T A H E R A   C O R P O R A T I O N

Jericho

Diamond Project

Environmental Baseline Studies

1999 Vegetation Report

P A G E M. B U R T

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Includes community and association descriptions, species lists, report on preliminary phenology work.

- **Suggested search strings:**

Tahera Corporation, Jericho Diamond Project, Carat Lake, Contwoyto Lake, Kitikmeot, vegetation, baseline environmental studies, plant communities, plant associations, arctic plants, plant phenology.

- **Cover photo:**

Aerial view over proposed mine site, ore stockpile area, and wasterock laydown areas. Caret Lake and Caret Camp in background.

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Tahera Corporation
JERICHO DIAMOND PROJECT
1999 Vegetation Baseline Studies

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Tahera Corporation, JERICHO DIAMOND PROJECT Vegetation Baseline Studies Report, 1999

1. Abstract

Field studies on the vegetation in the vicinity of Carat Lake (at the west end of Contwoyto Lake) were carried out during the summer of 1999. The purpose of these studies was to provide additional information for the Jericho Diamond Project.

Previous studies (Jericho Diamond Project, Baseline Environmental Studies, 1995) were reviewed, and field studies carried out to check plant community descriptions, to ground-truth vegetation maps prepared in 1995, to check for the occurrence of plants considered "rare" in the Northwest Territories and Nunavut, and to check wildlife use of vegetation.

Phenology plots were established, and a detailed examination of the plant communities was performed. About 90% of these plots were located in areas of potential intensive use, for mine infrastructure, transport road systems, kimberlite storage, or waste rock storage. Some were located along watercourses that may be affected by mining activities.

This report includes a map of plot locations, written descriptions of the plant communities and associations encountered on the site, species lists of plants encountered, and a list of potential species. Common representatives of plant associations are summarized in a list by plant community, and photos of representative associations are included.

Key results:

- The vegetation of the Jericho area is typical of the northern interior barrenlands, exhibiting slightly more diversity than the Contwoyto Pipe area
- The vegetation is a mosaic, sedge communities in drainage basins, riparian birch communities in stream channels, birch seeps, lichen associations on boulder fields, felsenmeer, and bedrock outcrops, and heath tundra, typical crest and slope communities of eskers. (**Appendix A**, community descriptions.)
- The heath tundra community is the "climax" community, exhibiting considerable variation due to terrain features such as eskers, frost scars and solifluction slopes.
- Diversity is highest in transitional communities such as the hummock zone or the birch seeps, with sedge association species mixed with heath tundra species.
- Phenology studies confirm the brevity of the growing season and the strong effects of winter winds and blowing snow, with abrupt changes occurring in most plant species.

2. Introduction

“Vegetation” refers to the plant species growing in an area, and how they form communities and associations that are typical throughout the region. Plants form the base of the food chain; they provide food and shelter for animals, stabilize the soil, and modify the local environment. Some fruits and roots are important to man, and parts of many woody plants provided fuel for cooking fires for man, both Dene and Inuit.

Vegetation baseline studies are an integral part of environmental impact assessment work. A study of the terrestrial vegetation occupying an area intended for mining provides information that allows us to create a “snapshot” of the plant communities at one point in time. In our area (unlike most of North America), this environmental assessment tends to precede any strong human influence on the land and life upon it.

Since any disturbance of the surface of the land usually destroys the plants, knowledge of what was there before the disturbance started is important, even essential to development of mitigation and reclamation plans.

3. Acknowledgements

Two field assistants were of tremendous assistance to the principal investigator in this study. Michele Tanguay of Fort Smith assisted in the field during the June study period, and with plant identification and preservation, and data recording. Heather Murdoch of Yellowknife helped in the field during July, and also helped with identification and plant pressing. Their keen interest and enthusiasm was highly appreciated.

Bruce Ott, manager of Tahera’s environmental program, assisted in the field as needed, and also helped during some very long evenings in the kitchen at Carat Camp, pressing plants. Michele Tanguay and Bruce Ott collected most of the phenology data.

Tahera Corporation provided assistance with the logistics of the project, including helicopter support, and assistance with the drafting and mapping aspects of the project. I certainly appreciate Mike Johnson’s work in creating maps of the plot locations.

Plant identifications were provided by Drs. George Argus, John Thieret, and Robert Naczi, tremendous effort that so often goes unnoticed. I am deeply grateful to them for this help.

4. General description of study and the area

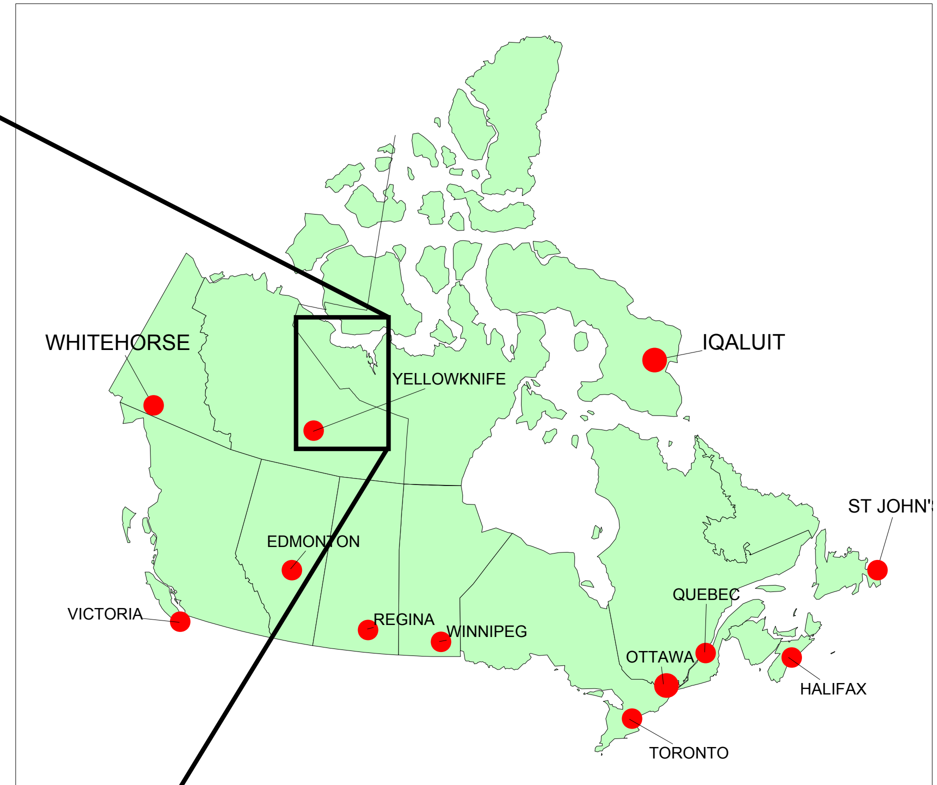
4.1 Location

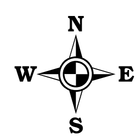
The Jericho Gold Project is located at the northwest end of Contwoyto Lake, just west of the outflow of the Burnside River from this big lake, which straddles a divide between streams flowing into the Arctic Ocean at Bathurst Inlet, and the Back River system, which reaches the Arctic Ocean at Chantrey Inlet, far to the east. Politically, it is located in Canada's newest territory, Nunavut.

Approximate coordinates of the Jericho site are 66^{o} N x 111^{o} 28' W. (See **Map 1** for location.)

The Carat Lake/Jericho site is located in the Takajuq Lake Upland Ecoregion of the Southern Arctic Ecozone (Environment Canada, 2000). The brief description of this ecoregion, from the Environment Canada website, follows:

> "The Takajuq Lake Upland takes in the eastern half of the Bear-Slave Upland south of the Coronation Gulf. Much of the upland surface is composed of unvegetated rock outcrops that are common on the Canadian Shield. The mean annual temperature is approximately –10.5^{o} C with a summer mean of 6^{o} C and a winter mean of – 26.5^{o} C. The mean annual precipitation ranges 200-300 mm. This ecoregion is classified as having a low arctic ecoclimate. Numerous lakes fill its lowlands.
>
> "Vegetative cover is characterized by shrub tundra, consisting of dwarf birch, willow, northern Labrador tea, *Dryas* spp., and *Vaccinium* spp. Depressional sites are dominated by willow, sphagnum moss, and sedge tussocks. Scattered stands of spruce occur along the southern boundary of the ecoregion.
>
> "The region consists mainly of massive Archean rocks that form broad, sloping uplands, plateaus, and lowlands. Bathurst Hills form a prong of rugged ridges that reach about 610 m asl and stand as much as 185 m above nearby lakes. Turbic and Static Cryosols have formed on thin discontinuous sandy morainal and fluvioglacial materials, and in association with rock outcrops, dominate the uplands. Organic Cryosols are the dominant soils in the lowlands. Permafrost is deep and continuous with low ice content throughout the majority of the region, although the ice content along the west side of Bathurst Inlet is low to medium. The ecoregion has hid mineral development potential and considerable exploration activity has taken place.
>
> "Characteristic wildlife includes caribou, muskox, grizzly bear, hare, fox, wolf, raptors, shorebirds, seabirds, and waterfowl. Land uses include subsistence trapping and hunting. "





Tahera Corporation

Map 1
Jericho Project
Property Location Map

Date:17/3/2000

Author: MJ

Office: Van

Tahera CORPORATION

The climate of this area is decidedly “arctic” and continental, with long cold winters and short cool summers, which can include hot, dry periods. The average frost-free period is less than 70 days (French and Slaymaker, 1993).

Map 2 delineates what we have called the Local Study Area, this being the area in which most plant studies were carried out. It includes all areas identified by the company as mining locations, as places where waste rock and tailings will be deposited, where the kimberlite will be stored, and all roads, camps and other infrastructure will be located, including the airstrip. The Local Study Area for vegetation is always smaller than the Local Study Area for wildlife.

All 5 m x 5 m study plots are indicated on **Map 3** and **Map 4.**.

4.2 Duration of study

This portion of the vegetation baseline work was done in a single field season in 1999. The technicians started setting up phenology plots on the ridges and areas as they became snow-free, in mid May. They continued to check phenology plots once per week until the first week in September.

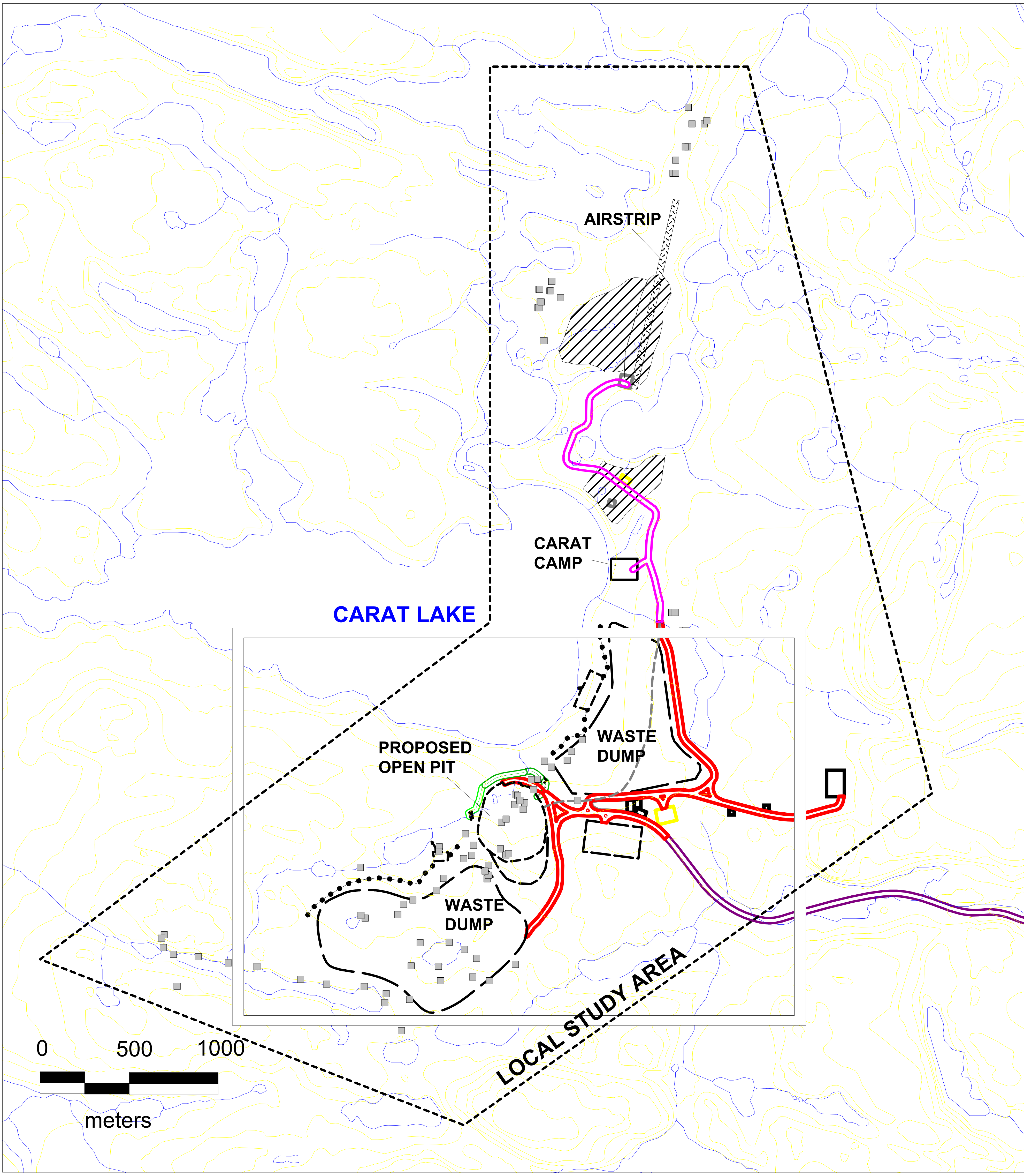
Major vegetation fieldwork was done in two visits to site, first on June 10 and 11, and later, from July 27 through July 31. A total of 7 days were spent in the field, collecting data on the Jericho site.

4.3 Scope of the study

As the intent of the study was to catalogue as many species of plants as possible, and to describe their relationships to each other, to the environment, and to the terrain features on the sites, we identified the vascular plants from a total of 89 plots.

Several species lists were developed: **Appendix B** lists the species of vascular plants actually collected or identified in the Local Study Area. **Appendix C** is a list of species that potentially *may* occur in the area, based on previous studies and collections in the central and western part of the NWT and Nunavut. It is expected that this list will be useful as the project progresses, and as decisions need to be made regarding revegetation of the site.

The time schedule and budget for this project did not allow for extensive identification work to be done on lichens (which are poorly known and difficult to identify, especially the crustose types) and mosses. However, both were collected and preserved. Should funding become available or should interest be expressed in identification of these lichens, they can be shipped to specialists for identification, and the identifications correlated with the other data.



LEGEND

- Vegetation Study Plot
- LOCAL STUDY AREA
- Lake Shore or Stream
- 5m Contours

N
W E
S

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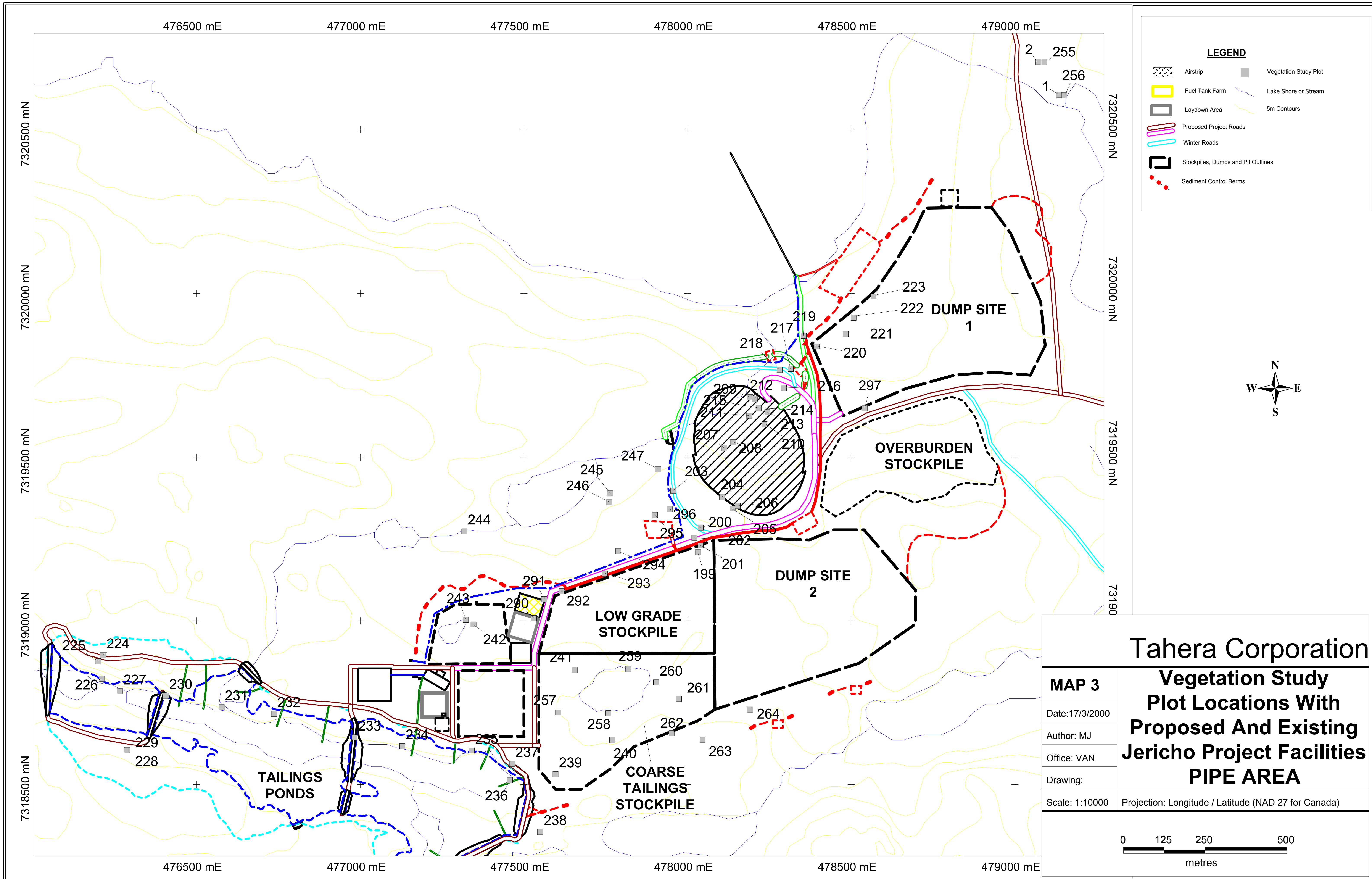
MAP 2	Vegetation Study Area With Proposed And Existing Jericho Project Facilities
Date:17/3/2000	
Author: MJ	
Office: VAN	
Drawing:	
Scale: 1:22000	Projection: Longitude / Latitude (NAD 27 for Canada)



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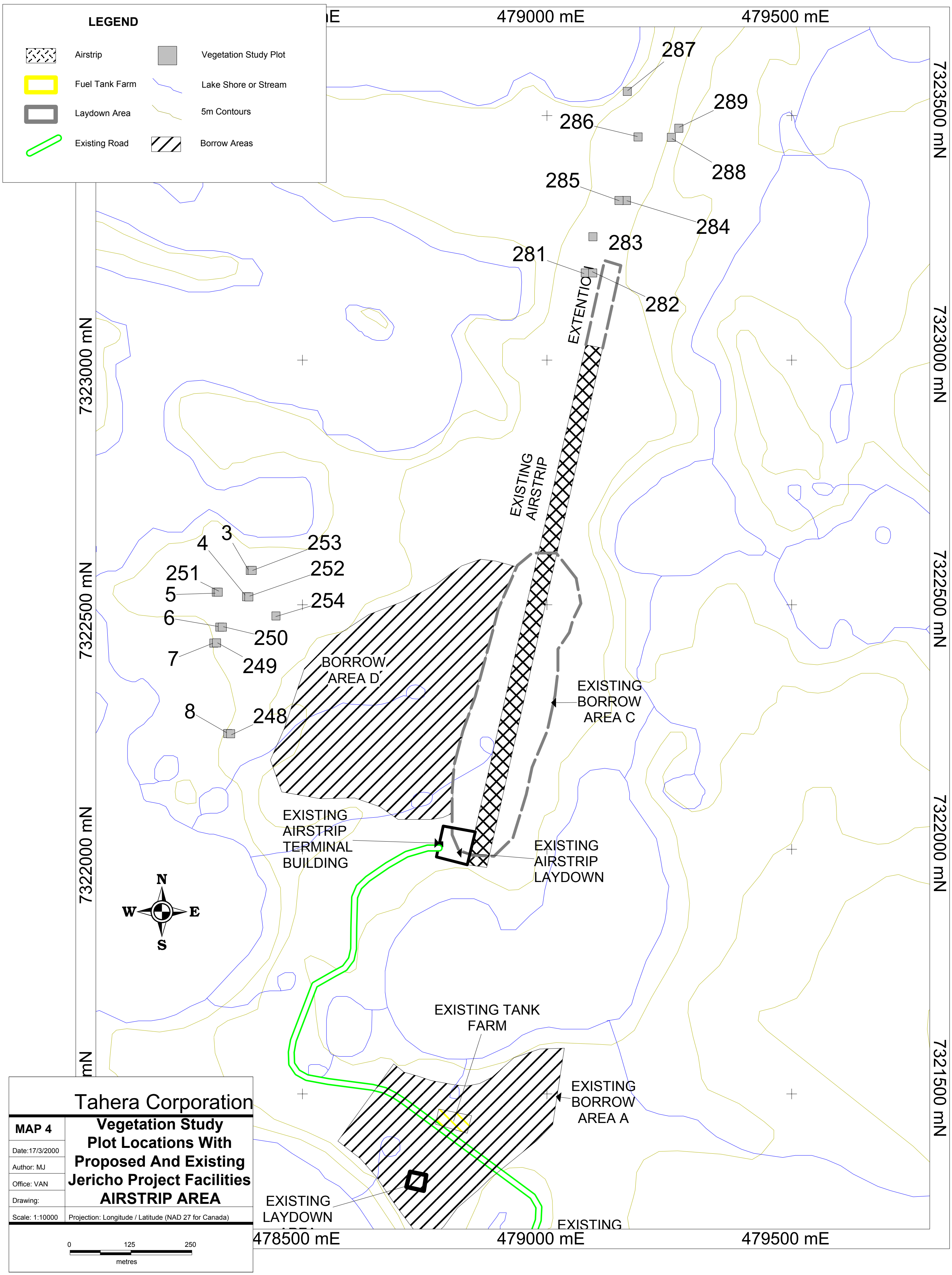
MAP 3
Vegetation Study Plot Locations With Proposed And Existing Jericho Project Facilities PIPE AREA
Date:17/3/2000
Author: MJ
Office: VAN
Drawing:
Scale: 1:10000
Projection: Longitude / Latitude (NAD 27 for Canada)
0 125 250 500
metres
LEGEND
Airstrip
Vegetation Study Plot
Fuel Tank Farm
Lake Shore or Stream
Laydown Area
5m Contours
Proposed Project Roads
Winter Roads
Stockpiles, Dumps and Pit Outlines
Sediment Control Berms
N
W
E
S
476500 mE
477000 mE
477500 mE
478000 mE
478500 mE
479000 mE
7320500 mN
7320000 mN
7319500 mN
7319000 mN
7318500 mN
DUMP SITE 1
DUMP SITE 2
OVERBURDEN STOCKPILE
LOW GRADE STOCKPILE
COARSE TAILINGS STOCKPILE
TAILINGS PONDS



LEGEND
Airstrip
Vegetation Study Plot
Fuel Tank Farm
Lake Shore or Stream
Laydown Area
5m Contours
Existing Road
Borrow Areas
479000 mE
479500 mE
478500 mE
7323500 mN
7323000 mN
7322500 mN
7322000 mN
7321500 mN
287
289
286
288
285
284
283
281
282
EXTENTION
EXISTING AIRSTRIP
4
3
253
252
251
5
254
6
250
7
249
8
248
BORROW AREA D
EXISTING BORROW AREA C
EXISTING AIRSTRIP TERMINAL BUILDING
EXISTING AIRSTRIP LAYDOWN
N
W
E
S
EXISTING TANK FARM
EXISTING BORROW AREA A
EXISTING LAYDOWN
EXISTING
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MAP 4
Vegetation Study Plot Locations With Proposed And Existing Jericho Project Facilities AIRSTRIP AREA
Date:17/3/2000
Author: MJ
Office: VAN
Drawing:
Scale: 1:10000
Projection: Longitude / Latitude (NAD 27 for Canada)
0
125
250
metres

5. Objectives of the 1999 study

Since fieldwork had been done in 1995, the objectives for the 1999 study were:

- To establish, permanently mark, and record initial data on phenology plots that can be used for monitoring environmental effects on the vegetation for a number of years, during all phases of the development of the project.
- To check vegetation work previously, collecting more detailed data.
- To check for rare plants.

6. Methods

Elders in both the Dene and Inuit culture have expressed the desire to see that people doing environmental impact studies spend time on the land, studying it firsthand, rather than remotely. In this study, we walked the land, performing our studies with respect for the land and the vegetation, as well as for the elders of both cultures, learning from the plants and the land itself.

Two separate but overlapping studies were performed, phenology studies and community studies. Methods were adapted and modified from those described in the International Tundra Experiment (ITEX, 1996), from *Research and Management Techniques for Wildlife and Habitats* (Bookhout, 1994), especially the chapter on vegetation sampling (Ch. 22, Higgins, Oldemeyer, et.al.), and from *Standards for Terrestrial Ecosystems Mapping in Birtish Columbia* (Ecosystems Working Group, 1995).

Many species were identified in the field, using *Vascular Plants of the Continental Northwest Territories, Canada* (Porsild and Cody, 1980), *A Photographic Field Guide to Mosses, Lichens, and Ferns of Northwest North America* (Vitt, Marsh, and Bovey, 1988), and other references.

Appendix F contains examples of data sheets used in the field for both phenology and plant community studies.

Collections were not made wantonly, but to confirm identifications, and plant specimens were pressed and carefully preserved. Representative collections of willows will be housed in the Canadian National Museums collection under the care of Dr. George Argus, and collections of grasses and sedges will be kept at Northern Kentucky University, under the care of Drs. John Thieret and Rob Naczi.

6.1 Phenology

Plant phenology is the study of the development of plants throughout the growing season. It is most easily observed by keeping track of changes in the leaves and non-reproductive parts of the plant, and in the flowers and structures related to the production of seeds.

Data collected in a single season is of limited use, due to the fact that local weather conditions can cause major variations in plant activity from one year to the next. However, data collected over several years can show trends and the effects of human activities in the region. It also becomes an important part of the monitoring program for a project. Phenology work in 1999 was designed to set up the plots and collect initial data.

Plant communities important to wildlife were selected. Plots were established in an area convenient to Carat Camp, yet well out of the way of actual mining activities. Several are located west of the airstrip, between the strip and the north arm of Carat Lake. Others are located east of the junction of the main road and the road leading into camp.

Phenology plots were established in the following plant communities or associations:

- Sedge community
  - Non-tussock sedge association
  - Tussock sedge association
- Sedge-Heath Tundra transition
  - Hummock association
- Heath Tundra
- Ridge complex (esker)
  - Esker crest
  - Heath tundra slope (windward slope)
  - Birch/heath tundra slope (leeward slope)
- Snowbank community
- Birch Seep at lakeshore

One plot was established in each association. To be as consistent as possible with ITEX methodology, 5 m x 5 m plot sizes were used. Plots were semi-permanently marked in the center with re-bar stakes wrapped with flagging tape to increase visibility, and the co-ordinates of each location recorded with hand-held GPS units.

Plant activity was observed and recorded weekly throughout the monitoring period (mid-May to September). Leaf and flower/seed development was recorded for several species in each plot.

An initial study was run on each plot to establish edaphic and biological parameters.

Weekly checks established the following:

- Depth of the active layer at that point in time,
- State of the vegetative structures of representative species
- Point in the flowering cycle of the plant for each species.

Phenology studies being run at the Tundra Ecosystem Research Station at Daring Lake, 100 km to the south of the Jericho site, include daily checks on individual plants as well as continuous recording of temperature, humidity, wind speed, precipitation, and radiation. Daily checks were beyond the budget requirements of the Jericho study, but the results of the Daring Lake studies, because the site is so close, will be of use in studies on the Jericho site (Matthews and Clark, 1999).

6.2 Plant Community Analysis

Based on systems developed for the Diavik Diamond Project and for WMC International Ltd. Meliadine West Gold Project, we collected a standard set of data for each of ninety plots.

The vegetation was sampled by the use of 5 m x 5 m plots, randomly located within each vegetation type. The choice was made as to what vegetation type occurred in a given area, and the plots located so that they did not cross a transition zone between two plant communities. Plot locations were recorded by GPS, and are illustrated on **Map 2**. It is important to note here that the GPS units used are handheld units not connected to a base station, thus subject to the ordinary inaccuracies of non-military units.

All plots were photographed, and photos are preserved in two albums, one to be held by Tahera, and one to be retained by the principal investigator. Representative photos of various associations are included as **Appendix H**.

Two aerial surveys were flown over the Local Study Area to make sure that no atypical plant communities were missed.

Tahera provided two field assistants to help with this work. Michelle Tanguay worked with me during the June fieldwork, and Heather Murdoch assisted me in August. Bruce Ott assisted as needed, with fieldwork and phenology data collection.

As many plants as possible were identified in each plot, and the percent of cover of each species was estimated and recorded. In addition, information as to site position on a slope, percent of slope, moisture, and substrate was also recorded for each plot.

Plant community descriptions were prepared based on the species found, and their relative abundance.

7. Literature Survey

Since some work has already been done on this project, we did not do a full scale literature survey, just checked for more recent work. Work done for the establishment of Echo Bay's Lupin Mine (Mary Collins Consultants Ltd., 1980) is applicable, as is the Environmental Impact Statement for BHP's Ekati Diamond Mine (BHP/Diavik, 1996) and a 1995 baseline study update (BHP Diamonds, 1995).

The principal investigator for this project did a literature search for the (then) GNWT Dept. of Economic Development and Tourism on the Bloody Falls area near Kugluktuk, summarizing all vegetation work done in that part of the region (Burt and Hubert, 1996). It was our conclusion then that the entire area was poorly studied prior to the 1990s.

Vegetation work done for Diavik Diamond Mines (Burt, 1997) and for the WMC International Meliadine West Gold Project (Burt, 1999) is also applicable in that both projects establish plant association descriptions.

The Government of the Northwest Territories has established a research station at Daring Lake, located approximately 300 km north of Yellowknife at 64^{o} 52' N, 111^{o} 35' W. Plant studies at this research station include work on plant phenology, following a modification of the International Tundra Experiment system (ITEX, 2000), in which individual plants or branches are tracked, with data kept on events like opening of buds, development of seeds, etc. Nothing is published yet, but lists and internal reports are available directly from the GNWT Department of Resources, Wildlife, and Economic Development (Clark, K., personal communication, 2000).

The West Kitikmeot Slave Study Society was formed to encourage "environmental, socio-economic and traditional knowledge research focused on a mineral rich area that stretches north of Yellowknife to the coast of the Arctic Ocean" (West Kitikmeot Slave Study Society, 2000). Two papers, "Esker Habitat Studies in the Slave Geological Province" (Cluff, Walton, and Paquet, 1998) and "Habitat/Vegetation Classification for the West Kitikmeot/Slave Study Region" (Epp and Matthews, 1999) refer to field work and satellite-based mapping, and include brief descriptions of habitat types.

The classic work , *Vascular Plants of Continental Northwest Territories, Canada* (Porsild and Cody, 1980) includes a chapter summarizing all botanical work done in the NWT up to approximately 1979. An interesting comment may be made that, when one examines the range maps in this text, the Contwoyto Lake area and watershed of the upper Burnside River represent a blank hole in the maps. Little work has been done in this part of the central barrenlands until the recent gold and diamond exploration occurred in the 1980s and 1990s.

Since references to the literature are made in the main body of the report, and also in Appendix A, the literature cited section is attached as **Appendix I**.

8. Results

8.1 Plant phenology

Plant phenology studies do not provide reliable data over a single season. Local weather, including precipitation, storms, snow accumulation, etc. can vary from year to year, and will influence events like leafing out, the development of flower buds, maturation of seeds, etc. Phenology studies produce useful results when maintained over several to many years, in a consistent fashion.

Studies run at Daring Lake (Matthews and Clark, 1999) are done on individual plants; no attempt is made to collect individual data on plants in different vegetation associations. "The eight species monitored at Daring Lake are *Oxytropis nigrescens**, *Ledum decumbens, Vaccinium vitis-idaea, Betula glandulosa, Salix* sp., *Saxifraga tricuspidata, Eripohorum vaginatum*, and *Carex aquatilis*."

Table 1 provides the raw data from phenology studies during the summer of 1999.

The summer of 1999 was in general a cold summer. Some species (especially some species of arctic cotton) had few blooms, and in many cases did not even "green up" as fully as would be expected. Some plants did not bear fruit at all.

Once the ground was snow free, leaf and flower development was very rapid. Late June/early July was the time of swiftest leaf development and flowering in most dicots. In some plants (bearberry and crowberry, for example), flowering precedes the development of the leaves, or change to the summer leaf colour. Plants like the bearberry and blueberry went from tight buds to petal fall in a single week. Cloudberry took even less time, with each plant blooming only 3-4 days.

It is important to point out that many flower buds actually develop almost a year prior to flowering, and are hidden deep in the axils of the leaves, or in a basal rosette at ground level (Savile, 1972, and Porsild, 1951)

We had few willows in the plots studied, but noted that the new leaves on willows were present in the third week of June in this area. During the early weeks of data collection, it is almost impossible to find willows in the plots; they are apparent only when the leaves begin to unfurl. New leaves on willows are preferentially browsed by muskox in early summer, making willow phenology important in areas frequented by muskox. If muskox are present around a site, it may be possible to reduce activity during the time the ox are browsing the willows, thus minimizing disturbance to the animals.

Table 1.

Jericho Diamond Project

1999 Phenology Study Results

Community/Plant	June		July				August				September
NON-TUSSOCK SEDGE											
Active layer depth (cm) >	17	23	23	31	33	35	36	36	35	50	46
Arctic cotton (non-tussock)	L2/F4	L3/F5	L3/F5	L4/F7	L4/F6	L4/F6	L4/F6	L5/F7	L5/F9	L5/F10	L6/F10
Arctic cotton (tussock)	L1/F4	L3/F5	L4/F5	L4/F5	L4/F7	L5/F7	L5/F7	L5/F7	L5/F9	L5/F9	L6/F10
Bog rosemary	L4/F2	L4/F3	L4/F4	L5/F5	L5/F6	L5/F6	L5/F6	L5/F9	L5/F10	L6/F10	L6/F10
Carex sp.	L3/F1	L3/F1	L3/F1	L3/F2	L4/F5	L4/F5	L4/F5	L4/F7	L5/F9	L5/F9	L6/F9
Dwarf birch	L4/F3	L4/F4	L4/F4	L4/F4	L4/F5	L4/F5	L5/F7	L5/F9	L6/F10	L6/F10	L6/F10
TUSSOCK SEDGE											
Active layer depth (cm)>	14	21	23	27	31	27	33	NA	32	34	39
Arctic cotton (tussock)	L1/F5	L3/F5	L3/F6	L4/F6	L4/F7	L4/F7	L4/F7	L4/F9	L5/F9	L5/F9	L6/F10
Bog rosemary	L4/F2	L4/F3	L4/F4	L5/F5	L5/F7	L5/F7	L5/F8	L5/F8	L5/F8	L6/F9	L6/F10
Cloudberry	L1/F1	L3/F3	L4/F4	L5/F6	L5/F6	L5/F7	L5/F7	L5/F7	L5/F7	L6/F8	L6/F8
Dwarf birch	L4/F3	L4/F4	L4/F4	L5/F7	L5/F7	L5/F7	L5/F7	L5/F9	L5/F9	L6/F9	L6/F10
Labrador tea	L4/F2	L4/F2	L4/F4	L4/F6	L4/F7	L5/F7	L5/F9	L5/F9	L5/F9	L5/F10	L6/F10
Mountain cranberry	L3/F1	L4/F2	L4/F2	L5/F3	L5/F5	L5/F7	L5/F1*	L5/F1	L5/F1	L6/F1	L6/F1
HEATH TUNDRA											
Active layer depth (cm)>	58	53	57	59	59	57	56	56	57	50	58
Arctic heather	L3/F2	L3/F3	L3/F4	L4/F5	L4/F6	L4/F7	L4/F7	L4/F8	L5/F9	L5/F10	L6/F10
Bearberry	L3/F3	L4/F4	L5/F5	L5/F7	L5/F7	L5/F7	L5/F1*	L5/F1	L5/F1	L5/F1	L6/F1
Blueberry	L4/F2	L5/F2	L5/F3	L5/F4	L5/F6	L5/F7	L5/F8	L5/F9	L5/F9	L6/F9	L7/F9
Crowberry	L5/F6	L5/F6	L5/F6	L5/F7	L5/F7	L5/F7	L5/F7	L5/F7	L5/F7	L6/F9	L6/F10
Labrador tea	L3/F2	L4/F2	L4/F3	L4/F4	L4/F4	L4/F6	L4/F7	L4/F8	L5/F9	L5/F10	L5/F10
Mountain cranberry	L4/F2	L4/F3	L5/F3	L5/F4	L5/F5	L5/F5	L5/F7	L5/F8	L6/F8	L6/F8	L6/F8
HUMMOCKS											
Active layer depth (cm)>	33	28	30	39	49	51	63	75	66	85	86
Arctic cotton	L3/F5	L3/F6	L4/F6	L4/F6	L5/F7	L5/F9	L5/F9	L5/F9	L5/F9	L5/F10	L6/F10
Blueberry	L3/F2	L4/F3	L5/F3	L5/F5	L5/F7	L5/F7	L5/F7	L5/F8	L5/F8	L6/F8	L6/F9
Bog rosemary	L3/F2	L4/F3	L4/F3	L4/F4	L5/F5	L5/F6	L5/F7	L5/F8	L5/F9	L6/F10	L6/F10
Cloudberry	L2/F1	L3/F2	L3/F3	L4/F6	L5/F7	L5/F1*	L5/F1	L5/F1	L5/F1	L5/F1	L6/F1
Labrador tea	L3/F2	L4/F2	L4/F3	L4/F5	L4/F6	L4/F7	L4/F7	L5/F8	L5/F9	L5/F9	L6/F10
Willow	L3/F3	L3/F4	L3/F5	L4/F6	L4/F7	L4/F9	L4/F9	L4/F10	L5/F10	L6/F10	L6/F10

* Plants did not bloom/produce seeds/berries this year.

Leaves		L7	Leaves withering	F2	Buds appear in axils
		L8	First leaf fall	F3	First open flower
SF	Snow free	L9	Main leaf fall	F4	Full flower, pollen on anthers
L1	New leaves on grasses/sedges	L10	Inactive	F5	Pollen on stigmans
L2	Leaf buds swelling			F6	First petals/corollas fading/falling
L3	New leaves open	Flowers		F7	Fruits/seeds developing
L4	Fully leafed out			F8	Berries ripe
L5	First leaf colour change	SF	Snow free	F9	Capsules maturel (appear dry)
L6	Fall colour	F1 No sign of flowers		F10	Seeds being released
				S	Snow cover

Table 1.

Jericho Diamond Project

1999 Phenology Study Results

Community/Plant	June		July				August				September
BIRCH SEEP											
Active layer depth (cm) >	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock
Bog rosemary	L4/F2	L4/F3	L4/F4	L4/F4	L4/F5	L4/F7	L4/F7	L5/F9	L5/F10	L5/F10	L6/F10
Crowberry	L3/F5	L4/F6	L4/F6	L4/F7	L4/F7	L4/F7	L5/F7	L5/F8	L6/F8	L6/F9	L6/F9
Dwarf birch	L4/F4	L4/F4	L4/F4	L4/F7	L4/F7	L4/F7	L4/F7	L4/F8	L5/F8	L5/F8	L6/F10
Labrador tea	L3/F2	L4/F2	L4/F4	L4/F4	L4/F6	L5/F7	L5/F7	L5/F8	L5/F8	L5/F8	L6/F10
Carex sp.	L3/F2	L4/F3	L4/F4	L4/F6	L4/F9	L4/F9	L5/F9	L5/F9	L5/F9	L5/F9	L5/F9
RIDGE CREST											
Active layer depth (cm)>	37	34	35	35	31	29	29	29	29	27	26
Bearberry	L3/F1	L4/F3	L4/F3	L5/F3	L5/F3	L5/F5	L5/F1*	L5/F1	L5/F1	L5/F1	L6/F1
Blueberry	L3/F2	L3/F3	L3/F4	L4/F5	L5/F6	L5/F7	L5/F7	L5/F8	L5/F8	L6/F8	L6/F8
Labrador tea	L4/F3	L4/F4	L4/F4	L4/F4	L5/F5	L4/F5	L5/F6	L5/F7	L5/F9	L5/F9	L6/F10
Moss campion	L3/F3	L4/F4	L4/F5	L4/F6	L4/F7	L4/F7	L4/F7	L5/F9	L5/F10	L5/F10	L6/F10
Prickly saxifrage	L3/F2	L3/F2	L3/F4	L4/F4	L5/F4	L5/F5	L5/F6	L5/F7	L5/F9	L6/F9	L7/F10
WINDWARD SLOPE											
Active layer depth (m)>	NA	0.62	0.67	0.66	0.65	0.57	0.57	0.55	0.54	0.53	0.56
Arctic heather	L3/F3	L4/F4	L4/F4	L4/F6	L4/F7	L4/F7	L4/F7	L5/F9	L5/F9	L6/F9	L6/F10
Dwarf birch	L4/F3	L4/F3	L4/F3	L4/F6	L4/F7	L4/F7	L4/F7	L5/F8	L5/F8	L5/F8	L6/F9
Labrador tea	L4/F3	L4/F3	L4/F4	L4/F6	L4/F7	L4/F7	L4/F7	L5/F9	L5/F9	L5/F9	L6/F9
Mountain cranberry	L3/F3	L4/F3	L4/F4	L4/F6	L4/F7	L4/F7	L4/F7	L5/F7	L5/F7	L5/F8	L6/F8
LEE SLOPE											
Dwarf birch	SF/F1	SF/F1	SF/F1	L3/F3	L4/F4	L4/F7	L4/F7	NA	NA	NA	NA
Labrador tea	L2/F2	L2/F2	L2/F2	L3/F2	L3/F2	L4/F4	L4/F6	NA	NA	NA	NA
Crowberry	SF/F1	SF/F1	SF/F1	SF/F3	SF/F4	L3/F6	L4/F7	NA	NA	NA	NA
Arctic heather	L2/F1	L2/F1	L2/F1	L2/F2	L3/F2	L4/F7	L4/F7	NA	NA	NA	NA
SNOWBANK											
Arctic heather	S	S	S	L3/F2	L3/F2	L4/F6	L4/F7	L4/F7	L4/F7	L5/F7	L5/F9
Dwarf birch	S	S	S	L4/F4	L4/F5	L4/F3	L4/F7	L5/F7	L5/F7	L5/F7	L6/F8
Labrador tea	S	S	S	L3/F2	L4/F2	L4/F2	L4/F6	L4/F7	L4/F7	L5/F9	L5/F9
Least willow (Salix herbacea)	S	S	S	SF	can't find	L4/F4	L4/F4	L4/F7	L4/F7	L5/F7	L5/F9

* Plant did not bloom/produce seeds/berries this year.

Leaves		L7	Leaves withering	F2	Buds appear in axils
		L8	First leaf fall	F3	First open flower
SF	Snow free	L9	Main leaf fall	F4	Full flower, pollen on anthers
L1	New leaves on grasses/sedges	L10	Inactive	F5	Pollen on stigmans
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L3	New leaves open	Flowers		F7	Fruits/seeds developing
L4	Fully leafed out			F8	Berries ripe
L5	First leaf colour change	SF	Snow free	F9	Capsules maturel (appear dry)
L6	Fall colour	F1	No sign of flowers	F10	Seeds being released

* Note from author; this is likely an incorrect identification; *O. nigrescens* is found in the Mackenzie Mountains – this is likely *O. arctica* or *O. arctobia*.

Some plots were tentatively established before all the snow was off the ground; this is necessary to ensure that data is collected as early as possible. In a couple cases, the vegetation revealed by the melting snow was not typical of the vegetation association needed, so the locations of a couple plots were shifted to ensure they were located in a community that was clearly one type or another.

A late snowbank community plot was established in early July. By the end of July, the plants in the late snowbank community plot were at the same stage as areas that had become snow-free in mid-June. One ravine area did not become snow-free until mid-July. It was not studied as a plot, but was watched carefully. As of late July, flowering of *Saxifraga rivularis* and *S. nivalis* had just begun.

Forbs (generally including non-woody, non-graminoid species) tend to develop very rapidly. An example is chickweed (*Stellaria monantha*). Often no sign of the plant appears above ground prior to the beginning of that year's development. Once it starts, the plant appears, stem extends, and leaves unfurl very quickly, often within the span of a single week. Flowers usually are open by the next week.

8.2 Plant communities

The plant communities found at the Jericho site are summarized in **Appendix A,** and correspond roughly to communities identified in the 1995 study. In some cases, the names assigned to the communities are altered slightly to better fit the vegetation.

Table 2 compares plant associations found in this study with "ecological zones" identified in the 1995 work, and with systems developed for Diavik, WMC International Ltd., and in the West Kitikmeot Slave Study Habitat/Vegetation Classification study.

Appendix B is a list of species actually encountered or collected on the Local Study Area, and **Appendix C** is a list of potential species of the general area, based on the literature. It will be useful if the area of interest is expanded and during reclamation. **Appendix D** is a list of plant species by community, and **Appendix E** is a tentative list of possible lichens that are likely to occur in the area.

9. Aerial Survey

Two aerial surveys were flown over the Jericho Local Study Area to ascertain that no unusual plant communities were missed. In addition, we watched the ground carefully en route to any drop-off points to make sure we were not flying over an area that should be examined more closely.

Table 2.
Jericho Diamond Project
Comparison of Plant Association Terminology

JERICHO, 1999	JERICHO, 1995	DIAVIK, 1997	WKSS Study, 1998	WMC MELIADINE WEST
			Deep Water	
			Shallow Water	
Sedge Community	Wet grass/Sedge Meadow	Sedge Associations	Sedge wetland	Sedge Communities
Emergent association		Emergent association		Emergent association
Sedge association, non-tussock		Sedge assoc. - non-tussock		Non-tussock sedge assn.
Sedge association, tussock		Sedge association, tussock	Tussock/Hummock Tundra	Tussock sedge assn.
no equivalent	no equivalent	Wastewater outflow areas		Wastewater outflow areas
Birch riparian	Wet Birch Brush	Riparian birch seeps	Riparian Tall Shrub	no equivalent
no equivalent	no equivalent	Riparian shrub		Willow riparian
Birch seeps	Moist Birch Meadow	Birch seeps	Birch Seep	Birch seep
no equivalent	no equivalent	Riparian shoreline shrub		no equivalent
no equivlaent	no equivalent	no equivalent	Spruce Forest	no equivalent
Heath tundra	Dry Barrenland Tundra	Upland heath tundra	Heath Tundra	Heath tundra
Snowbank communities		Snowbank communities		Snowbank communities
no equivalent	no equivalent	Lichen veneer	Lichen Veneer	Lichen-heath tundra
Avens association		no equivalent		no equivalent
Lichen-rock communities	Dry Rocky Tundra	Boulder associations		Lichen-rock communities
Boulders in heath tundra			Heath/Boulders	Boulders in heath tundra
Boulder-rock associations			Boulder Association	Boulder-rock associations
(Boulder fields/streams, felsenmeer)				
Bedrock associations		Bedrock associations	Bedrock Association	Bedrock outcrops
			Heath/Bedrock	
Ridge complex	Esker/Kame Delta	Esker complex	Esker Complex	Ridge complex
Crest associations		Esker crest		Ridge crests
Slope associations		Esker slopes		Ridge slopes
no equivalent		Esker pond margins		no equivalent
Transitional associations				Sedge-heath tundra trans.
Hummock zone		Birch hummocks	Tussock/Hummock Tundra	Hummock zone

From the air, some general patterns are readily visible. There are few areas where plants grow in standing water. Low areas, drainage basins, and depressions are inhabited by sedge communities, including non-tussock and tussock sedge associations. The major sedge communities in the local study area occur in the area between the portal and Carat Lake, where a well-defined stream drains down from C-1 and other small ponds. In the channels of these larger streams, birches and willows grow together, creating low riparian “forests”.
Sedge basins blend into hummock communities which in turn blend into heath tundra, which covers a larger portion of the uplands. Heath tundra crowns most hills where there are no bedrock outcrops, and occurs on many slopes. Bedrock outcrops, such as those on the hill to the southwest of the portal, in the proposed plant site, characteristically bear few rooted plants, but are covered by a varied flora of crustose lichens. Boulder fields and felsenmeer form a mosaic across the land, and are occupied mostly by crustose lichens and a web of fruticose and foliose lichens between the boulders. At the edges of many boulder fields, birch seeps indicate reliable sources of water.

A large esker system (or kame delta) extends from Carat Camp north. It exhibits typical esker complex communities, crests with patches of blueberry, bearberry, and prickly saxifrage, windward slopes with heath tundra, and leeward slopes with a fringe of dwarf birches along the slope, ponds and sedge communities in the low areas. Snowdrifts collect in the ravines, and last into mid-summer, creating snowbank communities.

The valley at the west end of Long Lake and the south-facing slopes on the north side of Long Lake have the best examples of snowbank communities seen in the course of this study. These include areas with bog laurel, mountain heather, violets, and other species normally found in the treeline and northern part of the taiga. These species are by no means rare; it is just that this site is at the northern limit of their ranges.

All in all, the Jericho area exhibits a more diverse flora than at Contwoyto Pipe, mostly due to a larger variety of landforms and terrain features, and more protected areas that can harbour plants more typical of the treeline.

10. Rare Plant Survey

No plant species identified as rare in the two main papers on rare plants in the Canadian arctic (McJannet, Argus, and Cody, 1995; or McJannet, Argus, Edlund and Cayouette, 1993), were found in this study.

One species of willow (*Salix tyrrellii*) listed on the COSEWIC list (COSEWIC, 1999) as a “threatened” species was found, but occurs abundantly throughout the area. Based on information collected in this and the WMC International Meliadine West project, willow specialist Dr. George Argus is now suggesting that this species be delisted, as he believes it to simply have been misidentified in the past (Argus, 1999). (Correspondence on this matter is included as **Appendix G**.)

One major range extension in a sedge was identified by Dr. Rob Naczi (Thieret, personal communication, 2000). *Carex atratiformis* ssp. *raymondii* has so far been found only at the confluence of the Bear River with the Mackenzie and south of Great Slave Lake, but was recognized as something odd, and collected between plots in this study. This is not a rare plant where it normally occurs, however, so does not merit rare plant concerns here.

11. Recommendations

None of the plant communities found on the Jericho Local Study Area are unique; all occur where terrain features permit in other nearby areas.

Any mining or construction activity will destroy whatever plant community occurs where the activity is carried out. Reclamation will be necessary.

Because of this, accurate pre-mining mapping of the vegetation will be needed. Digitization of the maps will allow calculation of the percentages of the land occupied by each vegetation association.

Monitoring can be limited to phenology work, as destruction of plant communities is complete where it occurs. Some effects of road and mine dust deposit will likely be seen, but the disadvantages of chemical dust inhibition must be balanced with the advantages.

Limiting the extent of the destruction of plant communities is advisable. This can be accomplished by restricting the “footprint” of the mine and related kimberlite storage and wasterock laydown areas. If possible, these should be restricted to a single watershed, and measures taken to limit siltation.

The esker system is valuable to wildlife. It likely will be needed as a source of gravel for road and pad building, but borrowing should be limited as much as possible. Known densites of mammals larger than siksiks should be avoided if possible.

In my opinion, this area (and its infrastructure of roads and camps) has possibilities as a tourist destination, especially if an all-weather road is built from the mine site to Contwoyto Lake. The esker system and hills offer superb hiking, the airstrip is an asset extremely valuable to a tourist operation, and the wildlife potential is high, for caribou viewing and observation of raptor nest sites.

If reclamation is done correctly, the entire project would have value as a teaching tool, demonstrating how a project can be carried out with minimal environmental damage. There may even be value in leaving part of the shaft open as an interpretive feature, so people could see a small part of the mine workings, and some kimberlite *in situ.*

I suggest consulting with the closest communities as the project proceeds to see if there is interest in taking over the land leases at the end of the project, with the intent of developing the property for tourism. This could be a model project with vast interpretive possibilities.

Tahera Corporation
Jericho Diamond Project

Vegetation Baseline Studies, 1999

Appendix A.

Plant Community Classification

Appendix B.

Species List of Vascular Plants

Appendix C.

Potential Vascular Plant Species of the Carat Lake Area, Kitikmeot Region, Nunavut

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Appendix D.

Plant Species by Community

Appendix E.

List of Possible Lichens

Appendix F.

Data Forms Used in Vegetation Baseline Studies, 1999

Appendix G.

Communications re *Salix tyrrellii*

Appendix H.

Representative Photos of Plant Communities and Associations

Appendix I.

Literature Cited

Tahera Corporation
Jericho Diamond Project

Vegetation Baseline Studies, 1999

Appendix A.

Plant Community Classification

Appendix A.
JERICHO DIAMOND PROJECT
Vegetation Baseline Report, 1999
Plant Community Classification

Table of Contents

Appendix A
JERICHO DIAMOND PROJECT
Vegetation Baseline Report, 1999
Plant Community Classification

In this section, the plant communities and associations found in plots on the Jericho Diamond Project are described. These are based on observable species groupings in conjunction with terrain features or ecological conditions in the immediate area.

It is important to realize that in many cases, these plant communities or associations are almost like a mosaic. They overlay terrain features, making it possible to have more than one association in a given area. For example, glacial erratic boulders may be scattered throughout a sedge community, or perched on a ridge and surrounded by heath tundra. The boulders bear their own plant associations of lichens, and the surrounding community may be completely different. Conversely, an expanse of heath tundra may include within it small sedge meadows, birch seeps, and bedrock outcrops, each with its own typical plant associations. The very mosaic nature of the plant communities in the arctic point out the difficulty of vegetation mapping (especially by remote sensing); in this environment, it is almost impossible to include these tiny enclaves.

In this paper, we have used the term "plant community" to refer to the major groups, and the term "plant association" to refer to subgroups within each major community. For example, the Sedge Community includes emergent plant associations, non-tussock sedge associations, and tussock sedge associations.

In order to save space, we have used common names where possible, including the scientific name the first time the name is used, and omitting it thereafter.

Table 2 (following p. 9 in the Report text) provides a comparison of the terminology used in this paper with that used in several related studies, and **Appendix D** provides a list of plant species by community. Representative photographs of most of these plant associations appear in **Appendix H**. References to citations in this section appear in **Appendix I**. Plot locations are plotted on **Maps 3 and 4** (following p. 4 in the Report text).

1. Sedge Communities

Sedge communities typically occur in drainage basins, depressions, or at the edges of lakes and ponds. They are typically wetlands, with standing or slowly flowing water during enough of the growing season that the soil remains saturated.

Sedges (*Carex* sp.) or arctic cotton (*Eriophorum* sp.) make up the dominant vegetation in these communities. Arctic cotton is in the sedge family, but has such a distinctive flower that it has its own common name. It is also known as cottongrass.

1.1 Emergent association

PHOTO 3, Plot 243

Emergent associations occur where plants grow in standing water, usually at the edge of a lake or pond. Some ponds are so shallow that rooted vegetation can occur throughout the pond basin. The depth limit for rooted emergent vegetation in this area seems to be about 30 cm.

Plants in this association are mostly non-tussock sedges (*Carex* sp.) or large cottongrasses (*Eriophorum angustifolium*).

The emergent association is rare in the Local Study Area.

1.2 Sedge association, non-tussock

PHOTO 4, Plot 237
PHOTO 5, Plot 220

The non-tussock sedge association occurs in the center or deepest part of a drainage basin, and consists of non-tussock-forming sedges or cottongrasses. Some species of *Carex* and *Eriophorum* grow in tight clumps called tussocks; in other species, individual plants are connected by underground rhizomes, and are spaced evenly, not clumped.

Non-tussock formers typically grow in the wetter parts of a basin, where water tends to remain on the ground longer, or tends to flow in shallow channels, producing an intermittent flow of slowly moving water a few centimeters deep.

Characteristic species of this association in the Local Study Area include: *Carex aquatilis*, *C. bigelowii*, *C. membranacea*, *Eriophorum angustifolium*, and *E. scheuchzeri*.

Occasionally woody plants like willows (*Salix arctica*, *S. arctophila*, *S. glauca* ssp. *callicarpaea*, *S. fuscescens*, *S. planifolia*, and *S. tyrellii*) occur in this association, but usually are quite small. Moisture-tolerant forbs like marsh five-finger (*Potentilla palustris*), *Saxifraga foliolosa*, bulblet saxifrage (*S. cernua*), Sudetan lousewort (*Pedicularis sudetica*) also occur here. Occasionally legumes, including the arctic crazyweed (*Oxytropis arctica)* and (rarely*) O. bellii* were encountered, usually growing on mounds.

Grasses are uncommon in this association as it usually is too wet, but *Calamagrostis neglecta*, and *Luzula confusa* were occasionally found here.

The non-tussock association blends into the tussock association wherever the ground is higher or drier in the drainage basins. In places the two, plus hummocky tundra, form a mosaic of different associations, with any mound providing drier habitat that supports species more typical of the heath tundra communities. (See Photo 5, with non-tussock association in the foreground, and the tussock association in the background.)

1.3 Sedge association, tussock

PHOTO 6, Plot 249 (also Phenology Plot 7)
PHOTO 7, Plot 238
PHOTO 8, Plot 238 (close-up of cottongrass tussock)

The tussock sedge association occurs at the edges of a drainage basin, where water only occasionally flows in a thin sheet over the ground. Standing water may be present in the spring or after a rain, but does not persist long.

The sedges and cottongrasses of this association usually form durable "tussocks", clumps of stems and leaves attached to a network of roots and growing in a flexible clump like a tuft of hair. These tussocks form a visible tufted pattern. (See Photo 8 for illustration of a tussock of cottongrass.)

Tussock zone sedge and cottongrass species include: *Carex aquatilis*, *C. membranacea*, *Eriophorum brachyantherum*, and *E. callitrix*. Non-tussock species may occur here, amidst the tussocks.

Heath (and other) species invade the tussocks, and mosses become established in the interstices between the tussocks. Commonly, bog rosemary (*Andromeda polifolia*) and cloudberry (*Rubus chamaemorus*) become established in the sides of the tussocks, while blueberry (*Vaccinium uliginosum*), cranberry (*Vaccinium vitis-idaea*), and Labrador tea (*Ledum decumbens*) grow from the tops. Lapland lousewort (*Pedicularis lapponica*), and bistort (*Polygonum viviparum*) also often grow in and around tussocks.

Dwarf birch (*Betula glandulosa*) and willows (*Salix arctica*, *S. fuscescens*, *S. arctophila*, and occasionally *S. herbacea* or *S. reticulata*) also gain footholds in the tussocks. The birches can attain sizes of over 20 cm, but the willows seldom exceed 10 cm in this association.

The tussock association is often transitional between the non-tussock association and the surrounding heath tundra. As the drainage basin ages, it receives organic material, especially at the edges, which impedes the flow of water, and actually raises the level of the land. This causes the upper layers of the soil to be drier, which allows other species to become established.

As they age, the tussocks lose their tufted shapes due to the growth of non-sedge species. They eventually become rounded humps and the association blends into hummocky tundra.

2. Birch Communities

These associations occur where there is a consistent and reliable supply of water throughout the growing season, but where water does not pool or stand on the ground. They are characterized by the fact that the dwarf birch (*Betula glandulosa*) is the dominant species. They vary in their location due to the amount of water available throughout the growing season.

The birch communities provide nesting habitat for small passerine (perching) birds that usually nest in trees in the southern parts of their ranges, shelter for roosting ptarmigans, and cover for other mammals, like the tundra voles and lemmings. Short-tailed weasels also utilize their cover for hunting.

2.1 Birch riparian association (also birch/willow riparian)

PHOTO 9, Plot 214
PHOTO 10, near Plot 244
PHOTO 11, Plot 206
PHOTO 12, Plot 206, willow close-up with moth galls

A birch riparian association is characterized by a thick growth of dwarf birch in the vicinity of a stream channel, often with a substantial flow of water that is sustained throughout the growing season. These birches (usually 20 – 60 cm tall) often grow so thickly that the density of sedges, grasses, and heaths under their shade is drastically reduced. The ground underneath is often covered only with leaf litter from the birches.

Where enough sunlight penetrates to permit other plants to grow, the ground cover is often crowberry (*Empetrum nigrum*), blueberry, and cranberry, as well as a few mosses. In most cases, these individuals look quite different than individuals of the same species growing out on the open tundra in full sunlight. They are taller, with larger leaves – demonstrating an adaptation known as “shade leaves”, leaf adaptation to lower light levels.

In the larger stream channels, the birch riparian association often includes willows, some of which can attain fairly large sizes, trunks some 10 cm or more in diameter, and heights up to 100 cm. These willows include *Salix glauca*, *S. planifolia*, and *S. tyrellii. Salix arctophila* also occurs here, but most often is prostrate, growing among the other willows.

In places this birch riparian association with fairly large willows occurs where water collects at the base of a cliff, even if there is not a lot of standing water. (See Photo 11, Plot 206 for an example, and Photo 12 for a closeup of a willow with moth galls)

2.2 Birch "seeps"

PHOTO 13, Plot 219

Birch "seeps" are rarely associated with constantly flowing streams, but usually occur where water flows out of a boulder field, at the edge of an esker, on the margin of a slope, or where the active layer has slipped. The flow of water is not generally visible on the surface of the land, but is reliable. They are quite visible as a low but solid growth of dwarf birches, often in a crescent shape on a hillside. This plant association is often associated with large boulder groups or at the edges of boulder fields or areas of felsenmeer (shattered bedrock that has been somewhat rearranged by glaciation, but retains its angular forms).

Where the birch "grove" is thick enough, only leaf litter and a few scraggly mosses occur beneath the birches. If sunlight penetrates, however, birch seeps can support an understory of heaths (blueberry, Labrador tea, mountain cranberry) crowberry, mosses, buttercups (*Ranunculus lapponicus*), large-flowered wintergreen (*Pyrola grandiflora*), and bublet saxifrage (*Saxifraga cernua*). Several willows (*Salix glauca, S. arctophila, S. herbacea, S. tyrrellii*) occur here in this protected environment, as well as sedges (*Carex aquatilis, C. bigelowii, Eriophorum scheuchzeri*) and grasses (*Arctagrostis latifolia, Hierochloe alpina, Calamagrostis inexpansa, C. neglecta,* and *Poa arctica*).

3. Heath Tundra Community

The heath tundra is the climax community in the Contwoyto Lake area, and covers most of the upland where the soil is stable or deep enough to support rooted plants. The term "heath" refers to plants of the family Ericaceae, and is used as a general term to describe this group of plants, which often grow in association with each other in the tundra.

The heath tundra community is characterized by a mixture of heaths, forbs, small xeric sedges, and grasses. The composition of the vegetation of the heath tundra community is governed by the amount of water in the soil, soil amount and type, and exposure to wind.

Terrain features are the most important cause of variations in the heath tundra community, especially those that affect the amount of water available to plant roots or those that cause the soil to be more exposed to winds in winter than in surrounding areas.

3.1 Upland heath tundra

PHOTO 14, Plot 242
PHOTO 15, Plot 225
PHOTO 16, Plot 225 (Close-up of alpine azalea)

This association occurs on most slopes and fairly well-drained level ground which is covered by a blanket of snow in winter, preventing wind erosion of the vegetation.
Characteristic plants of the upland heath tundra include Labrador tea, blueberry, mountain cranberry, and bearberry, black bearberry (*Arctostaphylos alpina*) on the drier sites, and red bearberry (*A. rubra*) where there is more moisture. Crowberry is often intermingled in the mat of vegetation, and dwarf birch is also an important component of this community, but grows in a scattered fashion, not in dense "groves". Willows (*Salix glauca* ssp. *callicarpaea, S. arctica, S. tyrrellii)* also occur throughout the upland heath tundra, and are mostly small and prostrate due to the shallow snow cover in winter.

Arctic bluegrass (*Poa arctica*), alpine holygrass (*Hierochloe alpina*), wood rush (*Luzula confusa*), and dryland sedges like *Carex bigelowii, C. membranacea, C. rotundata, C. rupestris,* and *C. vaginata* grow scattered throughout the upland heath tundra, not in pure stands. Alpine holygrass occurred in almost every plot we studied, except where the ground was saturated.

In windswept areas where the snow cover is likely quite thin in winter, mat plants like alpine azalea (*Loiseleuria procumbens*) or *Diapensia lapponica* can become established. Mountain avens (*Dryas integrifolia*) also occurs in thin snow areas.

3.2 Heath tundra on frost scars

PHOTO 17, Plot 262
PHOTO 18, Plot 262 (Close-up of frost scar.)

The freeze-thaw cycle in arctic soils creates typical terrain features across the Arctic. One of the most common of these are "frost scars", described by Britton (1966) in a paper on the vegetation of the Alaskan arctic tundra. A type of frost scar, mud boils are defined as "nonsorted circles developed in fine-grained materials" (van Everdingen, 1998). These are common on many gentle slopes in the Contwoyto area.

Mud boils form where conditions allow the establishment of convection currents in the active layer (French and Slaymaker, 1993). Circular structures form, with a center disk composed of exposed mineral soil, rocks, or a combination of these, surrounded by a raised ridge usually covered with vegetation. Particles in the center disk may be moving too swiftly to allow the establishment of rooted vegetation.

The vegetation on frost scars creates a different type of mosaic, several different associations all mixed together, impossible to separate, as far as mapping is concerned.

Outside the circular mud or frost "boils", the plant association may be heath tundra or a sedge association. On the elevated ridges of the "boils", heath tundra predominates, with a mixture of species more typical of dry sites mixed with the heaths – legumes such as arctic crazyweed

(*Oxytropis arctica*), and occasionally liquorice-root (*Hedysarum alpinum*). In addition, mountain avens (*Dryas integrifolia*) and grasses such as *Arctagrostis latifolia*, *Trisetum spicatum*, arctic bluegrass, alpine holygrass also occupy the ridges.
The center disk of the boil is composed of particles moving rapidly in relation to the outer ring. This prevents most vegetation from becoming established. In some cases, there is little vegetation here; in others, the center disk bears mats of alpine milkvetch (*Astragalus alpinus*), tiny gnarled plants of Lapland rosebay (*Rhododendron lapponicum*), or a sparse growth of sedges.

3.3 Heath tundra on solifluction slopes

In places, the active layer creeps downslope over the permafrost, forming a distinct layer that resembles frosting applied to a cake while the cake is still warm, a sort of "festooned" pattern where one layer creeps over another. From above, these lobes can be seen overlying the original ground.

The face of the moving layer is rotating, with soil particles moving in a wheel-like motion around the end of the layer. This movement carries rooted vegetation with it, creating a thicker growth of plants in the face of the slowly moving ridge.

Some of the plants often found in the face of a solifluction lobe are dwarf birch, small willows (several species), blueberry, Labrador tea, mountain cranberry, Calamagrostis neglecta, alpine holygrass, .

Solifluction slopes are uncommon in the local study area, and usually occur on a small scale where they do occur.

4. Snowbank Community

PHOTO 19, near Plot 228, showing profile of snowbank
PHOTO 20, Plot 228
PHOTO 21, Plot 229
PHOTO 22, Plot 229 (Close-up of mountain heather.)
PHOTO 23, Plot 229 (Close-up of Richardson's anemone)
PHOTO 24, near Plot 229, pellets from arctic hare

In the lee of a south or east-facing slope, deep snowbanks accumulate (Photo 19), and often do not disappear before July, drastically shortening the growing season for the plants beneath the snow. A characteristic plant association develops in these areas. Typical of most snowbank communities is the least willow (*Salix herbacea*), Labrador tea, and the white arctic heather. Mountain sorrel (*Oxyria digyna*), *Saxifraga punctata, S. nivalis,* and *Antennaria eckmaniana* are often also present.

The higher the bank or cliff which causes the snowbank to form, the deeper the snowbank, and more pronounced its effect on the local vegetation. We found particularly distinct snowbank communities at the west end of Long Lake, which is located to the southwest of the portal. Here, steep cliffs some 10 m tall cause snow accumulation and distinct local microclimates. Wind turbulence in these valleys causes snowbanks to develop on both south and north-facing slopes. However, due to longer exposure to direct sunlight, the south-facing cliff bases (Photo 21) tend to become snow free earlier than those facing north (Photos 19 and 20). These south-facing slopes are protected from drying winds, and have a reliable source of moisture throughout most of the growing season. The plant community that develops here consists of a number of species that are much more common further south, near Lac de Gras, Jolly Lake, and Courageous Lake.

Among the normal snowbank indicator species, we found bog-laurel (*Kalmia polifolia*), mountain heather (*Phyllodoce coerula*) (Photo 22), Richardson's anemone (*Anemone richardsonii*) (Photo 23), *Sibbaldia procumbens*, and in places a species of violet tentatively identified as *Viola epipsala* ssp. *repens*.

Arctic hares and ptarmigans apparently use the shelter of these cliffs in harsh weather. Here, we found many fecal deposits of both species, as well as unusual fecal pellets of arctic hares. These pellets seem to be covered with a fine mud veneer, and are composed of much finer plant material than are the typical pellets. Each pellet we opened also contained one to three small pieces of gravel. The reason for the formation of these atypical pellets is unknown, and a cursory search of the literature revealed no descriptions that fit (Photo 24).

5. Avens Association

PHOTO 25, Plot 239

A fairly uncommon plant association occurs in "saddles" and on slopes where there is little soil, and a base of gravel ranging in particle size from 5 mm to 1 cm. (Since the mountain avens seems to dominate this association, we called it the "Avens association". It does not seem to fit clearly into the designation of "heath tundra", and is not a sedge association, but seems to have its own characteristics.)

Although mountain avens (*Dryas integrifolia*) is dominant in this association, but the least willow, reticulated willow (*Salix reticulata*), Lapland rosebay, alpine milkvetch (*Astragalus alpinus*) and arctic oxytrope (*Oxytropis arctica*) also occur. Arctic bluegrass (*Poa arctica*), *Deschampsia caespitos*a, and *Carex scirpoidea* are present. Several species of small willows occur here, including *Salix reticulata*, *S. herbacea*, *S. glauca*, and *S. arbusculoides*. Black bearberry (*Arctostaphylos alpina*), purple mountain saxifrage (*Saxifraga oppositifolia*), star chickweed (*Stellaria* sp.), and false asphodel (*Tofieldia pusilla* and *T. coccinea*) are sometimes present in small numbers.

Frost boils are common in this area, and these plants often arrange themselves typically on the frost boils, with the legumes, small sedges, and Lapland rosebay on the center disks, and heaths and avens on the surrounding ridges.

We found only two examples of this type of association. The best example is on the south-facing slope above the east end of Long Lake.

6. Lichen-rock Communities

Where there is a high percentage of boulders or fractured bedrock in the substrate, rooted vascular plants are uncommon, and the plant association is made up of lichens growing on and around the rocks. In the Jericho Project area, most rocks are about 80% covered with crustose lichens.

The species of lichen inhabiting the rock usually depends on the chemical composition of the rock, the amount of weathering or fracturing, and the exposure to wind abrasion. The lichen flora of rocks in the Jericho area is generally a flora typical of "acidic" rocks rather than calcareous rocks.

The following lichens constitute the "typical" lichen flora of local rocks, and can be found on boulders, felsenmeer and bedrock outcrops: rock tripe (*Umbilicaria* sp.), map lichen (*Rhizocarpon geographicum, R. geminatum*), sunburst (*Arctoparmelia centrifuga, A. incurvata*), bloodspot (*Haematomma lapponicum*), *Pseudophebe minuscula* and *P. pubescens* (which we called "brush-cut lichens"), Tremolecia atrata ("Halloween lichen") and grey and black crustose lichens.

The orange jewel lichen (*Xanthoria elegans*), occurs where siksiks use the boulders for lookouts; it is characteristic of calcareous rocks and places high in nitrogen, growing here on the urine and feces of the ground squirrels.

6.1 Boulders in heath tundra

PHOTO 26, Plot 233

This is a transitional association, scattered boulders (usually about 80% covered with lichens) surrounded by heath tundra. It is very common in the Local Study Area. The boulders are covered with the typical lichen association listed above, and the surrounding heath tundra is typical of the general heath tundra for the area.

Occasionally, a local effect can be observed around the boulders – a small increase in nutrients and water may occur due to runoff from the boulder and from fecal material deposited on it by birds and mammals. This may cause an increase in the lushness of the plants around the base of the boulder, and in a higher percentage of grasses immediately surrounding the boulder.

Scattered glacial erratic boulders also occur in sedge communities. When they do, the coverage of lichens on the boulders is about 60%, significantly less than those in heath tundra.

The microhabitats on these erratic boulders is likely not particularly important to any species of wildlife, with the possible exception of some insects or spiders.

6.2 Boulder field associations

PHOTO 27, Plot 223
PHOTO 28, Plot 223 (Close-up of boulders, lichens.)

The plant communities on boulder fields, boulder streams, and felsenmeer* are all similar, with the species of lichens determined primarily by the chemical composition of the rocks. Boulders are covered by a mosaic of crustose lichens (see list above) and the interstices between boulders, if small enough to provide protection, support an assemblage of foliose and fruticose lichens. Typical species between boulders include: *Cetraria* sp., *Cladina stellaris, Alectoria* sp. ("hair lichens"), and *Cladonia cervicornis, C. cornuta, C. coccifera,* and *C. uncialis.*.

As the mats of lichens webbing the boulders together become denser, dust and organic debris accumulate, and form a substrate that can support rooted plants. Mats of tundra slowly become established in the midst of the boulders. The fragrant shield fern (*Dryopteris fragrans*) often becomes established in protected niches. Crowberry and mountain cranberry are also common species in these mats. Prickly saxifrage often becomes established, rooting in cracks on the boulders.

6.3 Bedrock associations

PHOTO 29, Plot 204
PHOTO 30, Plot 204 (Close-up of lichens.)

Bedrock outcrops rounded and polished by the continental ice sheets are common in the local study area of the Jericho Project. These provide a substrate that is not only lacking in nutrients, but often exposed to the wind and subjected to great variations in temperature. Few rooted vascular plants can become established here, so the rock outcrops are left to the lichens. Most outcrops are approximately 80% covered with crustose lichens (See Photo 30). A few vascular plants like prickly saxifrage (*Saxifraga tricuspidata*) and some of the grasses find footholds in cracks in the rocks.

Cliff faces usually support a flora similar to rounded outcrops, with rooted plants clinging to crevices and mats of tundra established on ledges. Grasses (*Poa* sp., *Hierochloe* sp.) are common, as is prickly saxifrage, and sometimes *Saxifraga nivalis*.

Cliff faces usually funnel or concentrate the flow of water (either over the surface or through the active layer), creating a moist microclimate at their base. If they are too small to form snowbank communities, the base of cliffs often supports a lush growth of grasses (*Poa* sp., and *Luzula confusa*) or sedges (*Carex bigelowii*, *C. aquatilis*, and *C. podocarpa*) (See Photos 11 and 12).

*** Felsenmeer is a"surficial layer of angular shattered rocks formed in either modern or Pleistocene periglacial environments (Van Everdingen, 1998), literally "frost-riven debris", often slightly modified by ice (Bird, 1967).**

Taller cliff faces may provide nesting sites for raptors. "Whitewash" (fecal material) from the birds and decaying organic matter from nest material and prey items creates small pockets of enrichment around the nest sites. These areas may have sufficient nitrogen compounds and calcium to support growths of bright orange jewel lichens (*Xanthoria* elegans).

7. Ridge Complex

Eskers and kame deltas are common in the Jericho area; the airstrip is built on a large esker that runs north from Carat Camp. These large systems encompass a number of plant communities, but some (such as the ridge crest communities) are characteristic only of the esker/drumlin/kame complexes, as they occur on the less stable sand/gravel substrates exposed to wind erosion.

7.1 Ridge crest communities

PHOTO 31, Plot 252 (Phenology Plot #4)
PHOTO 32, Plot 252 (Close-up of *Potentilla nivalis*)

Due to exposure to winds and the instability of the sand or gravel material of the esker or ridge crests, very specific plant communities develop there. These typically consist mostly of mats of vegetation (blueberry, crowberry, black bearberry, Labrador tea, mountain avens), semi-succulent plants (*Antennaria* sp., prickly saxifrage, *Draba glabella* and *D. lactea*), deeply-rooted cushion plants like moss campion (*Silene acaulis*), or clumps of grass (*Poa* sp. , *Arctagrostis latifolia*, *Festuca brachyphylla*, or *Arctophila* sp.). The tiny sandwort, *Minuartia rubella*, can also be found in some of these very dry, very unstable sites. A few legumes also can find a foothold here, including *Oxytropis arctica* and *Astragalus alpinus*.

Where the winds are particularly severe, due to topographical features and funneling, the snow cover in winter may be nonexistent and the soil may be so eroded and unstable that it cannot support any kind of rooted vegetation. In these areas, sand "blowouts" occur, which do not have any visible vegetation at all. More stable crests with thin snow cover may develop a thin veneer of black lichens.

7.2 Ridge slope communities

PHOTO 33, Plot 251 (Phenology plot #5)

The slopes of eskers can vary in exposure, orientation, and steepness, and the plant communities occupying them vary also. Slopes facing away from the prevailing winds may support a fringe of dwarf birches with an understory of crowberry, blueberry, Labrador tea, arctic heather, mountain cranberry, and occasionally large-flowered wintergreen and *Antennaria* spp. These lee slopes usually face south or southeast.

Snowdrifts collect on these slopes and help protect the vegetation. They also ensure a more reliable supply of water, enabling the dwarf birches to survive there. Snowbank communities may occupy the lower portions of lee slopes that accumulate deep snowdrifts. Windward slopes usually are covered with heath tundra.

8. Transitional Associations; Hummock zone

PHOTO 34, Plot 216

In some cases, the transition zone between two plant communities is occupied by an association that contains elements of each but that is clearly definable on its own.

An example of this is the hummock zone, which occurs in the transition between the sedge community and heath tundra. This association, because of its diverse microclimates, is a complex mosaic, with a high number of plant species, each occupying a specific niche.

A turf hummock is defined (Van Everdingen, 1998), as a "hummock consisting of vegetation and organic matter with or without a core of mineral soil or stones". Occasionally, hummocks are ice-cored, especially in areas where there is considerable flow of water in the fall, when freezing and thawing occur each day.

Turf hummocks may originate as sedge tussocks are invaded by heaths. These are mounds developed initially from the tussocks of certain species of *Carex* and *Eriophorum* sedges, a tight but flexible mass of stalks, leaves, and roots. Bird (1967) states that this is the most common form of hummock in northern Canada.

Heath growth usually starts in the drier places on a tussock, with blueberry, Labrador tea, mountain cranberry, and occasionally red bearberry (*Arctostaphylos rubra*) rooting in the sides and top of the tussock, and gradually displacing the sedges. Mosses cover the ground between the tussocks, and add to their bulk by growing up the sides. Cloudberry (*Rubus chamaemorus*) and bog rosemary (*Andromeda polifolia*) become established in the moss, and gradually the structure ceases to resemble a tussock and becomes a mound of heaths and related species.

Moss mats that become established in sedge meadows may be an alternate source of hummocks (Pielou, 1994). The thickening growth of mosses insulate the ground in specific places, allowing ice lenses to develop when water percolates through the system in the fall. These enlarge each year, and, with the vegetation growth, cause the hummock size to increase. Plant species are similar, heaths, mosses, cloudberries, and a few forbs like bistort (*Polygonum viviparum*), Labrador lousewort and Lapland lousewort.

Toward the sides of the drainage basin or depression, there is less water in the soil, and colonization by heaths is more complete. Heaths fill the interstices between the mounds, and the surface becomes undulating, gradually merging with the surrounding heath tundra.

9. Disturbed Sites

Disturbances may be of geological, animal, or human origin. They may occur because the plant cover is destroyed or disturbed, or because nutrients are added to the soil. Both cause variances in the vegetation from the surrounding terrain.

9.1 Nutrient-enriched sites

These occur where nutrients like calcium, nitrogenous compounds, or organic matter has been added to the soil. These materials may be added by animal action, such as denning, nesting, or even the decay of the body of a large mammal. Or, nutrients may be added by human activities such as dumping food wastes, greywater outflows from a camp, or the deposit of human waste.

Nesting on ledges adds nitrogen compounds and encourages the development of grasses on ledges or jewel lichens on cliff faces. (See section 6.3) Loons build nests on the edges of tundra ponds, mats of sodden vegetation that are often used (and enlarged) year after year. These, and feces from the incubating loon, may encourage a thicker growth of sedges in the vicinity of the nest, depending on exposure of the nest and on water currents in the area.

Den sites located in the Jericho area include mostly den sites of arctic ground squirrels, locally known as siksiks or hikhiks, and a few den sites of red foxes. In most cases, the activity of the animals around the site, the disturbance of the soil, and enrichment of the site causes a thick growth of grasses (*Poa arctica*, *Arctophila latifolia*, *Calamagrostis inexpansa*, *Festuca brachyphylla*) in the vicinity of the den. Intermingled with the grasses are forbs and a few woody plants, including willows (*Salix glauca* and other species). Blue-green chickweed (*Stellaria monantha*) is almost always present, and cinquefoils (*Potentilla nivea*, *P. hyparctica*) are common on these sites. Pussytoes (*Antennaria* sp.) occur on sandy areas around dens. We examined few den sites in the local study area for the Jericho Project. A single red fox den was located near the airstrip, but was occupied by fox kits, so we did not approach the den. Lush grasses surrounded the opening, however.

Greywater outflows from camps, or other human activities that involve deposit of plant nutrients on the land, usually are in time marked by an unusually lush growth of sedges and cottongrasses. This is not currently obvious at the Carat Camp, likely due to limited use of the camp.

Thick sedge growths downstream from the portal may in part indicate nutrient enrichment from the camp located at the portal, or it may indicate a change in the reliability of the water supply at that place. Sedge/cottongrass species include: *Carex aquatilis*, *C. bigelowii, C. membranacea, C. rotundata, Eriophorum angustifolium, E. brachyantherum,* and *E. scheuchzeri*. Grasses, especially *Calamagrostis neglecta,* grow in lush clumps.

Generally, the main difference between areas that are natural wetlands and those with nutrient enrichment is the size and density of the vegetation. Plants in the enriched areas are larger, with denser foliage.

9.2 Planned use areas.

PHOTO 35, Plot 210
PHOTO 36, Plot 210 (Close-up of *Antennaria* sp.)

The other main type of disturbed site at the Jericho Project is caused by modification of the land to allow human use. This includes the intentional deposit of material on the surface of the ground, or by abrasion of the surface due to use or construction.

The buildings located at the portal are built on gravel and waste rock laid down over the surface of the ground. These waste rock areas may be as much as 5 m thick. This construction was done fairly recently (during the past 5 years), and the average rock particle size is fairly large (from 5 – 15 cm), so plants are not well established on most of the laydown areas. In the upper terrace, mountain avens, blueberry, bearberry, and a few small sedges (*Carex capillaris* and *C. scirpoidea*) are the only vegetation.

There seems to be a lower (and older) terrace to the northwest of the portal, below the main waste rock laydown area (See Photo 35). This is more densely vegetated, with scattered mats of mountain avens, *Draba nivalis*, mountain cranberry, Labrador tea, *Antennaria eckmaniana (*Photo 36*)*, blue-green chickweed, and prickly saxifrage. A few dwarf birches and willows (Salix reticulata, and S. glauca) and grasses (*Calamagrostis neglecta*, *C. inexpansa*, *Poa arctica*, and *Festuca brachyphylla*) grow in scattered clumps. The ground is about 80% covered with vegetation.

Roads in the area are constructed of esker material and waste rock. They are in use, so not vegetated at all. There is evidence that there is dust blown from the roads over the adjoining vegetation, which may in time affect the vegetation. Recent studies done at Lupin may be useful in helping to predict the effects of road dust (Svoboda, 1997).

In some cases, extra material is not deposited, but the plant cover is destroyed due to human use. These areas include campsites such as Carat Camp, the storage area, and the airstrip, all located on the south end of a large esker system. The main effect in these areas is the removal of vegetation and to a certain extent, change in contours of the surface of the land. Over the next few years, it is reasonable to expect that a number of species, including dwarf fireweed (*Epilobium latifolium*), tall fireweed (*E. angustifolium*), tansy-mustard (*Descurainia sophioides*), and wild rye (*Hordeum jubatum*) will become established.

Vegetation Baseline Studies, 1999

Appendix B.

Species List of Vascular Plants

Appendix B.
JERICHO DIAMOND PROJECT
Species List of Vascular Plants

The following species were encountered on the plots at Tahera Corporation's Jericho Diamond Project at the west end of Contwoyto Lake, Kitikmeot Region, Nunavut. Common names in regular use are included.

Nomenclature for most groups is based on Porsild & Cody, 1980. For the willows, it is based on personal communication with Dr. George Argus. For grasses, nomenclature is based on that used by Dr. John Thieret, and for sedges/rushes, that used by Dr. Rob Naczi.

Scientific Name	Common Name	Vegetation type
POLYPODIACEAE		
Cystopteris fragilis	fragile fern	lichen-rock
Dryopteris fragrans	fragrant shield fern	lichen-rock
EQUISETACEAE		
Equisetum arvense	common horsetail	birch seep, birch riparian
E. variegatum	variegated horsetail	sedge community
LYCOPODIACEAE		
Lycopodium annotinum	mountain clubmoss	heath tundra, birch seep
L. selago	shining clubmoss	birch seep, birch riparian
GRAMINAE		
Arctagrostis latifolia		heath tundra, sedge community
Calamagrostis inexpansa	reed bentgrass	birch seep, disturbed sites
C. neglecta		birch seep, riparian, sedge comm.
C. purupurascens		esker crest
Deschampsia caespitosa	hairgrass	sedge community
Festuca brachyphylla	fescue	esker crest, avens association
Hierochloe alpina	alpine holy grass	ubiquitous
Poa arctica	arctic blue-grass	heath tundra, sedge assns,
Trisetum spicatum		esker crest, slopes, dist. sites

CYPERACEAE

Carex arctogena		
C. aquatilis		sedge assn., birch seep. hummocks
C. atrataformis ssp. *raymondi* (major range extension for this species)		snowbank
C. bigelowii		sedge assn., birch seep
C. capillaris		sedge assn.
C. glacialis		esker complex
C. holostoma		sedge assn, birch riparian
C. membranacea		heath tundra
C. nardina		esker complex
C. podocarpa		heath tundra
C. rariflora		sedge assn., birch seep, riparian
C. rotundata		heath tundra, birch seep
C. rupestris		heath tundra, esker complex
C. saxatilis		sedge assn.
C. scirpoidea		esker complex, avens assn., disturbed sites
C. supine		esker complex
C. vaginata		heath tundra
Eriophorum angustifolium	narrow-leaved cotton-grass	sedge assn.
E. brachyantherum		sedge assn.
E. callitrix		esker complex
E. scheuchzeri		sedge assn.
Scirpus caespitosus	bulrush	sedge assn

JUNCACEAE bog-rushes and wood-rushes

Juncus albescens	bog rushes	sedge assn.
Luzula confusa	wood-rush	heath tundra,
L. nivalis		snowbank community, hummocks
L. wahlenbergii		sedge assn.

LILIACEAE

Tofieldia pusilla	false asphodel	heath tundra
Tofieldia coccinea	red false asphodel	heath tundra

SALICACEAE

Salix arbusculoides		avens assn.
S. arctophila		heath tundra, birch seeps, riparian
S. arctica/arctophila	apparent hybrid	snowbank community
S. arctica	arctic willow	heath tundra, snowbank communities
S. fuscescens		heath tundra, birch seeps
S. glauca var. *callicarpaea*	blue-green willow	ubiquitous
S. herbacea	least willow	snowbank community, heath tundra
S. planifolia		snowbank community, heath tundra
S. reticulata	net-veined or reticulated willow	heath tundra
S. tyrrellii	Tyrrell's willow	ubiquitous

BETULACEAE

Betula glandulosa	dwarf birch	birch seep, heath tundra, hummocks
POLYGONACEAE		
Oxyria digyna	mountain sorrel, sweet leaf	snowbank community, heath tundra
Polygonum viviparum	bistort	sedge assn., hummocks, heath tundra
CARYOPHYLLACEAE		
Cerastium alpinum	mouse-eared chickweed	heath tundra, disturbed sites
Minuartia rubella	sandwort	esker crest
Silene acaulis	moss campion	esker crest
Stellaria edwardsii	star chickweed	sedge assn.
S. monantha	bluegreen chickweed	disturbed sites
RANUNCULACEAE		
Anemone richardsonii	Richardson's anemone	snowbank community, birch seep, riparian
R. gmelinii	small yellow water crowfoot	emergent assn.
R. lapponicus	Lapland buttercup	birch seep
CRUCIFERAE		
Draba glabella	smooth whitlow-grass	esker crest, disturbed sites
D. lactea	milky whitlow-grass	esker crest, disturbed sites
D. nivalis	snow whitlow-grass	heath tundra, disturbed sites
SAXIFRAGACEAE		
Saxifraga cernua	bulblet saxifrage	heath tundra, sedge assn.
S. foliolosa		sedge assn.
S. nivalis	snow saxifrage	snowbank community
S. oppositifolia	purple mountain saxifrage	lichen-rock, heath tundra
S. punctata ssp. porsildiana	heart-leaved saxifrage	disturbed sites, heath tundra
S.rivularis	brook saxifrage	snowbank community
S. tricuspidata	prickly saxifrage	lichen-rock, esker crest
ROSACEAE		
Dryas integrifolia	mountain avens, arctic dryad	avens assn., heath tundra
Potentilla hyparctica	arctic cinquefoil	esker crest
P. nivea ssp. *nivea*	snow cinquefoil	esker crest
P. palustris	marsh five-finger	sedge assn.
Rubus chamaemorus	cloudberry	heath tundra, hummocks
Sibbaldia procumbens	Sibbaldia	snowbank community

LEGUMINOSAE

Astragalus alpinus	alpine milkvetch	heath tundra
Oxytropis arctica	arctic crazyweed	heath tundra
O. bellii	Bell's crazyweed	heath tundra
O. maydelliana	yellow crazyweed	heath tundra

EMPETRACEAE

Empetrum nigrum	crowberry	birch seep, heath tundra, esker crest

VIOLACEAE

Viola sp. (prob. *V. epipsila* ssp. *repens*)	violet	snowbank community

ONAGRACEAE

Epilobium angustifolium	tall fireweed	disturbed sites
E. latifolium	dwarf fireweed	esker crest, disturbed sites

HALORAGACEAE

Hippuris vulgaris	mare's tail	emergent assn.

PYROLACEAE

Pyrola grandiflora	large-flowered wintergreen	birch seep

ERICACEAE

Andromeda polifolia	bog rosemary	hummock, sedge assn.
Arctostaphylos alpina	black bearberry	heath tundra
Arctostaphylos rubra	red bearberry	heath tundra, hummocks
Cassiope tetragona	arctic white heather	heath tundra, snowbank
Kalmia polifolia	bog laurel	snowbank community
Ledum decumbens	Labrador tea	heath tundra, hummocks, birch seep
Loiseleuria procumbens	alpine azalea	heath tundra
Phyllodoce coerulea	mountain heather	snowbank community
Rhododendron lapponicum	Lapland rosebay	heath tundra
Vaccinium uliginosum	blueberry, bilberry	heath tundra, esker crest, birch seep
V. vitis-idaea var. *minus*	mountain cranberry	heath tundra, birch seep, hummocks

DIAPENSIACEAE

Diapensia lapponica		heath tundra

PLUMBAGINACEAE

Armeria maritima ssp. *Labradorica*	thrift	heath tundra

SCROPHULARIACEAE

Pedicularis capitata	crowned lousewort	heath tundra
P. flammea	flame-tipped lousewort	heath tundra
P. labradorica	Labrador lousewort	heath tundra
P. lapponica	Lapland lousewort	hummocks, heath tundra, birch seep
P. sudetica	Sudetan lousewort	sedge assn.

LENTIBULARIACEAE

Pinguicula villosa	small butterwort	heath tundra, in moss
P. vulgaris	butterwort	sedge assn.

COMPOSITAE

Antennaria angustata	pussy-toes	esker crest, disturbed sites
A. eckmaniana		esker crest, disturbed sites
Saussurea angustifolia	fireworks flower	heath tundra

REFERENCES:

Porsild, A.E. and Cody, W.J. 1980. *Vascular Plants of the Continental Northwest Territories, Canada*. National Museum of Natural Sciences, National Museums of Canada. 667 pp.

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Appendix C.

Potential Vascular Plant Species of the
Carat Lake Area, Kitikmeot Region, Nunavut

Appendix C.
JERICHO DIAMOND PROJECT
Potential Vascular Plant Species of the Carat Lake Area, Kitikmeot Region, Nunavut

The following species of vascular plants *potentially occur* in the area where the Jericho Diamond Project is located, at the northwest end of Contwoyto Lake in the inland barrenlands of the Kitikmeot Region of Nunavut. This list may be useful in future expansion of the project or in monitoring of the area.

Species are included in this list because of ranges reported in Porsild and Cody (1980) or inclusion in the literature on the region. This list <u>includes</u> species observed or collected in the area.

NOTES:

1. Taxonomy followed is from Porsild and Cody (1980). Exceptions to the above taxonomy are noted.

2. Common names noted are in part from Porsild and Cody, and in part those in use by the W.P. Fraser Herbarium at the University of Saskatchewan.

3. Species actually found on the site are marked with*.

POLYPODIACEAE

Cystopteris fragilis	fragile fern
**Dryopteris fragrans*	fragrant shield fern
Woodsia glabella	smooth woodsia

EQUISETACEAE

**Equisetum arvense*	common horsetail
E. sylvaticum var. *pauciramosum*	woodland horsetail
**E. variegatum*	variegated horsetail

LYCOPODIACEAE

**Lycopodium annotinum*	bristly clubmoss
**L.selago*	mountain clubmoss

SPARGANIACEAE

Sparganium hyperboreum	northern bur-reed

POTOMOGETONACEAE

Potamogeton filiformis	filiform pondweed

GRAMINAE

Agrostis borealis	
**Arctagrostis latifolia*	polar grass
Arctophila fulva	pendant grass
Bromus pumpellianus	brome grass
Calamagrostis canadensis	
**C. inexpansa*	
**C. lapponica*	
**C. neglecta*	
**C. purpurescens*	
**Deschampsia caespitosa*	tufted hairgrass
**Festuca brachyphylla*	alpine fescue
F. rubra	red fescue
**Hierochloe alpina*	alpine sweet grass
Poa alpigena	alpine bluegrass
P. alpina	alpine bluegrass
**P. arctica*	arctic bluegrass
P. glauca	greenland bluegrass
P. pratensis	
Puccinellia borealis	northern alkali-grass
**Trisetum spicatum*	spike trisetum

CYPERACEAE

**Carex aquatilis*	water sedge
**C. arctogena*	
**C. atratoformis* ssp. *raymondi*	
C. atrofusca	dark-brown sedge
**C. bigelowii*	stiff sedge
**C. capillaris*	hair-like sedge
C. chordorrhiza	
**C. glacialis*	glacier sedge
C. glareosa var. *amphigena*	clustered sedge
**C. holostoma*	
C. maritima	seaside sedge
**C. membranacea*	fragile-seeded sedge
C. misandra	nodding sedge
**C. nardina*	
C. physocarpa	bubble sedge
**C. podocarpa*	
**C. rariflora*	scant sedge
**C. rotundata*	
**C. rupestris*	rock sedge
**C. saxatilis*	rocky-ground sedge
**C. scirpoidea*	rush-like sedge
**C. supina*	
C. ursina	bear-like sedge

**C. vaginata*	sheathed sedge
**Eriophorum angustifolium*	tall cottongrass
**E. brachyantherum*	close-sheatherd cottongrass
**E. callitrix*	beautiful cottongrass
**E. scheuchzeri*	one-spike cottongrass
E. vaginatum	sheathed cottongrass
**Scirpus caespitosus*	tufted bulrush

JUNCACEAE

**Juncus albescens*	white rush
J. biglumis	two-glumed rush
J. castaneus	chestnut rush
**Luzula confusa*	northern wood-rush
L. groenlandica	
**L. nivalis*	arctic wood-rush
L. parviflora	
**L. wahlenbergii*	mountain wood-rush

LILIACEAE

**Tofieldia coccinea*	northern false asphodel
**T. pusilla*	small false asphodel

ORCHIDACEAE

Corallorhiza trifida	coral-root orchid
Habenaria obtusata	small northern bog orchid

SALICACEAE

Salix alaxensis	Alaska willow
**S. arbusculoides*	
**S. arctica*	arctic willow
**S. arctophila*	trailing willow
S. bebbiana	Bebb's willow
**S. glauca* var. *callicarpaea*	blue-green willow
S. glauca var. *glauca*	blue-green willow
S. glauca var. *acutifolia*	blue-green willow
**S. fuscescens*	Alaska bog willow
**S. herbacea*	least willow
S. lanata ssp. *Richardsonii*	Richardson's willow
S. niphoclada	
**S. planifolia*	flat-leaved willow
S. pulchra	
S. richardsonii (Syn. *S. lanata* ssp. *richardsonii*)	per: G.W. Argus
**S. reticulata*	net-veined willow
**S. tyrrellii* (Syn. *S. planifolia* ssp. *tyrrellii*) per: G. W. Argus	

BETULACEAE

Alnus crispa	green alder
**Betula glandulosa*	glandular dwarf birch

POLYGONACEAE

**Oxyria digyna*	ountain sorrel
**Polygonum viviparum*	alpine bistort

CARYOPHYLLACEAE

Arenaria humifusa	low sandwort
**Cerastium alpinum*	mouse-eared chickweed
C. beeringianum	Bering's mouse-eared chickweed
Melandrium affine	arctic campion
M. apetalum ssp. *arcticum*	apetalous campion, red bladder-campion
M. ostenfeldii	Ostenfeld's campion
**Minuartia rubella*	boreal sandwort
**Silene acaulis*	moss campion
**Stellaria edwardsii*	Edward's starwort
S. laeta	bright starwort
S. longipes	star chickweed
**S. monantha*	long-stalked starwort, blue-green chickweed

RANUNCULACEAE

Anemone parviflora	few-flowered anemone
**A. richardsonii*	Richardson's anemone
Ranunculus aquatilis var. *eradicatus*	white water-buttercup
R. flammula	
R. gmelinii	small yellow water crowfoot
**R. lapponicus*	Lapland buttercup
R. pedatifidus	birdfoot buttercup
R. pygmaeus	pygmy buttercup

PAPAVERACEAE

Papaver radicatum	arctic poppy

CRUCIFERAE

Arabis arenicola	arctic rock-cress
Cardamine digitata	northern bitter cress

C. pratensis	meadow bitter cress, cuckooflower
Descurainia sophioides	northern flixweed
Draba alpina	alpine whitlow-grass
D. cinerea	
**D. glabella*	smooth whitlow-grass
**D. lactea*	milky whitlow-grass
**D. nivalis*	snow whitlow-grass
Erysimum inconspicuum	yellow wallflower
Eutrema edwardsii	Edward's eutrema

SAXIFRAGACEAE

Chrysosplenium tetrandrum	golden saxifrage
Parnassia kotzebuei	small grass-of-Parnassus
P. palustris var. *neogaea*	northern grass-of-Parnassus
Saxifraga aizoides	yellow mountain saxifrage
**S. cernua*	nodding saxifrage
**S. foliolosa*	
S. hieracifolia	
S. hirculus	yellow marsh saxifrage
**S. nivalis*	snow saxifrage

Saxifragaceae, cont'd.

**S. oppositifolia*	purple mountain saxifrage
**S. punctata*	heart-leaved saxifrage
**S. rivularis*	brooklet saxifrage
**S. tricuspidata*	three-toothed saxifrage

ROSACEAE

**Dryas integrifolia*	mountain avens
Potentilla fruticosa	St. John's wort
**P. hyparctica* var. *elatior*	arctic cinquefoil
**P. nivea*	snow cinquefoil
P. norvegica	Norwegian cinquefoil
**P. palustris*	marsh cinquefoil, marsh five-finger
P. rubricaulis	red-stemmed cinquefoil
**Rubus chamaemorus*	cloudberry, aqpik
**Sibbaldia procumbens*	Sibbaldia

LEGUMINOSAE

**Astragalus alpinus*	alpine milkvetch
A. eucosmus	elegant milkvetch
**A. richardsonii*	Richardson's milkvetch
**Hedysarum alpinum* var. *americanum*	alpine hedysarum, liquoriceroot
H. mackenzii	northern hedysarum, wild sweet pea
Lupinus arcticus	arctic lupine

**Oxytropis arctica*	arctic crazyweed
**O. bellii*	Bell's crazyweed
O. hudsonica	Hudson Bay locoweed
**O. maydelliana*	Maydell's locoweed, yellow oxytrope

EMPETRACEAE

**Empetrum nigrum* ssp. *hermaphroditum*	crowberry

VIOLACEAE

**Viola epipsila* ssp. *repens*	blue violet
Viola palustris	violet

ELAEGNACEAE

Shepherdia canadensis	soapberry

ONAGRACEAE

**Epilobium angustifolium*	tall fireweed
**E. latifolium*	broad-leaved willowherb, dwarf fireweed
E. palustre	marsh willowherb

HALORAGACEAE

**Hippuris vulgaris*	mare's tail
Myriophyllum exalbescens	northern spiked water milfoil

PYROLACEAE

**Pyrola grandiflora*	large-flowered wintergreen
P. secunda	side-flowered wintergreen

ERICACEAE

**Andromeda polifolia*	bog rosemary
**Arctostaphylos alpina*	alpine bearberry, black bearberry
**A. rubra*	red bearberry
**Cassiope tetragona*	arctic white heather
Chamaedaphne calyculata	leather-leaf
**Kalmia polifolia*	bog-laurel
**Ledum decumbens*	narrow-leaved Labrador tea
L. groenlandicum	large-leafed Labrador tea
**Loiseleuria procumbens*	alpine azalea
Oxycoccus microcarpus	bog cranberry
**Phyllodoce coerula*	purple mountain heather
**Rhododendron lapponicum*	Lapland rosebay

**Vaccinium uliginosum*	bog bilberry, blueberry
**V. vitis-idaea*	mountain cranberry, lingonberry

DIAPENSIACEAE

**Diapensia lapponica*	northern diapensia

PRIMULACEAE

Androsace septentrionalis	northern pygmy-flower, fairy candelabra
Primula egaliksensis	Greenland primrose
P. stricta	erect primrose

PLUMBAGINACEAE

**Armeria maritima*	Labrador sea-thrift, thrift

SCROPHULARIACEAE

Castilleja elegans	pink paintbrush
Pedicularis capitata	large-flowered lousewort, crowned lousewort
P. flammea	flame-coloured lousewort
**P. labradorica*	Labrador lousewort
P. lanata	woolly lousewort
**P. lapponica*	Lapland lousewort
**P. sudetica*	purple rattle, Sudetan lousewort

LENTIBULARIACEAE

**Pinguicula villosa*	small butterwort
**P. vulgaris*	butterwort
Utricularia vulgaris	bladderwort

CAMPANULACEAE

Campanula uniflora	alpine bluebell

RUBIACEAE

Galium trifidum	bedstraw

COMPOSITAE

Achillea nigrescens	yarrow
**Antennaria angustata*	narrow-leafed pussytoes
A. compacta	small pussytoes
**A. eckmaniana*	
A. isolepis	
Arnica alpina ssp. *angustifolia*	narrow-leafed arnica

Artemisia borealis	northern wormwood
A. tilesii	wormwood
Aster sibiricus	Siberian aster
Crepis nana	dwarf hawksbeard
Erigeron acris	fleabane
E.eriocephalus	
E. humilis	arctic fleabane
Petasites sagittatus	coltsfoot
**Saussurea angustifolia*	fireworks flower
Senecio congestus	marsh ragwort, mastodon flower
Taraxacum lacerum	incised dandelion

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Appendix D.

Plant Species by Community

Appendix D.
JERICHO DIAMOND PROJECT
Plant Species by Community

This list outlines vascular plant species typical of each community, based on common occurrence in the plots. Species which can be dominant in each community are starred.

Sedge Community

Arctagrostis latifolia
Betula glandulosa
Calamagrostis neglecta
**Carex aquatilis*
**C. bigelowii*
C. holostoma
**C. membranacea*
**C. rotundata*
C. saxatilis
C. vaginata
**Eriophorum angustifolium*
E. brachyantherum
E. callitrix
**E. scheuchzeri*
Hierochloe alpina
Juncus albescens
**Luzula confusa*
L. wahlenbergii
Oxytropis arctica
O. bellii
O. maydelliana
Pedicularis sudetica
**Potentilla palustris*
**Salix arctica*
S. arctophila
S. fuscescens
**S. glauca ssp. callicarpaea*
S. herbacea
**S. planifolia*
S. reticulata
**S. tyrrellii*
Saxifraga cernua
S. foliolosa
Scirpus caespitosa

In addition, invading members of the heath family (Ericaceae) and others, including *Andromeda polifolia*, *Rubus chamaemorus*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Ledum decumbens*, and *Polygonum viviparum.*

Birch Communities

**Arctagrostis latifolia*
**Betula glandulosa*
**Calamagrostis inexpansa*
C. neglecta
Carex aquatilis
**C. bigelowii*
**Empetrum nigrum*
**Eriophorum scheuchzeri*
Festuca brachyphylla
Hierochloe alpina
Pedicularis lapponica
Poa arctica
Pyrola grandiflora
Ranunculus lapponicus
Salix arctophila
S. fuscescens
**S. glauca*
S. herbacea
**S. planifolia*
S. tyrellii
Saxifraga cernua
Stellaria monantha

Plus assorted heaths: *Arctostaphylos rubra*, *Cassiope tetragona*, *Vaccinium uliginosum, V. vitis-idaea, Ledum decumbens*.

Heath Tundra Community

Antennaria angustata
Arctagrostis latifolia
Arctostaphylos alpina
A. rubra
**Astragalus alpina*
**Betula glandulosa*
**Calamagrostis inexpansa*
Carex bigelowii
C. glacialis
**C. membranacea*
C. nardina
**C. rotundata*
C. rupestris
C. vaginata
**Cassiope tetragona*
Diapensia lapponicum
Dryas integrifolia
**Empetrum nigrum*
Eriophorum scheuchzeri
**Hierochloe alpina*
**Ledum decumbens*
**Loiseleuria procumbens*
**Luzula confusa*
Oxytropis arctica
O. maydelliana
**Poa arctica*
Polygonum viviparum
Rhododendron lapponicum
Rubus chamaemorus
Saussaurea angustifolia
**Salix arctica*
**S. glauca*
S. herbacea
S. reticulata
S. tyrrellii
Saxifraga oppositifolia
S. punctata
Tofieldia coccinea
T. pusilla
Trisetum spicatum
**Vaccinium uliginosum*
**V. vitis-idaea*

Snowbank Community

**Anemone richardsonii*
Antennaria eckmaniana
Betula glandulosa
**Cassiope tetragona*
Carex aquatilis
C. bigelowii
Eriophorum brachyantherum
**Hierochloe alpina*
**Kalmia polifolia*
**Ledum decumbens*
**Oxyria digyna*
Pedicularis lapponica
**Phyllodoce coerula*
Poa arctica
Rubus chamaemorus
**Salix herbacea*
Saxifraga nivalis
S. punctata
Sibbaldia procumbens
Silene acaulis
Trisetum spicatum
Vaccinium uliginosum
V. vitis-idaea
Viola epipsala ssp. *repens*

Avens Association

Arctostaphylos alpina
**Astragalus alpinus*

Carex bigelowii
C. capillaris
C. scirpoidea
Cerastium sp.
Deschampsia caespitosa
**Dryas integrifolia*
**Oxytropis arctica*
Poa arctica
**Rhododendron lapponicum*
Salix arbusculoides
**S. arctophila*
**S. glauca*
**S. herbacea*
S. reticulata
Saxifraga oppositifolia
Stellaria sp.
Tofieldia pusilla
Vaccinium uliginosum
V. vitis-idaea

Lichen-rock communities

Since lichens dominate these communities, they have been included here.

On rocks:

Alectoria sp.
Aspicilea cinerea
**Arctoparmelia centrifuga*
A. incurvata
Dryopteris fragrans
**Haematomma lapponicum*
Parmelia omphalodes
Pseudephebe minuscula
P. pubescens
**Rhizocarpon geminatum*
**R. geographicum*
Saxifraga nivalis
S. tricuspidata
Tremolecia atrata
**Umbilicaria* sp.
Xanthoria elegans

Between boulders:

Alectoria nigricans
A.ochroleuca
Calamagrostis neglecta
Carex glacialis
**Cetraria islandica*
C. nivalis
**Cladina rangiferina*
**C. stellaris*
Cladonia cervicornis
C. coccifera
C. cornuta
C. uncialis
**Empetrum nigrum*
Hierochloe alpina
Ledum decumbens
Thamnolia subuliformis
Vaccinium uliginosum
V. vitis-idaea

Ridge Complex

Crest:

Antennaria sp.
Arctagrostis latifolia

**Arctostaphylos alpina*
Astragalus alpinus
Calamagrostis purpurescens
Carex bigelowii
C. glacialis
C. supina
Draba glabella
D. lactea
**Dryas integrifolia*
**Empetrum nigrum*
Festuca brachyphylla
Ledum decumbens
Minuartia rubella
Oxytropis arctica
Potentilla nivea
Salix tyrellii
**Saxifraga tricuspidata*
**Silene acaulis*
**Trisetum spicatum*
**Vaccinium vitis-idaea*
**V. uliginosum*

Lee slope:

Antennaria sp.
**Arctagrostis latifolia*
**Betula glandulosa*
Carex aquatilis
C. bigelowii
**C. membranacea*
**Cassiope tetragona*
**Empetrum nigrum*
Eriophorum angustifolium
E. callitrix
**Hierochloe alpina*
**Ledum decumbens*
Poa arctica
Pyrola grandiflora
**Vaccinium uliginosum*
V. vitis-idaea

Windward slope:

See heath tundra.

Transitional Association: Hummock Association

**Andromeda polifolia*
**Arctogrostis latifolia*
Arctostaphylos rubra
Astragalus alpinus
**Betula glandulosa*
Carex arctogena
C. bigelowii
C. rotundata
C. vaginata
Cassiope tetragona
**Eriophorum scheuchzeri*
Hierochloe alpina
**Ledum decumbens*
Luzula nivalis
Pedicularis labradorica
P. lapponica
Polygonum viviparum
**Rubus chamaemorus*
Salix arctophila
S. fuscescens
**Vaccinium uliginosum*
**V. vitis-idaea*

A variety of mosses are also dominant in this community.

Disturbed Sites; Animal Den Sites

Antennaria spp.
**Arctophila latifolia*

**Calamagrostis inexpansa*
C. neglecta
Draba nivalis
Dryas integrifolia
Festuca brachyphylla
**Poa arctica*
Potentilla hyparctica
P. nivea

Salix glauca
**Stellaria monantha*
**Vaccinium uliginosum*
**V. vitis-idaea*

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Appendix E.

List of Possible Lichens

Appendix E.
JERICHO DIAMOND PROJECT
List of Possible Lichens

This is a tentative list of lichens derived from field identifications and from the literature. Species marked with * have been identified with reasonable certainty in the field. It is important to note that the principal investigator is not a lichen specialist, and that specimens were not sent to specialists for identification. Collections were made and preserved, and, if future budgets permit, verified identifications can likely be obtained.

**Alectoria nigricans*	black hair lichen
**A. ochroleuca*	green hair lichen
**Arctoparmelia centrifuga* (= *Parmelia centrifuga*)	sunburst lichen
A. incurva	
A. separata	
**Aspicilia cinerea* (= *Lecanora cinerea*)	
**Bryocaulon divergens* (= *Cornicularia divergens*)	antler lichen
**Bryoria nitidula*	
**Cetraria andrejevii*	
**C. cucullata*	
**C. delisei*	brown lettuce lichen
C. ericetorum	brown lettuce lichen
**C. islandica*	
**C. laevigata*	
**C. nivalis*	Iceland moss
Cladina mitis	yellow reindeer lichen
**C. rangiferina*	reindeer lichen
**C. stellaris*	reindeer lichen
Cladonia amaurocraea	
C. carneola	
**C. coccifera*	British soldiers lichen
C. chlorophaea	
**C. cornuta*	
C. fimbriata	
C. gracilis	
C. pleurota	
**C. pocillum*	
**C. uncialis*	
**Dactylina arctica*	glove lichen
**Haematomma lapponicum*	bloodspot lichen
Hypnogymnia physodes	
Masonhalea richardsonii	antler lichen
**Nephroma arcticum*	

**N, expallidum*	
**Parmelia omphalodes*	
**P. sulcata*	
**Peltigera aphthosa*	leather lichen
**P. malacea*	
**Pseudephebe pubescens*	"brush-cut" lichen
**P. minuscula*	
**Rhizocarpon geographicum*	map lichen
**R. geminatum*	
**Sphaerophorus globosus*	
**Stereocaulon tomentosum*	gray mealy lichen
**Tremolecia atrata* (= *Lecidia atrata*)	
**Thamnolia subuliformis*	worm lichen
**Umbilicaria hyperborea*	
**U. vellea*	rock tripe
**Xanthoria elegans*	jewel lichen

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Tahera Corporation
Jericho Diamond Project
Vegetation Baseline Studies, 1999

Appendix F.

Data Forms Used in Vegetation Baseline Studies, 1999

PLOT DATA SHEET
Vegetation Baseline Studies

Plot # ____ Crew:	Date: 99 M___ D___		P.__ of __	T C	
Location:					
Coord. (UTM):		Airphotos: Line:___ No.___			
Coord. Lat/Long:		Photos: Roll: ___ No.___			
Vegetation type:	Surf. feat.:				
Site pos.: 1.Crest 2. Up. Slope 3. Mid-slope 4. Lw. Slope 5. Slope base 6. Level 7. Strm. Valley 8. Lkshore					Other:
Moisture: (Dry) 1 2 3 4 5 6 7 (Wet)	Slope %: 0-5 6-15 16-30 31-45 46-70 >70				Facing:___
Bedrock Boulders/stones Gravel	Min. soil	Organic soil	Water	Plants	Other:
		Plants by layer (% of cover)			Notes:
Species	**Low shrub**	**Dwarf shrub**	**Herb**	**Lichen/moss**	
Ferns/club mosses					
Horsetails					
Grasses					
Sedges					
Rushes					
Tofieldia					
Orchids					
Willows					
Dwarf birch					
Bistort					
Cerastium					
Stellaria					
Moss campion					
Anemone					
Buttercups					
Mustards					
Saxifraga					
Prickly saxifrage					
Mt. avens					
Aqpik					
Potentilla					
Legumes					
Crowberry					
Fireweed					
Pyrola					

PLOT DATA SHEET
Vegetation Baseline Studies

Bog rosemary					
Bearberry					
Heather					
Labrador tea					
Alpine azalea					
Rhododendron					
Blueberry					
Mt. cranberry					
Thrift					
Paintbrush					
Louseworts					
Butterwort					
Composites					
Antennaria					
Arnica					
Artemisia					
Aster					
Mosses					
Lichens					
Lichens on rocks					
Wildlife **Notes:**	**Sight**	**Scats**	**Nests**	**Trails/runs**	**Burrows**
Sm. Mammals					
Lg. Mammals					
Birds					
Invertebrates					

RIDGE COMPLEX	Date (day/month) of phenology checks; record in column heads below:									
Dates ->										
Plot #: Coord:										
Crest										
blueberry										
bearberry										
prickly saxifrage										
moss campion										
pussy-toes (Antennaria)										
Other:										
Plot #: Coord:										
Windward slope (N or NW)										
dwarf birch										
blueberry										
Labrador tea										
mt. cranberry										
grass										
Other:										

CODES: LEAVES:

- S = snow
- SF = snow free but no activity
- L1 = new leaves on grasses/sedges/arc.cotton
- L2 = leaf buds swelling
- L3 = new leaves open/new green in evergreen plants
- L4 = fully leafed-out
- L5 = 1st leaf colour chg.
- L6 = Fall colour
- L7 = Leaf withering/chg. to fall bronze in evergreens
- L8 = first leaf fall (few coloured leaves on ground)
- L9 = main leaf fall/leaves withering
- L10 = Inactive state: all leaves shed/winter colour

Flowers:

- S = snow
- SF = snow free, no activity
- F1 = no sign of flowers
- F2 = buds appear in axils
- F3 = 1st open flower
- F4 = full flower, pollen on anthers
- F5 = pollen on stigmas
- F6 = 1st petals/corollas falling/fading
- F7 = fruits/seeds developing (swelling calyx)
- F8 = berries ripe
- F9 = seed capsules mature (appear to be dry)
- F10 = seeds being released (capsules splitting)

Directions: record dates in col heads.
Rec. codes opposite each species.
Leaf & flower codes in same box.

NOTES:

TAHERA CORP.
Vegetation Baseline Studies
PHENOLOGY DATA SHEET
RIDGE COMPLEX, crest & slope

HEATH TUNDRA/HUMMOCKS	Date (day/month) of phenology checks; record in column heads below:									
Dates ->										
Plot #: Coord:										
Hummock transition										
arctic cotton (tuss.)										
Labrador tea										
bog rosemary										
blueberry										
cloudberry (akpik)										
Other:										
Plot #: Coord:										
Heath tundra										
blueberry										
mt. cranberry										
Labrador tea										
arctic heather										
grass										
Other:										

CODES: LEAVES:

S = snow
SF = snow free but no activity
L1 = new leaves on grasses/sedges/arc.cotton
L2 = leaf buds swelling
L3 = new leaves open/new green in evergreen plants
L4 = fully leafed-out
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Flowers:

S = snow
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F1 = no sign of flowers
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F3 = 1st open flower
F4 = full flower, pollen on anthers
F5 = pollen on stigmas
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F7 = fruits/seeds developing (swelling calyx)
F8 = berries ripe
F9 = seed capsules mature (appear to be dry)
F10 = seeds being released (capsules splitting)

Directions: record dates in col heads.
Rec. codes opposite each species.
Leaf & flower codes in same box.

NOTES:

TAHERA CORP.
Vegetation Baseline Studies
PHENOLOGY DATA SHEET
Heath tundra and Hummocks

SNOWBANKCOM./RIPARIAN	Date (day/month) of phenology checks; record in column heads below:										
Dates ->											
Plot #: Coord:											
Snowbank Community											
dwarf birch											
least willow											
Labrador tea											
alpine arnica											
bog laurel											
arctic heather											
Plot #: Coord:											
Riparian (birch seep)											
dwarf birch											
willow											
Labrador tea											
cloudberry											
grass											
Other:											

CODES: LEAVES:

- S = snow
- SF = snow free but no activity
- L1 = new leaves on grasses/sedges/arc.cotton
- L2 = leaf buds swelling
- L3 = new leaves open/new green in evergreen plants
- L4 = fully leafed-out
- L5 = 1st leaf colour chg.
- L6 = Fall colour
- L7 = Leaf withering/chg. to fall bronze in evergreens
- L8 = first leaf fall (few coloured leaves on ground)
- L9 = main leaf fall/leaves withering
- L10 = Inactive state: all leaves shed/winter colour

Flowers:

- S = snow
- SF = snow free, no activity
- F1 = no sign of flowers
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- F6 = 1st petals/corollas falling/fading
- F7 = fruits/seeds developing (swelling calyx)
- F8 = berries ripe
- F9 = seed capsules mature (appear to be dry)
- F10 = seeds being released (capsules splitting)

Directions: record dates in col heads.
Rec. codes opposite each species.
Leaf & flower codes in same box.

NOTES:

TAHERA CORP.
Vegetation Baseline Studies
PHENOLOGY DATA SHEET
Snowbank Com/Riparian

SEDGE COMMUNITIES	Date (day/month) of phenology checks; record in column heads below:									
Dates ->										
Plot #:	Coord:									
Non-tussock assn:										
arc.cotton (non-tuss)										
Carex aquatilis										
Small carex										
grass (Calamagrostis)										
marsh five-finger										
Other:										
Plot #:	Coord:									
Tussock assn:										
arc. cotton (tussock)										
tussock sedge										
willow										
lousewort										
bitter cress										
Other:										

CODES: LEAVES:

- S = snow
- SF = snow free but no activity
- L1 = new leaves on grasses/sedges/arc.cotton
- L2 = leaf buds swelling
- L3 = new leaves open/new green in evergreen plants
- L4 = fully leafed-out
- L5 = 1st leaf colour chg.
- L6 = Fall colour
- L7 = Leaf withering/chg. to fall bronze in evergreens
- L8 = first leaf fall (few coloured leaves on ground)
- L9 = main leaf fall/leaves withering
- L10 = Inactive state: all leaves shed/winter colour

Flowers:

- S = snow
- SF = snow free, no activity
- F1 = no sign of flowers
- F2 = buds appear in axils
- F3 = 1st open flower
- F4 = full flower, pollen on anthers
- F5 = pollen on stigmas
- F6 = 1st petals/corollas falling/fading
- F7 = fruits/seeds developing (swelling calyx)
- F8 = berries ripe
- F9 = seed capsules mature (appear to be dry)
- F10 = seeds being released (capsules splitting)

Directions: record dates in col heads.
Rec. codes opposite each species.
Leaf & flower codes in same box.

NOTES:

TAHERA CORP.
Vegetation Baseline Studies
PHENOLOGY DATA SHEET
Sedge associations

Tahera Corporation
Jericho Diamond Project

Vegetation Baseline Studies, 1999

Appendix G.

Communications re *Salix tyrrellii*

Appendix G.
Communication re *Salix tyrrellii*

Date: Mon, 04 Jan 1999 14:10:14 -0500
From: George Argus <argus@sympatico.ca> Organization: R.R. 3 - 310 Haskins Rd, Merrickville, Ont., Canada, K0G 1N0 To: Page Burt <outcrop@arctic.ca>
Subject: *Salix tyrrellii*

Dear Page,

Thank you for the interesting letter. I called Erich Haber (chairman of the the COSEWIC Plants Subcommittee) and we discussed how best to handle the *S. tyrrellii* updated status report.

I had just finished writing an updated report for him but it has not yet been sent to the provincial reps. We have agreed that I would write an addendum to the report suggesting that the species be delisted.

Briefly, the story is this. *S. tyrrellii* was described from the Athabasca Sand Dunes. It grows on the active dunes and has the ability to produce long annual shoots that are able to stay above the agrading sand. It is common in the dune region. It was selected about ten years ago as a COSEWIC species as a representative of an endemic growing on the active dunes. At that time I had done growth and phenolic glycoside studies on the bark that showed that it had adapted to growing on agrading sand. One of its diagnostic characters is the presence of stomata in both leaf surfaces. I had known of occasional plants from Keewatin that had amphistomatous leaves but these were rare and dismissed, at the time, as anomalous variants of *S. planifolia*. Your large collection *of S. tyrrellii* was the first good series of the species from Keewatin that I had seen. I am sure that they are good *S. tyrrellii*. As well as their amphistomatous leaves they have narrowly elliptic leaves with serrulate margins, and slender stems. The stems are not as long as in the dune *S. tyrrellii* nor is the habitat the same but I suspect that the growth form of the Athabasca plants may be an ecotypic response to the dune habitat. It is interesting that another dune endemic, *Salix silicicola*, also has a Keewatin connection. It is characterized by densely hairy leaves and stems and is related to *S. alaxensis*. Such densely hairy plants do not usually occur outside of the Athabasca dunes but I have a single specimen from Pelly Lake, Keewatin, (collected by Larsen in 1966) that has tentatively been named *S. silicicola* or an unusually hairy *S. alaxensis*. Now it looks as though there may have been a connection between plants in Keewatin and those in the Athabasca region.

In reply to your questions, *S. tyrrellii* is common on the Lake Athabasca dunes where it grows on the active dunes. In the adjacent riparian habitatats occurs the very closely related *S. planifolia*. (I had once proposed the name *S. planifolia* ssp. *tyrrellii). Salix tyrrellii* presently has a COSEWIC status of threatened but there will be a recommendation that it be delisted.

It would be very interesting to have photographs of some of its habitats. Also, could you send me label data, including latitude and longitude, for one or two specimens so that I can map and cite them in my addendum to the status report? Is the name of the place in which the collections were made Kivalliq?

Best wishes,
--
George Argus
R.R.3-310 Haskins Rd.

Merrickville, Ontario Canada K0G 1N0 PH: (613) 269-4605

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Jericho Diamond Project
Vegetation Baseline Studies, 1999

Appendix H.

Representative Photos of Plant Communities and Associations

PHOTO 1.
Aerial, general landscape in the vicinity of Carat Camp, looking north toward esker system.

PHOTO 2 Near Plot 205
Hillside above portal, Jericho Diamond Project. Possible plant site.

PHOTO 3. Plot 243
Sedge Community, emergent association, sedges in standing water.

PHOTO 4. Plot 237
Sedge Community, non-tussock association.

PHOTO 5. Plot 220
Sedge Community, non-tussock association with transition to tussock association in background.

PHOTO 6. Plot 249
(Phenology Plot #7) Sedge Community, tussock association.

PHOTO 7. Plot 238
Sedge Community,
tussock association.
(above)

PHOTO 8. Plot 238
Tussock association, single
tussock of cottongrass. (left)

PHOTO 9. Plot 214
Birch Community, birch/willow riparian association.

PHOTO 10. Near Plot 244
Birch Community, birch/willow riparian association at natural rock "dam"
in stream valley above Lake C-1.

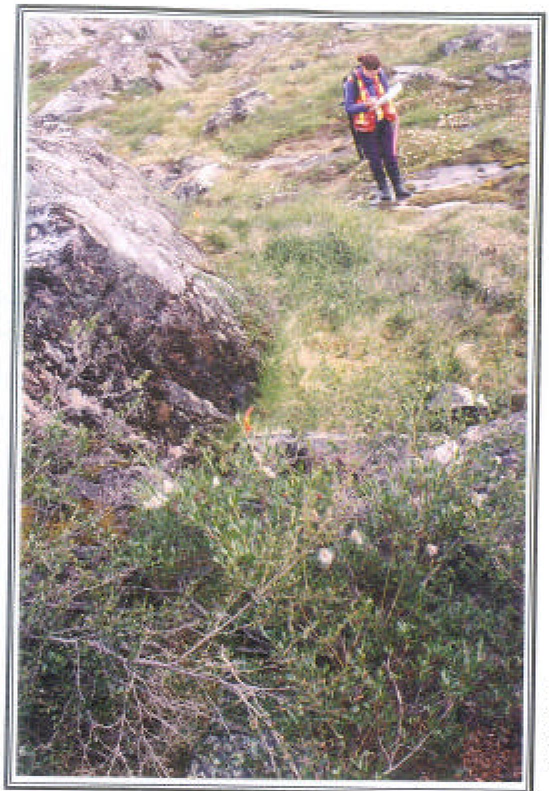

PHOTO 11. Plot 206
Willows at edge of heath tundra/sedge association at base of small cliff. (left)

PHOTO 12. Plot 206
Close-up of willow at base of small cliff. Red globes are moth galls. (below)

PHOTO 13. Plot 219
Birch Community, birch seep.

PHOTO 14. Plot 242
Heath Tundra Community on top of ridge with perched glacial erratic boulder.

PHOTO 15. Plot 225
Heath Tundra Community at base of small cliff near Long Lake. (above)

PHOTO 16. Plot 225
Close-up of alpine azalea in heath tundra. (left)

PHOTO 17. Plot 262
Heath Tundra Community with frost scars.
rock "dam" in stream valley above Lake C-1.

PHOTO 18. Plot 262
Close-up of frost scar.

PHOTO 19. Near Plot 228
Snowbank on north-facing slope, south side of Long Lake, photographed in late July.

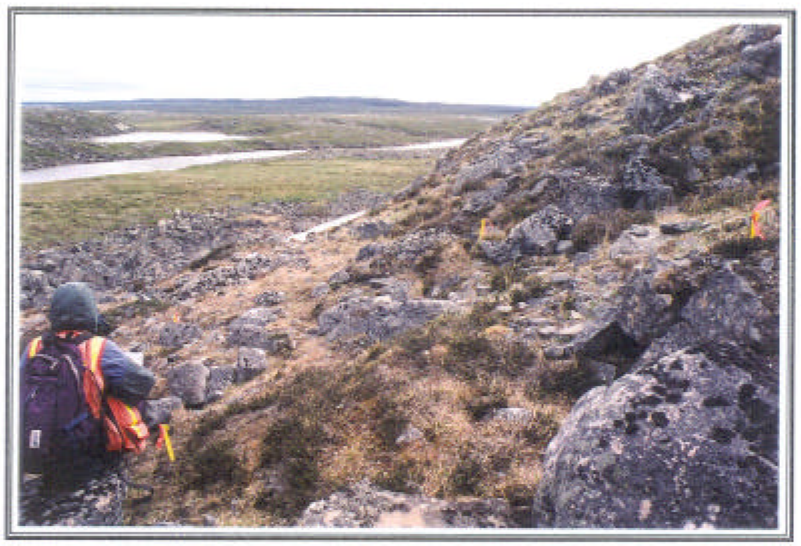

PHOTO 20. Plot 228
Snowbank Community adjacent to snowbank in Photo 19. North-facing slope above Long Lake.

PHOTO 21. Plot 229
Snowbank Community on south-facing slope, north side of Long Lake, base of cliff.

PHOTO 22. Plot 229
Close-up of mountain heather, typical snowbank community indicator species.

PHOTO 23. Plot 229
Close-up of Richardson's anemone, in snowbank community.

PHOTO 24. Near plot 229
Unusual fecal pellets of arctic hare, with apparent mud coating.
Each contains a small pebble.

PHOTO 25. Plot 239
Avens association on gravel saddle between ridges, northeast of the esst end of Long Lake.

PHOTO 26. Plot 233
Type of lichen-rock transition association, heath tundra with lichen-covered boulders.

PHOTO 27. Plot 223
Lichen-rock Community, lichens on boulders in boulder field.

PHOTO 28. Plot 223
Close-up of boulders with crustose lichens and foliose lichens webbing boulders together.

PHOTO 29. Plot 204
Lichen-rock Community, lichens on bedrock outcrop.

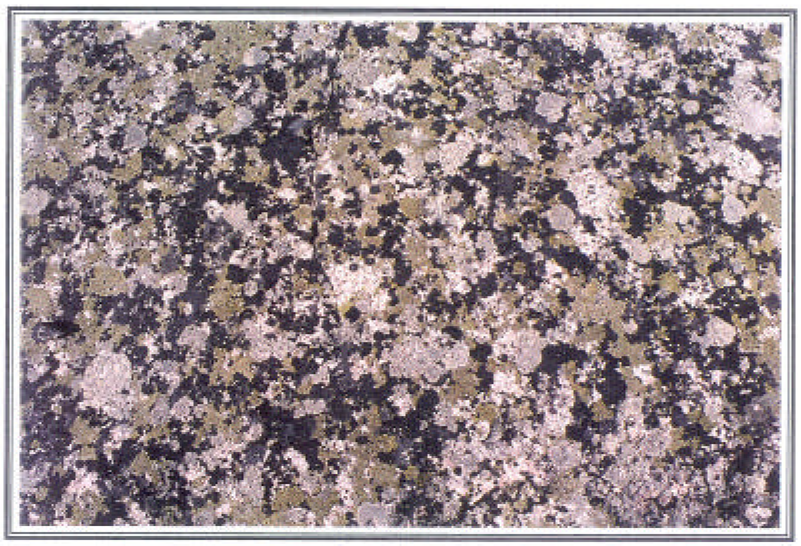

PHOTO 30. Plot 204
Close-up of lichens on glacially polished bedrock outcrop.

PHOTO 31. Plot 252
(Phenology Plot #4) Ridge Complex; esker crest association with mats of blueberry, avens, and crowberry.

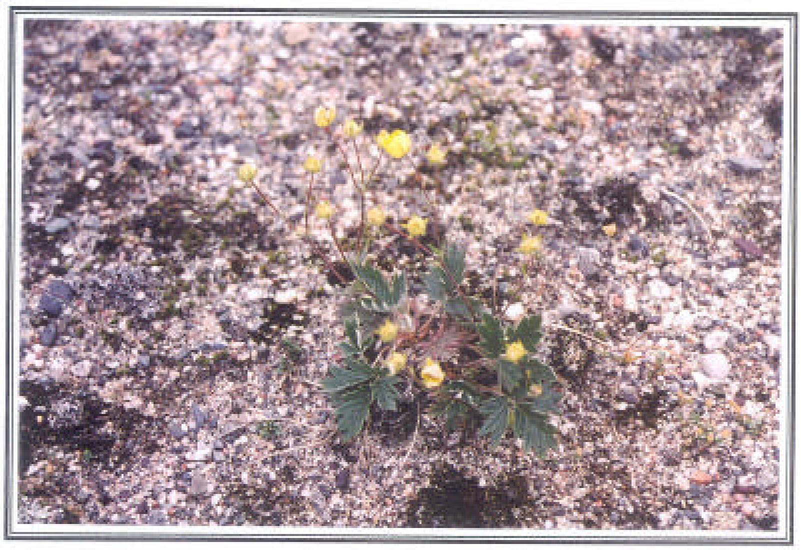

PHOTO 32. Plot 252
(Phenology Plot #4) Close-up of *Potentilla nivea* in esker crest association.

PHOTO 33. Plot 251
(Phenology Plot #5) Ridge Complex; esker slope association with dwarf birches, leeward slope.

PHOTO 34. Plot 216
Transitional association; turf hummocks invaded by heaths.

PHOTO 35. Plot 210
Disturbed Site; mine waste rock laydown area about 5 years old.

PHOTO 36. Plot 210
Close-up of *Antennaria sp.*, typical pioneer species on gravel.

Tahera Corporation
Jericho Diamond Project

Vegetation Baseline Studies, 1999

Appendix I.

Literature Cited

Appendix I.
JERICHO DIAMOND PROJECT
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