CST-EBMWG DS03- Operational Costs and Benefits:

Phase 2: Incremental Costs and Benefits from EBM at the Stand Level

REPORT

For: The Ecosystem Based Management Working Group

By Ken Zielke RPF, Bryce Bancroft RPBio, and Laurie Kremsater RPF, RPBio

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For more information contact:

Ken Zielke, Symmetree Consulting Group Ltd

4654 Keith Road

West Vancouver, BC V7W 2M6

ph. 604-921-6077 email: kzielke@telus.net

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This report was commissioned by the Ecosystem-Based Management Working Group (EBM WG) to provide information to support full implementation of EBM. The conclusions and recommendations in this report are exclusively the authors', and may not reflect the values and opinions of EBM WG members.

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OVERVIEW

There is uncertainty about the costs and/or benefits, economic and ecological, of implementing EBM in the coastal forest sector, particularly at the operational level. Most analyses have been strategic, using computer models to estimate effects on timber supply or "supply side impacts" that accrue as a result of additive landbase net-downs. Other efforts have used finer scale field inventory and cost data to assess operational level impacts; however, the results have varied due to data uncertainties, use of different mapping and analysis procedures, and lack of peer review.

This project has attempted to develop reasoned estimates, at an operational level, of the range of potential stand level costs and benefits, both economic and ecological, of implementing EBM in the coastal forest sector. Application of initial land use objectives and more comprehensive objectives vis-à-vis the EBM Handbook have been assessed.

Discussion of operational forestry costs is complicated by a variety of spatial and temporal scales. Some planning and logging costs that are influenced by major changes in management approach (such as EBM) can be determined at the cutblock level. However, significant costs may be incurred at higher spatial and planning levels over time, as a result of spreading less volume over fixed costs for infrastructure and other forestry activities. Because these fixed volume-reduction costs are best assessed by modeling harvesting on larger areas over time, as in the current CFCI Patchworks modeling projects, and to avoid confusion between scales, they are avoided here. The focus for this project is on those costs and benefits occurring at the cutblock or stand level.

This cutblock level analysis project, will complement current and future modeling of higher level, long-term costs by providing more accurate picture of reserve volumes and average variable costs associated with cutblocks. The complete package of costs (cutblock and higher level) when considered together with timber values over watersheds and landscapes will provide insight to operability questions under EBM.

Objectives

The primary purpose of this project is to provide reasoned estimates of the potential short term cutblock level costs and benefits, ecological and economic, of implementing EBM within coastal forestry operations.

METHODS

Sample Selection

The original intent for this project was to examine information from 15-25 cutblocks in each of the key EBM subregions (North Coast, North Central and South Central Coast), providing for total sample size of 45 to 75 cutblocks. This sample would include both EBM and pre-EBM blocks, split between licensees and harvesting approach (cable, ground, helicopter) to best represent what is generally conducted in each of the subregions. Because BCTS was determined to have special challenges when implementing EBM, they were not included in the sample. Instead the focus was on the major licensees in the area – International Forest Products Ltd., Western Forest Products Ltd., TimberWest, and Triumph Timber. This approach for sampling was challenged by the fact that only two of the four major licensees (Western Forest Products and Triumph Timber) were able to provide the necessary block information.

To subsequently allow for a suitable sample size, Symmetree Consulting Group, with the agreement of the Coast Forest Conservation Initiative (CFCI), added information from 29 cutblocks previously assessed in 2006 under a transitional monitoring project for the CFCI. In this way the sample was rounded out to include block information from all four major licensees, but not necessarily in a way that best represents proportional licensee harvesting or the proportional range of harvesting approaches.

Analysis of EBM on each cutblock

Where different levels of EBM were practiced on the various blocks, the consultants estimated:

- what was done that was over and above FRPA/FPC requirements;
- what is needed to comply with the current Legal Orders (Ministerial Orders);
- what is needed to comply with perceived "Full EBM";
- the difference between FPC/FRPA requirements and implementation; and
- the difference between EBM requirements and implementation.

This was not merely an arithmetic exercise, subtracting exact minimum buffer requirements under FPC/FRPA from similar minimums set under the Legal Orders. Rather, conventional layout considerations (terrain, sensitive sites) were considered as much as possible, as well as other non-EBM objectives that could result in cutblocks fully or mostly meeting some EBM requirements under FRPA/FPC legislation alone.

Added requirements or tasks to achieve EBM (under current Legal Orders) or "Full EBM" were considered on each cutblock using standardized approaches with reasonable efficiencies (Appendix 1). For the 29 blocks monitored in 2006 for implementation under CFCI direction, the consultants had been on the ground and were well-acquainted with the attributes of the various reserves for features and retention patches.

Cost questionnaire to Licensees

Once all blocks had been analysed, added requirements or tasks to meet EBM were be categorized generically (with some stratification) and assembled in a questionnaire to licensees. The questionnaire was designed to encourage the licensees to roughly estimate average cost data

based on their experience with EBM thus far. Triumph Timber and Western Forest Products participated in answering the questionnaire.

EBM benefit determination

Ecological benefits/gains were quantified based on additional retention or protective measures (amount of added habitat or habitat structures, or improved connectivity etc) as well as economic benefits (added person days of work for EBM).

EBM cost determination

Final estimated average cost data was then be applied appropriately to the EBM requirements or tasks identified in the sample cutblocks. Results are summarized to estimate the average incremental cost of MO EBM and FULL EBM (over and above costs incurred under FRPA alone).

Peer Review of methodology

A peer review process was initiated for this project in March, with four peer reviewers actively engaged. Written comments were received and a follow-up conference call on April 11th helped to clarify key points and main concerns. A response was prepared for each of these key points (Appendix 2). Following a further discussion of these key points, the methodology was further refined (Appendix 1).

RESULTS

Data from each cutblock in the sample were analysed using a set of spreadsheets contained in the file labelled "*DATA INPUT Spreadsheet Sept30_08 Version 2.4.xls*". This file consists of a set of five spreadsheets:

- Retention need to meet the Ministerial Order
- DS03 Data Spreadsheet
- Notes spreadsheet
- Harvesting Cost spreadsheet
- Planning Cost spreadsheet

In the DS03 Data spreadsheet information was recorded for general block descriptors, as well as the type and amount of retention or reserves associated with the cutblocks. A multi-coloured set of columns includes key EBM features and associated reserves required based on buffer requirements under the Ministerial Orders. A green section of the spreadsheet includes the relevant information associated with stand level retention and requirement to meet the Ministerial Orders. It is also in this green section that requirements under a FRPA-only approach are quantified. Data that is anticipated to require interpretation is highlighted with a double-lined box and hyper-linked to the "Notes" sheet, which holds one to six comments for each block. The far left, mostly white set of columns on the DS03 Data Spreadsheet describe the features that may be relevant to what is at this time is indicated to be "Full EBM".

The Nature of the Sample

As mentioned previously, the sample was not prestratified as was originally intended and described in the original methodology. Due to the non-participation of some licensees, cutblocks from a prior CFCI EBM monitoring project in 2006 had to be included to provide a sufficient sample.

The resulting sample had a reasonable representation between the North Coast and the Central Coast, considering the rate of harvesting in each area (Table 1). Geographically, the sample was weighted toward the South Central Coast, and so averages across the entire sample area must be used with this in mind. There is a reasonable distribution of blocks across all four licensees and all three harvest methods, although it may not be entirely representative of what occurs on average across this area.

The harvesting patterns predominantly used were clearcut-with-reserves, group retention and dispersed retention at almost an equal split (Table 2). The remaining small percentage of the sample was in standard clearcuts and multi-pass small opening approaches.

Table 1. General Characteristics of the Sample (49 total cutblocks) for DS03- Phase 2.

Key Characteristic	Stratification of Sample	% of Sample Blocks
Source and era of information		
	Non-EBM[1]	31%
	CFCI 2006 (EBM pre legal orders)	59%
	EBM, but not 2006 CFCI and not under EBM legal orders	10%
Regional Location of cutblocks		
	North Coast	23%
	North Central Coast	29%
	South Central Coast	48%
Licensee responsible		
	International Forest Products	37%
	Western Forest Products	31%
	Triumph Timber	22%
	TimberWest	10%
Harvesting Method		
	Helicopter Yarding	46%
	Grapple / cable yarding	29%
	Ground-based forwarding	25%

[1] **Non-EBM** – These blocks either were generally planned and/or harvested between 2005 and 2007 and were not subject to the transitional Agreement in Principle for EBM, or they were planned prior to implementation of the AIP. Some of these cutblocks were part of the 2006 CFCI monitoring, and some were not.

Table 2. Silvicultural Systems/ Harvest Patterns used for the Sample (49 total cutblocks) for DS03- Phase 2.

Silvicultural System / Harvest Pattern[2]	% of Sample Blocks
Clearcut	4%
Clearcut with reserves	29%
Group retention	29%
Dispersed retention	24%
Mixed group and dispersed retention	10%
Multi-pass system with small openings	4%

First Nations Features required by the Legal Orders

Objectives 3-7 in the Legal Orders describe a range of requirements for First Nations. These requirements focus on traditional forest resources and heritage features in general, and culturally modified trees (CMTs), monumental cedar and cedar retention specifically. They allow for alterations as long as steps have been taken to plan with First Nations. The only specific stand level features that may be related to EBM for First Nations in our sample was the presence of CMTs, and the requirement for retention of a cedar component, based on the proportion of dispersed retention in the block.

Culturally modified trees (CMTs) were included in site plans for 20% of the sample (10 blocks of 49), sometimes targeted for protection or a reserve (Table 1). Most of the blocks with CMTs were found in the North and North Central Coast. Because all blocks were harvested prior to the Legal Orders, we assume that associated reserves for CMTs, where they were left, were not specifically associated with EBM and would have been left regardless. It is recognized that participation in planning processes, and increased consultation with First Nations is a planning cost that is relevant to all cutblocks.

Twenty-four percent of cutblocks would require cedar retention under the Legal Orders for EBM. Objective 7 of the Legal Orders for EBM specify requirements for maintaining the first 15% of retention with a proportion of cedar that is representative of the preharvest stand when more than 15% dispersed retention is left on a cutblock. This requirement has some clear benefits for First Nations, and possibly for habitat.

[2] Harvesting pattern is likely the best way to think about these categories although the name applied sometimes also communicates the silvicultural system used. A clearcut with reserves generally had a reserve appended to its boundary. Dispersed retention reflected the dominant harvesting approach, even though an additional associated reserve patch may have more volume than the retention dispersed throughout the block. Cutblocks were labelled as a mix disperse / group approach when the dominant approach to harvesting was not obvious. Multi-pass systems clearly had small openings, often several tree-lengths wide, distributed throughout, with a plan for future similar harvesting entries.

No blocks were planned or harvested under the Legal Orders. Because the cedar retention requirement is related to the composition of the retention, not the amount, we assumed that the current amount of retention or reserves would not be altered under the Legal Orders, considering that all such stands had high levels of retention (27 – 43%). Because retention pattern and distribution would not be altered, stand level costs for such a requirement are strictly planning-related. Planning and monitoring such a block to meet these requirements requires more staff time before, during, and perhaps after harvesting.

Table 3. Presence of potential First Nations EBM features and the amount of EBM reserves estimated to be associated with those features.

FEATURE	Sub-sample	% of Sample Blocks that have CMTs	Reserves/ Retention needed to add to achieve MO EBM[3]
Culturally Modified Trees			
	North Coast	36%	0
	North Central Coast	36%	0
	South Central Coast	4%	0
	ALL	20%	0
Requirement for Cedar Retention			
	North Coast	64%	0
	North Central Coast	36%	0
	South Central Coast	0%	0
	ALL	24%	0

Watershed Level EBM Features under the Legal Orders

The Legal Orders target specific sensitive watersheds throughout the Coast for added planning requirements to meet some general and specific watershed (not cutblock level) targets. The project sample had 24% of the cutblocks in sensitive watersheds, mostly in the South Central Coast (46%), and none on the North Coast (Table 4). In the South Coast Legal Order upland stream requirements apply only to a subset of "important fisheries" watersheds. Yet, in the North Coast Legal Order, the upland stream requirements apply to all North and North Central Coast watersheds. In those watersheds with upland stream requirements additional retention or

[3] These reserves and/or retention are those expected to be planned at the cutblock level as part of the gross cutblock area, and not associated with a watershed, subwatershed or landscape target.

reserves may be required to meet watershed level targets, and not stand level requirements (hence the n/a in column 4 of table 4).

Because these requirements are clearly linked to the watershed level, it is assumed that stand level costs will only be influenced by a proportional increase in planning.

NOTE: Representation is viewed as a landscape level requirement and so it not discussed here. Planning for representation, however, is a cost that is incurred on every cutblock and so is considered where planning costs are discussed.

Table 4. Relevant watershed-level EBM features for the cutblocks sampled.

FEATURE	Sub-sample	% of Sample Blocks	Reserves/ Retention for MO EBM[4]
Designated Important Fisheries			
Watershed	North Coast	0%	na
	North Central Coast	1%	na
	South Central Coast	46%	na
	ALL	24%	na
Upland Stream Requirement			
Applies	North Coast	100%	na
	North Central Coast	100%	na
	South Central Coast	46%	na
	ALL	73%	na

Stand Level Ecological EBM Features under the Legal Orders

The ecological features discussed in this section are related to Objectives 9-17 (excluding 16) in the Legal Orders. While these features are mostly riparian and aquatic in nature, they also include some specific stand level features related to biodiversity in general, such as red and blue listed plant communities and sensitive grizzly bear habitat. The Legal Orders specify approaches for minimum reserve sizes and other layout criteria around most of these features. Direction for reserves and/or retention in sensitive grizzly habitat is not yet clear. As well, the final map of sensitive grizzly areas for the North and North Central Coast is not available.

[4] These reserves and/or retention are those expected to be planned at the cutblock level as part of the gross cutblock area, and not associated with a watershed, subwatershed or landscape target.

Table 5. Relevant stand level ecological EBM features for the cutblocks sampled. Bracketed numbers are the potential amount based on features classified as "maybe" and/or "not clear".

FEATURE- the % of blocks with the feature and the average area in those blocks.	North Coast	North Central Coast	South Central Coast	**ALL**
High Value Fish Habitat				
% of Sample Blocks with the feature	9% (36%)	0	0 (4%)	**4% (10%)**
Average Reserves/ Retention / blk for LO EBM[5]	0.04 ha (0.07 ha)	0	0 (0.25 ha)	**0.04 ha (0.1 ha)**
Objective 10 Streams, Lakes and Wetlands.				
% of Sample Blocks with the feature	91%	29%	25%	**41%**
Average Reserves/ Retention / blk for LO EBM	0.22 ha	0.03 ha	0.4 ha	**0.24 ha**
Forested Swamps				
% of Sample Blocks with the feature	9%	0	4.2%	**4.1%**
Average Reserves/ Retention / blk for LO EBM	1.0 ha	0	0	**0.49 ha**
Active Fluvial Units				
% of Sample Blocks with the feature	18% (36%)	0	0	**8 %**
Average Reserves/ Retention / blk for LO EBM	0	0	0	**0**
Red-listed Plant Communities				
% of Sample Blocks with the feature	0	0	4%	2%
Average Reserves/ Retention / blk for LO EBM	0	0	0	0
Blue-listed Plant Communities				
% of Sample Blocks with the feature	9%	36%	0	**12%**
Average Reserves/ Retention / blk for LO EBM	0	0	0	0
Sensitive Grizzly Habitat				
% of Sample Blocks with the feature	Not clear	Not clear	Not clear	9% possibly
Average Reserves/ Retention / blk for LO EBM	Not clear	Not clear	Not clear	Not clear
Total – Blocks With At Least One Ecological Feature				
% of Sample Blocks	**100%**	**50%**	**29%**	**51%**
Average Reserves/ Retention / blk for LO EBM	**0.32**	**0.03**	**0.38**	**0.13**

Based on our analysis cutblocks on the North Coast are 3-4 times more likely to have an EBM feature than on the South Central Coast, and 2 times more likely to have an EBM feature than on the North Central Coast (Table 5). When EBM features are found the South Central Coast

[5] Legal Order EBM Retention - This average applies only to those blocks with the feature – it is not an average across all blocks in the stratum. These reserves and/or retention are those expected to be planned at the cutblock level as part of the gross cutblock area, and not associated with a watershed, subwatershed or landscape target. This retention is incremental to what is estimated would have been left with FRPA (or FPC) requirements only.

cutblocks generally require the most reserved area at 0.38 ha on average, while the North Coast blocks require just slightly less reserve area at 0.32 ha on average. On the North Central Coast where EBM features are found they seem to be mostly protected be default approaches to layout and FRPA requirements, with an average added requirement for EBM of only 0.03ha.

Although they were relatively uncommon, the North Coast had more blocks with active fluvial units, forested swamps and high value fish habitat than other jurisdictions. However, it was the Objective 10 lakes, streams and wetlands that were more common in the North Coast than anywhere else. On the North Coast these features were found on most cutblocks, often as an S3 stream segment close to an inlet or lake. On the North Central and South Central Coast Objective 10 features were only found on 25-29% of blocks.

Red-listed communities, as might be expected, were rarely found. One block on the South Central Coast was found to have a red-listed community that was protected sufficiently to meet EBM requirements (prior to the orders). Blue-listed communities were more common, with more than one-third of North Central Coast blocks indicating presence of a blue-listed comunity. However, none of these blocks appeared to require more reserve area to adequately protect these communities, since more than enough reserves or retention was already present, although it may need to be reconfigured in some cases.

Amount of Stand Level Retention and Reserves for EBM under the Legal Orders

To consider the total amount of retention and/or reserved timber set aside at the stand level for EBM, it is important to look beyond just EBM features to include stand level retention (Table 6).

Total stand level retention, including reserves for riparian and other features as well as other stand level retention (group patches or dispersed) ranged from 8% of the preharvest basal area up to 45% of the preharvest basal area, with an average of 26% (Table 6). This level of retention greatly exceeds that required to meet the requirements for EBM under the Legal Orders because in most cases other objectives drove the block design. In fact it is estimated that 95% of the reserves and retention would likely have been left using the direction from FRPA or FPC, without the added Legal Order requirements.

Of all the blocks examined, 47% (23 of 49) required no added retention over and above what was estimated to be necessary under FRPA or the FPC (Fig 1). The sample on average only required 0.5 ha retention incremental to FRPA to meet EBM requirements, although this retention varied from 0.04 ha up to more than 4.0 ha. Of the 26 blocks that needed added retention to meet the Legal Orders, 46% need retention to meet riparian or high value fish requirements, the other 64% needed extra retention to meet the legal objectives for stand-level retention .

Table 6. Description of average stand level retention (including that left as reserves for EBM and other resource features) as an average per block.

Stand Level Average Retention (ha) per block

Subsample	Group Retention (ha)	Dispersed Retention[6] (ha equivalent)	Total Retention (ha)	% Retention	Estimated as likely under FRPA alone,	Estimated to meet EBM Legal Orders
N. Coast	2.5	4.9	7.4	29%	8.4	9.2
N.C. Coast	2.6	1.1	3.7	29%	3.4	3.5
S. C. Coast	3.4	0.2	3.7	23%	3.1	3.7
ALL	**3.0**	**1.5**	**4.5**	**26%**	**4.4**	**4.9**

The North Coast had the highest proportion of blocks requiring more retention to meet LO EBM (over and above that which would be likely under FRPA) at 64%, followed closely by the South Central Coast at 63%. The North Central Coast only required added retention on 36% of blocks to meet LO EBM requirements beyond FRPA. The North Coast blocks tended to have the highest incremental requirement to meet LO EBM at 0.8 ha average per block (Table 6). As mentioned previously, this was due to the higher frequency of Objective 10 riparian and aquatic features.

The North Coast had the highest levels of retention, with more dispersed retention than the other jurisdictions, while the South Coast had the lowest levels of retention with most retention in groups. The North Central Coast was intermediate in level of retention and approach to retention pattern.

[6] Dispersed Retention – The amount of retention in basal area or % of original basal area was converted to an area equivalent value in hectares. Without post harvest data (as in the CFCI monitoring) often the exact amount of retention on the block was not known and the prescribed amount (often 30-40%) was instead used as a proxy. Experience would suggest that these levels are generally underestimates.

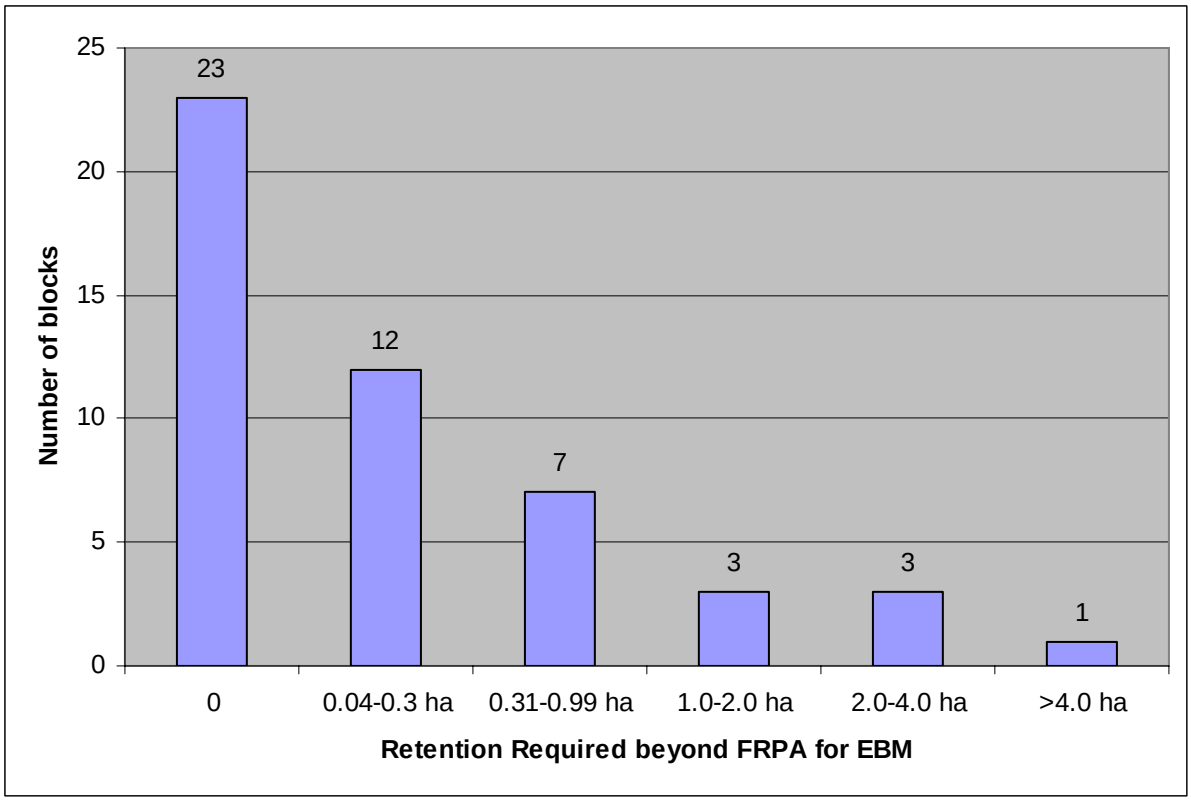

Fig 1. Estimated retention requirements beyond that required under FRPA (or FPC if prior to FRPA) to meet the requirements under the Legal Orders.

Additional Stand Level Ecological Features from "Full EBM".

There is an expectation that all requirements or targets for EBM as envisioned for the Coast have not all been applied. Therefore, there is some interest in added costs and benefits of what has been called "Full EBM". To this end an EBM Working Group member developed a listing of potential Full EBM requirements and how they compare to FRPA and the Legal Orders (Appendix 3).

This list was examined for features that could potentially provide an incremental cutblock level cost or benefit. These were then tracked on each cutblock with retention incremental to the Legal Orders documented. These "Full EBM" requirements apply to features that are mostly rare, except for the Coastal Shoreline requirement (Table 7). When averaged over all blocks in the sample, Full EBM adds only 0.11 ha of retention or reserves per block.

Table 7. Description of stand level features and associated required retention to go beyond the Legal Orders to what has been called "Full EBM".

	HVFH (increased reserve width)	AFU on the SCC (added retention to make 90% of reserve)	Coastal Shoreline (added reserve)	Red listed Comm. (from CDC)	Blue listed Comm. (from CDC)
% of blocks	4% (+ 6% maybe)	(4%maybe)	33%	2%	6%
Average added Retention / blk with the feature	0.11	0	0.16	0	0.83

Stand Level Ecological Benefits from EBM

As previously mentioned, most of the sample blocks had moderate to high levels of retention for a variety of reasons. While that extra retention has large ecological benefits, it is not additional due to the Legal Orders or Full EBM. In most cases, when extra retention was required, it was only a small additional amount (Table 6).

The major ecological benefits of EBM appear to be at the landscape level, which this project explicitly does not address. Issues addressed at the landscape level with EBM requirements include: where to locate blocks to ensure representation of unmanaged ecological communities (Site Series Surrogates or SSS[7]), planning to avoid major riparian areas, Sensitive Watershed planning, Upland stream objectives, red and blue ecosystems, and mapping to ensure the protection of important wildlife areas, among others. These landscape level requirements likely have a relatively large influence on protection of habitats and maintenance of structures over the Central and North Coast. The fact that they were not included in this analysis is important context when considering the conclusions here.

Some issues overlap between landscape and stand levels. For example, in the sample population, there were at times blue- or red-listed ecosystems potentially present or some site series in deficit potentially present. Generally it was felt that within-stand retention could be re-arranged to capture red or blue listed ecosystems. Situations arose in the sample blocks where SSS in deficit likely occurred in the block, but because those were second growth, harvesting was permitted. This clearly is an issue that needs to be addressed at the landscape level. If the SSS is in deficit, enough second growth needs to be reserved at the landscape level to eventually become old growth and thus remove that old growth deficit. We could not tell if that planning had occurred.

Ecological benefits of stand-level retention have been well-documented. At the stand scale, retention serves three primary functions (Franklin et al. 1997):

[7] SSS –site series surrogates area combination of timber analysis units with BEC variants.

1) maintaining ('lifeboating') species and processes through the disturbance process that would otherwise be absent from early seral stands,

2) enriching re-established forest stands with structural legacies, so that they develop complex structures and begin to function as older stands sooner than they otherwise would; and;

3) enhancing landscape connectivity by providing a habitat mosaic in which organisms can move over small scales.

Lifeboating implies a persistent occupancy of the cut stand by some species through the whole disturbance, establishment, and stand development process. Structural enrichment is intended to allow re-establishment by other organisms that may be initially extirpated locally during the disturbance process or in the early seral stages thereafter. Connectivity maintains a habitat mosaic that not only provides direct habitat for some organisms, but facilitates dispersal of others between old forest patches. Additionally, and of critical importance, stand level retention serves to protect specific small features or ecosystems such as swampy areas, bear dens, nest trees, and other localized features. These typically occur at scales too fine to be represented at the map scales used in landscape planning and are often only identified in on-the-ground mapping and planning of stand-level treatments. No bear dens or nest trees were identified as present in the sample blocks. Forested swamps did receive attention.

Most evidence suggests that stand level retention is most effective above levels of 20 to 30% above the minimum required by EBM. A review by Rosenvald and Löhmus (2007) suggests that 30% retention is a minimum to achieve lifeboating for that subset of species that respond to it. They acknowledge that not all species respond to lifeboating, even at high levels of retention (i.e. 50% does not represent unharvested forest for all species; small, young trees do not function for lifeboating epiphytes and play little role as structural enrichment for many years (Lohmus et al. 2006). Also in their review, Rosenvald and Löhmus (2007) analysed the success of retention at enriching structure—and noted significant benefit in terms of species using the stands earlier than might otherwise be expected. In their meta-analysis, the highest levels of retention they considered (16 – 33% and 34 – 50% classes) had significantly different species richness and abundance when compared with clearcuts, whereas the lowest retention levels (< 15% dispersed retention and < 20% group retention up to 1 ha) did not differ. These results are supported by Huggard's (2006) analyses of structure and birds responses to variable retention. Clearly, for lifeboating and for structural enrichment, there are benefits to providing a variety of retention levels over the landscape, but higher benefit at levels above 20 to 30%. In our sample, 31 of the 49 blocks had levels above 20% and 18 had levels above 30%, so a high proportion of blocks had very effective levels of stand retention. Most of this would have existed even under FRPA.

Many of the sample blocks had retention to protect riparian functions. The 1.5 tree height rules for EBM were extensive consideration and discussion among scientists and practitioners, and are not discussed here. The value of having all sections of all reaches with this level of protection has not been documented and is precautionary.

Stand Level Cost Increases for EBM

Stand level costs for EBM were anticipated to have two components – incremental harvesting costs, and incremental planning costs. Upon review it was clear that EBM to meet the

requirements of the Legal Orders, or "Full EBM" did not entail incrementally higher harvesting costs over and above that which would be apparent without EBM (see the discussion below).

Incremental Harvesting Costs

As outlined in the methodology (Appendix 1), after determining how much added retention or reserves were necessary to meet EBM on each cutblock, maps, air photos and *google earth*® images were examined to determine the most effective and efficient way to add retention on the cutblock. Similarly for blocks designed under the 2003 Agreement in Principle, with some EBM targets, the approach used to meet those targets was examined and compared to what was considered likely with FRPA alone. These approaches to incrementally achieve EBM fell into five categories for layout of reserves or retention that may influence harvesting:

1. Added patches or strips on the block edge.
2. Accounting as retention, peninsulas or strips in the block that were not previously counted as retention.
3. Widening peninsulas or strips that were originally designed for the block.
4. Extending existing peninsulas inside the block
5. Adding reserve patches that would be completely surrounded by harvested area.

Although there were potentially five approaches to alter the cutblock design to address EBM features, for the blocks examined in this project it was found that the requirements of the Legal Orders for EBM could be satisfied by using just three of these approaches to move beyond FRPA / FPC requirements (Table 8).

Most of the approaches necessary to alter layout for harvesting to meet EBM included adding retention on the edge of cutblocks to augment riparian reserves or other reserve requirements for an EBM feature. A significant number of blocks required additional retention, often to satisfy the internal stand level retention requirements under the Legal Orders. However this requirement was frequently met by counting retention or reserves that already exist on the block as retention, rather than ignoring it as timber excluded from the block.

In two blocks extra retention was necessary to augment existing riparian strips and/or peninsulas. There may some question as to whether such an alteration would increase costs due to changes to yarder locations and/or less volume accessed with one yarder setup. However, one of these blocks required only a very small amount of added retention (0.1 ha) and it was a helicopter-yarded block, making the considerations for yarder set-up irrelevant. The other block was relatively large at 36 ha, with several options for adding retention to strips and peninsulas. Therefore, it was felt that the two incremental hectares required for EBM could likely be added while minimizing significant added harvesting costs.

Although many of the cutblocks had high levels of retention, as previously mentioned, this retention was generally left for visual landscape management, sensitive terrain or other non-EBM related objectives. It is therefore not anticipated that less retention would be left without EBM. For this reason it appears that all the cutblock level costs associated with EBM are associated with planning.

Table 8. Layout adjustments necessary to meet the Legal Orders for EBM and the associated estimated incremental harvesting costs.

Approach to Adjust Layout to Meet EBM Legal Orders	% of blocks where the approach is required	Frequency of use[8]	Average reserve area affected/ block (where used)	Incremental Harvesting Cost
TO MEET EBM LEGAL OBJECTIVES:				
Added reserve patch on the edge of the block.	29%	16	0.67	0
Peninsulas and/or strips not previously accounted for now used for retention.	12%	17	2.48	0
Widened existing peninsulas or strips in the block.	4%	3	1.05	(0 or very small)
Extended existing peninsulas.	0	0	0	NA
Reserve patches added that are completely surrounded by harvesting	0	0	0	NA
TO MEET "FULL EBM":	14%	11	0.47	0

Incremental harvesting costs for "Full EBM" (over and above that required by the Legal Orders) is similarly zero or negligible, since Full EBM would entail a slight expansion of existing reserves or a slight movement of a small segment of block boundary (as in the Coastal Shoreline requirement).

Incremental Planning Costs as Total Cutblock Level Costs for EBM

The incremental planning costs for EBM were estimated on these cutblocks principally by polling the two major contributing licensees for average cost estimates per block for the planning elements identified (Table 9). The response from both licensees was provided as a range, as it was a rough estimate and clearly may vary.

An adjusted average cost was calculated by considering the questionnaire results and were then applied to blocks where planning for those particular elements were relevant. Some costs were anticipated to be incurred on every block including those associated with: objective 14 (representation); and objective 15 (red- and blue-listed ecosystems). It was assumed that these features and the associated costs are best considered equally across cutblocks. Planning for representation is a pre-layout planning cost and is conducted for all blocks in each cutting permit. It was felt by licensees that red and blue listed communities will not add to pre-planning and

[8] Frequency of use – describes the number of times this approach was used by the authors (total across all blocks). It must be recognized that occasionally the approach may have been used more than once on a particular block.

layout costs. However, because blue listed communities are relatively new as a management objective, and they are more common, it was felt that occasional examination by a specialist may be required to confirm identification when they are found. For this reason an adjusted blue listed cost range was applied only to blocks where blue listed communities were found to be likely in the sample. This represents a cost that could drop in the future, as experience with EBM increases.

Planning costs specifically for the requirements of Objective 16 in the Legal Orders (stand level retention) were not considered in this report because there are none. It is anticipated that adequate retention levels would be found under FRPA for most blocks (as previously indicated). On a few blocks (3 of 49) a small modification would be necessary to meet the internal retention requirement under objective 16. However, these requirements could be met with only minor adjustments of existing boundaries and therefore no added boundary layout in the field.

The two licensees indicated no added costs beyond what they would normally incur under FRPA for the First Nations requirements in the Legal Orders However, is seems that for some licensees added costs might occur. These would be associated with additional consultations with First Nations, either in a strategic planning setting or in another forum. However, considering the response of the two licensees who completed the questionnaire, it was not clear what this cost would be. It is also likely that over time this incremental cost would be reduced as experience with EBM and First Nations objectives increases.

Where alterations are necessary to get from EBM requirements under the Legal Orders to what is anticipated as "Full EBM", added planning costs are not anticipated. This is because most of the incremental "Full EBM" requirements merely add more reserve area to features covered under the Legal Orders, except for the Coastal Shoreline requirement. However, the coastal shoreline requirement would include no added cost for identification or layout since it merely entails ensuring block boundaries do not come too close to the shoreline.

It is worth noting again that many of the incremental cutblock level planning costs identified here build in the potential to consult with specialists. As time goes on this may become less necessary and therefore costs could be reduced.

Table 9. Reported and adjusted costs for cutblock planning. The adjusted costs were estimated based on the reported costs and other considerations for the purpose of estimating a cost/m^3.

Associated EBM Objective from the Legal Orders	Potential Cost/block Range Reported (> than that required for FRPA)[9] ($)	Potential Cost/block Range Adjusted ($)	Average Cost/ block based on likelihood of occurrence ($)
Objective 3-6 First Nations Objectives – traditional resources, heritage features, CMTs and Monumental cedar.	0	Not clear	Not clear
Objective 7 – First Nations Objectives – Cedar Retention	0 - 750	500-750	122-184
Objective 8 – Planning in Sensitive Watersheds	0	100-200	25-49
Objective 9 – Planning for High Value Fish Habitat	600-1500	600-1500	105-260
Objective 10 – Planning to protect non-HVFH large streams, lakes and wetlands.	300-600	300-600	123-245
Objective 11 – Planning to protect forested swamps	300-600	300-600	12-25
Objective 12 – Planning to protect upland streams	300-1000	300-1000	220-735
Objective 13 – Planning to protect Active Fluvial Units	300-1000	300-1000	31-77
Objective 14 – Planning to meet the ecosystem representation targets.	100-1000	100-750	100-750
Objective 15 – Planning to protect red listed plant communities	0	0	0
Objective 15 – Planning to protect blue listed plant communities	0	0 - 600	0-80
Objective 16 – Stand level retention	NA	NA	NA
Objective 17 – Planning to protect sensitive grizzly bear habitat	Not clear	Not clear	Not clear

The estimated incremental planning costs for stand level implementation of EBM ranged from $788-$2604 per cutblock (Table 10). Considering EBM features on each block which will influence planning costs, EBM planning costs that are common to all blocks, the size of each cutblock and the volume of timber harvested on each block, the estimated cost per unit volume ranges from $0.11 to $0.36 per cubic metre (Table 10). This represents an incremental cost of EBM over and above that required with FRPA direction alone, not considering potential added costs for First Nations and Sensitive Grizzly Habitat. It should be noted that incremental harvesting costs were not considered as they were considered to be zero or negligible.

[9] Averaged between the two licensee respondents to the questionnaire.

Table 10. The range of costs per block is estimated for the sample based on occurrence of the objective by block within the sample. The resulting cost/block was then converted to a cost per cubic metre by using an average volume per block based on the reported volume on logging plans for 40 of the blocks in the sample (it was not specified on the other nine logging plans)[10].

Associated EBM Objective from the Legal Orders	Yes	Maybe	Not clear	Low Range predicted cost / block	High Range predicted cost / block
Objective 3-6 First Nations – heritage / resources	Applied to all blocks			$0	$0
Objective 7 – First Nations – Cedar Retention	12			$122.45	$183.67
Objective 8 – Planning in Sensitive Watersheds	12			$24.49	$48.98
Objective 9 – High Value Fish Habitat	2	3		$104.08	$260.20
Objective 10 – non-HVFH specified riparian.	20			$122.45	$244.90
Objective 11 – Forested swamps	2			$12.24	$24.49
Objective 12 – Upland streams	36			$220.41	$734.69
Objective 13 – Active Fluvial Units	4		2	$30.61	$76.53
Objective 14 – Ecosystem representation targets.	Applied to all blocks			$100	$750
Objective 15 – red listed plant communities	Applied to all blocks			$0	$0
Objective 15 – blue listed plant communities	Applied to all blocks			$0	$79.59
Objective 17 – sensitive grizzly bear habitat	0	1		$0	$0
TOTAL incremental costs for EBM under the Legal Orders (Not considering Ob 3-6 and 17)				**$787.76**	**$2604.08**
AVERAGE Cost/ m3 – based on an average of 7145 m^3 per block calculated over 40 blocks (Not considering Ob 3-6 and 17).				**$0.11**	**$0.36**
TOTAL incremental costs for FULL EBM (above that required by the Legal Orders)				**0**	**0**

It is important to note again that this report only considers the costs of EBM that occur at the stand or cutblock level. It is anticipated that these costs are relatively small compared to those costs entailed at the watershed or higher scales.

[10] For more information of this data and how it was derived, refer to the file "*Data Input Spreadsheet Sept 30-08 V 2.3. xls*".

SUMMARY OF CONCLUSIONS

Ecological Benefits from EBM

Ecological benefits of stand-level retention have been well documented. At the stand scale, retention serves three primary functions (Franklin et al. 1997): 1) maintaining ('lifeboating') species and processes; 2) enriching re-established forest stands with structural legacies and; 3) enhancing landscape connectivity. Additionally, stand level retention serves to protect specific small features or ecosystems.

Most evidence suggests that stand level retention is most effective above levels of 20 to 30%, above the minimum required by EBM. In our sample, 31 of the 49 blocks had levels above 20% and 18 had levels above 30%, so a high proportion of blocks had very effective levels of stand retention. Most of this would have existed even under FRPA.

Many of the sample blocks had retention to protect riparian functions. The 1.5 tree height and 2 tree height rules for EBM were based on best practices, and are not discussed here. The value of having all sections of all reaches with this level of protection has not been documented and is precautionary.

Clearly many of the ecological benefits from EBM will be accrued at the watershed or landscape level (and higher) from requirements that include: where to locate blocks to ensure representation of unmanaged ecological communities (Site Series Surrogates or SSS[11]), planning to avoid major riparian areas, Sensitive Watershed planning, Upland stream objectives, red and blue ecosystems, and mapping to ensure the protection of important wildlife areas, among others. These landscape level requirements likely will have a relatively large influence on protection of habitats and maintenance of structures over the Central and North Coast. The fact that they were not included in this analysis is important context when considering the relatively small benefits from stand level EBM requirements.

There is a balance between approaches at the various spatial scales when considering ecological benefits. As time goes on, it is possible that EBM requirements at the watershed level and higher may encourage timber managers to use stand level approaches with higher levels of retention to increase access to timber on the Coast. This may shift the reliance on ecological benefits at the landscape more to the stand level (see the discussion at the end of the next section).

Cost of EBM

The study estimated incremental planning costs for EBM to influence the cost per unit volume by $0.10 to $0.34 per cubic metre. This represents an incremental cost of EBM over and above that required with FRPA alone not including potential added costs for First Nations and Sensitive Grizzly Habitat. It should be noted that the sample was perhaps weighted a bit too heavily toward the South Central Coast – beyond the actual proportion of the Coastal harvest that occurs there.

[11] SSS – expressed currently as site series surrogates or a combination of timber analysis units and site series characteristics.

It was found on almost half of the sample that FRPA approaches alone would meet the requirements of EBM. These blocks generally occurred in upland stands with no specific EBM features. Where EBM features were present or stand level retention targets were not quite met, usually only small adjustments were necessary to meet the requirements for EBM. None of these adjustments were seen as changing the economics of harvesting at the cutblock level, although planning requirements were anticipated to increase.

It is expected that planning costs beyond the cutblock level will have a greater impact on the overall incremental cost per cubic metre of EBM. For example: representation considerations, sensitive watershed concerns, upland stream requirements and/or the presence of other more specific EBM features across the landscape can significantly alter the development associated with a cutting permit. The result may entail a significant reduction in the total area harvested under the cutting permit. It may also result in spreading the area harvested across more blocks with more roading. These factors may significantly increase the cost per cubic metre when considering watershed level or landscape level fixed costs for infrastructure and the amount of timber volume that can offset those costs. These costs can only be considered in a modelling exercise at the watershed and/or landscape scales.

While this study points out that block level costs have, to a large extent, been captured under previous legislated guidance and interpretation by licensees, harvesting approaches in the future may change in response to influences such as large-scale landscape level restrictions.

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APPENDIX 1 - DISCRIPTION OF METHODOLOGY VERSION 2.0 (April, 2008 -Peer Reviewed).

A. Sampling Approach

In collaboration with the DS03 working committee, a representative sample of logged or recently-designed harvest cutting permits will be examined.

The Population - Target Era of Sample Cutting Permits

Because the goal is to determine the added EBM costs over and above standard FRPA practices, it was initially thought that preEBM cutting permits should be examined to see what was needed to upgrade them to MO EBM and Full EBM standards. There were some concerns however with this approach. It is difficult if not impossible to determine the existence of many EBM hydroriparian and biodiversity features without a field examination (forested swamps, redlisted ecosystems, HVFH, possibly active fluvial units). Once these areas are harvested there are few clues available on aerial photos to allow for post harvest identification of these features (except perhaps for active fluvial units). Therefore, hydroriparian protection with this approach will be underestimated.

As well, baseline preEBM blocks may clearly show problems for representation targets, with blocks harvested in site series surrogates that are in deficit. However, it is difficult to estimate how this situation could be improved except by simply removing the site series surrogate from the cutting permit and eliminating cutblocks that subsequently are not feasible for harvesting. In reality, licensees may redesign the cutblocks in a CP to address the available timber somewhat differently. This would be difficult to second guess with preEBM blocks, even after discussions with the operational foresters and engineers.

There are also drawbacks to using EBM blocks. By trying to determine design alterations to meet EBM, assumptions may be incorrect regarding the potential FRPA baseline, assessing the difference between EBM and FRPA requirements rather than FRPA implementation. This concern specifically refers to the fact that implementation normally exceeds requirements for a number of operational reasons. PreEBM cutblocks will clearly show exactly what logging would be like without EBM.

For these reasons, 25% to 30% of the sample will be in preEBM cutblocks (2001 to 2003), with the remainder in EBM blocks, either fully-planned and/or harvested (since April, 2004[12]). The intent with the EBM blocks is to capture most EBM hydroriparian features, as well as representation requirements.

The Sample:

It was decided that the sample would include cutblocks from each of the three subregions: North Coast; North Central Coast; and South Central Coast. Major licensees would be targeted in each region to maximize expedient participation, and BCTS would not be included as they have specific challenges that might not reflect costs or benefits in the same manner.

[12] By spring 2004 the requirements in the December 2003 Agreement in Principle (AIP) were starting to be understood. The AIP included seven key EBM transitional elements, including most hydroriparian features, redlisted ecosystems and representation.

STEPS:

- The aim will be to have 60-70 total blocks in the sample (with the target to assess at least 50) - just in case we can do more.
- Cutblocks from the provincial MFR RESULTS database a list will be compiled that will have logged or laid out in the two time periods (preEBM and EBM) by the participating licensees - then we will randomly choose the blocks from that list and ask for the detailed info packages for our sample (using a random number generator).
- These block lists will be prestratified by NC, NCC and SCC in an appropriate manner according to where more or less logging is done (basing it on the proportion of total area harvested for the two periods). Included in this initial stratification, will be 20 preEBM cutblocks as follows – four from the NC and eight from each of the NCC and the SCC.
    - The number of blocks chosen will likely best breakdown as 10 - 14 from the NC / 20 - 28 from the NCC / 20 - 28 from the SCC. NOTE: This isn't exact, but there is about 10X the AAC in the NCC plus SCC combined relative to the NC.
- In each of these subregions the blocks (if appropriate) will split between licensees based on the amount of logging they do in that region. This will mean Triumph only on the NC / IFP and WFP in the NCC / and TimberWest, WFP and IFP on the SCC.
- Lastly, the blocks per licensee per subregion will be split by primary harvest type (based on the proportion of logging in that harvest type) – ground / cable / helicopter.
- It will difficult to prestratify the sample any further by biogeoclimatic, other ecological or geographic criteria, as there will only be 2-6 blocks for each harvest method for each licensee in each subregion. However, any clustering of results around BEC subzone or other criteria will be assessed when the data is summarized.

B. Data Collection:

Once the sample has been chosen in each subregion, the participating licensees will be contacted and asked to provide the following specific operational planning and harvest information for the cutblocks selected (digital form preferable).

- *Individual logging plan block maps (pdf format)*- showing location of patches or groups of retention inside and outside the cutblock.
- *Site Plan map (pdf format)* – showing site series across the cutblock.
- *Site Plan (Word or pdf format)* – to check the rationale behind stand level retention and other design elements that might tie to EBM requirements.

- *The CFCI Site Level Checklist for each block (Word or pdf format)* – if available. This document is extremely valuable as it clearly identifies presence or absence of EBM features.
- *All relevant assessments* – such as Terrain / Windthrow / Active Fluvial Units / HVFH, Other. These will help determine rationales for various design elements.
- *Additional cutblock-level information sheet for this project with:*
    - *An indication of timber volume* - harvested volume if harvesting is completed. If harvesting is not completed – the average cruise volume.
    - And indication of added planning elements that came into play for each block (e.g. upland streams, representation, sensitive watershed).
- *Ortho Photos or Air Photos (if available digitally)* – Otherwise, the EBMWG may have access to photos for the NC/CC area.

In addition to the cutblock level information, the following information will be used for the entire region:

- Site Series Surrogate (SSS) maps – Current GIS layer of SSSs.
- Sensitive Grizzly Habitat maps (if available).

C. Determination of EBM elements beyond those required by FRPA:

The actual design of these EBM blocks will be analysed by the consultants to determine additional EBM design elements (such as wider buffers) necessary to meet the separate requirements of the Ministerial Orders and "Full EBM" in the following steps:

1. ***Determine the cutblock design alterations required to meet the Ministerial Orders*** - Using the maps, assessments and other materials supplied by the licensee for individual blocks, first the alterations needed to bring the blocks up to the requirements in the Ministerial Orders will be determined. A checklist of guidance that will be used for this step was designed (Table 1). Note: at this stage costs are not the focus.

   Note: Cutblock consultations afterwards with licensees may be required - Design alterations first need to be identified to be considered for both costs and ecological benefits. However, questions may emerge that will need to be addressed afterwards through consultation with the associated licensee operations before costs and benefits can be determined. These may provide insights to ecological and other planning drivers that will not be obvious from the block documents alone.

2. ***Describe the FRPA-plus attributes necessary to meet the Ministerial Orders*** – Based on the added design elements to meet the Ministerial Orders, we will determine what, if anything has been done (EBM blocks only) on the cutting permit blocks that would not have been done under standard FRPA practices alone. This requires a consideration of all the EBM features and requirements associated with the cutting permit blocks. Hydroriparian and other habitat features may or may not be present. For FRPA-only

(pre2004) blocks design elements will be determined to bring them up to standards to meet the Ministerial Orders.

If all stand level retention is external and the block is less than 15 ha in size, the amount will be checked against that required for wildlife tree patches (WTPs) under FRPA in the area. Also, where levels of stand level retention are found that are higher than standard FRPA requirements for WTPs, the rationale for that retention will be checked. If it is clear that the retention was left for other reasons (i.e. visual landscape management), it will not be counted as a FRPA-plus attribute.

Using both the preEBM and EBM blocks we will analyse trends in:

a. The difference between FPC/FRPA implementation and FPC/FRPA requirements.

b. The difference between EBM implementation and EBM requirements

c. Some possible reasons for the observed differences in a and b, and the implications of these trends for interpretation of EBM costs in general.

3. ***Determine the additional cutblock design attributes required to meet Full EBM*** - Using the maps, assessments and other materials supplied by the licensee for individual blocks, and additional alterations needed to upgrade the block to what is considered to be Full EBM will be determined (over and above that already considered necessary to meet the Ministerial Orders). For FRPA-only (pre2004) blocks design elements will be determined to bring them up to standards to meet the Ministerial Orders.

   NOTE: The EBMWG is currently in the process of constructing a table that will inform what is considered to be "Full EBM".

TABLE 1. Checklist of guidance to determine block alterations to meet the requirements of the 2008 Ministerial Orders for EBM. Where preEBM blocks are being used, we will determine if these features can be added.

EBM Features under specific MO objectives.	Approach to Determine Required Alterations in cutblocks
Objective 3 to 6 Planning costs for Traditional Forest Resources, Traditional Heritage Features, CMT's, and monumental cedar.	• Record any EBM-related inventories or findings of First Nations features and subsequent adjustments in layout occur due to an identified feature – that is recorded – from additional cutblock level information sheet. • If CMTs are clearly post 1846, they will be EBM-related. If clearly prior to 1846, they will be FRPA-related. If not clear – maybe.
Objective 7 Cedar Retention for First Nations	This requirement applies where there is more than 15% stand level retention in dispersed retention – it must be representative for amount of mature cedar (red or yellow). To get at that we will:

EBM Features under specific MO objectives.	Approach to Determine Required Alterations in cutblocks
	• Record the number of cutblocks where this is applicable. NOTE: The lost value of extra cedar on the block would be impossible to determine.
Objective 8 Important / Sensitive Fisheries Watersheds	• The additional planning time will be determined - time that may attribute to the cutblock by virtue of it being in a sensitive watershed – from additional cutblock level information sheet. • Note: - This is mostly a watershed level consideration related to less volume available in the watershed - borne out over time with multiple harvesting entries – best determined with a modeling approach (patchworks or other).
Objective 9 High Value Fish Habitat	Where HVFH should be identified in EBM blocks (since 2004). If identified, a 1.5 average dominant tree height[13] will be used to determine if more buffer is required. For pre2004 preEBM blocks, the block will be assumed to be HVFH if it meets any of the specific criteria in the Ministerial Orders, and the licensee has indicated that fish are present. • How much more retention is required to ensure the buffer is never less than 1.5 tree heights over the length of the HVFH reach.
Objective 10 – south central coast • Non –HVFH in: S1 to S3 streams; lakes > 0.25 ha and marsh & fens > 0.25 ha	• S1-3 streams, may not currently be considered for EBM on the block, but should be identified on the maps. As well, lakes, fens and marshes can be easily identified from maps and airphotos. Note: S1-S3 streams will be classed under this category where they do not meet the definition of HVFH or active fluvial units. Where these features are found we will: • Ensure the buffer[14] is 0.90 x 1.5 dominant tree heights wide - calculating dominant tree height as in objective 9.
Objective 10 – north central and north coast • Non –HVFH in: S1 to S3 streams; lakes > 1.0 ha and marsh & fens > 1.0 ha	Where identified - we will • Ensure the buffer is 0.90 x 1.5 dominant tree heights wide - calculating dominant tree height as in objective 9 UNLESS… o IF a lake, marsh or fen is 0.25-1.0 ha, ensure buffer is 0.90 x 1.0 dominant tree heights wide.
Objective 11	Forested swamps should be identified in EBM blocks (since 2004). If

[13] Dominant tree height - based on the tallest species average in the cruise summary, or the top of the inventory height class, whichever is available.

[14] A challenge with this type of assessment is that the defaults for buffers must be used, since it is impossible to know if site conditions will allow for use of the flexibility offered (to adjust to varying site conditions) by the Orders. As well, it is difficult to cost the extra planning requirements for use of such flexibility as it has not been applied yet.

EBM Features under specific MO objectives.	Approach to Determine Required Alterations in cutblocks
Forested Swamps	identified, we will ensure: • A buffer is maintained at 0.70 x 1.5 dominant tree height in width. Site series and visual clues on air photos will be used to determine if a forested swamp occurs next to or in a cutblock that is preEBM. Some assumptions will be necessary and will made explicit.
Objective 12 Upland Streams	• The additional planning time attributed to the cutblock because it is in an area where the upland stream requirements apply will be determined – from additional cutblock level information sheet. • Note: - This is mostly a watershed level consideration related to less volume available in the watershed - borne out over time with multiple harvesting entries – best determined with a modeling approach (patchworks or other).
Objective 13 Active Fluvial Units	Active fluvial units should be identified in EBM blocks (since 2004). They can also be cross-checked with airphotos. For preEBM cutblocks good airphotos will be necessary. If identified - we will: • IN the South Central Coast -Ensure 90% of the wet floodplain is excluded , or • IN the North Central and North Coast - Ensure all the wet floodplain is excluded plus 90% of a 1.5 dominant tree height buffer.
Objective 14 Landscape Level Representation	Location of site series surrogates in deficit can alter the location or layout of cutblocks to increase costs. The most efficient way to get at this cost is to: • Ask the licensee upfront in the "additional information sheet", if not indicated in an EBM checklist for the block. • If identified as adding costs – the presence of deficit SSSs will be checked with SSS maps and current SSS accounting spreadsheet.
Objective 15 Red listed community	Red listed site series should be identified in EBM blocks (since 2004). If not (preEBM) we will use the SP map with site series delineated to identify potential red listed site series (along with airphotos). If identified, we will: • First determine if the redlisted community required added alterations not already required for another EBM feature, or adequately covered by the amount of retention left (reconfigured). • Also – Determine how the planning may need to be, or has been altered for EBM. This will also be considered for ecological benefits. Note: based on this discussion we will determine if it is possible to include a cost for such impact.

EBM Features under specific MO objectives.	Approach to Determine Required Alterations in cutblocks
Objective 15 blue listed communities	• First determine if the bluelisted community required or requires added alterations not already required for another EBM feature, or adequately covered by the amount of retention left (reconfigured). • Then add the additional planning time attributed to the cutblock because it is in an area where the blue listed plant community requirements apply will be determined – either from additional cutblock level information sheet or based on the site series mapping in the SP (for older EBM and preEBM blocks). • Note: - This is may be a watershed level consideration related to less volume available in the watershed (if TEM is available) - borne out over time with multiple harvesting entries – best determined with a modeling approach (patchworks or other).
Objective 16 Stand level retention	• Check amount of overall retention on each block – ensure it meets 15%. • For blocks where the harvested area is > 15 ha - Ensure retention distribution is such that there is 7.5% of the retention inside the block boundaries[15]. If not some will need to be added. • For blocks where the harvesting area is < 15 ha, retention may all be outside the block on the edge, but must equal at 15% of the volume or area in the harvested area.
Objective 17 Sensitive Grizzly Habitat	• Determine if the block is in sensitive grizzly habitat – maps and/or licensee consultations. • If so, try to determine the alterations necessary to comply with the Ministerial Orders – through consultations with the licensee .

D. Determination of Ecological Gains from EBM

Based on the FRPA-plus EBM cutting permit design elements, the ecological benefits/gains will be determined separately for those elements required to meet the Ministerial Orders, and those required to meet Full EBM. Just as for other components of this project, three situations are

[15] Unless it is in second growth and it is shown that the windthrow hazard is high.

described: the ecological situation if the block was harvested under FRPA requirements; the ecological gains under the Ministerial Orders, and gains under full EBM.

This is primarily a cutblock level project and many of the ecological gains of EBM beyond what is typically done under FRPA occur at the watershed level or higher. Those will not be considered here. Many requirements of EBM are in place to meet ecological needs. Hence, most of the additions to FRPA levels will be ecological in nature. From the list of ecological issues below, it is clear that the main spreadsheet (Section C above) that will be used to gather costs and gains, includes many ecological factors.

Ecological gains will be characterized both in terms of requirements under the Ministerial Order (1a to 1h below), and more general ecological gains (see 2) below). For both situations, the task will be to see if current cutblocks have these issues, what has been done (or should have been done)to address them under the Ministerial Order, what more should be done under full EBM, and what would have been done under FRPA.

1. Addressing ecological requirements from the Ministerial Orders and Full EBM.

(these are also found in Section C above, but since they are ecological in nature they are repeated here)

a. Retention added for high value fish habitat:

    i. We will note incremental retention for the Ministerial Orders and full EBM.

b. Retention added for riparian values:

    i. Extra retention is required around S1 to S3 streams; wetlands, and lakes. The requirements differ somewhat between regions of the central coast Note: S1-S3 streams will be classed under this category where it does not meet the definition of HVFH or active fluvial units. Fens or Marshes should be obvious from an airphoto. Where these features around found we will calculate buffers under FRPA, Ministerial Orders and full EBM.

c. Retention around forested swamps:

    i. Forested swamps must be identified by the SP forester in the EBM site level checklist – otherwise it is impossible to assess from air photos. If identified, we calculate the buffers under the 3 scenarios

d. Retention around active fluvial streams

    i. (Should be checked by SP forester – may be cross checked with decent airphotos). We will calculate retention under the 3 scenarios for the south central coast or north central/north coast as appropriate.

e. Retention added to improve site series representation for landscape targets.

    i. Location of site series surrogates in deficit can make alter location or layout of cutblocks to increase costs. We will evaluate costs and retention gains of stand level activities to reduce deficits.

f. Plans for red and blue listed species.

i. Retention of other protection for red and blue listed species will be noted as expected under FRPA, implemented under Ministerial Orders, or expected under full EBM. Costs will also be noted as described in Section C.

g. Gains in total stand retention of the cutblock due to EBM

i. When comparing to what would have been done under FRPA we will ensure there is not another objective that is driving the layout design (amount and distribution of retention) – such as visuals.

h. Grizzly habitat.

i. We will note increased retention or other actions taken to protect grizzly habitat and report these gains as ha retention, and a subjective assessment of improvement to grizzly habitat.

2. Broader consideration of ecological gains:

The blocks designed under Ministerial Orders, blocks projected to full EBM, and block back-cast to FRPA design, can be assessed to see how they would provide some basic ecological values that were drivers of some of the recommendations under EBM.

i. Likely gains in snags and down wood due to EBM

i. For most coastal ecosystems we have an idea of natural levels of snags and down wood. This knowledge can help interpret the gain in retention in terms of gains of these habitat elements. The size and shape of retention affects the numbers of snags likely left standing, so the relationship is not direct. We will include edge effects. We may be able to extend consideration of habitat elements to also include large trees.

ii. Looking at snags and down wood involves knowing retention levels (under FRPA, EBM, ministerial orders), knowing the site series retention falls in, and knowing if snags have actively been removed from edges. Using information on natural levels we can do some rough calculations in likely changes in these habitat elements under the 3 different scenarios.

j. Increases in forest influence due to EBM

i. Similarly, retention will increase the amount of the cutblock close to groups of trees or individual trees. We will look at maps or ortho photos of the block, depending on what is available, to determine forest influence under current plan, projected full EBM and old FRPA guidelines.

k. Increased protection of particular features.

i. Where current EBM has caused particular features to be protected above the levels stated by FRPA, or where full EMB would require that protection but at present it is not yet required, we will evaluate the level of increased protection. The evaluation will consider both the amount of additional buffer or retention (e.g., x meters of buffer, or y% retention) and the likely effectiveness or benefit or that additional protection (e.g., how much ecological benefit is there to a 20 m buffer rather than a 10 m buffer around a bear den). The latter evaluation will be subjective. We will note if other features would receive protection under full EBM.

l. A rough evaluation of very fine scale connectivity.

i. Connectivity is best addressed at scales broader than cutblocks, and organisms that travel at the cutblock scale are usually also those that can use slash, down wood, shrubs etc as cover, travel routes and connections. Instead of running a connectivity model (e.g., Huggard 2007[16]), we will simply calculate minimum and maximum distance between trees and patches to suggest necessary dispersal distances for lichens, mosses and other slow dispersing organisms restricted to trees.

m. For Increased buffers around streams

i. As noted under the ministerial orders section (5 above), a main focus of EBM is increased riparian protection. Using photos and site maps we will document increased (beyond FRPA) riparian buffer widths and extent (length of stream). We will report the likely gains due to those buffers by referring to the literature about what is likely found in riparian buffers and likely impacts of water quality or flow. Just as for all the previous points, we will also forecast the likely extent of buffers under full EBM and the gains associated with those buffers.

E. Determination of Added Costs Associated with EBM

Based on the FRPA-plus EBM cutting permit design elements, the added costs of EBM will be determined separately for those elements required to meet the Ministerial Orders, and those required to meet Full EBM. The EBM costs that will be explored concurrently with steps B, C and D are the average incremental cutblock level variable costs. Variable costs are those that

[16] [16] Huggard, D.J., W. Klenner, L. Kremsater, and G. Dunsworth. 2007. Dispersal-based indices and mapping of landscape connectivity. BC Journal of Ecosystems and Management 8(3):14-28. http://209.85.173.104/search?q=cache:f7xWMwKLZREJ:www.forrex.org/publications/jem/ISS42/vol8_no3_art2.pdf+Huggard,+D.J.,+W.+Klenner,+L.+Kremsater,+and+G.+Dunsworth.+2007.&hl=en&ct=clnk&cd=1

vary, in direct proportion to changes in the level of timber harvesting activity as in the adjustments required at the block level for EBM. These will include planning and field design (layout) activity, and the actual harvesting activity itself (tree-to-truck (conventional and helicopter) phases). We will explore the incremental costs associated with specific planning and harvesting tasks or challenges with a minimum and maximum range to represent a 90% confidence interval.

General EBM planning and administrative costs are significant costs for EBM, although it may be misleading to portray them as cutblock level costs. We will therefore track this cost separately if licensees are willing to provide it. These include all the general consultation and information sharing with First Nations, Adaptive Management planning and other contributions through the EBMWG and elsewhere, likely expressed as a number of person-days per year, per licensee, with a min and max range to represent a 90% confidence interval. As much as possible we will try to separate out what are ongoing planning costs, and start-up costs for engaging in EBM under the Ministerial Orders or Full EBM.

The General Licensee Questionnaire

To determine these costs, we will utilize a general questionnaire that will be sent to a key operational planning coordinator within each of the participating companies. The consultants will work with these licensee representatives to fine tune questions so that the information requested will garner the most reliable and valuable information. The general questionnaire will ask for information to help establish an average cost per cubic metre for each licensee for the general planning costs (#1 above).

As well, a set of questions will be structured to gather information on all of the individual variable costs for planning and harvesting associated with the elements required to meet EBM under the Ministerial Orders and Full EBM (beyond those required by FRPA - Step C). The intent is to establish an average cost for each of these specific variable costs under the circumstances specified, and then apply those costs appropriately to each cutblock. Conversions will be necessary to achieve a cost per cubic metre, especially for variable planning costs that will be initially be expressed in person-days. An average day rate will also be acquired to help make this conversion.

The questionnaire will be structured as follows:

COSTS ASSOCIATED WITH MINISTERIAL OBJECTIVES

1. *GENERAL EBM PLANNING COSTS: First Nations Planning Costs for Traditional Forest Resources, Traditional Heritage Features, CMT's, and monumental cedar:*

   For general planning (consultation or info sharing etc), including planning or consultation associated with monumental cedar, we propose asking for an estimate of persondays/year for general planning with local first nations across a company operational unit (or the company as a whole – depending which estimate is most accessible).

2. *GENERAL EBM PLANNING COSTS: Adaptive management and other EBM administration:*

   An estimate will be required, likely across the company as a whole, of person-days / year devoted to work with the EBMWG and other related work on adaptive management and

general EBM administration. An indication of a suitable day rate will also be needed to translate this cost into a dollars per cubic metre cost for a cutblock.

3. CUBLOCK VARIABLE COSTS – Associated with planning and harvesting on each block.

We will ask licensees for average planning costs[17] for

a. Identification and Planning associated with EBM riparian / biological features (CMTs or Monumental Cedar with a buffer, cedar retention, HVFH, Streams Lakes and Wetlands that are not HVFH, forested swamps, active fluvial units, redlisted ecosystems, other) and then to design a suitable EBM buffer:

    i. If EBM just required an extended buffer on a feature, the cost should only include that associated with a positive identification of the specific feature. This assumption will also be checked in the questionnaire. The occasional use of specialists will also be factored in.

    ii. If EBM required a new retention patch or strip in a block, costs should include that associated with a positive identification of the specific feature as well as the added costs to mark the boundary of the retention.

    iii. Some features like cedar retention will require their own question – If more than 15% dispersed retention is used, how much added planning would generally be required in a 20 ha block to ensure that mature cedar left is representative of the preharvest stand. We will use this to prorate larger or smaller blocks.

b. Planning Costs Associated with Stand Level Retention - This is for retention purely associated with EBM, not retention that is mostly driven by other objectives such as visual landscape management. Similarly to (a.ii) the planning costs would be associated with time associated with extra boundary layout for retention. Because this added cost also involves identification of ideal retention locations through general field reconnaissance, it will require its own question in the questionnaire – the average amount of time to conduct reconnaissance and layout three 0.5 ha patches of retention inside a 20 ha block[18]. We will use this to prorate larger or smaller blocks.

c. Harvesting Costs Associated with Stand Level Retention – This may be achieved by asking for the average incremental cost in terms of extra dollars per cubic metre paid to logging contractors for several harvesting scenarios with different retention scenarios (patches/groups vs dispersed):

    i. Hoechucking – average incremental cost/m^3 with retention dominated by patches or groups of retention.

    ii. Hoechucking – average incremental cost/m^3 with retention dominated by dispersed retention.

[17] This will involve several different questions that would generally be answered in terms of hours or days of work - this will need to be converted with appropriate rates to a cost/m3.

[18] This would equate exactly to the requirement for internal retention in the Ministerial Orders for blocks larger than 15 ha.

iii. Grapple yarding – average incremental cost/m^3 with retention dominated by patches or groups of retention.

iv. Helicopter yarding – average incremental cost/m^3 with retention dominated by patches or groups of retention.

v. Helicopter yarding – average incremental cost/m^3 with retention dominated by dispersed retention.

Again, incremental harvesting costs will only be considered for retention purely associated with EBM, not retention that is mostly driven by other objectives such as visual landscape management. Where dispersed retention is used, a rationale will be necessary to specifically link it to EBM, since there are no explicit EBM requirements for dispersed retention. Otherwise, costs for a patch approach will be used.

4. *OTHER QUESTIONS - Cedar Retention for First Nations:*

For this objective it must be determined what if any direction has been provided by First Nations on Cw and Yc retention (If so – for which cutblocks). This information will be captured from a questionnaire to the licensee. Added costs would only be accrued if added planning were to occur to address the objective.

COSTS ASSOCIATED WITH FULL EBM

Fixed or Variable costs associated with incrementally moving from the requirements under the Ministerial Orders to Full EBM will also be explored. They will first need to be finalized by the EBMWG

F. Determination of Economic / Social Gains from EBM

Based on the general EBM planning cost analysis and the cutblock-level planning cost analysis described in Section E, we will summarize the added person-days on average associated with each hectare logged. Based on the average annual harvesting in the region, added forest planning employment directly associated with harvesting can be calculated.

G. Reporting

The report associated with this project will include:

1. An introduction similar to this document
2. A brief outline of the approach, with a detailed revised methodology in an appendix
3. Results
    a. *Cutblock level requirements for EBM* - An assessment of added reserves and/or retention for EBM over and above preEBM blocks. This section will explore the differences between FPC/FRPA requirements and EBM requirements, and differences between requirements and implementation for both FPC/FRPA and EBM. This discussion will provide some insights for interpretation of the

associated benefit and cost analysis that follows. This discussion will also provide some useful information that can feed into subsequent modeling projects.

b. *Ecological Benefits* / Gains - An assessment of ecological benefits/gains associated with EBM (at the cutblock level)– with an overall assessment of gains and a breakdown by:

    i. The types of ecological gain

    ii. Subregions - if applicable.

    iii. Other strata as determined.

    A discussion and rationale, will be included which will also include the assumptions made in this analysis. As well, we will touch again on how this data should be interpreted, tying into (a).

c. *Economic Cost* - An assessment of average cost (at the cutblock level) – with an overall assessment of cost and a breakdown by:

    i. The types of costs – stratified by subregions / harvesting approach / other strata as determined.

    A discussion and rationale, will be included which will also include the assumptions made in this analysis. As well, we will touch again on how this data should be interpreted, tying into (a).

d. *Economic/Social Gain* - An assessment of average benefit or gain (at the cutblock level) – with an overall assessment of cost and a breakdown by:

    i. Roughly a description of Economic gains

    ii. Subregions - if applicable.

    iii. Other strata as determined.

    A discussion and rationale, will be included which will also include the assumptions made in this analysis.

4. Recommendations
5. Excel Spreadsheets and associated data summaries.

APPENDIX 2 - Key Peer Reviewer Comments and Response (April 2008).

Summarized below are the key points from the peer review – submitting either in a written or verbal fashion. Our responses provide an indication of how we will deal with the suggestion, and any questions we have for the EBMWG regarding the suggestion.

2. **POINT – Consider a broader range of variables in stratification of the population for sampling – included BEC subzone and Ecozone / mesic vs wetter / different licensees / different harvest methods. Not just by geographic area**

OUR RESPONSE: A slight modification…

Probably the best we can do is to use subregion, licensee, and harvest method and then see how results cluster and report back at the back end.

For now – Use the following procedure:

- Aim for 60-70 total blocks in the sample (with the target to assess at least 50) - just in case we can do more.
- From the licensees participating -ask for a complete list of blocks that they have logged or laid out since 2004 under EBM (to tease out the start-up confusion in 2004) - then we will randomly choose the blocks from that list and ask for the detailed info packages for our sample (using a random number generator).
- We stratify these lists by NC, NCC and SCC in an appropriate manner according to where more or less logging is done (if possible we could base it on the proportion of total area harvested for the period 2004-2008).
    - The number of blocks we choose would likely best breakdown as 10 - 14 from the NC / 20 - 28 from the NCC / 20 - 28 from the SCC. NOTE: This isn't exact, but there is about 10X the AAC in the NCC plus SCC combined relative to the NC.
- In each of these subregions we split the blocks (if appropriate) between licensees based on the amount of logging they do in that region. This will mean Triumph only on the NC / IFP and WFP in the NCC / and WFP and IFP on the SCC[19]. We will need to get a rough breakdown from someone on the amount these folks log in each region (probably to the nearest 10% is close enough for the sample size we will be using).
- Lastly, the blocks per licensee per subregion would be split by harvest type (based on the proportion of logging in that harvest type) – ground / cable / helicopter.

[19] Note: until the Ministerial Orders came in Timberwest only partly voluntarily implemented the transitional elements in the AIP. They can be included on the SCC, but it will be a bit more challenging to forward cast to the Ministerial Orders.

- It will now be pretty much impossible to prestratify the sample any further by BEC or other ecological or geographic criteria before we choose the sample, as we will only be choosing 2-6 blocks for each harvest method for each licensee in each subregion. However, we can check any clustering of results around BEC subzone or other criteria when we summarize our data.

3. **POINT – Should focus at cutblock level and ensure we do not mix scales.**

OUR RESPONSE: Change…

Agree – The concern here was that we narrow the scope to minimize spatial and temporal variability. We will ensure that is the case. Probably the biggest confusion in scales was our stated intent to include EBM influence on volume per unit of fixed cost. This is clearly a watershed or landscape scale item as it includes roads and other infrastructure, and is best assessed based on impacts over time and many harvesting entries. We received informal input regarding fixed costs from a consultant with involvement in these Patchworks projects as well as the TSR 3 on the MidCoast. The recommendation was to focus at the cutblock level with variable costs, since fixed costs are being teased out at the landscape scale over time through the Patchworks modelling projects.

We will specifically focus on variable costs including:

1. Planning and Layout (including assessments, prescriptions etc)
2. Tree-to-truck logging costs – falling, yarding, processing at roadside and loading.
3. Extra roading for EBM retention – spur roads to facilitate logging under EBM.

The added cost of spreading less volume over fixed costs is better assessed at higher scales with the Patchworks modelling projects.

4. **POINT – use FRPA blocks as the baseline**

OUR RESPONSE: No Change…

Not sure that the rationale for this is as strong as our rationale against it (as explained in our methodology). There are a number of specific concerns from the peer reviewers on this one:

First concern – If we backcast to FRPA regulations, actual FRPA implementation is often higher – so the impacts from EBM may be over estimated.

If more reserve would be implemented under FRPA than is required strictly through regulation, I think our experience will generally be able to predict that. Usually this is due to an engineering consideration. For example, stream or wetland requires different reserve buffers under FRPA vs. MO EBM. Under FRPA even though say a 20 m buffer is prescribed, the engineers would take the boundary to a logical engineering break which would never be less, but sometimes be more. Again, if we can get good airphotos, we should be able to determine this and account somewhat for the FRPA implementation vs FRPA regulation concern when backcasting.

Second concern – A focus on EBM blocks may limit and skew the population away from what would have occurred under FRPA-only.

This concern implied that a focus on EBM blocks (logged in the past few 3 years or so) may not be representative of cutblocks across the region of interest for various reasons – it was suggested that possibly licensees are seeking easier areas while they are on the EBM learning curve.

There are over 300 blocks logged under EBM now – providing a pretty decent population from which to draw our sample. We believe that there is enough flexibility in EBM requirements not to discourage logging in some challenging harvesting situations at the cutblock level. If the population of cutblocks from the past few years is skewed, it is more likely due to a desire to reduce fixed costs associated with roads etc (due to current poor economics)[20]. This is something that will likely be evident in the Patchworks projects. Another key driver for block location choices may be value, which is often a driver for cutblock choices, although under today's markets it becomes critical. We do not believe that these factors are significant enough to substantially skew the cutblock population and the results using our proposed sampling approach.

NOTE: THE RESPONSE TO THIS POINT WAS CHANGED UPON FURTHER DISCUSSION TO INCLUDE AT LEAST 20 PRE-EBM CUTBLOCKS IN THE SAMPLE.

5. POINT – Use Cutblocks rather than CP's

[20] Note: this is one reason why it is likely better that we focus on variable costs in our project, and leave the analysis of fixed costs to the landscape unit level patchworks analyses over time.

OUR RESPONSE: Change…

This is not a problem if the licensees don't balk at providing us with the supporting documentation for a significant number of cutblocks (20 blocks from one licensee). There are benefits for prestratification by block. Sampling by CP only gives us roughly 15 CP to prestratify, whereas using blocks would allow more than 40 blocks to stratify by various factors. This is an important point.

6. **POINT – Along with averages use a confidence limits for questions – range (min max) with 90% confidence when you ask questions in questionnaire.**

OUR RESPONSE: Add…

Very good idea.

7. **POINT – Bias in cost questionnaire from licensees is a concern.**

OUR RESPONSE: Add…

Using the range with confidence limits suggested by Martin is one way to help get at this. If an average or range from one licensee is out of line it will be obvious and can be followed with some discussion. Also, some costs are pretty straightforward to get at – additional time to identify a forested swamp on the ground when designing block boundaries – it might be half a day or so – if you said two or three days that would clearly be out of line. Logging costs are probably the big question mark. We will split logging costs up into many different specific cost elements, so that one estimate from licensees for one cost element might influence one small aspect of costs on a few blocks, but not dramatically influence the total cost across all blocks.

We will also point out clearly the uncertainties associated with our methods and the results.

8. **POINT – Need to be explicit that this project will not reveal the total cost or total benefits of EBM – need to be clear about what this project is addressing and what it is not.**

OUR RESPONSE: Add…

Totally agree.

9. POINT – Should consider this project more as a pilot to explore the variables that affect costs and benefits and the variability and uncertainty associated with those variables

OUR RESPONSE: Add or modify to a degree…

Good idea – might have to look at this project as a bit of a hybrid of this idea and the original intent. Consider it a pilot, but at the same time look at the cost estimate for what it is – a decent estimate of stand level, short term EBM costs and benefits with some specified uncertainties and variation. AND point out that total costs and benefit associated with EBM must look at a number of added spatial and temporal scales.

There will be work after this that might be able to tie into knowledge gaps, uncertainties, and variability of concern.

10. POINT – Complexity – not sure how to deal with retention left for FRPA reasons – visuals etc.

OUR RESPONSE: Good point, but no change…

We are not sure how this is an issue. If retention is left in a block, especially if it is significantly more than that required for EBM, and there are good visual reasons for it, it is logical to assume that EBM has no influence on block layout, and presumably costs and benefits, unless there are other EBM features present (hydroriparian, biodiversity, sensitive grizzly, First Nations). We will have a conversation with the responsible forester to determine if that assumption is correct.

11. POINT – Not sure how we can separate out the cost of meeting with and planning with First Nations for EBM, apart from what the licensee would have done anyway under FRPA.

OUR RESPONSE: Modify slightly with provisions to change…

We share this concern. Planning with and for First Nations across the Coast has been evolving for some time. For a number of EBM requirements (traditional forest and heritage resources and CMTs) it would be difficult to speculate whether these features would be managed for without EBM (just FRPA) or not. We suspect it depends on the licensee and the First Nation. Some requirements are new under EBM, such as those for cedar retention. As well, some general requirements across all aspects of EBM may increase the amount of consultation and/or information sharing with First Nations, but that depends on how much was occurring before.

We could try getting at this mostly through questions to licensee – Can they separate out these costs (strictly associated with EBM)? Also – use a confidence range (min/ max) at 90%. We suggest that we explore this question and see what we get. If our sense is that this information is not very useful, it may be one item we need to drop because it cannot track at a block level.

12. POINT – Focusing in on blocks with hydroriparian and other EBM features – some concern that our weightings overall at the backend (based on earlier EBM monitoring etc) may not be entirely accurate.

OUR RESPONSE: Change (with a question)…

Our concern was that hydroriparian and other EBM features are a significant influence on block layout. The only other way to address this is to use a random sample of cutblocks as large as possible and take what we get, basing the occurrence of EBM features on that sample. We suggest asking for more blocks in our initial sampling (sixty or seventy) blocks just in case we can do more than fifty[21]. In the end, we are not sure that prestratification of the population for sampling down past subregion, and licensee is possible due to the sample size.

In the end the occurrence of hydroriparian and other EBM features may not be an overly costly item (for variable costs at the cutblock level) as they often occur on the cutblock boundary and were often avoided anyway under FRPA (perhaps with a smaller buffer).

[21] We will of course need to pick from the initial sampling in a fashion to remove bias.

13. POINT – Include consideration of site series mapping on the cutblocks

OUR RESPONSE: Add…

A good idea

14. POINT – Sensitive Fisheries Watersheds and Upland Streams – should be considered for costs – considerable planning costs. Also should be considered for benefits as they were a focus of the hydroriparian planning guide.

OUR RESPONSE: Add in part – cost – no benefits…

Should consider cost based on the cutblock only. If planning (around ECA, or proportion of functional riparian forest) had to be done for a development of ten cutblocks in a watershed, then the cost for one sample block will be that planning cost divided by ten. Will have to ask licensees for this information on appropriate blocks (in sensitive watersheds or watersheds where the upland stream requirement applies).

Benefits are difficult to determine. Based on the Ministerial Orders these are watershed level cost and benefit items. Basically they are addressed through ECA or "maintaining an amount, type and distribution of forest cover that is sufficient to sustain natural hydrological and fluvial processes, based on watershed level assessments". We do not see how these can be addressed at the blocks level.

15. POINT – Consider added planning costs associated with assessing red and blue listed communities – don't assume that blue listed will just be taken care of at the watershed scale.

OUR RESPONSE: Add…

Should be able to do this – but will have to ask for the added planning required for this on each block where red or blue listed communities are found.

16. POINT – Unclear how we will inform development of tactical and operational planning

OUR RESPONSE: We will clarify…

Expect this to fall out at the end – is not the focus, but seen as a tangential benefit. We should state that.

17. POINT – Internal retention can lead to more roads – spur roads.

OUR RESPONSE: Add…

A variable cost and we should consider it in our analysis and cost questionnaire.

18. POINT – Consider costs vs added values or revenues.

OUR RESPONSE: No change…

Are not assessing value – too difficult if not impossible to assess credibly.

We thought about this factor – but is very complex, and perhaps impossible to get at with strictly an office exercise. There is no sampling of retention patches done operationally to record or track timber attributes and values. Unless we did a field sampling, it is very difficult to get at.

We will point this consideration out – value has always been a strong supportive rationale for helping to make variable retention operationally feasible. If the retention in general is of somewhat lower value, but high ecological value, that may counter the added costs. We could only get at this potentially if we could do some fieldwork.

19. POINT Should consider calculating costs/benefits per unit of feature (per metre of stream or per bear den) – as a proportion of total in watershed or LU.

OUR RESPONSE: No change (with some exploratory work to check feasibility)…

Not sure how we would come up with a credible denominator (total length of stream type or total number of forest swamps or total bear dens per watershed or LU). Laurie will give this some thought as we work through the examples.

20. POINT – Local vs outside employment for economic benefits

OUR RESPONSE: No change…

Not sure this is within our budget and scope – it is a good question and should be pointed out at the end of the report.

21. POINT – Include some other licensees (than the CFCI majors)

OUR SUGGESTED RESPONSE: No change…

We will include Triumph timber, but not sure how well the smaller companies will cooperate as they are really stretched right now. We will be explicit who is considered and who is not.

BCTS appears to be an anomaly in terms of layout vs logging, and ability to get at costs. We didn't think it was worth trying to integrate BCTS information into the mix.

APPENDIX 3. Comparison of "Full EBM" to Requirements under FRPA and the Legal Orders for EBM – by the EBMWG, 2008.

Value	FRPA	North/Central Coast	South Central Coast	Potential FIOEBM	Comment
Traditional Forest Resources	° No specific FRPA rule ° May be covered by FSP cultural heritage results or strategies	° Identify & conserve traditional forest resources to support FN food, social & ceremonial use ° Harvesting possible for safety, access or economics, but consultation & accommodation required	Generally same intent and outcome as N/C Coast	Same as N/C Coast but FN may "make known" lists of culturally important plants and other traditional forest resources (e.g. see Haida SLUA)	° Current MO will create pressure to establish more stand level reserves and selective harvest areas ° Implementation monitoring will reveal amount retained ° Effectiveness monitoring may result in change to LUO over time
Traditional Heritage Resources	° Pre-1846 resources covered by Heritage Conservation Act ° FSP must have strategy to "Conserve and where necessary protect cultural heritage resources that are of continuing importance to FN "	° Identify & protect traditional heritage resources ° Establish a mgt zone to protect integrity ° Alteration possible for safety or access, but consultation and accommodation required	Generally same intent and outcome as N/C Coast	No change to LUO, but FN may make specific traditional heritage sites 'known" through DSP planning	° Current MO will create pressure to establish more stand level reserves and selective harvest areas ° Implementation monitoring will reveal amount retained ° Effectiveness monitoring may result in change to LUO over time
CMTs	° Pre-1846 CMTs covered by Heritage Conservation Act ° Post-1846 may be covered by FSP strategies or results	° Identify & protect CMTs ° Establish a MZ to protect integrity ° Alteration possible for safety or access, but consultation and accommodation required	Generally same intent and outcome as N/C Coast	No change to LUO, but FN may make more specific direction "known" through DSP planning (e.g. Haida SLUA has a 50m RMZ)	° Current MO will create pressure to establish more stand level reserves and selective harvest areas ° Implementation monitoring will reveal amount retained ° Effectiveness monitoring may result in change to LUO over time ° Consider analysis of Haida CMT objective to assess FIOEBM option
Monumental Cedar	None	° Identify and reserve monumental cedar ° Harvesting possible for safety, access or economics, but consultation and accommodation ° Reserve stands of monumental cedar for FS&C use	° No stand level objective ° Reserve stands of monumental cedar for FS&C use	No change to LUO, but FN may make more specific direction known through DSP planning (e.g. cedar stewardship areas and monumental cedar reserves)	° Current MO will create pressure to establish more stand level reserves and selective harvest areas ° Implementation monitoring will reveal amount retained ° Effectiveness monitoring may result in change to LUO over time
Cedar	None	° Maintain sufficient cedar to support FN cultural use ° Design stand retention to maintain cedar profile.	Generally same intent and outcome as N/C Coast	No change to LUO, but FN may make more specific direction known through DSP planning (e.g. replant and stand tend to produce of cedar for FS&C purposes)	° Current MO will create pressure to establish more stand level reserves and selective harvest areas ° Implementation monitoring will reveal amount retained ° Effectiveness monitoring may result in change to LUO over time
Sensitive Watersheds	None	° Maintain <20% ECA ° Or complete a coastal watershed assessment and apply results	Generally same intent and outcome as N/C Coast	° Maintain <20% ECA roaded ° Maintain <30% ECA unroaded ° Or complete a watershed assessment & apply results	Potential FIOEBM of 30% unroaded may add flexibility, but also create incentive against convention operations

Value	FRPA	North/Central Coast	South Central Coast	Potential FIOEBM	Comments
High Value Fish Habitat	No specific direction; dealt with through fish bearing stream measures	° 1.5 tree height RRZ (35-85 m) ° Width can be varied	Generally same as N/C Coast	° Same as N/C Coast but RRZ may increase to 2 tree heights (e.g. Haida SLUA)	FIOEBM RRZ may be wider
Larger Fish Bearing Streams (Class 1-3)	° 20-50 metre RRZ (depending on stream class) ° 20 metre RMZ ° > 20% basal in RMZ	° 1.5 tree height RMZ (35-85m) ° Width can be varied ° Maintain >90% basal in RMZ (risk-managed > 70%)	Generally same as N/C Coast but allows for FRPA as risk-managed alternative	No change to LUO expected	No separate FIOEBM analysis required
Other Streams (Class 4-5)	° No RRZ ° 30 metre RMZ ° > 10% basal in RMZ	° FRPA requirements apply ° Maintain functional riparian forest next to 70% of small stream streams in watershed	Generally same intent and outcome as N/C Coast	No change to LUO expected	No separate FIOEBM analysis required
Small Steep Streams (Class 6)	° 0 metre RRZ ° 20 metre RMZ ° 0% retention	° FRPA requirements apply ° Maintain functional riparian forest next to 70% of small stream streams in watershed	Generally same intent and outcome as N/C Coast	No change to LUO expected	No separate FIOEBM analysis required
Lakes & Wetlands	° 0-10 metre RRZ ° 20-40 metre RMZ ° > 10% basal in RMZ	° 1.5 tree height RMZ (35-85m) next to lakes/wetlands >1m ° 1 tree height RMZ (20-55m) next to lakes/wetlands >.25m ° Width can be varied (0.5 tree heights) ° Maintain >90% basal in RMZ (risk-managed >70%)	° 1.5 tree height RMZ (35-85m) ° Width can be varied (0.5 tree heights) ° Allows for FRPA as risk-managed option	South Central Coast objective may change to same as N/C Coast	No separate FIOEBM analysis required
Forested Swamps	No specific direction	° 1.5 tree height RMZ (35-85m) ° Width can be varied (0.5 tree heights) ° Maintain >70% basal in RMZ (risk-managed >60%) ° Does not apply in outer coastal bog ecosystems	° 1.5 tree height RMZ (35-85m) ° Width can be varied (0.5 tree heights) ° Maintain >70% basal in RMZ (risk-managed >60%) ° Does not apply in outer coastal bog ecosystems	LUO may be changed to clarify extent of application (i.e. does not apply to extensive outer coast bog ecosystems	No separate FIOEBM analysis required
Active Fluvial Units	No specific direction	° 1.5 tree height RMZ (35-85 m) ° Maintain 90% basal retention in RMZ (risk-managed >80%)	° No RRZ or RMZ ° Maintain >90% basal retention (risk-managed >80%)	South Central Coast expected to change to same as N/C Coast	FIOEBM analysis should assess implications of South Central being same as N/C Coast
Coastal Zone	No specific direction	No specific direction	No specific direction	LUO may be developed to establish 1.5 tree length RMZ requirements similar to lakes and wetlands	FIOEBM analysis should assess implications of coastal zone RMZ

Value	FRPA	North/Central Coast	South Central Coast	Potential FIOEBM	Comments
Old Growth	° Design timber harvesting to resemble natural disturbance ° Ministerial Order requires 13-19% maintenance of each BEC variant in each landscape unit	° Maintain 30% RONV of common, very common site series ° Maintain 70% RONV of modal, rare, very rare site series ° Harvesting allowed for safety or access	° Maintain 30% RONV of common, very common site series ° Maintain 70% RONV of modal, rare, very rare site series ° Harvesting allowed for safety or access	° In each LU, maintain 50-90% RONV of each site series in old growth ° Target will vary by LU (50-70-90) ° May include lower recruitment rule for heavily harvested site series	Whatever the FIOEBM solution, will be difficult to assess stand level implications
Mid Seral	° None explicit ° Design timber harvesting to resemble natural disturbance	° In each LU, maintain less than 50% of site series in mid seral	Generally same intent and outcome as N/C Coast	No change to LUO expected	No separate FIOEBM analysis required
Early Seral	° None explicit ° Design timber harvesting to resemble natural disturbance	None	None	No LUO expected	No separate FIOEBM analysis required
Red-Listed Plant Communities	None explicit	° Protect each occurrence of identified red-listed communities ° 5% alteration of each occurrence allowed for safety or access.	Same as N/C Coast	No change to LUO targets expected, but list may be revised to better correspond to CDC listings	FIOEBM analysis should consider implications of applying full CDC list
Blue-Listed Plant Communities	None explicit	° Max 30% alteration of each occurrence of identified blue-listed plant communities ° Max 30% alteration of each type in landscape	Same as N/C Coast	No change to LUO targets expected, but list may be revised to better correspond to CDC listings	FIOEBM analysis should consider implications of applying full CDC list
Stand Retention	° Retain wildlife trees ° Maintain 3.5-5% stand retention in each cutblock ° Maintain 7-10% stand retention in cutblocks harvested in any given year	° Maintain >15% stand retention in each cutblock ° In cutblocks >15 ha, distribute >50% of retention in cutblock	Generally same intent and outcome as N/C Coast	No change to LUO expected	No separate FIOEBM analysis required
Wildlife	° Conserve sufficient habitat for species at risk, regionally important wildlife etc. ° Compliance with general wildlife measures	° Maintain 100% of class 1 GB habitat and 50% of class 2 GB habitat ° Allocate landscape level old forest retention to include habitat elements for species at risk, ungulate winter range, & regionally important wildlife ° Allocate stand level retention to include habitat elements for species at risk, ungulate winter range, & regionally important wildlife	° Maintain sensitive GB habitat ° Allocate landscape level old forest retention to include habitat elements for species at risk, ungulate winter range, & regionally important wildlife ° Allocate stand level retention to include habitat elements for species at risk, ungulate winter range, & regionally important wildlife	LUO may be amended to deal with specific wildlife issues For example, Haida SLUA has specific targets to project bear den sites, goshawk nesting sites, and Mamu habitat	° Current MO will create pressure to establish more stand level reserves and selective harvest areas ° Implementation monitoring will reveal amount retained ° Effectiveness monitoring may result in change to LUO over time ° FIOEBM analysis should consider analysis of Haida wildlife objective as example