Summary of Issues pertaining to the Multi-Storey Survey Procedures and Uneven-aged Stocking Guidelines

Issue review and recommendations
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Introduction:

The following document is meant to highlight issues and provide recommendations to the Forest Practices Branch pertaining to the Multi-storey survey procedures and uneven-aged stocking guidelines. Numerous practitioners have provided detailed examples of issues and along with their recommendations[1]. We have attempted to capture the issues and have sorted them into the following categories:

1. Uneven-aged single tree selection (the intended use of the Multi-Storey Survey and UEA).
2. Stands with a regeneration objective, with uniform short or long-term retention creating an even -aged stand, e.g., uniform seed tree or shelterwood (Stand Structures follow those described by Zielke and Klenner, 1994 – See Appendix 2 for a complete list).
3. Stands with no regeneration objective, uniform short or long-term retention creating even - or setting up of uneven aged stands (intermediate cuttings such as CT and Beetle Proofing, salvage harvesting, limited entry harvests in constrained areas, and preparatory cuts for uneven-aged management, etc.).

Once the issue is described, suggested approaches and or recommendations are provided.

Some Background:

The Multi-Storey Survey procedure was originally designed to:

1. Make a stocking status decision to ensure there is adequate growing stock to provide timber volume in a timely fashion. This is now the legal obligation to provide for a stocked stand within the prescribed time frame. The stocking should help predict a Mean Annual Increment (MAI) that can be factored into the Allowable Annual Cut (AAC) determination. In addition to the MAI the Ministry of Forests, in interpreting the Forest Act wants to ensure that a merchantable product can be achieved without undue risks (health, resilience) to the Crown.
2. To a lesser extent the multi-storey survey procedure was used to provide information to determine if the management goals have been achieved based on the current stand conditions. The survey numbers do not necessarily provide this information and often will require additional information over and above the stocking numbers, e.g., Residual Basal Area (RBA), level of brush competition, information on distribution – clumpy or not, size range of larger stems, etc. Some of this should be, and is, likely a responsibility of harvest implementation and monitoring, rather than as a survey requirement (e.g., RBA and size range of larger stems). We need to be careful here, as prescriptions will vary in their intent and desired structure. A simple set of minimum and target standards may not provide a good link with the stated objectives – the key may be to require compliance to the prescription at the time of harvest – for the merchantable classes. Adding RBA to the survey may help in assessing whether one portion of the objectives was met.

[1] Please see appendix one for a list of contributors.

Some questions we should ask prior to harvest - i.e., at the Silviculture Prescription (SP) stage are: do we need to manage for all ages within this block? Is continuous forest cover necessary including larger trees? Is regeneration required at this entry? When will I be back for my next harvest entry? What are the risks to fire, disease and blowdown in the intervening period? These types of questions will help decide what information is needed within the survey and what should be addressed at the time of harvest.

3. To provide up to date information for the forest inventory and its link to forest estate models used for timber supply planning (e.g., Timber Supply Review TSR). This is an important link and one that requires additional input.

   The Uneven-aged stocking guidelines were derived from the Correlated Guidelines for Management of Drybelt Douglas-fir Stands in British Columbia (1992). They follow the four layered approach provided by the Fdi guidelines that includes: no minimum intertree distance for layer 1, 2 m for other layers, and that all layers contribute to the stocking with increasing stems per ha required to achieve minimums and targets as you move from layer 1 to layer 4 (nested approach)2.

   Our main recommendation is for the **Multi-storey** stocking procedure to be used only for stands being managed as single tree selection (or in some cases planned Irregular Shelterwoods, as they both have long term recruitment strategies). Some data may be collected preharvest and require only minor field checking post harvest.

   Other even-aged stands, with more than one layer (**Multi-layer**), should be tallied by layers, but be assessed using the present even-aged approach, combining all layers. Field-testing to determine what if any minimum or target stocking changes are needed, by defined structure types, is recommended.

   For older blocks or more complex structures, field training in stratification and use of experienced personnel, as mentors should be a priority.

[2] Layer 1= mature layer = trees ≥ 12.5 cm dbh; Layer 2 = pole layer = trees 7.5 cm to 12.4 cm dbh; Layer 3 = sapling layer = trees ≥ 1.3 m in height and up to 7.4 cm dbh; Layer 4 = regeneration layer = trees < 1.3 m in height.

1. Uneven-aged Management - Single Tree Selection - General issues

1.1. Stocking Standards[3]

1.1.1. Link to Management Objectives

This issue has been raised by a number of respondents. That is, the SP has specific objectives regarding stand structure that are not linked to the multi-storey survey as per the guidebook but the multi-storey stocking standards are used as a default in their prescriptions.

The key here is to use the stocking standards for uneven-aged management only. Where the stocking standards do not fit the agreed upon objectives for the stand, modify the standards and include them in the prescription. This has been done at the University of British Columbia (UBC) Alex Fraser Research Forest, see Appendix 3 for an example. As well as assessing the stand using the stocking standards additional information is required by law, e.g.,

Section 70 of the Forest Practices Code of British Columbia Act (the Act):

70. (1) In this section:

(4) Without limiting subsections (2) to (3.1), the person who is required to establish the free growing stand under the prescription must do all of the following:

> (a) create the post harvest stand structure and site conditions specified in the prescription;

OPR Section 39 (d)

(d) for single tree selection, all of the following:

(viii) the planned residual basal area per hectare;

(ix) the approximate number of trees by diameter class;

Overall there is agreement that there needs to be clear and enforceable standards in the SP that are additional to the stocking standards, the issue becomes how much information is needed up front to provide for the desired outcome?

As we are still in our infancy at knowing how to manage stands using uneven-aged management, it is important to encourage its use where it is suited, without the burden of extremely complex SP's and corresponding obligations. The recommendations are made with this in mind.

[3] From the Establishment to Free Growing Guidebooks, MOF, May 2000, Stocking Standards are meant to provide guidance on maximum density and the number of target and minimum well-spaced stems/ha to meet identified management objectives. Management units with differing approved timber product or other objectives (e.g., IRM or biodiversity) may have different stocking standards than those suggested in the Guidebooks.

Recommendations:

- Assessment of post harvest structure from the SP. For Compliance & Enforcement, the Code requires a planned RBA by ha and the approximate number of trees by diameter class (OPR 39 1 d viii and ix) – the hard part is to use pre harvest data to assess the stand post harvest without excessive sampling, both before and after harvest. We recommend providing a minimum RBA in the prescription (with a range) along with the approximate number of trees by diameter class using relatively broad diameter class (e.g. a 15 cm class for larger stems - 30-45 cm) to promote meeting the stated objectives, and to comply with the Code without undue sampling intensity. The lower limit of the planned residual basal area is the minimum that the SP holder would be accountable for – a suggestion would be to plan to harvest above the minimum to some level to provide a 'comfort level'. Ocular estimates, with reconnaissance level sampling to assess the RBA and diameter distribution by C&E staff is recommended. **The key to a successful partial cutting prescription is effective communication of the prescription to the harvesting crews and ongoing monitoring and feedback to the crews to ensure the prescription is followed as it was designed.**
- Within the regeneration delay period use the **multi-storey procedure** to determine overall stocking compliance. Where the guideline numbers fit with the desired structure use those in the prescription. Where needed, to match structural objectives for the stand modify targets and minimums in the SP. As described in the Guidelines for Tree Species selection – "Follow not the system as a blind man might follow a wall" Or put another way - Deviate from the guidelines where a good cause warrants it – i.e., where the guideline numbers do not fit the desired structure.
- To provide a more accurate picture of the stand, alternative options for the survey were presented. At this time we do not recommend modifying the multi-storied nested approach to one where individual layers are counted independently, assessed with stats and aggregated to provide the stocking level. Instead we recommend that field-testing be done to create a stand table to provide information that better describes the stand in concert with the stocking procedure. This information should be collected in such a way that it is compatible with forest inventory inputs and for growth and yield modeling and treatment recommendations (this would solve counting beyond M by layer). This would also capture layer 4 information if prescribed as necessary. The intent of this table is not as a check against the pre-harvest version, instead it is meant to provide a snapshot of the stand for management purposes, the inventory update when and if they move to stand table inputs. Field-testing to determine: diameter classes, size of plots (fixed vs. variable or mix) and desired accuracy, is recommended.
- Where new regeneration is an objective to meet the desired stand conditions identified in the SP, some minimum level should be indicated for layer 4. As pointed out in Appendix 3, the amount of recruitment needed to meet the structural objectives may be small or in some cases non-existent if established layer 3 stems will provide the needed recruitment, this needs to be described clearly in the SP.
- Where a prescription writer identifies critical densities in the non-merchantable classes, to achieve the prescription objectives, they need to be described in the SP. Post harvest treatment to achieve the densities would be assessed using the appropriate assessment procedure (e.g., juvenile spacing assessment procedure).

Outstanding Issues and Questions:

1. We suggest a need to separate out what is needed to meet code derived standards, described above – for C&E and stocking standards (essentially implementation monitoring – are we doing what we said we would do), and

   A monitoring and auditing process to look at issues towards meeting long term objectives through prescribed structure. This is effectiveness monitoring –answering the question - is what we are doing what we expected it would do? – i.e., are we getting the levels of regeneration we expect under the prescribed RBA and stand structure type, are we getting the amount of diameter growth by cohort for timely recruitment into larger diameter classes; is the amount of snow interception adequate for the objectives by managed structure. Effectiveness monitoring can then be used to provide feedback to prescription writers to create desired stand conditions.

   C&E assessments and stocking standards are not designed for effectiveness monitoring.

2. For effectiveness monitoring to be useful we have the following questions – Who does it? What should be monitored and how? How do we ensure it is done adequately? How do we get the information back to the practitioners.

   We need some procedures and protocols for specific questions – that go beyond stocking surveys. It is likely that research establishments are required to answer some of these questions.

1.1.2. Layer 4 Recruitment

Layer 4 recruitment is not required on all blocks. The key element is to have adequate site occupancy and have adequate levels of recruitment from one age class to the next. Where there are adequate numbers of good quality layer 3 (advance regeneration) there may not be a need at the harvest entry for additional regeneration. By default some will usually seed-in during the cutting cycle, but may not have been required to maintain stocking.

Alternatively

A stand may be SR with layer 1 and 2 following harvest with no layer 3 and 4 objectives. The intent may be to create an uneven-aged stand structure in the future, but at this time the entry is made to increase stand vigour, making it an intermediate harvest and should be assessed accordingly. The silvicultural system could be seen by the prescriber as single tree selection, but at this time there are numerous future options, one of which is to open up the stand at the next harvest entry to promote an un-even aged condition. The current concept for the stand should be recorded for future practitioners, but just because it is identified as a future STS block, it need not be assessed or regulated as STS at this entry if indeed the harvest has left a fully stocked stand of good quality layer 1 (and possibly 2) trees.

Recommendations:

- Layer 4 recruitment may or may not be an objective. The key is to identify up front the intent of the harvest entry (need for new regeneration or not – intermediate entry or not) and assess accordingly. Note layer 3 may provide for timely recruitment.
- The nested approach created for Uneven-Aged management was meant to provide a spatial allowance for larger stems. In some cases the available space within the block for new regeneration will be taken up by layers 2 and 3 stems with only minor openings created where the layer 1 trees were removed (possibly taken up by established layer 2 and 3 stems). With well distributed stems in layer 3, inputs from layer 4 may not be required to maintain the productive potential for the site. If the stocking assessment showed insufficient numbers based on the survey results using all layers it would indicate additional stocking in layer 4 is required. Where gaps are created in the stand without regeneration, this should be captured by the survey process.
- Where it is a clear objective within the prescription to have new recruitment come from layer 4 an additional requirement to tally layer 4 stems with a minimum by strata may be needed. This may require some form of line transect approach where the proportion of open area is correlated with minimum standards for layer 4. At a minimum, where the prescription calls for layer 4 recruitment, stocking plots would require a tally including layer 4 (this would be covered if the use of a stand table is implemented). Where the level of recruitment is not sufficient at the end of regeneration delay period planting to meet the objectives would then be required. This approach requires field testing to determine feasibility and to work out operational direction.

Relevant sections from the Code: Silviculture Practices Regulation

Reforestation requirements

11.(1) …must do the following:

(a) retain a registered professional forester to specify a regime of silviculture treatments that can reasonably be expected to produce the target stocking levels specified in the silviculture prescription by the end of the free growing assessment period specified in the silviculture prescription;

(b) implement the regime of treatments referred to in paragraph (a);

(2) A holder of a silviculture prescription is exempted from the requirements of section 70 (4) (d) of the Act and subsection (1) if the timber harvesting proposed for the area under the silviculture prescription is limited to intermediate cuttings, and there are no regeneration objectives specified in the silviculture prescription.

Surveys required

23.(1) Subject to section 11 (2), a person who is required to establish a free growing stand on an area under a silviculture prescription must carry out the following surveys:

(b) a survey, on or before the regeneration date specified in the silviculture prescription, of the number of healthy well spaced trees per hectare;

(c) a survey, within the free growing assessment period, containing sufficient information to enable the district manager to determine if the stand meets the free growing standards specified in the prescription.

(2) Despite subsection (1), if a silviculture prescription meets the requirements of section 11 (2), the person who is required to establish a free growing stand on the area under the silviculture prescription does not have to carry out the survey specified in subsection (1) (b) and (c).

(3) More than 12 months after the completion of harvesting, a person exempted under subsection (2) must carry out a survey that meets the requirement of section 26.

(4) If the harvesting has not been completed before the date this section comes into force, subsection (2) applies, despite any silviculture prescription approved or given effect before that date.

Recommendations:

- Be clear in the SP if regeneration is an objective and administer accordingly. It is the responsibility of an RPF to specify a regime of silviculture treatments that can reasonably be expected to produce the target stocking levels specified in the silviculture prescription by the end of the free growing assessment period. This would either include regeneration or not (by natural, artificial or by a mix).
- If regeneration is needed it should be specified in the regime as noted above (SPR 11 1 a and b).

- The declaration period is tied to regeneration objectives. In cases where Drybelt Douglas-fir stands are being 'groomed' for single tree selection, there may not be regeneration objectives, classifying it as an intermediate cut and the associated administrative requirements.
- Where there are identified risks in an area – longer time frames may be required to reduce the risk to the crown. This would require identified risk zones (e.g., windthrow, root disease, spruce budworm, etc. and associated minimum time to assessment – this would require changes to the SPR section 23 (3).

1.2. Multi-Storey Surveys

1.2.1. Lower Stocking Standards for Layers 1, 2, 3 and 4

Specifically for dry Douglas-fir forests the current stocking standards set the target density much too high to fit with lower B and Q values used to set up management regimes for these stands.

Comment:

This appears to be a bigger issue than just working on the numbers in the present stocking standards. At issue here is what structures will promote volume production while maintaining resistant and resilient stands (for example to insects, disease and fire). As well, the idea of allocating more space to larger stems (as per the lower Q value and work done by O'Hara in Montana using leaf area index (LAI)) indicates a lower target for all layers, than those given in the present guidelines, may be preferable.

This requires density control in non-merchantable layers. To quote Mathews (1989)[4]:

> *"If selection fellings are to be raised to the status of a silvicultural system, something more is required than mechanical removal of exploitable trees. It is necessary also to provide for sustained yields by making thinnings among the various age classes to ensure:*
>
> > *That these are maintained in their correct proportions;*
> >
> > *That a suitable mixture of species is maintained, if this is necessary;*
> >
> > *That young saplings are freed from suppression; and*
> >
> > *That defective stems of any size are removed wherever they are hampering with better ones."*

This issue then is more of a maximum density by layer as well as a minimum. The issue then becomes a 'who pays' one.

This requires additional input for resolution.

Recommendations:

- There is a need to look at this issue based on desired structures. New information since the Fdi guidebook indicates using lower Q and B values than previously suggested to guide our stands – should we revisit the numbers for Fdi based on that information? We think so.
- Where recruitment is needed from the various layers and damage to those layers would be a problem to meet the objectives, strong wording in the SP regarding damage to non-merch layers should be used. There is provision in the Code to use administrative remedies for unacceptable damage (Section 67). Because of the scattered nature of the stems it is likely better to have a % of stems criteria in the SP than a minimum number value, as that will be difficult to determine.
- In some cases a minimum or maximum by layer may be required to meet the structural objective. A who pays issue emerges as the number will likely be below the maximum density value for layer 3. We recommend this be looked into.

[4] Mathews. J.D. 1989 Silvicultural Systems. Clarendon Press, Oxford.

Note

We should be careful here with too much detail by layer. The layers are meant to provide a timely recruitment of stems through the diameter classes to replenish those harvested. The growth responses, by class, may vary and not respond as expected, depending on a variety of factors (e.g., vigor, length of time in the understory, species, genetics, microsite, location within the new stand, density, etc.) The key is to have sufficient healthy growing stock with space to grow well, keep healthy and remain resilient to fire and other factors. This may not have a specific density by layer that is easily measured or adhered to. Instead energy may be better spent identifying desirable clump densities and maximum gap size without regeneration. The key is to choose a RBA that promotes site occupancy and at the same time opens the stand up enough to promote growth of the understory layers.

1.2.2. Minimum Free Growing Height

There has been uncertainty identified on what to use for minimum free growing height.

Recommendations:

- Follow the May 2000 revised edition of the Establishment to Free Growing Guidebook guidance:
    - Species same as in even-aged stocking standards.
    - Crop tree to deleterious brush ratio and minimum height: same as in even-aged stocking guidelines except for uneven-aged drybelt Douglas-fir stands within the Interior Douglas-fir zone where trees must be five years on site and at least 40 cm tall.

Note

Acceptability of leave trees in the overstory may be different than those in the understory. For example, recent research on the effects of suppression and release on sapling growth for eleven tree species in the northern interior of BC [5]indicate significant differences in strategies between shade tolerant and shade intolerant species. Shade intolerant species showed significant reductions in growth under suppression. This relates to the acceptability of species based on the structure left (RBA) and the expected cutting cycle. Where cutting cycles are relatively short e.g., 1 or 2 years- RBAs can be higher as length of suppression may not be an issue. Where cutting cycles are long, e.g., 20 years, RBAs need to be lower if shade intolerants are part of the management mix as they will either grow very slowly or not survive at low light levels. Thus we need to use our knowledge of silvics to create workable prescriptions. In some cases Pl should not be considered acceptable as an understory species if high overstory BA is to be left for long cutting cycles. This is a SP specific issue and difficult to provide generic acceptability ranges at this time.

1.2.3. Statistics on Survey Data

A standard method for statistical analysis on layered stocking and free growing surveys has been identified as an issue in order to reduce the cost of 1 plot per hectare and reduce

[5] (Wright, E. F., Canham, C.D., and K.D. Coates. 2000. Effects of suppression and release on sapling growth for eleven tree species of northern interior British Columbia, Can. J. For. Res – in press)

the risk of 5 plots in 100's of hectares. Survey intensity and costs are an ongoing issue. The issue is how many plots are needed to provide confidence in the outcome.

Summary/Suggestions from practitioners:

We have received differing opinions on how this should be addressed – some say leave it as it is others want to revise the system significantly.

Recommendations:

- It is our recommendation that we should determine what benefit stats will provide before we make any decision on incorporating their use.
- We need to link the accuracy needs of the output with the survey intensity before choosing an appropriate approach.
- We do see a need for greater certainty for modeling the growth and yield of STS stands. We recommend following a recommendation regarding data input, provided by the Prognosis specialist[6], to set up a trial where areas are selected from the database that have been cut using single tree selection. Survey those areas with the Multi-Storey Survey procedure with additional information collected to form a stand table. Prism sweeps would be used to capture layer 1 stems, the fixed radius plots for the other layers. The blocks would be sampled with a high intensity of plots (to be determined). The data would be used to run Prognosis. Subsamples of the data would then be used to run Prognosis. The results would be compared. A minimum number of samples to achieve an acceptable output would be recommended. This approach would form a baseline from which sampling intensity could be derived. **We do not see the need for each block to have a Prognosis run** – Prognosis will be used to determine adequate sampling intensity. This would lead to the creation of stand types and associated yield curves where future stands would be classified with input from appropriate survey intensities.
- New information is being proposed to capture the forest inventory – it has been indicated that they will be moving to the use of stand tables as an input source. The inventory now records information for two layers – layer 1 the tallest, layer 2 a composite of the remaining stocking – i.e., modal diameter (most common diameter). Prognosis also uses stand tables as an input source. We see linking G&Y data needs with inventory objectives as a means to determine accuracy requirements.

  #### Note:

  As STS is by nature heterogeneous, the number of plots to meet "stats" will be high. Using stats by layer, that has been suggested, assumes we want the numbers within those layers at the level prescribed, within some range of accuracy (stats). In most cases the Q value or coefficient for recruitment (numbers by layer) is a less important factor when using BDq to manage structure, especially in the first few managed entries (Becker, 1995, Fiedler, 1995[7]). The most important is to leave a healthy stand

[6] Barry Snowden, Forest Practices Branch. Pers com November 2000.

[7] Becker, R. 1995. Operational Considerations for Implementing Uneven-aged Management. IN. Uneven-aged Management: Opportunities, Constraints and Methodologies, Ed. By K. O'Hara, School of Forestry University of Montana, p 67 – 81.

Fiedler, C. 1995. The Basal Area-Maximum Diameter (BDq) Approach to Regulating Uneven-aged stands. IN Uneven-aged Management: Opportunities, Constraints and Methodologies, Ed. By K. O'Hara, School of Forestry University of Montana, p 94 – 109.

of a density able to use the site resources to maximize standing growth and provide room for regeneration and subsequent growth. This likely will not be captured well using stats.

We need to be careful here not to get to caught up in the numbers and forget the trees, STS is as much an art as it is a science and requires thoughtful assessment, rather than strict adherence to statistically derived values. Other jurisdictions (e.g., Montana, Oregon) use mark to cut or leave and keep a tally by diameter class to ensure compliance with desired structure – this would alleviate the concern for stats in the larger size classes, and produce desired structure. The smaller size classes would need to be managed based on desired clump densities and recruitment objectives. These are likely to be site specific and result from an "if then this" statement. Such as if a gap is greater than one tree height it should have X healthy recruits.

1.2.4. Sampling methodology does not capture the variability and treatment options

The present sampling procedure does not describe the stand conditions adequately. E.g., the survey should be able to determine the percentage of forest types present, (skid trail vs. maximum density vs. mature) and provide areas where treatments would be beneficial.

We see this a separate component of assessment, additional to assessing stocking and providing an inventory label. It may be better served at the SP stage to identify the areas. The following approach seems to fit with blocks that do not have a clear direction from the prescription.

A suggested method was provided through the consultation process. It is as follows:

Strip lines are established at regular intervals (50 to 200m apart). "Point" plots established (10 to 50m apart). At each "point" mark a ✓ in a table indicating the forest type that best represents the 1m (or 2m) radius of the surveyor. Suggested forest types are; SR, NSR, FG, Over Maximum Density, Brushing Required, NP, with sub categories of; over SR or FG based in L1, L1&2, L1,2&3, L1,2,3&4. Very few (possibly still 5 plots as a minimum) 3.99m (or 5.64m) "regular" layered plots are established where the surveyor determines they would be representative of the forest type. This method would be suitable to estimate the proportion of the block that is made up of the forest types. It also could replace the line transect method. This was indicated as an effective method to identify proportions of "competitive environment" or strata to help to prescribe treatments based on these forest types not necessarily on mapable strata. A target and maximum number of plots could be set after consultation with Branch biometricians.

Recommendations:

- The data collection to prescribe all treatments (regen, spacing, CT, and gap harvests) should be done in conjunction with the SP prior to a harvest entry (something we can't do with even-aged management). We need this information to formulate a meaningful strategy at the stand level. This is where we need meaningful detail, using perhaps a mix of plots and line transects. Things will change after harvest, but the magnitude of change could likely be determined

after a post-harvest walkthrough. The compliance survey can then be far less onerous and be used to determine if the prescription is on or off the track. We are too used to our regen survey approach in clearcuts which is used for many purposes and quite rightfully so since we are looking at a completely new stand that didn't exist before at all.

- We can look into the use of the above strip line approach or the line transect approach to capture treatment options where a reconnaissance survey or walkthrough has indicated a problem exists (e.g., more relevant for backlog blocks, blocks without SPs, Irregular Shelterwoods with varied structure, and the like). It would provide a more complete picture of the variability and may provide suggested treatments by area (that may be useful). This approach is similar to good SP data collection that describes the variability and hence the harvest and post treatment options. It could be used to quantify treatment areas – brushing, spacing, planting – if needed.
- More discussion is warranted on the pros and cons of the above approach versus professional judgment or using the stand tables, with descriptions of the type along with identified treatment options. All approaches assume and require some level of stratification.

1.2.5. The Sampling Methodology does not capture the stand structure.

Because of the nature of the survey method, where the layers are counted from the largest down and the maximum number can be achieved prior to counting the lower layers, some have suggested, incorporating into the survey methodology, written standards that require the surveyor to continue counting past the point of meeting the target stocking standard (i.e. go past the "M" or Maximum counted values for each layer to maximize each plots potential for stocking and free growing numbers).

They suggest that often layer 3 stems show little representation in the summary but have over 5000 stems per hectare. This is because layer 1 and 2 stems have reached the M value for the plot limiting the tally of layer 3 stems. They suggest that this does not allow the client to know if the layer 3 or 4 stems are of good quality or form. Health and management comments by layer could be provided. Such questions as: Is some form of brushing needed to free the trees in this layer? What is the probability that trees from each layer will provide the desired number of stems in layer 1? Could then be answered.

Note:

The M value was created to reduce the effect of highly stocked plots from overcompensating areas of under stocking. The present survey procedure provides for the option of recording more then the M value number of well space/free growing trees by species. Only the M value number is extended into the Total W column. The ASSC program was capable of this function. It also calculated the number “disregarding M”.

To use M to provide the desired effect, i.e., minimize overcompensation – it is suggested that M values be used only for Minimum values, Target values need not use M as a maximum per plot.

Summary/Suggestions from practitioners:

Some feel the system works and does not need changing. Others indicate they would get more information from a modified survey approach, one that counts beyond M. One suggested variation was to modify the procedure to count each layer separately (no nesting and use distance criteria by layer only).

Recommendations:

- An option instead of going beyond M to provide a description of the block is the creation of a stand table is recommended. I it will be used as input to the inventory database and to place the block into Prognosis based analysis units. Description of form and vigour of layers 3 and 4 should be a requirement of the survey (e.g., modal and range of ht/diam ratio,% live crown by layer). For uneven-aged management, often the issue is not with the number of well spaced stems per ha, instead what is more important is the density by layer and whether they are free to respond once the overstory has been removed or thinned out. A stand table will help with this (if the area is stratified to capture it).
- Nesting provides a measure of site occupancy. Tallying by layer without nesting presupposes that the stems in the smaller diameter classes are being actively managed to the minimums and targets by layer. Because of the inherent variability in growth rates within each of the layers, especially in the first few entries into previously unmanaged stands, the minimum numbers by layer are less important than having the site occupied by healthy desirable stems. The nested approach is meant to capture occupancy taking into account that fewer larger stems are needed compared with their smaller counterparts to occupy the site.
- We recommend that updating ASSC (or similar approach) and ISIS to accommodate any new data collection standards be a high priority.
- The line-transect method, or other revised approach (as described above) can be used to identify treatment options where appropriate. Do not use for stocking assessment, as the stand is a mixture of dispersed strata by design.

From the Silviculture Surveys Guidebook –

A line intersect survey is used on openings with dispersed strata to determine the area of each stratum. The characteristics of each stratum must be very clearly defined. The amount of strip line that crosses each occurrence of the stratum is used to calculate the proportion of the opening that is represented by each stratum. The amount of strip line per hectare required in an opening is dependant on the characteristics of the stratum. An opening with two evenly distributed strata requires less strip line than an opening with more strata or less evenly distributed strata.

Note:

Again it is worthy to note that single tree selection is as much an art as it is a science. Numbers in themselves are not enough to make management decisions. However the use of a stand table would clearly display the results of the survey – using total stems, providing a guide to future options. The stand table could then be used by field foresters to help frame options at the time of the next field visit. No recommendations should be followed without a field visit by the prescribing forester (or designate as identified by the RPF).

- Inventory is not interested in M values, they are interested in the area taken up by the tallest trees (BA as layer 1) then the sph in layer 2 (silv layers 2,3,4). They also want a modal diameter, species breakdown, age and height. Stand tables will provide this information. Where the compliance walkthrough finds structure as described by the SP stand table that information could entered as the Inventory label without further surveying.

Recommendation - Modified Assessment Procedure:

For Single Tree Selection – to be tested in the summer of 2001.

1. Set up Prognosis trial to assess plot intensity to provide repeatable volume outputs from uneven-aged stands
2. Create a protocol for collecting data using a stand table to incorporate layers 4,3,2 and breaking out layer 1 into 10 cm diameter classes. The data would be collected using the standard 3.99 m radius plot for layers 2-4, with layer 1 trees tallied using a variable radius plot (prism plot). The prism plot should capture between 4 and 10 trees per sweep. The BAF of the prism should be selected accordingly. Tree diameters would need to be estimated accurately, not necessarily measured. This would be done every plot, every fourth plot, where representative??? To ensure data are compatible with end users – e.g., inventory and G&Y modelers, their input into this protocol is critical.
3. Use the present system to determine Minimum and Target stocking, disregarding M for targets.
4. Continue with the intensity of presently used until direction from the above trial provides an alternative.

1.2.6. Regeneration Delay/Early Free Growing Assessment

This issue has been raised regarding regeneration delay periods for single-tree selection versus intermediate harvest entries. It is clear that intermediate entries are not STS as they do not have a recruitment strategy in place. Intermediate entries are discussed in section 3.

Recommendations:

- For uneven-aged management it is recommended to leave regeneration delay as suggested in the Establishment to Free Growing Guidebook (2000) unless a risk assessment by the prescribing RPF indicates the stand does not require such a delay to provide certainty to the crown. MoF would review and agree or disagree. The DM would determine the risk and grant a decision.
- Free-growing as it was originally derived was not created for uneven-aged STS. What is desired, and more appropriate to ensure proper management, is a stand level commitment for multiple entries (successful examples often come from smaller holdings on private land, where the landowner has a vested interest in success and a long term view of management). Stocking standards that end at some arbitrary point are not suited to continuous management. Possibly some form of tenure arrangement for STS stands may be appropriate where shown adherence to good stewardship (their desired structure), which would include managing the non-merch classes, would result in greater security of tenure. This is a tenure related issue and needs to be addressed at that level.

Note

Prescription holders may apply for early FG anytime under any system, except intermediate cuts, subject to minimum age and heights. A request may or may not be approved following a Ministry risk assessment. Early FG should not be automatic; there are certainly high-risk blocks where prescription holders should not be relieved of obligations just because they have met minimums prior to the early date. Risk assessment before a transfer of liability is a common sense approach to doing business.

1.2.7. Layer 1 Broadleaf trees on FG status

Some have indicated an issue with Layer 1, 2 and 3 broadleaf trees, that are left after harvesting are reducing the number of free growing trees that can be tallied.

Recommendations:

- The issue appears to belong in the SP, as it is site and situation specific.
- The idea of having other layers considered free growing must be linked to the desire for timely recruitment into larger size classes. If the trees in layers 2 and 3 are not considered to be adversely affected by the deciduous component, this could be put in the SP and become part of the assessment procedure. As well broadleaf trees may be considered as beneficial to the regeneration by creating shade for establishment.

1.2.8. Forest Health Damage Criteria

The current Free Growing Damage Criteria indicate that they apply to Age Class 1 Stands. Multi-storey stands are clearly not Age Class 1 (1 – 20 years), therefore what should be used?

Recommendations:

- Use the appropriate tables from the Establishment to Free Growing Guidebooks.

From the Establishment To Free Growing Guidebook, May 2000 version.

Table A10-1. Free growing acceptability guidelines for layer 3 and 4 advance regeneration

Species*	**Ba, Bl,**	**Cw**, Hm, Yc**	**Hw**		**Sx, Se, Sw**	**Fdi, Lw**	**Pa, Pli, Py**
BEC Zones	All***	CWH, CDF, MH, ICH	CWH, CDF, MH, ICH (Pr.Rup.)	ICH (other regions)	All*** (except BWBS)	All***	All***
Height at time of release	No height limit			<0.5m	No height limit		
Scars and damage	All species: No open (unhealed) injuries; no closed (healed) injuries with a horizontal width at the widest point(s), which is greater than 25% of the circumference of the tree at that point; no closed injuries that exceed 10% of the total length of the stem; no stem infection caused by a stem rust or dwarf mistletoe; no other externally visible pathological indicators including broken top, frost crack, conk, extreme basal sweep or unacceptable forks and crooks (see free growing damage criteria in Appendix 5 for description of unacceptable forks and crooks)						
Continuous live crown	All species: An acceptable tree has greater than 30% continuous live crown. Continuous live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height. Continuous live crown refers to foliage on adjacent live green branches that forms the main part of the crown of a tree and extends over at least half of the circumference of the tree.						
Vigour	All species: Evidence of release (i.e., generally good post-harvest height increment) — Increased leader growth is not a requirement for trees in layer 3 and 4 in partial cut situations with low basal area removal where the trees remain heavily shaded by layer 1 and 2 trees.						

* For those species not listed here, the normal free growing acceptability criteria apply.

At regeneration delay, consider whether naturals will meet these criteria by free growing.
If western white pine (Pw) is to be considered, consult the *Pine Stem Rust Management Guidebook.*

** Beware of sun scald. If advance regeneration western redcedar is to be used, check for incidence of heart rot.
*** All refers to zones where these species are acceptable.

For additional information regarding decay fungi and advance regeneration refer to the *Tree Wounding and Decay Guidebook*.

Table A10-2. Acceptability guidelines for residual mature and pole layer crop trees

Scars and Damage	The impact that decay fungi have on residual trees depends largely on the retention period for the trees left behind. The management objectives determine how decay fungi should be managed. The *Tree Wounding and Decay Guidebook* provides recommended damage criteria by management regime. A tree is not acceptable as a residual crop tree if it meets or exceeds the applicable level of damage as determined by the stand management regime defined in Table 4 of the *Tree Wounding and Decay Guidebook*.
Continuous Live Crown	An acceptable tree should generally have greater than 30% continuous live crown. However, for trees greater than 17.5 cm dbh (>12.5 cm dbh for Pli), greater than 20% live crown will be acceptable.
Vigour	Evidence of release.
Other Considerations	Destructive sampling of a few stems is encouraged to ensure that most of the retained stems are sound. This is critical when heart rot susceptible species are retained as pole/mature residual crop trees and are listed as *preferred* in the SP.

- Follow the guidebook suggestions including suggested use of the Tree Wounding and Decay Guidebook that breaks out the level of wounding and decay acceptable by silvicultural system.
- Where mistletoe is at high levels in layer 1, trees of the same species below should not be considered free growing (as per even-aged recommendations), other non-susceptible species could be.
- Where release has not been observed, use the morphological indicators to determine probability (size of live crown, color, damage/wounding) – this will always be somewhat subjective. New research from the ICH indicates release will occur with most species, some may take more time. Snow breakage may be a problem in the interim.

1.2.9. Forest Health Root Disease

The issue of root disease as it relates to single tree selection and multi-storey stocking surveys was identified and as of yet has no identified solution.

Some input that was received gives this brief overview. *Firstly, we know that there is considerable variation in the occurrence and above-ground manifestation of DRA, and measurements solely of infected trees (or stumps) have dubious significance. We need to evaluate the risk assessment matrix for DRA, plus consider the management objectives for the area or site in question. Secondly, what or how should we evaluate DRA if the original intent of a prescription were to leave certain numbers of DRA-infected trees for wildlife habitat or coarse woody debris? We need to specify or define what are well-growing acceptable trees first, then throw out or discount any that are obviously infected with DRA, including of course any layer 1 trees, if our major concern is with future timber production. We discarded the "old" criterion of DRA-infected stumps because there wasn't any relationship between new infection and proximity to stumps. Instead of trying to define DRA free-growing criteria for multi-layered stands, I recommend focusing on the pre-treatment evaluation to guess what would be the best prescription in view of apparent occurrence and risks of Armillaria impacts, and monitoring results over several years to substantiate or modify our prescription guidelines.*

Recommendations:

- Identify the risk of using STS in areas known to harbor *Armillaria* or other root rot pathogens preharvest and create the plan accordingly (i.e., avoid STS of Fdi in areas with a high level or probability of *Armillaria*).
- At the time of the survey quantify the observable effects of root disease in the stand using a system that provides some linkage to management options. The data could be collected in plots or preferably, as a running tally as one moves through the stand doing the survey. The category would be tallied at each plot. A suggested approach follows (the number of categories can be increased to better fit volume reduction coefficients if the level of sophistication is available)[8]:
    - No evidence of root disease observed in the plot or along the transect line
        - Management Option – Record as level 1 - no issue.
    - Canopy reduction is evident, up to 20% of the overstory trees are dead or dying.
        - Management Option – record as level 2 – use growth reduction factors to account for this level of infection. Use species of highest tolerance for regeneration, if an option.
    - Canopy reduction is obvious, between 20 and 60% of the trees are dead or dying.
        - Management Option – record as level 3 – use growth reduction factors to account for this level of infection. Consider remedial action.
    - The entire area has trees of the susceptible species that are dead or dying.

[8] The Pacific Northwest Region, Inventory and Monitoring System, Current Vegetation Survey methodology use 9 categories to describe root disease incidence USDA FS Portland Ore. Version 2.01 2001. This section is meant to begin the discussion on root disease and STS – we recommend any assessment procedure and rating should have a related management option by category described.

- Management Option – record as level 4 – consider remedial actions, i.e., harvest all that is economic and slash the rest. Use methods to reduce or compete with inoculum, use non-susceptible species as per even aged strategies.

1.2.10. Communication/Update

This was an area where there were many concerns. Some comments received on this issue were:

We need a common place/method to stay up-to-date on issues.

If a District has a 'special' requirement, then the onus should be on 'them' to make the licences aware.

In some districts there is an SOP. Surveys must be done to the satisfaction of the DM.

In the process of canvassing individuals some comments expressed were inconsistent with current survey methods and interpretation of silviculture prescription standards. Even though the current system has been in place for almost 8 years there are important concepts that are not being correctly applied by surveyors and foresters. The current training methods and or materials have not been effective at assuring complete understanding by the users. The subject of "how to keep surveyors informed" continues to be an issue for consideration. (Note: FPB has started an Accredited Surveyor webpage. Training materials and surveyor updates will eventually be posted).

I think there needs to be mandatory upgrading after surveyors become accredited. Maybe this should be part of keeping your accredited status in the province? The class I was in there were people who had never surveyed before who passed the exam, is this what we want? There are also no repercussions for accredited surveyors who perform poorly in this province so what does the accreditation prove? Overall there needs to be more accountability for surveyors. Another problem is all the changes over the last two years and access to this has been tough for surveyors since it seems to come out during the field season. Maybe there should be a mailing list or e-mail list of the accredited surveyors so they can be updated by the province? The test also doesn't deal with multi-layered scenarios very much and the course workbook can be deciphered different ways, the way it's written.

The current training methods and or materials have not been effective at assuring complete understanding by the users. Because few people understand the definitions of a multi-story stand and the intent of these different standards, they fail to properly complete the surveys or include proper standards in SPs. They cannot piece the picture together. They do not have a broader knowledge of the survey system and its intent. I am constantly trying to explain to surveyors/MOF staff (numerous of which prepare and review SPs) what constitutes a multi story stand and why we need to survey to different standards. There is a lot of ignorance out there regarding multi-storey stands. The majority of people relate multi story only to uneven-age Fdi. I agree that "how to keep surveyors informed" continues to be an issue for consideration.

I support the need for multi-layer training. For there seems to be a lot of confused people attempting to collect multi-layer data, for it is not often used by the average contractor.

Recommendations:

- We need to clearly outline the difference between the **Multi-Storied Stocking Procedure** – that is used to assess Single Storey Selection Prescriptions, and **Multi-**

Layered stands, that are being managed as Even-aged Systems, but have more than one layer in the stand. **Multi-layered** stands use even-aged assessment procedures that describe the layers within the stand, while incorporating all layers into one value to assess stocking. See section 2 for more detail on **Multi-layered** even aged stand types.

- For successful implementation of STS more emphasis should be placed on prescription development and implementation monitoring than simply on post harvest surveying and assessment. This requires an understanding of local objectives, stand structure, silvics, growth expectations, and forest health, and will likely require additional training in one or more of those areas.
- Some form of training will be required to clarify use of **Multi-Storey Stocking** Procedures and Other **Multi-Layered Procedures** being recommended for stands with more than one layer, that are being managed as even aged systems – i.e., the harvest is at rotation age, all stems on site at that time are available for harvest or retention.
- A multi-faceted approach to training is recommended. Training and awareness can take many forms. Initial identification of the stand types (**uneven-aged single tree selection prescriptions**) for the use of the **multi-storey stocking procedure** vs. other **multi-layer stands** and the use of the **multi-layer even aged procedure** is first and foremost.
- Identification of new procedures for other partial cut stands (**multi-layered**) needs to be clearly described and transferred. This can be done over the web, through brochures, or be provided as background information for all those bidding on assessments for partially harvested stands other than STS. Traditional training sessions may also be appropriate.
- Updates on procedures must be readily available – an example is to have them posted on the web with update notices emailed to known silviculture contractors, licensees, and MoF.

1.2.11. Application for Group Selection[9]

It has been identified that current survey methods are not appropriate/adequately descriptive for group selection systems. They are more reflective of a dispersed type (small clear cut patches and un-harvested areas). Inventory and silviculture labels are difficult to produce or are often misrepresentative.

Group, strip and random openings form a mid point in the continuum from single tree selection to mapable sized gaps within unharvested areas. There has been some preliminary work done on recommending sampling intensity and design for group selection and shelterwood, but requires additional input.

Recommendations:

- An approach to choose groups randomly is recommended (Inventory Branch has a program used for choosing polygons and locations within those polygons at random, it may be useful). The sample would use the same survey intensity as would be done

[9] Group selection is an area based uneven-aged management system – not STS and needs to be assessed differently.

for clearcuts using the total harvested area (even-aged approach) locating the plots in harvested groups using a random number generator (number groups – pick using Random Number Generator). The plot location would be chosen randomly using coordinates for each of the chosen openings. The survey method would be even-aged. Stratification of the groups would be needed where differences in stocking standards or competition are identified.

Some issues and key questions:

- Other options included fewer openings sampled but with 3 or more systematically located plots per opening.
- Where surveys are being done to capture stocking after beetle salvage – a clear set of long-term objectives should be incorporated into the design. Is the stand now going to be two storied? (e.g., an irregular shelterwood[10]). If so using the Multi-Storey Survey procedure may be appropriate (capture structure using a stand table).
- Where small openings are made throughout a stand, and the rest of the stand will be harvested in the next 10 to 20 years, to be managed using an even-aged system, the question is how important is regeneration in the gaps now? How much area needs to be regenerated, will it survive the harvest entry? Here are some questions that should be asked before reforestation is taken on with the incumbent assessment procedures.
    - The answers are area and site specific. For general guidance look into the feasibility of managing the small gaps, are they to be tracked, will they provide volume sooner within the timber supply area, or will they grow as part of the external matrix as part of that analysis unit with the same curve? Will reforesting them create larger trees at rotation or will their growth be restricted by the surrounding timber, resulting in no net benefit? Will reforesting these gaps provide for larger recruits for wildlife trees faster, or are the species that are planted short lived and this is not an issue? Will gaps be beneficial to wildlife and should be considered as future WTPs? Will the gaps brush in heavily and require extensive site preparation at the time of the next entry, maybe they should be reforested now, or left for biological diversity if shrub patches are scarce in the area?. If they are reforested, will they be damaged significantly by the next harvest entry? What proportion of the area is being opened up, is it operational efficient to reforest the gaps? How large of a gap are we talking about – 1 ha and larger are trackable units. Once these questions and other local issues have been addressed a decision on reforestation and tracking can be made.

[10] An irregular shelterwood is intermediate between an even-aged and uneven-aged single tree selection systems. It has, by definition, a longer regeneration period than the traditional even aged system (that is often described as 20% or the rotation length (Smith, 1986. The Practice of Silviculture, John Wiley and Sons, New York). Thus the stand that is created is irregular in structure, as regeneration comes in over time. This system does not lend itself well to either even-aged or uneven aged assessment – either could be adapted to be used as long as the desired attributes are provided in the SP. In some ways the Multi-Storied Stocking approach is suited as the smaller trees are nested within the larger trees, and the overstory trees are to be harvested in some 40 years or so, similar to a longer cutting cycle.

2. Blocks with a regeneration objective and have uniform leave trees with short or long-term retention creating an even aged stand.

Examples include: Uniform seed tree, Uniform Shelterwood and any even-aged system with uniform reserves.

2.1. What survey method to use?

Modified even-aged or uneven-aged?

Recommendations:

- These are even aged systems and should be assessed using a **multi-layer even-aged** procedure. All stems will be tallied by layer (1 – 4). A stand table with layers 2-4 and 10 cm classes in layer 1, to capture the structure is recommended. The minimum and target stocking are to be assessed using all the well spaced or free growing stems combined (depending upon the survey – WS or FG). To allow for the influence of larger trees, it is being recommended that layer 1 trees have no minimum intertree distance, and that no nesting be done, any tree no matter the layer can be well spaced or free growing if it meets the spacing criteria from other well spaced or free growing tree. There will be no silviculture summary by layer. M will only be used for minimums. We recognize that at some level of overstory retention or in stands with larger stems the minimums and targets will be lower than provided in the establishment to free-growing guidebooks. Some suggestions to field test are as follows:
    - Use the present minimums and targets for all stands with less than 10 m^2/ha of stems greater than 12.5 cm dbh. At uniform spacing 10 m^2 of 12.5 to 17.5 cm diameter stems would amount to approximately 566 sph or 4 m plus spacing. This is close to the even aged minimum and there is a likelihood that additional stems in the smaller classes would make up the difference.
    - Where larger stems constitute the 10 m^2 few sph would be found in layer one (e.g., approximately 100 35 cm average diameter stems makes up 10 m^2), therefore the MSS and TSS may need to be less, or there will be adequate space between the trees to allow for the minimums to coexist – 10 m spacing if uniformly distributed).
    - Over 10 m^2 and up to 15 m^2 lower minimums and targets to 80% of the guidebook values, above 15 m^2 to 60% as per the backlog reduction value.
- Inventory label will record trees larger than 12.5 cm as layer 1 or Vets, with the new stand as layer 2. For the time being (until inventory changes its requirements) record leave trees as L1 if there is > 6% crown closure, and as Vets if < 6%. Crown closure for an area can be estimated on the ground by using the average crown radius to estimate the number of trees needed to achieve 6% crown closure.

Table to estimate number of trees by average crown radius to achieve 6% crown closure.

Ave crown radius (m)	No of trees for 6%cc	Ave crown radius (m)	No of trees for 6%cc
2	48	4	12
2.5	31	4.5	9
3	21	5	8
3.5	16		

- Once the ministry's vegetation resources inventory (VRI) is fully implemented, the Vet layer will be dropped. There will need to be some guidance on where to cut off layer 1 at that point. The VRI definition of layer is: each layer must be distinct and relatively homogeneous throughout the type.
- Traditional 3.99 plots will not likely capture, with much accuracy, the amount of overstory retention on site, especially when they are few and scattered. Where overstory levels are low, e.g., less than 50 sph, it is recommended that some other form of assessment be looked into to provide a more accurate picture of the retention layer – perhaps through air photographs or total stems tallies within a representative stratum.
- To determine what if any effects there may be to timber supply it is necessary first to identify the range of partial harvest systems being used[11]. We recommend this approach be followed, suggested categories are:
    - Spatial distribution of retained stems – uniform or clumped,
    - Ranges by percent BA retained,
    - Size classes of the retained stems,
    - Species retained,
    - Timing of future cuts and intent of retention,
    - Determine the area within each category.

  Once a list of structural types and range of retention levels is created an approach to develop a set of yield 'curves' that describe the various systems could be created. Expert opinion would help determine the shape of the curves. These general curves could then be used to examine the sensitivity of the various structural types to the timber supply. At this time we could game with removing the retention at the end of the rotation or not to assess the effect on Timber Supply.
- If found to cover a significantly large area, TASS runs could be used to represent volume differences based on the overstory competition.
- We recommend removing the ghost tree category, all trees should be tallied. Vegetation inventory wants no cultural bias, only what is there.
- There should be no difference in tallying wildlife trees and those available for harvest at the next entry. TSR assumptions would remove X amount of volume based on assumptions for the retention (see TSR assessment described above).

[11] (As suggested by Chris Fletcher Timber Supply Analyst, MoF):

- Clear direction from the SP is needed. If the retention is clumped (e.g., up to 0.25 ha) it should be considered as a dispersed stratum (i.e., not mapped but identified and quantified). Areas between the groups of leave trees would be assessed using the even-aged procedure.

2.2. When to survey?

Should the area be surveyed prior to the removal of the overstory or after? Can it be declared free growing with the leave trees still unharvested?

Recommendations:

- When to survey is set by the regen date and free growing dates in the SP, regardless of when the seed/shelterwood trees are removed.
- It can be declared free growing with trees left on site and will depend upon the free growing date.

2.3. What standards should be put in the SP for leave tree removal?

What should be put into the SP regarding removal of overstory trees, is it to be an auditable standard or an objective?

Recommendations:

- Leave tree removal is a treatment, and is does not appear to be required in the SP, other than described below in the OPR and as whether it is required in the silviculture treatment regime (SPR 11). The treatments in the regime are only those that are required to achieve target stocking levels. One could reasonably argue that removal of these trees is not required to meet the target levels, but would depend upon overstory density and shade tolerance of the regeneration. The OPR directs the SP to have any critical site conditions that may affect the timing of operations. This may be interpreted to include timing of removal where potential damage to regeneration may be considered a critical condition, and one that needs to be specified. It is likely not going to be construed an obligation, as additional stocking could be added post harvest. It is meant to show intent.

From the OPR Section 39 (3) A person must ensure, for the area under the silviculture prescription, that the prescription does the following:

> (e) describes any critical site conditions that affect the timing of operations and the manner in which they affect them;

- For blocks declared free growing a new SP is needed to harvest the remaining overstory trees with incumbent regeneration obligations.

3. Blocks with no regeneration objective and have uniform leave trees with short-term retention creating an uneven aged or even aged stand – i.e., Intermediate cuttings under the Code.

Examples include: Commercial thinning, Beetle Proofing, Intermediate harvest to sanitize or make the stand more windfirm (all considered intermediate cuts within the OPR).

The assumption is that the leave trees will be left on site leaving a fully stocked stand. The trees will be removed later creating a regeneration objective (separate SP and set of stocking requirements).

Excerpts from the SPR

SPR 11(2) A holder of a silviculture prescription is exempted from the requirements of section 70 (4) (d) of the Act and subsection (1) if the timber harvesting proposed for the area under the silviculture prescription is limited to intermediate cuttings, and there are no regeneration objectives specified in the silviculture prescription.

SPR 23(3) More than 12 months after the completion of harvesting, a person exempted under subsection (2) must carry out a survey that meets the requirement of section 26.

Survey requirements for areas without regeneration objectives

26.(1) In addition to the requirements of section 24, a report of a survey for an area under a silviculture prescription without regeneration objectives must confirm the following information:

(a) the identification of the area under the silviculture prescription and, if the report is required of a holder of a major license, the agreement and the name of the holder of the agreement;

(b) for the net area to be reforested

(i) the area,

(ii) the biogeoclimatic ecosystem classification,

(iii) the incidence of damage by forest health factors affecting trees,

(iv) the inventory label, including species component, age, height, density, basal area and site index, and

(v) the number of acceptable and preferred trees per hectare.

Survey requirements for all surveys under section 23

24.A person who is required to carry out a survey under section 23 must

(a) carry it out to the satisfaction of the district manager,

(b) keep a written record that allows the district manager to determine whether the requirements of the silviculture prescription have been met, and

(c) provide a report of the survey and written record to the district manager promptly on request.

3.1. What is the definition of an intermediate cut?

To determine whether a regeneration objective is warranted a more detailed definition of an intermediate cut has been suggested.

The definition in the OPR 39 (1) b is

(b) for commercial thinning, harvesting of poles, sanitation treatments and other intermediate cuttings that do not have regeneration objectives.

Comments/Suggestions:

We have a range of opinions on whether the above definition is defined enough. Some would like to leave it to district discretion, others would like to make it more formalized.

Because the use of partial cut reduces liability, and possibly increases the risk to the crown there may be administrative slow downs created by an open-ended definition of an intermediate cut.

Recommendations:

- We recommend that either districts or the FPBranch (with district input) should provide guidance on what constitutes an intermediate cut. This guidance would not create a regulated definition, it would help prescription makers and district staff determine regeneration obligations.
- For any definition there should be a clear linkage between the objectives for the harvest and the post harvest stand structure, be it clumped, uniform or mixed.
- To provide adequate input some type of formalized approach to come to a desired level of consensus is suggested, possibly a workshop facilitated by SIFERP?

3.2. What is the definition of Beetle Proofing? When will the trees be harvested?

Recommendations:

- Leave to local discretion. Beetle proofing may be considered an intermediate harvest or not depending upon the post harvest stand conditions.

3.3. What survey method should be used for intermediate cuts?

Should some form of the Multi-Storey Survey procedure be used, as the leave trees are likely mostly to be from layer 1 and hence have lower required numbers to create a stocked stand?

Recommendations:

Silviculture Practices Regulation Division 5, section 26 outlines the survey report requirements. It does not describe the type of survey to be used.

Relevant sections from the SPR are as follows:

Survey requirements for areas without regeneration objectives

26.(1) In addition to the requirements of section 24, a report of a survey for an area under a silviculture prescription without regeneration objectives must confirm the following information:

(a) the identification of the area under the silviculture prescription and, if the report is required of a holder of a major license, the agreement and the name of the holder of the agreement;

(b) for the net area to be reforested

(i) the area,

(ii) the biogeoclimatic ecosystem classification,

(iii) the incidence of damage by forest health factors affecting trees,

(iv) the inventory label, including species component, age, height, density, basal area and site index, and

(v) the number of acceptable and preferred trees per hectare.

Recommendations:

- Follow section 26 of the SPR. It does not mention well-spaced trees or free growing trees per ha, only the number of acceptable and preferred trees per ha. It also calls for the inventory label.
- Present the number of acceptable and preferred trees per ha in the form of a stand table. This could be used in creating an updated Inventory label. The stand table need only tally the layer stems identified in the prescription to meet the intent of the intermediate harvest. Information on other layers may be of interest and collected at the time of the survey if deemed suited to future entries.
- The type and number of plots will vary by the type and complexity of the intermediate harvest. An agreement prior to harvest on the level of accuracy required should be made. Fixed radius (larger than 3.99 will be needed to capture lower densities, e.g., 5.64 or 11.28 m radius – depending upon leave tree densities) or prism sweeps would be acceptable. An average number of trees per plot or sweep should be identified to ensure accurate and cost effective sampling (e.g., 4 to 10 trees per plot). If larger plots are used fewer plots would be needed to capture the variability. Where clear direction was provided in the prescription on the desired structure, and follow-up assessment by walkthroughs shows successful adherence to the plan, few plots would provide adequate data. Where there the outcome is less clear, some level of statistical rigour is recommended, such as cruise level accuracy.

Note

This method or the method described in section two could also be used for multi-layered even-aged partial cut pre-Code blocks and backlog areas depending upon the type of retained structure. Older blocks with no regeneration objectives should be a separate entity in any roll-ups to determine what, if any, reductions are appropriate to the yield curve.

These type of blocks may be well suited to the earlier described approach, where lines are walked within the block to describe the various structural components (i.e., these stands are diverse and may benefit from management in portions, and description of what is there in others).

This is an area where more discussion and input is needed – possibly in a structured workshop environment? Scenarios presented – options evaluated for their

appropriateness – this should likely occur after an overview of the amount of the various stand structural types within the administrative unit – i.e., what structural types are large enough to be an issue for timber supply.

3.4. What happens if the stand is not considered stocked? What happens then?

A survey is used to determine stocking, all or parts of the block are below the specified minimums.

Recommendations:

- The stand no longer meets the objectives of the SP and this contravention must be reported to the District Manager. The SP must then be amended to reflect the new stand conditions and include regeneration objectives.

3.5. How should stocking gaps be dealt with in these stands?

Where removal was varied, holes in the intermediate cut may emerge. At what point should they be considered a new standards unit and have regeneration objectives? At present there is no provincial minimum stratum size – should there be?

Note

This issue needs to be assessed based on the time to final harvest for the stand and opportunities to track and/or reforest gaps within a stocked matrix. The desirability of gaps depends on the objectives of the SP. Where forage production is an objective, gaps are good, where timber production with low OAF estimates are in place, gaps do not conform to the modeled yield curves and may be considered a problem. A certain amount of 'gappiness' is natural and likely well suited to biodiversity. It is presently modeled in the Timber Supply using Operational Adjustment Factors (some quite high e.g., >30% in some ICH zones). There is presently a Provincial process looking at defining a gap. Some form of description should be available for the number of gaps – there is an OAF 1 sampling procedure available. The size of the gap should reflect desired conditions for the forest estate.

Recommendations:

- Maximum gap size should be part of the SP with remedial actions identified. These gaps can be located by walkthroughs and do not have to be found through structured surveys. In some cases gaps may be desirable for structural diversity and be described as such in the SP. In some cases gaps occur preharvest and their preservation post harvest must be identified in the prescription.
- For areas with patches of beetle kill where small holes are created in the matrix forest, local district guidance is needed. One option is for the next licensee to absorb the responsibility to reforest the small holes at the time when the matrix is harvested. Alternatively the groups could be reforested creating a more diverse structure if this is desired. Needs localized input (see also section 1.2.11 for a discussion on groups due to beetle kill).

3.6. What if any regeneration delay and free growing window should be used?

Section 23 (3) of the Silviculture Practices Regulation states that "More than 12 months after the completion of harvesting, a person exempted under subsection (2) must carry out a survey that meets the requirement of section 26". Thus a survey must be completed after one-year post harvest.

Recommendations:

- Follow the legislated direction.
- Where risk to the crown is known to be high for factors such as windthrow, snow breakage, or other known and identified forest health agents (IDed at the FDP stage) a new category could be created that has a longer time to assessment.
- Use only risks that are pertinent to the stand to extend time frame for assessment. Recommend moving from one year to two or more depending upon the type of risk and what will happen to the stand. This will require changes to the regulations – needs further discussion. In most cases this is likely not an issue, see the next point.
- Should determine if this is an issue or not, how large an area are we talking about, what are the main concerns – and what actions are available to the licensee if some form of problem occurs within the period prior to assessment? Often the only option is to harvest more and create a regeneration objective.
- Where prescriptions are amended from single tree selection to IC all the new content requirements and standards, and new management objectives must be included and provided to the DM for decision on whether it is appropriate to change obligations. We recommend that when blocks were harvested without a regeneration objective to meet IRM objectives such as maintaining snow interception cover for Mule Deer Winter Range, that the MoF consider changing the blocks from STS to Intermediate Cuts where full stocking can be shown.

4. Other general issues:

4.1. Should the UEA standards be used for any silvicultural systems other than single tree selection? (e.g., backlog sites and those stands with some form of retained overstory).

Recommendations:

- No, the UEA standards are for single tree selection. Even aged systems will use a **multi-layered even-aged survey** for the retained trees.
- Where surveys are being used as a means of assessing partial cuts with poorly described objectives – we suggest using a form of survey that captures the stand variability by describing dispersed strata and collecting stand table data for each strata (e.g., following a similar method outlined in 1.2.4). An inventory label would be created that would be two layered if appropriate. Management options would flow from the area within each of the potentially treatable strata that were below minimum stocking. Minimums would be based on even-aged standards with backlog reductions, where appropriate.

4.2. There needs to be a linkage of any data capture to models and AAC determinations – we need a clear link. How should we go about doing this?

Recommendations:

- Follow the procedure outlined in section 2.1. First we must quantify different structural types and determine possible yield impacts by type.
- For initial Prognosis runs use layers 4 (0 diam class), layer 3 (5 cm midpoint), layer 2 (10 cm midpoint), followed by 10 cm classes in layer 1 (e.g., 12.5 – 22.5) or simplify to 12.5 to 25, then 25-35 etc. These would be used to determine required sampling intensity to provide reasonable G&Y estimates. It is not envisioned for each block to require a Prognosis run; instead we see the creation of structural types with associated curves. Surveys would put the block into the appropriate structural type.
- There needs to be additional modeler input as well as from inventory and timber supply personnel to create a workable link.

4.3. Will we suffer volume losses on partially cut blocks, if so how much, and can it be minimized?

Recommendations:

- Identify stand structures being left. Determine what objectives the trees are being left for. Use expert opinion and/or models to help determine growth reductions (or increases) for the most common retention patterns and densities. Determine if other structural options would meet the stated objectives. Compare the expected growth reductions (or increases).

4.4. How do we pass on what has worked and what has not?

Recommendations:

- We recommend field testing the recommendations in 2001. Choose sites in Southern BC with a range of residual structures to test the new survey procedures.
- One option is to use stands in the Alex Fraser Research Forest for the Prognosis trial, where areas are super sampled and subsamples of model output are compared to see the level of information needed for repeatable results . Meet in the fall to discuss results.
- Meet with field staff in each Region to discuss recommendations.
- Ongoing training using a range of venues, from updated web sites, to yearly meetings to local visits to a District by a qualified person to provide updated information, to traditional workshops based on a specific topic.
- Update the multi-storey survey course once there is agreement on recommendations. Post the revised version on the web.
- Direct feedback - Use implementation audits/evaluations to see if prescriptions were implemented as planned – have a report format that is used to update those involved with the prescription.
- Effectiveness audits/evaluations – set up procedures and protocols to measure factors desired for achieving the objectives of the prescription.

4.5. For C&E there needs some form of specifications of tolerance for partial cutting.

Recommendations:

- See comments in earlier sections regarding ranges being used in SP, monitoring done at the time of harvest. Sections 67 and 70 of the ACT can provide legislated guidance.
- Suggest using ranges and minimums for compliance.
- For larger diameter classes suggest SP writers provide a wide diameter range to allow for variability (e.g., 10 to 20 cm class breaks).
- Have damage criteria and acceptable percentages in the SP – use the appropriate guidebooks.

Appendix 1

Summary of Contacts

Our thanks go to all those who have contributed comments and recommendations. Special credit goes to Prifor Management Limited who were responsible for contacting and collating comments from the Cariboo Region. Their initial issues and recommendations formed an original framework for the project. The following is a summary of those solicited for comments:

Ministry of Forests

Cariboo Forest Region

Nola Daintith

Rick Dawson

Quesnel Forest District

Mike Pelchat

Penny Hendricks

Ellery Tetz

Williams Lake Forest District

Gerry Chapman

Cindy Gibson

Rob Wiffen

Barry Penny

Horsefly Forest District

Gerry Mooney

100 Mile House Forest District

Mark Seilis

Dawn State

Chilcotin Forest District

Doug Harris

Kevin Kansky

Williams Lake TSA Silviculture Subcommittee – Licensees

Lignum Ltd.

West Fraser Mills Ltd.

Riverside Forest Products Ltd. – Tim Harding

Slocan Forest Products Ltd.

Ainsworth Lumber Co. Ltd.

Weldwood Of Canada Ltd

Albert Vandenberg

University of British Columbia – Alex Fraser Research Forest

Ken Day

Lignum Ltd.

Kim Peel

Shawn Housden

Birchbark Forest Resources

Brian Rogers

GPS Forest Consultants Ltd.

Chris Lohr

Dick Hall

Inland Timber Management Ltd.

Ron Meister

Keen Forestry Ltd.

Bob Keen

Black Sheep Forestry

Rod Krimmer

Chiltech Forestry Ltd.

JD Forestry

D & D Forestry

Nelson Forest Region

Ivan Lister

Kristine Sacenieks

Bruce Fraser

Darrell Regimbald

Bill Olsen

Cliff Beliveau

Pat Wadey

Barb Wadey

Prince George Region

Frances Hall

A special thanks to the Reviewers who commented on the October "Comment Document"

Barb Wadey, Columbia District

Barry Snowden, Forest Practices Branch

Bill Laing, Survey Contractor, Kamloops Area
Bill Olsen, Cranbrook District
Brian Russell, Kamloops District
Bruce Pamplin, Kamloops Region,
Chris Fletcher, Timber Supply Branch
Dave Weaver, Tyhee Forestry Consultants, Smithers
Gerry Chapman, Nola Daintith, Cindy Gibson, Barry Penny, and Rob Whiffen, Cariboo Region
Ivan Lister, Nelson Region
Leisbet Beaudry, Consultant PG
Neil Endacott, Prince Rupert Region.
Tim Salkeld, Resources Inventory Branch
Thanks also to Regional and Branch Forest Health staff who provided useful comments.

Appendix 2 Common options for Stand Structural Design

From: Zielke and Klenner. 1994. *A protocol for designing silvicultural systems to meet IRM objectives*. Unpublished report for the Ministry of Forests, Kamloops Forest Region.

Common Options for Stand Structural Design			
Cutting Patterns	**Overstory Leave Tree Retention**	**Age Class Structure**	***Silvicultural Systems***
1. Overstory Removal or Clearcutting	• none	Even-aged[12]	* *Clearcut* * *Natural Shelterwood* * *Patch Cuts*
2. Uniform Leave Trees	• short term[13]	Even-aged	* *Uniform Seed Tree* * *Uniform Shelterwood* * *Uniform Nurse-Tree Sheltewood*
3. Uniform Leave Trees	• long term [14]	Even-aged	* *Clearcut with uniform reserves*[15] * *Uniform Seed Tree with reserves* * *Uniform Shelterwood with reserves* * *Nurse-tree Shelterwood with reserves* * *Irregular Shelterwood with or without reserves.* * *Natural Shelterwood with uniform reserves*
4. Uniform Leave Trees	• long term	Uneven-aged[16]	* *Single-tree selection* * *Single-tree selection with reserves*
5. Leave Tree Groups [17]	• short term	Even-aged	* *Group Seed Tree*
6. Leave Tree Groups	• long term	Even-aged	* *Clearcut with group reserves* * *Group Seed Tree with reserves* * *Natural Shelterwood with group reserves*
7. Group Removal	• short term	Even-aged	* *Group Shelterwood* * *Group Nurse-tree Shelterwood*
8. Group Removal	• long term	Even-aged	*Group Shelterwood with reserves*

[12]**Even-aged** = one age class or two age classes (which may appear as two layers, uniformly distributed or clumped)

[13]**Short-term** = during the regeneration period or the first 20 years after the regeneration harvest

[14]**Long-term** = after the regeneration period (20 years), often for the entire rotation. These leave trees are known as 'reserves'..

[15]**Reserves** - Can be left in a uniform, group or strip fashion.

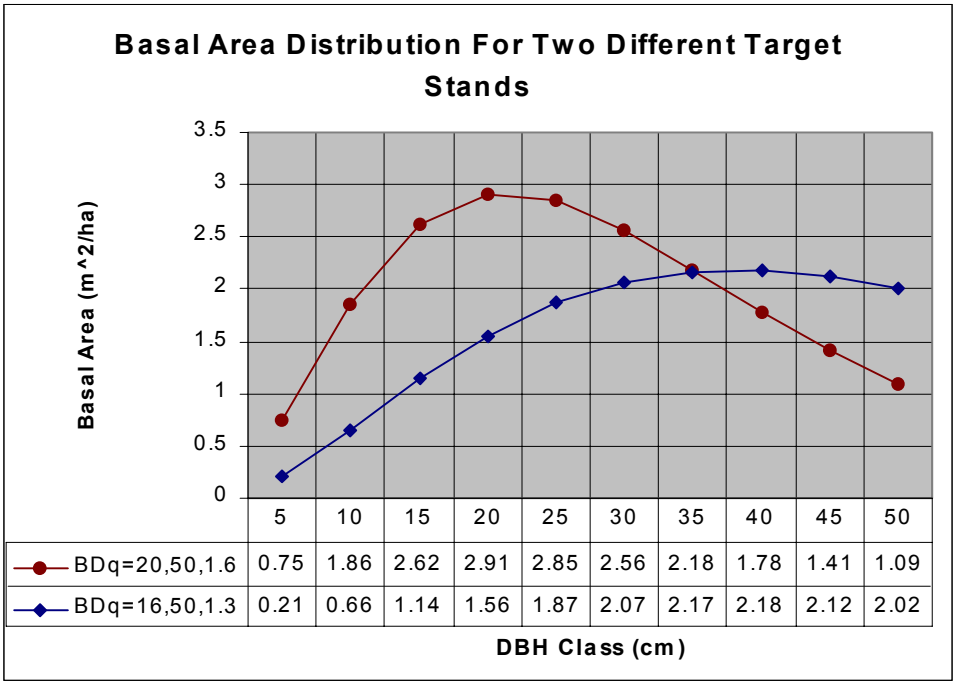
[16]**Uneven-aged** = three or more well-represented, vigorous age classes which appear as multiple vertical layers, uniformly distributed or clumped.

[17]**Groups** = resulting openings are small enough to have a different (more moderate) environment from that of a clearcut opening.

Common Options for Stand Structural Design			
Cutting Patterns	**Overstory Leave Tree Retention**	**Age Class Structure**	***Silvicultural Systems***
9. Group Removal	● long term	Uneven-aged	* *Group selection* * *Group selection with reserves*
10. Strip Removal (only)	● short term	Even-aged	* *Strip clearcut*
11. Strip Removal (only)	● long term	Uneven-aged	* *Strip selection*[18]
12. Strip Removal (with uniform leave trees)	● short term	Even-aged	* *Strip Shelterwood*
13. Strip Removal (with uniform leave trees)	● long term	Even-aged	* *Strip Shelterwood with reserve trees*
14. Strip Removal (with uniform leave trees)	● long term	Uneven-aged	* *Strip Selection with reserve trees*

[18]**Strip selection** - Note: that strips are narrow enough to be environmentally different (more moderate) than a strip clearcut. There are other differences as well (Fig. 5 & 6).

Appendix 3A - Comparison of two Q values and the resulting desired stocking levels (from Ken Day, UBC/Alex Fraser Research Forest)



	5	10	15	20	25	30	35	40	45	50
BDq=20,50,1.6	0.75	1.86	2.62	2.91	2.85	2.56	2.18	1.78	1.41	1.09
BDq=16,50,1.3	0.21	0.66	1.14	1.56	1.87	2.07	2.17	2.18	2.12	2.02

Appendix 3B

Stocking Standards For Uneven-Aged Management (Excerpt from UBC/Alex Fraser Research Forest Management and Working Plan #2 December 1997, page 50, 51.)

All Species And Sites Except Dry Douglas-fir

Attached at [Appendix] are the general stocking standards (from the guidebook) for uneven-aged management of all species and sites except IDFxm, IDFdk3, SBPSmk, and SBSdw1 mesic and drier. These stocking standards will apply to all other sites where uneven-aged management is practiced, until sufficient experience has been gathered to refine the stocking standards.

Dry Douglas-fir

The uneven-aged stocking standards published in the guidebook are often not appropriate for the stand structure goals designed for the management of dry Douglas-fir (IDFxm, IDFdk3, SBPSmk, and SBSdw1 mesic and drier). The critical measures of stocking in uneven-aged management are residual basal area (RBA) and maximum density in layer 3. If an area is left stocked with an appropriate residual basal area distributed across the range of diameters, and the layer 3 trees are not suffering stagnation, then the site is stocked.

Table 1 Below illustrates why the uneven-aged stocking standards from the guidebook do not fit the stand structures designed for the Research Forest. The stand can be fully stocked in terms of residual basal area and still not meet the stems/ha guidelines as published. (Twenty square metres per hectare is used for illustration only -- actual RBA's will vary). This is a function of the low q-factor and the high maximum diameter, which concentrates stocking into the larger diameter classes, and therefore does not require many trees in the small size classes. Table 1 does not include any stocking in layer 4, since regeneration may or may not be present at the time of logging, and because uneven-aged management can rely on small amounts of regeneration each year.

Stocking Standards for Uneven-aged Management of Dry Douglas-Fir:

1) Appropriate residual basal area is either:

- Sixty percent or more of initial basal area; or
- B-level stocking from Langsaetter's curve, as determined by periodic growth measurements.

2) Maximum density for uneven-aged management is 2,000 stems per hectare in layer 3 (from 1.3 m in height to 7.4 cm dbh).

3) Target stocking for layer 4 is 500 stems/ha;
Minimum stocking for layer 4 is 300 stems/ha.

4) Leave trees are designated on criteria described in [Appendix 7]

5) Regeneration Delay is 7 years

6) Free Growing Dates: Early -- 3 years
Late -- 15 years

7) Minimum Inter-Tree Distance 0.5 m (at breast height)

Table 1: Target stocking for typical dry Douglas-fir uneven-aged management stand structure goals, compared to the guidebook standards.

		Target Stocking B = 20 D = 60 q = 1.25			CUMULATIVE	
Layer	Diam Class	STEMS/HA GOAL	BA/HA	STEMS/HA GOAL BY LAYER	MWP Target Stocking Stems/ha	Guide-book Target Stocking Stems/ha
3	5	86	0	86	400	1000
2	10	69	1	69	314	800
1	15	55	1	245	245	600
1	20	44	1			
1	25	35	2			
1	30	28	2			
1	35	22	2			
1	40	18	2			
1	45	14	2			
1	50	12	2			
1	55	9	2			
1	60	7	2			
	TOTAL	399	20	399		