Closure

We trust the information contained in this report is sufficient for your present needs. Should you have any questions regarding the project, please do not hesitate to contact the undersigned at (780) 483-3499.

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APPENDIX A

Vegetation

The vascular plant list summarized below includes all species encountered during the field programs competed for the project and any other potential species that are represented by previous collections or adjacent reported ranges. Plant species that were encountered in the local or regional study area are designated by an 'X' under the Family column. Any species that was identified as having a "Sensitive" status under "Draft Status of Vascular Plants in Nunavut" is identified as such under the Notes column.

Table A1-1: Vascular Plant Species List

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
Ferns	**Polypodiaceae**			
X	*Cystopteris fragilis*	Fragile fern	Damp rocky slopes	
X	*Dryopteris fragrans*	Fragrant cliff woodfern	Non-calcareous rocks, cliffs and screes	
	Woodsia alpina	Northern woodsia	Uncommon, rock crevices, calcareous rocks	
X	*W. glabella*	Smooth woodsia	Uncommon, moist calcareous slopes, crevices	
Horsetails	**Equisetaceae**			
X	*Equisetum arvense*	Field horsetail	Damp areas, stream or banks	
X	*E. variegatum*	Giant horsetail	Wet alluvial sand and clay, sometimes in moss	
Club-moss	**Lycopodiaceae**			
X	*Huperzia selago* (Syn: *Lycopodium selago*)	Fir clubmoss	Heath tundra, turfy, mossy tundra, wet meadows, depressions of low-centre polygons	
X	*Lycopodium annotinum*	Stiff clubmoss	Moist areas, gravel, sand, till, noncalcareous, often under birches and willows, riparian associations	
Pondweed	**Potomogetonaceae**			
	Potamogeton filiformis (syn: *Stuckenia filiformis*)	Slender pondweed	Submergent/emergent in ponds	
Grasses	**Poaceae (Formerly: Graminae)**			
X	*Alopecurus alpinus(*Syn*: A.magellanicus)*	Mountain foxtail	Wet tundra, lakeshores, brooks mostly seacoast, nitrophilous	
X	*Hierochloe alpina (*Syn:*Anthoxanthum monticola)*	Alpine sweet grass	Dry tundra, rocky places, acidic rocks	
X	*Hierochloe pauciflora (*Syn*: Anthoxanthum arcticum)*	Arctic sweet grass	In sphagnum, wet tundra, not littoral but coastal lowland	
X	*Arctagrostis latifolia*	Broadleaf arctagrostis	Damp turfy tundra	
X	*Arctophila fulva*	Pendantgrass	Wet meadows, edges of ponds, marshes, streams, rivers	
	Calamagrostis deschampsioides	Circumpolar small-reedgrass	Littoral, damp tundra, low seacoasts	
X	*C. stricta* ssp. *stricta*	Northern reedgrass	Well-drained calcareous sand or stony areas	
	Deschampsia caespitosa (Syn.: D. pumila)	Tufted hairgrass	Wet meadows, stony/gravelly shores including river banks	

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*Dupontia fisheri*	Fisher's Duponita	Wet meadows, littoral, brackish	
	Elymus alaskansus ssp. *latiglumis (*Syn*: Agropyron violaceum)*	Alaska wild rye	Well-drained calcareous sand or clay	
	Festuca brachyphylla	Shortleaf fescue	Sandy, gravelly, rocky	
X	*Leymus mollis (*Syn.*: Elymus arenarius* ssp. *mollis)*	American dunegrass; beach rye grass	Beaches, dunes, sea shores, marine backshores	
	Pleuropogon sabinei	Sabine-grass	Shallows, small sheltered ponds	
X	*Poa alpina*	Alpine bluegrass	Calciphile, dry tundra, owl perches	
X	*Poa arctica*	Arctic bluegrass	Not too moist tundra, lake shores and brooks	
	*Poa autumnalis (*Syn.*: P. flexuosa)*	Autumn bluegrass	Gravelly, not too dry sites, often pioneering disturbed sites	possible range extension
	Poa glauca	White bluegrass	Open, sandy, gravelly spots	
X	*Poa pratensis (*Syn.*: P. alpigena)*	Kentucky bluegrass	Strongly nitrophilous, so often at bird perches, old campsites, damp sand along shores, creek floodplains, gravel beach ridges	
	Puccinellia deschampsioides	Polar alkali grass	Littoral, likely along coast of RSA	"Sensitive"
	P. phryganodes	Creeping alkali grass	Littoral, likely along coast of RSA	
	P. tenella ssp. *langeana*	Tundra Alkali grass	Littoral, likely along coast of RSA	
X	*Trisetum spicatum*	Narrow false oats	Rocky, gravelly spots	
Sedges	**Cyperaceae**			
X	*Carex aquatilis*	Water sedge	Wet tundra, shallow ponds, emergent	
	Carex aquatilis var. *aquatilis*	Water sedge	Shallow water, margins of ponds/lakes	
	C. aquatilis var. *stans*	Water sedge	Wet tundra, shallow ponds, emergent	
X	*C. atrofusca*	Scroched alpine sedge	Drooping female flowers, wet places, snowbanks	
X	*C. bigelowii*	Bigelow's sedge	Small in dry spots, larger in wet	
X	*C. capillaris*	Hair-like sedge	Moist pond margins	
X	*C. chordorrhiza*	Creeping sedge	Pond margins, sometimes on sand beaches	
	C. glareosa	Weak-clust sedge	Seashore plant, flat tussocks, at seabird nesting sites	
	C. maritima	Seaside sedge	Mostly littoral, sandy, gravelly, sometimes inland	
X	*C. membranacea*	Fragile-seed sedge	Xeric, turfy places, dry tundra	
X	*C. misandra*	Shortleafsedge	Xeric, dry turfy places, rocky spots	
X	*C. nardina*	Nard sedge	Xeric, calcareous sands, gravels, dry slopes	
X	*C. rariflora*	Loose-flowered sedge	Wet peaty spots, wet moss by brooks and ponds	
X	*C. rotundata*	Roundfruit sedge	Moist, turfy tundra, mostly western	
X	*C. rupestris*	Rock sedge	Xeric, dry turfy places, rocky ledges, often with Dryas	

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*C. saxatilis*	Russet sedge	Shallow water, acid tundra ponds, lakeshores	
X	*C. scirpoidea*	Bulrush sedge	Xeric, dry turfy places, calcareous soil	
	C. subspathacea	Hoppner's sedge	Seacoast, wet clay on beaches	
	C. ursina	Bear sedge	Littoral, seashores, inundated at high tide	
X	*C. vaginata*	Sheathed sedge	Moist, calcareous, rocky, turfy places	
X	*Eriophorum angustifolium*	Narrowleaf cotton-grass	Shallows of ponds, lakes, streams	
	E. brachyantherum	Short anther cotton-grass	Lowland muskeg and tundra, tussock-former	
	E. callitrix	Sheathed cotton-grass	Calcareous, turfy, tussockgrass	
X	*E. scheuchzerii*	Scheuchzer's cotton-grass	Wet meadows, shallows, non-tussock	
X	*E. vaginatum*	Tussock cotton-grass	Peaty soils, tussock former	
X	*Kobresia myosuroides*	Pacific kobresia	Calciphile, dry ridges	
X	*Kobresia simpliciuscula*	Simple kobresia	Damp calcareous gravels	
X	*Trichophorum caespitosum* (Syn.: *Scirous caespitosus)*	Tufted clubrush	Wetlands	
Rushes	***Juncaceae***			
X	*Juncus albescens* (Syn.: *J. triglumis* ssp. *albescens)*	Northern white rush	Calcareous clay or sand, pond edges	
X	*J. arcticus*	Arctic rush	Wet sand/clay shores, lakes/rivers, sometimes strand flats	
X	*J. biglumis*	Two-flowered rush	Wet sand or clay	
X	*J. castaneus*	Chestnut rush	Wet sand or clay lakeshores	
X	*J. stygius* ssp. *americanus*	Moor rush	Wet margins of seepages, bog pools, western	possible range extension
X	*Luzula arctica* (Syn.: *L. nivalis)*	Arctic woodrush	Heath and not too dry tundra, snowbanks	
X	*L. confusa*	Northern woodrush	Xeric, dry turfy places, rocky slopes and ledges	
	L. wahlenbergii	Wahlenberg's woodrush	Sphagnum bogs in tundra, mossy shorelines	
Lilies	**Nartheciaceae (Formerly: Liliaceae)**			
X	*Tofieldia coccinea*	Purple featherling	Calcareous soils, often dry sites	
X	*T. pusilla*	Scotch false asphodel	Moist calcareous turfy places	
	Orchidaceae			
X	*Corallorhiza trifida*	Early coralroot orchid	Turfy open places, calcareous soils, often associated with Dryas integrifolia	
X	*Platanthera obtusata* (Syn.: *Habenaria obtusata)*	Small northern bog orchid	Lowland heath tundra, along low shores	
Willows	**Salicaceae**			

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*Salix arctica*	Arctic willow	Extremely variable in form and habitat, highly used by Inuit	
X	*S. arctophila*	Arctic willow	Wet mossy tundra, eastern	
X	*S. lanata ssp. calcicola* (Syn.*:*)	Lanate willow	Shrub, calcareous rocky, gravelly places	"Sensitive"
	S. brachycarpa ssp. *niphoclada*	Short-fruit willow	Moist, stony lakeshores, barrens	Endemic to Hudson Bay
X	*S. fuscescens*	Alaska bog willow	Damp, mossy tundra	
X	*S. glauca* var. *callicarpaea*	Gray willow	Often prostrate, sand/cobbles in granite boulders, sandy alluvium, exposed eskers, sometimes w/Empetrum	
X	*S. herbacea*	New England dwarf willow	Snowbank indicator species, tiny, snowflush assns.	
X	*S. lanata* ssp. *Richardsonii* (Syn.*:*)	Lanate willow	Well-watered sandy, gravelly places	
X	*S. planifolia*	tealeafed willow	Snowpatches, and sheltered slopes	
X	*S. planifolia* ssp. *tyrrellii*	Tealeaf willow	*Very* similar to *S. planifolia*; delisted from COSEWIC list as result of this project.	Range extension, but much larger range than originally thought.
X	*S. reticulata*	Net-veined willow	Calcareous soils, sandy, turfy not-to-dry spots	
Birch	**Betulaceae**			
X	*Betula nana* (Syn.*: B. glandulosa)*	Swamp birch	Very common throughout project. Some affiliation with acidic rocks, but ubiquitous in this area.	
Smartweed	**Polygonaceae**			
X	*Oxyria digyna*	Mountain-sorrel	Snowbanks, cool moist ravines, below bird cliffs, etc.	
X	*Polygonum viviparum*	Viviparous pondweed	Turfy, rocky, moist grassy areas, animal dens	
Purslanes	**Portulaceae**			
	Montia fontana (Syn.*: M. lamprosperma)*	Fountain miner's - ettuce	Wet places, mossy lakeshores, sedge assns, pond edges	"Sensitive"
Pinks	**Caryophyllaceae**			
	Arenaria humifusa	Creeping sandwort	Moist calcareous gravels, crevices	
X	*Cerastium alpinum*	Alpine chickweed	Rocky, sandy, gravelly, bird cliffs and animal dens	
X	*Honckenya peploides*	Seabeach sandwort	Sandy or gravelly beaches, seaside mud flats	
X	*Minuartia rubella*	Boreal sandwort	Dry, sandy, gravelly places, exposed	
	Sagina caespitosa	Tufted pearlwort	Seepage slopes	
X	*Silene acaulis*	Moss campion	Well-drained gravelly or turfy places	
X	*Silene involucrata* (Syn.*: Melandrium affine)*	Arctic catchfly	Not too dry, stony, gravelly, animal dens	
X	*Silene uralensis* (Syn.*: Melandrium apetalum)*	Apetalous catchfly; red bladder campion	Wet tundra, lakeshores	

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*Stellaria humifusa*	Creeping sandwort	Salt flats, seashores, mud flats	
X	*S. longipes (*includes*: S. monantha* and *S. edwardsii)*	Long-stalked stitchwort (inc. blue-green chickweed)	Wide variety of habitats, wet meadows to dry slopes; animal dens, disturbed sites, grassy/gravelly moist tundra	
Buttercups	**Ranunculaceae**			
X	*Anemone richardsonii*	Yellow anemone	Moist tundra, often under willows, near snowbanks	
	Ranunculus cymbalaria	Seaside crowfoot	Seashores, mud flats	"Sensitive"
X	*R. flammula var. filiformis*	Lesser spearwort	Pond edges	
X	*R. gmelinii*	Small yellow water crowfoot	Ponds, shallow water	
	R. hyperboreus	Arctic buttercup	Shallow fresh or brackish water, among sedges/grasses	
	R. longirostris (Syn.*: R. aquatilis)*	Eastern white water-crowfoot	Shallow water ponds	"Sensitive"
	R. pallasii	Pallas' buttercup	Wet, brackish meadows, sloughs, coastal	"Sensitive"
X	*R. pedatifidus*	Northern buttercup	Calcareous gravelly, sandy or grassy spots	
	R. pygmaeus	Dwarf buttercup	Snowbank communities	
Poppies	**Papaveraceae**			
X	*Papaver radicatum*	Greenish yellow	Wet calcareous gravelly spots	
Mustards	**Brassicaceae (Formerly: Cruciferae)**			
X	*Arabis arenicola*	Arctic Rockcress	Calcareous sand/gravel, lake shores or river banks	
X	*Cardamine bellidifolia*	Apline Bittercress	Wet mossy places, shady crevices	
X	*C. digitata*	Richardson's bittercress	Moist, turfy places, hummocks, strongly nitrophilous	
X	*C. pratensis*	Cuckoo-flower	Sedge meadows	
X	*Cochlearia groenlandica (*Syn.*: C. officinalis)*	Greenland cochlearia	Rocky islands, coasts, bird nesting areas	
X	*Descurainia sophioides*	Northern tansy-mustard	Disturbed sites, dens, roadsides	"Sensitive"
	Draba alpina	Alpine whitlow-grass	Snowbeds, moist tundra, clay in wet gravelly barrens	
X	*D. glabella*	Rock whitlow-grass	Rocky grassy situations, strongly nitrophilous, nest/den sites	
X	*D. lactea*	Milky whitlow-grass	Not too dry turfy places, snowbanks	
X	*D. nivalis*	Yellow Arctic whitlow	Dry, rocky gravelly places, should be present	
X	*Eutrema edwardsii*	Edward's euterma	Calcareous soils, nitrophilous, not too dry turfy tundra	
Saxifrages	**Saxifragaceae**			
X	*Parnassia kotzebuei*	Kotzebue grass-of-Parnassus	Edges of wetlands, low coasts, lee slopes of eskers	
	P. palustris	Marsh grass-of-Parnassus	Low areas along coast	

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*Saxifraga aizoides*	Yellow mountain saxifrage	Edges of lakes or ponds	
X	*S. cernua*	Nodding saxifrage	Moist ledges, moss or wet sand by brooks or lakeshores	
X	*S. cespitosa*	Tufted saxifrage	Rocky, gravelly situations	
X	*S. foliolosa*	Leafy saxifrage	Mossy, springy places, lakeshores, brooks, wet tundra	
X	*S. hirculus*	Yellow marsh saxifrage	Sedge meadows	
X	*S. oppositifolia*	Purple mountain saxifrage	Moist calcareous gravels, wet cliffs.	
X	*S. rivularis*	Alpine Brook saxifrage	Wet gravelly mossy places, nitrophilous, bird nesting areas	
X	*S. tricuspidata*	Prickly saxifrage	Dry rocky gravelly spots.	
Roses	**Rosaceae**			
X	*Argentina egedii (*Syn.*: Potentilla egedii)*	Egede's cinquefoil	Seashores, littoral	"Sensitive"
X	*Comarum palustre*	Marsh cinquefoil	Pond and stream edges, shallow water	
X	*Dryas integrifolia*	Entireleaf mountain-avens	Rocky, gravelly spots, exposed ridges	
	Potentilla nana (Syn: *Potentilla hyparctica*)	Arctic cinquefoil	Rocky places, ravines, talus slopes	
X	*P. nivea*	Snow cinquefoil	Rocky sunny spots, animal burrows, cliffs	
X	*P. pulchella*	Pretty cinquefoil	Sandy, gravelly, dry tundra, sometimes strandflats	
X	*Rubus chamaemorus*	Cloudberry, aaqpiq	Edges of wetlands, hummocks	
X	*Sibbaldia procumbens*	Arizona cinquefoil	Sheltered slopes, near snowbanks	
Peas	**Fabaceae (Formerly: Leguminosae)**			
X	*Astragalus alpinus*	Alpine milkvetch	Well-watered calcareous sand or gravel	
X	*A. eucosmus*	Pretty milkvetch	Calcareous gravels, often among willows on sand/gravel bars, sheltered lakeshores	"Sensitive"
X	*Hedysarum alpinum*	Apline sweet-vetch	Calcareus sands/gravels, sheltered lake or river shores	
X	*H. boreale* ssp. *mackenzeii (*Syn.*: H. mackenzeii)*	Boreal sweet-vetch	Calcareous clays and gravels, sheltered lakeshores	
X	*Oxytropis arctica var. bellii (*Syn.*: O. bellii)*	Arctic crazy-weed	Dry, gravelly slopes and in rocky tundra	
X	*Oxytropis borealis (*Syn.*: O. hudsonica)*	Boreal locoweed	Not too dry, calcareous sand and gravels	
X	*Oxytropis maydelliana*	Maydell's point-vetch	Dry, turfy tundra, many places	
Crowberry	**Empetraceae**			
X	*Empetrum nigrum*	black crowberry	Dry uplands, ridge crests, eskers	
Evening Primrose	**Onagraceae**			

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*Chamerion angustifolium* (Syn.: *Epilobium angustifolium*)	Fireweed	Disturbed sites, roadsides	
X	*Chamerion latifolium* (Syn.: *Epilobium latifolium*)	River beauty	Dry gravels, sandbars in rivers, dry slopes	
X	*Epilobium palustre*	Marsh willowherb	Uncommon and easily missed, wet clay on tundra barrens	
Water milfoil	**Haloragaceae**			
X	*Hippuris vulgaris*	Mare's tail	Emergent, shallow ponds, lake bays	
Wintergreen	**Pyrolaceae**			
X	*Orthilia secunda* (Syn.: *Pyrola secunda*)	one-sided wintergreen	Moist thickets and under willows/birches	
X	*Pyrola grandiflora*	Arctic wintergreen	Shady areas under willows	
Heaths	**Ericaceae**			
X	*Andromeda polifolia*	Bog rosemary	Hummocky areas, edges of wetlands	
X	*Arctostaphylos alpina*	Alpine manzanita; alpine bearberry	Acid, rocky to gravelly, dry areas	
X	*Arctostaphylos rubra*	Red Manzanita, Red bearberry,	Moist slopes, edges of wetlands, hummock areas	
X	*Cassiope tetragona*	Arctic bell-heather	Tundra, snowbank edges	
X	*Ledum palustre* (Syn.: *L. decumbens* and *L. palustre decumbens*)	Marsh Labrador tea	Shrub moss-lichen heath, ledges	
X	*Loiseleuria procumbens*	Alpine-azalea	Open tundra, well-drained uplands	
X	*Phyllodoce caerulea*	Blue mountain heath	Snowbank areas, sheltered lee slopes	
X	*Rhododendron lapponicum*	Lapland azalea	Dry rocky tundra,stony slopes	
X	*Vaccinium uliginosum*	Alpine blueberry	Acid soil, great variety of habitats	
X	*Vaccinium vitis-idaea*	Mountain cranberry	Well-drained areas, hummocky terrain, widespread	
Diapensia	**Diapensiaceae**			
X	*Diapensia lapponica*	Lapland diapensia	Exposed ridges	
Primrose	**Primulaceae**			
X	*Androsace septentrionalis*	Pygmy-flower rock-jasmine	Disturbed sites, sandy, dry sites	
	Primula egaliksensis	Greenland primrose	Moist pond edges	
	P. stricta	Stiff primrose	Moist pond edges, edges of wetlands	
Leadwort	**Plumbaginaceae**			
X	*Armeria maritima* (Syn.: *Armeria maritima* ssp. *labradorica*)	Thrift seapink	Gravelly tundra, floodplains, lake shores	
Borage	**Boraginaceae**			
	Mertensia maritima	Seaside bluebells,	Gravels or sands, by seashore	
Snapdragon	**Scrophulariaceae**			
	Castilleja raupii	Raup's Indian-paintbrush	Riverbanks, lakeshores	
X	*Pedicularis capitata*	Capitate lousewort	Gravelly, calcareous tundra or heath	
X	*P. flammea*	Red-tiplousewort	Moist calcareous tundra, snowbeds	

Table A1-1: Vascular Plant Species List (continued)

Family	Scientific Name[a]	Common Name[a]	Habitat	Notes
X	*P. labradorica*	Labrador lousewort	Open upland tundra	
X	*P. lanata* ssp. *lanata*	Woolly lousewort	Moist stony tundra	
X	*P. lapponica*	Northern lousewort	Sheltered slopes, sometimes under willows	
X	*P. sudetica*	Sudetan lousewort	Wetlands, sedge associations, pond edges	
Bladderwort	**Lentibulariaceae**			
X	*Pinguicula villosa*	Hairy butterwort, small butterwort	Found *only* in Sphagnum moss, in small hillside seeps	"Sensitive"
X	*P. vulgaris*	Common butterwort	Wetlands	"Sensitive"
Harebells	**Campanulaceae**			
X	*Campanula uniflora*	Arctic harebell	Calcareous slopes and gravelly ridges	
Composite	**Asteraceae (formerly: Compositae)**			
X	*Artemisia campestris* (Syn.*: A. borealis)*	Pacific wormwood	Sandy areas on eskers	
X	*Antennaria alpina*	Alpine pussytoes	Dry slopes	
X	*A. friesiana*	Fries' pussytoes	Rocky lichen-covered slopes	
X	*Dendranthema arcticum (*Syn.*: Chrysanthemum arcticum &Leucanthemum arcticum)*	Arctic daisy	Moist, saline meadows, moist gravel, seashores	
	Erigeron uniflorus ssp.*eriocephalus (* Syn.*: E. eriocephalus)*	One-flower fleabane	Dry, gravelly, calcareous soils	
X	*E. humilis*	Arctic alpine fleabane	Below snowbank associations, damp slopes	
X	*Saussurea angustifolia*	Narrow-leaved saw-wort	Open upland tundra	
	Taraxacum officinale (Syn.*: T. lacerum)*	Common dandelion	Moist, mineral soils seashores, den sites, bird cliffs, etc.	
X	*Senecio congestus*	Mastodon flower	Seashores, salt marshes, wetlands	
X	*Tripleurospermum maritimum* ssp. *phaeocephala (* Syn.*: Matricaria ambigua)*	False chamomile	Moist sandy seashores, salt marshes	

[a] Source: NatureServe (2009)

REFERENCES:

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: November 27, 2009).

Tentative list of possible lichens present in the Meliadine area, Kivilliq Region derived from field identifications and literature on the Rankin Inlet area.

Scientific Name	Common Name
Alectoria nigricans	Black hair lichen
A. ochroleuca	Green hair lichen
Arctoparmelia centrifuga (Syn.: Parmelia centrifuga)	Sunburst lichen
Asahinea chrysantha	Arctic rag lichen
Aspicilia cinerea (Syn.:Lecanora cinerea)	Cinder lichen
Bryoria nitidula	Tundra horsehair lichen
Bryocaulon divergens (Syn.:Cornicularia divergens)	Antler lichen
Cetraria ericetorum	Iceland lichen
C. islandica	True Iceland lichen
Cetrariella delisei	Snowbed Iceland lichen
Cladina arbuscula	Reindeer lichen
C. mitis	Green reindeer lichen
C. rangiferina	Grey reindeer lichen
C. stellaris	Star-tipped reindeer lichen
Cladonia borealis	Boreal pixie-cup
C. cervicornis ssp. *verticillata*	Ladder lichen
C. chlorophaea	Mealy pixie-cup
C. cornuta	Bighorn cladonia
C. crispata	Organ-pipe lichen
C. pyxidata	Pebbled pixie-cup
C. squamosa	Dragon-funnel
C. uncialis	Thorn cladonia
Collema tenax	Tar-jelly
Dactylina arctica	Arctic finger lichen
Flavocetraria cucullata (Syn.: Cetraria cucullata)	Curled snow lichen
F. nivalis (Syn.*: Cetraria nivalis)*	Crinkled snow lichen
Haematomma lapponicum	Bloodspot lichen
Hypnogymnia physodes	Hooded tube lichen
Icmadophila ericetorum	Candy lichen
Masonhalea richardsonii	Arctic tumbleweed
Melanelia stygia	Alpine camouflage lichen
Nephroma arcticum	Arctic kidney lichen

Scientific Name	Common Name
Ophioparma ventosa	Arctic bloodspot lichen
Parmelia sulcata	Hammered shield lichen
Peltigera aphthosa	Common frecklepelt
Peltigera didactyla	Alternating dog-lichen
Pertusaria dactylina	Finger wart lichen
Porpidia flavocaerulescens	Orange boulder lichen, Halloween lichen
Pseudephebe pubescens	Fine rockwool, brushcut lichen
Rhizocarpon geminatum	Twinned map lichen
Rhizocarpon geographicum	Yellow map lichen
Sphaerophorus fragilis	Fragile coral lichen
Stereocaulon tomentosum	Gray mealy lichen
Tremolecia atrata (= Lecidia atrata)	Rusty rock lichen
Thamnolia vermicularis	Whiteworm lichen
Umbilicaria hyperborea	Blistered rock tripe
Xanthoria elegans	Jewel lichen

REFERENCES:

Brodo, I.M., Sharnoff, S.D., and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven, CT.

Cochrane, G.R., and Rowe, J.S. 1969. Vegetation studies in the Rankin Inlet region, NWT, Canada. Musk-Ox 5: 41-44.

Korol, J.B. 1992. The vascular plant flora of Rankin Inlet, District of Keewatin, Northwest Territories. Canadian Field-Naturalist. 106(3): 342-347 (July – Sept., 1992).

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.

Rowe, J.S., Cochrane, G.R., and Anderson, D.W. 1977. The tundra landscape near Rankin Inlet, N.W.T. Musk-Ox 20: 66-82.

Vitt, D.H., Marsh, J.E., and Bovey, R.B. 1998. Mosses, Lichens, and Ferns of Northwest North America. Lone Pine Publishing, Edmonton, AB. 296 pp.

APPENDIX A3
Mosses and Liverwort Species List

The following are mosses and liverworts reported in the literature for the Rankin Inlet/lower Meliadine River area.

Scientific name	Common name
Abietinella abietina	Abietinella moss
Aulacomnium palustre var. imbricatum	Light aulacomnium moss
A. turgidum	Stiff aulacomnium moss
Ceratodon purpureus	Ceratodon moss
Dicranum elongatum	Tall dicranum moss
D. groenlandicum	Greenland dicranum moss
Drepanocladus revolvens revolvens	–
Hylocomium splendens	Splendid feather moss
Hypnum callichroum	Hypnum moss
H. hamulosum	
Oncophorus wahlenbergii	Wahlenberg's oncophorus moss
Pohlia nutans	Pohlia moss
Polytrichum juniperinum	Juniper polyrtichum moss
Ptilidium ciliare	–
Racomitrium lanuginosum	Grey moss, woolly hair-moss
Sphagnum fimbriatum	Sphagnum moss
S. girgensohnii	–
S. rubellum	Red sphagnum moss
Tomenthypnum nitens	–
Marchantia polymorpha	Common liverwort

REFERENCES:

Cochrane, G.R., and Rowe, J.S. 1969. Vegetation studies in the Rankin Inlet region, NWT, Canada. Musk-Ox 5: 41-44.

Rowe, J.S., Cochrane, G.R., and Anderson, D.W. 1977. The tundra landscape near Rankin Inlet, N.W.T. Musk-Ox 20: 66-82.

Vitt, D.H., Marsh, J.E., and Bovey, R.B. 1998. Mosses, Lichens, and Ferns of Northwest North America. Lone Pine Publishing, Edmonton, AB. 296 pp.

The following list was taken directly from a note on botanical research done at Rankin Inlet by Finnish botanist E. Ohenoja, who visited Rankin Inlet 9 to 24 August 1971. No attempt has been made to determine current taxonomy for the fungi.

Mycorrhizal fungi living in association with roots of woody plants, especially *Betula nana* and the willows:

Hebeloma
Inocybe
Dermocybe
Cortinarius
Lactarius
Russula
Amanita nivalis
Leccinum scabrum

Fungi living in association with algae:

Omphalina ericetorum

Saprophytes:

Helvella
Peziza
Sepultaria
Thuemendidium
Hygrocybe
Hygrophorus
Clitocybe
Laccaria
Omphalina
Mycena
Rhodophyllus
Calvata
Lycoperdon
Marasmius epidryas
Calvatia
Corynetes arenarius

Wet places:

Scutinellia
Leptoglossum lobatum
Omphalina philonotis
Galerina

REFERENCES:

Ohenoja, E. 1972. Preliminary note on botanical research at Rankin Inlet, 1971. Musk-Ox 10: 67.

Date: Y 2008	**M:** 09	**D:**	**Plot #: 08-**	**Code:** Meliadine W	**Notes:**
Team: Page Burt,					Perm. Plot#:
Location:					

Photos	Card:	Photo #'s:		
Coordinates:		**Lat./Northing**	**Long/West**	**Elevation:**
Wpt:	**UTM:**			

SITE INFO:						
Slope:		**Aspect:**		**Moist:**	**Nutrients:**	
Terrain:	**(Circle)**		**Microtopography:**		**(X)**	
esker/ridge crest		cliff:	hummocky		frost fiss.	
ridge slope		stream	frost boils		flat	
valley bottom		delta	solifluct		br. outcrop	
lakeshore			circles		boulders	
floodplain, river			bould strm		bould field	
upland			polygon		shattered br.	
Substrate:						
Organics:		Mineral soil:		Water:		
Bedrock		% Sand	% Gravel	Standing	Flowing	
Rocks:						
% of surf. covered:		**Moisture:**				
dist betw stones:		Wet	Wet-mesic	Mesic	Mesic-Dry	Dry
type of stones:						

Perm. Plot species coll:	**a.**	**b.**
c.	**d.**	
e.	**f.**	

Soils notes (for soil plots only):

Misc. notes

Vegetation:												
											Veg. Code 1:	
Representing:											Veg. Code 2:	
% Cover by layer:		Organics: fr other side: ____		Tree/erect shrub:_____							Lichens:	%
Dwarf Shrub:	_____	Herb:	_____	Moss/Lichen:	_____						cetrniva	
Shrubs:	%	Non-flow:	%	Saxifrages	%						cetrtile	
betunana		cystfrag		chrytetr							Cladina	
salirich		equiarve		saxiaizo							Cladonia	
Salix _____		Equisetum		saxicaes							stertome	
ledupalu		Lycopodium		saxicern							thamsubu	
Dwarf shr.	%	dryorrag		saxifoli							Alectoria	
saliarct				saxihirc							dactarct	
saliherb		Forbs:	%	saxiniva							Rock lichens	
salireti		Tofieldia ____		saxioppo							map	
Salix _____		oxyrdigy		saxirivu							jewel	
Arcto _____		polyvivi		saxitric							rock tripe	
andrpoli		ceraalpi		Saxi._____							bloodspot	
vaccviti		potenivi		Saxi._____							blk crustose	
vacculig		Potentilla ____		epillati							sunburst	
casstetr		melaaffi		hippvul								
rhodlapp		melaapet		pyrogran								
dryainte		Minuartia		armemari							Mosses	
Sedges:	%	sileacau		Pedic._____							racolanu	
careaqua		Stellaria		pediarct							Sphagnum	
caremisa		ranuniva		pedicapi							str. mosses	
carebige		ranupygm		pedihirs							cushion	
carecapi		ranulapp		pedilana								
carememb		Ranunculus sp.		pedisude							Biol. crust.	
carenard		paparadi		Composite								
carescir		Mustards	%	Antennaria	%						Other:	%
carerupe		Arabis		leucinte							Campanula	
Cottongr:	%	Braya		Erigeron							loisproc	
erioangu		carddigi		matrambi							diaplapp	
eriocalli		cardprat		senecong							empenigr	
erioruss		cochoffi		Taraxacum								
eriosche		Draba		Grasses:								
eriovagi		drabalpi		arctlati							Legumes:	
Rushes:	%	drabglab		Cala._____							Astr._____	
luzuconf		Eutrema		alopalpi							Oxyt:_____	
luzuniva		lesqarct		Hier._____							Hedy._____	
Juncus				Poa _____								
WILDLIFE NOTES:		Sighting/heard	Scats	Dens/burrows	Runs/trails	Nests	Other					
ARCHAEOLOGY NOTES:												

APPENDIX A6
RSA Classification Error Matrix Summary (based on TTA Mask)

Confusion Matrix

	RSA Classes							
User \ Reference Classes	Heath Tundra	Bare Ground	Heath Boulder	Heath Lichen-Cetraria	Low Shrub	Tussock-Hummock	Heath Lichen - Hair Lichen	Total
Heath Tundra	10	0	0	0	0	2	1	**13**
Bare Ground	0	6	0	0	0	0	0	**6**
Heath Boulder	0	2	7	2	0	2	1	**14**
Heath Lichen-Cetraria	0	0	1	7	0	1	0	**9**
Low Shrub	0	0	0	0	10	0	0	**10**
Tussock-Hummock	0	0	2	1	0	7	1	**11**
Heath Lichen - hair lichen	0	0	0	0	0	0	5	**5**
Unclassified	0	2	0	0	0	0	0	**2**
Total	**10**	**10**	**10**	**10**	**10**	**12**	**8**	

Accuracy

	RSA Classes						
	Heath Tundra	Bare Ground	Heath Boulder	Heath Lichen-Cetraria	Low Shrub	Tussock-Hummock	Heath Lichen - Hair Lichen
Producer	1	0.6	0.7	0.7	1	0.5833	0.625
User	0.7692	1	0.5	0.7778	1	0.6364	1
Hellden	0.8696	0.75	0.5833	0.7368	1	0.6087	0.7692
Short	0.7692	0.6	0.4118	0.5833	1	0.4375	0.625
KIA per Class	1	0.5625	0.625	0.6557	1	0.5056	0.5962

Totals

Overall Accuracy	**0.7429**
KIA	**0.7006**

1.0 INTRODUCTION

Plant community types represent mappable units at a scale of 1:10 000 and correspond to major vegetation units that are often associated with distinct terrain features. Within each plant community type, a series of subgroups, or plant associations, have been described that are based on field level observations. These units are not mappable, but have been described to provide additional information on the natural level of variability associated with each plant community type and are summarized in the following sections.

2.0 SEDGE COMMUNITY

The sedge community is found adjacent to lakes and streams on very poorly drained soils and in low-lying areas between upland ridges or plateaus, where substantial amounts of water drain from the uplands and accumulate on poorly to very poorly drained soils. Within the sedge community, 4 non-mappable plant association units were identified as follows:

- Sedge association – emergent (Se);
- Non-tussock sedge association (Snt);
- Tussock sedge association (St); and
- Sedge association – frost scars (Sfs).

2.1 Sedge Association – Emergent (Se)

This association includes vegetation that is rooted in shallow water (less than 30 cm), in small tundra ponds (2008, PHOTOS 1 and 2), and in the shallow bays of larger ponds or lakes. It also occurs around the shores of some larger ponds or lakes where it forms a narrow band along the shore depending on the slope of the lake bottom.

Emergent vegetation consists predominantly of *Carex aquatilis*, which does not form tussocks or tufts, but instead grows in loose stands with plants connected by underground or underwater rhizomes. In shallower water, smaller sedges, such as *C. saxatilis* or *C. rariflora*, form small stands, along with pendantgrass (*Arctophila fulva*). The narrowleaf cotton-grass (*Eriophorum angustifolium)* also occurs along the edges of ponds. Occasionally, shallow ponds support a uniform growth of mare's tail (*Hippuris vulgaris*) or a few plants of *Ranunculus gmelinii*. Rarely, small rushes (*Juncus albescens, J. biglumis*) grow among the sedges where the water is less than 10 cm deep, or among plants at the edges, and the grass *Arctophila fulva* grows in tufts at the edges or on small ridges on the shore. Variegated horsetail (*Equisetum variegatum*) and the lesser spearwort, *Ranunculus flammula* var. *filiformis* sometimes occur where there are small mudflats. The cuckoo-flower (*Cardamine pratensis*) often occurs in this association. Occasionally, the insectivorous butterwort *Pinguicula vulgaris*, grows in the damp edges of small ponds, but it is not common along the west coast of Hudson Bay.

In some cases, a dense brownish green scum, likely the cyanobacteria *Nostoc,* develops on the bottom of ponds. This species is often stranded by receding water levels in ruffled lettuce-like pieces on the shores and is an important species to these communities as it not only adds oxygen to the water through photosynthesis, but is also a "nitrogen fixer," contributing to the fertility of the pond and adjacent soils (Rowe et al. 1977; Pielou 1994). Little other vegetation occurs in the small ponds.

Representative photos of this community association are identified below:

- 1998, PHOTO 1, Plot 98-235
- 2008, PHOTO 1, Plot 08-025, small pond near Meliadine River crossing
- 2008, PHOTO 2, Near Plot 08-040, small pond, interior
- 2008, PHOTO 3, Near Plot 08-025, *Eriophorum angustifolium*

2.2 Drainage Basin Non-tussock Sedge Association (Snt)

This plant association occurs where water forms shallow dendritic drainage patterns (in which case it occupies the channels or their edges) or flows slowly across the land in a thin sheet (see A7-1). In watercourses, such as the one to the west of the Meliadine West camp, the flow of water in the channels varied in depth from 40 cm in June to 20 cm in August (1998, PHOTO 2).

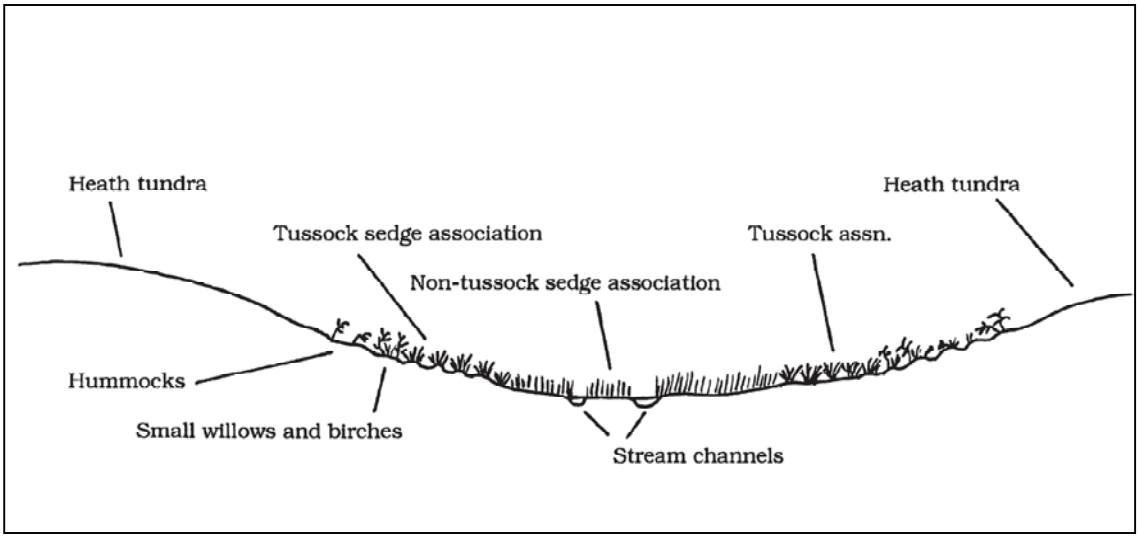

Figure A7-1: Sedge Associations in a Drainage Basin

Most of the sedges in this association do not form tussocks, but have a uniform growth of upright leaves and stems, though some tussock-forming sedge species may be present. Characteristic species of this area include *Eriophorum angustifolium*, *E. scheuchzeri, Juncus albescens, J. arcticus,* and *J. biglumis, Carex aquatilis*, *C. atrofusca*, *C. membranacea*, *C. rariflora*, *C. rotundata*, and others. Small, prostrate willows are common in this association, mostly the trailing type, especially *Salix arctophila*, *S. glauca* var. *callicarpaea* is often present in this association, and *S. planifolia* sp. *tyrrellii* was found at the edge of the association in several locations. Common forbs include *Saxifraga hirculus*, *S. foliolosa*, *Cardamine pratensis*, *Silene uralensis*, *Parnassia kotzebuei*, and *Comarum palustre*. A few of the larger sedge basins enclose a fairly thick growth of willows, and could be considered to grade into riparian willow communities.

In wide, gently sloping terrain, this association often occurs upslope from small solifluction ridges that are represented by peaty ridges enclosing small sedge mats and occasionally, small ponds. Since the ridges

develop across the slope of the land, the sedgy depressions appear to be roughly aligned behind or upslope of the ridges. Rowe et al. (1977) use the interesting analogy that these resemble rice "paddies." Occasionally, the transition from sedge association to lichen-heath is quite abrupt and distinct (2008, PHOTO 6). This is a small transitory pond with non-tussock sedges in the basin, a distinct lip to the pond, and lichen-heath with black hair lichen right to the edge.

Representative photos of this community association are identified below:

- 1998, PHOTO 2. Watercourse to west of camp
- 1998, PHOTO 3, Plot 98-225
- 2008, PHOTO 4, Plot 08-018, non-tussock association at edge of lake
- 2008, PHOTO 5, Plot 08-052, area south of Lake A54
- 2008, PHOTO 6, Near Plot 08-035, small transitory pond showing abrupt transition non-tussock sedge to lichen-heath

2.3 Tussock Sedge Association (St)

Tussock-forming species tend to become established toward the edges of the sedge basins, in places where water flow is more sporadic, or where flowing water forms a sheet less than 2 cm in depth. These include members of the genera *Eriophorum,* mostly *E. vaginatum,* as well as *Carex atrofusca, C. membranacea, C. misandra,* and *C. scirpoidea*. The tussock growth form is thought to be an adaptation to exposure to frost injury and desiccation and erosion due to wind and wind-borne ice crystals as the old leaves and fruiting stalks persist for several years, protecting the sheathed growing points (Savile 1972). Tussock sedge associations are much less common in the Meliadine area than was expected. They do occur, but are relatively small, and most are well on the way to becoming hummocks, invaded by heaths and forbs.

Due to the compact growth form, each tussock provides a little "island" microclimate, surrounded by a wetter "matrix" through which water often flows. The elevated heads of the tussocks provide more mesic (dry) conditions in summer. This permits heaths, such as blueberry (*Vaccinium uliginosum*), marsh Labrador tea (*Ledum palustre*), bog rosemary (*Andromeda polifolia*), mountain cranberry (*Vaccinium vitis-idaea*), and arctic white heather (*Cassiope tetragona*) to become established. Also, small shrubs, including mountain avens (*Dryas integrifolia*), willows and birches, and forbs, such as the Lapland lousewort (*Pedicularis lapponica*), *Cardamine digitata* (and others), may also be found growing on top of the tussocks. Grasses, such as *Arctagrostis latifolia*, and the blue-grasses, *Poa arctica* and P*. alpina,* also become established in the tussocks, especially in the drier areas.

A different type of tussock is often found at the edges of tiny ponds, in areas high in peat. In these cases, almost pure stands of *Trichophorum caespitosum* extend for a metre or so from the edge (2008, PHOTO 7). These likely become established in areas subject to occasional flooding due to summer rains, and may also be associated with calcareous soils (Porsild and Cody 1980).

Representative photos of this community association are identified below:

- 1998, PHOTO 4, Plot 98-307

- 2008, PHOTO 7, Plot 08-033

2.4 Sedge Association – Frost Scars (Sfs)

Very rarely, frost scars (frost boils, mud boils, and sorted circles) occur in the tussock zone, but these are not mappable. The areas between the tussocks are often occupied by a peaty organic matter, which appears to be mostly dead moss, flattened to the ground. There is evidence (flotsam and bent stems) of a seasonal flow of water among the tussocks, but this flow does not persist nearly as long as the flow in the non-tussock areas. The centres of these boils usually have little vegetation due to the movement of the soil. The rims are usually elevated, and in sedge areas, are usually colonized with heaths and sometimes *Rubus chamaemorus*.

3.0 SEDGE-HEATH TUNDRA TRANSITIONS

In many cases, the margins of the sedge communities are not always clearly delineated, and there is an ecotone several metres wide between the sedge community and adjacent heath tundra. In this ecotone or transitional zone, sedges communities are intermixed with heath communities, blending gradually into the typical heath tundra in drier areas. The exception is the transition between sedges and boulder, which tends to be quite abrupt. These transition types are not mapped as distinct communities, but are recognized as unique plant associations that are usually included as part of the sedge community.

3.1 Transitions – Hummocks (Th)

At the edges of many sedge associations, especially those in which a well-defined tussock zone is present, the transition to heath tundra occurs in a turf hummock zone. A turf hummock is defined as “a hummock (mound) consisting of vegetation and organic matter with or without a core of mineral soil or stones” (van Everdingen 1998). Turf hummocks change size with the seasons, enlarging as ice within them expands and accumulates by capillary action and ice needles form, lifting the crown of the hummock. When the crown extends above the snow line in winter, plant cover is eroded away, and the soil is exposed. The heat from the sun in summer penetrates more deeply melting the frost layer, and water percolates to the surface, raising the moisture content there. Frost heaving increases, pushing any rocks out the top of the hummock, causing a scar, often called a frost boil. When the frost needles melt in summer, the centre of the boil collapses slowly. Plants invade from the edges, eventually forming a complete cover, and the cycle begins again (Zwinger and Willard 1972).

Turf hummocks may originate as sedge tussocks invaded by the heaths and other species more typical of heath tundra. According to Bird (1967), this is the most common form of hummock in northern Canada -- a mound developed initially from the tight mat of stalks, leaves, and roots of certain sedges (*Carex aquatilis, C. atrofusca, C. scirpoidea,* and others) and cotton-grasses (*Eriophorum* sp.). Colonization of the mound by heaths usually occurs on the sides of the tussocks, with blueberries, Labrador tea, and mountain cranberries growing amongst the leaves of the sedge or cotton-grass (2008, PHOTO 9). Mosses cover the ground between the tussocks and extend up the sides of the tussocks, while cloudberries (*Rubus chamaemorus*) often become established in the moss.

An alternate origin of the hummocks may be moss mats that become established in the sedge meadows (Pielou 1994). These insulate the ground, and miniature ice lenses form within the growing hummock, enlarging with its growth. Heaths invade the moss cushion, and other plants, like cardamines (*Cardamine digitata)* and viviparous pondweed (*Polygonum viviparum*) also become established in the mounds. The tops of the larger

hummocks may be quite dry, with swamp birch (*Betula nana*) and mountain-avens (*Dryas integrifolia*) becoming firmly established.

Rowe et al. (1977) mentioned that 3 classic types of hummock formation (soil injection, erosion, and plant growth) were all found between Rankin Inlet and the Meliadine River, near Nipisar Lake. They also state that "in a few places beyond the study site, *Sphagnum fimbriatum*, *S. girghensonii*, and *S. rubellum* formed hummocks on wet slopes. However, *Sphagnum* spp. are typically uncommon in the region and contribute little to the vegetation and to the microtopographic forms.

Representative photos of this community association are identified below:

- 1998, PHOTO 5, Plot 98-257
- 2008, PHOTO 8, Plot 08-046, hummocky terrain
- 2008, PHOTO 9, Plot 08-046, close-up of hummock

3.2 Transitions – Hummocks with Frost Scars (Th+fs)

Hummocky areas may also include frost scars, like mud boils or solifluction ridges. The mud or frost boils usually have a centre, sometimes containing a high percentage of sand, with little vegetation growth. This centre is often saturated with water and any shock, such as stomping on it, will cause it to go to an unstable jelly-like consistency. These boils often have a raised rim occupied by sedges, as well as heaths, especially blueberry, lingonberry, and Labrador tea, with bog rosemary and cloudberry on the perimeter (2008, PHOTO 14). These are usually not mappable as they are incorporated in the hummock area, which usually intergrades with the sedge community and heath tundra on the hillsides.

Along the perimeters of a sedge basin, the soil is less saturated, and as a result, less prone to frost heaving activity. In these areas, colonization by heaths is more complete, and each tussock or moss mound seems to lose its identity, becoming a cushion covered with heaths. Closer to the margins of these sedge basins, even the spaces between cushions are filled with heaths and related species, and the surface becomes merely undulating. Where it merges with the surrounding heath tundra, the hummocks are barely visible, and the sedges are represented only by small individual plants.

3.3 Transitions – Gradual Intergradation on Slopes (Tsl)

Hummocks do not commonly form on most slopes, particularly those that have a stepper gradient. In this transitional type, the change from sedge association to heath tundra is simply one of replacement of sedges by heaths and related species, such as black crowberry (*Empetrum nigrum*). The more gradual or steep the slope gradient is, the wider or narrower the ecotone band becomes.

Representative photos of this community association are identified below:

- 1998, PHOTO 6, Plot 98-285
- 2008, PHOTO 10, Plot 08-050, Ecotone on slope

3.4 Transitions – Solifluction Ridges (Tsolif)

Solifluction ridges are another transition zone characterized by long narrow ridges usually extending across the slope of the land (Figure A7-2). Solifluction ridges typically have a frozen core of stony, sandy soil capped by mosses, sedges and heaths and they slowly migrate downslope, rolling over and over, incorporating organic matter as they move (Rowe et al. 1977). According to Bird (1967) solifluction ridges develop as the plant cover moves downslope with the active layer, creating steplike ridges.

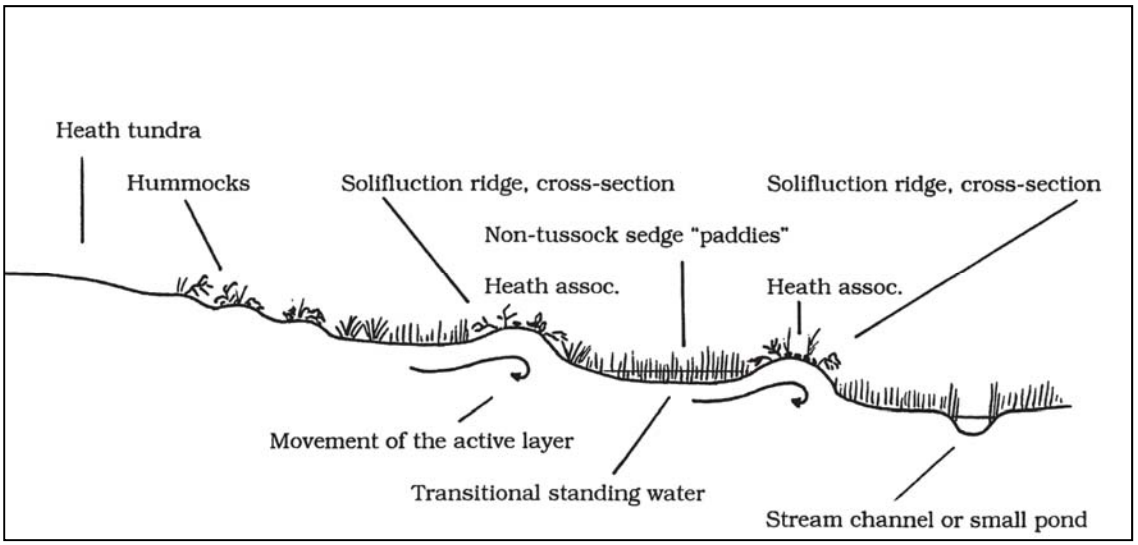

Figure A7-2: Cross Section of Solifluction Ridge

Since solifluction ridges tend to be elevated, they are better drained, and are occupied by heaths and other species more typical of the heath tundra than of the sedge associations. They provide a foothold where willows (*Salix arctica* and *S. arctophila*) and swamp birches (*Betula nana*) become established, as well as a few sedges (*Carex atrofusca*, *C. rariflora,* and others). Small solifluction lobes often have a wet area where the soil has pulled away from the hillside, forming a dam that collects water. These small "pools" are sometimes filled with sphagnum moss, and occasionally, the hairy butterwort (*Pinguicula villosa*).

Upslope of each solifluction ridge, a sedge community may occupy a flat or slightly depressed area. After a rainfall, these depressions retain water, sometimes for several days. The sedges occupying these areas are usually loosely-tufted species, such as *Carex membranacea* and *C. scirpoidea,* and a dark gelatinous algae (*Nostoc* sp.) often coats the ground, or drifts into the low areas (Rowe et al. 1977). At the interface of the flat sedge area and the ridge, there is a narrow, meandering transition zone where the sedge community and heath tundra overlap.

A representative photo of this community association is identified below:

- 1998, PHOTO 7, Plot 98-009

4.0 HEATH TUNDRA

The Heath tundra community type is found throughout the uplands and slopes of most ridges and is characterized by gently rolling to undulating terrain that may contain a high percentage of boulders; as a result, these areas tend to be associated with rapidly to well-drained soils that can be quite dry. Within the heath tundra community, 5 non-mappable plant association units could be differentiated based on variations in terrain features and soil moisture, or exposure to wind, frost heaving, and movement of the active soil layer:

- Heath tundra - uplands (HTu);
- Heath tundra - solifluction slopes (HTsolif);
- Heath tundra - frost scars (HTfs);
- Heath tundra - boulders (HTb/LRb); and
- Ridge or esker slope [(RCsl) described further in Section 6.0].

4.1 Heath Tundra – Uplands (Htu)

On the rolling uplands and gentle, well-drained slopes, much of the land is covered with a dense carpet of vegetation that is often 10 to 40 cm thick. The dominant plant cover is a mixture of heaths (blueberry, cranberry, Labrador tea, white arctic heather, and often bearberry) and related groups (crowberry) interspersed with the occasional occurrence of small sedges and grasses. Forbs, such as narrow leaved saw-wort (*Saussurea angustifolia*), thrift seapink (*Armeria maritima*), arctic harebell (*Campanula uniflora*), Labrador lousewort (*Pedicularis labradorica*), red-tip lousewort (*P. flammea*), and capitate lousewort (*P. capitata),* are common, and arctic wintergreen (*Pyrola grandiflora*) can be found beneath the willows. Grasses, such as *Anthoxanthum monticola, Poa arctica*, *P. alpina*, *Arctagrostis latifolia*, and *Trisetum spicatum,* do not form dense stands, but grow as scattered individuals throughout the heath tundra. Sedges, such as *Carex misandra*, *C. scirpoidea*, *C. vaginata*, and wood-rushes (*Luzula arctica* and *L. confuse)* also occur in this association. Occasionally, thick growths of the alpine sweet-vetch (*Hedysarum alpinum*) are found on gentle slopes, especially along the Meliadine River.

Lichens, especially hair lichen (*Alectoria* sp.), *Flavocetraria nivalis*, *Cladonia* sp., and *Cladina* sp., form small patches or are intermingled with the vascular plants, and glove (*Dactylina arctica*) and worm lichen (*Thamnolia subuliformis*) occur as isolated small tufts throughout. The yellowish green club moss, *Huperzia selago*, grows on drier slopes, whereas a mixture of mosses underlies much of the vegetation in moister areas.

Representative photos of this community association are identified below:

- 1998, PHOTO 8, Plot 98-133
- 1998, PHOTO 9, Plot 98-270 (Close-up)
- 2008, PHOTO 11, Plot 08-D01, plot on Discovery deposit
- 2008, PHOTO 12, Plot 08-022 (Close-up)

4.2 Heath Tundra – Solifluction Slopes (Htsolif)

Solifluction slopes occur where the soil in the active layer is creeping downhill over the permafrost and the terrain appears as a series of ridges, or a long slope with a lobed front. In some cases, the downslope movement exposes mineral soil on the upslope side of the ridges. This is in an earlier stage of succession and supports a different flora, with fewer heath plants, more exposed subsoil, and a higher percentage of sedges. Further uphill, the plant communities are more mature, with thicker vegetation, and more heath species or woody plants on soil that has been exposed longer.

The plant associations that occur on heath tundra–solifluction slopes are represented by a mixture of members of the heath family (*Ericaceae*), with other species (especially black crowberry). Pioneer species, including mustards, such as northern tansy-mustard (*Descurainea sophioides*), and *Cardamine digitata* are also common inhabitants of solifluction slopes. Woody plants, such as willows and birches, can survive the movement of the active layer and are often found growing on solifluction slopes along with mountain-avens and arctic wintergreen (*Oxytropis hudsonicus)*, *Carex scirpoidea,* and occasionally the small one-sided wintergreen (*Orthilia secunda).*

Representative photos of this community association are identified below:

- 1998, PHOTO 10, Plot 98-327
- 1998, PHOTO 11, Plot 98-331 (top of lobe)
- 2008, PHOTO 13, near Plot 08-007 solifluction lobe on opposite slope

4.3 Heath Tundra – Frost Scars (Htfs)

The term “frost scar” is used as a collective term for small landforms developed by frost action and includes mud boils and frost boils. Mud boils are defined as “nonsorted circles developed in fine-grained materials” (van Everdingen 1998) and form where conditions allow the establishment of convection currents in the active layer, (French and Slaymaker 1993). These circular structures occur on moist slopes, in silty or finely sandy soil and are comprised of an elevated ridge with a centre comprised of exposed mineral soil, rocks, or a combination of both and can have diameters of 1.0 to 2.5 m (1998, PHOTO 12). In spring, the fine material in the centre of these circles is often saturated with water, and the whole structure will turn almost fluid when shocked. In fall and early winter, layers of ice form, and ice needles grow, elevating the surface of the boil. Frost heaving within the boil causes rocks to be pushed to the surface and ejected. If the dome is high enough, they tumble down the sides to form a ring around the boil, otherwise, they accumulate in the surface soil (Zwinger and Willard 1972). Where these structures occur in soils that once were below sea level, marine shells are usually incorporated in the sediments, and pushed to the surface (Bird 1967).

The terrain features of mud boils results in a mosaic of plant associations within a single structure. Sedge associations often encircle the outside perimeter of the boil (1998 PHOTO 13 and 2008, PHOTO 13). An elevated rim is occupied by a thick growth of heaths and scattered grasses (e.g., *Arctophila latifolia*), *Juncus albescens*, and sedges, including *Carex membranacea*, *C. rariflora*, and *C. vaginata*. In the relatively dry environment of the ridge, small shrubs (including *Salix calcicola* and dwarf birches), Maydell’s point-vetch (*Oxytropis maydelliana*), and mountain-avens become established. Inside the rim, there is a centre disk of mineral soil churning so actively that plants cannot become strongly established. Usually the centre disk is bare

or occupied by mats of alpine milkvetch (*Astragalus alpinus)*, *Carex vaginata*, and occasionally scattered plants of yellow mountain saxifrage (*Saxifraga aizoides*). Purple mountain saxifrage (*Saxifraga oppositifolia*) often occurs on either the rim or the central disk (Figure A7-3).

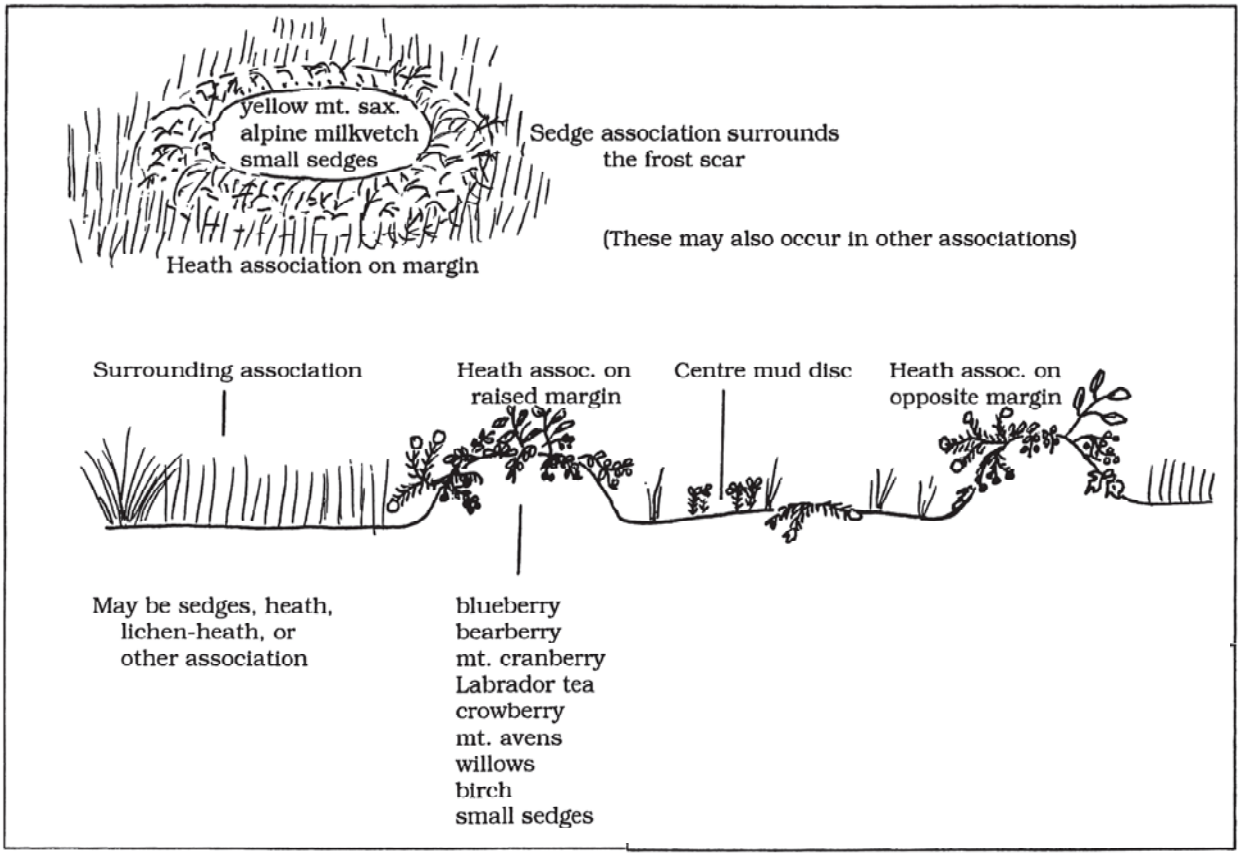

Figure A7-3: Heath Tundra on Mud Boil

Frost boils or “earth mounds” occur where small lenses of ice are trapped in, or just below, the active layer. In the fall, when temperatures hover around freezing and there is a lot of water percolating through the soil, these ice lenses can rapidly expand. Capillary action allows water to move into small interstices in the soil matrix, and when water contacts the ice lenses, it freezes, expanding the lens and pushing up the overlying vegetation. This vertical "growth" can push the small mound above the usual snow level in winter, where the harsh winter winds and blowing snow crystals can then erode the vegetative cover on the mound, exposing the soil (Zwinger and Willard 1972; Pielou 1994). This erosion results in frost boils that will not liquefy by shocking, as the ice core provides support to the pushed up subsoil.

Rowe et al. (1977) identifies one type of frost boil as “frost mounds with mixed lichen-heath.” Located on moist slopes and higher areas in lowlands, this is a complex association, with a mixture of lichens (both *Alectoria* and Cetraria), heaths (Labrador tea, red bearberry, blueberry, and mountain cranberry) and alpine holy-grass (*Hierochloe alpina*) growing on the edges of the mounds. A sedge/heath mixture also occurs in the lower (wetter) areas surrounding the mounds. Rowe et al. (1977) noted that “the mosses *Dicranum groenlandicum*, *D. elongatum*, and *Tomenthypnum nitens* play an important role” in the formation of these frost boils. This

community association is rare in the Local Study Area, but is noted to occur on the long ridge extending south from the green fuel tanks on the hill to the west of Meliadine West camp.

A second type of mound, "stony earth mounds with *Dryas*-heaths," was also described by Rowe et al. (1977). This is one of the most prominent terrain types in the LSA, occurring on convex slopes below the crests of ridges, where snow cover is thin. These structures are larger (1 to 2.5 m in diameter, and 30 to 60 cm in height), and consist of slightly domed stony earth disks surrounded by a trench filled with heaths and mosses. The mounded centres are sparsely vegetated, with low sedges (*Carex vaginata, C. rariflora,* or *C. scirpoidea*), a few grasses (*Arctogrostis latifolia*), mountain avens, Lapland rosebay (*Rhododendron lapponicum*), and black bearberry. Occasionally, several species of oxytrope (*Oxytropis arctica* var. *bellii*, *O. maydelliana*, and less commonly *O. borealis)* occur on these structures.

Representative photos of this community association are identified below:

- 1998, PHOTO 12, Plot 98-181
- 1998, PHOTO 13, Plot 98-127
- 2008, PHOTO 14, Plot 08-D03, margin of frost boil

4.4 Heath Tundra – Boulders (Htb)

Heath tundra with embedded or perched glacial boulders, or small bedrock outcrops occurs over large areas of the Regional Study Area, as well as the Local Study Area. The Laurentide ice sheet vanished from the area to the west of Hudson Bay only about 7000 years ago (Riley 2003), leaving the land denuded of vegetation and interspersed with glacial erratics (i.e., boulders) of varying sizes. In some areas, there are more boulders than vegetation, and in others, the heath tundra surrounds the boulders, leaving them either embedded in the till or perched on gravely ridges. The heath tundra – boulders association grades into the Lichen-rock community, depending on the amount of boulders, such that when the percentage of boulders constitute less than 60% of the ground cover, it is considered part of the heath tundra - boulders association, and if more than 60%, it is considered to be part of the Lichen-rock community type.

5.0 MOSS COMMUNITY (MS)

A thick blanket of moss occurs at the bases of some slopes, especially those along lake shorelines, where the terrain can be somewhat hummocky, but it is mostly characterized by an undulating blanket of moss. In these areas, several species of moss may be present, including *Hypnum*, *Aulicomnium*, and perhaps *Sphagnum,* and this community is also occupied by either sedges or heath species, depending on the amount of moisture available. In general, cloudberry, mountain cranberry, Labrador tea, blueberry, and bog rosemary are common occurrences. A few small willows (mostly *Salix glauca* var. *callicarpaea* and *S. reticulata*) and dwarf birch may also occur, and *Salix tyrrellii* was occasionally found in association with this community. Forbs often include northern buttercup (*Ranunculus pedatifidus*), viviparous pondweed, Lapland lousewort, and *Cardamine digitata*. Lichens are infrequent, but if present, grow on the tops of mounds, where conditions are drier, and include such species as *Peltigera* sp and *Nephroma arcticum*. Very few representatives of the moss community were present in the LSA.

Moss communities may occasionally occur below a snowbank community, where the seepage of water from the late-lying snowbank provides uniform humidity through most of the summer season. Where there is sufficient shelter, forbs, such as Arizona cinquefoil (*Sibbaldia procumbens*), blue mountain heather (*Phyllodoce caerulea*), and Kotzebue grass-of-Parnassus (*Parnassia kotzebuei*), may occur (2008, PHOTO 26).

Moss associations are also found at the base of cliff faces, in areas that receive a reliable runoff of moisture from the cliff face. In the mossy areas below cliffs, *Saxifraga rivularis, Stellaria longipes*, and *Oxyria digyna* often occur. None of these cliff associations were found in the Local Study Area, but such moss communities could be expected to be present where cliffs occur in the Regional Study Area.

Representative photos of this community association are identified below:

- 1998, PHOTO 20, Plot 98-047
- 1998, PHOTO 21, Plot 98-047
- 2008, PHOTO 26, near Plot 08-015, moss association on esker with *Sibbaldia procumbens* and *Parnassia kotzebuei*

6.0 RIDGE COMPLEXES

Ridge complexes include a range of plant associations that form on esker and drumlin ridges. Eskers are large ridges that snake across the landscape, formed as streambeds in reverse during the retreat of the Laurentide ice sheet. They are composed of varying amounts of sand and gravel, which tends to be sorted, with particles of one size deposited together. Eskers often include several different habitats, from ponds and birch seeps to very dry gravel crests (Figure A7-4) Side slopes are usually covered with heath tundra, but may also include snowbank communities, where deep snow accumulation has occurred. In contrast, drumlins are glacially-streamlined hills oriented in the direction of glacial movement that are composed of till deposited by the ice (Zoltai et al.1980). Since these soils are ice-laid, they are generally unsorted (i.e., a mixture of particle sizes).

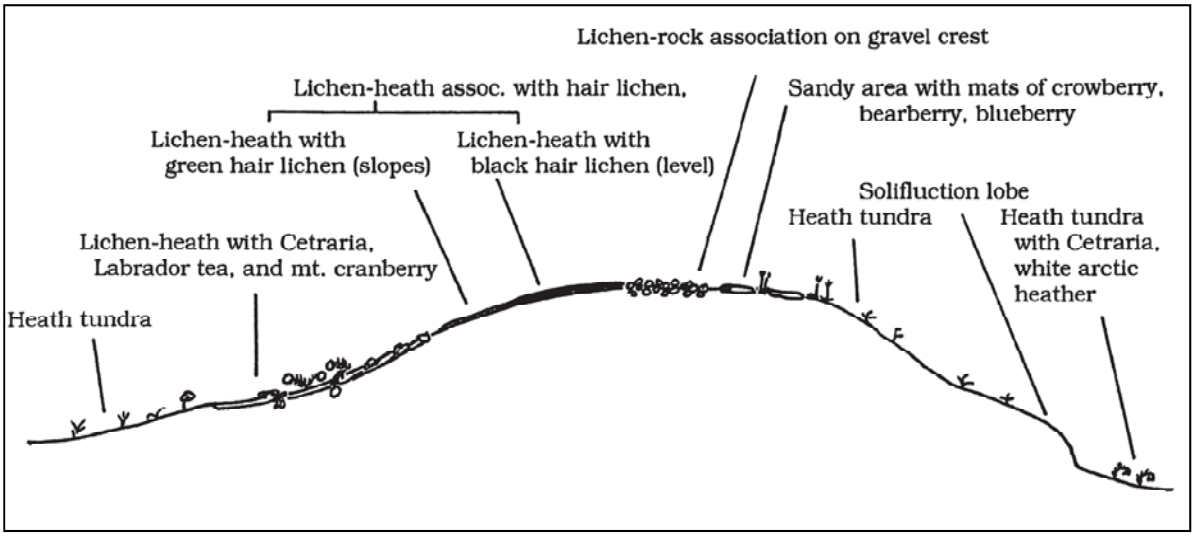

Figure A7-4: Profile of Ridge with Typical Vegetation

6.1 Ridge Crests (RCc)

The land within the study area has risen due to isostatic rebound (upward movement of the land) after it was relieved of the weight of the Laurentide ice sheet. Some ridge crests "appear to have been wave washed and eroded, leaving a surface that in places is about half-covered with dark protruding boulders" (Rowe et al. 1977). This is covered by a lichen-heath association or heath tundra. Heath tundra occupies the lower ridges with less well-defined crests, areas that are usually covered with an insulating blanket of snow in winter. The crests of ridges are very exposed and windswept, with little accumulation of snow in winter. The plant cover is thin, usually characterized by a lichen-heath–Cetraria and lichen-heath–hair lichen communities, mats of heaths on sand, or unvegetated sand, gravel, cobbles, or even boulders in heath or lichen-heath tundra (Figure A7-4). The ridge crest association is affiliated with the lichen-heath–Cetraria and lichen-heath–hair lichen communities.

Lichens cannot become established where the ridge is composed of sand, and subject to extensive wind erosion. In these areas, mats of bearberry, blueberry, or crowberry cling to the ground. Isolated plants of prickly saxifrage, alpine pussytoes (*Antennaria alpina*), Pacific wormwood (*Artemisia campestris*), thrift seapink (*Armeria maritima*), or moss campion (*Silene acaulis*) occur where their roots can gain a foothold. The legume, *Oxytropis arctica* var. *bellii* (2008, PHOTO 29) forms tight tufts of silky leaves on dry crests, and the closely related *Oxytropis borealis* is also often found in this habitat, mostly where the ground is covered with pebbles.

On many ridge crests covered with lichen-heath–Cetraria and lichen-heath–hair lichen communities, the land surface is a network of small depressions, forming large polygons. These are frost fissures, formed by thermal contraction in winter's intense cold, which causes deep fissures to form. When the snow thaws, water runs down through the sandy soil, and freezes in the fissure, causing a frost wedge to grow by accretion to its outside margins (Pewe 1966; Bird 1967; van Everdingen 1998). The water carries some soil with it, which causes a depression to develop over the frost wedge. In winter, this depression collects snow, which protects the plants that happen to be growing there, allowing them to survive. Over time, a relatively lush plant flora develops in the shallow crevice that follows the frost wedges in their polygon shapes. This flora includes heaths, such as mountain cranberry, arctic white heather, and Lapland rosebay. Lichens, such as antler lichen (*Bryocaulon/Cornicularia divergens*) and green hair lichen, also more readily become established in this protected microclimate (Rowe et al.1977).

Some ridge crests, especially those of eskers, morainal ridges, or drumlins, have areas that are covered with cobbles, fist-sized rounded rocks that abut each other without any soil showing. The "fines" (fine soil and sand) have long since been blown off these areas of the ridges, leaving the rocks behind. This type of crest is usually occupied by a Lichen-rock Community with a high percentage of crustose lichens (see Lichen-rock section below). In other areas, there is little vegetation at all on the sandy tops of ridges, or sometimes on the sides of the ridges.

Representative photos of this community association are identified below:

- 1998, PHOTO 22, Plot 98-035
- 1998, PHOTO 23, Plot 98-323
- 1998, PHOTO 24, Plot 98-016
- 2008, PHOTO 27, Plot 08-015 esker with hair lichen crest and crowberry

- 2008, PHOTO 28, Plot 08-041 crowberry, black berry, or *Empetrum nigrum*
- 2008, PHOTO 29, Plot 08-030 *Oxytropis arctica* var. *bellii*, on ridge crest
- 2008, PHOTO 30, Plot 08-043 cobble crest of ridge

6.2 Ridge Slopes (RCsl)

The slopes of eskers and drumlins are typically associated with heath tundra, but may be composed of boulder fields, lichen-heath–Cetraria and lichen-heath–hair lichen communities with a high percentage of *Cetraria* lichens, birch seep associations, or even specialized snowbank communities. The plant association occupying a particular ridge slope is affected by the amount of moisture and the texture of the soil. Where solifluction creates ridges or terraces on the slopes, water can accumulate, allowing a different plant association to develop. These different associations often form distinct bands across the slopes (2008, PHOTO 31). Here, hair lichen is on the most exposed area, Labrador tea in the depression, bearberry on the slope, and black crowberry on the next crest.

Representative photos of this community association are identified below:

- 1998, PHOTO 25, Plot 98-115
- 2008, PHOTO 31, Plot 08-D06, bands of vegetation on terraced slope, hair lichen, Labrador tea, bearberry, and crowberry

7.0 SNOWBANK COMMUNITY (SB)

Snowbank communities are small, but distinct plant associations that usually occur on a steep slope where large snowdrifts accumulate on lee slopes in winter. These deep snowdrifts persist long into the summer, creating unique conditions that prevent most plants from growing there**.** The growing season for plants under the snowdrift is much shorter than that of the rest of the area. In addition, the plants growing adjacent to the shrinking snowbank are supplied with abundant water early in the season when the snow is available, then have limited access to water for the remainder of the growing season. Two photos (1998, PHOTO 26 and 1998, PHOTO 27) illustrate the variability of a snowbank community at different times of the season. The 1998, PHOTO 26 was taken in mid-June while the snowbank remained, and the 1998, PHOTO 27 was taken in mid-July after the snow was gone.

Due to the unique habitat characteristics of the snowbank community, a number of specialized species occur on these sites, but no where else, as they cannot compete with other species in locations where the snow does not accumulate. These include New England dwarf willow (*Salix herbacea*) (1998, PHOTO 28), blue mountain heather (*Phyllodoce caerulea*) (2008, PHOTO 32), and a grey mealy lichen (*Stereocaulon tomentosum)* (2008, PHOTO 33). Other plants that often occur in snowbank communities include snow cinquefoil (*Potentilla nivalis*), alpine chickweed (*Cerastium alpinum*), yellow anemone (*Anemone richardsonii*), dwarf buttercup (*Ranunculus pygmaeus*), arctic alpine fleabane (*Erigeron humilis*) and mountain sorrel (*Oxyria digyna*). A few sedge plants may occur on these slopes, mostly *Carex membranacea* and *C. scirpoidea*, and the fine arctic blue-grass, *Poa arctica,* often grows in small tufts in the heaths (Figure A7-5). At the edges of the snowbank community, where the growing season may be significantly longer, net-veined willow (*Salix reticulata*), white arctic heather, and

Marsh Labrador tea may form dense patches. Where a snowbank community is adjacent to a wetland, cloudberries often carpet the ground (2008, PHOTOS 34 to 36). Around the persistent snowbank, taller willows (such as *Salix calcicola*) and swamp birch occur on the steeper parts of the slopes. Blueberries and crowberries may form an understory beneath these taller plants. In the wettest areas, sedges (such as *Carex atrofusca, C. scirpoidea, and C. rariflora*) are the only plants that can survive.

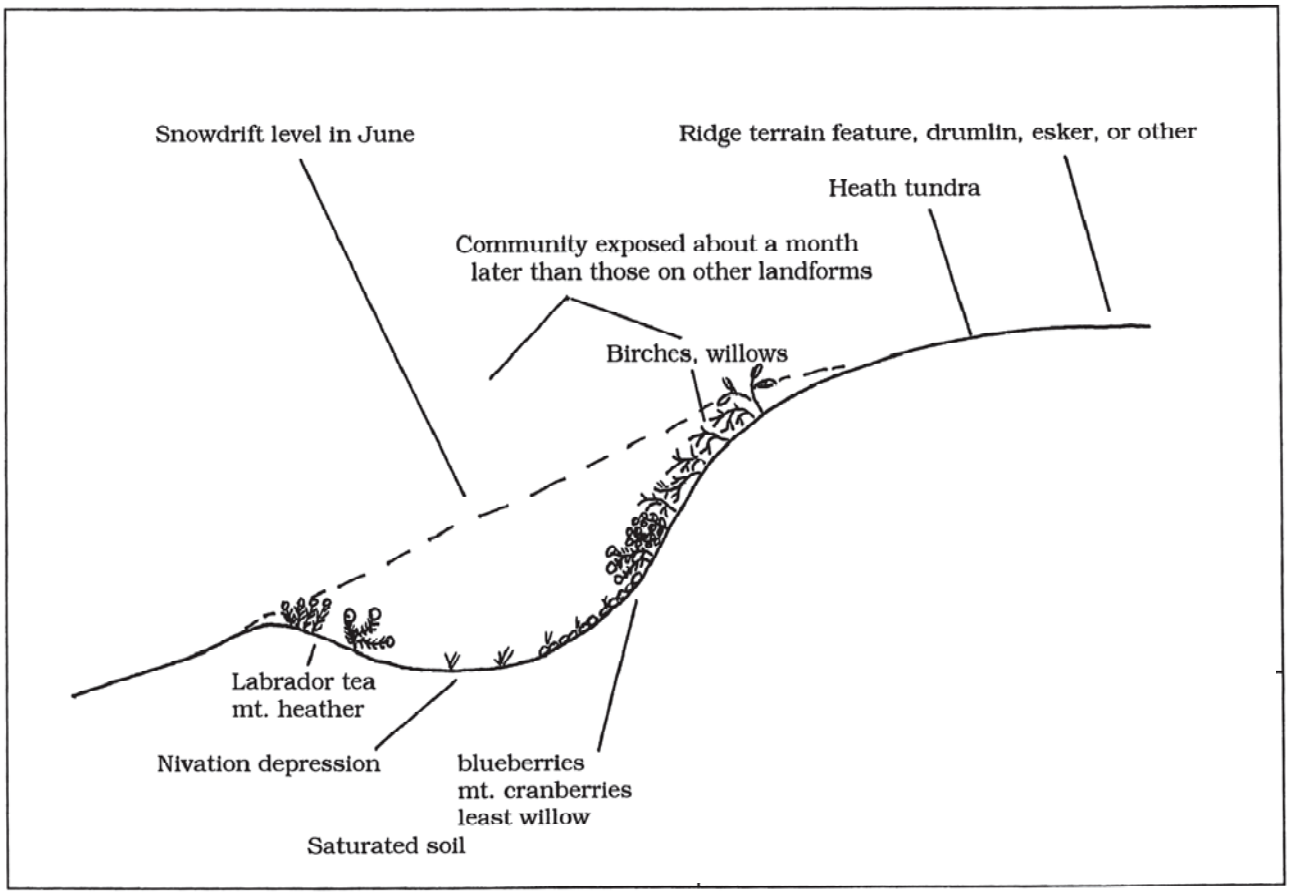

Figure A7-5: Profile of Snowbank Community

In the LSA, the relief of the land is so slight that long-lasting snowdrifts are rare, as they are not of sufficient size to persist into late July or August. Hence, snowdrift communities, though present, are neither abundant nor easy to identify, except in late June, when most of the snow cover has melted, but the drifts remain. As the prevailing winds in winter along the Hudson Bay coast are usually from the northwest, snowbank associations are typically found on southeast- or south-facing slopes.

Representative photos of this community association are identified below:

- 1998, PHOTO 26, Plot 98-011
- 1998, PHOTO 27, Plot 98-038
- 1998, PHOTO 28, Plot 98-227, New England dwarf willow (*Salix herbacea*)

- 2008, PHOTO 32, near Plot 08-015, blue mountain heather (*Phyllodoce coerulea*) in lee of esker
- 2008, PHOTO 33, Plot 08-048, *Stereocaulon tomentosum* lichen
- 2008, PHOTO 34, Plot 08-048, snowbank community in lee of small bedrock ridge
- 2008, PHOTO 35, Plot 08-048, cloudberry, least willow, and moss in snowbank community
- 2008, PHOTO 36, Plot 08-048, aqpiq berry, also cloudberry (*Rubus chamemorus*)

8.0 LICHEN-ROCK COMMUNITIES (LR)

The lichen rock community is characterized by crustose lichens growing on the boulders or rocks that predominate on eskers or rocky plateaus. The lichen rock community is typically interspersed among other community types where boulder fields may be common (e.g., the heath tundra community or lichen-health – Cetraria community), but this community type refers to the specific plant community that is defined by lichens growing on rock surfaces. Within the lichen rock community, 5 non-mappable plant association units could be differentiated as follows:

- Boulder fields/streams, felsenmeer, heath tundra - boulders(LRb/HTb);
- Cobbles/gravel on ridges (LRb/RCc);
- Rounded/polished bedrock outcrops (LRrpol);
- Fractured bedrock outcrops and shattered bedrock (LRrf); and
- Cliff faces (LRrcf).

Representative photos are identified below:

- 1998, PHOTO 29, Plot 98-028
- 1998, PHOTO 30, Plot 98-028 (Close-up)
- 2008, PHOTO 37, Plot 08-027, sunburst lichen (*Arctoparmelia centrifuga*)
- 2008, PHOTO 38, Plot 08-035, rock tripe (*Umbilcaria* sp.)
- 2008, PHOTO 39, Jewel lichen (*Xanthoria elegans*)

8.1 Boulder/Shattered Rock Associations (Lrb)

Boulder associations include plants growing on and among rocks larger than cobbles, which cover areas of varying sizes. These plant associations may occupy boulder fields, boulder streams, or felsenmeer (Figure A7-6). For the purposes of this study, “boulders” have been defined as rocks rounded by movement in the continental ice sheets or in water, and have used the term “rocks” or “felsenmeer” to refer to rocks shattered by frost action. Boulder fields are usually composed of rocks rounded by action within the continental ice sheet, or by abrasion in water. Whatever the origin, the rocks are isolated by wind or water removal of the smaller

particles, leaving the larger pieces stranded in a mass that may cover many hundreds of square metres (1998, PHOTO 31). Felsenmeer (from the German for a “sea of rocks”) is defined as an expanse of broken, angular rocks (Pielou 1994), usually from frost weathering of bedrock. If the weathered-out chunks of bedrock do not tumble downslope or are not otherwise removed, the “intense mechanical weathering will bury the bedrock beneath frost-riven debris”, called “felsenmeer” (Bird 1967) (1998, PHOTO 32).

In some areas, boulders or angular rocks are concentrated by frost action that due to repeated freezing and thawing in the ground, causes formation of ice crystals that grow and melt, fracturing rocks and loosening the soil. Fine materials sift downward, and frost action forces larger particles upward, resulting in terrain features composed mostly of boulders or rock particles. On slopes, the rocks forced out in this way (or fractured due to frost action) become arranged into rock stripes or boulder streams (running up and down the hill) or into rock polygons or rock circles on level areas. Boulder streams often have water running deep beneath the boulders.

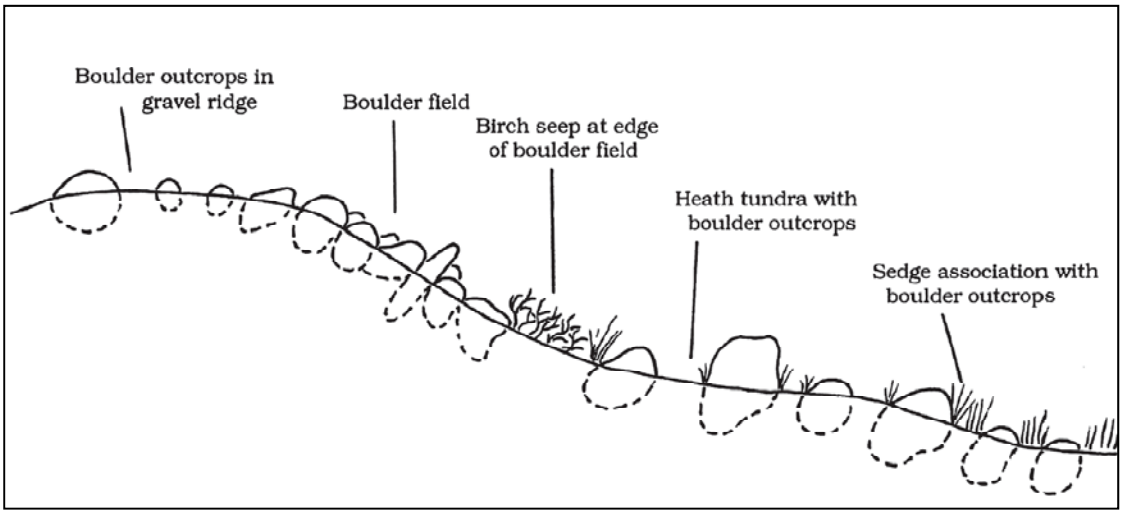

Figure A7-6: Boulder Field and Scattered Boulders

Typically, the rocks or boulders are usually about 80 to 90% covered with crustose lichens, including map lichen, rock tripe, bloodspot lichen, sunburst lichen, *Rhizocarpon geminatum*, *R. geographicum*, *Tremolecia atrata*, *Pseudephebe pubescens*, *Lecidia*, and *Lecanora*. As the crustose lichens thicken, they begin to collect dust and plant fragments. Eventually foliose lichens like *Cladina rangiferina, C. stellaris*, *Flavocetraria nivalis, Cetraria islandica*, *Asahinia chrysantha*, and *Cladonia* form mats between boulders, webbing the boulders together. These mats in turn collect more dust, and seeds of vascular plants, and gradually begin to support a rooted flora.

Crevice-rooted plants like fragrant shield fern (*Dryopteris fragrans*), and prickly saxifrage are among the first to become established, and several heaths, such as black bearberry and mountain cranberry, soon follow. Grasses, such as *Arctagrostis latifolia* and *Hierochloe alpina*, wood-rush (*Luzula arctica*), and sedges (*Carex membranacea*), also become established in the vegetative mats, which by this time form islands among the boulders. The delicate harebell *Campanula uniflora* is occasionally found at the edges of boulder fields. Eventually, vegetation may cover the entire boulder field, at which point the larger boulders appear as outcrops in the tundra.

Smaller rocks like cobbles or gravel often are exposed on the tops of ridges, as the finer materials have blown away. These are covered by 70 to 80% crustose lichens, and often have perched mats of rooted vegetation in small depressions where there is some protection from the wind. These cobble/gravel areas fall into the Lichen-rock boulder association, but also are often part of the Ridge Complex, forming the crest of the ridge.

Representative photos of this community association are identified below:

- 1998, PHOTO 31, Plot 98-099
- 1998, PHOTO 32, Plot 98-087
- 2008, PHOTO 40, Plot 08-035, lichens on old storage cache in boulder field

8.2 Boulders with Heath Tundra (Lrb Or Htb)

The boulders with heath tundra association is defined as being more than 60% boulders, and, in some cases, the boulder fields are almost completely covered with plant matter, to the extent that only the largest boulders are visible. This creates the appearance of heath tundra studded with boulders. The vegetation surrounds the boulders, growing up to their bases, and, in some cases, over part of the rock. In some areas, these boulders are so common that there seem to be more boulders than tundra. In other cases, the ground is littered with glacial erratic boulders, dropped by the ice sheets, and now perched on the surface of the land. In both cases, the plant communities are similar, with heath tundra or sedge associations surrounding the boulders, and lichen associations on the boulders.

Where boulders are scattered, micro-communities exist at the bases of many boulders, with more grasses and slightly taller vegetation growing there. This is likely caused by a slightly higher level of moisture around the boulders due to runoff from the boulder itself or due to the fact that the boulder creates its own snowdrift, which melts, supplying extra water. In some cases, the lush plant growth around these boulders is due to animal activity, especially of arctic ground squirrels (sik siks), arctic hares, and Arctic foxes. Raptors also use large boulders as places to rest, survey for prey, and feed. There are many references to “bird stones” in the literature, referring to these perches and the plant associations that grow up around them. There is one large erratic in the Regional Study Area, which is a traditional rough-legged hawk nesting site, quite unusual, but used almost every year.

Representative photos of this community association are identified below:

- 1998, PHOTO 33, Plot 98-317
- 2008, PHOTO 41, Plot 08-016, boulders in heath and lichen-heath tundra

8.3 Bedrock Outcrops (Lrr)

In the Local Study Area, there are few bedrock outcrops. However, bedrock outcrop landforms are common in the Regional Study Area, particularly on the peninsulas across Meliadine Lake to the northeast of the camp, where the bedrock emerges in outcrops that are weathered, but not reduced to rubble. Most plants occupying the flat rock outcrops are lichens except where heath tundra patches are perched on the rock, or where plants

are rooted in cracks in the bedrock. The exposed bedrock in the Meliadine area is approximately 60 to 80% covered by crustose lichens.

8.4 Rounded Bedrock Exposures (Lrrpol)

Rounded bedrock outcrops were sculpted by the passage of the continental ice sheets, and the resulting polished surfaces make it difficult for plants to establish. As a result, crustose lichens, such as map lichen, rock tripe, and sunburst lichen, cover about 60% of the surface of these outcrops. Soil may accumulate in small cracks caused by weathering or frost action and permit rooted plants to grow. Fragrant shield ferns, prickly saxifrage, star chickweed (*Stellaria longipes*), bearberry, and various mustards like *Draba glabella* and *D. lactea* often occur on these outcrops.

A grey-green moss occurs frequently on glacially-rounded outcrops and other bedrock exposures. Rowe et al. (1977) evidently identified it as "*Rhacomitrium lanuginosum.*" However, Vitt et al. (1988) list a *Racomitrium lanuginosum* as "a common moss of drier acidic alpine habitats throughout the western cordillera....not found at lower elevations east of the continental divide." Whatever its identity, this moss is certainly common. It grows in domed colonies loosely attached to the rock; indeed, it often slides down slope slowly, inhibiting the growth of lichens as it moves, and leaving a distinct path denuded entirely of all lichen growth.

Representative photos of this community association are identified below:

- 2008, PHOTO 42, Plot 08-D04, monitoring plot markers on bedrock with lichens

8.5 Fractured Bedrock Outcrops (Lrrf)

In the Meliadine area, the edges of relatively small outcrops may form small cliffs or a series of crevices. Fractured bedrock outcrops on relatively level ground can blend into felsenmeer, which is similar to a boulder field, except that the rocks are frost-shattered more or less in place and are sharp-sided and angular, not water or ice-rounded. In the crevices, moisture accumulates, and supports the growth of marsh Labrador tea, black crowberry, arctic manzanita (*Arctostaphylos alpina*), mountain sorrel, nodding saxifrage (*Saxifraga cernua*), and occasionally alpine brook saxifrage (*Saxifraga rivularis)*. Fragrant cliff woodfern, prickly saxifrage, and *rock whit-low grass (Draba glabella* take advantage of small cracks in these outcrops. Occasionally *Woodsia* or *Cystopteris* ferns grow under) overhangs where moisture is present throughout the summer, raising the humidity to the level that will permit these shade ferns to grow. Fractured bedrock outcrops also provide areas where soft snow accumulates and provides winter shelter for some burrowing predators, such as weasels and wolverines.

8.6 Cliff Faces (LRcl)

The edges of larger outcrops may form sheer (or almost sheer) vertical faces interspersed with horizontal ledges. Depending on their exposure to wind, cliff faces and accompanying ledges support a varying flora of lichens, with small mats of heath tundra or grasses on ledges, and fragrant shield ferns or prickly saxifrage rooting in small crevices. These are important nesting sites for raptors, such as peregrine falcons, gyrfalcons, and roughlegged hawks. Nest sites are typically marked by the presence of orange lichens like *Caloplaca* and *Xanthoria*, growing where the rock surface is enriched by the "whitewash" from the nesting birds. Major cliff faces do not occur in the Local Study Area, but are present to the northeast, on the north side of Meliadine Lake, and in the vicinity of Peter Lake.

9.0 DISTURBED SITES (DS)

This is a generalized category characterized by distinct plant associations where the surface of the land has been disturbed or nutrients added by animals or man.

9.1 Animal-Disturbed Sites

Animals disturb the soil in several ways, including the creation of burrows, dens, and trails. They also affect plant communities through feeding damage to individual plants, and through the addition of nutrients to frequently used trails, den sites, roosts, feeding, and nesting sites. In certain situations, the influx of nutrients from the decay of a single large animal can affect the plant associations for years to come.

9.1.1 Den Sites (DSd)

Burrowing animals disturb the soil during the creation and use of their burrows. They are selective in their choice of areas for burrows, preferring sandy or loamy soil that can be excavated, and that will support the roof of the burrow. Because conditions that permit burrowing are rare in the Meliadine area, den sites are often re-used over many generations. This traditional use not only maintains the disturbed aspect of the sites, but also continuously adds nutrients to the soil, through the decay of feces, nesting material, deceased animals, and prey items brought to the den by predators.

Within the Local Study Area, most dens found are those of ground squirrels (locally called sik siks) and arctic foxes, as well as a few possible dens of the short-tailed weasel. These are usually located in drumlin or esker material, on the edge of a solifluction ridge, or around large boulders. Burrows of ground squirrels are used year after year, and the animals deposit nutrients regularly, enriching the soil around the burrow entrance. Burrow sites are readily recognizable from a distance, as they are often covered with dense plant growth, and sometimes dwarf birches and willows (*Salix arctica*, *S. brachycarpa* sp. *niphoclada*) (2008, PHOTO 43), but most often, clumps of tall grasses (2008, PHOTO 45).

The loosening of the soil and addition of nutrients permits growth of a number of plant species that may not otherwise exist here. These include blue-green chickweed (*Stellaria longipes*) and several species of grass, including American dunegrass (*Leymus mollis)*, northern reed grass (*Calamagrostis stricta* ssp. *stricta)*, alpine sweet grass (*Hierochloe alpina*), mountain foxtail (*Alopecurus alpinus*), and blue-grass (*Poa alpigena*, *P. alpina*, and *P. arctica*). Heaths, forbs, and small shrubs add to the mix, especially around the openings of the burrows. Northern chickweed (*Cerastium alpinum*), *Draba glabella*, *D. lutea*, snow cinquefoil (*Potentilla nivalis*), mountain sorrel, river beauty (*Chamerion latifolia*), mountain-avens, *Ranunculus pedatifidus*, arctic alpine fleabane (*Erigeron humilis*), and alpine pussy-toes (*Antennaria alpina*) were also typical of these areas. White bladder campion or arctic catchfly (*Silene involucrata*) is sometimes found on the sides of denning mounds (Figure A7-7).

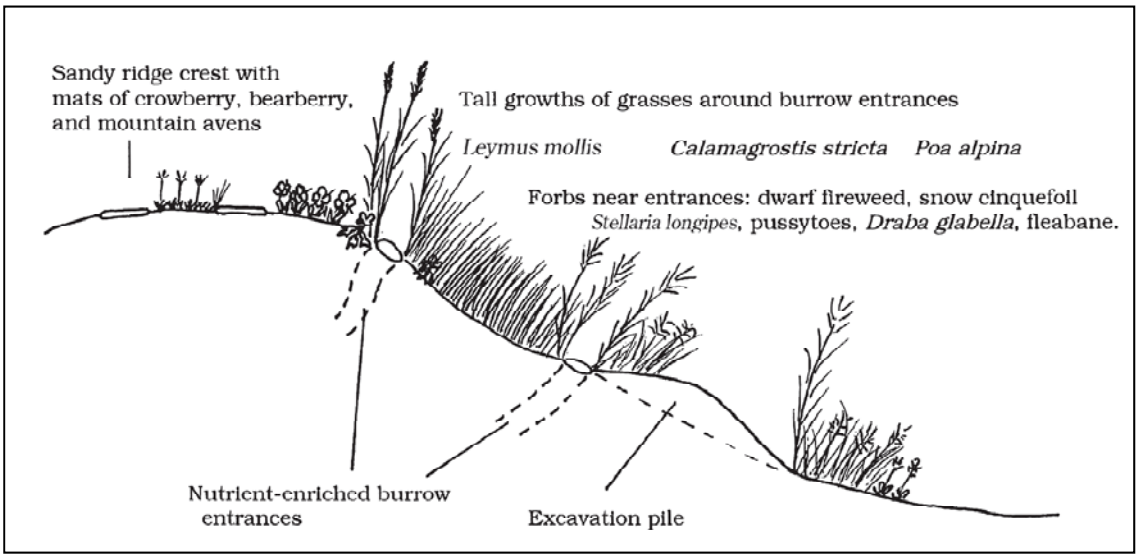

Figure A7-7: Disturbed site, Den Site of Ground Squirrels

Representative photos of this community association are identified below:

- 1998, PHOTO 34, Plot 98-068
- 1998, PHOTO 35, Plot 98-249
- 2008, PHOTO 43, Plot 08-028, burrow hill with birches, note soil fan
- 2008, PHOTO 44, Plot 08-028, close-up of burrow of sik siks (arctic ground squirrel)
- 2008, PHOTO 45, Plot 08-023, burrow hill with dense grasses
- 2008, PHOTO 46, Plot 08-023, heaths around burrow entrance
- 2008, PHOTO 47, Plot 08-035, alpine manzanita (*Arctostaphylos alpina*), fall foliage

9.1.2 Caribou Trails (DStrail)

Caribou trails take on a characteristic appearance depending on the plant community they traverse. Trails in lowland sedge communities tend to be trenches filled with standing water and are most distinct where they pass near the shore, or in wet years. Caribou trails crossing heath tundra or along the sides or tops of the ridges usually appear as light lines through the darker heath-lichen tundra. Up close, it is apparent that the black hair lichen has been worn away, and that the trail is filled with heaths that have grown in from the sides, usually Labrador tea, or the green form of the hair lichen. This creates a light green line through the black lichen (2008, PHOTO 48). Where trails are actively used, and where annual migrations of caribou both churn the soil and add significant fecal material, rich green plant communities develop along the trails, especially in moist areas where rapid decomposition makes the nutrients available to plants on an annual basis. This was not observed in the Local Study Area. Based on the growth of plants in the trails, it is likely that most of the incised trails in the Local Study Area were made when there were much larger herds moving through the area, likely in the 1950s.

Representative photos of this community association are identified below:

- 1998, PHOTO 36, Plot 98-179
- 2008, PHOTO 48, Plot 08-019, caribou trail in heath tundra

9.1.3 Bird Nesting/Feeding Sites, Gulls and Geese (DSng)

Gulls and geese tend to nest on islands in lakes, likely due to some amount of protection from foxes afforded by the open water. Gulls nest on rocky islands, and create little “gardens” around each nest, as they build the nest of pieces of moss and other plant materials, then fertilize the area by defecating while sitting on the nest. Snow cinquefoil (*Potentilla nivea*), common dandelion (*Taraxacum officinale*), blue-green chickweed (*Stellaria longipes*), brooklet saxifrage (*Saxifraga rivularis*), and other forbs form dense growths around each nest, and traditional perching rocks become covered with “whitewash,” making each island obvious. Near the sea, northern bitter cress (*Cardamine digitata*) and scurvy-grass (*Cochlearia groenlandica*) may grow near the nests or in protected areas nearby.

Geese (snow geese and Canada geese) and tundra swans nest on low islands or on narrow peninsulas. Both build nest platforms from mosses, sedges, and other vegetation, and destruction of vegetation is substantial, due to nest-building and foraging activities (Kerbes et. al.1990). The density of nesting geese is not nearly as high in the Rankin area as it is around Arviat and along the southern end of Hudson Bay, but there are some sites with nesting geese.

Geese tend to remain around in the vicinity of the nest while the female is incubating. Their defecation encourages a lush growth of grasses and sedges. They then graze on the vegetation, further encouraging dense growth, and creating a lawnlike effect. This effect was observedin the Local Study Area, mostly in grassy areas, sedge meadows or mossy areas on lakeshores or peninsulas. Geese feed on sedges, especially *Eriophorum vaginatum*, which occasionally grows in mossy shorelines, and through feeding, damage the surrounding moss, but do not feed directly on the mosses. Where there are colonies of snow geese nesting together, the cumulative damage to the vegetation due to overgrazing is substantial (Alisauskas et.al. 2006). Often the mastodon flower (*Senecio congestus*) tends to become common in these areas.

9.1.4 Bird Nesting Sites, Raptors (DSnr)

Many raptors, such as peregrine and gyrfalcons, rough-legged hawks, and ravens nest on ledges on cliff faces if such sites are locally available, although some raptors will nest on the tops of large rocks if there are no cliffs nearby. In each case, the birds not only add nutrients to the area immediately around the nest, but also fertilize traditional outlooks or perching sites. “Whitewash” from birds is high in calcium and nitrogen, and creates miniature areas where specialized plants can grow. Most obvious and characteristic of these are the jewel lichens, *Xanthoria elegans,* and other lichen species, which form bright orange patches on the cliffs around traditional perching sites. In addition, regurgitated pellets as well as bits of dropped prey also decompose in the area, adding nutrients to the site and influencing plant growth. Thus, such species as cinquefoils (*Potentilla* sp.), prickly saxifrage, dandelions, and bluegrasses (*Poa* sp.) tend to develop lush growth in the vicinity of the nests.

Isolated large boulders, especially those on ridges, as well as some inukshuks on ridges, tend to be utilized by raptors (including falcons, hawks, and owls, but also jaegers, gulls, and ravens) as perches. Areas around these stones, occasionally referred to in the literature as “bird stones” (Polunin 1948), are enriched by the addition of

nutrients from bird feces, pellets, and prey, and thick clumps of grasses often grow up around the base of the stone. Arctic hares often use these boulders as shelter, crouching at the base, depositing fecal pellets, which further add to the nutrients.

9.1.5 Faces of Solifluction Slopes - Disturbed by Movement of the Active Layer (DSsolif)

On more distinct solifluction slopes, the face of the moving material churns around, and is occupied by a different plant community that is dominated by a greater percentage of grasses, and blueberries. A number of forbs, including mouse-ear chickweed and chamomile (*Matricaria ambigua*), also occur on these sites.

9.1.6 Hillside Slumps (DSls)

These are similar to solifluction slopes, but are much more limited in nature, most often occurring as a single event rather than an ongoing process. Hillside slumps tend to occur on steeper slopes where a soil mass has slipped downhill, exposing the subsoil. The accumulated mass at the base of the slope usually supports a plant community typical of a disturbed site, with a high percentage of grasses, star chickweed, tansy-mustard, and dwarf fireweed (*Chamerion latifolium*). The exposed slip face is generally characterized by having little to no vegetation cover.

9.2 Sites Disturbed by Human Activity

Human activity disturbs the land in several ways: by the removal of plant cover through abrasion or erosion; by the deposition of additional material; by chemical disruption of the plant cover; or by the changing of the water supply due to construction upslope. Disruption may involve either destruction of plants or addition of nutrients, water, or both, causing the development of a lush flora. It can also involve the uptake (by plants) of larger quantities of metals and other elements than were otherwise available to plants, but this has not yet occurred. Tracking metals uptake by plants and in the soil will be part of the monitoring plan.

9.2.1 Drill Sites (DSdrill)

Areas where diamond drilling activities have taken place are characterized by accumulations of drill mud on the surface of the land, and downslope from the location of the drillhole. Although many of these sites are too recent to have new plant material growing on the drill mud, in cases where the mud was less than 5 cm thick, plants were growing up through the drill mud from below. These are the plants originally covered by the mud, not plants from germinating seeds. Most commonly, it is the willows and the heaths (Labrador tea, white arctic heather, and blueberry) that are the first to penetrate the coating of drill mud. Many drill sites were remediated by WMC International Ltd. in the early years of the project, and by removing most of the drill mud and adding sterilized peat to the ground, re-colonization by plants was accelerated.

9.2.2 Road/Trail Sites (DSrd)

There are several all-terrain vehicle trails (“Honda trails”) through the Local Study Area, which existed before exploration efforts began, and are still being used by area residents to access outpost camps and cabins. There are also a few traces of overland paths created when heavy loads are moved to the exploration camp over the snow by winter road. Honda trails on the uplands generally create an area where the plant cover is worn away, exposing the subsoil or gravel, which is often moved by the tires, creating a ridge along the outside and inside of each track. In sedge associations, trails produce dark lines on the land, where the plant cover is removed or

ground into the peat. Hubert (1998) illustrates this effect particularly well with a photo of a trail running from sedge meadow onto a drumlin (1998, Print #28). During snowmelt and rainy periods, these become flooded ruts.

Plant communities are non-existent in the active trails. Willow roots persist for a while, but are eventually worn through or rot due to damage to their surfaces. Where roads are built, the edges are disturbed but not compressed by traffic, and it is expected that these areas will quickly be invaded by pioneer species like tansy-mustard (*Descurainia sophioides*), dwarf fireweed (*Chamerion latifolium*), and, in sandy areas, Pacific wormwood (*Artemisia campestris)*.

Representative photos of this community association are identified below:

- 1998, PHOTO 37, Plot 98-021
- 1998, PHOTO 38, Hubert Photo #28
- 2008, PHOTO 49, near Plot 08-034, active Honda trails through wetland

9.2.3 Building Sites/Campsites/Fuel Tank Sites (DSc)

Where camps are built, original plant communities are damaged or destroyed in the campsite and in any area where there is extensive human traffic, either vehicular or foot traffic. Comaplex has correctly prohibited the use of wheeled vehicles on the land around the camp, and has constructed boardwalks to reduce the effects of foot traffic on the land, thus minimizing the damage. These reduce but do not entirely prevent the wearing away of the plant communities. In high traffic areas, the plant cover tends to be worn away on the higher, drier sites, and pressed into the peat on the wetter areas. In general, the longer the camp operates, the more effect there is on the vegetation.

The areas where the original vegetation is worn away do not remain unvegetated as “Pioneer species” typical of disturbed sites appear in these areas, often growing in great profusion. In the case of the Meliadine camp, this includes a number of grasses, including *Arctagrostis latifolia*, *Calamagrostis stricta* ssp. *stricta*, *Alopecurus magellanicus*, and several species of bluegrass (*Poa* sp.). Liverworts, small mosses and soil algae also become established, once the competition from heaths and other plants is reduced. Forbs, such as dwarf fireweed (*Chamerion latifolium*), fireweed (*C. angustifolium*), and northern tansy-mustard (*Descurainia sophioides*), are gradually becoming established.

Representative photos of this community association are identified below:

- 2008, PHOTO 50, Meliadine West Gold Project camp

9.2.4 Wastewater Outflows (DSgrey)

“Anthropogenic ecosystems” are those established by human activity, examples include sewage lagoons gravel pits and/oror construction areas. These, especially sedge wetlands associated with sewage lagoons, and the artificially enriched environment at refuse dumps, tend to allow the propagation of plant species that were originally not common in the area. The increase in potential food sources or cover (as well as possible protection from predators) can foster an increase in the number of birds and/or mammals using these “urban environments” (Staniforth 2002). Around sewage wetlands, there would likely be a great increase in the diversity and quantity of

sedges and cottongrasses, as well as algae, creating a “eutrophic oasis” that certainly benefits waterfowl and other birds.

At Meliadine West camp, there is one outflow, below the kitchen and the “dry.” The greywater outflows from kitchens and washing areas both add water to the land and provide nutrients, fertilizing the soil in the immediate area. Over a period of several years, this can encourage the development of a lush growth of vegetation in the outflow area. A lush sedge association has developed there, due to the increased nutrient load. Among the heath species that predated the outflow, there are several species of sedges, including *Carex aquatilis* and *C. membranacea*, a new growth of arctic cotton (*Eriophorum angustifolium*), and several grass species. A filamentous green alga has also become established, and is growing in the little pools of the outflow.

Adjacent to the greywater outflow area, there is an area where a building burned. All debris has been removed; all that is left is the bare spot where it once stood. This is occupied by a thin film of green algae on the soil, some tiny birches, a small white fireweed (*Epilobium palustre*), and a lush growth of liverwort (*Marchantia polymorpha*) including fruiting bodies (2008, PHOTO 53). There are numerous reports in the literature of the tendency of *Marchantia polymorpha* to colonize areas after fire (Matthews 1993), so its presence here is not surprising.

Representative photos of this community association are identified below:

- 2008, PHOTO 51, Plot 08-049, greywater outflow area below kitchen building
- 2008, PHOTO 52, Plot 08-049, marsh willowherb (*Epilobium palustre*)
- 2008, PHOTO 53, Plot 08-049, liverwort (*Marchantia polymorpha*)

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APPENDIX A.
SUB-APPENDIX 1 (1998).
MELIADINE WEST GOLD PROJECT
REPRESENTATIVE PHOTOS, INFRASTRUCTURE AREA

PHOTOS FROM 1998

The following are photos from the 1998 vegetation baseline studies, which illustrate the various plant communities and associations found in the infrastructure area at the Meliadine West Gold Project.

Taken before digital cameras were in wide usage, the pages of the original sub-appendix have been scanned from original prints from 35 mm film.

The captions text has not been changed from the original.

In the text, we have retained the original photo designations, adding 1998 before the photo listing and adding “98” to the plot designation (example: **1998, PHOTO 1, Plot 98-235, emergent sedge association**).

Aqpiq, or cloudberry, *Rubus chamaemorus*. This plant is typical of hummock areas, and at the edges of sedge associations.

PHOTO 1. Sedge community. Emergent vegetation association. Plot 98-235; text reference 1.1.1.

PHOTO 2. Sedge community. Non-tussock sedge association in riparian area to west of camp. Plot 98-4 (phenology plot); text reference 1.1.2.

PHOTO 3. Sedge community. Non-tussock sedge association with distinct stream channels. Plot 98-225, text reference 1.1.2.

PHOTO 4. Sedge community. Tussock association. Plot 98-307, text reference 1.2.

PHOTO 5. Sedge-heath tundra transition. Tussock zone. Plot 98-257; text reference 2.1.

PHOTO 6. Sedge to heath tundra gradual transition on slope. Plot 98-285; text reference 2.2.

PHOTO 7. Heath tundra on solifluction ridges in sedge community. Plot 98-9; text reference 2.3.

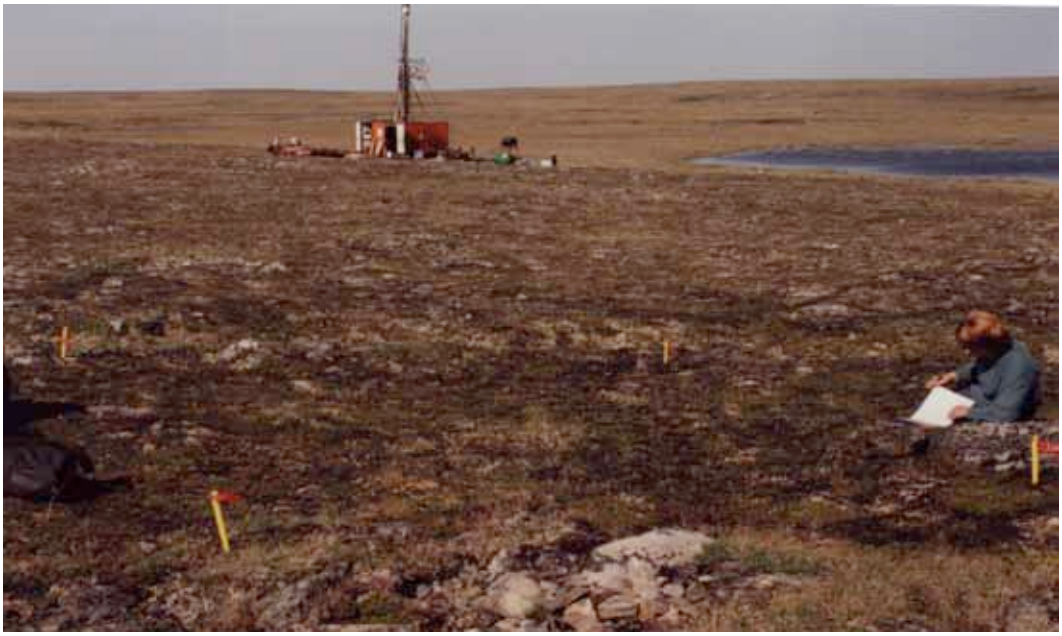

PHOTO 8. Upland heath tundra. Plot 98-133; text reference 3.1.

PHOTO 9. Upland heath tundra, detail with mountain cranberries, bearberry, Labrador tea. Plot 98-270, text reference 3.1.

PHOTO 10. Heath tundra on solifluction slope, showing distinct solufluction lobe. Near Plot 98-327; text reference 3.2.

PHOTO 11. Heath tundra on crest of solifluction lobe. Plot 98-331; text reference 3.2.

PHOTO 12. Heath tundra on frost scar, “turf-rimmed mud circle”. Plot 98-181; text reference 3.3.

PHOTO 13. “Mud boil” in sedge community. Plot 98-127; text reference 3.3.

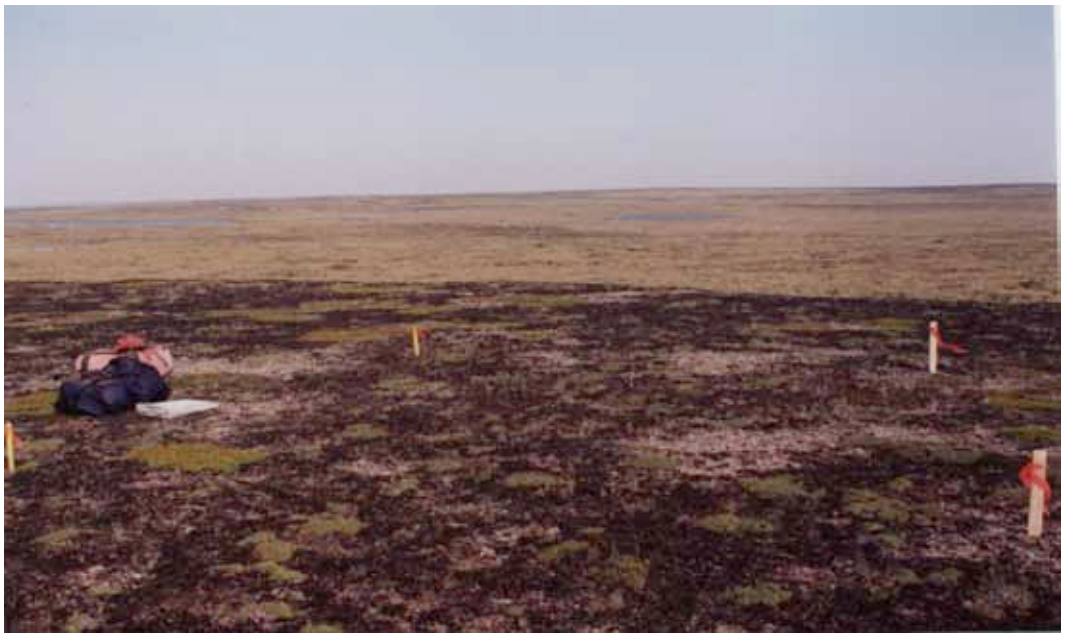

PHOTO 14. Lichen-heath tundra, hair lichen association. Plot 98-88; text reference 4.1.

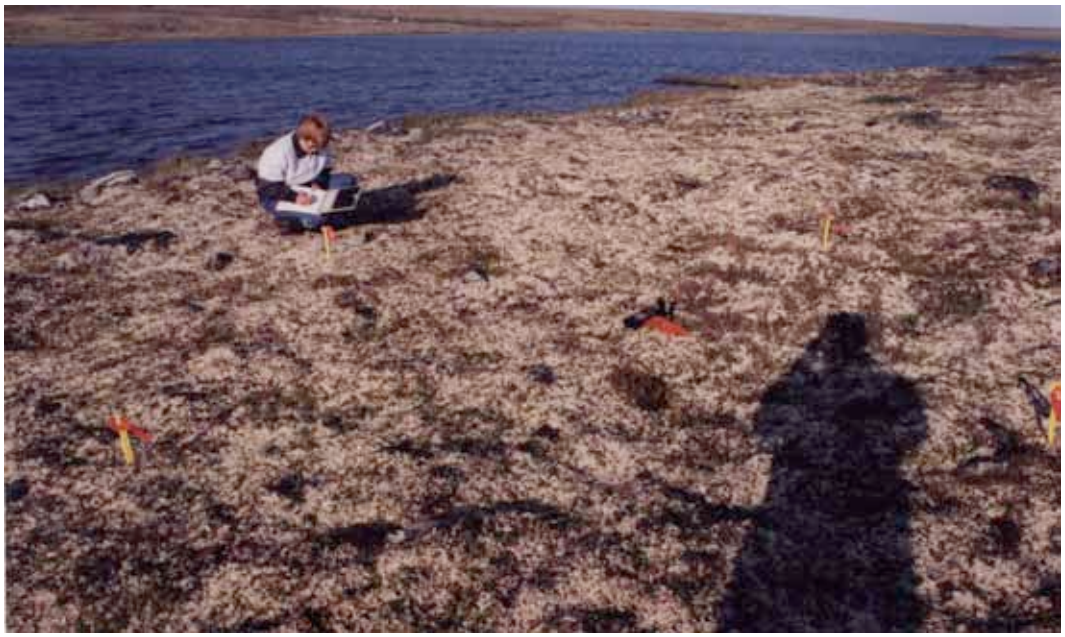

PHOTO 15. Lichen-heath tundra, *Cetraria* lichen association. Plot 98-157; text reference 4.2.

PHOTO 16. Lichen-heath tundra, detail of *Cetraria* lichen assocation. Plot 98-157; text reference 4.2.

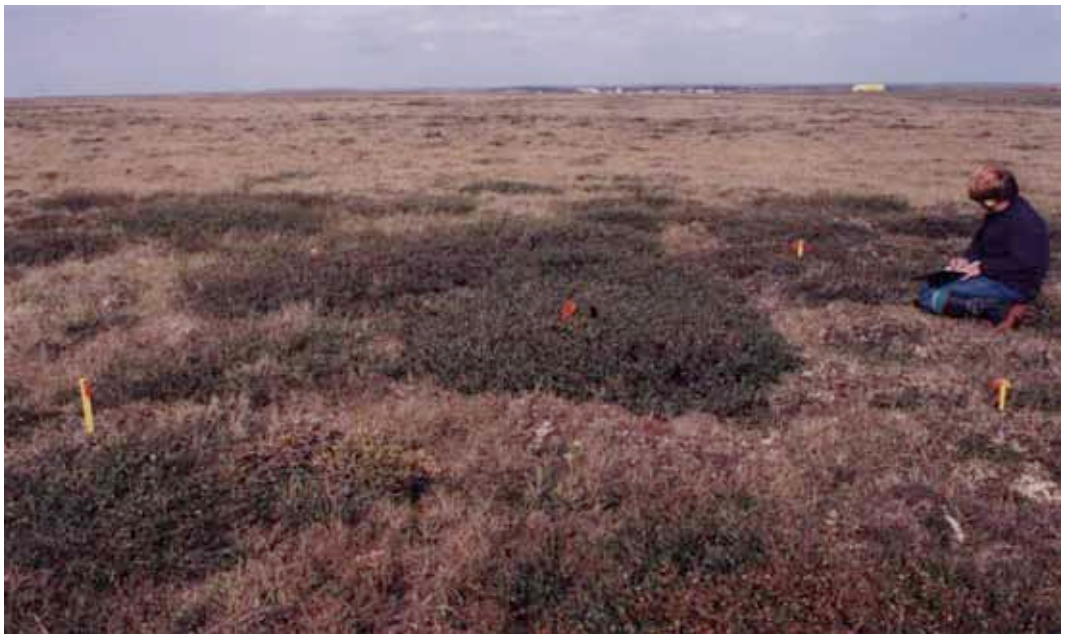

PHOTO 17. Birch “seep” community. Plot 98-183; text reference 5.

PHOTO 18. Birch “seep” community; detail. Plot 98-109; text reference 5.

PHOTO 19. Willow riparian community. Plot 98-279; text reference 6.

PHOTO 20. Shoreline moss association with cloudberries in bloom. Plot 98-47; text reference 7.

PHOTO 21. Cloudberries, detail. Plot 98-47; text reference 7.

PHOTO 22. Lichen-rock community; ridge crest cobbles. Plot 98-16; text reference 8.1.

PHOTO 23. Ridge complex, crest with vegetation mats in gravel. Plot 98-323; text reference 8.1.

PHOTO 24. Ridge complex; sandy ridge crest with bearberry and crowberry mats. Plot 98-35; text reference 8.1.

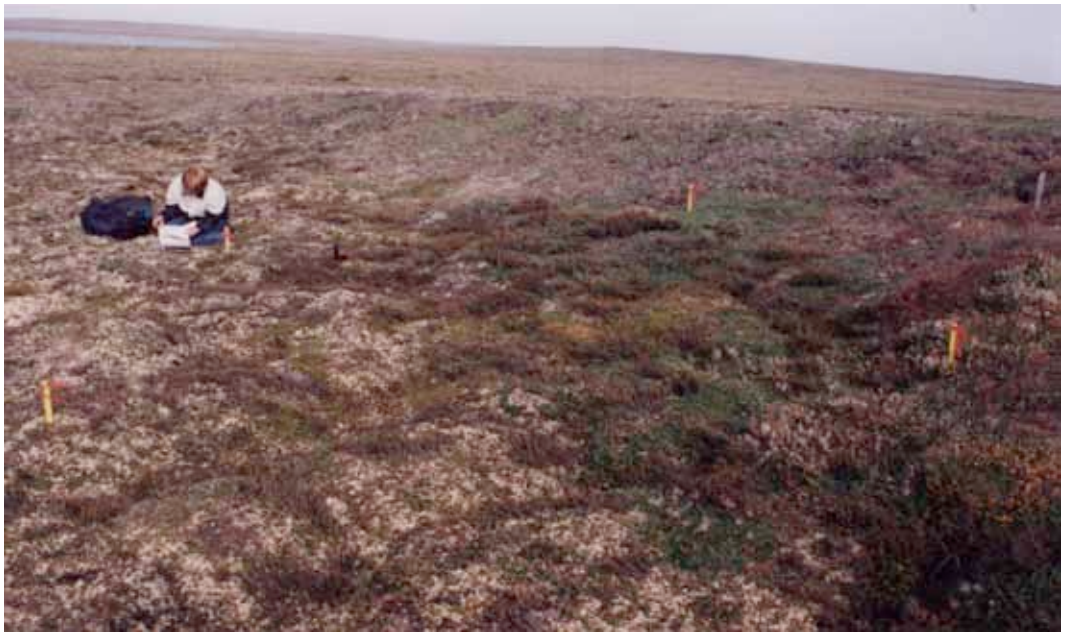

PHOTO 25. Ridge complex; slope with lichen-heath/*Cetraria* association and birch seep. Plot 98-115; text reference 8.2.

PHOTO 26. Snowbank in lee of ridge in June, showing approximate extent of snowbank community. Plot 98-11/38; text reference 9.

PHOTO 27. Snowbank community in July. Plot 98-11/38; text reference 9.

PHOTO 28. "Typical" snowbank plant, least willow (*Salix herbacea*). Plot 98-227; text reference 9.

PHOTO 29. Large glacial boulder partially buried, with heath tundra extending onto the top surface, otherwise lichen-covered. Plot 98-28; text reference 10.

PHOTO 30. Detail of crustose lichens on rock surface. Near Plot 98-28; text reference 10.

PHOTO 31. Lichen-rock community; boulder field with fragrant shield ferns (*Dryopteris fragrans*) and crowberry (*Empetrum nigrum*) mats. Plot 98-99; text reference 10.1.

PHOTO 32. Frost-shattered boulders in heath tundra. Plot 98-87; text reference 10.1.

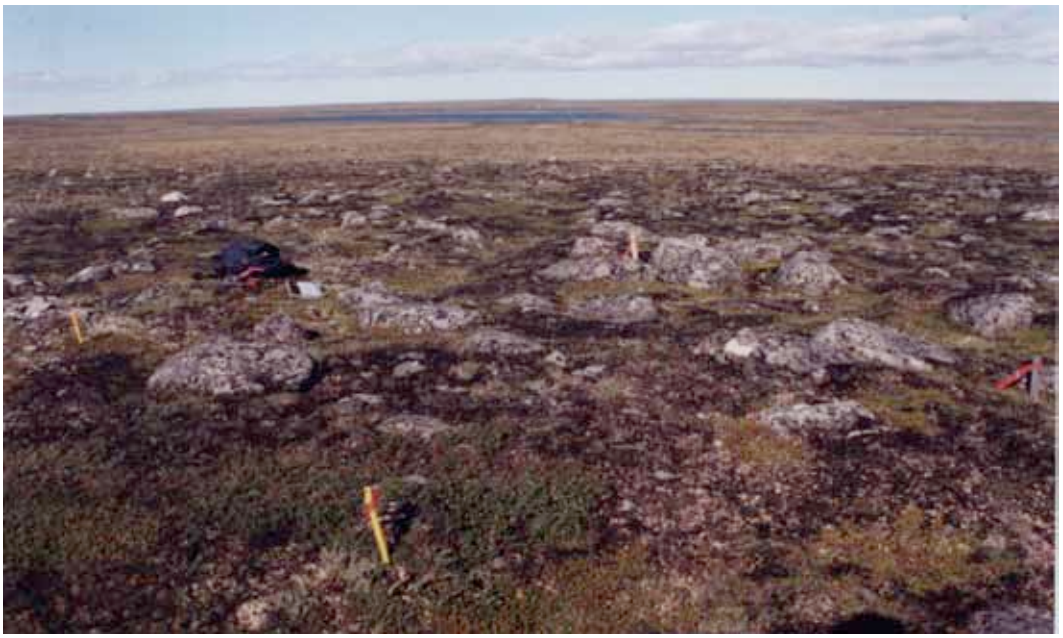

PHOTO 33. Lichen-covered boulders in heath tundra. Plot 98-317; text reference 10.2.

PHOTO 34. Grassy den site on top of ridge, in heath tundra. Plot 98-68; text reference 11.1.1.

PHOTO 35. Grassy den site on small drumlin ridge above pond. Plot 98-249; text reference 11.1.1.

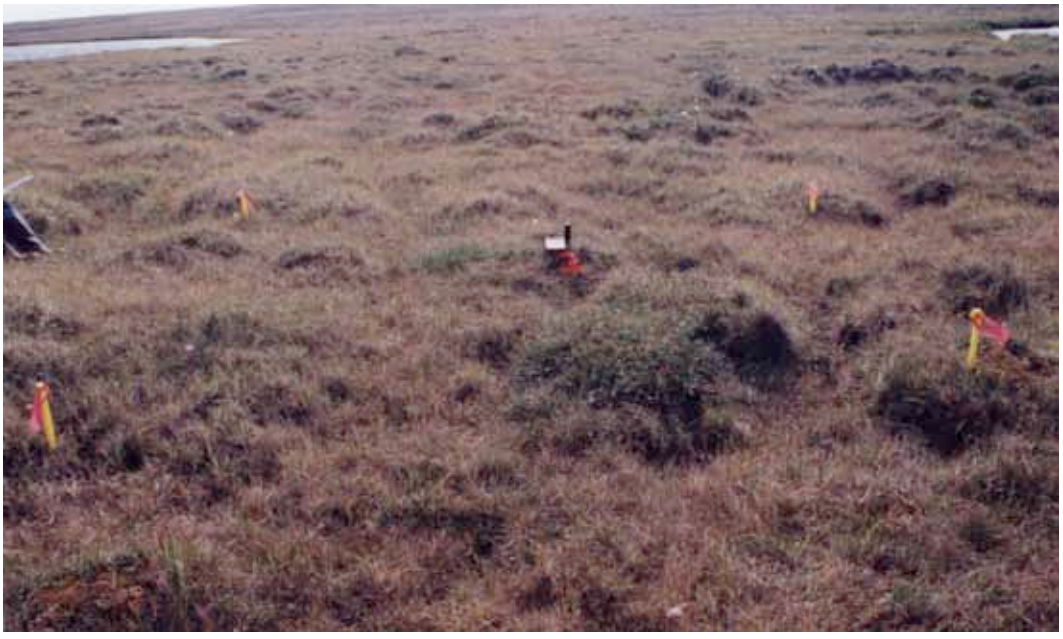

PHOTO 36. Old caribou trails in sedge community. Plot 98-179; text reference 11.1.2.

PHOTO 37. Disturbed site; Honda trail on top of ridge, through lichen-heath community. Near Plot 98-21; text reference 11.4.2.

PHOTO 38. Honda trail running from sedge community onto drumlinoid ridge. Photo by Ben Hubert. Text reference 11.4.2.

APPENDIX A.
SUB-APPENDIX 2 (2008).
MELIADINE WEST GOLD PROJECT
REPRESENTATIVE PHOTOS, INFRASTRUCTURE AREA

PHOTOS FROM 2008

The following photos from the 2008 vegetation baseline studies, illustrate the various plant communities and associations found in the Local Study Area at the Meliadine West Gold Project.

Tall cottongrass (*Eriophorum angustifolium*) on the bank of the Meliadine River. Typical non-tussock sedge association species.

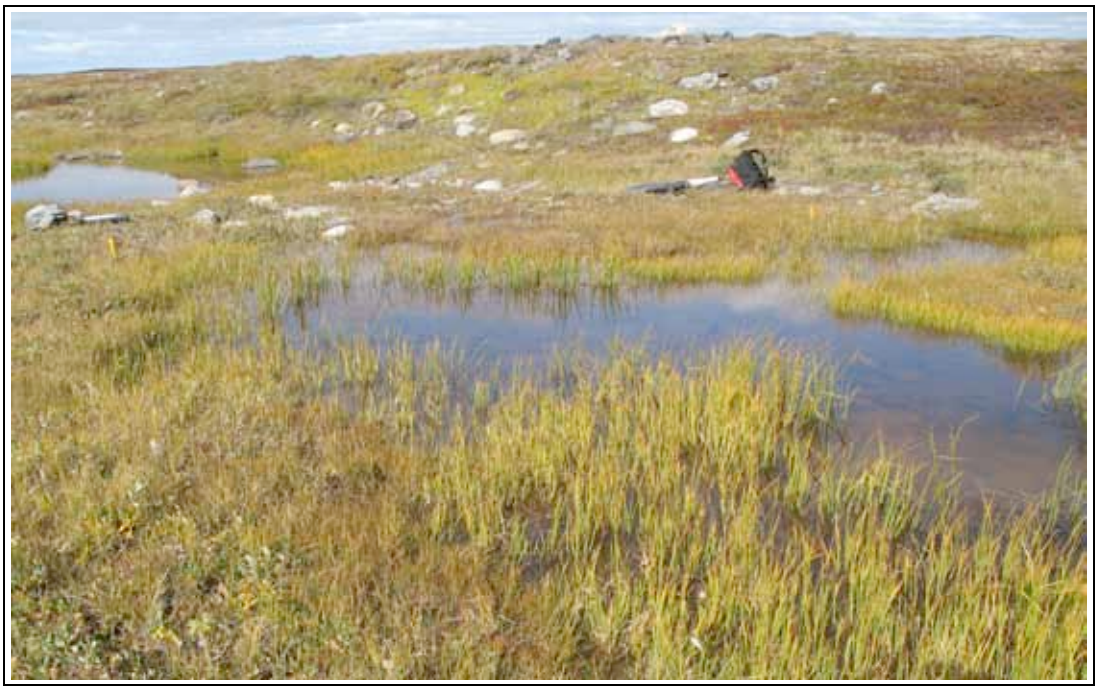

PHOTO 1. Plot 08-025. Emergent sedge association on small pond near Meliadine River crossing.

PHOTO 2. Near Plot 08-040. Emergent sedge association on small pond, interior.

PHOTO 3. Near Plot 08-025. Tall cottongrass (*Eriophorum angustifolium*).

PHOTO 4. Plot 08-018. Non-tussock sedge association at edge of lake.

PHOTO 5. Plot 08-052. Non-tussock sedge association in area south of Peanut Lake.

PHOTO 6. Near Plot 08-035. Small transitory pond showing abrupt transition from non-tussock sedge to lichen-heath on the shore of the pond.

PHOTO 7. Plot 08-033. Tussock sedge association with tufted bulrush (*Trichophorum caespitosum*) at edge of wetland.

PHOTO 8. Plot 08-046. Sedge to heath tundra transitions, hummocky terrain with tufts of *Eriophorum vaginatum*.

PHOTO 9. Plot 08-046. Close-up of tussock, showing colonization by heaths.

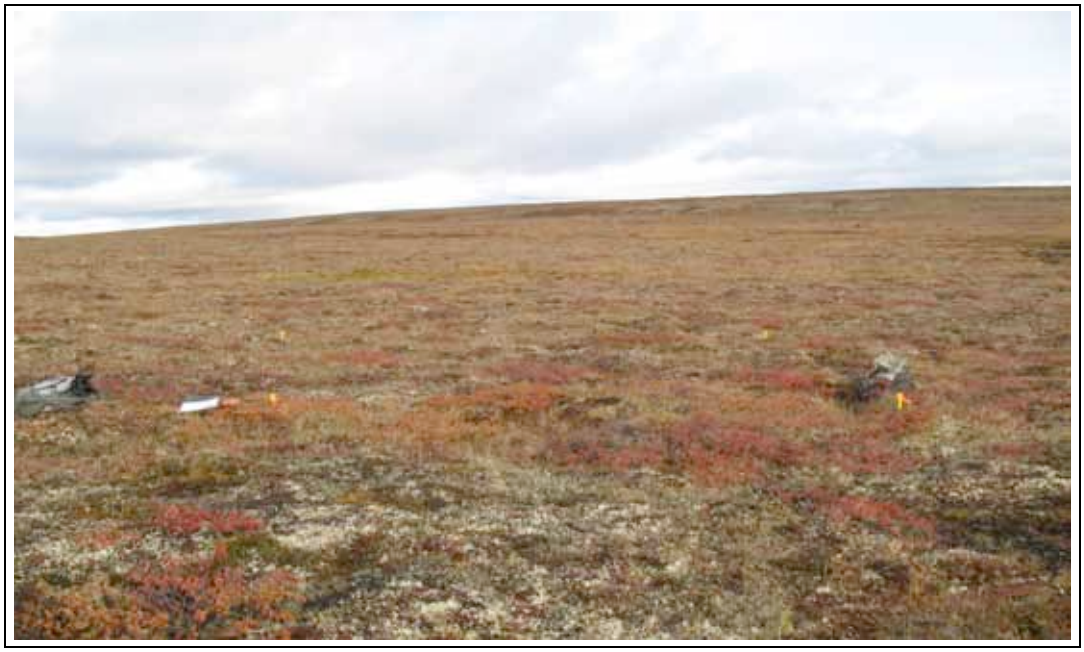

PHOTO 10. Plot 08-050. Sedge to heath transition, gradual change on slope.

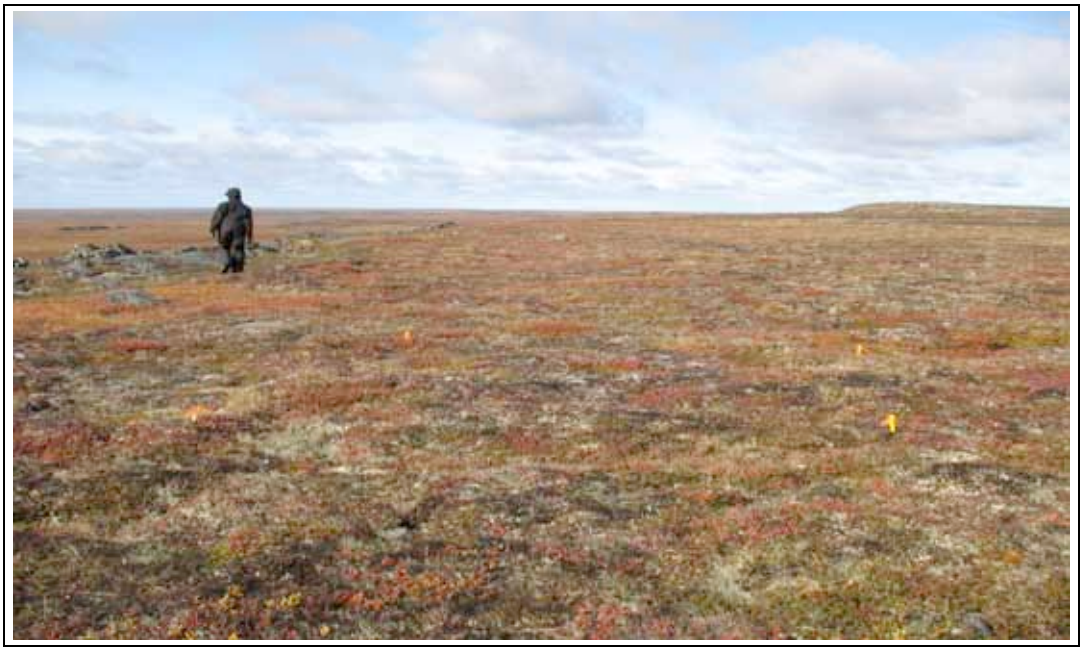

PHOTO 11. Plot 08-D01. Upland heath tundra on the Discovery deposit.

PHOTO 12. Plot 08-022. Close-up of upland heath tundra with blueberries, lingonberries and Labrador tea.

PHOTO 13. Near Plot 08-007. Solifluction lobe on opposite slope of valley. Dark line is shadow of ridge plus darker woody vegetation in the lobe.

PHOTO 14. Plot 08-D03. Frost boil, margin of lichen-heath with both hair and Cetraria lichens, centre without much vegetation at all.

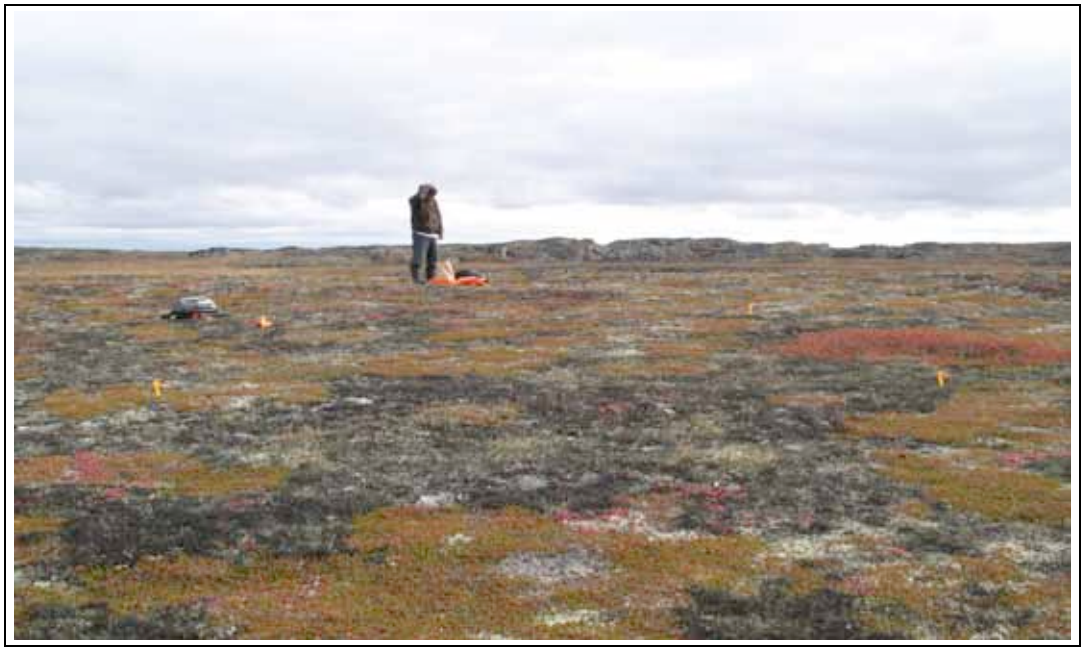

PHOTO 15. Plot 08-042. Lichen-heath with hair lichen dominating, on ridge crest.

PHOTO 16. Plot 08-D07. Lichen-heath with hair lichen. Caribou trails outlined in green hair lichen.

PHOTO 17. Plot 08_D07. Lichen-heath with hair lichen, close-up.

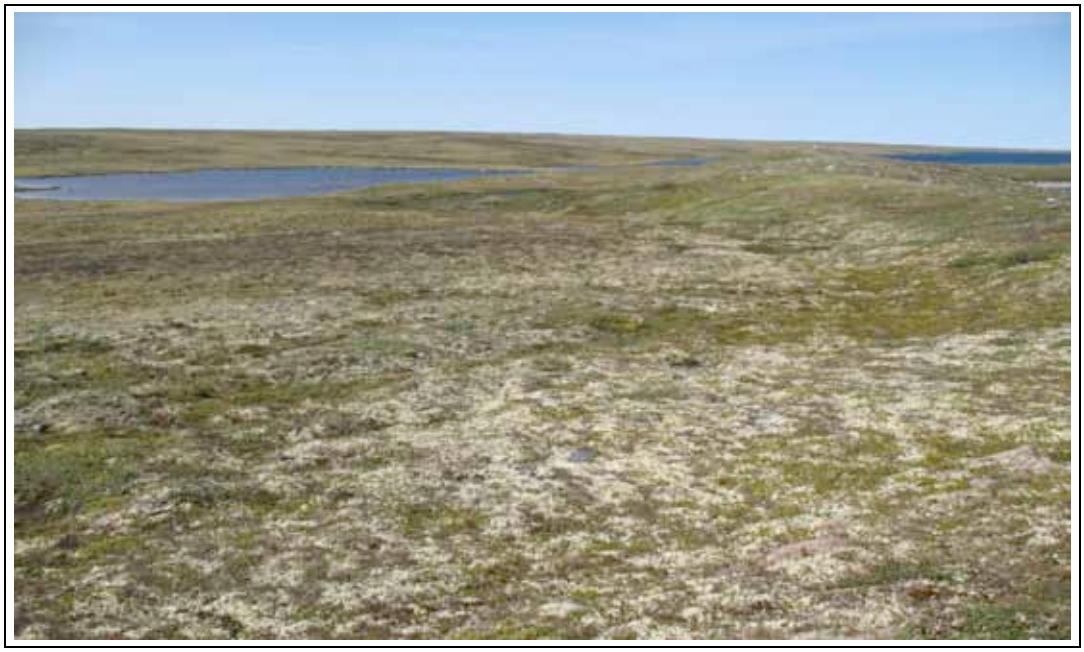

PHOTO 18. Near Plot 08-015. Lichen-heath with *Cetraria nivalis*.

PHOTO 19. Plot 08-040. Birch seep between pond and Honda trail.

PHOTO 20. Dwarf birch (*Betula nana*) leaves in fall.

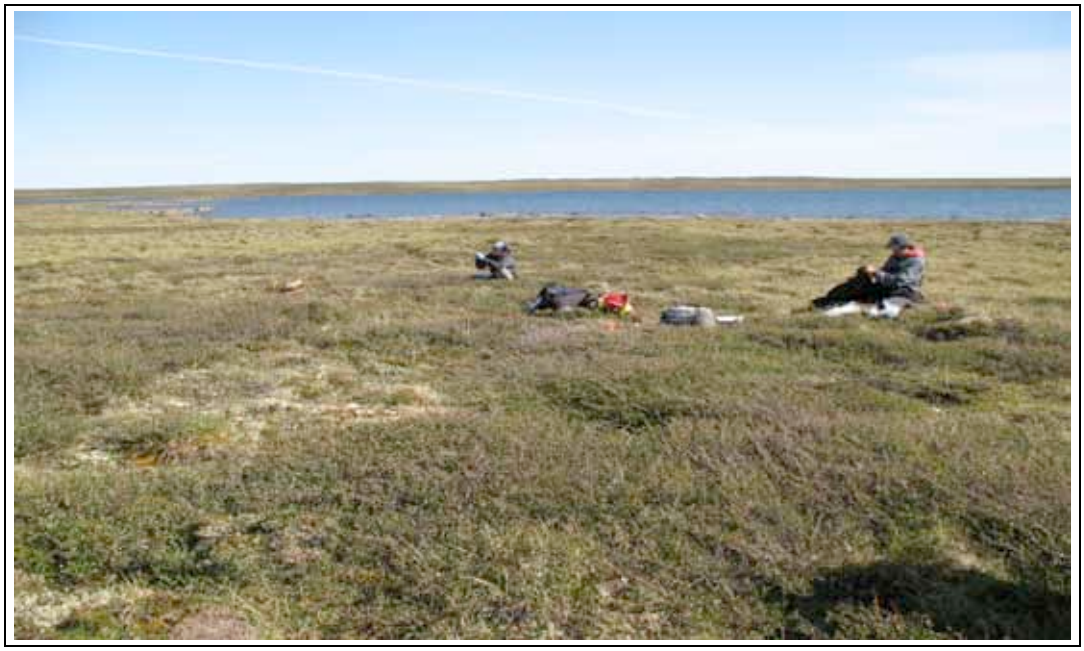

PHOTO 21. Plot 08-013. Birch seep on gentle slope on esker, birches wind-pruned.

PHOTO 22. Plot 08-015. Birch seep on steep esker slope, birches taller due to protection.