NORTH COAST LEVEL R TERRESTRIAL ECOSYSTEM MAPPING

(LANDSCAPE UNITS: KAIEN, QUOTOON, SCOTIA, BROWN, KUMEALON, HEVENOR)

PROJECT FINAL REPORT

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Service Request
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1.0 INTRODUCTION

After a successful proposal submission, the Ministry of Environment (MOE) has issued Ecora Resource Group Ltd. (Ecora) a General Services Agreement (GSA) to complete Terrestrial Ecosystem Inventory (TEI) and Mapping Services. The MOE issued a Service Request (SR) in July 2012 to complete services related to the North Coast Ecosystem Inventory and Mapping (Northern Section). The service request is for the completion of the Terrestrial Ecosystem Mapping (TEM) Level R inventory covering six Landscape Units (LUs).

The following services are included in the SR:

1. Development of a project plan;
2. Project management;
3. Project administration;
4. Image search and acquisition;
5. Field sampling;
6. Ecosystem mapping; and
7. Digital data capture.

1.1 Background

TEM is the stratification of a landscape into ecological map units, according to a combination of features including climate, physiography, surficial material, bedrock geology, soil, and vegetation (RIC, 1998). The method used to create TEM products was standardized by the province of BC to allow for consistent and high quality mapping deliverables to be produced around the province. Numerous TEM projects have been produced in the past decades for a variety of purposes.

The main difference between the various TEM projects of the past is survey intensity, also called field sampling intensity. It is generally assumed that greater field survey intensity improves map reliability, given the same level of mapper's experience and mapping skills. The TEM Standards (RIC, 1998) recommend 6 different levels of survey intensity, ranging from all TEM mapping polygons to be field verified (Level 1) to minimal or zero polygon visitation (Level R). The selection of survey intensity level is determined by a number of factors such as project size, utility of the mapping products, timeframe requirement and the resources available to the project.

1.2 Project Objectives

The project area is located within the Coast Region of British Columbia, North Coast Forest District. The primary objective of the mapping project is to improve the provincial coverage of Ecosystem Inventory and Mapping information in order to best inform land base investment and resource management decision-making. Emphasis is currently focused on the implementation of the Ecosystem Based Management (EBM) Land Use Orders (LUOs) on the coast and mid-term timber supply issues in the central Interior BC. A secondary objective is to maintain a healthy and competitive environment within the TEI professional community.

Based on the project size and funding availability, MOE has requested Ecora complete a Level R survey intensity TEM following existing RISC and TEI standards for the selected LUs.

1.3 Project Scope and Variances

The scope of the project is based on the following considerations:

1. Survey Intensity Level R with approximately 2% ratio of inspection points to polygons;
2. The TEM includes all forested and non-forested ecosystems, excluding large water features (inlets, lakes, etc.) already mapped through TRIM;
3. Average polygon size of approximate 20 ha with minimum polygon size of 0.5 ha;
4. TEM polygon attribution does not include bioterrain attributes; and
5. All other aspects of the TEM follow applicable RISC and TEI standards.

1.4 Project Area Description

The project area includes six LUs and is approximately 229,000 ha, excluding large water features such as inlet and large rivers and lakes etc. The geographical location of the six LUs is presented in Figure 1.1. The size and ecological conditions of the LUs are summarized in Table 1.1.

The six LUs include Kiaen, Quottoon, Scotia, Brown, Kumealon and Hevenor. The project area spans from lowland in the west to steep mountains in the east, with many rugged hills in-between. The elevation ranges from sea level to approximately 1200m. Although the poor bedrock type is still dominating all LUs, there are considerable amounts of medium to rich bedrock in the project area, particularly within Kiaen, Quottoon, Kumealon, and Hevenor (Table 1.1). In combination to the significant percentage of moderate to steep slopes, the forests in the project area are expected to be fairly productive. Major tree species include: western hemlock, western red-cedar, mountain hemlock, Amabilis fir and Sitka spruce, with insignificant occurrences of red alder and black cottonwood.

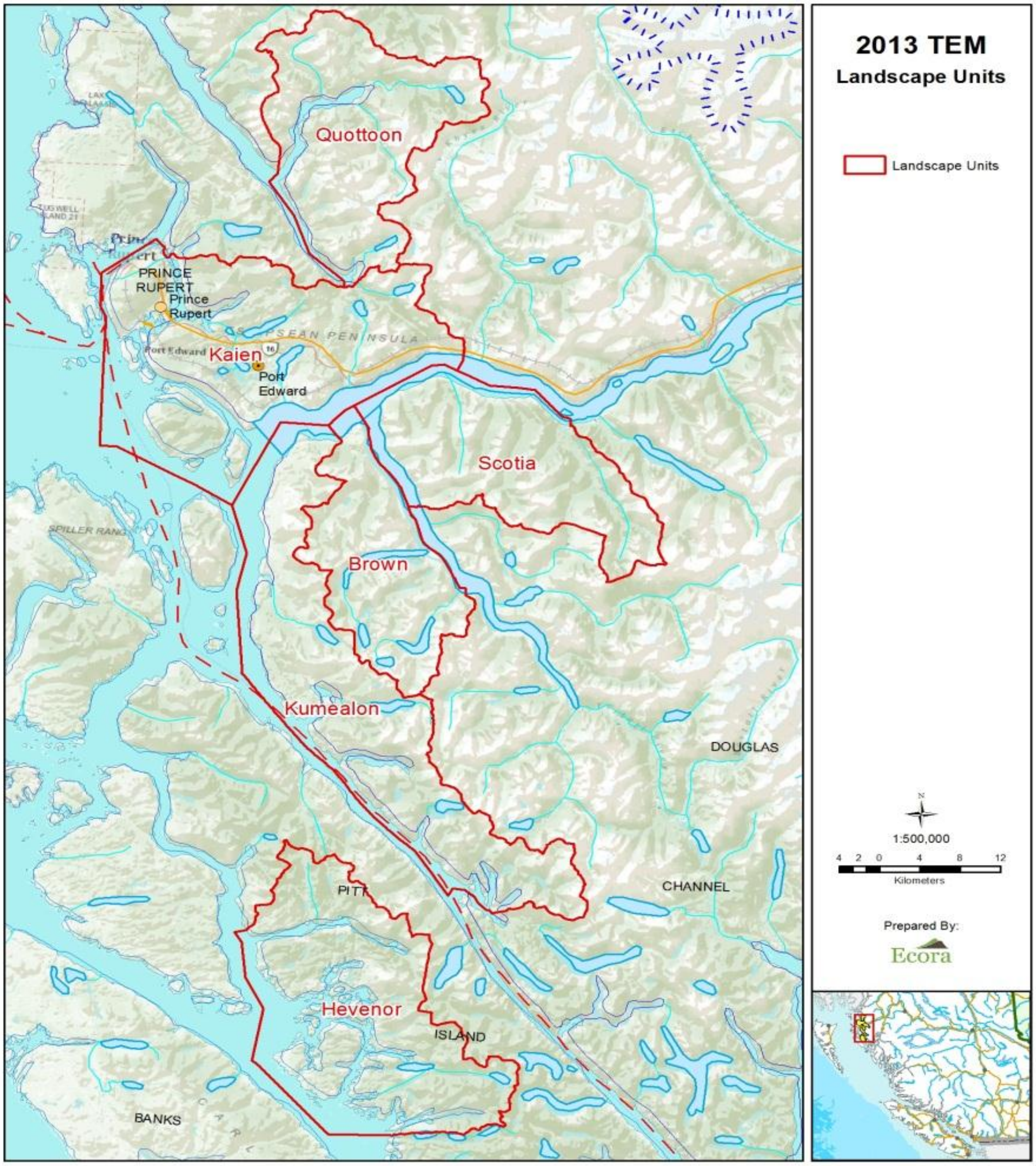

Figure 1.1: Overview of Project Area by LU

Table 1.1: Ecological Conditions by LU

Category	Kaien	Quotoon	Scotia	Brown	Kumealon	Hevenor	Total (ha)
Total Area (ha)	65,943	40,583	37,173	28,442	58,325	54,152	284,618
CWHvh2	54,177	6,641	3,119	2,027	40,128	47,201	153,293
CWHvm1	190	4,682	9,567	7,011	5	0	21,455
CWHvm2	1	5,880	8,152	8,397	195	0	22,625
MHwh1	7,423	2,887	824	388	8,211	4,592	24,325
MHmm1	0	6,769	6,260	5,420	166	0	18,615
MHwhp	4,112	3,865	888	913	8,837	2,359	20,974
MHmmp	16	6,417	7,123	4,047	259	0	17,862
CMAun	24	3,441	1,242	239	524	0	5,470
Slope 0-35.0%	42,313	11,044	12,394	10,347	31,714	31,761	139,573
Slope 35.1-70.0%	17,800	15,823	15,906	10,862	18,475	16,163	95,029
Slope 70.1-100.0%	4,393	8,137	5,982	4,735	5,571	4,998	33,816
Slope 100.0% +	1,437	5,579	2,891	2,497	2,647	1,462	16,513
Bedrock-rich (ha)	18,305	2,046	0	0	26,702	0	47,053
Bedrock-med. (ha)	13,974	19,629	13,319	0	1,624	29,665	78,211
Bedrock-poor (ha)	33,665	18,908	23,854	28,442	30,081	24,718	159,668

1.5 Project Team

The project was initiated and managed by Sari Sauders of Ministry of Forests, Lands, and Natural Resources Operations (MFLNRO), and Corey Erwin (MOE). The project mapping team includes Shikun Ran, Dan Bernier, Tom Braumandl, Robyn Laubman (all from Ecora), and Dave Yole (an independent consulting ecologist). Expert knowledge and quality assurance were provided by Allen Banner (Banner Consulting). GIS support and mapping services were provided by David Myers of Ecora. Madrone Consultants Ltd., working on LUs adjacent to the Ecora project area, provided initial elevation rules for large scale BGC mapping and edge matching polygons between Ecora and Madrone project areas.

2.0 METHODS

2.1 Data Assembly and Information Digest

Several important sources of data and information were assembled for the purpose of the TEM project:

- Digital aerial photo images and Purview® files;
- DEM (Digital Elevation Model);
- Vegetation Resources Inventory (VRI) coverage;
- Provincial BGC (version 8.0) and Ecosection maps;
- Provincial ecosystem map codes (2006);
- Bedrock geology map (1:250,000 scale);
- BC provincial BEC database plots that fall into the project area;
- Regional field guides for ecosystem identification and interpretation (Banner *et al*. 1993, Green and Klinka 1994);
- North Coast PEM project (Shamaya Consulting, 2003)

The map unit concept forms the basis of ecological mapping. As part of the information digest, the map unit concept was compiled using information from a variety of sources including ecosystem field data, regional field guides, and expert knowledge etc.

There are significant numbers of existing Provincial BEC field plots in the mapping areas but the spatial accuracy for many of them is questionable due to the unavailability of GPS technology in early era of the BEC data collection. However, the plots constitute a useful source of data for site series/map unit concept verifications. The North Coast TSA PEM (Shamaya, 2003) and related map accuracy assessment have also established a number of field plots which were assembled (provided by Allen Banner of the Banner Consulting).

2.2 Large Scale Biogeoclimatic Mapping

Large scale BGC mapping was completed on this TEM project. Initial rules for elevation breaks of all occurring BGC units were provided by the mapping team of the Madrone Consultants Ltd. who worked in the adjacent LUs to the Ecora project area. After reviewing the rules against Ecora project area field data and images, majority rules were considered reasonable except subalpine parkland boundary where the proposed elevation break was considered too low. After discussions with Sari Saunders, Allen Banner, and Madrone ecologists, the elevation break for the parkland boundary was raised and rules were consistently applied to both project areas (i.e., Madrone and Ecora).

In existing provincial BGC mapping, (version 8.0) there is a set of hard lines which divide outer coast BGC units (i.e., CWHvh2, MHwh1, MHwhp) from inner coast BGC units (i.e., CWHvm1, CWHvm2, MHmm1, MHmmp). The hard lines were all directly transferred to the current project from the large-scale BGC mapping, since there was inadequate field data and information to change the location of the divides. On either side of the divide, corresponding BGC elevation rules were consistently applied to the project area.

The 2nd set of BGC hard lines in the provincial BGC (version 8.0) are intended for cold air associated with certain topography. For example, CWHvm1 may occur in a deep cold valley based on a simple elevation rule. In reality, the cold deep valley will be replaced by CWHvm2 or even occasionally by MHmm1. This 2nd set of hard lines was also transferred to the new mapping, unless field data revealed different results.

All modeled BGC lines of the raster format were smoothed in order to be compatible to TEM polygon lines.

2.3 Polygon Delineation

The Softcopy PurView® system was used for polygon delineation. The PurView® system is a mature technology which has been used as a standard for polygon delineations of BC's VRI projects. There have also been many TEM projects completed using the Purview® system across BC. The system has the obvious advantage of delineating polygons at any required scale, in addition to the benefits of being user-friendly and efficient for edge-matching and/or edge tie to adjacent mapping projects of a similar nature. Digital data capture using Purview is generally superior to monorestitution as it is more cost effective and allows the ecologist full control of all line locations.

The revised BGC lines by this project (section 2.2) and TRIM water features were incorporated into the base map for polygon delineation. Water features were modified only if significant discrepancy was revealed by the PurView® images. There were also minor BGC line modifications during the polygon delineation. The BGC polygons were deleted if the polygon size was considered too small, i.e., smaller than average polygon of the proposed ecosystem units - 20 ha. When BGC lines bisect certain unique landscape features of small size such as water body, wetland, and rock outcrop etc. the lines were moved to snap to the feature polygon boundary in order to maintain the feature integrity.

To aid polygon delineation, field data sources and several reference map products were provided digitally to the mapping ecologists, such as slope gradient map, aspect map, VRI map, and bedrock geology map etc. It was expected that the availability of the reference materials and data sources would significantly enhance delineation quality of the polygons. To be consistent amongst all the mappers, a technical document was developed to provide clear and specific requirements about the delineation outcome. The document also outlines delineation criteria, focuses, polygon size requirements and the recommended uses of the reference materials etc.

Prior to polygon delineation, direction was given to all the mapping ecologists that larger than average polygon size would be mostly used for lowland wetland complexes such as bog and bog woodland complexes, and alpine ecosystem unit complexes such as rock, meadow, shrub, krummholz etc. During the delineation process, special attention was paid to riparian ecosystems such as fluvial benches, alluvial fans, surface seepages, colluvium cores etc.

2.4 Field Sampling

Field sampling is an important phase of the TEM project for the following reasons:

- Provides opportunity for mapping ecologists to familiarize themselves with the project landscape;
- Verifies pre-defined mapping concepts for site series/ecosystem units;
- Collects data for local calibration of aerial photo interpretation;

- Provides data for site series/ecosystem unit description in reports; and
- Verifies BGC units and corresponding boundaries.

Field work was completed during the period of August 22 – 29th, 2012 by two field crews led by Shikun Ran and Dan Bernier. Two field assistants from Ecora also participated: Robyn Laubman and Krysta Giles-Hansen. Field work was initiated with field calibration on the first day for all field crew members. The calibration included data collection standards and understanding and interpretation of site series concepts. Several field plots were established for the purpose of calibration.

Due to access restrictions, helicopter access was used for all field data collection with the exception of the field calibration day. The weather conditions during the field work were considered fair to poor with clouds capping the upper elevations of the mountains most sampling days. There was limited access to upper elevation BGC units during the sampling period.

With limited numbers of plots over a large geographic area, several factors were given special consideration during the sampling period:

- Sampling a wide range of ecosystems and topographic features;
- Greater proportions of samples were allocated to map units or BGCs with the least conceptual knowledge and/or existing data; and
- Samples were placed in each LU and all BGC units.

Each field crew was equipped with Garmin GPS unit, iPad loaded with digital BGC lines, ortho maps, TRIM contours etc. GPS coordinates were taken at the centroid of each plot and weather permitting a plot photo was also taken at each plot location. All field plots were ground calls and there were no air-calls conducted during the project. A field transect approach was used for the data collection. The sampling crews were dropped by helicopter in a higher elevation site and picked up at a lower elevation site each day. Depending on the transect length and weather conditions, the field crews were moved to multiple locations within one day. In the evening, all crew members were worked on the additional tasks such as plot cards review and editing, identifying unknown plant species, discussing sampling findings, and exchanging sampling experience etc.

Data collection standards followed TEM Inventory Standards (RIC, 1998) and the Field Manual for Describing Terrestrial Ecosystems, LMH No. 25, 2nd edition (2010). All indicator species regardless of percent cover were recorded, and other species greater than 1% cover were recorded on the GIF plot cards. In quick visual plots, the presence of ecosystem units (site series) was recorded, as well as key site, soil and vegetation features. Structural stage and approximate composition of over-story tree species composition and estimates of tree productivity were also noted to aid the identification of photo-signatures during classification.

All field data collected was digitally captured using standard software. VENUS (5.1) with “validation on” was used for capturing all ecosystem full plot and GIF data while MS Excel was used for capturing visual plot data. All field plot locations were mapped using recorded GPS coordinates. Photographs taken at each of the plot locations were geo-referenced to assist in the classification stage.

2.5 TEM Polygon Attribution

A variation to TEM Standards (RIC, 1998) was applied to the polygon attribution process of the TEM. Bioterrain and related attributes were not captured during the process of polygon attribution. All other TEM core attributes including site series, ecosystem units, site modifiers, and structural stages per list by the TEM Inventory Standards (RIC, 1998), were captured during the process of photo interpretation.

Polygon attribution is a critical step to ensure final ecosystem inventory products of sufficient quality and reliability. To ensure a high-quality end product, the following measures were implemented during photo interpretation:

- *Clarity of map unit concept*: Prior to the photo interpretation, mappers/photo interpreters must have a clear understanding of mapping concepts for individual map units or site series. It is important for the mappers to consistently apply the mapping concepts to the entire project area, adjusting the concept locally if field data suggests a variation. A table of the mapping concept for all site units was developed and was available to all mappers. The concepts were developed using a variety of data and information including ecosystem field data, regional ecosystem field guide, expert knowledge etc.
- *Technical workshop*: For a large size TEM project such as the one completed, an internal technical workshop prior to the polygon attribution was considered valuable. The workshop would provide the opportunity to discuss a range of issues including the individual's responsibility and accountability, clarifying the mapping concepts for individual site units, mapping experience exchange, quality assurance procedures and expectations etc. The internal workshop was attended by all mapping ecologists.
- *Mapping consistency:* Mapping consistency is the single most important factor affecting thematic accuracy of a map product. Past projects from TEM or other land base inventory have showed that the mapping consistency issue existed not only amongst different mappers, but also within a single mapper working in different parts of the project area or at a different time. Unfortunately, many of these issues can't be eliminated due to human nature. Our effort was to minimize it using a variety of means such as providing mappers with a variety of reference materials in digital format. The digital reference materials provided by this project include slope gradient map, aspect map, VRI map, bedrock geology map, North Coast PEM map. The use of Purview® system makes the utility of the digital reference maps feasible and convenient.

  It is always preferential that the mapping proceeds by BGC unit, i.e., complete one BGC unit before moving to next one. This is an important strategy to improve consistency within a single mapper. Although each mapping ecologist was assigned independent LU in the current project, the mapping order proceeded by BGC unit within the assigned LU. No multiple mappers worked in a single LU.

- *Quality Assurance (QA)*: QA is an important means to ensure mapping consistency between mappers. In addition to internal quality reviews conducted regularly by the TEM technical lead, Shikun Ran, external quality assurance was also conducted by Allen Banner, an ecological expert in coastal ecosystems Allen worked with the mappers for a week in the Ecora head office in Kelowna. All mapping concepts were reiterated and a portion of polygons attributed by each mapper was reviewed by Mr. Banner. All issues revealed through the review process were documented and discussed with each respective mapper. The external QA process of the project occurred in the initial stage of mapping to ensure all comments from the QA reviewer could be effectively incorporated into the remaining areas of the mapping.

2.6 Digital Mapping and Deliverables

All digital mapping followed relevant RIC/RISC and provincial TEI Standards. A map legend that follows the TEM convention was developed. ECP and ECI coverages and corresponding database and metadata were also produced in geo-database format, according to the provincial TEI standards. Our rigorous QA processes on our deliverables ensure error-free final products.

A final report, at the conclusion of the project, was produced to describe project objectives, project area ecological conditions, project methodology, results and discussions, and recommendations. An expanded legend was also developed. The expand legend utilized a variety of data information including ecosystem field data (existing and the project collected), the regional field guide (Banner et al. 1993), and expert knowledge of the map units (i.e., Mr. Banner and other senior ecologists from Ecora).

Following the digital mapping, the following products were delivered:

1. Approved work plan (pdf);
2. Project final report (pdf);
3. QA sign-off form (pdf);
4. FS882 and GIF plots (Venus 5.1);
5. Quick visual plots (xls);
6. Scanned copy of all field cards (pdf);
7. Map Legend (pdf) (also attached to the project final report);
8. Expanded Legend (pdf) (also attached to the project final report); and
9. Spatial data set in ESRI File Geo-database (GDB) format with full attributes (embedded) as per required templates. One spatial data set was provided for the entire project area (no mapsheet tiles or LU boundaries).

All files were placed in a single ZIP file for delivery, with the appropriate directory structures within.

2.7 Technical Standards and Variances

We will complete the TEM and deliver the products consistent with the following standards:

- Standard for Terrestrial Ecosystem Mapping in British Columbia (1998);
- Terrestrial Ecosystems Information – Digital Data Submission Standard - Draft for Field Testing; Version 1. (2010);
- Standard for Terrestrial Ecosystem Mapping - Digital Data Capture in British Columbia, Version 3.0 (2000);
- Standard for Terrestrial Ecosystem Mapping - Digital Data Capture in British Columbia, Version 3.0, Errata (2004);
- Field Manual for Describing Terrestrial Ecosystems, LMH No. 25, 2nd Edition (2010);

- Terrestrial Ecosystems Information – Guidelines for developing a project plan (2010);
- Quality Assurance Guidelines for Terrestrial Ecosystem Mapping (2003);
- Quality Assurance Guidelines for Terrestrial Ecosystem Mapping – Digital Data Capture (2003);
- Quality Assurance Guidelines for Describing Terrestrial Ecosystems in the Field (DTEIF) (2003); and
- Provincial Site Series Map Codes (2006).

The following variance to TEM standards is identified for this project:

- TEM polygon attribution does not include bioterrain attributes.

3.0 Results and Discussions

The section describes the results of the North Coast TEM completed by Ecora and discusses the results.

3.1 Polygon Size

An average polygon size of 20.4 ha has been achieved by the TEM project, consistent with the Ecora proposed average polygon size. However, when non-forested ecosystem units are included, the average polygon size increases considerably (23.5 ha). It mainly caused by large water body polygons such as ocean (at 31,275 ha, the largest polygon over the project area), Skeena River, and many large lakes. The largest polygon for forested ecosystems is approximately 350 ha, which is a bog and bog woodland complex. The smallest polygon (water feature in alpine) is approximately 0.21 ha. Overall the polygon size statistics are consistent with the original mapping intention which stated that larger than average polygon sizes would be mostly used for low land wetland complex and subalpine/alpine rock and heath complex.

3.2 Field Sampling Distribution

A total of 238 field sample plots were established during the sampling period. The distribution of the plot type based on data documentation standards was:

- FS882 (ecosystem full plots): (12 plots);
- Ground inspection form (GIF): (47 plots); and
- Quick visuals: (179 plots).

The 238 field plots were distributed in approximately 31 transect locations (Figure 3.1). The 31 transects intersected 100 polygons, indicating multiple field plots within a single TEM polygon. The distribution of the field plots by BGC and site units are presented in Table 3.1.

Several factors have contributed to the result of single TEM polygon with multiple field plots:

- *The availability of TEM polygons*: there were no TEM polygons available for the field sampling. The TEM project was initiated when field season has started. With significant time and effort required for the PurView® image acquisition and project planning, no TEM delineation was completed prior to the field sampling. The field sampling adopted a transect approach and sampling plots were established when ecosystem change was detected along a given segment of the transect.
- *Average polygon size*: the 19-20 ha average polygon size is larger than the ones in a typical TEM project of comparable scale (1:20,000). However, the average polygon size of a TEM project is directly related to the cost of the TEM. With limited project resources, 19-20 ha polygon size was pre-determined and considered appropriate.
- *Ground sampling challenge*: all field sample plots were ground collected by this project. However, ground-truthing has always been challenging in coastal ecosystems due to steep and rugged terrain with heavy brush. Only limited distance of the ground can be covered in a field day.
- *Ecological complexity*: the frequent change of ecosystems in a given transect requires significant time and effort to document. Although significant numbers of

plots (i.e., ecosystem changes) were established by each transect, delineation of discrete ecosystem units as revealed by the transect data is not feasible during the polygon delineation stage.

Although ground plots may provide higher data reliability and quality, the number of points inspected in a given time can be limited. On the other hand, extensive use of helicopter for air calls can be very expensive, as well as lowering data quality. It is recommended that future sampling in similar ecosystems use a balanced approach of ground sampling and air-calls. For example, air-calls can be used for some obvious ecosystems such as devil's club, skunk cabbage, and ecosystems characterised by certain combination of tree species. When a transect approach is used, sampling of several short transects or multiple geographic locations in a given day are a preferable method.

The distribution of sample site units, as shown in Table 3.1 is considered reasonable. As stated previously, poor weather conditions during the sampling period led to lower sampling intensity of the higher elevation units, particularly the parkland units. There was also a tendency for over-sampling of bog woodland units, which might be attributable to helicopter access, i.e., both drop-off and pick-up sites were near or within the bog woodland complex. Due to safety concerns, the field crews also tended to walk down a mountain through less steep slopes where the occurrence of bog woodland units is relatively common.

Table 3.1: Distribution of Site Series and Ecosystem Units BGC Units

Site Unit	CWHvh2	CWHvm1	CWHvm2	MHwh1	MHmm1	MHwhp	MHmmp	Total
01	32	10	11	3	1	-	-	57
02	1	-	-	1	-	-	-	2
03	1	-	-	-	6	-	-	7
04	8	-	-	2	-	-	-	10
05	0	7	-	-	1	-	-	8
06	10	-	-	-	2	-	-	12
07	4	-	-	-	-	-	-	4
08	-	3	1	16	-	-	-	20
09	-	7	1	-	-	-	-	8
10	-	3	4	-	-	-	-	7
11	17	3	4	-	-	-	-	24
12	30	6	-	-	-	-	-	36
13	-	7	-	-	-	-	-	7
14	-	2	-	-	-	-	-	2
Other	2	12	6	0	1	4	9	34

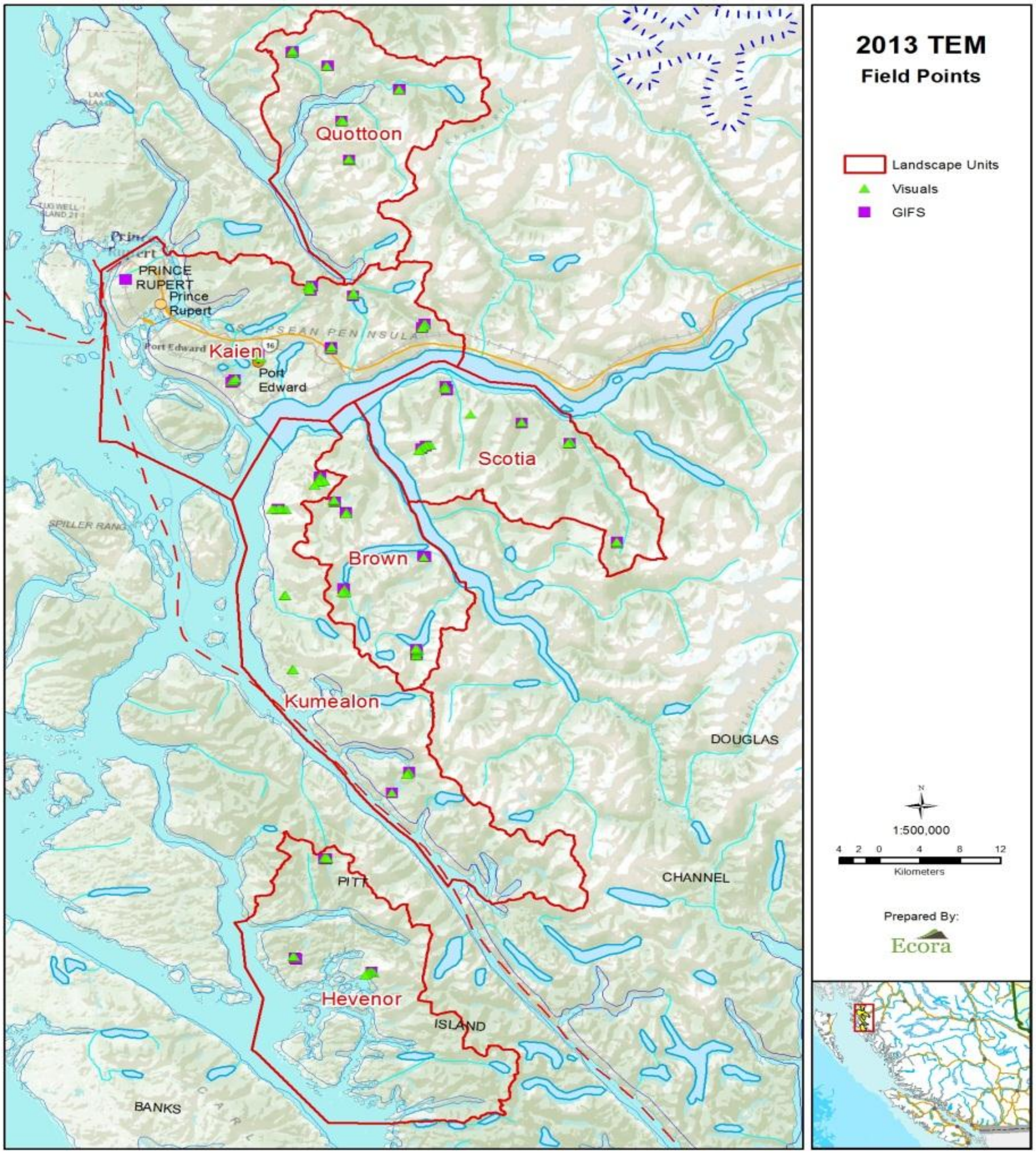

Figure 3.1: Distribution of Field Sampling Transects

3.3 Biogeoclimatic Classification

Table 3.2 documents specific elevation rules implemented by the Ecora mapping team during the revision of BGC boundaries. The documented rules were a result of consulting the government ecologists and coordinating with other mapping firms (Madrone, Blackwell) working in adjacent LUs with similar BGC units. The total area changes of BGC units after implementing the new elevation rules are shown in Table 3.3.

The largest change in BGC units, in terms of net area, occurred in CWHvh2, while the largest percentage change, based on the original BGC landmass, occurred in subalpine parkland. Both changes are not unexpected since the CWHvh2 has the largest land base and accounts for approximately 60% of the total project area. Relatively minor revision of the BGC elevation would result in large change of absolute area. As for parkland units, a major change in elevation rules occurred, i.e., from original (i.e., BGC version 8.0) 740 m to the current 660 m. During the process of polygon attribution, it was felt that the 660 m elevation rule is somewhat overly aggressive, which is supported by the large area (ha) of MB (closed canopy forest) site unit in the parkland units (see Table 3.5). It was also found that the elevation breaks for parkland units varied with the types of bedrock, which may indicate that the bedrock has a modifying effect on regional climate. In general, the 660 m elevation break is suitable for the areas of poor bedrock type. For medium and rich bedrock types, an elevation rule of 700-720m is more appropriate.

Table 3.2: Elevation Rules Implemented for Biogeoclimatic Revision

Landscape Unit	CWHvh2	MHwh1	MHwhp	CWHvm1	CWHvm2	MHmm1	MHmmp	CMAun
Henenor	0-460 m	460-660 m	> 660 m	-	-	-	-	-
Kumealon	0-460 m	460-660 m	660-1100 m	-	360-600m	600-800m	>800m	>1100 m
Kaien	0-460 m	460-660 m	> 660 m	0-360m	360-600m	600-800m	>800m	>1100 m
Brown	0-460 m	460-660 m	> 660 m	0-360m	360-600m	600-800m	>800m	>1100 m
Scotia	0-460 m	460-660 m	> 660 m	0-360m	360-600m	600-800m	800-1100m	>1100m
Quottoon	0-460 m	460-660 m	>660 m	0-360m	360-600m	600-800m	800-1100m	>1100m

Table 3.3: Area Changes Before and After Biogeoclimatic Revision

BGC Unit	CWHvh2	MHwh1	CWHvm1	CWHvm2	MHmm1	MHwhp	MHmmp	CMAun
Version 8.0 (ha)	164,312	20,859	22,009	24,938	20,207	13,431	13,895	4,966
New TEM version (ha)	153,293	24,326	21,454	22,625	18,615	20,974	17,861	5,469
Area Change (ha)	-11,019	7,543	-555	-2,313	-1,592	7,543	3,966	503
% Change (ha)	-6.7	16.6	-2.5	-9.3	-7.9	56.2	28.5	10.1

3.4 Site Series and Ecosystem Units Distributions

The description of the mapped site units for all BGC units of this project is appended in Appendix 1.

Table 3.4 and Table 3.5 show the gross area distribution of mapped BGC site units. The area distribution provides a summary of ecosystem presence, absence, and abundance within the TEM project area.

Site series proportions of all forested BGC units are considered reasonable based on the general ecological conditions (Table 1.1) of the project area and mappers' understanding of the local ecological land base. For example, site series proportion for CWHvh2/04 seems abundant, however after considering the amount of medium and rich bedrock types within the project area (Table 1.1), the 04 abundance is expected. The CWHvh2/04 is found particularly common on medium to rich bedrock types.

The CWHvh2 is the largest BGC unit and accounts for approximately 60% total project area. When the CWHvh2 forested site units distribution is compared to other projects of comparable size, e.g., Blackwell (2012) for mid-Coast TEM , Ecora (2011) for Queen Charlotte Island (QCI) TEM), several statistics are worthy of discussion (Table 3.5). The proportions of zonal sites are comparable amongst all the projects. The largest discrepancy existed for site units 03, 04, 06, and 12. The mid-Coast TEM showed a high percentage of 03 but significantly less 04, while the current North Coast TEM and the QCI TEM produced similar proportions on both site series. The QCI TEM showed significantly higher percentage of 06 while the mid-Coast TEM and the current TEM produced comparable area distributions. For site unit 12, the current TEM showed significantly higher area percentage, while the mid-Coast TEM and the QCI TEM produced comparable distributions.

When mapping areas are sufficiently large, it is expected that the distribution of forested site series are comparable amongst different projects. Through the comparative statistics of this report, it is suspected that the inconsistent mapping concepts were applied by different companies for the listed site units. It is important for future projects to apply the same mapping concepts of individual site series across the entire coastal region.

As for the area distribution of the ecosystem units presented in Table 3.5, several units need further clarifications. As expected, large areas of SW (salt water-ocean), RI (mainly Skeena River), and Ro (bedrock outcrop-mainly on higher elevation BGC units) are found in Ecora's project area. However, large areas of MB (closed canopy forests) in subalpine parkland units are not expected, due to the reasons discussed in previous section.

Table 3.4: Distribution of Site Series Area Percentage by BGC Units

BGC Unit / Site Unit	CWHvh2	CWHvm1	CWHvm2	MHwh1	WHmm1
BGC Area (ha) / Site unit (%)	96,016	14,439	16,755	18,651	10,857
01	29.18	40.56	43.46	36.48	48.04
02	0.57	0.00	0.29	6.22	9.89
03	2.37	2.28	2.69	0.08	4.53
04	20.38	0.23	0.00	11.60	6.71
05	0.37	22.58	14.97	14.19	6.67
06	8.74	8.82	10.13	8.00	13.38
07	4.12	0.13	0.00	3.61	1.08
08	0.11	10.98	5.50	18.69	8.63
09	0.03	0.41	8.91	1.14	1.07
10	0.00	0.00	10.02	-	-
11	17.51	0.00	4.03	-	-
12	12.83	8.52	-	-	-
13	3.77	2.17	-	-	-
14	0.02	3.33	-	-	-
Total	100.00	100.00	100.00	100.00	100.00

Table 3.5: Distribution of Ecosystem Unit (ha) by BGC Units

CWHvh2		CWHvm1		CWHvm2		MHwh1		MHmm1		MHwhp		MHmmp		CMAun	
Site Unit	Area (ha)	Site Unit	Area (ha)	Site Unit	Area (ha)	Site Unit	Area (ha)	Site Unit	Area (ha)	Site Unit	Area (ha)	Site Unit	Area (ha)	Site Unit	Area (ha)
Bb	13	Bb	3	ES	23	Ag	1	Ah	11	Af	76	Af	60	Ah	647
Br	4	Em	7	Fl	2	Ah	343	ES	3	Ag	11	Ah	1,387	As	309
Ed	0	ES	10	LA	590	Am	3	LA	30	Ah	4,379	Am	70	At	131
Em	1	Et	1	PD	56	LA	96	PD	15	As	99	As	17	GL	244
Et	3	Fl	115	Rc	848	LM	13	PN	26	At	3	ES	2	PN	127
Fa	1	Fm	32	Rl	35	MB	2	Rc	936	GL	56	GL	20	Rc	60
Ff	0	LA	930	RM	298	MH	10	Ro	2,072	LA	143	LA	182	Ro	3,176
Fl	153	MU	20	Ro	578	MU	1	Rt	18	LM	599	LM	342	Rt	1
GP	21	PD	11	Rt	17	PD	131	Vh	534	MB	2,789	MB	1,504	Sk	469
LA	5,132	Rc	195	Vh	144	Rc	471	Vs	2,333	MH	2,897	MH	1,604	Ss	295
MU	14	Rl	3,116	Vs	1,616	Ro	894	Vt	930	PD	155	PD	23	Vh	1
PD	655	RM	93	Vt	985	Rt	6	Wb	503	PN	102	PN	62	Vs	3
Rc	524	Ro	196	Wb	596	Vh	38	Wf	47	Rc	979	Rc	995	Vt	5
Rl	1,374	Rt	14	Wf	64	Vs	913	Wm	1	Ro	4,153	Ro	6,296	-	-
RM	49	RW	32	Wm	3	Vt	1,332	Ww	16	Rt	68	Rt	60	-	-
Ro	462	RZ	5	Ws	3	Wb	1,221	YR	286	Sk	869	Sk	1,243	-	-
Rt	6	SW	917	Ww	1	Wf	18	-	-	SP	111	SP	71	-	-
RW	269	UR	13	Xs	12	Ws	3	-	-	Ss	1,234	Ss	1,028	-	-
RZ	87	Vh	22	-	-	Ww	9	-	-	Vh	142	Vh	1,024	-	-
SW	41,896	Vs	798	-	-	Xs	34	-	-	Vs	987	Vs	1,391	-	-
UR	1,246	Vt	116	-	-	YR	136	-	-	Vt	713	Vt	330	-	-
Vh	69	Wb	234	-	-	-	-	-	-	Wa	32	Wb	4	-	-
Vs	883	Wf	62	-	-	-	-	-	-	Wb	106	Wf	32	-	-
Vt	428	Wm	27	-	-	-	-	-	-	Ww	3	Ww	1	-	-
Wb	3,624	Ws	18	-	-	-	-	-	-	YR	297	YR	114	-	-
Wf	130	Ww	30	-	-	-	-	-	-	-	-	-	-	-	-
Wm	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ws	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ww	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xs	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	57,239	-	7,015	-	5,871	-	5,676	-	7,758	-	21,005	-	17,861	-	5,469

Table 3.6: Comparison of Forested Site Series Distribution Between Different Mapping Companies for CWHvh2

Projects	01	02	03	04	05	06	07	11	12	13	14
Current TEM	29.2	0.6	2.4	20.4	0.4	8.7	4.1	17.5	12.8	3.8	<0.1
Mid-Coast TEM	30.6	1.6	19.4	7.0	0.0	3.5	3.2	20.3	2.9	8.0	0.7
QCI TEM	35.4	0.0	1.5	20.1	1.7	18.5	2.1	13.7	2.5	<0.1	0.0

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5.0 APPENDIX 1: DESCRIPTION OF MAPPED SITE UNITS FOR THE NORTH COAST TEM 2013

BGC Units	Site Series No	Site Series Codes	Site Series Name	SMR/SNR
CWHvh2	01	HS	CwHw - Salal	4-5, A-C
	02	LR	PlYc - Rhacomitrium	0, A-C
	03	RS	CwYc - Salal	1-2, A-C
	04	HM	HwSs - Lanky moss	3, A-C
	05	RF	CwSs - Sword fern	2-3, D-E
	06	SF	CwSs - Foamflower	3-4, D-E
	07	SD	CwSs - Devil's club	4-5, D-E
	08	SL	Ss - Lily-of-the-valley	4-6, D-E
	09	ST	Ss - Trisetum	4-6, D-E
	10	AL	Dr - Lily-of-the-valley	4-6, D-E
	11	YG	CwYc - Goldthread	5-6, A-C
	12	LS	PlYc - Sphagnum	6-7, A-B
	13	RC	CwSs - Skunk cabbage	6-7, A-B
	14	SS	Ss - Salal	0-3; B-D
CWHvm1	01	AB	HwBa - Blueberry	3-4; B-C
	02	LC	HwPl - Cladina	0; A-C
	03	HS	HwCw - Salal	1-2; A-C
	04	RS	CwHw - Sword fern	1-2; D-E
	05	AF	BaCw - Foamflower	3-4; D-E
	06	HD	HwBa - Deer fern	5; B-C
	07	AS	BaCw - Salmonberry	5-6; D-E
	08	AD	BaSs - Devil's club	5-6; D-E
	09	SS	Ss - Salmonberry	5-6; D-E
	10	CD	Act - Red-osier dogwood	5-6; D-E
	11	CW	Act - Willow	6-7; C-E
	12	YG	CwYc - Goldthread	6-5; A-C
	13	LS	Pl - Sphagnum	7; A-B
	14	RC	CwSs - Skunk cabbage	7; C-E
CWHvm2	01	AB	HwBa - Blueberry	3-4; A-C
	02	LC	HwPl - Cladina	0; A-C
	03	HS	HwCw - Salal	1-2; A-C
	04	RS	CwHw - Sword fern	1-2; D-E
	05	AF	BaCw - Foamflower	3-4; D-E
	06	HD	HwBa - Deer fern	5; A-C
	07	AS	BaCw - Salmonberry	5-6; D-E

BGC Units	Site Series No	Site Series Codes	Site Series Name	SMR/SNR
	08	AD	BaSs - Devil's club	5-6; D-E
	09	YG	CwYc - Goldthread	5-6; A-C
	10	LS	Pl - Sphagnum	7; A-B
	11	RC	CwYc - Skunk cabbage	7; C-E
MHwh1	01	MB	HmSs - Blueberry	2-4; A-C
	02	MM	HmYc - Mountain-heather	0-2; A-C
	03	MR	SsHm - Reedgrass	2-4; D-E
	04	YG	HmYc - Goldthread	5; A-C
	05	YT	YcHm - Twistedstalk	5; D-E
	06	MD	HmYc - Deer cabbage	6; A-C
	07	YH	YcHm - Hellebore	6; D-E
	08	YS	HmYc - Sphagnum	7; A-B
	09	YC	YcHm - Skunk cabbage	7; C-E
MHmm1	01	MB	HmBa - Blueberry	2-4; A-C
	02	MM	HmBa - Mountain-heather	0-1; A-C
	03	MO	BaHm - Oak fern	2-4; D-E
	04	AB	HmBa - Bramble	5; A-C
	05	MT	BaHm - Twistedstalk	5; D-E
	06	MD	HmYc - Deer cabbage	6; A-C
	07	YH	YcHm - Hellebore	6; D-E
	08	YS	HmYc - Sphagnum	7; A-B
	09	YC	YcHm - Skunk cabbage	7, C-E
MHwhp/MHmmp	00	Af	Alpine Fellfield Class	-
	00	Ag	Alpine Grassland Class	-
	00	Ah	Alpine Heath Class	-
	00	Am	Alpine Meadow Class	-
	00	As	Alpine Nivation Class	-
	00	At	Alpine Tundra Class	-
	00	LM	Hm-Lichen Parkland	-
	00	MB	HmBa-blueberry	-
	00	MH	Hm-Mountain heather parkland	-
	00	Sk	Alpine Tundra Class	-
	00	SP	Sedge Parkland Meadows	-
	00	Ss	Subalpine Shrub Seepage	-
	00	YR	Yc-Rhacomitrium bluffs	-
CMAun	00	Ah	Alpine Heath Class	-
	00	As	Alpine Nivation Class	-
	00	At	Alpine Tundra Class	-
	00	Sk	Alpine Tundra Class	-
	00	Ss	Subalpine Shrub Seepage	-

BGC Units	Site Series No	Site Series Codes	Site Series Name	SMR/SNR
Other Non-forested and Non-vegetated Ecosystems	00	Bb	Beachland Class	-
	00	Br	Headland Class	-
	00	Ed	Estuarine Meadow Class	-
	00	Em	Estuarine Marsh Class	-
	00	ES	Exposed Soil	-
	00	Et	Estuarine Tidal Flat Class	-
	00	Fa	Active Channel Flood Class	-
	00	Ff	Fringe Flood Class	-
	00	Fl	Low bench Flood Class	-
	00	Fm	Middle bench Flood Class	-
	00	GL	Glacier	-
	00	GP	Gravel Pit	-
	00	LA	Lake	-
	00	MU	Mudflat Sediment	-
	00	PD	Pond	-
	00	PN	Permanent Snow	-
	00	Rc	Rock Group Cliff Class	-
	00	RI	River	-
	00	RM	CwHw-Fern Bluffs	-
	00	Ro	Rock Outcrop Class	-
	00	Rt	Talus Class	-
	00	RW	Rural	-
	00	RZ	Road surface	-
	00	SW	Salt Water	-
	00	UR	Urban/Suburban	-
	00	Vh	Avalanche Herb Meadow Class	-
	00	Vs	Avalanche Shrub Thicket Class	-
	00	Vt	Avalanche Treed Class	-
	00	Wa	Alpine Wetland Class	-
	00	Wb	Bog Wetland Class	-
	00	Wf	Fen Wetland Class	-
	00	Wm	Marsh Wetland Class	-
	00	Ws	Swamp Wetland Class	-
	00	Ww	Shallow-water Wetland Class	-
	00	YR	Yc-Rhacomitrium Bluffs	-