Environmental Impact Statement

Long Harbour Commercial Nickel Processing Plant

Volume 2

Biophysical Environment

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1.0 Introduction

This volume describes the existing biophysical environment and presents the effects assessment for biophysical Valued Ecosystem Components (VECs). The section on Existing Environment provides perspective on the regional and local environments and summarizes relevant data useful for the prediction of effects. In large measure, the first chapter in this volume draws on, and provides a summary review of, the Component Studies prepared and submitted for Government review as per the EIS Guidelines. The Component Studies form part of this EIS and should be referred to where a more detailed description of the existing biophysical environment is sought.

Each section under Existing Environment describes the regional setting followed by the local environmental setting at the Project site. Three study areas that have been defined for this EIS:

1. Terrestrial Environment – general area within a 10 km radius of the Project site;
2. Atmospheric and Freshwater Environment – airshed and waterbodies within a 10 km radius; and
3. Marine Environment – Placentia Bay with emphasis on the eastern side and Long Harbour.

The second part of Volume 2 contains the effects assessments on the VECs. This part of the EIS contains the prediction of effects for the Construction, Operation, and Decommissioning phases of the Project, the effects of potential accidents, and the cumulative effects of the Project in combination with other planned and ongoing activities.

The major sections of this volume present the assessments of identified VECs as established by the EIS Guidelines and confirmed through VBNC (now Vale Inco NL) consultations. Particular attention has been paid to accidental events because of their potential to result in significant effects; however, it is notable that the corporate target is to achieve zero unplanned discharges to the environment. Wherever helpful, Vale Inco NL has used modeling to predict the fate and effects of any planned discharges. These tools are a valuable means to identify patterns and provide feedback to ongoing design; however, by nature they produce conservative projections.

2.0 Existing Environment

Placentia Bay is a diverse and productive ecosystem that has been of economic, social and cultural importance to humans for centuries. It contains large seabird colonies of international significance, relatively large populations of Bald Eagles and river otters, a number of Atlantic salmon rivers, and important human enterprises such as the commercial fisheries (including aquaculture), an oil refinery and a transshipment terminal, shipyards, ports, and cultural and tourism facilities. This ecosystem is composed of a number of inter-related physical, chemical, biological and human components.

Information on this ecosystem was gathered from the libraries of Memorial University, Fisheries and Oceans Canada, and the consultants who prepared this document. In addition, VBNC and Vale Inco NL conducted a number of original Component and supporting studies:

- Air Quality (SENES 2007a, 2007b);
- Terrestrial Environment (JWL 2007);
- Freshwater Environment (AMEC 2007a);
- Marine Environment (LGL 2007); and
- Ecological and Human Health Risk Assessment (Intrinsik 2007, 2008).

These studies were prepared by specialist consultants on behalf of VBNC and Vale Inco NL. The Component Studies were subjected to detailed Government and public review and formal acceptance as comprising baseline description documents that provide information to assist in the prediction of environmental effects. The specialist technical studies provided necessary input to, and support for, the predictive statements made with respect to anticipated environmental effects.

2.1 Atmospheric Environment

The Project site is a predominantly rural area located on the southwestern portion of the Avalon Peninsula, on the east side of Placentia Bay. The closest industrial activities within Placentia Bay include the Vale Inco NL Demonstration Plant at Argentia, the Come By Chance oil refinery, the Newfoundland Transshipment Terminal, the Marine Atlantic Ferry Terminal, the Port of Argentia, the Marystown Shipyard, the Cow Head Fabrication Facility, and commercial fisheries and associated processing plants.

Ambient monitoring data obtained from Newfoundland Department of Environment and Conservation describe the existing environment in the vicinity of the Project Area (B. Lawrence, pers. comm.). All the data described in this section are from monitoring stations in close proximity to a known emission source. Since there are no significant emission sources near to the proposed Project, the actual baseline concentrations there are expected to be lower than any of the reported data.

2.1.1 Particulate Matter (PM10 and PM2.5)

Table 2.1 summarizes measurements of airborne particulate matter with a mass medium diameter <2.5 microns ($PM_{2.5}$) at two monitoring stations at the Argentia Demonstration Plant, and three monitoring stations operated by North Atlantic Refining Limited (NARL). Only one station (NARL) collects PM_{10} (<10 microns) data.

Table 2.1 Measured Concentrations of $PM_{2.5}$/PM_{10} (µg/m^3)

Station	Approximate Distance and Direction from Site	Data Period	Averaging Time			
			Annual (µg/m^3)	24-hour (µg/m^3)		
				Maximum	90th Percentile	98th Percentile
Argentia – Runway	17 km southwest	Oct-05- Oct-06	2.8	20.9	6.1	11.0
Argentia – Roadway	17 km southwest	Oct-05- Oct-06	2.4	14.2	5.1	8.5
NARL – Tricentia	40 km northwest	Jan-02 – Jan-05	5.5	62.9	8.1	11.8
NARL - Come By Chance	50 km northwest	Jan-02 – Jan-05	5.4	52.2	8.2	11.7
NARL – Gardner $PM_{2.5}$	50 km northwest	Jan-02 – Jan-05	5.2	60.4	8.1	11.4
NARL - Gardner PM_{10}	50 km northwest	Jan-02 – Jan-05	7.3	69.9	11.7	16.8
Key: NARL - North Atlantic Refining Limited.						

PM levels in the atmosphere are a function of both natural and anthropogenic sources. 'Background' PM is generally defined as the distribution of PM concentrations observed in the absence of anthropogenic emissions including precursor emissions of VOC, NO_x and SO_2. The actual magnitude of background PM for a given location is difficult to determine because of the influence of long-range transport of anthropogenic particles and precursors. The range of expected background concentrations on an annual or long-term basis is from four to 11 µg/m^3 for PM_{10} and one to five µg/m^3 for $PM_{2.5}$ for remote sites in North America (Health Canada 1998).

The annual average $PM_{2.5}$ concentrations from the Argentia Demonstration Plant, and the PM_{10} concentration from the North Atlantic Refining Limited (NARL-Gardner) site fit within this range of typical rural concentrations.

The average annual PM_{10} concentration measured at the NARL-Gardner site is also in the range of measurements made in 1998 at three monitoring locations in Argentia (NewfoundKnowledge Inc. 1999):

1. Water Reservoir 4.7 µg/m^3;
2. Pearce Peak 4.2 µg/m^3; and
3. Fox Harbour 6.7 µg/m^3.

Based on these data, it is estimated that the background concentration of PM_{10} is in the order of five $\mu g/m^3$. The average one-hour concentrations over one year of measurements at the Argentia Demonstration Plant suggest that the background concentrations at the Project site are in the order of 2.5 $\mu g/m^3$. This level is also in agreement with data from monitoring sites across Canada that show that approximately 50 per cent of PM_{10} is made up of $PM_{2.5}$.

2.1.2 Nitrogen Dioxide (NO_2)

The closest monitoring stations that measure NO_2 are located approximately 50 km east of the Project site. These five stations are operated by Newfoundland and Labrador Hydro, and the available data are limited to one or two months in 2005.

The average annual ambient NO_2 concentrations range from 1.8 to 2.8 $\mu g/m^3$ at locations close to potential sources (Table 2.2). Due to the lack of significant proximate sources of NO_2, the average background concentration of NO_2 is anticipated to be less than two $\mu g/m^3$ at Long Harbour.

Table 2.2 Measured Concentrations of NO_2 ($\mu g/m^3$)

Station	Distance and Direction from Site	Data Period	Averaging Time			
			Annual ($\mu g/m^3$)	24-hour ($\mu g/m^3$)		
				Maximum	90th Percentile	98th Percentile
NL Hydro – Butterpot	Approximately 50 km east	Feb-05	2.8	7.4	4.7	6.6
NL Hydro - Green Acres		Feb-05	2.5	7.2	4.0	6.9
NL Hydro – MAAMS		Jan-05, Feb-05	1.8	7.3	3.3	5.3
NL Hydro - Indian Pond		Feb-05	2.5	8.2	4.3	7.2
NL Hydro - Lawrence Pond		Jan-05, Feb-05	2.0	6.3	3.9	5.1

Key: NL Hydro – Newfoundland and Labrador Hydro.

2.1.3 Sulphur Dioxide (SO_2)

SO_2 monitoring data are available for several locations northwest and east of the Project site. The annual average SO_2 concentrations range from three to eight $\mu g/m^3$ (Table 2.3).

For comparison, NewfoundKnowledge Inc. (1999) reports annual average (1998) SO_2 concentrations for three sites in Argentia:

1. Water Reservoir 0.4 $\mu g/m^{3;}$
2. Pearce Peak 0.6 $\mu g/m^3$; and
3. Fox Harbour 3.4 $\mu g/m^3$.

Table 2.3 Measured Concentrations of SO_2 (µg/m^3)

Station	Distance and Direction from Site	Data Period	Averaging Time			
			Annual (µg/m^3)	24-hour (µg/m^3)		
				Maximum	90th Percentile	98th Percentile
NL Hydro - Butterpot	Approximately 50 km east	Jan-02-Jan-04	3.0	44.5	43.2	44.4
NL Hydro - Green Acres			3.8	68.1	48.6	65.5
NL Hydro - Indian Pond			5.6	251.1	110.9	235.9
NL Hydro - Lawrence Pond			7.3	111.5	67.1	88.0
NARL - Tricentia	40 km northwest		3.2	166.2	158.9	164.7
NARL - Come By Chance	50 km northwest		7.1	86.6	54.6	77.3
NARL - Gardner	50 km northwest		8.2	94.2	62.3	76.0

Key: NL Hydro – Newfoundland and Labrador Hydro.
NARL - North Atlantic Refining Limited.

Overall, the SO_2 concentrations recorded at all three sites were low, with the exception of occasional elevated levels associated with activities at the Come By Chance Refinery. The higher annual average concentration at Fox Harbour may be due to local sources (NewfoundKnowledge Inc. 1999).

Based on the range of data presented above, the background SO_2 concentration in the vicinity of the Project site is anticipated to be on the order of three µg/m^3.

2.1.4 Existing Noise Levels

There are no measured sound level data (historical or recent) for the Long Harbour area (E. Dwyer, Vale Inco NL, pers. comm.). Long Harbour is a predominantly rural area. The closest residences to the Project site are located about 0.5 km away, on the north side of the harbour. Ambient sound levels are probably typical of a small coastal community, i.e., relatively low with the possible exception of the demolition works and scrap metal site described below. Local vehicle and boat traffic likely compose most of the background noise.

Historically, Long Harbour was an active area and would have routinely been subject to industrial noise. The lower site (Tier 1) and surrounding area was used from 1969 to 1989 by Albright and Wilson Americas Limited (AWA), and was decommissioned in the mid-1990s.

Long Harbour Development Corporation has subleased its portion of the site to Marex Inc., which has been demolishing the unused facilities. Newco Metals, a scrap metal dealer, also operates at the site, barging scrap from the existing wharf, which Marek Inc. has also used to receive salt for distribution around the province; the company also conducts boat repair activities intermittently throughout the year. Canadian Coast Guard vessels dock at the wharf. The site has also seen some incidental offshore oil supply vessel traffic in recent years related to storage of drilling fluids.

Other industrial activities within Placentia Bay add little to the background sound levels at Long Harbour.

2.2 Terrestrial Environment

The western Avalon Peninsula is an area of rolling uplands interspersed with small plateaus at elevations ranging up to 300 m above sea level (asl). The influence of bedrock geology on local physiography is highlighted by the numerous northeast to north-northeast aligned coastal fjords, coinciding with the axis of major folds and faults (NLDNR 2002). Erosional and striation data suggest that an independent ice sheet occupied the Avalon Peninsula, with the main ice dome located at the head of St. Mary's Bay and smaller ice fields located near Collier Bay Brook, just north of Long Harbour. It is likely that this ice remained until approximately 9,000 BP. Surface features of the area have been crafted by these glacial and erosional events, which have left over the Project Site a blanket of till of varying thickness and composition (Batterson and Taylor 2003).

2.2.1 Geology and Soils

The western Avalon Peninsula lies with the Avalon Tectonostratigraphic zone and forms the eastern extent of the Northern Appalachians, with bedrock consisting mainly of Pre-Cambrian igneous and sedimentary rocks, overlain by Paleozoic shallow-marine, terrestrial sedimentary, and minor volcanic rocks (King 1988). In the Long Harbour area, subaerial sedimentary rocks consisting of sandstones, siltstones and conglomerate (Musgravetown Group) are intruded by Devonian granitic rocks composed mostly of fine to medium-grained diorite, gabbro and granite.

Till, commonly occurring as a veneer over bedrock and present throughout the western Avalon, is poorly consolidated and very poorly sorted with a silty-sand matrix. Near Long Harbour the approximate thickness of till is 3.0 m. Glaciofluvial sand and gravel are found in the Project Site, although this sediment is commonly thin.

Soils of the western Avalon Peninsula are predominantly podzolic in nature, formed from the glacial and glaciofluvial tills and sediments that blanket the site. Organic soils occur in depressions and areas of impeded drainage. Mineral soils of the area tend to be strongly acidic (pH less than 4.5) with very low buffering capacity, reflecting the nature of the parent material from which they were derived. A combination of low fertility, moderate precipitation, and a cool climate has resulted in shallow soil profiles, with moderately well defined horizons. For the same reasons, productivity of the soils is poor, with no agricultural potential and low potential for commercial forestry. Organic matter levels in mineral soils range from 0.5 to eight per cent in surface horizons (Heringa 1981).

Baseline studies (JWL 2007a) have shown that soil chemical characteristics are within the ranges of values normally expected for similar soils in North America (Kabata-Pendias and Pendias 2001), being relatively high in iron and aluminum. High levels of manganese have been observed in some locations, and are attributable to surface exposure of manganiferous rocks. Elevated levels of cobalt, selenium and

copper have also been noted at a few sampling sites (JWL 2007a). Soils in the immediate Project site, predominantly of acidic humo-ferric podzols of the Fair Haven and Bauline series (Heringa 1981), have developed from stony and moderately coarse-textured till derived from siltstone, slate, sandstone and granitic rocks. Depending on local topography, soils range from imperfectly drained to well-drained. Bedrock outcrops are common, and surface soils tend to be excessively stony. Soil profile development tends to be somewhat restricted by a cool climate and recalcitrant soil parent material.

The soils near Long Harbour are nutrient-poor, and are classified predominantly as Class 7, with no capability for agriculture due to restrictions of steep topography, exposure of bedrock, and stoniness (Heringa 1981).

2.2.2 Vegetation

The Project site is located within the Southeastern Barrens Subregion of the Maritime Barrens Ecoregion of Newfoundland (Damman 1983). Prior to European settlement, mixed forest stands dominated the Southeastern Barrens Subregion. Intentional and accidental fires combined with the slow growing conditions have since altered the vegetation of the Subregion to extensive areas of heathland barrens and exposed rock. Balsam fir stands are now largely restricted to smaller patches, often in sheltered valleys and on steep slopes. Slope bogs and basin bogs are more common than fens and are scattered throughout the area.

The heathland barrens are dominated by low shrub species, such as crowberry, sheep laurel, Labrador tea, blueberry and leatherleaf, as well as stunted larch, black spruce and balsam fir. The forest stands are dominated by balsam fir with lesser amounts of black spruce. White birch, when present, forms a minor component in the canopy layer. Typical shrub species include willow (*Salix* spp.), Labrador tea, squashberry and red-osier dogwood. Bunchberry and creeping snowberry, twinflower and corn lily often dominate the herb layer.

The wetlands are typically nutrient poor. Typical dominant species include sphagnum moss, bakeapple, bunchberry and pitcher plant, with minor amounts of sedges and grasses.

Project Area

Field investigations (JWL 2007b) indicate that there are six general vegetation community types in and around the Project Area (Figure 2.1). The Project footprint (comprising the two combined options, Hydromet and Matte) is indicated in brown on Figure 2.1 and the area surveyed is outlined in yellow.

Figure 2.1 Vegetation Communities

The vegetation community areas are shown in Table 2.4 and the common and scientific names of the plants are listed in Table 2.5.

Balsam fir forests (BF) cover 762 ha of the area surveyed and dominate the survey area. This forest cover comprises mainly balsam fir with lesser amounts of black spruce and birch within the tree layer. Kalmia, Labrador tea, young balsam fir, and black spruce dominate the shrub layer when present. Typical herb species include creeping snowberry and bunchberry. The moss layer is largely comprised of red-stemmed feather moss, knight's plume and step moss. Parent material, slope position and moisture regime vary throughout the range of the community, which has resulted in a variable composition from near-scrub forest to open mature succession stands.

Scrub Forest/Rock Outcrop (SR) units are scattered throughout the area and are situated on the crest and upper slopes of the rock outcrops. Soils, where present, are shallow and rapidly drained. The trees within this unit are stunted and limited to shrub-size on the more exposed areas. Species include balsam fir and black spruce with lesser amounts of larch. Vegetative cover ranges from moderate to non-existent, and when present, includes common juniper, kalmia, crowberry, reindeer lichen and mosses.

Wetlands were classified according to the Canadian Wetland Classification System (National Wetlands Working Group 1997). Three wetlands, all classed as floating (sedge) fens (SF), cover approximately 3.17 ha of the total area surveyed, and are largely restricted to the southwestern section. Only two SF units were large enough to map at the scale of 1:12,500. Other units were observed during the field surveys, but were isolated and generally less than 200 m^2 or forming narrow fringes around shallow ponds. Typical species within this herbaceous community include bluejoint, sedges, bulrushes, bog aster, and violets. Floating pondweed is a common aquatic submergent species.

Table 2.4 Vegetation Community Areas for the Project Area

Vegetation Community Type	Map Label	Total Area (ha)	Percent within Footprint (ha)
Open water	(OW)	64.03	2.46
Sphagnum bog	(BG)	0.45	0.00
Sedge fen (wetlands)	(SF)	3.17	0.78
Empetrum heathland	(EH)	2.45	2.24
Kalmia heathland	(KH)	20.07	7.14
Scrub forest/Rock outcrop	(SR)	118.49	0.30
Complex of riparian and balsam fir forest	(RP, BF)	15.03	3.92
Logged/Burned/Cleared	(LF)	13.62	1.01
Balsam fir forest	(BF)	762.13	80.88
Riparian	(RP)	3.30	0.14
Complex of balsam fir forest and Logged/ Burned/Cleared forest	(BF, LF)	17.56	0.69
Total		**1,020.31**	**99.55**

Table 2.5 Common and Scientific Names of Plants Found in the Project Area

Tree Layer		**Herb Layer (continued)**	
Balsam fir	*Abies balsamea* >4 m	Northern bedstraw	*Galium boreale*
Mountain white birch	*Betula cordifolia* >4 m	Creeping snowberry	*Gaultheria hispidula*
American larch (tamarack)	*Larix laricina* >4 m	Oak fern	*Gymnocarpium dryopteris*
Black spruce	*Picea mariana* >4 m	Dwarf rattlesnake plantain	*Goodyera repens*
Shrub Layer		Hawkweed	*Hieracium sp.*
Chuckley-pears	*Amelanchier spp.*	Canadian rush	*Juncus canadensis*
Alder	*Alnus rugosa*	Rush	*Juncus spp.*
Balsam fir	*Abies balsamea* <4 m	Bog laurel	*Kalmia polifolia*
Mountain white birch	*Betula cordifolia* <4 m	Twinflower	*Linnea borealis*
Leather leaf	*Chamaedaphne calyculata*	Heart-leaved twayblade	*Listera cordata*
Red-osier dogwood	*Cornus stolonifera*	Canada mayflower	*Maianthemum canadense*
Larch/ Tamarack	*Larix laricina* <4 m	One-flowered wintergreen	*Moneses uniflora*
Labrador tea	*Rhododendron groenlandicum*	Indian pipe	*Monotropa uniflora*
Common juniper	*Juniperus communis*	Sidebells wintergreen	*Orthilia secunda*
Sheep laurel (kalmia)	*Kalmia angustifolia*	Lesser round-leaved orchid	*Platanthera orbiculata*
Sweetgale	*Myrica gale*	Ribbonleaf pondweed	*Potamogeton natans*
Mountain holly	*Nemopanthus mucronatus*	Tall buttercup	*Ranunculus acris*
Black spruce	*Picea mariana* <4 m	Bakeapple	*Rubus chamaemorus*
Choke cherry	*Prunus virginiana* subsp. *virginiana*	Dwarf raspberry	*Rubus pubescens*
Skunk currant	*Ribes glandulosum*	Pitcher plant	*Sarracenia purpurea*
Red raspberry	*Rubus idaeus*	Panicled bulrush	*Scirpus microcarpus*
Willow	*Salix spp.*	Rough-stemmed goldenrod	*Solidago rugosa*
Northern mountain ash	*Sorbus decora*	Spirea	*Spirea latifolia*
Northern wild-raisin	*Virburnum cassinoides*	Tall meadowrue	*Thalictrum pubescens*
		Starflower	*Trientalis borealis*
Herb Layer		Horned bladderwort	*Utricularia cornuta*
Rough bentgrass	*Agrostis scabra*	Lowbush blueberry	*Vaccinium angustifolium*
Purple-stemmed aster	*Aster puniceus*	Violet	*Viola sp.*
Common ladyfern	*Athyrium filix-femina*	Partridgeberry	*Vaccinium vitis-idaea*
Bluejoint	*Calamagrostis canadensis*	Dwarf bilberry	*Vaccinium cespitosum*
Soft-leaf sedge	*Carex disperma*	**Bryophyte Layer**	
Sedge	*Carex* spp.	Reindeer lichen	*Cladina spp.*
Blue bead lily	*Clintonia borealis*	Broom moss	*Dicranum spp.*
Threeleaf goldthread	*Coptis trifolia*	Step moss	*Hylocomium splendens*
Bunchberry	*Cornus canadensis*	Red-stemmed feather moss	*Pleurozium schreberi*
Black crowberry	*Empetrum nigrum*	Knight's plume	*Ptilium crista-castrensis*
Fringed willowherb	*Epilobium ciliatum*	Racomitrium moss	*Racomitrium sp.*
Joe-pye weed	*Eupatorium maculatum*	Sphagnum moss	*Sphagnum spp.*

Much of the riparian habitat (RP) within the area surveyed has been disturbed due to the past channelling of Rattling Brook; as a result, the riparian habitat is poorly defined and variable in vegetation composition and distribution. A smaller area of undisturbed riparian habitat, mapped as a complex with the surrounding BF, occurs sporadically along an unnamed stream to the west of Rattling Brook. Species observed in the shrub layer include red-osier dogwood, spirea, alder, and willow. Typical herbs include bluejoint, sedges, asters, and willow herbs.

The broader heathland barrens habitat is represented in the area surveyed by empetrum heathland (EH) and kalmia heathland (KH) variants and covers approximately 2.0 ha and 14 ha respectively. The EH community type is isolated to one site in the southern part of the survey area, although it is widespread in the South Eastern Barrens Subregion. This open, low shrub community is dominated by black crowberry, kalmia, bakeapple and reindeer lichen. The KH is interspersed throughout the BF forming variable sized patches. This open, low shrub community is drier than the EH community and is dominated in the shrub layer by kalmia, leather leaf and Labrador tea. The herb layer is often sparsely vegetated, while the bryophyte layer is dominated by reindeer lichen and red-stemmed feather moss. Although not field checked, the sphagnum bog (BG) mapped on the western edge of the survey area is likely dominated by sphagnum peat moss. Vascular plants likely present in varying amounts include buckbean, bakeapple, crowberry, leather leaf and bog aster. Minor amounts of sedges, rushes and grass species may also be present.

Approximately 10 ha of the area surveyed has been disturbed recently by fire or logging activities, and is mapped as LF. These areas were observed to be typically comprised of a robust shrub layer of balsam fir, kalmia, and blueberries. Observed herb and bryophytes include crowberry, bunchberry and reindeer lichen. These areas may either revert to forest community types or develop into heathland barrens (as is typically the case in the Southeastern Barrens Subregion), and are not considered a stable vegetation community type.

2.2.3 Forest Resources

The forest surrounding Long Harbour supports a number of activities, both consumptive (including wood harvesting, trapping, and hunting) and non-consumptive (such as recreation and aesthetic uses) (Department of Natural Resources 2006).

The area is used for domestic cutting, indicated by the presence of stumps and cutovers. Balsam fir covers 75 per cent of the 1,020 ha comprising the area surveyed for vegetation in 2006 (JWL, 2007b). The remainder is largely scrub forest, heathland and rock outcrop uplands. A modest portion of the forest is merchantable timber; however, accessibility is an issue due to the rough terrain and lack of access trails.

A portion of the Project site is located within Domestic Cutting Area H-5D (Rattling Brook) in Forest Management District 1 (Avalon Peninsula). One of the designated areas surrounds Sandy Pond (Figure

2.2). The Avalon forests are part of the larger boreal forest ecosystem and are dominated by balsam fir, black spruce, white birch, and larch.

The forests of the Avalon are primarily affected by harvesting, windthrow and insects. Balsam fir forest types are stable (i.e., they naturally come back to the same forest type) following disturbance. Spruce types generally go to another spruce type following fire, but after cutting will go to a more open spruce type or heath in the absence of silvicultural treatment (Department of Natural Resources 2006). This was the site history of large portions of heathland in the Project Area. There was also evidence of insect damage (*Coleoptera* sp.) in some forested areas, and some windthrow and ice damage (JWL 2007b). These areas were small and isolated.

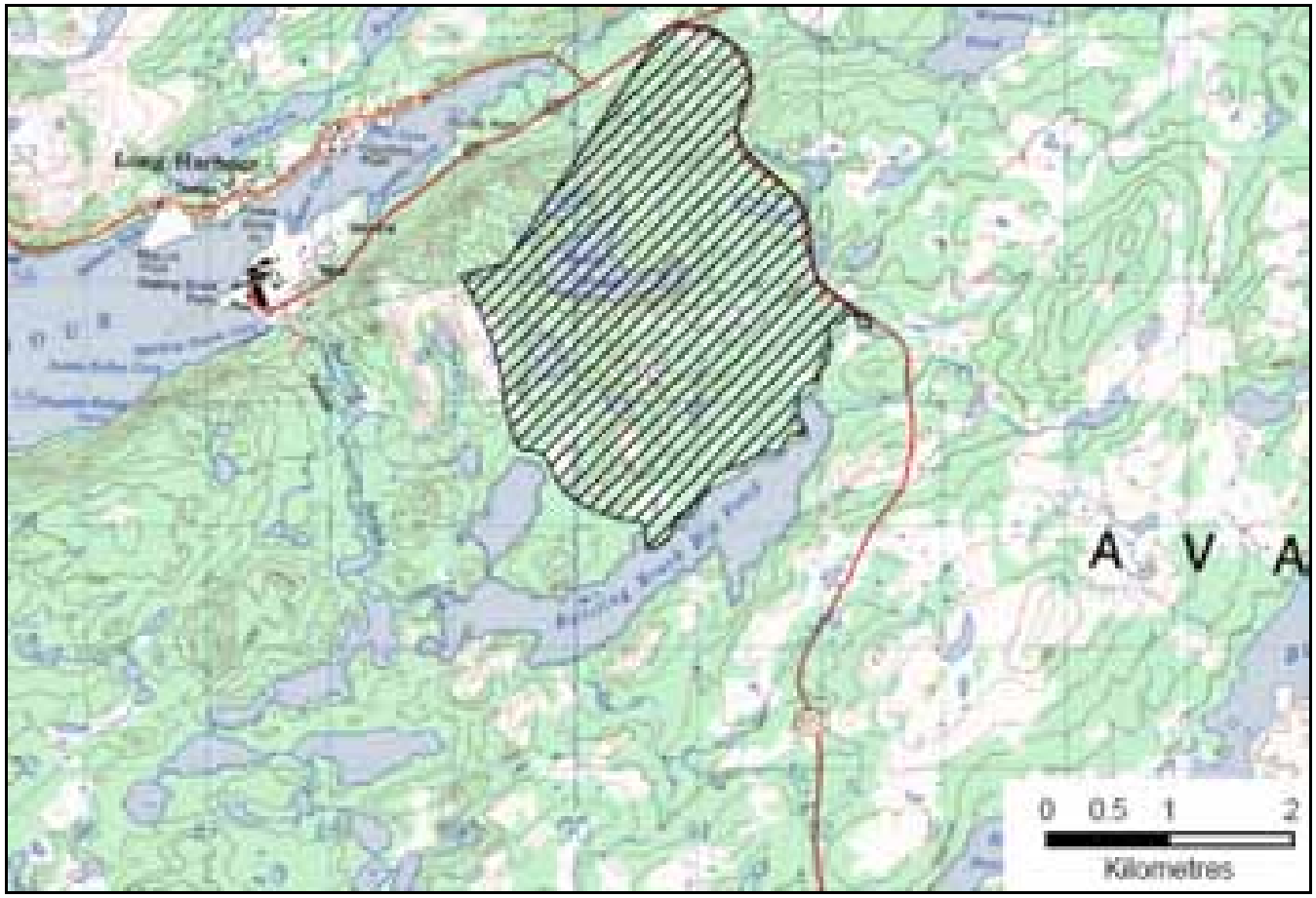


Figure 2.2 Location of Domestic Cutting Area H-5D (Rattling Brook) in Forest Management District 1

2.2.4 Terrestrial Avifauna

Approximately 120 species of avifauna breed, and over 340 species are known to occur, in insular Newfoundland. Recent surveys (JWL 2007b) indicate that at least 34 of these are known to use the Project Area that contains appropriate habitat for many species of terrestrial birds, particularly songbirds. Table 2.6 lists the species observed in and around the Project site and in the area of Long Harbour. Newfoundland, relative to nearby Nova Scotia and Quebec, generally shows a noticeable paucity of avifauna (Peters and Burleigh 1951; Godfrey 1966); approximately one-quarter of the species breeding in Nova Scotia do not breed in Newfoundland (Godfrey 1966). This relatively low diversity of terrestrial species is typical for an island, especially one with a relatively low diversity of habitats. Habitat to support raptors and waterfowl is also considered limited.

Habitats such as the boreal forest, riparian zones, heaths, bogs, and upland scrub provide the nesting and foraging opportunities in this ecosystem. Migratory passerines such as warblers, thrushes, sparrows and flycatchers nest in the trees, shrubs and grasses in the area, and feed on the abundant insects, invertebrates and seeds. The ponds, rivers and wetlands in the area provide some breeding and foraging habitat for waterfowl.

Ruffed Grouse was observed in mixed-forest habitat in the Project site (JWL 2007b). It is likely that this species is using the area year-round, as it has been reported previously (Albright & Wilson Americas 1992). Although no observations of Spruce Grouse were recorded, it is possible that this species also occurs in the area, given the amount of suitable boreal habitat present. Willow Ptarmigan, although undetected on the surveys, may also use the area, specifically barren upland areas where windswept spruce would provide adequate cover.

Suitable habitat also exists for species of raptor to nest and/or hunt in the area. The following discussion of existing conditions considers their current state in and near the Project Area.

Raptors

Raptors (Order: *Falconiformes*) are diurnal, predatory birds that include Osprey, eagles, falcons, hawks and harriers. Diets of raptors range from insects and fish to large vertebrates and carrion. Most species breed in trees, on cliff ledges or in cavities (Gill 1990).

The raptors observed or expected in the area around Long Harbour comprise two Families: *Accipitridae* (Osprey, Sharp-shinned Hawk, Northern Goshawk, Northern Harrier and Bald Eagle), and *Falconidae* (Merlin). The Osprey is a cosmopolitan species found around lakes and coasts around the world, feeding almost exclusively on fish (Chubbs and Trimper 1998; Poole et al. 2002). Ospreys have been previously observed in Long Harbour (Albright & Wilson Americas 1992).

Table 2.6 Species of Birds Observed or Heard in Long Harbour Survey Areas during Point Count Surveys, June 15 to 17, 2006

Common Name	Scientific Name	Project site	Long Harbour
Ruffed Grouse	*Bonasa umbellus*	√	
Greater Yellowlegs	*Tringa melanoleuca*	√	
Wilson's Snipe	*Gallinago delicata*	√	
Herring Gull	*Larus argentatus*	√	
Great Black-backed Gull	*Larus marinus*	√	
Belted Kingfisher	*Megaceryle alcyon*		√
Downy Woodpecker	*Picoides pubescens*	√	
Black Backed Woodpecker	*Picoides arcticus*	√	
Northern Flicker	*Colaptes auratus*	√	√
Yellow-bellied Flycatcher	*Empidonax flaviventris*	√	
Alder Flycatcher	*Empidonax alnorum*	√	
Gray Jay	*Perisoreus canadensis*	√	
American Crow	*Corvus brachyrhynchos*		√
Common Raven	*Corvus corax*		√
Black-capped Chickadee	*Poecile atricapillus*	√	
Boreal Chickadee	*Poecile hudsonica*	√	
Red-breasted Nuthatch	*Sitta canadensis*		√
Golden-crowned Kinglet	*Regulus satrapa*		√
Ruby-crowned Kinglet	*Regulus calendula*	√	√
Swainson's Thrush	*Catharus ustulatus*	√	√
Hermit Thrush	*Catharus guttatus*	√	√
American Robin	*Turdus migratorius*	√	√
European Starling	*Sturnus vulgaris*		√
Yellow Warbler	*Dendroica petechia*	√	
Yellow-rumped Warbler	*Dendroica coronata*	√	√
Blackpoll Warbler	*Dendroica striata*	√	√
Black-and-white Warbler	*Mniotilta varia*	√	√
Northern Waterthrush	*Seiurus noveboracensis*	√	√
Mourning Warbler	*Oporornis philadelphia*	√	√
Common Yellowthroat	*Geothlypis trichas*		√
Wilson's Warbler	*Wilsonia pusilla*	√	
Savannah Sparrow	*Passerculus sandwichensis*	√	√
Fox Sparrow	*Passerella iliaca*	√	√
Swamp Sparrow	*Melospiza georgiana*		√
White-throated Sparrow	*Zonotrichia albicollis*	√	√
Dark-eyed Junco	*Junco hyemalis*	√	√
Pine Grosbeak	*Pinicola enucleator*	√	√
Red Crossbill	*Loxia curvirostra*		√
White-winged Crossbill	*Loxia leucoptera*	√	
Pine Siskin	*Carduelis pinus*		√
American Goldfinch	*Carduelis tristis*		√

The Sharp-shinned Hawk is much smaller than the Osprey, feeding on small mammals and even insects, although its diet is primarily small birds (Bildstein and Mayer 2000). The Northern Goshawk can take a variety of prey, including squirrels, hares, grouse, corvids, woodpeckers and passerine birds (Squires and Reynolds 1997). Northern Harriers forage on the wing, capturing a wide range of prey, mainly small- and medium-sized mammals and birds (MacWhirter and Bildstein 1996). Harriers are mostly found around fields, barrens, and grasslands that are limited to some upland barrens within the Project site. The Bald Eagle (*Haliaeetus leucocephalus*) is an opportunistic forager that eats a variety of mammalian, avian, and reptilian prey, but generally prefers fish to other food types (Buehler 2000). It typically breeds in forested areas adjacent to large bodies of water.

Bald Eagles were observed during VBNC terrestrial surveys in 2006 and by residents during winter and less frequently during summer (JWL 2007b). No nest sites were detected during those surveys within or adjacent to the Project site. Directed surveys for Bald Eagle were conducted as part of the VBNC marine studies and additional detail is contained in the discussion of the marine environment.

Owls (Order: *Strigiformes*) are mainly nocturnal birds of prey that feed on small rodents, shrews, frogs, insects, and birds. Owls usually take over the nests of other birds, the burrows of mammals, or find natural cavities. Great Horned, Northern Hawk, and Short-eared Owls are possibly present in the area, based on available habitat types (Birds of North America Online 2007). The Great Horned Owl is a habitat generalist, breeding in forested habitats throughout the Island of Newfoundland; it has the most extensive range, the widest prey base, and the most variable nesting sites of any North American owl (Houston et al. 1998). The Northern Hawk Owl is mainly diurnal and nests in dead tree stubs or woodpecker holes in open coniferous or mixed coniferous-deciduous forests, burned-over areas, or muskeg (Duncan and Duncan 1998). The Short-eared Owl is an open-country, ground-nesting species that inhabits marshes, grasslands, and tundra throughout much of North America (Wiggins et al. 2006). This species may occur in the area, but is not likely in the Project site, given the lack of suitable open country habitat.

Passerines and Woodpeckers

The Project site provides habitat for passerines and woodpeckers throughout most of the forested areas. The term passerine encompasses flycatchers, crows, warblers, vireos, sparrows, thrushes, wrens, nuthatches, swallows, chickadees, kinglets, grosbeaks, and blackbirds. Many of the species found in the area are migratory and present only during the breeding season, approximately June-September. These birds come to Newfoundland to exploit abundant seasonal food resources (i.e., insects) and raise their young. Some are neotropical migrants, coming from Central and South America, the Caribbean and Mexico; these species include most of the warblers, thrushes, flycatchers, vireos, swallows and blackbirds that breed in Newfoundland. Other species are temperate migrants, coming from the United States to breed and leaving in the fall. These species include the Ruby-crowned Kinglet, sparrows, and the Yellow-rumped Warbler. Other species such as crows, nuthatches, chickadees and grosbeaks are resident year-round in Newfoundland, and are able to exploit seed resources or have adaptations to help them through winter (e.g., food caching, bark gleaning). These species include: Gray Jay and Common

Raven, which employ food-caching and a varied diet to survive winter; Black-capped and Boreal Chickadees, who can switch from insects to seeds or fruit; Dark-eyed Junco, White-winged Crossbill, Pine Grosbeak; and the tiny insectivorous Golden-crowned Kinglet; and some American Robins have overwintered in recent years, surviving on berries.

Woodpecker species in the Project Area are all Newfoundland residents. The Northern Flicker and the Downy Woodpecker are confirmed in the area, and it is likely that Hairy and Black Backed Woodpeckers are also present. They may supplement their winter diets by exploiting birdfeeders and suet.

From current data collected in 2006 (JWL 2007b), bird species richness varied from five to 22 according to habitat. The highest species richness occurred in mixed forest (balsam fir dominant) sites (22), followed by the burns/cuts (19), balsam fir/spruce (18), and riparian sites (17). The spruce (dry) sites had a richness of 11 over two sites, and the spruce (wet) site had a richness of 5. Birds are known to respond to habitat structure and composition, and since mixed forest provides the greatest variety of structure and composition, it supports the greatest number of bird species.

The most abundant species in the area surveyed in 2006 are typical of a migratory boreal forest songbird assemblage (JWL 2007b). Northern Waterthrush and White-throated Sparrow (occurring at essentially every survey point), plus Blackpoll Warbler, Alder Flycatcher, Fox Sparrow and Ruby-crowned Kinglet are all highly associated with boreal forest habitat (Birds of North America Online 2007). These species would be expected to be in greater abundance than the rest of the observed species. Others recorded in abundance were generalist species such as American Robin and Yellow-rumped Warbler, which can exploit several types of forested habitat.

Waterfowl

Several species of waterfowl occur in Eastern Newfoundland: American Black Duck (*Anas rubripes*), Green-winged Teal (*Anas crecca*), Ring-necked Duck (*Aythya collaris*), Common Goldeneye (*Bucephala clangula*), Common Merganser (*Mergus merganser*), and Red-breasted Merganser (*Mergus serrator*). The most common duck species in the Project Area is the American Black Duck (*Anas rubripes*), a large dabbling duck that breeds in freshwater wetlands, brooks, lakes, ponds and bogs throughout the boreal forest (Longcore et al. 2000). The Long Harbour area displays rugged terrain with a mixture of boreal forest cover and peatlands. Beaver are abundant in the many lakes and ponds, and their impoundments enhance potential for use by waterfowl, notably American Black Duck, (Longcore et al. 2000). Waterfowl nesting in Newfoundland are characterized by early-breeding (dabbling ducks and geese) and late-breeding (diving ducks and sea ducks) species.

Black Duck, Northern Pintail (*Anas acuta*), Green-winged Teal, Ring-necked Duck, Common Merganser, and Common Loon (*Gavia immer*) were confirmed as breeding in low densities in the survey area during the breeding season aerial survey on August 2, 2007 (Goudie 2007a). No unusually large aggregations or uncommon species of waterfowl were located, and the area was typical of the

general southeastern barrens ecodistrict. By late July to early August 2007, broods of dabbling ducks in eastern Newfoundland were mostly feathered and almost full grown, whereas diving ducks such as Ring-necked Duck were still in mid to late downy stages, and young Common Mergansers were partially feathered. Overall, the Ring-necked was the most abundant duck species, and biologists detected adult males in eclipse plumage in early August 2007 on wetlands, indicating that some sites were used to complete the annual feather moult. This species is noted for the northward expansion of its breeding range over the past four decades and its exploitation of acidic wetlands, especially peatlands (Goudie 1987). The Common Loon was ubiquitous in the survey area, indicating that many lakes and ponds support healthy fish populations. During a general reconnaissance survey in late winter (March 18-19, 2006,) 23 to 26 American Black Ducks were found in a small pond in the Rattling Brook Big Pond watershed (JWL 2007b). A single Green-winged Teal sighted during a general reconnaissance survey on October 11, 2006, suggested that this individual was using the area as a stopover before continuing migration (JWL 2007b).

2.2.5 Wildlife

The terrain in and around the Project site provides habitat for 13 species of aquatic and terrestrial mammals. Several taxonomic families are represented including: shrews, bats, hares, squirrels, beavers, mice, canids, weasels, cats and deer. The boreal forest, riparian zones, heaths, bogs and upland scrub provide different habitats for mammal species occupying different niches in the ecosystem. Some of these species are semi-migratory or occupy large home ranges, and others are more sedentary, occupying smaller areas. The ponds, rivers and wetlands provide some breeding and foraging habitat for aquatic and semi-aquatic mammals such as mink, beaver, muskrat and northern river otter. Suitable habitat also exists for several forest and open-country species. The following discussion provides a description of mammals that occur in or near the Project site.

Small Mammals

Several species of small mammals are known or expected from the Project site: the common (or masked) shrew (*Sorex cinereus*), introduced in the late 1950s; little brown bat (*Myotis lucifugus*); deer mouse (*Peromyscus maniculatus*); meadow vole (*Microtus pennsylvanicus*); house mouse (*Mus musculus*); and Norway rat (*Rattus norvegicus*) are possible, but the habitat is marginal to support these species.

The common shrew is the most widely distributed shrew in North America. They are found in damp forest habitats. Their diet consists primarily of worms, insects, and snails; they can eat their own body weight in a day. Shrews occur in the Project Area (JWL 2007b).

The little brown bat is found throughout the Island of Newfoundland wherever there are trees, buildings or caves. In summer, they roost in buildings or trees; in winter, they hibernate in frost-free locations such as caves, mineshafts, cellars, tunnels or unoccupied buildings. Little brown bats feed on insects

including moths, beetles, mosquitoes and flies; during summer they consume about half their weight in insects each night, gaining the body fat needed to survive months of hibernation.

The deer mouse, occurring in forests and grasslands throughout Newfoundland, is the most widely distributed small native rodent in North America. Its diet consists of seeds, fruits, fungi, and the eggs and larvae of insects and spiders.

The meadow vole inhabits forest habitat of Newfoundland and has been found at the Project site (JWL 2007). It inhabits wet meadows and open grassland near streams, lakes, ponds and swamps, and eats mainly herbaceous vegetation, grasses, sedges, fruits, seeds, grain, and some snails and insects.

Terrestrial Furbearers

Several species of terrestrial furbearers are known or likely to occur in and around the Project site. These include snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), red fox (*Vulpes vulpes deletrix*), coyote (*Canis latrans*), ermine (*Mustela erminea*), and Canada lynx (*Lynx canadensis subsolanis*).

Snowshoe hares, introduced to the Island of Newfoundland around 1870, occur throughout most of the boreal forest in coniferous, deciduous or mixed habitat. They are a major prey item for carnivores and are considered by many to be a keystone species in the ecosystem, meaning they are crucial to the functioning of the ecosystem as it now exists. Predators that depend heavily on hare abundance include coyote, pine marten (*Martes americana atrata*), red fox, lynx, ermine, Great Horned Owl and Northern Goshawk. Hares exhibit a 9-to-10 year population cycle (Boutin 1995). In spring and summer, they feed primarily in open areas on grasses and herbaceous plants; in winter, they strip bark from young trees or the new growth of woody plants. Evidence of snowshoe hare occurs in essentially all terrestrial habitats in the Project site, particularly where there is cover and adequate food (JWL 2007a).

The red squirrel is the most widely distributed squirrel in North America, generally associated with coniferous forest but also found in mixed-wood and deciduous (Kemp and Keith 1970). It is important to the ecosystem as a prey item for many species such as hawks, owls, coyotes, weasels, lynx and pine marten. Squirrels are omnivorous and have a varied diet including seeds, nuts, berries, fungi, insects, bird eggs, juvenile animals (e.g., birds, rodents, and hares), carrion, and tree bark (Klugh 1927). Squirrels or their sign were regularly observed in Project site in 2006 (JWL 2007a).

The red fox is native to Newfoundland and is found across the island, mostly in semi-open habitats. Its generalist diet consists of small mammals (voles, squirrels, hares and mice), nesting waterfowl, berries, plants, young birds, eggs, and trout (Environment Canada 2006). Sign of this species was often encountered along streams and new and old access trails during surveys in 2006 (JWL 2007a).

Coyotes were first confirmed on the island in 1987, and according to sighting and trapping records, are now widely dispersed. It is believed they made their way from the Canadian mainland to the island on

pack ice, and they were actually sighted coming ashore (Parker 1995). Wildlife officials have documented the expansion of the coyote population in Newfoundland and are investigating their morphology, diet, age structure, and reproductive rates (Government of Newfoundland and Labrador 2004). The Newfoundland wolf (*Canis lupus beothucus*) became extinct in 1930; the coyote has replaced it as the top predator on the island.

Coyotes are generalists in their diet, feeding on small mammals, hares, caribou calves (and sometimes adults), moose calves, birds and eggs, insects, amphibians and berries. They are extremely adaptable and their continued population growth in Newfoundland has been controversial. Despite several eradication attempts throughout North America, coyotes have actually expanded their range (the litter size of a coyote increases with lower densities). In Newfoundland, as elsewhere, populations will likely be controlled more by the amount of available habitat than by management programs. From trapping data, it is probable that the coyote population in and around the Project site is "very low" (M. McGrath, pers. comm.).

Ermine (*Mustela erminea*) are primarily nocturnal hunters feeding on small mammals, hares, birds, insects, fish, frogs, carrion and berries. They prefer riparian forest, marsh, shrubby second-growth, and open areas adjacent to forests. Ermine were observed during surveys associated with the phosphorus plant decommissioning in 1991 (Albright & Wilson Americas 1992).

Lynx prefer old-growth boreal forest, usually with thick cover and usually in areas where the snowshoe hare population has increased. The lynx winter diet consists 75 per cent of snowshoe hare; thus the population cycles of the two species coincide. When prey is scarce – when snowshoe hare numbers are very low – lynx will venture onto the tundra for food (Environment Canada 2006) and supplement their diet with rodents and birds. Moose (*Alces alces*) and caribou (*Rangifer tarandus caribou*) (usually calves) may account for some of the lynx diet, but they rarely attack large prey (Environment Canada website). From trapping data, it is probable that the population of lynx in and around the Project site is "very low" (M. McGrath, pers. comm.). Lynx sign was noted during earlier surveys at Long Harbour (Albright & Wilson Americas 1992).

Aquatic and Semi-aquatic Furbearers

Four species of aquatic and semi-aquatic mammals are known or expected to occur in or around the Project site: northern river otter (*Lutra canadensis*), American mink (*Mustela vison*), American beaver (*Castor canadensis*), and muskrat (*Ondatra zibethicus*).

The northern river otter, part of the weasel family *Mustelidae*, is found throughout North America, inhabiting rivers, lakes, and coasts. Otters feed on fish, insects, molluscs, crustaceans, small mammals, and waterfowl, and occupy relatively large home ranges of 55 to 102 km of linear coastline (Coté et al. in prep.). In coastal areas such as Placentia Bay, otters also forage in the ocean for fish, lobster, and likely other shellfish (M. Pitcher, pers. comm.). Brook trout is likely the primary fish species of choice in Newfoundland freshwater ecosystems, as well as eel, ouananiche, dragonfly larvae and Atlantic

salmon (M. Pitcher, pers. comm.). Directed surveys for otter were conducted during the marine program and results described in that section of this volume.

The American mink also occurs throughout Newfoundland. It is a carnivore, like the otter, and shares a similar diet, but may take a greater proportion of small mammals and birds. Fresh mink tracks were noted in the Project Area in winter 2006 (JWL 2007b). Otters are dominant to mink and will usually kill them if their territory overlaps.

Beavers occupy rivers, streams, marshes, lakes and ponds, and exist in and around the Rattling Brook-Big Pond watershed. Beavers may actually increase habitat diversity by damming small streams, which leads to increased species richness of plants and animals (Snodgrass 1997). While densities in Newfoundland tend to be the lowest in North America (Novak 1987), surveys at the Project site during 2006 indicate that at least one active colony is present. Research elsewhere in Newfoundland indicates this group could represent over six individuals, on average (Payne 1982). This rodent feeds mainly on bark and twigs but will also eat leaves, grasses, herbs, berries and aquatic plants. Their activity in freshwater environments can have considerable localized effects on the physical and biological components of riparian ecosystems (Sigourney et al. 2006). Like other furbearers (aside from the marten), beaver is trapped in Newfoundland (Payne 1984).

The muskrat, also in the rodent family, inhabits marshes, pond and lake edges, and streams throughout Newfoundland, feeding primarily on the roots and stems of aquatic vegetation and sometimes on clams, frogs, and fish. In 2006, a muskrat lodge was found in a wetland near the location of an otter family, but no muskrats were observed (JWL 2007a); it is possible that otters have taken over the lodge.

Big Game

Moose were introduced to Newfoundland in 1878 and 1904, with the second introduction considered successful. The species has rapidly expanded to all parts of the island. Moose prefer coniferous forest, especially near wetlands and lakes with regenerating coniferous trees. Their summer diet consists mainly of aquatic vegetation, deciduous trees, shrubs, and grasses. Considerable evidence of moose was found at the Project site during summer surveys in 2006 (JWL 2007b). It is probable that they use this area frequently, given the number of water bodies present. In summer, moose often cool off in water for several hours each day, foraging and avoiding the irritation of flies (Renecker and Schwartz 2005). Fresh tracks, droppings, bedding areas, and browsed vegetation indicated that moose are common in fall. Browsed species consisted primarily of balsam fir, willow, serviceberry, and white birch.

During winter, moose browse primarily on balsam fir, white birch, pin cherry, and willow; however, they prefer pin cherry followed by birch and willow (Parker and Morton 1978). In periods of excessive snow, their movements become impeded when depths exceed knee deep, and are essentially restricted when at chest height (Renecker and Schwartz 2005). Two wintering areas were identified during the late-winter surveys in 2006, at the outlet of Sandy Pond and on the south and east slopes of a large hill in the vicinity of the Project site (JWL 2007a). Both locations showed repeated use.

Woodland caribou are native to Newfoundland and move about seasonally. In spring they prefer evergreen and deciduous shrubs and sedges; in summer, they eat mainly deciduous shrubs and *Cladonia* spp. lichens, and fungi; in autumn, *Cladonia* spp. lichens; and in winter, arboreal lichens and evergreen shrubs (Bergerud 1972). The most southerly Canadian herd of Woodland caribou (numbering a few hundred animals) exists on the Avalon Peninsula, using the area from the Avalon Wilderness Area south to the Southern Shore. This is the closest caribou range to Long Harbour, approximately 60 km to the east. Caribou are not reported from the Long Harbour area and, since the habitat types they prefer are deficient, the area can be deemed insignificant for this species.

The black bear (*Ursus americanus hamiltoni*) Newfoundland population is recognized as a distinct subspecies. Black bear tend to exist in low densities by nature, and have large territories, making them difficult to monitor. The Newfoundland population was estimated at 6,000 to 10,000 animals and was considered stable in the mid-nineties (Pelton et al. 1994). They have rarely been reported on the Avalon Peninsula and currently do not have an established population there. Lack of sightings indicates it is unlikely that there are black bears using the area around Long Harbour due to the poor bear habitat.

2.2.6 Terrestrial Species at Risk

Avifauna Species at Risk

A total of 14 species or populations of birds occurring in Newfoundland and Labrador have been listed as "species at risk" by provincial and federal legislation (Table 2.7). Eleven of these species/populations may occur in the Placentia Bay area. The temporal and spatial occurrences of the eight of these populations that are primarily terrestrial are described below. The distributions of the three marine species/populations likely to occur in the Placentia Bay are described under Marine Environment.

Table 2.7 Species at Risk in Newfoundland and Labrador as listed by COSEWIC, *SARA* and ESA

	ESA	COSEWIC	SARA
Barrow's Goldeneye (eastern population)	Vulnerable[1]	Special Concern	Special Concern
Harlequin Duck (eastern population)	Vulnerable	Special Concern	Special Concern
Peregrine Falcon (*anatum* ssp.)	Threatened	Special Concern	Threatened[2]
Peregrine Falcon (*tundrius* ssp.)	Threatened	Special Concern	Special Concern
Piping Plover	Endangered	Endangered	-
Eskimo Curlew	Endangered	Endangered	Endangered
Red Knot (*rufa* ssp.)	Endangered	Endangered	Endangered
Ivory Gull	Vulnerable	Endangered	-
Short-eared Owl	Vulnerable	Special Concern	Special Concern
Chimney Swift	-	Threatened	-
Common Nighthawk	-	Threatened	-
Gray-cheeked Thrush	Vulnerable	-	-
Rusty Blackbird	Vulnerable	Special Concern	-
Red Crossbill (*percna* ssp.)	Endangered	Endangered	Endangered

Notes: [1]Vulnerable is a Newfoundland and Labrador designation equivalent to Special Concern for COSEWIC and *SARA*.
[2]*SARA* schedule does not yet reflect recent change in COSEWIC status.

Barrow's Goldeneye Eastern Population

Barrow's Goldeneye (*Bucephala islandica*) is designated as *vulnerable* under the *ESA* and a species of s*pecial concern* by COSEWC and *SARA*. The total population is about 4,500 birds, and the core breeding area is believed to be small lakes at high elevation in watersheds draining into the north shore of the Gulf of St. Lawrence. Indications of breeding in northern Labrador remain unsubstantiated and require further investigation. Summer moulting sites have been identified on the northeastern side of Hudson Bay, Ungava, Frobisher Bay, and the coast of Labrador from Nain northward (Schmelzer 2006).

At least 90 per cent of the eastern Barrow's Goldeneye population winter in the St. Lawrence estuary; approximately 400 winter in coastal Atlantic Canada and Maine, and in Newfoundland, small numbers have been documented wintering at the mouth of the Humber River near Corner Brook, in Traytown, Port Blandford, Spaniard's Bay, and St. Mary's Bay. There have been sightings at St. Paul's Inlet and Inner Newman Sound, and at least one sighting of Barrow's Goldeneye in Placentia Bay, an adult male and female at Arnold's Cove estuary November 30, 1993 (B. Mactavish, LGL, pers. comm.).

Barrow's Goldeneye is very rare in Placentia Bay. Judging from the regular occurrence of a few wintering individuals in eastern Newfoundland, including the Avalon Peninsula (Spaniard's Bay and St. Mary's Bay), it is possible a few are wintering undetected among Common Goldeneyes in parts of Placentia Bay. The 1993 sighting from Arnold's Cove shows the species can occur in Placentia Bay during the non-breeding season.

Harlequin Duck Eastern Population

The eastern population of Harlequin Duck (*Histrionicus histrionicus*) was designated as *endangered* by COSEWIC in 1990. During the 1990s an increased effort in research and monitoring of the species on breeding grounds, moulting sites, and wintering sites resulted in improved knowledge of their distribution. An increase in numbers at four key wintering sites in North America and the discovery that some eastern North American Harlequin Ducks winter in southwest Greenland was instrumental in COSEWIC relisting it to a species of s*pecial concern* in 2001 (Environment Canada 2006). The eastern harlequin duck is legally listed (i.e., Schedule 1) as a species of s*pecial concern* under *SARA*.

The eastern harlequin breeds on rivers in northern Quebec (rivers draining in to the eastern side of Hudson Bay and Ungava Bay), Labrador (Nachvak Fiord to Hopedale), the western coast of Great Northern Peninsula, Gaspé Peninsula, and northern New Brunswick (Robertson and Goudie 1999). It winters on the coast, mainly from Newfoundland to Massachusetts, with more than half the population wintering in coastal Maine (Robertson and Goudie 1999).

In Newfoundland, Harlequin Duck is a coastal migrant and winterer, of which Cape St. Mary's has the largest known wintering population. Survey results in late winter 2005 and 2006 showed 200+ individuals between Point Lance and Cape St. Mary's (P. Thomas, CWS, pers. comm.). Cape St. Mary's Christmas bird count totals for the period 1997 to 2006 range from 51 to 200 individuals with an

average of 120 (http://www.audubon.org/bird/cbc/hr/). Small numbers probably occur in northern reaches of Placentia Bay during migration and winter (October to April). Suitable habitat exists around small islands and rocky islets in zones of high energy. Potential habitat exists in the Iona Islands group at the mouth of the greater Long Harbour area. There are no known sightings for Long Harbour.

Peregrine Falcon

The Peregrine Falcon (*Falco peregrinus*) is practically cosmopolitan, breeding on all continents but Antarctica. It breeds throughout North America in low densities. In Canada, the two main subspecies are *anatum*, breeding in southern Canada, and *tundrius* in the Arctic and Subarctic. The *anatum* subspecies is designated a species of special concern by COSEWIC. The *tundrius* subspecies is considered threatened by the Newfoundland and Labrador Special Status Advisory Committee (SSCA) and a species of special concern by COSEWIC.

Anatum is generally darker with a stronger malar stripe than *tundrius*. Features overlap where the two subspecies meet in northern Canada. In Newfoundland and Labrador, the division in the breeding ranges of the two subspecies is approximately at the tree line in northern Labrador. The Peregrine Falcon does not nest on the island of Newfoundland, but is mainly a fall migrant and a scarcer spring migrant. A few over-winter on the southern Avalon Peninsula.

In Placentia Bay, Peregrine Falcon occur mainly as uncommon fall migrants, with a few possible during spring migration. One or two over-winter in the Cape St. Mary's area every year. Both subspecies have been identified in Placentia Bay, but the ratio of the occurrence of *anatum* to *tundrius* is not known. They could occasionally occur in Long Harbour during fall migration.

Short-eared Owl

The Short-eared Owl (*Asio flammeus*) was designated as a *vulnerable* species in Newfoundland and Labrador under the *ESA* in 2001. It is listed as a species of *special concern* in Canada by COSEWIC in 1994, and is of *special concern* under *SARA* Schedule 3. It breeds in North America, South America and Eurasia. It is widespread in Canada, breeding from the sub-Arctic southward. Distribution is patchy and numbers have declined in the United States and most of Canada. In Newfoundland and Labrador, it has been reported in tundra, coastal barrens, sand dunes, field, and bog habitats (Schmelzer 2005). Short-eared Owls feed on small rodents, mainly meadow voles in Newfoundland, and occasionally small birds that are surprised in the low vegetation (grasses) of coastal locations. In the early 1990s, a pair summered at the Argentia airbase and was suspected of breeding (B. Mactavish, LGL, pers. comm.). They are also regular during the breeding season (April-September) in the Cape St. Mary's area. In Placentia Bay, the species is expected to occur locally in small numbers from April to November. Suitable open terrain exists at Cape St. Mary's, the former Argentia airbase, and various sites on all coasts of Placentia Bay. Migrating Short-eared Owls might turn up at any coastal site, including Long Harbour, from April-May to September-November.

Gray-cheeked Thrush

The Gray-cheeked Thrush (*Catharus minimus*) is listed as *vulnerable* in Newfoundland and Labrador by SSAC. The analysis of data from 21 Breeding Bird Surveys routes on insular Newfoundland indicates a major decline between 1980 and 2003 (Dalley et al. 2005).

The breeding range of the Gray-cheeked Thrush is northern boreal forests near the tree line from Alaska to Newfoundland and Labrador (Godfrey 1986). It winters from southern Mexico south to Brazil (Godfrey 1986), and occurs in Newfoundland from late May to September. The preferred breeding habitat includes dense low coniferous woods, open canopy old growth forest having dense growth of small conifers in the understory, and dense stunted spruce and fir on windblown sites on the coast or at higher elevations. The species is an uncommon breeder on the west side of Placentia Bay, preferring the steep slopes of the coastal enclaves including the Placentia area (B. Mactavish, LGL, pers. com). It may breed in the dense low conifer forest of outer Long Harbour, although a recent insect infestation that killed many of the trees bordering Long Harbour has probably reduced the available breeding habitat.

Rusty Blackbird

The Rusty Blackbird (*Euphagus carolinus*) is listed by COSEWIC as a species of s*pecial concern*. It breeds throughout the boreal forest of North America from Alaska to Newfoundland and Labrador, and winters from southern Canada to Mexico (Godfrey 1986). In Newfoundland and Labrador, it is a widespread breeder on lakes, waterways, and bogs from late April to October. Evidence of a continent-wide decline within the breeding range and wintering areas has resulted in COSEWIC placing it on the s*pecial concern* list. Reasons for the overall population decline are unknown.

Suitable habitat exists in freshwater wetlands around Placentia Bay, although it is probably a scarce bird during late April to October. It was observed incidentally outside the Project Area during the baseline surveys.

Red Crossbill

The Red Crossbill (*Loxia curvirostra*) is widespread in coniferous forest of North American south in mountains to Nicaragua (Godfrey 1986). The Newfoundland subspecies *percna* is listed as e*ndangered* under *SARA* Schedule 1 and the *ESA*.

A sharp decline in Red Crossbills recorded on Christmas Bird Counts from 1968 to 2002 shows a 75 per cent decrease per decade (COSEWIC 2004 *in* Environment Canada 2006). The reasons for decline are uncertain, but the decline of white pine (*Pinus strobus*) caused by the accidental introduction of white pine blister rust (*Cronartium ribicola*), widespread logging, and the introduction of the red squirrel (*Tamiasciurus hudsonicus*) may be contributing factors (Environment Canada 2006). The Avalon Peninsula is one of its remaining strongholds in Newfoundland. In 2005 and 2006, there were reports from several feeder watchers in the Trinity Bay and Bay de Verde Peninsula areas (B. Mactavish, LGL,

pers. comm.). Nesting in the Whitbourne area was confirmed when adults that had been using a feeder on a daily basis brought juveniles to the feeder in June (B. Mactavish, LGL, pers. comm.). One bird was encountered flying over inner Long Harbour on July 21, 2006. The forest habitat around Long Harbour is homogenous with the surrounding parts of the Avalon Peninsula and is only 20 km from Whitbourne, where Red Crossbills were known to breed in 2005 and 2006. The species probably occurs annually in small numbers and potentially could nest in the Long Harbour area, where it was observed (but outside the Project Area) during baseline surveys in 2006.

Of the avian species at risk known to occur in insular Newfoundland and more specifically in the southern Avalon region, only the Red Crossbill and Rusty Blackbird have been recently reported in the vicinity of the Project site (B. Mactavish, LGL, pers. comm.).

Plants

A search of the Atlantic Canada Conservation Data Centre (AC CDC) database of known rare plant species within five kilometres of the Project site was conducted during the baseline field investigations (JWL 2007b). Rare plant species are defined as those designated with sub-national (provincial) rank of S1 and S2 as determined by the provincial Wildlife Division of the Department of Environment and Conservation. The ranking criteria are shown in Table 2.8.

Table 2.8 Definitions of the Atlantic Canada Conservation Data Centre "S" Rankings

S Rank	Description
S1	Extremely rare throughout its range in the province (typically five or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in some locations (21 to 100 occurrences).
S4	Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the species is of long-term concern (e.g., watch list) (100+ occurrences).
S5	Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions.
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the species (e.g., S1S2).
?	Inexact or uncertain: for numeric ranks, denotes inexactness (e.g., SE? denotes uncertainty of exotic status). (The ? qualifies the character immediately preceding it in the S RANK).
SU	Unrankable: Possibly in peril, but status is uncertain - more information is needed.
SH	Historical: Previously occurred in the province but may have been overlooked during the past 20-70 years. Presence is suspected and will likely be rediscovered; depending on species/community.
SR	Reported but without persuasive documentation (e.g., misidentified specimen).

The search of the ACCDC indicated that no rare plants were known to occur within five kilometres of the Project site.

The surveys in 2006 focused on areas considered to have the highest potential to contain rare species (JWL 2007): riparian zones, wetlands, groundwater seepage sites and unique geological landforms such as limestone rock outcrops. Of the 70 species identified, only one water horehound or bugleweed (*Lycopus americanus*) (S2), was found, in only one location, a small riparian habitat within a balsam fir forest. No S1 ranked species were observed within the surveyed areas. Figure 2.3 presents the locations of all rare plant survey plots including the location of *Lycopus americanus* (JWL 200b).

An organism of particular interest in the surveys is the boreal felt lichen (*Erioderma pedicellatum),* listed as critically *endangered* on a global basis by the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (IUCN 2006). The Newfoundland (Boreal population) is listed as *special concern* under the federal *SARA* (Schedule 1) and by COSEWIC. It is listed as v*ulnerable* under the *ESA*.

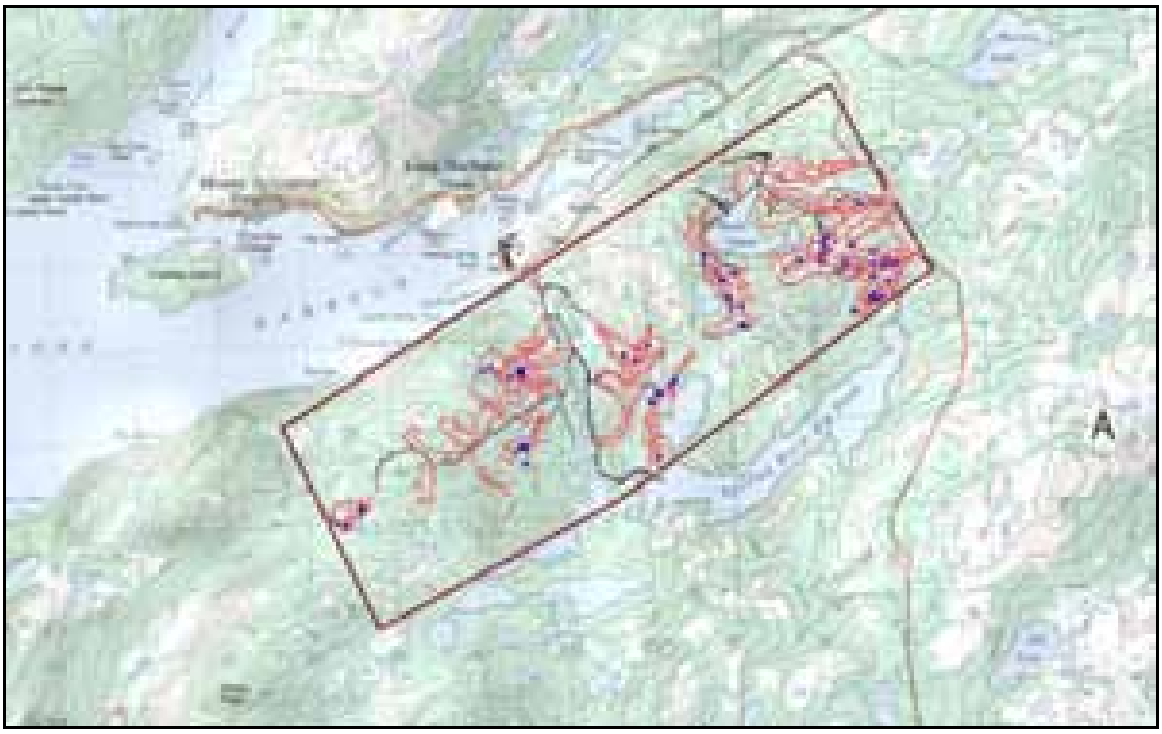
The boreal felt lichen is a conspicuous lichen, discovered in the early 19th century; it may occur in two regions of the world: Scandinavia (Sweden and Norway) and Atlantic Canada (Island of Newfoundland, Nova Scotia and New Brunswick). All known populations from New Brunswick have disappeared and the Nova Scotia population has collapsed during the past 20 years, the cause being air pollution (Maass and Yetman 2002). However, additional search effort (March 2006) has resulted in a known Atlantic (NS and NB) population of nine sites with 31 thalli (Environment Canada 2007). The North American distribution of this species is mainly restricted to several sites in Newfoundland; however, its populations at many locations have disappeared since the first reports in the 1970s (Ahti and Jørgensen 1971).

In early 2006, VBNC approached the Newfoundland Lichen Education and Research Group (NLERG) to undertake a reconnaissance of the Long Harbour area in order to assess the presence of this lichen. Surveys and reporting were conducted by C. Scheidegger, Lichen Specialist Group of the IUCN, I. Goudie, and E. Conway, who spent approximately 300 hours searching over a 20 km^2 area from June 1 to September 6, 2006 (Goudie et al. 2006).

Approximately 30,000 trees were surveyed. Of these, 60 were documented as hosting 97 thalli of *E. pedicellatu;* that is, phorophytes represented approximately 0.22 per cent of Balsam fir stems (Figure 2.4). This represents the first documentation of the lichen in the Long Harbour area. It had previously been documented in the area of Ship Harbour (W. Maass, pers. comm.) and also in the inner portion of Placentia Bay, and a population in the area of southeast Placentia is monitored with support from Vale Inco NL.

Erioderma identified in this study occurred in cool, moist habitats in areas of scrub and forest cover. Southwestern Barrens subregion locations have cool summers with frequent fog and strong winds, and relatively mild winters with intermittent snow cover, particularly near the coastline. Annual precipitation exceeds 1,250 mm (Protected Areas Association 2000).

Figure 2.3 Rare Plant Plot Locations



(Irregular red lines represent field searches, and blue dots indicate locations of host trees)

Figure 2.4 Results of Surveys for *E. pedicellatum* in the Long Harbour Area in 2006

2.3 Freshwater Environment

Extensive surveys of the Long Harbour Project Area were conducted in 2005-06 as part of the baseline characterization. These surveys included sampling for fish species presence, habitat mapping, hydrological data collection, water and sediment quality, macroinvertebrate and related biophysical (groundwater and wetland) surveys. From a review of historic information and baseline studies an overview of the existing freshwater environment within the Project site has been developed. Readers are referred to the individual baseline Component Studies for supporting details.

2.3.1 Surface Water

Historic sampling conducted in ponds in the Long Harbour area indicates that pond water is typically high colour, low conductivity and very soft (O'Connell and Andrews 1987). Past sampling of ponds located to the north-east of the former plant (the direction of prevailing winds) indicated elevated levels of phosphate, calcium, and fluoride, which were assumed to be the result of airborne phosphate ore-dust from the phosphorus plant property (see O'Connell and Andrews 1987; Lake 1984). The effect on pond ecology at the time was an enrichment process (eutrophication) and an increase in the level of water hardness during the open water season.

Public concern regarding fluoride levels in the environment during the 1970s prompted DFO to examine fish flesh from samples collected in ponds downwind of the plant between Long Harbour and the Trans-

Canada Highway (Albright and Wilson 1992). The study was conducted circa 1982-83 (two to three years after the installation of stack scrubbers at the phosphorus plant) and indicated no elevated levels of fluoride in any samples analyzed.

The 2005-06 surface water sampling program included ponds within the direct footprint of the Project site as well as many that might serve as reference or control locations. The total suite of parameters analyzed and the results are presented in the Freshwater Component Study (AMEC 2007a).

The water quality of the Rattling Brook watershed is similar to that of other watersheds in the area, acidic with a pH of less than 7.0. With a lower pH come elevated levels of some metals above Canadian Council of Ministers of Environment (CCME) Guidelines for the Protection of Freshwater Aquatic Life (CCME 2006). Metals such as aluminum and cadmium show consistently elevated levels while copper, iron, lead, arsenic, and nickel show occasional elevated levels, particularly in summer and fall. Occasional elevations in these metals were reported from the smaller plateau ponds (P22, P23 and S30, Figure 2.6). Arsenic was above CCME Guidelines in the Rattling Brook watershed in Pond P28 (surface and mid-depth) from the August 2006 sampling. These levels are generally indicative of the surficial geology of the area and reflect groundwater influences.

Fluoride was sampled in all ponds as part of the 2006 program. While there are no applicable CCME Guideline values, the *Canadian Drinking Water Quality Guidelines* identify an upper limit of 1.5 mg/L (CCME 2006). Results from ponds and brooks in the 2006 program showed all fluoride levels less than 0.2 mg/L (AMEC 2007a).

The water quality of the Sandy Brook watershed is similar to that of other watersheds in the area. This includes being acidic with a pH of less than 7.0. As in the Rattling Brook watershed, there have been elevated levels of some metals identified above CCME *Guidelines for the Protection of Freshwater Aquatic Life* (CCME 2006). In general, aluminum showed consistent elevated levels while cadmium, copper, iron, lead, and mercury were occasionally elevated, particularly in spring and summer.

Fluoride was sampled as part of the 2006 sampling program in all ponds. As with the Rattling Brook watershed, results show fluoride levels less than 0.2 mg/L (AMEC 2007a) indicating baseline levels and no likely residual effects from past industrial activity.

Water samples were collected from a sub-tributary of Little Rattling Brook during the 2006 program. Like the nearby small plateau ponds, Little Rattling Brook also had a low pH and elevated aluminum, cadmium, and iron levels (AMEC 2007a). The brook also had elevated mercury levels above CCME Guidelines.

2.3.2 Groundwater

Regional

On a regional scale groundwater occurs in two major hydrostratigraphic units: (1) within a relatively thin overburden usually composed of glacial or glacio-fluvial deposits, and (2) within lower Paleozoic fractured bedrock.

Overburden soils are generally rich in sands and coarser particles, and contain little fines (i.e., silt and clay size fractions). This results in a highly permeable shallow groundwater regime characterized by relatively rapid flows and a high connectivity with surface water bodies. As a consequence, recharge of groundwater by surface seepage occurs soon after rainfall events and is quickly followed by discharge of groundwater to the surface at springs, streams, ponds, and other water bodies.

Primary porosity of the sedimentary and volcanic bedrock in the Study Area is generally quite low; therefore, groundwater flow in this unit is primarily through fractures, joints, faults, shear zones, and other open discontinuities that transect various geologic formations. In general, there is a trend of decreasing permeability (and well yield) with depth that reflects a corresponding decrease in discontinuity frequency and aperture width.

Because of the relatively high permeability of overburden material and upper levels of fractured bedrock, shallow groundwater quality is often very similar to that of surface water (freshwater) bodies. Typically, these waters are very low in total dissolved solids (TDS), less than 25 mg/L, pH levels are generally between four and 6.5, and average alkalinity and hardness values are less than 10 mg/L.

The quality of bedrock groundwater can be quite different from that of shallow overburden groundwater and typically reflects the water's longer residence time within various geologic formations. There are three types of bedrock groundwater: Group I - calcium bicarbonate, with appreciable hardness and alkalinity (>50 mg/L as $CaCO_3$), and pH values between 6.5 and 9; Group II – sodium bicarbonate, with high alkalinity, low hardness, and high pH (>8); and Group III, which is very soft, acidic (pH 4.0 – 5.5), low in alkalinity, and low in TDS (Gale et al. 1984).

Local

Based on the hydrogeological characterization study carried out by AMEC (2007b), three hydrostratigraphic units were identified in the Project Area:

1. Till (HU1): This unit overlies bedrock and consists of sand and gravel with less than about 20 per cent fines. Glacial till is prevalent in areas of thicker overburden (>12 m thick) and high water table. The hydraulic conductivity of this unit is believed to about 10^{-3} to 10^{-4} cm/s, and the effective porosity is likely between 0.3 and 0.4.

2. Till / Bedrock Contact Zone (HU2): This unit is prevalent in areas where glacial till is less than 12 m thick, which includes most of the Project Area. Measured hydraulic conductivities (K) range from 10^{-3} to 10^{-4} cms. It is believed that the horizontal K (K_h) is greater than the vertical K (K_v) based on the observed fracture network in the till / bedrock contact zone. The effective porosity within this unit is unknown, but is surmised to range between 0.01 and 0.1.

3. Bedrock (HU3): This unit underlies all of the Project Area and is important at depths greater than 12 m or where overburden deposits are absent. The measured hydraulic conductivities vary widely over the range of 10^{-3} to 10^{-6} cm/s (AMEC 2007c).

On average, groundwater is found at about 3.2 m below ground surface throughout the Project Area, and is encountered at depths ranging from surface to about nine m. The water table generally mimics the ground surface, except where it discharges into streams, ponds, springs, or the marine environment of Long Harbour. Zones of higher groundwater flux are likely to be focussed in areas of localized topographic and bedrock lows, especially in areas with thicker saturated overburden and fractured bedrock contact zones.

Groundwater flow in the Study Area is heavily controlled by the occurrence of ponds and streams, marine waters of Long Harbour, and bedrock highs. Shallow groundwater flows can be approximated by surface flows within drainage basins. As an example, shallow groundwater within the proposed plant site is believed to flow towards Long Harbour along a broad pathway that centres on Rattling Brook (AMEC 2007b). Similarly, shallow groundwater has been modelled and found to flow from the area of Sandy Pond and along a broad pathway that centres on Sandy Brook.

The pathways followed by deep groundwater are less influenced by local topographic irregularities than those of shallow groundwater (AMEC 2007b), however, deep groundwater flow around Sandy Pond has been shown through modelling to flow in the same general direction as the shallow groundwater (AMEC 2007c).

Based on AMEC studies (2007b and 2007c), the area of potential influence on groundwater resources associated with the Project is essentially confined to the Project site shown on Figure 2.5. Zones of groundwater recharge are typically found in areas of topographic highs and along steep slopes. Groundwater discharge to the surface often typically occurs into ponds, streams, and at the foot of steep slopes where topographic gradients decrease or flatten out.

The chemistry of the groundwater across Tier 2 of the Project Area is quite similar and can be classified as Group I – calcium bicarbonate type groundwater. Within HU1 and HU2 groundwater is slightly more acidic and has a lower TDS content than that collected from HU3 in deeper bedrock. With depth, there is a trend towards increasing calcium, bicarbonate, alkalinity, harness, and pH level. An analysis of the groundwater major ion chemistry suggests that groundwater is mixing from two different sources: young infiltrating rain water (HU1 and HU2) and older bedrock groundwater (HU3) (AMEC 2007b).

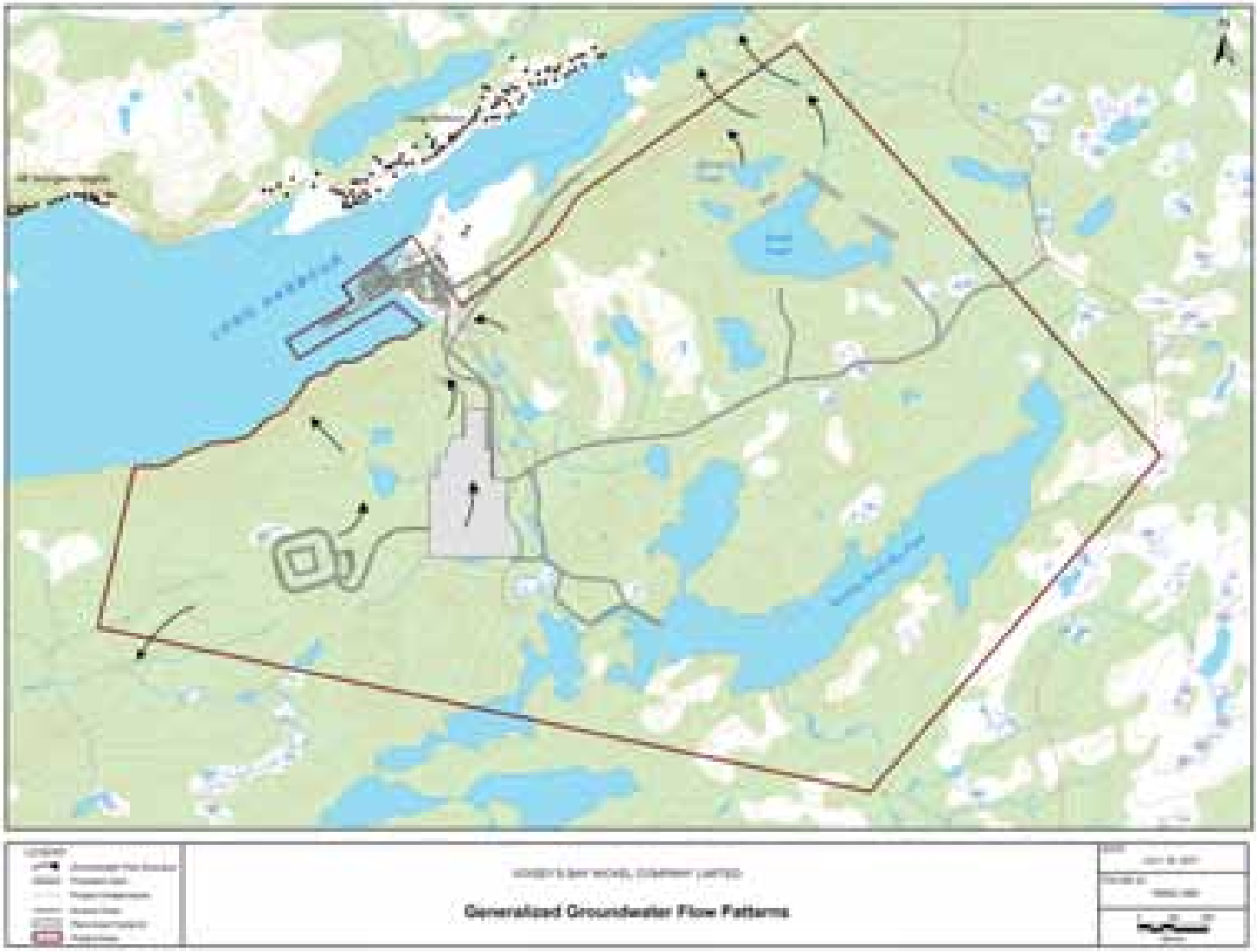


Figure 2.5 Generalized Groundwater Flow Patterns

In HU1 and HU2, iron levels above the freshwater and / or marine aquatic life criteria of the *Canadian Environmental Quality Guidelines (CEQG)* are typical, whereas iron concentrations are usually lower or non-detectable in HU3. Manganese levels are characteristically elevated in all three hydrostratigraphic units (AMEC 2007b).

Other metals that were found at elevated levels with respect to these criteria include arsenic, cadmium, copper, lead, zinc, and aluminum. These levels may be related to leaching from the till and sediments within the Project site, but may also be the result of deposition of airborne contaminants during operation of the phosphorus plant in the Lower Tier I area (AMEC 2007b).

Within the Lower Tier I area the primary contaminants of concern are free cyanide, elemental phosphorus (P_4), and fluoride, which are associated with past operations at the site. Other chemicals found at elevated levels include sulphate, total phosphate, arsenic, iron, and manganese, all of which may be naturally occurring or derived from anthropogenic sources. Previous work carried out to support the decommissioning of the phosphorus plant concluded that P_4 is practically immobile and would never reach the marine environment of Long Harbour. Groundwater modelling of free cyanide and fluoride indicated that the plumes had reached steady state and that the concentrations would remain constant over time (AMEC 2007b).

Sandy Pond is the site of the proposed subaqueous residue disposal facility associated with the Project. AMEC (2007b and c) did extensive testing on groundwater collected from the area around Sandy Pond for a wide variety of inorganic parameters. Those of primary concern, based on surface water quality modelling, are nickel, copper, iron, and sulphate. The background concentrations reported for groundwater within this area are 0.0017 mg/L (Ni), 0.004 mg/L (Cu), 0.5 and 0.05 mg/L (Fe, for overburden and bedrock, respectively), and 2.7 mg/L (Sulphate).

2.3.3 Fish Habitat

It is important to understand the Project Area's hydrology, in particular that of the Rattling Brook and Sandy Brook watersheds, as Vale Inco NL will require water extraction for the refining process; engineering design for water and effluent containment; and, water monitoring as part of its operations (e.g., waste water from the marine diffuser, diversion water around the Project footprint, Sandy Pond containment efficiency).

To address this, VBNC installed hydrographs in the Project Area and conducted extensive freshwater studies (AMEC 2007a, b, c). Appropriate aspects of these reports are provided below.

The streams are relatively small in size and many of them have been delineated as intermittent on provincial 1:50,000 topographic mapping. Aquatic mapping was completed for streams (AMEC 2007a) and classified in accordance to both the Beak (1980) and a more recent habitat classification system (McCarthy et al. 2007).

The mapping of the habitat types present was conducted using standard stream survey methods (see Scruton et al. 1992; Sooley et al. 1998; McCarthy et al. 2007), Global Positioning System (GPS) and Geographic Information Systems (GIS). GIS was used to present the location of each habitat type as well as to calculate overall aerial extents. Each pond was surveyed for fish habitat as per the DFO requirements for lacustrine habitat classification/quantification (Bradbury et al. 2001a).

Of the five watersheds within the Long Harbour area, two are directly within the footprint of the Project. If the Matte Plant were built, a third watershed would be affected. Provided below is a general description of the existing environment within each of these three watersheds: Rattling Brook, Sandy Brook and Little Rattling Brook. The material presented below has been summarized from the Freshwater Component Study (AMEC 2007a) and utilizing the labeling system for watersheds, streams tributaries and ponds as described in that report and shown in Figure 2.6.

Rattling Brook (S20)

The Rattling Brook watershed extends inland approximately 6.5 km from the southern shore of Long Harbour. It drains a total area of 38 km^2, with the majority of this coming from Rattling Brook Big Pond (23.5 km^2), and its outflow is near the existing Long Harbour Industrial Park and wharf. This watershed contains many large and small ponds with a large network of tributaries, most identified as intermittent in nature. Figure 2.6 presents the Long Harbour area and the watershed boundaries. Fish species in the watershed are brook trout with limited use by American eel and resident Arctic char.

The plant site will be located within the Rattling Brook watershed, principally within small tributaries draining from the west (T1-1 and T1-1-1– AMEC 2007a). The water required for processing will also be extracted from Rattling Brook Big Pond. This proposed location is similar to that used by the former AWA plant in Long Harbour.

Main Stem (T1)

The main stem of Rattling Brook is 3.17 km between its mouth at Long Harbour and its origin at Rattling Brook Big Pond. It is relatively small with a series of very steep rapids at its mouth, making it inaccessible to anadromous salmonids (Figure 2.7), although American eel were captured just above the existing concrete weir approximately 400 m from mouth. In addition to the falls and cascades below the weir, a second set of steep falls and rapids approximately 200 m upstream of the weir are totally impassible (Figure 2.8).

The substrate composition is primarily cobble and larger, up to and including bedrock. Indications of past channelization in the area are evident. Gravels and smaller substrates occur in relatively low quantities, typically located in isolated patches behind larger boulders. There are, however, small areas identified that contain suitable gravels and are recorded as supporting brook trout spawning activity in September 2006.

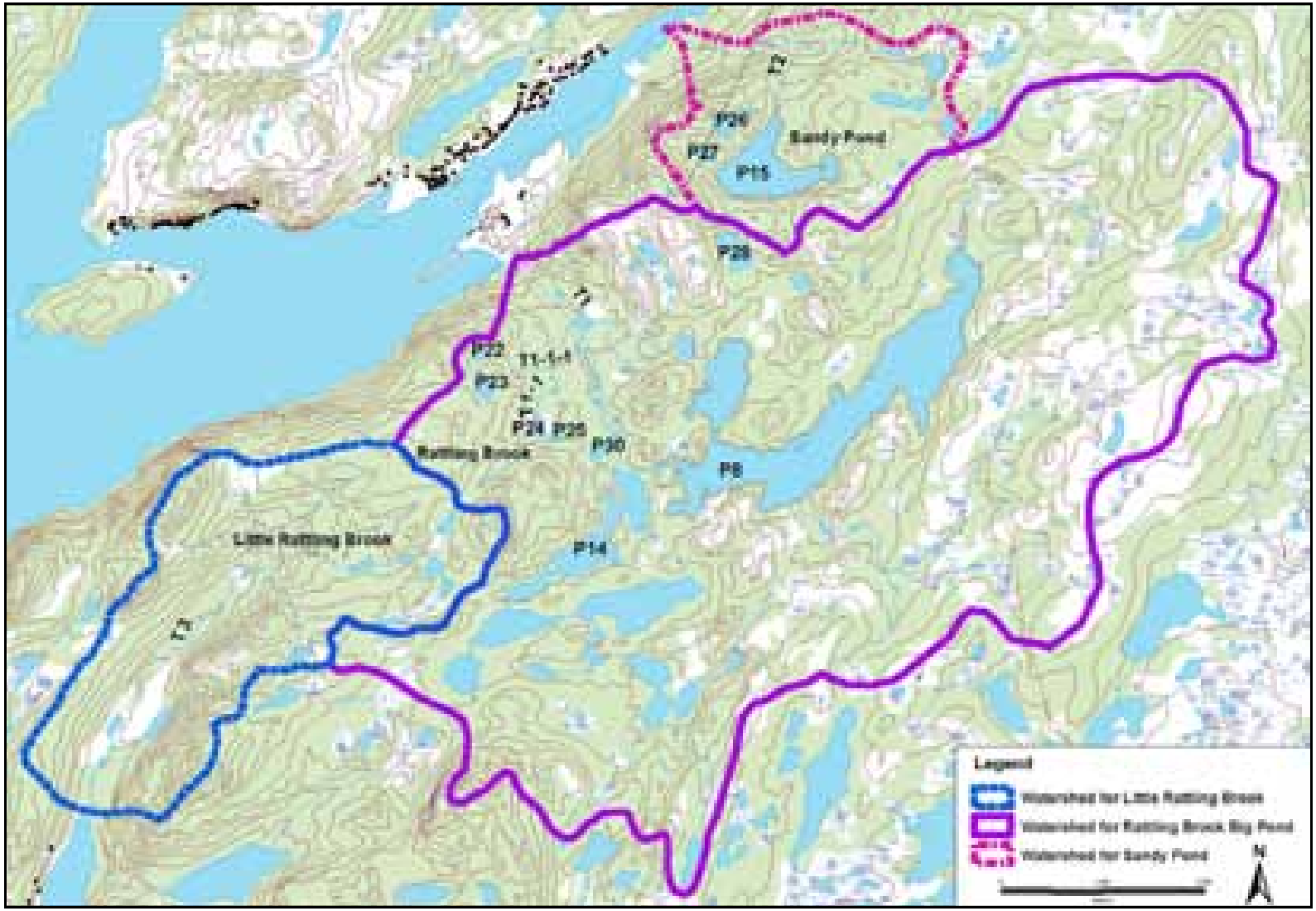


Figure 2.6 Watersheds Within and Adjacent to the Project Area