

Decision Matrix
For Management of Mountain pine Beetle Stands
For Protection of understory
To assist in the Mitigation in the
Mid Term Timber Supply falldown

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Ministry of forests

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Mid Term Timber Supply (MTTS) Mitigation Strategy Decision Matrix **For Understory Retention and Partial Harvest Strategies**

Introduction

With the level of pine across the landscape varying from 30% to 80 % of the landbase for any particular forest district there is a need for strategies to assist in mitigating the mid term timber supply (MTTS) falldown, which may occur between 15 and 50 years from now. The issue arises with the level of harvesting and the potential shelf life of the unharvested dead pine. Not only are the mature stands of 60 years of age and older being attacked, but plantations and stands >20 years of age are being killed (100%). One current strategy is understory retention within those stands that have sufficient understory growth to meet legal free growing obligations and provide sufficient volume to assist in MTTS mitigation. The various tree layers that can contribute to reducing the MTTS falldown include mature trees, poles, saplings and regeneration layers. To provide the best results for the earliest possible time frames for addressing the MTTS falldown the priority should be placed on the pole and sapling layers.

The following tool, in the form of a decision matrix, has been developed to assist forestry staff with decision making on when, where and how to address the understory retention strategy prior to harvest activities. The matrix considers all silviculture layers and provides for site constraints and factors such as windthrow, ecology, stand age, stand density, species, clumpiness, biodiversity, etc. This document also provides the reader with factors to consider when gathering information in the field including harvesting strategies to manage retention.

The decision matrix may be used as a strategic planning filter after objectives are established and field assessments are complete. The matrix may aid strategic planners in addressing the MTTS mitigation strategy by identifying acceptable understory levels within mature forests for potential non-harvest.

During the harvesting preparation, harvesting and post harvesting processes, there will be an operational learning curve for those collecting the information, completing layout, the operators and their equipment, pre and post measurements, etc. This paper is intended to provide information for decisions makers on understory retention and/or partial harvesting strategies. In the decision process there are many factors to consider including biodiversity visuals, hydrology etc. that play a part in the final outcome. The matrix focuses on harvesting strategies for understory retention or partial harvest with the objective focused on MTTS.

Rationale for the Decision Matrix

The decision matrix was developed to address the many concerns expressed by professionals for the need of a decision making tool for understory retention and harvesting strategies focused on mitigating the MTTS falldown. In developing the decision matrix, consideration was given for the need for due diligence, operational factors, future research to address uncertainties and future MTTS needs including community stability.

Decision Matrix Goal

The goal of the decision matrix is to assist operational staff and decision makers identify current stand structures and appropriate harvesting strategies that should foster future stand structures capable of contributing to MTTS (15 to 50 years from 2007). It is important to recognize that the strategies for understory retention or partial harvest will vary by area and will not apply everywhere.

Decision Matrix Objectives

The key objectives for the decision matrix is to focus on understory protection for MTTS (15 – 50 years), provide revenue to the Crown in areas otherwise lost as non-recoverable losses without impacting the MTTS, provide alternatives to clearcutting and planting, promote the achievement of

free-growing stands immediately post-harvest, provide old growth recruitment opportunities and to maintain biodiversity and wildlife habitat across the landscape.

Decision Matrix Considerations

Some of the factors considered in the matrix decision making process include: BEC Zones, stand density (stems per ha), stand volume (m^3 /ha/total volume), windthrow, value for early mid-term timber supply, patchiness and distribution of understory pine, understory retention strategies based on standard recommended stocking levels (FGSS Guidebook) and MTTTS objectives.

Volume to be harvested varies by District and location, based on the type of stands and the harvesting practices of the area. For example, some areas of the province may harvest volumes down to $65m^3$ /ha whereas other areas may not consider harvesting volumes below $100m^3$ /ha or $200m^3$ /ha. Economics is a key component in the harvesting and retention strategy. It is important to recognize that as operators become more experienced with partial harvesting and understory retention, efficiencies are gained, strategies are improved and costs are reduced.

Matrix Stages

The assessment process considers five key areas including gathering information, pre harvest factors, harvesting and post harvesting considerations and post harvest assessments. The following is a break down of the some of the key factors in each area.

1. Pre-harvest assessments

- Walk through using random plots (plot size selection will depend on the out come and amount of detail desired). An option is to gather the information during cruising or ecological assessments.
- Stand eligibility factors include stand structure, species, density, volume distribution, understory, etc.
- Understory composition including species, layers, distribution and density
- Windthrow risk will influence retention levels
- Ecological site diagnosis (site series identification) will assist in growth and yield, best species selection, etc
- To assist researchers and operational staff to broadly translate approximately equivalent measurements the following information may be used in general terms; BA of 32 to 42 m^2 = density of 500–1100 stems/ha = volume of 180 to 400 m^3 /ha

2. Layout and pre-harvest factors

- Block layout based on the needs of the operators and capabilities of the equipment in use.
- Layout by field staff to assist operators (field staff rates less than equipment rates) may include:
 - Rub trees
 - Designated main skid trails
 - Falling strategies
 - Landing locations vs roadside
 - To extend winter operations per day use of reflective tape to assist operators to identify trees in poor light conditions (mark to cut).
- Training of equipment operators to meet specific objectives of keeping site disturbance to a minimum, protection of understory and limit damage to retained trees to achieve (i.e., leave behind) a free growing stand is essential.
- Supervision during the initial stages of operation by experienced foreman and layout crews is necessary.

3. Harvesting

- Focus on mountain pine beetle damaged pine trees
- Non-pine tree removal should be kept to <5% by volume
- Keep trail development to a minimum; e.g., width <4.5m and trails >150m apart
- Maximize understory retention through operator training, minimizing skid trails, etc
- Maximize rub tree location by pre-selecting trees e.g., dead pine, deciduous non-merchantable trees (depending on stand objectives), etc. Note that rub trees may be utilized by removing them during exiting or by high stumping those trees. In some cases the rub tree may be left if the damage is <25% of the tree circumference and dependant upon the year.

4. Post harvest activities

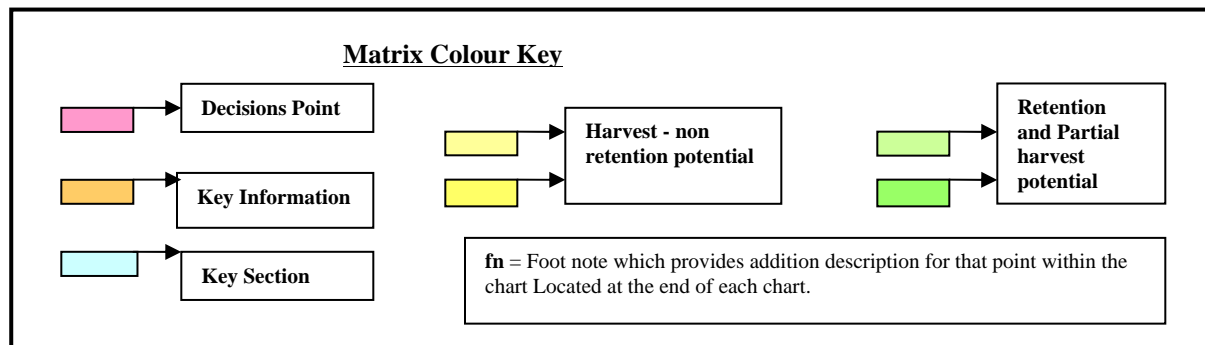
- Manage rub trees.
- Manage damaged understory, consider removing damaged understory. If funding allows for it, thin dense thickets.
- Link basal area for researchers and research publications.
- To assist researchers and operational staff to broadly translate approximately measurements the following information may be used in general terms Basal Area of 6-12 m² = 200–400 stems/ha = volume of 80–160 m³/ha.

5. Post-harvest assessment

Post-harvest assessments are set up using sample plots to assess whether the stand has achieved the pre-harvest objective and can be recognized as a free-growing stand. In the event a free-growing stand is not achieved, the planting of voids will be required to meet free-growing legal requirements. This will result in a multi-aged and multi-layered stand for the future.

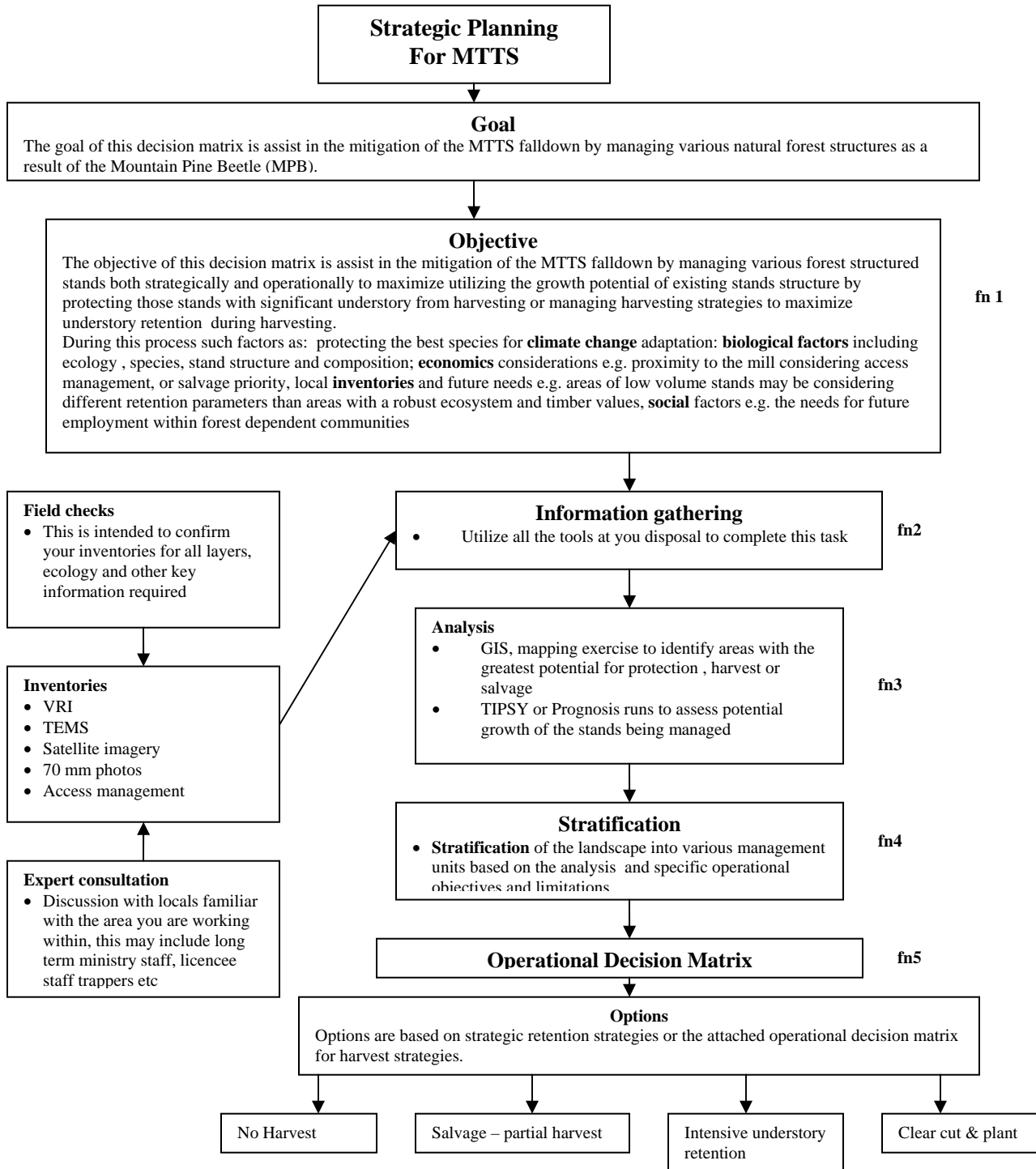
Professional approach and Matrix usage

The overall strategy of the matrix is to aid professionals and non professionals in assessing the resource while balancing the key values of social, economic and biological factors. Within each one of these key factors there are many sub factors that will take priority for that specific section within a specific area. As an example for the biological factor one may have several important aspects such as biodiversity and hydrology for one area as the key factors for biological where as in another block there may be soil disturbance, hydrology and old growth. In these two examples the professional balances the biological with economics (e.g. cost of harvesting or leaving and area, etc.) and the social needs (e.g. employment). The matrix is intended to assist in the process for identifying the areas that have the greatest potential for a positive impact for assisting in the mitigation of the MTTs. One may conclude these strategies, in many instances, provide benefits and/or balancing of many of the other resource values such as wildlife, hydrology, visuals, etc.



Strategic Planning

This is the initial steps one may wish to consider when approaching a landscape affected by MPB. This step of the decision process may be beneficial in assisting you in identifying the priorities for harvesting, retention or a mixture of harvest and retention. The retention strategy may involve both mature timber and other silviculture layers within a stand to achieve a specific objective. The overall goal for this exercise is to assist in mitigating the MTTs fall down effect as a result of the MPB impacts across many TSA's throughout the province. The strategic steps for this process are as follows:



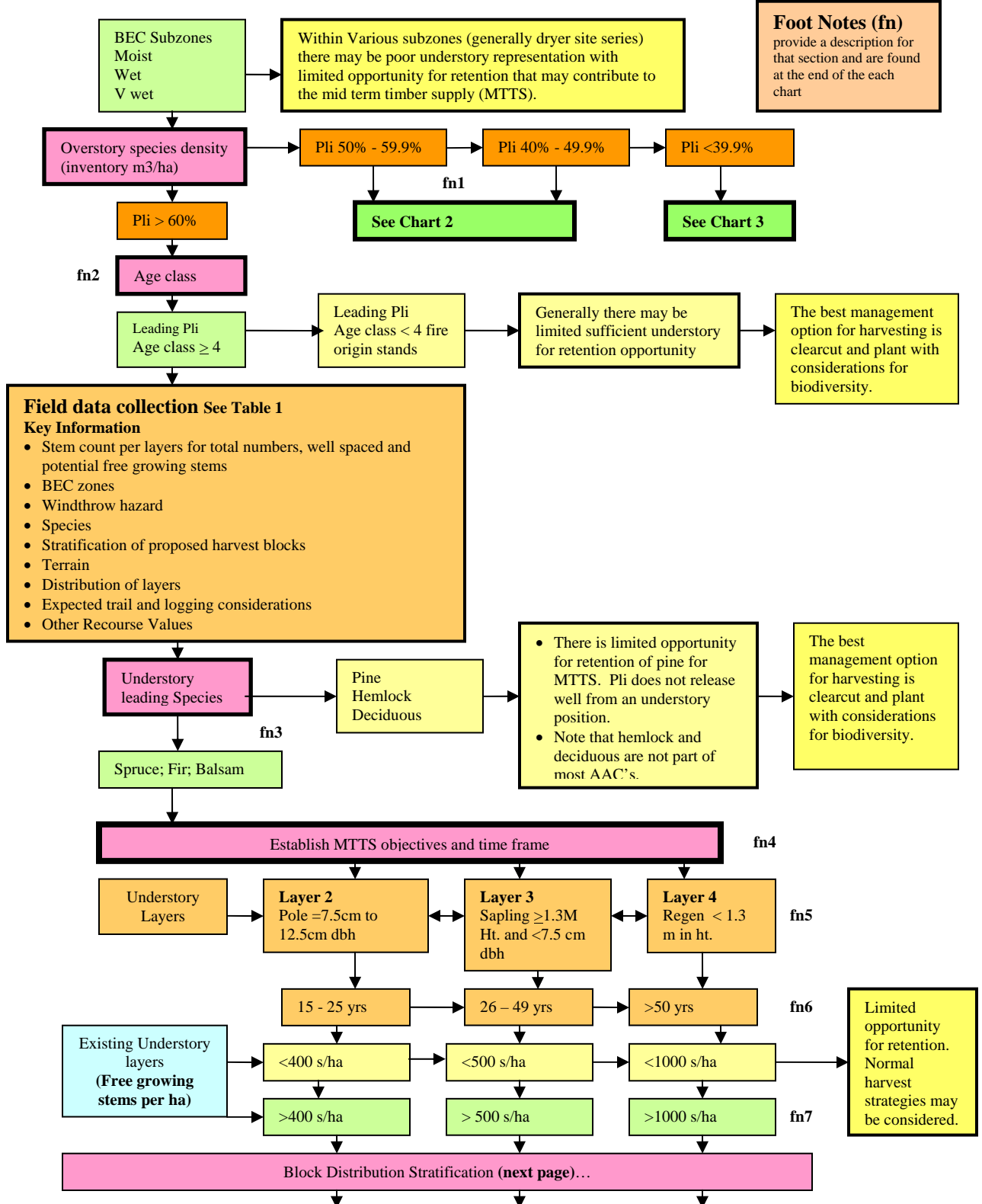
Foot Notes (fn) Strategic Planning

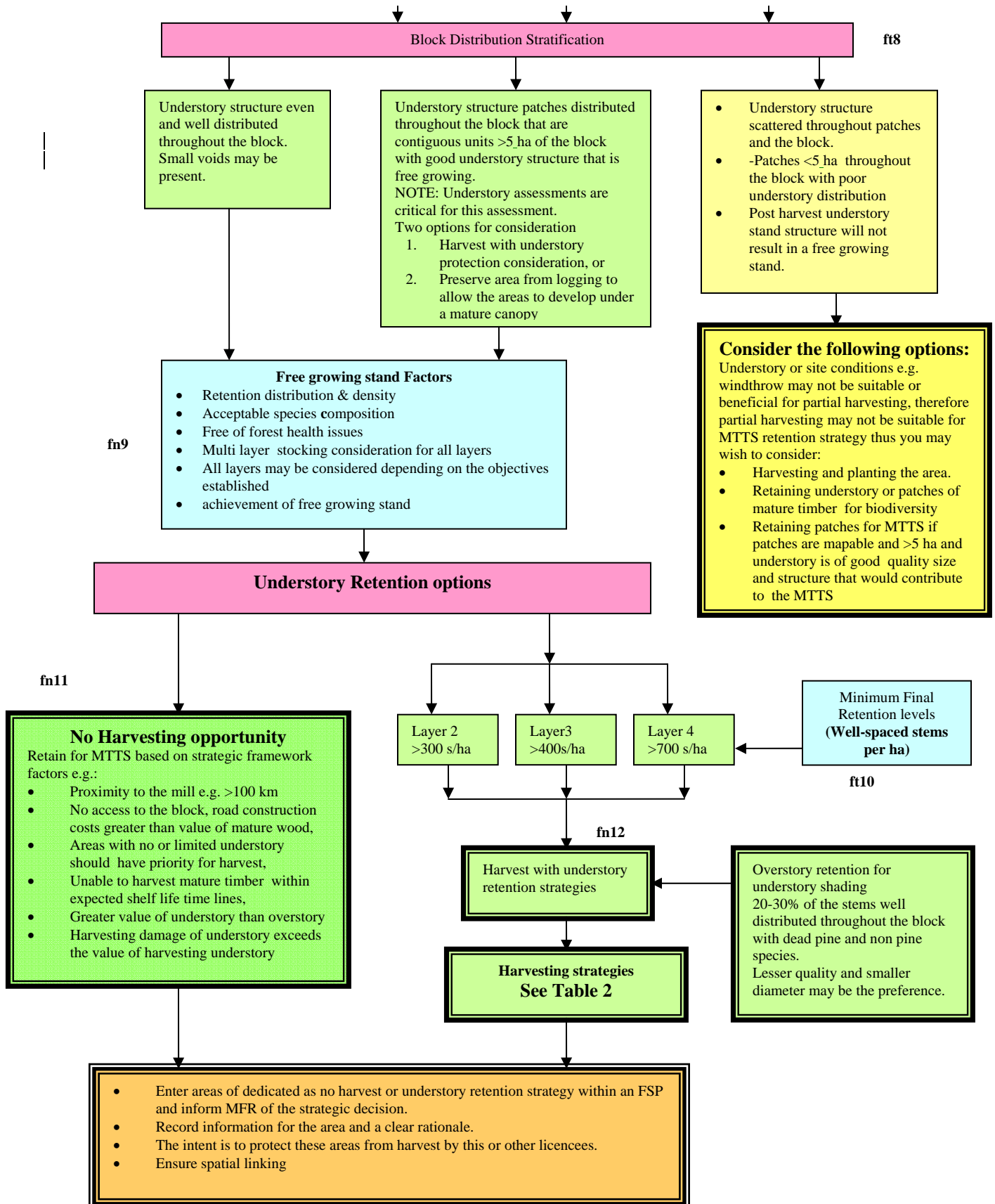
- fn1:** Goals and objectives are stated here with a focus of managing the mid term timber supply (MTTS). The intent is to address the falldown effect of the MTTS through the management of stand structure considering several short and long term factors (biological, economic, social, climate change etc.) which must have clear directions in order to factor into the analysis e.g. harvesting in proximity to mills and road development, priority harvest, etc.
- fn2:** Gathering the correct information with clear direction in mind are key for the analysis. Most information systems do not collect understory information thus collection of this information may be required. To ensure the information is accurate there may be a need to field check the data. Note, that there may not be one tool that will provide you with all the key information needed for the analysis.
- fn3:** The analysis should consider all available tools. Efforts should be given to utilize the most current and best quality information available for analysis. Caution should be taken not to over analyze the information.
- fn4:** Stratification may be based on understory analysis, ecology, and mature timber types, etc. to meet strategic and operational strategies. Information gathering and the analysis are key to the success of the stratification and implementation
- fn5:** The operational decision matrix can assist in the analysis and decision making processes. The focus of the DMK is to provide a frame work for what to leave, what to harvest and what to protect.

Understory Retention and Harvest Decision Matrix

To assist in the Mitigation of the Mid Term Timber Supply Fall-down as a result of the Mountain Pine Beetle

Chart 1

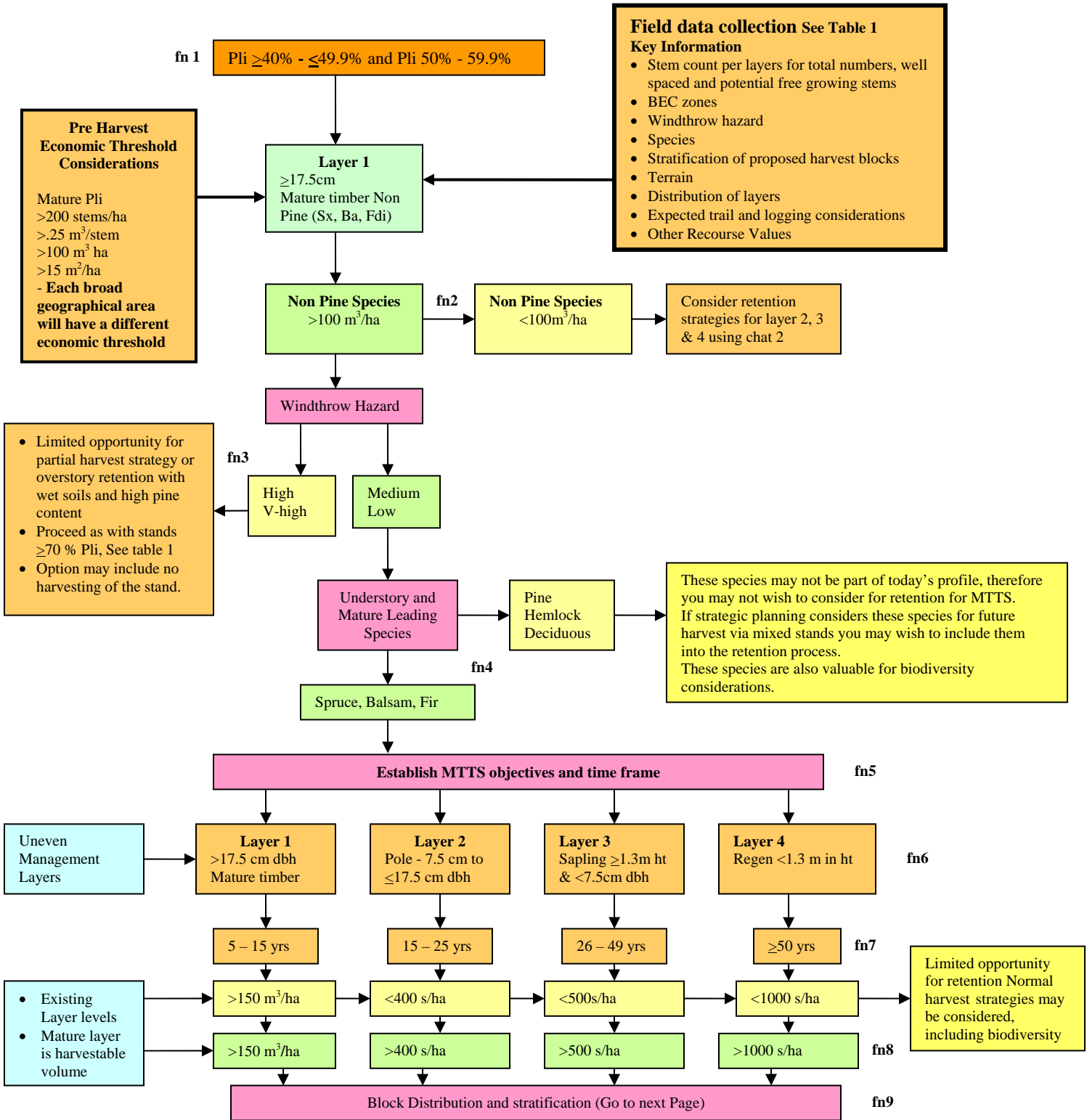




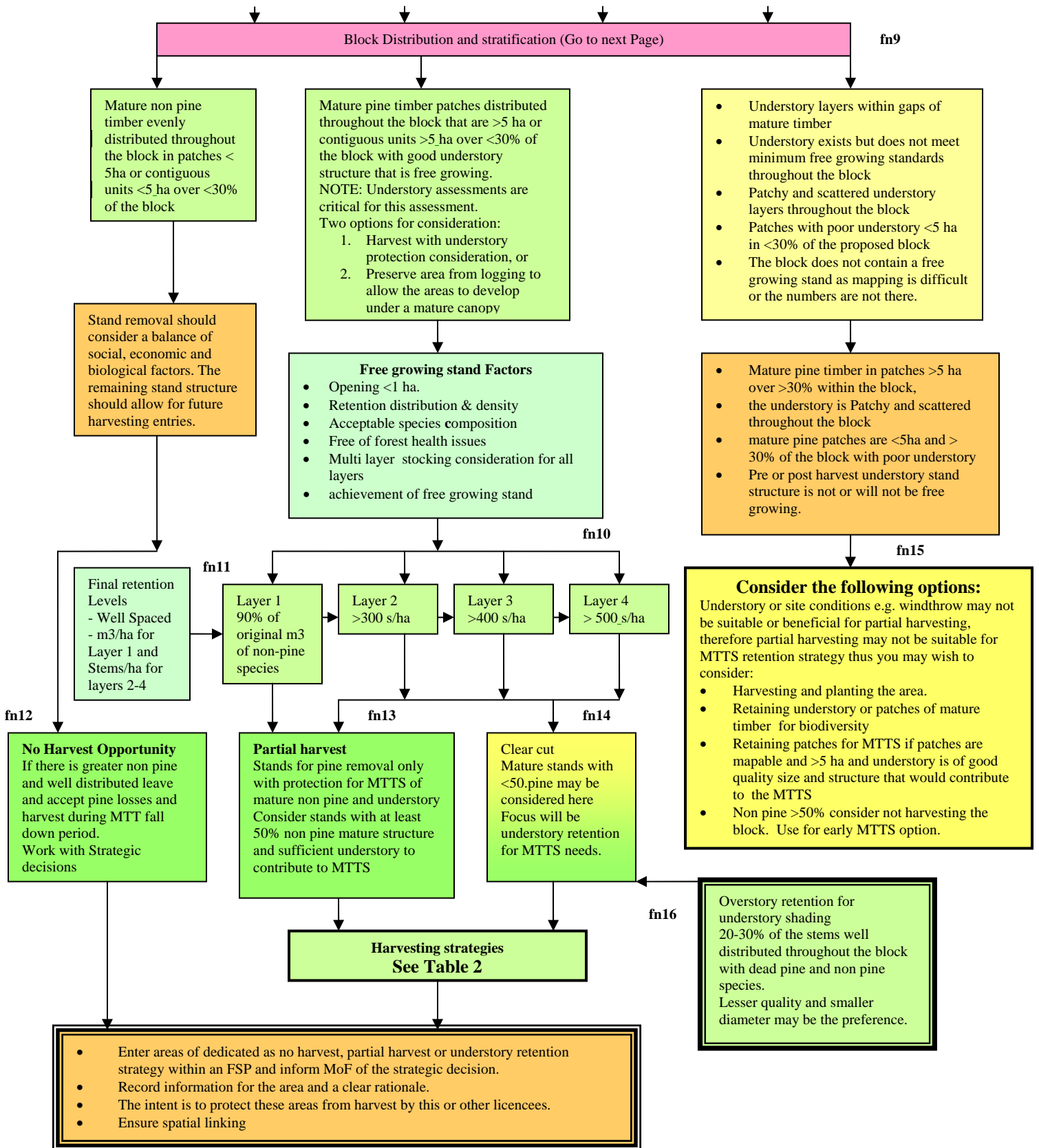
Foot notes Pli > 70%

- fn1:** Stands with less than 50% pine have greater opportunity for partial harvest. As the pine component increases the potential for partial harvesting of mature trees for the early part of the MTTs may decrease.
- fn2:** As a general guideline, fire origin stands regenerate at high densities. In these stands there generally is very little understory existing in these areas. However, there are areas where pine regeneration numbers post fire are low enough for other more shade tolerant species to germinate and grow below the faster growing pine stand.
- fn3:** All leading species of spruce balsam and fir are acceptable for MTTs. Species are noted in position of priority. Pine is not included in the priority list for potential understory because of poor performance as a release tree under sustained suppression (poor height-to-diameter ratios, poor crown development, poor leader growth, insufficient needles, etc).
- fn4:** Mid term period is determined in yrs from the assessment date.
- fn5:** For free growing standards one starts counting with layer one and proceeds to layer four to achieve a free growing stand. More than one layer may be retained for several objectives.
- fn6:** The years identified are to aid decision makers in selecting the timeframe for retention. The goal is to work from the earliest impacted years e.g. 15-25 years then 26-49 years etc. Earlier years will retain older larger trees e.g. 15 years retain mature timber.
- fn7:** The numbers and levels noted are guidance as a Minimum Stocking Standards per ha from uneven Stocking Standards. Expressed in well spaced stems per ha. The total numbers of stems may be significantly higher thus the more trees you have the better chance of success. The intent is to achieve sufficient number of stems that post logging will result in a free growing stand to address MTTs mitigation strategy. Note that you may be working with one or more layer to achieve one or more objectives. Nesting of layers to achieve post harvest free growing stands is acceptable. Note there are pre harvest and post harvest surveys available for determining stocking levels.
- fn8:** Nature does not distribute understory evenly, therefore blocks will require stratification and identification of understory patches. It appears that there will be a mosaic of understory retention across the landscape with different sizes and distribution that will contribute to the MTTs. Where patchiness exists, the focus for MTTs should be directed at those patches that are continuous and greater than 5ha in size. Where understory patches are less than 5ha, one may wish to consider protecting those patches through no harvesting or harvesting with protection of the understory. Stratification for MTTs may also consider patches of mature non-pine timber.
- fn9:** These are free growing factors relating to achieving a free growing stand. The numbers below in **fn10** are minimum numbers for stocking. Post harvest assessment survey system should use a multi story system which may include the equivalent partial harvest survey system.
- fn10:** Final numbers are minimums well spaced stems. In some associations there may be low numbers and in other more dynamic associations you will have greater numbers. Ensure the correct post harvest survey system is used to address free growing requirements (uneven aged or equivalency survey system).
- fn11:** There are two options for understory retention. The first is identified as no harvesting. This option may be based on several factors including strategic decisions, other resource value benefits, or one of a few areas with sufficient understory present within an operating area. The second option is noted as fn12.
- fn12:** The second option for understory retention is using a harvesting strategy to protect the understory and achieve a free growing stand. If there are areas that are NSR they will be required to be planted. Part of the protection strategy for the retained understory is the retention of 20 to 30% overstory distributed throughout the block to provide shading for the understory to address growth habitat and avoid potential sunscald. The larger the tree within the understory e.g. layers 1 and 2 the less susceptible to sunscald.

Chart 2 Pli $\geq 40\%$ - $\leq 59.9\%$



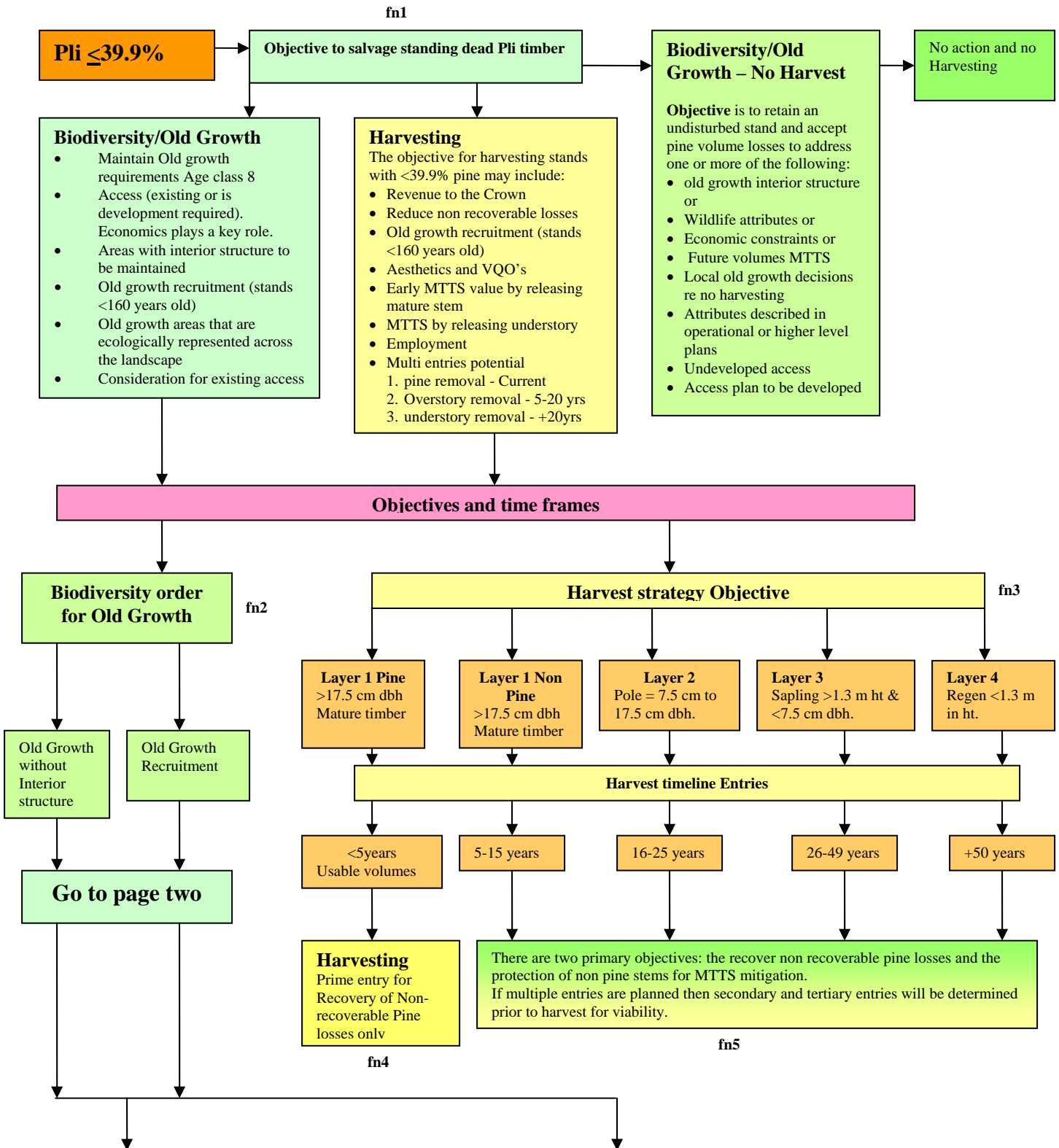
Continuation of Chart 2



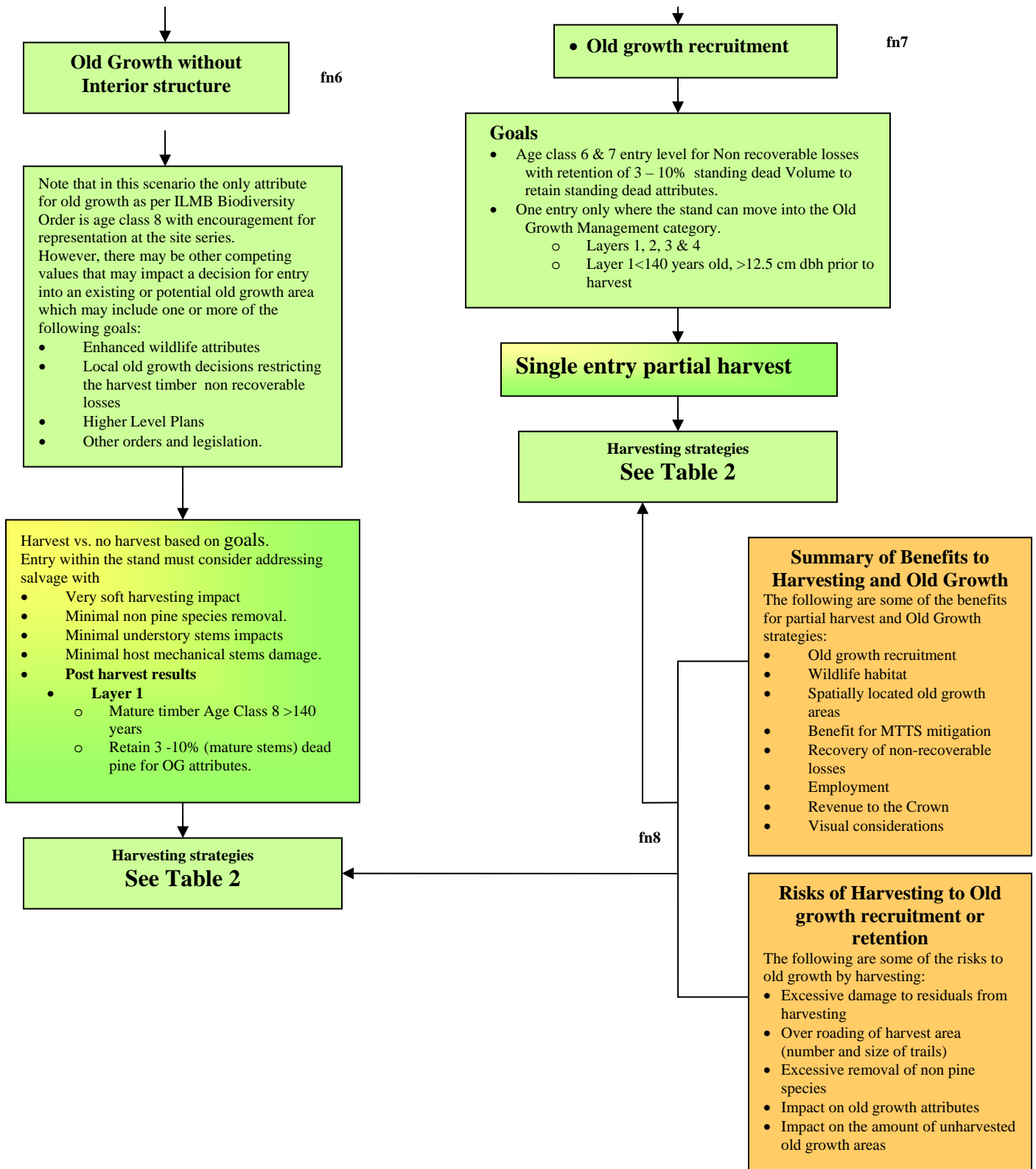
Foot note: Pli >40% to 59.9%

- fn1:** The amount of pine within a stand may influence one approach for harvesting. The lower the pine content within a stand, the greater the opportunity for partial harvesting to address early MTTS (5-15 years) needs.
- fn2:** This section addresses the economic component of harvesting the stand. The economic threshold for harvesting lower volume stands may be influenced by such key factors as availability of volume, strategic planning objectives, equipment type, mill capacity, timber quality etc. The 100m³ may be acceptable in some parts of the province but 200m³/ha may be more appropriate for these parts of the province. The 100m³/ha is a general guide to consider.
- fn3:** Windthrow assessment process is guided by the provincial Windthrow Guide handbook of BC. Where there is high or very high windthrow hazard there are two options available, non harvest or Understory retention strategy. The partial harvest option may also be available if the mature pine timber removal is light e.g. <50% removal of Pine evenly mixed throughout the proposed block. Note, that the larger the opening within the stand the greater the potential for windthrow of retained residuals and opening edge.
- fn4:** Pine as a general rule does not release well when growing beneath a mature closed canopy. Young pines growing beneath a closed canopy have small crowns, few needles and the height to diameter ratio is outside of a healthy range. Hemlock and deciduous are generally not considered part of the AAC. Therefore the focus is placed on current species that contribute to AAC for the mid term, spruce Balsam and Douglas fir.
- fn5:** Mid term period is determined in yrs from the assessment date.
- fn6:** For free growing standards one starts counting with layer one and proceeds to layer four to achieve a free growing stand. More than one layer may be retained for several objectives.
- fn7:** The years identified are to aid decision makers in selecting the timeframe for retention. The goal is to work from the earliest impacted years e.g. 15-25 years then 26-49 years etc. Earlier years will retain older larger trees e.g. 15 years retain mature timber.
- fn8:** The numbers and levels noted are guidance as a Minimum Stocking Standards per ha from uneven Stocking Standards. Expressed in well spaced stems per ha. The total numbers of stems may be significantly higher than the more trees you have the better chance of success. The intent is to achieve sufficient number of stems that post logging will result in a free growing stand to address MTTS mitigation strategy. Note that you may be working with one or more layers to achieve one or more objectives. Nesting of layers to achieve post harvest free growing stands is acceptable. Note there are pre harvest and post harvest surveys available for determining stocking levels.
- fn9:** Nature does not distribute understory evenly, therefore blocks will require stratification and identification of understory patches. It appears that there will be a mosaic of understory retention across the landscape with different sizes and distribution that will contribute to the MTTS. Where patchiness exists, the focus for MTTS should be directed at those patches that are continuous and greater than 5ha in size. Where understory patches are less than 5ha, one may wish to consider protecting those patches through no harvesting or harvesting with protection of the understory. Stratification for MTTS may also consider patches of mature non-pine timber.
- fn10:** These are free growing factors relating to achieving a free growing stand. The numbers below in **fn10** are minimum numbers for stocking. Post harvest assessment survey system should use a multi story system which may include the equivalent partial harvest survey system.
- fn11:** Final numbers are minimums well spaced stems. In some associations there may be low numbers and in other more dynamic associations you will have greater numbers. Ensure the correct post harvest survey system is used to address free growing requirements (uneven aged or equivalency survey system).
- fn12:** There are four options for understory retention. **Option one** is identified as no harvesting. This option may be based on several factors including strategic decisions, other resource value benefits, one of a few areas with sufficient understory present within an operating area or a high percentage of non pine present within the stand. The second and third options are noted as fn13 and fn14.
- fn13:** Harvest **option two** provides for stand structure where partial harvesting is a reasonable option for overstory while protecting the overstory. The benefit of this system is a positive impact on the early part of the MTTS, growth release for mature and understory trees and protection from sunscald of the understory. Note, that the level of non pine overstory retention may be more than 50% of the stand.
- fn14:** Harvest **option three** is directed at stands where partial harvesting is not practical as result of low levels (<50%) of non pine stands that would create an environment with significant windthrow and would not contribute to the MTTS. The focus then is to manage the understory levels with some protection of the overstory for non MTTS purposes. Note that the trees retained may be a mixture of pine and/or non pine species.
- fn15:** Harvest **option four** is used where understory retention is distributed patchy and scattered in patches less than 5 hectares in size throughout the block. Within this option there are several factors one should take into account prior to harvest. This may include levels of mature pine and non pine species mixes, strategic strategies, etc. Some of the options include protection of the understory or the patches with the understory and overstory from harvest, not harvesting to retain the overstory for a later harvest within the MTTS time lines or remove the dead pine while protecting both the understory for MTTS and the non pine overstory for other values. In the event there is significant pine within the stand, greater than 50 % there is a need to address economic threshold for logging vs not logging.
- fn16:** Part of the protection strategy for the retained understory is the retention of 20 to 30% overstory distributed throughout the block to provide shading for the understory to address growth habitat and avoid potential sunscald. The larger the tree within the understory e.g. layers 1 and 2 the less susceptible to sunscald.

Chart 4
Pli <39.9%



Continuation of Chart 4



Foot Notes

fn1: This is the start of the options for managing stands with <40% pine within the stand. The objectives include considerations for old growth, harvesting and protection of the stand from harvest.

fn2: For areas with existing set biodiversity orders and sites that contribute to this legal requirement, **do not have interior structure** and have good road access with a desire to recover timber there is some thought one may consider recovering the dead pine and still maintain old growth attributes. The second option is those stands that do not meet the old growth definition and have the potential as recruitment there is the opportunity to manage are the for recovery of potential non recoverable losses and provide an opportunity for old growth biodiversity recruitment. Note that there are pros and cons to these options. The prescribing forester must ensure that the impact is minimal and the stand will withstand scrutiny for old growth.

fn3: This section identifies the layers that are to be protected or harvested with guidelines for initial numbers to ensure a free growing stand may be achieved. The objective here is to determine the time limes for mid term and an options for harvest.

fn4: This option is directed at the first entry of salvaging the non recoverable losses by salvaging the pine. A second entry may be considered for removal of the remaining stand for MTTs needs.

fn5: This option is directed at those stands that have the potential for three entries. The first entry is for the salvage of non recoverable losses by harvesting the pine, the second entry is the removal of the non-pine overstory within the early part of the MTTs with a third entry to address the removal of the understory for the later part of the MTTs.

fn6: This option considers the opportunity to salvage the majority of the standing dead pine in non-recoverable losses and still retain the integrity for old growth requirements. The following boxes in this section provide a description of some factors to consider when approaching this strategy. Note this is a one time entry.

fn7: This option of old growth recruitment is directed at stands that are younger than 140 years and can be managed with a single entry to salvage non-recoverable losses and develop an opportunity for old growth recruitment. Note that this should only occur in areas where there is a need for old growth recruitment.

fn8: The two tables noted as benefits and risks are directed at entry into these stands for dead pine salvage. The lists addresses key points and is not a complete list of benefits or risks.

Table 1

Field data collection for understory retention

The following information should be considered for collection prior to decisions relating to harvesting and the potential retention of understory and regeneration. The information can be collected at any time prior to harvest with the two best times being at a reece stage or during the cruising stage. The plot size can be a 3.99 m radius or 2.56 m radius plots for regen layer and prism sweeps or 5.64 m radius plots for mature layer depending on time and crew size. The more information collected the easier the decision may become. The decisions and success of the strategy will greatly be influenced on using high quality professional survey standards, understanding, analyzing and interpreting the information gathered. There are also other contributing factors including economics and other resource values one should take into consideration when making the final decision.

- **Overstory structure**
 - Species composition
 - % pine within the stand
 - % non-pine species within the stand and what species are retained
 - Windthrow hazard
 - Age
 - Height
 - Forest health issues within the stand or in adjacent stands
 - Piece size
 - Volume (m³)
 - Density (stems /ha)
 - The square meters pre and post harvest of mature trees is variable based on the age and stand structure but as a general guide you may wish to consider the following as guidelines for acceptable basal area:
 - Pre harvest 28m² to 50m²
 - Post harvest 8m² to 16m²
- **Ecology**
 - BEC
 - Soils (consideration for windthrow assessments and site disturbance ratings)
 - Site index – SIBEC (calibrated)
 - Terrain (considerations for seep slopes for harvesting capacity)
- **Understory Contributing to MTTs Mitigation Strategies**
 - Species
 - Composition
 - Density
 - Age
 - Heights
 - Diameter (dbh if >1.3 m tall)
 - Height to diameter ration of <90
 - Live crown ratio of ≥30%
 - Layers (poles, saplings, regen)
 - Minimal forest health factors (insects, diseases, wildlife and abiotic conditions)
 - Distribution (well distributed vs. clumpy ness – record your plots in quadrants to assess distribution).
 - Height diameter ratio of ≤80 (height in centimetres DBH in centimetres)
 - Live crown >40%
 - Free of unacceptable forest health factors
 - Understory of good form
 - Primary, secondary or tertiary species as per the reference guide to stocking standards for ecologically suitable species

**Harvesting Strategies
Table 2**

Key Factors in harvesting strategies

Layout to maximize layered retention

Considerations for the type of equipment to be used will be determined by those making the decisions on harvesting activities. However, smaller equipment provides for greater manoeuvrability to achieve retention objectives. The key factors in determining the success of understory retention is layout, operator skill, operator training, operator's attitude towards the strategy, selection of equipment and the implementation of a clear layout for a retention strategy. Therefore understanding of the concepts and training are very important. The following are steps one may wish to consider in the process for understory retention.

1. Layout – staff should be familiar with the equipment they are laying out for e.g., feller buncher/grapple skidder.
 - a. Recognize the limitations of the equipment for the job.
 - b. Recognize the layout is for the equipment and the operator not just running lines and compass bearing
 - c. Layout is the start of making or breaking the project.
2. Falling
 - a. Fall within designated trails or gaps
 - b. Feller buncher – zero tail swing or minimum swinging
3. Processing
 - a. Processing at the stump reduces damage to layers when hand falling
 - b. Mechanized processing can be done at the stump or at landings depending on felling process and processing equipment.
4. Trails (key to success for retention)
 - a. Supervision consider intensive at the start of operations until all are familiar with the harvest system.
 - b. Layout should be completed for operators initially until there is experience and commitment to the retention plan by operators.
 - c. Trail Locations
 - i. Voids
 - ii. Undesirable understory
 - iii. Dense patches
 - iv. Etc.
 - d. Designated trails
 - i. Trail width (<5m)
 - ii. Selected rub Trees
 - iii. Trail design based on equipment and tree size.
 - iv. Short spurs off of designated trails
 - v. May require longer skid distances
5. Skidding
 - a. Stay on designated trails
 - b. Strategic turnaround points
 - c. Selected rub trees
6. Landings vs Roadside – Landing have less impacts than roadside because of the width of the right of way for processing. Silviculture liability with road side.
7. Operators
 - a. Motivated
 - b. Experienced or well trained
 - c. Understanding with clear direction of objectives and standards.

Summary

Key success factors for Understory strategies

There are many factors which will determine the success of harvesting for understory retention and the overall objective for this decision matrix is assisting the mitigation strategies for the MTTTS fall down expected in the future. The first crucial component is gathering information from the field. The information must be complete and of high quality and standard. Once the decision has been to manage the understory component of the forest it is all about expertise of the layout crews in conjunction with the operators and the right pieces of equipment. The decision matrix provides guidance on understory retention numbers and stand composition to assist in the mitigation strategy for the mid term timber supply falldown expected as a result of the mountain pine beetle epidemic within British Columbia.

Benefits of understory retention strategies

The following are some of the many benefits of using an understory of an overstory retention strategy

- Course woody debris
- Improved biodiversity
- Old growth recruitment
- Visual Objectives
- Free growing stand
- Limited silviculture costs
- Improved Forest Health
- Ecological adaptation
- Climate change buffer
- Hydrology considerations
- Species Diversity
- Genetic Diversity
- Mid term timber supply considerations reduced harvest time lines
- Recovery of non recoverable losses and revenue to the crown for partial harvest
- Positive community impacts
- Continued employment

Glossary of terms

Forest fragmentation - the subdivision of large natural landscapes into smaller, more isolated fragments. Fragmentation affects the viability of wildlife populations and ecosystems.

Group selection - a process of harvesting patches of trees to open the forest canopy and encourage the reproduction of unevenaged stands.

High grading - to remove all mature, good quality trees from a stand and leave inferior species and individuals. High grading should be distinguished from even-aged management in which mature and immature trees are removed to aid regeneration.

Old-growth forest - a wooded area, usually greater than 140 years of age, that has never been altered or harvested by humans. An old-growth forest often has large individual trees, a multi-layered crown canopy, and a significant accumulation of coarse woody debris including snags and fallen logs. In BC the legal term is focused on stand >140 year of age only and may include disturbance.

Overmature - a quality exhibited by trees that have declined in growth rate because of old age and loss of vigour.

Overstocked - the situation in which trees are so closely spaced that they compete for resources and do not reach full growth potential.

Overstory - the level of forest canopy that includes the crowns of dominant, co dominant and intermediate trees.

Partial cut - A silvicultural cutting scheme that removes at any one time less than the total tree stand (selective cut, seed tree cut, shelterwood. cut).

Patch cut - a clearcut on a small area.

Regeneration cut - a timber harvest designed to promote natural establishment of trees.

Release - to remove overtopping trees that compete with understory or suppressed trees.

Regeneration - the process by which a forest is reseeded and renewed. Advanced regeneration refers to regeneration that is established before the existing forest stand is removed.

Residual stand - the trees remaining intact following any cutting operation.

Rotation - the number of years required to grow a stand to a desired size or maturity.

Selection Harvest - The periodic removal of trees, usually at 10-20 year intervals, individually or in small groups, from an uneven aged forest in order to realize yield and establish regeneration or irregular constitution.

Shelterwood harvest - the harvest of all mature trees in an area in a series of two or more cuts, leaving enough trees of other sizes to provide shade and protection for forest seedlings.

Salvage cut - the removal of dead, damaged, or diseased trees to recover maximum value prior to deterioration.

Stand - a group of forest trees of sufficiently uniform species composition, age, and condition to be considered a homogeneous unit for management purposes.

Stand density - the quantity of trees per unit area, usually evaluated in terms of basal area, crown cover and stocking.

Stocking - the number and density of trees in a forest stand. Stands are often classified as understocked, well-stocked or overstocked.

Stratification - division of a forest, or any ecosystem, into separate layers of vegetation that provide distinct niches for wildlife. See canopy, understory, and herbaceous vegetation.

Succession - the natural replacement of one plant (or animal) community by another over time in the absence of disturbance.

Suppressed - a tree condition characterized by low growth rate and low vigor as a result of competition with overtopping trees. See overtopped.

Understory - the level of forest vegetation beneath the canopy.

Uneven-aged stand - Three or more age classes of trees represented.

Watershed - a region defined by patterns of stream drainage. A watershed includes all the land that contributes water to a particular stream or river.

Well-stocked - the situation in which a forest stand contains trees spaced widely enough to prevent competition yet closely enough to utilize the entire site. In BC a well stocked stand means a free growing stand that meets legal requirements at densities based on ecological variations as noted by the Chief Forester.

Wildlife habitat - the native environment of an animal. Habitats ideally provide all the elements needed for life and growth: food, water, cover and space.

Windthrow - a tree felled by wind. Windthrow, also known as blowdown, are common among shallow-rooted species and in areas where cutting has reduced stand density.

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