

# *Protocol for* Stand-level Retention Monitoring

Steps for field data collection  
and administration

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## Acknowledgements

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## FREP Background

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The *Forest and Range Practices Act* (FRPA) introduces the transition to a results-based forest practices framework in British Columbia. Under this new approach to forest management, the forest industry is responsible for developing results and strategies, or using specified defaults, for the sustainable management of the 11 resource values (subject areas) identified under FRPA. The role of government is to ensure compliance with approved results and strategies, and other practice requirements, and evaluate the effectiveness of forest and range practices in achieving government's objectives for FRPA's resource values.

Resource stewardship monitoring (RSM) is a key component of the provincial Forest and Range Evaluation Program (FREP).

Resource stewardship monitoring will help identify implementation issues regarding forest policies, practices, legislation, and Forest Stewardship Plan results and strategies. As a result, RSM will be a fundamental component for implementing continuous improvement of forest management in British Columbia.

FREP has been established as a multi-agency program to evaluate whether practices under FRPA are meeting not only the intent of current FRPA objectives, but also to determine whether the practices and the legislation are meeting government's broader intent for the sustainable use of resources.

FREP is a long-term commitment designed to:

- assess the effectiveness of FRPA and its regulations in achieving stewardship objectives
- determine if forest and range policies and practices are achieving government's objectives, with a priority on environmental parameters, and consideration for social and economic parameters, where appropriate
- identify issues regarding the implementation of forest policies, practices, and legislation as they affect achieving stewardship objectives
- implement continuous improvement of forest management in British Columbia.

In order to accomplish these objectives, FREP will:

- develop specific monitoring and evaluation questions to be addressed
- document the status and/or trends of resource values over time through the use of detailed protocols
- identify causal factors where the status or trend is found to be undesirable
- determine whether resource values are being managed in a sustainable manner through proven or alternative forest practices
- communicate the results of evaluations
- recommend changes to forest and range policies and legislation, where required.

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## Document Purpose

The purpose of this document is to introduce the Stand-Level Retention (SLR) protocol as an update and replacement to the Stand-Level Biodiversity (SLBD) protocol last updated in 2009. The following document provides background information and instructions for data collection for Stand-Level Retention monitoring under FREP.

## What Has Changed?

Several changes have been made to evaluate stand-level wildlife tree and downed wood retention practices relative to existing guidance and scientific literature. Primary changes include:

- 1) Re-naming the protocol to emphasize evaluation of stand-level retention practices such as wildlife tree retention consistent with the FRPA objective, also recognizing the protocol measures retained forest structure and does not directly measure wildlife habitat and biodiversity,
- 2) Adding GIS-based indicators of landscape context for the stand-level retention practices being evaluated within individual cutblocks,
- 3) Modifying the protocol to include questions that rate retention practices using indicators and targets based on management guidance/ecological benchmarks, consistent with other FREP protocols.
- 4) Provides an overall rating for the cutblock as to how well the retention practices achieve the FREP question, consistent with other FREP protocols.

## What Hasn't Changed?

The field sampling and data collection portion of the protocol hasn't changed from the original protocol to ensure that any new data collected will be compatible with all data collected to date. The FREP data collected under the previous versions of the protocol from 2005-2019 on blocks harvested from 1996-2017 includes over 2800 samples province- wide and provide a rich data set to evaluate practices over time.

Changes to the field portion of the protocol are intended to be minimal, recognizing that existing field work can be time-consuming and to ensure sampling for most cutblocks can still be usually completed in one field day. The only changes involve comparing measured data to benchmarks after field data collection to determine how likely stand-level retention practices are achieving outcomes for biodiversity and wildlife habitat.

## Goal of Stand-level Retention Monitoring

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The goal of stand-level retention monitoring is to determine if the present policy of retaining wildlife tree patches and coarse woody debris is achieving the desired levels and types of structures to maintain species diversity. More specifically, this monitoring protocol is designed to answer the following question:

*“Is stand-level retention providing the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD?”*

## Objectives of the Monitoring Process

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The objectives of the monitoring process are to:

- quantify levels of stand structure attributes by BEC unit
- compare these data with known historical levels to determine what if any structures are lacking or significantly below expected quantities
- place the information into a landscape-level context to determine the significance of results.

## Principles of Site Selection

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A number of statistical design principles were used to develop site selection protocols for RSM. These principles ensure that the data collected and analyzed can be used at multiple scales (district, region, and province) with statistical validity and credibility.

This protocol is for provincial RSM. Districts may choose to sample from an alternate population than described here and apply a different site selection criteria. Please discuss any alternate sampling schemes with the Resource Value Team Leader. Such alternate blocks must be analyzed separately from the standard list, and are considered targeted sampling.

The sampling population is the entire population of potential sites that could be sampled for a given resource value. To ensure the results are objective and defensible, all sites sampled under RSM will be selected using random sampling.

The number of sites sampled may vary depending on available resources (largely staff time and access dollars). Very large, very steep or rough terrain, or very diverse blocks will take longer to sample. Problems in accessing sites will likely mean more expensive travel options. For each sample season, districts will set their own goal for sampling. This is expected to be about 6 SLBD blocks. “Big Blocks”, greater than 100 ha, can count for more than one sample.

For additional information on the site selection process, refer to [Protocol for 2006 Resource Stewardship Monitoring](http://www.for.gov.bc.ca/hfp/frep/7_rsm.html) at [http://www.for.gov.bc.ca/hfp/frep/7\\_rsm.html](http://www.for.gov.bc.ca/hfp/frep/7_rsm.html).

## Site Selection Criteria for Stand-level Retention

For stand-level retention, each participating district is provided with a random list of 200 sites generated from the population of cutblocks that meet the selection criteria in Forest Tenure Administration (FTA). The list is housed in the FREP Information Management System (FREP IMS) located on the [BC Forest Service Intranet](#).

From the list of 200 sites, each district will begin at the top of the list and select up to 15 sample sites, working down in sequential order. Site selection criteria include:

- a defined timeframe with an earliest and latest harvest completion date (see IMS Admin/Generate Master List tab on the toolbar for timeframe related to a specific year)
- cutblocks greater than 2.0 ha in size.

If a district completes sampling of their sites and wants to sample additional blocks, the next sites should continue to be selected sequentially from the random list.

Sites should only be removed from the list for very specific reasons, which must be recorded within IMS (see District Random List tab). If a site clearly does not belong to the population, it can be deleted. Do not sample blocks that show up on the list but were sampled in previous years. Questions regarding whether a site is in or out of the defined population should be referred to the Resource Value Team (RVT). For example, a site may be deleted from the population if active nearby harvesting or other activities in the block make it too dangerous to sample.

Allocate sufficient time to sample all blocks chosen to do in the year. These blocks may be sampled in any order. However, be careful not to miss blocks. Blocks must be sampled even if there are no wildlife tree patches noted on the site plan. Often, there is retention that is not noted on the SP and, even if that is not the case, zero retention is part of the population. Blocks must also be sampled even if there are no streams on the block.

## Introduction

### Management Context

British Columbia's approach to biodiversity and wildlife habitat conservation is rooted within concepts originally outlined in the Biodiversity Guidebook and associated guidebooks (Riparian Management Guidebook and Managing Identified Wildlife Guidebook). These guidebooks outline a coarse-fine filter management approach where coarse-filter strategies are expected to provide for the habitat requirements of most species, while fine-filter strategies are required to manage for species requiring specific habitat attributes. The coarse-fine filter approach includes various strategies to conserve biodiversity from the establishment of spatial reserves such as Parks and Protected areas that protect habitats, seral targets for the amount of young, mature and old forests at the landscape level over time, to site-level targets for wildlife tree and coarse woody debris retention. The coarse-fine filter approach is applied at scales ranging from a sub-region (Natural Resource District

or Timber Supply Area) to the site-level.

The underlying premise of the coarse-fine filter approach is to maintain habitat diversity, and that all native species and ecosystem processes are more likely to be maintained if managed forests resemble the patterns left following natural disturbances. Generally, if the full range of habitats are maintained the assumption is that native species diversity and genetic diversity will be maintained. Thus, habitat diversity is a surrogate for species and genetic diversity.

These concepts formed the basis for legal requirements for wildlife tree retention in the *Forest Practice Code of BC Act* (FPC) introduced in 1992, and later carried forward under the *Forest and Range Practices Act* (FRPA) that replaced the FPC in 2004. Stand-level retention of wildlife trees, wildlife tree retention areas, riparian reserves and coarse woody debris (CWD) are considered part of the coarse-filter approach, and so legal planning and practice requirements are outlined in the *Forest Planning and Practices Regulation* (FPPR). Managing for biodiversity and wildlife habitat at the stand-level is recognized as one of the 11 FRPA values where objectives are specified in the FPPR. Specifically, *FPPR* Section 9.1 states:

“the objective set by government for wildlife and biodiversity at the stand level is, without unduly reducing the supply of timber from British Columbia's forests, to retain wildlife trees.

To be consistent with the FRPA objective, forest licensees specify results and strategies for wildlife tree retention and CWD at the cutblock level in Forest Stewardship Plans (FSPs). Minimum default legal requirements are stated under Section 66 (Wildlife Tree Retention) and Section 68 (Coarse Woody Debris) of the FPPR. While these legal targets provide a minimum requirement at the cutblock level, forest professionals have the flexibility to increase stand-level retention depending on both site-specific factors (e.g. riparian areas or specific wildlife habitat features) that may require protection, and landscape-level context (i.e. the extent of both the area of timber harvesting land-base and area disturbed). Various guidance is available to support stand-level retention decisions for wildlife tree retention<sup>1</sup> and CWD management practices to help maintain biodiversity and wildlife habitat. Additional guidance also provides direction for stand-level retention in the context of large-scale salvage operations in response to extensive natural disturbance events such as insect outbreaks<sup>2</sup> or wildfire.

When considering stand-level retention it is important to recognize that forest harvesting creates different amounts and patterns of residual forest structure than what remains following a natural disturbance event such as wildfire, windthrow, or insect attack. However, by following existing guidance on wildlife trees and CWD retention at the time of harvest, forest practices can help to emulate the patterns, types, and in some cases the amount of residual forest structure that may remain after natural disturbances. Whether left by natural disturbance or harvesting, post-disturbance residual forest structure provides ‘ecosystem memory’<sup>3</sup> allowing forest ecosystems to recover and re-organize following disturbance. Residual forest structure also maintains key ecosystem functions into the regenerating post-

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<sup>1</sup> <https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/conservation-habitat-management/wildlife-conservation/wildlife-tree-committee/wt-guidance-05-2006.pdf>

<sup>2</sup> <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/sustainable-forest-management-practices>

<sup>3</sup> Ecosystem memory is defined as the adaptations, individuals, and materials that persist after a disturbance and shape responses to future disturbances. (Johnstone et al. 2016. Changing disturbance regimes, ecological memory and forest resilience. *Frontiers in Ecology and Environment* 14(7))

harvest forest, including (after Franklin et al. 1997, Rosenvald and Lohmus, 2008):

1. Life-boating of species and processes over the regenerating phase,
2. Enriching re-established forest stands with structural features, and
3. enhancing landscape connectivity.

By retaining residual forest structure, forest harvesting can be compatible with objectives for maintaining wildlife habitat and biodiversity conservation, so long as other appropriate stand and landscape-level management practices are also applied.

Stand-level retention alone cannot meet the needs of all species as the habitat needs of wildlife vary considerably. Some wildlife species are 'open-habitat' specialists that benefit from condition created from recently disturbed forests or non-forest conditions; others are 'generalist' species that make use of a wide range of habitat conditions. While others are considered 'forest specialist' species that primarily rely on forest conditions and that have specific life requisites associated with forested habitats. As a result, there is no one amount of stand-level tree retention that is optimal or best for wildlife habitat or biodiversity, and none that will meet the needs of all species. In general, 'open-habitat' and 'generalist' species will benefit from conditions created by more severe natural disturbances or forest harvesting, while 'forest' species may decline with loss of forest conditions.

Biodiversity and wildlife habitat conservation in managed landscapes where forest harvesting occurs is most concerned with maintaining habitats for 'forest' species since the habitat requirements for open-habitat and generalist species will largely be met by conditions created by harvested openings. Wildlife tree retention can mitigate some of the effects of forest harvesting on forest species and has been shown

to increase both the richness and abundance of forest species compared to clearcuts (Figure 1; Fedrowitz et al., 2014). Some forest species taxonomic groups, particularly lichens, bryophytes, and forest birds showed greater abundance in retention cuts compared to clearcuts (Huggard 2007, Fedrowitz et al. 2014). Mammal response to retention cuts measured 15-18 years post-harvest can vary where early seral or open-habitat' species generally declined or showed no response to retention (Franklin et al. 2019). Some generalist and late-seral forest specialists used forests with increased retention levels, while one forest species of conservation concern (Woodland caribou) only used retention cuts at levels greater than 20% retention (Franklin et al. 2019).

June, 2022

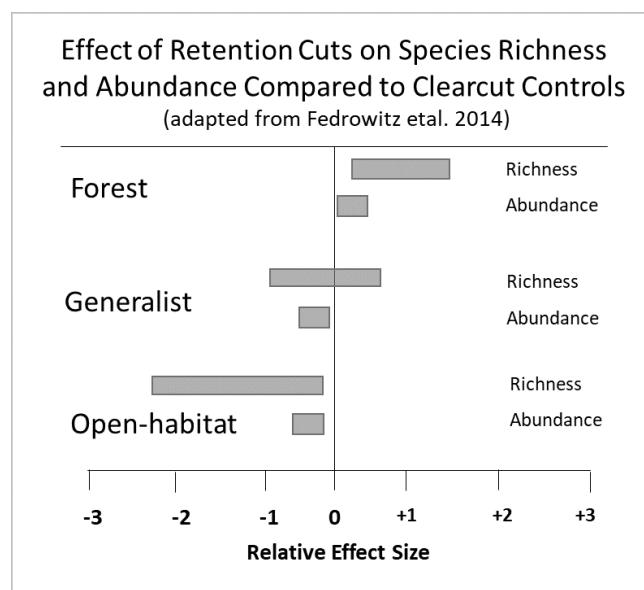


**Figure 1.** A comparison of the relative effects on forest, generalist, and open-habitat species richness and abundance in retention cuts compared to clearcuts. A relative effect size = 0 means no difference, whereas positive and negative effect sizes relate to increased or decreased richness or abundance compared to clearcuts. Bars represent the range of effects measured across multiple studies analyzed.

This protocol focuses on evaluating tree retention practices (amount, spatial pattern, type) recognized as necessary to maintain key ecosystem functions (habitat refugia, structural enrichment and landscape connectivity for a limited subset of forest species<sup>4</sup>. Some forest species will require higher levels of retention or retention of specific habitat attributes to support continued use. Stand-level retention alone cannot offset loss of mature and old forest habitats at a landscape scale and managing for most wildlife species and conserving biodiversity requires both stand and landscape-level management of habitats.

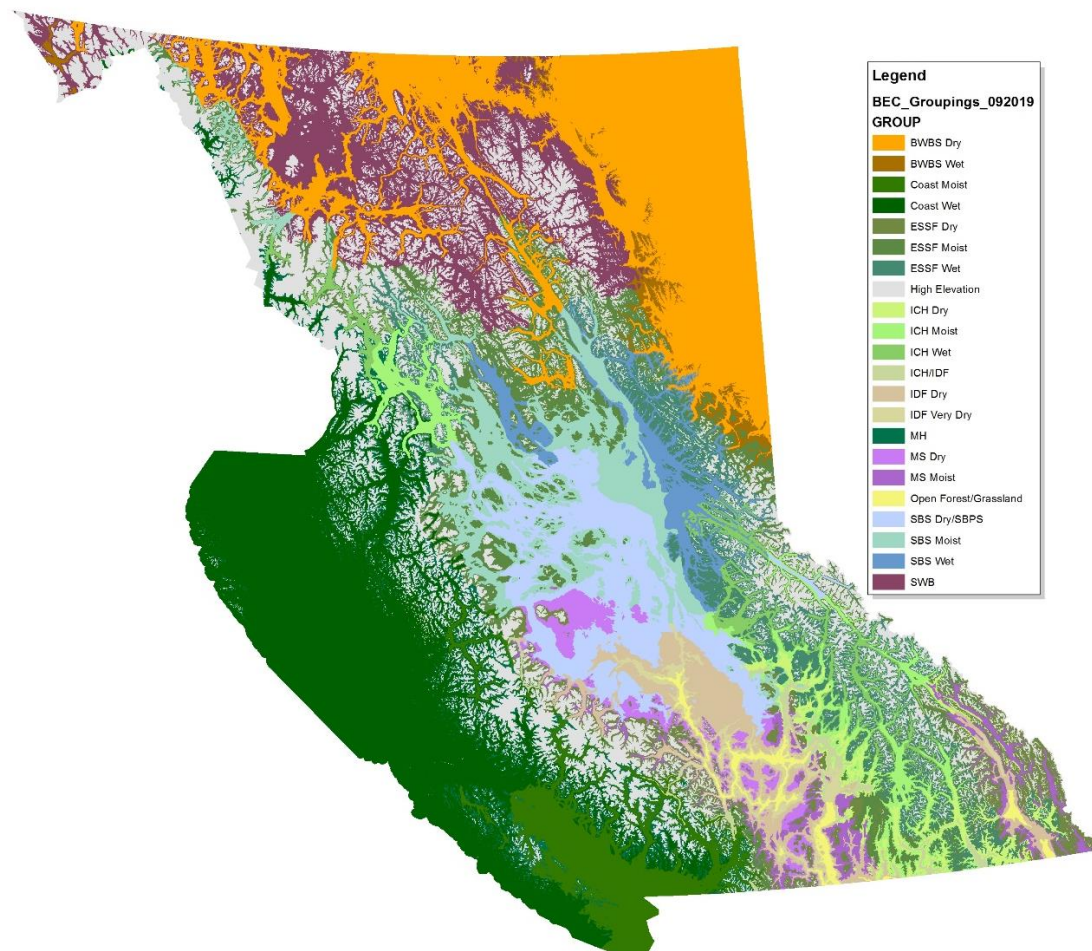
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<sup>4</sup> Currently this subset has not been defined.

## Ecosystem Context

British Columbia has a wide range of forested ecosystems that provide diverse habitat conditions for different species. Forest structural conditions including tree species composition, tree size and the amount of important habitat structures (large live trees, snags and downed wood) varies considerably between these ecosystems due to factors such as ecosystem productivity and natural disturbance type, extent and severity. When evaluating against guidance targets using the protocol, benchmark conditions for landscape context indicators take into consideration different ecosystems and natural disturbance types (NDTs) in the province. Benchmarks used in the protocol for stand-level attributes are based on existing plot and transect data summarized for distinct groupings of Biogeoclimatic subzone variants Biogeoclimatic Groups; Fig. 2 and Appendix 1))<sup>5</sup>

**Figure 2.** An illustration of Biogeoclimatic groupings (BGC Groups) upon which benchmark levels for pre-harvest structural conditions are summarized.



<sup>5</sup> Data was summarized using various data sources and relies heavily on cruise plot data to represent likely pre-harvest stand conditions. Data summary by Dave Huggard (2020).

## How are Stand-level Retention Practices Evaluated?

Stand-level retention practices are evaluated using 8 questions, organized into 3 categories (Table 2). Each question asks evaluators about key characteristics of stand-level retention that are known to be important to maintaining wildlife habitat and conserving biodiversity in managed forests.

**Table 2:** Main Questions to Assess Post-Harvest Stand-Level Retention.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Category: Landscape Context</b></p> <p><b>Question #1 – Tree Retention Amount</b> - is the amount of stand-level retention adequate considering the landscape context?</p> <p><b>Question #2 - Patch Size</b> – Is the amount of stand-level retention in the cutblock adequate considering the size of the associated patch?</p> <p><b>Question #3 – Landscape Connectivity</b> – Is the amount and spatial location of stand-level retention adequate to help maintain landscape-level connectivity?</p> <p><b>Question #4 - Micro-Environment</b> - Does Wildlife Tree Retention and block shape contribute to a range of microenvironments and structural complexity within the block?</p> |
| <p><b>Category: Wildlife Tree Retention Practices</b></p> <p><b>Question #5 - Standing Live and Dead Tree Size and Condition</b> – Will standing live and dead wildlife trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?</p> <p><b>Question #6 –Wildlife Tree Retention Practices</b> - Do stand-level retention practices retain wildlife trees and conserve important habitat features by minimizing windthrow?</p>                                                                                                                                                                                                                      |
| <p><b>Category: Coarse Woody Debris Retention Practices</b></p> <p><b>Question #7 – Amount and Spatial Dispersion of Downed Wood</b> – Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?</p> <p><b>Question #8 - Downed Wood Size and Condition</b> – Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?</p>                                                                                                                                                                                                               |

Each main question contains one or more indicator sub-questions that are used to provide additional information related to answer the main question. Indicator sub-questions require evaluators to compare data collected in the protocol to measurable targets based in existing management guidance or ecological benchmarks to answer the question. The collected data is summarized either to the strata or block level and is compared to the target specified in the protocol. Guidance targets vary based on Landscape Context, NDT or BGC Group. Depending on how closely the measured data aligns to the specified target, the outcome is assigned to one of four categories:

- *Exceeding* – retention levels exceed minimum guidance targets
- *Meeting* – retention levels meet minimum guidance targets
- *Below* - retention levels are below minimum guidance targets
- *Well Below* – retention levels are well below minimum guidance targets

Retention levels that meet or exceed guidance targets are generally considered to be beneficial to biodiversity and wildlife habitat conservation, while retention levels below or well below targets less so. However, we recognize there is uncertainty and challenges in applying generalized guidance targets to answering these types of questions.

Guidance targets are estimates based on best available information and are applied across simplified categories of landscape context, ecosystems and natural disturbance types. In real-world situations these targets may not always account for all the possible stand and landscape conditions that may be encountered and that may influence stand-level retention practices, including:

- The type and amount of structural attributes available within the stand considering stand history, affected by factors such as;
  - Previous harvest entries (harvesting in 2<sup>nd</sup> growth stands or harvest re-entries into partially harvested stands)
  - Natural disturbances such as insects, wildfire or windthrow
- The type and amount of, or lack of, harvest constraints (riparian, wildlife habitat) and ‘ecological anchors’ (important wildlife trees, nesting or denning trees) available within the stand that provide opportunities to locate retention within or adjacent to the stand, and
- Legal objectives or management goals expressed in site plans may alter retention levels compared to benchmarks levels.

To account for these types of situations, the protocol includes some built-in flexibility in two ways:

- 1) The breakpoints between the categories *Exceeding*, *Meeting*, *Below* and *Well Below* purposefully span a range to acknowledge the potential for measurement error or circumstances where retention levels are close to guidance targets – achieving the intent.
- 2) Evaluators can over-ride some analysis results to modify the outcomes to best suit on-the-ground conditions and provide a rationale that explains why they chose to do so.

## Concluding on Stand-level Retention Practices

As noted earlier, the response of elements of biodiversity and wildlife to stand-level retention is not directly measured by the protocol, so the effectiveness of retention practices at conserving biodiversity and wildlife habitat can only be inferred from existing management guidance and research information. In the protocol, we use the term *Likely* as a qualitative statement about how probable stand-level retention practices will conserve biodiversity and wildlife habitat given how well retention practices follow existing guidance. Likelihood is a qualitative approach of estimating probability and incorporates uncertainty in our understanding. These statements refer directly back to the FREP question.

Table 3. Ratings used to describe how likely stand-level retention practices relate to the FREP question

| Likelihood rating | Estimated probability of Occurrence | Description                                                                                                                                                                                         |
|-------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Very Likely-      | >90%                                | <i>Very Likely</i> that stand-level retention provides the range of habitats with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD |
| Likely            | >66%                                | <i>Likely</i> that stand-level retention <i>provides the range of habitats...</i>                                                                                                                   |
| Somewhat Likely   | 33-66%                              | <i>Somewhat Likely</i> that stand-level retention <i>provides the range of habitats...</i>                                                                                                          |
| Unlikely          | <33%                                | <i>UnLikely</i> that stand-level retention provides the range of habitats...                                                                                                                        |
| Very Unlikely     | <10%                                | <i>Very Unlikely</i> that stand-level retention provides the range of habitats ...                                                                                                                  |

Using these ratings, the outcome of the protocol is an estimate of how likely stand-level retention practices maintain biodiversity and wildlife habitat based on the outcomes of the 8 questions. Based on how close the evaluated cutblock is to guidance targets, each question is scored from 1 to 4 where: *Exceeding*= 4, *Meeting* = 3, *Below* = 2, and *Well Below* =1. The cumulative score determines the rating. To be rated as *Likely* or *Very Likely* that the evaluated cutblock provides the range of habitats with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD, the cutblock must be *Meeting* or *Exceeding* targets in at least half of questions, achieving a minimum combined score of >20. Cutblocks that are *Below* or *Well Below* guidance targets of most of the questions will score lower and are considered *Unlikely* or *Very Unlikely* to maintain the range of habitat attributes.

**Note:** not all sampled cutblocks will have wildlife trees directly associated with the cutblock. Legal wildlife tree retention targets can be achieved at the cutting permit scale. As a result, not all sampled cutblocks will include a wildlife tree patch strata, or dispersed wildlife tree strata.

In circumstances where no wildlife tree retention exists, the cutblock will not be evaluated based on questions that are specific to wildlife tree retention amount (Questions 1 and 2) or question that evaluate wildlife tree retention quality (Question 5) or windthrow (Question 6). In that case, scoring for Questions 3, 4, 7 and 8 are averaged and used to calculate a final likelihood rating where <1.625 = *Very Unlikely*, <2.25 = *Unlikely*, <2.875 = *Somewhat Likely*, <3.375 = *Likely* and >3.375= *Very Likely*).

**Table 3.** Rating and scores for determining the likelihood that stand-level retention practices achieve the FREP question

| Rating          | Score<br>(Out of 32) | Relationship to Evaluation Questions                                         |
|-----------------|----------------------|------------------------------------------------------------------------------|
| Very Likely     | >26                  | Meeting or Exceeding retention guidance benchmarks for most or all questions |
| Likely          | 22-26                | Meeting or Exceeding retention guidance benchmarks for most questions        |
| Somewhat Likely | 18-21                | Meeting or Exceeding retention guidance on about half of the questions       |
| Unlikely        | 13-17                | Below or Well Below retention guidance benchmarks for most questions         |
| Very Unlikely   | <13                  | Below or Well Below retention guidance on most to all questions.             |

## How to Evaluate Stand-level Practices

Evaluating stand-level retention practices using this protocol is broken down into two key parts:

- 1) Evaluating Landscape Context – This portion is an office-based exercise where evaluators review a set of GIS-based indicators provided for each random cutblock sample. This portion of the evaluation is used to answer Questions #1-4 of the protocol. The landscape context information can be accessed at any time, but preferably the information should be compiled and verified prior to going in the field as part of the office-review when reviewing the cutblock site plan and establishing the field sampling plan. This ensures evaluators have a good understanding of the block and can verify any information when in the field. Landscape context indicators can also be verified after field sampling.
- 2) Field sampling – the field portion of the evaluation is where evaluators establish plots and transects on the ground to record wildlife trees and CWD in randomly sampled cutblocks. Ground plots and transects are stratified to sample in both the reserved wildlife tree patches (WTPs) and in the harvested, or net are to be reforested (NAR), portion of the cutblock. This portion of the evaluation is used to answer Questions #5-8 of the protocol.

Once the field data is submitted to FREP IMS, the collected data is compiled and summarized and compared to pre-defined benchmarks for stand-level attributes summarized by different forest types in the province. The landscape context information will be combined with the results of the field sampling to answer all 8 questions in the protocol and assign the overall block rating as described in the previous sections.

### Landscape Context

Landscape context refers to the condition of the forested land-base surrounding a cutblock being evaluated. The Landscape Unit (LU) and Biogeoclimatic subzone (BEC Unit) combination in which the cutblock being evaluated falls is used to define the landscape. Landscape context is important and determines what is necessary and appropriate for stand-level retention (Beese et al. 2019). When considering landscape context in the evaluation of stand-level retention practices, three main factors are important:

- 1) The area of the operable land-base or timber harvesting land-base (THLB). A land-base that has more area available (either has been or can be harvested) is more sensitive to loss of important habitat attributes due to harvest practices. Landscapes with high levels of reserves or non-operable forest will generally have habitat attributes available, and so within-stand retention becomes less critical.

- 2) The amount of area disturbed through forest harvesting, wildfire and insect attack. Landscapes with low levels of disturbance will generally have available wildlife habitats. Highly disturbed landscapes, particularly where extensive and severe natural disturbances and forest harvesting have occurred in quick succession, will require more stand-level retention to ensure sufficient habitat is available.
- 3) Natural Disturbance Type (NDT). A characterization of the frequency and severity of natural disturbances in a forested ecosystem. Biogeoclimatic subzones in BC are classified into one of five NDTs. Forest ecosystems with fewer stand-initiating disturbance events and more frequent, smaller and less severe disturbances (e.g. gap phase dynamics), will require more stand-level retention to resemble natural disturbance patterns.

Landscape context affects the potential for forest harvesting to negatively impact wildlife habitat and biodiversity, and so the landscape Context Rating reflects the level of concern that forest harvesting can negatively affect biodiversity and wildlife habitat will change accordingly (Table 4). In general, the level of concern increases as both the amount of operable timber harvesting land-base and level of forest disturbance that converts forests to early seral habitats (<40 years old) also increase.

**Table 4.** The Landscape Context rating describes the level of concern for maintaining wildlife habitat and biodiversity

|                          | % Forest Disturbance (<40 years old) |          |          |          |           |           |
|--------------------------|--------------------------------------|----------|----------|----------|-----------|-----------|
|                          |                                      | <20      | 20-40    | 40-60    | 60-80     | >80       |
| % THLB in LU/BGC Subzone | <20                                  | Very Low | Very Low | Very Low | Low       | Low       |
|                          | 20-40                                | Very Low | Very Low | Low      | Low       | Moderate  |
|                          | 40-60                                | Low      | Low      | Moderate | Moderate  | High      |
|                          | 60-80                                | Low      | Moderate | Moderate | High      | Very High |
|                          | >80                                  | Moderate | Moderate | High     | Very High | Very High |

In landscapes with higher levels of concern, existing management guidance recommends modifying forest harvesting practices to minimize impacts<sup>6</sup> such as modifying cutblock shape, and the amount and location of stand-level wildlife tree retention within the cutblock. Questions #1-4 of the protocol evaluate how well stand-level retention practices, which relate to the amount and configuration of retention within the block as well as block shape, consider the landscape context.

**Question #1** – retention amount- evaluates the total amount of retention in the cutblock relative to the amount of timber harvesting land-base (THLB) and existing disturbance

<sup>6</sup> Note: some landscapes may have objectives that prioritize timber harvesting over wildlife habitat and biodiversity considerations, and so the generalized matrix of management concern shown here may not always reflect management direction.

**Question #2 – Patch Size** – evaluates the total amount of retention within the cutblock relative to the size of the ‘patch’ or ‘functional opening’ created by the cutblock and adjacent cutblocks harvested within a 30-year period.

**Question #3- Landscape Connectivity-** evaluates the maximum distance across the block between forest cover within and adjacent to the block

**Question #4- Microenvironment** – evaluates the percent gross cutblock area that is covered by forest or within 1 tree length of forest

For cutblocks harvested between 2015-2020 currently being evaluated under this protocol, landscape condition up to 2015 is used as an estimate of the adjacent forest and landscape condition that planning foresters would have need to consider prior to harvesting.

Landscape context summary information is analyzed and provided annually and for each random block on the District Random List. This is done to ensure consistency in analysis methodology across the province and provides efficiencies for district staff or others competing stand-level retention evaluations.

## Landscape Context Indicators

The following are a subset of outputs and indicators that provide the key indicators used to evaluate landscape context. All information is summarized to the Landscape Unit and Biogeoclimatic Subzone variant (LU/BEC) combination that the cutblock falls within. The indicators include:

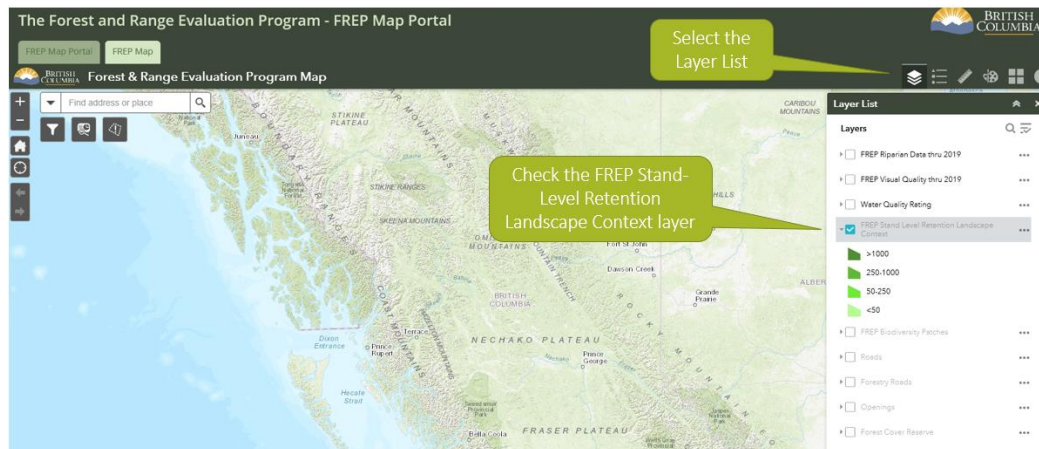
- BGC Group (Biogeoclimatic Group) – groupings of Biogeoclimatic subzone variants that represent similar climatic and natural disturbance conditions)
- Natural Disturbance Type (NDT)
- Percent (%) Timber Harvesting land-base (% of total forest area)
- Percent (%) area harvest (% of forest area harvested <40 years old)
- Percent % burn (% of forest area in Moderate-High burn severity class due to wildfires- areas harvested pre or post wildfire are counted as harvested)
- Percent (%) insect (% of forest area in cumulatively affected by insect to 2015 – includes Medium to High Severity insect attack mountain pine beetle (IBM), spruce beetle (IBS)
- Percent (%) total disturbance (% of forest area cumulatively affected by forest harvest, wildfire and insect attack- areas affected by more than one disturbance are counted once where harvest>wildfire>insect)
- Percent (%) Forest Influence - Percent of the Gross area of the cutblock that is covered by a wildlife tree retention area (WTRA) and/or within 25m of within stand retention or adjacent forest (>40 years old)
- Maximum distance (metres)- maximum distance across the cutblock
- Patch Size - the size in hectares of the 'patch' to which the opening is associated.
- Patch Class - the size class (<50, 50-250, 250-1000, 1000+) to which the opening is associated.

Resource District Landscape Context Data summary tables are generated for all random cutblocks in each district. The results are provided in an Excel spreadsheet available on the FREP Sharepoint Site. To access the Tables, navigate to the ‘Stand-Level Biodiversity folder’ on the FREP Sharepoint site, then open the District Landscape Context Summary Table folder.

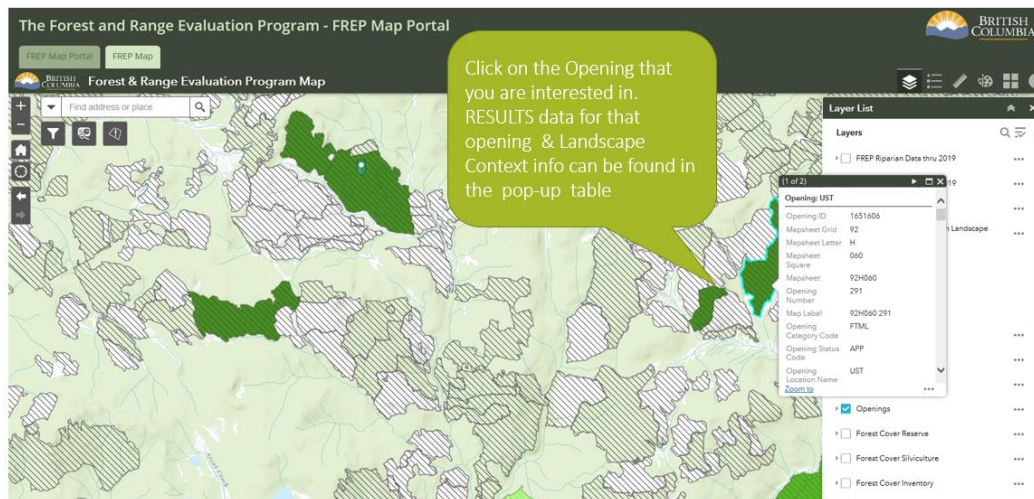
## Navigate to Stand-Level Biodiversity

In addition, the landscape context information can be viewed spatially on FREP Map. To access this information in FREP Map, follow these steps:

- 1) Open FREP Map, select the layer List and check the FREP Stand-Level Retention Landscape Context layer to ensure you can access the Stand-Level Retention information for the



- 2) On the map, zoom into the cutblock of interest. Place your cursor on the cutblock and right-click the mouse and RESULTS data and Landscape Context will show up on the pop-up table. Scroll down through the pop-up table to find the landscape context indicator data toward the bottom of the table.



## Verifying Landscape Context Information

The landscape context information in the District Landscape Context Summary Tables is derived by completing a province wide analysis using available provincial datasets. The analysis is generally accurate, but data inaccuracies or analysis issues can sometimes cause incorrect results.

The accuracy of the GIS analysis should be verified prior to use to ensure it accurately reflects the broader landscape condition, and forest condition immediately adjacent to the cutblock which affect patch size, forest influence and maximum distance.

The Section titled “Answering the Routine Evaluation Questions” on Pages xx-xx of this protocol provides further information on the indicators used to evaluate stand-level practices relative to landscape context. That section also provides detailed steps and considerations to verify and, if necessary, override the landscape context results.

## Over-riding GIS-based Landscape Context Results

Evaluators can override the GIS indicators if the results of the GIS analysis don’t accurately reflect conditions on the ground around the time the cutblock was planned and harvested. To do this, the evaluator should identify specific indicators associated with each question. Other sources of information can also be used to estimate conditions that better reflect actual conditions.

The Landscape Context Summary tables provides additional columns at the end of the table to incorporate. These columns are labelled “Q1\_Override”, “Q2\_Override”, “Q3\_Override”, “Q4\_Override” and “Comments”. When verifying the landscape context indicators and ratings, if an evaluator has evidence that a different rating is appropriate for that question, the evaluator can override the rating and assign an appropriate rating in the column associated with that question. If an override is used, that rating will replace the rating in the associated column. Evaluators also need to provide a rationale in the “Comments” column describing why the change was made.

## Recording the Landscape Context Information

The landscape context information is compiled separately from the field sampling data that is recorded in FREP IMS. Once the field sampling data has been recorded in FREP IMS, the Stand-level Retention value lead will summarize the field sampling data and assign ratings based on the benchmarks described for Questions #5-8 later in this protocol. As a final step, the summarized data and ratings for all questions will be joined for each sampled cutblock and made available with the final rating for each cutblock. District staff involved in the sampling will have an opportunity to review the outcomes of the combined GIS landscape context and field sampling ratings

To record the landscape context data for the cutblocks from the Random list that have been sampled follow these steps:

1. Create a new excel spreadsheet – a blank template with the field headings can be found on the FREP Sharepoint site labelled “landscape context

template.xlsx”

2. Save the excel file to the same folder in the Sharepoint site, but save the file under a new name that shows it contains sample data and the district name. For example, landscape context information for sampled cutblocks in the Okanagan Shuswap Resource District can be named “DOS\_Landscape\_context\_Samples.xlsx”
3. For each random cutblock that has been sampled, copy the landscape context information from the original District Landscape Context Summary Table into the new excel spreadsheet. Copy over information for those cutblocks that have or will be sampled. This will result in a spreadsheet that is identical to the original District Landscape Context Summary Table but only includes the random cutblocks that were sampled for that year.

## Field Sampling

### Indicators

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The indicators used to assess stand-level retention include:

- tree species and size (height and diameter)
- WT classes 1 and 2 (live trees), and 3+ (standing dead trees)
- invasive plants
- amount and type (size, species and decay class) of coarse woody debris (CWD)
- amount of windthrow
- harvesting constraints and ecological attributes used to anchor retention.

### Getting Started: Required Equipment and Information

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Both office and field procedures are provided in this document. What follows are the required plans, maps, and equipment that will be used to collect the information in an effective and efficient fashion.

For each randomly selected block, you will require:

- a site plan map, or post-harvest map of the site showing retention areas, standard units (SUs), and BEC information. The map should be of suitable quality to be used in the field.
- a site plan (optional).
- air photos/orthophoto (optional).

For field sampling, you will need:

- prisms appropriate for local conditions – suggested range of prisms 4 BAF to 10 BAF (Interior) or 20 BAF (Coast) (to bring in, on average for a stratum, about 6 trees in a sweep)

Note: Use only one prism BAF per reserve stratum (e.g., BAF 6).

- compass
- diameter tape
- diameter stick (optional) – with centimetres marked off
- 30-m tape
- clinometer
- calculator
- laser range finder (optional – but highly recommended) or instrument such as the Vertex
- flagging tape and marking pen
- tree marking spray paint for marking trees and CWD
- GPS
- increment borer (optional)

- binoculars (optional but highly recommended)
- camera
- clipboard or field binder to hold field forms
- field forms (FS 1244-A1, A2, B1, B2, C1, C2, D1, D2) and a copy of this protocol.

## General Office Procedures

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1. Select cutblocks sequentially from the random list provided.
2. For each cutblock, collect the post-harvest map and access information, and if available, the orthophotos, aerial photos, and site plan.
3. Identify the patch retention strata and determine if the harvest area requires stratification. Remember that EACH retention patch is a separate stratum.
4. Prior to heading into the field, randomly choose plot locations and mark them on the map. A suggested low-tech technique is to place an appropriate scale dot grid over the site map.
  - a. Patch: Randomly pick one plot per hectare of reserve patch and mark the plot location(s). Record the distance and bearing from an obvious feature (e.g., SW corner of the group, or where a particular creek enters the block) to be used to locate the plots in the field.
  - b. Harvest area: Randomly locate three plots in the harvest area (may be dispersed retention or clearcut). Harvest area plots are established to assess dispersed retention and coarse woody debris. If the harvest area has clearcut and areas having different levels of dispersed retention, try to randomly divide these 3 harvest area plots amongst the treatments. Very large cutblocks (>100 harvest area) will require more harvest area plots (e.g., 5 plots per 100 ha), as described in Appendix 1. If possible increase the number of plots in harvest areas with high levels of dispersed retention to allow for better estimates of the tree indicators.
5. Fill in the opening identification section of Form C (Section 11) and the header information for the anticipated number of plot cards (Form A) and stratum summary cards (Form B) as necessary for the particular block. Number all plots consecutively, regardless of stratum, starting with 1 for each new block. The important thing is not to duplicate plot numbers in a cutblock.
6. Fill in a Stratum Summary card (Form B – or Section 16 on Form C) for each stratum even if there is no intent of establishing a plot in the field. This will ensure basic information, such as reserve size and type, will be included in the analysis for every reserve and allows for the correct calculation of percent area retention.

## Definition of the Term Stratum/Strata (pl)

Stratum: *One of a number of layers, levels, or divisions in an organized system*  
(Source: [www.dictionary.com](http://www.dictionary.com))

In order to facilitate efficient sampling of the cutblock, it will need to be divided into a number of strata. The strata will include each of the reserves and the harvest area. Example 1 shows that a 32-ha cutblock with two 1-ha wildlife tree (WT) patches and one riparian reserve area would have four strata. Each reserve area and the harvest area (no retention) would be considered individual strata.

### Example 1. Potential stratum ID and type - 32 hectare cutblock

| Description                  | Stratum ID | Stratum type | Plot type   |
|------------------------------|------------|--------------|-------------|
| Edge patch                   | WTP1       | PW           | BAF 6       |
| Internal patch               | WTP2       | PW           | BAF 6       |
| 20-m reserve along S3 stream | WTP3       | PR           | 10-m radius |
| Negligible retention         | NAR        | CC           | 30-m radius |

Example 2 shows that a 70-ha cutblock with two 4-ha wildlife tree (WT) patches, 10 ha of uniform dispersed retention (approximately 10 stems per ha), and another 15 ha of dispersed retention at 75 stems per ha can be stratified into five sample strata: two strata in the WT patches, two strata in each of the different dispersed retention areas and one in the clearcut. Stratification of the net area to be reforested (NAR) (i.e., the harvest area) allows for a different plot type (e.g., BAF, fixed-area radius or fixed area) to be used between the strata in order to get a “reasonable” number of sample trees. Plot type (e.g., same BAF or fixed-area radius) *must* be consistent within a single stratum. Ideally, these strata would be designed prior to going into the field, which may be possible if good post-harvest aerial photography is available. If this is not possible, the assessors may have to define the area in the field, being careful to clearly mark the stratum on the map (Figure 1) and include the stratum area on the Stratum Summary card (Form B).

### Example 2. Potential stratum ID and type - 70 hectare cutblock

| Description                           | Stratum ID | Stratum type | Plot type   |
|---------------------------------------|------------|--------------|-------------|
| Edge patch – rocky outcrop, few trees | WTP1       | PW           | BAF 4       |
| Internal patch                        | WTP2       | PW           | BAF 8       |
| Heavy retention                       | NAR1       | DW           | BAF 4       |
| Sparse seed tree                      | NAR2       | DW           | Full count  |
| Clearcut                              | NAR3       | CC           | 30-m radius |

| Standard Unit Treatment Summary |     |      |       |
|---------------------------------|-----|------|-------|
|                                 | SU1 | SU2  | Total |
| Reserve                         |     |      | 19.2  |
| NAR*                            | 45  | 11.2 | 56.2  |
| Gross                           |     |      | 75.4  |
| External reserve                |     |      | 5.0   |
| Override (adjusted gross)       |     |      | 80.4  |

\* NAR refers to Net Area to be Reforested

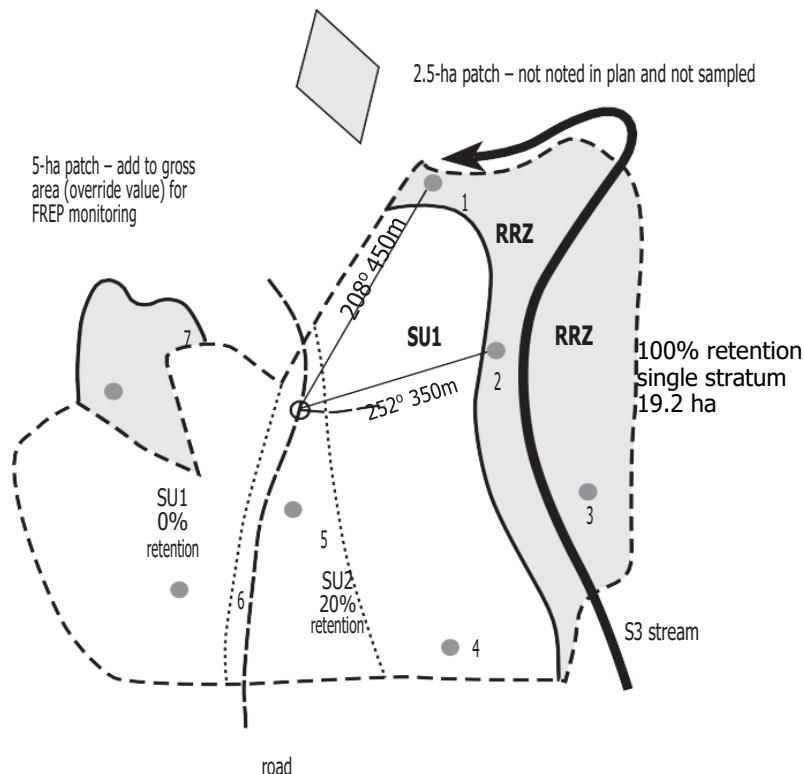


Figure 3. Example map showing strata definition.

### Suggested Number of Plots in Post-harvest Cutblock

The number of plots to establish is based on the retention strategy and the cutblock size. You should establish 1 plot per ha of patch retention, up to a maximum of 5 plots per patch and at least 3 plots within the harvest area.

Time and stand structure variability need to be considered. If the retention is homogeneous, it may be acceptable to reduce the number of plots where time is limited.

If multiple strata are designated in the harvest area to allow for different plot types, it is not necessary to establish three plots in each harvest area strata. However, areas of high density dispersed retention will benefit from additional harvest area plots to better estimate the tree indicators.

The following table outlines the intensity of sampling for six different scenarios that will ensure we meet the objectives of stand-level retention monitoring.

| Description of retention                                                                                                                | # of plots in cutblock                                                                                                                                                                                                           | Discussion                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 60-ha homogenous cutblock. No trees >12.5 cm DBH retained.                                                                              | <ul style="list-style-type: none"> <li>3 randomly located plots in the harvest area.</li> </ul>                                                                                                                                  | Since the harvest area is homogenous, 3 plots should be sufficient. How do you tell if it's homogeneous? A visual overview and knowledge of harvest methods.                                                                                                                                                                                                                  |
| 40-ha cutblock with evenly distributed dispersed retention (approximately 6 trees per ha), no patch retention                           | <ul style="list-style-type: none"> <li>3 randomly located fixed-area plots in the dispersed area.</li> </ul>                                                                                                                     | Full count would take too much time for limited benefit. Three fixed-area plots should adequately characterize relatively uniform retention.                                                                                                                                                                                                                                  |
| 60-ha mixed-wood cutblock with variable density dispersed retention and no patch retention. No easily defined strata.                   | <ul style="list-style-type: none"> <li>3 randomly located CWD transects. Establish a full count area that is easily defined (so area can be estimated).</li> </ul>                                                               | Conducting a full count for the entire harvest area would not be practical. Fixed-area plots would be too large to be practical. Establishing one smaller full count area with an easily defined area will allow extrapolation to the entire harvest area.                                                                                                                    |
| 25-ha cutblock with a 1.3-ha WTP                                                                                                        | <ul style="list-style-type: none"> <li>1 randomly located plot in patch retention.</li> <li>3 randomly located plots in harvest area.</li> </ul>                                                                                 | This conforms with the one plot per ha in patch.                                                                                                                                                                                                                                                                                                                              |
| 158-ha Mountain Pine Beetle cutblock with 35 ha of retention. Two 14-ha patches with riparian influence and 12 smaller internal patches | <ul style="list-style-type: none"> <li>6 randomly located plots in the harvest area.</li> <li>8 randomly located plots in the riparian influence retention.</li> <li>6 randomly located plots in the smaller patches.</li> </ul> | Relatively uniform pine stand allows for a reduced number of plots, according to the "Big Block" sampling procedure (Appendix 1). Establish 8 plots total in the two 14-ha WTPs. Randomly select 6 of the smaller patches to sample. Ensure reserve summaries are done for all of the patches. In the harvest area, establish 6 plots randomly in the 123 ha of harvest area. |
| 36-ha cutblock with one 2.6-ha WTP and 7 ha of RRZ. Harvest area has evenly distributed (50 stems per ha) dispersed retention.          | <ul style="list-style-type: none"> <li>3 randomly located plots in WTP and 5 randomly located plots in RRZ.</li> <li>3 randomly located plots in dispersed retention.</li> </ul>                                                 | Conforms to the strategy. Dispersed retention plots will likely be fixed area (possible prism plot depending on tree size).                                                                                                                                                                                                                                                   |

## Navigating to Plots

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Once the required plots have been located on the field map, navigating to the plots requires planning for efficiency and safety. The following principles should guide plot establishment.

- Safety is paramount; if your plot(s) cannot be safely accessed (e.g., steep cliffs, deep-water barriers, extensive windthrow), randomly select an alternative plot from the office exercise.
- Plot locations are horizontal distances, so try to correct for slope distances when working on steep terrain (i.e., slopes >40%).
- Traversing to plots can be done using GPS hand-helds (e.g., Garmin GPS 60), compass and hip-chain, compass and rangefinder, or compass and pacing (see Appendix 2 for use of GPS to navigate).

## General Procedures for Establishing Plots

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In general, to establish plots:

- Use flagging tape to establish plot centres and the CWD transect segments.
- Record plot #, date of assessment, and identify as RSM plot on flagging tape.
- Measure at least one height and diameter per plot to calibrate; likewise measure one length and diameter per 30-m CWD line transect. Record measured trees and CWD to one decimal place. Estimates should be recorded without a decimal.
- Use only one measurement type and plot size (i.e., prism, fixed area, or full count) per stratum (see section on stratification).

### Prism Plots

- Prism sweeps should be done in patch areas or areas of dense dispersed retention.
- Target is an average of 6–10 trees per plot. In a stratum with variable stocking, some plots will have few (or no) trees, others will have many trees. Try for a BAF that averages about 6–10 trees per plot.
- Standardize the way in which prism sweeps are done. Paint or mark the first tree measured and sweep your prism clockwise.
- For prism plots, use the same BAF within a stratum (reserve).

### *Prism plots on the stratum edge*

Where a plot is situated within the fringe areas of a stratum, move the plot centre into the stratum. The fringe width of a stratum depends on the selected prism BAF and the largest diameter tree in the plot. The following procedure can be used.

Determine whether the plot is an edge plot by calculating the plot's limiting distance (LD) based on the largest tree in your prism sweep and the plot radius factor (see Table 1).

For example:

- prism BAF = 4 (has a plot radius factor of 0.25)
- DBH of largest tree = 45 cm
- LD = PRF × DBH = 0.25 × 45 = 11.25 m.

Shift the plot perpendicular from the edge so that the plot centre is now 11.25 m from the stratum edge.

**Table 5.** Table showing plot radius factors  $PRF = \frac{1}{2\sqrt{BAF}}$

| BAF | PRF  | BAF | PRF  |
|-----|------|-----|------|
| 1   | .500 | 11  | .151 |
| 2   | .354 | 12  | .144 |
| 3   | .289 | 13  | .139 |
| 4   | .250 | 14  | .134 |
| 5   | .224 | 15  | .129 |
| 6   | .204 | 16  | .125 |
| 7   | .189 |     |      |
| 8   | .177 | 18  | .118 |
| 9   | .167 |     |      |
| 10  | .158 | 20  | .112 |

### Full prism plot cannot fit in narrow stratum

A very narrow stratum, such as a riparian reserve zone, may not be wide enough to allow for a complete prism plot, even if it is moved to the centre of the stratum. In that case, follow the MFR *Cruise Manual* procedure for establishing a border plot (<http://www.for.gov.bc.ca/hva/manuals/cruising/pdf/CH3.pdf>).

*Plots which are located on or adjacent to timber type lines or harvesting boundaries inside the sample area, are split through the plot centre parallel to the type line. The trees inside the sample area are recorded and note on the plot card that it is a border or half plot. Each tree captured by the prism sweep will be tallied twice. When entering this data into the Information Management System, ensure each tree is entered twice.*

### Borderline trees for prism plots

Use the following procedure for determining if borderline BAF trees are in/out of plot:

- For prism plots, measure borderline trees to determine if they are indeed IN or OUT. The formula is: LD = PRF\*DBH.

For example, when using a prism with a BAF of 4, the PRF is 0.25. If you have measured a 30-cm tree, it must be within 7.5 m from the plot centre to be IN (0.25\*30 = 7.5). If the distance to the pith of the tree is >7.5 m (at 1.3 m DBH), it is OUT.

## Fixed-area Plots

- For strata with very low retention levels (e.g., 15 trees/ha), conduct a fixed-area plot.
- For fixed-area plots, a 30-m radius is recommended. When adjusting this radius to try to achieve about 6–10 trees per plot, go up or down in 5-m increments to a maximum of 50 m and a minimum of 15 m.
- Use the same plot radius for all plots within a given stratum (reserve).
- Paint or mark the first tree measured and sweep your fixed-area plot in a clockwise fashion.
- If a plot lands on the border of the stratum, move the plot so that it is fully within the stratum. Moving a fixed-area plot is done by relocating the plot centre in a perpendicular direction from the stratum edge so that the plot centre is now 1 plot radius distance from the edge.

## Full Count Area

### *Entire area of stratum*

This method is suitable in a stratum with an extremely low density of trees (e.g., less than 30 sample trees total).

The stratum area will typically be the full area of NAR, or the full area of one or more treatment units which make up the stratum. If more than 20 or 30 trees are likely to be counted, use another method to get a smaller tree count.

### *Subset of stratum area*

You may do a full count of a representative subset of the total stratum area. Choose an easily recognizable area in which you can obtain a full count of all trees and an area estimate. Only one full count area is allowed per stratum and the tree tally is recorded as if it is one plot. If possible, put all the tree data onto the stand table of the first plot card (Form A) in that stratum. You will still require plots to tally CWD. Whenever the full count area is smaller than the total stratum area, the data will be extrapolated to the full stratum. Be sure to show this subset area on the field map.

## Stumps and Stubs

Stems are generally to be tallied in a plot if they are taller than 1.3 m (breast height) and with a DBH greater than 12.5 cm. Stubs and high stumps could fall into that size category. High stumps from first pass logging or winter logging may add some biodiversity value to a block. However, this value is usually minimal compared to full size trees, and thus are NOT tallied. Stubs are purposefully made at time of harvest to enhance biodiversity. Stubs may have marginal value as habitat if they already have heartrot established. If stubs occur in regular prism or fixed-area plots, tally them with a comment noting they are a stub. However, don't bother doing a full count of stubs – that time would be better spent doing another retention plot, or getting home earlier.

In summary:

- Do not tally high stumps.
- Tally stubs found in prism or fixed-area plots – do not do a full count of stubs.

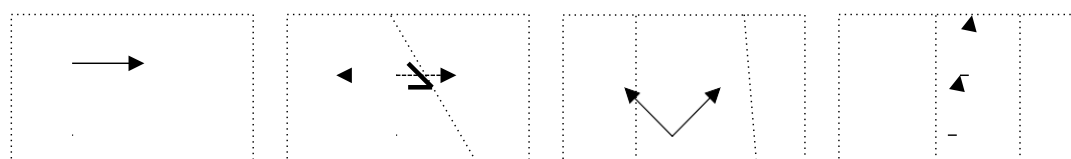
## CWD Transects

Data collected for CWD include species, diameter, length, and decay class. Only diameter is used in the line transect equation to calculate volume. Length is collected as a qualitative indicator for CWD – long pieces are generally better for habitat and decay slower. Knowing the species and decay class of the wood helps in an assessment of diversity of CWD, and overall decay rates.

- A CWD line transect is established from each plot centre.
- Establish the first 15-m leg and record the bearing.

General rule for direction (to avoid bias):

- First choice is to continue the bearing from last plot or point of commencement.
- If the transect extends out of the stratum, add 90°. If that still takes you outside the stratum, go to options 3 or 4 shown in the Figure 2.
- The second leg is at a 90° angle additive from the first bearing, as long as that keeps you within the same stratum. If not, subtract 90°. The purpose of the 90° angle is to avoid bias in sampling. For example, CWD resulting from yarding or from windthrow can be oriented predominantly in one direction. A transect along that orientation may pick up very little CWD, but by having half of the transect at a right angle, the probability of this type of error is reduced.
- Flag the end of each of the two 15-m transects. Consider painting the CWD pieces at the point where they are crossed by your transect, especially when there are a lot of pieces (it helps to ensure you have tallied all pieces).
- If the transect extends outside of a stratum, this leg of the transect must be repositioned so that it is fully within the stratum. If both of the perpendicular directions extend outside the stratum, try establishing both transects perpendicular from the plot centre. And if this does not work, make a single 30-m transect. Record your results on the field card including how you established the anomalies.



1. Normal CWD line transect – continue direction from previous plot or initial WP then turn 90°.

2. Turn transect opposite direction to remain in stratum.

3. Establish both legs from plot centre if necessary to fit in stratum.

4. In a very narrow stratum, establish both legs in line.

*Figure 2. Locate CWD transect within the stratum.*

#### CWD and piles

If your random transect location ends up on a pile, it should be tallied unless it will be removed or burned. Safety is paramount, so do not climb over piles that are at risk of shifting. Estimate the data for all logs falling under your line transect. In the case of large piles, make a trade-off against time on the block and data collected. For large, fairly uniform piles (where time is limited), it is acceptable to measure a portion (e.g., 50%) of the line transect that is on the pile, and pro-rate the data (i.e., double the data if only 50% of the line was measured).

For large piles where it isn't possible to safely and accurately determine sizes, it may be quickest to keep a running tally of logs in various species groups/diameter classes and length classes. Often wood in such piles is consistently decay class 1. This can then be summarized onto Form A Side 2. The following is an example of a pile summary:

| Diameter classes | <2 m length |       |    | 2–6 m length |    |     | 7–11 m length |     |     |
|------------------|-------------|-------|----|--------------|----|-----|---------------|-----|-----|
|                  | Cw          | Fd    | Dr | Cw           | Fd | Dr  | Cw            | Fd  | Dr  |
| 12–20 cm         |             |       |    |              |    | /// |               |     | /// |
| 20–30 cm         |             |       |    | ////         |    |     | //            | ### |     |
| 30–40 cm         |             | ### / |    |              |    |     |               |     |     |

| Log # | Spp. | Decay class | Dia. (cm) | Length (m) | Comments        |
|-------|------|-------------|-----------|------------|-----------------|
| 1–6   | Fd   | 1           | 35        | 1          | Start of pile   |
| 7–10  | Cw   | 1           | 25        | 4          |                 |
| 11–13 | Dr   | 1           | 16        | 4          |                 |
| 14–15 | Cw   | 1           | 25        | 9          |                 |
| 16–20 | Fd   | 1           | 25        | 9          |                 |
| 21–23 | Dr   | 1           | 16        | 9          | End of pile     |
| 24    | Fd   | 2           | 22.5      | 4.3        | Start of Leg #2 |
| 25    | Dr   | 2           | 17        | 3          |                 |

## Block Stratification

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Plots are located randomly within each stratum and only a single sampling technique (i.e., prism, fixed-area plot size, full count area entire stratum, full count area subset of stratum) can be used within a single stratum. Therefore, it is important to first understand what constitutes a stratum. Here are a few points to keep in mind when considering the patch retention mapped for a cutblock:

- All patch retention internal to the harvest boundary is considered part of the cutblock.
- Patch retention external but contiguous, or external and non-contiguous, with the harvest boundary is considered part of the cutblock if it is acknowledged as such on the SP or post-harvest map. If it is not acknowledged as associated with the cutblock, do not sample it, as it may be retention related to adjacent or future cutblocks.
- Patch retention may be considered part of the cutblock, but the patch area is not included in the gross area indicated on the SP map. If this is the case, the patch area needs to be added into the gross area noted on Form C, Section 11 and this total is recorded as the “override” area (the adjusted gross area).
- Even if a road splits up an area of retention, it is considered one retention patch (one stratum ID and one summary). Sample it as such.
- If the SP map shows two patches which are contiguous (e.g., a WTP immediately alongside a RRZ), consider these as one stratum (a single patch). This ensures that the correct patch size (i.e., sum of area for contiguous patches) is recorded on the stratum summary. If the two areas within the single patch are very distinct timber types, and this is not reflected in the plot data, please comment on this in the stratum summary (Form B).
- Non productive areas (e.g., swamp) that are netted out of NAR should not be sampled.

The variability in dispersed retention can cause problems when choosing the type of plot to establish for the tree count. For example, a 30-m fixed-radius plot in one area of the dispersed retention may pull in a reasonable tree count (6–20) while the same 30-m plot elsewhere may end up with a very high tree count. If possible, pre-stratify the dispersed retention area using aerial photos to identify significant variation in tree density. If that isn't possible, stratify areas of dispersed retention in the field (do not do this for patch retention) in order to utilize an appropriate (efficient) tree count methodology. Remember, each time you switch plot types you must stratify the dispersed area and attribute a size for the stratum, as well as to complete a Form B. In this way, the appropriate weighting can be applied during data analysis.

**Note:** This stratification of dispersed retention areas is intended to encourage efficient tree count methodology. It is not intended to force 3 plots within each dispersed stratum. The same “rule of thumb” for plot numbers in the harvest area applies regardless of the number of stratum in harvest/dispersed areas (i.e., minimum 3 plots in the harvest area (this may be increased if high density of dispersed retention), increasing to 5 plots per 100 ha for larger cutblocks).

## Logic for Use of Section 16: When is it acceptable to not sample a patch?

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There are cases – one of them being a multitude of very small variable retention patches made up of essentially the same timber type – where it is not likely worth the time to plot each one of a number of similar patches. However, it is always necessary to confirm the existence and approximate size of each patch. Hence Section 16, which is essentially an abbreviated version of the stratum summary (Form B). The purpose of Section 16 is to save on using multitudes of stratum summary pages. The ecological anchors listed in Section 16 are limited to those that you might see when observing the patch from a distance (i.e., those that could stand out from the canopy). It is your choice whether to use Form B (and note “zero” plots in stratum) or Section 16 of Form C.

It is acceptable to not sample a patch when your other observations tell you it is homogeneous with what you’ve already seen, and time is a critical factor. However, if there are patches in existence on a block, always establish *at least* one patch plot. A block containing retention patches may be rejected for data analysis if there are no patch plots established (no information for development of tree indicators). Where access is an issue (e.g., long or difficult access), a level of professional judgement needs to be made regarding the number and choice of strata sampled versus the time and cost of returning for a second field day. A stratum summary must be done for each patch stratum regardless of whether they are sampled. *Do not* use Section 16 for a dispersed stratum.

## Stratum ID: Why we need to standardize

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The format for stratum ID has been standardized at a maximum of five characters – zero to three alphabetical characters followed by zero to two numeric characters with no spaces between (e.g., WTP1, RMZ2, VR, VR1, NAR, SU1). Since it is essential to have identical identification linking all plots in a stratum, this standardized approach will help to stifle creativity and improve the odds of the same identification being moved forward on all plot cards and onto the stratum summary. Each stratum in a cutblock must have a unique identifier using this standardized approach.

## Stratum Type: What is it anyway?

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The allowable coding ID for stratum type is shown on Form B, Section 8. It is a two-letter code.

- CC stratum type = clearcut – a stratum with no trees >12.5 cm DBH in any of the plots (regardless of tree species or merchantability) and, in the assessor’s opinion, the total of the dispersed trees in the stratum equate to a patch smaller than 0.1 ha (see Appendix 3).

## Retention Areas

### *First letter*

First letter designations for retention areas are:

- P = patch reserves – no harvesting in the stratum (other than removal of trees from patch likely done for safety reasons).
- D = dispersed retention reserves – harvest occurred in the stratum and there are trees larger than 12.5 cm dbh.

### *Second letter*

Second letter designations are:

- T = temporary, if there is a plan to harvest the retention prior to rotation end. Retained dispersed trees in a commercial thinning operation are considered temporary.
- R = riparian, if there are any riparian areas (either RRZ or RMA) in the stratum and reserve expected to be maintained for the full rotation.
- W = wildlife tree, if the SP or SP map note a wildlife or biodiversity purpose for the retained trees and reserve expected to be maintained for the full rotation.
- O = other.
- U = unidentified.

## Required Accuracy

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Field assessors should measure one (or more if you are not comfortable estimating) tree diameter and height per plot to calibrate your eye. These measured trees should be recorded to one decimal place of accuracy. The remainder of the trees in a plot can be estimated. Estimated trees should be recorded with no decimal place. The amount of measurement that is required can be monitored by occasionally checking your own estimates. Estimates should be within 10% of actual size.

Acceptance of estimated data is appropriate for RSM monitoring as the data will be lumped into diameter and height classes. During the pilot testing of this procedure, an attempt was made to have tree data collected categorically. We found that, in order to place trees in the appropriate categories, field assessors needed to estimate height and diameter. It was felt that since that work was being done anyway, the complete data should be collected. Furthermore, if different diameter or length or height limits are required, the data can be re-analyzed.

## Innovative Practices

*Innovative – ahead of the times... something new or unusual.*  
 (Source: www.dictionary.com)

This section of the field forms is intended to record new or unusual practices that, in the opinion of the evaluator, would be beneficial to biodiversity. As a result of the evaluators collecting this information, it will be possible to identify new or unusual practices that are being implemented in various areas of the province. This may lead to more specific evaluations of a particular practice to determine effectiveness and ultimately to extend this information to practitioners.

## Reserve Constraints

A constraint percentage is determined for every stratum other than the CC (clearcut) stratum type. This information is used in the provincial analysis to assess the component of retention that either:

- is being maintained to fulfill an additional purpose other than WT retention (e.g., RRZ, RMZ, Visuals, Recreation Feature), or
- had a very low likelihood of providing an economic harvest opportunity (e.g., rock, non-commercial, sensitive terrain).

In essence, what percentage of the area would have been retained regardless of WT retention? An ungulate winter range or wildlife habitat areas should only be noted as a constraint if the block overlaps the designated UWR or WHA, harvesting is permitted and retention requirements are specified in the SP or UWR/WHA order. A spatially designated old growth management area is not likely going to be a component of a cutblock. However, if this does occur – the percent constraint is likely 100 (assuming no harvesting is allowed in the OGMA).

## Windthrow

Windthrow is tallied as the percentage of windthrown trees by stratum. In previous years this was collected within categories (<5%, 5-15%, 15-30% and >30%). For the 2009 field season the categories have been eliminated to more accurately reflect the windthrow - particularly for strata with very high percentage of windthrow.

It is recommended that you sketch out areas of very high windthrow on your field map. When all sampling is completed in a stratum, assign a total windthrow percentage by weighting areas of higher and lower windthrow amounts. Windthrow is often highly variable, dependent on prevailing winds and stand structure therefore it is best to sketch and make notes on windthrow amounts as you travel through a stratum.

For example: A 5 hectare retention patch

1 ha is 70% windthrow (equivalent to 0.7 ha windthrown)

4 ha is 4% windthrow (equivalent to 0.16 ha windthrown)

$$\frac{(.7 + .16)}{5 \text{ ha}} = 0.172 \text{ or } 17\% \text{ windthrow average for the stratum}$$

Example using tree count estimates: 2 plots in the WTP with a total of 17 trees standing and 8 trees windthrown. The total windthrow estimate is  $8/(17+8)$  or  $8/25 = 32\%$ . This example is simply a ratio, does not require a particular fixed area plot size – just keep the size consistent at each plot and large enough to capture a good tally.

## Ecological Anchors

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The provincial guidance given for choice of wildlife tree retention is to first look for important features to protect such as high value wildlife trees (e.g., veteran tree or tree containing cavity nest, hollow stem, stick nest, large witches broom, bear den, active feeding on the tree), or features such as a mineral lick or hibernaculum. A hibernaculum would be an important feature – this is primarily a den (e.g., hollow tree or cave) where bats may overwinter. The presence of bat guano and the smell should be your clues to such a hibernaculum. Other hibernacula are possible for ground dwelling creatures (e.g., snakes), but since these are much harder to spot – unless they are a component of a WHA and noted as such in a silviculture prescription – it is not expected that you will be finding and noting them. Presence of these types of ecological anchors on a site may indicate a choice on the part of the licensee to protect such high value attributes.

The provincial guidance goes on to say that if no important features require protection through wildlife tree retention, then look to retain an area with trees that will likely attain high value wildlife tree status. If you determine that there are trees being retained equivalent in size to the dominant trees pre-harvest, then we might assume that this guidance is being considered (i.e., largest tree for the site).

It is understood that you will not be walking through 100% of every stratum. However, take some time to visually assess each stratum as you walk by or through it. An unsampled stratum should also be scanned with binoculars to detect the presence of ecological anchors.

## Evaluator Opinion

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This section is meant to provide a check against the data collected. It is not the conclusion for the cutblock. During the design of this routine assessment, it was recognized that the assessor's opinions of how well they feel the cutblock retained stand structures and representative stand conditions could provide valuable feedback to the assessment model. If, for example, the assessment model consistently places cutblocks in the high risk category when the assessors feel they are well done, the assessor's rationale may provide insight into data that should have been collected or a way in which the data might be interpreted differently.

Assessors should ask the questions:

- How well did this cutblock do at retaining the types of stand structural attributes that existed prior to harvest?
- How well does the retention represent the stand conditions present in the area?
- Is the retention distributed in a way that will be beneficial to biodiversity?

## Filling in the Field Forms

This section will lead you through the process of filling out stand-level biodiversity RSM forms (FS 1244 A, B, and C). Sample completed forms are provided in Appendix 4.

[illegible]

## Section

### Instructions/Descriptions

## Plot Information

### Form A Side 2

[illegible]

#### 4 Plot Information (CWD)

Transfer *Stratum ID* and *Plot #* from front of card, in case cards are photocopied or dropped.

*CWD in transect* – tick “Yes” or “No.”

**1st Leg and 2nd Leg** (a transect “leg” is 15 m)— record compass bearing of the transect. This is to help relocate transect for mentoring or auditing.

*Log #* – number each piece of CWD on transect that is >7.5 cm diameter and CWD classes 1–4; see Reference Form – Side 2 (FS 1244-D2)

*Spp.* – record CWD species using codes on Reference Form – Side 2 (FS 1244-D2). Record to species if known, if not to genus or unknown (e.g., in order of preference Hw, H, Xc or Xd, X).

*Decay Class* – record CWD decay class using codes on Reference Form – Side 1 (FS 1244-D1) for CWD classes 1–4.

*Dia. (cm)*—diameter in cm where transect intersects  
log; record decimal place if measured.

*Length (m)*—length in metres; record decimal place if measured.

**Comments** – record any comments on individual piece of CWD. General comments on plot should be recorded on the stratum summary Form B Side 1.

For guidance on measuring CWD, refer to Appendix 5.

#### Section

#### Instructions/Descriptions

#### Stratum Summary Form B Side 1



Stand-level Biodiversity  
Resource Stewardship Monitoring  
Stratum Summary-- Form B Side 1

**5 Stratum Summary (one card per Stratum)**

Date / /  Opening ID

Assessed by

Stratum ID  Stratum type

# of plots in stratum  Mapped ☐ Stratum size (ha)

BEC subzone variant and site series

**Stratum location and size consistent with map?** Yes ☐ No ☐ Not mapped  
If 'no' or 'not mapped', estimated size (ha)

Tick one of: ☐ Harvest area with no retention ☐ Harvest area with dispersed retention  
☐ Patch Reserve

**6 Patch/Dispersed Summary**

Estimated age of oldest trees in reserve (other than Vets)

Patch location: ☐ Internal to block ☐ Edge of block  
☐ External/not touching block ☐ NA

% of total trees in reserve windthrown:  %

Distribution of windthrow: ☐ Edge ☐ Internal ☐ NA

Windthrow treatment: ☐ Feathering ☐ Topping ☐ Both ☐ None ☐ Other

| 7 Reserve Constraints     | % of reserve             | Ecological Anchors               | stratum estimate         |
|---------------------------|--------------------------|----------------------------------|--------------------------|
| None                      | <input type="checkbox"/> | None                             | <input type="checkbox"/> |
| Wet site                  |                          | Bear Den                         | stratum count            |
| RMZ                       |                          | Hibernaculum                     | stratum count            |
| RRZ                       |                          | Vet tree/ha                      | 0, 1-10, 10-20, etc.     |
| Rock outcrop              |                          | Mineral lick                     | stratum count            |
| Non-commercial brush      |                          | Large stick nest                 | stratum count            |
| Non (or low) merch timber |                          | Cavity nest                      | stratum count            |
| Sensitive terrain or soil |                          | Large hollow tree                | stratum count            |
| UWR / WHA                 |                          | Large witches broom              | stratum count            |
| OGMA                      |                          | Karst feature                    | Y N                      |
| Visuals                   |                          | Largest tree for site (not Vets) | Y N                      |
| Cultural heritage feature |                          | CWD heavy natural concentration  | Y N                      |
| Recreation feature        |                          | Active wildlife trails           | Y N                      |
| Other:                    |                          | Active WLT/CWD feeding           | Y N                      |
|                           |                          | Uncommon tree species            | Y N                      |
| <b>Total constrained</b>  |                          | Other:                           |                          |

Comments:

FS 1244-A1 HFP 2009/02

#### 5 Stratum Summary

*Date* – date of assessment.

*Opening ID* – numeric identification from the RESULTS database.

*Assessed by* – names or initials of assessors.

*Stratum ID* – unique plot ID number; must be identical to stratum ID used for plots within the strata (maximum 3 letters plus 2 numbers).

*Stratum Type* – as recorded on Form A Side 1.

*# of plots in stratum* – record the number of plots established in the stratum.

*Mapped stratum size* – record stratum size from RESULTS or harvest map; note that all non-contiguous patch retention is a separate stratum.

*BEC subzone variant and site series* – record as per site map; please change if reserve is obviously a different variant or site series from the harvest area.

*Stratum location and size consistent with map?* – tick either yes, no, or not mapped. If not consistent, or not mapped, record the estimated size in hectares. Harvest areas are considered as mapped by SU designation.

Tick one of:

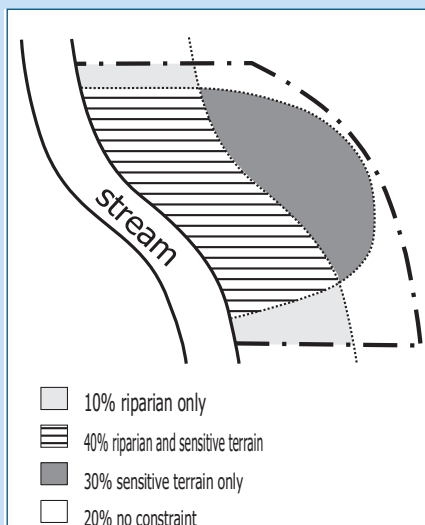
*Harvest area with no retention* – tick this box if harvested area contains no trees >12.5 cm dbh.

*Harvest area with dispersed retention* – tick this box if harvested area contains dispersed retention >12.5 cm dbh.

*Patch reserve* – tick this box if the area is a designated patch reserve.

Only Section 5 is filled out for a clearcut (CC) stratum.

| Section                                  | Instructions/Descriptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stratum Summary<br>Form B Side 1 (cont.) | <p>6 Patch/Dispersed Summary</p> <p><i>Estimated age of oldest trees in reserve (other than Vets)</i> – use pre-harvest inventory label, local knowledge, or bore the tree. Confirm approximate age through field verification – occasional coring of trees, or counting the rings on stumps.</p> <p><i>Patch location</i> – tick the appropriate box identifying the location of the reserve or dispersed area. If any part of the patch touches the external harvest boundary, it should be considered on the edge of block.</p> <p><i>% of total trees in reserve windthrown</i> – estimate the % of trees windthrown in the stratum. Tick one or two boxes indicating the distribution pattern of windthrow. Identify any observed or known windthrow management treatments. Collect this data for both patch and dispersed retention.</p> <p>Estimate the windthrow impacts based on the number of stems affected (dominant and codominant). Basically, we want to know if windthrow is impacting the features retained for biodiversity: whether lots of blocks are affected; whether the windthrow impacts are edge, or internal, or throughout. Overall, what % of retained trees was affected by wind.</p> <p>7 Reserve Constraints and Ecological Anchors</p> <p><i>Reserve constraints</i> – the amount of area contributing to an alternate requirement or if it is inoperable. Record the % of the reserve that is affected by the identified constraint. This may add up to &gt;100% (e.g., 50% riparian + 70% sensitive terrain), as constraints can overlap. In this example, if 80% of the riparian is also sensitive terrain (4/5 overlap so 10% of the area is constrained by riparian alone, 40% by riparian and sensitive terrain, and 30% sensitive terrain alone), there is a total constraint of 80%. The “total” must be the total proportion of the stratum that is constrained (e.g., 80%) NOT the sum of all constraints.</p> <p><i>Ecological anchors</i> – for a “stratum count” – record the number of times you observed the indicator in the stratum. For vet trees, give an estimate of category for stems per ha of the stratum. Several indicators are just presence or absence (i.e., circle Y [Yes] if at least one instance of the indicator or N [No] if you do not see any incidences). An example of “other” ecological anchors could be an artificially modified tree (e.g., nest platform, nest box). Check the “none” box if there are no anchors.</p> |



#### Section

#### Instructions/Descriptions

#### Reserve Codes/Plot Guidance Form B Side 2

#### Reserve Codes and Plot Guidance

This form provides reference material for:

- reserve codes
- plot establishment
- CWD transects.



BRITISH COLUMBIA

Forest and Range

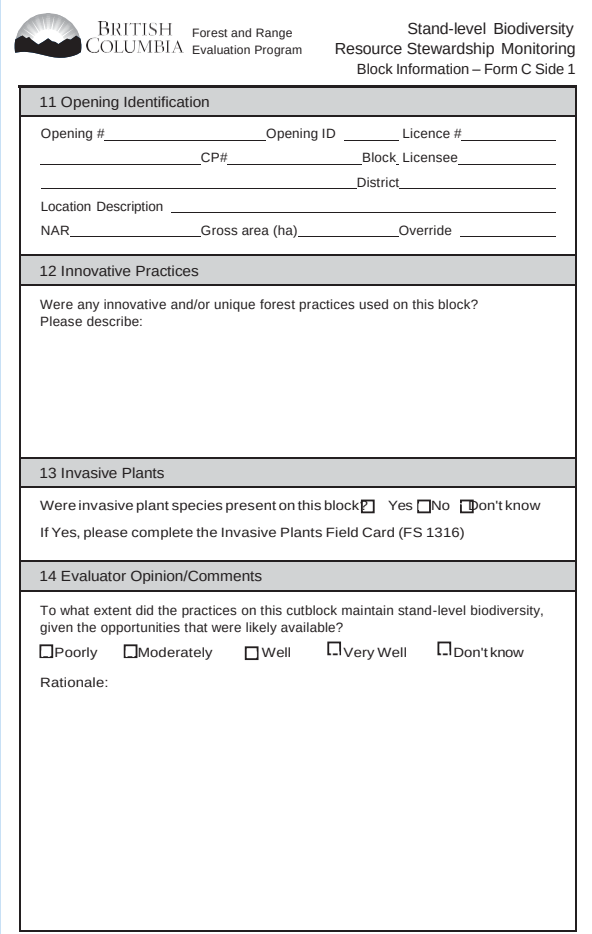
Stand-level Biodiversity

Evaluation Program

Resource Stewardship Monitoring

Reserve Codes/Plot Guidance – Form B Side 2



| Section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Instructions/Descriptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| <p><b>Block Information</b><br/>Form C Side 1</p>  <p>BRITISH COLUMBIA Forest and Range Evaluation Program Stand-level Biodiversity Resource Stewardship Monitoring Block Information – Form C Side 1</p> <p><b>11 Opening Identification</b></p> <p>Opening # _____ Opening ID _____ Licence # _____<br/>         _____ CP# _____ Block Licensee _____<br/>         _____ District _____<br/>         Location Description _____<br/>         NAR _____ Gross area (ha) _____ Override _____</p> <p><b>12 Innovative Practices</b></p> <p>Were any innovative and/or unique forest practices used on this block?<br/>         Please describe:</p> <p><b>13 Invasive Plants</b></p> <p>Were invasive plant species present on this block? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know<br/>         If Yes, please complete the Invasive Plants Field Card (FS 1316)</p> <p><b>14 Evaluator Opinion/Comments</b></p> <p>To what extent did the practices on this cutblock maintain stand-level biodiversity, given the opportunities that were likely available?<br/> <input type="checkbox"/> Poorly <input type="checkbox"/> Moderately <input type="checkbox"/> Well <input type="checkbox"/> Very Well <input type="checkbox"/> Don't know<br/>         Rationale:</p> <p>FS 1244-A1 HFP 2009/02</p> | <p><b>11 Opening Identification</b></p> <p>This section header contains complete identification for the block. Information can be filled in at the office with data from the post-harvest map, SP, or RESULTS.</p> <p><i>Opening #</i> – from RESULTS.</p> <p><i>Opening ID</i> – from RESULTS.</p> <p><i>Licence #</i> – from RESULTS or post-harvest map.</p> <p><i>CP #</i> – from RESULTS or post-harvest map.</p> <p><i>Block #</i> – from RESULTS or post-harvest map.</p> <p><i>Licensee</i> – from RESULTS or post-harvest map.</p> <p><i>District</i> – enter name or 3-letter code.</p> <p><i>Location Descriptor</i> – general description of location (e.g., Fury Creek).</p> <p><i>Year of Harvest</i> – enter year of harvest completion (disturbance end date) from RESULTS (if doing a pre-harvest block, note that here).</p> <p><i>Net Area to be Reforested (ha)</i> – enter the total net area to be reforested (the total hectares actually receiving reforestation treatment). From RESULTS.</p> <p><i>Gross area</i> – equivalent to “total area under prescription” (i.e., inclusive of harvest area and all reserves associated with the cutblock). From RESULTS.</p> <p><i>Override</i> – to attribute reserves associated with cutblock but not included in gross area. Sum gross plus reserves as the “override” area (the corrected gross area).</p> <p><i># of patch reserves in block</i> – record the number of patch reserves (multiple patch areas that are contiguous [i.e., touching] are counted as a single patch) identified on site map or in RESULTS.</p> <p><i># of patch reserves sampled</i> – record the number of reserves that were sampled.</p> <p>Note: Whether or not a patch reserve has been sampled, please fill out either Form B Side 1, Section A or use Form C Side 2, section 16, but NOT both.</p> <p><b>12 Innovative Practices</b></p> <p><i>Were any innovative and/or unique forest practices used on this block?</i> Please note and describe any practices other than variations in levels of retention that can impact stand-level biodiversity. Innovative may include treatments not commonly used in the district but that have been implemented with the intent of managing for biodiversity.</p> |

| Section                                                                                                                                                                                                                                                                                                                                                                    | Instructions/Descriptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Block Information</b><br><b>Form C Side 1 (cont.)</b>                                                                                                                                                                                                                                                                                                                   | <b>14 Evaluator Opinion/Comments</b><br><i>To what extent did the practices on this block maintain stand-level biodiversity, given the opportunities that were likely available – tick one of poorly, moderately, well, very well or don't know.</i><br><br>This is a subjective ranking of the cutblock, which will be used as a check against the objective data collected. A question you should ask yourself is “did they do as well as they could have considering the forest they began with?” Note general comments as well as anything unusual about the cutblock in the comments section. Please provide a rationale for your professional opinion. Some points to consider:<br><br>Species mix is different from pre-harvest (e.g., Pw left in Fd-dominated stand): <ul style="list-style-type: none"> <li>– often considered good as it provides greater species diversity and a possible seed source of a rust-resistant tree</li> <li>– mistletoe-laden hemlock left in a stand dominated by Fd with planned natural regeneration may be seen as a negative, as Hw would impact negatively on the next crop and does not provide the same long-term standing potential as the Fdc</li> <li>– mistletoe in mature trees can provide excellent nesting habitat.</li> </ul> Height is different from pre-harvest: <ul style="list-style-type: none"> <li>– shorter than pre-harvest trees may be better if taller trees are susceptible to windthrow.</li> <li>– if trying for longer term inputs of CWD, a few younger patches may be considered good.</li> <li>– short, stunted, unhealthy trees may be considered poor, as they will not age well and may not create desired WT characteristics.</li> </ul> Amount of standing retention: <ul style="list-style-type: none"> <li>– high levels of retention with good ecological anchors is good.</li> <li>– high levels of retention with no ecological anchors is not necessarily good.</li> </ul> Amount of CWD: <ul style="list-style-type: none"> <li>– long (&gt;10 m) logs in decay classes 1, 2, and 3 in the harvested area is good.</li> </ul> |
|  <b>BRITISH COLUMBIA</b> Forest and Range Evaluation Program<br>Stand-level Biodiversity Resource Stewardship Monitoring<br>Block Information – Form C Side 1                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>11 Opening Identification</b><br>Opening # _____ Opening ID _____ Licence # _____<br>_____ CP# _____ Block Licensee _____<br>_____ District _____<br>Location Description _____<br>NAR _____ Gross area (ha) _____ Override _____                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>12 Innovative Practices</b><br>Were any innovative and/or unique forest practices used on this block?<br>Please describe:                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>13 Invasive Plants</b><br>Were invasive plant species present on this block? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know<br>If Yes, please complete the Invasive Plants Field Card (FS 1316)                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>14 Evaluator Opinion/Comments</b><br>To what extent did the practices on this cutblock maintain stand-level biodiversity, given the opportunities that were likely available?<br><input type="checkbox"/> Poorly <input type="checkbox"/> Moderately <input type="checkbox"/> Well <input type="checkbox"/> Very Well <input type="checkbox"/> Don't know<br>Rationale: |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

FS 1244-A1 HFP 2009/02

### 13 Invasive Plants

Tick one of the boxes to indicate the presence or absence of invasive plants. If you do not know, tick “don't know.” Record distribution code (e.g., CT/5) from Reference Form, Sides 1 and 2. Species codes will be provided separately.

Invasive plants are not plot-based information; simply look for invasive plants during and between plots, while driving the road system, etc.

Record any comments you may have concerning invasive plants.

[illegible]



Figure 4 shows field cards required to fully sample a 30-ha cutblock with two wildlife tree patches (WTPs) and dispersed retention.

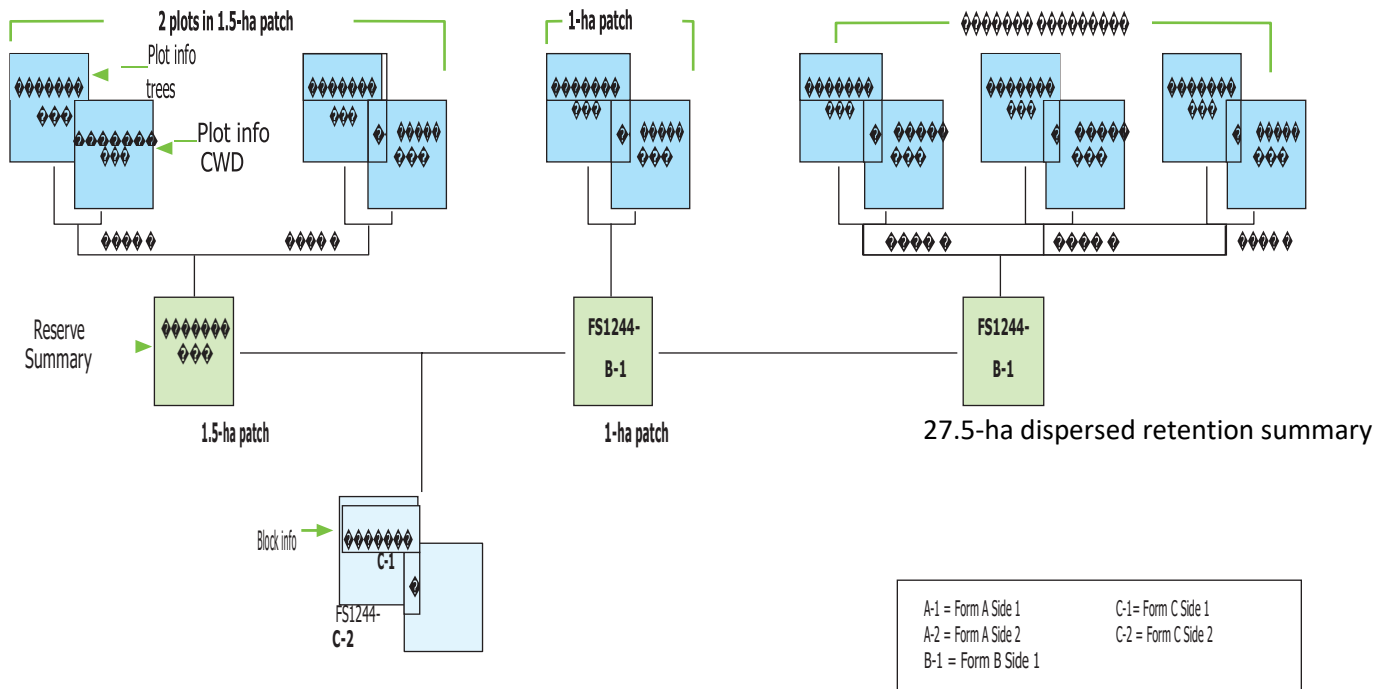


**Figure 4.** Field cards used to complete sampling of 30-ha cutblock. This cutblock contains two WTPs and dispersed retention.

Wildlife Tree Classes

Wildlife tree classes are shown in Figure 5 and Appendix 6.

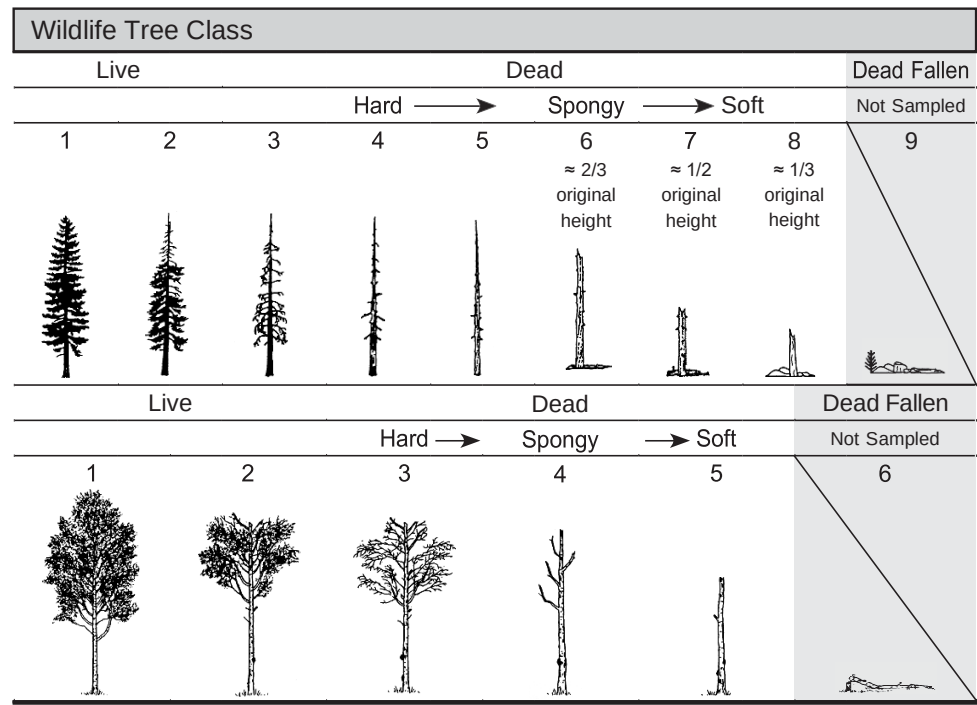


Figure 5. Wildlife tree classes for conifers and hardwoods.

Species codes are found in Appendix 7. Use standard species coding – tree species list provided on summary field card. For invasive plants, use the species codes identified on reference card (Form D Side 2).

## CWD Decay Classes

For a more detailed description of CWD line transect methodology, see Appendix 7 and visit the following web site: <http://ilmbwww.gov.bc.ca/risc/pubs/teecolo/fmdte/cwd.htm#sampling%20Methods>.

The following are CWD decay classes (Figure 6 and Appendix 6). Decay class 5 is not tallied since it is subsurface and therefore too difficult to accurately identify for the purposes of this assessment.

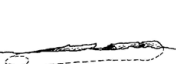
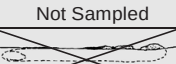
| CWD Decay Class                                                                   |                                                                                   |                                                                                   |                                                                                   |                                                                                    |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|  |  |  |  |  |
| Log class 1                                                                       | Log class 2                                                                       | Log class 3                                                                       | Log class 4                                                                       | Log class 5                                                                        |
| Hard                                                                              | Sap rot (but still hard)                                                          | Advanced decay (spongy)                                                           | Extensive decay (crumbles/mushy)                                                  | Many small pieces, soft                                                            |
| Bark firm                                                                         | Loose bark                                                                        | Bark trace/absent                                                                 | Bark absent                                                                       | Bark absent                                                                        |
| Elevated                                                                          | Sagging                                                                           | Sagging to settled onground                                                       | Fully settled on ground                                                           | Partly sunken in ground                                                            |
| Hard branches with twigs                                                          | Soft branches                                                                     | Branches stubs/absent                                                             | No branches                                                                       | No branches                                                                        |
| Supports person                                                                   | May not support person                                                            | Breaks easy                                                                       | Shape collapses when stepped on                                                   | Collapsed oval                                                                     |
| No invading roots                                                                 | No invading roots                                                                 | Roots in sapwood                                                                  | Roots in heartwood                                                                | Roots in heartwood                                                                 |

Figure 6. CWD decay classes.

## Analysis

Field card data is entered into the FREP Information Management System (IMS). This data is then summarized and indicators calculated for each block. These indicators include:

- % area retained (dispersed and patch retention)
- Number of patch strata <2ha and >2ha
- Number of patch strata, internal, on the edge, and external and non-contiguous
- Number and type of tree species found on the block
- Density of large trees found on the block (any wildlife tree class, 40, 50, and 70 cm dbh)
- Density of large snags (wildlife tree class 3 or greater, >10m tall and 30 cm dbh)
- CWD volume within patch retention and on the harvest area
- CWD density of long pieces (>10m) within patch retention and on the harvest area
- Presence of invasive plants on the block
- Average amount of windthrow in retention areas on the block

The Forest Stewardship Officer, or main stand-level biodiversity representative within each districts is given the summarized data for their district when it is completed. Along with this data is a district report which compares some of the indicators against baseline data. The baseline data used for the tree data is cruise data from the same BEC unit. The baseline data used for CWD within harvest areas is CWD within patch retention areas.

## Answering the Routine Retention Evaluation Questions

This section of the protocol describes the rationale for each question used to evaluate stand-level retention and background information on the specific indicators used to help answer each question. Additional information is also provided to describe the indicator and how to measure it in the field.

### Category: Landscape Context

#### Question 1: Is the amount of stand-level retention adequate considering the landscape context?

Early guidance on stand-level retention amounts within the Biodiversity Guidebook recognized the need to increase stand-level retention in landscapes with more operable THLB, and/or where more of the landscape is affected by previous harvesting with no wildlife tree retention (Pre-1995). The Biodiversity Guidebook provided initial estimates for wildlife tree retention at the individual cutblock level, suggesting ranges from 0-15% and 3-18% as appropriate considering the area of the operable land-base, existing area harvested or disturbed, and depending on whether landscape units and biodiversity objectives had been established.<sup>7</sup> These targets assumed that landscape-level biodiversity tools such as seral stage distribution targets, Old Growth Management Areas (OGMAs), Forest Ecosystem Networks (FENs) and riparian reserves would be established to help maintain habitat attributes for wildlife outside of harvested areas. However, it is important to note that not all of the landscape-level tools outlined in the Biodiversity Guidebook were implemented. As a result, in some situations, such as large-scale natural disturbances and salvage harvesting occur, additional guidance recommends increased wildlife tree retention compared to the original Biodiversity Guidebook estimates. Most salvage harvest guidance is derived from NDT3 forest ecosystems where large-scale severe natural disturbances are more frequent (See Eng 2004, Snetsinger 2005, Klenner 2006, BCMFLNORD 2018)). For other forest ecosystems that experience less frequent severe disturbances (NDT1,2,4), the minimum retention targets provided here are based on guidance from the Coast Forest Conservation Initiative (CFCI 2007) and Zielke et al. (2008), or are scaled according to landscape condition as for NDT3 ecosystems (Table 6). Both natural disturbance regime and landscape context play a significant role in guidance targets for wildlife tree retention at the cutblock level, (Table 6).

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<sup>7</sup> See Table 20(a) and 20(b) Page 65 Biodiversity Guidebook.  
June, 2022

**Table 6.** Minimum recommended stand-level wildlife tree retention based on natural Disturbance Type (NDT) and landscape context (adapted from Biodiversity Guidebook 1995 and Klenner 2006)

|                                   |       | NDT3 <sup>b</sup>                                                                                                                                                                                               |                   |       |       |     | NDT 1/2/4 <sup>c</sup> |       |       |       |     |
|-----------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------|-------|-----|------------------------|-------|-------|-------|-----|
|                                   |       | Percent (%) Forest Disturbance                                                                                                                                                                                  |                   |       |       |     |                        |       |       |       |     |
|                                   |       | Percent of LU/BGC subzone that is early seral forest (<40 yrs) based on harvested openings, and forests >40yrs affected by <i>Very Severe</i> insect-induced mortality or <i>Medium-High</i> severity wildfires |                   |       |       |     |                        |       |       |       |     |
|                                   |       | <20                                                                                                                                                                                                             | 20-40             | 40-60 | 60-80 | >80 | <20                    | 20-40 | 40-60 | 60-80 | >80 |
| Percent of THLB in LU/BGC subzone | <20   | >3.5 <sup>a</sup>                                                                                                                                                                                               | >3.5 <sup>a</sup> | 3.5   | 7     | 10  | 3.5                    | 3.5   | 3.5   | 10    | 15  |
|                                   | 20-40 | 3.5                                                                                                                                                                                                             | 3.5               | 7     | 10    | 15  | 3.5                    | 3.5   | 10    | 15    | 20  |
|                                   | 40-60 | 7                                                                                                                                                                                                               | 7                 | 10    | 15    | 20  | 10                     | 10    | 15    | 20    | 25  |
|                                   | 60-80 | 10                                                                                                                                                                                                              | 10                | 15    | 20    | 25  | 15                     | 15    | 20    | 25    | 30  |
|                                   | >80   | 10                                                                                                                                                                                                              | 15                | 20    | 25    | 25  | 15                     | 20    | 25    | 30    | 30  |

<sup>a</sup> 3.5% wildlife tree retention is the minimum legal requirement at the cutblock level and is consistent with recommended levels of 0-3 and 3-6% for landscapes where <33% is available for harvest and percent of area harvested <50% as per Table 20(a) and 20(b) of the Biodiversity Guidebook.

<sup>b</sup> The remaining retention targets for NDT3 ecosystems are based on Klenner (2006) reflecting increased retention as the area available for harvest (THLB) increases and area subject to harvest or disturbances has occurred. These values are consistent with Biodiversity Guidebook Table 20(a) and 20(b) that recommend 6-10% and 10-16% where 30-70% occurs, or >70% occurs in either THLB or existing harvest\disturbance. In landscapes where both THLB and extent of existing harvest exceed 70%, 11-15% and 14-18% are recommended in the Biodiversity Guidebook. The increased stand-level retention at greater disturbance levels considers that other landscape scale biodiversity elements (e.g. seral stage distribution targets) are not able to be applied.

<sup>c</sup> NDT1, NDT2 and NDT4 ecosystems experience infrequent stand-initiating disturbance events and longer disturbance return intervals (>200 years) and more frequent intermediate to small gap phase disturbances (Biodiversity Guidebook 1995, Delong 2011). For all landscape combinations where THLB and harvested/disturbed area both exceed *Low-Moderate* a level of 15% was used as a starting point based on guidance from the 2007 Coast Forest Conservation Initiative (CFCI), and retention amounts were scaled according to NDT3 estimates and consistent with Zielke (2008).

### Indicator Sub-question

The indicator sub-question required to answer Question #1 asks: “*Is the total amount of retention associated with the cutblock is equal to or less than recommended based on the landscape context within the Landscape Unit and Biogeoclimatic subzone (LU/BEC) the random cutblock is located?*”

To answer the question, the District Landscape Context Summary Tables provide outputs to evaluate whether the total amount of retention in the cutblock is *Exceeding*, *Above*, *Below* or *Well Below* the recommended guidance target. The cutblock is automatically assigned to one of the four categories in the district summary spreadsheet based on the retention information provided for the cutblock in RESULTS compared to the recommended targets in Table 2. The categories *Exceeding*, *Meeting*, *Below* or *Well Below* are assigned as per Figure 7.

**Note:** The categories of *Exceeding*, *Meeting*, *Below* or *Well Below* recommended guidance target are interpreted around the minimum guidance target. For Example, the category *Meeting* is set slightly below the minimum guidance target. So, if the recommended minimum guidance target is 10%, the *Meeting* guidance targets category is set at 8-15%. This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

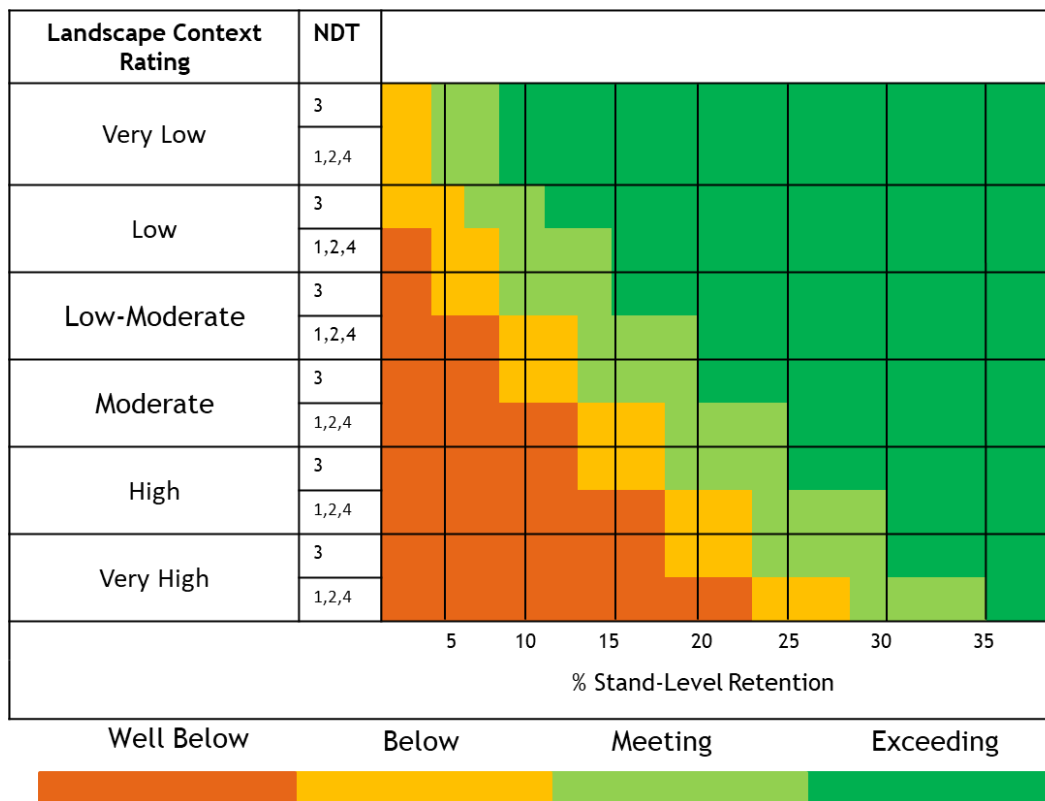


**Figure 7.** Categories of *Exceeding*, *Meeting*, *Below* and *Well Below* for comparing actual percent stand-level retention to recommended percent (%) stand-level retention considering natural disturbance type (NDT) and landscape context (Percent timber harvesting land base and percent disturbance)

### Verifying the Indicator Information

As the answers to the indicator sub-questions are provided based on the GIS analysis, evaluators are asked to verify if the answer to this question is accurate. To verify the provided answer is accurate, complete the following steps:

- 1) Familiarize yourself with the landscape context for the random cutblock by identifying which categories of % THLB, % forest disturbance. Note if any of the reported amounts are close to the breakpoints between %THLB of % Forest Disturbance classes (20%, 40%, June, 2022

60% and 80%)

- 2) Next, identify the total retention amount (PCT\_RET) for the random sample cutblock from the summary table. Compare the block gross area (GROSS\_HA), reserve area (RES\_HA), dispersed reserve area (DISP\_RES\_HA) and percent total retention (PCT\_RET) provided in the District Landscape Context Summary Table of FREP Map with the Site Plan provided to ensure the amounts align with the Site Plan. If there are differences field verification may be required.

Note: wildlife trees in areas of dispersed retention are not counted towards the total retention amount in the District Landscape Context Summary Table. If dispersed retention amounts exist these will need to be quantified and added to the overall retention amount and re-considered in the rating.

- 3) If the percent retention is consistent with the site plan, compare the reported retention amount with the target amount (Q1\_Target) and rating (Q1\_Rating)  
If the total Retention for the cutblock appears to be different than the site plan or, evaluators have the option to over-ride the outcomes in the steps below if they feel the licensees attempted to follow the guidance and are close, or the landscape context is close to a breakpoint that will affect the rating for the cutblock.

Tip: Note if the % stand-level retention is close to the breakpoints between categories. If either is close to the lower breakpoint note the amount. Moving to a landscape context category with higher %THLB or disturbance will change the guidance targets, which may mean a cutblock is rated as *Below* targets using one THLB % category and *Meeting* guidance targets if it fell in the next category lower. For example, if THLB is 41% for a LU/Bec Subzone it will fall in the 40-60% THLB category. This could change the retention target from 10-15%. So, a block with 12.6% retention would easily be *Meeting* the recommended guidance target in the 21-40%% THLB category but would fall *Below* the guidance target at 15% in the 40-60% THLB category.

- 4) As a final step, if the evaluator has modified the rating, provide the revised rating in the "Q1\_Override" column and record any rationale for modifying the block retention amount, targets, or ratings in the "Comments" column.

## Question #2 - Patch Size - Is the amount of stand-level retention adequate considering the size of the harvested patch?

In managed landscapes, as forest harvesting progresses over time or as severe disturbance occur, existing harvested or disturbed areas can coalesce to create large ‘functional openings’ or ‘patches’. To help conserve wildlife habitat and biodiversity within these patches, existing guidance recommends increasing the amount of stand-level retention within newly planned cutblocks that form parts of the larger ‘patches’ with adjacent young forest (Table 7). In heavily affected and cutover landscapes where large areas are rapidly converted to young forest, increasing stand-level retention can help offset the reduction in mature forest outside of harvested areas (Eng 2004, Snetsinger 2005, Klenner 2006, BC MFLNRORD 2017).

**Table 7.** Recommended percent stand-level wildlife tree retention for different patch size classes relative landscape context ratings and natural disturbance type. Adapted from (Eng 2004; Snetsinger 2005; Klenner 2006, BCMFLNRORD 2018)

Wetzelinger 2005, Kienner 2006, SCHMIDTKE 2010,

| Patch Size               | Landscape Context       |    |     |    |    |    |                        |    |     |    |    |    |
|--------------------------|-------------------------|----|-----|----|----|----|------------------------|----|-----|----|----|----|
|                          | VL                      | L  | L-M | M  | H  | VH | VL                     | L  | L-M | M  | H  | VH |
|                          | NDT3                    |    |     |    |    |    | NDT 1/2/4 <sup>a</sup> |    |     |    |    |    |
|                          | Recommended % Retention |    |     |    |    |    |                        |    |     |    |    |    |
| <50ha <sup>b</sup>       | 3.5                     | 7  | 10  | 15 | 20 | 25 | 3.5                    | 10 | 15  | 20 | 25 | 30 |
| 50-250 ha <sup>c</sup>   | 7                       | 10 | 10  | 15 | 20 | 25 | 10                     | 15 | 15  | 20 | 25 | 30 |
| 250-1000 ha <sup>c</sup> | 10                      | 15 | 15  | 20 | 25 | 25 | 15                     | 20 | 20  | 25 | 30 | 30 |
| >1000 ha <sup>c</sup>    | 15                      | 20 | 20  | 25 | 25 | 25 | 20                     | 25 | 25  | 30 | 30 | 30 |

<sup>a</sup> Estimates for patch sizes in NDT1/2/4 are scaled according to NDT3 estimates with increased retention levels representing lower severity disturbances.

<sup>b</sup> For cutblocks and patches <50ha – guidance targets follow Table xx for Question 1 based on landscape context and NDT.

<sup>c</sup> Patch sizes >50 ha where the landscape context is Low-Moderate (L-M) or greater, representing landscape conditions where large-scale salvage situations may occur, minimum retention levels by patch size class follow Eng (2004), Snetsinger (2005) and BCMFLNRORD 92018) in NDT3 ecosystems and are scaled by accordingly for other NDTs.

### Indicator Sub-question

The indicator sub-question required to answer Question #2 asks: “Is the total amount of retention associated with the cutblock is equal to or less than recommended based on the patch size and landscape context that the random cutblock is located?” Retention amounts by in patches <50ha are at minimum consistent with recommended levels by NDT and landscape context referenced in Question #1, but increase with larger patch sizes.

To answer the sub-question, the District Landscape Context Summary Tables provide outputs to evaluate whether the total amount of retention in the cutblock is *Exceeding*, *Above*, *Below* or *Well Below* the recommended guidance target. The cutblock is

automatically assigned to one of the four categories in the district summary spreadsheet based on the retention information provided for the cutblock in RESULTS compared to the recommended targets in Table 3. The categories *Exceeding*, *Meeting*, *Below* or *Well Below* are assigned as per Figure 8.

**Note:** The categories of *Exceeding*, *Meeting*, *Below* or *Well Below* recommended guidance target are interpreted around the minimum guidance target. For example, the category *Meeting* is set slightly below the minimum guidance target. So, if the recommended minimum guidance target is 10%, the *Meeting* guidance targets category is set at 8-15% (Figure 8). This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

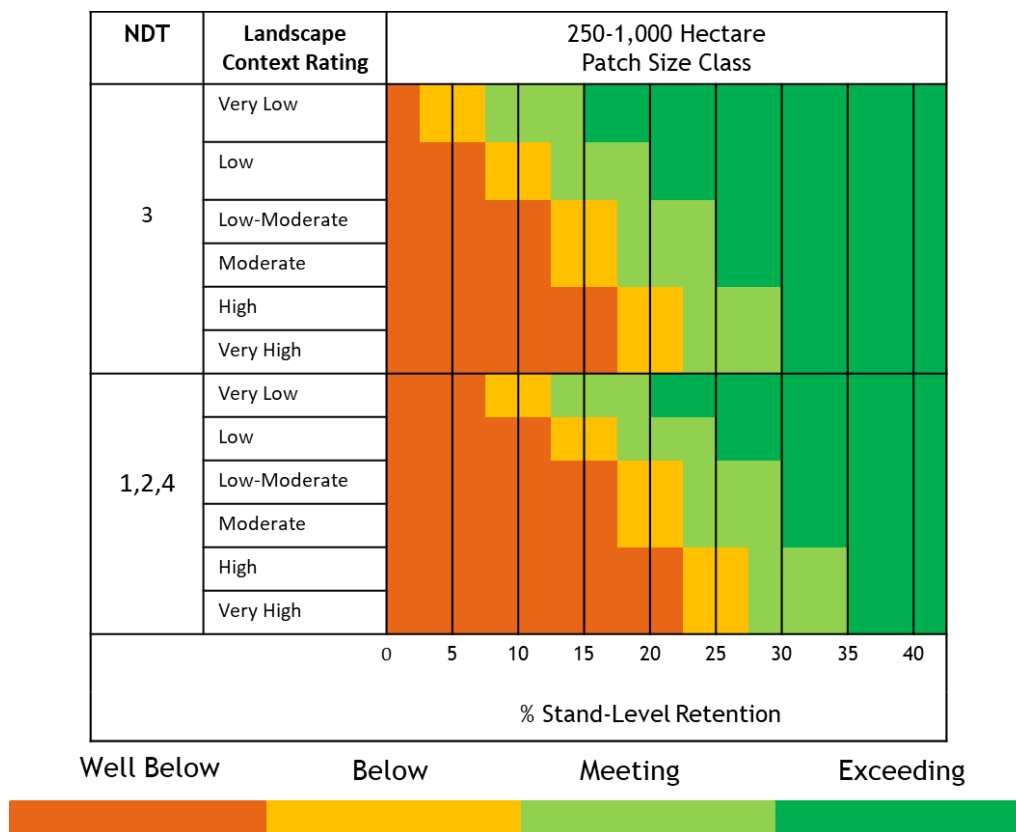


**Figure 8.** Categories of *Exceeding*, *Meeting*, *Below* and *Well Below* for comparing actual percent stand-level retention to recommended percent (%) stand-level retention considering patch size class, Natural disturbance type (NDT) and landscape context.

To provide information to answer the sub-question a GIS-based patch size analysis was completed for all random cutblocks on the list. The GIS analysis completes a 3-step buffering exercise for each random cutblock to evaluate the size of patch the cutblock is associated with. The random cutblock is first buffered by 150 metres to identify any adjacent harvested openings harvested within 30 years prior to 2015 (2015 is used as the pre-harvest reference year for cutblocks harvested between 2015-2020). Any adjacent cutblocks are then merged

to create a new patch (Fig. 9A + B). This step is then repeated 2 more times forming a larger patch if adjacent blocks exist or stabilizing at the same size if no adjacent cutblocks are found (Fig. C + B). After the three iterations of the buffering exercise, the area in hectares of the resulting patch is calculated and assigned into one of the five patch size classes (<50, 50-250, 250-1,000, >1,000 and >10,000).

**Note:** several random cutblocks can be associated with the same patch if they fall nearby in the same landscape and incorporate the same adjacent cutblocks.

The results of the GIS patch size analysis are used to populate the District Landscape Context Summary Tables. The summary table shows the patch size (Patch\_Size) and patch size class (Ptch\_Class) that each random cutblock on the list is associated with. That information is used to provide the answer to whether the total amount of retention in the cutblock is *Exceeding, Above, Below* or *Well Below* the recommended guidance target for a patch of that size. The recommended targets for each patch size category considering both landscape context and NDT are assigned as per Table 3.

### *Verifying the Indicator Information*

As the answer to the sub-question is provided through a GIS analysis, evaluators are asked to verify if the answer to this question is accurate. To verify the answer, complete the following steps:

- 1) Familiarize yourself with the landscape context for the by identifying which categories of % THLB, % Forest Disturbance apply to the random cutblock. Note if any of the reported amounts are close to the breakpoints between %THLB of % Forest Disturbance classes (20%, 40%, 60% and 80%)
- 2) Next, identify the Patch Size (Patch\_Size), Patch Size Class (Ptch\_Class) and retention target for a patch of that size (Q2\_target) for the random cutblock from the District Landscape Context Summary Table of FREP Map and ensure it is consistent with Table 7. Note if the patch size (hectares) is close to the breakpoints between patch size classes as this may influence the final rating.
- 3) As an extra measure, visually review the patch boundary associated with the random cutblock in FREP Map. This will help to validate the results of the GIS analysis. Also, review the results against the site plan map provided for the cutblock to ensure any WTRAs inside the cutblock and adjacent forest is correctly captured. Remember, only cutblocks up to 2015 will be captured in the GIS analysis. Any blocks that occurred adjacent after this date will not.
- 4) Like Question #1 confirm the reported retention amount for the random cutblock is consistent with the Site Plan and compare to the target for a cutblock.
- 5) As a final step, confirm if the rating assigned for Question #2 (Q2\_Rating) is correct. If the evaluator decides to override the results, record the revise rating in the 'Q2\_Override' and provide rationale in the "Comments" column

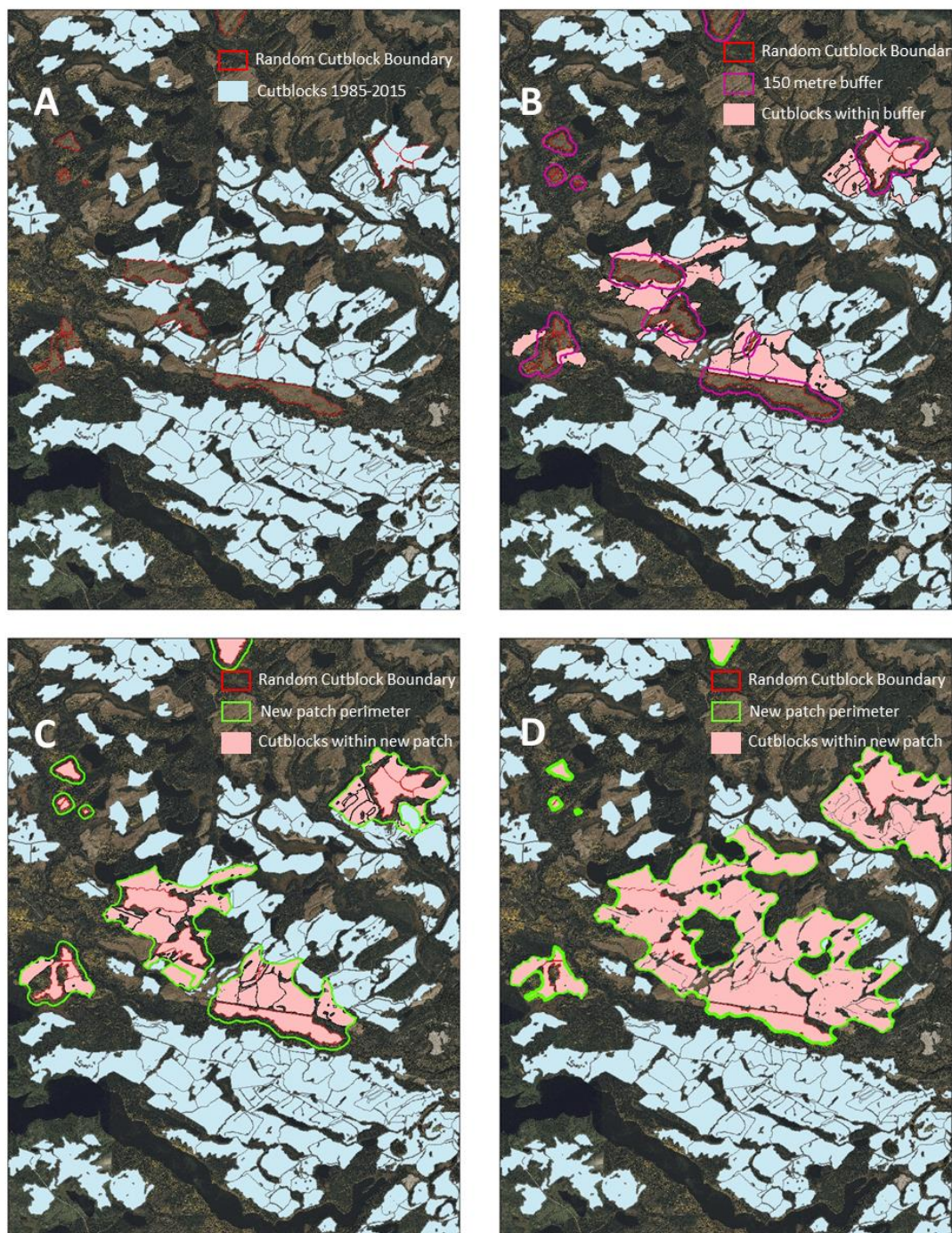


**Figure 9.** An illustration of steps in patch formulation for randomly selected cutblocks. A) Random cutblocks from the District random cutblock list (red outline) and cutblocks within 30 years (1985-2015) prior to harvest. B) a 150 metre buffer to the outside of the random cutblocks (dark pink line) and adjacent cutblocks within the 150 metre buffer (pink colored blocks). C) The harvested 'patch' (green outline- pink colored blocks) consistent of the random cutblock and any adjacent blocks harvested within 30 years after one buffering iteration. The new patch boundary will be used for further buffering. D) The final 'patch' after 3 buffering iterations. Note that some patches expanded significantly and could expand, whereas the patch associated with cutblocks with no surrounding blocks (upper left of inset photos) did not change after 3 buffering iterations.

### Question 3: Is the amount and spatial location of stand-level retention adequate to help maintain landscape-level connectivity?

Maintaining landscape connectivity<sup>8</sup> during forest harvesting can be improved by providing reasonable distances between wildlife tree retention areas (WTRAs), areas of dispersed tree retention within the cutblock, and forest adjacent to the cutblock. The Biodiversity Guidebook originally recommended a maximum distance of 500 metres between WTRAs and adjacent suitable forest habitat. This recommendation assumed other stand and landscape-level biodiversity elements (e.g. riparian reserves, OGMAs, seral distribution targets or FENs) would also be established to ensure habitat attributes associated with mature and old forests are generally available and connected in the surrounding landscape. However, in many cases these landscape-level tools were not implemented, and some landscapes have been highly modified through multi-pass harvesting or due to large-scale natural disturbances and salvage. In those situations, existing guidance recommends reducing the maximum distances between wildlife tree retention areas and adjacent suitable habitat is recommended (Klenner 2006, BCMFLNRORD 2018), coinciding with increased cutblock level wildlife tree retention amounts (Table 8).

**Table 8.** Recommended distances between retention areas >0.25ha within harvested openings relative to surrounding landscape condition. Table adapted from Klenner (2006).

|                                   |        | Percent (%) Forest Disturbance                                                                           |        |         |        |       |
|-----------------------------------|--------|----------------------------------------------------------------------------------------------------------|--------|---------|--------|-------|
|                                   |        | Percent of LU/BGC subzone harvested pre-1995, early seral forest and/or medium-high severity disturbance |        |         |        |       |
| Percent of THLB in LU/BGC subzone |        | <20%                                                                                                     | 21-40% | 41--60% | 61-80% | >80%  |
|                                   | <20%   | <500m <sup>a</sup>                                                                                       | <500m  | <500m   | <400m  | <300m |
|                                   | 21-40% | <500m                                                                                                    | <500m  | <400m   | <300m  | <300m |
|                                   | 41-60% | <400m                                                                                                    | <400m  | <300m   | <300m  | <200m |
|                                   | 61-80% | <300m                                                                                                    | <300m  | <300m   | <200m  | <150m |
|                                   | >80%   | <300m                                                                                                    | <300m  | <200m   | <150m  | <150m |

<sup>a</sup> 500m is the maximum recommended distance between wildlife tree patches in the Biodiversity Guidebook. The remaining distances are from Klenner (2006). Omenica Region Guidance (BCMFLNRORD 2018) also recommends <250m between retention consistent with ecosystems that experience fewer stand-replacing disturbances and more gap-phase dynamics (DeLong 2011) and is consistent with recommended levels in the lower right of this table.

<sup>8</sup> The term 'Landscape connectivity' is defined as a "human perception of the connectedness of patterns of vegetative cover in a landscape" (Lindenmayer and Fisher 2006). Landscape connectivity measured as the spatial distribution of specific vegetative cover can be directly related to habitat connectivity, but not always. The term 'habitat' is species-specific, referring to the environments necessary to support an individual species. The term 'Habitat Connectivity' refers to the connectedness of habitat patches for individual species (Lindenmayer and Fisher 2006). How connected habitats are is also species-specific as it relates to the natural distribution of species and the mobility and mode of travel – the ability of different animals to move between habitat.

### Indicator Sub-Question

The indicator sub-question required to answer Question #3 asks: “Is the average distance between WTPs and adjacent forest equal to or less than recommended?”

The District Landscape Context Summary Tables provide outputs to evaluate whether the maximum distance in the cutblock is *Exceeding*, *Above*, *Below* or *Well Below* the recommended guidance target. The cutblock is automatically assigned to one of the four categories in the district summary spreadsheet based on the maximum distance information calculated for the cutblock compared to the recommended targets in Table 4. The categories *Exceeding*, *Meeting*, *Below* or *Well Below* are assigned as per Figure 10.

**Note:** The categories of *Exceeding*, *Meeting*, *Below* or *Well Below* recommended guidance target are interpreted around the minimum guidance target. For Example, the category *Meeting* is set slightly below the minimum guidance target. So, if the recommended minimum guidance target is <300, the *Meeting* guidance targets category is set at 350m. This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

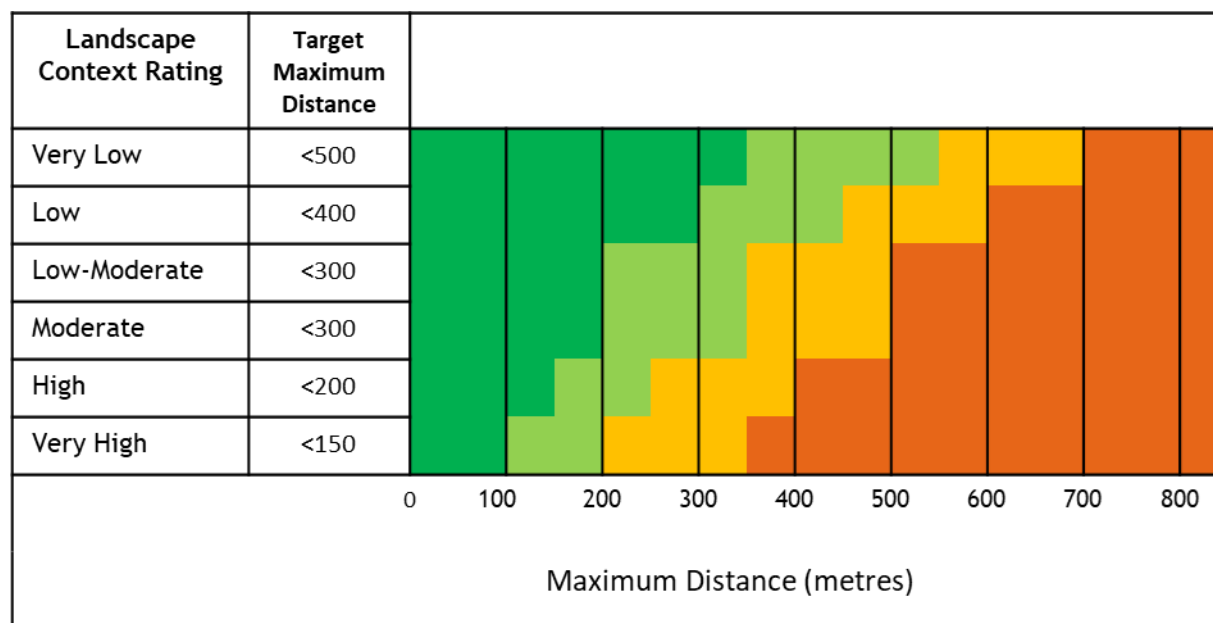


**Figure 10.** Rating categories assigned to maximum distance (metres) between wildlife tree retention and based on target maximum distance by landscape Context rating.

To provide information to answer the sub-question a GIS-based buffer analysis was completed for all random cutblocks on the list. First, the GIS analysis identifies any internal forest reserves and adjacent forest >40 years that is within 100 metres of the cutblock boundary (Fig 11 A and B). Next a series of buffer distances are computed at 25, 50, 100,

150, 200 and 250 metres internal to the cutblock (Fig. 11B). The area of the cutblock that is covered by internal forest reserves and each buffer distance is then calculated. The area of forest reserves inside the block and any of the NAR within 25m (1 tree length) of internal forest or forest adjacent to the cutblock is calculated as the area of 'Forest Influence' (Fig 11C). If a buffer distance covers >90% of the gross area of the cutblock, then that buffer distance is used to calculate the maximum distance across the cutblock. So, maximum distance = 2X the buffer distance covering >90% of the gross cutblock area (reserve areas internal to the cutblock are part of the internal buffer). For example if 90% of the cutblock is covered by combination of WTRAs or is within 100 metres of an WTRA or adjacent forest, then the maximum distance an organism would need to travel between adjacent forest within or across the cutblock is <200 metres (Fig 11D).

### *Verifying the Indicator Information*

As the answer to the sub-question is provided through a GIS analysis, the evaluators are asked to verify if the answer to this question is accurate. To verify the answer to this question is accurate complete the following steps:

- 1) Familiarize yourself with the landscape context for the by identifying which categories of percent THLB and percent disturbance apply to the random cutblock. Note if any of the reported amounts are close to the breakpoints between %THLB of % Forest Disturbance classes (20%, 40%, 60% and 80%)
- 2) Next, identify the calculated maximum distance (Max\_Dist) and target maximum distance (Q3\_target) for the cutblock from the District Landscape Context Summary Table of FREP map and ensure it is consistent with Table 8.
- 3) Visually review the Forest Influence layer for the cutblock in FREP map to validate the results of the GIS analysis. Review the results against the Site Plan map provided for the cutblock to ensure any WTRAs inside the cutblock and adjacent forest is correctly captured. Remember, only cutblocks up to 2015 will be captured in the GIS analysis. Any blocks that occurred adjacent after this date will not and should not be considered as these were not present at the time the cutblocks was planned and harvested.
- 4) Identify if any dispersed retention for the cutblock is captured in the District Landscape Context Summary Table and compare with the Site Plan. Dispersed retention is not accounted for in the GIS analysis but contributes to within-block connectivity and should be considered. As a rule, if at least 25% of the cutblock has dispersed strata, the calculated maximum distance (Max\_Dist) for the cutblock can be reduced by 100 metres.
- 5) If the Forest influence layer appears to be incorrect, evaluators can visually estimate the portion of the cutblock that has forest influence and assign the appropriate rating based on Table 8. Likewise, if a cutblock is close to the breakpoint between categories and is close to a breakpoint for %THLB or % Forest Disturbance the evaluator can assign a different target value that may better reflect that the intent of the retention is close to the landscape context.
- 6) As a final step, if the measured maximum distance, compare the measured maximum distance to the target maximum distance in the landscape context summary table. Use the difference between the measured and target amount to assign whether the stand-level retention is *Exceeding*, *Above*, *Below* or *Well Below* the recommended guidance targets.

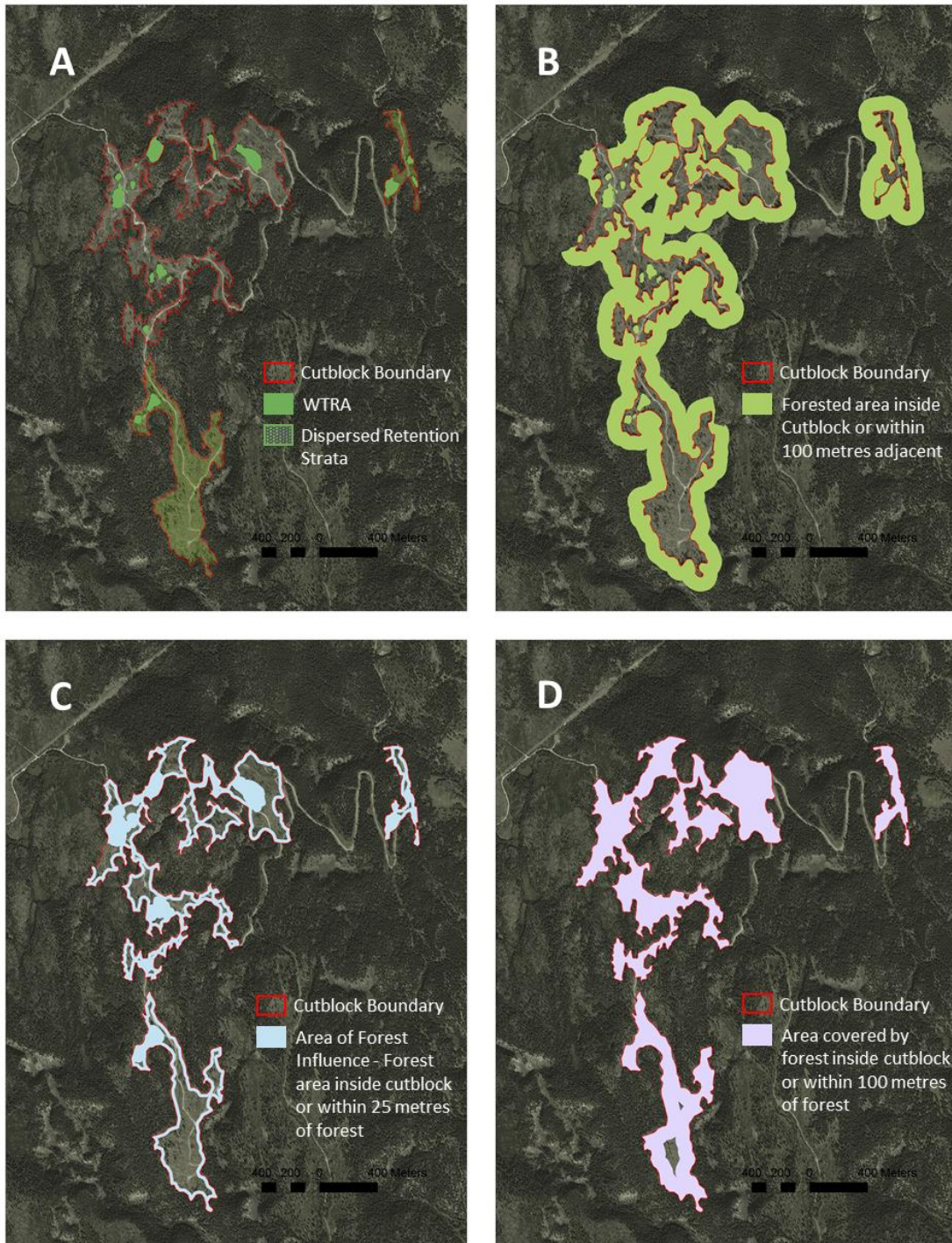


**Figure 11.** Cutblock boundary (red), WTRAs within the block (green) and area of dispersed retention (green hatched) are shown in the top left (A). The area of forest influence including WTRAs inside the block and forest within 100m surrounding the cutblock perimeter (B). Note: the area of dispersed retention is not included. The percent forest influence inside the cutblock includes areas covered by forest or within 1 tree length (25m) of forest (C). Area of the cutblock within 100 metres of forest influence covers >90% of the cutblock area (D) and so the maximum distance for the cutblock is <200 metres.

## Question #4 - Does Wildlife Tree Retention and block shape contribute to a range of microenvironments and structural complexity within the block?

Green tree retention in harvested openings has long been used as a silviculture treatment to modify the microenvironment in the harvested stand to promote tree regeneration (e.g. seed-tree, shelterwood and selection silviculture systems). Green tree retention within a harvested opening and forest edge adjacent to an opening also has ecological benefits within the harvested opening because modifying the micro-environment allows some forest species to persist, facilitates dispersal of organisms, and contributes to structural complexity. The term ‘forest influence’ is used to describe the ecological effects of residual trees and forest edge on a harvested opening and is typically measured as the area surrounding a tree or forest edge with a radius equal to the tree height (Beese, 2019). The extent of forest influence in a cutblock is affected by cutblock size, shape and the amount, type (patch, dispersed or aggregate) and placement (interior, edge or exterior to the cutblock) of wildlife trees.

Limited guidance exists to define the area of the block that should be within forest influence to achieve biodiversity and wildlife habitat conservation goals. As a preliminary target, a minimum of 40% of the gross block area should be within 1 tree length (approximately 25m) of adjacent forest or a WTP  $>0.1 \text{ Ha}^9$ . The area of forest influence is calculated as both the total area of the cutblock as WTP, the total NAR that is within 25m of a WTP or adjacent forest edge as well as retention-weighted area of dispersed tree retention. The 40% target is based on work of Chan-McLeod and May (2007) who modelled different amounts (10, 20, 30 and 40% retention) and sizes of retention areas (0.1, 0.5, 1.0, 1.5 and 2 ha) randomly dispersed in a 40 hectare cutblock. They found that at 10% retention inter-patch distance ranged from as low as 40m to 180m. Assuming 25m either side of the inter-patch distance is influenced by adjacent forest, then approximately 25% of the harvested area would have forest influence at 10% retention and 2 ha patches. The level of forest influence increases at that level of retention with more smaller patches and a lower inter-patch distance. At or above 20% retention – approximately 50% or more of the harvested area will have forest influence. The 40% target is based on a minimum 25% forest influence in the NAR plus 10% associated with WTPs.

### Indicator Sub-Question

The indicator sub-question required to answer Question #4 asks: “Is 40% or more of the gross area of the cutblock under Forest Influence?”

The District Landscape Context Summary Tables provide outputs to evaluate whether the level of forest influence in the cutblock is *Exceeding*, *Above*, *Below* or *Well Below* the recommended guidance target of 40%. The cutblock is automatically assigned to one of the four categories in the district summary spreadsheet based on the forest influence calculated for the cutblock compared to the recommended target of 40%. The categories *Exceeding*,

<sup>9</sup> For most cutblocks <10 ha in size, the 40% area of forest influence should be achieved even with no internal retention patches.

*Meeting, Below or Well Below* are assigned as per Table 11.

**Note:** The categories of *Exceeding, Meeting, Below* or *Well Below* recommended guidance target are interpreted around the minimum guidance target. For example, the category *Meeting* is set slightly below the minimum guidance target. So, if the recommended minimum guidance target is 40%, the *Meeting* guidance targets category is set at 38-45%. This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

**Table 11.** Assigned ratings for Question #4 based on the percent of forest influence in the sampled cutblock

| Percent (%)<br>Forest Influence | Assigned<br>Rating |
|---------------------------------|--------------------|
| <33%                            | Well Below         |
| 33-38%                          | Below              |
| 38-45%                          | Meeting            |
| >45%                            | Exceeding          |

To provide an answer for this question, the protocol uses outputs from the same GIS buffer analysis used for Question #3 and as illustrated in Fig. 11 and results of the field sampling for dispersed strata. The GIS analysis outputs provide the gross area of the block that is covered by WTRA plus any part of the NAR that is within the 25m buffer (approximating 1 tree length) of a WTRA or forest >40 years adjacent to the cutblock is considered under forest influence. The field sampling data provides information on strata within the NAR that has dispersed wildlife tree retention. Forest influence associated with dispersed wildlife trees is calculated based on the percent of gross cutblock area as dispersed wildlife tree retention. Percent area of dispersed wildlife tree retention is calculated using the basal area equivalent hectares of dispersed retention where the measured basal area ( $m^2/ha$ ) of dispersed retention from plots is divided by the average basal area ( $m^2/ha$ ) based on cruise data from the same BEC zone. The results is a number from 0-1.0 that is then multiplied by dispersed stratum size in hectares. As the percent dispersed WT retention basal area increases the contribution to forest influence also increases (Table 12).

**Table 12.** Percent of dispersed strata area that contributed to overall cutblock forest influence based on percent of pre-harvest basal area that is retained as wildlife trees (Percent dispersed wildlife tree retention)

| Percent Dispersed Wildlife Tree Retention | Percent of Dispersed Strata Area that Contributes as Forest Influence |
|-------------------------------------------|-----------------------------------------------------------------------|
| 0%                                        | 0%                                                                    |
| 1-5%                                      | 10%                                                                   |
| 5.1-10%                                   | 25%                                                                   |
| 10.1-15%                                  | 40%                                                                   |
| >15%                                      | 50%                                                                   |

### Verifying the Indicator Information

As the answer to the sub-question is provided through a combination of GIS analysis and results from the field sampling, the evaluators are asked to verify if the answer to this question is accurate. To verify the answer to this question is accurate complete the following steps:

- 1) Familiarize yourself with the landscape context for the random cutblock by identifying which categories of percent THLB and percent disturbance apply. Note if any of the reported amounts are close to the breakpoints between %THLB or % Forest Disturbance classes (20%, 40%, 60% and 80%)
- 2) Next, identify the percent forest influence (PCT\_Forest\_Influence) for the random sample from the District Landscape Context Summary Table or FREP Map.
- 3) Visually review the Forest Influence layer for the cutblock in FREP map to validate the results of the GIS analysis. Review the results against the Site Plan map provided for the cutblock to ensure any WTRAs inside the cutblock and adjacent forest is correctly captured. Remember, only cutblocks up to 2015 will be captured in the GIS analysis. Any blocks that occurred adjacent after this date will not.
- 4) Identify if any dispersed retention for the cutblock is captured in the District Landscape Context Summary Table and compare with the Site Plan. Dispersed retention is considered in the calculation of percent forest influence as contributing 50% of the dispersed retention area.
- 5) If the Forest influence layer appears to be incorrect, evaluators can visually estimate the portion of the cutblock that has forest influence and assign the appropriate rating based on the breakpoint value of 25%. Likewise, if a cutblock is close to the breakpoint between categories and is close to a breakpoint for %THLB or % Forest Disturbance the evaluator can assign a different target value that may better reflect that the intent of the retention is close to the landscape context.
- 6) As a final step, compare the calculated percent forest influence to the target maximum distance in the landscape context summary table. Use the difference between the measured and target amount to assign whether the stand-level retention is *Exceeding*, *Above*, *Below* or *Well Below* the recommended guidance targets.

## Category: Quality of Standing Live and Dead Tree Retention

Stand-level forest structure plays a key role in providing habitat for many wildlife species that have life history traits (e.g. breeding, nesting, denning) associated with unique tree structural attributes (e.g. large size, large branches, loose bark or hollows on dead trees). Forest structural conditions that support these attributes may only occur or develop in some seral stages (e.g. post disturbance or late seral conditions) and so the amount and frequency at which these conditions occur varies with natural disturbance regimes. The abundance and distribution of many vertebrate species is often directly related to the range of forest structural conditions that emerge consistent with natural disturbance patterns (Bunnell 1995).

To ensure a range of habitat structures are available to support wildlife use in managed stands requires careful consideration and planning during forest operations. Maintaining and recruiting large structural attributes (large trees, snags, CWD) into managed forests is challenging as rotation periods for managed stands are often short (60-80 years) relative to disturbance return intervals. Shortened rotation periods do not allow for the decades or even centuries of later seral forest conditions necessary to develop large trees and snags with important habitat attributes. So, retention and recruitment of large trees and snags through wildlife tree retention practices can assist in improving how well managed stands function at maintaining wildlife habitat and biodiversity in managed stands. Guidance for wildlife tree retention includes:

- Target specific tree species, or large, rare, or uncommon larger trees as well as larger hard (class 3-6), or soft` snags (class 7-8),
- Plan WTRAS to incorporate 'ecological anchors' such as high densities of large snags or uncommon standing live (large veteran trees) or dead trees (large soft snags),
- Retain a buffer for windfirmness and to allow for safety tree removal on the perimeter of the WTRA without affecting targeted trees.
- Spatially locate wildlife tree retention to protect unique features within or adjacent to the cutblock such as wetter sites, riparian features or dry rocky outcrops that due to their unique site conditions may host uncommon or rare tree species.

To evaluate the quality of live and dead standing tree retention at the individual cutblock scale, the protocol identifies two questions (Questions 5 and 6) related to the size and condition of standing live and dead trees, and whether effects of windthrow on residual trees has been minimized:

- 5) Standing Live and dead tree size and condition – Will standing live and dead wildlife trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?
- 6) Wildlife Tree Retention Practices - Do stand-level retention practices retain wildlife trees and conserve important habitat features by minimizing windthrow?

### *Factors Influencing Standing Dead and Live Tree Retention Attributes*

Prior to answering indicator statements, evaluators should review the cutblock Site Plan to determine factors that may alter standing live or dead wildlife tree density relative to ‘average’ pre harvest conditions. Several factors can influence the ability of prescribing foresters to retain large wildlife trees because large wildlife trees or snags have yet to develop in the stand or have been affected by recent disturbance. These include:

- Harvesting of 2<sup>nd</sup> or 3<sup>rd</sup> growth forests,
- Commercial thinning in young stands (<60 years), or
- Salvage harvesting of forests affected by wildfire, windthrow or insect-induced tree mortality

### Question #5 - Will standing live and dead trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?

Wildlife tree retention guidance recommends maintaining larger trees and snags, and trees in later stages of decay (Wildlife Tree Class 3-8). In managed stands, trees with these attributes are most difficult to recruit. By following this guidance, wildlife trees retained at the time of harvest should capture a range of tree sizes similar to or greater than the average and range of the tree diameter (dbh) for live and dead trees than ‘average’ pre-harvest stands.

Pre- harvest stand structural conditions (tree size, species composition, decay) for each cutblock being evaluated by FREP are not available, and so ‘average’ pre-harvest stand conditions are provided as benchmarks for different forest ecosystems in BC . To characterize wildlife tree characteristics in different ecosystems in the province, a comprehensive data summary compiled existing plot information from various sources by Biogeoclimatic (BGC) Groups<sup>10</sup>. Due to similar structural conditions across multiple BGC Groups, the BGC Groups were further lumped into broad Forest Types to simplify the comparison against measured data (Table 5). Benchmark information from various Forest Types in BC show differences in the expected amount and percent of live trees >30cm and >50cm DBH in mature to old forests. Differences are associated with forest productivity and disturbance return intervals. Areas with relatively frequent stand-initiating disturbances (NDT3) consist of shorter-lived tree species such as lodgepole pine or trembling aspen that rarely achieve large diameters, while NDT 1 and 2 ecosystems associated with more productive Cool Montane and Cool Wet Montane forests having longer periods between stand-initiating events and longer-lived tree species such as red cedar that grow to larger diameter.

**Table 13.** Categorization of Biogeoclimatic Groups into six broad Forest Types by used in developing benchmark levels of wildlife trees and snags.

| Forest Type | Biogeoclimatic (BGC) Group |
|-------------|----------------------------|
| Dry Forest  | IDF Dry, IDF Very Dry      |

<sup>10</sup> Huggard, D. 2020. Baseline datasets  
June, 2022

|                    |                                                       |
|--------------------|-------------------------------------------------------|
| Cool Dry Montane 1 | SBS Dry/SBPS, MS Dry (SWB)*                           |
| Cool Dry Montane 2 | ICH/IDF, ICH Dry                                      |
| Cool Montane 1     | SBS Moist, BWBS Dry, BWBS Moist, ESSF Dry, ESSF Moist |
| Cool Montane 2     | SBS Wet, ESSF Wet, ICH Moist                          |
| Cool Wet Montane   | ICH Wet, CWH Moist, CWH Wet, MH                       |

### Indicator Sub-Questions

The following three indicator sub-questions are used to evaluate Question #5 that asks: “Will the amount, size, and condition of retained wildlife trees provide habitat refugia and structural complexity within the regenerating stand now and in the future?”

- **Question 5a- Large Trees** – “Is the total density of large (>30cm DBH) retained stems (standing live and dead trees) in the cutblock equal to or greater than the average pre-harvest stand condition?”
- **Question 5b- Large Snags** – “Is the total density of all large (>30cm DBH) snags (WT Class 3-5) in the cutblock equal to or greater than the average pre-harvest stand condition?”
- **Question 5c - Large Soft Snags** – “Is the total density of large (>30cm DBH) soft snags (WT Class 6-8) in the cutblock equal to or greater than the average pre-harvest stand condition?”

Each sub-question is evaluated and categorized as either *Exceeding*, *Meeting*, *Below* or *Well Below* pre-defined guidance targets. To answer the main question the average score assigned to each category (*Exceeding*=4, *Meeting*=3, *Below*=2, and *Well Below*=1) across all sub-questions is used. The average score is rounded up or down to the nearest whole number. For example, if the 2 sub questions are *Meeting* (score =3), and 1 sub questions is *Below* (score =2), the arithmetic average is  $2.5((3+3+2=8)$ , divided by the number of questions (3), so,  $(8/3=2.67)$ . This value is then rounded up to the nearest whole number, which is 3, the retention is *Meeting* recommended guidance targets.

**Note:** Cutblocks with no wildlife tree retention are not evaluated for sub-questions 5a-5c, assigned a “NA” value and Question 5 does not contribute to the overall cutblock rating.

**Note:** In assigning rating, the recorded density of large live trees and snags is calculated from plots sampled in both WTP and dispersed strata in the Net Area to be Reforested (NAR). However, when assigning the rating any large live trees or snags retained in the NAR are additive to the WTP densities, and not area-weighted. So, if a WTP has 75 stems/ha >30cm DBH measured in a WTP and an additional 10 stems/ha is retained in the NAR, the cutblock is credited with 85 stems/ha trees >30cm DBH. This approach inflates the density of large trees in the cutblock when assigning the ratings for question 5a-5c, giving increased value to practices that retain large wildlife trees in the harvested portion of cutblocks.

### Question 5a.- Large Trees

The indicator sub-question required to answer Question#5a asks: “Is the total density of large (>30cm DBH) trees (standing live and dead trees) in the cutblock equal to or greater than the average pre-harvest stand condition?”

To answer the question, field data collected in WTPs and dispersed tree strata is summarized and compared against benchmark levels depending on which forest type the cutblock resides. Benchmark levels for all trees >30cm DBH are derived based on the reported interquartile range (20-80% of all plots fall in this range) from benchmark data compiled for different Biogeoclimatic groups in BC and then grouped by Forest Type (Table 14).

**Table 14.** Representative pre-harvest tree density by Forest Type. Reported data shows the approximate interquantile range (20-80%) density (stems/hectare) for all trees >30cm and >50cm and percent (%) of total stems DBH.

| Forest Type               | all trees      |               |                |               |
|---------------------------|----------------|---------------|----------------|---------------|
|                           | Trees>30cm DBH |               | Trees>50cm DBH |               |
|                           | % of all trees | stems/hectare | % of all trees | stems/hectare |
| <b>Dry Forest</b>         | 15-25%         | 90-125        | 1-4%           | 10-20         |
| <b>Cool Dry Montane 1</b> | 5-15%          | 70-85         | <1%            | 2-7           |
| <b>Cool Dry Montane 2</b> | 25-30%         | 175-200       | 3-6%           | 25-35         |
| <b>Cool Montane 1</b>     | 15-20%         | 125-175       | 1-3%           | 5-20          |
| <b>Cool Montane 2</b>     | 25-35%         | 175-225       | 2-6%           | 20-35         |
| <b>Cool Wet Montane</b>   | 35-40%         | 250-350       | 10-15%         | 75-125        |

The reported range of large tree density is interpreted from Table xx to provide a target large tree density range in Table xx. The target categories of *Meeting* and *Exceeding* are set to include the interquartile range. Essentially, if the assessed large tree density retained on the cutblock is greater than the lowest 20% of benchmark conditions, retained large tree density is assessed as *Meeting* or *Exceeding* the target. The measured density of large trees is assessed a *Well Below*, *Below*, *Meeting*, or *Exceeding* the target densities in Table 15.

**Table 15.** Target densities (stems/ha) for large trees (>30cm DBH) by Forest Type used to evaluate question 5a.

| Forest Type               | Trees>30cm |        |         |           |
|---------------------------|------------|--------|---------|-----------|
|                           | Well Below | Below  | Meeting | Exceeding |
| <b>Dry Forest</b>         | <50        | 50-70  | 70-150  | >150      |
| <b>Cool Dry Montane 1</b> | <25        | 25-50  | 50-110  | >110      |
| <b>Cool Dry Montane 2</b> | <75        | 75-125 | 125-250 | >250      |

|                         |      |         |         |      |
|-------------------------|------|---------|---------|------|
| <b>Cool Montane 1</b>   | <50  | 50-75   | 75-225  | >225 |
| <b>Cool Montane 2</b>   | <75  | 75-125  | 125-275 | >275 |
| <b>Cool Wet Montane</b> | <150 | 150-200 | 200-400 | >400 |

#### Question 5b:

The indicator sub-question required to answer Question #5b asks: “Is the total density of all larger (>30cm DBH) snags (WT Class 3-8) retained stems in the cutblock equal to or greater than the average pre-harvest stand condition?”

To answer the question, field data collected in WTPs and dispersed tree strata is summarized and compared against benchmark levels depending on which forest type the cutblock resides. Benchmark levels for all large snags >30cm DBH are derived based on the reported interquartile range (20-80% of all plots fall in this range) from benchmark data compiled for different Biogeoclimatic groups in BC and then grouped by Forest Type (Table 16).

**Table 16.** Representative pre-harvest snag density by Forest Type. Reported data shows the approximate interquartile range (20-80%) density (stems/hectare) and percent (%) of total stem density for all snags, and snags >30cm and >50cm DBH.

| Forest Type               | Snags          |               |                 |               |                 |               |
|---------------------------|----------------|---------------|-----------------|---------------|-----------------|---------------|
|                           | All Snags      |               | Snags >30cm DBH |               | Snags >50cm DBH |               |
|                           | % of all trees | stems/hectare | % of all snags  | stems/hectare | % of all snags  | stems/hectare |
| <b>Dry Forest</b>         | 15-35%         | 90-200        | 5-15%           | 5-15          | <1%             | <1            |
| <b>Cool Dry Montane 1</b> | 45-60%*        | 400-550       | 5-10%           | 30-40         | <1%             | <1            |
| <b>Cool Dry Montane 2</b> | 15-20%         | 150-200       | 15-20%          | 15-25         | 2-3%            | 2-3           |
| <b>Cool Montane 1</b>     | 20-50%         | 150-300       | 10-20%          | 25-50         | 1-2%            | 1-4           |
| <b>Cool Montane 2</b>     | 15-35%         | 125-225       | 20-35%          | 30-60         | 1-5%            | 3-7           |
| <b>Cool Wet Montane</b>   | 5-15%**        | 40-75         | 20-35%          | 10-25         | 5-15%           | 3-10          |

\*Note: Most BGC groups (MS, SBS, SBPS, ESSF-Dry, some IDF and ICH) with lodgepole pine leading show high snag densities, particularly hard snags – reflecting cruise data of MPB-impacted salvage logged forests.

\*\*Note: Pre-harvest conditions for the Coast -Moist and Coast-Wet BGC Groups show relatively low snag levels – likely reflecting data from cruise plots in 2<sup>nd</sup> growth forests.

The reported range of large snag density is interpreted from Table xx to provide a target large snag density range. The target categories of *Meeting* and *Exceeding* are set around the interquartile range. Essentially, if the assessed large snag density retained on the cutblock is greater than the lowest 20% of benchmark conditions, retained large snag density is assessed as *Meeting* or *Exceeding* the target. The measured density of large snag is assessed as *Well Below*, *Below*, *Meeting*, or *Exceeding* the target densities in Table 17.

**Table 17.** Target densities (stems/ha) for large snags (>30cm DBH) by Forest Type used to evaluate question 5b.

| Forest Type | Snags (WT Class 3-8)>30cm |       |         |           |
|-------------|---------------------------|-------|---------|-----------|
|             | Well Below                | Below | Meeting | Exceeding |

|                    |     |       |       |     |
|--------------------|-----|-------|-------|-----|
| Dry Forest         | 0   | 1-2   | 2-20  | >20 |
| Cool Dry Montane 1 | <5  | 5-10  | 10-50 | >50 |
| Cool Dry Montane 2 | <5  | 5-10  | 10-30 | >30 |
| Cool Montane 1     | <10 | 10-20 | 20-55 | >55 |
| Cool Montane 2     | <10 | 10-20 | 20-70 | >70 |
| Cool Wet Montane   | 0   | 1-5   | 5-30  | >30 |

5c. Large

### Soft Snags

The indicator sub-question required to answer Question #5b asks: “Is the total density of large (>30cm Dbh) soft snags (WT class 6-8) in the cutblock equal to or greater than the average pre-harvest stand condition?”

To answer the question, field data collected in WTPs and dispersed tree strata is summarized and compared against benchmark levels depending on which forest type the cutblock resides. Benchmark levels for large soft snags >30cm DBH are derived based on the reported interquartile range (20-80% of all plots fall in this range) from benchmark data compiled for different Biogeoclimatic groups in BC and then (Table 18).

**Table 18.** Representative pre-harvest soft snag density. Reported data shows the approximate interquartile range (20-80%) density (stems/hectare) and percent (%) of total snag stems for all soft snags, and soft snags >30cm and >50cm DBH.

| Forest Type        | Soft Snags (WT Class 6-8) |               |                |               |                |               |
|--------------------|---------------------------|---------------|----------------|---------------|----------------|---------------|
|                    | ALL Soft snags            |               | >30cm DBH      |               | >50cm DBH      |               |
|                    | % of all snags            | stems/hectare | % of all snags | stems/hectare | % of all snags | stems/hectare |
| Dry Forest         | 2-10%                     | 5-8           | <1 -2%         | <1            | 0 to <1%       | <1            |
| Cool Dry Montane 1 | 1-2%                      | 5-8           | <1 -2%         | <1            | 0 to <1%       | <1            |
| Cool Dry Montane 2 | 15-20%                    | 15-20         | 1-3%           | 1-3           | 0-<1%          | 0             |
| Cool Montane 1     | 5-10%                     | 10-20         | <1 -2%         | <1-3          | 0-<1%          | <1            |
| Cool Montane 2     | 5-20%                     | 10-25         | 1-5%           | 1-5           | <1-2%          | <1            |
| Cool Wet Montane   | 10-30%                    | 5-25          | 2-7%           | 2-7           | 1-5%           | 1-5           |

The reported range of large soft snag density is interpreted from Table xx to provide a target large soft snag density range. The target categories of *Meeting* and *Exceeding* are set around the interquartile range. Essentially, if the assessed large snag density retained on the cutblock is greater than the lowest 20% of benchmark conditions, retained large soft snag density is assessed as *Meeting* or *Exceeding* the target. The measured density of large soft snags is assessed a *Well Below*, *Below*, *Meeting*, or *Exceeding* the target densities in Table 19.

**Note:** Large soft snags are relatively rare in most ecosystems. Thus, target values are not set for most Forest Types except the Cool Montane 2 and Cool Wet Montane. Where targets are not applicable 'NA' and large soft snags are recorded, the indicator sub-question 5c is automatically assessed as *Meeting* the target.

**Table 19.** Target densities (stems/ha) for large (>30cm DBH) soft snags (Wildlife Tree Clas 6-8) by

Forest Type used to evaluate question 5c.

| Forest Type        | Soft Snags (WT Class 6-8) >30cm |       |         |           |
|--------------------|---------------------------------|-------|---------|-----------|
|                    | Well Below                      | Below | Meeting | Exceeding |
| Dry Forest         | NA                              | NA    | NA      | NA        |
| Cool Dry Montane 1 | NA                              | NA    | NA      | NA        |
| Cool Dry Montane 2 | NA                              | NA    | NA      | NA        |
| Cool Montane 1     | NA                              | NA    | NA      | NA        |
| Cool Montane 2     | NA                              | NA    | 1-5     | >5        |
| Cool Wet Montane   | 0                               | 1     | 1-7     | >5        |

### Verifying the Indicator Information and Ratings

The verification step provides an evaluator the opportunity to verify the outputs of field data collection and the ratings assigned to wildlife tree retention practices. This is an important step, and because field data is summarized and indicator questions answered after field data is collected and submitted, wildlife tree retention practices observed on the cutblock during the field data collection stage can help verify the final rating for this question. Since the rating for Question #5 is based on recorded plot information that is compared against pre-defined benchmark levels, the outcomes may not always accurately reflect wildlife tree retention decisions made in a particular cutblock. The indicators and ratings are sensitive to both how the data in the field is collected and the pre-harvest benchmarks used. The following factors can affect the final rating:

- 1) **Sampling intensity** - the # of forest structure plots completed in the cutblocks is relatively low. In some cases, plots will miss large trees and snags by chance, particularly large snags and soft that are relatively rare in many stands.
- 2) **Pre-harvest conditions** – some stands may not reflect the ‘average’ pre-harvest conditions that were used. Second and third growth stands, or immature or early mature forest (40-80yrs old) that is being commercially thinned may not have large trees and snags available for retention.

To ensure the ratings for Question #5 reflect what is observed on the cutblock, FREP evaluators should observe wildlife tree retention practices throughout the cutblock when collecting field data. In particular, evaluators should visually inspect the interior of WTPs, rocky outcrops, next to riparian areas and outside of plot locations for large trees and snags that may have been targeted for retention. When completing plots, evaluators should consider:

- Do the plots capture a representative sample of large trees and snags in the strata?
- Are there large trees (such as Vet trees or snags) that a WTP uses as an ecological anchor, but were missed by the plot?
- Would there have been opportunities to retain large trees through the cutblock, or was the pre-harvest stand young or lacking large trees?

When considering these questions in the field, a good practice is to record observations of

notable wildlife tree retention practices on a separate piece of field paper. If estimates of large live trees and snags at the plot locations appears to under-represent actual conditions, or notable retention practices are observed (e.g. a retention patch is anchored to a clump of vets or large snags), evaluators can record a separate estimate of the large live tree and snag densities. In situations, where recorded field data may under-represent large wildlife tree densities relative to benchmark levels, estimates can be used to support a rationale to override the rating assigned based solely on the summarized field data and assign a different rating for that question. This step can be very important where recorded densities are close to the *Meeting* target category. The key is to ensure that the field data collected under the protocol does not unfairly penalize licensees where good wildlife tree retention practices are observed.

To assist in estimating large tree density (snags/ha), the following tables (Table 20 and 21) can be used to estimate the density of trees based on the number that would be found in a typical variable radius (prism) or fixed area plot. For variable radius plots, each tree 30cm DBH would count as 71 stems/ha when using a basal area factor (BAF) 5. In variable radius plots, larger trees are more likely to be included in the plot, and essentially increase the plot radius resulting in each large tree representing fewer stems/ha

**Table 20.** Density of trees by tree size (cm DBH) and basal area factor (BAF) commonly used in most variable radius (prism) plots

| BAF | # of stems/ha at different tree sizes |      |      |      |      |      |      |
|-----|---------------------------------------|------|------|------|------|------|------|
|     | 30cm                                  | 35cm | 40cm | 45cm | 50cm | 55cm | 60cm |
| 2   | 28                                    | 20   | 16   | 13   | 10   | 8    | 7    |
| 3   | 42                                    | 31   | 24   | 19   | 15   | 12.5 | 11   |
| 4   | 57                                    | .    | .    | .    | .    | .    | .    |
| 5   | 71                                    | .    | .    | .    | .    | .    | .    |
| 6   | 85                                    | .    | .    | .    | .    | .    | .    |
| 7   | 99                                    | .    | .    | .    | .    |      |      |
| 8   | 113                                   | .    | .    | .    |      |      |      |
| 9   | 127                                   | .    | .    |      |      |      |      |
| 10  | 142                                   | .    |      |      |      |      |      |

In fixed area plots, each tree counted in the plot contributes the same number of stems/ha regardless of tree size. For example, if a 5.64m radius fixed area plot has two trees >30cm DBH (one 31cm and one 46cm) each contribute as 100/stems/ha for a total of 200 stems/ha >30cm Dbh. A 5.64m radius plot has the same area as a 10m x 10m square plot (100 m<sup>2</sup>) which may provide an easier approach to visually estimating tree density where plots are not established.

**Table 21.** Tree density (stems/ha) associated with each tree counted in a fixed area radius plot

| Fixed radius plot size (m) | Area (m <sup>2</sup> ) | Stems/ha trees >30cm |
|----------------------------|------------------------|----------------------|
| 3.99                       | 50                     | 200                  |
| 5.64                       | 100                    | 100                  |
| 7.98                       | 200                    | 50                   |
| 11.28                      | 400                    | 25                   |
| 12.62                      | 500                    | 20                   |
| 17.84                      | 1,000                  | 10                   |

## Question #6 - Do stand-level retention practices retain wildlife trees to conserve important habitat features, and minimize windthrow effects?

Managing post-harvest windthrow<sup>11</sup> of wildlife tree retention is an important management consideration to ensure wildlife tree retention persist through the entire rotation of the managed stand. Maintaining wildlife trees can help ensure that the life-boating functions and structural complexity provided by wildlife trees are available to help organisms disperse into and re-colonize the regenerating stand. Retained standing wildlife trees can continue to grow to develop many of the important wildlife attributes associated with larger older trees. Ensuring large live standing trees remain standing is also necessary to recruit large old snags and many structural attributes of snags that provide other important habitats. Ensuring standing live wildlife trees persist into the next rotations is particularly critical when harvesting 2<sup>nd</sup> or 3<sup>rd</sup> growth stands or younger mature growth stands where important wildlife tree attributes haven't had the time to develop.

Forest harvesting can increase the susceptibility of residual trees to windthrow by exposing residual trees to the effects of wind. Almost all forests experience some endemic windthrow but some areas of the province are also more susceptible to windthrow due to higher or more frequent winds. In most cases, by recognizing prevailing wind patterns, topography, soils, forest structure and composition, and applying appropriate mitigation treatments during harvesting, windthrow of retained wildlife trees can be minimized (Mitchell 1994, Zielke et al. 2010).

Existing windthrow management guidance documents (Mitchell 1994, Zielke et al. 2010) do not provide quantitative minimum post-harvest windthrow target levels. Instead, forest managers can set acceptable levels of windthrow when conducting windthrow risk assessments that balance the trade-offs of harvesting and windthrow mitigation practices with the consequences of windthrow to timber or environmental values (Zielke et al. 2010).

Preliminary windthrow levels applied in this protocol considered acceptable for biodiversity and wildlife habitat conservation purposes recognize that some level of post-harvest windthrow can be expected, and even desirable as windthrow or breakage is an important process to create snags and downed wood and create structural diversity in forest stands. However, significant levels of post-harvest windthrow of wildlife trees will reduce the intended benefits of wildlife tree retention for the duration of the rotation, or longer. Thus, target levels specified here consider that >10% windthrow on average across all WTRAs, and >30% maximum windthrow in any one WTRA to be below acceptable levels

### Indicator Sub-Questions

The following two indicator sub-questions are used to evaluate Question #6:

- **Question 6a- Average Windthrow** – *“Is the average amount of blowdown across all WTRAs in the cutblock is maintained at acceptable levels?”*

<sup>11</sup> Mainly endemic windthrow and not catastrophic windthrow events  
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- **Question 6b- Maximum Windthrow-** “Is the maximum amount of windthrow in any one WTRA in the cutblock maintained at acceptable levels?”

Each sub-question is evaluated and categorized as either *Exceeding*, *Meeting*, *Below* or *Well Below* the guidance targets. To answer the main question the average score for each category (*Exceeding*=4, *Meeting*=3, *Below*=2, and *Well Below*=1) across both sub questions is used. The average score is rounded up or down to the nearest whole number. For example, if one sub questions is *Meeting* (score =3), and 1 sub questions is *Below* (score =2), the arithmetic average is 2.5((3+2=5), divided by the number of questions (2), so, 5/2=2.5). This value is then rounded up to the nearest whole number which is 3, and the windthrow levels are rates as *Meeting* the recommended guidance targets.

### Question 6a – Average windthrow

The indicator sub-question required to answer Question 6a asks: “Is the average amount of windthrow across all WTPs in the cutblock is maintained at acceptable levels?”

Data to answer this question is recorded on the Form B Stratum card (or Form C Block Card Section 16 where multiple strata are assessed but no plots located) of the SLR protocol. When a Form B Stratum card is completed for each WTP and dispersed WT retention strata on the block, evaluators are asked to estimate (to the nearest 1%) the percent of each WTP or dispersed strata that is windthrown (Section xx pages). The average amount of windthrow across all WTP and/or dispersed strata is summarized to answer indicator sub-question 6a.

The District Retention Summary Tables provide outputs of Average Percent Windthrow which is used to determine if averages amount of windthrow is *Exceeding*, *Meeting*, *Below* or *Well Below* the recommended guidance target of 10%. The cutblock is automatically assigned to one of the four categories in the district summary spreadsheet. The categories *Exceeding*, *Meeting*, *Below* or *Well Below* are assigned as per Table 22.

**Table 22.** Ratings assigned to a cutblock for indicator sub-question 6a based on average percent windthrow across all WTRAs in a cutblock

| Average Percent (%) Windthrow | Assigned Rating |
|-------------------------------|-----------------|
| <1%                           | Exceeding       |
| 1-10%                         | Meeting         |
| 11-30%                        | Below           |
| >30%                          | Well Below      |

### Question 6b. Maximum Windthrow

The indicator sub-question required to answer Question 6b asks; “Is the maximum amount of windthrow in any one WTP or dispersed strata in the cutblock maintained at acceptable levels?”

To answer this question, the same data on percentage windthrow recorded on the Form B Strata card (or Form C Block Card) is summarized and used.

The Retention Summary Tables provide an outputs for each cutblock on Maximum Percent Winthrow to evaluate whether the maximum amount of windthrow is *Exceeding*, *Meeting*, *Below* or *Well Below* the recommended guidance target of 30% in any one WTP or dispersed strata. The cutblock is automatically assigned to one of the four categories in the District Retention Summary spreadsheet. The categories *Exceeding*, *Meeting*, *Below* or *Well Below* are assigned as per Table 23.

**Table 23.** Ratings assigned to a cutblock for indicator sub-question 6a based on average percent windthrow across all WTRAs in a cutblock.

| Maximum Percent (%) Windthrow | Assigned Rating |
|-------------------------------|-----------------|
| <10%                          | Exceeding       |
| 11-30%                        | Meeting         |
| 31-50%                        | Below           |
| >50%                          | Well Below      |

### *Verifying the Indicator Information and Ratings*

Unlike other questions that rely on data summarized from randomly located plots, data used to answer Question 6 is an estimate of percent windthrow on 100% of each stratum. Thus, the possibility of missing important information due to low sampling intensity or other forms of sampling error is unlikely.

The key to verifying the results for this question is to ensure an accurate estimate for each stratum is provided which may require thorough walk-through or perimeter evaluation during field data collection. Evaluators should also be aware of the 10% average across stratum and 30% maximum windthrow in a single stratum used as a benchmark to differentiate between assigning a rating of *Meeting* and *Below* recommended targets. When percent windthrow is close to benchmark levels, evaluators should take extra time to ensure an accurate estimate.

## Category: Amount and Quality of Downed Wood Retention

Coarse woody debris (CWD) is an important structural component of forests that provides habitats for a broad range of wildlife species. The amount or volume of CWD is a key component to maintain biodiversity and habitats, but only one of many factors that determine how organisms utilize CWD. Several other important factors include (after Harmon et al. 1986):

- Physical orientation – birds and bats use standing snags, while many mammals, amphibians and reptiles use downed logs, CWD pile or windrows .
- Size –some organisms utilize larger diameter logs
- Decay Class and tree species – variable use by invertebrates and fungi based on decomposition characteristics

In managed stands, pre-harvest planning is required to ensure adequate amounts and types of CWD habitats are available throughout the rotation. Much of the pre-harvest CWD, particularly advanced decay classes, may be lost during harvest operations. Also, by removing tree biomass from the site, less of the pre-harvest stand volume will be available to provide initial CWD volume in the regenerating forest. Thus, four factors should be considered when planning harvests to manage the amount of CWD available through the full rotation of managed forests, include (after Harmon et al. 1986, Densmore et al. 2004):

- 1) The initial volume left at the time of harvest,
- 2) Input of new CWD as the new stand grows and experiences mortality
- 3) Depletion of the initial and new inputs of CWD by various decay processes, and
- 4) Input of CWD from standing trees initially retained in reserves such as WTRAs or from dispersed or aggregated retained trees in the harvested area.

Ensuring adequate CWD volume is retained on site at the time of harvest is critical to maintaining CWD habitats in the first few decades following harvest. However, much of the initial CWD will decay by 30-40 years post-harvest. Thus, in addition to managing for initial CWD volume, certain practices can also help maintain and recruit specific CWD attributes in managed stands, including<sup>12</sup>:

- Retain larger (diameter and length) CWD pieces - Large CWD pieces take longer to decay and thus CWD persists longer into the regenerating stand.
- Maintain a full range of decay classes, diameters and tree species – to provide variability in post-harvest downed wood habitats.
- Maintain overlapping or elevated logs to provide more structural diversity. Debris piles and windrows have been shown to provide important interim habitats in regenerating stands (Sullivan and Sullivan 2019).
- Retain standing trees for CWD recruitment – a staggered input of CWD through falldown of live and dead standing trees will need to occur throughout the life of the stand. Retaining safe dead standing and live trees can provide downfall to recruit CWD in 50-80 years when deficits occur in later stages of managed stand development.

To evaluate the effectiveness of stand-level retention practices at maintaining CWD at the individual cutblock scale, the protocol identifies two questions (Questions 7 and 8) related to

<sup>12</sup> See BC's Chief Forester Guidance CWD Management (2010), and Arsenault (2002)

the amount, type, condition and spatial distribution of CWD, including;

- 7) Amount and Spatial Dispersion of Downed Wood – Does the amount and dispersion of downed wood provide habitat refugia and structural complexity in the regenerating stand now and in the future?
- 8) Downed Wood Size and Condition – Does the size (diameter, length) and condition (decay class) of downed wood provide habitat refugia and structural complexity in the regenerating stand now and in the future?

### *Factors Affecting Coarse Woody Debris Retention*

Forest managers may wish to modify the amount of CWD retained to achieve specific stand or landscape-level objectives. For example, low post-harvest CWD accumulations may be desired in areas where biomass utilization or forage management for livestock has been prioritized. Managing post-harvest fuel is also a concern in high wildfire risk areas (e.g. adjacent to communities or infrastructure)<sup>13</sup>. Likewise, higher CWD levels and large CWD pieces elevated in piles and windrows may be retained for specific wildlife species (e.g. mustelids; fisher<sup>14</sup> or marten). No one amount of CWD is ‘correct’ for any site and naturally high levels of variability in CWD amounts, sizes and condition means that variability in post-harvest CWD is also acceptable.

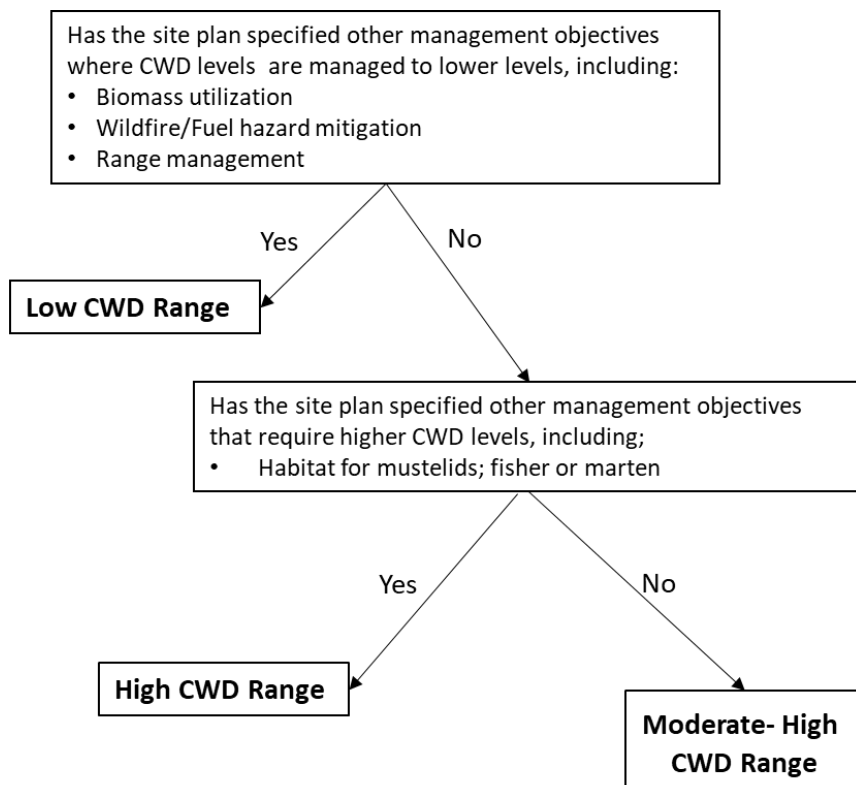
Before answering these questions, evaluators should check site plans to determine if specific CWD management objectives have been identified for the harvested area. Based on the decision key below (Fig. 10), evaluators can assign a CWD target for the harvested area (Low, Moderate or High CWD) based on any specified CWD objectives.

Where CWD objectives are not specified, the ratings in Question 7 for CWD volume automatically default to use the Moderate category as a target post-harvest condition. Where CWD objectives have been specified, evaluators can over-ride the results. For example, a cutblock may be rated as *Below* or *Well Below* guidance targets for CWD volume or large CWD pieces when using the Moderate category. However, if that cutblock was completed for wildfire risk reduction and CWD levels are purposefully managed to low levels to remove fuels, then an evaluator can over-ride the results and assign a rating of *Meeting* CWD volume targets for the block.

<sup>13</sup> See : *A guide to fuel hazard assessment and abatement in British Columbia*. 2012. Wildfire Management Branch, BC Min. For., Lnds., Nat. Res. Ops.

<sup>14</sup> Refer to fisher guidance: <https://www.bcfisherhabitat.ca/>  
June, 2022

**Figure 10.** Decision Tree to determine target post-harvest CWD volume range for evaluating measured CWD levels related to Question #7.



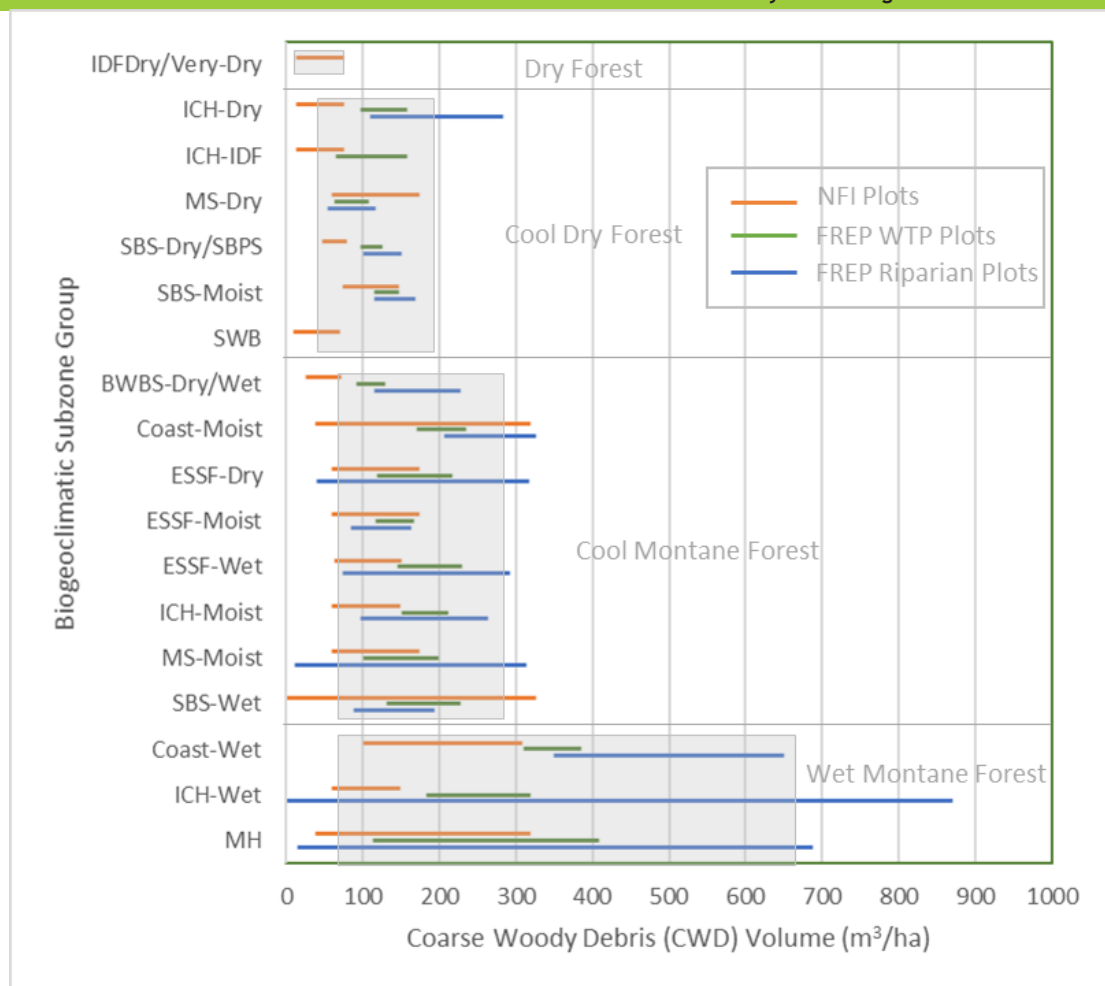
## Question #7 -Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

The volume of CWD in any forest stand can vary substantially within an ecosystem but also between ecosystems based on factors such as productivity and disturbance history. Some work has been completed to identify CWD targets for different forest ecosystems. For example, in dry forest to lower subalpine forest ecosystems in the Northwestern United States, Brown et al. (2003) identified a range of optimal post-disturbance CWD levels based on wildlife habitat and soil productivity requirements, that also considered historic CWD levels and the contribution of CWD >3 inches diameter (>7.5cm diameter) to wildfire hazard and soil heating. These ranged from approximately 35-70 m<sup>3</sup>/ha, and 70-210 m<sup>3</sup>/ha for Dry Forest and Cool Dry Forest-lower subalpine forests respectively, values that coincide well with the range of CWD reported from measured plots in mature forests across similar forest ecosystems in British Columbia<sup>15</sup> (Fig. 23). The lower limit of the optimal range is determined based on ecological benefits while upper limits by excessive fire hazard (Brown et al. 2003).

As a preliminary estimate for BC forest ecosystems, the results from Brown et al. (2003) are extrapolated to BC forests. The lower end of the optimal range also coincides with approximately 50% of average pre-harvest CWD levels recommended in the Biodiversity Guidebook. The range of CWD volumes by BGC Group and Forest Type shown here is expected to maintain CWD volume within the optimal range for up to 40 years post-harvest assuming most logs decay. Achieving the optimal range of CWD up to 50-80 years post-harvest will rely on staggered input of CWD through falldown of wildlife trees in the block or from adjacent forest along the cutblock edge during that period.

**Figure 23.** Range of stand-level CWD volume for based on available National Forest Inventory (NFI) transects and Forest and Range Evaluation Program (FREP) transects in Wildlife Tree Patches (WTP) and Riparian reserves. Shaded areas show 'optimal' CWD levels for as interpreted from Brown et al. (2003) and adapted to BC Forests.

<sup>15</sup> Baselines for downed wood volume for BC in Figure 8-1 are based on FREP and National Forest Inventory (NFI) transect information for 1996-2015 and 2000-2006 (See Huggard, 2020).  
June, 2022



The following table (Table 24) summarizes preliminary estimates for Low, Medium and High CWD volume targets based on the concept of an optimal range as applied to broad forest types based on Biogeoclimatic Groups in BC in Figure 11 above.

**Table 24.** Preliminary estimates for optimal coarse woody debris (CWD) volume targets by broad forest types and Biogeoclimatic Groups considering different CWD management priorities.

| Forest Type                | Biogeoclimatic Group                                                        | Optimal Coarse Woody Debris (CWD) Volume Range (m3/ha) <sup>a</sup> |                |                |
|----------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------|----------------|----------------|
|                            |                                                                             | Low                                                                 | Moderate       | High           |
| <b>Dry Forest</b>          | IDF -Dry and Very Dry                                                       | <b>30-50</b>                                                        | <b>50-70</b>   | <b>&gt;70</b>  |
| <b>Cool Dry Forest</b>     | ICH/IDF, ICH – Dry, MS Dry<br>SBS - Dry/SBPS, SBS Moist, SWB                | <b>50-100</b>                                                       | <b>70-150</b>  | <b>&gt;150</b> |
| <b>Cool Montane Forest</b> | BWBS- Dry/Wet, Coast-Moist,<br>ESSF -Dry/Moist/Wet, SBS-Wet,<br>ICH – Moist | <b>70-150</b>                                                       | <b>150-250</b> | <b>&gt;250</b> |

| Wet<br>Montane<br>Forest | Coast – Wet, ICH-Wet, MH | 70-150 | 150-350 | >350 |
|--------------------------|--------------------------|--------|---------|------|
|--------------------------|--------------------------|--------|---------|------|

<sup>a</sup> – CWD volume is measured from a database of CWD for each Biogeoclimatic zone or subzone group

### Indicator Sub-Questions

The following two Indicator sub-questions are used to evaluate Question #7 which asks: “Does the amount and distribution of CWD provide habitat refugia and structural complexity within the regenerating stand?” The two sub-questions are:

- **Question 7a – CWD Volume** - “Is the total volume of CWD measured at transects equal to or greater than the specified target range for that forest type and considering stated objectives for the cutblock?”
- **Question 7b – CWD Recruitment**- “Is at least 45% of the area of the block under forest influence that can contribute future CWD recruitment through falldown of standing trees?”

Each sub-question is evaluated and categorized as either *Exceeding*, *Meeting*, *Below* or *Well Below* the guidance targets. To answer the main question the average score for each category (*Exceeding*=4, *Meeting*=3, *Below*=2, and *Well Below*=1) across both sub questions is used. The average score is rounded up or down to the nearest whole number. For example, if one sub questions is *Meeting* (score =3), and 1 sub questions is *Below* (score =2), the arithmetic average is 2.5((3+2=5), divided by the number of questions (2), so, 5/2=2.5). This value is then rounded up to the nearest whole number which is 3, and the windthrow levels are rates as *Meeting the* recommended guidance targets.

### 7a.CWD Volume

The indicator sub-question #7a is related to the total volume of CWD retained on the site in WTRAs and the NAR, and asks: “Is the total volume of CWD measured at transects equal to or greater than the specified target range for that forest type and considering stated objectives for the cutblock?”

To answer this question, data collected along CWD transects in all stratum types is used. The CWD data is area-weighted when summarized to provide average values across the cutblock. The Average CWD volume is compared against benchmark levels depending on which forest type the cutblock resides. Benchmark levels for CWD are specified for different Low Moderate and High CWD management target categories derived from the estimated optimal range for Biogeoclimatic groups and Forest Types in BC (Table xx).

The rating categories of *Well Below*, *Below*, *Meeting* or *Exceeding* guidance targets (Table 25) were interpreted from Table 24 and assigned based on the optimal CWD levels in the *Moderate* range for each Forest Type.

**Table 25.** Rating categories based on coarse woody debris (CWD) volume (m<sup>3</sup>/ha) by forest type

| Forest Type            | Rating Category                                  |         |         |           |
|------------------------|--------------------------------------------------|---------|---------|-----------|
|                        | Well Below                                       | Below   | Meeting | Exceeding |
|                        | Coarse Woody Debris Volume ( m <sup>3</sup> /ha) |         |         |           |
| Dry Forest             | <10                                              | 10-30   | 30-80   | >80       |
| Cool Dry Montane 1 & 2 | <25                                              | 25-50   | 50-175  | >175      |
| Cool Montane 1 & 2     | <50                                              | 50-100  | 100-300 | >300      |
| Wet Montane            | <100                                             | 100-200 | 200-500 | >500      |

**Note:** The categories of *Exceeding*, *Meeting*, *Below* or *Well Below* recommended guidance target are interpreted around the Moderate CWD target level. For Example, the category *Meeting* is set slightly below the optimal range. So, if the optimal CWD range is 50-70 m<sup>3</sup>/ha for the Dry Forest type, the *Meeting* guidance targets category is set at 30-80 m<sup>3</sup>/ha. This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

#### 7b. Future CWD Recruitment:

The indicator sub-question required to answer question #7b is related to the area of the cutblock that can contribute future CWD recruitment and asks: “*Is at least 50% of the area of the block under forest influence that can contribute future CWD recruitment through falldown of standing trees?*”

To answer this sub-question the protocol uses the Percent Forest Influence indicator provided in the District Retention Summary Table also as applied in question #4 of the protocol (See overview of Question #4 for a description of the GIS analysis used). This indicator utilizes outputs of the both the GIS analysis and results of the field sampling for dispersed strata.

The rating categories of *Well Below*, *Below*, *Meeting* or *Exceeding* guidance targets (Table 26) are assigned based on the target of 50% Forest Influence.

**Table 26.** assigned ratings for area of the cutblock available to recruit future CWD based on the percent of the cutblock in forest influence (covered by retention or within 1 tree length of wildlife tree retention or adjacent forest edge).

| Percent (%)<br>Forest Influence | Assigned<br>Rating |
|---------------------------------|--------------------|
| <30%                            | Well Below         |
| 30-45%                          | Below              |
| 45-60%                          | Meeting            |
| >60%                            | Exceeding          |

**Note:** The categories of *Exceeding*, *Meeting*, *Below* or *Well Below* recommended guidance target are interpreted around the target of 50%. For Example, the category *Meeting* is set slightly below the target at 45-60%. This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

## Question #8 - Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

Benchmarks for large CWD piece size are based on the 2010 Chief Forester guidance that asked for a 20% increase in the median density of large CWD pieces in the Net Area to be Reforested (NAR) across harvested blocks within a Biogeoclimatic zone or subzone<sup>16</sup>. The following table (Table xx) is an updated estimate for average numbers of large CWD pieces across measured transects within a cutblock.<sup>17</sup> The target levels in Table 27 are based on a 20% increase relative to the difference between the density of large CWD in Wildlife Tree retention Areas and at the Biogeoclimatic Subzone Group level. The underlying assumption is that as the average density increases within a block, the median density across sampled blocks would correspondingly increase. Reported densities are based on FREP data from sampled cutblocks harvested up to 2010.

**Table 27.** mean density at the cutblock level of long (>10m) and Large (>20cm diameter and >10m long) CWD pieces from FREP samples on baseline pre-2010 cutblocks, and target levels with a 20% increase over baseline levels

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<sup>16</sup> Median densities across sampled cutblocks within a district or BGC group as per the Chief Forester's 2010 guidance can be reported elsewhere such as in district MRVA reports

<sup>17</sup> Recognizing that due to variability in measurements and, some evaluations may not record any large CWD pieces along any transect, or measured values may be highly variable between transects within a cutblock.

| Biogeoclimatic Group | Mean density (CWD pieces/Hectare) >10m long and large pieces (>20cm diameter and 10m long) |                |                                                    |                |                                        |                |
|----------------------|--------------------------------------------------------------------------------------------|----------------|----------------------------------------------------|----------------|----------------------------------------|----------------|
|                      | Net Area to be Reforested (Pre-2010 FREP data)                                             |                | Wildlife Tree Retention Areas (Pre-2010 FREP data) |                | Target Levels in NAR with 20% increase |                |
|                      | >10m                                                                                       | >20cm and >10m | >10m                                               | >20cm and >10m | >10m                                   | >20cm and >10m |
| BWBS- Dry            | 32                                                                                         | 15             | 118                                                | 48             | 49                                     | 22             |
| BWBS - Wet           | 39                                                                                         | 15             | 104                                                | 32             | 52                                     | 18             |
| Coast - Moist        | 39                                                                                         | 21             | 82                                                 | 48             | 48                                     | 26             |
| Coast - Wet          | 60                                                                                         | 39             | 92                                                 | 69             | 67                                     | 45             |
| ESSF - Dry           | 45                                                                                         | 19             | 161                                                | 59             | 68                                     | 27             |
| ESSF - Moist         | 40                                                                                         | 19             | 137                                                | 60             | 59                                     | 27             |
| ESSF - Wet           | 43                                                                                         | 25             | 129                                                | 83             | 60                                     | 37             |
| ICH - Dry            | 46                                                                                         | 15             | 136                                                | 54             | 64                                     | 23             |
| ICH - Moist          | 65                                                                                         | 29             | 119                                                | 58             | 76                                     | 35             |
| ICH - Wet            | 62                                                                                         | 41             | 86                                                 | 61             | 67                                     | 45             |
| ICH/IDF              | 50                                                                                         | 17             | 106                                                | 50             | 61                                     | 24             |
| IDF - Dry            | 34                                                                                         | 7              | 115                                                | 33             | 50                                     | 12             |
| IDF – Very Dry       | 33                                                                                         | 4              | 46                                                 | 13             | 35                                     | 5              |
| MH                   | 58                                                                                         | 41             | 68                                                 | 50             | 60                                     | 43             |
| MS - Dry             | 20                                                                                         | 4              | 146                                                | 34             | 45                                     | 10             |
| MS - Moist           | 46                                                                                         | 11             | 160                                                | 61             | 69                                     | 21             |
| SBS - Dry/SBPS       | 46                                                                                         | 11             | 178                                                | 49             | 72                                     | 19             |
| SBS Moist            | 48                                                                                         | 16             | 165                                                | 60             | 72                                     | 25             |
| SBS Wet              | 50                                                                                         | 19             | 186                                                | 85             | 77                                     | 32             |
| SWB                  | 32                                                                                         | 15             | 118                                                | 48             | 49                                     | 22             |

### Indicator Sub-Question

The indicator sub-question required to answer Question #8 asks: *‘Is the average density of large CWD pieces (>10m length and >20cm diameter) found in the NAR equal to or greater than the benchmark number for that ecosystem?’*

To answer this question, the average number of large CWD pieces/ha recorded on CWD transects in the NAR is summarized in the District Retention Summary Table.

The rating categories of *Well Below*, *Below*, *Meeting* or *Exceeding* guidance targets for large CWD pieces in the NAR are interpreted by Forest Type (Table 28).

**Table 28.** Target categories for large CWD pieces/ha by Forest Type.

| Forest Type   | Large CWD Pieces/ha |       |         |           |
|---------------|---------------------|-------|---------|-----------|
|               | Well Below          | Below | Meeting | Exceeding |
| Dry Forest    | <5                  | 5-10  | 10-20   | >20       |
| Dry Montane 1 | <5                  | 5-15  | 15-30   | >30       |
| Dry Montane 2 | <5                  | 5-15  | 15-30   | >30       |
| Montane 1     | <10                 | 10-20 | 20-30   | >30       |
| Montane 2     | <15                 | 15-25 | 25-40   | >40       |
| Wet Montane   | <15                 | 15-25 | 25-45   | >45       |

Note: The categories of *Exceeding*, *Meeting*, *Below* or *Well Below* recommended guidance targets are interpreted around the minimum guidance target set by BGC group in Table xx. For example, the category *Meeting* is set slightly below the minimum guidance target. So, if the recommended minimum guidance target is 23-27 large CWD pieces/ha, the *Meeting* guidance targets category is set at 20-30 large CWD pieces/ha5% (Figure 8). This accounts for situations where:

- Measured or recorded retention amounts may underestimate actual retention levels
- Forest licensees have attempted to achieve close to the minimum recommended guidance

### Verifying the Indicator Information and Ratings

The verification step provides an evaluator the opportunity to verify the outputs of field data collection and the ratings assigned to wildlife tree retention practices. This is an important step, and because field data is summarized and indicator questions answered after field data is collected and submitted, wildlife tree retention practices observed on the cutblock during the field data collection stage can help verify the final rating for this question. Since the rating for Question #7 and #8 is based on recorded CWD transect information that is compared against pre-defined benchmark levels, the outcomes may not always accurately reflect CWD retention decisions made in a particular cutblock. The indicators and ratings are sensitive to both how the data in the field is collected and the pre-harvest benchmarks used. The following factors can affect the final rating:

- 1) Sampling intensity - the # of CWD transects completed in the NAR is relatively low. In some cases, transects will miss large CWD pieces by chance, or large logs may have been moved into piles or windrows
- 2) Pre-harvest conditions – some stands may not reflect the ‘average’ pre-harvest conditions that were used. Second and third growth stands, or immature or early mature forest (40-80yrs old) that is being commercially thinned will likely not have significant CWD volume or large CWD pieces remaining from the previous stand, or have recruited new large pieces.
- 3) Management objectives- as discussed earlier, management practices that remove large woody debris for wildfire hazard risk reduction, or biomass

utilization, can create situations where less CWD volume and few large CWD pieces remain.

To ensure the ratings for Question #7 and #8 reflect what is observed on the cutblock, FREP evaluators should observe CWD retention practices throughout the cutblock when collecting field data. In particular, evaluators should visually inspect the NAR for large CWD pieces, windrows and CWD piles that have been purposefully retained and not pile for future burning. When completing transects, evaluators should consider:

- Do the transects capture a representative sample of CWD volume and large CWD pieces in the strata?
- Are there large CWD pieces available in CWD pile or windrows that have been retained for wildlife habitat purposes?
- Would there have been opportunities to retain large CWD pieces through the cutblock, or was the pre-harvest stand young or lacking CWD volume or large trees to recruit as CWD?

When considering these questions in the field, a good practice is to record observations of notable CWD retention practices on a separate piece of field paper. If estimates of CWD volume or large CWD pieces at the transect locations appear to under-represent actual conditions, or notable CWD retention practices are observed (e.g. CWD pile or windrows connected to a retention patch or adjacent forest edge), evaluators can record a separate estimate of the CWD volume and large CWD pieces. In situations, where recorded field data may under-represent large CWD volume or large CWD pieces/ha relative to benchmark levels, estimates can be used to support a rationale to over-ride the rating assigned based solely on the summarized field data and assign a different rating for that question. This step can be very important where recorded densities are close to the *Meeting* target category. The key is to ensure that the field data collected under the protocol does not unfairly penalize licensees where good wildlife tree retention practices are observed.

Evaluators should also record if specific CWD management objectives were identified based on the site plan for the block. After visiting the cutblock, if you are unsure, contact the licensee to confirm if any specific CWD management objectives exist.

To assist in estimating large CWD pieces/ha, it is important to note how each large CWD piece encountered on a transect contributes per hectare. Log length affects the probability a log will be encountered on a transect and affects the # pieces/ha that log represents. For example, 1Log (>20cm and 10m length) encountered on a 30m transect = 52 pieces/ha. As the length of the piece increases, the number of corresponding pieces/ha represented by that piece declines, where:

- 11m length = 47 pieces/ha
- 12m length = 44 pieces/ha
- 13m length = 40 pieces /ha
- 14m length = 37 pieces/ha
- 15m length = 35 pieces/ha

## Help

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If you require assistance on the use of the stand-level biodiversity RSM forms and/or protocol, please contact one of the following:

Doug Lewis (250) 312-6777 or [Doug.W.Lewis@gov.bc.ca](mailto:Doug.W.Lewis@gov.bc.ca)

Dean McGeough (250) 642-2666 or [DeanMcG@shaw.ca](mailto:DeanMcG@shaw.ca)

## Appendix 1. Big block sampling

---

### Purpose

Design a sampling scheme for blocks larger than 100 hectares that limits the numbers of plots established – but still captures the general variability of retention on the block – and confirms the size, type and existence of every separate retention patch.

### Methodology for Determining Number of Plots and Plot Location

#### *Patch Retention*

Make at least three lists (i.e., stratification by like features):

1. all retention polygons that are riparian or wetland
2. all non-riparian retention polygons
3. all retention polygons that are temporary or immature.

Note: The purpose of the first two lists is to lump reasonably similar timber types.

This would generally be a mapping exercise, but use better information (such as aerial photos) if available to identify similar timber types. If time allows and you determine there is sufficient variability to warrant it – you may decide to create an additional list of polygons to sample from. For example, subdivide the list of non-riparian polygons into large and small patches.

For the riparian/wetland:

- sum up the area in each list
- number of plots to sample is one per hectare for first five hectares and one per 10 hectares after that (round up) to a maximum of 15 plots
- locate the plots within the polygons on each list by using a grid overlay to determine potential plots and randomly select from these potential plots
- it is not necessary to force a potential plot into each polygon on the list – as long as the overlay of a dot grid (or other such method), captures an equal or greater number of potential plots than your number of sample plots
- each contiguous stratum (stand alone patch) still requires a Form B (or section 16 if no plots established)

For the non-riparian patches:

- same as riparian/wetland

For the temporary or immature polygons:

- don't establish plots (unless for some reason you've got extra time on block)
- fill out Form B or section 16 for each non-contiguous polygon

*Harvest Area*

Number of plots: 3 plots for first 60 ha, plus one plot per 20 ha after that to a maximum of 15 plots.

*Maximum Number of Plots for a Large Block*

Maximum plots is likely 45 (30 patch plots if two lists of similar timber types to be sampled and, 15 harvest area plots).

## Appendix 2. Using the GPS unit

The GPS hand-held unit is a great tool when there is adequate satellite reception. When you have open canopies, open ground, and good satellite reception, the following process works for field-locating your plots.

Find a central access point in the cutblock that has a mapped control (e.g., a road junction). Confirm that this location is positionally true by taking 2 or 3 range finder shots to identifiable reference points (e.g., another road junction, creek crossing, visible F/C, corners of WTR, etc.) and confirm that the junction is relatively correct. If it is not, find an alternate access point.

Using the GPS, establish the access point to be a “WAY POINT” (WP). Locating plots using a GPS hand-held can be accomplished using steps 1–7.

For those using the Garmin GPS 60 hand-held unit, the following steps are used.

- STEP 1:** Turn on the unit. Hold the GPS unit upright (the antenna will get better reception). Let the unit acquire satellites and wait until the location coordinates are  $<\pm 10$  m (top of screen).
- STEP 2a:** Press “mark,” then toggle left to select “Avg;” press “enter” and wait until the “estimated accuracy” is below 10 m or there are 100 measurement counts.
- STEP 2b:** Press “enter” to save this location as a WP location. Record this WP number (seen at the top of the screen) on your map access point location.
- STEP 3a:** Using a scale, draw radial transects for the WP to each of the mapped plots. Measure the distance from the WP to the plot and record this distance for each transect. Be sure to verify the map scale.
- STEP 3b:** Using a protractor or your compass, determine the compass bearing from the plot to the WP, and record this for each transect (see Figure 1). Now you are ready to go to the plots. You can “project WPs” for each of your plots, or work “backwards” from your initial WP as described below.
- STEP 4:** Orient yourself towards the plot you seek and begin your hike to the plot. Press “find,” select “waypoint” with toggle, press “enter,” and now select the applicable WP using the toggle; press “enter.” Select “go to,” press “enter.” The GPS unit will now guide your position relative to the WP.
- STEP 5:** Head towards a plot and track your progress on the GPS screen – the bearing and distance readings should equal the mapped transect information for the plot. Hold the GPS unit upright in order to get better reception. You have arrived at the plot the moment the bearing and distance equal the plot’s position from the WP.
- CAUTION: Be sure to watch your footing and be aware of your surroundings as you walk and monitor the GPS screen.
- STEP 6:** At the plot, tie flagging tape to a stick to mark the plot centre. Tie a length of flagging tape to a secure branch above 1.3 m (this helps in relocating the plot). Remember to record RSM plot details on the flagging tape.

**STEP 7:** Determine the UTM co-ordinates for this plot:

- Select “mark.”
- Select “Avg,” then press “enter.”
- Wait until “estimated accuracy” is below 10 m or 100 measurement counts.
- Record the UTM co-ordinates displayed.
- You can select “quit” to avoid creating a WP for this plot; or select “enter” to create a WP for this plot (in case you need/want to find this plot again).

Once you have finished the plot work, use your GPS to find the next plot by repeating steps 4–7.

At the end of the day, return to your access point (where you parked your vehicle) by using step 4 to return to the WP. The Garmin GPS 60 has a compass that will guide your return route to the WP.

## Appendix 3. When is a clearcut stratum actually dispersed?

**Issue:** Each stratum is given a designation as either; patch (P) retention, dispersed (D) retention or clearcut (CC). When should a few trees in a harvest area change the designation from CC to D?

**Background:** The data will be entered into the FREP Information Management System. A current requirement of this system is that if a single tree shows up in any of the stand tables for a harvested stratum the designation of that stratum must be “dispersed.”

However, if trees exist only outside of plots (i.e., no trees recorded in stand tables for the stratum), and, in the consideration of the assessor those trees are of little biodiversity value, then the harvest stratum can be designated as “clearcut.” The logic behind stating trees have “little” or “some” biodiversity value is if all the retained trees within the harvest stratum could add up to equal or greater than 0.1 ha of basal area equivalent area (i.e. if all the dispersed trees were squished together they would make up a patch of at least 0.1 ha) then we should call the stratum “dispersed.” Smaller amounts of trees would have negligible impact on the percent area retained indicator.

**Discussion:** Basal area equivalency can be done by:

1. estimating the total basal area left in the dispersed stratum
2. estimating the average basal area/hectare that was present on the block pre-harvest
3. dividing the total basal area in dispersed stratum by the average pre-harvest BA/ha to get the equivalent hectares.

The following table gives an example of the number of total trees (of differing diameters) that are required (compared to two different average BA/ha) to make up equivalent to a 0.1 patch.

| DBH  | BA/tree | # of trees equivalent to a 0.1 ha patch |                             |
|------|---------|-----------------------------------------|-----------------------------|
|      |         | Interior 30 m <sup>2</sup> /ha          | Coast 50 m <sup>2</sup> /ha |
| 12.5 | 0.01    | 245                                     | 408                         |
| 15   | 0.02    | 170                                     | 283                         |
| 20   | 0.03    | 95                                      | 159                         |
| 30   | 0.07    | 42                                      | 71                          |
| 40   | 0.13    | 24                                      | 40                          |

**Conclusion:** The total number of dispersed trees retained in the harvest area that are required to add up to atleast equivalent of 0.1 ha of patch retention is dependent on:

- the average basal area/hectare of a fully stocked stand
- the total (i.e. – NOT m<sup>2</sup>/ha , but TOTAL m<sup>2</sup> in the stratum) basal area of the retained trees.

## Appendix 4. Sample completed forms

## Plot Information - Form A Side 1

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Plot Information – Form A Side 1

[illegible]

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\* Decimal place means measured

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#### 4 Plot Information (CWD)

Stratum ID WTP2 Plot # 1

**Course Woody Debris (30 m transect)**

CWD in transect ☒ Yes ☐ No  
1st Leg 300 ° 2nd Leg 30

[illegible]

\* Decimal place means measured

## Stratum Summary - Form B Side 1



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Stratum Summary– Form B Side 1

|                                                                                                                                                                                                              |                          |                                  |                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------------|--------------------------|
| <b>5 Stratum Summary (one card per Stratum)</b>                                                                                                                                                              |                          |                                  |                          |
| Date <u>2009</u> / <u>07</u> / <u>12</u> Opening ID <u>103807</u> Assessed by <u>IB/WB</u>                                                                                                                   |                          |                                  |                          |
| Stratum ID <u>WTP2</u> Stratum type <u>PR</u>                                                                                                                                                                |                          |                                  |                          |
| # of plots in stratum <u>3</u> Mapped Stratum size (ha) <u>3.1</u>                                                                                                                                           |                          |                                  |                          |
| BEC subzone variant and site series <u>SBS mc2 01</u>                                                                                                                                                        |                          |                                  |                          |
| Stratum location and size consistent with map? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not mapped<br>If 'no' or 'not mapped', estimated size (ha) _____ |                          |                                  |                          |
| Tick one of: <input type="checkbox"/> Harvest area with no retention <input type="checkbox"/> Harvest area with dispersed retention<br><input checked="" type="checkbox"/> Patch Reserve                     |                          |                                  |                          |
| <b>6 Patch/Dispersed Summary</b>                                                                                                                                                                             |                          |                                  |                          |
| Estimated age of oldest trees in reserve (other than Vets) <u>120</u>                                                                                                                                        |                          |                                  |                          |
| Patch location: <input type="checkbox"/> Internal to block <input checked="" type="checkbox"/> Edge of block<br><input type="checkbox"/> External/not touching block <input type="checkbox"/> NA             |                          |                                  |                          |
| % of total trees in reserve windthrown: <u>7</u> %                                                                                                                                                           |                          |                                  |                          |
| Distribution of windthrow: <input checked="" type="checkbox"/> Edge <input checked="" type="checkbox"/> Internal <input type="checkbox"/> NA                                                                 |                          |                                  |                          |
| Windthrow treatment: <input type="checkbox"/> Feathering <input type="checkbox"/> Topping <input checked="" type="checkbox"/> Both <input type="checkbox"/> None <input type="checkbox"/> Other _____        |                          |                                  |                          |
| <b>7 Reserve Constraints</b>                                                                                                                                                                                 |                          | <b>Ecological Anchors</b>        |                          |
|                                                                                                                                                                                                              | % of reserve             |                                  | stratum estimate         |
| None                                                                                                                                                                                                         | <input type="checkbox"/> | None                             | <input type="checkbox"/> |
| Wetsite                                                                                                                                                                                                      |                          | Bear Den                         | stratum count            |
| RMZ                                                                                                                                                                                                          | <u>10</u>                | Hibernaculum                     | stratum count            |
| RRZ                                                                                                                                                                                                          |                          | Vet tree/ha                      | 0, 1-10, 10-20, etc.     |
| Rock outcrop                                                                                                                                                                                                 |                          | Mineral lick                     | stratum count            |
| Non-commercial brush                                                                                                                                                                                         | <u>15</u>                | Large stick nest                 | stratum count            |
| Non (or low) merch timber                                                                                                                                                                                    |                          | Cavity nest                      | stratum count            |
| Sensitive terrain or soil                                                                                                                                                                                    |                          | Large hollow tree                | stratum count            |
| UWR / WHA                                                                                                                                                                                                    |                          | Large witches broom              | stratum count            |
| OGMA                                                                                                                                                                                                         |                          | Karst feature                    | Y N                      |
| Visuals                                                                                                                                                                                                      |                          | Largest tree for site (not Vets) | Y N                      |
| Cultural heritage feature                                                                                                                                                                                    |                          | CWD heavy natural concentration  | Y N                      |
| Recreation feature                                                                                                                                                                                           |                          | Active wildlife trails           | Y N                      |
| Other:                                                                                                                                                                                                       |                          | Active WLT/CWD feeding           | <u>Y</u> N               |
|                                                                                                                                                                                                              |                          | Uncommon tree species            | Y N                      |
| <b>Total constrained</b>                                                                                                                                                                                     | <u>15</u>                | Other:                           |                          |
| Comments:                                                                                                                                                                                                    |                          |                                  |                          |

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## Block Information - Form C Side 1



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Block Information – Form C Side 1

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                           |                 |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------|---------------|
| <b>11 Opening Identification</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |                 |               |
| Opening #                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <u>93 L 018 112</u>       | Opening ID      | <u>103807</u> |
| Licence #                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <u>A16828</u>             | CP#             | <u>473</u>    |
| Block                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <u>PARRSX10</u>           | Licensor        | <u>Canfor</u> |
| District                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <u>DND</u>                |                 |               |
| Location Description                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <u>24 Km Parrott West</u> |                 |               |
| NAR                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <u>47.7</u>               | Gross area (ha) | <u>67.6</u>   |
| Override                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |                 |               |
| <b>12 Innovative Practices</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                           |                 |               |
| <p>Were any innovative and/or unique forest practices used on this block?<br/>Please describe:</p> <p><b>No</b></p>                                                                                                                                                                                                                                                                                                                                                             |                           |                 |               |
| <b>13 Invasive Plants</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |                 |               |
| <p>Were invasive plant species present on this block? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know</p> <p>If Yes, please complete the Invasive Plants Field Card (FS 1316)</p>                                                                                                                                                                                                                                       |                           |                 |               |
| <b>14 Evaluator Opinion/Comments</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            |                           |                 |               |
| <p>To what extent did the practices on this cutblock maintain stand-level biodiversity, given the opportunities that were likely available?</p> <p><input type="checkbox"/> Poorly <input checked="" type="checkbox"/> Moderately <input type="checkbox"/> Well <input type="checkbox"/> Very Well <input type="checkbox"/> Don't know</p> <p>Rationale:</p> <p><b>Good amount, plus number of patches – primarily the wet areas. S3 reserve mostly dead or windthrown.</b></p> |                           |                 |               |

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Block Summary – Form C Side 2

Block Information - Form C Side 2

| 15 Photo Notes                                                                                 |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
|------------------------------------------------------------------------------------------------|--------------|-----------|-----------|----------------|------|----------|---------------------|-------------------------------------------------------------|------------------|-------------|-------------|-------------|------------------------|-------|------|-------------|
|                                                                                                |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
| 16 Stratum Summary When No Plots Established (S.16 or Form B, not both for each stratum ID)    |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
| Stratum ID                                                                                     | Stratum type | Size (ha) | BEC       | Patch Location |      |          | Total Constrained % | Ecological Anchor (count by stratum unless otherwise noted) |                  |             |             |             |                        |       |      | Windthrow % |
|                                                                                                |              |           |           | Internal       | Edge | External |                     | Vets / (ha)                                                 | Large Stick Nest | Cavity Nest | Large Broom | Lgst Tr Y/N | Uncom Tree Species Y/N | Other | None |             |
| WTP1                                                                                           | PW           | 0.6       | SBSmc2 06 | 3              |      |          | 50                  |                                                             |                  |             |             |             |                        |       | 3    | <5          |
| WTP5                                                                                           | PW           | 0.7       | SBSmc2 06 | 3              |      |          | 50                  |                                                             |                  |             |             |             |                        |       | 3    | 5-15        |
|                                                                                                |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
|                                                                                                |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
|                                                                                                |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
|                                                                                                |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |
| 17 Quality Check: Sum of patch area + Sum of dispersed + CC + NP + Other = Cutblock gross area |              |           |           |                |      |          |                     |                                                             |                  |             |             |             |                        |       |      |             |

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## Appendix 5. CWD measurements

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To assist with the fieldwork for the *Protocol for Stand-level Biodiversity*, the following information is provided following the summer 2005 field training sessions.

Field procedures for measuring CWD were adapted from the CWD field procedures, as found at <http://ilmbwww.gov.bc.ca/risc/pubs/teecolo/fmdte/cwd.htm#coarse>.

Excerpts are included here to clarify and guide protocol fieldwork.

### CWD Defined

Coarse woody debris is dead woody material, in various stages of decomposition, located above the soil, larger than 7.5 cm in diameter (or equivalent cross-section) at the crossing point, which is not self-supporting. Trees and stumps (intact in ground) are considered self-supporting, and therefore are NOT considered CWD.

Pieces of CWD may be suspended on nearby live or dead trees, other pieces of CWD, stumps, or other terrain features. There is NO minimum length for CWD.

Coarse woody debris includes:

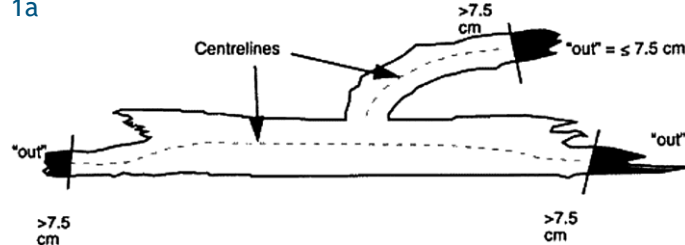
- downed horizontal or suspended (not self-supporting) dead tree boles with or without roots attached
- fallen trees which still have green foliage if they no longer have roots attached (no living cambium) to the ground to keep them alive
- woody pieces greater than 7.5 cm at the point where the sampling line crosses the piece
- uprooted (not self-supporting) stumps greater than 7.5 cm in diameter at the crossing point and any of their exposed dead roots greater than 7.5 cm in diameter at the crossing point;
- fallen broken tree tops which may be horizontal or leaning, or large fallen branches
- recently cut logs.

Coarse woody debris does not include:

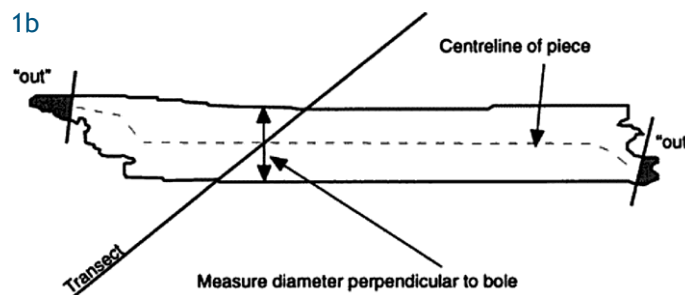
- dead branches still connected to standing trees
- self-supporting (not overturned) stumps
- exposed roots of self-supporting trees or stumps
- material that is buried beneath organic or mineral soil layers, or has decomposed enough to be part of the forest floor
- live or dead trees (still rooted) which are self-supporting.

#### Rules for Sampling Coarse Woody Debris

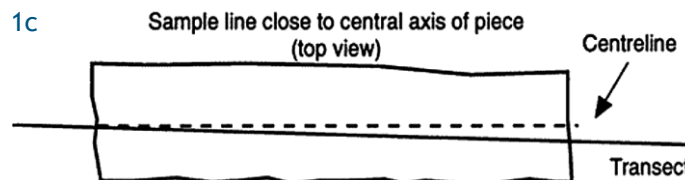
1a



1b



1c



1d

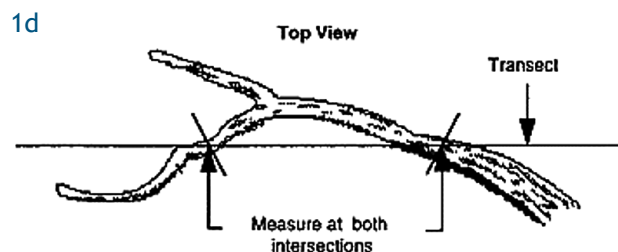


Figure A4-1. Rules for sampling CWD.

- Coarse woody debris must be greater than 7.5 cm in diameter (or equivalent) at the line intersect point (see Figure A4-1a). There is NO minimum length.
- The transect must cross the central axis of the piece (see 1b).
- If the transect coincides closely with the centreline, make the best decision as to whether the line crosses the centreline and where (see 1c).
- If the transect intersects a curved or angular piece more than once, measure each intersection as a separate observation (see 1d).
- If a log has split open, but is still partially held together, record the diameter as if the piece were whole. If a stem has shattered into a number of distinct, unconnected pieces, record each piece that is greater than 7.5 cm in diameter at the point of sampling.
- Do not tally undisturbed stumps. Tally uprooted stumps and their exposed dead roots if they meet the other criteria.

- Tally only the CWD that lies above the soil (see Figure A4-2). A piece is no longer above the soil when it is entirely buried beneath a layer of surface organic matter (forest floor) and/or mineral soil. Estimate an “equivalent” diameter for the remaining portion of logs where part of the wood has decayed and become part of the soil layer.

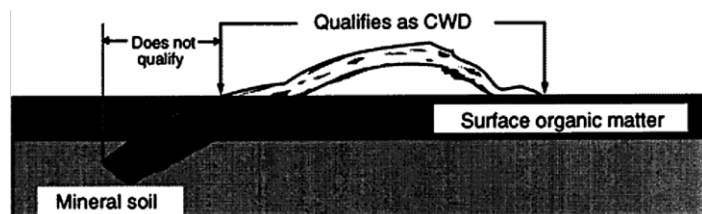


Figure A4-2. Tally only CWD that lies above the soil.

### CWD Length

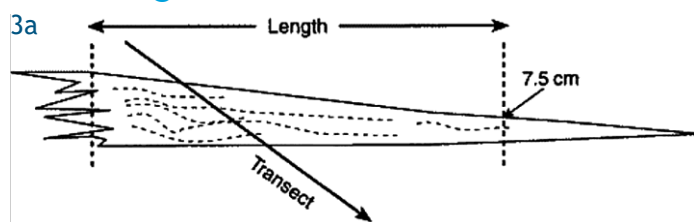
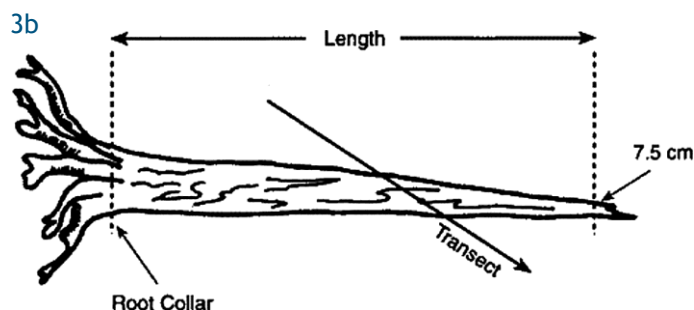
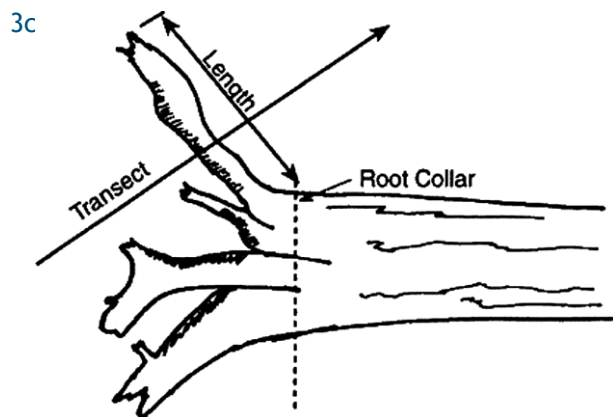


Figure A4-3. Rules for measuring length of CWD.

Record the length of each piece to the nearest 0.1 m (see Figure A4-3a).

- If a log has broken lengthwise but is still partially held together, record the equivalent length as if the piece were whole.
- If the end(s) of the piece are broken, visually fold in the broken sections to compensate for the missing parts.
- Piece length is from the largest end down to the 7.5-cm diameter limit.

Measurement of stems from attached roots:

- For main boles with exposed roots, piece length is measured only down to the root collar (see 3b).
- If a root mass is transected, piece length for individual roots (larger than the minimum diameter) is measured only up to the root collar (see 3c).

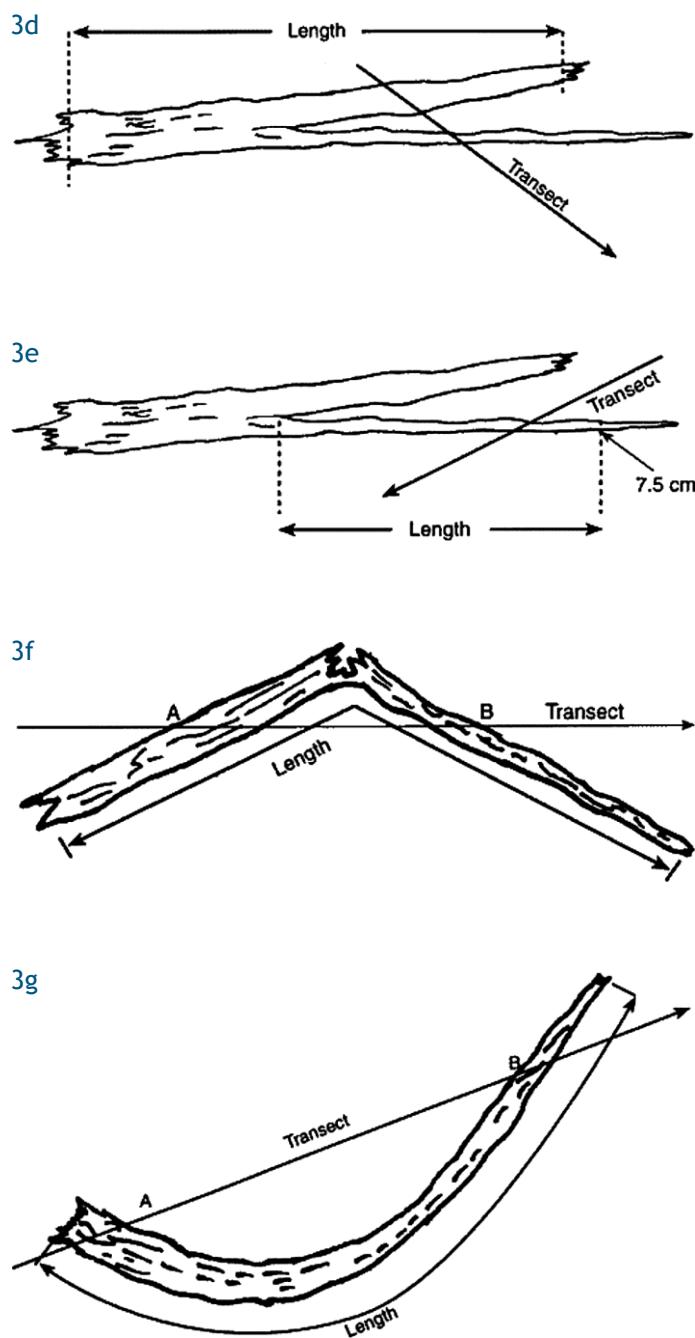


Figure A4-3. Rules for measuring length of CWD (cont.).

#### Measurement of forked stems

- Where one of the forks transected is determined (by largest diameter) to be a continuation of the main bole then the length will be measured to the ends of the main piece (see 3d).
- The piece length of the smaller stem(s) (smaller diameter) will be measured only to the junction with the main bole (see 3e).
- For forks of near equal stature, make a determination as above and measure accordingly.

#### Measurement of pieces that are crossed more than once on the transect:

- Pieces broken but still physically attached are measured as one piece at each transect point. The length measurement is taken along the central axis of the piece (see 3f).
- The full piece length of curved/crooked pieces is measured at both crossings (see 3g).
- In the same manner as above, record the full piece length twice where the same piece is crossed by two transects at right angles to each other.

## Appendix 6. Reference – Form D Side 1



BRITISH  
COLUMBIA

Forest and Range  
Evaluation Program

Stand-level Biodiversity  
Resource Stewardship Monitoring  
Reference – Form D Side 1

| Wildlife Tree Class      |      |                          |      |                                       |                                  |                                  |                                  |                         |
|--------------------------|------|--------------------------|------|---------------------------------------|----------------------------------|----------------------------------|----------------------------------|-------------------------|
| Live                     |      | Dead                     |      |                                       |                                  |                                  |                                  | Dead Fallen             |
|                          |      | Hard →                   |      |                                       | Spongy                           | → Soft                           |                                  | Not Sampled             |
| 1                        | 2    | 3                        | 4    | 5                                     | 6<br>≈ 2/3<br>original<br>height | 7<br>≈ 1/2<br>original<br>height | 8<br>≈ 1/3<br>original<br>height | 9                       |
|                          |      |                          |      |                                       |                                  |                                  |                                  |                         |
| Live                     |      | Dead                     |      |                                       |                                  |                                  | Dead Fallen                      |                         |
|                          |      | Hard →                   |      | Spongy                                | → Soft                           | Not Sampled                      |                                  |                         |
| 1                        | 2    | 3                        | 4    | 5                                     | 6                                |                                  |                                  |                         |
|                          |      |                          |      |                                       |                                  |                                  |                                  |                         |
| CWD Decay Class          |      |                          |      |                                       |                                  |                                  |                                  |                         |
| Log class 1              |      | Log class 2              |      | Log class 3                           |                                  | Log class 4                      |                                  | Not Sampled             |
| Log class 1              |      | Log class 2              |      | Log class 3                           |                                  | Log class 4                      |                                  | Log class 5             |
| Hard                     |      | Sap rot (but still hard) |      | Advanced decay (spongy)               |                                  | Extensive decay (crumbles/mushy) |                                  | Many small pieces, soft |
| Bark firm                |      | Loose bark               |      | Bark trace/absent                     |                                  | Bark absent                      |                                  | Bark absent             |
| Elevated                 |      | Sagging                  |      | Sagging to settled on ground          |                                  | Fully settled on ground          |                                  | Partly sunken in ground |
| Hard branches with twigs |      | Soft branches            |      | Branches stubs/absent                 |                                  | No branches                      |                                  | No branches             |
| Supports person          |      | May not support person   |      | Breaks easy                           |                                  | Shape collapses when stepped on  |                                  | Collapsed oval          |
| No invading roots        |      | No invading roots        |      | Roots in sapwood                      |                                  | Roots in heartwood               |                                  | Roots in heartwood      |
| Plot Radius Factor       |      |                          |      | PRF = $\frac{1}{2 \times \text{BAF}}$ |                                  |                                  |                                  |                         |
| BAF                      | PRF  | BAF                      | PRF  | BAF                                   | PRF                              | BAF                              | PRF                              |                         |
| 1                        | .500 | 6                        | .204 | 11                                    | .151                             | 16                               | .125                             |                         |
| 2                        | .354 | 7                        | .189 | 12                                    | .144                             |                                  |                                  |                         |
| 3                        | .289 | 8                        | .177 | 13                                    | .139                             | 18                               | .118                             |                         |
| 4                        | .250 | 9                        | .167 | 14                                    | .134                             |                                  |                                  |                         |
| 5                        | .224 | 10                       | .158 | 15                                    | .129                             | 20                               | .112                             |                         |

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## Appendix 7. Reference – Form D Side 2



Forest and Range  
Evaluation Program

Stand-level Biodiversity  
Resource Stewardship Monitoring  
Reference – Form D Side 2

| British Columbia Tree Code List |                                           |          |                                   |                               |          |
|---------------------------------|-------------------------------------------|----------|-----------------------------------|-------------------------------|----------|
| NATIVE CONIFERS                 |                                           |          | NATIVE HARDWOODS                  |                               |          |
| <b>Cedar</b>                    | <b>Thuja</b>                              | <b>C</b> | <b>Alder</b>                      | <b>Alnus</b>                  | <b>D</b> |
| western redcedar                | <i>T. plicata</i>                         | Cw       | red alder                         | <i>A. rubra</i>               | Dr       |
| Cypress                         | <i>Chamaecyparis</i>                      | Y        | <b>Apple</b>                      | <b>Malus</b>                  | <b>U</b> |
| yellow-cedar                    | <i>C. nootkatensis</i>                    | Yc       | Pacific crab apple                | <i>M. fusca</i>               | Up       |
| <b>Douglas-fir</b>              | <b>Pseudotsuga</b>                        | <b>F</b> | <b>Arbutus</b>                    | <b>Arbutus</b>                | <b>R</b> |
| Douglas-fir                     | <i>P. menziesii</i>                       | Fd       | Arbutus                           | <i>A. menziesii</i>           | Ra       |
| coastal Douglas-fir             | <i>P. menziesii</i> var. <i>menziesii</i> | Fdc      | <b>Aspen, Cottonwood, Populus</b> |                               | <b>A</b> |
| interior Douglas-fir            | <i>P. menziesii</i> var. <i>glauca</i>    | Fdi      | <b>or Poplar</b>                  |                               |          |
| <b>Fir (Balsam)</b>             | <b>Abies</b>                              | <b>B</b> | poplar                            | <i>P. balsamifera</i>         | Ac       |
| amabilis fir                    | <i>A. amabilis</i>                        | Ba       | balsam poplar                     | <i>P. b. ssp. balsamifera</i> | Acb      |
| grand fir                       | <i>A. grandis</i>                         | Bg       | black cottonwood                  | <i>P. b. ssp. trichocarpa</i> | Act      |
| subalpine fir                   | <i>A. lasiocarpa</i>                      | Bl       | hybrid poplars                    | <i>P. spp.</i>                | Ax       |
| <b>Hemlock</b>                  | <b>Tsuga</b>                              | <b>H</b> | trembling aspen                   | <i>P. tremuloides</i>         | At       |
| mountain hemlock                | <i>T. mertensiana</i>                     | Hm       | <b>Birch</b>                      | <b>Betula</b>                 | <b>E</b> |
| western hemlock                 | <i>T. heterophylla</i>                    | Hw       | Alaska paper birch                | <i>B. neoalaskana</i>         | Ea       |
| mountain x western              | <i>T. mertensiana</i> x                   |          | Alaska x paper                    |                               |          |
| Hxm                             | <i>heterophylla</i>                       |          | birch hybrid                      | <i>B. x winteri</i>           | Exp      |
| hemlock hybrid                  | <i>heterophylla</i>                       |          | paper birch                       | <i>B. papyrifera</i>          | Ep       |
| <b>Juniper</b>                  | <b>Juniperus</b>                          | <b>J</b> | water birch                       | <i>B. occidentalis</i>        | Ew       |
| Rocky Mtn. juniper              | <i>J. scopulorum</i>                      | Jr       | <b>Cascara</b>                    | <b>Rhamnus</b>                | <b>K</b> |
| <b>Larch</b>                    | <b>Larix</b>                              | <b>L</b> | cascara                           | <i>R. purshiana</i>           | Kc       |
| alpine larch                    | <i>L. lyallii</i>                         | La       | <b>Cherry</b>                     | <b>Prunus</b>                 | <b>V</b> |
| tamarack                        | <i>L. laricina</i>                        | Lt       | bitter cherry                     | <i>P. emarginata</i>          | Vb       |
| western larch                   | <i>L. occidentalis</i>                    | Lw       | choke cherry                      | <i>P. virginiana</i>          | Vv       |
| <b>Pine</b>                     | <b>Pinus</b>                              | <b>P</b> | pin cherry                        | <i>P. pensylvanica</i>        | Vp       |
| jack pine                       | <i>P. banksiana</i>                       | Pj       | <b>Dogwood</b>                    | <b>Cornus</b>                 | <b>G</b> |
| limber pine                     | <i>P. flexilis</i>                        | Pf       | Pacific dogwood                   | <i>C. nuttallii</i>           | Gp       |
| lodgepole pine                  | <i>P. contorta</i>                        | Pl       | <b>Maple</b>                      | <b>Acer</b>                   | <b>M</b> |
| lodgepole pine                  | <i>P. contorta</i> var. <i>latifolia</i>  | Plj      | bigleaf maple                     | <i>A. macrophyllum</i>        | Mb       |
| lodgepole x jack                | <i>P. x murraybanksiana</i>               | Pxj      | vine maple                        | <i>A. circinatum</i>          | Mv       |
| pine hybrid                     |                                           |          | <b>Oak</b>                        | <b>Quercus</b>                | <b>Q</b> |
| ponderosa pine                  | <i>P. ponderosa</i>                       | Py       | Garry oak                         | <i>Q. garryana</i>            | Qg       |
| shore pine                      | <i>P. contorta</i> var. <i>contorta</i>   | Plc      | <b>Willow</b>                     | <b>Salix</b>                  | <b>W</b> |
| western white pine              | <i>P. monticola</i>                       | Pw       | Bebb's willow                     | <i>S. bebbiana</i>            | Wb       |
| whitebark pine                  | <i>P. albicaulis</i>                      | Pa       | Pacific willow                    | <i>S. lucida</i>              | Wp       |
| <b>Spruce</b>                   | <b>Picea</b>                              | <b>S</b> | peachleaf willow                  | <i>S. amygdaloides</i>        | Wa       |
| black spruce                    | <i>P. mariana</i>                         | Sb       | pussy willow                      | <i>S. discolor</i>            | Wd       |
| Engelmann spruce                | <i>P. engelmannii</i>                     | Se       | Scouler's willow                  | <i>S. scouleriana</i>         | Ws       |
| Sitka spruce                    | <i>P. sitchensis</i>                      | Ss       | Sitka willow                      | <i>S. sitchensis</i>          | Wt       |
| white spruce                    | <i>P. glauca</i>                          | Sw       | <b>UNKNOWN</b>                    |                               |          |
| spruce hybrid                   | <i>Picea cross</i>                        | Sx       | Unknown                           |                               | X        |
| Engelmann x white               | <i>P. engelmannii</i> x <i>glauca</i>     | Sxw      | Unknown conifer                   |                               | Xc       |
| Sitka x white                   | <i>P. x lutzii</i>                        | Sxl      | Unknown hardwood                  |                               | Xh       |
| Sitka x unknown                 | <i>P. sitchensis</i> x ?                  | Sxs      | <b>OTHERS</b>                     |                               |          |
| hybrid                          |                                           |          | Other tree, not on list           |                               | Z        |
| <b>Yew</b>                      | <b>Taxus</b>                              | <b>T</b> | Other conifer                     |                               | Zc       |
| western yew                     | <i>T. brevifolia</i>                      | Tw       | Other hardwood                    |                               | Zh       |

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## Appendix 8. Data cleaning of field cards – Stand-level biodiversity

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### Suggested Methodology

- Order your cards to make it easier to review, Form C, then each Form B with related plot cards.
- Check RESULTS for the opening ID. See if NAR and Gross areas agree (cards to RESULTS), if they don't then investigate. Generally accept the RESULTS NAR if only a few hectares different and tweak the cards as necessary (i.e., make sure the sum of harvest strata area equals NAR). If Gross area is different determine if it is due to external retention that was not included in gross area for RESULTS. That is a legitimate change – which should show up as an “override” area.
- Confirm all retention acknowledged in the SP or RESULTS is accounted for on cards (check Forest Cover in RESULTS screen – MAT/NAT usually means a reserve). If some retention seems to be missing then look for evidence of their existence in photos. If you have confirmation of their existence – and they are not a big component of the retention – then add them in as unsampled strata (using known info such as area, location of retention).
- Confirm that separate (non-contiguous) patches are not lumped together on one Form B. If they are, they need to be separated.
- Check the list of strata that are unsampled. None of them should be a dispersed stratum. Make sure there is no duplication between section 16 and Form B's.
- Confirm all stratum ID meets the rules (maximum of three letters followed by maximum of two numbers). If a stratum is entire area of NAR – it should have stratum ID of “NAR.”
- Pay close attention to make sure all retention strata are correctly differentiated between rotation length strata and temporary strata. Temporary strata are those we have evidence that harvesting will occur before a full rotation is over. Retention left after a partial cut silvicultural system (e.g., commercial thinning or shelterwood) will be considered temporary unless there is a statement that contradicts that in the SP.
- Add up all the stratum areas to make sure they don't exceed gross (or override area).
- Review every card for complete information.
- Review plot cards for correct species codes and any anomalies in tree size.
- Make sure the same BAF or fixed area is used on all plots in single stratum.
- If a full count area – all stand table trees show up on first plot. The CWD data should be on separate plots.

When you've finished checking cards:

- re-order the plots for data entry (Form C, all Form B's, all Form A's).
- Headquarters only – document major changes for that opening ID (with rationale), note any communication with the district. Keep an electronic copy as a district file and put a paper copy in the folder.
- Headquarters only – sign your name on the folder for data validation.

