

Bear Mountain Highlands
Project

Preliminary Environmental
Assessment

Prepared for:

District of Highlands
1980 Millstream Road
Victoria, B.C. V9E 1C9
Attention: **Mr. Bruce Woodbury**
Administrator

Prepared By:

ENKON Environmental Limited
309-703 Broughton Street
Victoria, B.C. V8W 1E2
Telephone 1 (800) 374-5291
Fax: (250) 480-7103
enkon@enkon.com

Project No.: 1172-006

March 2004

EXECUTIVE SUMMARY

The Highlands Bear Mountain Estates Project is a proposed championship golf and club and residential subdivision located in the District of Highlands. The project is planned for portions of Sections 5, 6, 12, 16, 17, and 75 in the District of Highlands, and currently owned by Bear Mountain Master Partnership (Figure 1). The project site is formerly known as the Western Forest Products Lands and is located to the west of Millstream Road in southern Highlands at the District of Langford's northern border. Currently, the site consists of predominantly of second and third growth coniferous and mixed forests. Since 2002 much of this area has been logged (Appendix VII). In the past the area was frequently used recreationally by mountain bikers and is accessible by numerous logging roads and trails. The proposed development will consist of an 18 hole championship golf course, a driving range, a golf academy, 185 single family homes, 50 townhomes, 100 villas, 1115 m² of commercial space and approximately 75 ha of natural parkland. The development also proposes the dedication of the lands to the District of Highlands for the creation of a municipal community centre.

The site includes part or all of numerous Sensitive Ecosystem Inventory polygons, comprised of woodlands, wetlands, riparian, older growth and rocky outcrops. In addition, portions of four second growth forest general biodiversity polygons are also present on the property. A rare element occurrence report (EOR) for the project site indicates that there has been one reported occurrence of a rare vascular plant species, slender woolly-heads, which is red-listed, on Millstream Road and this species was also found during the rare plant survey in the vicinity of the powerline right-of-way. Rare plant communities known to occur on the site include Garry oak / brome, Western redcedar - Douglas-fir / Oregon beaked moss, Douglas-fir – arbutus, Red alder / skunk cabbage, Red alder / slough sedge [black cottonwood], Grand fir / three-leaved foamflower and Grand fir / dull Oregon-grape.

An interspersed of bedrock exposures and water-collecting sites on the subject site provide a mosaic of wildlife habitat types. As a result of this mix of habitats and existing habitat linkages to significant natural areas (e.g. Crown Forests, and Goldstream and Gowlland Tod Provincial Parks), the site supports moderate biodiversity in terms of wildlife. Like many areas of Vancouver Island, the mammal assemblage is modest in comparison to the adjacent Mainland Coast. Inventory and opportunistic sightings have so far documented use of the site by eight species of mammals, most of which are of relatively common.

In contrast to mammals, the site is expected to support a diverse assemblage of amphibians, both pond-breeding and fully terrestrial. Birds form a major component of the site's biodiversity values. A total of forty (40) bird species were observed and/or heard as incidental sightings and thirty-three of these birds are potential breeders on the site. Raptor, woodpecker, and forest songbird groups are well represented on the site.

Executive Summary

The site contains suitable habitat for eight species of conservation interest in the South Island Forest District. The only blue-listed species observed on the property to date is the red-legged frog. The Vancouver Island water shrew has been documented historically on the property in the vicinity of the Millstream Creek mainstem.

A habitat analysis indicates that the highest rated units from a wildlife perspective are the Wetland/Riparian and moist forest communities. A number of site-specific features of importance to local wildlife populations were identified throughout the property including raven's nests, accipiter (woodland hawk) nests, cavity nests, mature/veteran trees and large diameter snags.

Aquatic resources on the Bear Mountain Highlands property consist of a series of wetlands connected by ephemeral and permanent drainages, all of which are part of the Millstream Creek watershed. Coastal cutthroat trout, a blue-listed species has been documented on the site as well as pumpkinseed, three-spine stickleback and crayfish. It is expected that fish distribution changes seasonally due to limited flows during summer months. Fish likely spread out into ephemeral drainages during winter high flows and then concentrate in deep pools in the major channels during summer low flows.

To protect the surrounding environment during logging and clearing activities and following construction mitigation strategies have been proposed that will minimize vegetation, wildlife, fisheries and water quality impacts. Erosion control and stormwater management measures will be in place to minimize surface run-off from cleared areas and roads.

The concept plan indicates that 62% of the 196 ha site will be developed, allowing a significant degree of natural vegetation retention. To mitigate for vegetation impacts a tree protection plan and a sensitive ecosystem protection plan have been proposed as per the recommendations in "Environmental Objectives, Best Management Practices and Requirements for Land Developments, Vancouver Island Region" (MELP 2001).

Some impact on local wildlife will be expected. These include reduced carrying capacity for wildlife, bird nest abandonment, loss of veteran trees/snags as hazard trees, alteration of wildlife movement and activity patterns, habitat fragmentation, reduced water quality in wetlands. A wildlife management plan has been recommended to minimize impacts. Habitat enhancement methods including the placement of nest boxes and snag creation have also been recommended.

Impacts to aquatic resources can include augmentation or loss of fish habitat and water quality degradation. To mitigate these impacts guidelines have been provided for instream construction and sediment and erosion control. Logging and clearing will not take place within a 15 to 30 m setback of top-of-bank of all watercourses until a later date when authorization has been received from the Ministry of Water, Land and Air Protection and Fisheries and Oceans Canada.

Table of Contents

1	Introduction.....	1
1.1	Project Description.....	1
1.2	Previous Studies.....	2
2	Environmental Setting	5
2.1	Terrestrial Resources	5
2.1.1	Vegetation.....	5
2.1.1.1	Previous Studies.....	5
2.1.1.2	Methods.....	5
2.1.1.3	Results.....	6
2.1.2	Wildlife	20
2.1.2.1	Previous Studies.....	20
2.1.2.2	Methods.....	20
2.1.2.3	Raptor and Passerine Surveys.....	20
2.1.2.4	Herpetifauna.....	23
2.1.2.5	Small Mammals	25
2.1.2.6	Large Mammals	25
2.1.3	Wildlife Ratings.....	25
2.1.4	Results.....	26
2.1.4.1	Birds.....	26
2.1.5	Amphibians.....	33
2.1.5.1	Red-legged Frog (Blue-listed)	33
2.1.6	Small Mammals	34
2.1.7	Large Mammals	36
2.1.7.1	Black-tailed Deer	37
2.1.7.2	Red Squirrel	37
2.1.7.3	Eastern Cottontail Rabbit.....	37
2.1.7.4	American Mink.....	38
2.1.7.5	River Otter	38
2.1.8	Accounts of Red, Blue and Yellow Listed Species	38
2.1.8.1	Species Rating Definitions.....	39
2.1.8.2	Herpetifauna (Amphibians and Reptiles).....	40
2.1.8.3	Birds.....	42
2.1.8.4	Mammals.....	45
2.1.9	Habitat Use and Importance.....	46
2.1.9.1	Habitats with High Wildlife Values.....	47
2.1.9.2	Habitats with Moderate Wildlife Values	52
2.1.9.3	Habitats with Low Wildlife Values	53
2.2	Aquatic Resources	53
2.2.1	General.....	53
2.2.2	Surface Hydrology.....	54
2.2.2.1	Methods.....	54
2.2.2.2	Results.....	54
2.3	Fisheries Resources.....	60
2.3.1	General.....	60

Table of Contents

2.3.2	Previous Studies.....	60
2.3.3	Methods.....	60
2.3.4	Results.....	61
2.4	Water Quality.....	67
2.4.1	Previous Studies.....	67
2.4.2	Methods.....	67
2.4.3	Results.....	67
3	Impact Assessment.....	72
3.1	Vegetation.....	72
3.1.1	Potential Impacts.....	72
3.1.1.1	General.....	72
3.1.1.2	Rare Plants and Plant Communities.....	73
3.1.1.3	Sensitive Ecosystems.....	73
3.1.1.4	Mitigation Strategies.....	73
3.2	Wildlife.....	75
3.2.1	Potential Impacts.....	75
3.2.1.1	Habitat Loss.....	75
3.2.1.2	Construction-related Impacts.....	75
3.2.1.3	Post-construction-related Impacts.....	78
3.2.2	Mitigation Methods.....	82
3.2.2.1	Construction Impacts.....	82
3.2.2.2	Post-construction-related Impacts.....	83
3.3	Aquatic Resources.....	84
3.3.1	Habitat Loss or Augmentation.....	84
3.3.1.1	Potential Impacts.....	84
3.3.1.2	Mitigation Strategies.....	84
3.3.2	Surface Water.....	85
3.3.2.1	Potential Impacts.....	85
3.3.2.2	Mitigation Strategies.....	85
3.4	Fisheries Resources.....	90
3.4.1	Potential Impacts.....	90
3.4.1.1	Suspended Sediments.....	90
3.4.1.2	Deleterious Substances.....	91
3.4.1.3	Fish Habitat Loss or Augmentation.....	91
3.4.2	Mitigation Strategies.....	91
3.4.2.1	Fish Windows.....	91
3.4.2.2	Fish Salvage.....	92
3.4.2.3	Turbidity and Erosion Control.....	92
3.4.2.4	Environmental Monitor.....	92
3.4.2.5	Restoration of Creek Bed and Riparian Zone.....	92
4	Best Management Practices.....	93
4.1	Introduction.....	93
4.2	Tree Protection Plan.....	93
4.3	Sensitive Ecosystem Protection Plan.....	93
4.4	Wildlife Management Plan.....	94
4.4.1	Raptor and Breeding Bird Management Plan.....	94

Table of Contents

4.4.1.1	Passerine and General Bird Management	94
4.4.1.2	Raptor Management.....	95
4.4.1.3	Amphibian Management Plan.....	96
4.4.1.4	Small Mammal Management Plan.....	97
4.5	Stormwater Management Plan.....	98
4.5.1	Objectives	98
4.5.2	Structural Management Practices	98
4.5.2.1	Lot Level and Conveyance Controls.....	98
4.5.2.2	End of Pipe Controls.....	99
4.5.2.3	Non-structural Stormwater Management Practices	99
4.6	Sediment and Pollution Control Plan.....	99
4.6.1	Construction Phase.....	99
4.6.2	Post Construction Phase.....	100
4.7	Spill Prevention Plan.....	101
4.8	Environmental Monitoring.....	102
4.8.1	Meetings and Communication	102
4.8.2	Monitoring Prior to and During Site Clearing.....	102
4.8.3	Monitoring during Bridge Construction and/or Culvert Installation	103
4.8.4	Drainage and Sediment Control.....	103
4.8.5	Control of Deleterious Substances on the Development Site.....	104
4.8.6	Water Quality Monitoring.....	105
4.8.7	Frequency of Site Inspections.....	105
4.8.8	Reporting.....	105
4.9	Fertilizer and Pesticide Management Plan.....	105
5	References Cited or Reviewed.....	107

List of Tables

Table 1: Vegetation Typically Occurring within the Coastal Douglas-fir Moist Maritime Subzone (CDFmm)	7
Table 2: Plant Species Encountered During Field Surveys	8
Table 3: Sensitive Ecosystem and General Biodiversity Polygons within the Study Area	16
Table 4: Habitat Capability and Suitability Rating Scheme Used for Habitat Assessment	26
Table 5: Owl Sightings May 9th and 15th, 2002	28
Table 6: Birds Observed or Heard During the June 13th, 2002 Breeding Bird Survey ...	29
Table 7: Number of Bird Species at Each Point Count	31
Table 8: Results of Small Mammal Trapping, May 2002	35
Table 9: Habitat Importance Ratings for Selected Wildlife Groups Based on General Vegetation Types	49
Table 10: Summary of Wetlands, Bear Mountain Highlands Property	57
Table 11: Summary of Watercourse Characteristics, Bear Mountain Highlands Property	58
Table 12: Results of Minnow Trapping, May 2002.....	64
Table 13: Results of Electroshocking, July 2002.....	65
Table 14: Results of Minnow Trapping, July 2003	66
Table 15: Water Quality, Physical and Nutrient Characteristics	69
Table 16: Water Quality, Total and Dissolved Metals	70

List of Figures

Figure 1: Bear Mountain Resort Site Location.....	3
Figure 2: Bear Mountain Resort Conceptual Project Layout.....	4
Figure 3: Vegetation Units.....	17
Figure 4: Sensitive Ecosystem Polygons	18
Figure 5: Wildlife observations	22
Figure 6: Aquatic Features of the Bear Mountain Highlands Project.....	56
Figure 7: Aquatic Resource Sampling Locations	63

Appendices

Appendix I: Terrestrial Ecosystem Information
Appendix II: Conservation Data Centre Information
Appendix III: Rare Plant Survey
Appendix IV: Fish Wizard Information
Appendix V: Wildlife Habitat Enhancement Options
Appendix VI: Photoplates
Appendix VII: Logging Plan

Table of Contents

INTRODUCTION

1.1 Project Description

The Highlands Bear Mountain Estates Project is proposed a championship golf and club and residential subdivision located in the District of Highlands, B.C. The project is planned for portions of Sections 5, 6, 12, 16, 17, and 75 currently owned by Bear Mountain Master Partnership (Figure 1). The project site is formerly known as the Western Forest Products Lands and is located to the west of Millstream Road in southern Highlands at the District of Langford's northern border. Currently, the site consists of predominantly of second and third growth coniferous and mixed forests. Much of the area has been logged since 2002 (Appendix VII). In the past, the area was frequently used recreationally by mountain bikers and is accessible by numerous logging roads and trails. The proposed development will consist of an 18 hole championship golf course, a driving range, a golf academy, 185 single family homes, 50 townhomes, 100 villas, 1115 m² of commercial space and approximately 75 ha of natural parkland. The development also proposes the dedication of the lands to the District of Highlands for the creation of a municipal community centre.

Approximately 70% of the parent/original site will consist of open space including the golf course, natural greenways, parks, trails, wetlands, open water and riparian buffer zones. Main features of the green space plan include a network of footpaths and trails that run through the development that will link with the larger public trail systems of Langford, Goldstream Park and the Gowlland Tod trail networks. These trails will be constructed to the District of Highlands standards. The feature recreational pathway will connect Millstream Road through to Mount Finlayson Park.

There will be 235 housing units plus a villa development of approximately 100 rooms. The housing will consist of 185 single family homes and 50 townhomes. The lands needed for schools and community playfields will be provided in the District of Langford on the property immediately south of the site, which is also owned by Bear Mountain Master Partnership. A small commercial facility is proposed near the District of Highlands Municipal Hall.

There are three access points proposed at this time. Development considerations for adjoining properties are planned to create a comprehensive long-term roads and trails network. The first and primary access will be from the east, from Millstream Road, via the Bear Mountain Parkway (Figure 2). The second access will be to the southwest of Skirt Mountain and will connect to the Trans Canada Highway. The third access will be from Millstream Road in the District of Highlands, at the entrance to the Highlands Municipal Hall. This access, known as Hannington Road, will serve as the Highlands connection to the development.

The site contains sensitive ecosystem polygons that consist of wetland, riparian, terrestrial herbaceous and woodland types. In addition to the sensitive

ecosystems present within the study area, portions of four general biodiversity polygons are also present on the property.

The following report outlines the work program undertaken to assess the site for the presence and/or absence of rare and endangered species and to identify environmentally sensitive areas in the proposed development area.

1.2 Previous Studies

Preliminary environmental work was completed on the property in 1997 and 1998. This information included a synopsis of aquatic and terrestrial resources and was comprised of a vegetation overview, a rare plant assessment, and a wildlife overview and habitat capability analysis (Environmental Overview, Highlands South Community, ENKON Environmental Ltd., 1997 and Update of Environmental Information for Highlands Site, ENKON Environmental Ltd., 1998).

An overview report prepared by ENKON Environmental '*Highlands South Project Bioinventory for Rezoning Application (May 2001)*' addressed the aquatic and terrestrial resource significance of the southeast portion of the site, approximately 36 ha. A detailed environmental assessment to support the subdivision application was prepared by ENKON in September 2001, which provided a detailed analysis of the aquatic and terrestrial ecosystems in the proposed development area and provided mitigation strategies and best management practices to minimize impacts to the surrounding environment.

Introduction

Figure 1: Bear Mountain Resort Site Location

Figure 2: Bear Mountain Resort Conceptual Project Layout

ENVIRONMENTAL SETTING

2.1 Terrestrial Resources

2.1.1 Vegetation

Terrestrial Ecosystem Mapping (TEM), which was used in the current study described herein provides a more detailed description of the vegetation by taking into consideration not only species composition, but also aspect, slope position, gradient, soil nutrient and moisture characteristics and structural and successional stages.

2.1.1.1 Previous Studies

Preliminary mapping of the entire site was completed by ENKON in May 1997 and a follow-up site survey was completed in July 1998. Six vegetation communities were identified based on plant community composition and moisture regime. In June 2001, Terrestrial Ecosystem Mapping was completed for the southeast corner of the property where a 45-unit subdivision was proposed. A rare plant survey was also conducted in June and September 2001 in the vicinity of the subdivision.

2.1.1.2 Methods

Prior to the field survey air photos were examined to determine the approximate boundaries of vegetation polygons. These boundaries were initially determined using by assessing the aspect, slope, slope position and vegetation composition differences as observed on the air photos. Preliminary mapping identified 14 different potential vegetation polygons.

The field program, which took place July 17 to 20, 2002 ground-truthed the boundaries of the vegetation polygons and identified the site association and structural stage of each polygon. Approximately 80 vegetation plots were completed. Site association classification was determined based on vegetation composition, structural stage, successional stage, soil moisture regime and soil nutrient regime. Techniques as outlined in Resource Inventory Committee's *Standard Techniques for Terrestrial Ecosystem Mapping in British Columbia* (May 1998) and *Handbook 25, Field Manual for Describing Terrestrial Ecosystems* (1998) were followed. In addition, the CRD Parks' report titled 'Ecological Inventory of Thetis Lake, Francis/King and Mill Hill Regional Parks (July 2001) was reviewed as this document contained some previously undefined site associations. Ministry of Forests/BC Environment's Ecosystem Field Forms were used. A key to the various Terrestrial Ecosystem Mapping (TEM) communities is presented in Appendix I.

2.1.1.3 Results

General

The Highlands South Property is located in the Eastern Vancouver Island Ecoregion within the Nanaimo Lowland Ecosection. The Highlands South Property lies within the Coastal Douglas-fir Moist Maritime (CDFmm) Biogeoclimatic Subzone. Forests on zonal sites within the CDFmm are dominated by Douglas-fir as well as grand fir and western redcedar. The understory is dominated by salal, Oregon-grape, oceanspray and Oregon beaked moss. Less prominent species include baldhip rose, snowberry, western trumpet honeysuckle, vanilla leaf and electrified cattail moss. The presence of Garry oak and arbutus as well as numerous members of the lily family characterize drier sites. A species list for vegetation typically occurring in the CDFmm is presented in Table 1. A species list of the plant species observed during the field surveys are presented in Table 2.

Environmental Setting

Table 1: Vegetation Typically Occurring within the Coastal Douglas-fir Moist Maritime Subzone (CDFmm)

arbutus	<i>Arbutus menziesii</i>
bigleaf maple	<i>Acer macrophyllum</i>
Douglas-fir	<i>Pseudotsuga menziesii ssp. menziesii</i>
Garry oak	<i>Quercus garryana</i>
grand fir	<i>Abies grandis</i>
shore/lodgepole pine	<i>Pinus contorta</i>
western redcedar	<i>Thuja plicata</i>
baldhip rose	<i>Rosa gymnocarpa</i>
dull Oregon-grape	<i>Mahonia nervosa</i>
falsebox	<i>Paxistima myrsinites</i>
hairy honeysuckle	<i>Lonicera hispidula</i>
Indian plum	<i>Oemleria cerasiformis</i>
Labrador tea	<i>Ledum groenlandicum</i>
oceanspray	<i>Holodiscus discolor</i>
red elderberry	<i>Sambucus racemosa</i>
salal	<i>Gaultheria shallon</i>
salmonberry	<i>Rubus spectabilis</i>
snowberry	<i>Symphoricarpos spp.</i>
western trumpet honeysuckle	<i>Lonicera ciliosa</i>
Alaska oniongrass	<i>Melica subulata</i>
big-leaved sandwort	<i>Moehringia macrophylla</i>
bracken fern	<i>Pteridium aquilinum</i>
broad-leaved shootingstar	<i>Dodecatheon hendersonii</i>
false lily-of-the-valley	<i>Maianthemum dilatatum</i>
lady fern	<i>Athyrium filix-femina</i>
nodding trisetem	<i>Trisetum cernum</i>
Pacific sanicle	<i>Sanicula crassicaulis</i>
purple peavine	<i>Lathyrus nevadensis</i>
skunk cabbage	<i>Lysichiton americanum</i>
sword fern	<i>Polystichum munitum</i>
three-leaved foamflower	<i>Tiarella trifoliata</i>
vanilla leaf	<i>Achlys triphylla</i>
coastal leafy moss	<i>Plagiomnium insigne</i>
electrified cat's tail moss	<i>Rhytidiadelphus triquetrus</i>
juniper haircap moss	<i>Polytrichum juniperinum</i>
lanky moss	<i>Rhytidiadelphus loreus</i>
Oregon-beaked moss	<i>Kinbergia oregana</i>
palm tree moss	<i>Leucolepis menziesii</i>
red-stemmed feathermoss	<i>Pleurozium schreberi</i>
reindeer lichen	<i>Cladina spp.</i>
sphagnum moss	<i>Sphagnum spp.</i>
step moss	<i>Hylocomium splendens</i>

Environmental Setting

Table 2: Plant Species Encountered During Field Surveys

Common Name	Latin Name
TREES	
arbutus	<i>Arbutus menziesii</i>
bigleaf maple	<i>Acer macrophyllum</i>
bitter cherry	<i>Prunus emarginata</i>
casacara	<i>Rhamnus purshiana</i>
Douglas-fir	<i>Pseudotsuga menziesii</i>
Garry oak	<i>Quercus garryana</i>
grand fir	<i>Abies grandis</i>
mountain ash	<i>Sorbus aucuparia</i>
Pacific crab apple	<i>Malus fusca</i>
red alder	<i>Alnus rubra</i>
sitka spruce	<i>Picea sitchensis</i>
western hemlock	<i>Tsuga heterophylla</i>
western redcedar	<i>Thuja plicata</i>
western yew	<i>Taxus brevifolia</i>
SHRUBS	
baldhip rose	<i>Rosa gymnocarpa</i>
beaked hazelnut	<i>Corylus cornuta</i>
black raspberry	<i>Rubus leucodermis</i>
clustered wild rose	<i>Rosa pisocarpa</i>
dull Oregon-grape	<i>Mahonia nervosa</i>
English holly	<i>Ilex aquifolium</i>
evergreen blackberry	<i>Rubus laciniatus</i>
falsebox	<i>Paxistima myrsinites</i>
Geyer's willow	<i>Salix geyeriana</i>
gorse	<i>Ulex europaeus</i>
hairy honeysuckle	<i>Lonicera hispidula</i>
hardhack	<i>Spiraea douglasii</i>
Hooker's willow	<i>Salix hookeriana</i>
Labrador tea	<i>Ledum groenlandicum</i>
Nootka rose	<i>Rosa nutkana</i>
oceanspray	<i>Holodiscus discolor</i>
Pacific ninebark	<i>Physocarpus capitatus</i>
red huckleberry	<i>Vaccinium parvifolium</i>
red-osier dogwood	<i>Cornus stolonifera</i>
salal	<i>Gaultheria shallon</i>
salmonberry	<i>Rubus spectabilis</i>
Saskatoon berry	<i>Amelanchier alnifolia</i>
Scotch broom	<i>Cytisus scoparius</i>
Scouler's willow	<i>Salix scouleriana</i>
sitka willow	<i>Salix sitchensis</i>
snowberry	<i>Symphoricarpos albus</i>
tall Oregon-grape	<i>Mahonia aquifolium</i>
trailing blackberry	<i>Rubus ursinus</i>
western trumpet honeysuckle	<i>Lonicera ciliosa</i>
HERBS	
Alaska oniongrass	<i>Melica subulata</i>
American brooklime	<i>Veronica americana</i>
angled bitter-cress	<i>Cardamine angulata ?</i>
barren fescue	<i>Vulpia bromoides</i>
big chickweed	<i>Cerastium holosteoides</i>
bladder sedge	<i>Carex utriculata</i>
blue wildrye	<i>Elymus glaucus</i>
bluejoint	<i>Calamagrostis Canadensis</i>

Environmental Setting

bracken fern	<i>Pteridium aquilinum</i>
bristle-stalked sedge	<i>Carex leptalea</i>
broad-leaved shootingstar	<i>Dodecatheon hendersonii</i>
broad-leaved starflower	<i>Trientalis borealis subsp. latifolia</i>
broad-leaved stonecrop	<i>Sedum spathulifolium</i>
bulbous bluegrass	<i>Poa bulbosa</i>
bull thistle	<i>Cirsium vulgare</i>
California willowherb	<i>Epilobium foliosum</i>
Canada thistle	<i>Cirsium arvense</i>
chickweed	<i>Cerastium sp.</i>
cleavers	<i>Galium aparine</i>
Coastal hedgenettle	<i>Stachys chamissonis var. cooleyae</i>
colonial bentgrass	<i>Agrostis capillaries</i>
Columbia brome	<i>Bromus vulgaris</i>
common dandelion	<i>Taraxacum officinale</i>
common forget-me-not	<i>Myosotis discolor</i>
common horsetail	<i>Equisetum arvense</i>
common plantain	<i>Plantago major</i>
common rush	<i>Juncus effuses</i>
common velvet-grass	<i>Holcus lanatus</i>
corn speedwell	<i>Veronica arvensis</i>
creeping bentgrass	<i>Agrostis stolonifera</i>
creeping buttercup	<i>Ranunculus repens</i>
creeping spike-rush	<i>Eleocharis palustris</i>
crinkle-awn fescue	<i>Festuca subuliflora</i>
crisp sandwort	<i>Stellaria crispa</i>
Cusick's sedge	<i>Carex cusickii</i>
dagger-leaved rush	<i>Juncus ensifolius</i>
deer fern	<i>Blechnum spicant</i>
Dewey's sedge	<i>Carex deweyana</i>
early hairgrass	<i>Aira praecox</i>
false lily-of-the-valley	<i>Maianthemum dilatatum</i>
few-seeded bitter-cress	<i>Cardamine oligosperma</i>
field mint	<i>Mentha arvensis</i>
foamflower	<i>Tiarella laciniata</i>
fowl bluegrass	<i>Poa palustris</i>
foxtail fescue	<i>Vulpia myuros</i>
fringecup	<i>Tellima grandiflora</i>
giant horsetail	<i>Equisetum telmateia</i>
goldenback fern	<i>Pentagramma triangularis</i>
great camas	<i>Camassia leichtlinii</i>
hairy cat's-ear	<i>Hypochaeris radicata</i>
hairy vetch	<i>Vicia hirsute</i>
hairy wildrye	<i>Elymus hirsutus</i>
heath wood-rush	<i>Luzula subsessilis</i>
helleborine	<i>Epipactis helleborine</i>
Henderson's sedge	<i>Carex hendersonii</i>
Heuchera cylindrical	<i>Heuchera cylindrical</i>
inflated sedge	<i>Carex exsiccata</i>
Kentucky bluegrass	<i>Poa pratensis</i>
large-leaved avens	<i>Geum macrophyllum</i>
licorice fern	<i>Polypodium glycyrrhiza</i>
long-stoloned sedge	<i>Carex inops</i>
maidenhair fern	<i>Adiantum aleuticum</i>
many-flowered wood-rush	<i>Luzula multiflora</i>
march cudweed	<i>Gnaphalium uliginosum</i>
marsh speedwell	<i>Veronica scutellata</i>
musk-flower	<i>Mimulus moschatus</i>
nodding trisetem	<i>Trisetum cernuum</i>

Environmental Setting

Northern clustered sedge	<i>Carex arcta</i>
northern starflower	<i>Trientalis europaea subsp. arctica</i>
orchard grass	<i>Dactylis glomerata</i>
oval-leaved mitrewort	<i>Mitella ovalis</i>
Pacific bleeding-heart	<i>Dicentra Formosa</i>
Pacific sanicle	<i>Sanicula crassicaulis</i>
Pacific water-parsley	<i>Oenanthe sarmentosa</i>
pathfinder	<i>Adenocaulon bicolour</i>
pineapple weed	<i>Matricaria discoidea</i>
pinemap	<i>Monotropa uniflora</i>
pink wintergreen	<i>Pyrola asarifolia</i>
Prince's-pine	<i>Chimaphila umbellata</i>
purple marshlocks	<i>Comarum palustre</i>
purple-leaved willowherb	<i>Epilobium ciliatum</i>
redtop	<i>Agrostis gigantean</i>
rough bluegrass	<i>Poa trivialis</i>
Scouler's St. Johnswort	<i>Hypericum scouleri</i>
scouring-rush	<i>Equisetum hyemale</i>
sea blush	<i>Plectritis congesta</i>
self-heal	<i>Prunella vulgaris</i>
sheep sorrel	<i>Rumex acetosella</i>
Siberian miner's-lettuce	<i>Claytonia sibirica</i>
silver hairgrass	<i>Aira caryophyllea</i>
sitka sedge	<i>Carex sitchensis</i>
skunk cabbage	<i>Lysichiton americanus</i>
skunkweed	<i>Navarretia squarrosa</i>
slender rush	<i>Juncus tenuis</i>
slender woolyheads	<i>Psilocarphus tenellus</i>
slough sedge	<i>Carex obnupta</i>
small bedstraw	<i>Galium trifidum</i>
small fescue	<i>Vulpia microstachys var. pauciflora</i>
small hop-clover	<i>Trifolium dubium</i>
small-flowered alumroot	<i>Heuchera micrantha</i>
small-flowered blue-eyed Mary	<i>Collinsia parviflora</i>
small-flowered bulrush	<i>Scirpus microcarpus</i>
small-flowered forget-me-not	<i>Myosotis laxa</i>
small-flowered wood-rush	<i>Luzula fastigiata</i>
small-leaved montia	<i>Montia parvifolia</i>
smooth hawksbeard	<i>Crepis capillaries</i>
smooth sedge	<i>Carex laeviculmis</i>
soft broam	<i>Bromus hordeaceus</i>
spike bentgrass	<i>Agrostis exarata</i>
spinulose woodfern	<i>Dryopteris carthusiana</i>
spiny wood fern	<i>Dryopteris expansa</i>
stinging nettle	<i>Urtica dioica var. lyallii</i>
stream violet	<i>Viola glabella</i>
sweet vernalgrass	<i>Anthoxanthum odoratum</i>
sweet-scented bedstraw	<i>Galium triflorum</i>
sword fern	<i>Polystichum munitum</i>
tall annual willowherb	<i>Epilobium brachycarpum</i>
tall mannagrass	<i>Glyceria elata</i>
three-leafed foamflower	<i>Tiarella trifoliata</i>
thyme-leaved speedwell	<i>Veronica serpyllifolia</i>
toad rush	<i>Juncus bufonius</i>
trailing yellow violet	<i>Viola sempervirens</i>
tufted hairgrass	<i>Deschampsia cespitosa</i>
twinflower	<i>Linnaea borealis</i>
Vancouver groundcone	<i>Boschniakia hookeri</i>
vanilla-leaf	<i>Achlys triphylla</i>

Environmental Setting

wall lettuce	<i>Lactuca muralis</i>
water foxtail	<i>Alopecurus geniculatus</i>
wavy hairgrass	<i>Deschampsia flexuosa</i>
weak alkali grass	<i>Torreyochloa pauciflora</i>
Western coralroot	<i>Corallorhiza maculata</i>
Western fescue	<i>Festuca occidentalis</i>
white bog-orchid	<i>Platanthera dilatata</i>
white fawn lily	<i>Erythronium oregonum</i>
white-flowered hawkweed	<i>Hieracium albiflorum</i>
wood reedgrass	<i>Cinna latifolia</i>
yellow monkey-flower	<i>Mimulus guttatus</i>
MOSES AND LICHENS	
	<i>Eurhynchium praelongum</i>
	<i>Trachybryum megaptilum</i>
broom moss	<i>Dicranum scoparium</i>
cat-tail moss	<i>Isoetecium stoloniferum</i>
clear moss	<i>Hookeria lucens</i>
coastal leafy moss	<i>Plagiommium insigne</i>
coastal reindeer lichen	<i>Cladina portentosa</i>
electrified cat's-tail moss	<i>Rhytidiadelphus triquetrus</i>
Menzie's tree moss	<i>Leucolepis acanthoneuron</i>
pelt lichen	<i>Peltigera sp.</i>
rock moss	<i>Racomitrium elongatum</i>
step moss	<i>Hylocomium splendens</i>
Wallace's selaginella	<i>Selaginella wallacei</i>
AQUATICS	
Canadian waterweed	<i>Elodea Canadensis</i>
common bladderwort	<i>Utricularia macrorhiza</i>
common duckweed	<i>Lemna minor</i>
verticillate water-milfoil	<i>Myriophyllum verticillatum</i>
water -parsnip	<i>Sium suave</i>
water purslane	<i>Ludwigia palustris</i>
water smartweed	<i>Polygonum amphibium</i>
water-plantain	<i>Alisma plantago-aquatica</i>
watershield	<i>Brasenia schreberi</i>
whitestem pondweed	<i>Potamogeton praelongus</i>

Vegetation Communities

Rhacomitrium – Selaginella (RS)

The Rhacomitrium – Selaginella ecosystem typically occurs on gentle to moderately steep slopes. This ecosystem is dominated by mosses growing over bedrock outcrops and usually occurs in large open areas in association with other open type ecosystems such as Garry oak – brome. This ecosystem is dominated by rock moss, Wallace’s selaginella, reindeer lichen, sweet vernal grass, with lesser amounts of harvest brodiaea, satin flower, sea blush, grassland saxifrage, small flowered blue-eyed Mary. This plant community is heavily colonized by Scotch broom in many areas.

Garry oak – Brome (GB)

The Garry oak – Brome ecosystem is found on hillsides and hilltops in protected areas and can occur on slopes of varying steepness, and varying soil depth. These areas are frequently interspersed with rock outcrops and pickets meadows. This ecosystem is dominated by Garry oak, arbutus, California brome, sweet vernal grass, common and great camas, orchard grass and kinnikinnick. Other species frequently present include tall Oregon-grape, baldhip rose, oceanspray and spring gold. Communities on the site have in many cases been heavily colonized by Scotch broom. The Garry oak – Brome ecosystem is considered to be a rare plant community (red-listed).

Douglas-fir – Shore pine – Arbutus (DA)

The Douglas-fir – Shore pine – Arbutus site series has a very dry soil moisture regime and a very poor to medium soil nutrient regime. The tree canopy is often interrupted because of the rock outcrops and pockets of shallow soil. A characteristic floristic feature of this site association is the presence of Douglas-fir regeneration in the understory of the tree canopy. Mature stands are dominated by Douglas-fir and arbutus. Garry oak is often present as a minor tree species. The shrub layer contains oceanspray, dull Oregon-grape, and baldhip rose. Tall Oregon-grape and Saskatoon are also present in minor amounts. The herb layer consists of Columbia brome, purple peavine, Alaska oniongrass, western trumpet honeysuckle, broad-leaved starflower, white fawn lily, Pacific sanicle and often western fescue and cleavers. Oregon-beaked moss and electrified cat’s-tail moss are the predominant moss species. Another species that often occurs is step moss. Within the proposed residential zones the DA site series frequently exists as a Douglas-fir dominated Douglas-fir and arbutus woodland interspersed amongst a mosaic of hummocky rock outcroppings. On the site this site association exists as a young forest (structural stage 5).

Douglas-fir – Grand fir – Oregon-grape (DG)

The Douglas-fir – Shore pine – Arbutus site series has a very dry soil moisture regime and a very poor to medium soil nutrient regime. The tree canopy is often interrupted because of the rock outcrops and pockets of shallow soil. A

Environmental Setting

characteristic floristic feature of this site association is the presence of Douglas-fir regeneration in the understory of the tree canopy. Mature stands are dominated by Douglas-fir and arbutus. Garry oak is often present as a minor tree species. The shrub layer contains oceanspray, dull Oregon-grape, and baldhip rose. Tall Oregon-grape and Saskatoon are also present in minor amounts. The herb layer consists of Columbia brome, purple peavine, Alaska oniongrass, western trumpet honeysuckle, broad-leaved starflower, white fawn lily, Pacific sanicle and often western fescue and cleavers. Oregon-beaked moss and electrified cat's-tail moss are the predominant moss species. Another species that often occurs is step moss. Within the proposed residential zones the DA site series frequently exists as a Douglas-fir dominated Douglas-fir and arbutus woodland interspersed amongst a mosaic of hummocky rock outcroppings. On the site this site association exists as a young forest (structural stage 5).

Western redcedar – Douglas-fir – Kindbergia (RK)

The Western redcedar – Douglas-fir – Kindbergia site series has a slightly dry to fresh soil moisture regime and a very poor to medium soil nutrient regime. It typically occurs on gentle, lower slope positions, in receiving positions and soils are deep and medium textured. The tree layer typically is predominated by Douglas-fir with lesser amounts of western redcedar. The shrub layer is predominated by salal and dull Oregon-grape; baldhip rose and oceanspray also occur. The herb layer consists mostly of sword fern, bracken fern and vanilla leaf. The moss layer is comprised of Oregon beaked moss and step moss. The RK site series exists as both young (structural stage 5) and mature (structural stage 6) forest on the site.

Western redcedar – Grand fir – Foamflower (RF)

The tree layer in the Western redcedar – Grand fir – Foamflower site association consists of Douglas-fir, grand fir, western redcedar, bigleaf maple and sometimes western flowering dogwood. Salal and dull Oregon-grape constitute most of the shrub layer. The herb layer is predominantly vanilla leaf, sword fern, three-leaved foamflower, broad-leaved starflower and trailing blackberry. The moss layer is usually not well developed and consists of Oregon beaked moss, electrified cat's-tail moss and step moss. The RF site association usually occurs on a gentle slope in a lower slope receiving position. Soils are typically deep medium textured and have a rich nutrient regime. The soil moisture regime is subhygric to hygric. The RF site series exists as both young (structural stage 5) and mature (structural stage 6) forest on the site.

Western redcedar – Skunk cabbage (RC)

The Western redcedar – Skunk cabbage site series is found where the soil moisture regime is wet and the soil nutrient regime is rich to very rich. Trees tend to be restricted to elevated microsites, largely because of the increased availability of oxygen for root respiration there thus, the tree canopy is not continuous on this site association. Western redcedar and red alder are the major tree species; occasionally, bigleaf maple and western hemlock are also present.

Environmental Setting

The moderately well developed shrub layer is dominated by salmonberry. And also contains Indian-plum and red elderberry. The herb layer is well developed. Herbs that predominated include lady fern, spiny wood fern, giant horsetail, skunk cabbage false lily-of-the-valley and Cooley's hedge-nettle. The moderately well developed moss layer contains slender beaked moss, palm tree moss and coastal leafy moss. The riparian vegetation present on the site consists of this site association and is present as pole sapling and young and mature forest (structural stages 4, 5 and 6).

Western redcedar – Vanilla leaf (RV)

The western redcedar – vanilla leaf site association occurs in lower slope moisture receiving positions in areas of deep medium textured soils which have a rich nutrient regime. These areas usually experience extreme fluctuations in the water table throughout the season. The tree layer in this site association is typically diverse and consists of western redcedar, red alder, grand fir, Douglas-fir and bigleaf maple. The shrub layer consists of salal, Indian-plum, common snowberry and Oregon-grape. The herb layer is predominantly sword fern with lesser amounts of vanilla leaf and foamflower. The moss layer consists of Oregon beaked moss, palm tree moss and slender beaked moss. This site association occurs as both young and mature forests on the site.

Willow – Hardhack (WH)

The Willow - Hardhack ecosystem occurs in many of the swamp wetlands located on the site. Hardhack, Pacific and Scouler's willow and Pacific ninebark with lesser amounts of red-osier dogwood, red alder, salmonberry and trembling aspen dominate this ecosystem. The herb layer is dominated by American brooklime, marsh speedwell, northern clustered sedge, common rush and Pacific water parsley. Common water moss is also present.

Western redcedar – Slough sedge (CS)

The western redcedar - slough sedge site association occurs in flat to depressed areas as a forested swamp in poorly drained deep medium textured soil. The tree layer consists of western redcedar, red alder, grand fir and black cottonwood. The shrub layer is predominated by common snowberry, Indian plum and red-osier dogwood. The herb layer consists mostly of slough sedge.

Black cottonwood – Willow (CW)

The black cottonwood – willow site association typically occurs on low bench floodplains. The tree layer is usually predominated by red alder with a shrub layer of willow, salmonberry and thimbleberry. The herb layer is sparse and consists of scouring rush and Cooley's hedge-nettle.

Disturbed (D)

Disturbed areas include the hydro right-of-way, trails, roads and logged areas.

In summary, the site consists of the following:

Environmental Setting

- 9.2 ha of wetland vegetation (WH, CS, CW);
- 30.0 ha of wet forest vegetation (RC, RV);
- 82.7 ha of mesic forest vegetation (DG, RK, RF);
- 48.5 ha of dry upland woodland vegetation (DA, RS, GB);
- 22.0 ha of disturbed area (D).

Sensitive Ecosystems

According to the Sensitive Ecosystem Inventory maps from the Ministry of Environment, Lands and Parks (MELP) all or portions of twelve sensitive ecosystem polygons occur within the study area (Figure 4). In addition to those polygons identified by the SEI surveys, ENKON observed twelve wetland, eight woodland and three riparian ecosystems that meet the SEI criteria as sensitive ecosystems. There are also portions of four general biodiversity polygons on the property that are composed of coniferous and mixed second growth forest with lesser amounts of older growth conifer forest. Table 3 below provides a summary of the sensitive ecosystems, their total area and the area that they encompass within the property boundary.

Wetlands ecosystems can consist of swamps, fens, bogs, meadows or shallow open water. Swamps are vegetated by flood-tolerant trees such as Pacific crabapple, Sitka willow and Pacific willow. Shallow water wetlands feature submerged and floating plants such as yellow pond-lily, common duckweed, verticillate water-milfoil, common bladderwort, bur-reed and Canadian waterweed. Fens develop on continuously wet peaty soils; they are fed by water enriched with minerals from upslope drainage. Wet meadows consist of flood-tolerant grasses, low sedges and rushes. Many wetlands include a mosaic of these different wetland types.

Terrestrial herbaceous ecosystems are defined as natural grasslands or byrophyte-dominated vegetation, including rock outcrop/grassland and rock outcrop/moss types, having greater than 20% cover.

Woodlands can consist of Garry oak woodlands, arbutus/Douglas-fir woodlands or trembling aspen stands.

Riparian ecosystems are found on the margins of rivers, streams, lakes and marshes as well as the floodplains of large rivers and small streams and in gullies.

The second growth forest ecosystems in the study area have an average tree age of between 60 and 100 years.

Environmental Setting

Table 3: Sensitive Ecosystem and General Biodiversity Polygons within the Study Area

Insert Table Here

Figure 3: Vegetation Units

Figure 4: Sensitive Ecosystem Polygons

Rare and Endangered Vascular Plants and Plant Communities

Rare vascular plants occurring within the South Island Forest District listed by the Conservation Data Center (CDC) are shown in Appendix II. As of March 1, 2004, 164 plant species were present on the CDC list, including 78 red-listed species and 86 blue-listed species.

Rare and endangered vascular plant species are listed by the Conservation Data Center (CDC), which categorizes them as either red-listed or blue-listed. Red-listed species include species that are extirpated in British Columbia, in danger of becoming extirpated, or threatened. Blue-listed species are species that are sensitive or vulnerable to human activity or habitat encroachment. The CDC compiled a rare element occurrence report (EOR) for the project site. The EOR report outlines those species of red and blue-listed vascular plants, vertebrate animals and plant communities that have been documented in the area.

In response to an EOR request made on August 9, 2002, the Conservation Data Centre indicated that there have been no reported occurrences of rare species or plant communities at the Bear Mountain Highlands Property (Appendix II). However, the EOR report does indicate that there has been one recorded observation of slender woolly-head (*Psilocarphus tenellus* var. *tenellus*) along Millstream Road, north of the project area in 1951. Slender woolly-heads was observed along the powerline right-of-way during the July 17, 2002 survey, immediately to the west of Millstream Road.

The CDC reports the occurrence of 21 rare and endangered plant communities in the South Island District within the CDFmm of which 19 are red-listed and 2 are blue-listed (Appendix II).

Consultation with Jan Kirkby of the Conservation Data Centre indicates that there are rare plant communities on the Highlands Bear Mountain site. Although the current CDC list of rare plant communities specifies only mature plant communities (structural stages 6 and 7) Ms. Kirkby stated that the revised list would not be specific to these older communities. Therefore, the following rare plant communities are known to be present on the site:

- Garry oak / brome, CDFmm/00 – red-listed;
- Western redcedar - Douglas-fir / Oregon beaked moss, CDFmm/05 – red-listed;
- Douglas-fir – arbutus, CDFmm/02 –blue-listed;
- Red alder / skunk cabbage, CDFmm/11 – blue-listed;
- Red alder / slough sedge [black cottonwood], CDFmm/14 – red-listed;
- Grand fir / three-leaved foamflower, CDFmm/06 – red-listed and
- Grand fir / dull Oregon-grape, CDFmm/04 – red-listed.

Environmental Setting

2.1.2 Wildlife

2.1.2.1 Previous Studies

A preliminary assessment of the wildlife resources on the Bear Mountain Highlands site was completed in May 1997 and a follow-up visit was completed in July 1998. From June to September 2001, a wildlife inventory of the proposed Western Forest Products subdivision site was completed which included herpetile, small mammal and bird surveys.

2.1.2.2 Methods

A total of four wildlife inventory surveys were conducted from May 09, 15 and June 13th, 2002:

- Small Mammal Survey - May 09, 2002;
- Herpetifaunal Surveys - May 09 and 15, 2002;
- Nocturnal Raptor Nest Surveys - May 09 and 15, 2002 and
- Diurnal Bird Nest Surveys - May 09, and June 13, 2002.

All wildlife surveys were conducted as much as possible according to Resource Inventory Committee (RIC) standards. The standards used included:

- *RIC's Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 1.1)*; Sections 3.3.4, and 3.3.6;
- *Inventory Methods for Small Mammals: Shrews, Voles, Mice & Rats Standards for Components of British Columbia's Biodiversity, No. 31 (1998)*;
- *RIC's Inventory Methods for Pond-breeding Amphibians and Painted Turtle Standards for Components of British Columbia's Biodiversity No. 37 (Version 2.0)*; and,
- Section 2 'Conducting Wildlife Inventory' in *Species Inventory Fundamentals (No.1)*.

Raptor and Passerine Surveys

Foot Transects

Foot (transect) surveys along the stream and wetland margins on the study site were performed for any new and/or old raptor and passerine nests. The searches were done in order to verify use of the site by raptors, herons and passerines (Figure 5). Based on visual observations and calls heard, the occurrences of breeding or roosting raptors, heron nests and other nests on the property were classified as 'present' or 'not detected.'¹

¹ ENKON's not having observed nests would not rule out the possibility of one or more nests being present on the site.

Environmental Setting

ENKON's wildlife biologist investigated the occurrence of raptor and other bird species nests on the property. This was performed by searching for nests along the existing trail system, and each vegetation unit identified in Section 2.1.1. Any significant cavity trees, which may be potential roost sites, were also checked for bird (owl) presence. Raptor evidence and site use was evaluated by using fecal wash, prey remains or any other sign of raptors or herons that may inhabit the area.

Diurnal Call Playback Surveys (Hawk Surveys)

Methodology for the diurnal call playback surveys for raptors followed procedures outlined in 'Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 2.0) Section 3.0'.

Fifteen point counts were set up throughout the study area along the road and trail system (Figure 5). All points were spaced approximately 250 - 300 meters apart so that all areas within the study site would be surveyed. Counting involved a five-minute survey at each stop, standing and watching the surrounding area and recording the numbers and species of birds seen (visuals) and heard (calls) within a radius of approximately 250 meters surrounding the point.

The hawk call playback survey was conducted at each point count station. These surveys were conducted on foot, although transportation from station to station for some was by car. Calls of only the potentially breeding Cooper's Hawk (*Accipiter cooperii*) were played at all the stations for a duration of one minute. Following each broadcast, the observer looked and listened for one minute for visual and/or vocal response of the target species.

Nocturnal Call Playback Survey (Owl Survey)

Two owl call playback surveys were performed on the property. This methodology followed procedures outlined in 'Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors (Version 2.0) Section 3.0'.

Figure 5: Wildlife observations

Environmental Setting

Fifteen point counts were set up throughout the study area along the road and trail system (Figure 5). All points were spaced approximately 250 - 300 meters apart so that all areas within the study site would be surveyed. Counting involved a ten-minute survey at each stop, standing and watching the surrounding area and recording the numbers and species of birds seen (visuals) and heard (calls) within a radius of approximately 250 meters surrounding the point.

Call playback surveys were conducted at the point count stations. These surveys were conducted on foot, although transportation from station to station for some was by car. Calls of five target nocturnal raptor species potentially occurring in the study area were played at all the stations. Each species call was broadcast for one minute. Following each broadcast, the observer looked and listened for one minute for visual and/or vocal response of the target species. Following the playbacks of the five calls, the observer used a flashlight to see if any perching birds were present in the immediate area surrounding the point count center.

Target species songs and calls used at each point count station were played in the following order:

1. Northern Pygmy Owl;
2. Northern Saw-whet Owl;
3. Western Screech Owl;
4. Barred Owl and
5. Great-horned Owl.

Herpetifauna

Searches were performed along stream margins and wet pool areas to locate herpetifauna (reptiles and amphibians). The surveys targeted watercourses. ENKON's biologist searched potential amphibian and reptile habitat. Herpetifaunal survey methodologies included:

- Gee-trapping in wetland pools;
- Pitfall trapping;
- Time-constrained searches and
- Systematic surveys.

The amphibian surveys focused on identifying the presence/not-detected status of any frogs or amphibians, but special focus was on the Blue listed Red-legged Frog (*Rana aurora*). Although the Red-legged Frog and its habitat characteristics were the focus of the survey, all incidental amphibian sightings were recorded.

Time-constrained reptile surveys were performed during the afternoon, during optimal reptile activity. Searches focused on the potentially occurring species,

Environmental Setting

Common Garter Snake (*Thamnophis sirtalis*) and Northern Alligator Lizard (*Elgaria coerulea*).

24 hour Gee trapping

Gee trapping involved placing minnow traps (Gee-traps) baited with cat food in pools located in the south end of the property for a minimum of 24 hours. This is an effective way of capturing larval, neotenic² and adult aquatic (versus terrestrial) salamanders. Gee trapping is particularly effective in the late spring when amphibian spawning is at its height.

Pitfall Trapping

Using pitfalls (upturned plastic beverage bottles with the bottom cut off) and drift fences, traps were placed parallel to the wetland to intercept frogs and salamanders. The caps of the bottles were removed for drainage to prevent flooding and drowning of captured animals.

Salamanders and frogs forage along wetland margins, upon encountering the drift fencing they follow the fencing to the pitfall trap and fall in. Traps are checked every 24 hours to prevent mortality and stress.

Time-Constrained Searches

Time-constrained searches involved conducting reptile and amphibian surveys at specific times of the day (afternoon) when these herpetiles prefer to sun themselves. They were conducted on foot. For amphibians surveys were performed along all watercourses, riparian edges and pooled/ponded water. For reptiles surveys were performed throughout the study areas different vegetation units but focus was on the rock outcrop areas where the reptiles prefer to bask in the sunshine.

Systematic Searches

Systematic searches for amphibians were conducted in conjunction with the stream surveys. Salamanders and frogs encountered in the mud bottom of a stream or pond often turn and swim out to deeper water or under a log if they detect the surveyor approaching (MELP 1997). Therefore, the systematic searches focused on looking for disturbances in the water created by swimming amphibians and looking in areas where amphibians tend to hide. The following survey methodologies were employed to find larvae of salamanders and/or the target red-legged frog:

- Randomly uncovering woody debris encountered during the top-of-bank surveys; and,
- Examining stream edges, ephemeral pools, and searching among aquatic vegetation and under logs and debris adjacent to streams.

² Neotenic: Attaining reproductive maturity while in the larval state by delayed somatic development. The larva fails to metamorphose into an adult form, resulting in a permanent, sexually mature larva (neotene).

Small Mammals

Pitfall and Sherman (live-traps) traps were randomly located in the target habitat throughout the property (Figure 5). Focus was on identifying the presence of the Red listed Vancouver Island Water Shrew (*Sorex palustris brooksi*). The following methodology was used during the survey:

- All traps were placed at strategic locations where the shrew was expected to occur. These sites included positions along or under woody debris or rocks in forest habitat by fast flowing streams, along the fast flowing streams themselves and along worn small mammal travel trails associated with the stream habitat;
- Sherman live traps were placed near the pitfall traps;
- The traps were set in groups of two to three, with a minimum of 15 meter spacing between groups. Traps within groups were placed more than 2 meters apart;
- Each Sherman trap was baited with peanut butter and rolled oats, and the pitfall traps were baited with rolled oats, peanut butter and cotton placed in the bottom for bedding material;
- The GPS coordinates of all trap locations were recorded, and the locations of trap groupings were marked with flagging tape;
- The traps were set during daytime and checked the following day (after approximately 24 hours) to minimize mortalities and trap stress and
- On completion of the study all flagging tape, markers, traps and other debris were removed from the site.

Six pitfall traps and 24 Sherman traps were placed on the property.

Large Mammals

Large mammal presence/not-detected surveys were conducted during all field activities and results were recorded as incidental observations. The presence/not-detected status of large mammals was based on the following:

- Scat sign;
- Track sign;
- Forage/browse sign;
- Scrapings and
- Direct field observation.

2.1.2.3 Wildlife Ratings

For assessing the wildlife value of habitat (defined by the vegetation units), in the project study site we used the methodology outlined in *British Columbia Wildlife Habitat Rating Standards* (Version 2.0, 1999).

Environmental Setting

This methodology assigns habitat ratings based on the product of knowledge and assumptions of biophysical features within the study area (i.e. vegetation units, moisture, terrain etc.). Ratings assigned are limited by the extent of knowledge about a species in the province and ecosystems within the study site, the accuracy of the assumption made about a species' use of habitat and the limited amount of animal inventory and census data underlying the ratings.

The objective of using this methodology is that it assigns wildlife habitat capability ratings to define the relative importance of various ecological units to wildlife populations and it provides information for designing management activities that may affect those populations.

The assigned ratings and animal life requisites reflect the habitat's potential to support a particular species and provide a means to compare habitat to the best available for that species in the province and/or the animals' ideal habitat.

Each animal defined in the 1997 ENKON report as occurring in Southern Vancouver Island as well as the animals defined in the CDC's Rare Vertebrate Animal Tracking List (July 2000) were assessed using a six point rating scheme and the methodology outlined above. The rating scheme is presented in Table 4.

Table 4: Habitat Capability and Suitability Rating Scheme Used for Habitat Assessment

Habitat Use (6-class Rating)	
Animal Occurrence in Area	Code
High	1
Moderately High	2
Moderate	3
Low	4
Very Low	5
Nil	6

During the field reconnaissance each animal was rated using wildlife cards as defined in the British Columbia Wildlife Habitat Rating Standards (Version 2.0, 1999), for the growing season on a general 'Living' criteria that includes limiting life requirements of each animal.

The growing season is an amalgamation of three seasons, and Living during this season includes a number of specific life requisites (reproducing, migrating, staging and courtship). Our rating for Living in the growing season reflected habitats on the study site used for any of these activities.

2.1.3 Results

2.1.3.1 Birds

Raptors

Environmental Setting

Diurnal Species (Hawk Surveys)

A breeding raptor and nest survey was performed on June 13, 2002 through the property along the existing trail system. Point Counts were set up such that the raptor calls could be played throughout the property and all areas would be covered (Figure 5).

No red or blue-listed raptor species listed in the Southern Vancouver Island Forest District Rare Vertebrate Tracking List were recorded during any of the field surveys or field visits.

The only raptor recorded for the property was one Cooper's Hawk, which was seen during the May 9, 2002 fieldwork (Figure 5). No raptor nests were found on the property.

Forest-dwelling diurnal raptors that may use the study area for foraging include the Cooper's Hawk, Merlin and Sharp-shinned Hawk. Diurnal raptors such as the Cooper's Hawk, Sharp-shinned Hawk and Northern Goshawk would likely occur on the site, as they are dependent on the thicker forest areas with open understoreys, which are found throughout. However, due to their habitat requirements, it is unlikely that these diurnal raptors, except the Cooper's Hawk, would nest on the property.

Even though no positively identified hawk nests were found, the possibility of a Cooper's Hawk occurring on the property is high because the nests found in the location of the individual sighting appeared to be quite characteristic of a Cooper's Hawk nest.

In personal conversations with Andy Stewart (Wildlife Biologist, MWLAP, Victoria) on Southern Vancouver Island the Cooper's Hawk prefers nesting and foraging in the woods of all forest ages and urban areas. Nests have been observed in tree heights of 3 - 40 meters of pole sapling and mature forest stages. Territories have been observed to be from 10 ha in size and larger. This hawk is very opportunistic as well as quite tolerable to urban encroachment and presence. Food preference on the island has been observed to be primarily American robins and European starlings taken along forest edges (100 meters from edge). Territories have been separated approximately 1,000 meters apart of one another with densities at one nest every 3 kilometers.

Raptors like the Red-tailed Hawk and the Rough-legged Hawk (buteos), and owls such as the Short-eared and Barn Owl are unlikely to nest on the study area because they prefer to forage in open fields and use the forest edges and tall shrub areas for roosting. These habitats are not available on the proposed subdivision lands.

Nocturnal Species (Owl Surveys)

Nocturnal raptors like the Great-horned Owl, the Northern Saw-whet Owl, Western Screech-Owl and the Northern Pygmy-Owl prefer closed forest communities with riparian areas for nesting. These areas also provide opportunities to forage for small mammals. All riparian habitat areas on the study site may be considered high value for foraging and roosting for these

Environmental Setting

species. Additionally, the rodents in the area provide (i.e. Red Squirrels, Deer Mice and shrews) an abundant source of food for these species.

The most significant value of the site for raptors is its potential to provide food, roosting as well as nesting habitat. Many of the trees are large with heart rot and thus provide good cavity roost sites for small raptors like the Northern Saw-whet Owl, Western Screech-Owl and the Northern Pygmy-Owl.

The nocturnal raptor survey was conducted from the point counts on the night of May 09, 2002 along the southeast of the study site from 2100 to 2330 h and along the base of Mt. Finlayson along the trail network on May 15th, 2002 from 2055 to 0020 h. Conditions for broadcasting were excellent on both nights with no wind and starry skies.

Only barred owls and a Northern Saw-whet Owl replied to the calls on both survey nights. A total of two Barred Owls (two individuals) were seen and heard during both surveys. On Vancouver Island owls begin breeding by mid-March and the survey was conducted during the peak of nesting season for the target species identified in Section 2.1.3.1.1. Table 5 presents a summary of raptor sightings for both nights, the point count locations of the observations and the date the Point Count was performed.

Table 5: Owl Sightings May 9th and 15th, 2002

Point Count Station	Species Heard (H)/Observed (O)	Date
1	-	May 09, 2002
2	-	
3	-	
4	-	
5	-	
6	-	
7	(H) Northern Saw-whet Owl (H) Barred Owl (O) Barred Owl	
8	(O) Barred Owl	
9	(O) Barred Owl	
10		May 15, 2002
11	-	
12	(O) Two Barred Owls, (H) Northern Saw-whet Owl	
13	(O) Two Barred Owls	
14	(O) Two Barred Owls	
15	-	

Based on a surveys performed by ENKON on the parcel of land immediately south of Mt. Finlayson around Hatcher Swamp and the powerline corridor, a potential Barred Owl nest and territory was found adjacent to Goldstream Provincial Park off the property. The reply and sightings of the Barred Owls in

Environmental Setting

the southwest section of the property on both nights (May 09 and 15, 2002) is likely the result of the same owls investigating the call-playbacks.

During the May 2002 surveys, on both nights the owls approached the point counts from the south of the property. On the first survey (May 09, 2002) an owl followed the biologist for approximately two point counts, PC 8 and 9, while (possibly) its mate called from south of the study site. The calling Barred Owl was never observed. On May 15, 2002, a pair of Barred Owls followed the biologist for PCs 12, 13 and 14. This supposed pair, is not expected to nest on the proposed logged area, likely due to the active construction and human activity but they use the property for foraging as part of its 229 ha territory³.

The Northern Saw-whet Owl was heard on both nights from PCs 7 (May 09, 2002) and PC 12 on May 15, 2002. This owl never made any approaches to investigate the calls.

Passerine and Passerine-like Birds

Field surveys identified nine active and three inactive (old) passerine nests on the property (Figure 5). These consisted of:

- Three active Dark-eyed Junco (*Junco hyemalis*) nest - along a rock outcrop with one young;
- Three American Robin (*Turdus migratorius*) nests - all with 2-3 young;
- Active Red-breasted Sapsucker (*Sphyrapicus ruber*) nest – located on edge of Wetland N;
- An active Red-breasted Nuthatch (*Sitta canadensis*) nest with young; and,
- Three old thrush nests, either from the existing year or from the previous year.

A total of forty bird species were observed and/or heard as incidental sightings (Table 3) and all forty are potential breeders on the site. No Red or Blue listed bird species listed in the Southern Vancouver Island Forest District's Rare Vertebrate Tracking List (Appendix II) were observed or heard during the June 13th, 2002 survey period.

Table 6: Birds Observed or Heard During the June 13th, 2002 Breeding Bird Survey

Common Name	Latin Name	Potential Breeders
American Goldfinch	<i>Carduelis tristis</i>	Yes
American Robin*	<i>Turdus migratorius</i>	Yes
Bewick's Wren	<i>Thryomanes bewickii</i>	Yes
Brown Creeper	<i>Certhia americana</i>	Yes

³ Ben Olsen, Lisa Takats, Barbara Beck, James Beck, Richard Bonar (1999). Barred Owl Reproductive Habitat Suitability Index Model Version 3

Environmental Setting

Common Name	Latin Name	Potential Breeders
Brown-headed Cowbird	<i>Molothrus ater</i>	Yes
California Quail	<i>Callipepla californica</i>	No
Chestnut-backed Chickadee	<i>Poecile rufescens</i>	Yes
Cassin's Vireo	<i>Vireo cassini</i>	Yes
Common Raven	<i>Corvus corax</i>	Yes
Dark-eyed Junco*	<i>Junco hyemalis</i>	Yes
Downy Woodpecker	<i>Picoides pubescens</i>	Yes
European Starling	<i>Sturnus vulgaris</i>	Yes
House Finch	<i>Carpodacus mexicanus</i>	Yes
Hutton's Vireo	<i>Vireo huttoni</i>	Yes
McGillivray's Warbler	<i>Oporornis tolmiei</i>	No
Nashville Warbler	<i>Vermivora ruficapilla</i>	Yes
Northern Flicker	<i>Colaptes auratus</i>	Yes
Northwestern Crow	<i>Corvus caurinus</i>	Yes
Orange-crowned Warbler	<i>Vermivora celata</i>	Yes
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	Yes
Pileated Woodpecker	<i>Dryocopus pileatus</i>	Yes
Pine Siskin	<i>Carduelis pinus</i>	Yes
Purple Finch	<i>Carpodacus purpureus</i>	Yes
Red-breasted Nuthatch*	<i>Sitta canadensis</i>	Yes
Red-breasted Sapsucker*	<i>Sphyrapicus ruber</i>	Yes
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	No
Rufous Hummingbird	<i>Selasphorus rufus</i>	Yes
Song Sparrow	<i>Melospiza melodia</i>	Yes
Spotted Towhee	<i>Pipilo maculatus</i>	Yes
Steller's Jay	<i>Cyanocitta stelleri</i>	Yes
Swainson's Thrush	<i>Catharus ustulatus</i>	Yes
Townsend's Warbler	<i>Dendroica townsendi</i>	Yes
Turkey Vulture	<i>Cathartes aura</i>	No
Violet-green Swallow	<i>Tachycineta thalassina</i>	Yes
Warbling Vireo	<i>Vireo gilvus</i>	No
Western Tanager	<i>Piranga ludoviciana</i>	No
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Yes
Wilson's Warbler	<i>Wilsonia pusilla</i>	No
Winter Wren	<i>Troglodytes troglodytes</i>	Yes
Yellow-rumped Warbler	<i>Dendroica coronata</i>	Yes

*' Confirmed Actively Breeding - nest found or nesting activity observed

Species Diversity

The results of the bird survey show that Point Counts (PCs) 1, 9 and 11 had the highest species diversity (Table 7). This was likely due to the diversity of

Environmental Setting

vegetation and edge habitat very characteristic of cleared forest areas. Vegetation diversity creates a diversity of habitat thus allowing opportunistic nesters like the invasive species European Starling, the American Robin and Black-capped Chickadee to nest. These three were the most abundant species at each of the survey stations.

The lowest bird species diversity was observed at PCs 14 and 15 (Table 7). The low diversity was likely due to the deeper forest environment and lack of vegetative diversity. Dense mature forest habitat likely restricts use by many opportunistic species and favours forest specialists like the Townsend's Warbler and Swainson's Thrush.

Table 7: Number of Bird Species at Each Point Count

Point Count	Number of Species
1	22
2	8
3	5
4	5
5	8
6	11
7	7
8	5
9	16
10	5
11	13
12	7
13	7
14	4
15	1
16	4
17	6
18	6
19	11

Individual Diversity

The highest numbers of individual birds were recorded at PCs 1, 9 and 11 (Table 7). This was likely due to the diverse habitats present at both sites as well as due to natal dispersal from the seasons first clutch hatchings. Habitats at PC 1 and 9 are composed of both thick coniferous forest and open mixed deciduous and coniferous forest vegetation. This variation in vegetation structure, age and composition provides a diverse habitat for many species but it also provides better habitat for competitive invasive species such as the European Starling and House Sparrow characteristic of urban settings. These species compete with indigenous bird species (Violet-green Swallows, Bewick's Wrens and Tree Swallows) for nesting spaces. They tend to out compete these indigenous species because of their aggressive behaviour, earlier nesting times and greater number of clutches.

The least amount of individuals was counted at PC 15, likely due to the dense forest habitat with little vegetation canopy and structural stage diversity.

Potential Nesters

Table 6 presents all the species encountered during surveys. At the time of year of the bird survey a vast majority of the birds were nesting and active nesters display and protect territories. Many of the birds that were recorded around each point count nest approximately 200 m around each, therefore we may assume that the birds recorded at each point count may be actively nesting in close proximity. If this is so, then the results indicate that Point Counts 1, 9 and 11 had the greatest diversity of species nesting around them. This is likely because it has the most diverse vegetation consisting of shrub, pole/sapling and mature forest stands. This habitat structure allows for multi-species nesting. Point Counts 15, 13 and 14 had the least diversity possibly due to its mature forest habitat. This provides nesting to specific species (i.e. Townsend's Warbler and the Winter Wren). Many of the species encountered at these point counts were associated with mature forest areas (i.e. Cassin's Vireo, Swainson's Thrush, Western Tanager, and Warbling Vireo).

Rare Bird Species

As of March 2004, the CDC lists 28 bird species that breed in the Southern Vancouver Island Forest District as threatened or vulnerable (Appendix II). The study site contains suitable breeding habitat for the Blue listed Band-tailed Pigeon.

The Band-tailed Pigeon is found in the forests or coastal woodlands of Western British Columbia and America. They perch, nest and feed in coniferous trees such as pines as well as maples and alders. Unlike the common pigeon (Rock Dove) (*Columba livia*), which can be found in cities around the world, the Band-tailed Pigeon will avoid populated areas and any human contact. It prefers forest environments. This bird eats nuts, seeds, berries, blossoms and insects found in coastal woodland and forest habitat. When in season, it is also known to eat domestic crops such as cherries, berries, oats, barley and wheat. Breeding season

begins in March and lasts through late spring. The female builds a flat, loose nest on the ground, in low brush, or in the fork of lower tree branches usually associated with stream habitat. Nesting materials are provided by the male and consist mainly of twigs and pine needles. One, egg sometimes, two eggs are laid per season with both male and female responsible for incubation. They hatch within 18 - 20 days, and chicks fledge 28 - 30 days after hatching.

Field searches failed to detect any evidence of this bird's past or present nesting activity on the property.

2.1.3.2 Amphibians

Three species of amphibian were observed during the May survey period and one additional species was recorded in a survey performed by ENKON during June 13th, 2002 in Millstream Creek. The species was a Northwestern Salamander, captured by minnow trapping in Millstream Creek at the bridge at the inlet to Hatcher Swamp. The May 9-15, 2002 survey searches produced one Pacific tree Frog (*Hyla regilla*) and three Blue listed Red-legged Frogs (*Rana aurora*), (Figure 5). Several Red-legged Frogs were also observed during the fish survey in July 2002. Rough-skinned newts are also known to exist in the general area although none were caught during the surveys.

Favoured habitats for amphibians on the study site include wetlands and streams, the riparian zones and the mature forest zones adjacent to riparian areas. Areas of extensive coarse woody debris and wet areas are the most likely sites to encounter amphibians.

Red-legged Frog (Blue-listed)

Based on its life requirements and the habitat offered by the property, the Blue listed Red-legged Frog uses the property's ponds, wetlands and stream areas for all of its life requirements, breeding, foraging, shelter and as dispersal corridors between wetland areas adjacent to the property.

While lowland areas are the limiting/critical habitat areas for this frog, adult Red-legged Frogs also use the adjacent forested uplands for foraging as well as for dispersal from natal areas. These upland forested habitats are primarily used for living out its adult life.

'*Critical Habitat*', defined as habitat which is necessary for this species to carry out its entire life process includes areas that support all of the following:

- Suitable aquatic habitat;
- Associated uplands and,
- Suitable dispersal habitat connecting the suitable aquatic habitat.

The property has the potential to provide the frogs' critical habitat.

Aquatic Habitat

At a minimum, this includes two (or more) suitable breeding locations, one of which must be a permanent water source, the associated upland surrounding the

Environmental Setting

water body(s) (extending to approximately 150 meters from the water's edge), all within 1 kilometer of each other and connected by barrier-free dispersal habitat (of at least 150 meters in width)⁴. For this species suitable aquatic habitat on the property consists of the permanent water bodies along the south. They are virtually still and have slow-moving fresh water. For optimal growth of this species it requires a minimum water depth of 20 cm during the entire tadpole rearing season (at least March through July), and a dense, shrubby riparian vegetation, e.g. willow (*Salix spp.*) and bull rush (*Scirpus spp.*) species. The ponds along the south of the site provide these required habitats.

Upland Habitat

Suitable upland habitat for this frog consists of all upland areas (riparian or otherwise) within 150 meters of the water's edge, (but not further than the watershed boundary). This upland habitat is important in maintaining the integrity of the frog aquatic/breeding habitat.

Dispersal Habitat

For this frog's dispersal, habitat consists of all upland and wetland habitat that connect two or more patches of suitable aquatic habitat within 2 kilometers of one another. This is present at both the north and south end of the site. Dispersal habitat must be at least 150 meters wide and free of barriers such as, heavily traveled roads (with more than approximately 30 cars per hour)⁵.

2.1.3.3 Small Mammals

The focus of the small mammal surveys was on identifying the presence or non-detection of the Red listed Vancouver Island Water Shrew (*Sorex palustris brooksi*) on the property. All small mammal traps were set in foraging habitat characteristic of this species (Figure 5). Following the one nights survey this species was not located.

A total of twenty-four Sherman and six pitfall traps were used (Figure 5). The night's small mammal trapping, May 9, 2002, captured only one species of small mammal both nights, totaling eleven individuals (Table 8). The only species captured was the opportunistic Deer Mouse (*Peromyscus maculatum*). All individuals were captured in the Sherman traps. The pitfall traps collected nothing.

⁴ Center for Conservation Biology University of California Riverside, California Michael F. Allen Tracy Tennant November 2, 2000

⁵ Center for Conservation Biology University of California Riverside, California Michael F. Allen Tracy Tennant November 2, 2000

Environmental Setting

Table 8: Results of Small Mammal Trapping, May 2002

Trap Type and Number	Deer Mouse (<i>Peromyscus maculatum</i>)
Pitfall 1	-
Pitfall 2	-
Pitfall 3	-
Pitfall 4	-
Pitfall 5	-
Pitfall 6	-
Sherman 1	1
Sherman 2	-
Sherman 3	1
Sherman 4	-
Sherman 5	-
Sherman 6	1
Sherman 7	-
Sherman 8	1
Sherman 9	-
Sherman 10	2
Sherman 11	-
Sherman 12	-
Sherman 13	-
Sherman 14	2
Sherman 15	-
Sherman 16	-
Sherman 17	-
Sherman 18	1
Sherman 19	-
Sherman 20	1
Sherman 21	-
Sherman 22	1
Sherman 23	-
Sherman 24	-
TOTAL	11

The British Columbia Red listed Vancouver Island Water Shrew is a habitat specialist and prefers to occupy moist riparian habitats with dense, moist coniferous forests, beaches, marsh areas, heavily wooded but wet areas, it may be present on the banks of sluggish streams, found among beach debris, and

during the winter rainy season, it may be found well away from water (McComb et. al. 1993). On Vancouver Island this small mammal has historically been found primarily near estuaries, wetlands, lakes, streams, and in agricultural areas and riparian forests. Even though the Vancouver Island Water Shrew was not captured during the trapping exercise it does have the potential to occur in the area because there are historic accounts of the shrew in Matson Lake, which is part of the Millstream Creek system. As a result, its probability for occurrence on the southern section of the lake along Millstream Creek is considered high. This shrew has been found up to 350 meters from streams, but most individuals have been found within 50 meters of water. It is usually found in relatively extensive tracts of forest. The Ministry of Water, Air and Land Protection (MWLAP) recommends that minimum riparian leave strips of at least 60 meters be retained around areas where this species may likely occur, where possible, larger strips should be maintained.

Like other small rodents, the Deer Mouse is heavily preyed upon by birds (raptors) and carnivorous mammals. It is quite secretive and primarily active at night when it emerges from its nest to feed. The species is a habitat opportunist and very adaptable to almost any habitat. It can be found in a variety of forested habitats at various elevations but is primarily abundant in areas that contain good amounts of coarse woody debris. Deer Mice can be extremely numerous and it is the most widely distributed member of the *Peromyscus* group of mice, one of the most abundant of our small mammals. Due to the abundant coarse woody debris and the associated wetland regions it is the most common small mammal on the property.

In conclusion, the study site may be rated as high quality for small mammals. This is because it contains an abundant amount of coarse woody debris in all vegetation units and it has many pools of aquatic habitat with good riparian areas for small mammal foraging. These characteristics provide necessary small mammal microclimate and shelter areas. The wet stream and pool margins are used primarily as foraging zones. Upland habitat, approximately 30 meters on either side of the wetlands and streams, provide the most productive habitat for small mammals on the property.

2.1.3.4 Large Mammals

Signs of five larger mammals, a Black-tailed Deer (*Odocoileus hemionus*) (tracks bedding and foraging), Eastern Cottontail rabbit (*Sylvilagus floridanus*) (scat and forage), the Red Squirrel (*Tamiasciurus hudsonicus*) (forage) were recorded during the surveys on May 7, 8 and 9, 2002 (Figure 5). Additionally, sightings of an American Mink (*Mustela vison*) and River Otter (*Lutra canadensis*) were made on July 17, 2002 by ENKON at the outlet of the Matson Lake outlet and a tributary to Millstream Creek, respectively. Muskrat (*Ondatra zibethicus*) have also been observed in the Millstream Creek watershed in the vicinity of Hatcher Swamp (*R. King, pers.comm.*). Other mammals that have a potential to occur in the study area but only as transients include the Raccoon (*Procyon lotor*) and the Cougar (*Felis concolor*).

Environmental Setting

Due to the habitat structure the three most abundant large mammals on the property may be the Black-tailed Deer, Red Squirrel and the Eastern Cottontail rabbit. The wetland areas throughout the study site are important for the American Mink, and the open waterbodies like Matson Lake are important foraging and denning habitat for the River Otter.

Black-tailed Deer

The winter diet of Black-tailed Deer consists of Douglas-fir, western redcedar, trailing blackberry, red huckleberry, and salal. The summer diet is supplemented by a great variety of herbaceous plants. Many populations migrate to mountaintops and high valleys during the summer and back to lower ranges during the winter. Coniferous trees are essential for thermal cover during the winter. On Vancouver Island predators consist of Cougar and wolves.

Black-tailed Deer sign was present throughout the entire site and many of the sightings were concentrated on the rock outcrop areas. Sign of browse were seen on salal, grasses, red huckleberry, and bracken fern in. The deer use the area through all four seasons because scat (summer and winter) sign were observed throughout and most extensively in the rock outcrop areas. It is likely that the deer forage on the luscious vegetation in the lower wetland areas and then move to the rock outcrops to rest and bask in sunshine to better digest the food. All rock outcrop areas are important for deer resting. Several deer tracks were found in this area.

Red Squirrel

This squirrel feeds heavily on pine and the Douglas-firs tree seeds in the area. In the fall it cuts green cones and buries them in damp earth. Other food includes nuts, seeds, birds' eggs, young birds and fungi. It makes a nest of leaves in a hollow or fallen tree, hole in the ground or tree crotch. Three to seven young are born in March or April and there is sometimes a second litter in August or September. The squirrel is a loud with a variety of calls to announce its home range or the presence of intruders. While no individual was observed or heard, Red Squirrel foraging signs were observed throughout each of the polygons. Foraging evidence was on forest floors adjacent to coarse woody debris and at the edges of the rock outcrop areas throughout the property. This mammal uses all of the properties structural stages but prefers the mature forest areas.

Eastern Cottontail Rabbit

This rabbit is introduced to British Columbia and has become very abundant throughout southern Vancouver Island. Cottontails eat a wide variety of plant materials. In spring and summer they usually feed on herbaceous plants such as succulent wild grasses. In winter, Cottontails may eat woody plants including willows, huckleberries, salmon berries and blackberries. It is a prolific breeder. Although females are capable of breeding during their first year, most have their first litters during their second summer. Litter sizes up to 10 have been reported, but typical litters number from 3 to 5 young, born after a gestation period of about 28 days. The rabbits construct their nests by digging a shallow depression

in the ground and then lining it with grasses and other plants, along with fur plucked from the female's belly. Young Cottontails are blind at birth and their eyes remain closed until they are about a week old. Baby rabbits leave the nest and can survive on their own by the time they are 3 to 4 weeks old. Eastern Cottontails are most likely to be found in and around old, overgrown fields, brushy forest edges and other habitats with mixtures of herbaceous and shrubby plants. They can also be found living in close proximity to humans as long as there is adequate escape cover available.

Eastern Cottontail rabbit scat signs were observed in thick shrub zones and at along the rock outcrop areas. No sign of rabbit use was seen in any of the forested areas. The shrubby areas are important to this mammal because they act as winter cover as well as provide cover from potential predators like the Barred, Great-horned Owl and Cougar, which forage primarily on this species on the property. The larger rock outcrop areas may provide good winter denning habitat.

American Mink

This is an aquatic member of the weasel family and is found throughout most of northern North America. Commercially it is a valuable fur-bearer. Large males as adults are bold, ferocious, and virtually untamable. The mink is a skillful hunter and preys on a wide variety of game including rodents, and rabbits, as well as fish, crayfish, and frogs. Its own principal enemies are the Great Horned Owl, wolves, and coyotes in British Columbia. A solitary, mainly nocturnal animal, the mink is active throughout the year on the property. Critical habitat for this furbearer on the property is along the edges of the wetlands and within the 30 meters of riparian vegetation surrounding them.

River Otter

The North American River Otter is probably the most numerous otter species. They exhibit delayed implantation with breeding in March-April and birth in late winter/early spring. It is present throughout the year on the property. It is almost impervious to cold because of an outer coat of coarse guard hairs, plus a dense, thick undercoat that helps to 'water-proof' the animal.

The diet of the River Otter on the property may consist primarily of crayfish, frogs, and aquatic invertebrates, plus an occasional bird, rodent or rabbit. Because otters prey most easily on fish that are slow and lethargic, much of the diet consists of 'rough' fish like sculpins and sticklebacks. The best location on the study area would be on Matson Lake due to the deeper water and good food supply although it may be found along the larger wetlands on the property foraging for terrestrial food in close proximity to water.

2.1.3.5 Accounts of Red, Blue and Yellow Listed Species

In response to an EOR request made on April 19, 2001, the Conservation Data Centre indicated that there had been one reported occurrence of a rare vertebrate occurring on the property. The Vancouver Island Water Shrew was observed

adjacent to Millstream Creek approximately 150 meters to the north of the Hatcher Swamp bridge in 1965.

The following are accounts of potentially occurring Red, Blue and Yellow listed species on the study site. These species have been chosen based on the surveys conducted. The capability of each vegetative unit defined in the vegetation survey was assessed for its potential to provide limiting life requirements to the identified Red, Blue and Yellow listed species in the British Columbia Conservation Data Center's Rare Vertebrate Animal Tracking List for the South Island Forest District.

Rare or threatened animal species listed by the Conservation Data Center are shown in Appendix II. Habitat on-site is suitable for some species listed such as the Great Blue Heron, which may use marsh or lake areas, as well as the Red-legged Frog and Painted Turtle and the Pacific Water Shrew. Many species listed as rare or threatened are inconspicuous and would only be observed during intensive surveys. It was noted by the Conservation Data Center that the Vancouver Island Water Shrew (*Sorex palustris brooksi*), which is Red listed, has occurred on the property historically.

Species Rating Definitions

The COSEWIC and British Columbia's Red, Blue and Yellow rating status definition for each species identified are presented below.

COSEWIC ratings for species have been defined in the following ways:

Extinct - A species that no longer exists.

Extirpated - A species that no longer exists in the wild in Canada, but occurring elsewhere (for example, in captivity or in the wild in the United States).

Endangered - A species facing imminent extirpation or extinction.

Special Concern – A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Not At Risk - A species that has been evaluated and found to be not at risk.

Data Deficient - A species for which there is insufficient scientific information to support status designation.

Red, Blue and Yellow status are defined as the following by the B.C. Conservation Data Centre:

Red list - Includes any indigenous species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Red listed taxa include those that have been, or are being, evaluated for these designations.

Blue List - Includes any indigenous species or subspecies (taxa) considered to be Vulnerable in British Columbia. Vulnerable taxa are of special concern

because of characteristics that make them particularly sensitive to human activities or natural events. Blue listed taxa are at risk, but are not Extirpated, Endangered or Threatened.

Yellow list - This comprises any indigenous species or subspecies (taxa), which is not at risk in British Columbia. The CDC tracks some Yellow listed taxa, which are vulnerable during times of seasonal concentration (e.g. breeding colonies).

Species listed in British Columbia Conservation Data Centre's Rare Vertebrate Animal Tracking List South Vancouver Island Forest District (March 2004) and their COSEWIC status are presented in a species evaluation below. Presented are only the 'target species', potential animals occurring on the study area based on the study site characteristics and the animals' habitat requirements. The target species have been selected by evaluating the habitat necessary to sustain the animal and comparing these requirements to the study area's attributes. Study area attributes have been taken from information presented in 'Environmental Survey Overview Highlands South Community (1997)', review of BEC zone inventory data, forest cover mapping by the evaluation of the study sites general vegetative structure, and the field surveys.

Presented below is a short summary that describes the habitat requirements for each animal and it assesses the potential of it occurring on the study site.

Herpetifauna (Amphibians and Reptiles)

Red-legged Frog (Rana aurora), Blue listed

This species has been designated as being of special concern by COSEWIC and Blue listed by the CDC in the South Vancouver Island Forest District (March 2004).

Outside of the breeding season, these frogs are highly terrestrial and can be found in forests far from standing water. They can occasionally be found inside decayed logs and live in coniferous or deciduous forests and forested wetlands (Corkan and Thoms 1996). Breeding takes place early in the spring in shallow water in permanent ponds and swamps approximately 0.5-2 meters deep in cool well shaded ponds or lake edges, beaver ponds or slow flowing streams in the early spring (Green and Campbell 1992 Corkan and Thoms 1996, Licht 1969). This frog calls underwater and the calls are weak so it is difficult to hear above water. Eggs, which are laid in a large (20 to 30 cm) loose gelatinous cluster, tend to deteriorate toward the end of embryonic development. During the summer hatchlings cling to the egg mass or nearby vegetation living along streams, in moist sedge or brush, on shaded pond edges, under logs or debris (Licht 1971, (Corkan and Thoms 1996). The embryos develop and hatch after about four weeks of development, and the tadpoles transform after four or five months. Age to sexual maturity is probably three to four years (Hovingh 1993). During damp conditions the frogs may occur in forests far from water (Corkan and Thoms 1996). This frog has been confirmed on the subject property and located numerous times during field visits.

Environmental Setting

Painted Turtle (Chrysemys picta), Blue listed

This species has not been listed by COSEWIC but is Blue listed by the CDC in the South Vancouver Island Forest District (March 2004).

Potentially may occur in Matson Lake, or Hatcher Swamp, stream and wetland habitats of the Millstream River. Primarily in areas with muddy bottoms, slow-moving water and emergent aquatic vegetation (Green and Campbell 1996). The painted turtle is very common in such situations, often occurring at densities of 500 or more per hectare (Green and Campbell 1996). Movements of this turtle for several hundred meters on land are not uncommon. These are observed primarily on the spring and fall upon dispersal from local areas. They are quite hardy compared to other species and do not hibernate for as long as other species with which they co-exist. The only habitat present for this species is found in Matson Lake or in the Hatcher Swamp and associated wetlands of Millstream River.

Sharp-tailed Snake (Contia tenuis), Red listed

This species has been designated as endangered by COSEWIC and Red listed by the CDC in the South Vancouver Island Forest District (March 2004).

The Sharp-tailed Snake is very elusive and rarely seen (Cook 1984). In British Columbia, several scattered records have been made from Vancouver Island and the Gulf Islands, in the Coastal Douglas-fir Biogeoclimatic Zone; one additional record made from McGillivray Lake, in the Engelmann Spruce-Subalpine Fir Biogeoclimatic Zone. Elsewhere, range extends from western Washington and Oregon south to central California.

Little is known about the Sharp-tailed Snake because of its secretive activity and it is primarily nocturnal. Sharp-tailed Snakes occur in a variety of habitats, however, they are most commonly found in moist environments with an abundance of surface debris, such as twigs, roots, and leaves. The Sharp-tailed Snake is found in areas with surface moisture and it becomes active during the cool fall and winter temperatures. Because of their preference for cooler temperatures and higher moisture levels, *C. tenuis* is active at different times and in different microhabitats than most snakes. This snake can be found mainly in wooded areas or near intermittent streams (Leviton 1971; Morey 1989; Baisey 1976). The staple diet of the snake consists mainly of slugs (Cook 1960; Nussbaum et al. 1983; Spalding 1993).

Habitat on the study site for this snake is possible in several defined BGC zones but sightings on the Island are very few. Green and Campbell 1996, describe the Sharp-tailed Snake as mostly known from North and South Pender Islands in the Gulf Islands, although two specimens were caught near Chase in the interior in 1964. One specimen collected in the 1800's has its locality noted as Vancouver Island and two more specimens have recently been found in Metchosin on Vancouver Island. It is not clear whether this distribution is due simply to the secretive nature of the snake and the resulting scarcity of recorded specimens or

that the British Columbia populations are relicts of a wider range in the past. Due to the noted above it is likely not to occur on the study site.

Birds

American Bittern (Botaurus lentiginosus), Blue listed

The American Bittern is Blue listed because of its unknown population size and its dependence on wetlands with extensive stands of tall, emergent vegetation, a habitat that continues to be lost. It is not listed by COSEWIC, but is known to be declining throughout most of its North American range.

It inhabits lush, emergent vegetation along the borders of lakes, marshes and rivers. It breeds in valley bottom marshes or on flat plateau regions, from near sea level on the coast, up to 1,300 m in the interior. The American bittern nests in emergent vegetation, and builds its platform nest over water or mud. Nesting marshes must have extensive stands of emergent vegetation and have stable water levels throughout the nest-building, egg-laying, incubation and nestling periods. This is not characteristic of the study site. It occupies BEC zones of BG, BWBS, CDF, CWH, ICH, IDF, MS, SBPS and SBS in British Columbia.

There is limited to no breeding or foraging habitat available in the study site and it is unlikely to occur on the immediate study site due to the lack of cattails and open marsh habitat.

Great Blue Heron (Ardea herodias fannini), Blue listed

Only the pacific race (A.h.fannini) is considered to be of special concern by COSEWIC. This race is not likely to occur on the project site. Because Great Blue Heron prefer to nest in colonies, 'heronries', it is not anticipated that they would occur here due to insufficient habitat: no breeding habitat is present in the study site or adjacent to it. This species prefers large wetland areas to breed and forage in. It may occur as an incidental to the study site if at all. It would perhaps be present as a passing visitor to forage in streams, most likely during natal dispersal or during migration in spring and fall. The proposed development will have no impact on this species.

Green Heron (Butorides virescens), Blue listed

This heron is not listed with COSEWIC but it is Blue listed in the South Vancouver Forest District.

The Green Heron occurs regularly along Vancouver Island from Victoria north to Campbell River and on the southern mainland from the Fraser River delta east to Hope (Campbell et. al. 1990). It prefers aquatic habitats of either fresh or marine brackish water areas with good amounts of closed in shrubs or trees. It prefers ponds, rivers, lakes or sloughs but also uses marshes, sewage ponds, bays, irrigation ditches, beaches and golf courses for foraging. Preferred areas for breeding include lakes and sloughs (Campbell et al 1990).

It occurs year round in the coastal areas of British Columbia. Recorded records of breeding on southeastern Vancouver Island are from Victoria to Courtenay

and Port Alberni. On the mainland it has been found nesting throughout the Fraser Lowlands east to Chilliwack. Nesting habitat is restricted to areas of dense willow and alder shrub along the shore. Campbell (1990) describes nest found in the coastal areas as being in dense alder and willow thickets. One nest account was recorded to be located in a Douglas-fir tree. All nests encountered in British Columbia for this bird were made of sticks and twigs placed near the end of branches where nest height was approximately 3.8 to 9.1m above ground. Breeding for this species in British Columbia has been recorded from May 24th to the 5th of July.

Hatcher Swamp and the perimeter of Matson Lake is the most likely habitat for this bird. It was not located during the breeding bird surveys performed in June.

Bald Eagle (Haliaeetus leucocephalus), Yellow listed

The bald eagle is listed Yellow by the CDC in the South Vancouver Forest District (March 2004) and is considered not at risk by COSEWIC.

The habitat in the study site is not suitable for breeding or foraging for this species. The bald eagle is primarily associated with aquatic habitats including seashores, lakes, rivers, large sloughs, and marshes (Campbell et. al. 1990, Bent 1937 and Palmer, 1988). Most nests of this species along the coast have been no further than 100 m from the shore of a large water body (Campbell et. al. 1990).

Due to the lack of foraging habitat (rivers and lakes), on the subject property it is unlikely that this species would be found nesting or foraging.

Northern Goshawk (Accipiter gentilis laingi), Red listed

Two subspecies of the Northern Goshawk occur in British Columbia: *A. g. atricapillus* and *A. g. laingi*. *A. g. laingi* is Red listed because the population is sparse, restricted to coastal forest, and heavily reliant on mature-to-old forest. It is designated as threatened in Canada by COSEWIC. *A. g. atricapillus* is considered to be regionally important. It is considered a species of conservation concern because it is associated with habitats that are becoming rare, and it is a species for which British Columbia has a global responsibility because adjacent jurisdictions have listed it at risk.

For the Northern Goshawk major prey are usually associated with old-growth forests or forest edges, not present in the study area. The 'nest area', may contain several nest sites, is approximately 12 ha, and characterized by several stands of large, old trees with dense canopy cover (Crocker-Bedford 1990, Palmer 1988). Northern Goshawk foraging area occupies about 2,400 ha including the post-fledging area (Austin 1994). It may include a diversity of landforms and forest cover types, but areas with greater canopy cover, greater basal area, and more trees per hectare are used more frequently in some parts of the species range within mature forest and old forest interspersed with low and tall shrubs (Bright-Smith 1994, Crocker-Bedford 1990, Palmer 1988).

Northern Goshawk nest area is situated in stands of large trees, with dense canopies and relatively open understories. Nesting habitat is typically on gentle

Environmental Setting

slopes, usually less than 30% slope, and always less than 60%. Post-fledging habitat contains numerous feeding perches (stumps, downed snags, large horizontal limbs below the canopy), and their relatively open understorey is thought to facilitate the pursuit and capture of prey (Graham et. al. 1994 Austin 1994)

Post-fledging habitat should provide abundant hunting opportunities to young, while maintaining higher than average cover from predators. This post-fledging area is characterized by a mosaic of structural stages and coarse woody debris throughout the habitat. These provide extensive and varied habitat for the prey base of the Northern Goshawk (Graham et. al. 1994).

Due to the lack of breeding habitat requirements for this bird, it is unlikely that it would use the project study site for nesting. If it occurs, it would most likely be as a result of natal dispersal and/or migration.

Northern Pygmy-Owl (Glaucidium gnoma swarthy), Blue listed

This species has not been listed by COSEWIC but is Blue listed as species of concern by the CDC in the Southern Vancouver Island Forest District.

The Northern Pygmy Owl is an uncommon resident across the province of British Columbia and most abundant across the northwest and southern part of the province. Resident populations are restricted to the southern portions of the province (Campbell et. al. 1990).

This owl occupies the edges of open coniferous forests or mixed woodlands of riparian thickets, damp and dry meadows, vacant city lots, parks, cemeteries and residential areas.

Primarily a cavity nester, historically, all nests discovered in British Columbia have been in old woodpecker holes of coniferous trees including Douglas-fir, western hemlock, and western larch. It is very likely to occur in the study area.

Lewis's Woodpecker (Melanerpes lewis), Blue listed

This species has been designated by COSEWIC as a species of concern and is Blue listed in the Southern Vancouver Island Forest District.

It has been identified in British Columbia to occupy primarily IDFDk and IDFxh habitats. This species has a potential to occur along the riparian areas and it forages in open woodlands and riparian areas that provide sufficient visibility and space for effective fly catching. Nesting habitat consists of excavated cavities by other woodpeckers (i.e. Northern Flickers), but natural cavities are occasionally used (Campbell et. al. 1990). In a few places, Lewis' Woodpeckers nest in loose aggregations. During winter it keeps feeding areas of up to six hectares and may be impacted by the proposed development. In winter, they roost in mature deciduous and coniferous trees and snags, similar to those used for nesting. Scanning perches are important year-round adjacent to riparian zones.

Environmental Setting

Favored habitat by this species can be found in areas of open regions of structural aged stands 3a: shrub stage. For foraging, 6-7: mature - old conifer stands (age class 7-9), mature hardwoods, and finally, (age class 5-7), especially in low elevation riparian habitats.

It excavates cavities in large trees, primarily ponderosa pine and black cottonwood, with extensive heart rot (decaying centre). Optimal breeding habitats contain large snags (>30 cm dbh), open tree canopy (25% closure), and a shrub understorey (50% crown cover) that harbours abundant insect prey. In riparian areas the understorey component is not essential. Broken-topped or large limbed trees are used as hawking perches and live or dead trees with heartrot (Wild Tree class 2-6, dead internal decay, heartrot, loss of branches) are suitable nesting and roosting trees; however, softer snags (WT class 4-6) are preferred (Biodiversity Guidelines, 1995).

This species has been historically located in the Victoria area in 1984 (Campbell et al. 1990). Campbell et al. 1990 also indicates that from 1920 to 1940 it was an abundant nester in the environs of southeast Vancouver Island where logging and forest fires had left an abundance of tall 'snags' and standing trunks of giant Douglas-fir, western redcedar and western hemlock. The decline in Gary oak communities likely caused a decline in this species (Campbell et al. 1990). Additionally they state that the increase of European Starling (*Sturnus vulgaris*) has caused a decline in this species nesting due to the competition for nest habitat. This species is possible on the study site.

Mammals

Townsend's Big-Eared Bat (Corynorhinus townsendii), Blue listed

This bat is not listed under COSEWIC but is Blue listed in the Southern Vancouver Island Forest District.

This species occupies elevations from sea level to approximately 1,070 meters in British Columbia, although most occurrences have been in lower elevations. In British Columbia it has been found to occupy places like houses on Vancouver Island, on Thetis Island, and in old mine caves of the Okanagan Valley to the Williams Lake region. In the interior of British Columbia, bat hibernacula are found primarily in dry, open exposed locations near mine entrances where the temperature is 5-8°C. During a February 1990 survey in the Okanagan, this species was found to occupy caves along the north shore of Kamloops Lake. It is relatively sedentary and rarely ranges far from the hibernating location. If so, it moves only 10-65 kilometers between the summer roost and winter hibernaculum.

Since this bat prefers to roost and hibernate primarily in buildings and caves it is not expected to occur on the study site due to the lack of suitable habitat (Nagorsen 1993).

Vancouver Island Water Shrew (Sorex palustris brooksi), Red listed

This species has been designated as threatened by COSEWIC in British Columbia and Red listed by the CDC in the Southern Vancouver Island Forest District (March 2004).

It is the largest of the shrews in British Columbia occupying only the southwestern part of the province, in the section of the Fraser and Delta (Nagorsen 1996). This small mammal is a habitat specialist and prefers moist riparian habitats with dense, moist coniferous forests, on beaches, and in marshes, in heavily wooded, wet areas, on the banks of sluggish streams, in beach debris, and during winter rainy season may be found well away from water (McComb et. al. 1993). It is found primarily near estuaries, wetlands, lakes, streams, and in agricultural areas and riparian forests. In the south of North America along the west coast in Oregon, restricted to Skunk Cabbage Marsh and Riparian Alder/Small Stream habitats throughout most of the year (Nagorsen 1996). It is insectivorous, with foods including soft-bodied arthropods and terrestrial and aquatic invertebrates; insect larvae, slugs and snails; Ephemeroptera naiads, earthworms and unidentified invertebrates, primarily aquatic (Pattie 1969, Whitaker and Maser 1976). It has a potential of occurring on the study site.

Band-tailed Pigeon (Columba fasciata), Blue listed

This species has not been listed by COSEWIC but is Blue listed by the CDC in the Southern Vancouver Island Forest District (March 2004).

The Band-tailed Pigeon (*Columba fasciata*) is found in the forests or coastal woodlands of Western British Columbia and America. It perches, nests and feeds in coniferous trees such as pines, as well as maples and alders. Unlike the common pigeon (Rock Dove) (*Columba livia*), which can be found in cities around the world, the Band-tailed Pigeon will avoid populated areas and any human contact. It prefers forest environments. This bird eats nuts, seeds, berries, blossoms and insects found in coastal woodland and forest habitat. When in season, it is also known to eat domestic crops such as cherries, berries, oats, barley and wheat. Its breeding season begins in March and lasts through late spring. The female builds a flat, loose nest on the ground, in low brush, or in the fork of lower tree branches usually associated with stream habitat. Nesting materials are provided by the male and consist mainly of twigs and pine needles. One or sometimes two eggs are laid per season with both male and female responsible for incubation. Eggs hatch within 18 - 20 days, and chicks fledge 28 - 30 days after hatching.

2.1.3.6 Habitat Use and Importance

The relative importance of discrete habitat types described in Section 2.1.1 are qualitatively assessed below, in order to gauge the overall 'environmental fit' of the proposed development to the landscape. To determine habitat values for animals that may occur on the property, each vegetation unit was rated for its capability to support each species of wildlife encountered during the surveys.

Environmental Setting

This includes large and small mammals, herpetifauna⁶, passerines and passerine like birds as well as raptors.

The highest valued habitat units for many species are the wetland/riparian and Western redcedar – Douglas-fir – Kindbergia (RK) and the Western redcedar – Grand fir – Foamflower (RF) communities. These units were ranked high for every wildlife group in this analysis. The Douglas-fir – Shore pine – Arbutus (DA) forest units are rated low for all wildlife.

A number of site-specific features of importance to local wildlife populations were identified during the field program, including the wetland pools, rock outcrop areas, potential raptor nests (Figure 5), potential cavity nests, mature/veteran trees and large diameter snags.

Habitats with High Wildlife Values

Western redcedar – Douglas-fir – Kindbergia (RK)

The Western redcedar – Douglas-fir – Kindbergia site series is important to many wildlife groups. Reptiles and salamanders, favour the moisture receiving sites and coarse woody debris common in this type of vegetative habitat, but frogs are less likely to occur due to the low water levels. The slightly dry to fresh soil moisture and a very poor to medium soil nutrient regime offers good habitat for insect production; this is important to small mammals due to the high food abundance. These areas typically occur on gentle, lower slope positions, in receiving positions the soils are deep and medium textured.

The mature tree layer is important to raptors for nesting and roosting because it has the potential to have a high abundance of small mammals, it also has a high potential to contain good numbers of foraging raptors. The shrub layer is dominated by berry bushes such as salal and dull Oregon-grape. Mature forest passerine and passerine-like birds⁷ use this kind of habitat for nesting and many berry foraging birds such as the American Robin and Varied Thrush dominate. The hydrophitic zones in this vegetation habitat are the most important.

Finally, the mature forest with closed canopy cover and the shrub layer provide thermal cover, security and food for the larger mammals.

Western redcedar – Skunk cabbage (RC)

The Western redcedar – Skunk cabbage site series is found where the soil moisture regime is wet and the soil nutrients are rich to very rich. Trees tend to be restricted to elevated microsites, largely because of the increased availability of oxygen for root respiration thus, the tree canopy is not continuous on this site association. Western redcedar and red alder are the major tree species; occasionally, bigleaf maple and western hemlock are also present. These small microclimates provide excellent habitat for amphibians and some of the small mammals. Water present in these areas all year round allow for opportune

⁶ Herpetifauna: Amphibians and reptiles

⁷ Passerine-like birds: i.e. hummingbirds, pigeons and woodpeckers

Environmental Setting

hibernating sites for many of the salamanders and they also provide good food for foraging small mammals in the course woody debris.

The moderately well developed shrub layer is dominated by salmonberry and it also contains Indian-plum and red elderberry which provide food for bears and deer. This habitat provides very good nesting for many passerines and passerine-like birds.

Environmental Setting

Table 9: Habitat Importance Ratings for Selected Wildlife Groups Based on General Vegetation Types

Environmental Setting

Table 9 continued

Environmental Setting

Table 9 continued

Western redcedar – Grand fir – Foamflower (RF)

The Western redcedar - Grand fir - Foamflower vegetation type usually occurs on a gentle slope the lower receiving sites. Soils in these areas are typically deep, medium textured and have a rich nutrient regime that is good for insect production. Thus it is important foraging habitat for small mammals. The soil moisture is subhygric to hygric, which is beneficial to many amphibians especially for breeding and rearing of Red-legged and Pacific Tree Frogs. Coarse woody debris on the forest floor is used by many small mammals and amphibians for shelter, thermal cover and as foraging habitat.

The tree layer in the Western redcedar – Grand fir – Foamflower site association consists of Douglas-fir, grand fir, western redcedar, bigleaf maple and sometimes western flowering dogwood. This kind of habitat provides optimal shelter for raptors and the small mammals are a good food source for them. Salal and dull Oregon-grape constitute most of the shrub layer and the mature trees provide good nesting for all of the flycatchers. Like the Western redcedar – Douglas-fir – Kindbergia site series, the mature forest with closed canopy provides cover and the shrub layer provides thermal cover, security and food for the larger mammals.

Willow – Hardhack (WH)

The Willow - Hardhack ecosystem occurs in the two small wetlands located on the portion of the site and is most important to the amphibians. This ecosystem is dominated by hardhack, Pacific and Scouler's willow and Pacific ninebark with lesser amounts of red-osier dogwood, red alder, salmonberry and trembling aspen. It is important to all wildlife all year because in winter the water never freezes and stays open. Many mammals such as the ermine, deer and mink utilize this type of habitat all year because it has an abundance of food. Deer prefer moist areas in winter due to their rich shrub edge habitats. The buds are a staple diet for deer in winter. This wet zone is also important for many passerines due to the plentiful insects associated with aquatic environments.

Habitats with Moderate Wildlife Values

Douglas-fir - Grand fir - Oregon-grape (DG)

The Douglas-fir - Grand fir - Oregon grape site series has a moderately dry soil moisture regime and a rich to very rich soil nutrient regime of mesic soils which makes it of moderate value to herpetofauna, but it does provide good amounts of insects for forage. It typically occurs on gentle slopes in middle to upper slope position thus it is a good site for small mammal breeding and foraging.

The tree layer consists primarily of Douglas-fir, western redcedar and grand fir, but may also contain bigleaf maple and western flowering dogwood. This tree cover provides moderate thermal and security cover for deer and larger mammals. The herb layer is limited for food production. Because this habitat is not very diverse it is limited in passerine habitat.

Habitats with Low Wildlife Values

Rhacomitrium – Selaginella (RS)

The Rhacomitrium – Selaginella ecosystem typically occurs on gentle to moderately steep slopes. It is dominated by mosses growing over bedrock outcrops and usually occurs in large open areas in association with other open type ecosystems such as Garry oak – brome. This ecosystem is important primarily to reptiles like the garter snakes but provides limited life supporting value to other species due to its arid nature.

Garry oak – Brome (GB)

Much like the Rhacomitrium – Selaginella ecosystem, the Garry oak – Brome ecosystem occur on slopes of varying steepness, and varying soil depth frequently interspersed with rock outcrops and pickets meadows. This type of ecosystem is limiting in wildlife habitat and is important primarily to reptiles for hibernacula and for sunning. Opportunistic birds like the Dark-eyed Junco, Song Sparrow and the Spotted Towhee prefer this open habitat for foraging and the edges for nesting. Although the habitat is limiting to many species it provides extremely specialized habitat for a number of rare species such as yellow-legged meadowhawk, Taylor's checkerspot, sharp-tailed snake and vesper sparrow (affinis subspecies).

Douglas-fir – Arbutus (DA)

The Douglas-fir – Arbutus site series has a very dry soil moisture regime and a very poor to medium soil nutrient regime. Many rock outcrop areas are present and it is rated low for wildlife significance.

The tree canopy is often interrupted because of the rock outcrops and pockets of shallow soil. This habitat is most favoured by the reptiles for insect foraging and basking. It also provides opportune refuge and hibernating sites for snakes and the Northern Alligator Lizard.

The Douglas-fir regeneration in the understorey of the loose tree canopy has the occasional Garry oak. These provide limited thermal and security cover for larger mammals such as deer. The shrub layer contains oceanspray, dull Oregon-grape, baldhip rose as well as tall Oregon-grape and Saskatoon berry which provide food to mammals such as the opportunistic European Hare and Black-tailed Deer. The most common passerine birds that use this type of habitat include the Song Sparrow, Spotted Towhee, and Dark-eyed Junco. It is rated very low quality habitat for amphibians and low for small mammals and many passerines and passerine-like birds.

2.2 Aquatic Resources

2.2.1 General

Aquatic resources on the property consist of a number of permanent and ephemeral drainages that flow into the Millstream Creek watershed. The

Environmental Setting

Millstream Creek watershed has an area of 29.0 km² and consists of seven lakes including Mary Lake, Third Lake, Second Lake, Mitchell Lake, Matson Lake, Florence Lake and Lake Ida Anne. There are also at least 15 ponds, many of which have been created by excavating wetland areas. The stream channels vary significantly and the system includes two small canyons, at least eight cascades and five waterfalls (SHIP Environmental Consultants Ltd., 1996). The main stem has a total length of 13.3 kilometers and flows south to discharge into the Pacific Ocean at Esquimalt Harbour.

Hydrology records indicate that Millstream Creek is an extremely variable system with discharge values ranging from 2 litres/sec in August to 1108 litres/sec in December. Mean annual discharge for Millstream Creek is 377 litres/sec (Walsh et al., 1995).

2.2.2 Surface Hydrology

2.2.2.1 Methods

Streams identified through aerial photograph interpretation were examined to determine general flow characteristics and suitability for fish habitat. A biophysical habitat survey was conducted on July 17, 20 and 23, 2002, using the Ministry of Environment/Department of Fisheries and Oceans Stream Survey forms; the following information was collected:

- Channel characteristics - including floodplain description;
- Description of watercourse length, average channel width, average wetted width, average maximum depth and banks;
- Barriers to fish passage - including debris jams, culverts, weirs, beaver dams etc.;
- Substrate characteristics - including estimated percentages of materials;
- Description and percentage of pools, runs, and riffles;
- Location and description of bridges, culverts, water control, water intake and storm water discharge structures;
- Vegetation - detailed riparian overstorey, understorey, and herb layer characteristics including a species list;
- Threatened, rare and endangered species - estimated use and a detailed species list and
- Potential salmonid spawning and rearing habitat rating (low, medium or high) with rationale for rating described.

2.2.2.2 Results

The Bear Mountain Highlands Property has numerous wetlands and associated permanent and ephemeral drainages (Figure 6). For identification purposes, the wetlands were assigned a letter (Wetlands A to U) and the watercourses were

Environmental Setting

assigned a number (Creeks 1 to 14). There are 21 wetlands located on the property (Table 10) and 14 major drainages (Table 11).

The mainstem of Millstream Creek is located along the eastern border of the property. It flows south into Matson Lake and continues further south to drain into Hatcher Swamp. There is an overflow channel located at the outlet of Matson Lake, which is dammed. During high flows water discharges to the southwest and into a small shrub swamp before connecting with a tributary to Millstream Creek. The tributary collects water from the west, north and south of the property via a series of small channels, many of which are limited to seasonal flows. There are three large wetlands located to the west of Millstream Creek mainstem, which contribute significant flows during summer low flow conditions. There are several wetlands located on the site that do not appear to be connected to an outlet channel and simply collect water from surrounding slopes. Three are located near to the west boundary of the site. There are two wetlands located near the powerline corridor that discharge flows to the west into Millstream Creek mainstem downstream of Hatcher Swamp.

Figure 6: Aquatic Features of the Bear Mountain Highlands Project

Environmental Setting

Table 10: Summary of Wetlands, Bear Mountain Highlands Property

Wetland ID	Area of Wetland (ha)	Area of Riparian Zone (ha) 30-m Setback
A (C0705a)	3.06	4.85
B (C0711/C0712)	3.81	5.23
C (C0759)	2.74	2.48
D	0.88	1.6
E (C0710)	1.67	2.86
F (C0709)	0.35	1.19
G	0.22	1.16
H (C0706, partial)	0.3	1.01
I (C0706, partial)	0.13	0.73
J (C0704)	0.25	0.89
K	0.30	0.68
L (C0758)	0.51	1.56
M	0.22	0.81
N	0.56	1.24
O	0.36	1.1
P	0.47	2.09
Q	0.08	0.64
R	0.13	0.73
S	0.07	0.84
T	0.13	0.8
U	0.58	1.24

Environmental Setting

Table 11: Summary of Watercourse Characteristics, Bear Mountain Highlands Property

Insert Table 11

Table 11 continued

2.2.3 Fisheries Resources

2.2.3.1 General

According to the British Columbia Ministry of Fisheries' Fish Wizard Database the Millstream Creek watershed sustains eight species of fish including Brown Bullhead (*Ictalurus nebulosus*), Coho Salmon (*Oncorhynchus kisutch*), Cutthroat Trout (*Oncorhynchus clarki*), Prickly Sculpin (*Cottus asper*), Pumpkinseed (*Lepomis gibbosus*), Rainbow Trout (*Oncorhynchus mykiss*), Smallmouth Bass (*Micropterus dolomieu*) and Threespine Stickleback (*Gasterosteus aculeatus*). MELP stocking records indicate rainbow trout stocking in Millstream Creek and Second Lake.

Recently the watershed has been stocked with coho salmon; escapement data for 1998, 1999 and 2000 is presented in Appendix IV. Stocking of Coho fry also occurs upstream of Matson Lake and, as recently as February 2004, 7000 fry were released in the vicinity of Millstream Lake Road bridge. (pers. com. with District of Highlands residents). Anadromous populations such as Coho or sea-run Cutthroat Trout cannot gain access to the system due to a series of waterfall barriers in the extreme lower end of the system. In addition, a perched culvert at the Atkins Road crossing prevents movement upstream for salmonids, as does the outlet of Matson Lake as it has been dammed.

2.2.3.2 Previous Studies

On July 3, 2001 a total of 15 baited minnow traps were placed in Hatcher Swamp and in Millstream Creek at the inlet and outlet to the swamp for a period of 24 hrs. In April 2001, ENKON baited minnow traps. A total of 124 Threespine Stickleback, ranging from 20 mm to 38 mm in length, and one juvenile Pumpkinseed, 40 mm in length, were captured within the study area. In addition to the fish, one Northwestern Salamander and two crayfish were captured at two sites.

On August 2, 2001, the southern shore of Hatcher Swamp, the swamp outlet and a 50 m length of Millstream Creek, immediately downstream of the swamp were electrofished. These areas were spot-shocked using a Cofelt electroshocker; the total effort time was 700 seconds. Approximately 60 sticklebacks ranging from 20 mm to 40 mm in length were caught using electrofishing. The majority of the stickleback occurred at the outlet of Hatcher Swamp. In addition, three juvenile Cutthroat Trout (40 to 60 mm in total length) were caught in a deep pool approximately 50 m downstream of Hatcher Swamp.

2.2.3.3 Methods

A review of Ministry of Environment, Lands and Parks and the Department of Fisheries and Oceans environmental databases was undertaken. Internet addresses for these databases are as follows:

FISS Database Search Engine

<http://habitat.rhq.pac.dfo-mpo.gc.ca/cfdocs/fiss/dcf01.cfm>

B.C Watershed Atlas

<http://www.bcfisheries.gov.bc.ca/fishinv/wsg20k.html>

'Mapster'

<http://www-heb.pac.dfo-mpo.gc.ca/english/maps/maps-data.htm>

Fish Wizard (DFO & B.C. Fisheries)

<http://pisces.env.gov.bc.ca/>

B.C. Conservation Data Centre B.C. Species and Ecosystems Explorer

<http://srmapps.gov.bc.ca/apps/eswp/>

Fisheries Data Warehouse, Fisheries Inventory Data Queries

<http://srmapps.gov.bc.ca/apps/fidq/>

All data collected from these databases are presented in Appendix I.

On May 9, 2002 ten baited minnow traps were placed at four locations (F3, F4, F5 and F6) on the site for a period of 24 hours. On July 25, 2002 five locations on the site were electroshocked (F1, F2, F3, F4 and F5). These areas were spot shocked for approximately 50 to 75 m using a Cofelt electroshocker. The total effort at each site was recorded. Captured fish were placed in a bucket, identified, measured and then released. Results of the minnow trapping and electroshocking are presented in Table 12 and Table 13.

To determine the winter dispersal of fish in the study area a fish survey was completed at seven locations (F7 to F14). Three baited minnow traps were placed at each location on December 22, 2002 and checked every 48 hours for a period of seven days and removed on December 30, 2002. A total distance of 1675 m was spot-shocked using a Smith-Root electrofisher on December 23, 2002.

On July 22, 2003 the margins of Matson Lake were sampled using a Smith Root electroshocker and minnow traps. Five minnow trapping sites were established along the perimeter of Matson Lake. At each location two baited minnow traps were set (Figure 7). The traps were checked every 24 hours for a period of three days and then removed.

2.2.3.4 Results

As a result of minnow trapping in 2002 (May and July) a total of 43 three-spine stickleback (15 mm to 50 mm in length), and two Cutthroat Trout (38 and 42 mm length) were captured (Figure 7). Electroshocking resulted in the capture of 11 Cutthroat, 11 Three-spine Stickleback, and three Pumpkinseed ((Figure 7). In addition, three crayfish were caught. During the December 2002 survey no fish were caught through electroshocking or minnow trapping.

Environmental Setting

No fish were captured using the electroshocker during the 2003 sampling of Matson Lake. However a total of 24 pumpkinseed and two smallmouth bass were captured in Matson Lake using minnow traps (Table 14).

Coastal Cutthroat Trout, which was observed on several occasions on the site in 2002, is currently Blue listed by the CDC for the South Vancouver Island Forest District (Appendix II).

Figure 7 shows the distribution of fish bearing vs. non-fish bearing watercourses on the site. Those streams marked red are confirmed for fish presence. Creeks marked with a dotted red line include those systems that have suitable habitat characteristics (e.g. cover, substrate, gradient) and do not have migration barriers, but may not be suitable during summer months due to their ephemeral nature or those streams that were sampled but no fish were detected. Those watercourses marked with green are those streams that were dry during the time of the survey and had characteristics that made them unsuitable for fish.

Limiting factors to fish habitat on the Bear Mountain Highlands site are summer low flows and water quality. It is expected that fish distribution changes seasonally due to low flow conditions during summer months. Based on the survey results it appears that fish concentrate in deep pools in the major channels of Millstream Creek during winter high flows but spread out into ephemeral drainages during summer low flows. During summer low flows water temperature in the mainstem increases significantly (Section 2.2.4), which in turn decreases the oxygen carrying capacity of the water. Tests with cutthroat trout to determine maximum temperature tolerance indicated that water temperature above 22°C was lethal (Hunter 1973, Golden 1975, Behnke and Zarn 1976, Behnke 1992). During times of elevated water temperature fish will seek refuge in places such as deep pools and areas with significant cover from LOD and overhanging vegetation. It appears that several of the small tributaries of Millstream Creek in the vicinity of Wetlands G and H (Figure 6 and Figure 7) are permanent and are groundwater fed and therefore the water temperature remains colder (see Section 2.2.4 and Table 15).

Figure 7: Aquatic Resource Sampling Locations

Table 12: Results of Minnow Trapping, May 2002

Site ID	Trap Number	Fish Species	Size (mm)
F6	1	4 Three-spine Stickleback	ND
F6	2	5 Three-spine Stickleback	ND
F3	3	3 Three-spine Stickleback	ND
F3	3	1 Cutthroat Trout	42
F3	4	3 Three-spine Stickleback	ND
F3	5	6 Three-spine Stickleback	ND
F5	6	2 Three-spine Stickleback	ND
F5	7	5 Three-spine Stickleback	ND
F5	8	9 Three-spine Stickleback	ND
F4	9	4 Three-spine Stickleback	ND
F4	9	1 Cutthroat Trout	38
F4	10	2 Three-spine Stickleback	ND

Environmental Setting

Table 13: Results of Electroshocking, July 2002

Site ID	Catch Per Unit Effort (sec)	Fish Species	Size (mm)
F1	400	no fish caught	-
F2	418	Cutthroat Trout	35
F2		Cutthroat Trout	40
F2		Cutthroat Trout	40
F2		Cutthroat Trout	50
F3	235	Cutthroat Trout	40
F3		Cutthroat Trout	50
F3		Cutthroat Trout	60
F3		Cutthroat Trout	42
F3		Cutthroat Trout	40
F3		Three-spine Stickleback	30
F3		Three-spine Stickleback	30
F3		Three-spine Stickleback	30
F3		Three-spine Stickleback	35
F3		Pumpkinseed	40
F3		Pumpkinseed	45
F4		200	no fish caught
F5	510	Cutthroat Trout	150
F5		Cutthroat Trout	40
F5		Three-spine Stickleback	25
F5		Three-spine Stickleback	40
F5		Three-spine Stickleback	20
F5		Three-spine Stickleback	15
F5		Three-spine Stickleback	20
F5		Three-spine Stickleback	20
F5		Three-spine Stickleback	10
F5		Pumpkinseed	40
F5		crayfish	150
F5		crayfish	100
F5		crayfish	50

Table 14: Results of Minnow Trapping, July 2003

Site ID	Trap Number	Fish Species	Size (mm)
SS#1	1	Pumpkinseed	47
SS#1	1	Pumpkinseed	61
SS#1	1	Pumpkinseed	47
SS#1	2	Pumpkinseed	55
SS#1	2	Pumpkinseed	53
SS#2	1	Pumpkinseed	46
SS#2	2	Pumpkinseed	51
SS#2	2	Pumpkinseed	54
SS#3	1	Smallmouth Bass	51
SS#3	1	Pumpkinseed	54
SS#3	1	Pumpkinseed	55
SS#3	1	Pumpkinseed	53
SS#3	1	Pumpkinseed	50
SS#3	2	Pumpkinseed	55
SS#3	2	Pumpkinseed	58
SS#3	2	Pumpkinseed	51
SS#3	2	Smallmouth Bass	49
SS#4	1	Pumpkinseed	55
SS#4	2	Pumpkinseed	60
SS#4	2	Pumpkinseed	51
SS#4	2	Pumpkinseed	52
SS#4	2	Pumpkinseed	53
SS#5	1	Pumpkinseed	52
SS#5	1	Pumpkinseed	50
SS#5	2	Pumpkinseed	54
SS#5	2	Pumpkinseed	49

2.2.4 Water Quality

2.2.4.1 Previous Studies

A water quality program was completed in April 2001 in the vicinity of a proposed 45-unit subdivision planned by Western Forest Products. The locations of water quality stations WQ1 to WQ5 are presented in Figure 7.

2.2.4.2 Methods

A water quality-sampling program was completed in July 2002. Four water quality sites were identified within the study area. These locations were chosen so that all drainages within the study area were sampled.

Water samples were collected at WQ6, WQ7, WQ8 and WQ9 and sent overnight to Phillip Analytical Laboratories Inc. and were analyzed for the following parameters:

- Total suspended solids (mg/L);
- Turbidity (NTU);
- Ammonia (mg/L);
- Nitrates and Nitrites (mg/L);
- Ortho-phosphorous (mg/L) and
- Total and dissolved metals (ug/L).

In addition, dissolved oxygen, pH, temperature and conductivity were measured in-situ at all four sites with a Horiba water quality meter.

2.2.4.3 Results

Water quality samples were taken to establish baseline conditions prior to site disturbance. Samples indicate that waters within the study area are neutral to slightly acidic and have low turbidity and total suspended solids. Dissolved oxygen levels ranged from 1.1 mg/L at WQ4 (April 2001) to 10.5 mg/L at WQ7 (July 2002) (Table 14).

Conductivity measurements reflect the amount of dissolved nutrients in the water. The typical range for Victoria areas streams range from 0.10 to 0.15 ms/cm; those readings greater than 0.20 are above average and represent additional input of nutrient loaded water (SHIP Environmental, 1996). Conductivity levels at the Bear Mountain Highlands site ranged from 0.08 to 0.18 ms/cm. Nitrate, nitrite and ammonia nitrogen levels are also quite low, ranging from below detection to 0.07 mg/L (nitrates at WQ6). Water temperatures ranged from 7.0 oC (WQ5) taken in April to 19.8 oC (WQ7) taken in July (Table 15).

Biochemical oxygen demand was below detection in all samples. Results indicate that waters in Millstream Creek and the associated wetlands are typical of local freshwater systems and are ecologically in good condition (Table 15).

Environmental Setting

Total and dissolved metal levels in the Bear Mountain Highlands water samples met the Protection of Aquatic Life Standard as presented in the British Columbia Approved Water Quality Guidelines (Ministry of Water, Land and Air Protection, 2002). In most cases, harmful metals such as cadmium, arsenic, antimony, lead and copper were below detection (Table 16).

Environmental Setting

Table 15: Water Quality, Physical and Nutrient Characteristics

Parameter	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6	WQ7	WQ8	WQ9
pH	7.4	7.4	6.7	5.7	6.6	7.7	7.8	7.7	7.7
Dissolved Oxygen (mg/L)	7.0	6.9	3.6	1.1	8.6	8.7	10.5	8.3	10.1
Conductivity (mS/cm)	0.157	0.18	0.10	0.08	0.11	0.16	0.124	0.136	0.122
Temperature (°C)	10.6	10.0	7.5	9.0	7.0	15.4	19.8	14.5	17.5
Total suspended solids (mg/L)	<4	24	18	ND	ND	7	<4	<4	<4
Turbidity (NTU)	0.85	8.70	5.88	ND	ND	1.50	0.50	0.55	2.50
Biochemical Oxygen Demand (mg/L)	<6	<6	<6	ND	ND	<6	<6	<6	<6
Ammonia Nitrogen (mg/L)	<0.005	0.013	0.068	ND	ND	0.03	0.005	0.007	<0.005
Nitrate Nitrogen (mg/L)	<0.02	0.02	<0.02	ND	ND	0.07	0.10	0.17	0.10
Nitrite Nitrogen (mg/L)	<0.005	<0.005	<0.005	ND	ND	<0.005	<0.005	<0.005	<0.005
Ortho-phosphorous (mg/L)	0.006	<0.005	<0.005	ND	ND	<0.005	<0.005	<0.005	<0.005

* Water quality samples WQ1 to WQ5 were sampled in April 2001, WQ6 to WQ9 were sampled in July 2002

Environmental Setting

Table 16: Water Quality, Total and Dissolved Metals

PARAMETER	Unit	Minimum Detection Limit	Sample Location			
			WQ6	WQ7	WQ8	WQ9
PHYSICAL						
Hardness Total -T	mg/L		67.4	50.3	66.7	53.2
Hardness Total -D	mg/L		70.9	52.6	71	55.5
METALS TOTAL						
Aluminum	mg/L	0.02	0.02	< 0.02	0.02	< 0.02
Antimony	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Arsenic	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Barium	mg/L	0.001	0.004	0.005	0.005	0.005
Beryllium	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Boron	mg/L	0.008	0.016	0.015	0.012	0.013
Cadmium	mg/L	0.002	< 0.002	< 0.002	< 0.002	< 0.002
Calcium	mg/L	0.05	21	15.6	20.8	16.5
Chromium	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cobalt	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Copper	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Iron	mg/L	0.005	0.131	0.448	0.055	0.468
Lead	mg/L	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Magnesium	mg/L	0.05	3.63	2.75	3.59	2.91
Manganese	mg/L	0.001	0.009	0.004	0.024	0.186
Molybdenum	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nickel	mg/L	0.008	< 0.008	< 0.008	< 0.008	< 0.008
Phosphorus	mg/L	0.1	< 0.1	< 0.1	< 0.1	< 0.1
Potassium	mg/L	1	< 1	< 1	< 1	< 1
Selenium	mg/L	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Silver	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sodium	mg/L	0.05	4.3	5.91	4.36	5.64
Strontium	mg/L	0.001	0.044	0.045	0.049	0.046
Sulfur	mg/L	0.1	1.5	0.8	1.4	0.9
Tellurium	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Thallium	mg/L	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Tin	mg/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02
Titanium	mg/L	0.003	< 0.003	< 0.003	< 0.003	< 0.003
Vanadium	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zinc	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zirconium	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005

Environmental Setting

METALS DISSOLVED						
Aluminum Dissolved	mg/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02
Antimony Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Arsenic Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Barium Dissolved	mg/L	0.001	0.004	0.004	0.005	0.004
Beryllium Dissolved	mg/L	0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Bismuth Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Boron Dissolved	mg/L	0.008	0.019	0.016	0.023	0.024
METALS DISSOLVED						
Cadmium Dissolved	mg/L	0.002	< 0.002	< 0.002	< 0.002	< 0.002
Calcium Dissolved	mg/L	0.05	22.1	16.3	22.1	17.2
Chromium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cobalt Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Copper Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Iron Dissolved	mg/L	0.005	0.093	0.395	0.024	0.244
Lead Dissolved	mg/L	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Magnesium Dissolved	mg/L	0.05	3.82	2.88	3.85	3.05
Manganese Dissolved	mg/L	0.001	0.003	0.002	0.025	0.117
Molybdenum Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nickel Dissolved	mg/L	0.008	< 0.008	< 0.008	< 0.008	< 0.008
Phosphorus Dissolved	mg/L	0.1	< 0.1	< 0.1	< 0.1	< 0.1
Potassium Dissolved	mg/L	1	< 1	< 1	< 1	< 1
Selenium Dissolved	mg/L	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Silver Dissolved	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sodium Dissolved	mg/L	0.05	4.07	5.56	4.91	6.15
Strontium Dissolved	mg/L	0.001	0.044	0.044	0.049	0.045
Sulfur Dissolved	mg/L	0.1	1.6	0.8	1.4	0.9
Tellurium Dissolved	mg/L	0.05	< 0.05	< 0.05	< 0.05	< 0.05
Thallium Dissolved	mg/L	0.03	< 0.03	< 0.03	< 0.03	< 0.03
Tin Dissolved	mg/L	0.02	< 0.02	< 0.02	< 0.02	< 0.02
Titanium Dissolved	mg/L	0.003	< 0.003	< 0.003	< 0.003	< 0.003
Vanadium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zinc Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Zirconium Dissolved	mg/L	0.005	< 0.005	< 0.005	< 0.005	< 0.005

IMPACT ASSESSMENT

3.1 Vegetation

3.1.1 Potential Impacts

3.1.1.1 General

The project layout indicates that 120.9 ha (61.8%) of the 196 ha site will be impacted, or conversely 74.8 ha (38.2%) will be left undeveloped. Based on the present plan, the following provides an approximate breakdown of vegetation loss by vegetation type:

- 1.4 ha or 15.2% of wetland vegetation (WH, CS, CW);
- 19.2 ha or 64.0% of wet forest vegetation (RC, RV);
- 58.0 ha or 70.1% of mesic forest vegetation (DG, RK, RF);
- 32.1 ha or 66.2% of dry upland woodland vegetation (DA, RS, GB) and
- 11.7 ha or 53.2% of disturbed area (D).

Potential impacts to vegetation include the following:

- Loss of rare or endangered plants or plant communities;
- Loss of bylaw protected trees;
- Loss of wildlife habitat and
- Mass wasting or erosion due to removal of root systems.

The proposed development will consist of the following components:

- 18-hole golf course (fairways, driving range, greens, golf academy and adjacent areas) – 56.36 ha;
- Residential lots and commercial space – 35.74 ha;
- Roads – 13.14 ha and
- Future development sites – 15.65 ha.

The remainder of the site will remain undeveloped as private open space (13.84 ha) and municipal parkland (47.04 ha) or as drainage (13.96 ha).

The majority of the development area occurs in second growth conifer forest. If the golf course itself is considered part of the greenspace, then the total the area of greenspace is 131.20 ha (this includes, fairways, adjacent areas, drainages, and both private and municipal open spaces) which is 67 % of the total area.

The District of Highlands Bylaw No. 10, which regulates and prohibits the cutting of trees states that the following trees are protected:

- Garry oak (*Quercus garryana*);

- Arbutus (*Arbutus menziesii*);
- Pacific dogwood (*Cornus nuttallii*);
- Pacific yew (*Taxus brevifolia*);
- Cascara (*Rhamnus purshiana*);
- Hairy manzanita (*Arctostaphylos columbiana*);
- Douglas-fir (*Pseudotsuga menziesii*), having a diameter of greater than 60 cm and
- Any tree having a diameter greater than 80 cm.

There are numerous large diameter (greater than 60 cm DBH) Douglas-fir and western redcedar on the site. In addition, Garry oak, arbutus, Pacific dogwood, western yew and cascara are present on the site.

3.1.1.2 Rare Plants and Plant Communities

The only rare plant observed on the site was found on the road within the hydro right-of-way. There are no plans to modify this area. Although not found during the survey it should be noted that wetlands such as Wetland A (C0705A) have a high potential for rare plant occurrence. In addition, the rock outcrops and Garry oak communities have a high potential for rare plant occurrence. Wetland and Garry oak associated rare plants are presented in Appendix III. Residential development in the northwest corner of the property may impact Garry oak communities on the site. Wetlands D, K, L, M, N, S and T will be either impacted or removed entirely.

3.1.1.3 Sensitive Ecosystems

In addition to impacting Wetlands D, K, L, M, N, S and T, Riparian I-III, and Woodlands I-VIII will be impacted as well. Based on the site layout approximate losses to sensitive ecosystems are as follows:

- 4.2 ha wetland
- 16.4 ha riparian
- 32.1 woodland/terrestrial herbaceous

In addition to the loss of sensitive ecosystems approximately 111 ha of second growth general biodiversity ecosystem will also be lost.

3.1.2 Mitigation Strategies

Mitigation methods as outlined below were developed as per the recommendations in 'Environmental Objectives, Best Management Practices and Requirements for Land Developments, Vancouver Island Region' (MELP 2001).

To reduce the vegetation impacts the following mitigation practices are recommended:

Impact Assessment

- Maintain a minimum of 15 to 30 meter buffer from high water level adjacent to riparian and wetland sensitive ecosystem polygons;
- Erect fencing to discourage access and prevent direct human and domestic pet impact around sensitive ecosystem polygons where appropriate, such as those areas where maximum human access is expected. This could include split-rail fencing along trails near sensitive ecosystems;
- Replant all areas of vegetative impact with indigenous vegetation and use an indigenous seed mix to re-seed cleared areas;
- Protect all trees that are to be retained from mechanical damage to the trunk and root system. This protection can be achieved through marking and/or flagging trees that are to be protected during the construction phase of the project;
- Restrict vehicle traffic to designated access routes and travel lanes to avoid soil compaction and vegetation disturbances;
- Dispose of woody debris in an environmentally sensitive manner;
- Avoid alterations to existing hydrological patterns to minimize impact on riparian vegetation;
- Limit clearing to the minimum area required for construction boundaries and any additional working space. The minimum amount of vegetation possible will be removed from environmentally sensitive areas or areas where rare or endangered plants or plant communities are identified by the environmental monitor;
- Establish 'clear only' zones on steep or other environmentally sensitive areas. In these zones, tree and shrub roots will be left intact in ground to minimize impact due to erosion, to promote regeneration, or to retain aesthetic values;
- To prevent erosion, delay clearing and/or grubbing on sensitive slopes until immediately before the remaining construction. Minimize blasting and re-sloping of bank cuts wherever possible and re-vegetate banks as soon as practical to minimize erosion;
- Vegetation to be protected including the riparian zones associated with all fish bearing and non-fish bearing streams will be clearly marked using yellow tape to separate it from the construction area;
- Grubbing will be reduced as much as possible around the drip line of any tree to be retained. Flagging to identify the boundaries will be placed beyond the drip lines of the trees to ensure that any soil removal will be restricted to within the boundary;
- Where partial clearing of a treed area is required, damage to adjacent vegetation will be minimized and contained within the 6-meter

allowance. If any tree removal will be necessary for access the falling will be done so that trees fall toward the cleared area. The clearing will be done in a manner that minimizes the potential for windthrow and enhance wildlife habitat;

- Establish and follow Tree Protection and Sensitive Ecosystem Protection Plans and
- Covenant all sensitive ecosystems on the site.

3.2 Wildlife

3.2.1 Potential Impacts

3.2.1.1 Habitat Loss

Approximately 20.6 ha (52%) of high-valued wildlife habitat (wetland and wet forest vegetation) will be impacted from development, or conversely 18.7 ha (48%) will be protected as park. Approximately 58 ha (70%) of moderate-valued wildlife habitat (mesic mixed forest) will be impacted from development and 24.7 ha will be protected (30%). In addition, approximately 32.1 ha (66%) of low-valued wildlife habitat (rocky outcrops and dry mixed and deciduous woodlands) will be impacted or, conversely, 16.4 ha (34%) will be preserved.

3.2.1.2 Construction-related Impacts

The following sections discuss general potential construction and post-construction impacts, and also address specific impacts that may affect species of conservation interest.

Construction will result in two major impacts on wildlife: noise and fugitive dust. Heavy machinery and earth-moving equipment during the construction processes of both roads and free-standing developments may generate high-noise levels. Grading the earth releases tremendous amounts of dust into the atmosphere, which can alter the nesting and breeding of some birds.

Earthmovers and other heavy construction equipment will generate high noise levels. Noise levels may be particularly acute during the grading stages of construction and these noises may interfere with animal communication and detection of predators. If the construction is performed during the breeding season, mating calls may be lost or obscured by the intervening noises.

Fugitive dust, a threat unique to construction, may have noticeable repercussions for plants and nesting birds. Dust deposition on leaves can reduce photosynthesis through numerous means. It blocks stomata and increases transpiration. This increased water loss during the night can make plants more susceptible to drought. Secondary effects of dust deposition will include lower resistance to disease, pests, and fungi of both plants (Farmer, 1993) and young nest chicks.

Hydroseeding may be used during winter and spring construction projects to prevent soil erosion. If not performed correctly, hydroseeding can be a threat if invasive, exotic species are used. Hydroseeding exotic species could result in severe infestations of exotics such as Brassica (Black mustard). Another species, reed canary grass (*Phalaris arundinacea*), is an invasive grass species that does well in these harsh conditions. This grass grows so fast and so thick that it crowds out the native wetland grasses, rushes and sedges. The result is a less diverse plant system which alters the natural functioning of the ecosystem; it disrupts the use of the wetland areas by birds and amphibians, and also changes the food source for birds and benthic species. For hydroseeding, care should be taken to use grasses, annuals, and perennials indigenous to the area and to use local seed stock. Consultation with MWLAP would be helpful in determining an appropriate seed mix for each location.

Bird Nest Abandonment and Wildlife Avoidance

Clearing the site during the bird-breeding season, which is typically March through August, would result in potential nest abandonment or loss of habitat for birds actively engaged in incubation/rearing. In addition, noise generated during site-preparation activities such as falling, chipping, blasting and re-grading can disrupt breeding birds at some distance from the actual clearing area and cause other wildlife to avoid the area. Resulting short-term abandonment of nests can cause increased nest predation and also lower the temperature of nest contents to dangerously low levels causing natal mortality.

Alteration of Wildlife Movement/Activity Patterns

Few animals meet all their life requirements within a single location. Most move across the landscape in search of food, mates and favourable microclimates. Construction clearing activities can interrupt travel/hiding cover and require wildlife to adjust their movement and dispersal patterns. This, in turn, can result in increased risk of predation and/or failure to access critically important habitats. Construction activities can also cause species (e.g., deer and mink) with diurnal/crepuscular activity patterns to become more nocturnal. However, there is little evidence that this directly influences either foraging or reproductive success.

Habitat Fragmentation/Altered Microclimate

Habitat fragmentation impacts are closely linked to impacts on wildlife movement patterns as described above. Habitat fragmentation relates primarily to smaller wildlife with limited dispersal ability. Amphibians typically perceive roads as significant barriers to movement due to their absence of cover and, in some cases, their hostile microclimate. Fragmentation may result in creation of isolated sub-populations, which are more susceptible to extirpation in the face of changing conditions. Apart from potential road impacts, species groups such as pond-breeding amphibians can be impacted if their breeding areas become isolated from the moist upland forests, which are required during periods outside of their breeding season. In addition, lowered soil moisture along the exposed

edges of leave strips can render leave areas inhospitable to amphibians, particularly terrestrial salamanders, which require moist skins to respire.

The urban development proposed will fragment the natural area and destroy indigenous vegetation. This will be a benefit to habitat generalists (e.g. brown-headed cowbird, house sparrow and European starling) at the expense of species specialists (e.g. Townsend's, black-throated grey and yellow warblers). Non-native animals, such as pigeons, starlings, house sparrows and raccoons, may increase as native species decrease. Within the indigenous populations of wildlife, diversity will decline but total numbers will not. These types of population trends indicate that certain species will be favoured, but others will be harmed by the urbanization of the area (Adams, 1994).

Reduced Water Quality in Wetlands

Sediment-laden stormwater can reduce water quality in wetlands occurring on the site. Excessive sedimentation has the potential to suffocate amphibian egg masses and make foraging difficult for aquatic and semi-aquatic wildlife, which rely on visual cues to capture prey (e.g. mink).

A change in local site hydrology is inherent to development. Rooftops, streets, concrete pavements and other impervious surfaces decrease water infiltration and increase stormwater runoff. Stormwater runoff in urbanized areas is typically polluted due to organic and non-organic particulate matter being washed from houses, cars and streets. Other sources of pollution include fertilizer and pesticide from treated landscaping. The affects of changing runoff patterns include a decreasing water availability to some animals (Adams, 1994).

During construction, road dust may be considered a concern. Paved and dirt road dust is comprised of organic and inorganic matter. The most common constituents include brake lining wear particles, oil residues, tire wear particles, automobile exhaust, weathered street particles, dust from the side of the road, and organic material which may have settled on the road. Wind produced by natural forces and fast-moving cars constantly disperses the particles through the air but the effects of road dust depend on the composition of the particles (Adams 1994). The result of excessive dust is that it can change the pH of leaf surfaces, chemically react with plants, and alter soil composition: effects which can be toxic to plant life.

The development plan will require regrading of land during construction. All site runoff at this time will need to be directed to the roadside ditches or ponds where storm flows could be detained.

A residential development has the potential to affect water quality in a variety of ways. Potential effects of water quality as a result of the expansion, if left unmitigated, include the following:

- Increased sediment loadings due to erosion during construction;
- Potential spills of construction materials;

- Discharge of oils or other contaminants in stormwater runoff from the construction site; and,
- Discharge of fertilizers or pesticides in runoff from the residential lawns.

Further details on water quality impacts are presented in Section 3.3.2.

Loss of Veteran Trees/Wildlife Snags as Hazard Trees

Workers' Compensation Board regulations regarding hazardous trees within work zones may result in the removal of veteran trees and large diameter snags, which would otherwise perform valuable ecological functions as perches, feeding sites, roosts and nests.

Damage to Trees in Leave Strips

Accidental fill placement in leave strips around tree trunks can smother the root systems and cause extensive damage to trees that are to be retained. This can occur when as little as 10 cm of fill is piled around a tree trunk. Also, excavator work near leave areas can sever the roots of trees to be retained. These impacts can result in the removal of a tree due to its potential safety hazard.

With respect to upland habitat impacts, few mitigative options are ultimately as effective as retention and protection. Habitat types meriting additional protection include the riparian areas and edge shrub habitat. Impacts to these habitats can be reduced somewhat through reclamation of areas to be cleared.

Noise Due to Construction and Urban Encroachment

Impacts of noise disturbances from the houses are not well documented. However, noise at higher levels, such as car and urban noise, is not acceptable for wildlife which are sensitive to significantly lower levels of noise and rely on sounds for communication (e.g. ruffed grouse). Housing developments may affect breeding and rearing of some species birds in the area.

3.2.1.3 Post-construction-related Impacts

Post construction, it is inevitable that people will use the immediate areas surrounding the subdivision to create trails for walking and biking. The following are impacts associated with the development of the subdivision and golf course into the surrounding habitat and sensitive ecosystem polygons.

Noise

When people and their pets use the adjacent forest habitat, they produce noise disturbance that is harmful to some animal species. Human and pet presence, and especially voices, adversely affects certain birds. Noise caused by the close approach of people, loud voices or sustained conversation may alter their behaviour and may even cause them to desert their nests. Dogs that bark and disturb areas close to, or at, nesting sites are also harmful to birds. In subdivisions, dogs often bark relentlessly, regularly contributing to noise disturbance.

Exotic Species

Human use of the surrounding forest and plantings around dwellings can result in the introduction of non-indigenous species. Some of these ‘exotics’ have significant biological impacts on natural areas. Successful introductions of scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus discolor*), have in many areas displaced indigenous plants and animals, and disrupted the native ecosystem. Indirect effects of exotics may include the introduction of pathogens not familiar to indigenous species.

Traffic-related Wildlife Mortality

Though the design speed of roads is likely to be fairly low in proposed residential areas, there is a significant potential for traffic-related wildlife mortality where road networks intersect wildlife movement corridors. In addition to deer and Eastern Cottontail rabbits, several species of small wildlife are also susceptible to traffic-related mortality. For example, amphibians such as Rough-skinned Newts may undergo mass migrations to and from breeding ponds, which can result in significant mortality from road traffic. Reptiles (snakes) can also be vulnerable to traffic-caused mortality as they are frequently attracted to roads as basking sites.

Reduced Water Quality in Wetlands

Road runoff containing hydrocarbons and other deleterious substances can impact water quality for wetland-dependent wildlife. Runoff containing fertilizers can result in eutrophication of wetland habitats, which can result in algal blooms. This, in turn, can affect aquatic species by lowering oxygen levels in the water. Introduction of pesticides (insecticides, fungicides, herbicides) into watercourses can result in mortalities to aquatic invertebrate, amphibian and aquatic plant communities.

Introduction of pesticides (insecticides, fungicides, herbicides) into watercourses can result in mortalities to aquatic invertebrate, amphibian and aquatic plant communities.

Predation by Domestic Animals and Urban Impacts

Indigenous insectivorous bats that currently use the area, such as the little brown bat (*Myotis lucifugus*) and the big brown bat (*Eptesicus fuscus*) are of concern because they use urban lighting to catch insects, which may affect the food supply of insectivorous birds (*Empidonax* spp. flycatchers). Bats using houses to nest and roost in are generally not tolerated by homeowners and may be exterminated.

Household pets, primarily cats and dogs, pose a danger to birds and small animals. The impact of domestic cats on small mammal populations has been discussed in some detail in Zuleta and Galindo-Leal (1994). Cats are a significant predatory influence on birds and small mammals. Dogs harass birds and small mammals by chasing them and barking. Dogs roaming at large are

capable of injuring or killing wildlife as large as a deer. They may harass indigenous fauna that continue to frequent the less developed parts of the site.

Pet feces, if not controlled, may degrade the area and also act as a source of exotic seeds. Another possible consequence of feces introduction into the natural areas, if the quantity is large enough, is the introduction of additional nutrients to the soil. In nutrient-poor soils, the alteration of nutrient levels causes a disturbance that may facilitate the introduction of exotics and contribute to the reduction of species richness (Hobbs and Huenneke 1992). Often grasses, which displace indigenous vegetation, dominate under these circumstances.

Supplemental food for wildlife (bird feeders and people feeding wildlife), can alter species behaviour, keep populations above carrying capacity, favour opportunists (European starlings, house sparrows and raccoons), potentially introducing disease among some species (i.e. house finch conjunctivitis), and may directly increase chances of mortality. Birdfeeders used by granivorous bird species can spread the bacterial disease salmonellosis through feces-contaminated seed and the fungal disease, aspergillosis can be spread through moldy seed at feeders. Hummingbird feeders containing a sugar-water solution can spread bacteria. This urbanisation may indirectly contribute to birds at feeders becoming easy prey for cats and hawks. Some birds often collide with walls and windows due to being attracted to feeders. Non-native grainivorous birds (European starlings, house sparrows) using feeders are of concern because they may be aggressive towards indigenous species (Adams, 1994). Finally, human garbage and pet food allow opportunists such as raccoons to be supported at population levels above what is found in the wild.

Competition for Nest Cavities

Developments such as this can increase competition for remaining nest cavities between native birds and more aggressive, introduced species (e.g., starlings and house sparrows). In rural parts of southeast Vancouver Island, some cavity nesters such as flickers, nuthatches and hairy woodpeckers appear to persist in the face of heavy competition for nest cavities with starlings. However, since cavities are often a limiting habitat feature in urban settings, there is still potential for impacts to native birds.

Foreign birds are a concern because they may decrease the amount of food available to indigenous birds. Northwestern crows, house sparrows, and European starlings are all foreign birds that thrive on the urban/natural space interface. In particular, starlings have been observed to nest on lightposts. European starlings are insectivores and may decrease both the food supply for native insectivores and affect the populations of pollinating insects.

Increased Susceptibility to Windthrow Events

Depending on their orientation and composition, retention of narrow, linear forest strips increases the likelihood of their disturbance by winter storm events. Douglas-fir and western redcedar trees are generally less susceptible to windthrow than either western hemlock or black cottonwood. While windthrown

trees may affect some habitat values within a leave-strip, they may also be considered beneficial in introducing a more complex habitat.

Human Disturbance of Wildlife

Although the site has a trail system in place and it is frequented by hikers and cyclists, this has resulted in a certain degree of habituation to human activity. The proposed increased human presence associated with a residential development may cause some species to become more nocturnal or abandon the site altogether. Trail networks encircling wetlands would result in considerably more wildlife disturbance than those that lead to a few well-chosen viewpoints.

Roadside litter can also pose another risk to wildlife. With the development of housing and associated road networks, the animal habitat will be exposed to a wide array of human garbage. Items which pose a particular threat include cigarette butts, which can be mistaken for food and eaten, gum, plastics, and food wrappers that opportunist animals may find attractive. These items are not part of a healthy diet for animals and plastics interfere with digestive processes. Raccoon, red squirrel, and scavenging birds will suffer the most from human garbage if it is not kept in control.

Fertilizer and Pesticide Application

Maintenance of residential lawn and golf course fairways may require the application of fertilizers and pesticides, which could find their way into ponds and be taken up by vegetation. This may have some potential to impact wildlife; however, studies in British Columbia have found the use of chemicals on lawns and golf courses did not pose a significant threat to birds. A pesticide and fertilizer management plan should be developed which will prevent impacts from this source.

Impacts to the Red-legged Frog

Outside of the breeding season, the Blue listed Red-legged Frog is highly terrestrial and can be found in forests far from standing water. They can occasionally be found inside decayed logs. This upland habitat is important in maintaining the integrity of the frog aquatic/breeding habitat. Land use activities adjacent to and upstream of suitable aquatic habitat greatly affect the quality of aquatic/breeding habitat downstream. The proposed land use activities if unmitigated may alter the quantity and timing of water flow and may also alter the water and sediment quality. Breeding takes place early in the spring in shallow water in permanent ponds and swamps. The Red-legged Frog has a potential of occurring on the study site in the forest around wetlands. The impact on this and other amphibians as a result of the proposed development will be primarily to any ephemeral pond habitat and from construction, on the forest riparian areas. Additionally, there is expected to be habitat loss without proper mitigation, but degradation of water quality is the greatest impact issue associated with amphibian habitat in the area.

3.2.2 Mitigation Methods

Habitat retention is the primary mitigation technique to maintain wildlife or other biodiversity values. As discussed in the previous section, the concept plan includes designated lands dedicated to natural greenspace, which encompass approximately 71.19 ha (36.5 %) of the site.

3.2.2.1 Construction Impacts

In evaluating construction-related impacts over a broad range of wildlife, where complex interrelationships may exist between species and their habitats, a coarse filter analysis can have considerable utility. It assesses the success of the retention of the natural area on two fronts: 1) the representation of typical habitats in proportion to their pre-development distribution; and 2) the degree to which uncommon or high-value habitats are over-represented.

The following section presents a fine filter analysis of potential impacts to individual species/species groups from development.

Habitat Loss

The concept plan indicates that 37% of total area of natural vegetation will be retained and that 52% of the high value habitat will be retained. Impacts to wetland and riparian areas can be partially compensated through wildlife enhancements and protection of remaining habitat.

Typical wildlife enhancements for modified wetlands and created ponds include nesting islands, loafing logs, submerged root wads and riparian plantings. The suitability of riparian strips for amphibians and small mammals can also be improved through the installation of sections of large diameter fir or cedar logs (>50 cm diameter) at 5 to 10 meter intervals along their length.

With respect to impacts on upland habitat, few mitigative options are ultimately as effective as retention and protection. Habitat types meriting additional protection include the riparian areas and edge shrub habitat. Impacts to these habitats can be reduced somewhat through reclamation of areas to be cleared.

Bird Nest Abandonment

Scheduling activities such as falling, chipping and blasting outside of the main part of the breeding bird season would significantly reduce the potential for nest abandonment in parts of the site to be retained in a natural condition. If a sediment control plan is in place logging of the fairways during later summer/early fall may be environmentally feasible.

Habitat Fragmentation/Altered Microclimate

Corridors of natural vegetation connecting wetlands to moist forests, rocky outcrops and other wetlands will maintain important habitat linkages across the site. Conifer and/or tall shrub plantings along the outer edges of leave strips would increase shading and cover values in these areas.

Reduced Water Quality in Wetlands

Construction-related impacts can largely be avoided by common mitigation strategies and sediment erosion control plans following Best Management Practices. Barrier fencing should be used around all habitats to be retained in the sub-division area. Additionally, trees within construction envelopes should be felled away from habitats to be retained.

Loss of Veteran Trees/Snags as Hazard Trees

Identification of significant trees and snags will facilitate efforts to retain as many of these features as possible during the golf course planning phase. Additional snags could be recruited in suitable retention areas (e.g., forested edges of rocky outcrops) by girdling and/or fungal inoculation of the trunks of mature conifers. The former is useful for creating raptor perch/nest trees within a short period, while the latter encourages internal decay for cavity-dependent wildlife.

Damage to Trees in Leave Strips

Establish flagging around tree/vegetation retention areas and briefing by the environmental site monitor to the construction crew about these areas will prevent damage resulting from excavation and accidental fill placement.

3.2.2.2 Post-construction-related Impacts

Traffic-related Wildlife Mortality

The potential for traffic-related wildlife mortality can be significantly reduced through further study to identify wildlife movement patterns on the site and thus provide small wildlife passage culverts and roadside barriers at appropriate high-risk locations. Reptile mortality can be reduced by constructing artificial basking sites (e.g., linear boulder piles) outside of the roadside barrier system.

Reduced Water Quality in Wetlands

Discussed in construction-related impact mitigation.

Increased Susceptibility to Windthrow Events

The potential for large-scale blowdown events can be reduced by:

- Retention, favouring Douglas-fir and western redcedar trees within linear leave strips;
- Conifer plantings along the leave strip edges and
- Creation of small gaps in the forest cover at 100-meter intervals, thereby allowing winds to flow through leave strips in places.

Human Disturbance of Wildlife

Trails near wetland areas that lead to a few well-chosen viewpoints would limit the amount of human disturbance in these sensitive wildlife habitats.

3.3 Aquatic Resources

3.3.1 Habitat Loss or Augmentation

3.3.1.1 Potential Impacts

According to the concept plan all watercourses, with the exception of Millstream Creek will be impacted due to fairway crossings, road crossings and subdivision development. In addition, portions of Wetlands D, K, L, M, N, S and T will either be removed or encroached upon due to fairway, driving range and subdivision construction.

In many cases, such as fairway crossings, riparian vegetation adjacent to the watercourses will not be removed but a partial clearing of the tree and tall shrub layers will be required to allow for sight lines.

3.3.1.2 Mitigation Strategies

To mitigate the loss of stream channel, wetland and associated riparian zone, habitat creation and enhancement is proposed. Upon completion of final design a habitat balance sheet will be created. A habitat replacement of 1:1 for wetlands, watercourses and riparian will be achieved.

The creation of new wetland habitat is one way of compensating for habitat loss. The newly created shallow water habitat should be planted with indigenous submergent and emergent aquatic plants. The banks should have a 2:1 slope and be reinforced with rock riprap (minimum diameter of 30 cm). The riprap should be interspersed with live plant stakes of indigenous wetland shrub species. The top of banks should be planted to the waterline with wetland shrubs such as salmonberry, red elderberry and thimbleberry to provide overhanging vegetation cover and to stabilize the banks. To provide instream cover large organic debris can be placed in the deepest parts of the pool.

A potential reservoir site for the golf course is Matson Lake. The lake is currently dammed at its outlet and has a maximum depth of 3 m and a mean depth of 1.7 m. Raising the dam by 2 m would increase the maximum depth to 5 m which would improve water quality conditions within the lake by decreasing water temperatures and increasing oxygen carrying capacity of the water. It would also increase the surface area of the lake.

To protect the remainder of the stream and wetland network, buffer zones have been established throughout the planning of the subdivision and golf course. Where possible, all creeks will have a 15 meter setback and all wetlands will have a 30 meter setback. Activities within these buffer zones will be limited and no buildings or hard surfaces roads will be built in these areas.

Access by golfers into areas where fairways intersect creeks and wetlands will be strictly forbidden. Signs should be used to keep people on playable areas and away from riparian areas.

Streams will be crossed at right angles and raised pilings will be used and concrete and steel bridges will be used rather than treated wood. Where possible, riparian vegetation will not be disturbed during the bridge construction. Raised tees and greens will be used for easy visibility but riparian vegetation will not be removed.

3.3.2 Surface Water

3.3.2.1 Potential Impacts

Water Quality

The potential impacts to aquatic resources are related to both the construction and post-construction phases of the project. Potential changes to water quality during construction could include increased suspended sediments and turbidity and also the introduction of deleterious substances such as vehicle fuels, construction materials, fertilizers and pesticides. Potential sources of increased suspended sediments and turbidity are:

- The release of soils or stream bed materials as a direct result of construction activities and
- Erosion of disturbed areas on the approaches to stream crossings.

The release of potentially toxic materials could occur through spills or leaks from vehicles and construction activities. Surface run-off from the golf course could introduce fertilizers and/or pesticides into adjacent watercourses.

Water Quantity

During construction some limited effects on stream flows could result from the diversion of water during instream activities. Construction of stream crossings will not affect flows except within the immediate work area, around which flows will be diverted if necessary.

As part of the development there may be a need to modify surface drainages of on-site watercourses, which may change flow conditions present prior to development. In addition, an increase in the total area of impermeable surfaces will occur due to the construction of buildings and roads, which will increase surface run-off volumes. During summer months, maintaining the golf course will require irrigation, which could also change the water balance of the site and could affect water levels in wetlands and watercourses that are groundwater fed.

Water consumption by the residential development will not impact the ground or surface water as it will be CRD water.

3.3.2.2 Mitigation Strategies

Water Quality

The proponent and associated construction crew will implement mitigation measures to prevent or minimize the potential for sediments and toxic

substances to enter surface waters. The following practices will be followed to minimize sedimentation:

- Construction near watercourses will occur during dry weather, where possible;
- Clearing on approaches to streams and other areas near waterbodies will be delayed until just before instream work begins. Grading and grubbing in these areas will be minimized;
- Runoff and groundwater will be diverted away from construction areas on the approaches to streams;
- When construction areas are dewatered, settling ponds, basins or vegetated upland areas will be used to remove sediments before the water is returned to streams;
- Stream banks will be stabilized, restored and re-vegetated as soon as possible after the instream work has been completed and
- An environmental monitor will be present during work in or near streams. The monitor will have the authority to stop work if sedimentation or other problems develop.

Mitigation measures for construction will also include practices to prevent toxic substances from entering surface waters. These practices include:

- Ensuring that any vehicles used near streams are functioning properly and are free of fuel or oil leaks;
- Immediately removing and repairing any equipment that does develop a fuel or oil leak;
- Constructing vehicle and large equipment storage, fuelling and maintenance areas well away from waterbodies and providing these areas with spill containment structures;
- Developing a project specific spill containment and response plan and
- Providing absorbents and equipment to contain and remove spilled fuel, oil or other materials at each crossing.

Sediment and Erosion Control Plan

A sediment and erosion control plan should be completed which would include the following:

- To the extent possible, site clearing and grading will be scheduled for the dry weather period (summer), when the potential for surface runoff to erode exposed soils is lowest. As much as possible, the clearing and grading operations will be staged to avoid having large areas of disturbed soil present at any time and particularly during the winter;

- Site clearing will immediately precede construction to minimize the amount of time that disturbed soils are exposed to weathering. Clearing will be limited to the minimum area necessary for construction;
- If any soil or other erodible material is to be stockpiled for more than seven days, it will be covered with polyethylene sheeting that is anchored securely to prevent displacement by wind;
- Where necessary, sedimentation ponds and silt fencing will be used to retain sediments on the construction site. The design engineers will determine the appropriate sizes and locations of settling ponds;
- The sediment control structures will be installed as the first construction activity. All sediment control structures will be inspected regularly, and repaired/maintained as necessary;
- Ditches and/or berms will be installed as necessary to direct surface runoff away from disturbed areas. The ditches will be designed to prevent erosion due to high water velocities through the use of check dams (e.g., sandbags), filter fabric, rock rip-rap or polyethylene lining. Apart from these necessary diversions, the natural drainage patterns will be maintained and
- Sediment and erosion control materials will be stockpiled on site for use in any emergency situation that may arise. Stockpiled materials will include filter cloth, hay bales, rip-rap, grass seed, drain rock, culverts, matting polyethylene, used tires, etc.

As soon as practical after construction, any remaining disturbed soils will be re-vegetated using an appropriate grass seed mixture. Seeding will be conducted before the end of the growing season to allow establishment of germination/roots. These mitigation measures will minimize both the potential for release of sediments and/or toxic substances to waterbodies and the significance of any releases that do occur. With mitigation measures in place, there remains some potential for short-term increases in suspended sediments and turbidity during and shortly after construction. It is also possible that a small amount of fuel or oil could enter a stream if a piece of operating equipment develops a leak. These potential negative effects on water quality are expected to be minimal, short term and localized.

Stormwater Management Plan

The stormwater management system will provide treatment to ensure acceptable water quality in any discharge to downstream watercourses. Treatment will include the following:

- Oil/water separators will be provided in storm drains on parking lots;
- Where practical, runoff will be conveyed to settling ponds via vegetated swales, which will act as filters for oil and particulates;

- To maintain acceptable water quality either a biofiltration wetland will be constructed at the inlet to each of the golf course ponds, or the ponds will be planted with emergent and submergent aquatic vegetation. Plantings will conform with recommendations provided in Greening Your BC Golf Course, A Guide to Environmental Management (UMA Engineering Ltd. 1997) and
- Water from the tees and greens will be directed through a carbon filter prior to discharging into wetlands and/or watercourses.

Fertilizer and Pesticide Management

The use of fertilizers and pesticides at the golf course raises some concerns about potential impacts to on-site and downstream watercourses. The major issues are the possibility of runoff or leaching to the golf course water features or groundwater with eventual discharge to downstream fish bearing systems. The possible effects on water quality of the stream include fertilizer-induced algal blooms (eutrophication) and potential toxicity of pesticides to fish and amphibians.

By following a fertilizer and pesticide management plan, which will be developed for the Bear Mountain Highlands Golf Course, the golf course maintenance staff will prevent impacts of pesticide and fertilizers on water quality. The objective of the management plan is to minimize the potential for runoff or leaching of fertilizers and pesticides to golf course water features and groundwater. Research (Krause and Niemczyk 1989, Watschke and Mumma. 1989) has demonstrated that both runoff and leaching of pesticides and fertilizers from well-managed turf are negligible. The fertilizer and pesticide management plan therefore includes guidelines for producing a well managed, healthy turf. Key aspects of the plan include:

- Selection of turf grass species and cultivars that are appropriate for the site;
- Conservative application of fertilizers;
- Use of slow-release nitrogen sources;
- Appropriate timing of fertilizer applications;
- Implementation of an integrated pest management (IPM) program;
- Use of effective alternatives to pesticides when they are available;
- Selection of the 'least toxic' pesticide that will treat the condition;
- Establishment of pesticide-free zones adjacent to watercourses and
- Use of pesticides at the minimum effective application rate.

Monitoring of Water Quality

To ensure that water quality in the ponds is acceptable for discharge and is not adversely affecting on-site or downstream watercourses, the Bear Mountain

Highlands Golf Course will implement a water-quality monitoring program. The program will include sampling ponds on the golf course, on-site watercourses and downstream watercourses such as Millstream Creek and Goldstream River. The monitoring program should begin during construction (when turf is planted on the first holes) and continue through the first full year of golf course operation. The initial monitoring program will involve monthly sampling. The samples will be analyzed for the following parameters:

- pH (field measurement);
- Temperature (field measurement);
- Total ammonia;
- Nitrate;
- Nitrite;
- Chloride;
- Total phosphorous;
- Chemical oxygen demand (COD) and
- Biochemical oxygen demand (BOD).

At the end of the first year of operation, results of the monitoring program will be evaluated, and recommendations for future monitoring will be developed.

Water Quantity

Where possible development near wetlands will be avoided. If courses are to be located near wetlands, the course design should recognize and avoid disrupting the hydraulic connections between the course and the wetland, and consider the impacts of surface water alterations, diversions and course contouring. This will help avoid damaging or destroying wetlands by interrupting the connections between wetlands and their water supply.

To help maintain pre-development hydrology, surface runoff should be diverted using appropriate infiltration practices or structures such as trenches, basins, filter beds or soaking pits. Surface water drainage improvements such as French drains can be installed in areas, which develop drainage problems later after the turf is established.

Temporary holding back peak flows stabilizes flow, improves runoff quality and prevents erosion. Detention techniques such as wet ponds and storage tanks can moderate surface runoff and store peak flows. In dry climates the water held back may be used for irrigation later.

To reduce changes to pre-development hydrological conditions impermeable surfaces will be minimized. All paths, walkways and trails will consist of crushed granular materials. Major roads and high use areas will consist of asphalt, but will be crowned or sloped so that surface run-off can be directed to bioswales and collected in detention facilities.

Site runoff from the golf course will be directed to the golf course ponds, where storm flows will be detained. The ponds will be sized and managed to maintain pre-development flows off the site and still provide irrigation water. Thus, it is unlikely that there will be any impacts to the aquatic environment associated with a change in flows.

To minimize irrigation requirements the golf course design should consider the following:

- Leave as much native vegetation undisturbed and incorporated into the course design as possible to reduce irrigation needs;
- Design fairways and roughs as narrow as possible to reduce the irrigated area;
- Select the most drought-tolerant grass that is compatible with the intended use and the local climate and
- Optimize the irrigation regime to use the least amount of water that will still keep the grass healthy.

To minimize impacts to groundwater levels during golf course irrigation the damming of Matson Lake is being proposed.

3.4 Fisheries Resources

3.4.1 Potential Impacts

Potential impacts to fish habitat and populations due to instream construction are as follows:

- Suspended sediments resulting in the degradation of fish habitat and fish impairment;
- Introduction of deleterious materials into the stream and
- Destruction of riparian zone.

3.4.1.1 Suspended Sediments

Potential impacts of suspended sediment releases include the following:

- Suspended sediments can settle on downstream spawning areas, in-fill the intragravel voids and smother the eggs and alevins in the gravel;
- Bedload and settled sediments can in-fill pools and riffles, reducing the availability and quality of rearing habitat for fish;
- Suspended sediment can clog and abrade fish gills, causing suffocation or injury to fish;
- Suspended sediments can reduce water clarity and visibility in the stream, impairing the ability of juvenile fish to find food items;

- Settled sediments can smother and displace aquatic organisms (benthic invertebrates) reducing the amount of food items available to fish and
- Increased levels of sediment can displace fish out of prime habitat into less suitable areas.

3.4.1.2 Deleterious Substances

In addition to turbidity, other water quality concerns can arise during instream construction. These may include hydrocarbons released by instream activities of machines such as backhoes, generators and pumps, debris from excavation and construction and domestic refuse.

3.4.1.3 Fish Habitat Loss or Augmentation

It may be necessary to remove creek bed material during bridge construction and culvert installation. The removal of materials can have negative effects to stream flows and fish habitat. The disruption of the riparian zone is a particular concern because it has many characteristics that are necessary to aquatic biota. These characteristics include:

- Provides the largest supply of food to the creek by way of organic leaf matter to aquatic herbivorous insects and a major source of large organic debris;
- Regulates water temperature and therefore dissolved oxygen content by providing shade and intercepts runoff and acts as an effective filter for sediment and pollutants and
- Provides cover and shelter that reduces stress and losses from predation and enhances channel stability by limiting bank erosion.

Thus, impacts to the riparian zone can affect numerous biophysical habitat characteristics.

3.4.2 Mitigation Strategies

At the time of instream construction it is likely that some of the watercourses requiring instream works (e.g., culvert installation) will be dry. If the streams contain water the Land Development Guidelines for the Protection of Aquatic Habitat (MELP-DFO, 1998) will be followed. The following provides a general discussion of construction considerations and mitigation strategies relative to fisheries resources.

3.4.2.1 Fish Windows

It will be necessary to define an instream construction schedule that is compatible with fisheries resources downstream. Construction windows are dependent on the timing of alevin emergence and adult spawning. The proposed construction window for the streams in the area is typically August 1 to September 15.

3.4.2.2 Fish Salvage

A fish salvage may be necessary in Millstream Creek or its tributaries prior to any in stream construction activities such as bridge construction or culvert installation. Nets or fencing will confine the portion of the stream that will be affected by construction and the area will be electroshocked to remove all fish from the site. All fish captured will be identified and measured and then released upstream of the construction activities. The nets or fencing will remain in place through construction to prevent the migration of fish into the construction area.

3.4.2.3 Turbidity and Erosion Control

All residual waters within the construction area that appear to have high total suspended solids will be pumped away from the creek and will be redirected onto land where materials may settle out in a pond prior to these waters re-entering the system. Where necessary, sediment fences will be placed at the bottom of the approach slopes.

3.4.2.4 Environmental Monitor

An environmental monitor will be on-site during all instream construction activities to ensure that operators and crew comply with regulations. Water quality will be monitored upstream and downstream of the instream works throughout the construction.

3.4.2.5 Restoration of Creek Bed and Riparian Zone

After instream construction is completed it may be necessary to restore and stabilize the creek bed and riparian zone. The riparian zone will be re-vegetated, as required, once construction is completed and native plants will be used during replanting.

Water quality impacts of instream construction on downstream fish populations are anticipated to be low during the construction phase provided that all mitigation measures are undertaken. It will be important to closely monitor the construction and strictly follow all the best management practices including spill prevention plan, sediment and erosion control plan and construction guidelines in and about watercourses. All individuals operating equipment in the vicinity of watercourses should be provided with these guidelines. Those individuals responsible for the installation of sediment and erosion control should also be provided with documentation on proper installation and maintenance of these structures.

BEST MANAGEMENT PRACTICES

4.1 Introduction

The following section describes the guiding principles, proposed mitigation measures and best management practices to reduce potential impacts to fish and wildlife habitat from the proposed development. Although the mitigation measures outlined below are intended to reduce potential impacts to vegetation, fish and wildlife habitat and populations, there inevitably will be residual adverse effects.

4.2 Tree Protection Plan

All trees that are to be retained will be protected from mechanical damage to the trunk and root system. This protection can be achieved through:

- Marking trees or flagging areas that are to be protected during the construction phase of the project;
- Install 'Tree Protection' signs;
- Take all measures necessary to prevent the activities such as storage of materials or equipment, stockpiling of soil or excavated materials, burning, excavation or trenching or cutting of roots or branches within the tree protection areas;
- Restrict vehicle traffic to designated access routes and travel lanes to avoid soil compaction and vegetation disturbances and
- Avoid alterations to existing hydrological patterns to minimize impact on vegetation.

4.3 Sensitive Ecosystem Protection Plan

All Sensitive Ecosystems along the road will be protected from mechanical damage during construction. This protection can be achieved through:

- Limit clearing to the minimum area required for construction boundaries
Snow fence areas that are to be protected during the construction phase of the project;
- Install 'Sensitive Ecosystem Protection' signs;
- The minimum amount of vegetation possible will be removed from environmentally sensitive areas or areas where rare or endangered plants or plant communities are identified by the environmental monitor and
- Take all measures necessary to prevent the activities such as storage of materials or equipment, stockpiling of soil or excavated materials, burning, excavation or trenching or cutting of roots or branches within the sensitive ecosystem protection areas.

Due to the close proximity of the development to sensitive ecosystems the following guidelines as outlined in the SEI Conservation Manual (MELP, 2000) should be followed after the completion of construction where possible:

- Establish conservation covenants;
- Restrict recreational access;
- Control the introduction or spread of invasive species;
- Prevent wildlife disturbance (especially nesting or breeding areas);
- Locate developments away from sensitive core areas;
- Establish a buffer zone between the core sensitive areas and the development area and
- Maintain hydrologic regime.

4.4 Wildlife Management Plan

The following wildlife management guidelines are intended to act as a planning tool and a way to mitigate impacts for the subdivision development plan.

4.4.1 Raptor and Breeding Bird Management Plan

4.4.1.1 Passerine and General Bird Management

General recommendations for the retention and development of passerine habitat, not specific to any species, should include the following where possible:

6. Retain and enhance forest edge habitat along road areas to provide escape or thermal cover for passerines, also, when and where possible, accentuate these areas with indigenous berry bushes to provide more food;
7. Encourage the placement of nest boxes in areas throughout the area post-construction to benefit cavity nesters (i.e. Red-breasted Nuthatch, woodpeckers, and Chestnut-backed Chickadee), and along open primary successive vegetated growth areas for cavity nesting birds (i.e. Swallows, and Bewick's Wrens);
8. Where possible, retain natural corridors for wildlife movement and replant areas devoid of vegetation with indigenous shrubs and trees. This will allow contiguous corridor travel and create safety habitat for birds during the breeding season and during the migration seasons (spring and fall);
9. Where possible, maintain habitat diversity including vegetation age/successional structure and refrain from monocultural stocking when re-vegetating;
10. During replanting/re-vegetation, refrain from even-aged management and any single aged tree removal, encourage horizontal

Best Management Practices

three-dimensional successional planting of aged stands and utilize indigenous native plants to promote indigenous bird species. Discourage exotic/invasive species as a result of adjacent urban encroachment;

11. Where possible, retain and enhance coarse woody debris and brush pilings on forest floors for core forest nesters (i.e. Winter Wrens) and
12. Avoid the use of pesticides in the area post-development to control weeds.

4.4.1.2 Raptor Management

The site has potential to provide forage habitat for several raptor species (diurnal and nocturnal). This site contains nesting habitat for diurnal raptors like Cooper's Hawk. A general raptor management approach for the site should include the following:

1. Where possible retain representative even-aged second growth forest, with trees aged approximately 40-80 years having deep crowns and fewer trees per unit area. Forest canopy closure should be maintained at 60-70% with little or no ground cover;
2. Where possible, do not conduct site construction or maintenance around any identified, active raptor nest from March through late July;
3. Retain any potential roost trees in the site along the edges of retained or created trails adjacent to the study site boundary. These should be maintained primarily in relatively large reserve patches or areas of intact forest adjacent to the site. For this purpose, areas around foraging zones (i.e. the adjacent riparian corridors of the study site), should have corridor widths no less than 15 meters and be composed of indigenous vegetation;
4. While core forest habitat and the adjacent riparian areas may be important as a prey source for raptors as well as for potential roosting habitat, there should be a balance between the creation of beneficial feeding areas along the riparian edges and cleared areas of forest for other animals necessary for raptor foraging;
5. Where possible, along the edges of the development, retain a selection of stand structural elements, such as large green trees, snags, logs on the forest floor, and canopy gaps. Older green trees should have structural characteristics such as cracks and holes in the bole where limbs have been shed. Snags that are retained should have cracks, bird holes and hollow interiors or should have the potential to develop these characteristics;
6. Treed linkage corridors should be maintained along the edges (north and south) of the proposed development and between core forested areas to the primary successional zones along the edges of the study site. This will ensure connectivity between roosting habitat and any riparian foraging habitat for all birds. These linkage requirements should be

considered and accommodated within any forest ecosystem networks that are established through a landscape unit plan and

7. During any land practice, maintain where possible the retention of large snags and coarse woody debris along the development perimeter. This would benefit future habitat conditions for prey species of small mammals.

4.4.2 Amphibian Management Plan

The most significant habitat for local herpetofauna occurs along riparian areas on the property: primarily along the south, central and northerly areas. In Canada, development encroachment and degradation of water quality are the greatest issues associated with herpetofauna, especially for amphibians.

In general primary amphibian habitat in the study site is associated with the watercourses (ephemeral ponds/pools and streams). The following general recommendations should be taken into consideration and implemented where possible to reduce potential impacts to amphibians. They are as follows:

1. Where possible in the study area maintain a minimum 15-meter buffer zone around the central watercourse and restrict any access to these habitats. These areas contain key natal habitats for the Red-legged Frogs and salamanders. They have the following important life characteristics:
 - a. Year round water flow and coarse woody debris;
 - b. Stable channel beds;
 - c. Coarse rocky substrates and
 - d. Winter forest cover hibernating areas;
2. Where possible, any selective tree harvesting should be conducted to promote the current secondary or old growth forest characteristics such as the retention of large diameter trees, multi layered canopies, snags and coarse woody debris in all vegetative communities in and adjacent to the proposed development;
3. Post development avoid the use of pesticides. Spot treatments with herbicides may be used in exceptional circumstances (e.g., noxious weeds) where it can be demonstrated that the herbicide will not be harmful to the aquatic environment or herpetofauna habitat (i.e. runoff to watercourses), being managed;
4. The forested riparian areas associated and adjacent to the study site should be managed according to the recommended 'best management practices' from the Riparian Management Area Guidebook and
5. The Red-legged Frog has been identified on the property. Apart from implementing a sediment and erosion control plan to protect the wetlands in the center of the property, dispersal habitat for this species should be

maintained free of barriers such as, heavily travelled roads (with more than approximately 30 cars per hour).

4.4.3 Small Mammal Management Plan

The most significant habitat for local small mammal populations occurs along riparian areas and lowland zones, the forest communities including the ponds in the south of the property. Development encroachment, soil compaction, chemical treatments and degradation of wooded areas along with coarse woody debris removal are the greatest issues associated with small mammal habitat loss.

The following mitigation measures should be implemented where possible to reduce potential impacts to small mammals and sustain this food source for raptors and large mammals:

1. Minimize the range of the disturbance adjacent to the forested areas immediately beside the proposed development site and riparian zones; as in the southern half of the study area;
2. Post development allow the remaining protected habitat to provide insects, not only from the forest but also from the remaining/retained watercourses. This means protecting the aquatic environment as much as possible and retaining woodlot/riparian areas so that small microclimates can be sustained to favour foraging areas for small mammals;
3. Retain, where possible, the coniferous and mixed forest areas (i.e. study site perimeter habitat) that have well developed canopy cover and an abundance of coarse woody debris necessary for microclimate protection and cover;
4. Retain, in the forested and riparian areas loose bark trees and coarse woody debris;
5. When possible, refrain from performing construction activities from January to August when most young are born;
6. Maintain corridor connectivity amongst vegetation units to core forested areas surrounding the study site;
7. During any construction refrain from re-grading slopes to divert drainage into retained coarse woody debris and riparian areas to prevent habitat flooding;
8. Retain the mature riparian habitat in the north of the property and southern wetland/pool areas. Here logs, leaf litter, coarse woody debris, dense herbaceous and shrub cover, and forest litter are critical for security cover and
9. Where possible retain areas of dense herbaceous and/or shrub layers, and forest litter.

4.5 Stormwater Management Plan

Focus Intec prepared a preliminary stormwater management plan for the Bear Mountain Highlands Project Area in December 2002. This report was prepared to identify any hydrological changes to either the receiving groundwater and/or surface waters. The following provides a summary of a stormwater management plan that can be applied to the Bear Mountain Highlands Project.

4.5.1 Objectives

The following are the primary objectives of the stormwater management plan:

- Infiltrate or convey runoff through the development to a secure outlet with minimal impacts to people and properties;
- Contribute to the protection of water related resources and
- Balance the needs of economic development and environmental sustainability.

4.5.2 Structural Management Practices

4.5.2.1 Lot Level and Conveyance Controls

Lot level and conveyance controls rely primarily on infiltration and filtering as a mechanism to remove contaminants. They allow for the pretreatment of water and reduction of runoff volume and peaks flows. Peak flow source controls are used to reduce water quantity concerns of to reduce infrastructure cost and include:

- Rooftop storage;
- Parking lot storage;
- Superpipe storage;
- Rear yard storage and
- Lot grading.

Infiltration-based source controls function to mitigate the urbanization impacts of both water balance and quality. Through reduction in surface runoff volume, these controls also contribute to flood and erosion control. Infiltration based source controls include the following:

- Reduced grading to allow greater ponding of stormwater and natural infiltration;
- Directing roof leaders to rear yard ponding areas, soak-away pits or cisterns;
- Sump pumping foundation drains to rear yard ponding areas;
- Infiltration trenches;
- Grassed swales;

Best Management Practices

- Pervious pipe systems;
- Filter strips;
- Stream and valley corridor buffer strips and
- Redirecting roof leaders and foundation drains to distant surface ponding areas.

4.5.2.2 End of Pipe Controls

End-of-pipe stormwater management facilities receive stormwater from a conveyance system and discharge to the receiving waters. They are efficient at pollutant removal and flow control but do little to maintain pre-development hydrology or water balance. They include:

- Wet ponds;
- Artificial wetlands;
- Dry ponds;
- Extended detention areas;
- Infiltration basins and
- Sand filters.

4.5.2.3 Non-structural Stormwater Management Practices

Non-structural stormwater management practices include the following:

- Land use and comprehensive site planning;
- Landscaping and vegetative practices;
- Pesticide and fertilizer management;
- Litter and debris controls;
- Illicit discharge controls and
- Maintenance of stormwater management facilities.

4.6 Sediment and Pollution Control Plan

4.6.1 Construction Phase

A sediment control plan should be followed throughout and following the construction phase. The sediment control plan will consist of the following elements:

- To the extent possible, site clearing and grading will be scheduled for the dry weather period (summer), when the potential for surface runoff to erode exposed soils is lowest. As much as possible, the clearing and grading operations will be staged to avoid having large areas of disturbed soil present at any time and particularly during the winter;

Best Management Practices

- Site clearing will immediately precede construction to minimize the amount of time that disturbed soils are exposed to weathering. Clearing will be limited to the minimum area necessary for construction;
- If any soil or other erodible material is to be stockpiled for more than seven days, it will be covered with polyethylene sheeting that is anchored securely to prevent displacement by wind;
- Where necessary, sedimentation ponds and silt fencing will be used to retain sediments on the construction site. The design engineers will determine the appropriate sizes and locations of settling ponds;
- The sediment control structures will be installed as the first construction activity. All sediment control structures will be inspected regularly, and repaired/maintained as necessary;
- Ditches and/or berms will be installed as necessary to direct surface runoff away from disturbed areas. The ditches will be designed to prevent erosion due to high water velocities through the use of check dams (sandbags), filter fabric, rock rip-rap or polyethylene lining. Apart from these necessary diversions, the natural drainage patterns will be maintained;
- Sediment and erosion control materials will be stockpiled on site for use in any emergency situation that may arise. Stockpiled materials will include filter cloth, hay bales, rip-rap, grass seed, drain rock, culverts, matting polyethylene, used tires, etc and
- As soon as practical after construction, any remaining disturbed soils will be re-vegetated using an appropriate grass seed mixture. Seeding will be conducted before the end of the growing season to allow establishment of germination/roots.

4.6.2 Post Construction Phase

Ground water infiltrator systems associated with residences and driveways will allow for the separation of sediments and pollutants from mixing with surface run-off. The infiltrator systems will be regularly inspected and where necessary, cleaned.

Road run-off can be directed to bio-swales where suspended solids can settle out. Bioswales will be vegetated with indigenous wetland plants. For a period after construction a water-quality sampling program would be beneficial to ensure that water quality leaving the development will not negatively affect Millstream Creek.

The storm water best management practices are targeted at collecting sediment and erosion and maintaining water quality. The principles and proposed measures to achieve these guidelines are as follows:

- Areas within the proposed development area, will be planted with native tree and shrub species to intercept rainfall and provide habitat for wildlife post construction;
- Absorbent landscape materials (incorporation of 5-10 cm of compost into every 15-20 cm of soils) will be used to reduce stormwater runoff and increase infiltration during construction into the swamp and adjacent waterbodies and
- Water quality control facilities will be designed to maintain water quality in all watercourses by collecting and diverting ‘first flush’ events of smaller storms (more frequent runoff events) from impervious areas.

4.7 Spill Prevention Plan

The spill prevention plan consists of the following elements:

- The construction staging area should be located at least 30 meters away from any waterbody;
- Activities that carry a risk of materials spills should take place within a bermed staging area. These activities include mixing concrete or other materials and any vehicle fuelling and other maintenance that is done on site;
- Any areas where vehicle fuels or other potentially deleterious substances are stored should be equipped with impervious containment berms. If fuel tanks larger than 250 L are present within a berm, the bermed area should have a holding capacity equal to 125% of the capacity of the largest tank;
- Storage and maintenance facilities should have spill clean up and disposal equipment. They also should have MSDS sheets for any hazardous substances, a list of emergency contact names and telephone numbers, and a written list of emergency response and spill reporting procedures;
- Mobile construction equipment should be fuelled, lubricated and serviced only at these approved locations;
- Field servicing of equipment, particularly near waterbodies should not be permitted. In addition, equipment and machinery should not be washed near watercourses;
- If a spill does occur, it immediately should be reported to the environmental monitor and to the Provincial Emergency Program (1-800-663-3456). Written notification should follow within two weeks of the verbal report;
- If a spill does occur, site personnel should immediately take steps to stop the discharge (if possible). As quickly as possible, they should contain

the spill, clean up the affected area and dispose of waste materials at an approved disposal site;

- All hydraulic systems, fuel systems and lubricating systems should be in good repair;
- Equipment should be inspected before commencing work. Equipment with fuel or fluid leaks should not be permitted to work within or above any watercourse. Any equipment that develops a leak immediately should be removed from the watercourse and repaired;
- Before commencing work, all equipment should be steam-cleaned to remove oil, grease and other substances deleterious to aquatic life and
- Equipment should use only biodegradable hydraulic fluid.

The Spill Prevention Plan will be operationalized and put into effect by the Environmental Monitor, who will be responsible for ensuring that the contractor is familiar with the plan, and that all elements of the plan are appropriately put into effect (see Section 4.8).

4.8 Environmental Monitoring

The construction monitor will be responsible for ensuring compliance with these guidelines, the authorization from the District of Highlands and possibly provincial and government agencies. They will follow and enforce the approved sediment erosion control plans and other relevant legislation, and for operationalising the Spill Prevention Plan. The monitoring guidelines will be in place prior to any works proceeding.

4.8.1 Meetings and Communication

The environmental monitor will meet with the general contractor for the site to establish appropriate lines of communication. The monitor should also meet with the site contractor during any site inspection. The monitor will also meet with subcontractors, other field staff, environmental agency representatives, key stakeholders and other engineering staff associated with the project where required.

The monitor will be part of the project team coordinating the scheduling of the construction phasing. The monitor will also contact the District of Highlands designate prior to visiting the site.

The monitor will be available by pager 24 hours a day. The phone number will be provided to a number of individuals such as the General Contractor and the District of Highlands designate and will be posted at the site.

4.8.2 Monitoring Prior to and During Site Clearing

The monitor will be responsible for the following activities prior to and during site clearing:

- Examine construction areas prior to commencement of work to identify sensitive areas where adverse effects may occur to ensure that they are adequately delineated;
- Ensure contractors are aware of environmentally sensitive areas in advance of construction activities and assist in the development or modification of appropriate mitigative measures, if necessary;
- Mark environmentally sensitive areas and identify these areas to the construction foreman and/or crew;
- Review vehicle access points to the site and the sediment control structures at these points prior to start of clearing;
- Provide information and advice to project staff and contractors about construction matters related to environmental issues;
- Prepare site inspection field notes, and routinely take photographs (and where necessary video) to record conditions;
- Act as a liaison with the environmental agencies and
- Review the sediment control structures proposed during construction.

4.8.3 Monitoring during Bridge Construction and/or Culvert Installation

During the bridge construction/culvert installation or during any construction activity within the riparian zone the monitor should be on site to:

- Ensure that all equipment and machinery to be used adjacent to the watercourse is free of leaks and is in good condition;
- Ensure that runoff is diverted away from the work area with effective drainage control measures;
- Ensure that disturbance to the stream banks and riparian vegetation is minimized;
- Prevent deleterious substances such as concrete residue from entering the creek;
- Ensure that reseeded of the area is done expeditiously;
- Ensure that all materials placed within the wetted perimeter of the creek have been given prior approval by DFO and are coarse, non-erodible and non-toxic to fish and
- Ensure appropriate sediment control measures are in place.

4.8.4 Drainage and Sediment Control

The environmental monitor will review the proposed sedimentation control plan proposed for the site with the site contractor prior to construction activities. The monitor will be on site during construction of the sediment control system (SCS). It is understood that the General Contractor will be responsible for

Best Management Practices

ensuring the SCS is maintained and working adequately to control all discharges from the site. Their responsibilities will include inspection and maintenance of the SCS.

During construction the responsibility of the monitor will be to:

- Examine the adequacy of the sedimentation and control works in reaching acceptable sediment levels as recommended by DFO/MWLAP guidelines (i.e. total suspended solids and turbidity) discharged from the site;
- Make recommendations to the General Contractor on improving the SCS, if required;
- The monitor will instruct the construction foreman as to the site requirements and design specifications on sediment control structures and will complete an inspection of such structures on a routine basis, particularly during periods of inclement weather;
- Review placement of sand, gravel and materials (e.g. hydroseed, mulch) specified to control erosion in exposed areas;
- Require that works be stopped in the event of malfunctions of the sediment control system or contravention of discharges limits;
- The environmental monitor must ensure that runoff is diverted from cleared areas by use of swales or low berms and runoff is routed to the appropriate sedimentation control structures. In environmentally sensitive or problem areas, the monitor will need to oversee the installation and maintenance of sediment control structures;
- Review stockpiling methods of excavated materials to ensure that they are placed in an appropriate location and stored properly (e.g. covered with tarps) and
- Recommend mitigation measures and ensure expeditious implementation of if activities are found to have the potential for environmental impact or poor quality runoff.

4.8.5 Control of Deleterious Substances on the Development Site

The monitor will review housekeeping practices on site (e.g. daily cleanup, use of disposal bins) and ensure proper use, storage and disposal of deleterious substances and associated containers. This necessitates that the monitor be aware of all such substances used on site. Any fuels, lubricants or hydraulic oils that spill should immediately be reviewed by the monitor to determine if additional remedial measures are required and, if necessary, implemented expeditiously. The monitor will operationalise the Spill Prevention Plan and will ensure that an inventory of all hazardous materials is maintained.

4.8.6 Water Quality Monitoring

The monitor will sample water for turbidity and/or total suspended solids upstream and downstream of instream construction areas. During construction within the riparian zone there may also be a requirement to test water for oil and grease and extractable petroleum hydrocarbons if observed in the sedimentation ponds. In addition, the monitor will regularly examine adjacent wetlands for the occurrence of poor quality site runoff. Should there be a need for pouring cement near the watercourse pH will be tested routinely.

4.8.7 Frequency of Site Inspections

Initially, the monitor will visit the site daily. Once all the environmental management measures are in place and these measures have demonstrated effective site control, the frequency of monitoring will be decreased to once to twice per week. This frequency will increase during heavy rainfall events.

During the construction of the SCS and the work related to bridge crossing and culvert installation, the environmental monitor will be onsite at all times during working hours.

4.8.8 Reporting

The monitor will need to provide environmental monitoring summary reports. The reports will be submitted to the following:

- District of Highlands;
- Department of Fisheries and Oceans; and
- Bear Mountain Master Partnership.

The monitor will also complete an environmental completion report at the end of the construction phase, which will outline the major construction activities in relation to environmental issues, significant concerns encountered during the project and mitigation measures used to deal with those concerns.

4.9 Fertilizer and Pesticide Management Plan

The use of fertilizers and pesticides at the golf course raises some concerns about potential impacts to on-site and downstream watercourses. The major issues are the possibility of runoff or leaching to the golf course water features or groundwater with eventual discharge to downstream fish bearing systems. The possible effects on water quality of the stream include fertilizer-induced algal blooms (eutrophication) and potential toxicity of pesticides to fish and amphibians.

By following a fertilizer and pesticide management plan, which will be developed for the Bear Mountain Golf Course the golf course maintenance staff will prevent impacts of pesticide and fertilizers on water quality. The objective of the management plan is to minimize the potential for runoff or leaching of fertilizers and pesticides to golf course water features and groundwater.

Best Management Practices

Research (Krause and Niemczyk 1989, Watschke and Mumma. 1989) has demonstrated that both runoff and leaching of pesticides and fertilizers from well-managed turf are negligible. The fertilizer and pesticide management plan therefore includes guidelines for producing a well managed, healthy turf. Key aspects of the plan include:

- Selection of turf grass species and cultivars that are appropriate for the site;
- Conservative application of fertilizers;
- Use of slow-release nitrogen sources;
- Appropriate timing of fertilizer applications;
- Implementation of an integrated pest management (IPM) program;
- Use of effective alternatives to pesticides when they are available;
- Selection of the ‘least toxic’ pesticide that will treat the condition;
- Establishment of pesticide-free zones adjacent to watercourses and
- Use of pesticides at the minimum effective application rate.

REFERENCES CITED OR REVIEWED

- American Ornithologist's Union 1957, *Checklist of North American birds*, Fifth edition, p. 691, Amer. Ornith. Union, Baltimore.
- Austin, K. K. 1994, *Habitat use and home range size of breeding northern goshawks in the southern Cascades*, MSc thesis, Oreg. State Univ., Corvallis, OR.
- Berris, Catherine, and Associates Incorporated 1995, *Northeast Coquitlam Environmental Assessment*, prepared for the City of Coquitlam.
- Beebe, F.L. 1974, 'Field studies of Falciformes of British Columbia: vultures, hawks, falcons, eagles', *Occas. Pap. Brit. Columbia Prov. Mus.*, **17**. Victoria.
- Bent, A.C. 1937, *Life histories of North American birds of prey*, Part I. U.S Nat. Mus. Bull.
- Bright-Smith, D.J. and Mannan, R.W. 1994, 'Habitat use by breeding male northern goshawks in northern Arizona' in Block, W.M., Morrison M.L. and M.H. Reiser (eds.) 'The northern goshawk: ecology and management', *Proc. symp. Cooper Ornith. Soc.*, 14-15 April 1993, Sacramento, CA., *Studies in Avian Biol.* **16**.
- Brooke, M. and Birkhead, Tim (eds.) 1991, *The Cambridge encyclopaedia of ornithology*, Cambridge University Press, p362.
- Burt, William, H., and Grossenheider, Richard P. 1980, *A field guide to the mammals of North America: Peterson Field Guide*, Houghton Mifflin Press.
- Campbell, R. Wayne, Dawe, Neil K., McTaggart-Cowan, Ian, Cooper, John M., Kaiser, Gary W. and McNall, Micheal C.E. 1990, *The birds of British Columbia* Vol. 1-4, Univ. B.C. Press.
- City of Coquitlam. July 2001, *Northeast Coquitlam Official Community Plan*.
- City of Coquitlam. May 2001, *City of Coquitlam Tree Cutting Permit Bylaw*.
- Committee on the Status of Endangered Wildlife in Canada 2000 Web Site:
<http://www.cosewic.gc.ca/COSEWIC/faq.cfm>
- Cannings, Richard J. 1993, in Poole, A. and Gill, F. (eds) *Northern Saw-whet Owl. The Birds of North America*, No. 42. The academy of natural sciences of Philadelphia. p 17.
- _____, Richard J., and Harcombe A.P. (eds) 1990 *The Vertebrates of British Columbia: Scientific and English names*, Royal British Columbia Museum Heritage Record No. **20**; Wildlife Report No R24. Ministry of Municipal Affairs, Recreation and Culture and Min. of Environ., Victoria, B.C.

References Cited or Reviewed

- Heritage, Conant Roger, and Collins, Joseph T. 1991, *Reptiles and Amphibians: Eastern and Central North America. Peterson Field Guides* 3rd Ed. Houghton Mifflin Company, Boston New York.
- Corkan, Charlotte, C., and Thoms, Chris 1996, *Amphibians of Oregon, Washington and British Columbia: A field identification guide*, Lone Pine Press, p175.
- Dayton & Knight Ltd. 1999, 'Best Management Practices Guide for Stormwater' Appendix H *Construction Site Erosion and Sediment Control Guide*, Greater Vancouver Regional District.
- Dayton & Knight Ltd. 1998, *Northeast Coquitlam Terrain and Watershed Study*, Prepared for the City of Coquitlam.
- Department of Fisheries and Oceans. *Fisheries Act* [RSBC 1996] Chapter 149.
- Devereux, James, and Mosher, James, A. 1984, 'Breeding ecology of Barred Owls in the central Appalachians', *Raptor Research* **18**(2) pp.49-58.
- Ehrlich, Paul, E., Dobkin, David, S. and Wheye, Darryl 1988, *The birder's handbook: A Field guide to the natural history of North American birds*, p785.
- Envirowest Environmental Consultants (ECL Envirowest Consultants Limited) 1997, *Northeast Coquitlam Terrain and Watershed Assessment*, 1:10,000 Map. Drawing number 311-04-01. June 9, 1997. Appendix C to Dayton & Knight (1998).
- Graham, R.T., Reynolds, R.T., Reiser, M.H., Bassett R.L. and Boyce, D.A. 1994, 'Sustaining forest habitat for the northern goshawk: a question of scale' in Block, W.M., Morrison, M.L. and Reiser, M.H. (eds.) 'The northern goshawk: ecology and management', *Proc. symp. Cooper Ornith. Soc.*, 14-15 April 1993, Sacramento, CA., *Studies in Avian Biol.* No. **16**, pp.12-17.
- Green, M. David and Campbell, R. Wayne 1992, 'The amphibians of British Columbia', *Royal British Columbia Museum Handbook*, No. **45**, pp.100.
- Gregory, Patrick, T. and Campbell, R. Wayne 1996, 'The Reptiles of British Columbia', *Royal British Columbia Museum Handbook* No. **45**, p.102.
- Harrison, H.H., 1979, *A field guide to western birds' nests*, Boston, MA: Houghton Mifflin Co. p.279.
- Hayes, M. P. and Jennings, M. R. 1986, 'Habitat Correlates of Distribution of the California Red-Legged Frog: (*Rana catesbeiana*) Responsible?' *Journal of Herpetology*. **20**(4), pp.490-509.

References Cited or Reviewed

- Hovingh, P. 1993, 'Aquatic habitats, life history observations, and zoographic considerations of the spotted frog (*Rana pretiosa*) in Tule Valley, Utah', *Great Basin Nat.*, **53**, pp.168-179.
- Lawler, S. P., Dritz, D., Strange, T. and Holyoak, M. 1999, 'Effects of Introduced Mosquitofish and Bullfrogs on the Threatened California Red-Legged Frog.' *Conservation Biology* **13**(3), pp.613-22.
- Leviton, Alan E. 1971, *Reptiles and Amphibians of North America*, Doubleday & Company, Inc., New York.
- Licht, L. E. 1969, 'Comparative breeding behavior of the red-legged frog (*Rana aurora aurora*) and the western spotted frog (*Rana pretiosa pretiosa*) in southwestern British Columbia', *Can. J. Zool.* **47**, pp.1287-1299.
- Licht, L. E. 1971, 'Breeding habits and embryonic thermal requirements of the frogs (*Rana aurora aurora*) and (*Rana pretiosa pretiosa*), in the Pacific Northwest', *Ecology* **52**, pp.116-124.
- Maser, Chris 1998, *Mammals of the Pacific Northwest: From the Coast to the High Cascades*, Oregon State University Press.
- Mattison, Chris 1995, *The Encyclopedia of Snakes*, Facts on File, Inc., New York.
- McComb, W.C., McGarigal K. and Anthony R.G. 1993, 'Small mammal and amphibian abundance in streamside and upslope habitats of mature Douglas-fir stands, western Oregon', *Northwest Science* **67** pp.7-15.
- Meidinger, D. and Pojar, J. 1991, *Ecosystems of British Columbia*, B.C. Ministry of Forests, Victoria, B.C.
- Ministry of Environment, Lands and Parks (MELP) 2001, *Best Management Practices – Land Development*, Vancouver Island Region (Region 1).
- Ministry of Environment, Lands and Parks (MELP) September 2000, *Best Management Practices for Streambeds and Streambanks*.
- Ministry of Environment, Lands and Parks (MELP) September 2000, *Best Management Practices for Wildlife*.
- Ministry of Environment, Lands and Parks (MELP) September 2000, *Best Management Practices to Protect Water Quality*.
- Ministry of Environment, Lands and Parks (MELP) September 2000, *Best management Practices for Urban Runoff*.

References Cited or Reviewed

- Ministry of Environment, Lands and Parks (MELP) January 2000, *Fish Protection Act Streamside Protection Regulation*.
- Ministry of Environment, Lands and Parks (MELP) 1998, 'Inventory Methods for Small Mammals: Shrews, Voles, Mice & Rats', *Standards for Components of British Columbia's Biodiversity*, **31**.
- Ministry of Environment, Lands and Parks (MELP) 1997, *B.C. Conservation Data Centre: Rare Vertebrate Animal Tracking List*, Internet web site:
<http://www.env.gov.bc.ca/wld/cdc/atrkprov.htm>
- Ministry of Environment, Lands and Parks (MELP) 1995, *Biodiversity Guidebook*, Internet web site:
<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm>
- Ministry of Environment, Lands and Parks (MELP) 1988, *Water Act: Water Regulation (Part 7 'Changes in and about a Stream')*
- Ministry of Water, Land and Air Protection - Ministry of Forests web site
<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/other/species/species%2D15.htm>
- Mosher, J.A., Fuller, M.R. and Kopeny, M. 1990, 'Surveying woodland raptors by broadcast of conspecific vocalisations', *J. Field Ornithol.* **61** pp.453-461.
- Nagorsen, David 1990, *The mammals of British Columbia: A Taxonomic Catalogue*. Memoir No. 4, Royal British Columbia Museum.
- Nagorsen David, W. and Brigham, R. Mark 1996, *Opossums shrews and moles of British Columbia*, Royal British Columbia Museum handbook.
- Nussbaum, R.A., E.D. Brodie, E.D. and Storm R.M. 1983 *Amphibians and Reptiles of the Pacific Northwest*, University Press of Idaho.
- Pattie, D. 1973, 'Sorex bendirii' *Mammalian Species* **27**.
- Palmer, R S. (ed.) 1988, *Handbook of North American Birds, Diurnal Raptors* Vol. 4 and 5, Yale Univ. Press, New Haven, CT. Smithsonian Institution.
- Palmer, R S. (ed.) 1988, *Handbook of North American Birds, Diurnal Raptors*, Vol. 4, Yale Univ. Press, New Haven, CT. pp.187-237.
- Palmer, R S. (ed.) 1988, *Handbook of North American Birds, Diurnal Raptors* Vol. 4, Yale Univ. Press, New Haven, CT. pp. 355-378.
- Ralph, C.J., Geupel, G.R., Pyle, P., Martin, T.E. and DeSante, D.F. 1993, *Handbook of*

References Cited or Reviewed

- field methods for monitoring landbirds*, Gen. Tech. Rep. PSW-GTR-144. Albany, CA
- Resource Inventory Committee, Wildlife Branch, 1998, *Inventory Dataforms for Raptors Standards for Components of British Columbia's Biodiversity* No. **11** [Forms].
- Resource Inventory Committee, Wildlife Branch, 1997, *Inventory Methods for Pond-breeding Amphibians and Painted Turtle Standards for Components of British Columbia's Biodiversity* No. **37** (Version 2.0).
- Resource Inventory Committee, Wildlife Branch, 1997, *Standard Inventory Methodologies for Components of British Columbia's Biodiversity: Raptors* (Version 1.1)
- Resource Inventory Committee, Wildlife Branch, 'Conducting Wildlife Inventory' in *Species Inventory Fundamentals* No.1.
- Riley, John, L. and Mohr, Pat 1994, 'The natural heritage of southern Ontario's settled landscapes: A review of Conservation and restoration ecology for land-use and landscape planning', *Ont. Min. Nat. Res.* p77.
- Sherman, A. R., 1911, 'Nest life of the Screech Owl', *Auk* **28**, pp.155-168.
- Sibley, David Allen 2000, *The Sibley guide to birds*, National Audubon Society 3rd Ed. Alfred A. Knopf, New York pp 544.
- Snyder, N. F. R. and Snyder H. A. 1991, *Birds of prey: natural history and conservation of North American raptors*, Voyageur Press, Inc. Stillwater, MN.
- Stebbins, R.C. 1954, *Amphibians and Reptiles of Western North America*, McGraw-Hill, New York.
- Van Zyll de Jong, C.G., 1983, *Handbook of Canadian Mammals: Marsupials and Insectivores*, National Museum of Sciences, National Museums of Canada.
- Vantyne, Josselyn and Berger, Andrew J. 1971, *The fundamentals of ornithology*, Dover Pub. Inc. New York, p.624.
- Whittaker Jr, J.O. and Maser C. 1976, 'Food habits of five western Oregon shrews', *Northwest Science* **50**, pp.102-7.

Appendices

Appendix I: Terrestrial Ecosystem Information

Appendix II: Conservation Data Centre Information

Appendix III: Rare Plant Survey

Appendix IV: Fish Wizard Information

Appendix V: Wildlife Habitat Enhancement Options

Appendix VI: Photoplates

APPENDIX I

Terrestrial Ecosystem Information

APPENDIX II

Conservation Data Centre Information

APPENDIX III

Rare Plant Survey

APPENDIX IV

Fish Wizard Information

APPENDIX V

Wildlife Habitat Enhancement Options

APPENDIX VI

Photoplates

APPENDIX VII

Logging Plan