorphic rockland with stony, sandy glacial till and fluvial deposits. The soil climate is subarctic (humid), with discontinuous permafrost. The dominant soils are Orthic Dystric Brunisols in rockland areas. Orthic Grey Luvisols and Orthic Eutric Brunisols occur to a lesser extent. Most soils are well-drained and are often stony and/or lithic (shallow) (Agriculture Canada, 1977).

In the immediate area of the Discovery Mine, soils are limited in extent as bedrock is generally at or very near the surface. Mineral soils were observed in the valley bottoms to the north of the mine site and southeast of the tailings area. Most of these soils have an organic surface of varying thickness. Shallow mineral soils also occur in depressions in the bedrock. The mineral soils have developed primarily on fine-textured (silt and clay) glacial fluvial or lacustrine materials. Organic soils are present in poorly drained bog and fen areas. Permafrost is common in organic soils (Klohn Leonoff, 1992).

Laboratory tests were conducted on several soil, sand and gravel samples to determine their ability to support plant growth (Klohn Leonoff, 1992). Analyses were completed on

fine and coarse textured material and a summary of the results is presented below in Table 2. Complete analysis is provided in the 1992 report completed by Klohn Leonoff.

Table 2
Soil Chemical and Physical Analysis

	Fine Soil[1]	Coarse Soil[2]
Chemical Properties		
pH	6.28	5.55
Electrical Conductivity (dS/cm)	1.50	1.60
Cation Exchange Capacity (meq/100 g)	16.5	6.2
Ca^{++}	7.8	2.4
Mg^{++}	3.5	0.5
Na^{+}	0.1	0.2
K^{+}	0.36	1.13
Nutrient Analysis		
Organic carbon (%)	1.71	0.80
Total N %	0.10	0.05
NH_4-N	26	94
NO_3-N	5.9	8.6
PO_4-P (ppm)	57	4.9
SO_4-S (ppm)	15	12
Physical Properties		
Water holding capacity (% gravimetric)	17.7	4.4
Sand (%)	7	99
Silt (%)	52	0.5
Clay (%)	41	0.5

[1] Fine soil is defined as having a median grain size < 75 µ.
[2] Coarse soil is defined as having a median grain size > 75 µ.

5.2 Vegetation

Detailed vegetation data was collected in the field and used to determine ecosystem classification. Below is a description of how the ecosystem units were classified, what units were found and how they are distributed in the YGP study area.

5.2.1 Defining ELC Units

An ELC Unit (or Ecosystem Unit) is composed of five hierarchical components: zone, ecosystem type, site modifier, structural stage and stand composition. The zone is defined as Boreal. The ecosystem types developed for the boreal portion of the Tibbitt to

Contwoyto Winter Road project were used for this project. Table 3 lists each of the ecosystem types identified in the YGP study area.

Table 3
Ecosystem Types in the YGP Study Area

Type	Description
Wetland Riparian	
BR	Wetland, non treed scrub birch cloudberry low shrub bog
CA	Wetland, graminoid water sedge – narrow leaved cottongrass fen
CE	Wetland, graminoid round fruited sedge – Chamisso's
EA	Wetland, graminoid sheathed cottongrass – bog rosemary sedge
EM	Wetland, graminoid water sedge – horsetail shallow shore marsh
FA	Wetland, floating aquatic shallow open water
SH	Wetland, non-treed willow – sedge low shrub fen
TB	Wetland, treed spruce – cloudberry treed bog
TF	Wetland, treed tamarack – blueberry treed fen
WR	Riparian wetland, forest spruce – willow forest
Forest and Woodland	
AM	Upland, spruce – moss forest
JL	Upland, Jack pine – lichen woodland
SL	Upland, spruce – lichen woodland
Sparsely Vegetated	
BF	Upland, boulder field
RO	Upland rock outcrop
Water	
OW	Open water, less than 2 m deep
PD	Open water greater than 2 m deep and less than 50 ha in size
LA	Open water greater than 2 m deep and greater than 50 ha in size
Anthropogenic	
GP	Gravel pit
RP	Road surface
RR	Rural development
TD	Tailing deposit
Other	
CD	Cloud

Site modifiers for atypical conditions as developed by BHP (1995) were adopted for this project, as well a site modifier for high lichen cover and a site modifier to identify areas that had some coverage of mine tailings. The site modifiers used for this project are provided in Table 4.

Table 4
Site Modifiers for the YGP StudyArea

Code	Description
e	Unit occurs on an esker.
l	High lichen cover (visible from air).
r	30% or more of surface cover is bedrock.
t	30% or more of the surface cover is mine tailings.

Structural stages describe the existing dominant stand appearance or physiognomy for an ecosystem unit. This parameter emphasises structural habitat characteristics and it can be used to help describe the seral variation within an ecosystem type. As was done for BHP (1995), structural stage classes as defined by the DTEIF system (RIC, 1998a) were adopted for this project (Table 5). The adoption of the tree heights with the associated structural stages can be problematic in northern Canada. Trees can fall within structural stages 4 to 7 as far as age, and be less than 10 m tall. For this project, we did not use tree height as a measure for structural stage.

Table 5
Structural Stages Used for the YGP Study Area

Code	Structural Stage	Definition
1	**Sparse/Bryoid**	Initial stages of primary and secondary succession; bryophytes and lichens often dominant; time since disturbance may be prolonged where there is little or no soil development (bedrock, boulderfields, etc.).
1a	Sparse	Less than 10% vegetation cover.
1b	Bryoid	Bryophyte and lichen-dominated community (>50% of total vegetative cover).
2	**Herb**	Early successional stage or herb communities maintained by environmental conditions or disturbance; dominated by herbs; some invading or residual shrubs and trees may be present; many non-wooded communities are perpetually maintained in this stage.
2a	Forb-dominated	Includes non-graminoid herbs and ferns.
2b	Graminoid-dominated	Includes grasses, sedges, reeds, and rushes.
2c	Aquatic	Floating or submerged; does not include sedges growing in marshes with standing water (classed as 2b).
2d	Dwarf shrub-dominated	Dominated by dwarf woody species such as crowberry, mountain cranberry, twinflower, cloudberry, etc.
3	**Shrub/Woodland**	Early successional stage or shrub communities maintained by environmental conditions or disturbance; dominated by shrubby vegetation; seedlings and advance regeneration may be abundant.
3a	Low shrub	Dominated by shrubby vegetation < 2 m tall; seedlings and advance regeneration may be abundant; may be perpetuated indefinitely by environmental conditions or disturbance.
3b	Tall shrub/Woodland	Dominated by shrubs or trees that are 2-10 m tall; often the near-climax structural stage for woodlands in the study area.
4	**Pole/Sapling**	Typically densely stocked, have overtopped shrub and herb layers; self-thinning and vertical structure not yet evident in the canopy.
5	**Young Forest**	Self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers (dominant, main canopy, and overtopped).
6	**Mature Forest**	Trees established after the last disturbance have matured; understories become well developed as the canopy opens up; time since disturbance generally 80-140 years.
7	**Old Forest**	Old, structurally complex stands comprised mainly of shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition and patchy understories typical; time since disturbance generally > 140 years.

Stand composition modifiers are used to further differentiate structural stages 4 to 7 (i.e., pole-sapling, young forest, mature forest and old forest) based upon coniferous, broadleaf or mixed conifer-broadleaf stand composition (Table 6).

Table 6
Stand Composition for the YGP Study Area

Code	Stand Composition	Definition
B	Broadleaf	>75% of total tree cover is broadleaf
C	Coniferous	>75% of total tree cover is coniferous
M	Mixed	Neither coniferous or broadleaf account for >75% of total tree cover

Disturbance codes were also assigned to polygons when applicable (Table 7). Disturbance types were allocated into two classes: fire and soil. These two classes were further subdivided into a number of sub-classes (for example, fire was differentiated into severe or moderate sub-classes), to provide additional characterization of the disturbance type.

Table 7
Disturbance Codes for the YGP Study Area

Disturbance	Class	Code	Description
Fire	Severe	Fs	Severe fire with few standing snags remaining (forested areas).
	Moderate	Fm	Moderate fire with significant proportion of standing snags (forested areas).
Soil	Excavation	Se	Applies to an area exposed through the removal of sand and gravel.
	Mining	Sm	Applies to a non-vegetated area used for the extraction of mineral ore and other materials.
	Mining	Sd	Applies to areas that have tailing deposition.

5.2.2 Ecosystem Summaries

Each field site was classified into an ecosystem type. The types were analyzed for similarities and differences. Summary sheets were produced to provide easy, quick review of the characteristics of the ecosystems that were mapped for this project. The summaries are constructed from the data that was collected during the field sampling. The descriptions are not meant to be a final characterization of the units, and should be viewed as a representation of the vegetation sampled in the study area.

In total, 14 summary sheets were produced for the ecosystem types that were mapped in the study area. Twelve of these summaries are based on quantitative data collected in the field, and two are based on qualitative data collected in the field. Fact sheets were not made for the non-vegetated or anthropogenic ecosystem types. Brief summaries are provided below, with detailed fact sheets located in Appendix B.

Forest and Woodland

The forested and woodland ecosystems are upland units that are dominated by black and white spruce and jack pine in climax communities. Immediately after fire, these communities are dominated by fast growing deciduous seral species, such as paper birch (*Betula papyrifera*) and alder (*Alnus* spp.). The slower growing jack pine (*Pinus banksiana*) becomes the dominant species a few years after fire. In the YGP study area, there are numerous successional stages observed in the upland areas due to fire. These upland units cover approximately 55% of the study area.

AM: spruce – moss forest

This is the most productive forest ecosystem of the study area and is generally found on lower slopes or toe positions in the landscape. This ecosystem has a moderate nutrient regime with a mesic moisture regime. White spruce (*Picea glauca*) is the climatic climax

species, but seral communities are dominated by paper birch. This ecosystem is uncommon and accounts for less than 4% of the study area.

JL: jack pine – lichen woodland

This woodland is typical of dry sites and occurs on upper slopes and crest positions of hills or esker complexes. It has a poor to very poor nutrient regime with a subxeric to xeric moisture regime. Jack pine is the common tree species while bearberry (*Arctostaphylos uva ursi*) is the common shrub. Paper birch is present in young seral communities. Cushion mosses (*Dicranum* spp.) and haircap mosses (*Polytrichum* spp.) are common, as well as numerous *Cladonia* lichens. This ecosystem covers approximately 20% of the study area.

SL: spruce – lichen woodland

This woodland is the most commonly occurring ecosystem and covers approximately 33% of the study area. It is found on upland sites, in all slope positions. It has a very poor to moderate nutrient regime with a mesic to submesic moisture regime. Black spruce (*Picea mariana*) is common in mature stands, and jack pine and paper birch may dominate seral communities. Labrador tea (*Ledum groenlandicum*), alder and bog cranberry (*Vaccinium vitis idaea*) are common shrubs.

Riparian

One riparian ecosystem was identified in the study area. This ecosystem usually occurs adjacent to streams or in drainage systems between lakes, has a rich nutrient regime and a subhygric moisture regime. The riparian succession results in a broad range of structural stages from young seral to mature climatic climax.

WR: spruce – willow riparian forest

Paper birch and white spruce dominate in mature stands. Forests that are slightly drier have inclusions of balsam poplar. Shrubs include willow (*Salix* spp.), red raspberry (*Rubus idaeus*), and high-bush cranberry (*Viburnum edule*). This ecosystem represents less than 2% of the study area.

Wetland

Wetland ecosystems include sedge fens, shrubby fens, treed fens and bogs, marsh and floating aquatic. The fens and bogs are generally restricted to upland plateaus of poorly drained organic soils. Differences in water movement distinguish fens from bogs. Marshes and floating aquatic ecosystems are restricted to the edges of standing water. The wetland ecosystems represent less than 15% of the study area.

BR: scrub birch – cloudberry low shrub bog

This shrubby bog ecosystem is found in close association with TB ecosystems and is present as islands within larger TB polygons. It is rarely mapped on its own. It has a very poor to poor nutrient regime and a hygric to subhygric moisture regime. Common species include scrub birch (*Betula glandulosa*), willow, sedges (*Carex* spp.) and marsh reed grass (*Calamagrostis canadensis*). This ecosystem covers less than 1% of the study area.

CA: water sedge narrow-leaved cottongrass fen

This sedge fen co-occurs with other sedge fens and shrub bogs. It is also found within TB polygons and is rarely mapped on its own. It has a very poor to poor nutrient regime with a hydric moisture regime. Sedges and cotton grass (*Eriophorum* spp.) are the common species. This ecosystem represents less than 1% of the study area.

CE: round-fruited sedge chamisso's cottongrass fen

This is a slightly richer sedge fen than CA or EA. It is found in association with other sedge fens, shrubby fens and treed fens and is rarely mapped individually. It has poor to medium nutrient regime with a subhydric to hygric moisture regime. Sedges, cotton grass and peat mosses (*Sphagnum* spp.) are the common species. This ecosystem represents less than 1% of the study area.

EA: sheathed cottongrass bog rosemary sedge fen

This wetland ecosystem is found in association with other sedge fens, shrubby bog, treed bogs and fens, and is rarely mapped on it own. It has a very poor to poor nutrient regime and a subhydric to hygric moisture regime. Leatherleaf (*Chamaedaphne calyculata*), sedges and peat moss are common. This ecosystem accounts for less than 1% of the study area.

EM: water sedge horsetail shallow shore marsh

This shallow shore marsh occurs along the edges of lakes, ponds and open water. It is has a poor nutrient regime and a hydric moisture regime. Water sedge is the dominant sedge, but forbs and other sedge species are common. Leatherleaf and willow are also found in small numbers. This ecosystem represents less than 1% of the study area.

FA: floating aquatic shallow open water

This ecosystem occurs in shallow open water in lakes, ponds and open water. It has a medium to rich nutrient regime and a hydric moisture regime. Horsetails

(*Equisetum* spp.) and water lily (*Nuphar* spp.) are common. This ecosystem covers less than 1% of the study area.

SH: willow – sedge low shrub fen

This shrubby fen often co-occurs with sedge fens. Common distribution is near open water, treed fens or drainage areas where it is restricted to wet sites with some water movement. It has a medium to rich nutrient regime and a hydric moisture regime. Willows and sedges are common with a minor component of leatherleaf. This ecosystem accounts for approximately 2% of the study area.

TB: spruce – cloudberry treed bog

This wetland ecosystem commonly occurs on upland peat plateaus with poor drainage and is often surrounded by bedrock outcrops. It has a very poor nutrient regime with a subhydric to subhygric moisture regime. Vegetation is dominated by black spruce, Labrador tea, bog bilberry (*Vaccinium uliginosum*), and bog cranberry. Peat moss is common. This ecosystem was the most abundant of the wetland types, covering over 8% of the study area.

TF: tamarack blueberry treed fen

This ecosystem occurs in upland peat plateaus with some water movement and in drainage areas between lakes. It has a poor to rich nutrient regime and a subhydric to hygric moisture regime. Black spruce and tamarack *(Larix laricina*) form an open canopy; willow, scrub birch and bog bilberry are the common shrubs. This ecosystem was the second most common wetland type, covering approximately 4% of the study area.

Sparsely Vegetated

The sparsely vegetated ecosystems are restricted to naturally occurring units that are dominated by boulder or bedrock outcrops. Vegetation is restricted to microenvironments that have developed due to localized weathering of rock. Soil development is poor or non-existent. These ecosystems make up less than 1% of the study area.

BF: boulder field

This ecosystem occurs on exposed slopes of hills that have significant rock outcrops. Nutrient regime is very poor and moisture regime is very xeric. Vegetation includes common juniper (*Juniperus communis*), bearberry, and three-toothed saxifrage (*Saxifraga tricuspidata*). Crustose lichens are common.

RO: rock outcrop

This ecosystem is typical of bedrock outcrops that have undergone little weathering. Nutrient regime is very poor and moisture regime is very xeric. Microsites that support vegetation growth are uncommon. Vegetation cover is sparse. Crustose lichens are common.

Other Units

The anthropogenic ecosystems varied in their degree of vegetation coverage. Tailings (TD) and gravel pits (GP) are generally devoid of vegetation. Ecosystems defined as rural (RR) (i.e. some residential or commercial development) are restricted to camp areas and ranged in vegetative coverage. The developed area around the old town site is interspersed with mature trees, while the present campsite has very little vegetation coverage. Roads (RP) also ranged in vegetation coverage. Those that are actively used have sparse vegetation coverage. Abandoned roads and portages have variable vegetation coverage.

Water was divided into three ecosystem types: lake, pond and open water. A size limit of 50 ha was used to differentiate lakes and ponds. The open water category had a depth threshold of less than 2 m. A portion of the study area was covered by cloud and could not be mapped. This area was classified as cloud (CD).

5.2.3 Broad Ecosystem Units

To provide a simplified view of ecosystems suitable for basic vegetation summaries and for map presentation, broad ecosystem units were also assigned to each mapped polygon. Table 8 describes the broad ecosystem units used for this project. The ecosystem types were also compared to the broad ecosystem units used in the West Kitikmeot / Slave Study (Matthews and Epp 2001).

Table 8
Broad Ecosystem Units Used in the YGP Study Area

YPG Ecosystem Type	Description	Broad Ecosystem Unit for YGP	West Kitikmeot / Slave Class
All units with the fire disturbance code (Fs, Fm).	Applies to areas that have evidence of relatively recent fire disturbance.	Burns	Burns
AM, JL, SL: seral stands that contain mixed or deciduous stands.	Mixed or deciduous stands.	Mixed and Deciduous Woodland	Spruce Forest
AM: young forest or mature stands of conifers.	Mesic conifer-dominated stands.	Mesic Coniferous Woodland	Spruce Forest
BR	This broad unit is composed solely of scrub birch - cloudberry low shrub bog.	Birch Hummock	Tussock/ Hummock
CA, CE, EA	Fens dominated by sedges and grasses.	Sedge Fen	Sedge Wetland
EM, FA	Includes herb-dominated wetlands that do not occur in other categories.	Other Wetlands	Unclassified
GP, RP, RR, TD	Areas with very low vascular plant cover as a result of anthropogenic disturbance.	Anthropogenic	Unclassified
JL: young forest or mature stand	Dry jack pine dominated stands.	Dry Coniferous Woodland	Unclassified
LA, PD	Includes Lakes and Ponds.	Water	Deep Water
OW	Shallow open water and rivers.	Water	Shallow water
RO, BF	Includes rock outcrops and boulderfields. They support minimal vegetation.	Bedrock and Boulder Fields	Bedrock and Boulder Associations
SH	Shrubby sites with saturated organic soils and some water movement.	Shrubby Fen	Riparian Tall Shrub
SL: young forest or mature stands	Dry black spruce dominated stands.	Dry Coniferous Woodland	Spruce Forest
TB and TF	Fens and bogs with an open canopy of trees.	Treed Fens and Bogs	Peat Bog
WR: seral, young or mature stands	Shrubby or treed areas along streams, rivers, and lake margins.	Riparian Woodland and Shrubland	Unclassified

5.2.4 Ecosystem Descriptions in the YGP Study Area

The following section provides descriptive information on ecosystem types, broad units, complex polygons, stand composition, and structural stage, within the YGP study area.

Ecosystem Types

A total of 1,506 polygons were mapped in the 14,475 ha study area. The average polygon size was approximately 10 ha, with a range from 0.02 ha (an island) to 1,293 ha (a lake). While the average polygon size was 10 ha, the mode polygon size was 3.2 ha which indicates that over half of the polygons mapped were less than 3.2 ha in size. Twenty-two ecosystem types were assigned to the 1,506 polygons, 14 were naturally vegetated, three were classified as water, 4 were classified as anthropogenic and 1 was classified as cloud (Table 9). Visual distribution of the ecosystem types is provided in Figure 1.

Spruce-lichen woodland (SL) made up 33% of the study area, with jack pine-lichen (JL) comprising 19.5% of the study area (Table 9). Water covered 20.5% of the study area, and 6.3% of the study area in the northeast corner could not be mapped due to cloud cover. Treed bogs (TB) were the next most common ecosystem type, representing 8.5% of the study area. Eight of the natural ecosystem types had less than 1% cover. Ecosystems that have less than 1% cover are considered ecosystems of restricted distribution.

Some of the ecosystem types, mostly the sedge fens, are likely to be more common than the mapping indicates. This is because these ecosystems are small and are difficult to delineate individually. They were commonly mapped as the secondary or tertiary ecosystem type in the complexed TB or treed fen (TF) polygons. Complex polygons are discussed.

Table 9
Ecosystem Types Within the YGP Study Area

Ecosystem Type	Total Area (ha)	No. of Polygons	Average Polygon Size (ha)	Range (min – max) (ha)	Area as % Total Area
Wetland Riparian					
BR	24	7	3.5	0.8 to 8.1	0.2
CA	0.4	1	0.4	N/A	0.0
CE	3	4	0.7	0.2 to 1.5	0.0
EA	2	2	1.0	0.3 to 1.7	0.0
EM	73	57	1.3	0.1 to 7.8	0.5
FA	41	35	1.2	0.2 to 5	0.3
SH	211	89	2.4	0.2 to 9.2	1.5
TB	1,236	293	4.2	0.3 to 36.7	8.5
TF	529	50	10.6	0.4 to 88.6	3.7
WR	277	83	3.3	0.2 to 15.1	1.9
Forest and Woodland					
AM	528	64	8.2	1 to 53.8	3.6
JL	2,819	157	18.0	0.4 to 120.8	19.5
SL	4,753	415	11.5	0.0 to 101.6	32.8
Sparsely Vegetated					
BF	28	5	5.5	0.4 to 13.7	0.2
RO	8	7	1.1	0.1 to 2.1	0.1
Water					
OW	9	18	0.5	0.1 to 2.3	0.1
PD	295	127	2.3	0.1 to 22.7	2.0
LA	2,658	45	59.1	1.4 to 1,293.6	18.4
Anthropogenic					
GP	6	2	2.9	0.9 to 5.0	0.0
RP	18	18	1.0	0.4 to 2.3	0.1
RR	9	3	3.0	1.1 to 4.9	0.1
TD	37	2	18.4	3.6 to 33.1	0.3
Cloud	910	22	41.3	0.6 to 499.3	6.3
TOTAL	**14,475**	**1,506**			**100**

Broad Ecosystem Units

Fifteen broad ecosystem units were assigned: 12 natural and one anthropogenic land-based units, 1 water-based unit and 1 cloud unit (Table 10). To visualize the abundance and distribution of the broad ecosystem types, the study area mapped according to each

type (Figure 2). Dry coniferous woodland was the most abundant unit, with the burns unit second in abundance. The next most abundant broad ecosystem unit included treed fens and bogs, followed by mixed and coniferous woodlands. The amount of mixed and deciduous woodland might be underestimated. It was difficult to interpret stand composition from the satellite imagery; this is issue is discussed in more detail in Section 5.3.2.

Table 10
Broad Units Within the YGP Study Area

Broad Unit	Total Area (ha)	No. of Polygons	Average Polygon Size (ha)	Area as % Total Area
Birch Hummock	16	6	2.7	0.1
Sedge Fen	5	6	0.7	0.0
Shrubby Fen	140	64	2.2	1.0
Treed Fens and Bogs	1,253	208	6.0	8.7
Riparian Woodland and Shrubland	231	70	3.3	1.6
Other Wetlands	72	56	1.3	0.5
Aquatic Vegetation	41	35	1.2	0.3
Burns	3,292	346	9.5	22.7
Dry Coniferous Woodland	4,070	332	12.4	28.1
Mesic Coniferous Woodland	145	10	14.5	1.0
Mixed and Deciduous Woodland	1,247	126	9.1	8.6
Bedrock and Boulder Field	19	10	1.9	0.1
Anthropogenic	70	25	2.8	0.5
Water	2,962	190	23.3	20.5
Cloud	910	22	41.4	6.3
TOTAL	**14,475**	**1,506**		**100**

Complex Polygons

A number of polygons were mapped as complex polygons (i.e., they contained more than one ecosystem type). The most common ecosystem that was complexed with one other unit was SL. This is in part due to the high coverage that this ecosystem type has within the YGP study area. Treed bogs and the JL ecosystems also had a high number of polygons complexed with at least one other ecosystem type. Treed bogs were the most complexed with two other ecosystem types. This is due to the presence of small sedge and shrubby fens within the larger TB polygons. The distribution of complex polygons is provided in Table 11.

Table 11
Distribution of Complex Polygons Within the YGP Study Area

Ecosite	Total Area (ha)	Simple (1 Ecosite per Polygon)		Complex (2 Ecosites per Polygon)		Very Complex (3 Ecosites per Polygon	
		Area (ha)	No. of Polygons	Area (ha)	No. of Polygons	Area (ha)	No. of Polygons
Wetland Riparian							
BR	24	3.5	3	-	-	21.0	4
CA	0.4	-	-	0.4	1	-	-
CE	3	2.9	4	-	-	-	-
EA	2	0.3	1	1.7	1	-	-
EM	73	30.8	40	25.9	12	16.6	5
FA	41	40.8	35	-	-	-	-
SH	211	68.8	41	85.7	37	56.4	11
TB	1,236	429.7	158	456.9	97	349.6	38
TF	529	106.1	20	122.8	15	300.5	15
WR	277	214.4	71	49.2	10	13.7	2
Forest and Woodland							
AM	528	229.8	40	161.9	19	135.8	5
JL	2,819	222.2	52	2,112.1	92	467.6	12
SL	4,753	1,803.8	262	2,109.1	123	857.2	31
Sparsely Vegetated							
BF	28	21.9	4	5.8	1	-	-
RO	8	6.0	6	1.7	1	-	-
Water							
OW	9	7.1	17	2.0	1	-	-
PD	295	294.5	127	-	-	-	-
LA	2,658	2,658.2	45	-	-	-	-
Anthropogenic							
GP	6	5.9	2	-	-	-	-
RP	18	18.4	18	-	-	-	-
RR	9	8.9	3	-	-	-	-
TD	37	36.8	2	-	-	-	-
Cloud	910	22	910.3	-	-	-	-
TOTAL	**14,475**	**7,121.0**	**973**	**5,135.2**	**410**	**2,218.4**	**123**

Stand Composition

Stand Composition is provided in Table 12. Of the total study area (~14,475 ha), conifer-dominated stands were the most common category covering approximately 5,500 ha, and **[**mixed wood stands covering approximately 4,300 ha. Mixed wood stands were predominately pine and birch, a result of historical fire disturbances. There were few white spruce – balsam poplar or aspen stands. Difficulties in mapping stand composition from the satellite imagery were encountered and are discussed in detail in Section 5.3.2.

Table 12
Stand Composition Within the YGP Study Area

Stand Composition	Total Area (ha)	Number of Polygons	Area as % Total Area
Broadleaf	612	171	4.2
Coniferous	5,475	517	37.8
Mixed	4,319	476	29.8
Not applicable[1]	4,069	342	28.1
TOTAL	**14,475**	**1,506**	**100**

[1] Includes non vegetated, sparsely vegetated, sedge fens and water.

Structural Stages

The most abundant structural stages were young forest and low-tall shrub woodland. Young forests were characteristic of the upland areas that had been disturbed by fire in the past, but not recently. The northeast portion of the study area had a recent burn, and much of this area was mapped as low-tall shrub/woodland. The dominant vegetation was birch and alder as tall shrubs, with jack pine an understory tree species. Distribution of the structural stages is provided in Table 13.

Table 13
Structural Stages Within the YGP Study Area

Structural Stage	Total Area (ha)	Number of Polygons	Area as % Total Area
1 – Sparse Bryoid	73	27	0.5
2 – Herb	123	103	0.8
3 – Low / Tall Shrub / Woodland	4,016	517	27.8
4 – Pole / Sapling	753	75	5.2
5 – Young Forest	5,456	548	37.7
6 – Mature Forest	180	24	1.2
7 – Old Forest	0	0	0
Not applicable[1]	3,872	212	26.7
TOTAL[2]	**14,475**	**1,294**	**100**

[1]Water and cloud polygons.
[2]Individual units may not add to 14,475, due to rounding to whole numbers.

5.2.5 Rare Plants and Rare Plant Habitat

The intent of an ELC field program is to map vegetation units based on common characteristics so a rare plant survey was not conducted as part of the field program. Rare plants are often found in unique habitats that are not sampled within an ELC program.

To determine the potential impacts of the project on rare plants, a rare plant habitat potential map was generated based on the abundance of rare plants potentially found within each ecosystem type. Using existing information (McJannet *et al*. 1995 and Department of Resources, Wildlife, and Economic Development [RWED] data) on rare plants found in both the Taiga Plains and Taiga Shield Ecozones, a rare plant list was generated which includes 89 species (Table 14).

Table 14
Rare Plants That Could be Found in the YGP Study Area

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Acorus calamus (Acorus americanus)	Sweetflag	wetlands; borders of quiet water	EM, SH, WR
Adoxa moschatellina	Moschatel	rich leaf-mould in moist partly shaded alder and poplar woods; calcareous soils	AM
Agoseris aurantiaca	Orange False Dandelion	meadows, hot springs, disturbed areas	AM, RP
Agrostis exarata	Spike Redtop	moist, sedge meadows; open ground	CA, CE, EA
Anaphalis margaritacea	Pearly Everlasting	subalpine wooded areas and meadows, roadsides, open forests to subalpine	AM, SL
Apocynum cannabinum	Indian Hemp	exposed river banks	WR
Arabis holboellii	Reflexed Rock Cress	dry, open, sunny, calcareous slopes, open soil	JL, SL, BF, RO
Arabis lyrata	Lyre-leaved Rock Cress	sandy, open areas, moist stoney places, scree slopes	JL, SL
Asplenium viride (trichomanes-ramosum)	Green Spleenwort	moist rocky slope and crevices, crevices in calcareous rocks	SL, JL, BF. RO
Aster nahanniensis	Aster	hot springs and moist areas	AM, SL, JL, WR
Astragalus canadensis	Canadian Milk Vetch	river banks and moist, open woods	WR, AM
Botrychium minganense	Moonwort	grassy meadows, grassy slopes	AM, WR
Botrychium multifidum	Leather Grape Fern	circumpolar prairie clearings, sandy meadows and woods	AM, SL
Botrychium simplex	Dwarf Grape Fern	moist meadows and shores	AM, WR
Callitriche anceps	Water Starwort	shallow ponds, shallow water	EM, FA
Caltha palustris	Marsh marigold	shallow water or in wet marshy places, moist places	EM, CE, EA, SH
Carex arcta	Narrow Sedge	wet woodland bogs, marshes and sandy beaches, wet places	EM, CA, CE, EA, TB, TF, SH
Carex crawfordii	Crawford's Sedge	damp meadows	CA, CE, EA, WR, SH
Carex eleusinoides	Carex spp	wet gravelly river banks and meadows, wet places, gravel bars	WR, SH
Carex heleonastes	Hudson Bay Sedge	bogs, peat bogs and swamps	CA, CE, EA, TB, TF, SH
Carex prairea	Prairie Sedge	bogs	CA, CE, EA, TB, TF
Carex retrorsa	Turned Sedge	woodland marshes	EM
Carex sychnocephala	Long-beaked Sedge	wet places and open woodland meadows	CA, CE, EA, WR
Carex trisperma	Three-seeded Sedge	bogs	CA, CE, EA, TB

Table 14 continued
Rare Plants That Could be Found in the YGP Study Area

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Castilleja yukonis	Indian Paintbrush	spruce woods, treed bogs, and grassy slopes, dry hillsides	TB, TF, SL
Cornus suecica	Dogwood	wet mossy areas, woods, marshes, bogs	CA, CE, EA, TB, TF, SH
Crassula aquatica (Tillaea aquatica)	Pigmyweed	shallow ponds, inundated shores	EM, WR
Cryptogramma sitchensis (crispa)	Parsley Fern	calcareous talus slopes and moraine	BF, RO
Cryptogramma stelleri	Fragile Rock-brake	moist shale slopes, crevices in calcareous rocks in shaded localities with dripping water	BF
Danthonia spicata	Poverty Oat Grass	rocky places, dry places	JL, BF, RO
Descurainia pinnata	Green Tansy Mustard	sandy beaches and disturbed areas	RR, RP
Draba incerta	Whitlow-grass	alpine tundra and rocky slopes	BF, JL
Dryopteris carthusiana (D. spinulosa)	Narrow Spinulose Shield Fern	rich woods	AM
Dryopteris expansa (D. dilatata)	Spinulose Shield Fern	moist woods and slopes	AM
Elatine triandra	Waterwort	muddy shores and shallow pond margins	EM, FA
Elymus canadensis	Canada Wild Rye	sandy and gravelly places	AM, SL, JL
Epilobium leptophyllum	Narrow-leaved Willowherb	marshes, sloughs, bogs, and sedge meadows, lowlands	EM, CE, EA
Erigeron acris	Northern Daisy Fleabane	alpine gravelly slopes or sandy river banks, spruce forests, sandy soil	SL, JL
Erigeron yukonensis	Fleabane	calcareous, stony slopes	JL, SL, BF, RO
Euthamia graminifolia (Solidago graminifolia)	Flat-topped Goldenrod	sandy, silty, and gravelly river banks and flats	WR
Heuchera richardsonii	Richardson's Alumroot	woodland meadows	AM
Hudsonia tomentosa	Sand Heather	sand blow-outs, sandy beaches and open jack pine woods	JL
Impatiens capensis (I. bifora)	Spotted Touch-me-not	low wet woodlands and moist banks, wet ground	WR, EM, TF, SH
Isoetes lacustris (I. macrospora)	Quillwort	shallow, sandy lake margins	EM, FA
Juncus dudleyi (J. tenuis)	Bog Rush	wet, calcareous, lowland meadows and river banks, roadsides, open ground	WR, TF, CA, CE, EA, SH, RP
Juncus stygius	Marsh Rush	wet margins of woodland bog pools, wet bogs	EM, TB, CA, EA,
Juncus vaseyi	Big-head Rush	lowland slough-margins, moist shores	EM

Table 14 continued
Rare Plants That Could be Found in the YGP Study Area

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Limosella aquatica	Mudwort	wet, muddy or sandy pond margins, wet mud	EM
Lobelia dortmanna	Water Lobelia	shallow, sandy shores of lakes and ponds	EM, FA
Luetkea pectinata	Partridgefoot	alpine tundra and snowbeds	Unknown
Luzula rufescens	Reddish Wood Rush	bogs, marshes and river banks	WR, EM, CA, CE, EA, TF, TB, SH
Lycopus uniflorus	Bugleweed	sandy margins of lakes and streams	WR, EM
Malaxis paludosa (Hammarbya paludosa)	Bog Adder's Mouth	treed bog, wet sphagnum bogs, quagmires	TB, CA, CE, EA
Mertensia paniculata var. alaskana	Bluebell	open woods and river banks	AM, WR
Mimulus guttatus	Yellow Monkey Flower	wet meadows and streams, margins of ponds and streams, wet rocky slopes	WR, EM
Myriophyllum alterniflorum	Water Milfoil	shallow lakes and ponds	EM, FA, OW
Najas flexilis	Slender Naiad	shallow lakes and ponds	EM, FA, OW
Nuphar lutea (Nuphar polysepala)	Yellow Pond Lily	lakes, ponds and slow moving streams	EM, FA, OW, WR
Nymphaea tetragona	White Water Lily	shallow lakes and slow moving streams	EM, FA, OW, WR
Osmorhiza depauperata	Spreading Sweet Cicely	rich woods	AM
Pedicularis macrodonta (P. parviflora)	Lousewort	bogs and marshes	EM, CA, CE, EA, SH, TB, TF
Pellae glabella	Smooth Cliff Brake	limestone cliffs	RO
Platanthera (Habenaria) orbiculata	Large Round-leaved Orchid	spruce and tamarack woodland, dry to moist woods	AM, SL
Poa secunda	Sandberg Blue Grass	fens	CE, EA, TF
Potamogeton foliosus	Leafy Pondweed	shallow still waters	FA, OW
Potamogeton illinoensis	Pondweed	still water	FA, OW
Potamogeton obtusifolius	Blunt-leaved Pondweed	shallow lakes and ponds	FA, OW
Potamogeton robbinsii	Robbin's Pondweed	muddy water	FA, OW
Potamogeton subsibiricus (P. porsildiorum)	Pondweed	shallow lakes and ponds	FA, OW
Prunus virginiana	Choke Cherry	thickets	AM, WR

Table 14 continued
Rare Plants That Could be Found in the YGP Study Area

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Ranunculus hispidus (R. septentrionalis)	Buttercup / Crowfoot spp.	willow thickets and slough margins	AM, WR, TF
Ranunculus pensylvanicus	Buttercup / Crowfoot spp.	disturbed and marshy places	CA, CE, EA, SH, TF, RP
Rhynchospora alba	White Beak-rush	fens and bogs, peaty or sandy soil	CA, CE, EA, SH, TF, TB, RP
Rorippa barbareifolia	Yellow Cress	disturbed sites	RR, RP, GP, TD
Rorippa crystallina	Marsh Yellow Cress	carex meadows and marshes	EM, CA, CE, EA
Rosa blanda	Rose	gravelly river terraces	WR, SH
Ruppia cirrhosa (R. spiralis)	Widgeon-grass spp.	shallow lakes, salt and brackish water	EM, FA, OW
Salix raupii	Raup's Willow	gravel floodplains and treed bogs	WR, TF, TB
Sanguisorba officinalis	Burnet	wet tundra, moist places	CA, CE, EA, BR, SH
Sarracenia purpurea	Pitcher Plant	bogs	CA, CE, EA, BR, TB
Scirpus rollandii (Trichophorum pumilum)	Bulrush	marshy lake shores and hot springs, wet places	EM, CE
Scirpus rufus (Blysmus rufus)	Bulrush	wet river banks and saline meadows, seashores	EM
Senecio sheldonensis	Groundsel	subalpine meadows	Unknown
Smelowskia calycina ssp. Media	Silver Rock Cress	stoney slopes and lakeshores, rocky hillsides, gravel	GP, TD, JL, SL
Sparganium eurycarpum	Giant Bur-reed	shallow ponds and sloughs	EM, FA, OW
Tanacetum bipinnatum (T. huronense)	Indian Tansy	sandy river banks	WR
Valeriana dioica (V. septentrionalis	Northern Valerian	fens and lake shores, moist places	EM, CE, EA, SH, TF
Viola canadensis (V. rugulosa)	Western Canada Violet	woodlands along streams and hot springs	WR
Viola selkirkii	Great-spurred Violet	moist thickets, woods, fens and alpine tundra	WR, AM

Each plant was investigated for its preferred habitat using existing information sources (Anderson 1974, Douglas *et al*. 1981, Hulten 1968, McJannet *et al*. 1995, and Porsild and Cody 1980). Once habitat information was gathered, each ecosystem type was assessed for its potential to support each rare plant (Table 14). The total number of rare plants that potentially occur in each ecosystem type was then determined. The ecosystem types were ranked from very low potential to very high potential based on the total number of rare plant species potentially present.

The habitat suitability rank was derived from a frequency histogram that correlated each ecosystem type with the number of rare plants potentially found within them. While this method is somewhat objective, it does provide a basis to rank ecosystem types against each other for their potential to support rare plants. As a note of caution, rare plants often occur in microsites that cannot always be identified from satellite imagery or through the ELC mapping process. While an ecosystem type may be ranked as very low for rare plant habitat, there is a possibility that rare plants could be found in microsites within that ecosystem type. Ecosystem types, the number of rare plants they could support and their ranking is provided in Table 15.

Table 15
Rare Plant Habitat Potential for Each Ecosystem Type

Ecosystem Type	Total Potential Rare Plants	Rank
BR	2	Very Low
GP	2	Very Low
RR	2	Very Low
TD	2	Very Low
RP	5	Low
RO	6	Low
BF	7	Low
JL	11	Moderate
OW	11	Moderate
SL	12	Moderate
TB	14	Moderate
FA	15	High
SH	15	High
TF	15	High
AM	18	High
CA	19	High
CE	22	Very High
EA	22	Very High
WR	25	Very High
EM	27	Very High
Very Low: 1 to 4 species.		
Low: 5 to 9 species.		
Moderate: 10 to 14 species.		
High: 15 to 19 species.		
Very High: > 20 species.		

Initially area calculations for rare plant habitat were based on the primary ecosystem type. This method did not account for secondary or tertiary ecosystem types within complexed polygons. Consequently, small unmappable units that had high or very high habitat value (i.e., CA, EA or EM) were not included in the mapping process. This would result in the amount of high or very high habitat being underestimated. To be conservative, all complex polygons were mapped according to the ecosystem type that had the highest rare plant habitat potential regardless of whether it was the primary, secondary or tertiary unit identified in the polygon. Therefore, the map could represent an overestimation of high or very high habitat; but in early planning, it is better to be cautious (Figure 3). Area coverage for habitat potential is provided in Table 16.

Table 16
Rare Plant Habitat Coverage in the YGP Study Area

Habitat Potential	Potential Number of Rare Plants	Total Area (ha)	Area as % Total Area
Very Low	1 to 4	55	0.4
Low	5 to 9	46	0.3
Moderate	10 to 14	8,413	58.1
High	15 to 19	1,216	8.4
Very High	> 20	882	6.1
Water[1]	0	2,953	20.4
Cloud	0	910	6.3
TOTAL		**14,475**	**100**

[1]Only includes water > 2 m depth.

5.3 Discussion of Field Sampling and Mapping Results

There were four objectives outlined for the ELC: defining the ecosystem types, mapping and characterizing the landscape using ecosystem types, characterizing the extent the development footprint will have on the landscape, and identifying impacts and mitigation strategies for the development footprint. Meeting the first two objectives is discussed below.

5.3.1 Defining Ecosystem Types

Twelve ecosystem types were quantitatively sampled in the field, while two were characterized qualitatively. Eight of the ecosystem types had two or more plots and the most common ecosystem types had five or more plots for defining the ecosystem type. Four of the twelve ecosystem types sampled (i.e., BR, CA, EA and CE) had only one quantitative plot. While the numbers are low for these four, they have limited distribution within the YGP study area. The willow – sedge low shrub fen (SH) and the floating aquatic (FA) ecosystem types were qualitatively described. We feel that for mapping, the definitions are sufficient; however, further field characterization would enhance our knowledge of variability especially if any of these ecosystem types fall within the project footprint.

5.3.2 Mapping and Characterizing the Landscape

Landscape patterns and features associated with terrain and vegetation were mapped in the study area using the defined ecosystem types and satellite imagery. Confidence in mapping the vegetated units ranged from high to low, with high confidence for the EA,

EM, FA, SH, TB, TF and WR ecosystems, moderate confidence for the BR, BF, CA, CE, JL and SL ecosystems and low confidence for the AM ecosystem.

Confidence was moderate in the SL, JL and low in the AM due to a lack of detailed topographical information. In the field, SL units were often situated in level positions or on slopes, while the JL sites were confined to crests, areas of high bedrock or esker complexes. While it was possible to distinguish areas of high bedrock, without contour details, it was difficult to determine changes in slope position. Coloration of the SL and the JL units were similar and could not be used as an accurate tool to distinguish the two ecosystem units. During our field sampling, AM was found on a variety of slope positions, and its identification from the satellite image using color was not consistent. This resulted in a low confidence in the mapping of the AM unit.

Differentiation of the JL and the SLr (rock modifier for the SL unit) was made on the basis of the amount of continuous rock cover. From data collected in the field, JL units occurred in areas where there was high rock cover with sporadic vegetation. During the mapping process, if rock cover was high and vegetation cover was sparse, it was assigned as JL; if vegetation cover was moderate, it was mapped as an SLr unit. Eskers were not apparent from the imagery, and only those that were observed while in the field where identified in the mapping process.

Structural and stand composition was also attributed to each polygon. Confidence in mapping the structural stage is high in areas surrounding full and visual plots. Where possible, plot photos that were taken of the landscape were used to attribute polygons. There was little difference in the imagery color among deciduous, mixed or coniferous so mapping stand composition with the absence of field data was difficult. There is good coverage of the study area near the Discovery Mine and around Iguaçu, Maguire, Nicholas and Eclipse lakes. Plot coverage in the northwest and northeast is low resulting in low confidence in structural stage polygon attribution in these areas.

Confidence in mapping the broad ecosystem units is moderate. Confidence is not high due to the difficulty in mapping stand composition. The highest error is likely in the attribution of the mixed and deciduous stands versus the dry coniferous. Due the fire history, there were seral birch communities in what would eventually succeed to black spruce.

6.0 THE PROJECT FOOTPRINT

The purpose of this field report is not to provide a detailed impact assessment for the soil and vegetation and resources. The information provided below is an overview of the development and the potential effects and mitigation that may be required . Information is descriptive based on ecological principles and not necessarily based on the specific soils and vegetation types found within the footprint.

6.1 Project Effects

The project will have a direct effect on 117.2 ha, the majority of this from development around the processing facility, 88.2 ha, and 28.9 ha for the all weather road (Figure 1). Exploration, construction and site activities will require the clearing of vegetation, grading, cut and fills, excavations of borrow material and development of an all weather road. This may affect soil resources, and will result in a direct loss of vegetation. As well, air emissions from the processing facility could affect vegetation health.

Table 17 provides a list of the ecosystem types that will undergo vegetation removal. The majority of the clearing for both the plant area and the road will occur within the SL and JL ecosystems types. These are the most abundant types within the YGP study area. One ecosystem type of restricted distribution will be disturbed. The EM ecosystem will be affected by the facilities development. The size of the disturbance is 1.7 ha, which represents 1.5% of the footprint. No other natural ecosystems of restricted distribution will be disturbed by the proposed development. While the WR and AM ecosystems are not of restricted distribution, they are important ecosystems for wildlife habitat and biodiversity. Approximately 3.0 ha of WR and 1.8 ha of AM will be affected. Approximately 11.3 ha (9.7% of the footprint) will be on previously disturbed areas.

Table 18 provides details on the rare plant habitat that will be disturbed. The majority of the development, 79.3 ha or 67.7% of the footprint, will occur on moderate habitat potential. The footprint will affect 4.6 ha of high habitat and 5.3 ha of very high habitat. This represents 3.9% and 4.5% of the footprint, respectively. The coverage of these two habitats in the YGP study area is 8.4% and 6.3%, respectively.

Table 17
Vegetation Removal Proposed for Each Ecosystem Type in the YGP Study Area

Ecosystem[1] Type	Plant Area		Road Area		Total Area (ha)	Area as % Total Area
	Area (ha)	Area as % Plant Area	Area (ha)	Area as % Road Area		
Wetland Riparian						
EM	1.71	1.9	-	-	1.71	1.5
SH	0.23	0.3	-	-	0.23	0.2
TB	10.18	11.5	3.22	11.1	13.39	11.4
TF	1.16	1.3	0.57	2.0	1.73	1.5
WR	2.61	3.0	0.95	3.3	3.56	3.0
Forest and Woodland						
AM	2.16	2.4	-	-	2.16	1.8
JL	14.33	16.2	8.21	28.4	22.53	19.2
SL	32.94	37.3	10.90	37.6	43.84	37.4
Water						
LA	11.54	13.1	-	-	11.54	9.9
Anthropogenic						
GP	0.54	0.6	0.01	0.0	0.54	0.5
RP	1.60	1.8	1.49	5.2	3.09	2.6
RR	2.58	2.9	0.15	0.5	2.73	2.3
TD	5.06	5.7	-	-	5.06	4.3
Cloud	1.60	1.8	3.45	11.9	5.04	4.3
TOTAL[2]	**88.21**	**100**	**28.94**	**100**	**117.16**	**100**

[1] Bolded ecosystem types are of restricted distribution (did not include anthropogenic units in this category).
[2] Due to rounding errors, numbers may not total similarly.

Table 18
Vegetation Removal Proposed for Each Rare Plant Habitat Area

Rare Plant Habitat Potential	Plant Area		Road Area		Total Area (ha)	Area as % Total Area
	Area (ha)	Area as % Plant Area	Area (ha)	Area as % Road Area %		
VL	8.17	9.3	0.16	0.6	8.32	7.1
L	1.60	1.8	1.49	5.2	3.09	2.6
M	57.45	65.1	21.81	75.4	79.26	67.7
H	3.54	4.0	1.08	3.7	4.62	3.9
VH	4.32	4.9	0.95	3.3	5.27	4.5
NA[1]	13.13	14.9	3.44	11.9	16.59	14.16
TOTAL[2]	**88.21**	**100**	**28.94**	**100**	**125.57**	**100**

[1] NA – not applicable and includes lakes, ponds and cloud areas.
[2] Due to rounding errors, numbers may not total similarly.

Impacts are generally based on criteria such as direction, scope, duration, frequency, magnitude and confidence (Beanlands and Duinker, 1983; FEARO, 1994). Using these criteria, a level of significance can be placed on the impact. Significant impacts can occur if there is impairment to a resources function or process, if a large enough portion of the resource is impacted or if the impact is long term. At this time in the project planning it is only possible to indicate that impacts will occur; it is not possible to determine the level of significance at this time.

Based on the Project's activities, the following potential impacts on vegetation have been identified:

- vegetation removal;
- alteration of soil properties;
- increased air emissions;
- introduction of non-native or invasive species;
- increased risk of spills;
- site maintenance activities; and
- increased risk of fire due to human presence.

Mitigation measures, if required, are discussed below.

6.2 Mitigation Strategies

Potential mitigation strategies for the effects to soils and vegetation resources are provided in Table 19. This information is general in nature and is not meant to replace mitigation measures based on a more detailed impact assessment.

Table 19
Potential Effects and Mitigation Strategies

Potential Effect	Consequence	Mitigation
Vegetation Removal	Loss of vegetation; increase in ecosystem fragmentation; loss of high rare plant habitat; loss of ecosystems with restricted distribution.	Minimize footprint; minimize development on ecosystem types with restricted distribution or with high potential for rare plants; avoid sensitive ecosystems; minimize off-site activities such as ATV use; reclamation to restore to pre-disturbance conditions.
Alteration of Soil Properties	Loss of soil; compaction of mineral soil by vehicle traffic; erosion; changes in soil quality and chemistry due to spills.	Minimize footprint; where possible salvage mineral topsoil; minimize traffic off site; implement erosion control measures on slopes as required; implement emergency response plan.
Increased air Pollution	Increase dust fall from traffic; emissions of SO_2 and NOx are acidifying to vegetation (toxicity to leaf surfaces) and soil.	Use of dust suppressants; minimize traffic; minimize air emissions; continued monitoring of air emissions.
Introduction of Non-native or Invasive Species	Growth and spread of non-native or invasive species.	Clean all equipment before coming to site; train staff on the identification and control of non-native and invasive plants, vehicle washing as required.
Increased Risk of Spills	Direct impact to vegetation; contamination of soil and water.	Implement an emergency response system; follow appropriate procedures for spill containment and clean up.
Site Maintenance Activities	Use of herbicides, sterilants and dust suppressants; salts on road services can lead to contamination through surface water movement; waste disposal activities.	Implement vegetation control guidelines to minimize the affect of herbicides and sterilants on native vegetation; ensure use of road salts, oil, or dust suppressants is controlled and monitored; storage of chemicals must be in a facility that minimizes potential entry into the environment; dispose of all wastes in approved containers.
Increased Risk of Fire due to Human Presence	Fire is a natural disturbance, but human activity may increase the risk of fire, increasing risk to vegetation resources.	It is uncertain if mitigation is necessary since this can be considered a natural occurrence. More information is required.

7.0 SUMMARY

Ecological land classification mapping was carried out for the YGP study area. Baseline data was collected in July 2004, and 22 ecosystem types were classified within the 14,475 ha study area. Fourteen of these were naturally vegetated, three were classified as water, four were anthropogenic and one was cloud. Fifteen broad ecosystem units that correlated to the West Kitikmeot/Slave Study were also assigned to each polygon. The study area was mapped for potential rare plant habitat. A rare plant habitat potential map was generated based on the abundance of rare plants potentially found within each ecosystem type.

Confidence in the mapping and subsequent data analysis is moderate to high for most units, with the exception of the AM unit, which is low. Confidence in mapping structural stage, stand composition and broad ecosystem units is moderate. Confidence in mapping the rare plant habitat potential is moderate.

The project will have a direct impact on 117.2 ha, the majority of this is development of the processing facilities (88.2 ha) and the remaining 28.9 ha is from the all weather road. Based on the Project's activities, the following potential impacts have been identified: vegetation removal, alteration of soil properties, alternation of hydrology, change in water quality, increased air emissions, introduction of non-native or invasive species, increased risk of spills, site maintenance activities, increased risk of fire due to human presence. Potential mitigation strategies are identified for each of these impacts. At this time in the project planning, it is only possible to indicate that impacts will occur. It is not possible to determine the level of significance.

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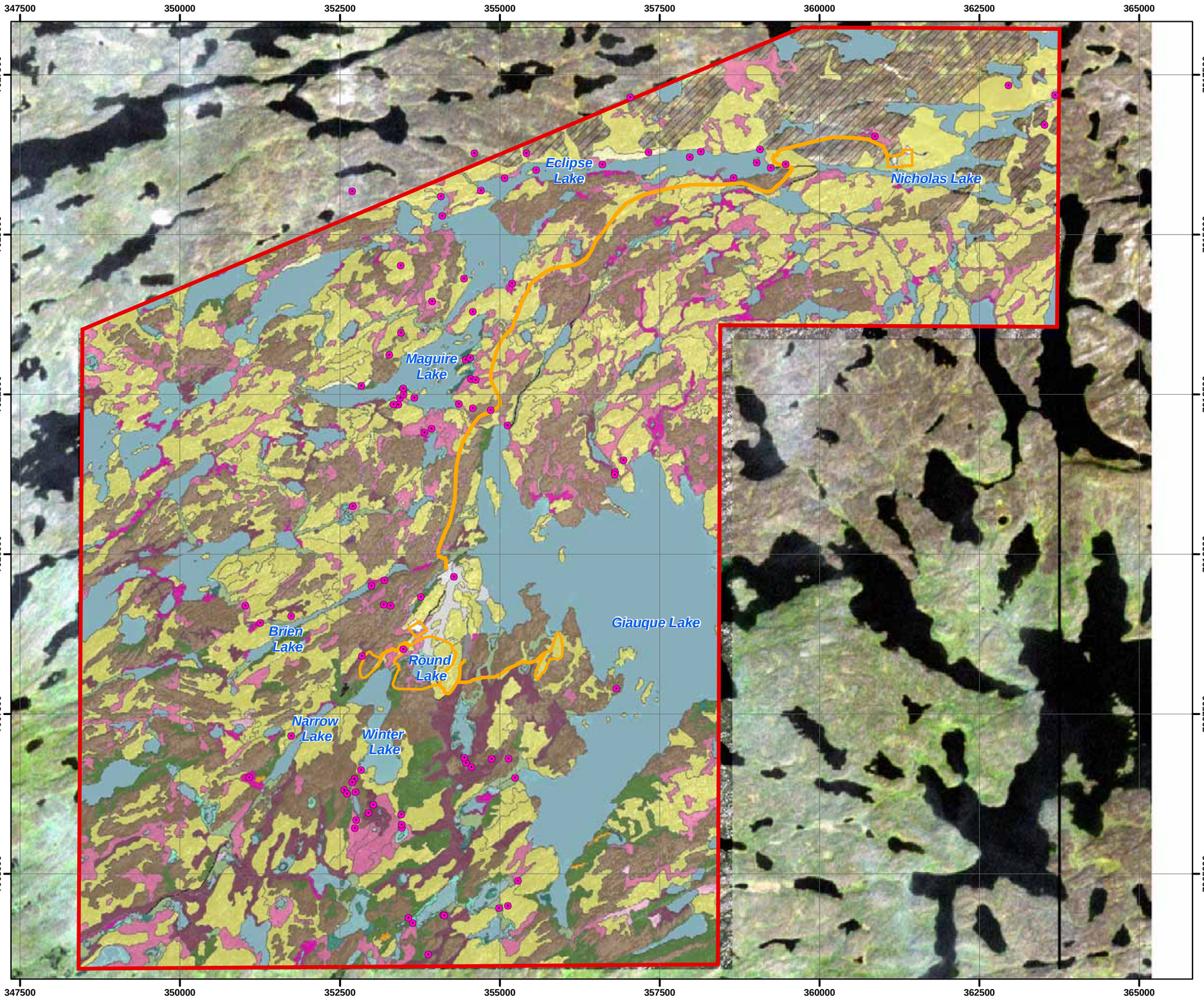
FIGURES



Legend

- Sample Location
- Local Study Area
- Proposed Footprint
- Cloud

Ecosystem Units

Wetland

- BR Scrub birch cloudberry low shrub bog
- CA Water sedge – narrow leaved cottongrass fen
- CE Round fruited sedge – Chamisso's cottongrass fen
- EA Sheathed cottongrass – bog rosemary sedge fen
- EM Water sedge – horsetail shallow shore marsh
- FA Floating aquatic shallow open water
- SH Willow – sedge low shrub fen
- TB Spruce – cloudberry treed bog
- TF Tamarack – blueberry treed fen

Riparian

- WR Spruce – willow riparian forest

Forest and Woodland

- AM Spruce – moss forest
- JL Jack pine – lichen woodland
- SL Spruce – lichen woodland

Sparsely Vegetated

- BF Boulder field
- RO Rock outcrop

Anthropogenic

- GP Gravel pit
- RP Road surface
- RR Rural development
- TD Tailing deposit

Water

- LA Lake
- PD Pond
- OW Open water

N W E S

Scale 1:60,000

Km

0 0.35 0.7 1.4 2.1

Imagery Source: IKONOS (July 27 and August 2 2004)
Landsat TM (August 11 2001)

Yellowknife Gold Project

Ecosystem Types in the Local Study Area

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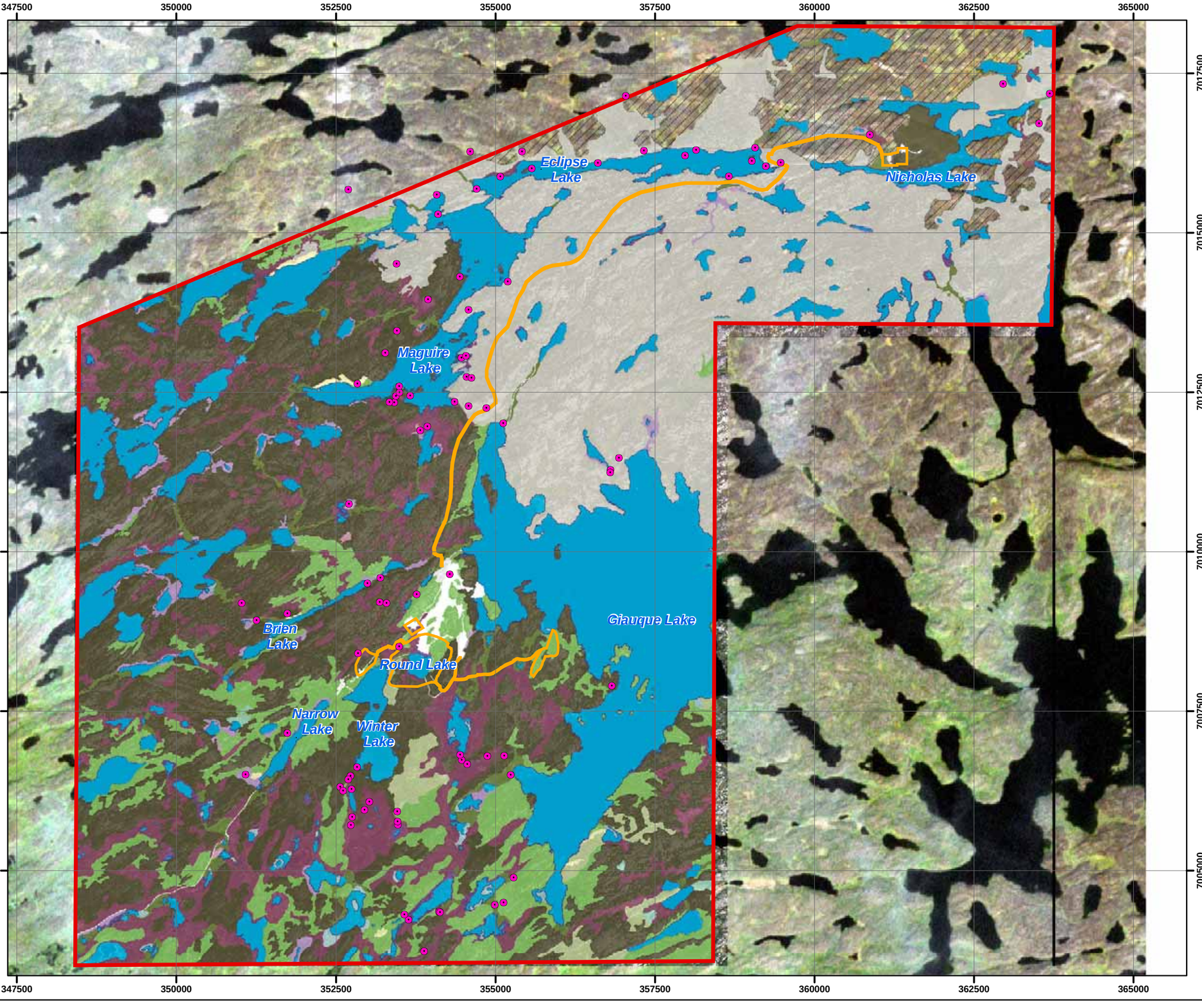
February, 2005 | Figure 1

Project No. 1740082



Legend

- Sample Location
- Local Study Area
- Proposed Footprint
- Cloud

Broad Ecosystem Units

- Anthropogenic
- Water
- Aquatic Vegetation
- Bedrock Boulder Field
- Burns
- Birch Hummock
- Dry Coniferous Woodland
- Mesic Coniferous Woodland
- Mixed and Deciduous Woodland
- Riparian Woodland and Shrubland
- Other Wetland
- Sedge Fen
- Shrubby Fen
- Treed Fens and Bogs

N W E S

Scale 1:60,000

0 0.35 0.7 1.4 2.1 Km

Imagery Source: IKONOS (July 27 and August 2 2004)
Landsat TM (August 11 2001)

Yellowknife Gold Project

Broad Ecosystem Units in the Local Study Area

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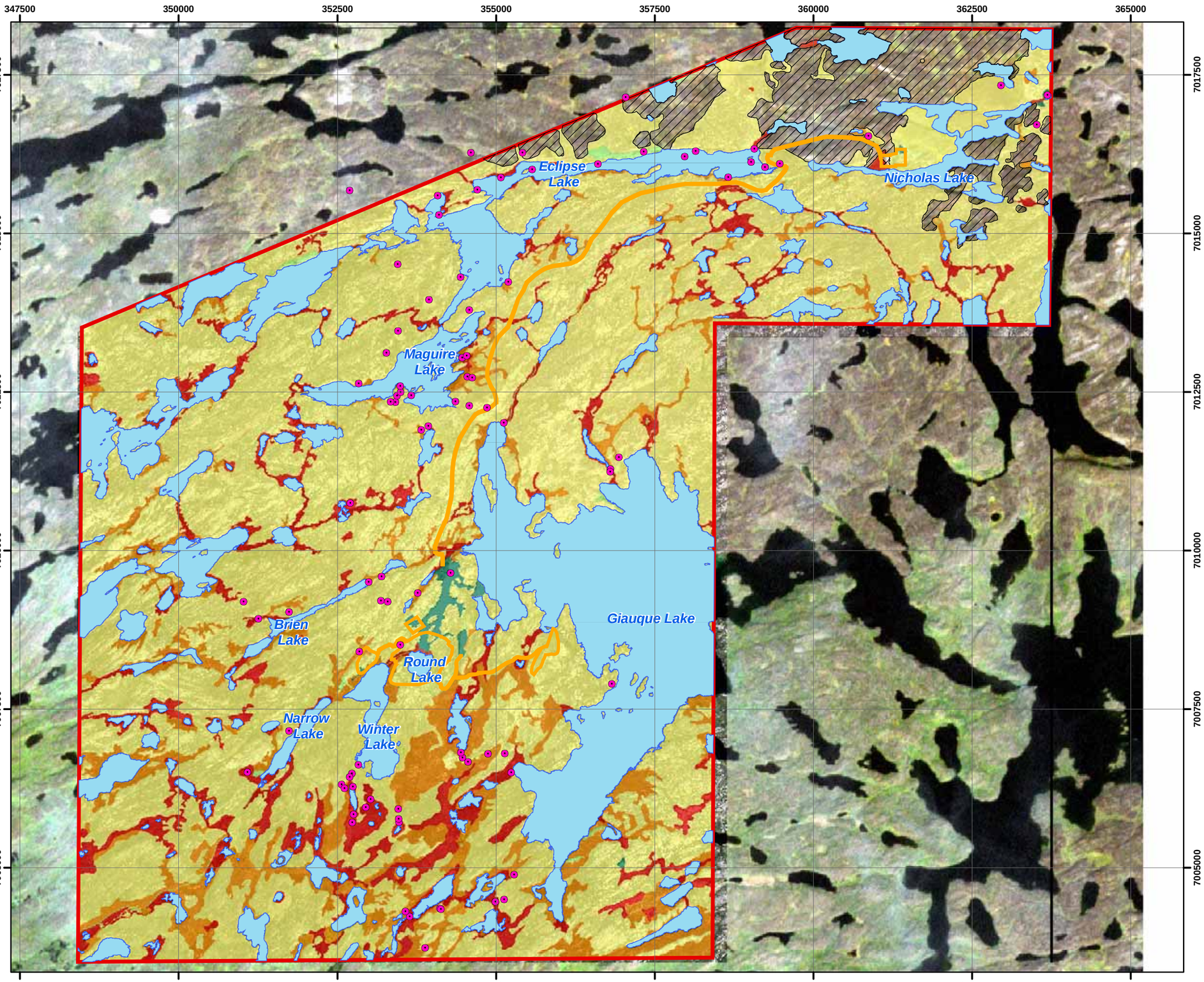
February 2005 | Figure 2

Project No. 1740082



Legend

- Sample Location
- Local Study Area
- Proposed Footprint
- Cloud
- Water >2m

Rare Plant Potential

- Very Low (0-4 Plants)
- Low (5-9 Plants)
- Moderate (10-14 Plants)
- High (15-19 Plants)
- Very High (20+ Plants)

yellowknife_river-basin-lakes_v2

N W E S

Scale 1:60,000

0 0.35 0.7 1.4 2.1 Km

Imagery Source: IKONOS (July 27 and August 2 2004)
Landsat TM (August 11 2001)

Yellowknife Gold Project

Rare Plant Potential in the Local Study Area

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Project No. 1740082

APPENDIX A

ELC FIELD DATA

Vegetation Table
Site Unit BR: scub birch - cloudberry low shrub bog

Lifeform	*Spp*	Common Name	P	MC	F19
1	*Larix laricina*	tamarack	100.0%	6.0	6.0
1	*Picea mariana*	black spruce	100.0%	1.0	1.0
4	*Betula nana*	scrub birch	100.0%	85.0	85.0
4	*Salix myrtillifolia*	bilberry willow	100.0%	1.0	1.0
4	*Salix sp.*	willow	100.0%	1.0	1.0
5	*Equisetum sylvaticum*	wood horsetail	100.0%	0.1	0.1
6	*Calamagrostis canadensis*	bluejoint	100.0%	0.1	0.1
7	*Epilobium sp.*	willow herb	100.0%	0.1	0.1
12	*Rubus chamaemorus*	cloudberry	100.0%	8.0	8.0

Vegetation Table
Site Unit CA: water sedge - narrow-leaved cottongrass fen

Lifeform	Spp	Common Name	P	MC	F34
1	*Larix laricina*	tamarack	100.0%	3.0	3.0
3	*Chamaedaphne calyculata*	leatherleaf	100.0%	10.0	10.0
6	*Carex aquatilis*	water sedge	100.0%	70.0	70.0
9	*Sphagnum sp.*	Peat moss	100.0%	1.0	1.0
12	*Andromeda polifolia*	bog-rosemary	100.0%	3.0	3.0
12	*Rubus chamaemorus*	cloudberry	100.0%	5.0	5.0
12	*Vaccinium vitis-idaea*	bog cranberry	100.0%	1.0	1.0

Vegetation Table
Site Unit CE: round-fruited sedge - Chamisso's cottongrass fen

Lifeform	*Spp*	Common Name	P	MC	F09
3	*Chamaedaphne calyculata*	leatherleaf	100.0%	0.1	0.1
3	*Ledum groenlandicum*	Labrador tea	100.0%	1.0	1.0
6	*Carex brunnescens*	brownish sedge	100.0%	1.0	1.0
6	*Carex capillaris*	hairlike sedge	100.0%	20.0	20.0
6	*Carex sp.*	sedge	100.0%	2.0	2.0
6	*Eriophorum chamissonis*	Chamisso's cotton-grass	100.0%	10.0	10.0
6	*Eriophorum vaginatum*	sheathed cotton-grass	100.0%	5.0	5.0
6	*Calamagrostis stricta ssp. inexpansa*	slimstem reedgrass	100.0%	1.0	1.0
7	*Epilobium sp.*	willowherb	100.0%	0.1	0.1
9	*Sphagnum fuscum*	common brown sphagnum	100.0%	20.0	20.0
9	*Sphagnum squarrosum*	shaggy sphagnum	100.0%	5.0	5.0
12	*Andromeda polifolia*	bog-rosemary	100.0%	2.0	2.0
12	*Oxycoccus oxycoccos*	small bog cranberry	100.0%	0.1	0.1
12	*Rubus chamaemorus*	cloudberry	100.0%	5.0	5.0

Vegetation Table
Site Unit EA: sheathed cottongrass - bog-rosemary sedge fen

Lifeform	*Spp*	Common Name	P	MC	F10
1	*Larix laricina*	tamarack	100.0%	0.1	0.1
3	*Chamaedaphne calyculata*	leatherleaf	100.0%	10.0	10.0
4	*Betula nana*	scrub birch	100.0%	5.0	5.0
4	*Salix arbusculoides*	northern bush willow	100.0%	1.0	1.0
6	*Carex aquatilis*	water sedge	100.0%	60.0	60.0
6	*Carex interior*	inland sedge	100.0%	0.1	0.1
6	*Eriophorum angustifolium*	narrow-leaved cotton-grass	100.0%	0.1	0.1
6	*Eriophorum chamissonis*	Chamisso's cotton-grass	100.0%	0.1	0.1
7	*Petasites sagittatus*	arrow-leaved coltsfoot	100.0%	1.0	1.0
7	*Comarum palustre*	marsh cinquefoil	100.0%	0.1	0.1
9	*Calliergon sp.*	water moss	100.0%	1.0	1.0
9	*Sphagnum fuscum*	common brown sphagnum	100.0%	6.0	6.0
9	*Sphagnum magellanicum*	midway peat moss	100.0%	2.0	2.0
9	*Sphagnum squarrosum*	shaggy sphagnum	100.0%	30.0	30.0

Vegetation Table
Site Unit EM: water sedge - horsetail shallow shore marsh

Lifeform	*Spp*	Common Name	P	MC	F11	F17	F03	F06
3	*Chamaedaphne calyculata*	leatherleaf	50.0%	0.1			0.1	0.1
4	*Myrica gale*	sweet gale	50.0%	6.3			25.0	0.1
4	*Salix myrtillifolia*	bilberry willow	25.0%	0.3	1.0			
4	*Salix sp.*	willow	25.0%	0.0				0.1
6	*Calamagrostis canadensis*	bluejoint	50.0%	0.3	1.0	0.1		
6	*Carex aquatilis*	water sedge	100.0%	55.3	1.0	90.0	70.0	60.0
6	*Carex brunnescens*	brownish sedge	50.0%	0.8	2.0		1.0	
6	*Carex capillaris*	hairlike sedge	25.0%	0.0	0.1			
6	*Carex paupercula*	bog sedge	35.0%	0.3				1.0
6	*Carex utriculata*	beaked sedge	75.0%	12.5	40.0	0.1		10.0
6	*Eleocharis palustris*	common spike-rush	25.0%	0.0	0.1			
7	*Calla palustris*	wild calla	25.0%	2.5		10.0		
7	*Cicuta bulbifera*	bulbous water-hemlock	25.0%	0.0		0.1		
7	*Epilobium sp.*	willowherb	25.0%	0.0		0.1		
7	*Galium trifidum*	small bedstraw	25.0%	0.0		0.1		
7	*Hippuris vulgaris*	common mare's-tail	25.0%	0.0	0.1			
7	*Potentilla norvegica*	Norwegian cinquefoil	25.0%	0.0		0.1		
7	*Comarum palustre*	marsh cinquefoil	100.0%	2.1	0.1	0.1	3.0	5.0
7	*Ranunculus gmelinii*	small yellow water-buttercup	25.0%	0.0		0.1		
7	*Rorippa palustris*	marsh yellow cress	25.0%	0.0		0.1		
7	*Sparganium sp.*		25.0%	0.0		0.1		
7	*Typha latifolia*	common cattail	25.0%	0.0	0.1			
7	*Utricularia intermedia*	flat-leaved bladderwort	25.0%	0.3	1.0			
7	*Utricularia macrorhiza*	greater bladderwort	25.0%	1.0		4.0		
7	*Utricularia sp.*	bladderwort	25.0%	0.5			2.0	
9	*Calliergon sp.*	water moss	25.0%	0.5				2.0
9	*Dicranum sp.*		25.0%	10.0	40.0			
9	*Drepanocladus sp.*		25.0%	1.3				5.0
9	*Polytrichum strictum*	bog haircap moss	25.0%	2.5	10.0			
9	*Sphagnum squarrosum*	shaggy sphagnum	25.0%	0.5			2.0	
12	*Andromeda polifolia*	bog-rosemary	25.0%	0.3			1.0	

Vegetation Table
Site Unit FA: floating aquatic shallow open water

Lifeform	*Spp*	Common Name	P	MC

No quantitative data collected

Vegetation Table
Site Unit SH: willow - sedge low shrub fen

Lifeform	*Spp*	Common Name	P	MC

No quantitative data collected

Vegetation Table
Site Unit TB: spruce - cloudberry treed bog

Lifeform	*Spp*	Common Name	P	MC	F01	F12	F15	F25	F05
1	*Larix laricina*	tamarack	20.0%	0.6	3.0				
1	*Picea mariana*	black spruce	100.0%	12.0	6.0	10.0	8.0	36.0	0.1
1	*Pinus banksiana*	jack pine	40.0%	0.1	0.2				0.2
2	*Betula occidentalis*	water birch	40.0%	1.8			6.0		3.0
2	*Betula papyrifera*	paper birch	20.0%	1.6			8.0		
3	*Ledum groenlandicum*	Labrador tea	100.0%	44.0	40.0	70.0	50.0	40.0	20.0
3	*Ledum palustre ssp. decumbens*	northern Labrador tea	20.0%	0.0					0.1
4	*Alnus viridis ssp. crispa*	green alder	20.0%	0.6					3.0
4	*Betula nana*	scrub birch	20.0%	0.6					3.0
4	*Salix glauca*	grey-leaved willow	20.0%	0.0					0.1
4	*Salix myrtillifolia*	bilberry willow	20.0%	0.2					1.0
4	*Salix planifolia*	tea-leaved willow	40.0%	2.2			10.0		1.0
4	*Salix sp.*	willow	20.0%	0.0					0.1
4	*Vaccinium uliginosum*	bog blueberry	60.0%	0.8	1.0	2.0			1.0
5	*Equisetum arvense*	common horsetail	40.0%	0.6	0.1				3.0
5	*Equisetum scirpoides*	dwarf scouring-rush	20.0%	1.4			7.0		
5	*Equisetum sylvaticum*	wood horsetail	20.0%	0.2					1.0
6	*Calamagrostis stricta ssp. inexpansa*	slimstem reedgrass	40.0%	0.2	0.1		1.0		
6	*Carex aquatilis*	water sedge	20.0%	0.0					0.1
6	*Carex brunnescens*	brownish sedge	20.0%	0.0					0.1
7	*Epilobium angustifolium*	fireweed	20.0%	0.0					0.1
7	*Geocaulon lividum*	bastard toad-flax	20.0%	0.2	1.0				
7	*Pinguicula vulgaris*	common butterwort	20.0%	0.0	0.1				
9	*Aulacomnium sp.*		20.0%	0.2					1.0
9	*Aulacomnium turgidum*	fat glow moss	20.0%	0.0	0.1				
9	*Calliergon sp.*		20.0%	0.0					0.1
9	*Dicranum sp.*		60.0%	12.0	15.0	25.0			20.0
9	*Drepanocladus sp.*		20.0%	0.4		2.0			
9	*Moss sp.*	moss	20.0%	6.0			30.0		
9	*Polytrichum strictum*	bog haircap moss	60.0%	1.5	4.0	3.0			0.5
9	*Sphagnum fuscum*	common brown sphagnum	40.0%	3.4	2.0				15.0
9	*Sphagnum squarrosum*	shaggy sphagnum	20.0%	0.0					0.1
9	*Tomentypnum nitens*	golden fuzzy fen moss	20.0%	0.0					0.1
11	*Cetraria sp.*	icelandmoss lichens	20.0%	7.0	35.0				
11	*Cladina mitis*	lesser green reindeer	40.0%	1.6	5.0		3.0		
11	*Cladina rangiferina*	grey reindeer	80.0%	3.2	10.0	5.0	0.1		1.0
11	*Cladina stellaris*	star-tipped reindeer	20.0%	0.6	3.0				
11	*Cladonia sp.*	clad lichens	80.0%	6.0	5.1	15.0	4.0		6.0
11	*Icmadophila ericetorum*	spraypaint	40.0%	0.1	0.1				0.2
11	*Peltigera aphthosa*	freckle pelt	40.0%	0.0	0.0				0.1
11	*Stereocaulon tomentosum*	eyed foam	20.0%	0.4			2.0		
12	*Andromeda polifolia*	bog-rosemary	40.0%	1.2	3.0	3.0			
12	*Arctostaphylos alpina var. rubra*	alpine bearberry	20.0%	0.4					2.0
12	*Empetrum nigrum*	crowberry	60.0%	0.4	1.0			1.0	0.1
12	*Oxycoccus oxycoccos*	small bog cranberry	20.0%	0.0	0.1				
12	*Rubus chamaemorus*	cloudberry	80.0%	2.0		1.0	2.0	5.0	2.0
12	*Vaccinium vitis-idaea*	bog cranberry	60.0%	0.8	2.0		1.0	1.0	

Vegetation Table
Site Unit TF: tamarack - blueberry treed fen

Lifeform	*Spp*	Common Name	P	MC	F36	F20
1	*Larix laricina*	tamarack	100.0%	6.0	9.0	3.0
1	*Picea mariana*	black spruce	100.0%	13.0	25.0	1.0
3	*Ledum groenlandicum*	Labrador tea	50.0%	5.0	10.0	
3	*Ledum palustre ssp. decumbens*	northern Labrador tea	50.0%	2.5	5.0	
4	*Betula nana*	scrub birch	100.0%	18.0	1.0	35.0
4	*Salix arbusculoides*	northern bush willow	50.0%	2.5		5.0
4	*Salix glauca*	grey-leaved willow	50.0%	0.1		0.2
4	*Salix sp.*	willow	100.0%	2.6	0.1	5.0
4	*Shepherdia canadensis*	russet buffalo berry	50.0%	0.1		0.1
4	*Vaccinium uliginosum*	bog blueberry	100.0%	0.6	1.0	0.1
5	*Equisetum sylvaticum*	wood horsetail	100.0%	0.6	1.0	0.1
6	*Carex aquatilis*	water sedge	100.0%	0.6	0.1	1.0
6	*Eriophorum chamissonis*	Chamisso's cotton grass	50.0%	0.1		0.1
7	*Epilobium sp.*	willow herb	50.0%	0.1		0.1
7	*Pedicularis labradorica*	Labrador lousewort	100.0%	0.1	0.1	0.1
7	*Ranunculus lapponicus*	Lapland buttercup	50.0%	0.1	0.1	
9	*Aulacomnium sp.*		50.0%	0.5	1.0	
9	*Dicranum sp.*		50.0%	2.5	5.0	
9	*Polytrichum strictum*	bog haircap moss	50.0%	1.0	2.0	
9	*Sphagnum fuscum*	common brown sphagnum	50.0%	15.0	30.0	
9	*Sphagnum squarrosum*	shaggy sphagnum	50.0%	1.0	2.0	
11	*Cetraria sp.*	icelandmoss lichens	50.0%	0.5	1.0	
11	*Cladina mitis*	lesser green reindeer	50.0%	2.5	5.0	
11	*Cladina stellaris*	star-tipped reindeer	50.0%	0.1	0.1	
11	*Peltigera aphthosa*	freckle pelt	50.0%	0.1	0.1	
12	*Empetrum nigrum*	crowberry	50.0%	2.0	4.0	
12	*Rubus chamaemorus*	cloudberry	50.0%	0.1		0.1
12	*Vaccinium vitis-idaea*	bog cranberry	100.0%	1.1	2.0	0.1

Vegetation Table
Site Unit WR: spruce - willow riparian forest

Lifeform	*Spp*	Common Name	P	MC	F37	F14	F23	F24
1	*Picea glauca*	white spruce	75.0%	4.0	2.1		3.0	11.0
1	*Picea mariana*	black spruce	25.0%	1.3		5.0		
2	*Betula occidentalis*	water birch	25.0%	5.0		20.0		
2	*Betula papyrifera*	paper birch	75.0%	22.5	5.0		40.0	45.0
2	*Populus balsamifera*	balsam poplar	25.0%	15.0	60.0			
4	*Betula nana*	scrub birch	25.0%	0.0		0.1		
4	*Ribes hudsonianum*	northern blackcurrant	25.0%	12.5				50.0
4	*Ribes sp.*	currant or gooseberry	50.0%	1.3	3.0		2.0	
4	*Rosa acicularis*	prickly rose	50.0%	0.8			0.1	3.0
4	*Rubus idaeus*	red raspberry	75.0%	2.0	3.0		0.1	5.0
4	*Salix arbusculoides*	northern bush willow	25.0%	0.8		3.0		
4	*Salix planifolia ssp. planifolia*	tea-leaved willow	25.0%	1.3		5.0		
4	*Salix sp.*	willow	75.0%	15.5	7.0		50.0	5.0
4	*Vaccinium uliginosum*	bog blueberry	25.0%	0.0		0.1		
4	*Viburnum edule*	highbush-cranberry	75.0%	5.0	0.1		5.0	15.0
5	*Equisetum sylvaticum*	wood horsetail	75.0%	1.3	0.1	2.0		3.0
6	*Calamagrostis canadensis*	bluejoint	50.0%	0.3	0.1			1.0
6	*Calamagrostis sp.*	reedgrass	50.0%	20.0	80.0		0.1	
6	*Calamagrostis stricta ssp. inexpansa*	slimstem reedgrass	25.0%	0.3		1.0		
6	*Carex aquatilis*	water sedge	25.0%	0.0		0.1		
6	*Carex brunnescens*	brownish sedge	25.0%	0.0		0.1		
6	*Carex sp.*	sedge	25.0%	0.0		0.1		
7	*Epilobium angustifolium*	fireweed	50.0%	0.3	0.1			1.0
7	*Epilobium palustre*	swamp willowherb	25.0%	0.1		0.2		
7	*Mustard sp.*	mustard	25.0%	0.0			0.1	
7	*Orthilia secunda*	one-sided wintergreen	25.0%	0.0		0.1		
7	*Potentilla sp.*	cinquefoil	75.0%	0.1	0.0	0.1	0.1	
7	*Pyrola asarifolia*	pink wintergreen	25.0%	0.0	0.1			
7	*Pyrola minor*	lesser wintergreen	25.0%	0.0		0.1		
7	*Rubus arcticus ssp. acaulis*	nagoonberry	25.0%	0.0	0.1			
7	*Viola canadensis*	Canada violet	25.0%	0.5			2.0	
9	*Dicranum sp.*		25.0%	0.0		0.1		
9	*Plagiomnium sp.*		25.0%	0.0				0.1
9	*Polytrichum strictum*	bog haircap moss	25.0%	0.0		0.1		
9	*Sphagnum fuscum*	common brown sphagnum	25.0%	0.0		0.1		

Common Name	P	MC	F18	F21	F08
white spruce	100.0%	10.0	1.0	14.0	15.0
paper birch	100.0%	76.7	85.0	75.0	70.0
Labrador tea	33.3%	0.3		1.0	
green alder	33.3%	3.3		10.0	
wood horsetail	33.3%	1.7			5.0
bluejoint	33.3%	0.7	2.0		
reedgrass	33.3%	0.0			0.1
slimstem reedgrass	33.3%	0.3	1.0		
willowherb	33.3%	0.0	0.1		
	33.3%	1.7			5.0
step moss	33.3%	0.3		1.0	
red-stemmed feathermoss	33.3%	0.3		1.0	
bog haircap moss	33.3%	0.3			1.0
clad lichens	66.7%	0.4		1.0	0.1
bog cranberry	66.7%	3.4	10.0		0.1

Vegetation Table
Site Unit JL: jack pine - lichen woodland

Lifeform	Spp	Common Name	P	MC	F02	F30	F35	F13	F16	F07
1	*Picea mariana*	black spruce	16.7%	1.2			7.0			
1	*Picea sp.*	spruce	33.3%	0.4					2.0	0.1
1	*Pinus banksiana*	jack pine	100.0%	23.0	7.0	20.0	1.1	30.0	30.0	50.0
2	*Betula papyrifera*	paper birch	66.7%	5.5		15.0	11.0	7.0		0.1
2	*Salix bebbiana*	Bebb's willow	16.7%	0.0				0.1		
3	*Ledum groenlandicum*	Labrador tea	16.7%	0.2					1.0	
4	*Rubus idaeus*	red raspberry	16.7%	0.3		2.0				
4	*Salix glauca*	grey-leaved willow	16.7%	0.0		0.1				
4	*Salix sp.*	willow	33.3%	0.4	2.0					0.1
4	*Viburnum edule*	highbush cranberry	16.7%	0.0				0.1		
5	*Cryptogramma acrostichoides*	parsley fern	16.7%	0.0	0.1					
5	*Polypodium virginianum*	Virginia polypody	33.3%	0.2		1.0				0.1
5	*Woodsia ilvensis*	rusty cliff fern	16.7%	0.0		0.1				
6	*Agrostis scabra*	hair bentgrass	33.3%	0.0	0.1					0.1
6	*Calamagrostis purpurascens*	purple reedgrass	33.3%	0.2		0.1		1.0		
6	*Calamagrostis sp.*	reedgrass	16.7%	0.0				0.1		
6	*Carex aenea*	bronze sedge	16.7%	0.0		0.1				
6	*Carex tracyi*	Tracy's sedge	16.7%	0.0						0.1
6	*Festuca sp.*	fescue	16.7%	0.0		0.1				
6	*Poa glauca*	glaucous bluegrass	50.0%	0.1	0.1	0.2				0.1
6	*Trisetum spicatum*	spike trisetum	16.7%	0.2			1.0			
7	*Antennaria sp.*	pussytoes	16.7%	0.0		0.2				
7	*Epilobium angustifolium*	fireweed	16.7%	0.3		2.0				
7	*Geocaulon lividum*	bastard toad-flax	16.7%	0.2			1.0			
7	*Potentilla sp.*	cinquefoil	16.7%	0.0		0.1				
7	*Potentilla norvegica*	Norwegian cinquefoil	16.7%	0.2		1.0				
7	*Saxifraga sp.*	saxifrage	16.7%	0.0	0.1					
7	*Saxifraga tricuspidata*	three-toothed saxifrage	33.3%	0.3		1.0				1.0
7	*Senecio sp.*		16.7%	0.2		1.0				
9	*Dicranum sp.*		33.3%	3.8	3.0	20.0				
9	*Polytrichum juniperinum*	juniper haircap moss	66.7%	1.9	0.1	5.0		4.0		2.0
9	*Tortella sp.*		16.7%	0.5						3.0
11	*Cetraria sp.*	icelandmoss lichens	33.3%	1.2	2.0	5.0				
11	*Cladina mitis*	lesser green reindeer	33.3%	0.7		4.0				0.1
11	*Cladina rangiferina*	grey reindeer	16.7%	0.0						0.1
11	*Cladina sp.*	reindeer lichens	16.7%	0.2				1.0		
11	*Cladina stellaris*	star-tipped reindeer	16.7%	0.5	3.0					
11	*Cladonia sp.*	clad lichens	33.3%	2.7				15.0		1.0
11	*Crustose lichen*	crust lichen	33.3%	5.8	30.0					5.0
11	*Stereocaulon tomentosum*	eyed foam	50.0%	3.7	10.0	10.0				2.0
12	*Arctostaphylos uva-ursi*	bearberry	66.7%	22.5	20.0		60.0	40.0	15.0	
12	*Vaccinium vitis-idaea*	bog cranberry	66.7%	1.8			3.0	5.0	2.0	1.0

Vegetation Table
Site Unit SL: spruce - lichen woodland

Lifeform	*Spp*	Common Name	P	MC	F27	F28	F32	F33	F22	F26	F04
1	*Picea mariana*	black spruce	85.7%	14.9	1.3	41.0		17.0	5.0	39.0	1.0
1	*Pinus banksiana*	jack pine	71.4%	12.5	10.0	0.2	0.1			2.0	75.0
2	*Betula papyrifera*	paper birch	71.4%	8.2	1.0	0.3	30.1		16.0	10.0	
3	*Ledum groenlandicum*	Labrador tea	100.0%	13.3	0.1	30.0	0.1	30.0	2.0	30.0	1.0
3	*Ledum palustre ssp. decumbens*	northern Labrador tea	14.3%	1.4				10.0			
4	*Alnus viridis ssp. crispa*	green alder	42.9%	1.9			8.0	5.0		0.1	
4	*Salix glauca*	grey-leaved willow	28.6%	0.4		0.1	3.0				
4	*Salix sp.*	willow	42.9%	0.1	0.1		0.1		0.2		
4	*Vaccinium uliginosum*	bog blueberry	28.6%	0.3		0.1		2.0			
5	*Equisetum sylvaticum*	wood horsetail	28.6%	0.3			0.1	2.0			
5	*Polypodium virginianum*	Virginia polypody	28.6%	0.0				0.1		0.1	
6	*Calamagrostis canadensis*	bluejoint	14.3%	0.0			0.1				
6	*Calamagrostis sp.*	reedgrass	28.6%	0.2				0.1	1.0		
6	*Eriophorum brachyantherum*	short-anthered cotton-grass	14.3%	0.0				0.1			
7	*Corydalis sempervirens*	pink corydalis	14.3%	0.0				0.1			
7	*Epilobium angustifolium*	fireweed	28.6%	0.7			3.0		2.0		
7	*Geocaulon lividum*	bastard toad-flax	14.3%	0.7						5.0	
9	*Dicranum sp.*		71.4%	2.6			1.0	10.0	1.0	5.0	1.0
9	*Polytrichum commune*	common hair-cap moss	14.3%	0.1						1.0	
9	*Polytrichum juniperinum*	juniper haircap moss	28.6%	0.9	3.0	3.0					
9	*Polytrichum sp.*		14.3%	0.1			1.0				
9	*Polytrichum strictum*	bog haircap moss	14.3%	0.7					5.0		
9	*Sphagnum fuscum*	common brown sphagnum	14.3%	0.4				3.0			
11	*Cetraria sp.*	icelandmoss lichens	57.1%	1.9	1.0	1.0				10.0	1.0
11	*Cladina mitis*	lesser green reindeer	57.1%	9.6	20.0	20.0		25.0		2.0	
11	*Cladina rangiferina*	grey reindeer	71.4%	6.4	5.0	5.0		10.0		25.0	0.1
11	*Cladina stellaris*	star-tipped reindeer	28.6%	0.2				0.1		1.0	
11	*Cladonia sp.*	clad lichens	42.9%	1.4		1.0				1.0	8.0
11	*Peltigera sp.*	pelt lichens	14.3%	0.1					1.0		
11	*Stereocaulon tomentosum*	eyed foam	28.6%	1.0	5.0					2.0	
12	*Arctostaphylos uva-ursi*	bearberry	28.6%	0.6	3.0						1.0
12	*Empetrum nigrum*	crowberry	14.3%	1.4				10.0			
12	*Vaccinium vitis-idaea*	bog cranberry	100.0%	6.7	0.1	5.0	0.1	15.0	1.0	25.0	1.0

Vegetation Table
Site Unit BF: boulder field

Lifeform	*Spp*	Common Name	P	MC	F29	F31
1	*Picea mariana*	black spruce	50.0%	0.1	0.2	
1	*Pinus banksiana*	jack pine	100.0%	0.2	0.1	0.2
2	*Betula papyrifera*	paper birch	100.0%	2.6	0.1	5.0
3	*Juniperus communis*	common juniper	100.0%	35.0	60.0	10.0
4	*Rubus idaeus*	red raspberry	100.0%	1.0	1.0	1.0
5	*Dryopteris fragrans*	fragrant wood fern	50.0%	0.1		0.1
5	*Polypodium virginianum*	Virginia polypody	50.0%	0.1	0.1	
5	*Woodsia glabella*	smooth cliff fern	50.0%	0.1		0.1
5	*Woodsia ilvensis*	rusty cliff fern	100.0%	0.1	0.1	0.1
6	*Agrostis scabra*	hair bentgrass	100.0%	0.1	0.1	0.1
6	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	50.0%	0.1	0.1	
6	*Poa glauca*	glaucous bluegrass	100.0%	1.0	1.0	1.0
7	*Corydalis sempervirens*	pink corydalis	50.0%	0.1	0.1	
7	*Epilobium angustifolium*	fireweed	50.0%	0.1	0.1	
7	*Saxifraga tricuspidata*	three-toothed saxifrage	100.0%	3.5	2.0	5.0
9	*Polytrichum juniperinum*	juniper haircap moss	50.0%	2.5		5.0
9	*Polytrichum sp.*	hair cap moss	50.0%	0.5	1.0	
11	*Cetraria sp.*	icelandmoss lichens	50.0%	1.0		2.0
11	*Cladina mitis*	lesser green reindeer	100.0%	7.5	10.0	5.0
11	*Cladonia sp.*	clad lichens	50.0%	0.1		0.1
11	*Peltigera sp.*	pelt lichens	50.0%	0.1		0.1
11	*Stereocaulon tomentosum*	eyed foam	100.0%	12.5	5.0	20.0
12	*Arctostaphylos uva-ursi*	bearberry	100.0%	2.6	0.2	5.0

APPENDIX B

ECOSYSTEM TYPE FACT SHEETS

Zone	*Boreal*
Class	*Riparian*
Type	*Forest*

Sample Ecosystem Fact Sheet

Spruce - Willow Riparian Forest

WR

1 **Header contains information on the zone(s) in which the unit occurs and two broad categories (Class and Type) that group similar units.**

General Characteristics (N=4) Vege... and understory tree species.

Site Description

This forest type generally occur... depres... have a rich nutrient regime a... derately moist to m... main saturated for a fe... after ...turation.

2 **Number of plots that were sampled for this Ecosystem Type.**

Vegetation

Paper birch and whit... ...tly drier have inclusions of balsam poplar. The ... w, red raspberry, and high-bush cranberry. The graminoid and forb layers are variable with little cover. Mosses have low cover and species diversity.

Variations

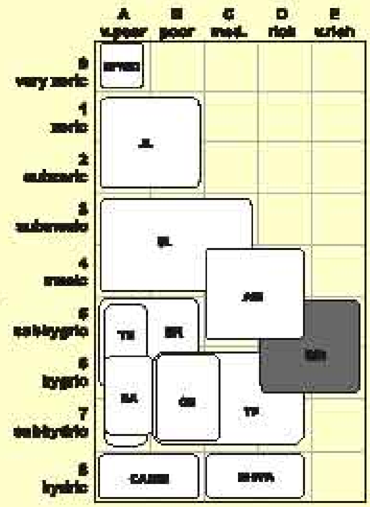
Riparian succession re... ...ging from young seral to mature clim... ...y with willow shrub layers. Low species ... ...late to rare flooding frequency have b... ...d high graminoid cover.

3 **Edatopic grid showing the relationship between Ecosystem Types in terms of Soil Moisture Regime (rows) and Soil Nutrient Regime (columns).**

Distribution

Stands of this ecosite usu... ...ystems between lakes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills

Meso Site Position: Lower ...

Successional Status: Mature ...

Soil Moisture: Fresh to Moderately Moist

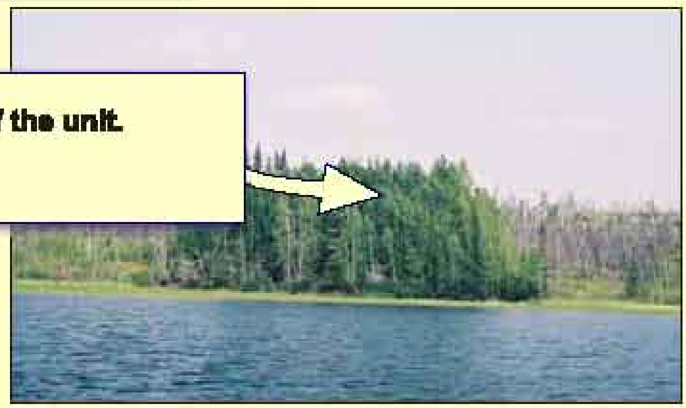
Soil Nutrient: Medium to Rich

Drainage: Moderately Well to Imperfectly

Perviousness: Moderate to Slow

Broad Ecosystem Units ...classified ... ...re ...ous ... *Burns.*

4 **Values for Site and Soil Characteristics are averages or most typical.**



5 **Photo examples of the unit.**

Characteristic Species of WR

Average % Cover	Range % Cover	
		Coniferous tree
4.0	0 - 11.0	...spruce *(Picea glauc...*
2.5	0 - 5.1	...
		D...
22.5	0 - 45.0	p...
15.0	0 - 60.0	b...
		D...
15.5		w...
12.5		n...
5.0		h...
2.0		re...
		G...
20.0		R...
0.2		b...
		Forb
0.1		cinquefoil *(Potentilla sp.)*

6 **The Characteristic Species table show typical percent cover of plant species for these Ecosystem Units that were sampled. Other structural stages and stand compositions may occur.**

Species of WR F14

% Cover	
	Coniferous tree
5.0	black spruce *(Picea mariana)*
	Deciduous tree
20.0	paper birch *(Betula papyrifera)*
	Deciduous shrub
5.0	tea leaved willow *(Salix planifolia sp. planifolia)*
3.0	northern bush willow *(Salix arbusculoides)*
	Fern and Fern Ally
2.0	wood horsetail *(Equisetum sylvaticum)*
	Graminoid
1.0	Slimstem reedgrass *(Calamagrostis stricta sp. inexpansa)*
	Forb
	...wamp willowherb *(Epilobium palustre)*

Zone	Boreal
Class	Riparian
Type	Forest

Spruce - Willow Riparian Forest

WR

General Characteristics **(N=4)** Vegetation within each site varied, including dominant canopy and understory tree species.

Site Description

This forest type generally occurs in depressional areas within hilly landscapes. These ecotypes have a rich nutrient regime and moderately moist to moist soil moisture. Soil is imperfectly drained and will remain saturated for a few days after saturation.

Vegetation

Paper birch and white spruce dominate in mature stands. Forests that are slightly drier have inclusions of balsam poplar. The shrub layer tends to be sparse. Shrubs may include willow, red raspberry, and high-bush cranberry. The graminoid and forb layers are variable with little cover. Mosses have low cover and species diversity.

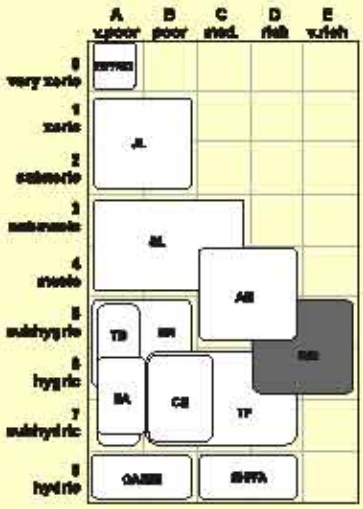
Variations

Riparian succession results in a broad range of structural stages of this ecosystem type, ranging from young seral to mature climatic climax. Frequently flooded sites support a paper birch canopy with willow shrub layers. Low species diversity is typical of frequently flooded sites. Sites with intermediate to rare flooding frequency have balsam poplar, and paper birch canopy with low shrub coverage and high graminoid cover.

Distribution

Stands of this ecosite usually occur adjacent to streams in the boreal zone and in drainage systems between lakes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills
Meso Site Position: Lower slope to Level
Successional Status: Mature Climatic Climax to Young Seral
Soil Moisture: Fresh to Moderately Moist
Soil Nutrient: Medium to Rich
Drainage: Moderately Well to Imperfectly drained
Perviousness: Moderate to Slow

Broad Ecosystem Units

•This unit is classified as Riparian Woodland and Shrubland.

Characteristic Species of WR

Average % Cover	Range % Cover	
		Coniferous tree
4.0	0 - 11.0	white spruce (*Picea glauca*)
		Deciduous tree
22.5	0 - 45.0	paper birch (*Betula papyrifera*)
15.0	0 - 60.0	balsam poplar (*Populus balsamifera*)
		Deciduous shrub
15.5	0 - 50.0	willow (*Salix* spp.)
12.5	0 - 60.0	northern blackcurrant (*Ribes hudsonianum*)
5.0	0 - 15.0	highbush cranberry (*Viburnum edule*)
2.0	0 - 5.0	red raspberry (*Rubus idaeus*)
		Graminoid
20.0	0 - 80.0	Reedgrass (*Calamagrostis sp.*)
0.2	0 - 1.0	bluejoint (*Calamagrostis canadensis*)
		Forb
0.1	0 - 0.1	cinquefoil (*Potentilla sp.*)

Species of WR F23

% Cover	
	Coniferous tree
3.0	white spruce (*Picea glauca*)
	Deciduous tree
40.0	paper birch (*Betula papyrifera*)
	Deciduous shrub
50.0	Willow (*Salix sp.*)
5.0	highbush-cranberry (*Viburnum edule*)
2.0	northern blackcurrant (*Ribes hudsonianum*)
	Graminoid
0.1	Reedgrass (*Calamagrostis sp.*)
	Forb
2.0	Canada violet (*Viola canadensis*)

Zone	Boreal
Class	Upland
Type	Forest

Spruce - Moss Forest

AM

***General Characteristics* (N=3)** This is a productive upland treed ecosystem. Understory vegetation composition varies between sites.

Site Description

This forest type develops on well drained sites underlain by fine-textured till veneers or bedrock. Moderately fresh soils assist with providing a modest amount of water and nutrients to plant forms.

Vegetation

The closed canopy is dominated by white spruce in climatic climax stages and paper birch as a seral community. Understory vegetation is variable and limited in cover. Shrubs include Labrador tea, green alder, and bog cranberry. Graminoid species present include bluejoint, however species cover is minimal. The moss and lichen layers are poorly developed, dominated by step moss, red-stemmed feathermoss and Cladonia lichens.

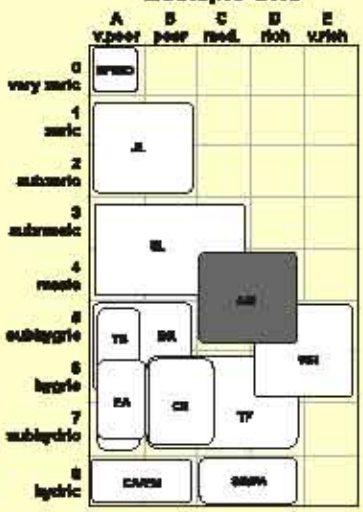
Variations

Paper birch is the dominant seral species following fire disturbance.

Distribution

Stands of this forest type were uncommon in the boreal zone of the study area. They were generally found on slopes above lake or at the toe of slopes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills
Meso Site Position: Toe to Upper Slope
Successional Status: Young Seral to Young Climatic Climax
Soil Moisture: Moderately Fresh to Fresh
Soil Nutrient: Medium
Drainage: Well to Rapidly drained
Perviousness: Moderate to Rapid

Broad Ecosystem Units

- Conifer dominated stands are classified as Mesic Coniferous Woodland.
- Deciduous and mixed stands are classified as Mixed and Deciduous Woodland.
- Burned stands are classified as Burns.

Characteristic Species of AM

Average % Cover	Range % Cover	
		Coniferous tree
10.0	1.0 – 15.0	white spruce *(Picea glauca)*
		Deciduous tree
76.7	70 – 85.0	paper birch *(Betula papyrifera)*
		Deciduous shrub
3.3	0 – 10.0	green alder *(Alnus viridis ssp. crispa)*
		Dwarf shrub
3.4	0 – 10.0	bog cranberry *(Vaccinium vitis-idaea)*
		Fern and Fern Ally
1.7	0 – 5.0	wood horsetail *(Equisetum sylvaticum)*
		Graminoid
0.7	0 – 2.0	bluejoint *(Calamagrostis Canadensis)*
		Moss
0.3	0 – 1.0	red-stemmed feathermoss *(Pleurozium schreberi)*
		Lichen
3.4	0 – 10.0	clad lichen *(Cladonia sp.)*

Species of AM F18

% Cover	
	Coniferous tree
1.0	white spruce *(Picea glauca)*
	Deciduous tree
85.0	paper birch *(Betula papyrifera)*
	Dwarf shrub
10.0	bog cranberry *(Vaccinium vitis-idaea)*
	Graminoid
2.0	bluejoint *(Calamagrostis Canadensis)*
1.0	slimstem reedgrass *(Calamagrostis stricta ssp. inexpansa)*

Zone	Boreal
Class	Riparian
Type	Forest

Boulder Field BF

General Characteristics **(N=2)** The sites are generally similar in successional status, soil moisture and nutrients, and vegetation composition.

Site Description

This ecosite occurs on exposed slopes on hills within the region. Bedrock is exposed and the available soil is nutrient poor. Vegetation growth on areas where shallow soil has developed, limiting species diversity and cover. As a result of exposed bedrock, drainage is very rapid and soil moisture is very dry.

Vegetation

Stunted jack pine trees are scattered throughout the ecosite forming a very open canopy. Black spruce and paper birch present in very low numbers, provide limited cover. Shrub species composition is limited to common juniper, red raspberry, and bearberry. Ferns within this ecosite include rusty cliff fern and smooth cliff fern. Minimal amounts of grass and forb species survive in this environment. The dominant grass species is glaucous bluegrass, and the most common forb is three-toothed saxifrage. Moss life forms are limited within Boulder Fields, however, lichen cover and diversity is relatively high.

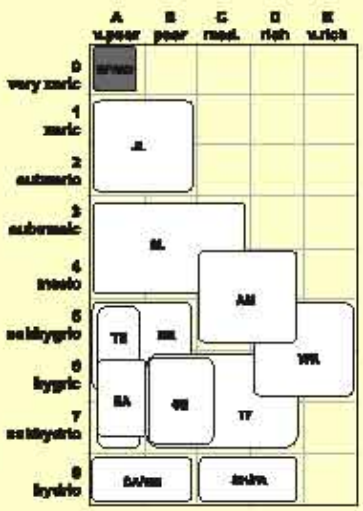
Variations

Species composition varies in relation to available soil and site microenvironments.

Distribution

The Boulder Field ecosite develops on areas that are dry, exposed, and have significant rock outcrops.

Edatopic Grid



Site and Soil Characteristics

Regional Landscape: Hills
Meso Site Position: Middle to Upper Slope
Successional Status: Young Seral to Mature Edaphic Climax
Soil Moisture: Very Dry
Soil Nutrient: Very Poor to Poor
Drainage: Very Rapidly to Rapidly drained
Perviousness: not applicable because of significant rock outcropping

Broad Ecosystem Units

•This unit is classified as Bedrock and Boulder Field.

Characteristic Species of BF

Average % Cover	Range % Cover		
0.2	0.1 – 0.2	Coniferous tree	jack pine *(Pinus banksiana)*
0.1	0 – 0.2		black spruce *(Picea mariana)*
2.8	0.1 – 5.0	Deciduous tree	paper birch *(Betula papyrifera)*
35.0	10 – 60.0	Evergreen shrub	common juniper *(Juniperus communis)*
1.0	1.0	Deciduous shrub	red raspberry *(Rubus idaeus)*
2.6	0.2 – 5.0	Dwarf shrub	bearberry *(Arctostaphylos uva-ursi)*
0.1	0.1	Fern and Fern Ally	rusty cliff fern *(Woodsia ilvensis)*
1.0	1.0	Graminoid	glaucous bluegrass *(Poe glauca)*
3.5	2.0 – 5.0	Forb	three-toothed saxifrage *(Saxifrage tricuspidata)*
2.5	0 – 5.0	Moss	juniper haircap moss *(Polytrichum juniperinum)*
12.5	5.0 – 20.0	Lichen	eyed foam *(Stereocaulon tomentosum)*
7.5	5.0 – 10.0		lesser green reindeer *(Cladina mitis)*

Species of BF F31

% Cover		
0.2	Coniferous tree	jack pine *(Pinus banksiana)*
5.0	Deciduous tree	paper birch *(Betula papyrifera)*
10.0	Evergreen shrub	common juniper *(Juniperus communis)*
1.0	Deciduous shrub	red raspberry *(Rubus idaeus)*
5.0	Dwarf shrub	bearberry *(Arctostaphylos uva-ursi)*
0.1	Fern and Fern Ally	rusty cliff fern *(Woodsia ilvensis)*
1.0	Graminoid	glaucous bluegrass *(Poe glauca)*
5.0	Forb	three-toothed saxifrage *(Saxifrage tricuspidata)*
5.0	Moss	juniper haircap moss *(Polytrichum juniperinum)*
20.0	Lichen	eyed foam *(Stereocaulon tomentosum)*
5.0		lesser green reindeer *(Cladina mitis)*
2.0		Icelandmoss *(Cetraria sp.)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Scrub birch - Cloudberry Low Shrub Bog

BR

General Characteristics (N=1) The term "bog" is applied to this ecosystem in the broad sense. Strictly, though, it is probably a "poor fen".

Site Description

This ecosite occurs in depression areas within upland regions. The soil remains moist due to poor drainage. The amount of nutrients available to vegetation is considered moderate.

Vegetation

Understory vegetation is generally homogeneous with scrub birch dominating and minimal cover from willows, horsetail, bluejoint, and fireweed. No moss and lichen life forms are present within this ecosite.

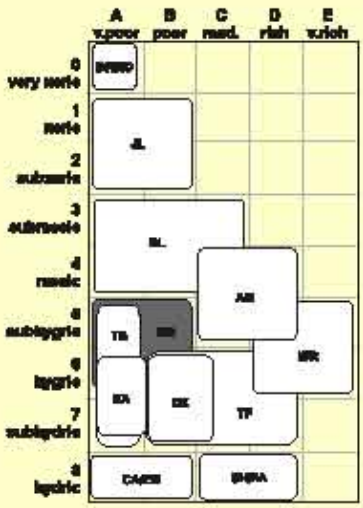
Variations

Water levels and fire can alter the distribution of shrubs, graminoids, mosses, and lichens.

Distribution

BR tends to occur in the polygon centres, while graminoid fen ecosystems (EA, CE, CA) occupy polygon perimeters. It is found in close association with TB ecosites and is present as islands within larger TB polygons. It is rarely mapped on its own.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Seral (scrub birch), Young Edaphic Climax (black spruce)
Soil Moisture: Moist
Soil Nutrient: Poor to Medium
Drainage: Poorly drained
Perviousness: Slow

Broad Ecosystem Units

•This unit is classified as Birch Hummock.

Characteristic Species of BR

Average % Cover	Range % Cover	
		Coniferous tree
6.0	6.0	tamarack *(Larix laricina)*
1.0	1.0	black spruce *(Picea mariana)*
		Deciduous shrub
85.0	85.0	scrub birch *(Betula nana)*
1.0	1.0	willow (*Salix* spp.)
1.0	1.0	bilberry willow *(Salix myrtilifolia)*
		Fern and Fern Ally
0.1	0.1	wood horsetail *(Equisetum sylvaticum)*
		Graminoid
0.1	0.1	bluejoint *(Calamagrostis canadensis)*
		Forb
0.1	0.1	fireweed *(Epilobium angustifolium)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Water sedge Narrow-leaved cottongrass Fen

CA

***General Characteristics* (N=1)** This is the wettest graminoid fen ecosites in the study area.

Site Description

This ecosystem occurs on saturated organic soils derived from sedge peat blankets and veneers. The soil is very poorly drained and there is standing water within this wetland type. These graminoid fens occur in depressions within larger benchland topography.

Vegetation

A moderate to lush cover of water sedge dominates the vegetation with moderate amount of cover from dwarf shrubs such as leatherleaf and bog rosemary. Moss cover is sparse and dominated by *Sphagnum* sp.

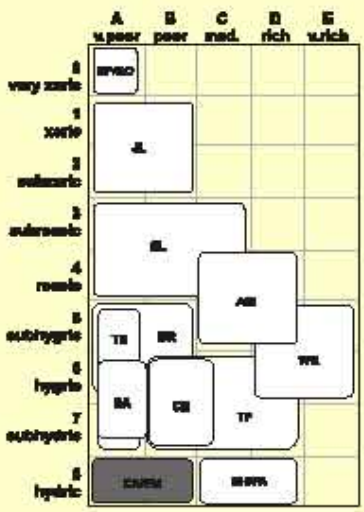
Variations

Changes in water movement may alter species composition.

Distribution

This common ecosystem often co-occurs with other graminoid fens (CE, EA), low shrub bogs (BR), and open water (OW). It is restricted to very wet sites with some water movement.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Edaphic Climax
Soil Moisture: Wet
Soil Nutrient: Rich
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit if classified as **Sedge Fen.**
- Complexes of BR, EA, and CA are classified as **Wetland Complex.**

No photo available

Characteristic Species of CA

Average % Cover	Range % Cover	
		Coniferous tree
3.0	3.0	tamarack (*Larix laricina*)
		Evergreen shrub
10.0	10.0	leatherleaf (*Chamaedaphne calyculata*)
		Dwarf shrub
5.0	5.0	cloudberry (*Rubus chamaemorus*)
3.0	3.0	bog rosemary (*Andromeda polifolia*)
1.0	1.0	bog cranberry (*Vaccinium vitis-idaea*)
		Graminoid
70.0	70.0	water sedge (*Carex aquatilis*)
		Moss
1.0	1.0	Sphagnum species (*Sphagnum sp.*)

Zone	Boreal
Class	Wetland
Type	Non-treed

Round-fruited sedge Chamisso's cottongrass Fen

CE

General Characteristics **(N=1)** These graminoid fens can vary in vegetation composition in relation to site and soil characteristics. For example, Chamisso's cottongrass is present within this site, but no round-fruited sedge was observed at the time of the site investigation.

Site Description

This ecosystem occurs on saturated organic soils in depressional areas. Nutrients available for vegetation are considered moderate.

Vegetation

Cottongrass and sedges are the dominant vegetation. Scattered bog rosemary and cloudberry are present. Common brown Sphagnum forms a significant component of the moss layer.

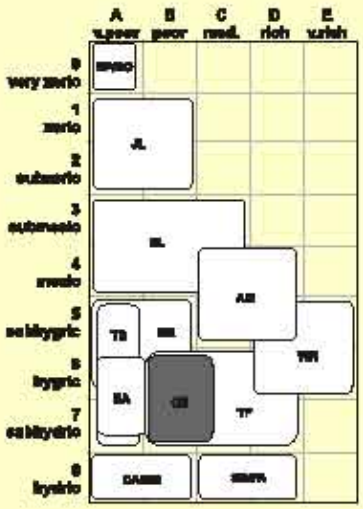
Variations

Changes in water movement may alter species composition.

Distribution

This ecosystem often co-occurs with other graminoid fens (CA, CE, EA) and low shrub bogs (BR). It is restricted to wet sites with some water movement.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Seral
Soil Moisture: Wet
Soil Nutrient: Medium
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as **Sedge Fen.**
- Complexes of BR, EA, and CE are classified as **Wetland Complex.**

Characteristic Species of CE

Average % Cover	Range % Cover	
		Evergreen shrub
1.0	1.0	Labrador tea *(Ledum groenlandicum)*
		Dwarf shrub
5.0	5.0	cloudberry *(Rubus chamaemorus)*
2.0	2.0	bog rosemary *(Andromeda polifolia)*
		Graminoid
20.0	20.0	sedge species *(Carex sp.)*
10.0	10.0	Chamisso's cotton grass *(Eriophorum chamissonis)*
5.0	5.0	sheathed cotton-grass *(Eriophorum vaginatum)*
		Moss
20.0	20.0	common brown sphagnum *(Sphagnum fuscum)*
5.0	5.0	shaggy sphagnum *(Sphagnum squarrosum)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Sheathed cottongrass Bog-rosemary Sedge Fen

EA

***General Characteristics* (N=1)** This graminoid fen occurs within a Tamarack Blueberry Treed Fen (TF).

Site Description

This ecosystem occurs in depressional areas within regional plateaus. As a result of poor drainage and slow perviousness, the soil is moderately wet.

Vegetation

A moderate cover of sedges dominates the vegetation, in particular water sedge. Shaggy sphagnum and other sphagnum species including common brown and midway peat moss are present. Scattered leatherleaf and scrub birch may occur.

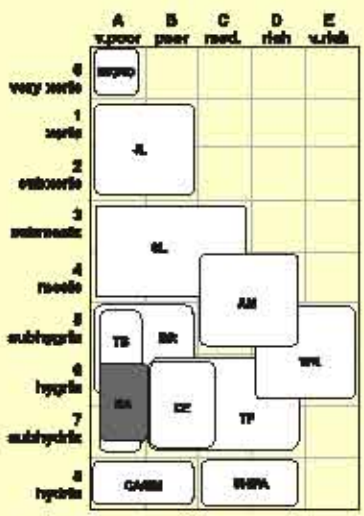
Variations

Changes in water movement may alter species composition.

Distribution

This ecosystem was uncommon and only found in small patches with TF ecosites.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Seral
Soil Moisture: Moderately Wet
Soil Nutrient: Medium
Drainage: Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as Sedge Fen.
- Complexes of BR and EA are classified as Wetland Complex.

Characteristic Species of EA

Average % Cover	Range % Cover	
		Evergreen shrub
10.0	10.0	leatherleaf *(Chamaedaphne calyculata)*
		Deciduous shrub
5.0	5.0	scrub birch *(Betula nana)*
		Graminoid
60.0	60.0	water sedge *(Carex aquatilis)*
		Forb
1.0	1.0	arrow-leaved coltsfoot *(Petasites sagittatus)*
		Moss
30.0	30.0	shaggy sphagnum *(Sphagnum squarrosum)*
6.0	6.0	common brown sphagnum *(Sphagnum fuscum)*
2.0	2.0	midway peatmoss *(Sphagnum magellanicum)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Water sedge Horsetail Shallow Shore Marsh

EM

General Characteristics **(N=4)** This shallow shore marsh occurs along lake and pond shores.

Site Description

This ecosystem occurs in shallow open water. High available nutrients support a variety of sedges.

Vegetation

Vegetation is patchy and interspersed with shallow open water. Water sedge is the dominant species. Potentilla and other sedge species are common. Forb cover is sparse but diverse.

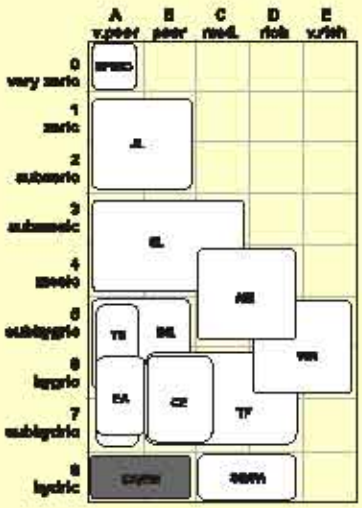
Variations

Water fluctuations can determine species composition and cover. Low water levels during drier years within the shallow shore marsh provide substrate for pioneer forb species to establish.

Distribution

This ecosystem is commonly found as a fringe along lake and pond shores.

Ecotopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression and Level
Successional Status: Mature Seral
Soil Moisture: Wet
Soil Nutrient: Medium and Rich
Drainage: Poorly to Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

•This unit is classified as Other Wetlands.

Characteristic Species of EM

Average % Cover	Range % Cover	
		Evergreen Shrub
0.1	0 – 0.1	leatherleaf *(Chamaedaphne calyculata)*
		Deciduous shrub
0.4	0 – 4.0	sweet gale *(Myrica gale)*
		Graminoid
55.3	1.0 – 90.0	water sedge *(Carex aquatilis)*
12.5	0 – 40.0	beaked sedge *(Carex utriculata)*
		Forb
2.0	0 – 5.0	cinquefoil *(Potentilla sp.)*
2.6	0 – 10.0	wild calla *(Calla palustris)*

Species of EM 17

% Cover	
	Graminoid
90.0	water sedge *(Carex aquatilis)*
	Forb
10.0	wild calla *(Calla palustris)*
4.0	greater bladderwort *(Utricularia macrorhiza)*

Zone	*Boreal*
Class	*Wetland*
Type	*Floating Aquatic*

Floating Aquatic Shallow Open Water

FA

***General Characteristics* (N=0)**
Visual assessments only were completed for this ecosite.

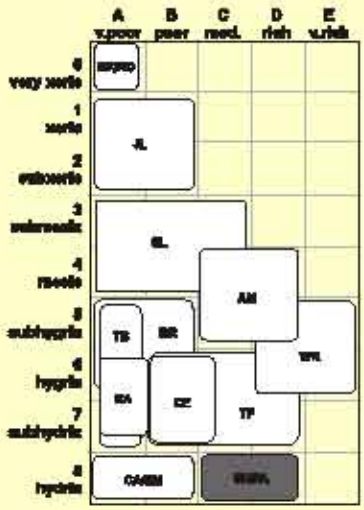
Site Description
Standing water is present throughout the year.

Vegetation
Vegetation is composed of floating aquatic vascular plants, including small yellow pond lily, water sedge, emergent horsetail, and pondweed.

Variations
Variations in species composition would depend on water depth and chemistry.

Distribution
Floating aquatic ecosites occur in shallow open water, approximately < 2 m in depth or in shallow portions of lakes or ponds.

Edatopic Grid



Site and Soil Characteristics
Regional Landform: Hills, Plateau
Meso Site Position: Depression topography
Successional Status: Mature Seral
Soil Moisture: Wet
Soil Nutrient: Moderate
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units
•This unit is classified as Aquatic Vegetation.

Characteristic Species of FA

No species composition data available

Zone	Boreal
Class	Upland
Type	Woodland

Jack pine - Lichen Woodland

JL

General Characteristics (N=6) This woodland type is typical of dry sites in the boreal zone.

Site Description

Jack pine lichen woodlands develop on crest of hills or esker complexes. Soils tend to be shallow with bedrock outcroppings or bedrock near the surface. As a result, nutrients and water are limited as drainage is very rapid and the soil is less permeable to water.

Vegetation

Stunted jack pine trees form a very open canopy. The understory is sparse, due to lack of soil development. Forbs typically include bearberry and bog cranberry. Graminoids are scant and limited to sedgrasses and bluegrass. Lichens cover much of the ground surface, and bedrock tends to be covered with crustose lichens. Eyed foam, clad lichen and Icelandmoss lichen have significant covers. Small patches of bryophytes include *Dicranum* spp. and haircap mosses.

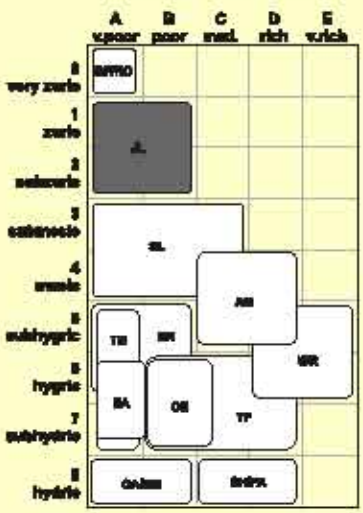
Variations

Birch is present as seral species on burnt sites.

Distribution

This ecosystem is mostly restricted to dry bedrock knolls, but it occasionally occurs on rapidly drained sandy deposits and rocky esker complexes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform,: Hills
Meso Site Position: Middle Slope to Crest
Successional Status: Young Seral to Mature Edaphic Climax
Soil Moisture: Very Dry to Dry
Soil Nutrient: Very Poor to Poor
Drainage: Very Rapidly to Rapidly drained
Perviousness: not applicable because of significant rock outcropping

Broad Ecosystem Units

- Conifer dominated stands are classified as Dry Coniferous Woodland.
- Deciduous and mixed stands are classified as Mixed and Deciduous Woodland.
- Burned stands are classified as Burns.

Characteristic Species of JL

Average % Cover	Range % Cover		
23.0	1.1 – 50.0	**Coniferous tree**	Jack pine *(Pinus banksiana)*
5.5	0 – 15.0	**Deciduous tree**	paper birch *(Betula papyrifera)*
0.4	0 – 4.0	**Deciduous shrub**	willow species *(Salix sp.)*
22.5	0 – 60.0	**Dwarf shrub**	bearberry *(Arctostaphylos uva-ursi)*
1.8	0 – 5.0		bog cranberry *(Vaccinium vitis-idaea)*
0.2	0 – 1.0	**Fern and Fern Ally**	Virginia polypody *(Polypodium virginianum)*
0.1	0 – 0.2	**Graminoid**	glaucous bluegrass *(Poa glauca)*
3.8	0 – 20.0	**Moss**	dicranum species *(Dicranum sp.)*
1.9	0 – 5.0		juniper haircap moss *(Polytrichum juniperinum)*
5.8	0 – 30.0	**Lichen**	crust lichen (Crustose lichen)
3.7	0 – 10.0		eyed foam *(Stereocaulon tomentosum)*
2.7	0 – 15.0		clad lichens *(Cladonia sp.)*

Species of JL F35

% Cover	
	Coniferous tree
7.0	black spruce *(Picea mariana)*
1.1	Jack pine *(Pinus banksiana)*
	Deciduous tree
11.0	paper birch *(Betula papyrifera)*
	Dwarf shrub
60.0	bearberry *(Arctostaphylos uva-ursi)*
3.0	bog cranberry *(Vaccinium vitis-idaea)*
	Graminoid
1.0	spike trisetum *(Trisetum spicatum)*
	Forb
1.0	bastard toad-flax *(Geocaulon lividum)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Willow - Sedge Low Shrub Fen

SH

General Characteristics (N=0) Visual assessments only were made for this ecosystem.

Site Description This ecosystem occurs on saturated organic soils derived from sedge peat blankets and veneers.

Vegetation

Low shrubs and sedges dominate the vegetation. The moderate shrub layer is mostly composed of willows, with leatherleaf present as a minor component. Several species of sedges may be present, but water sedge is usually the dominant species. Cloudberry plants may be scattered throughout the herb layer. The moderate moss layer has variable species composition. Peat mosses are often present.

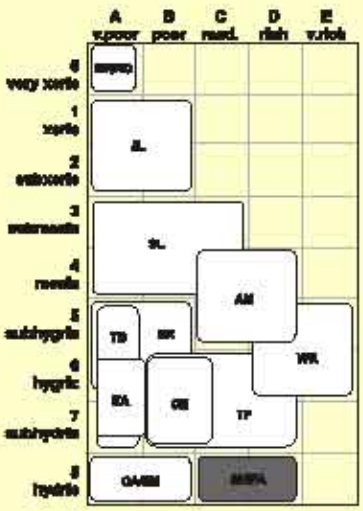
Variations

Species composition will vary with water movement and frequency of fire.

Distribution

This shrubby fen often co-occurs with graminoid fens. Common distribution was near open water, treed fens or drainage areas. It is restricted to wet sites with some water movement.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression and Level
Successional Status: Young Seral to Mature Seral
Soil Moisture: Wet
Soil Nutrient: Medium to Rich
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

•This unit is classified as Shrubby Fen.

Characteristic Species of SH

No species composition data available

Zone	Boreal
Class	Upland
Type	Woodland

Spruce - Lichen Woodland

SL

General Characteristics (N=7) This Spruce - Lichen woodland commonly occure within the study area.

Site Description

The Spruce-Lichen Woodland type typically occurs on slopes of hills. Soils range from Regosols with boulder and till deposits, or Brunisol soils over til veneer. Soil nutrient levels are low and soils are moderately dry.

Vegetation

Mature stands are dominated by black spruce. The shrub layer is composed of Labrador tea, green alder, willow, and bog cranberry. The herb layer is sparse and lacks species diversity. Moss are dominated by *Dicranum* species and have moderate cover. Reindeer, Icelandmoss lichens, and clad lichens are common. Lichen cover is high in mature stands.

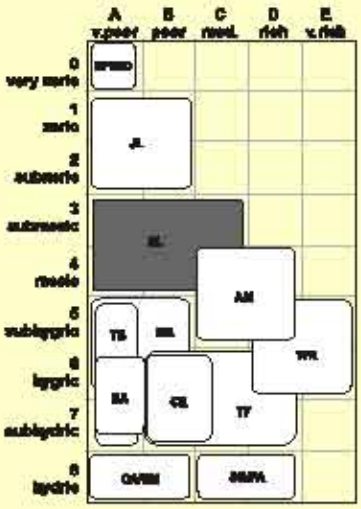
Variations

Stands are subjected to relatively frequent fires. Following fire, fireweed and deciduous shrubs are pioneer species. Paper birch and jack pine are seral canopy species with black spruce regeneration. Lichen coverage is limited in seral stands.

Distribution

This ecosystem occurs on a broad range of well-drained sites underlain by till and bedrock. It is also found on a variety of slope positions and aspects.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills
Meso Site Position: Crest to Level
Successional Status: Young Seral to Young Climatic Climax
Soil Moisture: Dry to Moderately Fresh
Soil Nutrient: Very Poor to Medium
Drainage: Very Rapidly to Moderately drained
Perviousness: Moderate to Rapid

Broad Ecosystem Units

- Conifer dominated stands are classified as **Dry Coniferous Woodland.**
- Deciduous and mixed stands are classified as **Mixed and Deciduous Woodland.**
- Burnt stands are classified as **Burns.**

Characteristic Species of SL

Average % Cover	Range % Cover	Coniferous tree
14.9	0 – 41.0	black spruce (*Picea mariana*)
12.5	0 – 75.0	Jack pine *(Pinus banksiana)*
		Deciduous tree
8.2	0 – 18.0	paper birch *(Betula papyrifera)*
		Evergreen shrub
13.3	0.1 – 30.0	Labrador tea *(Ledum groenlandicum)*
		Deciduous shrub
1.9	0 – 8.0	green alder *(Alnus viridis ssp. crispa)*
		Dwarf shrub
6.7	0.1 – 25.0	bog cranberry *(Vaccinium vitis-idaea)*
		Moss
2.6	0 – 10.0	dicranum species *(Dicranum sp.)*
0.9	0 – 3.0	juniper haircap moss *(Polytrichum juniperinum)*
		Lichen
9.6	0 – 25.0	lesser green reindeer *(Cladina mitis)*
6.4	0 – 25.0	grey reindeer *(Cladina rangiferina)*

Species of SL F4

% Cover	Coniferous tree
75.0	Jack pine *(Pinus banksiana)*
1.0	black spruce (*Picea mariana*)
	Evergreen shrub
1.0	Labrador tea *(Ledum groenlandicum)*
	Dwarf shrub
1.0	bog cranberry *(Vaccinium vitis-idaea)*
1.0	bearberry *(Arctostaphylos uva-ursi)*
	Moss
1.0	dicranum species *(Dicranum sp.)*
	Lichen
8.0	clad lichens *(Cladonia sp.)*
1.0	Icelandmoss lichen *(Cetraria sp.)*

Zone	Boreal
Class	Wetland
Type	Treed

Spruce - Cloudberry Treed Bog

TB

General Characteristics (N=5)

This wetland type is a Treed Northern Plateau Bog. The term "bog" is applied to this ecosystem in the broad sense. Strictly, though, it is probably a "poor fen".

Site Description

Treed bogs occur on *Sphagnum* peat deposits. This wetland type typically occurs in depressional areas within upland or hilly regions. These sites have low levels of nutrients available for plant growth and are generally moist. Organic soils develop over time due to poor drainage and elevated water levels.

Vegetation

Stunted black spruce usually forms a very open canopy with a relatively homogeneous shrub layer. Labrador tea, as well as minor components of cloudberry, bog blueberry and bog cranberry dominate the shrub layer. Graminoids and forbs are insignificant understory components. Moss and lichen life forms are diverse and contribute to a considerable amount of total cover within this wetland.

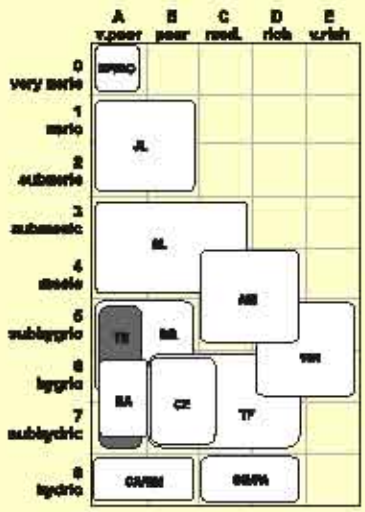
Variations

The lichen form (TBl) occurs when the ground surface becomes elevated and experiences moisture deficits. It has a carpet of reindeer lichens, with little living *Sphagnum* on the ground surface. In young seral and edaphic successional types, understory vegetation is more diverse with higher cover, compared to the mature stands.

Distribution

Treed bogs are located as plateaus within upland areas. They are often surrounded by bedrock outcrops supporting SL or JL ecosites.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Level to Depressional
Successional Status: Young Seral to Mature Edaphic Climax
Soil Moisture: Moderately Wet to Moist
Soil Nutrient: Very Poor to Poor
Drainage: Poor
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as Treed Fens and Bogs.
- Burned occurrences are classified as Burns.

Characteristic Species of TB

Average % Cover	Range % Cover		
12.0	0.1 - 36.0	Coniferous tree	black spruce (*Picea mariana*)
1.8	0 – 6.0	Deciduous tree	water birch (*Betula occidentalis*)
44.0	20.0 - 70.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
0.8	0 - 2.0	Deciduous shrub	bog blueberry (*Vaccinium uliginosum*)
2.0	0 - 5.0	Dwarf shrub	cloudberry (*Rubus chamaemorus*)
0.8	0 - 2.0		bog cranberry (*Vaccinium vitis-idaea*)
0.4	0 - 1.0		crowberry (*Empetrum nigrum*)
12.0	0 - 25.0	Moss	dicranum species (*Dicranum sp.*)
3.4	0 - 15.0		common brown sphagnum (*Sphagnum fuscum*)
6.0	0 - 15.0	Lichen	clad lichen (*Cladonia sp.*)
3.2	0 - 10.0		grey reindeer (*Cladina rangiferina*)

Species of TB FS

% Cover		
0.2	Coniferous tree	Jack pine (*Pinus banksiana*)
3.0	Deciduous tree	water birch (*Betula occidentalis*)
20.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
3.0	Deciduous shrub	green alder (*Alnus viridis sp. crispa*)
3.0		scrub birch (*Betula nana*)
1.0		bog blueberry (*Vaccinium uliginosum*)
2.0	Dwarf shrub	cloudberry (*Rubus chamaemorus*)
2.0		alpine bearberry (*Arctostaphylos alpina var. rubra*)
3.0	Fern and Fern Ally	common horsetail (*Equisetum arvense*)
20.0	Moss	dicranum species (*Dicranum sp.*)
15.0		common brown sphagnum (*Sphagnum fuscum*)
0.5		bog haircap moss (*Polytrichum strictum*)
6.0	Lichen	clad lichen (*Cladonia sp.*)
1.0		grey reindeer (*Cladina rangiferina*)

Zone	Boreal
Class	Wetland
Type	Treed

Tamarack Blueberry Treed Fen

TF

General Characteristics **(N=2)** This ecosite appears within a variety of topographic conditions including upland and valley floor environments. Vegetation composition and cover varies between sites.

Site Description

Treed fens occur on well developed organic layers that are moist to moderately wet and relatively nutrient rich. These sites are poorly drained with slow perviousness.

Vegetation

Stunted black spruce and tamarack usually form a very open canopy. The moderate shrub layer is variable, and can include Labrador tea, northern Labrador tea, scrub birch, willow species, and bog blueberry. Dwarf woody plants also occur including crowberry and bog cranberry. The moss layer is well developed and is the main component of the understory vegetation. Common moss species include common brown sphagnum, *Dicranum* sp., and *Aulacomnium* sp. Lichen cover is low.

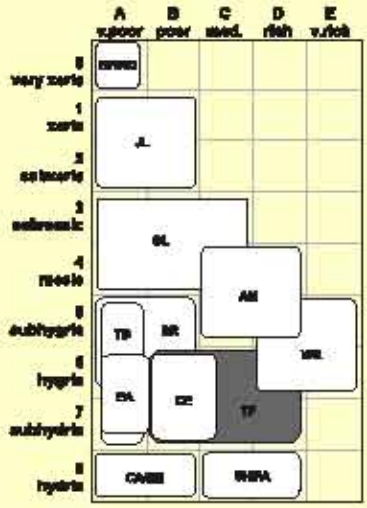
Variations

Sites categorized as Tamarack Blueberry Treed Fens may vary slightly in vegetation species composition and cover in relation to soil moisture conditions. In young seral and edaphic successional types, understory vegetation is more diverse with higher cover, compared to the mature stands.

Distribution

Treed fens occur in drainage areas of the boreal zone. They are usually found in upland plateaus that have water movement or near open wetlands.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression to Level topography
Successional Status: Mature Seral to Young Edaphic Climax
Soil Moisture: Moist to Moderately Wet
Soil Nutrient: Medium to Rich
Drainage: Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as Treed Fens and Bogs.
- Burned areas are classified as Burns.

Characteristic Species of TF

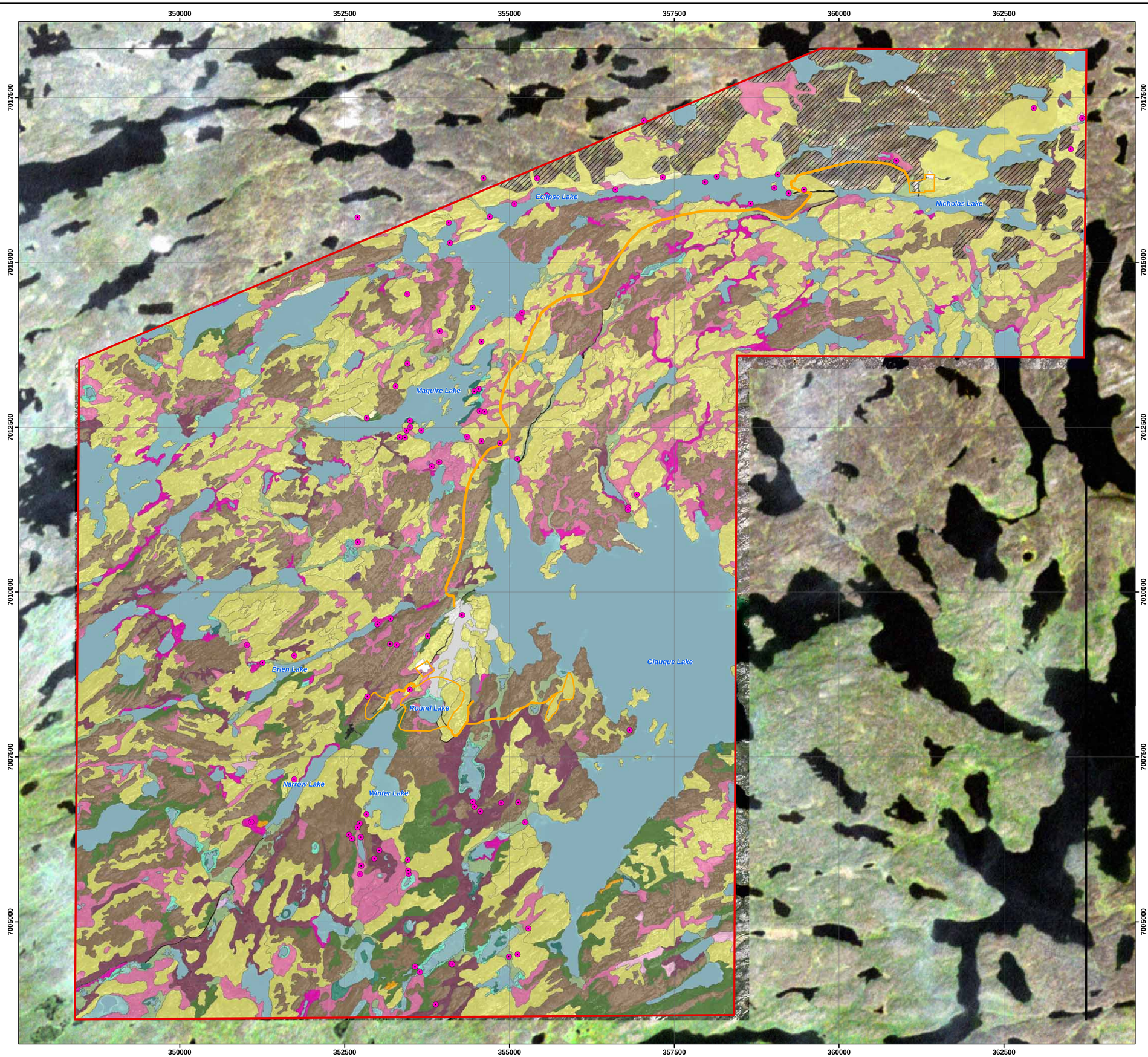
Average % Cover	Range % Cover		
13.0	1.0 – 25.0	Coniferous tree	black spruce (*Picea mariana*)
6.0	3.0 – 9.0		tamarack (*Larix laricina*)
5.0	0 - 10.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
2.5	0 - 5.0		northern Labrador tea (*Ledum palustre ssp. decumbens*)
18.0	1.0 – 35.0	Deciduous shrub	scrub birch (*Betula nana*)
2.6	0.1 – 5.0		willow species (*Salix sp.*)
0.6	0.1 - 1.0		bog blueberry (*Vaccinium uliginosum*)
2.0	0 - 4.0	Dwarf shrub	crowberry (*Empetrum nigrum*)
1.1	0.1 - 2.0		bog cranberry (*Vaccinium vitis-idaea*)
30.0	30.0	Moss	common brown sphagnum (*Sphagnum fuscum*)
6.0	6.0		dicranum species (*Dicranum sp.*)
2.0	2.0		sheggy sphagnum (*Sphagnum squarrosum*)
6.0	6.0	Lichen	lesser green lichen (*Cladina mitis*)
1.0	1.0		Icelandmoss (*Cetraria sp.*)

Species of TF F36

% Cover		
25.0	Coniferous tree	black spruce (*Picea mariana*)
9.0		tamarack (*Larix laricina*)
10.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
5.0		northern Labrador tea (*Ledum palustre ssp. decumbens*)
1.0	Deciduous shrub	scrub birch (*Betula nana*)
0.1		willow species (*Salix sp.*)
1.0		bog blueberry (*Vaccinium uliginosum*)
4.0	Dwarf shrub	crowberry (*Empetrum nigrum*)
2.0		bog cranberry (*Vaccinium vitis-idaea*)
30.0	Moss	common brown sphagnum (*Sphagnum fuscum*)
5.0		dicranum species (*Dicranum sp.*)
2.0		sheggy sphagnum (*Sphagnum squarrosum*)
2.0		bog haimap moss (*Polytrichum strictum*)
5.0	Lichen	lesser green lichen (*Cladina mitis*)
1.0		Icelandmoss (*Cetraria sp.*)

APPENDIX C

LARGE SCALE MAPS OF STUDY AREA



Legend

- Sample Location
- Local Study Area
- Proposed Footprint
- Cloud

Ecosystem Units

Wetland

- BR Scrub birch cloudberry low shrub bog
- CA Water sedge – narrow leaved cottongrass fen
- CE Round fruited sedge – Chamisso's cottongrass fen
- EA Sheathed cottongrass – bog rosemary sedge fen
- EM Water sedge – horsetail shallow shore marsh
- FA Floating aquatic shallow open water
- SH Willow – sedge low shrub fen
- TB Spruce – cloudberry treed bog
- TF Tamarack – blueberry treed fen

Riparian

- WR Spruce – willow riparian forest

Forest and Woodland

- AM Spruce – moss forest
- JL Jack pine – lichen woodland
- SL Spruce – lichen woodland

Sparsely Vegetated

- BF Boulder field
- RO Rock outcrop

Anthropogenic

- GP Gravel pit
- RP Road surface
- RR Rural development
- TD Tailing deposit

Water

- LA Lake
- PD Pond
- OW Open water

N W E S

Scale 1:29,986

Km

0 0.375 0.75 1.5 2.25

Imagery Source: IKONOS (July 27 and August 2 2004)
Landsat TM (August 11 2001)

Yellowknife Gold Project

Ecosystem Types in the Local Study Area

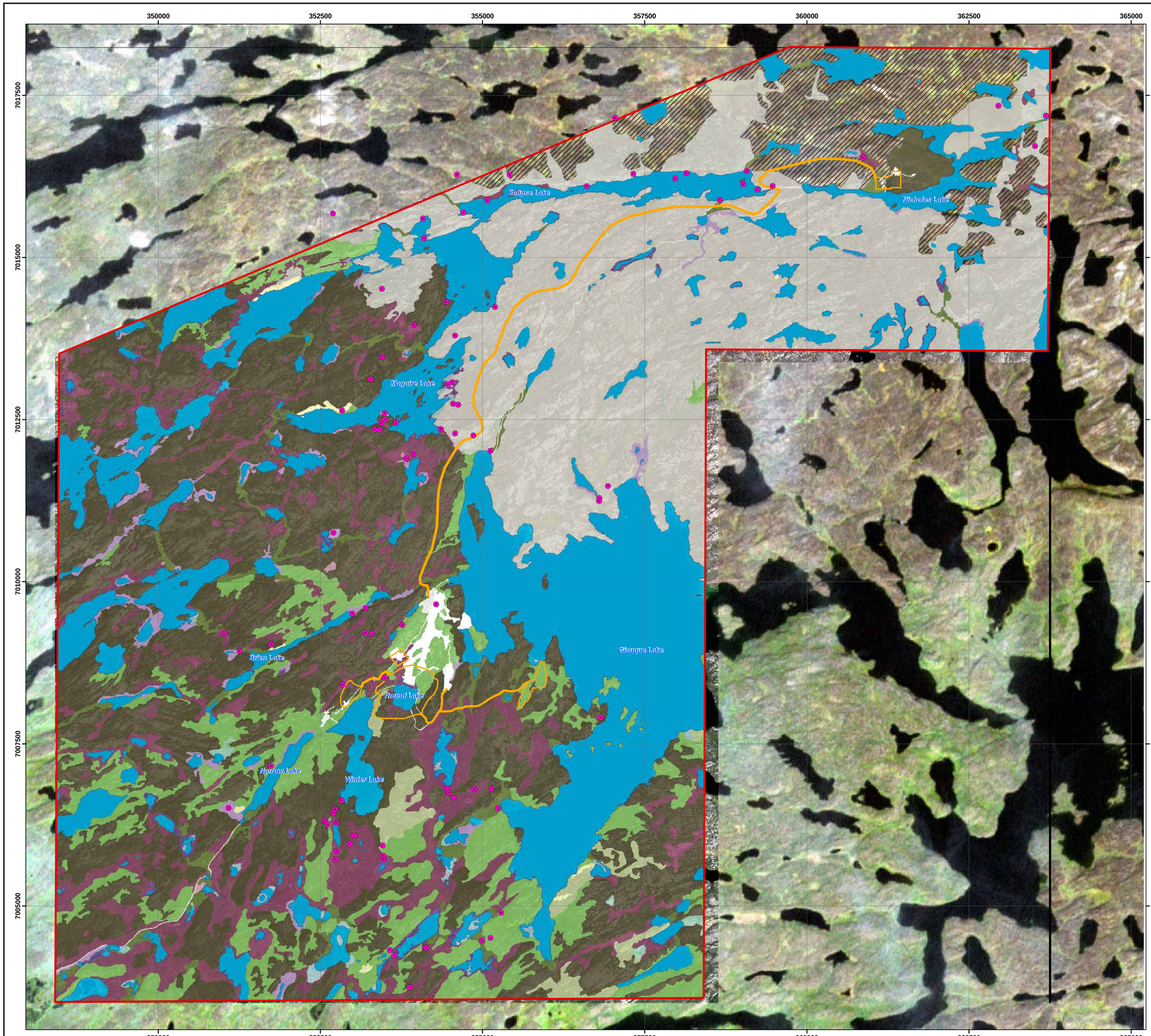
Tyhee NWT Corp

EBA ENGINEERING CONSULTANTS LTD.

February, 2005

Figure 1

Project No. 1740082



Legend

- Sample Location
- Local Study Area
- Proposed Footprint
- Cloud

Broad Ecosystem Units

- Anthropogenic
- Water
- Aquatic Vegetation
- Bedrock Boulder Field
- Burns
- Birch Hummock
- Dry Coniferous Woodland
- Mesic Coniferous Woodland
- Mixed and Deciduous Woodland
- Riparian Woodland and Shrubland
- Other Wetland
- Sedge Fen
- Shrubby Fen
- Treed Fens and Bogs

N W E S

Scale 1:29,983

0 0.375 0.75 1.5 2.25 Km

Imagery Source: IKONOS (July 27 and August 2 2004)
Landsat TM (August 11 2001)

Yellowknife Gold Project

Broad Ecosystem Units in the Local Study Area

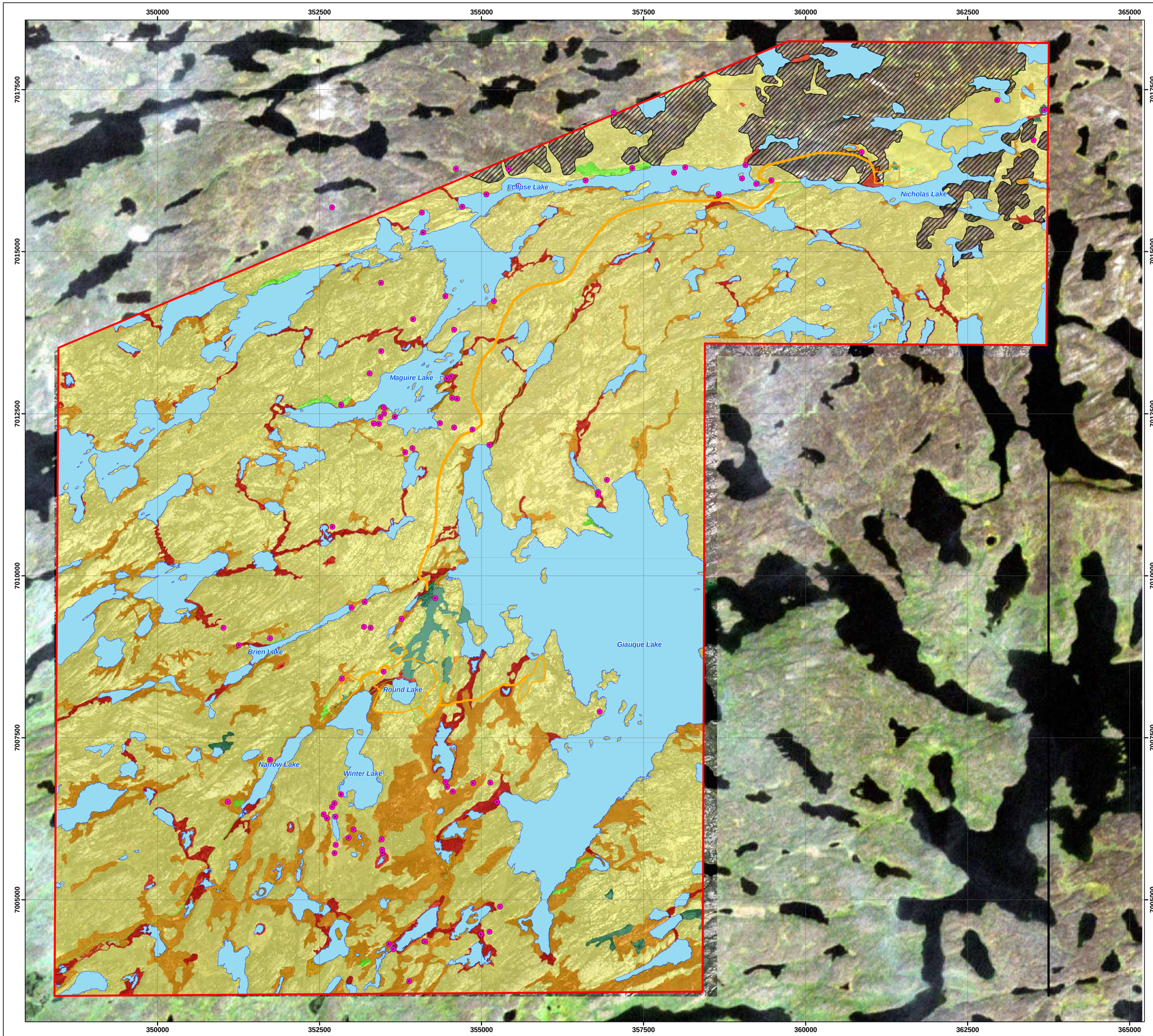
Tyhee NWT Corp

EBA ENGINEERING CONSULTANTS LTD.

February 2005

Figure 2

Project No. 1740082



Legend

- Sample Location
- Local Study Area
- Proposed Footprint
- Cloud
- Water >2m

ant Potential

- Very Low
- Low
- Moderate
- High
- Very High
- yellowknife_river-basin-lakes_v2

N
W
E
S

Scale 1:30,004

0 0.375 0.75 1.5 2.25 Km

Imagery Source: IKONOS (July 27 and August 2 2004)
Landsat TM (August 11 2001)

Yellowknife Gold Project

Rare Plant Potential in the
Local Study Area

Tyhee NWT Corp

EBA ENGINEERING CONSULTANTS LTD.

February 2005

Figure 3

Project No. 1740082

Tyhee NWT Corp

YELLOWKNIFE GOLD PROJECT

2005 ECOLOGICAL LAND CLASSIFICATION - FIELD REPORT AND RARE PLANT SURVEY

May 2006

CREATING AND DELIVERING BETTER SOLUTIONS

eba

Tyhee NWT Corp.

2005 ECOLOGICAL LAND CLASSIFICATION AND RARE PLANT SURVEY FIELD REPORT

YELLOWKNIFE GOLD PROJECT

1740180.001

May 2006

EBA Engineering Consultants Ltd.
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EXECUTIVE SUMMARY

Ecological land classification is a mapping process that involves the integration of site, soil, and vegetation information. This information is used to organize ecological data into units that respond to disturbance in a consistent manner. This information is then used to development integrated and sustainable resource management plans.

The Yellowknife Gold Project (YGP) study area (~14,475 ha) is located within the Tazin Lake Upland Ecoregion of the Western Taiga Shield Ecozone. It is characterized by cool summers and cold winters and has a sub-humid, high boreal ecoclimate. Upland areas are dominated by bedrock exposures, while organic deposits cover lowlands. Dystric Brunisols are the dominant upland soils and Organic Cryosols are found in poorly drained, peat-filled depressions. Trembling aspen, jack pine, and white and black spruce dominate upland areas, while stands of tamarack and black spruce dominate poorly drained fens and bogs.

Baseline data was collected in July 2004 and in July and August 2005 during the rare plant survey. There were 130 field inspections completed in 12 ecosystem types resulting in a Terrestrial Ecosystem Mapping (TEM) sampling intensity level 5. Mapping at a 1:20,000 scale was completed using IKONOS imagery. Twenty-two ecosystem types were classified within the study area. Fourteen of these were naturally vegetated, three were classified as water, four were anthropogenic and one was cloud. Spruce-lichen (SL) was the dominant ecosystem type covering 33% of the YGP study area. Jack pine-lichen was second covering 19.1%. Treed bog was the most dominant wetland type covering 8.3% of the YGP study area. There were eight naturally vegetated ecosystem types of restricted distribution, each covering less than 1% of the YGP study area. Fifteen broad ecosystem units that correlated to the West Kitikmeot Slave Study (WKSS) were assigned to each polygon. Dry Coniferous Woodland was the most abundant broad unit, with Burns second in abundance.

Complex polygons accounted for more than 35% of the polygons mapped and over 50% of the area mapped. Spruce-lichen was the most common ecosystem that was complexed with one other unit. Treed bogs were the most common complexed with two other ecosystem types. This is due to the presence of small sedge and shrubby fens within the larger TB polygons. Coniferous stands accounted for close to 36% of the study area. The most abundant structural stage was young forest, with low/tall shrub woodland being the second most abundant. This is due to the fire history of the area, and the recent fire that affected the northeast portion of the study area.

Confidence in the mapping and subsequent data analysis is moderate to high for most units, with the exception of the AM unit, which is low. Confidence in mapping structural stage, stand composition, and broad ecosystem units is moderate.

The study area was mapped for potential rare plant habitat. Each ecosystem rank was derived from a frequency histogram that correlated each ecosystem type with the number of rare plants potentially found within them. The following five ranks were assigned: very low (1 to 4 plants), low (5 to 9 plants), moderate (10 to 14 plants), high (15 to 19 plants) and very high (>20 plants). Fifteen percent (15%) of the study area is ranked as either high or very high for rare plant habitat potential.

The most common rank was moderate, covering 58% of the study area. Confidence in mapping the rare plant habitat potential is moderate.

Exploration, construction, and site activities will require the clearing of vegetation, grading, cut and fill, extraction of borrow material, development of an all weather road and a tailings containment areas. This will result in the potential impact to soil resources, and a direct loss of vegetation. As well, air emissions from the processing facility could affect vegetation health. Development of Winter Lake as the tailings containment area could affect aquatic vegetation. *Potamogeton foliosus*, a rare plant, was field identified two locations in Winter Lake. This identification was not confirmed by the University of Alberta, Herbarium.

Based on proposed Project activities, the following impacts on vegetation communities have been identified: vegetation removal, alteration of soil properties, alternation of hydrology, change in water quality, air emissions**,** possible introduction of non-native or invasive **s**pecies, increased risk of spills, site maintenance activities, increased risk of fire due to human presence. Many of these impacts can be mitigated by applying best management practices to minimize the projects' footprint. Impact to *P. foliosus,* if identification is confirmed, could be mitigated.

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1.0 INTRODUCTION

Ecological Land Classification (ELC), an ecological mapping process that involves the integration of site, soil and vegetation information, was undertaken as part of the integrated environmental baseline investigation conducted by EBA Engineering Consultants Ltd. (EBA) for Tyhee NWT Corp. (Tyhee). Integrated and sustainable resource management requires an understanding of ecosystem dynamics and functioning, and ecosystem classification helps organize ecological data into units that respond to disturbance in a similar and predictable manner. Understanding past, present, and potential future development requires an understanding of environmental baseline conditions. This baseline provides a basis for long-term monitoring of the environment associated with future mining activities. The ELC is also a biophysical base for other resource components such as wildlife and biodiversity.

Despite its growth in many parts of Canada, ELC has been completed in only select areas of northern Canada and Alaska. Several ELC-related projects have been completed in the Northwest Territories (NWT). Larsen (1971) described the vegetation from Great Slave Lake north to Artillery Lake. He sampled high boreal forest, tundra, and the forest-tundra transition zone, and classified a number of broad forest and tundra communities. Along the Mackenzie River, vegetation mapping was carried out at a scale of 1:125,000, including the mapping of several broad forest and tundra ecosystem units (Canada Forest Management Institute 1974). Bradley *et al.* (1982) conducted an ecological land survey of the Lockhart River map area, an area that extends from Mackay Lake in the northwest to Selwyn Lake in the southeast. Based on field investigations, they described a range of ecological features, and classified and mapped Ecoregions and Subregions, Ecodistricts, and basic structural vegetation types.

In recent years, new ELC work has been completed as part of the environmental assessments for development applications, particularly northeast of Yellowknife where diamond exploration and mining is underway. Table 1 provides a summary of ELC work that has occurred since 1995.

TABLE 1: RECENT ECOLOGICAL LAND CLASSIFICATION PROJECTS NORTH OF YELLOWKNIFE

Project	Description	Reference
EKATI Diamond Mine NWT Diamonds Project	• New description and classification of 12 detailed ecosystem units	• BHP (1995)
Diavik Diamond Mine	• Broad mapping of landcover units using Landsat™ • Same methodology and units as Epp and Matthews (1999) • YGP study area vegetation mapping was also completed using 11 vegetation units separate from the landcover units described above	• Golder Associates (1997a) • Golder Associates (1997b) • Diavik Associates (1997)
EKATI Diamond Mine Sable, Pigeon and Beartooth Mines	• 1:20,000 scale ecosystem mapping completed for the EKATI Diamond Mine area	• BHP (2000)
Kennady Lake Diamond Project	• 1:20,000 scale Ecosystem mapping of 225 km² using the tundra units developed for EKATI Diamond Mine • One additional spruce unit added for a total of 13 ecosystem units • Continued ecosystem mapping for Gahcho Kué	• EBA and JWEL (2000) • AMEC and EBA (2004)
West Kitikmeot Slave Study Region Final Report (WKSS)	• Broad mapping of land cover units using Landsat™	• Matthews and Epp (2001)
Snap Lake	• Mapping of vegetation classes using Landsat™ • Same methodology and units as Epp and Matthews (1999) plus four new vegetation units	• De Beers (2001)
Tibbit to Contwoyto Winter Road	• 1:3,500 scale ecosystem mapping of the portages for the winter road corridor • Used 18 ecosystem units adapted from the above studies	• EBA (2002a, 2002b)

2.0 YELLOWKNIFE GOLD PROJECT STUDY AREA

The Yellowknife Gold Project study area (YGP) is ~14,475 ha and is located within the Tazin Lake Upland Ecoregion, Western Taiga Shield Ecozone. The Tazin Lake Upland is characterized by cool summers and very cold winters and has a sub-humid, high boreal ecoclimate. Uplands are dominated by bedrock exposures, while lowlands are covered by organic deposits. Dystric Brunisols are the dominant upland soils formed on discontinuous veneers of sandy till. There are significant inclusions of Turbic Cryosols on permanently frozen sites and Organic Cryosols in poorly drained, peat-filled depressions (Environment Canada 2000).

Vegetation of the Tazin Lake Upland is characterized by medium to tall, closed stands of trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and paper birch (*Betula papyrifera*). Jack pine (*Pinus banksiana*) dominates early successional stands, while white spruce (*Picea glauca*) and black spruce (*Picea mariana*) dominate the later successional stands. Poorly drained fens and bogs in this region are covered with low, open stands of tamarack (*Larix laricina*) and black spruce (Environment Canada 2000).

3.0 PROJECT OBJECTIVES

The objectives of the ELC are to complete the following tasks:

- define ecosystem types on the basis of field studies;
- map and characterize the landscape in the YGP study area using ecosystem units and satellite imagery;
- characterize the aerial extent of the proposed development footprint on the landscape; and
- identify key management issues related to ecosystem types and the proposed development.

The objective of the Rare Plant Survey (RPS) is to:

- determine if any rare vascular plants are present within areas that will be directly affected by the development footprint.

4.0 ECOLOGICAL LAND CLASSIFICATION

The following sections provide information on the methods, results, and discussion on the ELC portion of this project.

4.1 METHODS

The ELC project methods are divided into four phases: preliminary ecosystem classification and sampling plan, field sampling, satellite imagery preparation, and ELC mapping. The methods and approach associated with each phase are discussed below.

4.1.1 Preliminary Classification and Sampling Plan

A literature review was completed of relevant ecosystem mapping in NWT at the initiation of the project. A list of potential ecosystem types was compiled prior to the field sampling based on the ecosystem units defined for the Tibbitt to Contwoyto Winter Road (EBA, 2002a). The ecosystem sampling plan was adapted from British Columbia's Terrestrial Ecosystem Mapping (TEM) system (Resources Inventory Committee [RIC] 1998a, 1998b) and other established ELC approaches (see Sims *et al.* 1996). The TEM standard has also been recently adopted for several other ELC mapping exercises conducted as a part of environmental assessments in northern Canada.

A TEM Level 4 survey intensity was planned for the ELC sampling of the study area. This sampling intensity includes 15% to 25% polygon visitation with a plot ratio of 5% detailed full plots, 20% ground inspection form (GIF) plots and 75% visual plots. This ratio was considered appropriate for the ELC mapping scale and the diversity of ELC units thought to be present within the study area. Given the size of the study area, and a mapping scale of 1:20,000 (average polygon size of 20 ha), it was estimated that a maximum of 188 plots (25% sampling intensity) would be needed of the following types:

- 10 full plots;
- 38 GIF plots; and
- 140 visual plots.

The minimum number of plots required would be 113 at a 15% sampling intensity (based on the above assumptions). Prior to field sampling, potential sampling locations were identified using national topographic system (NTS) maps and local knowledge of the study area.

4.1.2 Field Sampling

Field data collection occurred from July 19, 2004 to July 24, 2004, and July 8, 2005 to July 10, 2005 and August 13, 2005 to August 15, 2005, and followed the standards established in British Columbia for Describing Terrestrial Ecosystems in the Field (DTEIF) (Province of British Columbia 1998) and for TEM (RIC 1998a). All plot position

coordinates were determined using global positioning system (GPS) with an expected accuracy of 6 m to 8 m. The ELC field crew consisted of a two-person team, which undertook a range of field measurements that are described below.

A total of 37 full plots and 93 visuals were completed for a total of 130 sample plots. A sampling ratio of 28:0:72 was achieved for full, GIF, and visual plots in the field. The 130 plots sampled within 1,294 polygons (not including water), resulted in a 10% sampling intensity for the project. This meets the requirements for a TEM Level 5 survey. The final number of plots sampled was reduced from the pre-field planning target numbers (as mentioned in Section 4.1). This adjustment was due to difficulties in accessing potential sample locations. To make up for the difficulties in access, more full plots were completed to ensure sufficient information was collected to adequately describe the ecosystem types.

In each of the full plots, the following site information was collected: plot number, date, UTM coordinates, elevation, exposure, aspect, slope, macro- and meso-site position, soil moisture, drainage and nutrient regime, ecosystem unit name, successional status, structural stage, and surface substrate (bedrock, rocks, mineral soil, wood, organic matter, and water). Notes describing the plot, in context and variability within the polygon, were recorded. Photographs were taken at each plot.

All vascular plant species, and most bryophytes and lichens were identified in the full plots. Vegetation cover, density, and distribution estimates were recorded. Vascular plant identification followed Porsild and Cody (1968, 1980). Bryophyte and lichen identification followed Vitt *et al*. (1988).

Visual plots involved recording brief point or area characteristics made from the air or ground, and were used to note the basic ecosystem unit, vegetation, or other key features. The primary function of visual plots is to aid in the delineation of polygon labels and to confirm the placement of polygon boundaries during the photo interpretation and mapping phases of the work. No GIF plots were completed.

During the ELC field sampling, special features and other observations were recorded when encountered. These included observations of burn severity, wildlife, and signs of wildlife use. Evidence of recent burns was observed in the eastern section of the study area. Attempts were made to establish plots in unburned woodlands, recent burns, and several post-fire seral stages to characterize vegetation succession.

Following field sampling, GPS data associated with the plot locations were prepared for use in the project's GIS software (ESRI 3.2 and Arc/Info® 8.1). The ELC plot data was digitally transcribed from field plot forms, into MS Access database, using VPRO, an ecological data entry and management tool (Province of British Columbia 1999). The ELC plot data is provided in Appendix A.

4.1.3 Satellite Image Preparation

The imagery used for mapping was created from two ortho-rectified IKONOS scenes acquired between July 27, 2004, and August 2, 2004. There was significant cloud cover in

several areas in the northeastern portion of the study area. The clouds were visually identified, removed and imagery was replaced with Landsat 7^{TM} imagery from August 11, 2001. IKONOS imagery has a resolution of 4 m in the multi-spectral bands and 1 m in the panchromatic band. The imagery was enhanced to increase visual interpretation using a linear transformation and several mosaics were produced highlighting different band combinations. Images produced include: 4 m true colour image, 1 m pan-sharpened true colour image, 4 m false colour image (uses the near IR band to highlight vegetation), and 1 m pan-sharpened false colour image.

4.1.4 Mapping

Ecosystems were interpreted, mapped and labelled on-screen using ArcView® GIS 3.2. Interpretation and labelling followed approaches defined by the RIC (1998a). To maintain a high level of consistency, the staff that completed the field sampling also attributed the polygons. Ecosystems were mapped at a nominal scale of 1:20,000. A quality assurance/quality control (QA/QC) review of the mapping was conducted concurrently with the line work. At the beginning of each day, 10% of the polygons that were previously mapped were revisited to ensure consistency from day to day. At the end of the mapping process, 10% of the polygons were audited for accuracy. Final ELC documents include ecosystem summaries, analysis of the ecosystem units within the study area, and a map of the study area.

4.2 RESULTS OF FIELD SAMPLING AND MAPPING

Data collected in the field was used for ecosystem classification and mapping. Classification and mapping results for soils and vegetation are presented below.

4.2.1 Soils

A soil survey of the YGP study area was not completed as part of the baseline survey. The information contained in this report is based on a literature review of soils found in the region.

The YGP study area is described in the *Soils of Canada* as a strongly rolling plain comprised of igneous and metamorphic rockland with stony, sandy glacial till, and fluvial deposits. The soil climate is subarctic (humid), with discontinuous permafrost. The dominant soils are Orthic Dystric Brunisols in rockland areas. Orthic Grey Luvisols and Orthic Eutric Brunisols occur to a lesser extent. Most soils are well drained and are often stony and/or lithic (shallow) (Agriculture Canada 1977).

In the immediate area of the historic Discovery Mine, soils are limited in extent as bedrock is generally at, or very near, the surface. Mineral soils were observed in the valley bottoms to the north of the Ormsby portal and southeast of the proposed tailings containment area. Most of these soils have an organic surface of varying thickness. Shallow mineral soils also occur in depressions in the bedrock. The mineral soils have developed primarily on fine-textured (silt and clay) glacial fluvial or lacustrine materials. Organic soils are present in

poorly drained bog and fen areas. Permafrost is common in organic soils (Klohn Leonoff 1992)

Laboratory tests were conducted on several soil samples to determine their ability to support plant growth (Klohn Leonoff 1992). Analyses were completed on fine- and coarse-textured material and a summary of the results is presented below in Table 2. Complete analysis is provided in the 1992 report completed by Klohn Leonoff.

TABLE 2: SOIL CHEMICAL AND PHYSICAL ANALYSIS

	Fine Soil[1]	Coarse Soil[2]
Chemical Properties		
pH	6.28	5.55
Electrical Conductivity (dS/cm)	1.50	1.60
Cation Exchange Capacity (meq/100 g)	16.5	6.2
Ca^{++}	7.8	2.4
Mg^{++}	3.5	0.5
Na^{+}	0.1	0.2
K^{+}	0.36	1.13
Nutrient Analysis		
Organic carbon (%)	1.71	0.80
Total N %	0.10	0.05
NH_4-N	26	94
NO_3-N	5.9	8.6
PO_4-P (ppm)	57	4.9
SO_4-S (ppm)	15	12
Physical Properties		
Water holding capacity (% gravimetric)	17.7	4.4
Sand (%)	7	99
Silt (%)	52	0.5
Clay (%)	41	0.5

[1] Fine soil is defined as having a median grain size < 75 µ.
[2] Coarse soil is defined as having a median grain size > 75 µ.

4.2.2 Vegetation

Detailed vegetation data was collected in the field and used to determine ecosystem classification. Below is a description of how the ecosystem units were classified, what units were found, and how they are distributed in the YGP study area.

4.2.2.1 Defining ELC Units

An ELC Unit (or Ecosystem Unit) is composed of five hierarchical components: zone, ecosystem type, site modifier, structural stage, and stand composition. The zone is defined as Boreal. The ecosystem types developed for the boreal portion of the Tibbitt to Contwoyto Winter Road project (EBA 2002a) were used for this project. Table 3 lists each of the ecosystem types identified in the YGP study area.

TABLE 3: ECOSYSTEM TYPES IN THE YGP STUDY AREA

Type	Description
Wetland and Riparian	
BR	Wetland, non treed scrub birch cloudberry low shrub bog
CA	Wetland, graminoid water sedge – narrow leaved cottongrass fen
CE	Wetland, graminoid round fruited sedge – Chamisso's cottongrass fen
EA	Wetland, graminoid sheathed cottongrass – bog rosemary sedge fen
EM	Wetland, graminoid water sedge – horsetail shallow shore marsh
FA	Wetland, floating aquatic shallow open water
SH	Wetland, non-treed willow – sedge low shrub fen
TB	Wetland, treed spruce – cloudberry treed bog
TF	Wetland, treed tamarack – blueberry treed fen
WR	Riparian Wetland, forest spruce – willow forest
Forest and Woodland	
AM	Upland, spruce – moss forest
JL	Upland, Jack pine – lichen woodland
SL	Upland, spruce – lichen woodland
Sparsely Vegetated	
BF	Upland, boulder field
RO	Upland, rock outcrop
Water	
OW	Open water, less than 2 m deep
PD	Open water, greater than 2 m deep and less than 50 ha in size
LA	Open water, greater than 2 m deep and greater than 50 ha in size
Anthropogenic	
GP	Gravel pit
RP	Road surface
RR	Rural development
TD	Tailing deposit
Other	

TABLE 3: ECOSYSTEM TYPES IN THE YGP STUDY AREA	
Type	Description
CD	Cloud

Site modifiers for atypical conditions as developed by BHP (1995) were adopted for this project, as well a site modifier for high lichen cover and a site modifier to identify areas that had some coverage of mine tailings. The site modifiers used for this project are provided in Table 4.

TABLE 4 : SITE MODIFIERS FOR THE YGP STUDY AREA	
Code	Description
e	Unit occurs on an esker
l	High lichen cover (visible from air)
r	30% or more of surface cover is bedrock
t	30% or more of the surface cover is mine tailings

Structural stages describe the existing dominant stand appearance or physiognomy for an ecosystem unit. This parameter emphasises structural habitat characteristics and it can be used to help describe the seral variation within an ecosystem type. As was done for BHP (1995), structural stage classes as defined by the DTEIF system (RIC 1998a) were adopted for this project (Table 5). The adoption of the tree heights with the associated structural stages can be problematic in northern Canada. Trees can fall within structural stages 4 to 7 as far as age, and be less than 10 m tall. For this project, we did not use tree height as a measure for structural stage.

TABLE 5: STRUCTURAL STAGES USED FOR THE YGP STUDY AREA		
Code	Structural Stage	Definition
1	**Sparse/Bryoid**	Initial stages of primary and secondary succession; bryophytes, and lichens often dominant; time since disturbance may be prolonged where there is little or no soil development (bedrock, boulder fields, etc.)
1a	Sparse	Less than 10% vegetation cover
1b	Bryoid	Bryophyte and lichen-dominated community (>50% of total vegetative cover)
2	**Herb**	Early successional stage or herb communities maintained by environmental conditions or disturbance; dominated by herbs; some invading or residual shrubs and trees may be present; many non-wooded communities are perpetually maintained in this stage
2a	Forb-dominated	Includes non-graminoid herbs and ferns

TABLE 5: STRUCTURAL STAGES USED FOR THE YGP STUDY AREA		
Code	Structural Stage	Definition
2b	Graminoid-dominated	Includes grasses, sedges, reeds, and rushes
2c	Aquatic	Floating or submerged; does not include sedges growing in marshes with standing water (classed as 2b)
2d	Dwarf shrub-dominated	Dominated by dwarf woody species such as crowberry, mountain cranberry, twinflower, cloudberry, etc.
3	**Shrub/Woodland**	Early successional stage or shrub communities maintained by environmental conditions or disturbance; dominated by shrubby vegetation; seedlings and advance regeneration may be abundant
3a	Low shrub	Dominated by shrubby vegetation < 2 m tall; seedlings and advance regeneration may be abundant; may be perpetuated indefinitely by environmental conditions or disturbance
3b	Tall shrub/Woodland	Dominated by shrubs or trees that are 2 m to 10 m tall; often the near-climax structural stage for woodlands in the study area
4	**Pole/Sapling**	Typically densely stocked, have overtopped shrub and herb layers; self-thinning and vertical structure not yet evident in the canopy
5	**Young Forest**	Self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers (dominant, main canopy, and overtopped)
6	**Mature Forest**	Trees established after the last disturbance have matured; understories become well developed as the canopy opens up; time since disturbance generally 80 to 140 years
7	**Old Forest**	Old, structurally complex stands comprised mainly of shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition and patchy understories typical; time since disturbance generally > 140 years

Stand composition modifiers are used to further differentiate structural stages 4 to 7 (i.e., pole/sapling, young forest, mature forest, and old forest) based upon coniferous, broadleaf or mixed conifer-broadleaf stand composition (Table 6).

TABLE 6: STAND COMPOSITION FOR THE YGP STUDY AREA		
Code	Stand Composition	Definition
B	Broadleaf	>75% of total tree cover is broadleaf
C	Coniferous	>75% of total tree cover is coniferous
M	Mixed	Neither coniferous or broadleaf account for >75% of total tree cover

Disturbance codes were also assigned to polygons when applicable (Table 7). Disturbance types were allocated into two classes: fire and soil. These two classes were further

subdivided into a number of sub-classes (for example, fire was differentiated into severe or moderate sub-classes) to provide additional characterization of the disturbance type.

TABLE 7: DISTURBANCE CODES FOR THE YGP STUDY AREA

Disturbance	Class	Code	Description
Fire	Severe	Fs	Severe fire with few standing snags remaining (forested areas)
	Moderate	Fm	Moderate fire with significant proportion of standing snags (forested areas)
Soil	Excavation	Se	Applies to an area exposed through the removal of sand and gravel
	Mining	Sm	Applies to a non-vegetated area used for the extraction of mineral ore and other materials
	Mining	Sd	Applies to areas that have tailing deposition

4.2.2.2 Ecosystem Summaries

Using data that was collected during the field sampling, each field site was classified into an ecosystem type, and types were analyzed for similarities and differences. Summary sheets were produced to provide easy, quick review of the characteristics of the ecosystems that were mapped for this project. The descriptions are not meant to be a final characterization of the units and should be viewed as a representation of the vegetation sampled in the study area.

In total, 14 summary sheets were produced for the ecosystem types that were mapped in the study area. Twelve of these summaries are based on quantitative data collected in the field and two are based on qualitative data collected in the field. Fact sheets were not made for the non-vegetated or anthropogenic ecosystem types. Brief summaries are provided below, with detailed fact sheets located in Appendix B.

Forest and Woodland

The forested and woodland ecosystems are upland units that are dominated by black and white spruce and jack pine in climax communities. Immediately after fire, these communities are dominated by fast growing deciduous seral species, such as paper birch (*Betula papyrifera*) and alder (*Alnus* spp.). The slower growing jack pine (*Pinus banksiana*) becomes the dominant species a few years after fire. In the YGP study area, there are numerous successional stages observed in the upland areas due to fire. These upland units cover approximately 56% of the study area.

AM: Spruce – Moss Forest

This is the most productive forest ecosystem of the study area and is generally found on lower slopes or toe positions in the landscape. This ecosystem has a moderate nutrient

regime with a mesic moisture regime. White spruce (*Picea glauca*) is the climatic climax species, but seral communities are dominated by paper birch. This ecosystem is uncommon and accounts for less than 4% of the study area.

JL: Jack Pine – Lichen Woodland

This woodland is typical of dry sites and occurs on upper slopes and crest positions of hills or esker complexes. It has a poor to very poor nutrient regime with a subxeric to xeric moisture regime. Jack pine is the common tree species while bearberry (*Arctostaphylos uva-ursi*) is the common shrub. Paper birch is present in young seral communities. Cushion mosses (*Dicranum* spp.) and haircap mosses (*Polytrichum* spp.) are common, as well as numerous *Cladonia* lichens. This ecosystem covers approximately 19% of the study area.

SL: Spruce – Lichen Woodland

This woodland is the most commonly occurring ecosystem and covers approximately 33% of the study area. It is found on upland sites, in all slope positions. It has a very poor to moderate nutrient regime with a mesic to submesic moisture regime. Black spruce (*Picea mariana*) is common in mature stands, and jack pine and paper birch may dominate seral communities. Labrador tea (*Ledum groenlandicum*), alder and bog cranberry (*Vaccinium vitis- idaea*) are common shrubs.

Riparian

One riparian ecosystem was identified in the study area. This ecosystem usually occurs adjacent to streams or in drainage systems between lakes, has a rich nutrient regime and a subhygric moisture regime. The riparian succession results in a broad range of structural stages from young seral to mature edaphic climax.

WR: Spruce – Willow Riparian Forest

Paper birch and white spruce dominate in mature stands. Forests that are slightly drier have inclusions of balsam poplar. Shrubs include willow (*Salix* spp.), red raspberry (*Rubus idaeus*), and high-bush cranberry (*Viburnum edule*). This ecosystem represents approximately 2% of the study area.

Wetland

Wetland ecosystems include sedge fens, shrubby fens, treed fens and bogs, marsh and floating aquatic. The fens and bogs are generally restricted to upland plateaus of poorly drained organic soils. Differences in water movement distinguish fens from bogs. Marshes and floating aquatic ecosystems are restricted to the edges of standing water. The wetland ecosystems represent less than 15% of the study area.

BR: Scrub Birch – Vloudberry Low Shrub Bog

This shrubby bog ecosystem is found in close association with TB ecosystems and is present as islands within larger TB polygons. It is rarely mapped on its own. It has a very

poor to poor nutrient regime and a hygric to subhygric moisture regime. Common species include scrub birch (*Betula glandulosa*), willow, sedges (*Carex* spp.) and marsh reed grass (*Calamagrostis canadensis*). This ecosystem covers less than 1% of the study area.

CA: Water Sedge Narrow-leaved Vottongrass Fen

This sedge fen co-occurs with other sedge fens and shrub bogs. It is also found within TB polygons and is rarely mapped on its own. It has a very poor to poor nutrient regime with a hydric moisture regime. Sedges and cotton grass (*Eriophorum* spp.) are the common species. This ecosystem represents less than 1% of the study area.

CE: Round-fruited Sedge Vhamisso's Vottongrass Fen

This is a slightly richer sedge fen than CA or EA. It is found in association with other sedge fens, shrubby fens and treed fens and is rarely mapped individually. It has poor to medium nutrient regime with a subhydric to hygric moisture regime. Sedges, cotton grass and peat mosses (*Sphagnum* spp.) are the common species. This ecosystem represents less than 1% of the study area.

EA: Sheathed Vottongrass Bog Rosemary Sedge Fen

This wetland ecosystem is found in association with other sedge fens, shrubby bog, treed bogs and fens, and is rarely mapped on it own. It has a very poor to poor nutrient regime and a subhydric to hygric moisture regime. Leatherleaf (*Chamaedaphne calyculata*), sedges and peat moss are common. This ecosystem accounts for less than 1% of the study area.

EM: Water Sedge Horsetail Shallow Shore Marsh

This shallow shore marsh occurs along the edges of lakes, ponds, and open water. It is has a poor nutrient regime and a hydric moisture regime. Water sedge is the dominant sedge, but forbs and other sedge species are common. Leatherleaf and willow are also found in small numbers. This ecosystem represents less than 1% of the study area.

FA: Floating Aquatic Shallow Open Water

This ecosystem occurs in shallow open water in lakes, ponds, and open water. It has a medium to rich nutrient regime and a hydric moisture regime. Horsetails (*Equisetum spp.*) and water lily (Nuphar spp.) are common. This ecosystem covers less than 1% of the study area.

SH: Willow – Sedge Low Shrub Fen

This shrubby fen often co-occurs with sedge fens. Common distribution is near open water, treed fens, or drainage areas where it is restricted to wet sites with some water movement. It has a medium to rich nutrient regime and a hydric moisture regime. Willows and sedges are common with a minor component of leatherleaf. This ecosystem accounts for approximately 2% of the study area.

TB: Spruce – Vloudberry Treed Bog

This wetland ecosystem commonly occurs on upland peat plateaus with poor drainage and is often surrounded by bedrock outcrops. It has a very poor nutrient regime with a subhydric to subhygric moisture regime. Vegetation is dominated by black spruce, Labrador tea, bog bilberry (*Vaccinium uliginosum*), and bog cranberry. Peat moss is common. This ecosystem was the most abundant of the wetland types, covering over 8% of the study area.

TF: Tamarack Blueberry Treed Fen

This ecosystem occurs in upland peat plateaus with some water movement and in drainage areas between lakes. It has a poor to rich nutrient regime and a subhydric to hygric moisture regime. Black spruce and tamarack (*Larix laricina*) form an open canopy; willow, scrub birch and bog bilberry are the common shrubs. This ecosystem was the second most common wetland type, covering approximately 4% of the study area.

Sparsely Vegetated

The sparsely vegetated ecosystems are restricted to naturally occurring units that are dominated by boulder or bedrock outcrops. Vegetation is restricted to microenvironments that have developed due to localized weathering of rock. Soil development is poor or non-existent. These ecosystems make up less than 1% of the study area.

BF: Boulder Field

This ecosystem occurs on exposed slopes of hills that have significant rock outcrops. Nutrient regime is very poor and moisture regime is very xeric. Vegetation includes common juniper (*Juniperus communis*), bearberry, and three-toothed saxifrage (*Saxifraga tricuspidata*). Crustose lichens are common.

RO: Rock Outcrop

This ecosystem is typical of bedrock outcrops that have undergone little weathering. Nutrient regime is very poor and moisture regime is very xeric. Microsites that support vegetation growth are uncommon. Vegetation cover is sparse. Crustose lichens are common.

Other Units

The anthropogenic ecosystems varied in their degree of vegetation coverage. Tailings (TD) and gravel pits (GP) are generally devoid of vegetation. Ecosystems defined as rural (RR) (i.e., some residential or commercial development) are restricted to camp areas and ranged in vegetative coverage. The developed area around the old town site is interspersed with mature trees, while the present campsite has very little vegetation coverage. Roads (RP) also ranged in vegetation coverage. Those that are actively used have sparse vegetation coverage. Abandoned roads and portages have variable vegetation coverage.

Water was divided into three ecosystem types: lake, pond, and open water. A size limit of 50 ha was used to differentiate lakes and ponds. The open water category had a depth

threshold of less than 2 m. A portion of the study area was covered by cloud and could not be mapped. This area was classified as cloud (CD).

4.2.2.3 Broad Ecosystem Units

To provide a simplified view of ecosystems suitable for basic vegetation summaries and for map presentation, broad ecosystem units were also assigned to each mapped polygon. Table 8 describes the broad ecosystem units used for this project. The ecosystem types were also compared to the broad ecosystem units used in the West Kitikmeot/Slave Study (Matthews and Epp 2001).

TABLE 8: BROAD ECOSYSTEM UNITS USED IN THE YGP STUDY AREA

YPG Ecosystem Type	Description	Broad Ecosystem Unit for YGP	West Kitikmeot/Slave Class
All units with the fire disturbance code (Fs, Fm)	Applies to areas that have evidence of relatively recent fire disturbance	Burns	Burns
AM, JL, SL: seral stands that contain mixed or deciduous stands	Mixed or deciduous stands	Mixed and deciduous woodland	Spruce forest
AM: young forest or mature stands of conifers	Mesic conifer-dominated stands.	Mesic coniferous woodland	Spruce forest
BR	This broad unit is composed solely of scrub birch – cloudberry low shrub bog	Birch hummock	Tussock/hummock
CA, CE, EA	Fens dominated by sedges and grasses	Sedge fen	Sedge wetland
EM, FA	Includes herb-dominated wetlands that do not occur in other categories	Other wetlands	Unclassified
GP, RP, RR, TD	Areas with very low vascular plant cover as a result of anthropogenic disturbance	Anthropogenic	Unclassified
JL: young forest or mature stand	Dry jack pine dominated stands	Dry coniferous woodland	Unclassified
LA, PD	Includes lakes and ponds	Water	Deep water
OW	Shallow open water and rivers	Water	Shallow water
RO, BF	Includes rock outcrops and boulderfields – they support minimal vegetation	Bedrock and boulder fields	Bedrock and boulder associations

TABLE 8: BROAD ECOSYSTEM UNITS USED IN THE YGP STUDY AREA			
YPG Ecosystem Type	Description	Broad Ecosystem Unit for YGP	West Kitikmeot/Slave Class
SH	Shrubby sites with saturated organic soils and some water movement	Shrubby fen	Riparian tall shrub
SL: young forest or mature stands	Dry black spruce dominated stands	Dry coniferous woodland	Spruce forest
TB and TF	Fens and bogs with an open canopy of trees	Treed fens and bogs	Peat bog
WR: seral, young or mature stands	Shrubby or treed areas along streams, rivers, and lake margins	Riparian woodland and shrubland	Unclassified

4.2.2.4 Ecosystem Descriptions in the YGP Study Area

The following section provides descriptive information on ecosystem types, broad units, complex polygons, stand composition, and structural stage within the YGP study area.

Ecosystem Types

A total of 1,506 polygons were mapped in the 14,475 ha study area. The average polygon size was approximately 10 ha, with a range from 0.02 ha (an island) to 1,293 ha (a lake). While the average polygon size was 10 ha, the model polygon size was 3.2 ha which indicates that over half of the polygons mapped were less than 3.2 ha in size. Twenty-two ecosystem types were assigned to the 1,506 polygons, 14 were naturally vegetated, three were classified as water, four were classified as anthropogenic and one was classified as cloud (Table 9). Visual distribution of the ecosystem types is provided in Figure 1.

Spruce-lichen woodland (SL) made up 33% of the study area, with jack pine-lichen (JL) comprising 19.1% of the study area. Water covered 21.2% of the study area, and 5.6% of the study area in the northeast corner could not be mapped due to cloud cover. Treed bogs (TB) were the next most common ecosystem type, representing 8.3% of the study area. Eight of the natural ecosystem types had less than 1% cover. Ecosystems that have less than 1% cover are considered ecosystems of restricted distribution.

Some of the ecosystem types, mostly the sedge fens, are likely to be more common than the mapping indicates. This is because these ecosystems are small and are difficult to delineate individually. They were commonly mapped as the secondary or tertiary ecosystem type in the complexed TB or treed fen (TF) polygons. Complex polygons are discussed further in this section.

TABLE 9: ECOSYSTEM TYPES WITHIN THE YGP STUDY AREA

Ecosystem Type	Total Area (ha)	No. of Polygons	Average Polygon Size (ha)	Range (min to max) (ha)	Area as % Total Area
Wetland and Riparian					
BR	25	7	3.5	0.8 to 8.1	0.2
CA	0.4	1	0.4	0.4 to 0.4	0.0
CE	3	4	0.7	0.2 to 1.5	0.0
EA	2	2	1.0	0.3 to 1.7	0.0
EM	73	57	1.3	0.1 to 7.9	0.5
FA	41	35	1.2	0.2 to 5	0.3
SH	211	89	2.4	0.2 to 9.2	1.5
TB	1,208	292	4.1	0.3 to 36.7	8.3
TF	567	51	11.1	0.4 to 88.6	3.9
WR	271	82	3.3	0.2 to 15.1	1.9
Forest and Woodland					
AM	534	65	8.2	1.1 to 53.8	3.7
JL	2,769	155	17.9	0.4 to 120.8	19.1
SL	4,794	417	11.5	0.0 to 101.6	33.1
Sparsely Vegetated					
BF	28	5	5.5	0.4 to 13.7	0.2
RO	8	7	1.1	0.1 to 2.1	0.1
Water					
OW	9	18	0.5	0.1 to 2.3	0.1
PD	295	127	2.3	0.1 to 22.7	2.0
LA	2,764	46	60.1	1.4 to 1,293.6	19.1
Anthropogenic and Other					
GP	6	2	2.9	0.9 to 5.0	0.0
RP	18	18	1.0	0.4 to 2.3	0.1
RR	9	3	3.0	1.1 to 4.9	0.1
TD	37	2	18.4	3.6 to 33.1	0.3
CD	804	21	38.3	0.6 to 499.3	5.6
TOTAL[1]	**14,475**	**1,506**			**100**

[1] Individual units may not add to 14,475, due to rounding to whole numbers.

Broad Ecosystem Units

Fifteen broad ecosystem units were assigned: twelve natural and one anthropogenic land-based, one water-based, and one cloud (Table 10). To visualize the abundance and distribution of the broad ecosystem types, the study area was mapped according to each type (Figure 2). Dry coniferous woodland was the most abundant unit, with burns second. The next most abundant broad ecosystem unit after burns included treed fens and bogs, and mixed and coniferous woodlands. The amount of mixed and deciduous woodland might be underestimated. It was difficult to interpret stand composition from the satellite imagery; this is issue is discussed in more detail in Section 4.3.2.

TABLE 10: BROAD UNITS WITHIN THE YGP STUDY AREA

Broad Unit	Total Area (ha)	No. of Polygons	Average Polygon Size (ha)	Area as % Total Area
Birch Hummock	16	6	2.7	0.1
Sedge Fen	5	6	0.8	0.0
Shrubby Fen	140	64	2.2	1.0
Treed Fens and Bogs	1,263	208	6.1	8.7
Riparian Woodland and Shrubland	224	69	3.2	1.5
Other Wetlands	72	56	1.3	0.5
Aquatic Vegetation	41	35	1.2	0.3
Burns	3,292	346	9.5	22.7
Dry Coniferous Woodland	4,061	332	12.2	28.1
Mesic Coniferous Woodland	145	10	14.5	1.0
Mixed and Deciduous Woodland	1,254	127	9.9	8.7
Bedrock and Boulder Field	19	10	1.9	0.1
Anthropogenic	70	25	2.8	0.5
Water	3,068	191	16.1	21.2
Cloud	804	21	38.3	5.6
TOTAL[1]	**14,475**	**1,506**		**100**

[1] Individual units may not add to 14,475, due to rounding to whole numbers.

Complex Polygons

A number of polygons were mapped as complex polygons (i.e., they contained more than one ecosystem type). The most common ecosystem that was complexed with one other unit was SL. This is in part due to the high coverage that this ecosystem type has within the YGP study area. Treed bogs and the JL ecosystems also had a high number of polygons

complexed with at least one other ecosystem type. Treed bogs were the most complexed with two other ecosystem types. This is due to the presence of small sedge and shrubby fens within the larger TB polygons. The distribution of complex polygons is provided in Table 11.

TABLE 11: DISTRIBUTION OF COMPLEX POLYGONS WITHIN THE YGP STUDY AREA

Ecosite	Total Area (ha)	Simple (One Ecosite per Polygon)		Complex (Two Ecosites per Polygon)		Very Complex (Three Ecosites per Polygon	
		Area (ha)	No. of Polygons	Area (ha)	No. of Polygons	Area (ha)	No. of Polygons
Wetland and Riparian							
BR	25	3.5	3	-	-	21.0	4
CA	0.4	-	-	0.4	1	-	-
CE	3	2.9	4	-	-	-	-
EA	2	0.3	1	1.7	1	-	-
EM	73	30.8	40	25.9	12	16.6	5
FA	41	40.8	35	-	-	-	-
SH	211	68.8	41	85.7	37	56.4	11
TB	1,208	401.7	157	456.9	97	349.6	38
TF	567	106.1	20	122.8	15	337.6	16
WR	271	207.6	70	49.2	10	13.7	2
Forest and Woodland							
AM	534	236.6	41	161.9	19	135.8	5
JL	2,769	222.2	52	2,078.9	91	467.6	12
SL	4,794	1,803.8	262	2,133.1	124	857.2	31
Sparsely Vegetated							
BF	28	21.9	4	5.8	1	-	-
RO	8	6.0	6	1.7	1	-	-
Water							
OW	9	7.1	17	2.0	1	-	-
PD	295	294.5	127	-	-	-	-
LA	2,764	2,764.1	46	-	-	-	-
Anthropogenic and Other							
GP	6	5.9	2	-	-	-	-
RP	18	18.4	18	-	-	-	-
RR	9	8.9	3	-	-	-	-
TD	37	36.8	2	-	-	-	-

TABLE 11: DISTRIBUTION OF COMPLEX POLYGONS WITHIN THE YGP STUDY AREA							
		Simple (One Ecosite per Polygon)		Complex (Two Ecosites per Polygon)		Very Complex (Three Ecosites per Polygon	
CD	804	804.4	21	-	-	-	-
TOTAL[1]	**14,475**	**7,093.0**	**972**	**5,126.1**	**410**	**2,255.5**	**124**

[1] Individual units may not add to 14,475, due to rounding to whole numbers.

Stand Composition

Stand Composition is provided in Table 12. Of the total study area, conifer-dominated stands were the most common category covering approximately 5,206 ha, with mixed wood stands covering approximately 4,590 ha. Mixed wood stands were predominately pine and birch, a result of historical fire disturbances. There were few white spruce – balsam poplar or aspen stands. Difficulties in mapping stand composition from the satellite imagery were encountered and are discussed in detail in Section 4.3.2.

TABLE 12: STAND COMPOSITION WITHIN THE YGP STUDY AREA			
Stand Composition	Total Area (ha)	Number of Polygons	Area as % Total Area
Broadleaf	610	171	4.2
Coniferous	5,206	501	36.0
Mixed	4,590	492	29.8
Not applicable[1]	4,069	342	28.1
TOTAL[2]	**14,475**	**1,506**	**100**

[1] Includes non-vegetated, sparsely vegetated, sedge fens, and water.

[2] Individual units may not add to 14,475, due to rounding to whole numbers.

Structural Stages

The most abundant structural stages were young forest and low-tall shrub woodland. Young forests were characteristic of the upland areas that had been disturbed by fire in the past, but not recently. The northeast portion of the study area had a recent burn, and much of this area was mapped as low-tall shrub/woodland. The dominant vegetation was birch and alder as tall shrubs, with jack pine an understory tree species. Distribution of the structural stages is provided in Table 13.

TABLE 13: STRUCTURAL STAGES WTIHIN THE YGP STUDY AREA

Structural Stage	Total Area (ha)	Number of Polygons	Area as % Total Area
1. Sparse Bryoid	73	27	0.5
2. Herb	123	103	0.9
3. Low-tall Shrub/Woodland	4,016	517	27.7
4. Pole/Sapling	753	75	5.2
5. Young Forest	5,517	550	38.1
6. Mature Forest	119	22	0.8
7. Old Forest	0	0	0
Not applicable[1]	3,872	212	26.8
TOTAL[2]	**14,475**	**1,506**	**100**

[1] Includes water and cloud polygons.
[2] Individual units may not add to 14,475, due to rounding to whole numbers.

4.3 DISCUSSION OF FIELD SAMPLING AND MAPPING RESULTS

There were four objectives outlined for the ELC: defining the ecosystem types, mapping, and characterizing the landscape using ecosystem types, characterizing the extent the development footprint will have on the landscape, and identifying impacts and mitigation strategies for the development footprint. Meeting the first two objectives is discussed below.

4.3.1 Defining Ecosystem Types

Twelve ecosystem types were quantitatively sampled in the field, while two were characterized qualitatively. Eight of the ecosystem types had two or more plots and the most common ecosystem types had five or more plots for defining the ecosystem type. Four of the twelve ecosystem types sampled (i.e., BR, CA, EA, and CE) had only one quantitative plot. While the numbers are low for these four, they have limited distribution within the YGP study area. The willow – sedge low shrub fen (SH) and the floating aquatic (FA) ecosystem types were qualitatively described. We feel that for mapping, the definitions are sufficient; however, further field characterization would enhance our knowledge of variability especially if any of these ecosystem types fall within the project footprint.

4.3.2 Mapping and Characterizing the Landscape

Landscape patterns and features associated with terrain and vegetation were mapped in the study area using the defined ecosystem types and satellite imagery. Confidence in mapping the vegetated units ranged from high to low, with high confidence for the EA, EM, FA, SH, TB, TF, and WR ecosystems, moderate confidence for the BR, BF, CA, CE, JL, and SL ecosystems and low confidence for the AM ecosystem.

Confidence was moderate in the SL, JL, and low in the AM due to a lack of detailed topographical information. In the field, SL units were often situated in level positions or on slopes, while the JL sites were confined to crests, areas of high bedrock or esker complexes. While it was possible to distinguish areas of high bedrock, without contour details, it was difficult to determine changes in slope position. Coloration of the SL and the JL units were similar and could not be used as an accurate tool to distinguish the two ecosystem units. During our field sampling, AM was found on a variety of slope positions, and its identification from the satellite image using color was not consistent. This resulted in a low confidence in the mapping of the AM unit.

Differentiation of the JL and the SLr (rock modifier for the SL unit) was made on the basis of the amount of continuous rock cover. From data collected in the field, JL units occurred in areas where there was high rock cover with sporadic vegetation. During the mapping process, if rock cover was high and vegetation cover was sparse, it was assigned as JL; if vegetation cover was moderate, it was mapped as an SLr unit. Eskers were not apparent from the imagery, and only those that were observed while in the field where identified in the mapping process.

Structural and stand composition was also attributed to each polygon. Confidence in mapping the structural stage is high in areas surrounding full and visual plots. Where possible, plot photos that were taken of the landscape were used to attribute polygons. There was little difference in the imagery color among deciduous, mixed or coniferous so mapping stand composition with the absence of field data was difficult. There is good coverage of the study area near the Discovery Mine and around Giauque, Maguire, Nicholas and Eclipse lakes. Plot coverage in the northwest and northeast is low resulting in low confidence in structural stage polygon attribution in these areas.

Confidence in mapping the broad ecosystem units is moderate. Confidence is not high due to the difficulty in mapping stand composition. The highest error is likely in the attribution of the mixed and deciduous stands versus the dry coniferous. Due the fire history, there were seral birch communities in what would eventually succeed to black spruce.

5.0 RARE PLANT SURVEY

The following section provides information on the rare plant survey methods, mapping, and survey results.

5.1 METHODS

Prior to conducting the rare plant survey, lists of rare plants and plant communities of special concern potentially occurring in the study area and in similar habitats in the local region (Tazin Lake Upland Ecoregion of the Western Taiga Shield Ecozone) were obtained from Department of Resources, Wildlife, and Economic Development (RWED) and McJannet *et al.* (1995). A rare plant list, appropriate for this landscape, was generated which includes 89 species (Table 14). A variety of vascular plant references (e.g. Anderson 1974; Douglas *et al.* 1981; Hulten 1968; McJannet *et al.* 1995; and Porsild and Cody 1980) were

consulted for taxonomic diagnostic information. EBA also used pressed plant specimens located at the University of Alberta's herbarium to help with plant identifications prior to field surveys.

Along with taxonomic information, habitat information was gathered to determine the potential for each ecosystem type to support rare plants. A rare plant habitat potential map was generated based on the number of rare plants potentially found within each ecosystem type (Figure 3). The habitat suitability rank was derived from a frequency histogram that correlated each ecosystem type with the number of rare plants potentially found within them. While this method is somewhat objective, it does provide a basis to rank ecosystem types against each other for their potential to support rare plants. As a note of caution, rare plants often occur in microsites that cannot always be identified from satellite imagery or through the ELC mapping process. While an ecosystem type may be ranked as very low for rare plant habitat, there is a possibility that rare plants could be found in microsites within that ecosystem type. The ecosystem types were ranked from very low potential to very high potential based on the total number of rare plant species potentially present.

The RPS focussed on those areas that would be directly impacted by the project footprint with a moderate to very high potential to support rare plants. Survey methods followed Alberta Native Plant Council (ANPC) guidelines for qualitative and quantitative rare plant surveys (Lancaster 2000). Other references were consulted in refining the field approach for the rare plant survey. This included identifying ecosystem types, landscape features and landscape anomalies for field examination.

Fieldwork for the rare plant survey was conducted in two parts. The first survey was completed from July 8, 2005 to July 10, 2005, and the second survey was completed from August 13, 2005 to August 15, 2005. The survey occurred at two times during the growing season to respond to plants that flower in response to the photoperiod (long, short, or neutral day-length). This also allowed for the inclusion of plants with a neutral response to photoperiod.

TABLE 14: RARE PLANTS THAT COULD BE FOUND IN THE YGP STUDY AREA

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Acorus calamus (Acorus americanus)	sweetflag	Wetlands; borders of quiet water	EM, SH, WR
Adoxa moschatellina	moschatel	Rich leaf-mould in moist partly shaded alder and poplar woods; calcareous soils	AM
Agoseris aurantiaca	orange false dandelion	Meadows, hot springs, disturbed areas	AM, RP
Agrostis exarata	spike redtop	Moist, sedge meadows; open ground	CA, CE, EA
Anaphalis margaritacea	pearly everlasting	Subalpine wooded areas and meadows, roadsides, open forests to subalpine	AM, SL
Apocynum cannabinum	indian hemp	Exposed river banks	WR
Arabis holboellii	reflexed rock cress	Dry, open, sunny, calcareous slopes, open soil	JL, SL, BF, RO
Arabis lyrata	lyre-leaved rock cress	Sandy, open areas, moist stoney places, scree slopes	JL, SL
Asplenium viride (trichomanes-ramosum)	green spleenwort	Moist rocky slope and crevices, crevices in calcareous rocks	SL, JL, BF, RO
Aster nahanniensis	sster	Hot springs and moist areas	AM, SL, JL, WR
Astragalus canadensis	Canadian milk vetch	River banks and moist, open woods	WR, AM
Botrychium minganense	moonwort	Grassy meadows, grassy slopes	AM, WR
Botrychium multifidum	leather grape fern	Circumpolar prairie clearings, sandy meadows and woods	AM, SL
Botrychium simplex	dwarf grape fern	Moist meadows and shores	AM, WR
Callitriche anceps	water starwort	Shallow ponds, shallow water	EM, FA
Caltha palustris	marsh marigold	Shallow water or in wet marshy places, moist places	EM, CE, EA, SH
Carex arcta	narrow sedge	Wet woodland bogs, marshes and sandy beaches, wet places	EM, CA, CE, EA, TB, TF, SH
Carex crawfordii	Crawford's sedge	Damp meadows	CA, CE, EA, WR, SH
Carex eleusinoides	-	Wet gravelly river banks and meadows, wet places, gravel bars	WR, SH
Carex heleonastes	Hudson Bay sedge	Bogs, peat bogs and swamps	CA, CE, EA, TB, TF, SH
Carex prairea	prairie sedge	Bogs	CA, CE, EA, TB, TF

TABLE 14: RARE PLANTS THAT COULD BE FOUND IN THE YGP STUDY AREA

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Carex retrorsa	turned sedge	Woodland marshes	EM
Carex sychnocephala	long-beaked sedge	Wet places and open woodland meadows	CA, CE, EA, WR
Carex trisperma	three-seeded sedge	Bogs	CA, CE, EA, TB
Castilleja yukonis	indian paintbrush	Spruce woods, treed bogs, and grassy slopes, dry hillsides	TB, TF, SL
Cornus suecica	dogwood	Wet mossy areas, woods, marshes, bogs	CA, CE, EA, TB, TF, SH
Crassula aquatica (Tillaea aquatica)	pigmyweed	Shallow ponds, inundated shores	EM, WR
Cryptogramma sitchensis (crispa)	parsley fern	Calcareous talus slopes and moraine	BF, RO
Cryptogramma stelleri	fragile rock-brake	Moist shale slopes, crevices in calcareous rocks in shaded localities with dripping water	BF
Danthonia spicata	poverty oat grass	Rocky places, dry places	JL, BF, RO
Descurainia pinnata	green tansy mustard	Sandy beaches and disturbed areas	RR, RP
Draba incerta	Whitlow-grass	Alpine tundra and rocky slopes	BF, JL
Dryopteris carthusiana (D. spinulosa)	narrow spinulose shield fern	Rich woods	AM
Dryopteris expansa (D. dilatata)	spinulose shield fern	Moist woods and slopes	AM
Elatine triandra	waterwort	Muddy shores and shallow pond margins	EM, FA
Elymus canadensis	Canada wild rye	Sandy and gravelly places	AM, SL, JL
Epilobium leptophyllum	narrow-leaved willowherb	Marshes, sloughs, bogs, and sedge meadows, lowlands	EM, CE, EA
Erigeron acris	northern daisy fleabane	Alpine gravelly slopes or sandy river banks, spruce forests, sandy soil	SL, JL
Erigeron yukonensis	fleabane	Calcareous, stony slopes	JL, SL, BF, RO
Euthamia graminifolia (Solidago graminifolia)	flat-topped goldenrod	Sandy, silty, and gravelly river banks and flats	WR
Heuchera richardsonii	Richardson's alumroot	Woodland meadows	AM
Hudsonia tomentosa	sand heather	Sand blow-outs, sandy beaches, and open jack pine woods	JL
Impatiens capensis (I. bifora)	spotted touch-me-not	Low wet woodlands and moist banks, wet ground	WR, EM, TF, SH

TABLE 14: RARE PLANTS THAT COULD BE FOUND IN THE YGP STUDY AREA

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Isoetes lacustris (I. macrospora)	quillwort	Shallow, sandy lake margins	EM, FA
Juncus dudleyi (J. tenuis)	bog rush	Wet, calcareous, lowland meadows and river banks, roadsides, open ground	WR, TF, CA, CE, EA, SH, RP
Juncus stygius	marsh rush	Wet margins of woodland bog pools, wet bogs	EM, TB, CA, EA,
Juncus vaseyi	big-head rush	Lowland slough-margins, moist shores	EM
Limosella aquatica	mudwort	Wet, muddy or sandy pond margins, wet mud	EM
Lobelia dortmanna	water lobelia	Shallow, sandy shores of lakes and ponds	EM, FA
Luetkea pectinata	partridgefoot	Alpine tundra and snowbeds	Unknown
Luzula rufescens	reddish wood rush	Bogs, marshes, and river banks	WR, EM, CA, CE, EA, TF, TB, SH
Lycopus uniflorus	bugleweed	Sandy margins of lakes and streams	WR, EM
Malaxis paludosa (Hammarbya paludosa)	bog adder's mouth	Treed bog, wet sphagnum bogs, quagmires	TB, CA, CE, EA
Mertensia paniculata var. alaskana	bluebell	Open woods and river banks	AM, WR
Mimulus guttatus	yellow monkey flower	Wet meadows and streams, margins of ponds and streams, wet rocky slopes	WR, EM
Myriophyllum alterniflorum	water milfoil	Shallow lakes and ponds	EM, FA, OW
Najas flexilis	slender naiad	Shallow lakes and ponds	EM, FA, OW
Nuphar lutea (Nuphar polysepala)	yellow pond lily	Lakes, ponds, and slow moving streams	EM, FA, OW, WR
Nymphaea tetragona	white water lily	Shallow lakes and slow moving streams	EM, FA, OW, WR
Osmorhiza depauperata	spreading sweet cicely	Rich woods	AM
Pedicularis macrodonta (P. parviflora)	lousewort	Bogs and marshes	EM, CA, CE, EA, SH, TB, TF
Pellae glabella	smooth cliff brake	Limestone cliffs	RO
Platanthera (Habenaria) orbiculata	large round-leaved orchid	Spruce and tamarack woodland, dry to moist woods	AM, SL
Poa secunda	Sandberg blue grass	Fens	CE, EA, TF
Potamogeton foliosus	leafy pondweed	Shallow still waters	FA, OW
Potamogeton illinoensis	pondweed	Still water	FA, OW

TABLE 14: RARE PLANTS THAT COULD BE FOUND IN THE YGP STUDY AREA

Latin Name	Common Name	Habitat	Potential Ecosystem Types
Potamogeton obtusifolius	blunt-leaved pondweed	Shallow lakes and ponds	FA, OW
Potamogeton robbinsii	Robbin's pondweed	Muddy water	FA, OW
Potamogeton subsibiricus (P. porsildiorum)	pondweed	Shallow lakes and ponds	FA, OW
Prunus virginiana	choke cherry	Thickets	AM, WR
Ranunculus hispidus (R. septentrionalis)	buttercup/crowfoot spp.	Willow thickets and slough margins	AM, WR, TF
Ranunculus pensylvanicus	buttercup/crowfoot spp.	Disturbed and marshy places	CA, CE, EA, SH, TF, RP
Rhynchospora alba	white beak-rush	Fens and bogs, peaty, or sandy soil	CA, CE, EA, SH, TF, TB, RP
Rorippa barbareifolia	yellow cress	Disturbed sites	RR, RP, GP, TD
Rorippa crystallina	marsh yellow cress	Carex meadows and marshes	EM, CA, CE, EA
Rosa blanda	rose	Gravelly river terraces	WR, SH
Ruppia cirrhosa (R. spiralis)	widgeon-grass spp.	Shallow lakes, salt, and brackish water	EM, FA, OW
Salix raupii	Raup's willow	Gravel floodplains and treed bogs	WR, TF, TB
Sanguisorba officinalis	Burnet	Wet tundra, moist places	CA, CE, EA, BR, SH
Sarracenia purpurea	pitcher plant	Bogs	CA, CE, EA, BR, TB
Scirpus rollandii (Trichophorum pumilum)	bulrush	Marshy lake shores and hot springs, wet places	EM, CE
Scirpus rufus (Blysmus rufus)	bulrush	Wet river banks and saline meadows, seashores	EM
Senecio sheldonensis	groundsel	Subalpine meadows	Unknown
Smelowskia calycina ssp. Media	silver rock cress	Stoney slopes and lakeshores, rocky hillsides, gravel	GP, TD, JL, SL
Sparganium eurycarpum	giant bur-reed	Shallow ponds and sloughs	EM, FA, OW
Tanacetum bipinnatum (T. huronense)	indian tansy	Sandy river banks	WR
Valeriana dioica (V. septentrionalis	northern valerian	Fens and lake shores, moist places	EM, CE, EA, SH, TF
Viola canadensis (V. rugulosa)	western Canada violet	Woodlands along streams and hot springs	WR
Viola selkirkii	great-spurred violet	Moist thickets, woods, fens and alpine tundra	WR, AM

5.2 RESULTS

The objective of the RPS was to discover if any rare plants are present within areas that will be directly affected by the development footprint. This RPS is done because mapping vegetation units during an ELC is based on common characteristics. Rare plants may be found in unique habitats that are not sampled within an ELC program, so a RPS is often conducted in addition to an ELC program. Below is a discussion of the mapping and the survey results.

5.2.1 Habitat Mapping

A rare plant habitat potential map was generated based on the number of rare plants potentially found within each ecosystem type (Figure 3). Initially, area calculations for rare plant habitat were based on the primary ecosystem type. This method did not account for secondary or tertiary ecosystem types within complexed polygons. Consequently, small unmappable units that had high or very high habitat value (i.e., CA, EA, or EM) were not included in the mapping process. This would result in the amount of high or very high habitat being underestimated. To be conservative, all complex polygons were mapped according to the ecosystem type that had the highest rare plant habitat potential regardless of whether it was the primary, secondary or tertiary unit identified in the polygon. The map could represent an overestimation of high or very high habitat. Area coverage for habitat potential is provided in Table 15.

TABLE 15: RARE PLANT HABITAT COVERAGE IN THE YGP STUDY AREA

Habitat Potential	Potential Number of Rare Plants	Total Area (ha)	Area as % Total Area
Very Low	1 to 4	55	0.4
Low	5 to 9	46	0.3
Moderate	10 to 14	8,413	58.1
High	15 to 19	1,216	8.4
Very High	> 20	881	6.1
Water[1]	0	3,068	21.2
Cloud	0	804	5.6
TOTAL		**14,475**	**100**

[1] Only includes water > 2 m depth.

5.2.2 Survey Intensity

Five areas within the study area were surveyed for rare plants:

- camp area;
- gravel pit area and potential access road;
- portal;

- Round Lake;
- Winter Lake; and
- proposed road route to Nicholas Lake.

Vegetation data for each area is presented in Appendix C. Survey locations are shown in Figure 4 and Figure 5. Due to time restrictions, the entire length of road going to Nicholas Lake was not surveyed; for this area focus was placed on locations where it appeared potential for rare plants was high or very high.

A total of 92 km was surveyed in 14 ecosystem types. Table 16 provides the level of effort for each ecosystem type.

TABLE 16: RARE PLANT HABITAT POTENTIAL FOR EACH ECOSYSTEM TYPE

Ecosystem Type	Total Potential Rare Plants	Rank	Transect Distances (July) (m)	Transect Distances (August)
BR	2	Very Low	-	-
GP	2	Very Low	-	176
RR	2	Very Low	2,086	-
TD	2	Very Low	2,556	-
RP	5	Low	450	1,111
RO	6	Low	-	-
BF	7	Low	-	-
JL	11	Moderate	10,325	4,999
OW	11	Moderate	-	8,675
SL	12	Moderate	12,771	6,196
TB	14	Moderate	3,131	941
FA	15	High	-	5,205
SH	15	High	793	362
TF	15	High	3,819	7,747
AM	18	High	3,452	2,545
CA	19	High	-	-
CE	22	Very High	-	-
EA	22	Very High	-	-
WR	25	Very High	1,290	506
EM	27	Very High	1,189	3,470
		Total Length[1]	**41,864**	**50,429**

TABLE 16: RARE PLANT HABITAT POTENTIAL FOR EACH ECOSYSTEM TYPE
Very Low: 1 to 4 species
Low: 5 to 9 species
Moderate: 10 to 14 species
High: 15 to 19 species
Very High: > 20 species
[1] There were two surveyors for each of the July and August survey dates. Surveys were done over six days.

5.2.3 Rare Plant Observations

No rare plants were observed in July. There was one field identification of a rare plant during the August survey (Figure 4). A *Potamogeton* specie (pondweed) was identified (but not confirmed) as *Potamogeton foliosus* (leafy pondweed). This is listed as a rare species. The pondweeds are difficult to key and often plants at various stages of development are required to properly identify to species level.

The distinguishing characteristic in the key identifying this pondweed from one that is not rare (*P. pusillus*), is the prominence of the keel and beak on the achene (seed) (Moss 1994, Brayshaw 1985). This feature is only apparent with mature achenes. Another difference between *P. foliosus* and *P. pusillus* is the sheath margin of *P. foliosus* is connate (joined) when young, whereas with *P. pusillus* is open when young. On young specimens this may be apparent, but with older specimens this characteristic is not always apparent. A sample of this pondweed was collected from Winter Lake and sent to the University of Alberta herbarium for confirmation. They could not confirm its classification to *P. foliosus.*

This plant is located in two small bays on the southwest side of Winter Lake. Water was approximately 1 m deep and was protected from wave movement on the lake from surficial features (thought to be stagnant ice moraines). The ecosystem type immediately adjacent to the lake is treed fen. There was standing water in the fen area.

6.0 THE PROJECT FOOTPRINT

The purpose of this field report is not to provide a detailed impact assessment for the soil and vegetation resources. The information provided below is an overview of the development, its potential effects and mitigation that may be required. With the exception of the rare plant information, information is descriptive based on ecological principles and not necessarily based on the specific soils and vegetation types found within the projects' footprint.

6.1 SOIL AND PLANT COMMUNITIES

The project will affect soil and vegetation resources. The sections below discuss impacts to vegetation and soils.

6.1.1 Project Effects

Impacts are generally based on criteria such as direction, scope, duration, frequency, magnitude, and confidence (Beanlands and Duinker 1983; FEARO 1994). Using these criteria, a level of significance can be placed on the impact. Significant impacts can occur if there is impairment to a resources function or process, if a large enough portion of the resource is impacted or if the impact is long term. At this time in the project planning it is only possible to indicate that impacts will occur; it is not possible to determine the level of significance at this time.

Based on the Project's activities, the following potential impacts on soil and vegetation have been identified:

- vegetation removal;
- alteration of soil properties;
- increased air emissions;
- introduction of non-native or invasive species;
- increased risk of spills;
- site maintenance activities; and
- increased risk of fire due to human presence.

Exploration, construction, and site activities will require the clearing of vegetation, grading, cut, and fill, excavations of borrow material and development of an access route to Nicholas Lake. This may affect soil resources, and will result in a direct loss of vegetation. As well, air emissions from the processing facility could affect vegetation health.

6.1.2 Mitigation

Potential mitigation strategies for the effects to soils and vegetation communities are provided in Table 17. This information is general in nature and is not meant to replace mitigation measures based on a more detailed impact assessment.

TABLE 17: POTENTIAL EFFECTS AND MITIGATION STRATEGIES

Potential Effect	Consequence	Mitigation
Vegetation Removal	Loss of vegetation; increase in ecosystem fragmentation; loss of high rare plant habitat; loss of ecosystems with restricted distribution	Minimize footprint; minimize development on ecosystem types with restricted distribution or with high potential for rare plants; avoid sensitive ecosystems; minimize off-site activities such as ATV use; reclamation to restore to pre-disturbance conditions.
Alteration of Soil Properties	Loss of soil; compaction of mineral soil by vehicle traffic; erosion; changes in soil quality and chemistry due to spills	Minimize footprint; where possible salvage mineral topsoil; minimize traffic off site; implement erosion control measures on slopes as required; implement emergency response plan.
Increased air Pollution	Increase dust fall from traffic; emissions of SO_2 and NOx are acidifying to vegetation (toxicity to leaf surfaces) and soil	Use of dust suppressants; minimize traffic; minimize air emissions; continued monitoring of air emissions.
Introduction of Non-native or Invasive Species	Growth and spread of non-native or invasive species	Clean all equipment before coming to site; train staff on the identification and control of non-native and invasive plants, vehicle washing as required.
Increased Risk of Spills	Direct impact to vegetation; contamination of soil and water	Implement an emergency response system; follow appropriate procedures for spill containment and clean up.
Site Maintenance Activities	Use of herbicides, sterilants and dust suppressants; salts on road services can lead to contamination through surface water movement; waste disposal activities	Implement vegetation control guidelines to minimize the affect of herbicides and sterilants on native vegetation; ensure use of road salts, oil, or dust suppressants is controlled and monitored; storage of chemicals must be in a facility that minimizes potential entry into the environment; dispose of all wastes in approved containers.
Increased Risk of Fire due to Human Presence	Fire is a natural disturbance, but human activity may increase the risk of fire, increasing risk to vegetation resources	It is uncertain if mitigation is necessary since this can be considered a natural occurrence. More information is required.

6.2 RARE PLANTS

6.2.1 Project Effects

Development of Winter Lake as a tailings containment area including a polishing area will impact the population of *P. foliosus* growing in the lake. The following section discusses the habitat and growth requirements of *P. foliosus*.

These pondweeds have long, narrow leaves and, except for an occasional flower spike that briefly rises above the water, they remain underwater for their entire lives. *Potamogeton foliosus* is generally found in shallow open water, often greater than 1 m in depth (University of Wisconsin 2006). It can grow in eutrophic water, as well as slightly brackish (University of Wisconsin 2006; Environment Canada 2000). Detailed habitat data is lacking.

These plants are perennials and reproduce both sexually and asexually. Seeds require soft sediment soil in which to germinate, and water must be present above the sediment surface (Mortsch et al. 2006). *Potamogetan* seeds are a valuable food source for numerous waterfowl (Hellquist and Pike 2003). Research shows an increase in germination after the seed has passed through the digestive system of waterfowl; the waterfowl can digest both the exocarp and the mesocarp, while the endocarp passes through the digestive system (Haynes 1974). Little is known about the viability of the fruits or seed banking. For many *Potamogetons*, cold stratification is required for germination (Muenscher 1936).

The plant reproduces vegetatively by producing dense leafy winter buds at the tips of branches (Kershaw et al. 2001). These drop in the autumn and over-winter in the sediment. In the spring the buds sprout and new plants are produced. Since they reproduce both by seed and vegetatively, they have the ability to spread moderately well, within the water that they are situated, and to other open water via waterfowl movement.

Potamogeton foliosus is moderately tolerant to changes in water level; however, they are not tolerant to drying, nor will they germinate without water (Hoyer and Canfield 1997). They are affected by moose herbivory, especially in shallow water (Crete *et al.* 2001). The amount of impact is proportional to moose density.

6.2.2 Mitigation Strategies

There are three potential mitigation strategies for *P. foliosus*. The first is to confirm the identification, second is to determine the relative abundance of this plant relative to its rare designation. The third examines the opportunity for transplantation.

The first strategy is to get a positive identification of the *P. foliosus*. This would involve sampling the known locations again at an appropriate sampling time (ideally late summer, after achene maturation) and sending the sample in for confirmation.

The second strategy, after confirmation as *P. foliosus*, is to determine if it occurs commonly throughout the area. A plant may be designated rare within a larger region or territory when it can be quite common in a small local area if growing conditions are favourable. If there are other lakes that are already populated with *P. foliosus*, then mitigation for the population

within Winter Lake is may not be needed. This would require a survey of other lakes in the area.

The third strategy is to transplant the *P. foliosus*. This would be recommended if a survey of the other lakes is not done, or if the survey is done and no other populations are found. In a controlled experiment, seedlings of *P. foliosus* demonstrated substantial growth subsequent to transplanting (McFarland and Rogers 1998), and given that the plants produce winter buds in the fall, this could be a viable mitigation strategy. The transplant lake(s) would have to be similar to Winter Lake. Basic water biology and chemistry data, substrate conditions, and lake bathymetry would be collected and assessed to confirm viability of the transplant lake(s).

7.0 SUMMARY

Ecological land classification mapping was carried out for the YGP study area. Baseline data was collected in July 2004, and 22 ecosystem types were classified within the 14,475 ha study area. Fourteen of these were naturally vegetated, three were classified as water, four were anthropogenic, and one was cloud. Fifteen broad ecosystem units that correlated to the West Kitikmeot Slave Study were also assigned to each polygon. Confidence in the mapping and subsequent data analysis is moderate to high for most units, with the exception of the AM unit, which is low. Confidence in mapping structural stage, stand composition, and broad ecosystem units is moderate.

The project will have a direct impact on soils and vegetation communities. Based on the Project's activities, the following potential impacts have been identified: vegetation removal, alteration of soil properties, alternation of hydrology, change in water quality, increased air emissions, introduction of non-native or invasive species, increased risk of spills, site maintenance activities, increased risk of fire due to human presence. Potential mitigation strategies are identified for each of these impacts. At this time in the project planning, it is only possible to indicate that impacts will occur. It is not possible to determine the level of significance.

One rare plant was field identified (but not confirmed) during the RPS. If the identification is confirmed, mitigation strategies can be adopted to minimize the impact.

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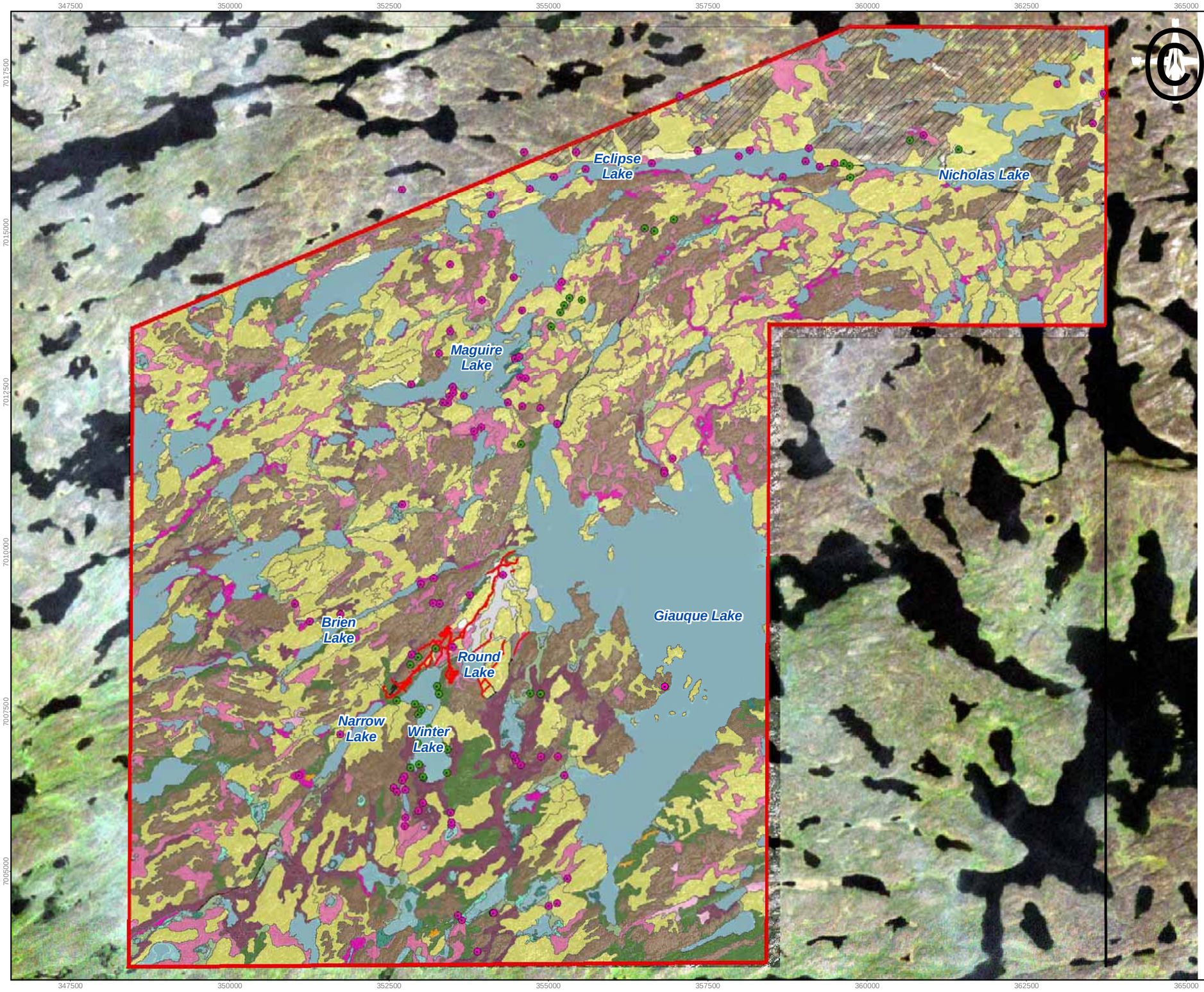
FIGURES



LEGEND

- Sample Locations 2004
- Sample Locations 2005
- Local Study Area
- Proposed Footprint
- Cloud

Ecosystem Units

Wetland Riparian

- BR - Scrub birch cloudberry low shrub bog
- CA - Water sedge – narrow leaved cottongrass fen
- CE - Round fruited sedge – Chamisso's cottongrass fen
- EA - Sheathed cottongrass – bog rosemary sedge fen
- EM - Water sedge – horsetail shallow shore marsh
- FA - Floating aquatic shallow open water
- SH - Willow – sedge low shrub fen
- TB - Spruce – cloudberry treed bog
- TF - Tamarack – blueberry treed fen
- WR - Spruce – willow riparian forest

Forest and Woodland

- AM - Spruce – moss forest
- JL - Jack pine – lichen woodland
- SL - Spruce – lichen woodland

Sparsely Vegetated

- BF - Boulder field
- RO - Rock outcrop

Water

- OW - Open water
- PD - Pond
- LA - Lake

Anthropogenic

- GP - Gravel pit
- RP - Road surface
- RR - Rural development
- TD - Tailing deposit

Base data sources:

Imagery Source: IKONOS (July 27th and August 2nd 2004.
Landsat TM (August 11th 2001)

DISCLAIMER

YELLOWKNIFE GOLD PROJECT

Ecosystem Types in the YGP Study Area

PROJECTION: UTM Zone 12	DATUM: NAD83	Tyhee Development Corp
Scale: 1:60,000 (0.5 0.25 0 0.5 1 1.5 2 Kilometres)		EBA Engineering Consultants Ltd.
FILE No: B-Veg-001.mxd		DATE: April 28, 2006
JOB NO: 1740180	REVISION NO: 4	Figure 1
OFFICE: EBA-VANCOUVER	DRAWN: BGP / CHECK: KO	

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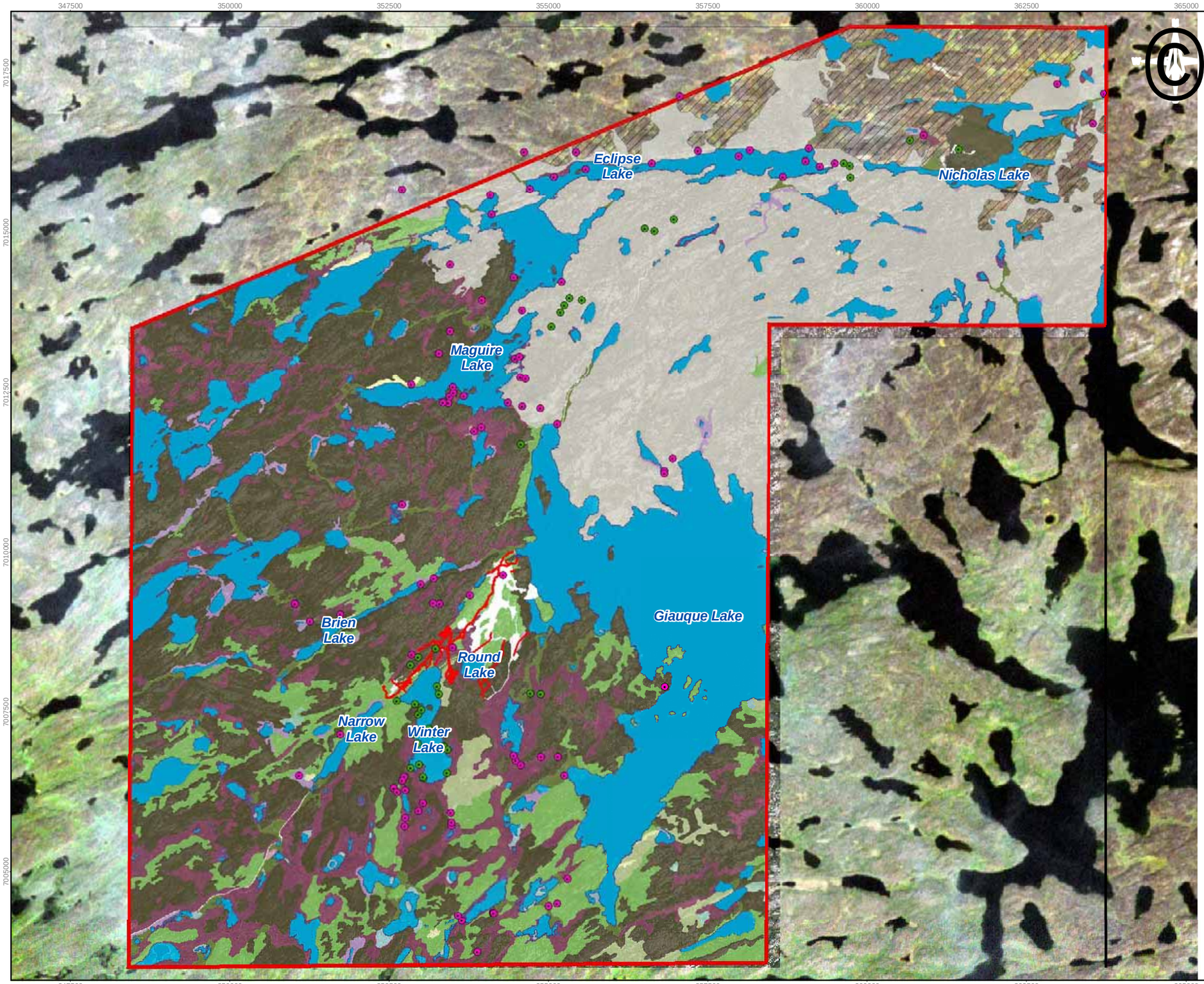

LEGEND

- Sample Locations 2004
- Sample Locations 2005
- Local Study Area
- Proposed Footprint
- Cloud

Broad Ecosystem Units

- Anthropogenic
- Water
- Aquatic Vegetation
- Bedrock and Boulder Field
- Burns
- Birch Hummock
- Dry Coniferous Woodland
- Mesic Coniferous Woodland
- Mixed and Deciduous Woodland
- Riparian Woodland and Shrubland
- Other Wetland
- Sedge Fen
- Shrubby Fen
- Treed Fens and Bogs

Base data sources:

Imagery Source: IKONOS (July 27th and August 2nd 2004.
Landsat TM (August 11th 2001)

DISCLAIMER

YELLOWKNIFE GOLD PROJECT

Broad Ecosystem Units in the YGP Study Area

PROJECTION: UTM Zone 12	DATUM: NAD83	Tyhee Development Corp / EBA Engineering Consultants Ltd.
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JOB NO: 1740180	REVISION NO: 4	Figure 2
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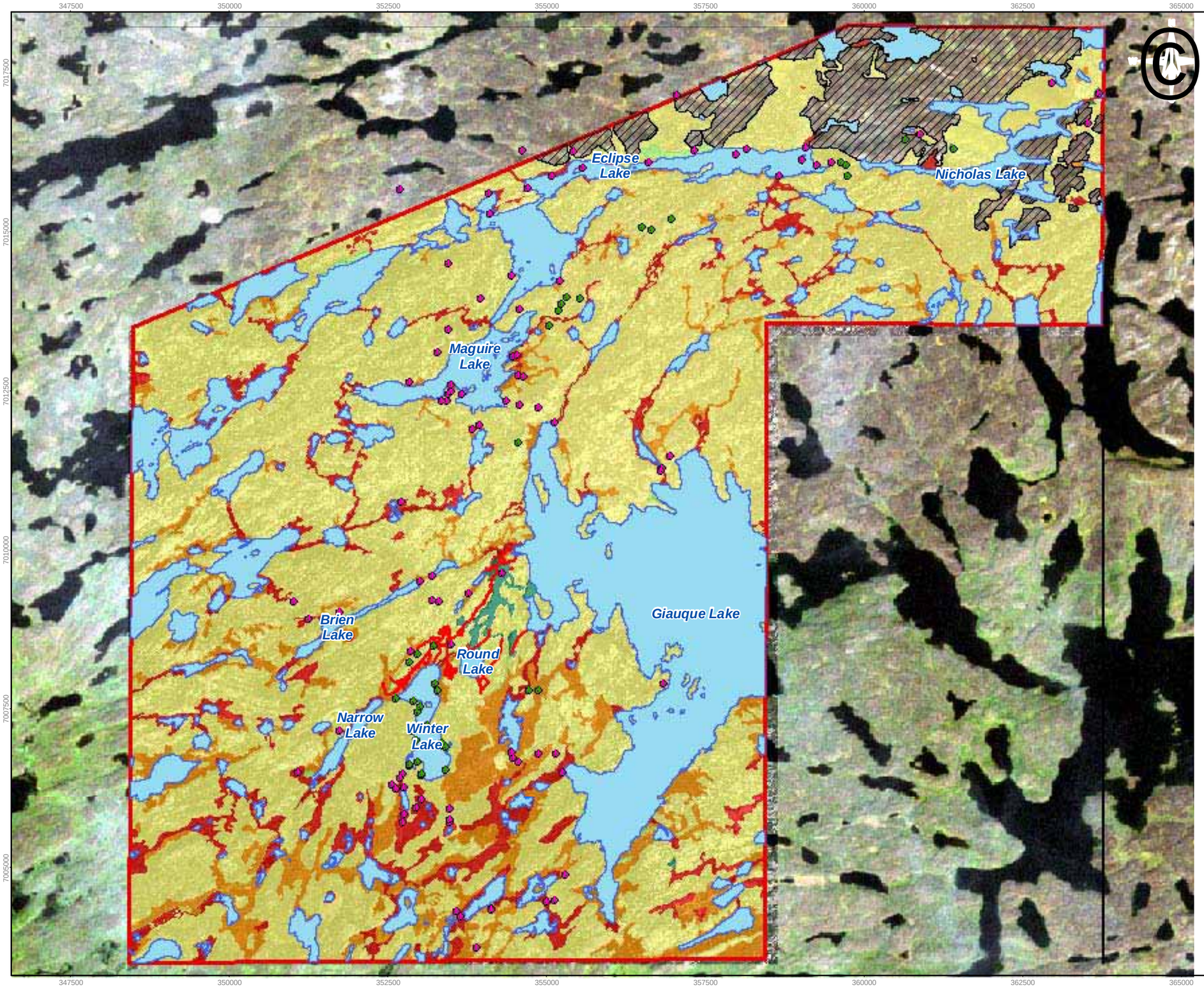

LEGEND

- Sample Locations 2004
- Sample Locations 2005
- Local Study Area
- Proposed Footprint
- Cloud
- Water >2m

Rare Plant Potential

- Very Low (0-4 Plants)
- Low (5-9 Plants)
- Moderate (10-14 Plants)
- High (15-19 Plants)
- Very High (20+ Plants)

Base data sources:

Imagery Source: IKONOS (July 27th and August 2nd 2004.
Landsat TM (August 11th 2001)

DISCLAIMER

YELLOWKNIFE GOLD PROJECT

Rare Plant Potential in the YGP Study Area

PROJECTION: UTM Zone 12	DATUM: NAD83	Tyhee Development Corp
Scale: 1:60,000 (0.5 0.25 0 0.5 1 1.5 2 Kilometres)		EBA Engineering Consultants Ltd.
FILE No: B-Veg-003.mxd		DATE: April 28, 2006
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OFFICE: EBA-VANCOUVER	DRAWN: BGP / CHECK: KO	Figure 3

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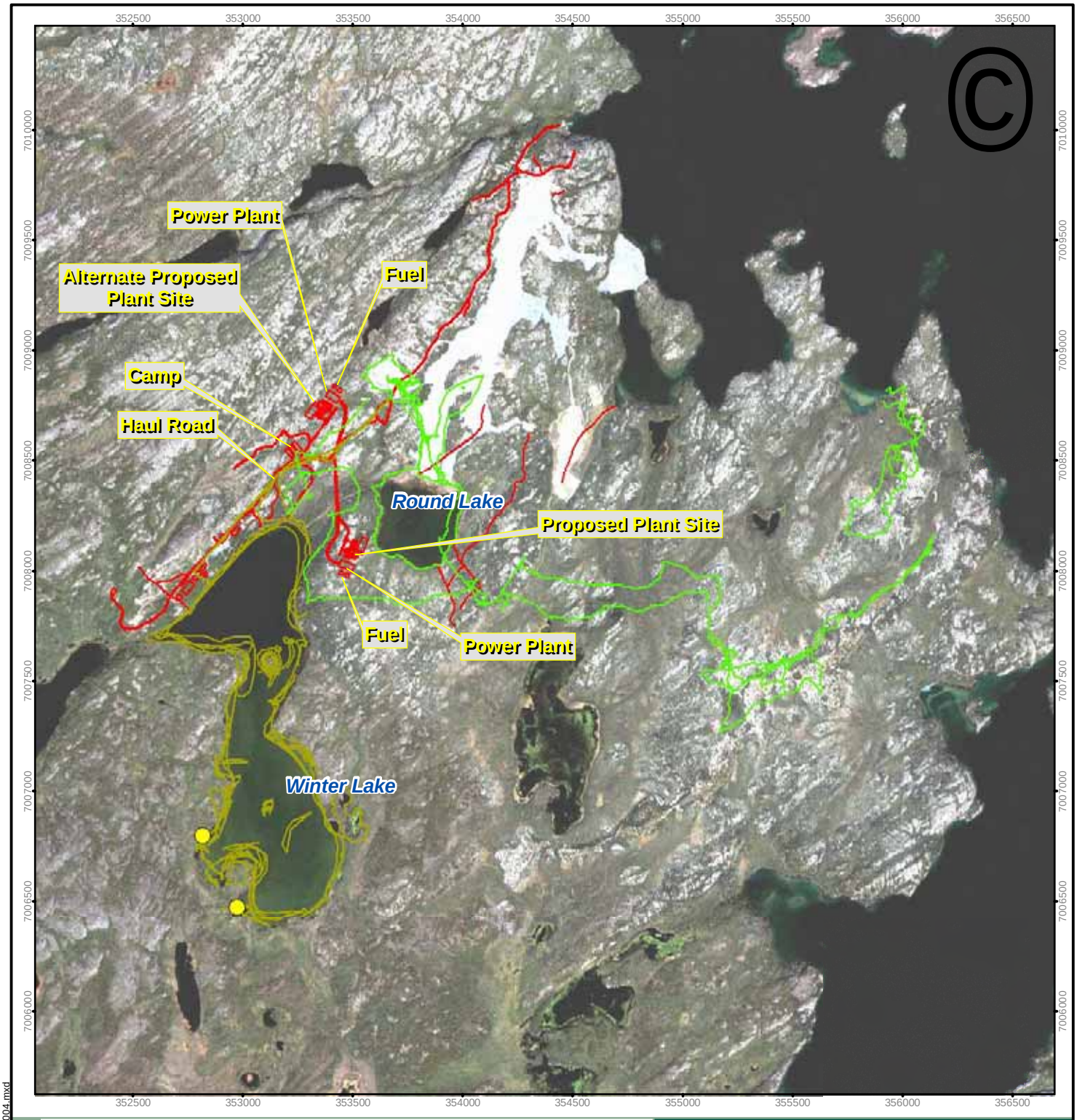

LEGEND

- Proposed Footprint
- July Sampling Tracks
- August Sampling Tracks
- (Locations of *Potamogeton foliosus* (unconfirmed)

Base data sources:

Imagery Source: IKONOS (July 27th and August 2nd 2004. Landsat TM (August 11th 2001)
Water Features: Extracted from IKONOS imagery

YELLOWKNIFE GOLD PROJECT

Rare Plant Survey Areas in Southern Portion of Study Area

PROJECTION: UTM Zone 12	DATUM: NAD83	Tyhee Development Corp
Scale: 1:25,000 (0, 0.25, 0.5, 1 Kilometres)		EBA Engineering Consultants Ltd.
FILE No: B-Veg-004.mxd		DATE: April 28, 2006
JOB NO: 1740180	REVISION NO: 1	
OFFICE: EBA-VANC	DRAWN: BGP / CHECK: KO	Figure 4

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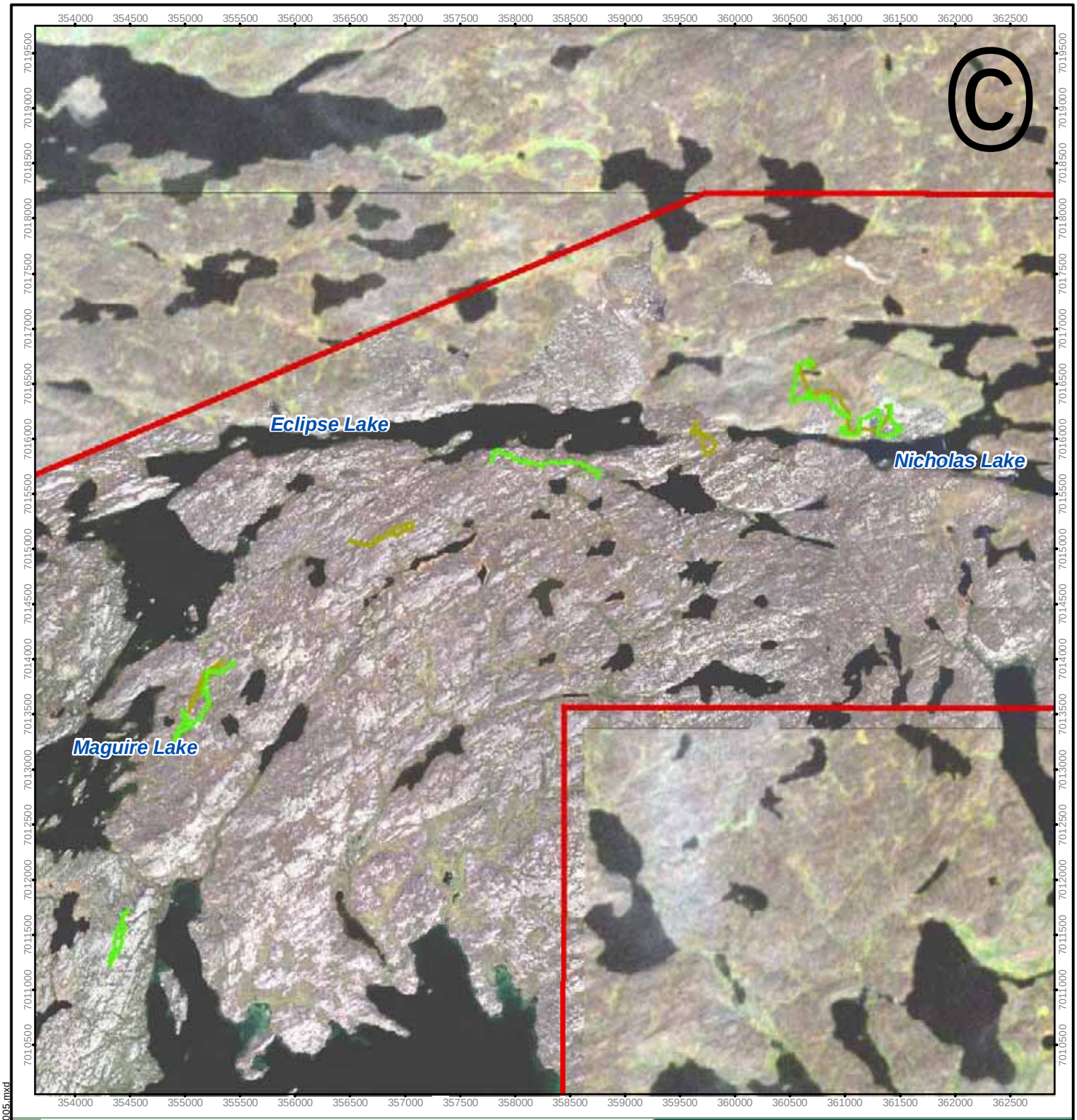

LEGEND

- Local Study Area
- July Sampling Tracks
- August Sampling Tracks

Base data sources:

Imagery Source: IKONOS (July 27th and August 2nd 2004. Landsat TM (August 11th 2001)
Water Features: Extracted from IKONOS imagery

YELLOWKNIFE GOLD PROJECT

Rare Plant Survey Areas in Northern Portion of Study Area

PROJECTION: UTM Zone 12	DATUM: NAD83	Tyhee Development Corp
Scale: 1:50,000 0 0.25 0.5 1 1.5 Kilometres		EBA Engineering Consultants Ltd.
FILE No: B-Veg-005.mxd		DATE: April 28, 2006
JOB NO: 1740180	REVISION NO: 1	
OFFICE: EBA-VANC	DRAWN: BGP / CHECK: KO	Figure 5

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APPENDIX

APPENDIX A ELC FIELD DATA

SITE UNIT BF: BOULDER FIELD						
Lifeform	*Spp*	Common Name	P	MC	F29	F31
1	*Picea mariana*	black spruce	50.0%	0.1	0.2	
1	*Pinus banksiana*	jack pine	100.0%	0.2	0.1	0.2
2	*Betula papyrifera*	paper birch	100.0%	2.6	0.1	5.0
3	*Juniperus communis*	common juniper	100.0%	35.0	60.0	10.0
4	*Rubus idaeus*	red raspberry	100.0%	1.0	1.0	1.0
5	*Dryopteris fragrans*	fragrant wood fern	50.0%	0.1		0.1
5	*Polypodium virginianum*	Virginia polypody	50.0%	0.1	0.1	
5	*Woodsia glabella*	smooth cliff fern	50.0%	0.1		0.1
5	*Woodsia ilvensis*	rusty cliff fern	100.0%	0.1	0.1	0.1
6	*Agrostis scabra*	hair bentgrass	100.0%	0.1	0.1	0.1
6	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	50.0%	0.1	0.1	
6	*Poa glauca*	glaucous bluegrass	100.0%	1.0	1.0	1.0
7	*Corydalis sempervirens*	pink corydalis	50.0%	0.1	0.1	
7	*Epilobium angustifolium*	fireweed	50.0%	0.1	0.1	
7	*Saxifraga tricuspidata*	three-toothed saxifrage	100.0%	3.5	2.0	5.0
9	*Polytrichum juniperinum*	juniper haircap moss	50.0%	2.5		5.0
9	*Polytrichum sp.*	hair cap moss	50.0%	0.5	1.0	
11	*Cetraria sp.*	icelandmoss lichens	50.0%	1.0		2.0
11	*Cladina mitis*	lesser green reindeer	100.0%	7.5	10.0	5.0
11	*Cladonia sp.*	clad lichens	50.0%	0.1		0.1
11	*Peltigera sp.*	pelt lichens	50.0%	0.1		0.1
11	*Stereocaulon tomentosum*	eyed foam	100.0%	12.5	5.0	20.0
12	*Arctostaphylos uva-ursi*	bearberry	100.0%	2.6	0.2	5.0

APPENDIX

APPENDIX B ECOSYSTEM TYPE FACT SHEETS

Zone	Boreal
Class	Riparian
Type	Forest

Sample Ecosystem Fact Sheet

Spruce - Willow Riparian Forest

WR

1 Header contains information on the zone(s) in which the unit occurs and two broad categories (Class and Type) that group similar units.

General Characteristics (N=4) Veg... and understory tree species.

Site Description

This forest type generally occur... in depres... ...ve a rich nutrient regime a... ...derately moist to m... ...main saturated for a fe... after ...turation.

2 Number of plots that were sampled for this Ecosystem Type.

Vegetation

Paper birch and whi... ...htly drier have inclusions of balsam poplar. The ... ...w, red raspberry, and high-bush cranberry. The graminoid and forb layers are variable with little cover. Mosses have low cover and species diversity.

Variations

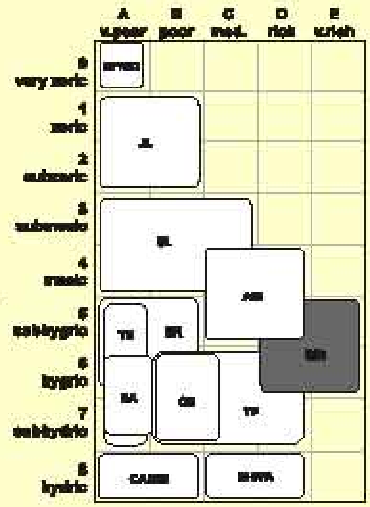
Riparian succession r... ...ging from young seral to mature cli... ...y with willow shrub layers. Low specie... ...late to rare flooding frequency have b... ...d high graminoid cover.

3 Edatopic grid showing the relationship between Ecosystem Types in terms of Soil Moisture Regime (rows) and Soil Nutrient Regime (columns).

Distribution

Stands of this ecosite usu... ...ystems between lakes.

Edatopic Grid



Site and Soil Characteristics

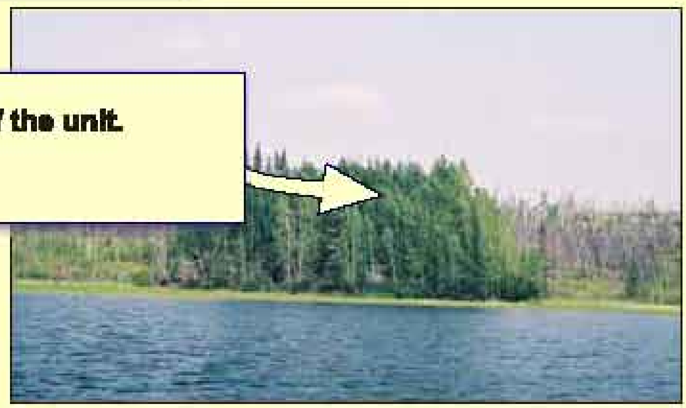
Regional Landform: Hills
Meso Site Position: Lower ...
Successional Status: Mature ...
Soil Moisture: Fresh to Moderately Moist
Soil Nutrient: Medium to Rich
Drainage: Moderately Well to Imperfectly
Perviousness: Moderate to Slow

Broad Ecosystem Units

...classified ... ...re ...ous ... *Burns.*

4 Values for Site and Soil Characteristics are averages or most typical.

5 Photo examples of the unit.



Characteristic Species of WR

Average % Cover	Range % Cover	
		Coniferous tree
4.0	0 - 11.0	... spruce *(Picea glauc...*
2.5	0 - 5.1	...
		D...
22.5	0 - 45.0	p...
15.0	0 - 60.0	b...
		D...
15.5		w...
12.5		n...
5.0		h...
2.0		re...
		G...
20.0		R...
0.2		b...
		Forb
0.1		cinquefoil *(Potentilla sp.)*

6 The Characteristic Species table show typical percent cover of plant species for these Ecosystem Units that were sampled. Other structural stages and stand compositions may occur.

Species of WR F14

% Cover	
	Coniferous tree
5.0	black spruce *(Picea mariana)*
	Deciduous tree
20.0	paper birch *(Betula papyrifera)*
	Deciduous shrub
5.0	tea leaved willow *(Salix planifolia sp. planifolia)*
3.0	northern bush willow *(Salix arbusculoides)*
	Fern and Fern Ally
2.0	wood horsetail *(Equisetum sylvaticum)*
	Graminoid
1.0	Slimstem reedgrass *(Calamagrostis stricta sp. inexpansa)*
	Forb
	swamp willowherb *(Epilobium palustre)*

Zone	Boreal
Class	Riparian
Type	Forest

Spruce - Willow Riparian Forest

WR

General Characteristics **(N=4)** Vegetation within each site varied, including dominant canopy and understory tree species.

Site Description

This forest type generally occurs in depressional areas within hilly landscapes. These ecotypes have a rich nutrient regime and moderately moist to moist soil moisture. Soil is imperfectly drained and will remain saturated for a few days after saturation.

Vegetation

Paper birch and white spruce dominate in mature stands. Forests that are slightly drier have inclusions of balsam poplar. The shrub layer tends to be sparse. Shrubs may include willow, red raspberry, and high-bush cranberry. The graminoid and forb layers are variable with little cover. Mosses have low cover and species diversity.

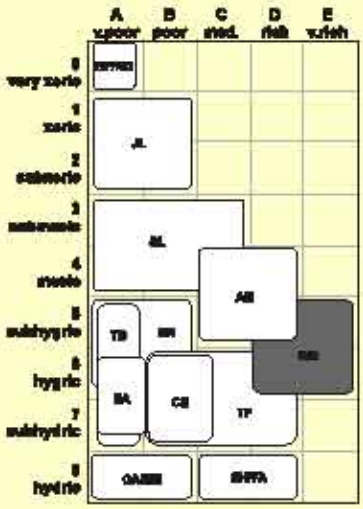
Variations

Riparian succession results in a broad range of structural stages of this ecosystem type, ranging from young seral to mature climatic climax. Frequently flooded sites support a paper birch canopy with willow shrub layers. Low species diversity is typical of frequently flooded sites. Sites with intermediate to rare flooding frequency have balsam poplar, and paper birch canopy with low shrub coverage and high graminoid cover.

Distribution

Stands of this ecosite usually occur adjacent to streams in the boreal zone and in drainage systems between lakes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills
Meso Site Position: Lower slope to Level
Successional Status: Mature Climatic Climax to Young Seral
Soil Moisture: Fresh to Moderately Moist
Soil Nutrient: Medium to Rich
Drainage: Moderately Well to Imperfectly drained
Perviousness: Moderate to Slow

Broad Ecosystem Units

•This unit is classified as Riparian Woodland and Shrubland.

Characteristic Species of WR

Average % Cover	Range % Cover	
		Coniferous tree
4.0	0 - 11.0	white spruce (*Picea glauca*)
		Deciduous tree
22.5	0 - 45.0	paper birch (*Betula papyrifera*)
15.0	0 - 60.0	balsam poplar (*Populus balsamifera*)
		Deciduous shrub
15.5	0 - 50.0	willow (*Salix* spp.)
12.5	0 - 60.0	northern blackcurrant (*Ribes hudsonianum*)
5.0	0 - 15.0	highbush cranberry (*Viburnum edule*)
2.0	0 - 5.0	red raspberry (*Rubus idaeus*)
		Graminoid
20.0	0 - 80.0	Reedgrass (*Calamagrostis sp.*)
0.2	0 - 1.0	bluejoint (*Calamagrostis canadensis*)
		Forb
0.1	0 - 0.1	cinquefoil (*Potentilla sp.*)

Species of WR F23

% Cover	
	Coniferous tree
3.0	white spruce (*Picea glauca*)
	Deciduous tree
40.0	paper birch (*Betula papyrifera*)
	Deciduous shrub
50.0	Willow (*Salix sp.*)
5.0	highbush-cranberry (*Viburnum edule*)
2.0	northern blackcurrant (*Ribes hudsonianum*)
	Graminoid
0.1	Reedgrass (*Calamagrostis sp.*)
	Forb
2.0	Canada violet (*Viola canadensis*)

Zone	Boreal
Class	Upland
Type	Forest

Spruce - Moss Forest

AM

***General Characteristics* (N=3)** This is a productive upland treed ecosystem. Understory vegetation composition varies between sites.

Site Description

This forest type develops on well drained sites underlain by fine-textured till veneers or bedrock. Moderately fresh soils assist with providing a modest amount of water and nutrients to plant forms.

Vegetation

The closed canopy is dominated by white spruce in climatic climax stages and paper birch as a seral community. Understory vegetation is variable and limited in cover. Shrubs include Labrador tea, green alder, and bog cranberry. Graminoid species present include bluejoint, however species cover is minimal. The moss and lichen layers are poorly developed, dominated by step moss, red-stemmed feathermoss and Cladonia lichens.

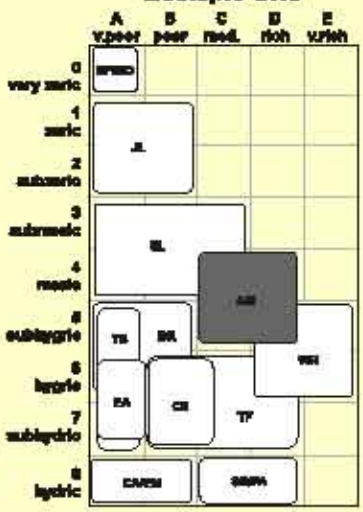
Variations

Paper birch is the dominant seral species following fire disturbance.

Distribution

Stands of this forest type were uncommon in the boreal zone of the study area. They were generally found on slopes above lake or at the toe of slopes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills
Meso Site Position: Toe to Upper Slope
Successional Status: Young Seral to Young Climatic Climax
Soil Moisture: Moderately Fresh to Fresh
Soil Nutrient: Medium
Drainage: Well to Rapidly drained
Perviousness: Moderate to Rapid

Broad Ecosystem Units

- Conifer dominated stands are classified as Mesic Coniferous Woodland.
- Deciduous and mixed stands are classified as Mixed and Deciduous Woodland.
- Burned stands are classified as Burns.

Characteristic Species of AM

Average % Cover	Range % Cover	
		Coniferous tree
10.0	1.0 – 15.0	white spruce *(Picea glauca)*
		Deciduous tree
76.7	70 – 85.0	paper birch *(Betula papyrifera)*
		Deciduous shrub
3.3	0 – 10.0	green alder *(Alnus viridis ssp. crispa)*
		Dwarf shrub
3.4	0 – 10.0	bog cranberry *(Vaccinium vitis-idaea)*
		Fern and Fern Ally
1.7	0 – 5.0	wood horsetail *(Equisetum sylvaticum)*
		Graminoid
0.7	0 – 2.0	bluejoint *(Calamagrostis Canadensis)*
		Moss
0.3	0 – 1.0	red-stemmed feathermoss *(Pleurozium schreberi)*
		Lichen
3.4	0 – 10.0	clad lichen *(Cladonia sp.)*

Species of AM F18

% Cover	
	Coniferous tree
1.0	white spruce *(Picea glauca)*
	Deciduous tree
85.0	paper birch *(Betula papyrifera)*
	Dwarf shrub
10.0	bog cranberry *(Vaccinium vitis-idaea)*
	Graminoid
2.0	bluejoint *(Calamagrostis Canadensis)*
1.0	slimstem reedgrass *(Calamagrostis stricta ssp. inexpansa)*

Zone	Boreal
Class	Riparian
Type	Forest

Boulder Field BF

***General Characteristics* (N=2)** The sites are generally similar in successional status, soil moisture and nutrients, and vegetation composition.

Site Description

This ecosite occurs on exposed slopes on hills within the region. Bedrock is exposed and the available soil is nutrient poor. Vegetation growth on areas where shallow soil has developed, limiting species diversity and cover. As a result of exposed bedrock, drainage is very rapid and soil moisture is very dry.

Vegetation

Stunted jack pine trees are scattered throughout the ecosite forming a very open canopy. Black spruce and paper birch present in very low numbers, provide limited cover. Shrub species composition is limited to common juniper, red raspberry, and bearberry. Ferns within this ecosite include rusty cliff fern and smooth cliff fern. Minimal amounts of grass and forb species survive in this environment. The dominant grass species is glaucous bluegrass, and the most common forb is three-toothed saxifrage. Moss life forms are limited within Boulder Fields, however, lichen cover and diversity is relatively high.

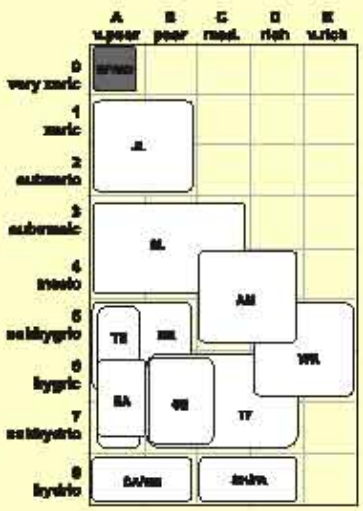
Variations

Species composition varies in relation to available soil and site microenvironments.

Distribution

The Boulder Field ecosite develops on areas that are dry, exposed, and have significant rock outcrops.

Edatopic Grid



Site and Soil Characteristics

Regional Landscape: Hills
Meso Site Position: Middle to Upper Slope
Successional Status: Young Seral to Mature Edaphic Climax
Soil Moisture: Very Dry
Soil Nutrient: Very Poor to Poor
Drainage: Very Rapidly to Rapidly drained
Perviousness: not applicable because of significant rock outcropping

Broad Ecosystem Units

•This unit is classified as Bedrock and Boulder Field.

Characteristic Species of BF

Average % Cover	Range % Cover		
0.2	0.1 – 0.2	Coniferous tree	jack pine *(Pinus banksiana)*
0.1	0 – 0.2		black spruce *(Picea mariana)*
2.8	0.1 – 5.0	Deciduous tree	paper birch *(Betula papyrifera)*
35.0	10 – 60.0	Evergreen shrub	common juniper *(Juniperus communis)*
1.0	1.0	Deciduous shrub	red raspberry *(Rubus idaeus)*
2.6	0.2 – 5.0	Dwarf shrub	bearberry *(Arctostaphylos uva-ursi)*
0.1	0.1	Fern and Fern Ally	rusty cliff fern *(Woodsia ilvensis)*
1.0	1.0	Graminoid	glaucous bluegrass *(Poe glauca)*
3.5	2.0 – 5.0	Forb	three-toothed saxifrage *(Saxifrage tricuspidata)*
2.5	0 – 5.0	Moss	juniper haircap moss *(Polytrichum juniperinum)*
12.5	5.0 – 20.0	Lichen	eyed foam *(Stereocaulon tomentosum)*
7.5	5.0 – 10.0		lesser green reindeer *(Cladina mitis)*

Species of BF F31

% Cover		
0.2	Coniferous tree	jack pine *(Pinus banksiana)*
5.0	Deciduous tree	paper birch *(Betula papyrifera)*
10.0	Evergreen shrub	common juniper *(Juniperus communis)*
1.0	Deciduous shrub	red raspberry *(Rubus idaeus)*
5.0	Dwarf shrub	bearberry *(Arctostaphylos uva-ursi)*
0.1	Fern and Fern Ally	rusty cliff fern *(Woodsia ilvensis)*
1.0	Graminoid	glaucous bluegrass *(Poe glauca)*
5.0	Forb	three-toothed saxifrage *(Saxifrage tricuspidata)*
5.0	Moss	juniper haircap moss *(Polytrichum juniperinum)*
20.0	Lichen	eyed foam *(Stereocaulon tomentosum)*
5.0		lesser green reindeer *(Cladina mitis)*
2.0		Icelandmoss *(Cetraria sp.)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Scrub birch - Cloudberry Low Shrub Bog

BR

General Characteristics **(N=1)** The term "bog" is applied to this ecosystem in the broad sense. Strictly, though, it is probably a "poor fen".

Site Description

This ecosite occurs in depression areas within upland regions. The soil remains moist due to poor drainage. The amount of nutrients available to vegetation is considered moderate.

Vegetation

Understory vegetation is generally homogeneous with scrub birch dominating and minimal cover from willows, horsetail, bluejoint, and fireweed. No moss and lichen life forms are present within this ecosite.

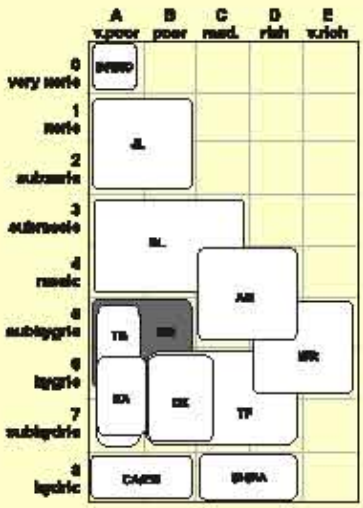
Variations

Water levels and fire can alter the distribution of shrubs, graminoids, mosses, and lichens.

Distribution

BR tends to occur in the polygon centres, while graminoid fen ecosystems (EA, CE, CA) occupy polygon perimeters. It is found in close association with TB ecosites and is present as islands within larger TB polygons. It is rarely mapped on its own.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Seral (scrub birch), Young Edaphic Climax (black spruce)
Soil Moisture: Moist
Soil Nutrient: Poor to Medium
Drainage: Poorly drained
Perviousness: Slow

Broad Ecosystem Units

•This unit is classified as Birch Hummock.

Characteristic Species of BR

Average % Cover	Range % Cover	
		Coniferous tree
6.0	6.0	tamarack *(Larix laricina)*
1.0	1.0	black spruce *(Picea mariana)*
		Deciduous shrub
85.0	85.0	scrub birch *(Betula nana)*
1.0	1.0	willow (*Salix* spp.)
1.0	1.0	bilberry willow *(Salix myrtilifolia)*
		Fern and Fern Ally
0.1	0.1	wood horsetail *(Equisetum sylvaticum)*
		Graminoid
0.1	0.1	bluejoint *(Calamagrostis canadensis)*
		Forb
0.1	0.1	fireweed *(Epilobium angustifolium)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Water sedge Narrow-leaved cottongrass Fen

CA

***General Characteristics* (N=1)** This is the wettest graminoid fen ecosites in the study area.

Site Description

This ecosystem occurs on saturated organic soils derived from sedge peat blankets and veneers. The soil is very poorly drained and there is standing water within this wetland type. These graminoid fens occur in depressions within larger benchland topography.

Vegetation

A moderate to lush cover of water sedge dominates the vegetation with moderate amount of cover from dwarf shrubs such as leatherleaf and bog rosemary. Moss cover is sparse and dominated by *Sphagnum* sp.

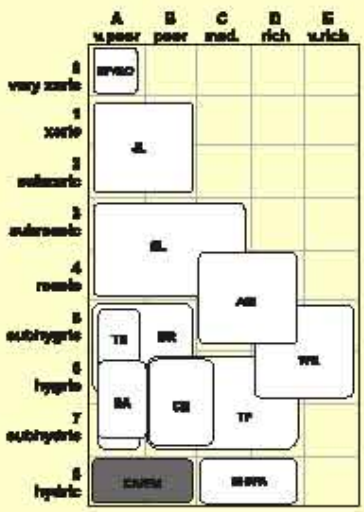
Variations

Changes in water movement may alter species composition.

Distribution

This common ecosystem often co-occurs with other graminoid fens (CE, EA), low shrub bogs (BR), and open water (OW). It is restricted to very wet sites with some water movement.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Edaphic Climax
Soil Moisture: Wet
Soil Nutrient: Rich
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit if classified as **Sedge Fen.**
- Complexes of BR, EA, and CA are classified as **Wetland Complex.**

No photo available

Characteristic Species of CA

Average % Cover	Range % Cover	
		Coniferous tree
3.0	3.0	tamarack (*Larix laricina*)
		Evergreen shrub
10.0	10.0	leatherleaf *(Chamaedaphne calyculata)*
		Dwarf shrub
5.0	5.0	cloudberry (*Rubus chamaemorus*)
3.0	3.0	bog rosemary *(Andromeda polifolia)*
1.0	1.0	bog cranberry *(Vaccinium vitis-idaea)*
		Graminoid
70.0	70.0	water sedge *(Carex aquatilis)*
		Moss
1.0	1.0	Sphagnum species *(Sphagnum sp.)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Round-fruited sedge Chamisso's cottongrass Fen

CE

General Characteristics **(N=1)** These graminoid fens can vary in vegetation composition in relation to site and soil characteristics. For example, Chamisso's cottongrass is present within this site, but no round-fruited sedge was observed at the time of the site investigation.

Site Description

This ecosystem occurs on saturated organic soils in depressional areas. Nutrients available for vegetation are considered moderate.

Vegetation

Cottongrass and sedges are the dominant vegetation. Scattered bog rosemary and cloudberry are present. Common brown Sphagnum forms a significant component of the moss layer.

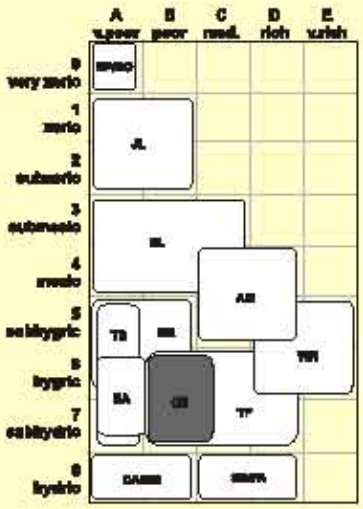
Variations

Changes in water movement may alter species composition.

Distribution

This ecosystem often co-occurs with other graminoid fens (CA, CE, EA) and low shrub bogs (BR). It is restricted to wet sites with some water movement.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Seral
Soil Moisture: Wet
Soil Nutrient: Medium
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as **Sedge Fen.**
- Complexes of BR, EA, and CE are classified as **Wetland Complex.**

Characteristic Species of CE

Average % Cover	Range % Cover	
		Evergreen shrub
1.0	1.0	Labrador tea *(Ledum groenlandicum)*
		Dwarf shrub
5.0	5.0	cloudberry *(Rubus chamaemorus)*
2.0	2.0	bog rosemary *(Andromeda polifolia)*
		Graminoid
20.0	20.0	sedge species *(Carex sp.)*
10.0	10.0	Chamisso's cotton grass *(Eriophorum chamissonis)*
5.0	5.0	sheathed cotton-grass *(Eriophorum vaginatum)*
		Moss
20.0	20.0	common brown sphagnum *(Sphagnum fuscum)*
5.0	5.0	shaggy sphagnum *(Sphagnum squarrosum)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Sheathed cottongrass Bog-rosemary Sedge Fen

EA

***General Characteristics* (N=1)** This graminoid fen occurs within a Tamarack Blueberry Treed Fen (TF).

Site Description

This ecosystem occurs in depressional areas within regional plateaus. As a result of poor drainage and slow perviousness, the soil is moderately wet.

Vegetation

A moderate cover of sedges dominates the vegetation, in particular water sedge. Shaggy sphagnum and other sphagnum species including common brown and midway peat moss are present. Scattered leatherleaf and scrub birch may occur.

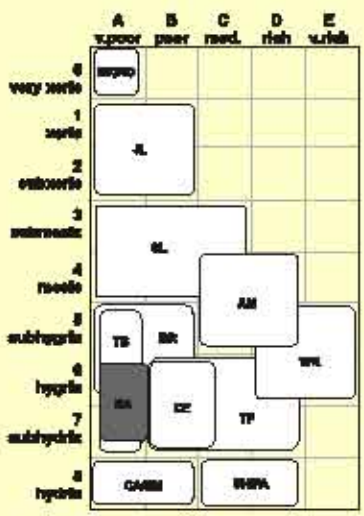
Variations

Changes in water movement may alter species composition.

Distribution

This ecosystem was uncommon and only found in small patches with TF ecosites.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression
Successional Status: Mature Seral
Soil Moisture: Moderately Wet
Soil Nutrient: Medium
Drainage: Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as Sedge Fen.
- Complexes of BR and EA are classified as Wetland Complex.

Characteristic Species of EA

Average % Cover	Range % Cover	
		Evergreen shrub
10.0	10.0	leatherleaf *(Chamaedaphne calyculata)*
		Deciduous shrub
5.0	5.0	scrub birch *(Betula nana)*
		Graminoid
60.0	60.0	water sedge *(Carex aquatilis)*
		Forb
1.0	1.0	arrow-leaved coltsfoot *(Petasites sagittatus)*
		Moss
30.0	30.0	shaggy sphagnum *(Sphagnum squarrosum)*
6.0	6.0	common brown sphagnum *(Sphagnum fuscum)*
2.0	2.0	midway peatmoss *(Sphagnum magellanicum)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Water sedge Horsetail Shallow Shore Marsh

EM

General Characteristics **(N=4)** This shallow shore marsh occurs along lake and pond shores.

Site Description

This ecosystem occurs in shallow open water. High available nutrients support a variety of sedges.

Vegetation

Vegetation is patchy and interspersed with shallow open water. Water sedge is the dominant species. Potentilla and other sedge species are common. Forb cover is sparse but diverse.

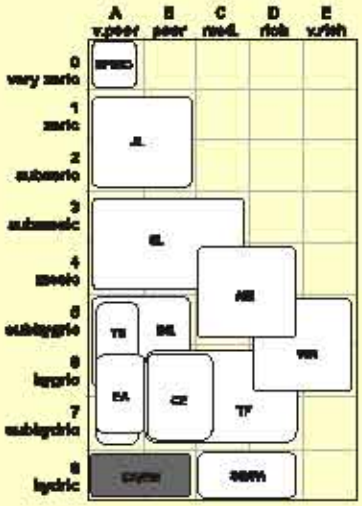
Variations

Water fluctuations can determine species composition and cover. Low water levels during drier years within the shallow shore marsh provide substrate for pioneer forb species to establish.

Distribution

This ecosystem is commonly found as a fringe along lake and pond shores.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression and Level
Successional Status: Mature Seral
Soil Moisture: Wet
Soil Nutrient: Medium and Rich
Drainage: Poorly to Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

•This unit is classified as Other Wetlands.

Characteristic Species of EM

Average % Cover	Range % Cover	
		Evergreen Shrub
0.1	0 – 0.1	leatherleaf *(Chamaedaphne calyculata)*
		Deciduous shrub
0.4	0 – 4.0	sweet gale *(Myrica gale)*
		Graminoid
55.3	1.0 – 90.0	water sedge *(Carex aquatilis)*
12.5	0 – 40.0	beaked sedge *(Carex utriculata)*
		Forb
2.0	0 – 5.0	cinquefoil *(Potentilla sp.)*
2.6	0 – 10.0	wild calla *(Calla palustris)*

Species of EM 17

% Cover	
	Graminoid
90.0	water sedge *(Carex aquatilis)*
	Forb
10.0	wild calla *(Calla palustris)*
4.0	greater bladderwort *(Utricularia macrorhiza)*

Zone	*Boreal*
Class	*Wetland*
Type	*Floating Aquatic*

Floating Aquatic Shallow Open Water

FA

***General Characteristics* (N=0)**
Visual assessments only were completed for this ecosite.

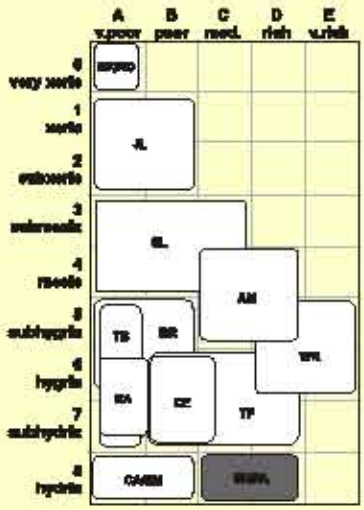
Site Description
Standing water is present throughout the year.

Vegetation
Vegetation is composed of floating aquatic vascular plants, including small yellow pond lily, water sedge, emergent horsetail, and pondweed.

Variations
Variations in species composition would depend on water depth and chemistry.

Distribution
Floating aquatic ecosites occur in shallow open water, approximately < 2 m in depth or in shallow portions of lakes or ponds.

Edatopic Grid



Site and Soil Characteristics
Regional Landform: Hills, Plateau
Meso Site Position: Depression topography
Successional Status: Mature Seral
Soil Moisture: Wet
Soil Nutrient: Moderate
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units
•This unit is classified as Aquatic Vegetation.

Characteristic Species of FA

No species composition data available

Zone	Boreal
Class	Upland
Type	Woodland

Jack pine - Lichen Woodland

JL

General Characteristics (N=6) This woodland type is typical of dry sites in the boreal zone.

Site Description

Jack pine lichen woodlands develop on crest of hills or esker complexes. Soils tend to be shallow with bedrock outcroppings or bedrock near the surface. As a result, nutrients and water are limited as drainage is very rapid and the soil is less permeable to water.

Vegetation

Stunted jack pine trees form a very open canopy. The understory is sparse, due to lack of soil development. Forbs typically include bearberry and bog cranberry. Graminoids are scant and limited to reedgrasses and bluegrass. Lichens cover much of the ground surface, and bedrock tends to be covered with crustose lichens. Eyed foam, clad lichen and Icelandmoss lichen have significant covers. Small patches of bryophytes include *Dicranum* spp. and haircap mosses.

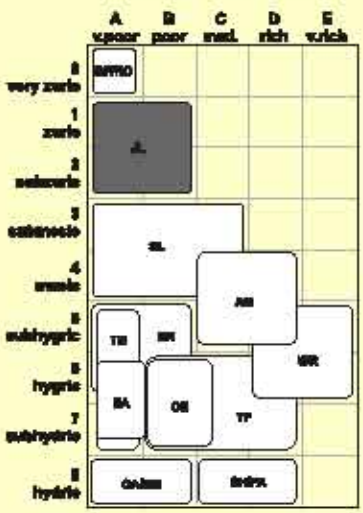
Variations

Birch is present as seral species on burnt sites.

Distribution

This ecosystem is mostly restricted to dry bedrock knolls, but it occasionally occurs on rapidly drained sandy deposits and rocky esker complexes.

Edatopic Grid



Site and Soil Characteristics

Regional Landform,: Hills
Meso Site Position: Middle Slope to Crest
Successional Status: Young Seral to Mature Edaphic Climax
Soil Moisture: Very Dry to Dry
Soil Nutrient: Very Poor to Poor
Drainage: Very Rapidly to Rapidly drained
Perviousness: not applicable because of significant rock outcropping

Broad Ecosystem Units

- Conifer dominated stands are classified as Dry Coniferous Woodland.
- Deciduous and mixed stands are classified as Mixed and Deciduous Woodland.
- Burned stands are classified as Burns.

Characteristic Species of JL

Average % Cover	Range % Cover		
23.0	1.1 – 50.0	**Coniferous tree**	Jack pine *(Pinus banksiana)*
5.5	0 – 15.0	**Deciduous tree**	paper birch *(Betula papyrifera)*
0.4	0 – 4.0	**Deciduous shrub**	willow species *(Salix sp.)*
22.5	0 – 60.0	**Dwarf shrub**	bearberry *(Arctostaphylos uva-ursi)*
1.8	0 – 5.0		bog cranberry *(Vaccinium vitis-idaea)*
0.2	0 – 1.0	**Fern and Fern Ally**	Virginia polypody *(Polypodium virginianum)*
0.1	0 – 0.2	**Graminoid**	glaucous bluegrass *(Poa glauca)*
3.8	0 – 20.0	**Moss**	dicranum species *(Dicranum sp.)*
1.9	0 – 5.0		juniper haircap moss *(Polytrichum juniperinum)*
5.8	0 – 30.0	**Lichen**	crust lichen (Crustose lichen)
3.7	0 – 10.0		eyed foam *(Stereocaulon tomentosum)*
2.7	0 – 15.0		clad lichens *(Cladonia sp.)*

Species of JL F35

% Cover	
	Coniferous tree
7.0	black spruce *(Picea mariana)*
1.1	Jack pine *(Pinus banksiana)*
	Deciduous tree
11.0	paper birch *(Betula papyrifera)*
	Dwarf shrub
60.0	bearberry *(Arctostaphylos uva-ursi)*
3.0	bog cranberry *(Vaccinium vitis-idaea)*
	Graminoid
1.0	spike trisetum *(Trisetum spicatum)*
	Forb
1.0	bastard toad-flax *(Geocaulon lividum)*

Zone	Boreal
Class	Wetland
Type	Non-treed

Willow - Sedge Low Shrub Fen

SH

General Characteristics (N=0) Visual assessments only were made for this ecosystem.

Site Description This ecosystem occurs on saturated organic soils derived from sedge peat blankets and veneers.

Vegetation

Low shrubs and sedges dominate the vegetation. The moderate shrub layer is mostly composed of willows, with leatherleaf present as a minor component. Several species of sedges may be present, but water sedge is usually the dominant species. Cloudberry plants may be scattered throughout the herb layer. The moderate moss layer has variable species composition. Peat mosses are often present.

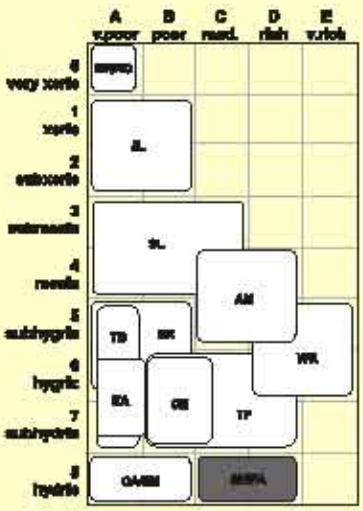
Variations

Species composition will vary with water movement and frequency of fire.

Distribution

This shrubby fen often co-occurs with graminoid fens. Common distribution was near open water, treed fens or drainage areas. It is restricted to wet sites with some water movement.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression and Level
Successional Status: Young Seral to Mature Seral
Soil Moisture: Wet
Soil Nutrient: Medium to Rich
Drainage: Very Poorly drained
Perviousness: Slow

Broad Ecosystem Units

•This unit is classified as Shrubby Fen.

Characteristic Species of SH

No species composition data available

Zone	Boreal
Class	Upland
Type	Woodland

Spruce - Lichen Woodland

SL

General Characteristics (N=7) This Spruce - Lichen woodland commonly occure within the study area.

Site Description

The Spruce-Lichen Woodland type typically occurs on slopes of hills. Soils range from Regosols with boulder and till deposits, or Brunisol soils over til veneer. Soil nutrient levels are low and soils are moderately dry.

Vegetation

Mature stands are dominated by black spruce. The shrub layer is composed of Labrador tea, green alder, willow, and bog cranberry. The herb layer is sparse and lacks species diversity. Moss are dominated by *Dicranum* species and have moderate cover. Reindeer, Icelandmoss lichens, and clad lichens are common. Lichen cover is high in mature stands.

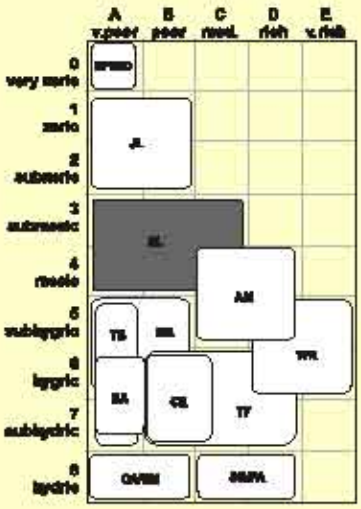
Variations

Stands are subjected to relatively frequent fires. Following fire, fireweed and deciduous shrubs are pioneer species. Paper birch and jack pine are seral canopy species with black spruce regeneration. Lichen coverage is limited in seral stands.

Distribution

This ecosystem occurs on a broad range of well-drained sites underlain by till and bedrock. It is also found on a variety of slope positions and aspects.

Ecotopic Grid



Site and Soil Characteristics

Regional Landform: Hills
Meso Site Position: Crest to Level
Successional Status: Young Seral to Young Climatic Climax
Soil Moisture: Dry to Moderately Fresh
Soil Nutrient: Very Poor to Medium
Drainage: Very Rapidly to Moderately drained
Perviousness: Moderate to Rapid

Broad Ecosystem Units

- Conifer dominated stands are classified as **Dry Coniferous Woodland.**
- Deciduous and mixed stands are classified as **Mixed and Deciduous Woodland.**
- Burnt stands are classified as **Burns.**

Characteristic Species of SL

Average % Cover	Range % Cover	
		Coniferous tree
14.9	0 – 41.0	black spruce *(Picea mariana)*
12.5	0 – 75.0	Jack pine *(Pinus banksiana)*
		Deciduous tree
8.2	0 – 18.0	paper birch *(Betula papyrifera)*
		Evergreen shrub
13.3	0.1 – 30.0	Labrador tea *(Ledum groenlandicum)*
		Deciduous shrub
1.9	0 – 8.0	green alder *(Alnus viridis ssp. crispa)*
		Dwarf shrub
6.7	0.1 – 25.0	bog cranberry *(Vaccinium vitis-idaea)*
		Moss
2.6	0 – 10.0	dicranum species *(Dicranum sp.)*
0.9	0 – 3.0	juniper haircap moss *(Polytrichum juniperinum)*
		Lichen
9.6	0 – 25.0	lesser green reindeer *(Cladina mitis)*
6.4	0 – 25.0	grey reindeer *(Cladina rangiferina)*

Species of SL F4

% Cover	
	Coniferous tree
75.0	Jack pine *(Pinus banksiana)*
1.0	black spruce *(Picea mariana)*
	Evergreen shrub
1.0	Labrador tea *(Ledum groenlandicum)*
	Dwarf shrub
1.0	bog cranberry *(Vaccinium vitis-idaea)*
1.0	bearberry *(Arctostaphylos uva-ursi)*
	Moss
1.0	dicranum species *(Dicranum sp.)*
	Lichen
8.0	clad lichens *(Cladonia sp.)*
1.0	Icelandmoss lichen *(Cetraria sp.)*

Zone	Boreal
Class	Wetland
Type	Treed

Spruce - Cloudberry Treed Bog

TB

General Characteristics (N=5)

This wetland type is a Treed Northern Plateau Bog. The term "bog" is applied to this ecosystem in the broad sense. Strictly, though, it is probably a "poor fen".

Site Description

Treed bogs occur on *Sphagnum* peat deposits. This wetland type typically occurs in depressional areas within upland or hilly regions. These sites have low levels of nutrients available for plant growth and are generally moist. Organic soils develop over time due to poor drainage and elevated water levels.

Vegetation

Stunted black spruce usually forms a very open canopy with a relatively homogeneous shrub layer. Labrador tea, as well as minor components of cloudberry, bog blueberry and bog cranberry dominate the shrub layer. Graminoids and forbs are insignificant understory components. Moss and lichen life forms are diverse and contribute to a considerable amount of total cover within this wetland.

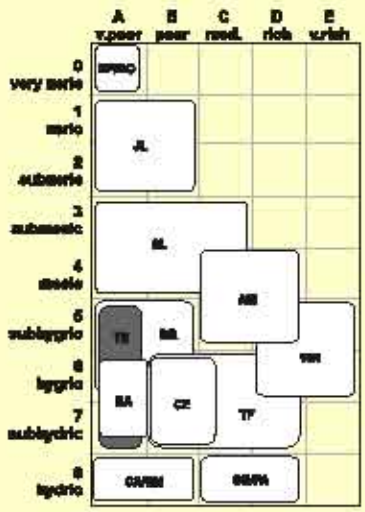
Variations

The lichen form (TBl) occurs when the ground surface becomes elevated and experiences moisture deficits. It has a carpet of reindeer lichens, with little living *Sphagnum* on the ground surface. In young seral and edaphic successional types, understory vegetation is more diverse with higher cover, compared to the mature stands.

Distribution

Treed bogs are located as plateaus within upland areas. They are often surrounded by bedrock outcrops supporting SL or JL ecosites.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Level to Depressional
Successional Status: Young Seral to Mature Edaphic Climax
Soil Moisture: Moderately Wet to Moist
Soil Nutrient: Very Poor to Poor
Drainage: Poor
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as Treed Fens and Bogs.
- Burned occurrences are classified as Burns.

Characteristic Species of TB

Average % Cover	Range % Cover		
12.0	0.1 - 36.0	Coniferous tree	black spruce (*Picea mariana*)
1.8	0 – 6.0	Deciduous tree	water birch (*Betula occidentalis*)
44.0	20.0 - 70.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
0.8	0 - 2.0	Deciduous shrub	bog blueberry (*Vaccinium uliginosum*)
2.0	0 - 5.0	Dwarf shrub	cloudberry (*Rubus chamaemorus*)
0.8	0 - 2.0		bog cranberry (*Vaccinium vitis-idaea*)
0.4	0 - 1.0		crowberry (*Empetrum nigrum*)
12.0	0 - 25.0	Moss	dicranum species (*Dicranum sp.*)
3.4	0 - 15.0		common brown sphagnum (*Sphagnum fuscum*)
6.0	0 - 15.0	Lichen	clad lichen (*Cladonia sp.*)
3.2	0 - 10.0		grey reindeer (*Cladina rangiferina*)

Species of TB FS

% Cover		
0.2	Coniferous tree	Jack pine (*Pinus banksiana*)
3.0	Deciduous tree	water birch (*Betula occidentalis*)
20.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
3.0	Deciduous shrub	green alder (*Alnus viridis sp. crispa*)
3.0		scrub birch (*Betula nana*)
1.0		bog blueberry (*Vaccinium uliginosum*)
2.0	Dwarf shrub	cloudberry (*Rubus chamaemorus*)
2.0		alpine bearberry (*Arctostaphylos alpina var. rubra*)
3.0	Fern and Fern Ally	common horsetail (*Equisetum arvense*)
20.0	Moss	dicranum species (*Dicranum sp.*)
15.0		common brown sphagnum (*Sphagnum fuscum*)
0.5		bog haircap moss (*Polytrichum strictum*)
6.0	Lichen	clad lichen (*Cladonia sp.*)
1.0		grey reindeer (*Cladina rangiferina*)

Zone	Boreal
Class	Wetland
Type	Treed

Tamarack Blueberry Treed Fen

TF

General Characteristics **(N=2)** This ecosite appears within a variety of topographic conditions including upland and valley floor environments. Vegetation composition and cover varies between sites.

Site Description

Treed fens occur on well developed organic layers that are moist to moderately wet and relatively nutrient rich. These sites are poorly drained with slow perviousness.

Vegetation

Stunted black spruce and tamarack usually form a very open canopy. The moderate shrub layer is variable, and can include Labrador tea, northern Labrador tea, scrub birch, willow species, and bog blueberry. Dwarf woody plants also occur including crowberry and bog cranberry. The moss layer is well developed and is the main component of the understory vegetation. Common moss species include common brown sphagnum, *Dicranum* sp., and *Aulacomnium* sp. Lichen cover is low.

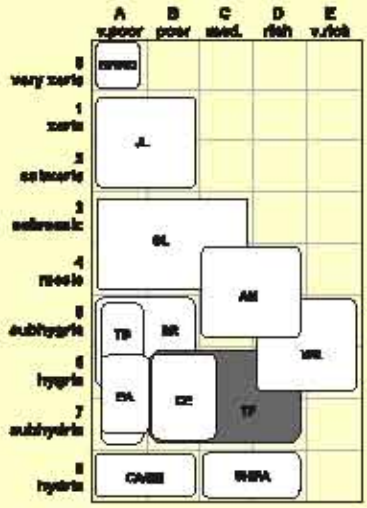
Variations

Sites categorized as Tamarack Blueberry Treed Fens may vary slightly in vegetation species composition and cover in relation to soil moisture conditions. In young seral and edaphic successional types, understory vegetation is more diverse with higher cover, compared to the mature stands.

Distribution

Treed fens occur in drainage areas of the boreal zone. They are usually found in upland plateaus that have water movement or near open wetlands.

Edatopic Grid



Site and Soil Characteristics

Regional Landform: Hills, Plateau
Meso Site Position: Depression to Level topography
Successional Status: Mature Seral to Young Edaphic Climax
Soil Moisture: Moist to Moderately Wet
Soil Nutrient: Medium to Rich
Drainage: Poorly drained
Perviousness: Slow

Broad Ecosystem Units

- This unit is classified as Treed Fens and Bogs.
- Burned areas are classified as Burns.

Characteristic Species of TF

Average % Cover	Range % Cover		
13.0	1.0 – 25.0	Coniferous tree	black spruce (*Picea mariana*)
6.0	3.0 – 9.0		tamarack (*Larix laricina*)
5.0	0 - 10.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
2.5	0 - 5.0		northern Labrador tea (*Ledum palustre ssp. decumbens*)
18.0	1.0 – 35.0	Deciduous shrub	scrub birch (*Betula nana*)
2.6	0.1 – 5.0		willow species (*Salix sp.*)
0.6	0.1 - 1.0		bog blueberry (*Vaccinium uliginosum*)
2.0	0 - 4.0	Dwarf shrub	crowberry (*Empetrum nigrum*)
1.1	0.1 - 2.0		bog cranberry (*Vaccinium vitis-idaea*)
30.0	30.0	Moss	common brown sphagnum (*Sphagnum fuscum*)
6.0	6.0		dicranum species (*Dicranum sp.*)
2.0	2.0		sheggy sphagnum (*Sphagnum squarrosum*)
6.0	6.0	Lichen	lesser green lichen (*Cladina mitis*)
1.0	1.0		Icelandmoss (*Cetraria sp.*)

Species of TF F36

% Cover		
25.0	Coniferous tree	black spruce (*Picea mariana*)
9.0		tamarack (*Larix laricina*)
10.0	Evergreen shrub	Labrador tea (*Ledum groenlandicum*)
5.0		northern Labrador tea (*Ledum palustre ssp. decumbens*)
1.0	Deciduous shrub	scrub birch (*Betula nana*)
0.1		willow species (*Salix sp.*)
1.0		bog blueberry (*Vaccinium uliginosum*)
4.0	Dwarf shrub	crowberry (*Empetrum nigrum*)
2.0		bog cranberry (*Vaccinium vitis-idaea*)
30.0	Moss	common brown sphagnum (*Sphagnum fuscum*)
5.0		dicranum species (*Dicranum sp.*)
2.0		sheggy sphagnum (*Sphagnum squarrosum*)
2.0		bog haimap moss (*Polytrichum strictum*)
5.0	Lichen	lesser green lichen (*Cladina mitis*)
1.0		Icelandmoss (*Cetraria sp.*)

APPENDIX

APPENDIX C RARE PLANT SURVEY VEGETATION DATA

STUDY AREA: CAMP			
Vegetation Type	Latin Name	Common Name	Notes
Forb	*Corydalis sempervirens*	Pale Corydalis	
	Cryptogramma sitchensis	Parsley Fern	Also known as *Cryptogramma sitchensis crispa*
	Epilobium angustifolium	Fireweed	Also known as *Chamerion angustifolium*
	Epilobium palustre	Marsh Willow Herb	
	Equisetum arvense	Field Horsetail	
	Geocaulon lividum	False Toadflax	
	Polygonum spp	Knotweed, Smartweed	
	Saxifraga tricuspidata	Prickly Saxifrage	
	Stellaria borealis	Northern Stitchwort	Also known as *Stellaria calycantha*
	Stellaria crassifolia	Fleashy Stitchwort	
Grass/Grass-like	*Agrostis scabra*	Rough Bentgrass	
	Calamagrostis neglecta	Reed Bentgrass	
	Carex aenea	Bronze Sedge	
	Carex aquatilis	Water Sedge	
	Carex aurea	Golden Fruit Sedge	
	Carex canescens	Hoary Sedge	
	Eriophorum angustifolium	Cotton Grass	Includes *Eriophorum triste*
	Glyceria striata	Fowl Manna Grass	
	Poa spp	Bluegrass	
	Trisetum spicatum	Narrow False Oat	
Lichen	*Cetraria nivalis*		
	Cladina mitis	Green reindeer lichen	
	Cladina rangiferina	Gray reindeer lichen	
	Cladonia spp	Club lichen	
	Peltigera aphthosa	Common freckle pelt, felt lichen	
	Stereocaulon tomentosum	Woolly foam lichen, eyed foam lichen	
Moss	*Aulacomnium palustre*	Tufted Moss, glow moss	
	Polytrichum juniperinum	Haircap Moss	
Shrub	*Alnus viridis*	Green Alder	Includes *Alnus crispa*
	Arctostaphylos uva-ursi	Bear Berry	
	Betula occidentalis	Spring Birch	Also known as *Betula fontinalis*
	Calamagrostis canadensis	Blue-Joint	
	Empetrum nigrum	Black Crowberry	
	Juniperus communis	Common Juniper	Also known as Ground Juniper
	Ledum groenlandicum	Common Labrador Tea	
	Potentilla norvegica	Norwegian Cinqefoil	
	Ribes oxyacanthoides	Canada Gooseberry	
	Rosa acicularis	Prickly Rose	
	Rubus idaeus	Wild Raspberry	Also known as *Rubus idaeus ssp. strigosus*
	Salix bebbiana	Bebb Willow	Also known as *Salix rostrata* , Long-beaked Willow
	Salix glauca	Gray willow	Also known as *Salix glauca cordiflora ssp callicarpea, Salix glauca ssp stenolepsis*
	Salix myrtillifolia	Myrtle-Leaf Willow	
	Salix planifolia	Tea-leaved Willow	Includes *Salix pulchra, Salix tyrrellii*
	Salix tyrrellii	Willow spp	
	Vaccinium uliginosum	Alpine Blueberry	
	Vaccinium vitis-idaea	Mountain Cranberry	
	Viburnum edule	Squashberry	
Tree	*Betula papyrifera*	Paper birch	Also known as *Betula papyrifera var. commutata* , White Birch
	Larix laricina	Larch	Also known as Tamarack
	Picea mariana	Black Spruce	
	Pinus banksiana	Jack Pine	Also known as *Pinus divaricata*
	Populus tremuloides	Quaking Aspen	

STUDY AREA: GRAVEL PIT			
Vegetation Type	Latin Name	Common Name	Notes
Forb	*Arctostaphylos rubra*	Red Manzanita	
	Astragalus alpinus	Alpine Milk Vetch	
	Astragalus americanus	American Milk Vetch	
	Compositae (family)		
	Corydalis sempervirens	Pale Corydalis	
	Cryptogramma sitchensis	Parsley Fern	Also known as *Cryptogramma sitchensis crispa*
	Dryopteris fragrans	Fragrant Cliff Wood-Fern	
	Epilobium angustifolium	Fireweed	Also known as *Chamerion angustifolium*
	Equisetum arvense	Field Horsetail	
	Equisetum spp	Horsetail	
	Erigeron elatus	Swamp Fleabane	
	Erigeron glabellus	Smooth Fleabane	
	Erigeron spp	Fleabane	
	Geocaulon lividum	Northern Comandra	
	Linnaea borealis	Twinflower	
	Orthilia secunda Pyrola secunda	One-sided Wintergreen	Also known as *Pyrola secunda*
	Oxycoccos microcarpus	Small Bog Cranberry	
	Pedicularis labradorica	Labrador Lousewort	
	Pinguicula vulgaris	Common Butterwort	
	Pyrola spp.	Wintergreen	
	Ranunculus gmelinii	Small Yellow Water-Buttercup	Includes *Ranunculus purshii*
	Ranunculus lapponicus	Lapland Buttercup	
	Rubus acaulis	Dwarf Raspberry	
	Rubus chamaemorus	Cloudberry	
	Saxifraga tricuspidata	Prickly Saxifrage	
	Senecio streptanthifolius	Rocky Mountain Groundsel	
	Stellaria spp.	Chickweed, Starwort	
	Woodsia ilvensis	Rusty Woodsia	
Grass/Grass-like	*Agrostis scabra*	Rough Bentgrass	
	Calamagrostis canadensis	Blue-Joint	
	Carex aenea	Bronze Sedge	
	Carex aquatilis	Water Sedge	
	Carex aurea	Golden Fruit Sedge	
	Carex brunnescens	Brownish Sedge	
	Carex canescens	Hoary Sedge	
	Carex capillaris	Hair-like Sedge	
	Carex concinna	Beautiful Sedge	
	Carex deflexa	Short-stemmed Sedge	
	Carex disperma	Softleaf Sedge	
	Carex interior	Inland Sedge	
	Carex norvegica	Scandinavian Sedge	
	Carex parryana	Parry's Sedge	
	Carex vaginata	Sheathed Sedge	
	Eleocharis palustris	Creeping Spike Rush	
	Eriophorum angustifolium	Cotton Grass	Includes *Eriophorum triste*
	Eriophorum chamissonis	Russet Cotton Grass	Also known as *Eriophorum russeolum var. albindum*
	Eriophorum scheuchzeri	Schechzeri Cotton Grass	
	Gramineae (family)	Grass spp	
	Poa glauca	White Blue Grass	
	Poa spp	Bluegrass	
	Scirpus cespitosus	Tufted Club-rush	
	Trisetum spicatum	Narrow False Oat	
Lichen	*Cetraria spp*		
	Cladina mitis	Green reindeer lichen	
	Cladina rangiferina	Gray reindeer lichen	
	Cladina stellaris	Star-tipped reindeer lichen	
	Cladonia spp	Club licken	
	Peltigera aphthosa	Common freckle pelt, felt lichen	
	Peltigera neopolydactyla	Carpet pelt	
Moss	*Aulacomnium palustre*	Tufted Moss, glow moss	
	Polytrichum juniperinum	Haircap	

STUDY AREA: GRAVEL PIT			
Shrub	*Alnus viridis*	Green Alder	Includes *Alnus crispa*
	Arctostaphylos uva-ursi	Bear Berry	
	Betula nana	Arctic Dwarf Birch	Also known as *Betula glandulosa,* Dwarf Birch
	Betula occidentalis	Spring Birch	Also known as *Betula fontinalis*
	Chamaedaphne calyculata	Leather leaf	
	Empetrum nigrum	Black Crowberry	
	Ledum groenlandicum	Common Labrador Tea	
	Ribes hudsonianum	Northern Black Currant	
	Rosa acicularis	Prickly Rose	
	Rubus idaeus	Wild Raspberry	Also known as *Rubus idaeus ssp. strigosus*
	Salix arbusculoides	Littletree Willow	
	Salix bebbiana	Bebb Willow	Also known as *Salix rostrata,* Long-beaked Willow
	Salix fuscescens	Alaska Bog Willow	
	Salix glauca	Gray willow	Also known as *Salix glauca cordiflora ssp callicarpea, Salix glauca ssp stenolepsis*
	Salix myrtillifolia	Myrtle-Leaf Willow	
	Salix scouleriana	Scouler Willow	Also known as Mountain willow, Fire willow
	Salix spp	Willow	
	Salix tyrrellii		
	Vaccinium uliginosum	Alpine Blueberry	
	Vaccinium vitis-idaea	Mountain Cranberry	
Tree	*Betula papyrifera*	Paper birch	Also known as *Betula papyrifera var. commutata* , White Birch
	Larix laricina	Larch	Also known as Tamarack
	Picea glauca	White Spruce	
	Picea mariana	Black Spruce	

STUDY AREA: NICHOLAS LAKE AND ROAD			
Vegetation Type	Latin Name	Common Name	Notes
Forb	*Comarum palustre*	Marsh Cinqefoil	Also known as *Potentilla palustris*
	Corydalis sempervirens	Pale Corydalis	
	Cryptogramma sitchensis	Parsley Fern	Also known as *Cryptogramma sitchensis crispa*
	Diphasiastrum complanatum	Northern running-pine	Also known as *Lycopodium complanatum*
	Drosera rotundifolia	Round-leaved Sundew	
	Epilobium angustifolium	Fireweed	Also known as *Chamerion angustifolium*
	Epilobium glandulosum	Willow Herb	
	Epilobium palustre	Marsh Willow Herb	
	Equisetum arvense	Field Horsetail	
	Geocaulon lividum	Northern Comandra	
	Lycopodium lagopus	Running Pine	
	Oxycoccos microcarpus	Small Bog Cranberry	
	Packera paucifora	Few-Flower Ragwort	Also known as *Senecio pauciflorus*
	Packera paupercula	Balsam Ragweed	Also known as *Senecio pauperculus*
	Pedicularis labradorica	Labrador Lousewort	
	Potamogeton richardsonii	Redheadgrass	
	Potentilla nivea	Snow Cinqefoil	
	Potentilla norvegica	Norwegian Cinqefoil	
	Potentilla rubricaulis	Rocky Mountain Cinqefoil	
	Ranunculus lapponicus	Lapland Buttercup	
	Rubus chamaemorus	Cloudberry	
	Saxifraga nivalis	Snow Saxifrage	
	Saxifraga tricuspidata	Prickly Saxifrage	
	Utricularia intermedia	Flatleaf Bladderwort	
	Woodsia ilvensis	Rusty Woodsia	
Grass/Grass-like	*Agrostis scabra*	Rough Bentgrass	
	Calamagrostis canadensis	Blue-Joint	
	Calamagrostis purpurascens	Purple Reed Grass	
	Calla palustris	Wild Calla	Also known as Water Dragon
	Carex aenea	Bronze Sedge	
	Carex aquatilis	Water Sedge	
	Carex concinna	Beautiful Sedge	
	Carex lapponica	Lapland Sedge	Also known as *Carex canescens ssp. subloliacea*
	Carex livida	Livid Sedge	
	Carex magellanica	Magellan's Carex	Also known as *Carex paupercula*
	Carex vaginata	Sheathed Sedge	
	Eriophorum angustifolium	Cotton Grass	Includes *Eriophorum triste*
	Eriophorum brachyantherum	Short-Antler Cotton Grass	Also known as *Eriophorum opacum*
	Eriophorum scheuchzeri	Schechzeri Cotton Grass	
	Gramineae (family)	Grass sp.	
	Poa glauca	White Blue Grass	
	Poa spp	Bluegrass	
	Sparganium angustifolium	Narrow-leaf Bur-reed	
	Trisetum spicatum	Narrow False Oat	
Lichen	*Cladina mitis*	Green reindeer lichen	
	Cladina rangiferina	Gray reindeer lichen	
	Cladonia spp		
	Peltigera neopolydactyla	Carpet pelt	
	Stereocaulon tomentosum	Woolly foam lichen, eyed foam lichen	
Moss	*Aulacomnium palustre*	Glow Moss, tufted moss	
	Calliergon spp		
	Polytrichum juniperinum		
	Polytrichum spp		
	Sphagnum angustifolium		
	Sphagnum fuscum		
	Sphagnum magellanicum		

STUDY AREA: NICHOLAS LAKE AND ROAD			
Shrub	*Alnus crispa, ssp crispa*	Green Alder	
	Alnus viridis	Green Alder	Inlcudes *Alnus crispa*
	Arctostaphylos uva-ursi	Bear Berry	
	Betula nana	Arctic Dwarf Birch	Also known as *Betula glandulosa* , Dwarf Birch
	Betula occidentalis	Spring Birch	Also known as *Betula fontinalis*
	Chamaedaphne calyculata	Leather leaf	
	Empetrum nigrum	Black Crowberry	
	Juniperus communis	Common Juniper	Also known as Ground Juniper
	Ledum groenlandicum	Common Labrador Tea	
	Myrica gale	Sweet Bayberry	
	Ribes glandulosum	Skunk Currant	
	Rubus idaeus	Wild Raspberry	Also known as *Rubus idaeus ssp. strigosus*
	Salix arbusculoides	Littletree Willow	
	Salix arctica	Arctic Willow	Also known as *Salix anglorum, Salix crassijulis, Salix hudsonensis*
	Salix arctophila	Northern Willow	
	Salix bebbiana	Bebb Willow	Also known as *Salix rostrata* , Long-beaked Willow
	Salix brachycarpa	Short-fruit Willow	
	Salix fuscescens	Alaska Bog Willow	
	Salix glauca	Gray willow	Also known as *Salix cordiflora ssp callicarpea, Salix glauca ssp stenolepsis*
	Salix maccalliana	Mccall"s Willow	
	Salix myrtillifolia	Myrtle-Leaf Willow	
	Salix niphoclada	Barren-ground Willow	
	Salix planifolia	Tea-leaved Willow	Includes *Salix pulchra, Salix tyrrellii*
	Salix pyrifolia	Balsam Willow	Also known as *Salix balsamifera*
	Salix scouleriana	Scouler Willow	Also known as Mountain Willow, Fire Willow
	Salix spp	Willow	
	Salix tyrrellii		
	Vaccinium uliginosum	Alpine Blueberry	
	Vaccinium vitis-idaea	Mountain Cranberry	
Tree	*Betula papyrifera*	Paper birch	Also known as *Betula papyrifera var. commutata* , White Birch
	Larix laricina	American Larch	Also known as Tamarack
	Picea glauca	White Spruce	
	Picea mariana	Black Spruce	
	Pinus banksiana	Jack Pine	Also known as *Pinus divaricata*

STUDY AREA: PORTAL			
Vegetation Type	Latin Name	Common Name	Notes
Forb	*Anemone multifida*	Hudson Bay Anemone	
	Arctostaphylos rubra	Red Manzanita	
	Corydalis spp	Pink corydalis	
	Cryptogramma sitchensis	Parsley Fern	Also known as *Cryptogramma sitchensis crispa*
	Dryopteris fragrans	Fragrant Cliff Wood-Fern	
	Epilobium angustifolium	Fireweed	Also known as *Chamerion angustifolium*
	Epilobium glandulosum	Willow Herb	
	Equisetum arvense	Field Horsetail	
	Erigeron elatus	Swamp Fleabane	
	Orthilia secunda	One-sided Wintergreen	Also known as *Pyrola secunda*
	Pedicularis labradorica	Labrador Lousewort	
	Rubus chamaemorus	Cloudberry	
	Saxifraga spp	Saxifrage	
	Saxifraga tricuspidata	Prickly Saxifrage	
	Tofieldia pusilla Tofieldia palustris	Scotch False Asphodel	Also known as *Tofieldia palustris*
	Woodsia ilvensis	Rusty Woodsia	
Grass/Grass-like	*Agrostis scabra*	Rough Bentgrass	
	Calamagrostis canadensis	Blue-Joint	
	Calamagrostis purpurascens	Purple Reed Grass	
	Carex aquatilis	Water Sedge	
	Carex aurea	Golden Fruit Sedge	
	Carex bebbii	Bebb's Sedge	
	Carex capillaris	Hair-like Sedge	
	Carex vaginata	Sheathed Sedge	
	Eriophorum angustifolium	Cotton Grass	Includes *Eriophorum triste*
	Eriophorum chamissonis	Russet Cotton Grass	Also known as *Eriophorum russeolum var. albindum*
	Festuca spp	Fescue	
	Geocaulon lividum	Northern Comandra	
	Poa glauca	White Blue Grass	
	Trisetum spicatum	Narrow False Oat	
Shrub	*Alnus viridis*	Green Alder	Includes *Alnus crispa*
	Arctostaphylos uva-ursi	Bear Berry	
	Betula nana	Arctic Dwarf Birch	Also known as *Betula glandulosa*, Dwarf Birch
	Betula occidentalis	Spring Birch	Also known as *Betula fontinalis*
	Betula papyrifera	Paper Birch	Also known as *Betula papyrifera var. commutata,* White Birch
	Empetrum nigrum	Black Crowberry	
	Juniperus communis	Common Juniper	Also known as Ground Juniper
	Ledum groenlandicum	Common Labrador Tea	
	Myrica gale	Sweet Bayberry	
	Potentilla norvegica	Norwegian Cinqefoil	
	Rosa acicularis	Prickly Rose	
	Rubus idaeus	Wild Raspberry	Also known as *Rubus idaeus ssp. strigosus*
	Salix glauca	Gray willow	Also known as *Salix cordiflora ssp callicarpea, Salix glauca ssp stenolepsis*
	Salix myrtillifolia	Myrtle-Leaf Willow	
	Salix planifolia	Tea-leaved Willow	Includes *Salix pulchra, Salix tyrrellii*
	Salix scouleriana	Scouler Willow	Also known as Mountain Willow and Fire Willow
	Salix sp	Willow	
	Shepherdia canadensis	Canada Buffalo-Berry	
	Vaccinium uliginosum	Alpine Blueberry	
	Vaccinium vitis-idaea	Mountain Cranberry	
	Viburnum edule	Squashberry	
Tree	*Picea glauca*	White Spruce	
	Picea mariana	Black Spruce	

STUDY AREA: ROUND LAKE			
Vegetation Type	Latin Name	Common Name	Notes
Forb	*Arctostaphylos rubra*	Red Manzanita	
	Barbarea orthoceras	American Winter Cress	
	Epilobium angustifolium	Fireweed	Also known as *Chamerion angustifolium*
	Epilobium palustre	Marsh Willow Herb	
	Equisetum arvense	Field Horsetail	
	Equisetum sylvaticum	Woodland Horsetail	
	Galium tinctorium	Bedstraw spp	
	Galium trifidum	Small Bedstraw	Includes *Galium brandegei, Galium tinctorium*
	Geocaulon lividum	Northern Comandra	
	Lycopodium annotinum	Stiff Club Moss	
	Myriophyllum sibiricum	Water Milfoil spp	Also known as *Myriophyllum exalbescens*
	Oxycoccos microcarpus	Small Bog Cranberry	
	Pedicularis labradorica	Labrador Lousewort	
	Pinguicula vulgaris	Common Butterwort	
	Potamogeton alpinus	Northern Pondweed	
	Potamogeton filiformis	Thread-leaved Pondweed	
	Potamogeton gramineus	Grassy Pondweed	
	Potamogeton pusillus	Slender Pondweed	Also known as *Potamogeton pusillus ssp. tenuissimus*
	Potamogeton richardsonii	Redheadgrass	
	Potentilla palustris	Marsh Cinquefoil	
	Ranunculus gmelinii	Small Yellow Water-Buttercup	Inludes *Ranunculus purshii*
	Ranunculus hyperboreus	Arctic Buttercup	
	Ranunculus lapponicus	Lapland Buttercup	
	Rorippa palustris	Bog Yellowcress	Also known as *Rorippa islandica*
	Rubus acaulis	Dwarf Raspberry	
	Rubus chamaemorus	Cloudberry	
	Stellaria borealis	Northern Stitchwort	Also known as *Stellaria calycantha*
	Triglochin palustre	Slender Bog Arrow Grass	
	Utricularia minor	Lesser Bladderwort	
Grass/Grass-like	*Agrostis scabra*	Rough Bentgrass	
	Calamagrostis canadensis	Blue-Joint	
	Carex aenea	Bronze sedge	
	Carex aquatilis	Water Sedge	
	Carex brevior	Shortbeak Sedge	
	Carex canescens	Hoary Sedge	
	Carex concinna	Beautiful sedge	
	Carex interior	Inland Sedge	
	Carex leptalea	Bristly-Stalk Sedge	
	Carex rossii	Short Sedge	
	Carex saxatilis	Russet Sedge	Also known as *Carex physocarpa*
	Carex tenuiflora	Sparse- Flowered Sedge	
	Carex vaginata	Sheathed Sedge	
	Eleocharis palustris	Creeping Spike Rush	
	Eriophorum angustifolium	Cotton Grass spp	Includes *Eriophorum triste*
	Eriophorum chamissonis	Russet Cotton Grass	Inlcudes *Eriophorum russeolum var. albindum*
	Glyceria pulchella	Mackenzie Valley Manna Grass	
	Hordeum jubatum	Fox-Tail Barley	
	Juncus balticus	Baltic Rush	Also known as *Juncus balticus var. littoralis*
	Juncus bufonius	Toad Rush	
	Juncus castaneus	Chestnut Rush	
	Juncus filiformis	Thread Rush	
	Poa glauca	White Blue Grass	
	Schoenoplectus tabernaemontani	Soft-Stem Bulrush	Also known as *Scirpus validus*
	Sparganium hyperboreum	Northern Bur-reed	
	Typha latifolia	Broad -leaf Cat-tail	

STUDY AREA: ROUND LAKE			
Lichen	*Cladonia sp.*	Club lichen	
	Peltigera aphthosa	Common freckle pelt, felt lichen	
	Stereocaulon tomentosum	Woolly foam lichen, eyed foam lichen	
Moss	*Aulacomnium palustre*		
	Dicranum spp		
	Sphagnum squarrosum		
Shrub	*Alnus viridis*	Green Alder	Includes *Alnus crispa*
	Betula nana	Arctic Dwarf Birch	Also known as *Betula glandulosa*, Dwarf Birch
	Betula occidentalis	Spring Birch	Also known as *Betula fontinalis*
	Chamaedaphne calyculata	Leather leaf spp	
	Empetrum nigrum	Black Crowberry	
	Juniperus communis	Common Juniper	Also known as Ground Juniper
	Ledum groenlandicum	Common Labrador Tea	
	Myrica gale	Sweet Bayberry	
	Rosa acicularis	Prickly Rose	
	Salix fuscescens	Alaska Bog Willow	
	Salix glauca	Gray willow	Also known as *Salix glauca cordiflora ssp callicarpea, Salix glauca ssp stenolepsis*
	Salix lutea	Yellow Willow	
	Salix maccalliana	Mccall"s Willow	
	Salix myrtillifolia	Myrtle-Leaf Willow	
	Salix planifolia	Tea-leaved Willow	Includes *Salix pulchra, Salix tyrrellii*
	Salix pyrifolia	Balsam Willow	Also known as *Salix balsamifera*
	Vaccinium vitis-idaea	Mountain Cranberry	
Tree	*Betula papyrifera*	Paper birch	Also known as *Betula papyrifera var. commutata*, White Birch
	Picea glauca	White Spruce	
	Picea mariana	Black Spruce	

STUDY AREA: WINTER LAKE AND SURROUNDING AREA			
Vegetation Type	Latin Name	Common Name	Notes
Algae	*Chara spp*		
Forb	*Antennaria microphylla*	Small-leaf Cat's-foot	Also known as *Antennaria nitida*
	Arnica angustifolia	Narrowleaf Arnica	Also known as *Arnica alpina var. tomentosa*
	Calla palustris	Wild Calla	Also known as Water Dragon
	Cardamine bellidifolia	Alpine Bitter Cress spp	
	Cicuta bulbifera	Bulb-Bearing Water-Hemlock	
	Corydalis sempervirens	Pale Corydalis	
	Cryptogramma sitchensis	Parsley Fern	Also known as *Cryptogramma crispa*
	Drosera rotundifolia	Round-leaved Sundew	
	Epilobium angustifolium	Fireweed	Also known as *Chamerion angustifolium*
	Epilobium glandulosum	Willow Herb	
	Epilobium palustre	Marsh Willow Herb	
	Equisetum arvense	Field Horsetail	
	Equisetum hyemale var. affine	Scouring Rush	
	Equisetum scirpoides	Dwarf Scouring Rush	
	Equisetum sylvaticum	Woodland Horsetail	
	Erigeron acris	Bitter Fleabane	Includes *Erigeron jucundus* , also known as *Erigeron acris ssp. debilis*
	Erigeron elatus	Swamp Fleabane	
	Erigeron uniflorus	One-flower Fleabane	Also known as *Erigeron uniflorus ssp. eriocephalus, Erigeron eriocephalus*
	Galium trifidum	Small Bedstraw	Includes *Galium brandegei, Galium tinctorium*
	Geocaulon lividum	Northern Comandra	
	Hippuris vulgaris	Common Mare's Tail	
	Huperzia selago	Mountain Club Moss	Also known as *Lycopodium selago*
	Myriophyllum alterniflorum	Alternate-Flower Water Milfoil	
	Myriophyllum sibiricum	Water Milfoil	Also known as *Myriophyllum exalbescens*
	Nuphar variegata	Yellow Cowlily	Also known as *Nuphar variegatum, Nuphar lutea ssp. variegata*
	Orthilia secunda	One-sided Wintergreen	Also known as *Pyrola secunda*
	Oxycoccos microcarpus	Small Bog Cranberry	
	Pedicularis labradorica	Labrador Lousewort	
	Petasites sagittatus	Arrow-Leaved Sweet-Coltsfoot	Also known as *Petasites frigidus var. sagittatus*
	Polygonum scabrum	Knotweed	
	Potamogeton filiformis	Thread-leaved Pondweed	
	Potamogeton foliosus	Leafy Pondweed	
	Potamogeton gramineus	Grassy Pondweed	
	Potamogeton praelongus	White-Stem Pondweed	
	Potamogeton richardsonii	Redheadgrass	
	Potentilla norvegica	Norwegian Cinqefoil	
	Pyrola grandiflora	Arctic Wintergreen	
	Ranunculus gmelinii	Small Yellow Water-Buttercup	Includes *Ranunculus purshii*
	Ranunculus lapponicus	Lapland Buttercup	
	Rhinanthus minor	Yellow Rattle	Also known as *Rhinanthus minor ssp. borealis, Rhinanthus borealis*
	Rorippa palustris	Bog Yellowcress	Also known as *Rorippa islandica*
	Rubus acaulis	Dwarf Raspberry	
	Rubus chamaemorus	Cloudberry	
	Sagittaria cuneata	Wapatum Arrowhead	
	Shepherdia canadensis	Canada Buffalo-Berry	
	Spiranthes romanzoffiana	Hooded Ladies' -tresses	
	Stellaria longifolia	Longleaf Stitchwort	Also known as *Stellaria atrata*
	Utricularia intermedia	Flatleaf Bladderwort	
	Utricularia macrorhiza	Bladderwort spp	Also known as *Utricularia vulgaris*
	Utricularia minor	Lesser Bladderwort	
	Viola macloskeyi	Smooth white violet	Also known as *Viola pallens*
	Woodsia ilvensis	Rusty Woodsia	

STUDY AREA: WINTER LAKE AND SURROUNDING AREA			
Grass/Grass-like	*Agrostis scabra*	Rough Bentgrass	
	Alopecurus aequalis	Short-Awn Meadow-Foxtail	
	Calamagrostis canadensis	Blue-Joint	
	Carex aenea	Bronze Sedge	
	Carex aquatilis	Water Sedge	
	Carex capillaris	Hair-like Sedge	
	Carex concinna	Beautiful Sedge	
	Carex disperma	Softleaf Sedge	
	Carex interior	Inland Sedge	
	Carex lapponica	Lapland Sedge	Also known as *Carex canescens ssp. subloliacea*
	Carex magellanica	Magellan's Carex	Also known as *Carex paupercula*
	Carex spp		
	Carex utriculata	Northwest Territory Sedge	
	Eriophorum angustifolium	Cotton Grass	Includes *Eriophorum triste*
	Eriophorum brachyantherum	Short-Antler Cotton Grass	Also known as *Eriophorum opacum*
	Eriophorum viridicarinatum	Green Keeled Cotton Grass	
	Festuca brachyphylla	Short-Leaved Fescue	
	Festuca saximontana	Rocky Mountain Fescue	
	Juncus bufonius	Toad Rush	
	Poa glauca	White Blue Grass	
	Poa lanata	Arctic Blue Grass	
	Schoenoplectus tabernaemontani	Soft-Stem Bulrush	Also known as *Scirpus validus*
	Sparganium angustifolium	Narrow-leaf Bur-reed	
	Sparganium multipedunculatum	Bur-reed spp	
	Sparganium natans	Small bur-reed	Also known as *Sparganium minimum*
	Typha latifolia	Broad -leaf Cat-tail	
Lichen	*Cladina mitis*	Green reindeer lichen	
	Cladina rangiferina	Gray reindeer lichen	
	Cladina spp		
	Cladonia spp	Club lichen	
	Flavocetraria nivalis	Crinkled snow lichen	
	Icmadophila ericetorum	Candy lichen, spraypaint	
	Peltigera aphthosa	Common freckle pelt, felt lichen	
	Peltigera neopolydactyla	Carpet pelt	
	Stereocaulon tomentosum	Woolly foam lichen, eyed foam lichen	
Liverwort	*Lophozia incisa*		
	Ptilidium ciliare	northern naugehyde liverwort	
Moss	*Aulacomnium palustre*		
	Calliergon spp		
	Dicranum polysetum		
	Dicranum spp		
	Hylocomium splendens		
	Pleurozium schreberi		
	Polytrichum commune		
	Polytrichum strictum		
	Spagnum spp		
	Sphagnum angustifolium		
	Sphagnum fuscum		
	Sphagnum nemoreum		
	Sphagnum squarrosum		

STUDY AREA: WINTER LAKE AND SURROUNDING AREA			
Shrub	*Alnus viridis*	Green Alder	Includes *Alnus crispa*
	Arctostaphylos rubra	Red Manzanita	
	Arctostaphylos uva-ursi	Bear Berry	
	Betula nana	Arctic Dwarf Birch	Also known as *Betula glandulosa* , Dwarf Birch
	Betula occidentalis	Spring Birch	Also known as *Betula fontinalis*
	Betula papyrifera	Paper birch	Also known as *Betula papyrifera var. commutata,* White Birch
	Chamaedaphne calyculata	Leather leaf spp	
	Empetrum nigrum	Black Crowberry	
	Juniperus communis	Common Juniper	Also known as Ground Juniper
	Ledum groenlandicum	Common Labrador Tea	
	Ledum palustre ssp decumbens	Labrador Tea	Also known as *Ledum decumbens*
	Myrica gale	Sweet Bayberry	
	Ribes hudsonianum	Northern Black Currant	
	Ribes oxyacanthoides	Canada Gooseberry	
	Ribes triste	Swamp Red Currant	
	Rosa acicularis	Prickly Rose	
	Rubus idaeus	Wild Raspberry	Also known as *Rubus idaeus ssp. strigosus*
	Salix glauca	Gray willow	Also known as *Salix glauca cordiflora ssp callicarpea, Salix glauca ssp stenolepsis*
	Salix myrtillifolia	Myrtle-Leaf Willow	
	Salix spp	Willow	
	Salix tyrrellii		
	Vaccinium uliginosum	Alpine Blueberry	
	Vaccinium vitis-idaea	Mountain Cranberry	
	Viburnum edule	Squashberry	
Tree	*Larix laricina*	American Larch	Also known as Tamarack
	Picea glauca	White Spruce	
	Picea mariana	Black Spruce	
	Pinus banksiana	Jack Pine	Also known as *Pinus divaricata*