

# **Crystal Mountain Ecosystem-based Land-use Plan**

**Parcel A of DL89 except part in plan 27287  
& Lot 9 Plan 31200 DL90  
Galiano Island, BC**



**Prepared by:**

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## **1.1 Background and Purpose of the Crystal Mountain Society**

The following is an excerpt from the “Crystal Mountain 2008 – 2009 Priorities” document:

*The purpose of Crystal Mountain Society is to support the awakening of individuals and thus their compassionate involvement with others through short and long-term meditation retreat instruction year round.*

*Operation and development of the Society and its properties should:*

- *Encourage the unfoldment and awakening of individuals*
- *Be low maintenance*
- *Scaled to the available human resource and financial capacity of the Society*
- *Rely on multiple sources of revenue generation (other than just teaching)*
- *Meet the physical needs and comforts of teachers and students to comfortably study meditation*
- *Be ecologically managed (green development, low impact and ecological harvesting)*

It is Crystal Mountain’s goal to create a forest retreat facility on Galiano Island in support of the practice of meditation. The following is an excerpt from the “Crystal Mountain Visioning Session Report” (included as Appendix 2). It is a portion of the brief review of the history of the land read by John de Jardin at a meeting held on August 19<sup>th</sup>, 2007.

*In 1978, a group of us living here on the West Coast incorporated Crystal Mountain as a registered non-profit educational and charitable society, with the stated objectives of performing charitable works and promoting the study of religion and philosophy through the teaching and practice of meditation. Finding ourselves with a rare fiscal surplus in the summer of 1980, the members of the society decided to buy some land for a retreat centre and, in November of that year, we purchased two 10-acre lots at the end of Devina Drive on Galiano.*

*Our first summer kitchen, with its’ hyperbolic paraboloid roof, must have left more than a few observers scratching their heads in bewildered amusement. Gradually, however, enough was accomplished to make the centre capable of handling modest summer retreats, and over the years the Venerable Namgyal Rinpoche and a number of his students, who have become qualified meditation teachers themselves, have led many successful courses on the property.*

*While most of our activities have had some connection with what might be called ‘the lineage’ of the Venerable Namgyal Rinpoche, our charter is purposefully non-denominational to reflect the universalist and eclectic flavour of this teaching. Rinpoche continues to draw on his early training as a Theravadin monk, while skilfully incorporating elements of Western mysticism, science and psychology into the ever-expanding Tantric mandala of his Vajrayana teaching.*

*‘Buddha dharma’, in its widest sense, means simply ‘the laws that underlie the awakening of human beings’, and it cannot be confined to any particular religion or culture. Though we recognize the value and necessity of preserving and supporting traditional forms, our primary concern is with furthering the inevitable development of a Western expression of Buddhism.*

## **1.2 Purpose of the Report**

The purpose of this report is to:

1. Determine how to protect, maintain and where necessary, restore functioning ecosystems on the Crystal Mountain land; and,
2. Recommend ways to minimize the impacts of Forest Retreat uses within the context of the identified ecological constraints.

To meet this purpose, an ecosystem-based approach has been used. An ecosystem-based approach focuses first on what to protect and second on what to use.

## **1.3 Consultation Process**

This report has been developed in consultation with several Crystal Mountain members. Primary direction has been provided by Stephen Foster, Helen Foster, Mark Webber and Jamie van Dam. Jamie van Dam and Stephen Foster also assisted with some of the data collection. Consultation included project development via e-mail and telephone with Kim Lenglet and Stephen Foster, four group visits to the property, several personal meetings and many e-mails and phone conversations with the primary contacts as well as an educational/planning workshop attended by 12 Crystal Mountain members.

## **1.4 Limitations, Assumptions and Disclaimer**

Most of the proposed uses within this document are not currently permitted by local land-use regulations. Proceeding with land use that includes a Retreat Centre will require a rezoning process and revisions to the current Official Community Plan (OCP). While a property plan that specifically addresses ecosystem protection goals and sustainable forest use is likely to be an essential component of a rezoning proposal, Crystal Mountain's success will also likely depend on favorable public input during rezoning and a willingness on the part of the Galiano Community to include educational / spiritual retreat facilities in Galiano's forests.

The contribution of some of the data used to create maps for this report was generously provided by the Galiano Conservancy Association. However, the provision of data does not imply support for the recommendations in this report or for any related land-use or planning.

## **1.5 Location of Properties**

The Properties are located on the northern end of Galiano Island, one of the southern Gulf Islands in the Strait of Georgia, British Columbia. The lower portions of the properties can be accessed from Porlier Pass Road through an easement across Lot B, Plan VIP68079, DL 88/89 and from the terminus of Devina Road. The upper portion of Lot A can be accessed from Cook Road across an easement through Lots B and C VIP68079 DL88/89 and the upper portion of Lot 9 can be accessed from the end of Devina road through Lot 10. Please refer to MAP 1 for the location of the Properties.

## **1.6 Legal Description and Size of the Properties**

The Properties are legally described as:

Parcel Identifier: 024-351-041

Lot A, District Lot 88 and 89, Plan VIP68079, Galiano Island, Cowichan Land District.  
20.25 hectares (50 acres)

Parcel Identifier: 000-851-035

Lot 9, District Lot 90, Plan 31200, Galiano Island, Cowichan Land District.  
4.05 hectares (10 acres)

## **1.7 Land Use Designation, Zoning and Regulations**

### **1.7.1 Lot A Zoning Regulation**

Lot A has a current Land Use Designation in the Galiano Island Official Community Plan (Consolidated Oct, 30 2013) of 'Forest'. These OCP policies state the following objectives for 'Forest':

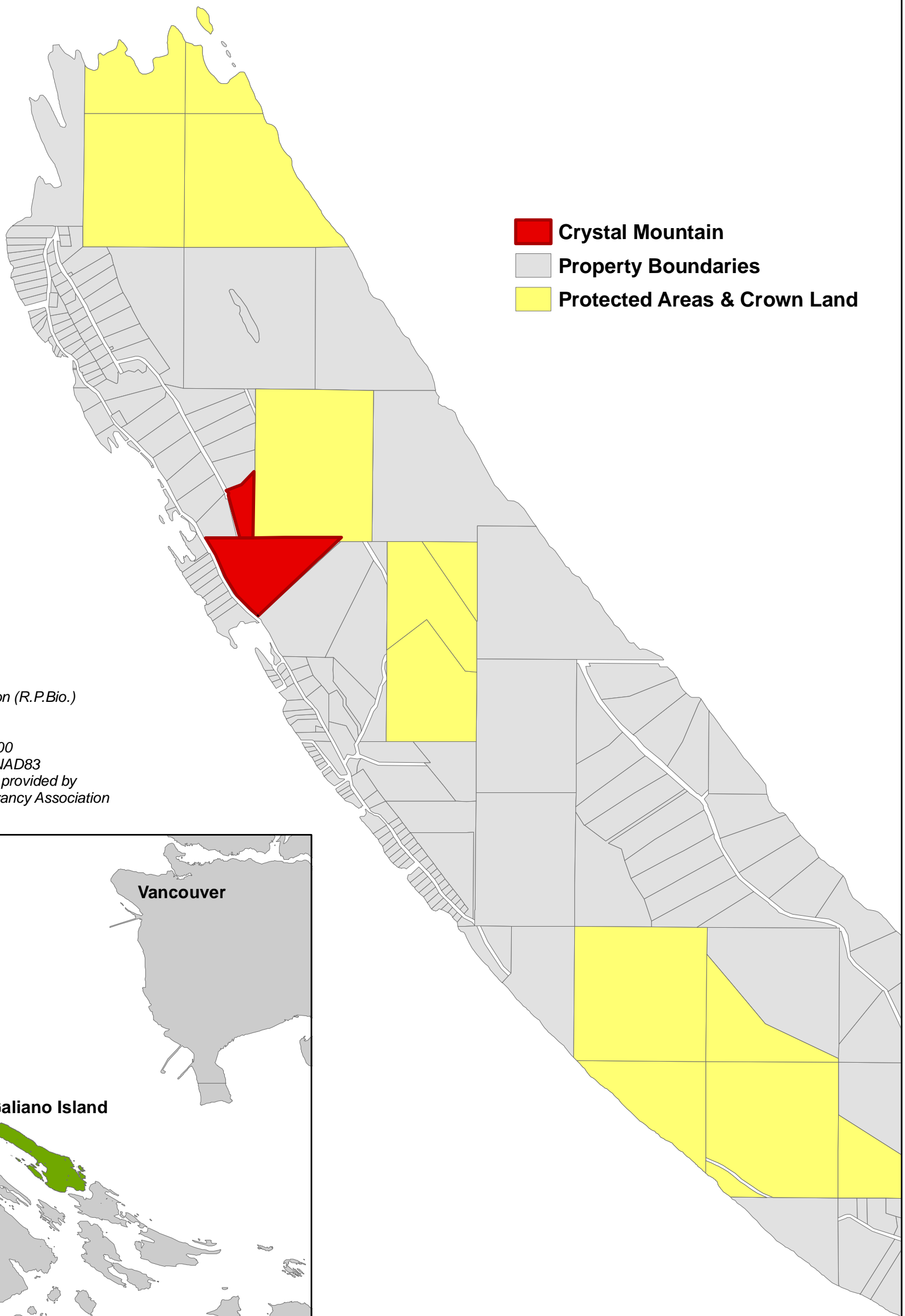
1. to preserve a forest land base,
2. to preserve and protect the forest, its biodiversity, integrity and ecological services,
3. to encourage ecosystem-based sustainable forest management for all forested lots and to encourage economic opportunities through this forest management practice,
4. to encourage ecological restoration of degraded forest stands, and
5. to maintain or enhance carbon storage and sequestration.




1.

The Properties have a current zoning designation of "Forest 1" under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013).

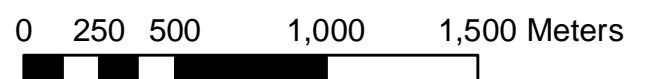
# Crystal Mountain Ecosystem-based Plan

-- Property Location and Surrounding Protected Areas --



-  **Crystal Mountain**
-  **Property Boundaries**
-  **Protected Areas & Crown Land**

Produced by: Keith Erickson (R.P.Bio.)  
Map Date: January 2009  
Scale: 1 : 25,000  
Inset Map Scale: 1 : 600,000  
Projection: UTM Zone 10 NAD83  
Data: Property boundaries provided by  
the Galiano Conservancy Association



Under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013), Section 7.1, the following uses are permitted in the Forest 1 Zone:

1. Timber production and harvesting
2. Accessory forest uses including the sawmilling and planing of timber harvested on the same lot and the growing of seedlings in nurseries.

Under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013), Section 7.1, the following Buildings and Structures are permitted in the Forest 1 Zone for Forestry Uses:

A single non-residential unenclosed building or structure with a floor area not exceeding 93 square metres is permitted in each lot and every such building or structure must be screened by a landscape screen not less than 9 metres in height and complying with the requirements of subsection 15.1.1 of this bylaw.

### **1.7.2 Lot 9 Zoning Regulation**

Lot 9 has a current Land Use Designation in the Galiano Island Official Community Plan (Consolidated October 30, 2013) of 'Residential'. These OCP policies state the following objectives for 'Residential':

1. to maintain the rural character, minimize impacts to ecosystems and services they provide and support social diversity of the Galiano Island Local Trust Area, and
2. to encourage affordable, rental and special needs housing.

1. .

The Property has a current zoning designation of "Rural 2" under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013Consolidated November 4, 2013).

Under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013Consolidated November 4, 2013), Section 5.5, the following uses are permitted in the Rural 2 Zone:

1. Dwellings
2. Cottages
3. Home occupations
4. Farm use

Under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013), Section 5.5, the following density of residential use is permitted on Lot 9:

1. One dwelling and one cottage



Under Galiano Land Use Bylaw NO. 127 (Consolidated November 4, 2013), Section 5.5, the following minimum setbacks are enforced: Buildings and structures must be sited

1. at least 7.5 metres from front and rear lot lines;
2. at least 6 metres from each interior side lot line; and
3. at least 6 metres from an exterior side lot line.

Buildings and structures for the accommodation of farm animals including poultry must be sited

1. at least 7.5 metres from a front lot line;
2. at least 30 metres from rear and interior side lot lines; and
3. at least 6 metres from an exterior side lot line.

### **1.7.3 Development Permit Areas**

The *Municipal Act* prohibits the subdivision of land, the construction of buildings and the alteration of land in a Development Permit Area unless the owner first obtains a development permit.

Both Lot 9 and Lot A are subject to *Development Permit Area 3 – Tree Cutting and Removal*, *Development Permit Area 5 – Sensitive Ecosystems*, and *Development Permit Area 7 – Steep Slope Hazard Areas* described in ‘Section V’ of the Galiano Island Official Community Plan (Consolidated October 30, 2013). The OCP stipulates that:

Lot A is also subject to Development Permit Area 1 – Riparian Areas as described in ‘Section V’ of the Galiano Island Official Community Plan (Consolidated October 30, 2013).

## **2.1 Land Management Philosophy**

In accordance with consultations with Crystal Mountain members, and in keeping with the vision expressed in the “Crystal Mountain 2008-2009 Priorities” and “Crystal Mountain Visioning Session” reports, the overarching philosophy behind the management of the land is to keep things simple – to minimize the ecological impacts, the overhead costs and the ongoing maintenance associated with the development and operation of all required services and infrastructure. The permaculture concept of layering or achieving multiple goals through a single action is central to keeping things simple.

Management and use of the land will strive to maintain or promote the inherent natural aesthetic and ecological composition, structure and function within property boundaries and across the landscape in perpetuity.

## **2.2 Objectives**

### *1. Educational and Spiritual*

To support the awakening of individuals and thus the compassionate involvement with others through short and long-term meditation retreat instruction and practice, year round.

### *2. Conservation*

To protect and enhance the integrity of Provincially significant Coastal Douglas-fir forest and associated aquatic ecosystems within the properties and to contribute to landscape level conservation values (ie. large contiguous natural areas, healthy groundwater recharge areas) through maintaining and enhancing ecological connections with adjacent protected areas and natural areas on other surrounding lands.

### *3. Ecological Restoration*

To help the land heal – to aid in the recovery of ecosystems that have been damaged primarily by destructive logging practices and to promote compositional diversity (the parts), structural diversity (the arrangement of the parts) and functional diversity (interactions among the parts).

### *4. Eco-forestry*

To provide opportunities for the harvest of wood products (such as firewood, poles or timber for construction) or wildcrafting products (such as greenery, edible plants and mushrooms, or medicinal plants) in a manner that is consistent with the stated conservation and ecological restoration objectives.

### 3.1 Biological and Geographical Inventory

#### 3.1.1 Climate<sup>1</sup>

The rainshadow effect of the Olympic and Vancouver Island mountains and the moderating effects of the ocean are the dominant influences on the climate of Galiano Island. Kerr (1951) describes the Island as having a “Transitional, Cool Mediterranean Climate”. Galiano exhibits a pattern of warm, dry summers and mild, wet winters with an average of approximately 1,900 to 2,000 hours of sunshine (Renneseth and Barr, 1982) and 254 frost free days (Agriculture Canada, 1989) per annum. The average annual rainfall recorded at the North Galiano Atmospheric Environment Service station is 920 mm (from 1977 to 1988). Annual rainfall ranges from 597.3 mm to 1152.6 mm (Harrison, 1994). Over 75% of the total annual precipitation falls during the winter months (Nov. to Feb.), with less than 10% falling as snow.

The months of January and February produce the coldest mean temperatures of 4° to 5° Celsius, while July and August are the warmest months with mean temperatures of 17° to 19° Celsius. The combined effects of low precipitation, warm temperatures, and high number of sunshine hours often result in an annual moisture deficit on Galiano Island from mid-June to early October (Harrison, 1994). This deficit can often reach drought conditions in areas of recent clearcuts, such as those found on Lot A, and can result in an extreme forest fire hazard.

#### 3.1.2 Topography

The properties exhibit a complex topography through a series of 4 major southeast to northwest running ridges with their associated steep southwest facing slopes and cliffs, gentle northeast facing slopes and wet depressions or flat benches. The elevation ranges from approximately 10 meters at the lowest point along Porlier Pass road to 125 meters at the highest point near the northeastern corner of Lot A. All areas of the property are below 140 meters in elevation and are not part of “Development Permit Area 4: Elevated Groundwater Catchment Areas” described in the Galiano Island Official Community Plan (Consolidated October 30, 2013).

#### 3.1.3 Hydrology

The properties fall within the North Trincomali Groundwater Region, with a surface flow that empties into the Trincomali Channel. Approximately 10 hectares or just over 40% of the properties are designated as Groundwater Recharge Areas. Recharge areas generally incorporate the higher elevation portions of the properties including the teaching platform ridge and its associated steep southwest facing slope and gentle northeast facing slope and the area including

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<sup>1</sup> Excerpt from: *Erickson, Keith. 2008. Heritage Forest Management Plan. Galiano Conservancy Association. Galiano Island.*

and above the major cliff/ridge that bisects the properties. The moist forest, wetland and creek areas in the depressions are considered to be part of the groundwater discharge zone. Elevated water recharge areas such as those found on the property are considered of great value to the maintenance of water quality in aquifers, of special significance for wells drilled at lower elevations along the shoreline with regard to salt water intrusion.

Spotlight Creek is the major drainage system associated with the properties running roughly from northwest to southeast through the lower portion of the properties. The creek originates from the large wetland complex adjacent to Devina Drive flowing under the main driveway access to Lot 10. The Spotlight Creek watershed is relatively small, even by Galiano standards, totaling approximately 60 hectares in size. The creek is intermittent and runs only during peak rainfall months from November through to the spring. In accordance with the BC Riparian Areas Regulation assessment methodology, Spotlight Creek is considered a non-fish bearing system and does not support salmonids, game fish or regionally significant fish. Fish absence was determined based on stream gradient and the presence of a human made permanent impassible barrier as the creek enters Spotlight Cove. The impassible barrier is a 20 meter long culvert at a 10% slope with a measured 2cm maximum stream depth at high flow (December 30, 2009). The creek gradient increases to 30% for a 15 meter stretch just upstream from the culvert and then flattens back down to 10% for close to 300 meters. The stream is completely dry over the summer months, eliminating the possibility for presence of any resident fish species.

The upper portion of the properties located roughly above 100 meters in elevation are a part of the Jack Creek Watershed, however, stream channels or any above ground flow associated with the Jack Creek were not observed on the properties.

### **3.1.4 Soil**

According to the Agriculture Canada report, *Soils of the Gulf Islands of British Columbia Volume 3*, the Properties are characterized by three different soil types:

1. Saturna: Saturna is the dominant soil type on the properties covering the majority of the gently to moderately sloping areas over roughly 55% of the property. Saturna soils are well-drained and droughty during the summer. They have developed on shallow deposits of channery, sandy loam to channery, loamy sand textured, colluvial and glacial drift materials over sandstone bedrock within 100cm of the surface. Areas of the property are characterized by very shallow lithic Saturna soils often associated with bedrock exposures or very thin mineral soil layers less than 50 cm deep. Coarse fragment content varies between 20 and 50%.
2. Rock-Saturna: Rock-Saturna soils are found along the ridges and associated steep southwest facing slopes on the properties and account for roughly 30% of the area. They are characterized by patches of exposed sandstone bedrock often covered with moss, mixed with

areas covered with a shallow well drained Saturna mineral soil layer. Mineral soils are either colluvial or glacial drift derived, generally between 10 and 50cm thick and have a coarse fragment content that varies between 20 and 50%.

3. Parksville: Parksville soils are a minor component of the properties accounting for roughly 15% of the area. They occur on nearly level to very gently sloping (0.5 – 5%) topography in depressional areas, swales and drainageways between bedrock ridges. Parksville soils are poorly drained with a layer of sandy or silty loam of fluvial origin overlying deep silty clay loam to silty clay textured marine deposits that are virtually stone free. Distinct mottles are often present within 50 centimeters of the surface. They are saturated with water to within 30cm of the surface from late fall to spring. During summer, the water table drops to below 60cm, allowing the surface horizons to become dry. Soil receives seepage and runoff water from surrounding slopes, which tends to keep the soil moist during dry periods.

### 3.1.5 Wildlife

The diversity of ecosystems on the properties supports many species of animals. Fauna observed while surveying the lot are listed below. Surveys took place between September 2009 and December 2009.

List of bird species observed:

Turkey Vulture	Northern Flicker	Winter Wren
Red-tailed Hawk	Pileated Woodpecker	Varied Thrush
Bald Eagle	Common Raven	American Robin
Barred Owl	Northwestern Crow	Dark-eyed Junco
Rufous Hummingbird	Chestnut-backed Chickadee	Pine Siskin
Downy Woodpecker	Common Bushtit	
Hairy Woodpecker	Brown Creeper	

Other fauna observed include:

<u>Mammals</u>	<u>Amphibians</u>	<u>Reptiles</u>
Red Squirrel	Red-legged Frog (blue-listed)	Northwestern Garter Snake
Raccoon	Pacific Tree Frog	
Black-tailed Deer	Rough-skinned Newt	
Deer Mouse		

### 3.1.6 Ecosystem Types

The Crystal Mountain Lands are characterized by a wide range of ecological conditions due to their topographic complexity and past logging activities. Ecosystem types are determined by two primary factors – the site characteristics (such as soil, slope and aspect) and the disturbance

history (the type of disturbance and time since it occurred). The soils and the topography determine the various species and assemblages of plants that will grow on a site and the disturbance history determines the present condition of the plant communities and their successional status (eg. plant communities that form immediately after a disturbance such as a regenerating clearcut vs. plant communities that form 300 years after disturbance - an old-growth forest).

Soil conditions generally follow topographic trends with deeper, moister, nutrient rich soils occurring in the depressions and shallow, dry, nutrient poor soils occurring on the ridge tops. The general pattern of vegetation from a wet depression to a dry ridge top is as follows:

- Depressions are often dominated by broadleaf trees with scattered large diameter conifers growing on rich raised mounds. The understory is diverse and lush in appearance, often characterized by a mix of shrubs, ferns, sedges, rushes, grasses and mosses.
- Moist depression areas generally transition to conifer dominated lower to mid-slopes with patchy but robust shrub and fern dominated understories that generally coincide with canopy gaps. The composition of the trees and understory varies depending on the aspect (the direction that the slope faces) and how steep or gentle the slope is.
- Upper slope and ridge-top areas are generally comprised of a mix of conifer and broadleaf (primarily *Arbutus* (*Arbutus menziesii*)) with a more consistent cover of understory shrubs and mosses with fewer ferns. The shallow and poor soils on the ridge-tops generally produce smaller diameter trees that are gnarly or weathered in appearance.

Succession ranges from undisturbed mature climax forest on some of the very steep southwest facing slopes to highly disturbed, non-vegetated sites where the soil disturbance from logging related activities was so severe that pioneering vegetation has not yet been able to establish. The general pattern of vegetation development after a clearcut is as follows – a flush of herbaceous and shrubby vegetation emerges as tree seedlings begin to establish about 3 years after the disturbance leading to a diverse mixed pole/sapling forest with a robust, diverse understory for about 20 years. The pole/sapling forest then moves into the young forest phase characterized by a very dense conifer dominated tree canopy with a sparse understory and general loss of diversity. The young phase lasts for roughly 40 to 50 years as the forest slowly thins itself out through natural competition and the onset of various root diseases and other pathogens. These natural processes lead to the young forest's transition into a more complex, multi-layered, mixed species mature and eventually old-growth forest diverse in composition (the parts), structure (the arrangement of the parts) and function (how the parts work).

The majority of Lot A is recovering from an intense clearcut which took place in 1993. The land is currently in the pioneering seral stage characterized by patchy and diverse pole / sapling forest of varied vegetative composition depending on slope position, aspect, slope and soil depth. The moist depression sites are generally dominated by red alder (*Alnus rubra*) with sword fern

(*Polystichum munitum*) and patches of salmonberry (*Rubus spectabilis*) in the understory. The drier, gently sloping logged areas are characterized by dense patches of Douglas-fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*) poles with very little understory vegetation scattered within a more open mix of Douglas-fir, red alder, bitter cherry (*Prunus emarginata*), big-leaf maple (*Acer macrophyllum*), grand fir and arbutus with salal (*Gaultheria shallon*), Oregon-grape (*Mahonia nervosa*) and sword fern dominant in the understory.

Remnant patches of healthy mature forest are located in thin strips along the ridge tops and down the associated southwest facing steep slopes where logging was not practical. The majority of Lot 9 is also characterized by mature forest growing under a variety of ecological conditions. Ecosystem types range from western redcedar (*Thuja plicata*), Douglas-fir, big-leaf maple dominated northeast facing, moderate slopes to red alder, salmonberry dominated seasonally flooded wetland depression to Douglas-fir, arbutus dry rocky ridge top.

Each of the 30 ecosystem types identified on the Crystal Mountain Lands has been listed and described according to its site characteristics, vegetation, and soils as well as its related disturbance history, successional trajectory and restoration issues. Ecosystem types have been identified through field work conducted between September 2009 and December 2009. The detailed ecosystem type descriptions have been included as Appendix 1 of this document. MAP 2 shows the locations of the various ecosystem types.

### **3.2 Disturbance History**

The primary disturbance on the properties over the past century has been logging. Lot A has been logged at least twice and Lot 9 once. MacMillan Bloedel records suggest that the upper portion of Lot A was cut in the late 1870's while the lower portion was cut in the early 1920's. Timbermarks suggest that Lot A was clearcut by the owner previous to Crystal Mountain between 1993 and 1996. It appears that the property was not planted and is regenerating naturally. The clearcut was intensive and appears to have been completed with excavators and skidders resulting in significant impacts to the soils, especially in moist and seasonally flooded areas.

### **3.3 Conservation Significance**

The Crystal Mountain lands are located within the Coastal Douglas-fir Biogeoclimatic Zone (CDF), an ecological classification that has recently been identified as imperiled (a high risk of extinction) both Provincially and globally in Biodiversity BC's "Taking Nature's Pulse: The Status of Biodiversity in British Columbia". The fact that the Crystal Mountain lands have not



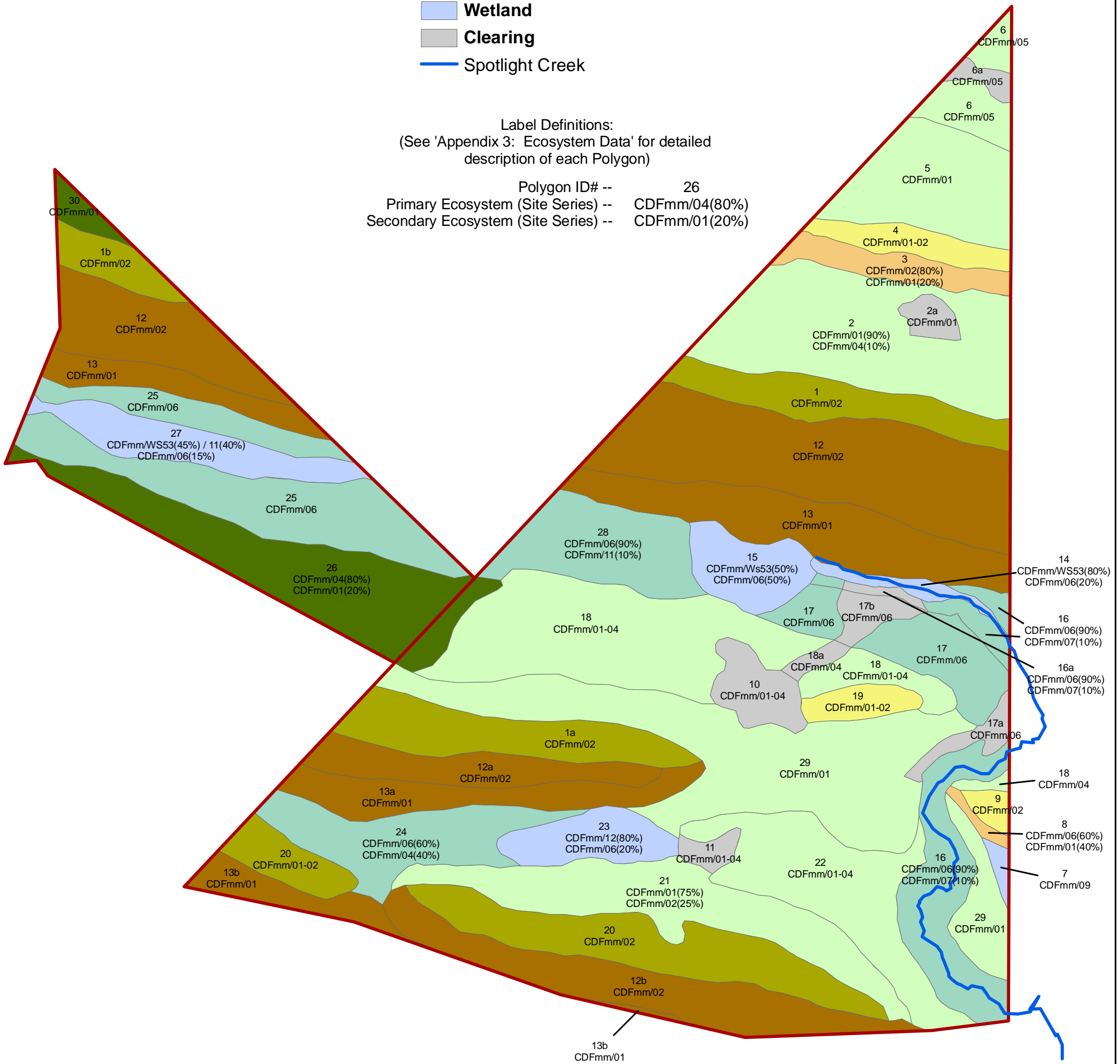
# Crystal Mountain Ecosystem-based Plan -- Ecosystem Types --

2

- Property Boundary
- Mature Forest
- Mature Forest Ridge
- Mature Forest Steep Slope / Cliff
- Pole Forest
- Pole Forest Ridge
- Pole Forest Steep Slope / Cliff
- Moist Soil / Riparian Forest
- Wetland
- Clearing
- Spotlight Creek

Label Definitions:  
(See 'Appendix 3: Ecosystem Data' for detailed description of each Polygon)

Polygon ID# --	26
Primary Ecosystem (Site Series) --	CDFmm/04(80%)
Secondary Ecosystem (Site Series) --	CDFmm/01(20%)



Produced by: Keith Erickson (R.P.Bio.)  
Map Date: December 2009  
Scale: 1 : 2,850  
Projection: UTM Zone 10 NAD83  
Rotation: 46.5 degrees W of N





been developed or permanently altered is a significant conservation achievement within the most densely populated region of the Province. Despite the industrial scale logging that has occurred on the lands in the past, there are a number of remnant patches of healthy mature and old-growth forest that have been identified along the steep slopes and ridge-tops of Lot A and over most of Lot 9. These areas are of significant conservation importance. In addition, a seasonal stream, a variety of small wetlands and the associated riparian ecosystems provide important habitat for wildlife. The diversity of ecological conditions and associated vegetation communities and wildlife resulting from the remarkable topographic complexity of the properties is also of high conservation significance – and is of particular importance when considering adaptation to climate change and migration routes of flora and fauna from drier to wetter sites or vice versa.

### 3.3.1 Ecosystems and Species at Risk

The properties include intact mature examples of two provincially red-listed ecological communities recognized by the British Columbia Conservation Data Centre:

- Community: Douglas-fir - arbutus (*Pseudotsuga menziesii* - *Arbutus menziesii*)  
Global Rank: Not Ranked  
Provincial Rank: Red (S2) – Imperiled  
Site Series: CDFmm/02  
Location (MAP2): Polygons 1, 12 and 20
- Community: Douglas-fir / dull Oregon-grape (*Pseudotsuga menziesii* / *Mahonia nervosa*)  
Global Rank: G2 – Imperiled  
Provincial Rank: Red (S2) – Imperiled  
Site Series: CDFmm/01  
Location (MAP2): Polygons 1, 12 and 20

The properties also include a young early successional example of the following listed ecological community:

- Community: red alder / skunk cabbage (*Alnus rubra* / *Lysichiton americanus*)  
Global Rank: Not Ranked  
Provincial Rank: Blue (S2S3) – special concern, vulnerable to extirpation or extinction  
Site Series: CDFmm/11  
Location (MAP2): Polygon 14

The properties are also home to a robust population of the provincially blue-listed (species of special concern, vulnerable to extirpation or extinction ) red-legged frog (*Rana Aurora*). Red-legged frogs were observed in, but are not limited to, the following locations on MAP 2: Polygons 2, 6, 7, 8, 14, 15, 16, 17, 25, 27 and 28.

### 3.3.2 Landscape Connections

Ecosystems located on the Crystal Mountain properties are part of a larger generally southeast to northwest running ridge and valley system that includes several significant wetland complexes and mature forest stands. Large portions of the system have been protected within Dionisio Provincial Park to the northwest, the Provincial Ecological Reserve #128 to the southeast and most recently within District Lot 87, immediately adjacent and wedged between the Crystal Mountain properties (See MAP3: Landscape Connections). District Lot 87 was acquired by the Provincial Government and is intended to become a BC Park’s managed protected area, but has not been officially transferred or designated at this time. Its transfer to BC Parks management may be contingent on additional rezoning and development of privately held lands linking District Lot 87 with Dionisio Park.

Protection of ecosystems on the Crystal Mountain lands will directly contribute to overarching goals for landscape connectivity on the northern portion of Galiano Island. It will specifically conserve portions of the Spotlight Creek watershed and will preserve ecosystem integrity along north/south and cross-island landscape level corridors.

### 3.4 Identified Threats to Ecosystem Values

Threats to ecosystem values are determined by identifying and assessing all current and potential uses or activities associated with the Crystal Mountain properties and surrounding areas. Threats have been identified and classified using criteria developed by the International Union for Conservation of Nature (IUCN) – a now generally accepted standard methodology. Threats and associated impacts will be addressed through the development of management zones and through the strategies and recommendations outlined in the remainder of this document.

<b>IUCN Threat Category</b>	<b>Specific Threat</b>	<b>Associated Impacts</b>
Residential and Commercial Development – Tourism and Recreation Areas	Development of retreat huts, service buildings, managers cottage, septic system	Habitat loss Habitat fragmentation Encroachment on sensitive ecosystems
Human Intrusions and Disturbance – Recreational Activities	Meditation sites - clearing for light or view sites on ridges	Habitat loss Soil erosion and compaction
	Walking / Hiking - trail network	Minor habitat fragmentation Soil erosion and compaction
Transportation and Service Corridors	Access roads and parking lot(s)	Habitat loss Habitat fragmentation Soil erosion and compaction
	Utility and Service Lines – hydro lines, water lines	Habitat loss Habitat fragmentation

Natural System Modifications – Fire Suppression	Fire suppression – general fire suppression and fuel load buildup	Habitat loss from catastrophic fire Alteration of natural disturbance regimes
Natural System Modifications – Water Management / Use	Damming of creek and use of water (for neighbouring water license)	Downstream habitat loss
	Excessive use of groundwater (wells) by Crystal Mountain and on surrounding properties within the groundwater region	Degraded groundwater quality
Invasive Species – Non-native Species	Scotch broom, Himalayan / Evergreen blackberry	Habitat loss
Pollution – Household Sewage	Leaking septic systems	Degraded stream water quality Degraded groundwater quality
	Seepage from Outhouses	Degraded stream water quality Degraded groundwater quality
Biological Resource Use – Gathering Terrestrial Plants	Uncontrolled harvest of native plants / fungi	Species loss Habitat loss
Biological Resource Use – Logging / Wood Harvesting	Unsustainable harvest of timber	Habitat loss Habitat fragmentation Degraded stream water quality Degraded groundwater quality Soil erosion and compaction
Climate Change	Droughts	Species loss Decrease in groundwater recharge
	Storms and Flooding	Species loss
	Habitat shifting	Species loss

### 5.1 Introduction to Management Zones

Management zones provide a framework for defining where and how various activities and uses may occur. They have been designed in a manner that facilitates the communicated vision of the Crystal Mountain Society for a forest retreat centre while protecting areas of conservation significance and minimizing the impacts of development and associated uses (threats) on ecological values.

Three Management Zones have been created:

<u>Zone:</u>	<u>Percentage of total Management Area:</u>
1. Protected Ecosystem Network	15.68%
2. Short-term Retreat Zone	6.62%
3. Long-term Retreat Zone	2.25%

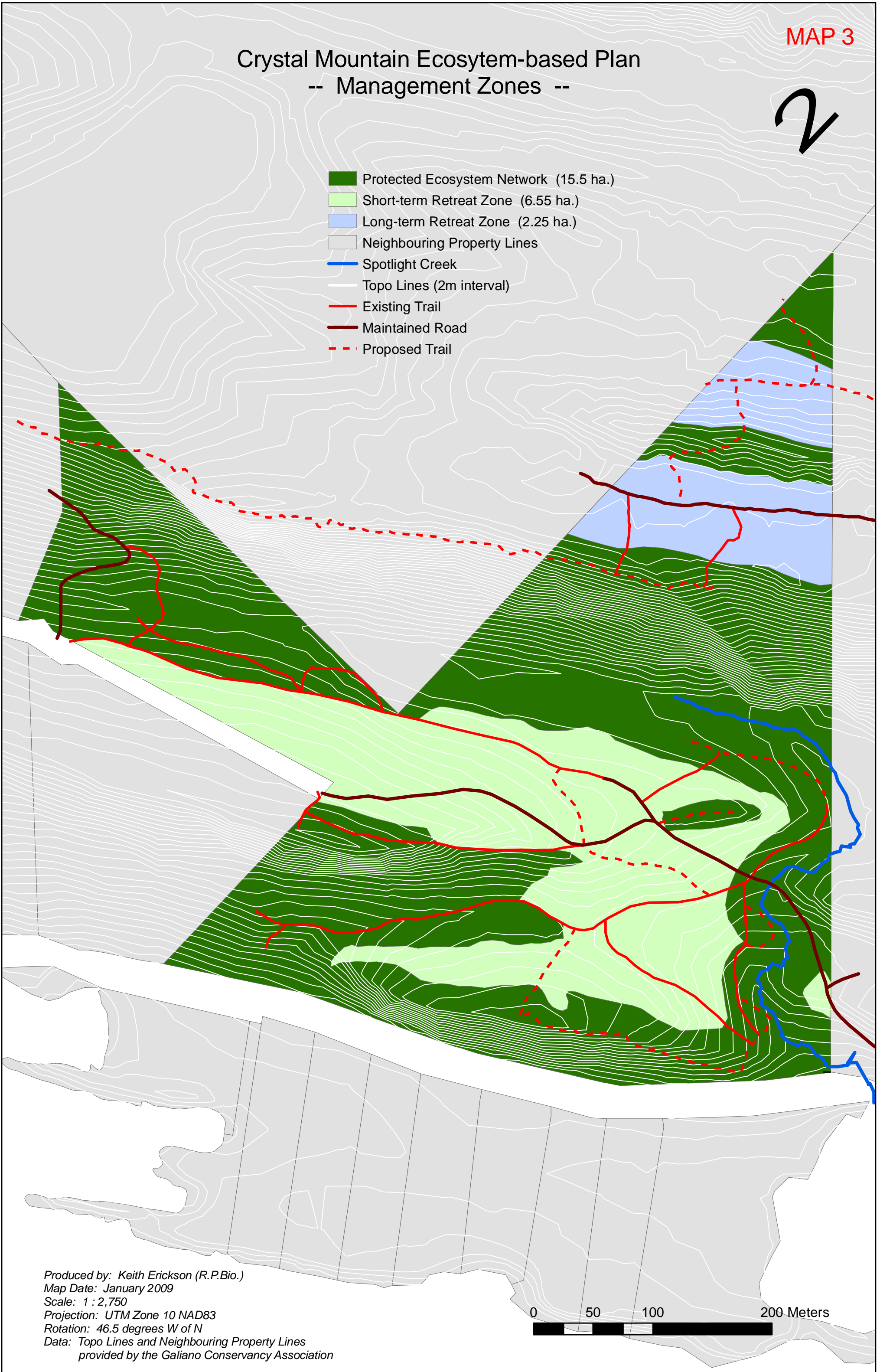
The extent and locations of the management zones are shown on MAP 3. Designation of the zones considered the conservation of ecological integrity first, and then user or activity based considerations. Considerations included:

- Protecting sensitive, rare or threatened species and ecological communities occurring on the property.
- Connectivity - maintaining or enhancing functioning ecosystems and the connections between them within the property and in relation to surrounding lands.
- Minimizing ecological fragmentation from utilities, roads and development/infrastructure.
- Minimizing disturbance in elevated water catchment areas.
- Restricting sustainable forestry to ecosystems and areas where the impacts from harvesting and related access are minimized.
- Maximizing spatial separation between short and long-term retreat accommodations.
- Minimizing infrastructure costs and maintenance for Crystal Mountain.
- Utilizing existing heavily impacted sites (old forestry landings etc) for location of buildings and structures.
- Utilizing the existing forestry road network to service building sites and as utility corridors.
- Maintaining privacy from and for neighbours.
- Using Porlier Pass Road as the main public access point.
- Focusing development on flatter areas that are also well drained.

# Crystal Mountain Ecosystem-based Plan -- Management Zones --

2

- Protected Ecosystem Network (15.5 ha.)
- Short-term Retreat Zone (6.55 ha.)
- Long-term Retreat Zone (2.25 ha.)
- Neighbouring Property Lines
- Spotlight Creek
- Topo Lines (2m interval)
- Existing Trail
- Maintained Road
- Proposed Trail



Produced by: Keith Erickson (R.P.Bio.)  
Map Date: January 2009  
Scale: 1 : 2,750  
Projection: UTM Zone 10 NAD83  
Rotation: 46.5 degrees W of N  
Data: Topo Lines and Neighbouring Property Lines  
provided by the Galiano Conservancy Association

0 50 100 200 Meters



## 5.2 Management Zone Definitions and Permitted Uses

A description of each Management Zone including a list of suggested uses and special restrictions is provided below. Specific strategies and recommendations related to the various listed uses are described later in this Plan.

### 5.2.1 Protected Ecosystem Network:

The Protected Ecosystem Network (PEN) consists of areas representative of all ecosystem types (Site Series) found within the properties and includes all unique, rare or sensitive ecosystems. The primary purpose of this Management Zone is to enhance the Conservation objective of this Plan and to mitigate threats to ecosystem values identified in Section 3.4 of this document. The following criteria were used to create the Protected Ecosystem Network:

1. Protect all ecologically sensitive areas (consistent with Islands Trust Sensitive Ecosystem Mapping). Ecologically sensitive areas are areas that are important for the maintenance of ecological values (eg. habitat for breeding and overwintering birds) or important for providing ecosystem services (eg. water recharge areas) or are rare or endangered. They may also have greater sensitivity to impacts from development such as soil compaction, erosion or disturbance to wildlife. Ecologically sensitive areas included in the PEN are:
  - **Riparian Ecosystems:** Areas adjacent to water bodies (streams and wetlands etc) that are directly influenced (flooding) by the water body or provide a direct influence to the water body (nutrient input, shading, erosion control, cover for wildlife etc.). For the purpose of this plan, a 30 meter buffer has been created around all wetlands and stream channels to represent the riparian area. The size of the buffer is consistent with maximum riparian protections for non-fish bearing systems outlined in the British Columbia *Riparian Areas Regulation (Fish Protection Act)*. Riparian ecosystems provide critical habitat for a wide variety of wildlife – including corridors for migration, and are vital for maintaining healthy functioning stream and wetland ecosystems.
  - **Wetlands:** Areas that are saturated or inundated with water for long enough periods of time to develop vegetation and biological activity adapted to wet environments. This may result from flooding, fluctuating water tables or poor drainage conditions. These areas provide critical habitat for a wide variety of wildlife. Wetland soils are extremely sensitive to disturbance and are generally not suitable for development of any kind.
  - **Forest Ecosystems characterized by wet soils:** These are moisture receiving areas in the lower slope and toe meso-slope positions often exhibiting fluctuating water tables and/or seasonally saturated soils. On the Crystal Mountain properties they include ecosystems characterized by Site Series CDFmm/05, CDFmm/06, CDFmm/07, CDFmm/11, and CDFmm/12 and are generally rich, good growing sites where soils are particularly sensitive to compaction. Impacts from development, roads or inappropriate

use can significantly alter the hydrology of these sites and surrounding areas and result in serious erosion issues. These areas often overlap with the 30 meter Riparian buffer created around streams and wetlands.

- **Forest Ecosystems characterized by dry, poor and shallow soils and Cliffs:** These areas include ridges, cliffs and associated steep southwest facing slopes. On the Crystal Mountain Properties they include ecosystems characterized by Site Series CDFmm/02 and are typically very slow growing sites that are particularly vulnerable to erosion and compaction. The combination of shallow, dry and nutrient poor soils along with considerable exposure to sun and wind results in ecological communities that are very sensitive to disturbance and require relatively long periods of time for recovery.
2. Provide protection for all identified Provincially red and blue listed species and ecological communities identified in Section 3.3.1 of this Plan.
  3. Provide the maximum protection for riparian areas in a non-fish bearing system in accordance with British Columbia Riparian Areas Regulation - Streamside Protection and Enhancement Area (SPEA) width calculations (30 meters). This also exceeds all requirements outlined in the Galiano Island Official Community Plan (Consolidated October 30, 2013) under Section V.1 – Development Permit Area 1: Riparian Areas.
  4. Contribute to landscape level conservation by including ecosystems that provide connectivity with surrounding Parks and Protected Areas and with unprotected natural areas located on neighbouring properties. In addition to sensitive and rare ecosystems defined in criteria 1 through 3, less sensitive areas exhibiting more zonal or common ecological characteristics were used to create connectivity within the property and at the landscape level. This also ensures that the PEN is representative of the full diversity of ecological conditions on the property.

*Activities or uses within the Protected Ecosystem Network:*

Activities occurring within the Protected Ecosystem Network should be consistent with the conservation objective of this plan and should be conducted in a manner which maintains or enhances the ecological integrity of the properties and surrounding areas. Uses or activities suitable for the PEN include:

1. Hiking and walking on a planned trail network.
2. Day-use meditation including temporary shelters (tent, tarp, small movable pad/floor).
3. Education, research and ecological monitoring activities.
4. Ecological restoration.
5. Removal of timber as part of an ecological restoration initiative that has as its primary objective the initiation or acceleration of the recovery of an ecosystem with respect to its health, integrity and sustainability.

6. Harvesting of wildcrafting or non-timber forest products that are not readily available within any other Management Zone. Such a product may only be harvested in a manner which does not compromise the integrity of the ecosystem from which it is being removed or threaten the viability of the local population.
7. No facilities or permanent structures (other than the existing Pagoda) should be located within the PEN. Permanent structures cannot easily be removed and do not biodegrade in the short-term – they are usually fixed to the ground through foundation or other means.

### **5.2.2 Short-term Retreat Zone:**

The Short-term Retreat Zone (SRZ) consists of ecosystems that are more resilient to disturbance from development of retreat infrastructure, sustainable forestry and associated uses of the land. The SRZ is restricted to the lower portion of the property and is easily accessible from both Devina Drive and the easement across Lot B from Porlier Pass road. It encompasses most of the existing heavily disturbed forestry landing sites where land clearing has already occurred and soils are compacted. It also includes all of the existing facilities on the Property including the wells, the kitchen platform and the main teaching platform. The primary objectives for the SRZ are to provide accommodations and support for short-term forest meditation retreats and to provide opportunities for sustainable harvest of timber and wildcrafting products.

*Activities or uses suitable for the Short-term Retreat Zone:*

1. Multi-day forest meditation retreats and educational programs.
2. Single-day educational workshops and programs.
3. Day-use meditation including temporary shelters (tent, tarp, movable pad/floor).
4. Low impact, non motorized recreational activities including hiking and walking on the planned trail network.
5. Small scale organic food production through the establishment and maintenance of garden and / or orchard areas.
6. Ecological research and monitoring activities.
7. Ecological restoration.
8. Sustainable harvesting of timber.
9. Sustainable harvesting of wildcrafting or non-timber forest products.
10. Facilities and structures required for the accommodation and support of multi-day and single-day meditation retreats, educational programs and for sustainable forestry including:
  - a. Accommodation huts
  - b. Teaching platform
  - c. Group kitchen and dining area
  - d. Bathroom / bathing facility



- e. Manager's cottage
- f. Related accessory buildings including pump house and power shed, wood, food or equipment storage sheds, greenhouse etc.
- g. Tent sites (small, flat area for a tent or similar temporary shelter) for low-budget, seasonal overnight accommodation of retreat participants.

### **5.2.3 Long-term Retreat Zone:**

The Long-term Retreat Zone (LRZ) also consists of ecosystems that are more resilient to disturbance from development of retreat infrastructure, sustainable forestry and associated uses of the land. The LRZ is restricted to the upper portion of the property and is accessible from an easement across Lot B and Lot C from Cook Road. It encompasses most of the existing heavily disturbed forestry landing sites in the upper portion where land clearing has already occurred and soils are compacted. The primary consideration for the location of the LRZ was to ensure privacy for long-term meditation retreat participants. The primary objectives for the LRZ are to provide accommodations and support for long-term forest meditation retreats and to provide opportunities for sustainable harvest of timber and wildcrafting products.

Due to the location of the LRZ within elevated water catchment areas (not subject to Galiano OCP Development Permit Area 4) it is recommended that the footprint of permanent structures is minimized and that no new utilities, service corridors or roads are created that may alter the surface drainage patterns or impair local groundwater recharge. It is also recommended that outhouses are equipped with composting toilets with contained tanks in order to prevent groundwater contamination.

#### *Activities or uses suitable for the Long-term Retreat Zone:*

1. Multi-day or long-term forest meditation retreats and educational programs.
2. Day-use meditation including temporary shelters (tent, tarp, movable pad/floor).
3. Low impact, non motorized recreational activities including hiking and walking on the planned trail network.
4. Ecological research and monitoring activities.
5. Ecological restoration.
6. Sustainable harvesting of timber.
7. Sustainable harvesting of wildcrafting or non-timber forest products.
8. Facilities and structures required for the accommodation and support of multi-day or long-term meditation retreats and educational programs
  - a. Self-contained off-grid accommodation huts
  - b. Food storage shed
  - c. Outhouses / composting toilets

### **6.1 Siting of Facilities and Accommodations**

The Crystal Mountain Society has determined a number of key criteria to guide the layout and general siting of buildings and facilities within the Short-term Retreat Zone (SRZ) and the Long-term Retreat Zone (LRZ). These guiding principles are deemed critical to the successful operation of short and long-term forest meditation retreats. They provide the overarching framework within which a number of “fine-filter” ecological criteria can be applied. The “fine filter” ecological criteria will help to buffer or enhance the ecological protection achieved through the delineation of the Protected Ecosystem Network and will further address threats to ecosystem values identified in Section 3.4 of this document. Key overarching criteria for siting buildings and facilities within the SRZ and LRZ are:

1. Accommodation huts in the SRZ and in the LRZ must be located in a manner which provides both a visual screen and an auditory buffer between buildings.
2. Accommodation huts in the SRZ must have visual and auditory separation from the kitchen and washroom/bathing facilities.
3. Retreat facilities including accommodations, teaching areas, the kitchen facility and the washroom facility must be isolated from the manager’s cottage, parking areas and access routes (driveways).
4. Vehicle access to the manager’s cottage must not interfere with retreat participants or programming.
5. The food storage shed in the LRZ must be located so that stocking can occur without intrusion on any retreat participants.
6. Good air circulation and light exposure are more subjective but equally important qualities to consider when siting accommodation huts.

Consideration of the following ecological criteria is recommended for determining general siting or layout of buildings and facilities within the SRZ and the LRZ in order to mitigate threats to ecosystem values identified in Section 3.4:

1. Minimize fragmentation of forest cover by clustering buildings and services. Utilize existing infrastructure and facilities on the properties as centers or hubs for clustering. Clustering structures will also:
  - Minimize the construction and maintenance costs of utilities and services such as hydro lines and sewage treatment (eg. septic fields and outhouses/composting toilets).
  - Minimize area of forest clearing for sunlight and airflow.
  - Minimize length of road required for construction and for emergency access.
2. Minimize impact to soils by using existing forestry roads and old landings or staging areas for building sites and access routes as much as possible.

3. Minimize encroachment by retreat related infrastructure and use on sensitive ecosystems within the Protected Ecosystem Network where possible by retaining undeveloped buffer areas around PEN boundaries.
4. Where possible, promote ecological connectivity by maintaining undeveloped connections or corridors that link areas within the Protected Ecosystem Network.
5. Minimize fragmentation of forest cover by using the existing driveway easement across Lot B from Porlier Pass road as the main access to facilities and buildings within the SRZ and as a power line corridor.
6. Minimize fragmentation by clustering facilities and structures that require power near the main access from Porlier Pass Road and/or near the electrical shed/supply.
7. Minimize fragmentation of forest cover by using the existing driveway easement across Lot B and Lot C from Cook Road to access buildings within the LRZ on the upper portion of Lot A. Buildings should be clustered near this access.

Once the general siting or layout has been established, consideration of the following ecological criteria is recommended to help to determine the specific site locations of buildings or other infrastructure within the SRZ and LRZ. The mitigation of threats to ecosystem values identified in Section 3.4 should be considered at every level or step.

1. Protect remnant old forest structures that were not degraded or removed during the most recent clearcut. Significant structures to be protected include:
  - Mature or old-growth trees and any remnant young trees (taller and larger than main forest canopy) that survived the clearcut. Leave a buffer around these trees to protect the rooting zone and any remaining soil mycorrhizal fungi associations from soil compaction and/or erosion.
  - Large diameter snags or “wildlife trees” (greater than 30cm in diameter).
  - Large fallen logs greater than 50cm in diameter.
2. Structures should be located adjacent to existing roads to minimize forest fragmentation and disturbance resulting from utilities, construction access, ongoing maintenance and emergency access.
3. Locate structures on sites where soil has already been disturbed.
4. Minimize forest clearing required for sunlight and airflow around structures by:
  - Locating structures in sites where natural canopy gaps exist to the south.
  - Site structures in north – south patterns so that more than one structure will benefit from any thinning or tree removal.
  - Locate structures near existing cleared areas such as roads or landings.
5. Avoid draws and micro-depressions where soils may be moister than immediately surrounding areas and more susceptible to compaction or erosion.

## **6.2 Access, Roads and Parking**

In accordance with the criteria mentioned in previous sections of this plan the primary access to

the Crystal Mountain property is from the easement across Lot B from Porlier Pass road. This access could be used by the property manager, by all visitors, for general maintenance and services and for utilities such as power lines. The secondary access point is from the end of Devina Drive. This access would primarily be used by retreat participants for parking their cars. Access to the upper portion of the property for long-term retreat participants and for the provision of supplies is over an easement across Lot B and Lot C from Cook Road.

It is recommended that an emergency access/evacuation route linking the southeast end of Devina Drive with Porlier Pass Drive be maintained.

Long-term parking will be required for retreat participants. While Crystal Mountain encourages car pooling for all participants and will likely require far less parking area than might be designated, it is recommended that long-term parking accommodate at least:

- 1 space per staff,
- 1 space per student
- 20 spaces total with manouvering aisles not less than 7.5m and spaces 5.5m x 2.5m in size (in accordance with Galiano Island LUB 127).

Property Manager and visitor parking will also be required. This should accommodate 1 space for the manager and up to 4 spaces for visitors to the property.

### **6.3 Trail Network and Temporary or Day-use Meditation Sites**

Low impact recreational and spiritual activities such as hiking and meditation are consistent with the objectives for all management zones including the PEN. A trail network along with a number of designated day-use or temporary meditation sites are required to facilitate these uses and are shown on Map 4.

#### **6.3.1 Day-use Meditation Sites**

Day use meditation sites are intended to be temporary in nature in order to reduce impacts from use on the surrounding ecology. Structures required for day-use meditation such as meditation platforms or shelters should be small in scale and temporary in their construction. These could include small movable (6'x6' or so) temporary platforms, tents or tarps for cover on rainy days or possibly just a bench to sit on. Day-use sites should be set-up as required to meet the needs of individual retreats and then dismantled afterward. Within the PEN, the maintenance of day-use sites should only include minor pruning of trees or vegetation to enhance views and site lines and should not include the removal or clearing of trees and vegetation unless it is consistent with objectives for ecological restoration.

#### **6.3.2 Trail Network**

A designated trail network will facilitate both physical and spiritual objectives of forest retreats. Trails within the network primarily follow old logging roads where compaction and

fragmentation have already occurred. However, several new routes that provide access to ridge tops and riparian areas have also been recommended. Recommendations for minimizing impacts of existing and new trails are:

- New trails in sensitive areas such as ridge tops or riparian areas should not run the length of the ecosystem, ensuring the retention of areas that are free from regular human use.
- Well defined trails, particularly in sensitive areas such as steep slopes, ridge tops and along streams, will help to minimize the spread of related impacts such as soil compaction and erosion.
- Minimize trail widths.
- Avoid constructing trails in areas with seasonally saturated or flooded soils.
- Where existing trails cross wetlands or moist soils such as the trail leading to the Pagoda, construct elevated boardwalks to minimize soil compaction in drier months and to ensure accessibility during wetter months.
- Avoid constructing trails on very steep slopes where soils are susceptible to erosion.

## 6.4 Ecological Restoration

A large portion of Crystal Mountain has been impacted by intensive forestry and associated road building over the past century. This has created long-term impacts to soil ecosystems, altered the hydrology, destroyed wildlife habitat, caused the spread of invasive exotic species and resulted in an overall reduction in biotic diversity. Over time, natural processes will heal the damaged landscape. However, there is potential for helping the land heal through the initiation of ecological restoration projects. The Society for Ecological Restoration (SER) International Primer on Ecological Restoration defines ecological restoration as:

*“The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. It is an intentional activity that initiates or accelerates ecosystem recovery with respect to its health (functional processes), integrity (species composition and community structure), and sustainability (resistance to disturbance and resilience).”*

The SER International Primer on Ecological Restoration (Society for Ecological Restoration International Science and Policy Working Group, Version 2, October 2004 – available at [http://www.ser.org/content/ecological\\_restoration\\_primer.asp](http://www.ser.org/content/ecological_restoration_primer.asp) )

Proposed ecological restoration projects or programs should generally follow the Society For Ecological Restoration (SER) International’s “Guidelines for Developing and Managing Ecological Restoration Projects, 2<sup>nd</sup> Edition” (Clewel, Rieger and Munro, 2005 – available at [http://www.ser.org/content/guidelines\\_ecological\\_restoration.asp](http://www.ser.org/content/guidelines_ecological_restoration.asp) )

### 6.4.1 Control of Invasive Exotic Species

Invasive exotic species such as Scotch broom and Himalayan blackberry are pervasive in areas such as landings, staging areas and roads where heavy soil disturbance has occurred and in naturally open ecosystems such as cliffs and ridge tops. Controlling the spread of invasive exotic vegetation will reduce impacts to biodiversity and improve the general ecological health of the properties. It is a high restoration priority and will require a long-term commitment.

Recommendations focused on the control of invasive exotic species are as follows:

#### Scotch Broom Control

- Scotch broom grows on sites where soils have been disturbed and in naturally open sites such as cliffs and ridge tops. They produce tens of thousands of seeds annually which can last in the soil for over 50 years before germinating. Scotch broom requires a long-term strategy for control which focuses on repeated removal that eliminates further seed production and exhausts the seed bank in the soil.
- Remove all flowering or seed producing plants on an annual basis.
- Ideally cut Scotch broom plants at or below the root collar while they are flowering between May and July. This is the most effective time to kill Scotch broom as it invests most of its energy in flower and seed production, leaving the roots with little reserve for re-sprouting.
- Small diameter plants which are not flowering can be left – do not cut these as they will likely re-sprout the following year and create a plant form that is more difficult to remove (multi-stemmed and bushy instead of a single stem). Smaller diameter broom plants not of seed producing age can be left until they flower (2 to 4 years old) or pulled during wet months when soil is moist to minimize soil disturbance. Scotch broom is adapted to growing in disturbed soil and will easily out-compete native species.
- Where possible plant native species such as red alder (fills a similar ecological niche as broom – association with nitrogen fixing bacteria on its roots that enhances the plants ability to grow in disturbed soils) or native conifers after removing broom. This will help to speed up the development of a tree canopy that will eventually create enough shade to inhibit further growth of broom and blackberry.

#### Himalayan blackberry control:

- Himalayan blackberry generally grows on richer disturbed sites, often on berms around landings or staging areas where top soil has been pushed and piled. The best strategy for controlling blackberry is to stop patches from spreading until they are shaded out by native trees and shrubs. Most blackberry patches on the property are located within pole forests – these areas will likely get shaded out naturally over the next decade.
- Cutting canes will not kill blackberry plants (this will only control the spread).
- The best strategy for removal is to dig up the root nodules of Himalayan blackberry in winter

when canes have died back and soil is moister.

- A good strategy for control of large patches of blackberry over the long-term is to create small “gaps” in the blackberry patch and plant native trees. Prune any new growth to maintain the “gaps” over time and to stop the patch from expanding until the trees are established and large enough to begin shading out the blackberry plants.

The general strategy for control of invasive exotic vegetation is to first eliminate the outliers – individual plants or small patches scattered around the property, which have the potential to become seed producing hubs that further the spread of these species. Once outliers have been eliminated work back along the pathways of spread – usually old logging roads – to the major hubs or centres (usually old landings or staging areas or utility corridors).

An annual work party in late May or early June is recommended. Have one or two participants walk the ridge top trails and cut all flowering broom plants and dig up blackberry root nodules in Polygons 1, 1a, 19, 20 and 21. The rest of the participants can focus on the major roads and landings (Polygons 11 and 6a).

#### **6.4.2 Landings and Staging Areas**

Restoration is recommended on landing sites and staging areas that are not proposed for siting of future buildings or infrastructure. Sites recommended for restoration include Polygons 6a, 17a, 17b and 18a. The following are specific recommendations for each Polygon:

- Polygon 6a: Removal of scotch broom, tansy ragwort and thistles followed by planting of native species including but not limited to Douglas-fir, western redcedar, grand fir (*Abies grandis*), red alder (*Alnus rubra*), evergreen huckleberry (*Vaccinium ovatum*), and red elderberry (*Sambucus racemosa*). De-compact soil around planting sites and protect species susceptible to deer browse.
- Polygons 17a and 17b: Recommend removal of any Scotch broom or Himalayan blackberry and spot planting of red alder, western redcedar, big-leaf maple (*Acer macrophyllum*) and grand fir throughout the polygons to hasten the formation of a tree canopy. Plant trees on raised micro-sites in areas near the wetland or stream where temporary flooding or saturated soils may occur. De-compact soil around planting sites to provide a more favorable growing condition for the planted tree. Protect western redcedar from deer browse and red alder from beaver damage by establishing fencing around planted trees.
- Polygon 18a: Recommend spot planting of Douglas-fir, grand fir and sword fern to hasten the formation of a tree canopy – de-compact soil around planting sites to provide a more favorable growing condition for the planted tree.



### 6.4.3 Forest Restoration

There are a number of polygons within the properties where well planned forest restoration treatments would help to enhance biological diversity while addressing a number of additional goals such as reducing wildfire risk, increasing resilience to climate change and providing wood products for Crystal Mountain's use. Recommended treatments include restoration thinning, planting native vegetation and dispersal of slash piles. Recommendations are focused on Crystal Mountain's young and pole forests currently recovering from the clearcut(s) that took place in the 1990's. Forest restoration treatments always have benefits to the ecology as their focus with other objectives such as the harvest of wood or reduction of fuel load as secondary or complimentary outcomes. Recommendations include:

- Polygon 2: Minor thinning of Douglas-fir over the next 20 years could maintain or increase diversity in the stand while providing small diameter poles for use. None of the older seed trees should be removed.
- Polygon 14 : Recommend planting red alder and western redcedar in appropriate raised (dryer) micro-sites within the more heavily disturbed (no red alder canopy) areas.
- Polygon 15: Recommend targeted thinning of red alder to encourage the growth of western redcedar and grand fir saplings. Thinning should be completed in dry summer months without the use of any machinery.
- Polygon 16a: Recommend planting western redcedar and red alder where soils have been disturbed.
- Polygon 17 Recommend pulling apart and spreading remaining slash piles to create a more natural distribution of coarse woody debris and to reduce the risk of high intensity fire getting into adjacent conifer dominated stands.
- Polygon 18: Thinning of Douglas-fir and some grand fir will increase species diversity and growth rates of remaining trees. Targeted trees could be removed through multiple entries over the next 30 to 40 years. Limited removal of Douglas-fir and grand fir stems from the site for firewood or construction is possible while still achieving restoration goals.
- Polygon 21: Thinning of Douglas-fir in high density patches (scattered throughout polygon) will increase the growth rate of remaining trees and will improve or maintain species diversity. A portion of the thinned stems could be removed from the site for firewood or construction products.
- Polygon 22: Thinning of red alder to increase species diversity and promote succession to a conifer dominated forest. Thinning should select for conifer release and maintenance of understory diversity but could also compliment the objective of providing light for triad meditation huts.
- Polygon 24: Light thinning of Douglas-fir and grand fir poles to increase growth in remaining trees and to maintain diversity in the stand. Leave thinned stems on the site as additions to coarse woody debris.



Polygon 29: Thinning Douglas-fir to maintain and enhance biological diversity in the polygon. Individuals and clusters of Douglas-fir should be removed as they begin to shade out other tree species and understory vegetation over the next 10 to 20 years. Restorative thinning could in this area could provide an ongoing sustainable supply of timber as the stand ages.

The completion of restoration thinning treatments will require ground level decision making based on details that are beyond the scope of this document. It is recommended that a biologist or forester with forest restoration experience be consulted to determine the number of trees, the timing of treatments and the individual selection of trees for thinning. The following are a number of general considerations for ground level restoration thinning prescriptions:

- Leave trees that are growing next to old stumps or large diameter woody debris where soil biology may have been preserved or protected from past logging operations. These areas likely contain remnant nutrient sources and potential mycorrhizal associations that will increase the health of nearby trees.
- Thin to promote diversity - remove trees that are overcrowding or beginning to shade out less dominant tree species and/or patches of understory vegetation.
- Leave larger or dominant trees – these trees have likely found the best micro-sites for growing and may have a better chance for long-term success.
- Also select for phenotypic diversity – leave some ‘funky’ and/or smaller trees – with a goal of retaining as much genetic diversity on the site as possible to increase the stand’s resilience to disease and changes in climate.
- When thinning, create gaps or holes in the canopy by removing clusters of trees rather than creating evenly spaced rows.
- Create gaps of a variety of sizes that together form a non-uniform mosaic or patchy appearance to the forest canopy.
- Consider thinning intensively on steep or upper slope areas in order to mitigate possible moisture deficits that may result from high densities of trees during long drought periods.
- Leave at least double the stands natural historic density of dominant trees (often 100 to 200 stems per hectare of dominant old-growth Douglas-fir) to accommodate natural mortality from disease and other environmental factors over time.
- Always leave a portion of the thinned stems on the site to provide coarse woody debris and nutrient inputs for the soil.
- Top some trees to create snags.

#### **6.4.4 Additional Restoration Recommendations**

Polygons 25 and 26: Remove the deteriorating hut structures, unused shed structures and old building materials from these polygons.

Spotlight Creek: Remove the black ABS pipe and the weir from the lower portion of the creek. Verify that the downstream landowner who has rights to extract water from the creek no longer requires the infrastructure prior to removal.

## **6.5 Pesticides and Fertilizers**

No chemical pesticides or fertilizers should be used or applied within the properties.

## **6.6 Fire**

There is a high risk of fire during months of low precipitation and warm temperatures. The risk is at its greatest in late July, August, and early September, before the autumn rains. Fuel loads within densely regenerating pole forest areas of the properties are high and are susceptible to high intensity wildfire conditions. Similar conditions exist on adjacent properties.

Emergency response to any fire is within the jurisdiction of the North Galiano Volunteer Fire Department. The BC Forest Service Fire Protection Branch should be alerted to any potential forest fire threat. Recommendations to reduce the risk of wildfire include:

1. The North Galiano Volunteer Fire Department should be notified of any controlled burning.
2. Adhere to a general policy of no open fires between June and October.
3. All participants in retreats during times of high or extreme fire risk should be notified that open fires are prohibited.
4. Emergency access roads within the properties should be maintained in order to allow fire department vehicles to access the properties.
5. Conduct forest restoration thinning treatments within dense conifer dominated stands. Treatments will create gaps resulting in a patchy forest canopy where tree crowns are not interwoven - much more resistant to the spread of catastrophic wildfire. Thinning will also promote the growth of more fire resistant trees such as red alder and other broadleaf species as well as shrubby vegetation such as salal.
6. Prune dead lower limbs of conifer trees to remove 'fire ladders' and reduce the ability of fire to move from the ground into the tree canopy.

**Ecosystem 1**

**Description:** Mature Douglas-fir (*Pseudotsuga menziesii*), Arbutus (*Arbutus menziesii*) – salal (*Gaultheria shallon*) (CDFmm/02) vegetation community along major ridgeline. The ecosystem is characterized by very shallow, rapidly drained, dry soils with a high coarse fragment content and poor to medium soil nutrient regime. The dominant Douglas-fir trees are generally between 80 and 150 years old with older veterans scattered throughout.

<b>Polygon ID:</b>	1	<b>Slope:</b>	convex	<b>Aspect:</b>	230°
<b>Structural Stage:</b>	MFm	<b>Mesoslope Position:</b>	crest	<b>Site Series:</b>	CDFmm/02
<b>Soil Nutri. Regime:</b>	VP - P	<b>Soil Moisture Regime:</b>	1	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	20	30	10	2	2			B1 is higher (20%) in poly 1a
<i>Arbutus menziesii</i>		10	10					Southwest side of crest
<i>Thuja plicata</i>		2	2					
<i>Acer macrophyllum</i>			T					
<i>Gaultheria shallon</i>					70			
<i>Mahonia nervosa</i>					3			
<i>Rosa gymnocarpa</i>					T			
<i>Lonicera ciliosa</i>				T				
<i>Lonicera hispidula</i>					T			
<i>Symphoricarpos alba</i>					T			
<i>Pachistima myrsinites</i>					T			
<i>Cornus nuttalli</i>				T				
<i>Goodyera oblongifolia</i>						T		
<i>Kindbergia oregana</i>							T	
<i>Dicranum scoparium</i>							T	
<i>Rhytidiadelphus triquetrus</i>							T	
<i>Timmia austriaca</i>							T	
<i>Racomitrium</i>							T	
<b>Cover by Layer (%)</b>	<b>Tree:</b>	70	<b>Shrub:</b>	75	<b>Herb:</b>	2	<b>Moss:</b>	2

**Soils:**

Soils range in depth from exposed bedrock to 50cm. Well defined L and F layers with a thin H and thin Ae and occasionally Ah in patches. High in coarse fragments (50-60%), rapidly drained, and light in colour. Abundant mycelia and fauna found in soil where decay class 5 cwd is present.

**Wildlife and Wildlife Habitat:**

Observed during data collection: bald eagle (heard in tree top) and seen flying,

Habitat: snags are rare but extensively used by woodpeckers, cwd is scattered throughout and includes a variety of diameters and decay classes.

*Disturbance History:*

Evidence of selective logging with single stem selection occurring during clearcutting of adjacent forest on northeast facing slope. In Polygon 1a logging has been more extensive resulting in ‘dog-hair’ like Douglas-fir regeneration on the northeast side of the crest. Polygon 1b has also been selectively logged but is adjacent to intact mature forest on the northeast and southwest facing slopes.

Both polygon 1, 1a and 1b have structures and clearing associated with meditation retreat activities – a recently cleared site with a pieced together platform (approx. 100 sqft) at the southwest edge of the ridge in Polygon 1; an established well constructed teaching platform (approx. 1200 sqft) in the transition area between the crest/ridge and northeast facing upper slope in Polygon 1a, and; a frequently visited pagoda (monument) in Polygon 1b.

*Succession:*

These mature forest sites will continue to move towards climax without too much variation in tree composition and cover. As ecosystems on the northeast facing slopes adjacent to Polygons 1 and 1a develop into young and mature forests, light in these ridge polygons will decrease slightly possibly resulting in a reduction of shrubby salal cover and an increase in moss ground cover.

*Restoration Recommendations:*

Restoration is not required.

**Ecosystem 2**

**Description:** Douglas-fir, western redcedar (*Thuja plicata*) naturally regenerating pole forest (CDFmm/01 – 90%, CDFmm/04 – 10%) approximately 15 years in age with scattered young 50 to 60 year old seed trees. The polygon includes a number of microsites of varying slope, aspect and mesoslope character ranging from moister micro depressions to dryer rock outcrops. Soils are generally well drained silty loams with moderate coarse fragment content and moder humus forms and vary in depth between 30 centimeters to greater than 80 cm.

<b>Polygon ID:</b>	2	<b>Slope:</b>	Variable, generally 5%		<b>Aspect:</b>	Concave - southwest to northeast
<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Flat		<b>Site Series:</b>	CDFmm/01 (90%) CDFmm/04 (10%)
<b>Soil Nutrient Reg.:</b>	M-R	<b>Soil Moisture Regime:</b>	2-4		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	5		20	10	T		T	
<i>Thuja plicata</i>	2		10	5	2		T	
<i>Alnus rubra</i>				3				On moister micro-sites
<i>Salix scouleriana</i>				5				On moister micro-sites
<i>Arbutus menziesii</i>			2					On drier micro-sites

<i>Gaultheria shallon</i>					60				
<i>Polystichum munitum</i>						5			
<i>Pteridium aquilinum</i>						1			
<i>Abies grandis</i>				1					On richer micro-sites
<i>Acer macrophyllum</i>				T					
<i>Kindbergia oregana</i>							10		On richer micro-sites
<i>Achlys triphylla</i>						T			On richer micro-sites
<i>Cornus nuttallii</i>				T					On moister micro-sites
<b>Cover by Layer (%)</b>	Tree:	35	Shrub:	85	Herb:	10	Moss:	10	

*Soils:*

Silty loam with 25-50% coarse fragment content, well drained to moderately well drained. Moder humus form. Soil depth varies from 30 to greater than 80cm.

*Wildlife and Wildlife Habitat:*

Observed during data collection: red legged frog, hairy or downy woodpecker, piliated woodpecker heard.

Habitat: mixed species, mixed aged forest with gaps and scattered snags is excellent habitat for birds, small mammals etc. Moist areas support amphibians.

*Disturbance History:*

The area was logged 15 to 20 years ago leaving a variety of scattered young seed trees that were not worth removing at the time of logging. Area is regenerating naturally. Char marks on cwd and stumps indicates low intensity slash burn after logging.

Landing area (Polygon 2a) has been cleared to support meditation retreat activities and currently includes an outhouse. Two trails leading from the road to the ridge have been established.

*Succession:*

Stand will develop into uneven aged, multi-storied young forest over the next 15 to 20 years with canopy closure increasing and stem exclusion occurring for several decades there after.

*Restoration Recommendations:*

Minor thinning over the next 20 years could maintain or increase diversity in the stand while providing small diameter poles for use. None of the older seed trees should be removed.

**Ecosystem 3**

**Description:** Small cliff and talus slope characterized by bedrock outcrops, exposed boulders, and pockets of shallow soil. The ecosystem is characterized by open, patchy Douglas-fir – oceanspray (*Holodiscus discolor*) (CDFmm/02 – 80%) plant community with a minor component of Douglas-fir – salal (CDFmm/01 - 20%) and approximately 30% exposed rock. A number of young Douglas-fir seed trees are scattered amongst regenerating Douglas-fir poles.

<b>Polygon ID:</b>	3	<b>Slope:</b>	80%	<b>Aspect:</b>	225°
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<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Upper Slope	<b>Site Series:</b>	CDFmm/01 (20%) CDFmm/02 (80%)
<b>Soil Nutri. Regime:</b>	VP – P	<b>Soil Moisture Regime:</b>	0-1	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	15			40	T			
<i>Thuja plicata</i>				T				
<i>Acer macrophyllum</i>		2		T				
<i>Mahonia nervosa</i>					10			
<i>Holodiscus discolor</i>				10				
<i>Lonicera hispidula</i>				T	T			
<i>Lonicera ciliosa</i>				T	T			
<i>Rhamnus purshiana</i>				T				
<i>Rosa gymnocarpa</i>					T			
<i>Gaultheria shallon</i>					50			
<i>Linnaea borealis</i>					2			
<i>Taxus brevifolia</i>				T				
<b>Cover by Layer (%)</b>	Tree:	15	Shrub:	90	Herb:	5	Moss:	2

**Soils:**

Pockets of soil are rapidly drained, generally shallow and light in colour with a sandy loam texture and between 35 and 70% coarse fragment content. They are characterized by a mor humus form and have a high content of semi decomposed wood and a deep litter layer.

**Wildlife and Wildlife Habitat:**

Habitat: exposed rock and cliff is good habitat for northern alligator lizard

**Disturbance History:**

Any trees of merchantable size were harvested 15 to 20 years ago at the time of the clearcut in Polygon 2. Young seed trees were left.

**Succession:**

A main canopy of Douglas-fir will slowly develop on this naturally regenerating site over the next several decades eventually leading to a closed canopy with very little exposed cliff face and sparse understorey cover.

**Restoration Recommendations:**

None recommended.

**Ecosystem 4**

**Description:** Douglas-fir – salal (CDFmm/01- 02) dominated regenerating pole forest with scattered young Douglas-fir and western redcedar seed trees on a convex ridgeline. Soils are very well drained, shallow with silty-loam texture and high (50-70%) coarse fragment content.

<b>Polygon ID:</b>	4	<b>Slope:</b>	Variable - convex	<b>Aspect:</b>	Southwest to northeast
<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Crest	<b>Site Series:</b>	CDFmm/01 - 02
<b>Soil Nutrient Reg.:</b>	VP-P	<b>Soil Moisture Regime:</b>	1-2	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	3		5	35				
<i>Thuja plicata</i>	5		5	5				
<i>Arbutus menziesii</i>			5					
<i>Gaultheria shallon</i>					60			
<i>Mahonia nervosa</i>					15			
<i>Kindbergia oregana</i>							10	
<b>Cover by Layer (%)</b>	<b>Tree:</b>	25	<b>Shrub:</b>	90	<b>Herb:</b>	T	<b>Moss:</b>	10

***Soils:***

Silty loam with 50-70% coarse fragment content, very well drained. Mor humus form. Soils are shallow.

***Wildlife and Wildlife Habitat:***

Observed during data collection: pacific tree frog, raven

Habitat: several snags along the ridge with evidence of woodpecker use.

***Disturbance History:***

Logging 15 to 20 years ago left a high concentration of western redcedar and Douglas-fir seed trees along the ridgeline.

***Succession:***

Stand will develop into uneven aged, multi-storied young Douglas-fir dominated forest over the next 20 to 30 years with a reduction in shrub / understorey cover due to canopy closure increasing and stem exclusion occurring for several decades there after.

***Restoration Recommendations:***

No restoration required – allow natural processes to continue.

**Ecosystem 5**

**Description:** Northeast facing, mid to upper slope, zonal Douglas-fir – salal (CDFmm/01) regenerating pole forest with scattered young Douglas-fir and western redcedar seed trees. Soils



are well drained and shallow with sandy loam texture and high (50%) coarse fragment content.

<b>Polygon ID:</b>	5	<b>Slope:</b>	35%	<b>Aspect:</b>	60°
<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Mid to upper slope	<b>Site Series:</b>	CDFmm/01
<b>Soil Nutrient Reg.:</b>	M	<b>Soil Moisture Regime:</b>	2	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	2		1	30	1			
<i>Thuja plicata</i>	5		2	5	1			
<i>Arbutus menziesii</i>	1		1					
<i>Gaultheria shallon</i>					75			
<i>Mahonia nervosa</i>					1			
<i>Rosa gymnocarpa</i>					1			
<i>Polystichum munitum</i>						3		
<i>Pteridium aquilinum</i>						10		
<i>Kindbergia oregana</i>							20	
<i>Holodiscus discolor</i>				T				
<i>Vaccinium ovatum</i>				T				
<i>Cytisus scoparius</i>				T	T			Along old road
<b>Cover by Layer (%)</b>	<b>Tree:</b>	12	<b>Shrub:</b>	95	<b>Herb:</b>	15	<b>Moss:</b>	20

*Soils:*

Silty loam with 50% coarse fragment content, well drained. Moder humus form.

*Wildlife and Wildlife Habitat:*

Habitat: abundant coarse woody debris scattered throughout.

*Disturbance History:*

The area was logged 15 to 20 years ago leaving a variety of scattered young seed trees that were not worth removing at the time of logging. Area is regenerating naturally. No evidence of burn after logging – slash remains on site.

Landing area (Polygon 2a) has been cleared to support meditation retreat activities and currently includes an outhouse.

*Succession:*

Stand will develop into uneven aged, multi-storied young Douglas-fir dominated forest over the next 20 to 30 years with a reduction in shrub / understory cover due to canopy closure increasing and stem exclusion occurring for several decades there after.

*Restoration Recommendations:*

There is an opportunity for restoration thinning treatments over the next 20 years with a goal of maintaining and enhancing structural and compositional diversity while removing a small portion

of the stems for use.

### **Ecosystem 6**

**Description:** Northeast facing, mid to lower slope, Douglas-fir, western redcedar – salal (CDFmm/05) regenerating pole forest with scattered young Douglas-fir and western redcedar seed trees. Soils are moderately well drained and with silty loam texture and moderate (25-35%) coarse fragment content.

<b>Polygon ID:</b>	6	<b>Slope:</b>	5-15% (concave)	<b>Aspect:</b>	60°
<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Mid to lower slope	<b>Site Series:</b>	CDFmm/05
<b>Soil Nutrient Reg.:</b>	M	<b>Soil Moisture Regime:</b>	5	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	5		T	30				
<i>Thuja plicata</i>	30		5					
<i>Alnus rubra</i>				1				On edge of landing
<i>Gaultheria shallon</i>					65			
<i>Holodiscus discolor</i>				T				
<i>Pteridium aquilinum</i>						5		
<i>Hylocomnium splendens</i>							8	
<i>Kindvergia oregano</i>							10	
<i>Rhytidiadelphus loreus</i>							1	
<i>Lonicera hispidula</i>					2			
<i>Polystichum munitum</i>						1		
<i>Trientalis latifolia</i>						1		
<i>Vaccinium ovatum</i>					1			
<i>Linnaea borealis</i>					1			
<i>Achlys triphylla</i>						T		
<i>Lonicera ciliosa</i>				1				
<i>Cytisus scoparius</i>				T	T			On landing – poly 6a
<i>Cirsium spp.</i>						T		On landing – poly 6a
<i>Senecio jacobaeae</i>						T		On landing – poly 6a
<i>Grass spp.</i>						2		On landing – poly 6a
<i>Juncus effusus</i>						T		On landing – poly 6a
<i>Carex spp.</i>						T		On landing – poly 6a
<b>Cover by Layer (%)</b>	<b>Tree:</b>	40	<b>Shrub:</b>	90	<b>Herb:</b>	10	<b>Moss:</b>	20

*Soils:*

Silty loam with 25-35% coarse fragment content, moderately well drained. Moder humus form.

*Wildlife and Wildlife Habitat:*

Observed during data collection: tree frog, squirrel nut cache, deer scat, red legged frog, dragonfly.

Habitat: Snags and large diameter coarse woody debris observed.

*Disturbance History:*

The area was logged 15 to 20 years ago leaving a variety of scattered young seed trees that were not worth removing at the time of logging. Area is regenerating naturally. No evidence of burn after logging – slash remains on site.

Landing area (Polygon 6a) was cleared and served as a staging area during past logging. Soils have been heavily disturbed and compacted and are now dominated by invasive grasses, thistles, scotch broom and tansy ragwort. Due to moist soils and timing of logging, deep ruts were left from machinery and are now compacted micro-depression sites where sedges and rushes are growing.

*Succession:*

Stand will develop into uneven aged, multi-storied young forest over the next 15 to 20 years with canopy closure increasing and stem exclusion occurring for several decades there after.

*Restoration Recommendations:*

There is an opportunity for restoration thinning treatments over the next 20 years with a goal of maintaining and enhancing structural and compositional diversity while removing a small portion of the stems for use.

Landing site: removal of scotch broom (*Cytisus scoparius*), tansy ragwort (*Senecio jacobaeae*) and thistles (*Cirsium spp.*) followed by planting of native species including but not limited to Douglas-fir, western redcedar, grand fir (*Abies grandis*), red alder (*Alnus rubra*), evergreen huckleberry (*Vaccinium ovatum*), and red elderberry (*Sambucus racemosa*). De-compact soil around planting sites and protect species susceptible to deer browse.

## Ecosystem 7

**Description:** Seasonally flooded wet bench dominated by Pacific willow (*Salix lucida ssp. laciandra*) nootka rose (*Rosa nootkensis*), and slough sedge (*Carex obnupta*) (CDFmm/09). This polygon is a moisture receiving site with soils that are very rich but poorly drained due to a clay mineral soil layer and is flooded during winter storm events.

<b>Polygon ID:</b>	7	<b>Slope:</b>	<1%	<b>Aspect:</b>	250°
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Flat	<b>Site Series:</b>	CDFmm/09
<b>Soil Nutrient Reg.:</b>	VR	<b>Soil Moisture Regime:</b>	05-07	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Salix lucida ssp laciandra</i>				15				
<i>Salix scouleriana</i>				10				

<i>Equisitum arvense</i>						10			
<i>Carex obnupta</i>						40			
<i>Rubus ursinus</i>						3			
<i>Elymus hirsutus</i>						5			
<i>Rosa nootkensis</i>				25	5				
<i>Alnus rubra</i>				20					
<i>Rubus discolor</i>				2	2				
<i>Kinbergia praelonga</i>								15	
<i>Menthe arvensis</i>						T			
<i>Rosa gymnocarpa</i>						T			
<i>Rubus spectabilis</i>						2			
<i>Gaultheria shalon</i>						T			On raised micro-sites
<i>Polystichum munitum</i>						T			On raised micro-sites
<b>Cover by Layer (%)</b>	Tree:	35	Shrub:	85	Herb:	10	Moss:	10	

*Soils:*

Silty loam over top of heavy clay approximately 50 cm deep. Thick H and Ah horizons, dark coloured. Low coarse fragment content (10 – 15%) characterized by a few platy sandstone cobbles. Poorly drained.

*Wildlife and Wildlife Habitat:*

Observed during data collection: heard lots of unidentified frog calls.

Habitat: Moist area supports amphibians and shrubby thicket like riparian provides high quality bird habitat.

*Disturbance History:*

The area appears to have been logged and is located next to the Crystal Mountain driveway – the ditch along the driveway provides significant water additions during storm events.

*Succession:*

Seasonal flooding will maintain willow and red alder in this ecosystem with possible infill of western redcedar as raised micro-sites develop over time. No cedar seedlings were observed.

*Restoration Recommendations:*

More in-depth investigation into hydrological alterations caused by the ditch and driveway should occur to determine whether restoration is required.

**Ecosystem 8**

**Description:** Red alder / bitter cherry (*Prunus emargenata*) – oceanspray (*Holodiscus discolor*) (CDFmm/01 – 40%) (CDFmm/06 – 60%) disturbed pole-sapling, lower/tow slope. The polygon is a transition zone from flat seasonally flooded Polygon 7 to a drier southwest facing upper slope characterized by Polygon 9.

<b>Polygon ID:</b>	8	<b>Slope:</b>	Concave, 25-60%		<b>Aspect:</b>	250°
<b>Structural Stage:</b>	PSm	<b>Mesoslope Position:</b>	Flat		<b>Site Series:</b>	CDFmm/01 (40%) CDFmm/06 (60%)
<b>Soil Nutrient Reg.:</b>	M-R	<b>Soil Moisture Regime:</b>	4-5		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Prunus emarginata</i>			15					
<i>Alnus rubra</i>		60	10					
<i>Salix scouleriana</i>			2					
<i>Pteridium aquilinum</i>						15		
<i>Gaultheria shallon</i>				10				
<i>Holodiscus discolor</i>				20				
<i>Rubus discolor</i>				40				
<i>Rubus parviflorus</i>				T				
<i>Acer macrophyllum</i>				T				
<i>Elymus glaucus</i>						1		
<i>Urtica dioica</i>						1		
<i>Rubus ursinus</i>					1			
<i>Lactuca muralis</i>						T		
<i>Polystichum munitum</i>						1		
<i>Kinderbergia oregana</i>							5	
<i>Pseudotsuga menziesii</i>				2				
<i>Abies grandis</i>				1	1			
<i>Lonicera ciliosa</i>				1				
<b>Cover by Layer (%)</b>	<b>Tree:</b>	75	<b>S`hrub:</b>	70	<b>Herb:</b>	15	<b>Moss:</b>	5

**Soils:**

Silty loam with moderate coarse fragment content between 35 and 50%. Patchy deeper soil pockets interspersed with exposed boulder talus from ridge crest above. Moderately well drained.

**Wildlife and Wildlife Habitat:**

Observed during data collection: heard lots of unidentified frog calls.

Habitat: Moist area supports amphibians and shrubby thicket like riparian provides high quality bird habitat.

**Disturbance History:**

Logged in mid 1990's. Logging likely contributed to slope instability leading to movement of boulders and soil from the cliff/ridge above.

**Succession:**

Red alder canopy will eventually be overtaken by Douglas-fir and grand fir that have established on drier, deeper soil micro-sites eventually leading to a conifer dominated mature forest.

*Restoration Recommendations:*

None recommended.

**Ecosystem 9**

**Description:** Douglas-fir / Arbutus (*Arbutus menziesii*) naturally regenerating pole forest (CDFmm/02) with scattered young seed trees. The polygon includes the upper slope and crest areas with an aspect that shifts from southwest to northeast. Soils are very shallow and very well drained with a high coarse fragment content and loamy textured mineral soil.

<b>Polygon ID:</b>	9	<b>Slope:</b>	Convex 0 - 90%		<b>Aspect:</b>	southwest to northeast
<b>Structural Stage:</b>	PSm	<b>Mesoslope Position:</b>	Crest – upper slope		<b>Site Series:</b>	CDFmm/02
<b>Soil Nutrient Reg.:</b>	P-M	<b>Soil Moisture Regime:</b>	1		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>			5	50				
<i>Arbutus menziesii</i>			10	2				
<i>Salix scouleriana</i>				1				
<i>Abies grandis</i>				1	2			
<i>Thuja plicata</i>				2				8% on northeast side of ridge
<i>Holodiscus discolor</i>				10				
<i>Mahonia nervosa</i>					5			
<i>Gaultheria shallon</i>					10			
<i>Lonicera hispidula</i>					10			
<i>Polystichum munitum</i>						T		
<i>Amelanchier alnifolia</i>						T		
<i>Vaccinium parvaflorum</i>				T	T			
<i>Cytisus scoparius</i>					T	5		
<i>Racomitrium spp.</i>							30	
<i>Prunus emarginata</i>				15				
<i>Kindbergia oregana</i>							20	
<i>Rhytidiadelphus triquetrus</i>							5	On northeast side of ridge
<b>Cover by Layer (%)</b>	<b>Tree:</b>	15	<b>Shrub:</b>	65	<b>Herb:</b>	25	<b>Moss:</b>	50

*Soils:*

Very shallow, characterized by cracks and crevices with deeper soils between exposed boulders and bedrock. Loam with high coarse fragment (50-60%) and very well drained. Some of the deeper soil pockets have a small Ah and darker soils indicating scattered richer micro-sites.

*Wildlife and Wildlife Habitat:*

Observed during data collection: evidence of intense deer browse on Saskatoon (*Amelanchier alnifolia*), red huckleberry (*Vaccinium parvaflorum*) and scotch broom.

*Disturbance History:*

Polygon was logged resulting in increased exposure to winds. Loose rock and soil also suggests susceptibility to mass wasting – also increased from logging. Intense deer browse was also noted to the extent where the establishment of preferred species such as Saskatoon is severely impeded.

*Succession:*

Stand will develop into a Douglas-fir dominated site with scattered Arbutus – species like bitter cherry (*Prunus emarginata*) will die off over the next 20 years.

*Restoration Recommendations:*

Remove scotch broom by cutting during flowering season. Pulling will damage shallow, loose soils.

## Ecosystem 12

**Description:** Mature to Old-growth Douglas-fir – Arbutus (CDFmm/02) southwest facing steep slope with exposed bedrock and boulder cliff micro-sites scattered throughout. Soils are generally less than 30cm in depth except on flatter “shelf” micro-sites also scattered throughout the polygon where deeper soil have been able to accumulate. In the smaller Polygon 12b along Porlier Pass road, there is a 25% component of Douglas-fir – salal (CDFmm/01) on a slightly shallower slope (50 – 60%).

<b>Polygon ID:</b>	12	<b>Slope:</b>	80%		<b>Aspect:</b>	250°	
<b>Structural Stage:</b>	MF m	<b>Mesoslope Position:</b>	Mid to upper slope		<b>Site Series:</b>	CDFmm/02	
<b>Soil Nutrient Reg.:</b>	M	<b>Soil Moisture Regime:</b>	0-1		<b>Photo Points:</b>		

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	5	40	5	1	T		T	
<i>Arbutus menziesii</i>		15	15					
<i>Acer macrophyllum</i>		10	5					Mainly on mid slope
<i>Thuja plicata</i>				T	T			In CDFmm/01 Poly 12b
<i>Holodiscus discolor</i>				1				
<i>Gaultheria shallon</i>					10			Mainly on mid slope
<i>Mahonia nervosa</i>					20			Mainly on mid slope
<i>Linnaea borealis</i>					T			
<i>Vaccinium ovatum</i>					1			
<i>Lonicera hispidula</i>					25			Mainly on upper slope
<i>Polystichum munitum</i>						1		



<i>Lactuca muralis</i>						T		
<i>Kinbergia praelonga</i>							5	On rocks
<i>Kinbergia oregana</i>							5	On rocks
<i>Lonicera ciliosa</i>				T				In CDFmm/01 Poly 12b
<i>Grass spp.</i>							15	
<b>Cover by Layer (%)</b>	Tree:	75	Shrub:	55	Herb:	15	Moss:	5

*Soils:*

Silty loam with medium coarse fragment content (30-50%), a medium to dark color, a mor humus form and very shallow. Exposed soil (no veg) and rock accounts for approximately 35% of the polygon.

*Wildlife and Wildlife Habitat:*

Observed during data collection: Bald eagles and Turkey vultures observed flying over steep slope / cliff.

Habitat: Large diameter snags and coarse woody debris and living veteran Douglas-firs are scattered throughout the polygon and all show signs of woodpecker use. A few scattered old-growth Douglas-fir trees provide rare canopy and below ground habitat associations.

*Disturbance History:*

Lower portion of the polygon has been selectively logged for Douglas-fir. Old-growth Douglas-fir trees show fire scars while mature trees do not indicating that the area was burned during or after the original logging entry in the early 1900's.

*Succession:*

Stand will continue to mature with a relatively stable species composition.

*Restoration Recommendations:*

None recommended.

**Ecosystem 13**

**Description:** Young Douglas-fir / western redcedar / big-leaf maple (*Acer macrophyllum*) (CDFmm/01) mixed forest characterized by large exposed boulders and soil deposited from the steep slope/cliff area above in Polygon 12. Exposed rock and boulder account for between 60% of surface cover at the bottom of the slope to 30% in the upper portion of the polygon.

<b>Polygon ID:</b>	13	<b>Slope:</b>	Concave 15 - 55%		<b>Aspect:</b>	250°
<b>Structural Stage:</b>	YFm	<b>Mesoslope Position:</b>	Mid to lower slope		<b>Site Series:</b>	CDFmm/01
<b>Soil Nutrient Reg.:</b>	M	<b>Soil Moisture Regime:</b>	3		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>		15	5	10	T		T	

<i>Thuja plicata</i>		25	10	5	T		T	
<i>Arbutus menziesii</i>			T					
<i>Acer macrophyllum</i>		15	10	1	T		T	
<i>Gaultheria shallon</i>					15			
<i>Mahonia nervosa</i>					3			
<i>Holodiscus discolor</i>				1				
<i>Polystichum munitum</i>						10		
<i>Kinbergia oregana</i>						15		
<i>Alnus rubra</i>				5				
<i>Lonicera hispidula</i>					5			
<i>Lactuca muralis</i>						T		
<i>Gallium aparine</i>						T		
<i>Racomitrium spp.</i>							15	Lower slope on talus
<b>Cover by Layer (%)</b>	Tree:	35	Shrub:	85	Herb:	10	Moss:	10

*Soils:*

Very well drained silty loam with medium coarse fragment content (30-50%), a medium to dark color, a mor humus form and generally shallow.

*Wildlife and Wildlife Habitat:*

Observed during data collection: Raven

Habitat: Lots of potential hiding and den sites in cracks and fissures created by boulders.

Abundant coarse woody debris.

*Disturbance History:*

The polygon was logged in the early 1900's and was high-graded again in the 1990's when the major clearcut on the property occurred. The major natural disturbance is from mass wastage with large gaps within the polygon formed due to high boulder content and very few soil pockets suitable for tree growth.

The major disturbance to Polygon 13b is from Porlier Pass road with permanently altered light conditions along with consistent disturbance from traffic. Also, polygon 13b was not high-graded.

*Succession:*

Lower boulder dominated area will slowly develop canopy cover as existing trees grow and more regen is recruited. The upper "less bouldery" area will continue to develop mature forest characteristics. The soil communities on in the talus dominated area where high-grade logging occurred will take many decades or even centuries to re-establish and support tree growth.

*Restoration Recommendations:*

None recommended.

**Ecosystem 14**

**Description:** Western redcedar – sword fern (*Polystichum munitum*) – skunk cabbage (*Lysichiton americanum*) swamp (Ws53 – 80%). The seasonally flooded wetland depression is recovering from logging related disturbance and is currently characterized by regenerating red alder pole forest mixed with graminoid dominated open patches. Raised micro-sites are scattered throughout the swamp area and transition into a CDFmm/06 (20%) moist forest along the edges of the polygon. A seasonal stream channel is braided through the wetland area and varies in width to from concentrated (1m width) to dispersed (no defined channel).

<b>Polygon ID:</b>	14	<b>Slope:</b>	Less than 1%		<b>Aspect:</b>	Depression (160°)
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Depression		<b>Site Series:</b>	CDFmm/11 (80%) CDFmm/06 (20%)
<b>Soil Nutrient Reg.:</b>	R-VR	<b>Soil Moisture Regime:</b>	6-7		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>	
<i>Alnus rubra</i>				65					
<i>Abies grandis</i>				T	T			On raised micro-sites	
<i>Thuja plicata</i>	2			T	T			On raised micro-sites	
<i>Acer macrophyllum</i>	T							On raised micro-sites	
<i>Rubus spectabilis</i>				1	1				
<i>Gaultheria shallon</i>					1			On raised micro-sites	
<i>Polystichum munitum</i>						55		On raised micro-sites	
<i>Urtica dioica</i>						3			
<i>Juncos effusus</i>						T			
<i>Lysichiton americanum</i>						5			
<i>Scirpus microcarpus</i>						5			
<i>Equisetum arvense</i>						25			
<i>Achlys triphylla</i>						2			
<i>Elymus glaucus</i>						5			
<i>Kindbergia praelonga</i>							2		
<b>Cover by Layer (%)</b>	<b>Tree:</b>	2	<b>Shrub:</b>	70	<b>Herb:</b>	95	<b>Moss:</b>	2	

*Soils:*

Soils range from wet year round in the centre to seasonally wet on the fringes. Characterized by deep organic horizon with underlying heavy clay.

*Wildlife and Wildlife Habitat:*

Observed during data collection: red legged frog and active beaver damming (freshly cut small diameter red alder stumps and downed stems with beaver tooth patterns)

Habitat: mixed species, mixed aged forest with gaps and open water for the majority of the year is excellent habitat for birds, amphibians and mammals.

*Disturbance History:*

The polygon was clearcut logged around 16 years ago with varying degrees of disturbance to soils – indicated by variation in regenerating vegetation communities.

Freshly felled red alder is being used by beaver to create a new dam which is increasing the size of the flooded wetland area.

*Succession:*

Swamp area will continue to develop forest canopy transitioning from a red alder dominated community into a western redcedar dominated community. Red alder will remain as a long-term component of the stand. Succession will depend on degree of soil disturbance with high impact areas taking longer to develop forest canopy. If beaver persist with the development of new dams the water table may be raised in affected areas creating pockets of year round marsh habitat – trees and shrubby vegetation in the flooded area will likely die and marsh vegetation adapted to year round flooding will increase.

*Restoration Recommendations:*

Recommend planting red alder and western redcedar in appropriate raised (dryer) micro-sites within the more heavily disturbed (no red alder canopy) areas.

**Ecosystem 15**

**Description:** Young red alder (*Alnus rubra*) / western redcedar – sword fern (*Polystichum munitum*) / salmonberry (*Rubus spectabilis*) swamp (Ws53 - 50%) in depression areas transitioning into sword fern dominated lower slope with scattered young big-leaf maple and western redcedar (CDFmm/06 - 50%) left after logging. The polygon also includes a seasonal stream channel that varies in width to from concentrated (1m width) to dispersed (no defined channel) to subsurface flow.

<b>Polygon ID:</b>	15	<b>Slope:</b>	1 - 5%		<b>Aspect:</b>	45°	
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Depression – lower slope		<b>Site Series:</b>	Ws53 (50%) CDFmm/06 (50%)	
<b>Soil Nutrient Reg.:</b>	R	<b>Soil Moisture Regime:</b>	5-7		<b>Photo Points:</b>		

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Alnus rubra</i>			65					
<i>Abies grandis</i>				1	1			Raised micro-sites
<i>Thuja plicata</i>	5		5	T	T			
<i>Acer macrophyllum</i>			15					
<i>Rubus spectabilis</i>				15	1			
<i>Polystichum munitum</i>						60		
<i>Climacium dendroides</i>							T	
<i>Plagiomnium insigne</i>							5	

<i>Kindbergia oregana</i>							10		
<i>Kindbergia praelonga</i>							5		
<i>Rhytididiadelphus triquetrus</i>							T		
<i>Achlys triphylla</i>						5			
<i>Elymus glaucus</i>						5			
<i>Carex sp.</i>						10			
<i>Gaultheria shallon</i>					1				Raised micro-sites
<i>Salix scouleriana</i>				T					
<i>Rubus ursinus</i>					1				
<b>Cover by Layer (%)</b>	Tree:	80	Shrub:	20	Herb:	80	Moss:	20	

*Soils:*

Dark silty loam with high organic content, thick Ah and low coarse fragment content (10%).  
Seasonally saturated with standing water during winter months.

*Wildlife and Wildlife Habitat:*

Observed during data collection: red legged frog, piliated woodpecker heard.  
Habitat: multi-layered vegetation with broadleaf canopy, salmonberry and water source  
extremely valuable for wildlife.

*Disturbance History:*

Soils have been heavily impacted from machinery during logging 15 to 20 years ago. Old stumps indicate a mature forest community dominated by large western redcedar with the odd Douglas-fir and grand fir scattered on micro-sites. Red alder is very spindly and dense due to soil disturbance and fluctuating water table.

*Succession:*

Western redcedar will gradually grow up and replace the red alder as the dominant cover with grand fir and Douglas-fir taking hold on appropriate microsites over the next 50 or 60 years. Micro-sites will continue to develop creating a more patchy swamp/dry site mosaic.

*Restoration Recommendations:*

Recommend targeted thinning of red alder to encourage the growth of western redcedar and grand fir saplings. Thinning should be completed in dry summer months without the use of any machinery.

**Ecosystem 16**

**Description:** Riparian forest characterized by young red alder - sword fern community (CDFmm/06 – 90%) on a lower slope mixed with red alder / black cottonwood (*Populus balsamifera spp. trichocarpa*) – salmonberry community (CDFmm/07) in small depression areas along the edge of the seasonal creek where flooding occurs. In polygon 16a, patches of young forest are mixed with open shrub and pole/sapling dominated areas where soils were more heavily impacted during logging and regeneration is hindered.

<b>Polygon ID:</b>	16	<b>Slope:</b>	2-30% - concave		<b>Aspect:</b>	variable
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Lower slope		<b>Site Series:</b>	CDFmm/06 (90%) CDFmm/07 (10%)
<b>Soil Nutrient Reg.:</b>	R	<b>Soil Moisture Regime:</b>	6		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>		2	T	T	T			No A2/A3 in disturbed areas
<i>Thuja plicata</i>		1	2	5	T			No A2/A3 in disturbed areas
<i>Alnus rubra</i>		25	20	5				No A2/A3 in disturbed areas
<i>Abies grandis</i>		T	T	1	T			No A2/A3 in disturbed areas
<i>Arbutus menziesii</i>				T				On raised micro-site
<i>Gaultheria shallon</i>					5			
<i>Polystichum munitum</i>						50		Less in flooded areas
<i>Pteridium aquilinum</i>						T		
<i>Acer macrophyllum</i>		3	T	T				
<i>Kindbergia oregana</i>							1	
<i>Achlys triphylla</i>						3		
<i>Equisetum arvense</i>						3		
<i>Rubus discolor</i>				1	1			In flooded area by road
<i>Vaccinium parvaflorum</i>				T				
<i>Populus balsamifera trichocarpa</i>				T				In flooded areas
<i>Sambucus racemosa</i>				T				In flooded areas
<i>Rubus spectabilis</i>				3	2			In flooded areas
<i>Carex spp.</i>						2		In flooded areas
<i>Grass spp.</i>						2		More in disturbed areas
<i>Urtica dioica</i>						1		
<i>Rubus ursinus</i>					T			
<i>Kindbergia praelonga</i>							2	more in flooded areas
<i>Climacium dendroides</i>							T	
<i>Plagiothecium undulatum</i>							T	
<i>Plagiomnium insigne</i>							T	
<i>Holodiscus discolor</i>				T				In disturbed areas
<i>Gallium aparine</i>						T		In disturbed areas
<i>Crataegus monogyna</i>					T			In disturbed areas
<i>Mahonia nervosa</i>					T			In disturbed areas
<i>Cirsium spp.</i>						T		In disturbed areas
<i>Symphoricarpos albus</i>					T			In disturbed areas
<i>Salix scouleriana</i>			1					In disturbed areas

<i>Tellima grandiflora</i>					T		In disturbed areas		
<b>Cover by Layer (%)</b>	Tree:	60	Shrub:	30	Herb:	65	Moss:	5	

*Soils:*

Imperfectly drained silty clay loam with low coarse fragment content (10%) and thick H and Ah horizons. Moder humus form. Mottles are present in clay layer approximately 50 cm deep indicating a slightly fluctuating water table and /or saturation during winter months.

*Wildlife and Wildlife Habitat:*

Observed during data collection: red legged frog, tree frog, red squirrel

Habitat: multi species, riparian forest with gaps, floodplains and scattered snags is excellent habitat for birds, small mammals, amphibians etc. Freshwater available in winter, fall and spring.

*Disturbance History:*

The area was clearcut 15 to 20 years ago. Machine use has damaged and compacted soils and is more pronounced in areas used for repeated access (polygon 16a). Regeneration has been compromised in these areas and they remain in the shrub/herb successional phase.

*Succession:*

Red alder will continue to dominate the polygon for several decades with western redcedar and grand fir slowly emerging as the red alder dies off. Areas of heavier soil disturbance will continue to develop very slowly with a mixed tree canopy forming over the next 20 – 30 years.

*Restoration Recommendations:*

Recommend planting western redcedar and red alder in polygon 16a where soils have been disturbed.

Recommend the removal of the black ABS pipe and the weir from the lower portion of the creek.

**Ecosystem 17**

**Description:** Moist, red alder dominated pole forest with a sword fern and grass dominated understory (CDFmm/06). The ecosystem is recovering from heavy soil disturbance and compaction that occurred during logging approximately 15 years ago. Polygons 17a and 17b were likely old road and staging areas during logging and have been significantly impacted by extensive soil compaction and disturbance. As a result, these areas have not been able to develop a tree canopy and have a dominant vegetation cover of grasses and sword fern.

<b>Polygon ID:</b>	17	<b>Slope:</b>	5-10% - concave	<b>Aspect:</b>	variable
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Lower slope	<b>Site Series:</b>	CDFmm/06
<b>Soil Nutrient Reg.:</b>	R	<b>Soil Moisture Regime:</b>	6	<b>Photo Points:</b>	



Vegetation Species	A1	A2	A3	B1	B2	C	D	Distribution Notes	
<i>Pseudotsuga menziesii</i>				5	1			1% in 17a/b	
<i>Thuja plicata</i>				T				1% in 17a/b	
<i>Alnus rubra</i>				60				5% in 17a/b	
<i>Abies grandis</i>				1	3			1% in 17a/b	
<i>Prunus emarginata</i>				10					
<i>Gaultheria shallon</i>					2				
<i>Polystichum munitum</i>						50		20% in polygons 17a/b	
<i>Pteridium aquilinum</i>						T		5% in 17a/b	
<i>Acer macrophyllum</i>				2					
<i>Kindbergia oregana</i>							2		
<i>Achlys triphylla</i>						T			
<i>Equisetum arvense</i>						3			
<i>Rubus discolor</i>				2					
<i>Scirpus microcarpus</i>						T		In 17b	
<i>Sambucus racemosa</i>				1					
<i>Rubus spectabilis</i>				2	2				
<i>Carex spp.</i>						T			
<i>Grass spp.</i>						25		60% in Polygons 17a/b	
<i>Urtica dioica</i>						5			
<i>Rubus ursinus</i>						T			
<i>Kindbergia praelonga</i>							2		
<i>Elymus hirsutus</i>						10			
<i>Rhytidiadelphus triquetrus</i>							T		
<i>Plagiomnium insigne</i>							4		
<i>Polytrichum juniperinum</i>							T		
<i>Gallium aparine</i>						T			
<i>Cirsium spp.</i>							T	5% in 17a/b	
<i>Dactylis glomerata</i>						3			
<i>Agropyron repens</i>							T		
<i>Tellima grandiflora</i>						T			
<b>Cover by Layer (%)</b>	Tree:		Shrub:	80	Herb:	95	Moss:	10	

**Soils:**

Modor humus form with 15 – 25% coarse fragments, a deep Ah layer and a silty clay loam mineral horizon texture. There are signs of compaction between 10 and 30 cm and a clay layer at approximately 40 cm.

**Wildlife and Wildlife Habitat:**

Observed during data collection: red legged frog, tree frog, raven

**Disturbance History:**

The area was very heavily impacted by machinery during logging. There is evidence slash pile burning after logging with large deposits of charred wood/ash in soils. Soil compaction is

evident as well as soil mixing from bulldozers. Stumps remaining on the site are dominated by western redcedar (75%) and Douglas-fir (25%)

*Succession:*

Red alder will continue to dominate the polygon for several decades with western redcedar and grand fir slowly emerging as the red alder dies off. Areas of heavier soil disturbance will continue to develop very slowly with a mixed tree canopy forming over the next 20 – 30 years.

*Restoration Recommendations:*

Recommend pulling apart and spreading remaining slash piles to create a more natural distribution of coarse woody debris and to reduce the risk of high intensity fire getting into adjacent conifer dominated stands.

Recommend spot planting of red alder, western redcedar and grand fir in polygons 17a and 17b to hasten the formation of a tree canopy – de-compact soil around planting sites to provide a more favorable growing condition for the planted tree.

### **Ecosystem 18**

**Description:** Dense Douglas-fir / grand fir (*Abies grandis*) dominated pole forest with sparse Oregon grape (*Mahonia nervosa*) / sword fern understory (CDFmm/04). The Polygon is characterized by dense conifer areas mixed with patches of red alder. Polygon 18a was likely an old road and staging area during logging and has been significantly impacted by extensive soil compaction and disturbance. As a result, this area has not been able to develop a tree canopy and has a dominant vegetation cover of grasses and sword fern.

<b>Polygon ID:</b>	18	<b>Slope:</b>	5-15% - concave	<b>Aspect:</b>	NE to E
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Mid Slope	<b>Site Series:</b>	CDFmm/04
<b>Soil Nutrient Reg.:</b>	R	<b>Soil Moisture Regime:</b>	2-3	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>				40	1			
<i>Thuja plicata</i>				T	T			
<i>Alnus rubra</i>				10				
<i>Abies grandis</i>				40	1			
<i>Prunus emarginata</i>				T				
<i>Gaultheria shallon</i>					5			
<i>Polystichum munitum</i>						2		
<i>Mahonia nervosa</i>					10			
<i>Kindbergia oregana</i>							2	
<i>Rubus discolor</i>				2				
<i>Dicranum spp.</i>							2	
<i>Lonicera ciliosa</i>				T				

<b>Cover by Layer (%)</b>	Tree:		Shrub:	95	Herb:	2	Moss:	4
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*Soils:*

Moderately well drained silty clay loam with 25% coarse fragments and moder humus form. Observed a distinct mushroom smell and an abundance of fungal mycelia.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed

*Disturbance History:*

Logged approximately 15 years ago, with very dense natural regeneration taking place resulting in a barren forest floor and relatively low diversity.

*Succession:*

The stand will continue as a very dense Douglas-fir, grand fir dominated young forest with very barren understory and poor species diversity for the next 80 to 100 years while natural stem exclusion takes place.

*Restoration Recommendations:*

Recommend well planned thinning treatments with a goal to increase species diversity and general tree growth - possibly making multiple entries over the next 30 to 40 years. Limited removal of Douglas-fir and grand fir stems from the site is possible while still achieving restoration goals.

Recommend spot planting of Douglas-fir, western redcedar and grand fir in polygon 18a to hasten the formation of a tree canopy – de-compact soil around planting sites to provide a more favorable growing condition for the planted tree.

**Ecosystem 19**

**Description:** Douglas-fir – Arbutus (CDFmm/01-02) pole forest on a small ridge and associated southwest facing steep slope. Dominated by pole trees with scattered young and mature trees throughout, characterized by exposed bedrock and very shallow soils on the crest with slightly deeper soil pockets on the southwest facing steep slope.

<b>Polygon ID:</b>	19	<b>Slope:</b>	Variable, 5-30%	<b>Aspect:</b>	S – SW, convex
<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Crest / upper slope	<b>Site Series:</b>	CDFmm/01-02
<b>Soil Nutrient Reg.:</b>	P - M	<b>Soil Moisture Regime:</b>	1-2	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	1			40				
<i>Thuja plicata</i>	1			5				
<i>Alnus rubra</i>				1				

<i>Abies grandis</i>				T				
<i>Arbutus menziesii</i>				10				
<i>Gaultheria shallon</i>					30			
<i>Holodiscus discolor</i>				5	T			
<i>Mahonia nervosa</i>					5			
<i>Rosa gymnocarpa</i>					T			
<i>Kindberia oregana</i>							1	
<i>Pteridium aquilinum</i>						2		
<i>Polytrichum juniperinum</i>							T	
<i>Lonicera hispidula</i>					2			
<i>Lonicera ciliosa</i>					1			
<i>Rubus discolor</i>				2				
<i>Cytisus scoparius</i>					1			
<b>Cover by Layer (%)</b>	<b>Tree:</b>	2	<b>Shrub:</b>	80	<b>Herb:</b>	5	<b>Moss:</b>	2

*Soils:*

Silty loam with 50% coarse fragment content, well drained. Mor humus form with an Ae horizon.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed

Habitat: Scattered medium diameter snags well used by woodpeckers.

*Disturbance History:*

Logged approximately 15 years ago with evidence of soil disturbance from heavy machinery scattered throughout in patches – often coinciding with Scotch broom (*Cytisus scoparius*) and Himilayan blackberry (*Rubus discolor*) cover. Scattered charred areas suggest spot slash burns after logging or a patchy broadcast burn.

*Succession:*

Stand will continue to develop into a Douglas-fir / Arbutus dominated young forest with a diverse canopy and understory.

*Restoration Recommendations:*

Recommend removal of Scotch broom and Himilayan blackberry.

**Ecosystem 20**

**Description:** Douglas-fir – Arbutus (CDFmm/02) / Oregon beaked moss mature forest ridge mixed with patches of regenerating pole forest clearcut 15 years ago. Polygon is characterized by very shallow soils with significant patches of moss covered exposed boulders and bedrock.

<b>Polygon ID:</b>	20	<b>Slope:</b>	Variable, 5-20%	<b>Aspect:</b>	SW - NE, convex
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<b>Structural Stage:</b>	MFm / PSm	<b>Mesoslope Position:</b>	Crest	<b>Site Series:</b>	CDFmm/02
<b>Soil Nutrient Reg.:</b>	P	<b>Soil Moisture Regime:</b>	0-1	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>		10	5	5	2		T	
<i>Thuja plicata</i>				5	2		T	Mainly on NE aspect
<i>Acer macrophyllum</i>		5						
<i>Abies grandis</i>		T	T	T				
<i>Arbutus menziesii</i>		20	5				T	
<i>Gaultheria shallon</i>					35			Increases on NE aspect
<i>Polystichum munitum</i>						T		
<i>Mahonia nervosa</i>					15			
<i>Rosa gymnocarpa</i>					T			
<i>Kindberia oregana</i>							30	
<i>Rhytidadelphus lorus</i>							T	
<i>Hylocomnium splendens</i>							1	
<i>Lonicera hispidula</i>					3			
<i>Lonicera ciliosa</i>				T				
<i>Trientalis latifolia</i>						T		
<i>Gallium aparine</i>						T		
<i>Vaccinium parvaflorum</i>				T	T			
<i>Dicranum spp.</i>							T	
<b>Cover by Layer (%)</b>	<b>Tree:</b>	45	<b>Shrub:</b>	60	<b>Herb:</b>	2	<b>Moss:</b>	35

**Soils:**

Mor humus form with a thin Ae horizon. Soil has a silty loam texture with a very high coarse fragment content (50-70%) mostly consisting of flat platy sandstone cobbles. Well to rapidly drained.

**Wildlife and Wildlife Habitat:**

Observed during data collection: Raven, bald eagle, seagull

Habitat: Scattered snags well used by woodpeckers and coarse woody debris of varying decay class scattered around the polygon.

**Disturbance History:**

Logging encroached up into slightly deeper soiled portions of the ridge creating a wavy border along the northeast side of the ridge between the mature forest and regenerating clearcut.

**Succession:**

Developing into a mixed species, multi-layered canopy young/mature forest with a diverse moss dominated understory. Regen in clearcut areas is thick and healthy and will begin to self thin over the next several decades.

**Restoration Recommendations:**

None recommended.

**Ecosystem 21**

**Description:** Patches of Douglas-fir dominated pole forest (CDFmm/01 – 75%) mixed with very shallow soiled, open areas dominated by exposed boulders and bedrock (CDFmm/02 – 25%). The northeast facing area spans from an upper slope to a lower slope and is characterized by appropriate variation in moisture and nutrient regimes with soils that are slightly drier and poorer at the top and slightly moister and richer at the bottom.

<b>Polygon ID:</b>	21	<b>Slope:</b>	20-30%	<b>Aspect:</b>	50°
<b>Structural Stage:</b>	PSc	<b>Mesoslope Position:</b>	Mid slope	<b>Site Series:</b>	CDFmm/01 – 75% CDFmm/02 – 25%
<b>Soil Nutrient Reg.:</b>	P - R	<b>Soil Moisture Regime:</b>	1-3	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>				60	2		T	
<i>Thuja plicata</i>				4	1		T	
<i>Alnus rubra</i>				5				
<i>Abies grandis</i>				T	T			
<i>Arbutus menziesii</i>				8				
<i>Acer macrophyllum</i>				5				
<i>Gaultheria shallon</i>					30			
<i>Holodiscus discolor</i>				5				
<i>Mahonia nervosa</i>					30			
<i>Rosa gymnocarpa</i>					T			
<i>Kindberia oregana</i>							5	
<i>Pteridium aquilinum</i>						T		
<i>Polytrichum juniperinum</i>							T	
<i>Rhytidiadelphus triquetrus</i>							T	
<i>Dicranum spp.</i>							T	
<i>Rubus discolor</i>				2	2			
<i>Hylocomnium splendens</i>							T	
<i>Gallium aparine</i>						T		
<i>Lactuca muralis</i>						T		
<i>Polystichum munitum</i>						5		Lower slope
<i>Symphoricarpus albus</i>					1			
<i>Vaccinium parviflorum</i>					T			
<i>Grass spp.</i>						5		
<i>Cytisus scoparius</i>				T				

<i>Lychnis coronaria</i>						T		
<i>Rubus ursinus</i>						T		
<b>Cover by Layer (%)</b>	Tree:		Shrub:	95	Herb:	15	Moss:	10

*Soils:*

Silty loam with 30 – 50% coarse fragments increasing to over 50% similar to polygon 20 in upper areas. Moder humus form with a thin Ah, very well drained.

*Wildlife and Wildlife Habitat:*

Observed during data collection: Raven, bald eagle

*Disturbance History:*

Logged approximately 15 years ago - thin soils are sensitive to compaction.

*Succession:*

The patchy appearance with dense stands of regenerating Douglas-fir and open rocky outcrops will continue for several decades until the canopies of large maturing trees begin to close in over rocky outcrop gaps. Dense regen areas will begin to lose diversity over the next 10 to 15 years and the dominant Douglas-fir canopies shade everything else out.

*Restoration Recommendations:*

Recommend removal of Scotch broom and Himalayan blackberry.

Recommend thinning of Douglas-fir in dense areas to increase tree growth and improve or maintain species diversity.

**Ecosystem 22**

**Description:** Young Red alder – salal dominated gently sloping south facing moisture receiving area. The polygon includes old logging access routes on its eastern and western edges and is characterized by relatively heavy disturbance and soil compaction with a central core of less disturbed young mixed red alder, Douglas-fir and western redcedar forest.

<b>Polygon ID:</b>	22	<b>Slope:</b>	5 - 10%	<b>Aspect:</b>	180°
<b>Structural Stage:</b>	SH	<b>Mesoslope Position:</b>	Mid slope	<b>Site Series:</b>	CDFmm/01-04
<b>Soil Nutrient Reg.:</b>	M-R	<b>Soil Moisture Regime:</b>	4	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Alnus rubra</i>	5	50						
<i>Abies grandis</i>				5				
<i>Thuja plicata</i>	5	5		2				
<i>Acer macrophyllum</i>		2						
<i>Psuedotsuga menziesii</i>		2		10				



<i>Gaultheria shallon</i>					45			
<i>Rubus spectabilis</i>					2			
<i>Polystichum munitum</i>						15		
<i>Mahonia nervosa</i>					5			
<i>Rubus parvaflorus</i>					T			
<i>Kindbergia oregana</i>							2	
<i>Kindbergia praelonga</i>							T	
<i>Achlys triphylla</i>						T		
<i>Urtica dioica</i>						3		
<i>Salix scouleriana</i>				T				
<i>Lonicera ciliosa</i>				T				
<b>Cover by Layer (%)</b>	Tree:	70	Shrub:	65	Herb:	20	Moss:	5

*Soils:*

Moder humus form with an Ah layer of variable thickness (0-5cm). Mineral soil has 20 to 35% coarse fragments, a sandy loam texture and a dark reddish brown hue. Soil is moderately to well drained and is moisture receiving from adjacent cliff/ridge areas.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed.

*Disturbance History:*

A wide strip (10 – 15m) area running down the northeastern side of the polygon was used as a skid road to access the creek area – deep ruts were observed. There is also an old logging road located on the southwestern edge of the polygon. Disturbance from logging and log hauling has likely resulted in the red alder dominance.

*Succession:*

Heavily disturbed road areas will remain dominated by red alder for 40 to 50 years – as the alder start to die and fall over, the Douglas-fir, grand fir and western redcedar waiting in the sub canopy will be released and gradually take over. The less disturbed central portion of the polygon will continue to grow into a multi-stories, mixed species young forest.

*Restoration Recommendations:*

None recommended.

**Ecosystem 23**

**Description:** Red alder – sword fern / salmonberry (CDFmm/12 – 80%) dominated pole forest with scattered young western redcedar and bigleaf maple. The site has a strongly fluctuating water table due to flat topography, dense relatively fine soils, and receiving moisture from adjacent cliff / ridge sites. The polygon is characterized by raised micro-sites scattered within and around its edges where there is less water table fluctuation in the rooting zone and the ecosystem more closely resembles a CDFmm/06 site series (20%) with no salmonberry and more salal.

<b>Polygon ID:</b>	23	<b>Slope:</b>	2 - 5%		<b>Aspect:</b>	320°	
<b>Structural Stage:</b>	PSb	<b>Mesoslope Position:</b>	Flat		<b>Site Series:</b>	CDFmm/12 (80%) CDFmm/06 (20%)	
<b>Soil Nutrient Reg.:</b>	VR	<b>Soil Moisture Regime:</b>	5f		<b>Photo Points:</b>		

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Alnus rubra</i>				40				
<i>Abies grandis</i>				T	T			
<i>Thuja plicata</i>	5		5	5				
<i>Acer macrophyllum</i>	5		5					
<i>Psuedotsuga menziesii</i>				1	T			
<i>Salix scouleriana</i>				20				
<i>Gaultheria shallon</i>					5			
<i>Rubus spectabilis</i>				20				
<i>Polystichum munitum</i>						50		
<i>Cornus stolonifera</i>				T				
<i>Plagiomnium insigne</i>							T	
<i>Kindbergia oregana</i>							3	
<i>Kindbergia praelonga</i>							3	
<i>Achlys triphylla</i>						3		
<i>Urtica dioica</i>						T		
<i>Carex opnupta</i>						1		
<i>Equisetum arvense</i>								
<i>Pteridium aquilinum</i>						2		
<i>Vaccinium parvaflorum</i>					T			
<i>Rubus ursinus</i>					T			
<i>Rubus discolor</i>				8	2			
<i>Sambucus racemosa</i>				2				
<i>Grass spp.</i>						6		
<i>Rubus parvaflorum</i>				T				
<i>Dicranum spp.</i>							T	
<i>Rhytidiadelphus loreus</i>							T	
<i>Gallium aparine</i>						T		
<i>Gallium trifidum</i>						T		
<i>Rubus laciniatus</i>				T	T			
<b>Cover by Layer (%)</b>	<b>Tree:</b>	20	<b>Shrub:</b>	90	<b>Herb:</b>	60	<b>Moss:</b>	10

**Soils:**

An underlying layer of moderately well drained sandy loam with a layer of sandy clay loam above with 10 to 15% coarse fragments. Very thick H and Ah layers combining to a depth of approximately 15cm. Moder humus form.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed.

Habitat: Moist area supports amphibians and shrubby thicket like salmonberry in fluctuating water table provides high quality bird habitat..

*Disturbance History:*

Logged approximately 15 years ago. Small areas where machinery was used extensively and possibly where logs were decked are scattered throughout this polygon – this has resulted in soil compaction and inhibited growth of native plants. These more heavily disturbed areas are often dominated by exotic grasses and blackberry thickets.

*Succession:*

Moving towards a young red alder dominated site with scattered individual large western redcedar and bigleaf maple trees. Western redcedar will gradually take over to form the dominant tree canopy with scattered Douglas-fir occurring on dryer micro-sites.

*Restoration Recommendations:*

None recommended.

**Ecosystem 24**

**Description:** Douglas-fir / grand fir / red alder - sword fern (CDFmm/06 – 60%) dominated gently sloped, moisture receiving pole forest site with a slightly drier soil area more characteristic of a CDFmm/04 site series (40%) mostly on the northwest side of the road that bisects the polygon. There are scattered young western redcedar and bigleaf maple trees scattered throughout the polygon.

<b>Polygon ID:</b>	24	<b>Slope:</b>	10%	<b>Aspect:</b>	320°
<b>Structural Stage:</b>	PSm	<b>Mesoslope Position:</b>	Mid slope	<b>Site Series:</b>	CDFmm/06 – 60% CDFmm/04 – 40%
<b>Soil Nutrient Reg.:</b>	R	<b>Soil Moisture Regime:</b>	4-5	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	2			30				
<i>Thuja plicata</i>	8			2				
<i>Alnus rubra</i>				15				
<i>Abies grandis</i>				25				
<i>Arbutus menziesii</i>				T				
<i>Acer macrophyllum</i>	5							
<i>Gaultheria shallon</i>					30			
<i>Holodiscus discolor</i>				10				
<i>Mahonia nervosa</i>					5			

<i>Rosa nootkensis</i>				T				
<i>Kindberia praelonga</i>							T	
<i>Pteridium aquilinum</i>						1		
<i>Rubus spectabilis</i>				5	1			
<i>Rhamnus purshiana</i>				T				
<i>Lonicera ciliosa</i>				T				
<i>Rubus discolor</i>				2	2			
<i>Salix scouleriana</i>				3				
<i>Achlys triphylla</i>							T	
<i>Lactuca muralis</i>							T	
<i>Polystichum munitum</i>							20	
<i>Symphoricarpos albus</i>						T		
<i>Rubus ursinus</i>						T		
<b>Cover by Layer (%)</b>	Tree:	15	Shrub:	85	Herb:	20	Moss:	1

*Soils:*

Silty clay loam overtop of a clay loam beginning at 30cm with 25 – 35% coarse fragments and a reddish hue. Mottling was observed below 30cm. The soils are characterized by a moder humus form and are moderately well drained.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed.

*Disturbance History:*

Logged approximately 15 years ago. Small areas where machinery was used extensively and possibly where logs were decked are scattered throughout this polygon – this has resulted in soil compaction and inhibited growth of native plants. There is a noticeable lack of coarse woody debris in this polygon.

*Succession:*

The ecosystem is moving towards a Douglas-fir – grand fir dominated young forest with scattered western redcedar and bigleaf maples and a very sparse understory due to shading from a dense canopy. The naturally regenerating stand will self thin over the next 70 to 100 years.

*Restoration Recommendations:*

Recommend a light thinning of Douglas-fir and grand fir poles to increase growth in remaining trees and to maintain diversity in the stand. Leave stems as additions to coarse woody debris on the site.

**Ecosystem 25**

**Description:** Western redcedar / bigleaf maple – sword fern (CDFmm/06) dominated mature forest mixed with disturbed areas including old logging roads and selectively logged patches where western redcedar, grand fir and western hemlock saplings are the dominant tree regeneration with a sword fern dominated understory.

<b>Polygon ID:</b>	25	<b>Slope:</b>	20% (concave)		<b>Aspect:</b>	55°
<b>Structural Stage:</b>	MFm	<b>Mesoslope Position:</b>	Lower slope		<b>Site Series:</b>	CDFmm/06
<b>Soil Nutrient Reg.:</b>	R - VR	<b>Soil Moisture Regime:</b>	6		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>	5	10						
<i>Thuja plicata</i>		25		5	T			
<i>Alnus rubra</i>			5					
<i>Abies grandis</i>		2	2	5	T			
<i>Tsuga heterophylla</i>				T				
<i>Acer macrophyllum</i>		20	2				T	
<i>Gaultheria shallon</i>					1			
<i>Trientalis latifolia</i>						T		
<i>Mahonia nervosa</i>					10			
<i>Kindbergia oregana</i>							3	
<i>Kindbergia praelonga</i>							2	
<i>Pteridium aquilinum</i>						T		
<i>Rubus spectabilis</i>				1	T			
<i>Climacium dendroides</i>							T	
<i>Plagiothecium undulatum</i>							T	
<i>Plagiomnium insigne</i>							1	
<i>Neckera Douglasii</i>							T	
<i>Achlys triphylla</i>						2		
<i>Lactuca muralis</i>						T		
<i>Polystichum munitum</i>						60		
<i>Vaccinium parvaflorum</i>					T			
<i>Rubus ursinus</i>					T			
<i>Isothecium myosuroides</i>								
<i>Metaneckera menziesii</i>							T	
<i>Rhytidiadelphus triquetrus</i>							T	
<i>Equisetum arvense</i>						T		
<i>Carex spp.</i>						1		
<i>Grass spp.</i>						1		
<i>Galium trifidum</i>						T		
<b>Cover by Layer (%)</b>	<b>Tree:</b>	65	<b>Shrub:</b>	25	<b>Herb:</b>	70	<b>Moss:</b>	10

**Soils:**

Moder humus form with small patchy Ae and thick Ah layers. Moderately well to imperfectly drained silty clay loam with a silty clay layer appearing roughly at 60 cm in depth where mottling is evident. Coarse fragment content is approximately 15 to 20%.

**Wildlife and Wildlife Habitat:**

Observed during data collection: Red-legged frog, raven, bard owl.

Habitat: Variety of large diameter coarse woody debris of varying decay class – excellent for amphibians breeding in nearby flooded areas.

**Disturbance History:**

Selective logging over the past 60 to 80 years along with a number of small clearings associated with meditation huts and other associated infrastructure as well as old logging roads and trails.

**Succession:**

The mixed species canopy will continue to mature and maintain a similar composition. The currently broadleaf dominated areas on the fringe of the lower slope bordering with the wetland will slowly transition towards a greater percentage of grand fir and western redcedar in the canopy.

**Restoration Recommendations:**

Recommend removal of the deteriorating hut structures and old building materials.

**Ecosystem 26**

**Description:** Maturing western redcedar / Douglas-fir – sword fern / Oregon beaked moss (CDFmm/04 – 80%) dominated forest characterized by sword fern dominated canopy gaps (often associated with laminated root rot (*Phelinus wierii*) scattered throughout the polygon’s dense conifer canopy and relatively barren forest floor. The polygon transitions to a Douglas-fir dominated canopy as it moves into a slightly shallower and coarser soiled upper slope CDFmm/01 (20%) ecosystem. The area is just beginning to develop mature forest characteristics as it transitions from a young forest.

<b>Polygon ID:</b>	26	<b>Slope:</b>	30%		<b>Aspect:</b>	65°
<b>Structural Stage:</b>	MFc	<b>Mesoslope Position:</b>	Mid slope		<b>Site Series:</b>	CDFmm/04 - 80% CDFmm/01 – 20%
<b>Soil Nutrient Reg.:</b>	R - M	<b>Soil Moisture Regime:</b>	2-3		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>		20	T					
<i>Thuja plicata</i>		50	5	1	T			
<i>Alnus rubra</i>			1					
<i>Abies grandis</i>		2		T				
<i>Acer macrophyllum</i>		4	T					
<i>Gaultheria shallon</i>					3			
<i>Trientalis latifolia</i>					T			
<i>Mahonia nervosa</i>					5			

<i>Kindbergia oregana</i>							25		
<i>Kindbergia praelonga</i>							1		
<i>Rhizomnium glabrescens</i>							T		
<i>Pseudotaxiphyllum elegans</i>							T		
<i>Achlys triphylla</i>							1		
<i>Lactuca muralis</i>							T		
<i>Polystichum munitum</i>							20		
<i>Vaccinium parvaflorum</i>					1				
<b>Cover by Layer (%)</b>	Tree:	80	Shrub:	10	Herb:	25	Moss:	30	

*Soils:*

Moder humus form with Ah layers. Moderately to well drained silty loam with a silty clay layer appearing roughly at 50 cm in depth along the lower slope edge of Polygon 25. Coarse fragment content is approximately 25 to 35% increasing to 35 – 50% towards the upper slope edge.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed.

*Disturbance History:*

The area was clearcut approximately 70 years ago – the stumps are low and almost all Douglas-fir. Prior to the clearcut, Douglas-fir would have occupied a much greater percentage of the canopy cover. The polygon appears to have naturally regenerated. Areas are scattered throughout where there appears to have been heavy soil disturbance from machinery.

Windthrow in areas affected by laminated root rot is the primary natural disturbance – the root rot gaps appear to be growing as die back in surrounding Douglas-fir canopies was observed.

Several meditation huts, sheds and trails are also located within the polygon.

*Succession:*

The stand is at the end of its young forest successional stage and is beginning to show mature forest characteristics resulting from root rot gap creation and the formation of a multi-storied canopy. The polygon will continue towards a mature forest as gaps and resulting understory diversity increase. The canopy will gradually move to a Douglas-fir dominated over the next century.

*Restoration Recommendations:*

Recommend removal of the deteriorating hut structures and unused shed structures.

**Ecosystem 27**

**Description:** Red alder – salmonberry dominated young forest characteristic of a seasonally flooded (WS53 – 45%) swamp interspersed with western redcedar / big-leaf maple areas occurring on very moist (CDFmm/11 – 40%) forest, and transitioning into a slightly drier (CDFmm/06 – 15%) lower slope ecosystem in a broad band along the gently sloping southern



edge and a narrow band along the toe of the adjacent cliff to the north.

<b>Polygon ID:</b>	27	<b>Slope:</b>	0-1%		<b>Aspect:</b>	160°
<b>Structural Stage:</b>	YFb	<b>Mesoslope Position:</b>	Depressio n		<b>Site Series:</b>	WS53 – (45%) CDFmm/11 (40%) CDFmm/06 (15%)
<b>Soil Nutrient Reg.:</b>	R-VR	<b>Soil Moisture Regime:</b>	7		<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Alnus rubra</i>		10	20					
<i>Abies grandis</i>							T	Drier CDFmm06 sites
<i>Thuja plicata</i>		5	5	2	1			
<i>Acer macrophyllum</i>		10						
<i>Psuedotsuga menziesii</i>	2							On raised micro-sites
<i>Gaultheria shallon</i>					5			On raised micro-sites
<i>Rubus spectabilis</i>				35				
<i>Polystichum munitum</i>						20		
<i>Stachys spp.</i>						T		
<i>Plagiomnium insigne</i>							2	
<i>Kindbergia oregana</i>							2	
<i>Kindbergia praelonga</i>							5	
<i>Achlys triphylla</i>								
<i>Urtica dioica</i>						2		
<i>Carex opnupta</i>						2		
<i>Equisetum arvense</i>						8		
<i>Atherium felix-femina</i>						1		
<i>Vaccinium parvaflorum</i>				T	T			
<i>Rubus ursinus</i>					T			
<i>Carex spp.</i>						8		
<i>Sambucus racemosa</i>				T				
<i>Oenanthe sarmentosa</i>						1		Flooded area
<i>Lactuca muralis</i>						T		
<i>Tellima grandiflora</i>						T		
<i>Porella navicularis</i>							2	On salmonberry branches
<i>Rhyzomnium glabrescens</i>							T	
<i>Climacium dendroides</i>							T	
<i>Rhytidiadelphus loreus</i>							1	
<i>Rhytidiadelphus triquetrus</i>							T	
<i>Plagiothecium undulatum</i>							T	
<i>Isothecium myosuroides</i>							2	
<i>Hylocomnium splendens</i>							T	

<b>Cover by Layer (%)</b>	Tree:	10	Shrub:	10	Herb:	95	Moss:	2
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*Soils:*

Clay with high organic content in the flooded areas transitioning to slightly raised where red alder are growing which have an upper silty clay horizon. Moder humus form with very low coarse fragment content (0-5%), imperfectly to poorly drained.

*Wildlife and Wildlife Habitat:*

Observed during data collection: red legged frog, piliated woodpecker heard.

Habitat: Salmonberry and water source extremely valuable for wildlife. Active beaver damming occurring above culvert on Lot 10.

*Disturbance History:*

The area was logged in the early to mid 20<sup>th</sup> century. The soil has been severely compacted where road access has occurred resulting in water collection and channelization in the old ruts. There are patches scattered throughout with evidence of heavier disturbance including a staging area where an old Douglas-fir snag with a 50 to 60 foot high burn scar may be evidence of an intense slashpile burn.

*Succession:*

Red alder is commonly the dominant tree species that regenerates after logging in wet soils – the alder will slowly be taken over by a higher percentage of western redcedar and big-leaf maple as the soils continue to recover. Red alder will persist on the sites in gaps and openings. The percentage of the area characterized by raised micro-sites will also increase allowing for slight increases in Douglas-fir and grand fir cover over time. This area may also move towards a flooded marsh ecosystem if beaver continue to expand their territory and construct more damns in this area (this seems unlikely due to the the broad, gradual slope of in this polygon with no easily dammable ‘bottlenecks’ observed).

*Restoration Recommendations:*

None recommended.

**Ecosystem 28**

**Description:** Sword fern dominated and scattered young western redcedar, big-leaf maple and red alder (CDFmm/06 – 90%) open recently logged lower slope with small patches of seasonally open salmonberry – slough sedge (carex obnupta) flooded wet soils (CDFmm/11 – 10%). There is no defined seasonal stream channel in this polygon with flow likely occurring below the surface.

<b>Polygon ID:</b>	28	<b>Slope:</b>	2 - 10%	<b>Aspect:</b>	160°
<b>Structural Stage:</b>	SH	<b>Mesoslope Position:</b>	Lower slope	<b>Site Series:</b>	CDFmm/11 (10%) CDFmm/06 (90%)
<b>Soil Nutrient Reg.:</b>	R	<b>Soil Moisture Regime:</b>	6-7	<b>Photo Points:</b>	

Vegetation Species	A1	A2	A3	B1	B2	C	D	Distribution Notes		
<i>Alnus rubra</i>			2	1						
<i>Abies grandis</i>				T	T					
<i>Thuja plicata</i>	2		3	T	T					
<i>Acer macrophyllum</i>	5									
<i>Psuedotsuga menziesii</i>				T						
<i>Gaultheria shallon</i>					2					
<i>Rubus spectabilis</i>					5					
<i>Polystichum munitum</i>						80				
<i>Cornus stolonifera</i>				T						
<i>Plagiomnium insigne</i>							T			
<i>Kindbergia oregana</i>							T			
<i>Kindbergia praelonga</i>							T			
<i>Achlys triphylla</i>						T				
<i>Urtica dioica</i>						2				
<i>Carex opnupta</i>						5				
<i>Equisetum arvense</i>						5				
<i>Pteridium aquilinum</i>						T				
<i>Vaccinium parvaflorum</i>				T						
<i>Rubus ursinus</i>					T					
<b>Cover by Layer (%)</b>	Tree:	10	Shrub:	10	Herb:	95	Moss:	2		

*Soils:*

Dark silty loam with high organic content, thick Ah and low coarse fragment content (10%).  
Seasonally moist.

*Wildlife and Wildlife Habitat:*

Observed during data collection: red legged frog, piliated woodpecker heard.  
Habitat: Salmonberry and water source extremely valuable for wildlife.

*Disturbance History:*

Soils have been heavily impacted from machinery during logging 15 to 20 years ago. Old stumps indicate a mature forest community dominated by large western redcedar with the odd Douglas-fir and grand fir scattered on micro-sites.

*Succession:*

Western redcedar will gradually increase in density and become the dominant cover with grand fir and Douglas-fir taking hold on appropriate microsites and maple remaining a minor component over the next 50 or 60 years. Sword fern will remain a dominant understorey cover though species diversity should increase as the tree canopy develops

*Restoration Recommendations:*

None recommended.

**Ecosystem 29**

**Description:** Douglas-fir / Arbutus – salal (CDFmm/01) regenerating pole forest with scattered patches of heavily disturbed soils near roads characterized by a higher percent cover of Himalayan blackberry (*Rubus discolor*), red alder and bitter cherry.

<b>Polygon ID:</b>	29	<b>Slope:</b>	10-20%	<b>Aspect:</b>	180-210°
<b>Structural Stage:</b>	PSm	<b>Mesoslope Position:</b>	Mid to upper slope	<b>Site Series:</b>	CDFmm/01
<b>Soil Nutrient Reg.:</b>	M	<b>Soil Moisture Regime:</b>	2-4	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>				25				
<i>Thuja plicata</i>				2	T		T	
<i>Alnus rubra</i>				7				
<i>Abies grandis</i>				5	T			
<i>Arbutus menziesii</i>			1	25				
<i>Acer macrophyllum</i>			1	T				
<i>Prunus emarginata</i>				2				
<i>Gaultheria shallon</i>					25			
<i>Mahonia nervosa</i>					10			
<i>Galium trifidum</i>						T		
<i>Kindberia oregona</i>							3	
<i>Pteridium aquilinum</i>						5		
<i>Grass spp.</i>						T		
<i>Lonicera hispidula</i>					2			
<i>Lonicera ciliosa</i>				T				
<i>Rubus discolor</i>				5	3			
<i>Cytisus scoparius</i>				T	T			
<i>Achlys triphylla</i>						T		
<i>Polystichum munitum</i>						1		
<i>Rubus ursinus</i>					T			
<b>Cover by Layer (%)</b>	<b>Tree:</b>	2	<b>Shrub:</b>	90	<b>Herb:</b>	7	<b>Moss:</b>	5

**Soils:**

Mor humus form with a charred layer in patches where slash piles were burnt after logging. Silty loam over top of a silty clay loam with approximately 25 to 35% coarse fragment content. Some orange/red mottles observed between 30 and 40 cm deep. Coarse fragments increase towards the upper slope areas. Well drained.

**Wildlife and Wildlife Habitat:**

Observed during data collection: none observed.

*Disturbance History:*

Clearcut approximately 16 years ago in 1993 or 94. Slash burn is indicated by scattered patches of charred material in soils and remaining coarse woody debris on site is charred. The site appears to have been left to naturally regenerate. Machine use on the site has disturbed the soils in general and has left scattered areas of higher disturbance where staging areas or access routes were located.

*Succession:*

Patches of dense Douglas-fir and grand fir are mixed with well spaced Douglas-fir, Arbutus and red alder dominated areas. Diversity will decrease over the next several decades with Douglas-fir emerging as the sole dominant tree species and forming a continuous canopy over a large portion of the area with very little understory cover. Self thinning will begin in 15 to 20 years and continue for another 40 to 50 years when mature forest characteristics such as canopy gaps, a diverse understory and a multi-layered, multi-species canopy will begin to emerge.

*Restoration Recommendations:*

Recommend thinning treatments over time to maintain tree diversity in the stand. Remove individual and clusters of Douglas-fir as they begin to shade out other trees and understory vegetation over the next 10 to 20 years. This area could provide an ongoing sustainable supply of timber as the forest ages.

**Ecosystem 30**

**Description:** Douglas-fir / salal (CDFmm/01) mature forest on a northeast facing moderately sloped site. Douglas-fir trees in the main canopy are approximately 150 years old and the ecosystem exhibits the structural characteristics of a maturing to old-growth forest.

<b>Polygon ID:</b>	30	<b>Slope:</b>	38%	<b>Aspect:</b>	45°
<b>Structural Stage:</b>	MFc	<b>Mesoslope Position:</b>	Mid to upper slope	<b>Site Series:</b>	CDFmm/01
<b>Soil Nutrient Reg.:</b>	M	<b>Soil Moisture Regime:</b>	2-3	<b>Photo Points:</b>	

<b>Vegetation Species</b>	<b>A1</b>	<b>A2</b>	<b>A3</b>	<b>B1</b>	<b>B2</b>	<b>C</b>	<b>D</b>	<b>Distribution Notes</b>
<i>Pseudotsuga menziesii</i>								
<i>Thuja plicata</i>								
<i>Arbutus menziesii</i>								
<i>Acer macrophyllum</i>								
<i>Gaultheria shallon</i>								
<i>Mahonia nervosa</i>								
<i>Lonicera hispidula</i>								
<i>Lonicera ciliosa</i>								
<i>Symphoricarpos alba</i>								
<i>Polystichum munitum</i>								

<i>Kindberia oregona</i>								
<i>Dicranum scoparium</i>								
<i>Rhytidiadelphus triquetrus</i>								
<i>Kinbergia praelonga</i>								
<i>Hylocomnium splendens</i>								
<i>Isothecium myosuroides</i>								
<b>Cover by Layer (%)</b>	<b>Tree:</b>		<b>Shrub:</b>		<b>Herb:</b>		<b>Moss:</b>	

*Soils:*

Range from approximately 60cm in depth to over 75cm in depth before hitting a shattered bedrock horizon. The depth of the soil corresponds generally to the position on the slope with the shallower areas occurring closer to the ridge top. High coarse fragment content (45% near the surface to over 70% at 70cm in depth). Rapidly drained.

*Wildlife and Wildlife Habitat:*

Observed during data collection: none observed.

*Disturbance History:*

Evidence of single tree selection (Douglas-fir) logging and trail up to the pagoda were observed. Wind is the most prevalent natural disturbance on the site. Relatively recent (last 10 to 20 years) windthrow was observed in the area. Fallen trees were generally perpendicular to the slope pointing downhill, indicating that winds blowing from the west are primarily responsible for the disturbance. Broken tops were observed on the upper slope area near the ridge top.

*Succession:*

This site will continue to develop structural and functional complexity as it moves towards an old-growth climax forest.

*Restoration Recommendations:*

No recommendations.

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