Predictive Ecosystem Mapping
Input Data Documentation

Prepared for

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And

Nicola-Similkameen Innovative Forestry Society
Merritt, BC

Project: MTI-311

March 25, 2002

J.S. Thrower & Associates Ltd. *Consulting Foresters*
Vancouver BC – Kamloops BC

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1. INTRODUCTION

1.1 BACKGROUND

In July 1997 five major licencees; Weyerhaeuser Company Limited, Tolko Industries Ltd., Aspen Planers Ltd., Ardew Wood Products Ltd., and Riverside Forest Products Limited; the Nicola Tribal Association (NTA), the Upper Similkameen Indian Band, and the Merritt Forest District Small Business Forest Enterprise Program (SBFEP) presented a written proposal to the Forest Minister requesting Innovative Forestry Practices Agreements (IFPAs) for the Merritt TSA. Their proposal was approved in November 1998. IFPAs encourage holders to practice innovative forest management in return for corresponding gains in Allowable Annual Cut (AAC) as outlined in Section 59.1 (7) of the Forest Act.

To facilitate the implementation of the approved IFPAs, the five licencees, the NTA, the Upper Similkameen Indian Band, and the Merritt SBFEP formed the Nicola-Similkameen Innovative Forestry Society (NSIFS). The NSIFS is responsible for implementing this innovative forestry program for the Merritt TSA.

Forestry Plan #1 for the Merritt IFPAs was submitted to the Ministry of Forests (MOF) in July 2000 and approved by the Regional Manager in January 2001. In Forestry Plan #1, the NSIFS committed to a co-operative approach with the MOF to develop a Predictive Ecosystem Map (PEM). The NSIFS, in consultation with Keystone Wildlife Research (KWR), the group charged with leading the environmental program, decided to pursue PEM in place of the more traditional Terrestrial Ecosystem Map (TEM) to reduce costs and to compress timelines.

The ecosystem is the fundamental unit of resource management in BC. Ecosystem maps are integrated planning tools that provide the location and distribution of ecosystems within a management unit. Predictive Ecosystem Mapping (PEM) is a cost-effective alternative to the original TEM, and is a method of predicting ecosystem occurrence on the landscape given basic inventory information and expert knowledge. Details on the history of the PEM project for the Merritt TSA are outlined in “Predictive Ecosystem Mapping (PEM) in the Merritt Forest District”.[1]

1.2 PROJECT HISTORY

The Merritt PEM project was initiated in 1998. Three collaborating consultants are completing this PEM project for the NSIFS. Keystone Wildlife Research Ltd. (KWR) is building the Predictive Ecosystem Map base, Oikos Ecological Services Ltd. (Oikos) is providing the knowledge base, and J.S. Thrower & Associates Ltd. (JST) is providing the Geographical Information Services (GIS) processing. This project team worked with the Ministry of Forests (MOF, Research Branch) to select EcoNGen[2] for the modeling process.At the time of the project inception in 1998, there were no documented standards for PEM processes. Hence, the Merritt PEM process largely followed methodologies used in Terrestrial Ecosystem Mapping (TEM) and PEM projects previously completed in BC. The PEM standards have evolved over the past four years, and new PEM standards were released in 2002. The Merritt PEM is adapting to the standards where possible. It should be noted that a Standards Agreement for the Merritt PEM project was not in place for the term of this project.In the fall of 2001, the NSIFS contracted EBA Engineering Consultants Ltd. (EBA) to review the Merritt PEM for quality and accuracy. EBA’s final report (Appendix I) outlined recommended changes to the Merritt PEM process and suggested a methodology that would adhere to several newly published PEM standards. KWR, Oikos, and JST have reviewed the EBA report, and modified the PEM process accordingly.

1.3 OBJECTIVES

The overall objective of this project is to:

Provide the NSIFS with an ecosystem map for the Merritt TSA.

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[1] Keystone Wildlife Research. 2000. Predictive Ecosystem Mapping in the Merritt Forest District Documentation Report. Unpublished.

[2] http://www.for.gov.bc.ca/research/ecogen/ecogen.htm. EcoNGen can be downloaded from the Ministry of Forests website. This site also provides a description of the model and its use.

This report documents the data quality of various input data layers used in the PEM, and outlines the methodology used to produce the final map.

1.4 Terms of Reference

This report was written by JST. The JST team includes Frits Nijholt, *RPF* (project manager), Ron Zayac, *BComm* (project advisor), Gordon Lester, *RPF* (project support), Louisje Redden, *BA* (GIS analyst), and Wendy Creighton, DoT (GIS analyst). As the project evolved, discussions continued with Del Meidinger (Ministry of Forests, Research Branch) for general guidance and technical support with the PEM process. This document will be submitted to Terry Gunning (Ministry of Sustainable Resource Management) for approval in principle of the input data for use in the final PEM process.

1.5 Study Area

The Merritt Timber Supply Area (TSA) is located in the south-central interior of the province and covers approximately 1.13 million ha of the Kamloops Forest Region. To the north of the Merritt TSA is the Kamloops TSA, to the west are the Lillooet and Fraser TSAs, and to the east is the Okanagan TSA. Manning Park, Cathedral Park, and the Canada-USA border are to the south of the TSA.

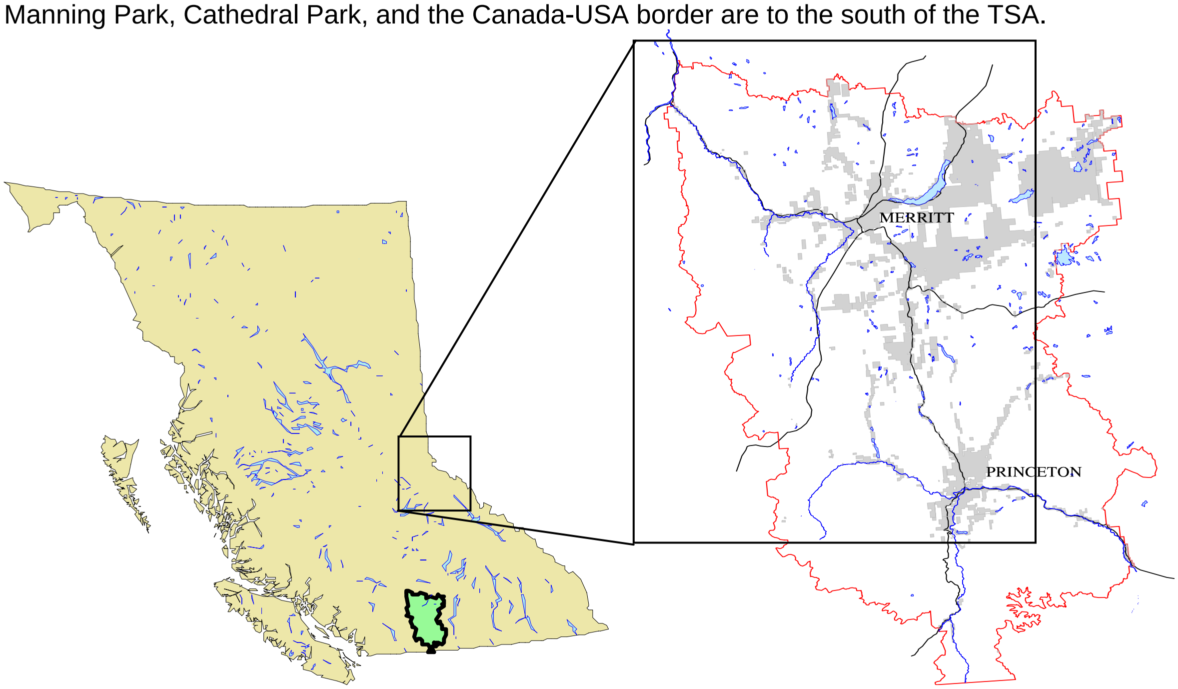

Figure 1. Merritt TSA location map.

2. PEM INPUT DATA SOURCES

2.1 OVERVIEW

The PEM process uses existing sources of data to produce a resultant dataset in GIS that is used as the input in the modeling process. This resultant dataset and interpretive knowledge bases produce PEM entities (site series/map codes). The following data layers were incorporated into the final GIS resultant of the Merritt TSA PEM:

- Bioterrain map
- Forest cover inventory map
- Terrain resource inventory (TRIM) map
- Biogeoclimatic ecosystem classification (BEC) map

2.2 BIOTERRAIN INPUT MAP

A bioterrain map was initiated by the NSIFS in 1998 to act as the key input data layer to the PEM modeling process. Through discussions with personnel from the MOF (Research Branch) and the Ministry of Environment, Lands, and Parks (MOELP),[3] the NSIFS decided that a bioterrain map based on photo-interpretation would provide greater reliability than one based on a terrain model.

Citation:

- Predictive Ecosystem Mapping (PEM) in the Merritt Forest District - Documentation Report, November 2000. Keystone Wildlife Research Ltd. (Appendix III)

Consultant/Department:

- J.M. Ryder & Associates Terrain Analysis Inc: responsible for completion of the pre-typing of the bioterrain
  Contact: June Ryder
- Baseline Geomatics Inc: responsible for transferring lines to TRIM base maps in an Arc/Info digital format
  Contact: Bonn Lee
- KWR: responsible for quality assurance on the bioterrain deliverables
  Contact: Sherry Ulansky

Publication Scale:

- 1: 20,000

Period of Compilation:

- January 13, 1999 – November 31, 1999

Projection:

- NAD83 Albers

2.2.1 Input Mapping Entities

A detailed list of the bioterrain attributes available to the PEM modeling process is given in Appendix IV.

2.2.2 Input Entity Relationships

All input coverage entity relationships used in the knowledge base can be found in the “Process Order Table” used in EcoNGen (Appendix V).

2.2.3 Edge Matching

The bioterrain dataset was received from KWR as a single seamless coverage. Bioterrain quality assurance, which included an edge matching process, is documented in the KWR report attached (Appendix III).

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[3] Del Meidinger, Bruce Enns, and Dave Clarke.

2.2.4 Positional Accuracy

The bioterrain coverage was based on the TRIM, therefore the creek testing methodology described in section 4.7.2.3.1 of the PEM Standards could not be used for testing map base differences.

2.2.5 Bioterrain Attribute Quality

At the onset of the PEM project, check plots were not available for quality assurance of the bioterrain photo-interpreted calls. Over the course of the project, plots that were established in the field recorded very little bioterrain information. Existing data has been summarized in the EBA report (Appendix I), Table 5. Two reviewed attributes, Surfm(1, 2, and 3) and Drainage, averaged 70% and 61% matches, respectively. The bioterrain slope and aspect attributes were inconsistently recorded during the photo interpretation process. Slope and aspect were deemed important in the modeling process; hence they were derived using TRIM. It is recommended that if more groundwork is completed, consideration be given to bioterrain attributes used in the knowledge base.

2.2.6 Landform Extraction and Derivation

The bioterrain map was used as the base for the entire PEM resultant. The bioterrain polygon lines were preserved in all further overlay analysis and GIS eliminates. A limited number of features were extracted from other datasets. When these features were added to the bioterrain base, slivers were eliminated while maintaining bioterrain lines. The results of each of these intersections were a new bioterrain base.

2.2.7 Attribute Extraction and Derivation

The new attribute, ecosoil, was derived to simplify the surficial material and surficial expression data into a smaller number of classes. In total, 12 new classes were created (Appendix IV, Ecological Soil Groups Table). These ranged in value from very thin (NOSOIL) to very deep and organic (DOSOIL).

2.3 FOREST COVER INVENTORY INPUT MAPS

The MOF Merritt District office provided forest cover inventory maps for the project. Certain forest cover attributes were deemed to be ecologically important for predicting PEM entities.

Citation:

- Website - http://www.for.gov.bc.ca/resinv/standard/volume5/maindoc.htm. Titled: The Preparation and Creation of FRGIS Data Files (volume 5). September 1998 Revision

Consultant/Department:

- MOF Merritt District, MOF Kamloops Forest Region

Publication Scale:

- 1: 20,000

Period of Compilation:

- Graphics date: October 14, 1997 – April 22, 1999
- Last FIP update May 4, 1999 (as listed by the version table created from each FIP file)

Projection:

- NAD83 Albers

2.3.1 Input Mapping Entities

A detailed list of the forest cover attributes available to the PEM modeling process is given in Appendix IV.

2.3.2 Input Entity Relationships

All input coverage entity relationships that are used in the knowledge base can be found in the "Process Order Table" used in EcoNGen (Appendix V).

2.3.3 Edge Matching

The forest cover files from the MOF arrived as an appended coverage. There were 2.8 ha of sliver polygons (approximately 900) across the entire Merritt TSA. These were removed using the eliminate command, thereby creating one seamless coverage with no slivers.

Two entities, polygon lines and polygon attributes, are assessed when edge matching to ensure matches across neatlines. The edges on ten mapsheets (~10% of the sheets in the Merritt TSA) were reviewed for two types of possible matching errors: missing lines and lines that were offset.

Table 1. Edge matching summary.

	Graphic attributes (arcs only) (m)							
Mapsheet	0-1	1-5	5+	Collapse	Dangles	Total Arcs	Forest cover attributes	# of edge polygons checked
092i028	125	2	0	0	0	127	6	138
092i035	189	1	0	7	1	198	2	200
092i027	126	3	0	8	0	137	12	149
092h095*	75/6	12/1	30/10	2	31/26	150/43	29/15	153/35
092i009	81	12	30	2	4	129	10	137
092i005	130	10	13	5	5	163	10	185
092h029	107	2	10	1	31	151	19	153
092h056*	91	22/21	4/1	0	9/9	126/31	21/17	126/29
092h059	106	3	3	1	3	116	5	116
092h097	103	10	26	0	19	158	22	146
Total	*1133*	*77*	*116*	*26*	*94*	*1455*	*136*	*1503*

* Two pairs of mapsheets in this sample (093h094/95 and 092h055/56) have an approximately 100 m gap between them. The MOF Chilliwack District is maintaining some of these mapsheets in NAD 27, which is causing the gap. The difference in inventory updates has resulted in 37 arc errors and 15 attribute errors for 093h094/95, and 26 arc errors and 17 attribute errors for 092h055/56.

There are major edge matching problems where inventory dates differ (in excess of 10 years); however, this area accounts for only 5% of the landbase, and most of the area occurs near the height of land at the TSA boundary. The problem is compounded on the eastern boundary of the TSA where the UTM zones change from 10 to 11. Appendix VI thematically shows the different inventory dates, and the magnitude of the potential problem.

The attribute edge matching review, excluding the mapsheets with different inventory dates, resulted in an average of 12 errors per mapsheet. Most of the errors were relate to the graphic arcs (i.e., if the arc was off, so were the attributes of the polygon). Most of the edge matching errors along map neatlines are created by one sheet being more up-to-date than the adjacent mapsheet. This is likely due to that fact that mapsheets along the edge of TSAs are managed by different MOF Districts.

2.3.4 Positional Accuracy

Creeks from TRIM were used in the creation of the forest cover maps with the inventory date 1991-1992; therefore, the creeks on the forest cover maps were identical to TRIM. No further testing was done on these mapsheets, which compose 5% of the study area. Two of the mapsheets with different inventory dates were chosen to check for positional accuracy. The thematic representation is shown in Appendix VII. Several of the creek junctions were off by more than 50 m, but the distance of the shifting was not consistent. Therefore, any adjustment to these 16 partial sheets would not increase the positional accuracy of the polygons.

2.3.5 Forest Cover Attribute Quality

The Vegetation Resources Inventory (VRI) sampling program, completed in the Merritt TSA, found no significant differences between the sample and forest cover map attributes with respect to age and height attributes (Appendix VIII). Statistical adjustments were made to the forest cover; however, these were not introduced into the version of forest cover used for the Merritt PEM. A comparison of VRI ground sample attributes (species, age, height) with those of the forest cover used in this PEM process was completed and is shown in Appendix IX. Using the classes for age and height used in PEM, 99% of the ages and 75% of the heights were in the correct classes. The average overlap for the forest cover species was 71%, while over 80% of the polygons have greater than 50% overlap. More than 75% of the VRI plots had the same leading species as the forest cover attributes.

Table 2. Species composition % overlap score distribution (122 VRI plots).

% Overlap class	# of polygons	% of polygons
0-9	2	1.6
10-19	1	1.0
20-29	5	4.0
30-39	4	3.3
40-49	12	9.8
50-59	7	5.7
60-69	14	11.5
70-79	25	20.5
80-89	20	16.4
90-100	32	26.2
Total	*122*	*100*

2.3.6 Landform Feature Extraction or Derivation

Non-productive polygons were extracted from the main forest cover inventory layer. This coverage was then dissolved, preserving the non-productive polygons. This resultant coverage was intersected with bioterrain. An eliminate process was then conducted to remove unwanted slivers while maintaining the bioterrain lines.

2.3.7 Attribute Extraction and Derivation

To reduce cross-product correlation problems, we developed a methodology to extract certain forest cover attributes without adding line work to the bioterrain resultant. This step was accomplished by intersecting the forest cover with the bioterrain base, calculating area-weighted averages for the simple attributes (age, height, crown closure), and joining the results back to the bioterrain. The complex attributes of interest in the forest cover were simply identified as being present or absent. The species information was standardized to minimize the number of species classes (e.g., B or BL = BL). Only species with greater than 5% were marked as present in the results.[4] The weighted age, height, and crown closure were grouped as shown in Tables 15, 16, and 17, respectively. (Appendix IV).

[4] Field Pocket Handbook, Ministry of Forests Inventory Branch , 1981 Forest Classification - > 5% chosen to ensure species with minimal percentages less than or equal to 5% would not have an impact on the final results.

2.4 TRIM INPUT MAPS

TRIM data were acquired from the MOF Merritt District office, and was used to generate features that would add to the bioterrain data layer. The TRIM Digital Elevation Model (DEM) was used to provide consistent slope, aspect, and elevation attributes to the final resultant. The TRIM water features were used to provide riparian buffers, depending on slope (section 3).

Citation:

- Website - http://home.gdbc.gov.bc.ca/TRIM/1to20species/specs20.pdf. Titled: BC Specifications & Guidelines for Geomatics Content Series. Volume 3. Digital Baseline Mapping at 1:20,000. Release 2.0, January 1992

Consultant/Department:

- Ministry of Sustainable Resource Management (MSRM) – Base Mapping & Geomatic Services Branch

Publication Scale:

- 1: 20,000

Period of Compilation:

- Compiled on January 30, 1997 (approximately)

Projection:

- NAD83 Albers

2.4.1 Input Mapping Entities

A detailed list of the TRIM derived attributes available to the PEM modeling process is given in Appendix IV.

2.4.2 Input Entity Relationships

All input coverage entity relationships used in the knowledge base can be found in the “Process Order Table” used in EcoNGen (Appendix V).

2.4.3 Edge Matching

To ensure seamless data, the DEM attributes for PEM were merged as one coverage, rather than on a mapsheet by mapsheet basis. The PEM attributes calculated from the DEM were slope, aspect, and elevation. The single line creeks were also used from the TRIM base. Ten mapsheets were checked for edge matching errors: no errors were found.

Table 3. Trim stream edge matching.

Mapsheet	# of arcs checked	# of arcs with matching edges
092i028	86	86
092i035	85	85
092i027	66	66
092h095	63	63
092i009	79	79
092i005	52	52
092h029	104	104
092h056	37	37
092h059	72	72
092h097	66	66
Total	*710*	*710*

Note: the coverage checked was the original from TRIM. The actual coverage used was only the single line creeks.

2.4.4 Positional Accuracy

Weighted slope, aspect, and elevation attributes were added to the resultant (biobufnp_elim) coverage. The TRIM DEM was used to derive these three attributes. This input coverage was built under the specifications and guidelines, as noted under the Citation; hence, the positional accuracy is deemed to be adequate.

2.4.5 Digital Elevation Model

The Merritt PEM DEM was received in Arc/Info format. JST did not convert or translate any of the TRIM files including the DEM.

2.4.6 Landform Feature Extraction or Derivation

Riparian areas that were not captured in the bioterrain base were generated by buffering single-line TRIM streams by 20 m. These buffers were created only on portions of streams that flowed along moderate to gentle slopes (< 20%). This feature was extracted by creating a slope coverage from a TRIM DEM derived Triangular Irregular Network (TIN). The TIN was reclassified into steep and gentle slope classes and then dissolved. This gentle slope class coverage was intersected with the single-line TRIM streams to mark the sections to be buffered. The resulting riparian buffers were added to the bioterrain base and slivers eliminated.

2.4.7 Attribute Extraction And Derivation

To create a TSA slope, aspect, and elevation coverage a TIN was created from the TRIM DEM data. This in turn was converted into a polygon coverage with slope and aspect attributes. Further processing of the resulting coverage was not possible because the number of polygons exceeded Arc/Info software limitation. As such, the bioterrain base coverage was broken up into eight pieces along BGC lines to facilitate overlay analysis. BGC lines were chosen as a means of partitioning the seamless coverage because they will become polygon boundaries later in the process; therefore no new sliver artifacts would be created. Each of the eight bioterrain pieces was identified with the slope/aspect coverage. Statistics were generated for each resultant polygon to derive an area-weighted average for slope and aspect for each original bioterrain polygon. These descriptive statistics were then joined back to the polygon attribute tables for the eight pieces based on the unique bioterrain coverage identifier (JST-ID). The slope and aspect attributes were then categorized for easier processing (Tables 10 and 11).

For elevation the above TIN was converted into a lattice with a pixel size of 50 x 50 m. The 50 m lattice was transformed into a polygon coverage. Again, an area-weighted mean elevation for each original bioterrain polygon (JST-ID) was calculated and loaded back into the resultant coverage. The elevation attributes were then coded and grouped (Table 12)(Appendix IV).

2.5 BGC INPUT MAPS

A localized BGC map was developed for the purposes of this project with the MOF Regional Ecologist, Dennis Lloyd. In July of 2001, a final BGC coverage was delivered to the NSIFS. This new map incorporated many line placement changes, guided by the extensive network of eco-plots established in the field over the past 3 years.

Citation:

- Website - http://www.for.gov.bc.ca/research/bigbgc.pdf Titled: A Method for Large-Scale Biogeoclimatic Mapping in BC. Ministry of Forests, Research Branch. Version 1.0. December 15, 1999. Dennis Lloyd, Regional Ecologist of the Kamloops Forest Region, modified this approach in building the BGC map for the Merritt TSA

Consultant/Department:

- Ministry of Forests Research Branch, Kamloops Forest Region
  Contact: Dennis Lloyd

Publication Scale:

- 1: 20,000

Period of Compilation:

- Compiled January 1 – August 31, 2001, following three years of fieldwork

Projection:

- NAD83 Albers

2.5.1 Input Mapping Entities

A detailed list of the TRIM derived attributes available to the PEM modeling process is given in Appendix IV.

2.5.2 Input Entity Relationships

All site series derivations are based on the definitions of the BGC zone, subzone, and variant contained within the BGC maps.

2.5.3 Edge Matching

The BGC lines were received from the MOF as a seamless coverage. The BGC lines were built by the Regional Ecologist, and digitized by Cascadia Natural Resource Consultants as a seamless coverage. Thematic plots were created to check for attribute mismatches, but none were found.

2.5.4 Positional Accuracy

The BGC lines were tied to an existing TRIM base so there are no issues of positional accuracy.

2.5.5 Thematic Accuracy

The BGC zone lines were built from extensive fieldwork completed by the MOF Kamloops Region.

2.5.6 Attribute Extraction and Derivation

Nothing was done for this input.

2.5.7 Landform Feature Extraction or Derivation

Certain BEC lines were used to produce hard breaks for the bioterrain resultant in order to minimize additional linework.

3. PEM GIS METHODOLOGY

3.1 METHODOLOGY

The Merritt PEM process has evolved over the past three years. The original processing methodology, as determined by the November 6, 1999 workshop,[5] intersected all of the input coverages to create a final resultant with many polygons. The final resultant coverage was dissolved at the last stage to produce 97 site series maps. However, the process was revised following the EBA report and recommendations (Appendix I). Four main issues identified in the report have been addressed, resulting in modifications to the original methodology:

1. Retain the integrity of the bioterrain polygons
2. Represent the forest cover data more accurately
3. Try to run the PEM process on seamless data, as opposed to tile by tile
4. Try to represent the slope/aspect/elevation data more accurately

Additional EBA comments and recommendations and responses from the project team are listed in Appendix X.

Several input coverages were obtained through data exchange agreements with the Merritt IFPAs. Additionally, a bioterrain layer provided a stronger ecological basis for the PEM modeling.

Table 4. List of input data sources.

Layer Name	Source
Bioterrain	KWR
TRIM (DEM & single line creeks)	MSRM
Forest cover (NP boundary & label attributes)	MSRM
BGC zone maps	MOF Kamloops Region

Descriptions and assessments of these coverages can be found in Section 4. The following is a description of the current revised PEM process including some explanations of why certain steps were taken. A flow diagram of the Merritt PEM process can be found in Appendix II.

All GIS processing was done using Arc/Info (version 7.2.1). Forest cover attribute weighting of resultant polygons was done using SAS software. The scores for the resultant polygons were derived using the EcoNGen model created by the MOF Research Branch.

The Merritt PEM utilized parts of the four input coverages. The process began with the seamless bioterrain coverage (approximately 58,600 polygons) having the column headings adjusted to a maximum size to accommodate maximum field size limitations in the EcoNGen software. Further simplification of certain attributes was done as requested by the project ecologist (e.g., bioterrain soil data was grouped into ‘Ecosoil’ groupings (Appendix IV)). The TRIM DEM was used to build a 20 m grid lattice; these polygons were dissolved to produce a simplified slope class map highlighting slopes less than 20%. This resultant was intersected with the TRIM seamless single line creeks coverage marking those creeks with the appropriate slope class. Twenty meter buffers were then created on creeks with slopes less than 20%. These buffer polygons were intersected with the bioterrain coverage to produce an intermediate resultant. This intersection process created many tiny sliver polygons, which were eliminated while preserving the bioterrain arcs. This resulted in a new coverage (biobuf_elim) containing approximately 85,600 polygons.

The next process incorporated forest cover derived attributes and features into the preliminary resultant. Non-productive forest polygons were extracted from the seamless forest cover dataset. This new coverage was dissolved on the non-productive forest descriptor to remove neatline boundaries. The interim resultant coverage was then intersected with the dissolved non-productive forest type polygons to

[5] Present at the workshop were representatives from KWR, JST, Oikos, Shearwater Mapping, Eco-Concepts, Shamaya Consulting, and Mike Ryan, Alex Inselberg, and Dennis Lloyd. The purpose of this meeting was to review GIS data required by ecologists for knowledge base building. The general PEM process was also reviewed.

create another interim resultant. Again an eliminate was run to remove tiny sliver polygons while retaining bioterrain lines. This resulted in a new coverage called Biobnp_Elim.

One of the bi-products of the TRIM DEM-TIN process produced slope, aspect, and elevation polygon coverages. Unfortunately, the number of polygons created (approximately 2.5 million) made it impossible to do further overlay analysis due to capacity limitations with the Arc/Info software used in the processing of the resultants. The solution reached involved splitting the slope/aspect/elevation coverages into 8 pieces using the BGC lines as boundaries. Note that eight BGC zones were not chosen as this would still not have solved the problem because of the size of several of the zones. Instead, eight clip coverages were created using BGC lines. The clipped TRIM derived coverages were intersected with the interim resultant (biobuf_elim) and descriptive statistics were run to calculate an area-weighted average for each polygon. This process was completed for both the slope and aspect coverages. Elevation was calculated differently as a 50 x 50 m grid was created over the TSA area and then a weighted average was calculated for each polygon. At this point all eight pieces were appended to produce the final resultant (biobufnp_final) comprising approximately 110,500 polygons.

A final set of attributes derived from the seamless forest cover dataset was then added to the final resultant. Note that new lines were not added at this time, instead presence/absence and averages were calculated for each resultant polygon. A temporary coverage intersecting the forest cover and the resultant coverage (biobufnp_final) was processed in SAS, creating a weighted average for age, height and crown closure for each resultant polygon. Species presence or absence was also derived at this time. The SAS output was then linked back to the interim resultant coverage (biobufnp_final). This coverage was then intersected with the BGC coverage provided by the Kamloops Forest Region (Section 4.4) providing a resultant (j_pem) ready for EcoNGen. Note that there was no eliminate process done after this intersection, so any slivers are due to resultant polygons crossing BGC lines.

EcoNGen incorporated an unloaded text file of the final resultant (j_pem) and the knowledge bases provided by Oikos. This results in an output of ranked site series by BGC subzone. The output is then post-processed to filter out the top ranked site series for each decile and then linked back to the final resultant (j_pem). Finally, a post-processing step converts the column headings back to the Terrestrial Ecosystem Mapping (TEM) standards, overides certain EcoNGen predictions for non-productive forest types, and provides a unique identifier to each polygon.

3.2 Mapping Entity Cross-Product Correlation

The bioterrain data is a map complex with up to three deciles containing terrain related information. When overlay analysis occurs using datasets with complex attributes, the potential that the thematic combinations actually occurred within a given resulting polygon is diminished. To reduce these unwanted effects, we chose to minimize the landform features added to the bioterrain base rather than have unpredictable and uncontrollable results of cross-product correlation.

The bioterrain was intersected over the course of the PEM project by three input coverages where linework was retained:

1. Creek buffer polygons.
2. Non-productive forest type polygons.
3. BEC polygons.

The creek buffer polygon coverage was intersected with bioterrain as Oikos deemed this process necessary to predict site series near riparian areas. The resolution of the bioterrain map did not identify these features well enough. The non-productive polygon coverage was also intersected with the bioterrain map. This was done to identify the "00" site series. Finally, the BGC coverage was intersected with the bioterrain to provide BEC attribute data. These three datasets were important to the validity of the final map entity predictions. Other attributes were also considered important, but other processing methods could be used to eliminate the lines added to the PEM resultant.

3.3 Sliver Adjustment

The eliminate command was run in Arc/Info after each of the three intersections to delete polygons less than one hectare in size. Each eliminate was completed without deleting bioterrain lines, thereby preserving the integrity of the coverage as much as possible (Appendix II).

4. SUMMARY

The Merritt PEM project was not complete at the time of submission of this document. There are no anticipated changes to the methodology of GIS processing or changes in the input coverages to be used. Changes may occur in how the various mapping entities are interpreted when ranking the resultant polygons for site series.

APPENDIX I – QUALITY AND ACCURACY ASSURANCE FOR THE MERRITT PROJECT

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APPENDIX II – MERRITT PEM PROCESS (MARCH 2002)

Flow Diagram

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APPENDIX III– PEM IN THE MERRITT TSA – DOCUMENTATION REPORT

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APPENDIX IV – INPUT ATTRIBUTE TABLES

4.1 BIOTERRAIN INPUT ATTRIBUTES

Table 5. Surficial materials. [6, 7]

Map Symbol	Material name	Material Description
A	Anthropogenic materials	Artificial materials, and materials modified by human actions such that their original physical appearance and properties have been drastically altered.
C	Colluvium	Products of gravitational slope movements; materials derived from local bedrock and major deposits derived from drift; includes talus and landslide deposits.
D	Weathered bedrock	Bedrock modified *in situ* by mechanical and chemical weathering.
E	Eolian sediments	Sand and silt transported and deposited by wind; includes loess.
F	Fluvial materials	Sands and gravels transported and deposited by streams and rivers; floodplains, terraces and alluvial fans.
FA	"Active" fluvial materials	Active deposition zone on modern floodplains and fans; active channel zone.
FG	Glaciofluvial materials	Sands and gravels transported and deposited by meltwater streams; includes kames, eskers and outwash plains.
I	Ice	Permanent snow and ice; glaciers.
L	Lacustrine sediments	Fine sand, silt and clay deposited in lakes, and beach gravels and sand.
L1	Alkali lake beds	Dried-up or partly dry lakes where white efflorescence is visible on air photos.
LG	Glaciolacustrine sediments	Fine sand, silt and clay deposited in ice-dammed lakes, and beach gravels and sand.
M	Till	Material deposited by glaciers without modification by flowing water. Typically consists of a mixture of pebbles, cobbles and boulders in a matrix of sand, silt and clay. Chiefly basal till, but may include small areas of ablation till.
M1	Ablation till	Material melted out on top of glacier ice. Contains less silt and clay and less dense than basal till.
O	Organic materials	Material resulting from the accumulation of decaying vegetative matter; includes peat and organic soils.
R	Bedrock	Outcrops, and bedrock within a few centimeters of the surface.
U	Undifferentiated materials	Different surficial materials in such close proximity that they cannot be separated at the scale of the mapping.
V	Volcanic materials	Unconsolidated pyroclastic sediments.
N	No surficial materials	Generally Non-productive types (e.g. Lakes, rivers, Rock.

Knowledge base heading = Sm, GIS-Pre-Ecogen heading = Sm_1,Sm_2,Sm_3, GIS-Post-Ecogen heading = surfm_1, surfm_2, surfm_3)

[6] Howes, D.E., Kenk, E., 1997. Terrain Classification System For British Columbia, Version 2.0, Res. Inv. Br. MoELP.

[7] http://www.for.gov.bc.ca/ric/Pubs/Earthsci/012/012t-34.htm#TopOfPage, Guidelines and Standards To Terrain Mapping in B.C., RIC January 1996.

Table 6. Surface expression.

Symbol	Surface expression name	Surface expression description
A	moderate slope(s)	predominantly planar slopes; 15-26° (27-49%).
B	Blanket	material >1-2m thick with topography derived from underlying bedrock (which may not be mapped) or surficial material.
C	Cone	a fan-shaped surface that is a sector of a cone; slopes 15° (27%) and steeper.
D	Depression	enclosed depressions.
F	Fan	a fan-shaped surface that is a sector of a cone; slopes 3-15° (5-27%).
H	hummocky	steep-sided hillocks and hollows; many slopes >15° (27%).
J	gentle slope(s)	predominantly planar slopes; 3-15° (5-27%).
K	moderately steep slope	predominantly planar slopes; 26-35° (49-70%).
M	rolling topography	linear rises and depressions; <15° (27%).
P	Plain	0-3° (0-5%).
R	Ridges	linear rises and depressions with many slopes >15° (27%)r.
S	steep slope(s)	slopes steeper than 35° (70%).
T	terrace(s)	stepped topography and bench lands.
U	undulating topography	hillocks and hollows; slopes predominantly <15° (27%).
V	Veneer	material <1-2m thick with topography derived from underlying bedrock (may not be mapped) or surficial material; may include outcrops of underlying material.
W	mantle of variable thickness	material of variable thickness infilling depressions in an irregular substrate (rock or surficial material).
X	thin veneer	a thin veneer, where material is predominantly 10-25 centimeters thick.

Knowledge base heading = Se, GIS-Pre-Ecogen heading = sf_1a, sf_2a, sf_3a, GIS-Post-Ecogen heading = surf_e1a, surf_e2a, surf_e3a[1] [2]

Table 7. Geological processes and mass movement subclasses.

Symbol	Geological process name	Geological process description
A	Avalanches	Slopes modified by frequent snow avalanches.
Af	Avalanches: major tracks	In zones of coniferous forest: broad avalanche track(s) occupied by predominantly shrubby, deciduous vegetation.
Am	Avalanches: minor tracks	Similar to above, but generally narrower than the height of adjacent trees.
Aw	Avalanches: mixed	Includes both major and minor avalanche tracks.
Ao	Avalanches: old tracks	Clearly visible on air photos, but less well defined than active tracks because they are partly or completely occupied by young conifers.
B	Braiding channel	Channel zone with many diverging and rejoining channels; channels are laterally unstable.
C	Cryoturbation	Heaving and churning of soil and surficial materials due to frost action.
D	Deflation	Removal of sand and silt particles by wind action.
E	Glacial melt water channels	Areas crossed by melt water channels that are too small or too numerous to map individually.
F	Failing	Slope experiencing slow mass movement, such as sliding or slumping.
H	Kettled	Area includes numerous small depressions and/or lakes where buried blocks of ice melted.
I	Irregularly sinuous channel	Channel displays irregular turns and bends.
J	Anastamosing channel	Channels diverge and converge around semi-permanent islands.
K	Karst processes	Solution of carbonates (limestone, dolomite) resulting in development of collapse and subsidence features.
L	Surface seepage	Abundant seepage.
M	Meandering channel	Channel characterized by regular turns and bends.
N	Nivation	Surface modified by hollows developed around semi-permanent snow banks.
P	Piping	Subsurface erosion of silty sediments by flowing water resulting in the formation of underground conduits.
R	Rapid mass movement	Slope affected by processes such as debris flows, debris slides, and rock fall.
S	Solifluction	Slope modified by slow down slope movement of seasonally frozen regolith.
U	Inundated	Areas submerged in standing water from a seasonally high water table.
U1	Inundated due to beaver activity	Inundation or partial inundation resulting from the presence of beaver dams.
V	Gullying	Slope affected by gully erosion.
W	Washing	Winnowing of fines by flowing water resulting in development of lag deposits.
X	Permafrost processes	Processes related to the presence of permafrost and permafrost aggradation or degradation.
Z	Periglacial processes	Solifluction, nivation and cryoturbation occurring together in a single terrain polygon.

(Knowledge base heading = Gp, GIS heading = Geop_1, Geop_2, Geop_3) [1 2]

Table 8. Soil drainage classes. [8]

Drainage code	Drainage class	Drainage description
x	very rapidly drained	water is removed from the soil very rapidly in relation to supply. Water source is precipitation and available water storage capacity following precipitation is essentially nil. Soils are typically fragmental or skeletal, shallow, or both.
r	rapidly drained	water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Water source is precipitation. Soils are generally coarse textured.
w	well drained	water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Water source is precipitation. On slopes, subsurface flow may occur for short durations, but additions are equaled by losses. Soils are generally intermediate in texture and lack restricting layers
m	moderately well drained	water is removed from the soil somewhat slowly in relation to supply because of imperviousness or lack of gradient. Precipitation is the dominant water source in medium- to fine-textured soils; precipitation and significant additions by subsurface flow are necessary in coarse-textured soils.
i	imperfectly drained	water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is the major source. If subsurface water or groundwater (or both) is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season. Soils generally have a wide range of texture, and some mottling is common.
p	poorly drained	water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface or groundwater flow (or both), in addition to precipitation, are the main water sources. AAA perched water table may be present. Soils are generally mottled and/ or gleyed.
v	very poorly drained	water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Ground water flow and subsurface are the major water sources. Precipitation is less important, except where there is a perched water table with precipitation exceeding evapotranspiration. Typically associated with wetlands.

Where two drainage classes are shown:

if the symbols are separated by a comma, e.g., “w,i”, then no intermediate state is present;

if the symbols are separated by a dash, e.g., "w-i", then all intermediate classes are present.

(Knowledge base heading = D_1 or D_2 GIS heading = D_1 or D_2)

Table 9. Ecological soil groups. [9]

Code	Group descriptions	Surficial material & surficial expression
NOSOIL	very thin to non-soil	Ru, Rk, Rs, Rh, Rr, Rm Rw, Ra, Rj
VTCSOIL	very thin (<20cm) coarse soils	Dx, Cx

[8] http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh025/02.soil.pdf Field Manual for Describing Terrestrial Ecosystems, Handbook 25, 1998.

[9] An ‘ecosoil’ variable was developed to create soil groups with similar ecological properties. These were summarized using combinations of surficial material and surface expression that had similar overall soil textures and depths.

VTMFSOIL	very thin (<20cm) medium/fine soils	Mx
MDCSOIL	moderately deep (20-100cm), coarse soils	Cv, FGv**,** Dv,Fv
MDMSOIL	moderately deep (20-100cm), medium soils	Mv**,** Mw
MDFSOIL	moderately deep (20-100cm), fine soils	Lv,Ev, LGv
DCSOIL	deep (>100cm) coarse soils	Ch, Cf, Cu**,** Cb, Cj, Ca, Ck, Cc, Cs, Cw, FGp, FGr, FGt**,** FGk, FGa, FGu**,** FGs, FGw, FGf, FGj, FGm, Fj, Ft, Fu, Ua, Us, Uk
DCSSOIL	deep (>100cm), coarse soils with subsurface seepage	FAf, FAp, Fp**,** Ff
DMSOIL	deep (>100cm), medium soils	Mb, Mm, Mp, Mu, Mw**,** Ma, Mr, Mt, Mk, Mj, Ms
DFSOIL	deep (>100cm), fine soils	Lp, Eu, LGp, LGu
MDOSOIL	moderately deep (20-100cm), organic soils	Ov
DOSOIL	deep (>100cm), organic soils	Op, Ob

1. Coarse Soils -S, LS; Medium soils - SL, L, SiL; Fine soils - Si and finer
2. Slope Se is not included
3. k table category is ECOSOILS
4. N = lake and water features and A = Urban road type features

(Knowledge base heading = ECOSOIL, GIS heading = ECOSOIL_1, ECOSOIL_2, ECOSOIL_3)

4.2 TRIM Resultant Attributes

Table 12. Elevation classes.[11]

E1 Class	Elevation (m)	E2 Class	Elevation (m)	E3 Class	Elevation (m)
1	< 1300	1	< 1600	1	< 1400
2	> 1299	2	> 1599	2	> 1399

(Knowledge base heading = E1, E2, E3, GIS heading = E1, E2, E3)

Table 10. Slope classes.[10]

Class	Slope %
1	0-10%
2	11-25%
3	26-45%
4	46-70%
5	>70%

(Knowledge base heading= S, GIS heading= S)

Table 11. Aspect classes.

Symbol	Aspect name	Aspect definition
k	Cold	285^o to 60^o (slope class is >2)
c	Cool	60^o to 135^o (slope class is >2)
h	Hot	135^o to 240^o (slope class is >2)
w	Warm	240^o to 285^o (slope class is >2)
n	Neutral	All aspects with slope class <3)

(Knowledge base heading = As GIS heading = AS) [3]

[10] The divisions of the 5 slope classes and the 5 aspect classes were discussed and approved at a Merritt Pem Project meeting held in Kamloops November 2, 2000. Which are different from those in the TEM standards.[2]

[11] Elevation breaks were assigned by Oikos to further differentiate Site Series within a BGC zone.

Table 13. Riparian areas (creek banks). [12]

Symbol	Riparian Class	Riparian Description
CB	1	A resultant polygon containing a 20-meter buffer along a single line stream, where the slope is less than 20 percent.

(Kb = CB and GIS = CB)

4.3 FOREST COVER INPUT ATTRIBUTES[13]

Table 14. Tree species.

Tree species code	Tree species name
AC	Black Cottonwood
AT	Trembling Aspen
BL	Balsam
CW	Western Red Cedar
EP	Paper Birch
FD	Douglas-Fir
HW	Western Hemlock
PL	Lodgepole Pine
PY	Ponderosa Pine
YC	Yellow Cedar
S	White and Englemann Spruce

(12) Tree Species (Kb = SP_S,SP_PL,SP_PY,SP_AC,SP_AT, SP_FD, SP_CW,SP_HW,SP_EP SP_BL,SP_YC
GIS = SP_S,SP_PL,SP_PY,SP_AC,SP_AT, SP_FD,SP_CW, SP_HW, SP_EP,SP_BL)

Table 15. Tree age grouping.

Age Class	Age (years)
1	1 – 20
2	21 – 40
3	41 – 60
4	61 – 80
5	81 – 100
6	101 – 120
7	121 – 140
8	141 – 250
9	251+

(Kb = AGEGRP GIS = AGEGRP)

Age Group	Age Class
1	5 - 9

Table 16. Tree height grouping.

Height class	Height (m)
1	0.1 to 10.4
2	10.5 to 19.4
3	19.5 to 28.4
4	28.5 to 37.4
5	37.5 to 46.4
6	46.5 to 55.4
7	55.5 to 64.4
8	64.5 +

(Kb = HTGRP GIS = HTGRP)

Height group	Height class
1	1-2

[12] A creek bank attribute was assigned by Oikos to differentiate wetter riparian areas next to single line creeks.
[13] Relational Data Dictionary (RDD 2.0) MoF, RIC January 31, 1995, Source document for the forest cover attributes. Groupings were created by Oikos as distinguishing feature for the knowledge base.

Table 17. Tree crown closure grouping.

Crown closure class	Crown closure percent
0	0-5%
1	6-15%
2	16-25%
3	26-35%
4	36-45%
5	46-55%
6	56-65%
7	66-75%

(Kb = CCGRP GIS = CCGRP)

CC group	CC class
1	1-2
2	3-4
3	5-6
4	7-10

Table 18. Non-productive forest codes.

FC-NP-Code	NPDESC used	Description
2	A	alpine
3	R	rock
6	G	gravel pit
10	Treated as normal	alpine forest with species
11	NPBR	non-productive brush
12	NP (without species) NP with species treated normally	non-productive forest (with or without species)
13	NPBU	non-productive burn
42	C	clearing
50	U	roads
54	U	urban
60	H	hayfield
62	M	meadow
63	OR	open range
35	SWAMP	swamp

(Kb = NPDESC GIS = NPDESC)

4.4 BIOGEOCLIMATIC INPUT ATTRIBUTES

Table 19. Biogeoclimatic input attributes.

BEC unit					
AT	At-Emwp				
BGxh2	BGxw1				
CWHms1					
ESSFdc2	ESSFdc2p	ESSFmw	ESSFmwp	ESSFxc	ESSFxcp
IDFdk1	IDFdk1a	IDFdk2	IDFxh1	IDFxh2	IDFxh2a
MHmm2	MHmm2p				
MSdm2	MSmw	MSxk			
PPxh1	PPxh2	PPxh2a			

4.5. ATTRIBUTES AVAILABLE IN BIOTERRAIN/SLOPE/ASPECT RESULTANT COVERAGE

The following is a list of attributes from the bioterrain/slope/aspect resultant coverage that were not used in the Knowledge Base creation. As the Knowledge Bases are being developed it is possible for more attributes to be used. This list will be periodically updated.

Bioterrain Decile 1

PRTFLG_1 TTEX_1A TTEX_1B TTEX_1C SM_Q1 SURFM_ST1
SURF_E1C BEDROCK_1 STTEX_1A STTEX_1B STTEX_1C SSM_1
SSURFM_Q1 SSURFM_ST1 SSURF_E1A SSURF_E1B SSURF_E1C

Bioterrain Decile 2

PRTFLG_2 TTEX_2A TTEX_2B TTEX_2C SM_Q2 SURFM_ST2
SURF_E2C BEDROCK_2 STTEX_2A STTEX_2B STTEX_2C SSM_2
SSURFM_Q2 SSURFM_ST2 SSURF_E2A SSURF_E2B SSURF_E2C

Bioterrain Decile 3

PRTFLG_3 TTEX_3A TTEX_3B TTEX_3C SM_Q3 SURFM_ST3
SURF_E3A SURF_E3C BEDROCK_3 STTEX_3A STTEX_3B
STTEX_3C SSM_3 SSURFM_Q3 SSURFM_ST3 SSURF_E3B
SSURF_E3C

Bioterrain Geophysical Attributes

GEOP_Q1 GEOP_ST1 GEOP_SCM1A GEOP_SCM1B
GEOP_SCM1C GEOP_Q2 GEOP_ST2 GEOP_SCM2A
GEOP_SCM2B GEOP_SCM2C GEOP_Q3 GEOP_ST3
GEOP_SCM3A GEOP_SCM3B GEOP_SCM3C D_1 DRAIN_SEP1
DRAIN_SEP2 D_3

Bioterrain Aspect/Slope Attributes

MEAN_ASP LOWREL_FLG POLY_COM ASP_CLS1 ASP_SEP1
ASP_CLS2 ASP_SEP2 ASP_CLS3 SLPC_1 SLPC_REL1 SLPC_2
SLPC_REL2 SLPC_3 RELIABILIT

4.6. BEC Zone Attributes

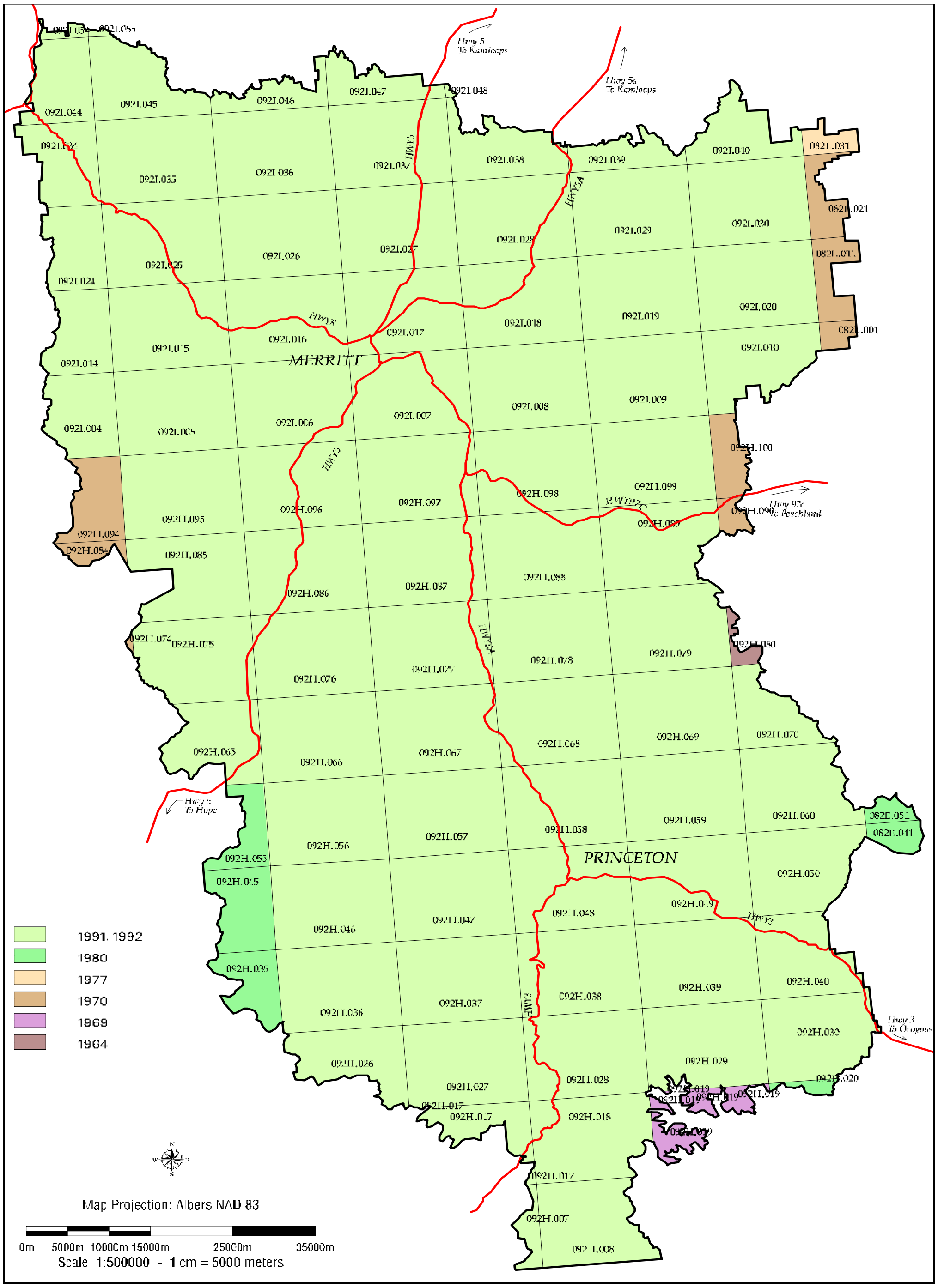
QBEC_TAG_BECLABEL_REF_NO_ZONE_SUBZONE

APPENDIX V – MERRITT PEM PROCESS ORDER TABLE

Order	Category	Param
10	As	AS
20	CCGRP+AGEGRP	CCGRP+AGEGRP
30	CB	CB
40	CB+S	CB+S
50	CB+Sm	CB+SM_1
60	D_1	D_1
70	D_2	D_2
80	E1	E1
90	E2	E2
100	E3	E3
110	ECOSOIL	ECOSOIL_1
120	ECOSOIL+D_1	ECOSOIL_1+D_1
130	ECOSOIL+D_2	ECOSOIL_1+D_2
140	Gp	GEOP_1
150	NPDESC	NPDESC
160	NPDESC+Se+Sm	NPDESC+SF_1A+SM_1
170	S	S
180	S+As	S+AS
190	Se	SF_1A
200	Sm	SM_1
210	Sm+NPDESC	SM_1+NPDESC
220	Sm+NPDESC+S	SM_1+NPDESC+S
230	SP_AC	SP_AC
240	SP_AT	SP_AT
250	SP_BL	SP_BL
260	SP_CW	SP_CW
270	SP_EP	SP_EP
280	SP_FD	SP_FD
290	SP_HW	SP_HW
300	SP_PL	SP_PL
310	SP_PY	SP_PY
320	SP_S	SP_S
330	SP_YC	SP_YC
400	SP_FD+SP_PL	SP_FD+SP_PL
410	SP_FD+SP_PY	SP_FD+SP_PY
420	SP_S+Sm+Se+As+S	SP_S+SM_1+SF_1A+AS+S
500	DecileEnd	TDEC_1
610	As	AS
620	CCGRP+AGEGRP	CCGRP+AGEGRP
630	CB	CB
640	CB+S	CB+S
650	CB+Sm	CB+SM_2
660	D_1	D_1
670	D_2	D_2
680	E1	E1
690	E2	E2
700	E3	E3
710	ECOSOIL	ECOSOIL_2
720	ECOSOIL+D_1	ECOSOIL_2+D_1
730	ECOSOIL+D_2	ECOSOIL_2+D_2
740	Gp	GEOP_2
750	NPDESC	NPDESC
760	NPDESC+Se+Sm	NPDESC+SF_2A+SM_2

Order	Category	Param
770	S	S
780	S+As	S+AS
790	Se	SF_2A
800	Sm	SM_2
810	Sm+NPDESC	SM_2+NPDESC
820	Sm+NPDESC+S	SM_2+NPDESC+S
830	SP_AC	SP_AC
840	SP_AT	SP_AT
850	SP_BL	SP_BL
860	SP_CW	SP_CW
870	SP_EP	SP_EP
880	SP_FD	SP_FD
890	SP_HW	SP_HW
900	SP_PL	SP_PL
910	SP_PY	SP_PY
920	SP_S	SP_S
930	SP_YC	SP_YC
1000	SP_FD+SP_PL	SP_FD+SP_PL
1010	SP_FD+SP_PY	SP_FD+SP_PY
1020	Sp_S+Sm+Se+As+S	SP_S+SM_2+SF_2A+AS+S
1100	DecileEnd	TDEC_2
1210	As	AS
1220	CCGRP+AGEGRP	CCGRP+AGEGRP
1230	CB	CB
1240	CB+S	CB+S
1250	CB+Sm	CB+SM_3
1260	D_1	D_1
1270	D_2	D_2
1280	E1	E1
1290	E2	E2
1300	E3	E3
1310	ECOSOIL	ECOSOIL_3
1320	ECOSOIL+D_1	ECOSOIL_3+D_1
1330	ECOSOIL+D_2	ECOSOIL_3+D_2
1340	Gp	GEOP_3
1350	NPDESC	NPDESC
1360	NPDESC+Se+Sm	NPDESC+SF_3A+SM_3
1370	S	S
1380	S+As	S+AS
1390	Se	SF_3A
1400	Sm	SM_3
1410	Sm+NPDESC	SM_3+NPDESC
1420	Sm+NPDESC+S	SM_3+NPDESC+S
1430	SP_AC	SP_AC
1440	SP_AT	SP_AT
1450	SP_BL	SP_BL
1460	SP_CW	SP_CW
1470	SP_EP	SP_EP
1480	SP_FD	SP_FD
1490	SP_HW	SP_HW
1500	SP_PL	SP_PL
1510	SP_PY	SP_PY
1520	SP_S	SP_S
1530	SP_YC	SP_YC
1600	SP_FD+SP_PL	SP_FD+SP_PL
1610	SP_FD+SP_PY	SP_FD+SP_PY
1620	Sp_S+Sm+Se+As+S	SP_S+SM_3+SF_3A+AS+S
1700	DecileEnd	TDEC_3

APPENDIX VI – MERRITT FOREST COVER REFERENCE YEAR MAP



APPENDIX VII – TRIM VS FOREST COVER CREEK POSITIONAL COMPARISONS

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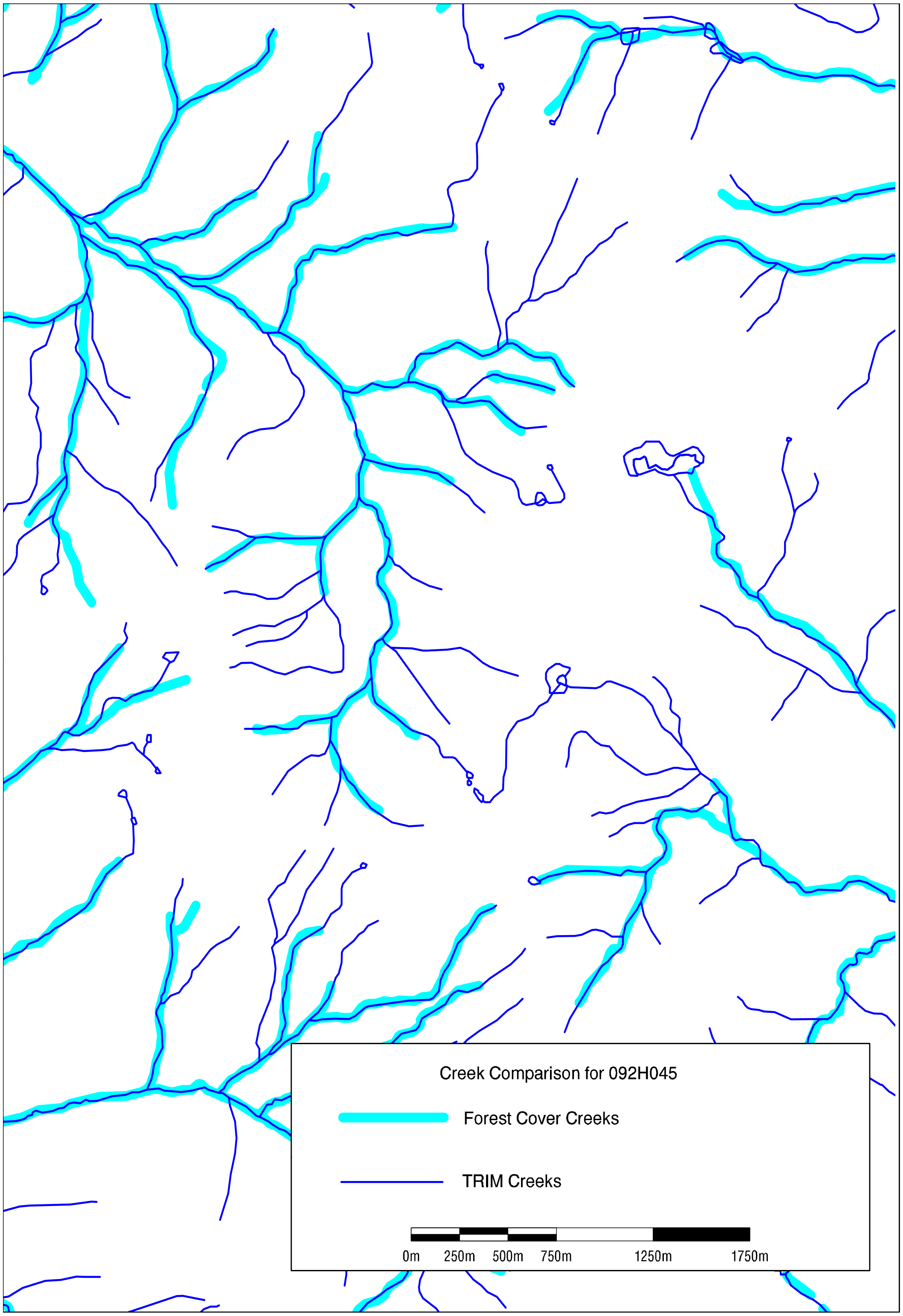
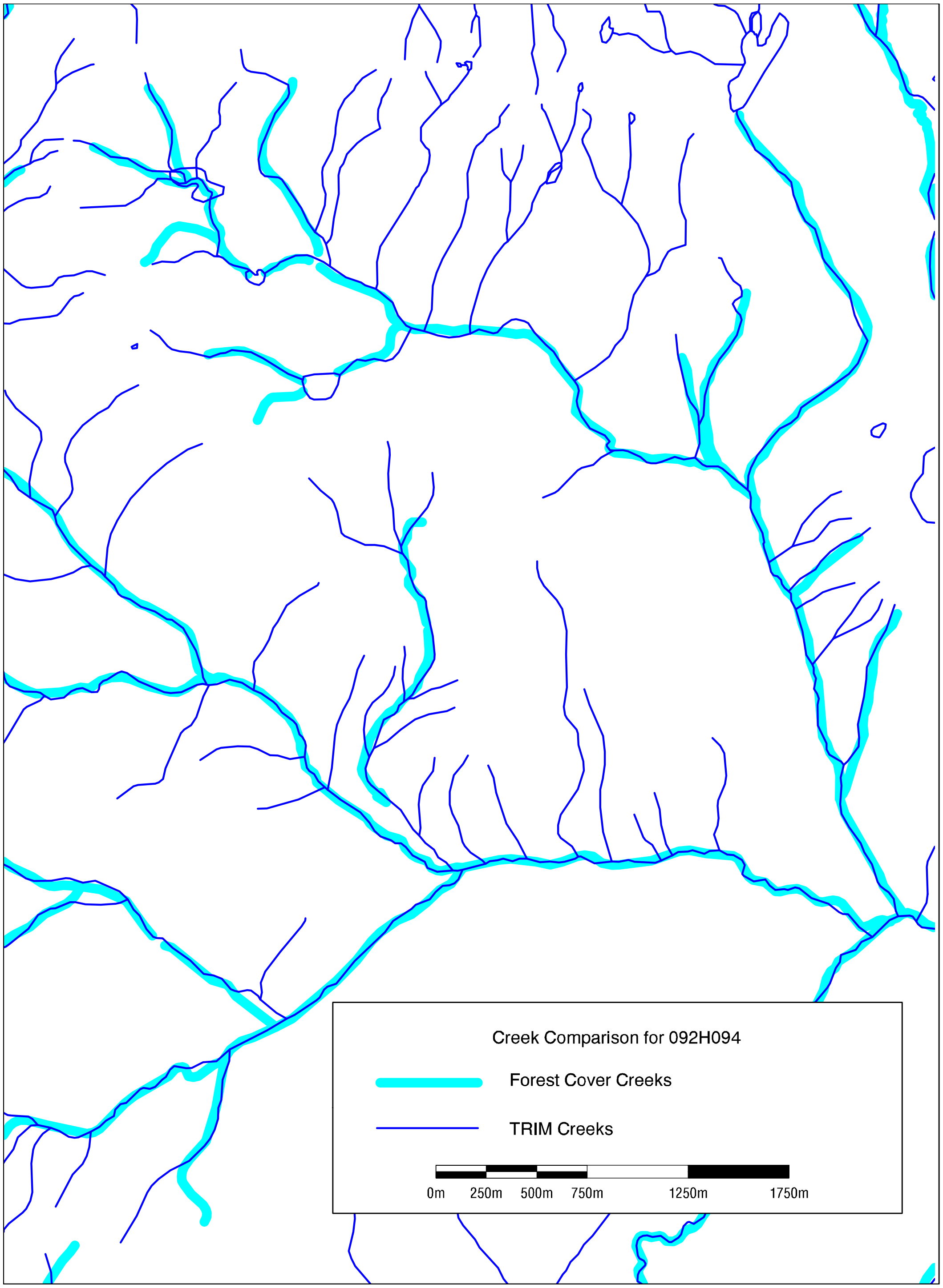

Creek Comparison for 092H045
Forest Cover Creeks
TRIM Creeks
0m
250m
500m
750m
1250m
1750m


Creek Comparison for 092H094
Forest Cover Creeks
TRIM Creeks
0m
250m
500m
750m
1250m
1750m

APPENDIX VIII – VEGETATIVE RESOURCE INVENTORY ADJUSTMENT FOR THE MERRITT TSA

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APPENDIX IX – VRI - FOREST COVER COMPARISON TABLE

Plot #	CLSTR_ID	Mapstand	VRI Species	Species	Prim. Sp. Corr.	Sp. % Overlap	VRI Age	Pr. Age	Age Cl Diff.	VRI Ht.	PR. Ht	Ht Cl. Diff.
3	DME1-0003-QO1	092I020_103	Ac 100	Ac 100	Y	100	76	150	0	33	35.4	0
4	DME1-0004-QO1	092H039_292	Pl 70 Fd 30	Pl 100	Y	70	66.543	67	0	19.68	14.1	0
5	DME1-0005-QO1	092H018_383	Pl 100	Pl 100	Y	100	106.19	118	0	19.46	18.6	0
6	DME1-0006-QO1	092H079_49	Pl 80 S 13 Fd 07	Pl 83 S 17	Y	87	121.27	134	0	25.32	23.6	0
7	DME1-0007-QO1	092H026_336	B 52 S 48	B 70 S 20 Pl 10	Y	72	177.15	141	0	22.33	18.6	0
8	DME1-0008-QO1	092H027_722	Fd 100	F 80 Pl 10 S 10	Y	80	121.47	158	0	.	27.6	
9	DME1-0009-QO1	092I019_215	Fd 100	F 100	Y	100	129.56	105	0	15.3	20.6	1
10	DME1-0010-QO1	092I027_494	Fd 97 S 03	F 70 S 20 Pl 10	Y	73	200.97	127	0	35.78	25.7	0
11	DME1-0011-QO1	092H057_29	Fd 56 Pl 44	F 60 Pl 40	Y	96	112.06	153	0	24.5	25.5	0
12	DME1-0012-QO1	092H078_478	Fd 100	Pl 70 F 20 S 10	N	20	81.707	10	1	20.1	1.6	1
13	DME1-0013-QO1	092I027_797	Fd 83 At 13 Pl 04	Pl 55 F 30 S 10 At 5	N	39	104.61	67	0	20.45	19.3	1
14	DME1-0014-QO1	092H095_590	Bl 65 Fd 18 Pl 06 Pw 06 Sx 05	F 70 S 20 Pl 10	N	29	98.058	188	0	21.9	30.5	0
15	DME1-0015-QO1	092H050_197	Pl 86 S 14	Pl 50 B 30 S 20	Y	64	118.72	121	0	22.8	23.7	0
16	DME1-0016-QO1	092H027_272	Pl 56 Fd 38 Bl 06	Pl 80 F 20	Y	86	151.11	228	0	17.36	27.2	0
17	DME1-0017-QO1	092H020_29	S 70 Bl 30	S 80 Pl 20	Y	70	280.4	230	0	21.6	29.3	0
18	DME1-0018-QO1	092H056_409	Bl 70 Hw 30	B 100	Y	70	93.633	88	0	15.82	13.1	0
19	DME1-0019-QO1	092H050_593	Fd 89 Py 11	F 70 Py 30	Y	81	69.308	158	0	13.15	24.5	1
20	DME1-0020-QO1	092I035_300	S 60 Pl 40	S 80 Bl 10 Pl 10	Y	70	188.55	137	0	9.85	22.9	1
24	DME1-0024-QO1	092H099_434	Pl 42 S 37 Fd 21	Pl 80 F 20	Y	62	56.676	132	0	14.72	27.9	1
25	DME1-0025-QO1	092H079_438	Pl 83 Bl 17	Pl 100	Y	83	100.87	97	0	23.28	21.8	0
26	DME1-0026-QO1	092I040_378	Pl 100	Pl 100	Y	100	130.88	129	0	21.53	20.9	0
27	DME1-0027-QO1	092H075_720	B 84 Pa 16	B 90 S 10	Y	84	270.69	118	0	13.97	16.9	0
28	DME1-0028-QO1	092H098_406	Fd 69 Pl 25 Py 06	F 90 Pl 10	Y	79	109.09	68	0	15.83	14.4	0
29	DME1-0029-QO1	092I025_592	Py 59 Fd 41	F 60 Py 40	N	81	118.37	107	0	15.65	15.6	0
30	DME1-0030-QO1	092H087_72	Fd 83 Pl 17	F 90 Pl 5 Py 5	Y	88	116.28	126	0	21.2	20.5	0
31	DME1-0031-QO1	092I017_186	Fd 96 Pl 04	F 40 Pl 30 At 20 S 10	Y	44	97.986	157	0	24.42	23.5	0
32	DME1-0032-QO1	092I035_783	Fd 85 Py 15	F 85 Py 10 Pl 5	Y	95	135.34	87	0	12.33	15.9	0
33	DME1-0033-QO1	092H066_663	Bl 74 Pl 13 Sx 13	Pl 50 B 40 S 9 F 1	N	62	84.762	69	0	13.5	15.4	0
34	DME1-0034-QO1	092H096_117	Pl 46 S 43 Bl 11	Pl 70 B 20 S 10	Y	66	135.54	108	0	13.15	18.7	0
35	DME1-0035-QO1	082E041_25	Pl 76 S 24	Pl 80 S 20	Y	96	115.98	129	0	22.35	21.4	0
36	DME1-0036-QO1	092I005_329	Pl 50 Fd 27 Bl 23	Pl 70 F 10 S 10 B 10	Y	70	194.64	148	0	25.35	22.4	0
37	DME1-0037-QO1	092H046_524	Bl 76 S 24	S 80 B 20	N	44	71.329	88	0	15.26	18.7	0
38	DME1-0038-QO1	092I027_117	S 44 Pl 30 Fd 22 Bl 04	S 60 Pl 30 B 10	Y	78	65.338	127	0	22.06	26.9	0
39	DME1-0039-QO1	092I037_365	Fd 67 Py 33	F 100	Y	67	120.94	127	0	19.8	22.7	0
40	DME1-0040-QO1	092I005_184	Fd 67 Py 33	Py 75 F 25	N	58	157.45	208	0	12.72	18.3	0
43	DME1-0043-QO1	092H077_125	Py 56 At 31 Pl 13	At 90 Py 10	N	41	113.89	78	0	21.93	18	0
44	DME1-0044-QO1	092I035_139	Pl 100	Pl 100	Y	100	62.103	60	0	12.8	10.8	0
45	DME1-0045-QO1	092H047_331	Pl 74 Fd 26	Pl 80 F 20	Y	74	118.37	108	0	22.43	15.7	1
46	DME1-0046-QO1	092H078_636	Pl 54 Bl 42 S 04	Pl 100	Y	54	122.82	124	0	24.1	19.7	0
47	DME1-0047-QO1	092H045_476	Bl 75 Hw 17 Yc 08	B 60 H 40	Y	77	110.01	135	0	15	20.3	1
48	DME1-0048-QO1	092I026_260	Fd 95 Py 05	F 100	Y	95	67.034	68	0	11.86	16.6	0
49	DME1-0049-QO1	092I006_1100	Fd 50 Pl 50	F 70 Pl 20 Py 10	Y	70	103.02	108	0	13.16	18.9	0
50	DME1-0050-QO1	092H037_607	Fd 92 Pl 08	F 60 Pl 40	Y	68	149.05	128	0	33.16	24.8	0
51	DME1-0051-QO1	092I024_577	Fd 74 Pl 26	F 85 Pl 10 S 5	Y	84	113.76	227	0	17.66	26.3	1
52	DME1-0052-QO1	092I046_907	Fd 67 S 33	F 80 S 15 Pl 5	Y	82	171.96	289	0	31.82	28	0

Plot #	CLSTR_ID	Mapstand	VRI Species	Species	Prim. Sp. Corr.	Sp. % Overlap	VRI Age	Pr. Age	Age Cl Diff.	VRI Ht.	PR. Ht	Ht Cl. Diff.
53	DME1-0053-QO1	092H039_146	Pl 100	Pl 100	Y	100	73.134	73	0	21.12	17.3	0
54	DME1-0054-QO1	092H049_365	Fd 83 Pl 17	Pl 70 F 30	N	47	126.06	107	0	20.87	19.6	0
55	DME1-0055-QO1	082L011_199	Pl 65 Fd 22 S 09 At 04	Pl 100	Y	65	101.01	129	0	21.57	23.2	0
56	DME1-0056-QO1	092H060_318	Pl 96 S 04	Pl 70 S 30	Y	74	131.63	207	0	23.1	26.2	0
57	DME1-0057-QO1	092H100_19	S 92 Bl 08	S 90 Pl 10	Y	90	313.24	139	0	26.4	27.8	0
58	DME1-0058-QO1	092I048_934	Bl 36 S 36 Pl 28	S 70 Pl 20 B 10	N	66	139.64	186	0	24.96	30.4	0
59	DME1-0059-QO1	092H048_182	Fd 83 Py 08 Jr 09	F 70 Py 30	Y	78	118.97	210	0	19.2	22.2	0
60	DME1-0060-QO1	092I018_167	Py 100	Py 100	Y	100	49.827	257	0	13.46	22.1	1
64	DME1-0064-QO1	092I035_185	Pl 100	Pl 100	Y	100	64.144	77	0	15.25	12.9	0
65	DME1-0065-QO1	092H050_26	Pl 100	Pl 100	Y	100	116.31	118	0	16.07	15.6	0
66	DME1-0066-QO1	092H078_742	Pl 71 S 26 Bl 03	Pl 100	Y	71	136.61	128	0	26.58	20.5	0
67	DME1-0067-QO1	092H036_42	Bl 58 Pl 26 S 16	B 70 S 20 Pl 10	Y	84	106.34	128	0	20.85	18.9	0
68	DME1-0068-QO1	092I029_217	Fd 90 Pl 10	F 80 At 20	Y	80	60.57	63	0	20.3	15.5	1
69	DME1-0069-QO1	092H097_293	S 60 Fd 40	F 60 Pl 40	N	40	75.564	208	0	18.7	19.4	0
70	DME1-0070-QO1	092H039_396	Fd 80 S 20	F 90 Pl 10	Y	80	154.28	128	0	16.65	24.8	1
71	DME1-0071-QO1	092I024_612	Fd 80 Pl 15 Py 05	F 50 Pl 40 Py 5 Pa 5	Y	70	311.48	157	0	15.26	22.5	1
72	DME1-0072-QO1	092I047_732	Fd 100	F 70 S 20 Pl 10	Y	70	235.39	276	0	25.73	30.3	0
73	DME1-0073-QO1	092H068_144	Pl 100	Pl 100	Y	100	63.399	68	0	21.23	16.4	1
74	DME1-0074-QO1	092H050_25	Pl 47 S 42 Bl 11	Pl 80 S 10 B 10	Y	67	121.95	108	0	22.17	19.7	0
75	DME1-0075-QO1	082L011_387	Pl 91 Fd 05 S 04	Pl 90 S 10	Y	95	138.09	139	0	23.2	22.9	0
76	DME1-0076-QO1	092H060_365	Pl 50 Bl 29 S 21	Pl 70 S 30	Y	71	134.36	148	0	20.96	24.4	0
77	DME1-0077-QO1	092H036_111	S 52 Pl 27 Bl 21	S 70 B 30	Y	73	148.18	140	0	25.26	28	0
78	DME1-0078-QO1	082E041_96	S 91 Bl 09	S 100	Y	91	185.29	219	0	23.25	33	0
79	DME1-0079-QO1	092H048_273	Ac 100	F 70 Py 30	N	0	42.798	210	0	19	22.2	0
80	DME1-0080-QO1	092I017_114	Fd 55 Py 36 Jr 09	Py 80 F 20	Y	56	153.18	258	0	15.7	21.6	1
84	DME1-0084-QO1	092H028_119	Pl 53 Fd 47	Pl 100	Y	53	54.232	58	0	13	10.3	0
85	DME1-0085-QO1	092H029_38	Pl 89 S 07 Bl 04	Pl 95 S 5	Y	94	106.44	97	0	17.34	16.7	0
87	DME1-0087-QO1	092H036_24	Bl 50 S 50	B 80 Pl 10 S 10	Y	60	307.7	58	0	31.65	14.1	1
88	DME1-0088-QO1	092I039_515	Fd 86 Pl 14	F 50 S 30 At 15 Pl 5	Y	55	90.91	58	0	16.86	13.7	0
89	DME1-0089-QO1	092I028_398	Py 54 Fd 46	F 75 Py 25	N	71	66.875	84	0	12.83	21.7	1
90	DME1-0090-QO1	092H086_335	Fd 46 Pl 46 Py 08	F 70 Py 30	Y	54	106.36	128	0	12.22	15.5	0
91	DME1-0091-QO1	092I024_469	Py 56 Fd 44	F 70 Py 30	N	74	135.26	207	0	17.02	23.3	1
92	DME1-0092-QO1	092H095_193	Fd 85 Bl 15	F 90 S 10	Y	85	170.57	238	0	29.9	34.3	0
93	DME1-0093-QO1	092H039_298	Pl 78 Fd 22	Pl 90 F 10	Y	88	57.684	73	0	16.94	14.1	0
94	DME1-0094-QO1	092H086_408	Pl 77 Fd 23	Pl 80 F 20	Y	97	107.5	109	0	23.35	14.7	1
95	DME1-0095-QO1	092I046_726	Pl 89 Bl 07 S 04	Pl 80 S 20	Y	84	133.17	127	0	16.93	18.5	0
96	DME1-0096-QO1	092H019_207	Pl 57 S 36 Bl 07	Pl 80 S 20	Y	77	85.176	190	0	8.3	22.1	1
97	DME1-0097-QO1	092H058_266	Fd 78 Py 22	PY 80 F 10 AT 10	N	32	71.837	103	0	23.64	28.7	0
99	DME1-0099-QO1	092H058_123	Fd 86 S 14	F 100	Y	86	117.7	83	0	22.78	27	0
100	DME1-0100-QO1	092H077_502	Fd 100	Pl 70 F 30	N	30	112.35	110	0	16.02	20.1	1
104	DME1-0104-QO1	092H030_242	Pl 100	Pl 100	Y	100	61.971	57	0	13.35	11.2	0
105	DME1-0105-QO1	092I035_504	Pl 100	Pl 95 F 5	Y	95	92.889	97	0	20.8	17	0
106	DME1-0106-QO1	092H059_201	Pl 45 Bl 41 S 14	Pl 100	Y	45	120.8	128	0	20.86	12.5	1
107	DME1-0107-QO1	092H046_417	Bl 53 S 47	B 80 S 20	Y	73	100.81	68	0	19.6	8.1	1
108	DME1-0108-QO1	092I020_461	Fd 100	F 60 Pl 30 S 10	Y	60	98.684	47	0	16.4	11.8	0
109	DME1-0109-QO1	092I027_798	Fd 100	F 90 Pl 10	Y	90	92.792	96	0	19.63	24.8	0
110	DME1-0110-QO1	092H049_582	Fd 100	F 100	Y	100	91.127	128	0	21.9	16.6	1
111	DME1-0111-QO1	092I024_519	Fd 76 Py 24	F 60 Py 40	Y	84	410.08	237	0	22.9	25.4	0

Plot #	CLSTR_ID	Mapstand	VRI Species	Species	Prim. Sp. Corr.	Sp. % Overlap	VRI Age	Pr. Age	Age Cl Diff.	VRI Ht.	PR. Ht	Ht Cl. Diff.
112	DME1-0112-QO1	092H098_409	Fd 100	F 90 Pl 10	Y	90	171.5	149	0	27.16	30.3	0
113	DME1-0113-QO1	092H040_543	Fd 78 Sx 11 Pl 06 At 05	Pl 50 F 30 At 20	N	41	43.65	66	0	13.17	13.1	0
114	DME1-0114-QO1	092H076_107	Bl 35 Fd 35 S 30	Pl 90 F 10	N	10	124.14	108	0	23.7	14.7	1
115	DME1-0115-QO1	092I035_982	Pl 90 Fd 10	Pl 95 F 5	Y	95	99.405	127	0	19.3	18.5	0
116	DME1-0116-QO1	092H029_209	Pl 50 S 30 Bl 20	Pl 80 S 10 B 10	Y	70	252.09	195	0	23.4	22.1	0
117	DME1-0117-QO1	092I006_213	Fd 60 Py 40	Py 60 F 40	N	80	58.08	128	0	16.12	20.8	1
118	DME1-0118-QO1	092H045_195	S 71 Bl 29	B 80 S 20	N	49	84.14	109	0	20.4	11.8	1
119	DME1-0119-QO1	092I007_700	Fd 78 S 20 Pl 02	F 60 Pl 30 At 10	Y	62	76.915	107	0	17.82	10.5	0
120	DME1-0120-QO1	092H047_439	Pl 67 S 22 Bl 11	Pl 100	Y	67	108.7	108	0	23.02	22.7	0
123	DME1-0123-QO1	092H045_121	S 58 B 25 Hw 17	B 100	N	25	75.054	360	0	19.42	22.1	1
124	DME1-0124-QO1	092H088_268	Pl 100	Pl 90 B 10	Y	90	72.192	78	0	18.96	17.1	0
125	DME1-0125-QO1	092H027_330	S 38 Pl 31 Bl 31	Pl 90 B 10	N	41	150.12	118	0	21.6	20.6	0
126	DME1-0126-QO1	092H047_249	S 59 Bl 41	Pl 90 S 5 F 5	N	5	117.97	138	0	27.27	26.5	0
127	DME1-0127-QO1	092H026_546	Sx 67 Bl 33	B 70 S 30	N	67	134.76	188	0	18.48	32.7	0
128	DME1-0128-QO1	092H068_633	Fd 77 Pl 15 S 08	F 80 Pl 20	Y	92	103.24	99	0	21.16	19	1
129	DME1-0129-QO1	092H040_631	Sx 54 Fd 32 Pl 14	F 90 Pl 10	N	42	62.186	108	0	20.7	23	0
130	DME1-0130-QO1	092I044_486	Fd 90 Py 10	F 80 Py 20	Y	90	129.77	165	0	13.72	16.9	0
131	DME1-0131-QO1	092I007_247	Fd 74 At 11 S 11 Pl 04	F 80 S 10 Pl 10	Y	88	113.41	157	0	20.48	27.5	0
132	DME1-0132-QO1	092H008_522	Pl 86 Fd 14	Pl 90 F 10	Y	96	60.378	70	0	15.02	13	0
133	DME1-0133-QO1	092I007_346	Fd 71 Pl 29	Pl 60 F 30 S 10	Y	59	113.69	107	0	19.13	22.6	0
134	DME1-0134-QO1	092H056_97	Pl 85 Fd 12 S 03	F 70 S 20 Pl 10	N	25	103.79	108	0	26.86	29.2	0
135	DME1-0135-QO1	092H050_42	Pl 96 S 04	Pl 100	Y	96	123.44	128	0	22.56	24.5	0
136	DME1-0136-QO1	092H039_441	Pl 61 S 39	Pl 70 S 30	Y	91	203.63	228	0	25.35	30.2	0
137	DME1-0137-QO1	092H029_57	Bl 38 Pl 38 S 24	S 80 Pl 20	N	44	218.18	188	0	20.5	30.6	0
138	DME1-0138-QO1	092H067_250	Fd 64 Bl 18 Pl 09 S 09	B 70 S 30	N	27	97.929	111	0	17.45	21.6	0
139	DME1-0139-QO1	092H097_601	Fd 75 Pl 25	F 100	Y	75	189.21	267	0	27	32.2	0
140	DME1-0140-QO1	092I006_816	At 100	F 30 Py 30 At 30 Ac 10	N	30	40.755	118	0	6.7	24.9	1
144	DME1-0144-QO1	092H068_611	Pl 100	Pl 95 AT 5	Y	95	71.868	70	0	19.5	17.2	0
156	DME1-0156-QO1	092H047_230	Fd 80 Ep 20	Pl 60 F 40	N	40	68.339	230	0	18.45	31.7	1
				Total		*8546*						
				Average		*70.9*						
	DME1-0098-QO1	*092H036_869*	*Bl 45 S 45 Pl 10*	*0*			*243.74*	*0*		*21.5*	*0*	
	DME1-0063-QO1	*092I017_535*		*At 90 F 10*				*67*			*17.1*	

APPENDIX X – EBA RECOMMENDATIONS

EBA was contracted by the NSIFS to review the quality and accuracy of the Merritt PEM project. The results were reported in the Quality and Accuracy Assurance for the Merritt PEM Project[14] (Appendix 1). After the release of the EBA document, meetings were held with representatives from EBA, KWR, NSIFS and JST to review the findings of the report. A subsequent meeting held November 9, 2001 attended by Stuart Aird, Gordon Lester, Ron Zayac, and Frits Nijholt resulted in the adoption of EBA report recommendations where possible. The following are the recommendations from the EBA report (in italics) followed by the response or actions taken to adopt them (relating to GIS processing only):

- 7.1 Plot Data

Given the nature of PEM, and the need to undertake a rigorous independent examination of the predictions using as much "real ground data" as possible, we recommend that there be additional effort to recover and use the initial Merritt PEM plots that were discarded. It appears a lot of these plots were not used because there were inadequate linkages established to the PEM mapping either geo-positioning by BEC sub-zone or other key attribute was missing.

A plot-by-plot re-examination would undoubtedly provide more plots that would be potentially useable to assist in PEM accuracy/validation processes.

Initial reviews found several of the data sets lacking in important attributes such as reliable locations, correct BGC map version. The plot data used in the evaluation of the PEM were those taken over the course of the PEM project by various ecologists which now form the basis of the review of the final PEM entities. The majority of data was collected during the summer of 2001 by a consortium of EBA, KWR, and Oikos field crews. Unfortunately, other sets of data had different objectives, and therefore were not suitable to the scope of this project. Efforts may be made in the future to try to recover some of this data to increase the data sets available for validation of the Merritt PEM.

The BGC and edatopic grid versions on which the Merritt PEM project were based changed three times over the course of the project (section). This made the selection of plots to be used for the final PEM evaluation difficult as the plots had varying BGC and site series source maps.

- 7.2 Input Data Layers

All input data layers should be prepared on a Forest District level before processing. As indicated in the results a major problem of data integrity, line work, attributes, gaps, slivers, etc is created by working on individual map sheets.

Make use of source and feature coding in GIS process to assist in QA process. This allows for easy confirmation on completion of major processes the subsequent line work and data are correct.

[14] EBA Engineering Consultants Ltd. 2001. Quality and accuracy assurance for the Merritt PEM project. November 2001. 31pp.

All input data layers (section) follow the Standards for Predictive Ecosystem Mapping Inventory Standards[15]. EBA had problems backtracking from the original data to check different layers because of the extensive dissolves and eliminates without retaining any hard lines. The new process (section) has minimal coverage intersections and eliminations and should allow for checking of the major processes. The new process defines hard lines prior to any eliminate process.

•7.2.1 Bioterrain

One of the difficulties we encountered in understanding and using the project Bioterrain data was the lack of unique identification labels for each entry. The whole Merritt PEM program should have a fundamental system of naming conventions so that there are not duplicate labels used in any of the map layers. We encountered duplicity in labeling frequently throughout the datasets, and this greatly hampered the process of making overall interpretations and assessments. We recommend that this be systematically cleaned up throughout the PEM input layers, and specifically within the Bioterrain database.

The area involved in the Merritt PEM is large and involves a considerable number of mapsheets. However, workstation PC's have the processing power to handle the entire area or at least large blocks of seamless data for a project such as the Merritt PEM. Our examination of the map layers, including Bioterrain and slope/aspect derivative mapping, indicated that there are problems associated with map edges and map block seams, and these have not been properly dissolved out. We recommend that the key input databases be reworked using full area seamless coverage's so that the problems associated with seaming are eliminated.

Each Bioterrain polygon has a unique identifier based on mapsheet and Bioterrain polygon number (e.g.92h045-35456), which is maintained throughout the processes. The final coverage will contain an item 'poly_nbr' to uniquely identify the seamless resultant polygons over the entire project. The Bioterrain input file is described in Section 4.1. KWR provided JST with a seamless Bioterrain coverage and this coverage is maintained as seamless throughout the process. JST did adopt the EBA recommendation of seamless data.

•7.2.2 Forest Cover

Our examination of Forest Cover also shows that this input database suffers from a lack of unique identification labels. As for the Bioterrain, this needs to be addressed and corrected, so that the data can be used seamlessly. We recommend that this be systematically cleaned up throughout the PEM forest cover input data layer.

JST received a more recent forest cover map version from Timberline Forest Inventory Consultants Ltd. (TFIC) after the EBA report was completed. The data from TFIC was seamless and is described under section 4.2. In the updated process, forest cover polygons, with the exception of those described as 'non-productive' (NPDESC), were

[15] TEM Alternatives Task Force. 1999. Standards for Predictive Ecosystem Mapping - Inventory Standards. Version 1.0. November 1999. 43p.

not intersected into the resultant PEM coverage (section 4). Duplicate ‘MAPSTAND’ numbers occur only where the Merritt IFPA boundary was clipped from the original mapsheet (e.g. where the boundary meets the Vancouver Region).

•7.2.3 Localized BGC

The legacy (old BGC) zonation data was used for the “PEM Resultant” mapping that we examined. In any re-running of PEM modeling, we recommend that the new BGC sub-zone lines be used, and the plot data associated with the BGC line work now be updated so that it is associated with the appropriate new BEC sub-zone.

We attempted to use the updated BGC line work and edatopic grids, received from the Kamloops MoF Regional Ecologist in July 2001. Unfortunately, as the grids were not fully documented or approved, the project fell back to using the approved grids. However, the new BGC lines were used and the approved edatopic grids were cross-referenced (section 4.4).

•7.2.4 Slope and Aspect

The slope and aspect calculations for the PEM would be significantly more useful if they were generated and used in relation to the Bioterrain base. Our examination of the input databases indicates that the Bioterrain base is a high quality and fundamental database for the project, but its effectiveness in discriminating ecological units is diminished by the manner in which input data layers are handled through the knowledge base process. To better solidify the Bioterrain mapping line work and link slope and aspect features associated with terrain landforms, we recommend that slope and aspect be generated using Bioterrain polygons, line work and contents as base features.

The slope and aspect attributes derived during the creation of Bioterrain were photo interpreted by several classifiers. This was felt to be a less accurate/consistent way of deriving slope and aspect, than using the TRIM DEM to create a weighted average slope and aspect for each polygon (Section 3). Hence, we did not incorporate this recommendation into the process.

•7.2.5 Other Input Data

Refers to input data related to structural stage. The only other outside data JST used for input validation was data collected during the VRI program.

•7.3 Knowledge Base (KB)

EBA did not have time to review the KB’s other than to repeat the recommendation to clean up the input coverage’s described in Section 4.

•7.4 PEM Processing

Final PEM processing was carried out on first Bioterrain decile only, and this greatly diminished the information content of thee Bioterrain labels. When we review the sources of misclassification throughout the PEM, we are encountering many conditions that would have been more adequately described if the secondary and tertiary bioterrain

labels had been included in the information content of the PEM. Some "net effects" of the Bioterrain simplification include:
This procedure eliminated 0 to 60% of the typed Bioterrain under conventional standards (ie 4Mv 4Cv 2R would become 10Mv). This methodology obscured the less abundant features of the landscape (at the scale of mapping), and resulted in an over-emphasis being placed on others.

The convention practiced by Bioterrain interpreters is to place till first in a 50/50 split of the polygon or in a series (as above). Using the first decile only overestimates the abundance of tills. Consequently, we recommend that the Bioterrain delineation be reanalyzed, using all 3 deciles, so as to capture and then use significantly more information content from the Bioterrain label…..

During the PEM processing, the methodology used to intersect all layers involved a process, which created and inordinate number of slivers……

Processing (cross-product cancellation) has always taken into consideration the other deciles, but the integrity of the polygons were compromised when they were split by the other input layers. The new process minimizes the splitting of Bioterrain polygons. The Bioterrain lines are only split by: 1) creek buffers, 2) NP forest cover types, and 3) BGC lines (section 3). The eliminate command is used only twice, in both cases where the Bioterrain coverage was intersected, to remove slivers but retaining Bioterrain lines as hard lines thereby minimizing the changes to the original Bioterrain coverage while maximizing its original integrity. The final resultant will not go through a dissolve process as was done in past versions of data processing therefore retaining original data integrity. This is described in Section 3.

The PEM processing also suffered from some specific issues. In our review of the PEM processing we have not confirmed the net effect of these issues, however for some specific location within mapsheets, they may have had a serious impact upon the predictions. These include:

a) FC1 attributes were not all transferred adequately (i.e., AC in riparian areas were sometimes moved upslope for some reason).

This was a result of the process of the extensive polygon splitting and dissolving. Attributes for smaller polygons became part of larger polygons, which accounted for the appearance of attributes moving up the hill. The new process minimizes the chance for this to occur (Section 3).

b) Legacy BGC lines were used in the initial PEM classification process. While we recognize there were scheduling and timeline issues associated with the incorporation of newer BGC lines, these are now available and need to be used in any final interpretations, fully incorporating associated new knowledge content with KB.

See Section 4.4 of this document for a discussion of this problem.

c) *The stream buffers chosen for the Merritt PEM are not, we feel, sympathetic to ecological conditions within the landscape. If they are to be automatically treated, then variable width buffers should be associated with different stream and water body types. For example, minor TRIM streams are frequently intermittent streams with little overall effect on local moisture conditions along the stream. The standard with buffering should be reexamined as it serves to overestimate wetter conditions.*

In consultation with Oikos, JST is to retained the stream buffers but reduced the steepness of the selection criteria to no greater than 20% (Section 3) Reducing the number of stream buffers noted by EBA.

•7.5 Output Data Layers

Any supplemental post EcoGen processing should be avoided, as it just blurs the data content and serves to degrade the overall mapping outputs. In addition, by not conducting further cleaning or filtering the result will:

a) *Ensure the data integrity of the underlying layers, especially if they are to be used in any future map derivatives (i.e. wildlife forage and adjacent escape terrain); and,*
b) *Be easier to QA/RA.*

There will be no final dissolve on the resultant coverage after the derived Ecogen PEM entities have been added. PEM map entities will be predicted for all three bio-terrain deciles if they are available.

•8.0 Future Directions

EBA outline two options to complete this project. The NSIFS has elected for option 2. Complete the PEM, but upgrading the input databases and revising the PEM processing approach as we have recommended in Section 7……

This is being done and is being outlined in this report.

APPENDIX XI – INPUT DIGITAL DATA (INCLUDING THEMATIC INPUT DATA SOURCE CSV)

These digital files are for the express use of checking the input files data for the Merritt PEM. Under **NO CIRCUMSTANCES** may this data be copied or distributed outside the scope of this contract for the Merritt PEM.

Digital Files contained herein;

1. bec_bt_bdy.zip – Biogeoclimatic Zone.
2. dem.zip – TRIM PEM
3. j_tc.zip – Forest Cover
4. kwr_bio.zip – Bio-Terrain
5. twtr.zip – TRIM Creeks