FREP Technical Note #6: Methodologies for Converting FREP Monitoring Results to Multiple Resource Value Assessment (MRVA) Resource Development Impact Ratings

Note: As part of the continuous improvement process, this document will be updated and finalized following a de-briefing of the 2013 MRVA implementation (lessons learned) and the 2013 FREP Continuous Improvement meeting.

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INTRODUCTION

This document is a companion to specific area-based (e.g. Timber Supply Area (TSA) and Resource District) Multiple Resource Value Assessment (MRVA) reports. This document describes how FREP monitoring results have been translated into the MRVA resource development impact ratings (very low, low, medium and high impact). Details on the FREP program can be found at the FREP website (http://www.for.gov.bc.ca/hfp/frep/index.htm)

PRODUCTION AND DISTRIBUTION OF MRVA REPORTS

Table 1 describes the production and distribution of FREP MRVA Reports; including tasks, timelines, responsibilities and important notes. This table is part of *FREP Quality Control Protocol Number 4A*.

Table 1: Production and distribution schedule of FREP MRVA Reports

Step	Description / Task	Timeline	Responsibility	Notes
1	Field season data entry	By Nov 30	District staff	Critical to ensure data included in MRVA.
2	Data preparation	Dec-Jan	RP Branch	QA - validation and verification. Data compilation.
3	Update provincial landscape level analysis tool	Jan	RP Branch	Update data layers for province and produce revised data tables and LU rankings.
4	Draft MRVA report	Feb-Mar	RP Branch	Reports on annual cycle provided sufficient data collected in area.
5	Review of draft MRVAs by RVTLs	Mar-Apr	RVTLs	RVTL = Resource Value Team Leads.
6	Operational review of draft MRVA	Apr-May	District staff	Operational lens/context. Do results reflect what you see on the ground?
	a. review of resource value summaries			
	b. draft environmental context			Local context important for understanding outcomes – approximately 150 words.
	c. draft District Manager commentary			Approximately 200 words. Focus on results not practices that lead to the results. Avoid justification of outcomes. Key conclusions from the data, both positive and negative with a clear indication of what is good, acceptable, and not acceptable (i.e., clearly define government expectations for the management of public resources and land). Identify key areas requiring licensee action (e.g., FSP content, practice improvements, information sharing etc.) and key areas requiring government action such as priority focus areas for ministry staff related to monitoring, research, investigation. Recommended that District Manager

				commit, in the DM Commentary, to a timeline for the development of a joint government – licensee action plan.
	d. review with local licensees			Discussion is not debating results – focus is on discussion of what is the appropriate response to the results e.g. are results satisfactory, how to address opportunities for improvement, how to build on success, what are next steps etc. These reviews will also identify further considerations for the District Manager commentary.
7	Final draft MRVA report	By May 31	RP Branch	All edits and review complete.
8	District Manager approval	Mid June	District	Where District Manager deems necessary, she/he will review "red flag" results with RED and Area ADM. Suggest that District Managers table their MRVA reports at RMT to ensure consistency and discuss response/actions.
9	Report Distribution and Discussion	June	District	Discussion focus on using MRVA report to inform on-the-ground and planning related decision making.
	a. Formalized discussion of final report with local licensee and others as appropriate (e.g., First Nations)			
	b. Post to FREP website		RP Branch	For each of the first TSA/district MRVA reports, provide a one week "heads up" to ADMs and GCPE. Review this requirement once we have completed round one of MRVA reports. Brief ADM Stewardship and Deputy Minister on any MRVA reports where results are particularly poor.
10	Annual MRVA debriefing and continued improvement meeting	Fall-winter	RP Branch-led	Open invite to all MRVA users – focus on CI of reports and process.

Next step is outside direct MRVA development and distribution, but mentioned as it is a critical success factor				
11	Action Plan to address MRVA	Start discussing at step 6, complete by June-July	District led in consultation with licensees and others	If an Action Plan has not already been developed in step 6 or 9 – then should be developed/ finalized once MRVA report has been published. This plan should address CI of practices and plans based on MRVA outcomes.

FRPA/FREP CONSTRUCT[1]

The development of the Forest and Range Practices Act (FRPA) was a major legislative initiative. Some of the key objectives of this work were to:

- simplify the forest management legal framework
- reduce operational costs to both industry and government
- create "freedom to manage"
- Maintain the Forest Practices Code's (FPC) high environmental standards; and,
- Strengthen the Compliance and Enforcement regime.

Government committed to achieving these objectives by transitioning from a government "command and control" model of forest management (Forest Practices Code) to a "results-based" model (FRPA) where forest and range licensees would have increased responsibility and accountability for the delivery of specified results, including sustainable management practices. This would be the first forestry application of this model anywhere in the world.

Eleven forest values were defined and policy teams were created to develop the results-based regime for each value. Their work was passed to a central management team responsible for overall coordination, and, ensuring consistency with the objectives. A recurring issue during FRPA development was the lack of science-based information that could be used to define acceptable standards of risk for the proposed regimes.

To address this risk and to build public confidence in FRPA, government committed to conducting and publicly reporting out on the results of effectiveness evaluations. The intent was to use the science-based information from these evaluations to determine if FRPA was achieving government's objective of maintaining high environmental standards and ensuing sustainable management of public resources. Where this was not the case, the information would be used to make the necessary adjustments to practices, policies and legislation. It was recognized that such adjustments could require amendments to the legal framework.

Government delivered on its effectiveness evaluation commitment through the Forest and Range Evaluation Program. This innovative, science-based partnership among government agencies, academia and the professional associations can provide the information to continually improve FRPA and make it a global model of sustainable forest management.

Multiple Resource Value Assessment (MRVA) reports document the results of stand and landscape-level monitoring carried out under the Forest and Range Evaluation Program (FREP). Resource values being

[1] FRPA-FREP construct paragraph authored by Ralph Archibald, former co-chair of the FRPA development committee. Ric Slaco the other co-chair reviewed the section prior to it being finalized.

monitored under FREP include: biodiversity, riparian, water quality, cultural heritage, timber (stand development monitoring), forage, visual quality, wildlife, resource features (karst) and recreation. MRVA reports are designed to inform decision making at multiple levels including; on-the-ground management practices, statutory decision maker approvals and, data for assessing cumulative effects.

FREP – RANDOM SELECTION AND USE OF DATA

To allow for inference of monitoring results to a larger area there are two major considerations. The first is that the data be collected randomly, and the second is that there is sufficient data. To ensure that FREP data is random, the following general sampling procedure is followed for each value:

1. The full population is defined for the value (e.g. all harvested cutblocks reported in the RESULTS data system that are greater or equal to 2 hectares gross area with harvest completion dates between January 1, 2011 and December 31, 2013 within a natural resource district).
2. This full population is determined and put in a list
3. The full population list is sorted randomly
4. The number of sites that will be sampled are taken from the top of the list

To ensure appropriate inferences are made from monitoring data collected, FREP uses the following set of guidelines within MRVA reporting:

1. Less than 10 samples in an area (e.g., TSA); only individual site results are reported (e.g. 3 good, 2 fair and 1 poor).
2. 10 or more samples in a set area; results will be graphed. Interpretations should be made with caution.
3. At 20 samples we begin to be comfortable with making inferences and suggestions about the broader population.
4. Our target is 30 samples for any given reporting area to increase precision and account for variability.

Sampling populations for the riparian/fish, biodiversity, water quality and cultural heritage resource values

The riparian, biodiversity, water quality and cultural heritage populations are the full population of harvested cutblocks greater than 2 hectares in size harvested within the previous three years, with the final harvest date being December 31 of the year prior to sampling. This full population is derived from the FLNRO corporate application RESULTS. Annually, in mid-January, the full population of harvested cutblocks for the district is determined then re-sorted randomly. Cutblocks that do not have an appropriate feature (e.g., stream for riparian, cultural feature/site for cultural heritage, water body leading to fish habitat and/or drinking water source for water quality) for the value being assessed are rejected. District staff selects sample areas from the top of the list for the number of cutblocks they will be sampling for the given value. The methodology gives a "rolling" population with a new harvest year added and old one dropped annually. This gives a redundancy in sampling so that even if circumstances mean little or no sampling occurs in one year, there is still potential for a harvest year to be sampled in any of three sample years.

Sampling population for the Timber (Stand Development Monitoring) assessments

The sample unit for SDM is the inventory polygon. SDM derives its potential samples from the population of managed stands (polygons) stored the RESULTS database. This database stores all the polygons in the province with a silviculture or disturbance history that are managed. Every five years, a list of all the potential even-aged sample polygons with stand ages from 20-40 years old and ≥5 ha in area are extracted from RESULTS for every TSA in the province. These lists are referred to as the SDM

TSA Master Lists. These TSA Master Lists may be reconstituted every five years to incorporate new polygons.

REPORT CONTEXT SECTIONS

TSA Stewardship/Environmental Context

This section is written by the local resource district staff. The following guidance is provided:

- Approximately 150 words (maximum ½ page)
- Describe the condition and or issues of the TSA. For example, significant factors that may affect outcomes such as; MPB impacts, significant levels of past harvest, low levels of past harvest, easy/difficult operating landscape, many or few opportunities/options for management.

District Manager Commentary

This section is written by the local district staff with support and approval of the district manager. The following guidance is provided:

- Approximately 200 words (maximum 2 pages in length)
- Focus on results (let resource professionals deal with the practices that lead to the results)
- Avoid justification of outcomes
- Key conclusions that the district manager draws from the data, both positive and negative with a clear indication of what is good, acceptable, and not acceptable (i.e., clearly define and communicate government expectations for the management of public resources and land)
- Key areas requiring licensee action (e.g., FSP content, practice improvements, information sharing etc.)
- Key areas requiring government staff action such as priority focus for ministry staff, areas of focus for research and investigation, FSP considerations (e.g. recommendation re: results and strategies, thoughts on future approvals)

METHODS FOR TRANSLATING FREP MONITORING RESULTS INTO MRVA RATINGS

Riparian/Fish Resource Value

Background

Riparian sampling is done on stream segments associated with recently harvested (and randomly chosen) cutblocks. Sampling on a stream involves both continuous and point data collection. This data is used for 15 general questions regarding stream condition which can be answered with a yes or no. Questions answered as "yes" are positive for stream health. The answers to the 15 questions determine which of four categories of stream functioning condition the stream segment falls in. For more information on riparian please see the FREP Riparian protocol and FREP Report 27.

MRVA Riparian Ranking

Table 2 shows the conversion of the properly functioning condition categories to MRVA categories.

Table 2: Conversion of the properly functioning condition categories to MRVA (Resource Development Impact Ratings)

Functioning Condition	Resource Development Impact Rating	FREP field assessment score
Properly functioning	Very Low Impact	0-2 no answers
Properly functioning with limited impact	Low Impact	2-4 no answers
Properly functioning with high impact	Medium Impact	4-6 no answers
Not properly functioning	High Impact	6 or more no answers

Water Quality Resource Value (fine sediment generation)

Background

Water quality sampling is done at sites that are in close proximity to streams that flow directly into larger water bodies. The sites sampled are located along haul roads that were used to transport logs from randomly chosen cutblocks. Water quality data collection on a site, involves summarizing the amount of area that is likely to cause fine sediment to enter the water body. Information collected includes area, connectivity to water body, portion of fine sediment, and portion of erodible surface. The data is summed resulting in the fine sediment generation potential. Five categories are then used. For more information on Water quality please see the FREP Water Quality protocol and FREP Extension Note 22.

MRVA Water Quality Ranking

Table 3 shows the conversion of the fine sediment generation potential categories to MRVA categories.

Table 3: Conversion of fine sediment generation potential categories to MRVA (Resource Development Impact Ratings)

Sediment Category	Resource Development Impact Rating	FREP field assessment score
Very low	Very Low Impact	<0.2 m^3 fine sediment potential
Low	Low Impact	0.2-1 m^3 fine sediment potential
Moderate	Medium Impact	1-5 m^3 fine sediment potential
High	High Impact	5-20 m^3 fine sediment potential
Very High	High Impact	>20 m^3 fine sediment potential

Stand-level Biodiversity Resource Value

Background

Stand-level biodiversity sampling is done on recently harvested (and randomly chosen) cutblocks. Both plot and non-plot based information is collected. Plots are randomly located both in the harvested area of the cutblock, i.e. in the net area to be reforested (NAR) and within retention patches. Modified cruise plots are used to collect the standing tree information and line transect plots are used to collect coarse woody debris information. Non-plot information includes the estimated amount of windthrow in retention, presence of ecological anchors, amount and location of patch retention, etc. For the analysis, wherever possible, individual indicators are compared back to a baseline. For more information on SLBD please see the FREP Biodiversity protocol and FREP reports 28, 29 and 30.

Baseline for Trees

The baseline is derived from timber cruise data from the same BEC subzone/variant for 86% of the sampled data (total of 2001 cutblocks sampled from 2006 to 2012 sample years). 10% of the cutblocks are compared against a baseline at the BEC subzone level, and 4% of the cutblocks had insufficient baseline at the subzone level (i.e., the relatively rarely harvested subzones such as MHmm, SBSvk, ICHdk, ESSFmm, BWBSdk) and therefore had no baseline comparison. The average number of baseline (cruise data) blocks at the variant level was 60 blocks, with the minimum used being 11. The same tree indicators are calculated from the cruise block plot data as are used in the FREP sampling to allow for a quartile comparison.

Baseline for Coarse Woody Debris (CWD)

A CWD baseline is derived from the CWD data collected within retention patches. Every block had baseline quartiles assigned for the following CWD indicators:

- CWD volume/ha within net area to be reforested (NAR),
- CWD density big pieces/ha and
- CWD volume from large diameter, within NAR

Similar to the tree baseline this allows a sense of how well the full range of natural variability is maintained. This use of CWD within retention patches is a surrogate baseline. CWD baseline was used at the subzone level if 11 or more blocks of patch data at the subzone level. If insufficient data at the subzone level, a zone level baseline is used. The two coastal Douglas-fir cutblocks and the one ponderosa pine cutblock did not have a CWD baseline due to insufficient data.

Compilation and Assigning Baseline Quartiles

Baseline indicators (e.g., SPH of large snags, volume/ha of CWD), either from timber cruise or CWD in retention patches are sorted from lowest to highest value for each BEC subzone or subzone variant. The first 25% of the data is the first quartile; the second 25% of the data is the second quartile etc. The following points indicate how indicators are compiled and baseline accounted for in the FREP SLBD data.

1. FREP SLBD data for the years sampling is downloaded from the FREP Information Management System (oracle database).
2. It is compiled together with previous years data, using a purpose built BC Stats APL (a Programming Language) program to calculate the indicators (e.g. density of large snags, volume of CWD) by cutblock.
3. The tree indicators (large snags per ha (≥ 10 m high and 30 cm dbh), number of live tree species per block, large trees (≥40, 50 or 70 cm dbh per ha)) for each block are assigned their baseline quartile. Assigning each FREP sampled block for each indicator to a baseline quartile (1, 2, 3 or 4 depending on where in the range of baseline data that block indicator is), allows an easy (but rough) look at whether the density of the indicator (e.g., large snags) in many harvested cutblocks represents the range of that indicator as found in pre-harvest stands. For example, if for a chosen indicator in a grouping of harvested blocks, the quartile falls 25% to each of 1, 2, 3 and 4 - that group of blocks is potentially indicative of retention choices of areas containing similar densities of the valuable ecological trait (the indicator) as expected to be present pre-harvest. This therefore allows for an assessment of how well (considering many stands), the licensees are choosing retention areas to maintain these high ecological value traits. If simply looking at averages, an average quartile of 2.5 (for many blocks) may indicate choosing areas overall that represent the distribution of that indicator in pre-harvest cutblocks. This is simply since a grouping of blocks with 25% in each of the four quartiles would have an average quartile

of 2.5. A lower number than 2.5 may indicate a choice of retention that "under-represents" that indicator.

4. A CWD baseline is derived from the CWD data collected within treed retention patches. The CWD indicators are CWD volume/ha and density of big pieces of CWD/ha with a big piece defined as ≥20 cm diameter at line transect crossing and ≥10 m long. A second quality indicator was added after a July 2012 review (David Huggard) which is volume from pieces ≥20 cm diameter (for BWBS, IDF, MS, SBPS, SPS, and ESSF zones) or ≥30 cm diameter (remainder of operable BEC zones) at line transect crossing. That indicator is regardless of length and serves to balance out a potential bias towards length in the CWD quality assessment. The two quality indicators receive equal weighting for the MRVA score.

Assigning MRVA scores for Tree Retention

Each cutblock has four "scores" calculated, plus an overall rank. A roll-up overall score is done using the actual percent numbers for the four components rather than just an average from the categorical ranks.

1. *Percent retention score* is based on the percent retention within a cutblock with percent retention calculated as total block retention (patch retention plus dispersed retention as basal area equivalency divided by gross cutblock area). The score for percent retention is expressed as a percentage of "perfect" with zero retention on a block having a 0%, 30% retention or more getting 100% and anything in between pro-rated. The 30% maximum is simply the top end for purposes of giving a percentage rank. It could be 35% from synthesis work from UBC on stand-level retention and forest birds showing 35-50% retention needed for some more sensitive (to harvest) bird species[2], however it is tempered to 30% considering the option for the landscape to provide the highest levels of retention for these most sensitive species, e.g. from OGMA's .

2. *Retention quality score* is a sum of the quality indicators collected by FREP. Points are assigned based on the valuable ecological traits found on the harvested cutblock:
   - 0-3 for dispersed retention[3] (3 points for 10% or more dispersed, pro-rated for less), plus
   - 1 point if an ecological anchor found on block, plus
   - 1 point if a >2ha patch on block[4], plus
   - 1 point if a >7ha patches on block, plus
   - 1 point if there is a retention patch internal to harvest boundary, plus
   - 1 point if there is a retention patch on the edge of the harvest[5], plus
   - Baseline quartile from count of live tree species (either 1, 2, 3 or 4), plus
   - Baseline quartile from large snag density quartile, plus
   - Baseline quartile from big tree density (big tree size dependent on ecosystem, either ≥40, 50 or 70 cm dbh alive or dead).

Maximum points would be 18, 19 or 20[6] (dependent on gross cutblock size and likelihood of large retention patches). The points are turned into percentage of the maximum possible for each block.

[2] Huggard, D. J. and F. L. Bunnell. 2007. Stand-level retention and forest birds: a synthesis of studies. Centre for Applied Conservation Research, University of British Columbia, Vancouver, B.C.

[3] Rather than an on/off for dispersed retention a score is used that recognizes worth of increasing levels of dispersed retention. See reference Smith, Nicholas J, William J. Beese *Effects of Low Levels of Dispersed Retention on the Growth and Survival of Young, Planted Douglas-fir* In forests www.mdpi.com/journal, 2012, 3, 230-243 which indicated reduced basal area diameter growth of seedlings but not until 30% retention.

[4] Only 1 point is given for a patch of 2 or 7ha to avoid any inadvertent encouragement to split up big patches.

[5] To acknowledge worth of both internal and edge patches and discourage external non-contiguous patches.

Assigning block scores for CWD

3. *CWD quantity score* is determined by the blocks baseline quartile for that indicator. CWD quantity is the m^3/ha of CWD in the harvested area of a cutblock (NAR).

Score	CWD quantity
1	falls in quartile 1
2	falls in quartile 2
3	falls in quartile 3
4	falls in quartile 4

4. *CWD quality rank* is determined by the blocks average baseline quartile for 2 CWD quality indicators. The first is the density (pieces/ha) of big pieces of CWD (≥20cm diameter and ≥10m length) in the harvested area of a cutblock (net area to be reforested). The second is the volume from CWD pieces of 20 or 30 cm (dependent on BEC zone) or larger pieces in the harvested area of cutblock. The same ranking criteria are used as for CWD quantity rank.

CWD ranking for quantity and quality should not be determined at the block level[7]. The objective is to maintain the full range of volume and quality over many blocks, not to have many blocks with either all high, or all low CWD. The scores from multiple blocks are rolled up to see if on many blocks the full range of naturally occurring CWD is maintained (as seen in retention patches in the same ecosystem). The closer an area is to having the full range of CWD quantity or quality, the better the rank for that area. A quartile average of 2.5 is considered to represent the full range of CWD data, therefore either higher or lower than 2.5 will be moving away from a perfect score. In consultation with ecologists however, CWD scoring is capped at a quartile of 2.5. There are numerous areas in the province with CWD levels are skewed to the higher amounts as defined by the baseline. There is no decrease in score for this higher skewing, though particularly high amounts will be discussed with ecologists. The higher amounts and quality of CWD may be a concern for fuel management and planting spots, however for biodiversity they may better represent the true baseline for CWD which would be the amounts of wood on the ground after natural disturbance, which can be levels similar to the full stand volume.

At this time, CWD ranking can be done at the TSA or District level (whichever is smaller) and therefore each block within the TSA or District share in the same CWD score for MRVA purposes. If sufficient data, the CWD ranking can also be done <2005 and ≥ 2005 harvest year for the TSA or District. If assessment is done for differing areas, time frames or licensees, then CWD scores would be developed considering only that data within the TSA or District.

[6] If gross cutblock area is < 6 ha, the maximum points is 18 (low possibility of either 2 ha or 7 ha patch). Maximum is 19 points if between 6 and 40 (possibility of 2 ha patch) and maximum is 20 points if gross > 40 ha.

[7] This is different than tree retention for two reasons: 1. CWD is ranked on NAR which is on average 85% of a cutblock, while tree retention is ranked on the retention component, on average 15% of a cutblock. Since the tree retention is a small component of the original forested stand, we welcome higher amounts of the particular ecological attributes. For CWD, it is not good to have high amounts of CWD on the NAR of *all* cutblocks, and, there are natural levels of CWD within retention patches. 2. 60% of the tree retention quality comes from a comparison to baseline versus 100% from the CWD.

MRVA Overall stand-level biodiversity ranking

An overall block score, as shown in table 4 is a summation of the four components described above, with a heavier weighting (60%) to the two tree retention components (percent retention and retention quality), versus the two CWD components (40%).

Table 4: MRVA Resource Development Impact Ratings as a summation of the four components of stand-level

Resource Development Impact Rating	Overall ranking
Very Low Impact	>70%
Low Impact	55-70%
Medium Impact	40-55%
High Impact	≥40%

Landscape-level Biodiversity Resource Value

Background

Landscape-Level Biodiversity (LLBD) is an assessment of whether the forested matrix at the landscape-level is providing the range of habitat understood as necessary for maintaining ecosystem function and old and mature forest dependant species.

LLBD indicators

A Geographic Information System (GIS) model incorporating publically available forest cover information for the province has been developed in cooperation with the Forest Practices Board. This model currently uses three indicators to report on the status of landscape-level biodiversity:

1. Age class (old, mature, mid and young)
2. Interior old forest (interior habitat)
3. Site index by leading tree species (surrogate for site quality)

Each of these three indicators can be reported within three administrative reporting strata:

1. Protected land-base (e.g. parks, OGMA, and UWR and WHA with minimal harvesting allowed)
2. Non-contributing land-base (common term used to describe outside of timber harvesting land base and not protected) (NCLB)
3. Timber harvesting land-base (THLB)

The model produces both spatial and tabular output for the indicators. The tabular output (MS Excel) allows for easy querying and summarizing by geographic area (e.g. TSA, landscape unit, or a specific BEC zone or subzone within a management unit). Comparison of the amount (percent of area) and quality (distribution of age class and site quality, amount of old interior forest) of protected area or NCLB within an area compared to the THLB can be used to assess the biodiversity attributes of the landscape. The known overlap of the THLB and NCLB (i.e. harvesting within the NCLB) can be assessed by repetition of the analysis every few years with updated input data.

MRVA Overall Landscape-level Biodiversity Ranking

A ranking system that will assign a MVRA rating based on the 3 landscape-level biodiversity indicators described above is under development. In the meantime, MRVA will simply report on the three indicators individually.

Cultural Heritage Resource Value

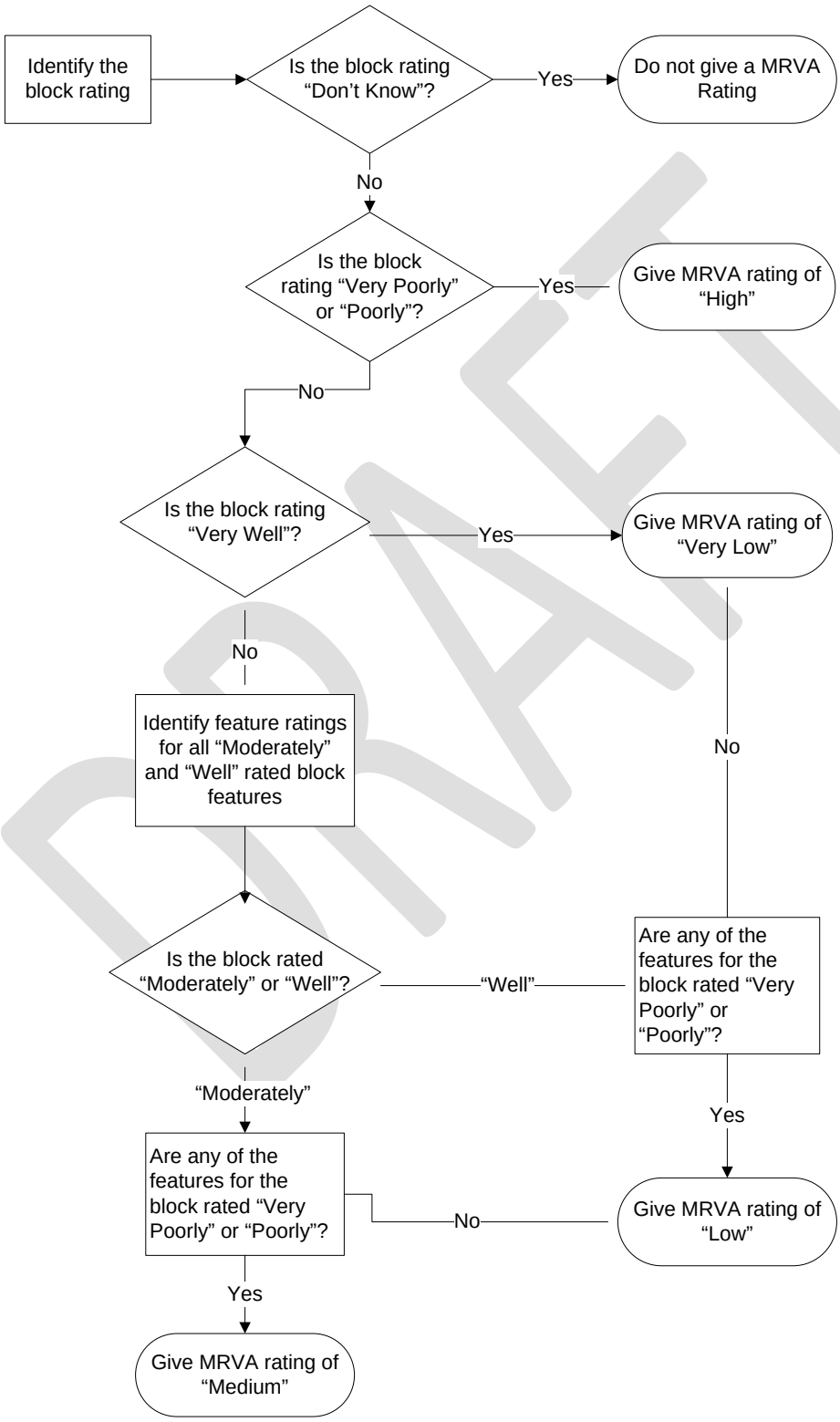
Background

The Cultural Heritage value is an assessment of the management practices of cultural heritage resources on a given block. An overall block rating is assigned to the cutblock opening sampled, based on how well the management practices were at maintaining the cultural heritage resources on that block. This block rating is the basis for the MRVA rating. In addition to the block rating, cultural heritage features found in the area are individually assessed and given a rating (again based on management practices). These individual ratings are also used to determine the MRVA rating for Cultural Heritage, in particular when the block rating is "Moderately" or "Well". For more information on Cultural Heritage please see the FREP Cultural Heritage protocol and FREP Extension Note 11.

MRVA Cultural Heritage Ranking

Figure 1 is a flowchart illustrating the rating selection procedure. This procedure provides a MRVA Rating of very low, low, medium or high impact for each cutblock sampled.

Figure 1. Determining MRVA rating of Cultural Heritage samples



Timber Resource Value (Stand Development Monitoring)

The Stand Development Monitoring (SDM) survey is used to assess the relative health and productivity of stands aged 20-40 years. Once a stand or polygon has been declared free-growing there are no further assessments made on the health and productivity of the stand until harvest. SDM provides a snapshot of the impact of abiotic and biotic factors impacting a stand ≥10 years post declaration. The table below provides a coarse filter on assessing the health and productivity of the stand based on total and well spaced (WS) stems/ha at time of assessment. If the stand has adequate total and WS stems/ha then a dark or light green colour is associated with this stand. If the stand is borderline in terms of total and WS stems/ha a yellow colour is associated with that stand. An orange colour means that this stand is under stocked for whatever reason; there are not enough total or WS stems/ha to produce a viable timber crop. Weightings were applied to the total and WS stems/ha values on the "X" and "Y" axes to ensure a reduction in the resulting score as you moved from left to right and from top to bottom on the table. An arbitrary cut-off number and range was assigned to each of the four (dark green, light green, yellow, orange) colours. These cut-off values and ranges are subjective and will be refined over time. All coastal and interior stands use this one table and cut-off values. The ranking achieved by a stand is no reflection on the stewardship performance of the field staff or district in which the stand resides. It is a reflection of the relative impact of abiotic and biotic factors on the current health and productivity of the stand at the time of SDM assessment. The SDM survey also provides feedback at a young age in the stands life that some silvicultural intervention may alleviate some forest health or other concern (e.g. vegetative competition, snow press). Feedback from SDM surveys may also be instrumental in changing silvicultural practices to improve stand productivity (e.g. planting density, species selection, species mix, spacing, etc).

Table 5: Stand Development Management Rating Criteria

Total Stems/ha \ Well Spaced Stems/ha	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900	850	800	750	700	650	600	550	500	450	400	350	300	250	200	150	100	
	1	1	1	1	1	1	1	1	1	0.95	0.9	0.85	0.8	0.75	0.65	0.65	0.6	0.5	0.3	0.005	0	0	0	0	0	0	0	
	4	3.5	3	2.5	2	1.5	1	0.9	0.8	0.7	0.6	0.5	0.45	0.4	0.3	0.25	0.2	0.15	0.1	0.05	0		0		0		0	
5000	14.3	13.0	11.5	10.0	8.3	6.5	4.5	4.3	4.0	3.5	3.0	2.5	2.3	2.0	1.4	1.3	1.0	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
4750	12.2	11.1	9.9	8.6	7.1	5.6	3.9	3.7	3.4	3.0	2.6	2.1	1.9	1.7	1.2	1.1	0.9	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
4500	11.6	10.5	9.3	8.1	6.8	5.3	3.7	3.5	3.2	2.8	2.4	2.0	1.8	1.6	1.1	1.0	0.8	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
4250	9.7	8.8	7.8	6.8	5.7	4.4	3.1	2.9	2.7	2.4	2.0	1.7	1.5	1.4	0.9	0.9	0.7	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
4000	9.1	8.3	7.4	6.4	5.3	4.2	2.9	2.7	2.6	2.2	1.9	1.6	1.4	1.3	0.9	0.8	0.6	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
3750	7.5	6.8	6.1	5.3	4.4	3.4	2.4	2.3	2.1	1.8	1.6	1.3	1.2	1.1	0.7	0.7	0.5	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
3500	7.0	6.4	5.7	4.9	4.1	3.2	2.2	2.1	2.0	1.7	1.5	1.2	1.1	1.0	0.7	0.6	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
3250	5.6	5.1	4.5	3.9	3.3	2.5	1.8	1.7	1.6	1.4	1.2	1.0	0.9	0.8	0.5	0.5	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
3000	5.1	4.7	4.2	3.6	3.0	2.3	1.6	1.5	1.4	1.3	1.1	0.9	0.8	0.7	0.5	0.5	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
2750	4.3	3.9	3.5	3.0	2.5	2.0	1.4	1.3	1.2	1.1	0.9	0.8	0.7	0.6	0.4	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.55
2500	3.6	3.2	2.9	2.5	2.1	1.6	1.1	1.1	1.0	0.9	0.8	0.6	0.6	0.5	0.3	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
2250	3.2	2.9	2.6	2.3	1.9	1.5	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.3	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
2000	2.3	2.1	1.8	1.6	1.3	1.0	0.7	0.7	0.6	0.6	0.5	0.4	0.4	0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
1750	1.5	1.4	1.2	1.1	0.9	0.7	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
1500	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1250				0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1000									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
750														0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
500																			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
250																								0.0	0.0	0.0	0.0	0

Dark green = very low impact	1.7+
Light green = low impact	0.8 - 1.69
Yellow = medium impact	0.3 - 0.79
Orange = high impact	0.0 - 0.29

For example, using the table above, if a stand has 3500 total stems/ha and a WS density of 950 stems/ha the resulting value from the table about is 1.7. This is determined by looking at the 3500 total stems/ha value on the "Y" axis and looking along the line until it intersects with the 950 WS stems/ha on the "X" axis. It is just into the dark green zone so that would be that stands relative ranking colour.

Visual Quality Resource Value

Background

The Visual Quality assessment is used for evaluating whether forestry operations are meeting established visual quality objectives in designated scenic areas. Effectiveness evaluations are performed in order to determine whether forest practices are meeting desired objectives; and existing policies and guidelines are resulting in desired objectives being met.

Visual Quality assessment includes two phases of evaluation. The first phase is a field visit to the designated scenic viewpoint where basic visual quality class (VQC) is determined. While in the field photographs are taken, as well as cut block design observations for use in the next phase. During the next phase, photographs taken during the field visit are further analyzed to confirm field ratings and to determine the percent alteration for the visual unit. This assessment takes into account the percentage of openings, impacts of roads, amount of tree retention and design. From this, an Adjusted VQC is determined. Final effectiveness evaluation ratings are determined by comparing the basic VQC to the adjusted VQC to produce one of five ratings. For more information on Visual Quality please see the FREP Visual Quality protocol and FREP Extension Note 13.

MRVA Visual Quality Ranking

Table 6 is shows the conversion of the Visual Quality effectiveness evaluation rating to MRVA categories.

Table 6: conversion of the Visual Quality effectiveness evaluation rating to MRVA Resource Development Impact Ratings

Effectiveness Evaluation Rating	Resource Development Impact Rating	Scoring
Well Met	Very Low Impact	VQO achieved, and % alteration low or mid-range
Met	Low Impact	VQO achieved, but % alteration for one or both close to alteration limit
Borderline	Medium Impact	Only one method indicates VQO achieved
Not Met	High Impact	Neither method indicates VQO achievement, but both are close to class boundary
Clearly Not Met	High Impact	Neither method indicates VQO achievement, both are far from class boundary

Soils Resource Value

Background

For the soils value, a process called Expert Elicitation was followed. This approach involved a structured process where cutblock images were displayed through an internet conference (Live Meeting) with a minimum of 3 experts in attendance. Each image was displayed in real time using ER Viewer 7.3 (Eridas Inc., Atlanta, Ga.). This software allows a navigator to zoom and pan the image following a standard approach, but also allows the experts to identify and view specific features of interest on a particular photo. Each expert provided interpretations of soil conservation questions (see table below) for each image, including a decision regarding the overall extent to which the observed results were consistent with soil conservation objectives having been achieved. In addition, participants had the option to provide written comments on all questions and were alert for features that indicated other FRPA resource values could be at risk. To facilitate data analysis, all questions were structured so that an affirmative answer ("Yes") identified a concern for soil conservation. The structured viewing was designed to ensure that a consistent approach was applied to each image, and to address some of the potential drawbacks of expert elicitation described by Meyer and Booker (2001). For each image the following steps were followed:

Step 1: Display an overview of the image, and measure the cutblock dimensions
Step 2: Carry out a close-up scan of all roads and landings
Step 3: View close-up roadside work areas (RWA) and soil disturbance in the net area to be reforested (NAR)
Step 4: View several areas within the NAR for coarse woody debris coverage and the presence of mature trees
Step 5: View close-up of any feature requested by any of the participants
Step 6: Return to overview of the image
Step 7: Fill out the form
Step 8: Discuss our evaluations individually, in rotating order

Soils Expert Elicitation Questionnaire

1. Does the total amount of permanent access seem excessive given the site conditions?
   - 1.1. Are there portions of the un-rehabilitated access that should have been rehabilitated?"
   - 1.2. Do any individual access structures seem larger than necessary?
   - 1.3. Were pre-existing access structures, such as old roads and trails, present in the NAR?
   - 1.4. Were pre-existing structures not used for access where it appears that they should have been?
2. Is there evidence that harvesting, access construction, or maintenance have led to (or increased the potential for) mass movement or erosion?
   - 2.1. Are there any potential or existing off-site effects related to mass movement, erosion or sedimentation evident?
3. Are there areas where measures should have been taken to restore natural drainage patterns, but they were not carried out?
   - 3.1. Are there rehabilitated areas where drainage control was not included in the rehabilitation treatments, but should have been?

4.1. Does there appear to be excessive soil disturbance associated with roadside work areas?
   - 4.11. Were any of the roadside work areas larger (i.e. Wider, or more extensive) than necessary for the harvesting system used?
   - 4.12. Does there appear to be more soil disturbance within the roadside work areas than necessary?

4.2. Does there appear to be excessive dispersed soil disturbance in the NAR outside the roadside work area?
  4.21. Does the area occupied by skid trails and temporary access and/or the associated disturbance appear excessive?
  4.22. Were there features smaller than 0.2 ha, or other areas where soil disturbance appeared to be a concern?
  4.23. Are there disturbance types present that should have been rehabilitated but the rehab treatments were not carried out?
5.1. Does it appear that there are insufficient mature forests to provide inoculum for organisms recolonizing the cutblock?
5.2. Does it appear that measures to conserve coarse dead wood should have been carried out but were neglected or ineffective?
6.1a In your professional opinion, to what extent did the practices on this block maintain soil productivity and hydrologic function?
6.1b Are there issues of concern for other FRPA Resource values?

Details on the Expert Elicitation methodology can be found in FREP Report 31.

MRVA Soils Ranking

Table 7 shows the conversion of the soils effectiveness evaluation rating to MRVA categories.

Table 7: conversion of the soils effectiveness evaluation rating to MRVA Resource Development Impact Ratings

Soils Score	Resource Development Impact Rating	Scoring
Soil conservation objectives achieved	Very Low Impact	2 or more evaluators expressing a low level of concern for all soils indicators on a cutblock
Soil conservation objectives moderately achieved	Low Impact	
Soil conservation objectives not achieved	High Impact	More than two evaluators expressing concern over a specific evaluation question

Wildlife Resource Value

Background

The focus of monitoring for the Wildlife Resource Value is the effectiveness of FRPA mechanisms to conserve wildlife habitat for species at risk and ungulate species including:

- Ungulate winter range; (UWR)
- Wildlife habitat areas; (WHA)
- Objectives for wildlife habitat areas; and
- General wildlife measures.

Although monitoring protocols for many species (10+) are under development, operational monitoring (beyond the pilot stage) has only been initiated for tailed frog WHAs. Results are reported in the Cascades Resource District MRVA report for 2013.

The approach adopted under the Wildlife Resource Value for routinely assessing condition of WHAs uses a multi-metric approach that includes indicators of a species population and its habitats. Habitat indicators represent important physical and biological attributes of a species habitat whereas population indicators monitor whether the biological function (purpose) is being maintained. For tailed frog WHA assessments, habitat and population indicators are largely measured through field measurements on stream segments. Field measurements include stream temperature, substrate particle size, cobble embeddedness, riparian forest, and channel morphology, disturbance and condition. At this time population monitoring is focused on the larval population. This data was used to answer yes or no to nine questions regarding site condition. These questions relate to each of the selected indicators. Best available information (includes both expert judgement and published literature) was used to set values to distinguish between a yes or no response. The intent was to distinguish desirable from undesirable conditions. The number of 'No' responses determines condition which is categorized as a resource development impact rating.

WHA monitoring also includes a separate assessment of pressures, representing risk to sites, because the condition of WHAs are most often influenced by the landscape (watershed) in which they occur and often they are more readily measured than their effects which may not be immediately apparent. For the tailed frog pressure indicators are measured through GIS queries at the watershed scale and are currently reported separately as high, moderate or low risk. Table 8 shows tailed frog resource development impact ratings.

Table 8: MRVA wildlife (tailed frog) ranking

Resource Development Impact Rating	FREP field assessment score
Very Low Impact	0-1 no answers
Low Impact	2-3 no answers
Medium Impact	4 no answers
High Impact	5 or more no answers

Forage

The main sampling criteria for conducting range health assessments are that the land be under Crown Grazing Tenure. District range agrologists carry out the majority of range health assessments as part of their monitoring of range use plan compliance. Tenures to be sampled include those up for licence/permit renewal, those previously identified (formally or informally) as being at risk, tenures where a major change has been implemented or is proposed to be implemented (long period of rest from grazing, construction of range infrastructure such as fencing designed to improve range health). Because livestock grazing is rarely in discrete blocks, but rather spread out in time and space across the landscape, randomly assigning sampling plots across a district's range tenures would not capture much grazing influence. Therefore, each tenure area identified for sampling is stratified by intensity of use into primary, secondary and tertiary range. The focus of range health monitoring is on primary use areas as secondary and tertiary use areas generally have not been impacted by livestock grazing. It is important to keep this in mind when viewing range health assessment data.
The primary use areas are sampled considering 11 to 16 main indicators of range health, depending if it is a wetland, upland or riparian site (for listing of questions see the FREP Forage Protocol).

Table 9 shows the criteria for converting range health ratings to MRVA resource development impact ratings.

Percent of "yes" answers	Range Health Rating	Resource Development Impact Rating
≥80%	Properly Functioning Condition	Very Low Impact
61-79%	Slightly at Risk	Low Impact
41-60%	Moderately at Risk	Medium Impact
20-40%	Highly at Risk	High Impact
<20%	Non-functional	High Impact