



*Nova Scotia's*  
**Forest Management Guide**

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**FRR # 100, REPORT FOR 2018-001  
February 2, 2018**



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# Acknowledgments

Thanks to Peter Neily and Eugene Quigley for drafting the Spruce-Pine Guide and for their review of the combined guide. Thanks also go to Jane Kent and Susan Melanovich for their many detailed reviews of the guide. Credit goes to Neily et al (2013) for their edatopic grids and succession table used in this guide. Thanks for the many comments and suggestions forwarded from numerous persons that contributed towards the improvement of this guide, especially Royce Ford and Lizz Cogan. Credit is also due to Bob Murray and Troy Rushton for their many years of research assessments that provide the foundation for this guide. Further suggestions are valued towards future improvements. Several management guides published for areas outside Nova Scotia were reviewed before starting the development of the Nova Scotia Forest Management Guide (FMG). Guides were reviewed from Ontario (Anderson and Rice, 1993) and the Northeastern United States (Lamson and Leak 2000, Leak et al. 1987, Boyce and Carpenter, 1968). These guides provided several ideas included in the FMG including the idea of Acceptable Growing Stock as an important factor in prescribing appropriate forest management treatments.

## Ecosystems-based Management (EBM) at the Operational (Stand) Level

This guide was produced to satisfy the requirements found in two key documents (i) “The Path We Share – A Natural Resources Strategy for Nova Scotia 2011-2020” (NSDNR 2011) and the (ii) “Nova Scotia’s Code of Forest Practice – A Framework for the Implementation of Sustainable Forest Management” (CFP, NSDNR, 2012).

The Natural Resources Strategy commits Nova Scotia to “*fully implement an ecosystem approach to forest management*” (NSDNR, 2011, pg. 35). It also calls for the “*application of the Code of Forest Practices on publicly and privately owned woodlands*”.

The Code of Forest Practices (CFP, NSDNR, 2012) provides more detailed guidance concerning Ecosystems-based Management (EBM) implementation in Nova Scotia.

- 1.1.3 Four (4) levels of forest management intensities are recognized, including (i) conservation reserves, (ii) extensively management forests (ecosystems-based), (iii) intensive managed forest (timber-based) and (iv) forest conversions
- 1.1.4 The distribution and amount of these intensities will be assessed to help manage ecological sustainability.

The Nova Scotia Forest Management Guide (FMG) published here recommends appropriate silviculture and harvesting for ecosystems-based forests management. It is one of the technical manuals included under the CFP (NSDNR, 2004, pg.3)

It is recognized that the stand-level plans must be consistent with the landscape level goals and plans. In some cases, the ecosystems-based landscape plan will call for a timber-based forest management and others an ecosystem-based approach. When ecosystems-based management is planned, this Nova Scotia Forest Management Guide will be utilized. When timber-based management recommendations are required use the Forestry Field Handbook (NSDNR, 1993).

In both cases, recommendations are based on Nova Scotia research and must be carried out within landscape-level ecological and timber sustainability.

Ecosystems-based forest management (EBM) as stated in the CFP uses the following guidelines:

- 1.1.5 Manage for resource production, using techniques that mimic natural disturbances based on the Forest Ecosystems Classification system (FEC, NSDNR, 2013)
- 1.1.6 Promote regeneration of native species typical of the ecosystem.
- 1.1.7 Maintain tree species diversity as described in the FEC

- 1.1.8 Do not include use of off-site or exotic species.
- 1.1.9 Protection from fires and pests.

To accomplish these goals the FMG:

- Prescribes uneven-aged management and non-clearcut harvesting methods when appropriate as a first choice.
- Favours natural regeneration harvest methods where possible within stand and site limitations.

Further the CFP in Sections 1.2.2 and 1.2.3 calls for the collection of data before treatment. This data is collected during a Pre-Treatment assessment (PTA) and includes information on the ecosystem (as defined by the FEC), site and forest conditions. This data is used as the basis for stand-level management within the context of a landscape level plans (see Restoration Shelterwood Section).

The harvest planning system for ecosystems-based management at the operation (stand) level requires three basic technical manuals/references:

- Pre-Treatment (**PTA**) data collection systems that enables the consistent collection of ecosystems, site and stand information need to prescribe treatments using the Nova Scotia Forest Management Guide (FMG)
- Nova Scotia's Forest Management Guide (**FMG**) prescribes appropriate ecosystems-based prescriptions and
- Forest Ecosystems Classification (**FEC**) for Nova Scotia that defines the standard categories for vegetation types, soils and ecosites that form the framework for EBM.

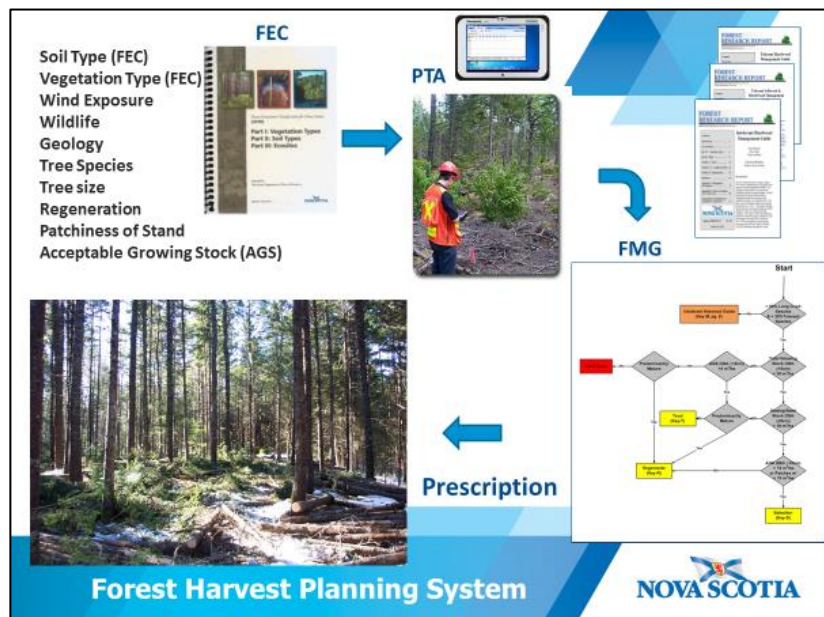
For all harvests, the Wildlife Habitat and Watercourse Protection Regulations (Nova Scotia Statutes, 2010) must be followed.

These tools are interrelated as shown in Figure 1.

The PTA and FMG tools are described in this guide, while the FEC is described in Neily et al. (2013)

By using this system, the following benefits are provided:

- consistency across the province (e.g. common ecosystem classification and harvest method terminology)
- research-based harvest/silviculture prescriptions.
- transparency in the treatment prescriptions and their foundation.
- ensures ecosystem characteristics are considered in management prescriptions
- identifies opportunities for non-clearcut harvest
- allows mitigation of risk such as compaction to sensitive soils
- establishes pre-treatment stand conditions to allow effective evaluation of the effectiveness of treatments
- allows matching prescriptions to stand and ecosystems conditions



**Figure 1. How the FEC, PTA and FMG are Used to Prescribe Ecosystem-Based Management Treatments.**

# Pre-Treatment Assessment (PTA)

Within the Code of Forest Practices, it is mandated that a Pre-Treatment Assessment (PTA) be performed prior to harvest/silviculture operations on Crown land. This system is encouraged on private land. The PTA is a ground-based cruising system that was designed to collect the site and stand conditions necessary to produce an ecosystem-based treatment recommendation using The Nova Scotia Forest Management Guide (FMG, this document).

For details on PTA data collection protocol and data collection/compilation/summary computer application Refer to McGrath (2017, <http://novascotia.ca/natr/forestry/programs/timberman/pta.asp>). Tally sheets have been designed (Appendix I) and a data collection program has been developed to increase efficiency.

The PTA program automates the prescription selection process based on the FMG. The data is saved in a database to enable storage and to use for improving treatment prescriptions and applications (adaptive management). This program also incorporates volume cruise and compilation capabilities. The PTA field collection cruise also provides an opportunity for gathering information on biologically sensitive features for use in mitigation plans (Neily and Parsons 2017).

Some key elements assessed for the PTA are discussed below. For a detailed description of the Soil, Vegetation and Ecosite information collected in the PTA refer to the FEC manual (Neily et al. 2013).

## Windthrow Hazard

When prescribing non-clear cut, partial harvesting systems in Nova Scotia, the potential for windthrow and stem breakage of leave trees is a major concern. Many parts of Nova Scotia have frequent storms that include high winds, potentially detrimental to standing trees. Trees are especially at risk when growing in shallow soils or exposed sites. By opening stands, leave-trees



partial harvesting (e.g. provide seed and shade for regeneration) depends on the remaining trees to be left standing with crowns intact. To mitigate the risk to wind damage, this guide incorporates an assessment of windthrow hazard and wind breakage as important considerations when prescribing treatments based on data collected during the PTA. Breakage risk is discussed in the section on Acceptable/Unacceptable Growing Stock (AGS/UGS).



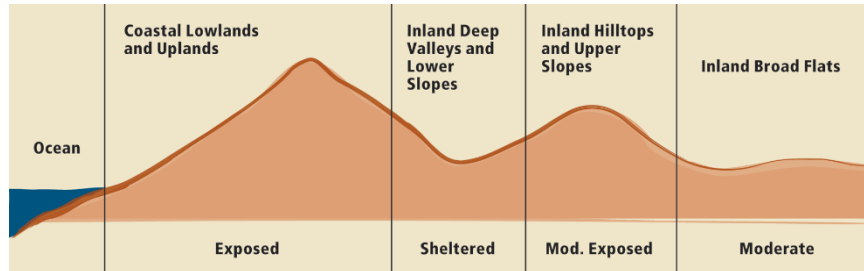
initially become more susceptible to wind damage, especially for heavier removals (McGrath and Ellingsen, 2009). Successfully meeting treatment objectives for





Windthrow hazard is an important consideration when prescribing treatments. The windthrow hazard rating (Low, Moderate or High) depends on site exposure and soil characteristics. The soil component of windthrow hazard is directly determined from soil type, per Neily *et al.* (2013). The main soil factor influencing windthrow hazard is potential rooting depth which is related to drainage, texture, stoniness, proximity of bedrock to the soil surface and overall depth.

Windthrow hazard also depends on exposure of the stand to winds due to topography, slope position and proximity to the coast (Stathers *et al.*, 1994). The Nova Scotia Forest Ecosystem Classification (Neily *et al.*, 2013, page 362) defines the exposure classes as either exposed, moderately exposed, moderate, moderately sheltered or sheltered (Figure 2 and Table 1).



**Figure 2. Wind Exposure Ratings.**

<b>Table 1. Wind Exposure Definitions Adopted from Neily <i>et al.</i> (2013)<sup>A</sup></b>		
<b>Class</b>	<b>Description</b>	<b>Code</b>
<b><i>Sheltered</i></b>	The most extreme category of protection from wind and atmospheric drought stress, best illustrated by lower slopes of deep valleys where protection is provided on all sides.	<b>S</b>
<b><i>Moderately Sheltered</i></b>	Intermediate between Moderate and Sheltered. Includes middle slopes between high ridges and broad basins which are afforded some wind protection from one or more directions	<b>MS</b>
<b><i>Moderate</i></b>	The topographically neutral category. Includes broad flats, lower and middle slopes of strong ridges (plus sheltered upper slopes), and upper slopes of gentle relief in a flat landscape.	<b>M</b>
<b><i>Moderately Exposed</i></b>	Intermediate between Exposed and Moderate. Includes upper slopes of inland ridges or hills, except where sheltered by a larger hill.	<b>ME</b>
<b><i>Exposed</i></b>	Sites with extreme exposure. Includes upper slopes of moderate ridges immediately along the coastline and steep upper slopes of uplands open to winds from two or more directions.	<b>EX</b>

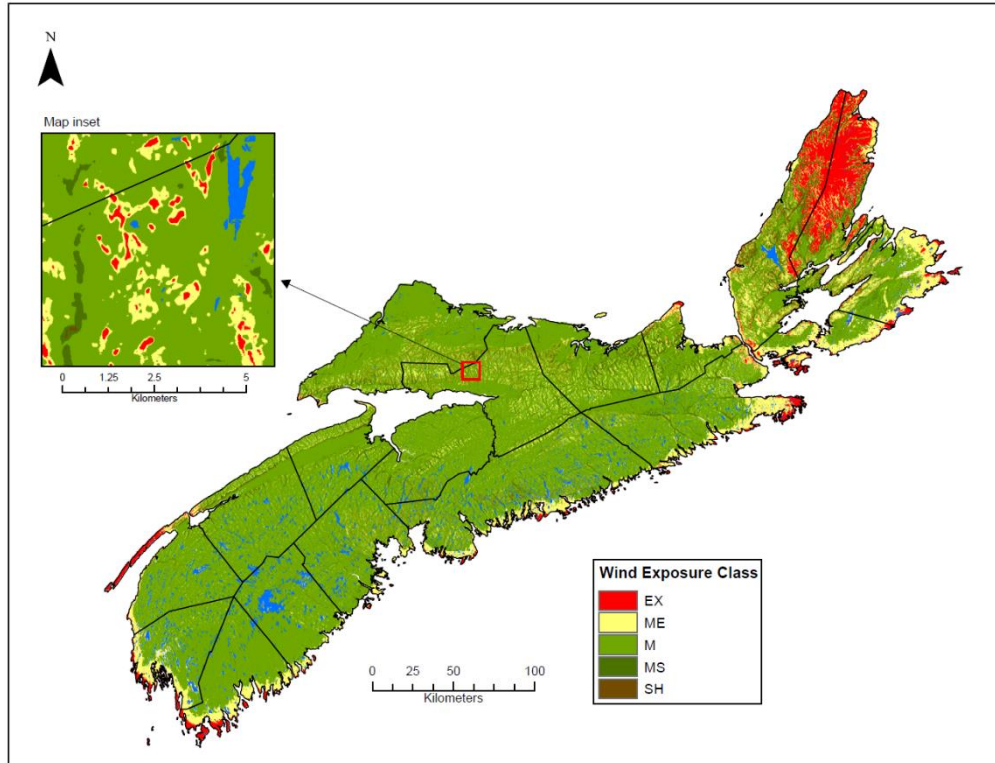
<sup>A</sup> Exposure refers to the relative openness of a site to weather conditions, particularly wind.

Wind exposure ratings have been mapped by NSDNR (Keys et al. 2017) to consistently assess wind exposure. These maps are to be used for PTA wind exposure ratings (Figure 3).

The wind exposure rating in combination with the soils type determine windthrow hazard as shown in Table 2. Stand density, tree species rooting patterns, crown dimensions, and overall tree health are also important factors.

In some Forest Groups, partial

harvests are not recommended in high windthrow hazard situations, but are recommended in low hazard conditions.



**Figure 3. Provincial Wind Exposure Map (Keys et al., 2017)**

Soil Type (Keys et al., 2011)	Exposure Class				
	<i>Sheltered</i>	<i>Moderately Sheltered</i>	<i>Moderate</i>	<i>Moderately Exposed</i>	<i>Exposed</i>
1, 1-G, 2, 2-G, 2-L, 8, 8-C Stony phases	Low	Low	Low	High	High
3, 3-G, 3-L, 5, 9, 9-C, 11 Stony phases	Low	Low	High	High	High
6, 12 Stony phases	Low	High	High	High	High
<b>All wet, organic, moist shallow, and talus soil types (ST4, ST7, ST10, ST13, ST14, ST16, ST18, ST19)</b>					
	High	High	High	High	High
<b>Dry shallow soil types (ST15, ST17) with 0-15 cm depth or stony (S) phase</b>					
	High	High	High	High	High
<b>Dry shallow soil types (ST15, ST17) with 16-30 cm depth and non-stony phase</b>					
	High	High	High	High	High
<sup>A</sup> Windthrow Hazard Rating	Low	Moderate	High		

The decision to proceed in moderate hazard situations is assumed to be dependent on the landowner/managers' aversion to wind damage risk. Where a land owner is willing to risk a moderate risk to wind damage a shelterwood treatment may be prescribed. If a landowner is not willing to risk wind damage an overstory removal will be prescribed.

For the Tolerant Hardwood forest group, windthrow hazard is not a factor considered when prescribing partial harvesting. These vegetation types include deep rooted species on deep soils and are less prone to windthrow.

### **Stem Breakage Hazard**

Breakage hazard is part of the evaluation of whether a tree is classed as Unacceptable Growing Stock (UGS). When live-crown ratio is less than 1/3 (ratio of length of live crown to total tree height) or H/D (ratio of total tree height in meters to Diameter at Breast Height in centimeters) ratio is greater than 0.8 a tree is considered prone to stem breakage when thinned and considered UGS. When UGS levels are too high the stand is not considered suitable for commercial thinning or selection harvesting (see next section for more details).





## Acceptable Growing Stock (AGS) and Unacceptable Growing Stock (UGS)

Another important factor needing consideration in the PTA is an assessment of whether trees are considered Acceptable Growing Stock (AGS) or Unacceptable Growing Stock (UGS). This information is necessary to determine whether a stand is suitable for partial cutting treatments, such as Commercial Thinning and Selection Management, where the objectives include improving the health and viability of stands for future harvest. Adequate numbers of well-formed, healthy and vigorous trees that have potential for higher value crops must be present to justify these types of harvests. Leaving poor formed trees, those prone to wind damage or decline due to defects, rot and insect infestations will result in degradation in the potential health and value of a stand. If insufficient amounts of well-formed vigorous trees with long-term potential (at least 15 years) do not occur in a stand, it is a poor candidate for Pre-Commercial Thinning, Commercial Thinning or Selection management harvests.

Stands can be degraded in the process of carrying out a Commercial Thinning or Selection Management Harvest by cutting the best trees and leaving unhealthy or poor formed trees with limited potential. This is referred to as high-grading or selective harvesting. Comparing the AGS proportion before and after treatment can be used as a means of assessing high-grading. If a Commercial Thinning or Selection Management Harvest is carried out successfully, the proportion of AGS trees in the stand is increased. If the proportion of AGS trees after treatment is lower, it is considered a high-grade. Treatment damage to tree boles, crowns or roots can turn an AGS tree to an UGS tree.

### Definition of AGS

Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.



**Acceptable Growing Stock (AGS)**



**Unacceptable Growing Stock (UGS)**

## Characteristics of UGS trees

Some characteristics of trees that would classify them UGS are indicated below:

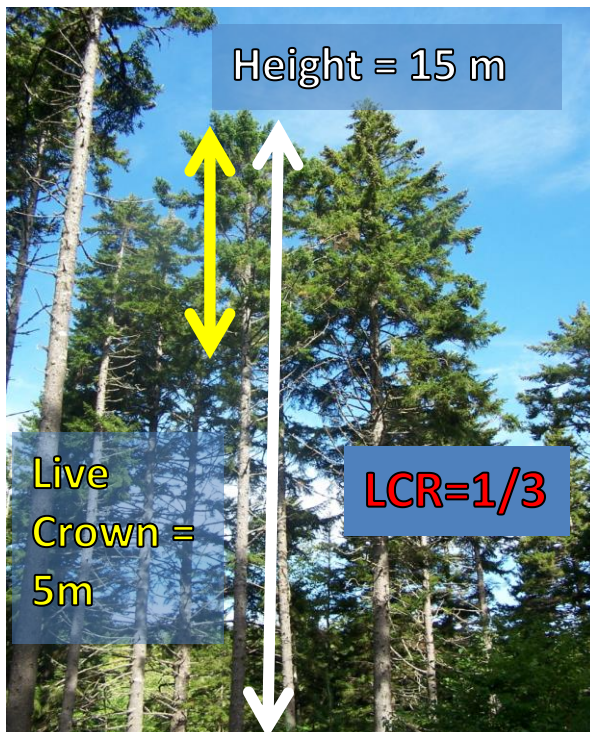
### Wind damage risk

Trees that have crown structures that make them prone to wind damage such as stem breakage or windthrow are considered UGS.

- Trees with a height to diameter ratio (H/D, m/cm) greater than 0.80 are spindly trees that are tall compared to their stem diameter with a higher potential for stem breakage and blowdown. This is measured as the height of a tree in metres divided by its Diameter at Breast Height in centimetres.
- Trees with short live crowns or a low live crown ratio (LCR) are more prone to wind damage. They are also slow to respond to a thinning. When LCR goes below 1/3, it is considered UGS and a poor candidate for release.



Height to Diameter Ratio (H/D)



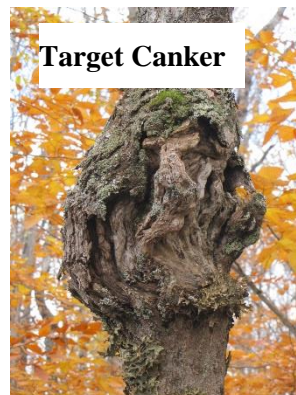
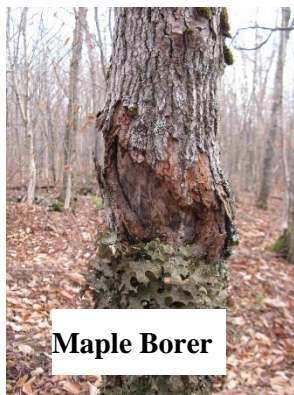
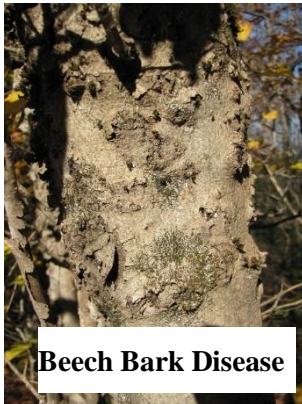
Live Crown Ratio (LCR)

## Insects/Disease

Trees affected by insects and/or diseases are considered UGS. For example, balsam fir infested with balsam woolly adelgid (BWA) is at increased risk to mortality and therefore a poor candidate for release.

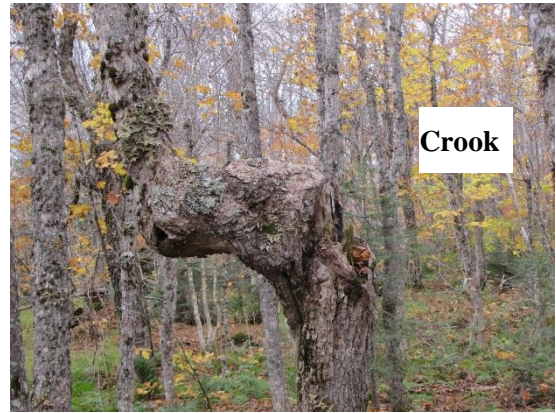
Some other common diseases and insects that would render trees UGS are:

- Sirococcus shoot blight in Red Pine,
- Bark beetle in Spruce,
- Beech Bark Disease,
- Internal stem rot evidenced by fungi fruiting bodies such as conks (frequently found on hardwoods)
- Cinder conk, severe maple borer and target canker
- Any defect with severe rot associated with it will render a tree UGS



### Poor form

Some trees have poor stem form, for example, severe crooks, sweeps, splits or forked stems. These trees will never grow a stem that is straight enough to meet the specifications for higher value products such as sawlogs or studwood. These trees are considered UGS.



### Tree Damage

Some trees are damaged either through natural occurrences or through harvesting. These defects may cause a tree to be rated as UGS. For example:

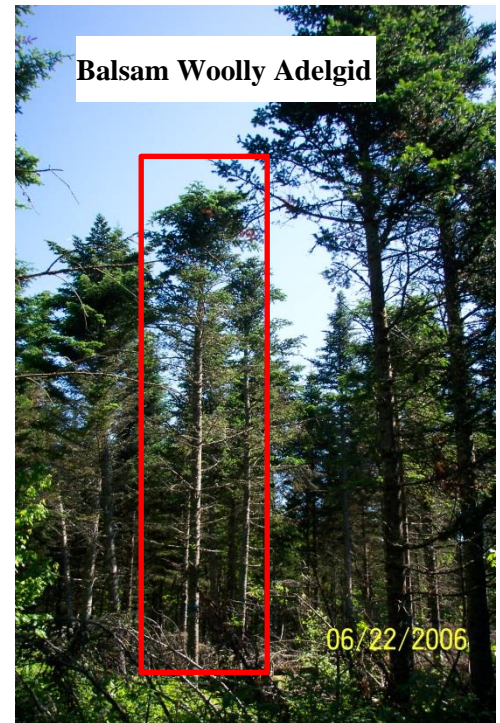


- Stem or root damage that exposes the inner bark over an area exceeding 100cm<sup>2</sup>
- Top damage that affects more than 1/3 of the live crown
- Trees with dying tops

In hardwoods, numerous small epicormic branches originating from dormant adventitious buds along the stem indicate stress and may be a sign of a defect causing a tree to be rated as UGS.

### Species

All commercial species are eligible to be graded as AGS but some non-commercial species are always considered UGS, such as (i) striped maple, (ii) pin cherry, (iii) grey birch or (iv) mountain maple. Some commercial species have characteristics that would make them more frequently graded as UGS.



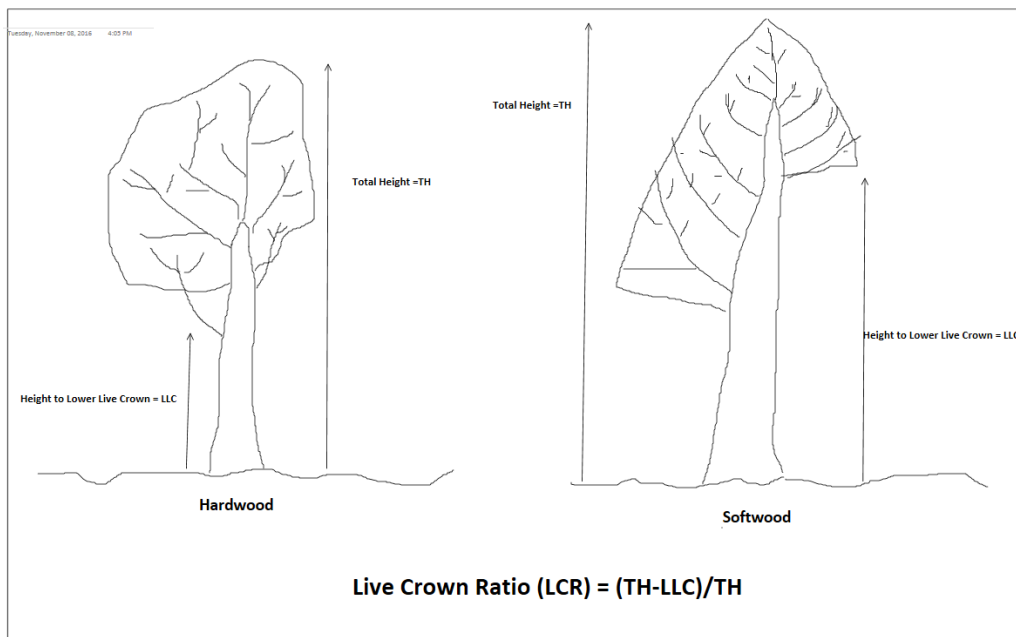
For example:

- Balsam fir is a short-lived species in Nova Scotia and is susceptible to many insects. Internal stem rot develops at an early age compared to spruce. If internal rot is indicated through increment core samples, balsam fir should be considered UGS, even when external features indicate AGS. The grader should be able to recognize signs of Balsam Woolly Adelgid (BWA), which would also cause balsam fir to be rated as UGS.
- Red maple is relatively short-lived compared to sugar maple and is also more prone to internal rot. Sugar maple has a greater ability to compartmentalize rot so that it spreads slowly. This means that a defect on red maple would more frequently result in an UGS rating compared to a similar defect in sugar maple.

Despite balsam fir and red maple being more prone to defects resulting in a UGS rating, not all balsam fir and red maple are UGS. Where healthy, vigorous trees of good form of these species exist in a stand and they are expected to maintain this state for 15 years, they are considered AGS.

## Frequently Asked Questions (FAQ)

1. There are two well-formed vigorous trees next to each other. Should I call the one I will cut in the thinning an UGS? No both trees should be rated as AGS
2. The tree I am grading has a sawlog in it now. Should I call it a AGS? Not necessarily. If you think that the tree is at risk over the next 15 years to degrade because of (for example) a broken top, rot or another defect then it should be rated UGS.
3. Are all Balsam fir trees UGS? No. Each tree should be considered based on its condition. If a balsam fir tree is healthy, vigorous, without stem-rot, or insects and has the potential to produce a piece of studwood and is forecasted to remain that way for 15 years it is considered AGS
4. Are all striped maple, mountain maple, grey birch and pin cherry UGS? Yes
5. Are all undersized trees considered UGS as they won't be sawlogs or studwood within 15 years? No. If you think that the undersized tree in question is healthy and vigorous with a LCR > 1/3 and will at some time grow a stem of sawlog or studwood size and quality, it is considered AGS.
6. The crown of one tree is intertwined with the crown of another tree. Should I call this UGS? Not necessarily. If it is healthy vigorous and well-formed and it can be released without damage it can be called an AGS.
7. Are all multiple stem trees considered UGS? Not necessarily. If both stems meet the criteria for AGS they can be rated as such. One of the stems can be rated AGS and the other UGS if one of the stems has poor form, vigour or defects that would render it UGS while the other does not.
8. If a multi-stem clump is within my plot with several stems of good form that meet all the specifications for AGS, should I tally them all as AGS? At most, tally 2 stems in a clump as AGS. If more than 2 stems in a clump meet AGS specifications, count the excess stems as UGS to avoid over-estimating the potential of the site for a Commercial Thinning or Selection Harvest.
9. A tree has a one-sided crown, should I call it UGS? In some cases, tree crowns are lopsided or one sided because they have grown in dense stands not previously spaced. In these cases, the live crown length is measured on the portion of the crown that is greater than 1/2 way around the circumference of the stem. If Live Crown Ratio (LCR) is 1/3 around more than 1/2 the stem it is AGS.
10. Where does the live crown start for determining live crown ratio? For softwoods, the live crown starts where live branches enter the stem at the point where the live crown encompasses more than 1/2 way around the circumference of the stem (see 9.) For hardwoods, the live crown starts where the lowest branch that contains the part of the main live-canopy that encompasses greater than 1/2 the circumference of the stem enters the stem.



enter the stem at the point where the live crown encompasses more than 1/2 way around the circumference of the stem (see 9.) For hardwoods, the live crown starts where the lowest branch that contains the part of the main live-canopy that encompasses greater than 1/2 the circumference of the stem enters the stem.

11. Why use a 15-year projection period? Fifteen years is used as the typical time when the next harvest is expected in Commercial Thinning or Selection harvests. In reality, the time of the next harvest should be scheduled for when the stand has grown back the wood that is removed in the harvest (or “caught-up”). This time varies with the number of trees removed (expressed as the % of Basal Area removed, %BAR) and the fertility of the site as measured by Land Capability (LC). On the very best of sites, where a relatively small percentage of the basal area (e.g. 20%) is removed, the catch up time could be as short as 10 years. On the other hand, on poor sites where a high percentage of basal area (e.g. 50%) is removed the catch-up time could be as long as 30 years. Most Softwood Thinnings are recommended for stands growing on sites of at least LC 4, typically LC 5 or greater, and removing 30 or 40 % of the basal area. If a typical LC 5 softwood stand is thinned by taking 30% of the basal area out of leave strips, approximately 15 years will be required for catch-up. This is why a 15 year projection time is used for assessing acceptability (AGS/UGS).
12. How should I grade an overmature Aspen? If you think a tree is overmature and will not maintain its sawlog quality 15 years into the future, it is considered UGS. The tree could be healthy and be alive in 15 years, but if it does not have a sawlog quality bole or will not maintain one it is UGS.
13. A tree has a major fork, should I call the tree an AGS or UGS? (i) If a tree has a fork that forms an angle of less than 45 degrees with the main stem above the fork and (ii) its diameter at the stem is greater than 1/2 the diameter of the main stem and (iii) affects more than 1/3 of the tree stem if it broke off at the fork and (iv) it has rot associated with the fork it is UGS. Trees with forks that are less severe than described but have severe rot associated with it should also be called UGS.
14. A tree is leaning, should I call it an UGS? If a tree has a lean with indications of root breakage or partial uprooting it should be called UGS. If a tree has a lean exceeding 15 degrees from vertical it should be called an UGS.
15. A tree has a crown with a partially dead or missing top should it be called an AGS. If a tree has a crown with a dead or missing top amounting to more than 1/4 of the crown it should be called UGS



## Silvics of Common Nova Scotia Trees

Knowledge of the characteristics (Silvics) of common native trees in Nova Scotia is critical in understanding how forest management activities affect regeneration, growth and succession. The PTA requires assessments of the maturity, longevity, rooting depth and shade tolerance of tree species for use in determining appropriate treatment prescriptions.

Harvests are optimally timed after they become mature and before over-maturity. Harvesting after maturity increases opportunities for natural regeneration. Tree losses are avoided if harvesting takes place before over-maturity as slow growth and increased mortality occur at this age. Shade Tolerance defines the ability of a species to regenerate from seed in shaded conditions. Tolerant and Intermediate species are successful in regenerating in partial shade, produced with shelterwood harvests, while intolerant species are not. Shade tolerance can vary according to site and development stage. For example, white spruce growing on old field sites are known to generally have a shorter life span than when growing on forest sites. White ash is known to be more tolerant early in its development and become less tolerant with age. The following Silvics table is used for PTA assessments. This table is based on the best localized silvic information available and relies on the Maritime specific Harrison guide where available and using the USDA and Farrar guides when necessary. Modifications have been made based on Nova Scotia conditions as they vary for site specific situations

<b>Table 3. Silvics of Common Nova Scotia Trees</b>							
<b>Species</b>	<b>Mature</b>	<b>Over-Mature</b>	<b>Longevity</b>	<b>Shade Tolerance</b>	<b>Rooting Depth</b>	<b>LIT</b>	<b>LT</b>
<i>Softwoods</i>							
<b>Red Spruce</b>	45	100	L	T	Shallow	<b>Yes</b>	<b>Yes</b>
<b>Eastern Hemlock</b>	50	100	L	T	Shallow	<b>Yes</b>	<b>Yes</b>
<b>White Pine</b>	50	100	L	IM	Deep	<b>Yes</b>	No
<b>White Spruce (OF, CO)</b>	40	60	M	IM	Shallow	No	No
<b>White Spruce (Other FG)</b>	60	80	L	IM	Shallow	<b>Yes</b>	No
<b>Black Spruce</b>	30	70	M	IM-T	Shallow	No	No
<b>Balsam Fir</b>	30	50	M	T	Shallow	No	No
<b>Red Pine</b>	50	70	M	I	Deep	No	No
<b>Jack Pine</b>	40	60	M	I	Deep	No	No
<b>Eastern Larch</b>	40	60	M	I	Shallow	No	No
<i>Hardwoods</i>							
<b>Sugar Maple</b>	80	100	L	T	Deep	<b>Yes</b>	<b>Yes</b>
<b>Yellow Birch</b>	70	90	L	IM	Deep	<b>Yes</b>	No
<b>White Ash</b>	50	80	L	IM-T	Deep	<b>Yes</b>	No
<b>Red Oak</b>	50	80	L	IM	Deep	<b>Yes</b>	No
<b>Red Maple (TH)</b>	40	80	L	IM-T	Shallow	<b>Yes</b>	No
<b>Red Maple (Other FG)</b>	40	60	M	IM-T	Shallow	No	No
<b>White Birch</b>	50	50	M	I	Deep	No	No
<b>Trembling Aspen</b>	30	50	M	I	Shallow	No	No
<b>Large-tooth Aspen</b>	30	50	M	I	Shallow	No	No
<p><b>Sources:</b> Harrison, MFRS; Burns and Honkala (coord.),1990. Farrar, 1995.</p> <p><b>Mature:</b> Age when trees generally reach full seed production</p> <p><b>Over-Mature:</b> Age when trees generally begin to reach senescence as evidenced by slow Catch-up and mortality.</p> <p><b>Longevity:</b> M – Moderate 50-70 years, L – Long Lived &gt;70 years</p> <p><b>Shade Tolerance:</b> I – Intolerant, IM – Intermediate, IM-T – Intermediate to Tolerant T – Tolerant</p> <p><b>LIT:</b> Long-Lived, Intermediate to Tolerant Species,</p> <p><b>LT:</b> Long-Lived, Tolerant Species</p> <p><b>White Spruce (OF, CO):</b> White Spruce in Old Field and Coastal Vegetation Types.</p> <p><b>White Spruce (Other FG):</b> White Spruce in non-Old Field and Coastal Forest Groups.</p> <p><b>Red Maple (TH):</b> Red Maple in Tolerant Hardwood vegetation types.</p> <p><b>Red Maple (Other FG):</b> Red Maple in non Tolerant Hardwood Forest Groups.</p>							

# Forest Management Guide (FMG)

The Forest Management Guide (FMG) described here uses PTA data to prescribe appropriate ecosystems-based management prescriptions.

This forest management guide has its origins in Forest Group-specific Forest Research Reports. They provide recommendations for the most common Forest Groups. Previous guides were produced for:

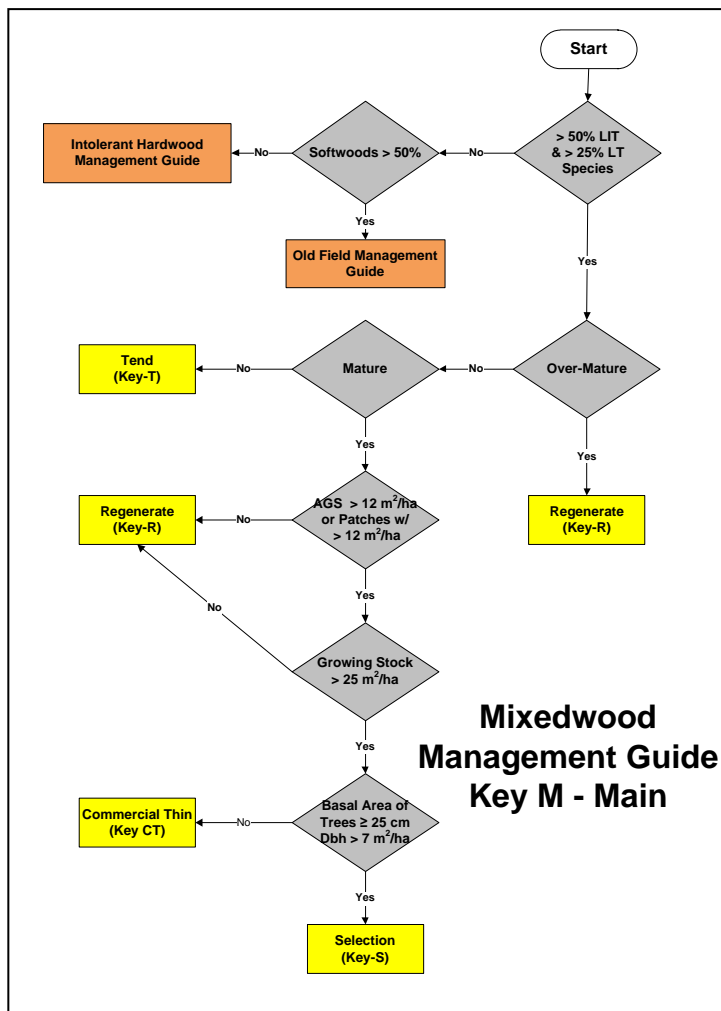
- Tolerant Hardwoods (McGrath, 2007)
- Tolerant Softwood/Mixedwoods (McGrath, 2010)
- Spruce-Pine (McGrath et al., 2015) and
- Intolerant Hardwoods (McGrath et al., 2015)

This combined FMG replaces these earlier guides. It includes updates to the original guides based on user feedback. In addition, all Forest Groups, as describe in the FEC, are included. Cedar, Coastal, Flood Plain, Highland, Karst, Old Fields, Open Woodland, Wet Coniferous and Wet Deciduous Forest Groups were added for this edition. The Tolerant Softwood/Mixedwood Guide was split into two guides; one on the Mixedwood and the other covering the Spruce Hemlock Forest Group.

## Use of the Keys

The FMG includes a series of decision keys that are used to reach a recommended prescription. A different set of keys apply to each Forest Group defined in the FEC. Initially, the FEC Forest Group that best describes most of the stand under consideration must be determined. The Main key for that group is used to start the assessment of the appropriate treatment. The user (or PTA computer program) advances through the keys by answering questions (indicated by grey diamonds) with information collected in the PTA. For yes/no questions, the “yes” response causes the user to proceed down through the keys, while a “no” response causes the user to proceed sideways through the keys. Eventually a management prescription is reached (green rectangle) or the user is referred to another sub-key (yellow rectangle) for further evaluation. If a sub-key is indicated, it is followed until arriving at a prescription or a recommendation to wait and re-evaluate later (Let it grow, red rectangle). In some cases, the user is directed to another Management Guide (brown rectangle). The guide is formatted so that descriptions of the items in the keys are included on facing pages. Short descriptions of the treatments are also included on these facing pages. Detailed descriptions are discussed under the following section.

For some Forest Groups, such as the Cedar group, harvesting is not recommended and no management keys are presented due to their unique characteristics. In these cases, a short description of the Group is included with the reason for not recommending harvesting.



management keys are presented due to their unique characteristics. In these cases, a short description of the Group is included with the reason for not recommending harvesting.



# Management Prescriptions

This guide recommends a variety of management prescriptions. The keys include glossaries with short descriptions of these prescriptions. This section provides more details concerning these prescriptions.

## Selection Management

Selection Management is an uneven-aged system where the intention is to keep a mature overstory at all points in its life, while promoting or developing at least three age classes. Different spatial arrangements of these age classes (separated by at least 20% of the rotation age) can be created in this system. Where the age classes are spread uniformly, intermixed on the same ground, this is called Individual Tree Selection. Where the different age classes consist of separate small patches of the same age; this system is called a Group Selection. Care must be taken to improve the stand at every harvest, avoiding degradation of the stand by removing high-quality trees, while leaving low-quality trees. This is termed High-Grading (or Selective harvesting) and does not qualify as a Selection harvest. To insure the effectiveness of Selection management, it is required that the proportion of Acceptable Growing Stock (AGS) and the long-lived intermediate to tolerant species (**LIT**, Table 3) and long-lived tolerant (**LT**, Table 3) content be increased.



- **Individual Tree Selection** — Different age classes are uniformly mixed spatially throughout the stand. At each harvest, the intention is to create another age class in the shade of the overstory. This method is suited to Shade Tolerant species adapted to regenerating under shade. At the same time, over-mature or low-quality stems are removed. This results in an improvement in the growth and quality of the remaining trees and subsequent value. The goal is to produce high-quality stems of high-value. When using this system, 30% of the basal area is to be removed from leave strips to encourage regeneration of shade tolerant species such as red spruce, sugar maple and eastern hemlock.

- **Group Selection** – When a stand is relatively patchy; with immature patches that have not reached their full potential, while in other areas, patches of overmature or low-quality stems occur, a group selection may be the appropriate selection method. Small even-aged patches can be created of a size that meets silvical requirements for the species desired. The location of these patches must be selected based on the conditions and distributed throughout the stand. For example, overmature or low-quality patches could be removed to be regenerated, while immature patches of high-quality will be left. The size



of these openings will be selected based on the shade tolerance of the species desired (see keys). Larger openings are suited to regenerate intermediate shade tolerant species such as yellow birch, red oak, white pine, white spruce and white ash, while smaller openings are suited to regenerate shade tolerant species such as red spruce, eastern hemlock and sugar maple. When using the Group Selection system, the growth and quality of the trees in the leave areas can be improved by using crop tree release, precommercial thinning or commercial thinning. The intention of the Group Selection treatment is to create more than three age classes separated by more than 20% of the rotation age. The last set of mature patches are to be harvested when the initial harvested patches become mature.

### Post Treatment Criteria

- 90% of residual stand basal area must not have damage to boles (trees with exposed cambium exceeding 100 cm<sup>2</sup> resulting from harvest) or crowns (greater than 1/4 of crown damaged by harvest activities).
- The Percent (by basal area) of **AGS**, Long-lived Intermediate to Tolerant (**LIT**, Table 3) on Silvics) and Long-lived Tolerant (**LT**, Table 3) species must be greater following treatment.
- The Basal Area removed from leave areas (excluding trails) in a single tree selection must not exceed 30%.
- When a group selection is utilized, less than 30% of the area in patches plus percentage removed from the leave areas (excluding trails). For example, 20% of the area can be removed in patches and 10% of the basal area from the leave area.

## Tending

- **Crop Tree Release** – A crop tree release is mainly a tending operation, where a few quality trees (AGS) with potential for high-value are released while the rest of the stand is left un-tended.

It is especially effective where there are a few high-value potential trees in a stand that is dominated by stems without high-value potential. Investment in this pre-commercial treatment concentrates on releasing stems with the best potential return on investment. This treatment is relevant where there is a high-value market for large trees of good stem quality. For example, a sugar maple tree that is too small to meet minimum specifications for a high-value sawlog, but has a clear bole of sawlog length without defects and has good vigor and crown structure, will give high return by investing in its release. It is important to limit the number of trees released to only the best quality trees at a minimum



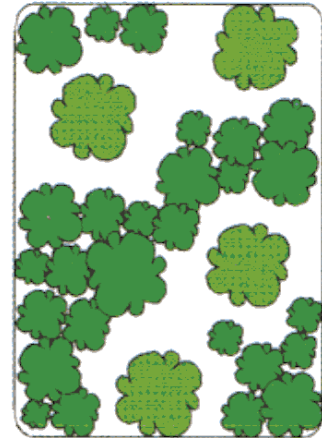
spacing (10 m) between released trees.

Since the objective is to produce large trees of high-quality and value, they need space to grow to the size necessary to meet log specifications. If too many trees are released, some will have to be cut later to release other higher quality trees to make growing room, wasting the initial investment. The crop trees should be released on at least 3 sides to maximize diameter growth. To avoid exposure damage, trees on the south facing side of the crop tree can be left. The release should only cut trees that are overtopping the crop tree or have their crowns touching the crowns of crop trees. If a tree is below the canopy or its crown does not touch the crop tree it should be left standing. In some cases, two high-quality trees are growing next to each other. The combined crowns of these trees can be considered as one crown and released on all sides. This will result in a three-sided release.

Ideally trees in the 15-20 cm Dbh class should be released. If trees are released at an earlier stage, branching may be encouraged, lowering quality and potential value. At this stage of development, risk to damaging agents is higher. When released later in development, response rates are lower.

This treatment will result in areas with small holes in the canopy formed by releasing crop trees, interspersed with unthinned areas. Some lower quality merchantable-sized trees of relative low value may have to be cut to release the crop trees. These trees should only be removed if this can be done without damaging the crop trees, as the main objective for this treatment is to release the trees with the highest potential. The crop trees must be vigorous, of good form and have high-value potential. Crop trees should be self-pruned for at least the length of one sawlog or be manually pruned. Avoid pruning in the same year as the release treatment to prevent epicormic branching.

- **Pre-commercial Thinning (PCT)** – A pre-commercial thinning is a treatment where the better-quality trees of preferred-species are spaced by cutting lower quality stems to accelerate diameter growth and improve stand composition. This treatment is performed when the stand is un-merchantable.



Cut stems are left on site to leave nutrients for the leave trees. If carried out effectively the stands treated with PCT can reach merchantable size earlier, thereby increasing the Mean Annual Increment of merchantable volume (GNY model:

<http://novascotia.ca/natr/forestry/programs/timberman/growthyield.asp>). Stand succession can be influenced by favouring tolerant species and moving stands towards later successional Vegetation Types (Neily *et al.* 2013). It is prescribed where high levels of AGS exist uniformly distributed throughout the



stand (on average at least every 3 m). The spacing of the trees left as future crop trees should be at least 1.8 metres but not more than 2.4 metres apart. The selection of the appropriate spacing and timing of the PCT treatment depends on the species and the anticipated future management scenario for the stand.

If softwood stands are spaced to less than 1.8 metre spacing, natural mortality due to crowding of released trees will occur before the stems become merchantable size. If softwoods are spaced wider than 2.4 metres apart, excessive branching will occur and wood quality degraded. When Commercial Thinning (CT) is anticipated as a follow-up treatment to the PCT, the wider spacings are preferred to improve the piece size and economic feasibility of the CT treatment. If it is anticipated that the stand will be clearcut and not CT the narrow spacing may be preferred to minimize rotation age. In terms of PCT timing, to maximize the growth returns from softwoods, early PCT's are most effective. In general, softwood PCT's should be performed when the crop trees are between 2 and 6 metres tall. If done earlier, crop tree selection is difficult, but when done too late, growth response and thinning productivity is lower. Care must be taken when releasing softwoods, to favour preferred species, even when they are shorter than less-preferred competing species. This is especially true in fir/spruce stands as the fir is often dominant over spruce but the spruce has better long-term growth and value potential. Care must also be taken when releasing quality softwood from low-quality vigorous red maple



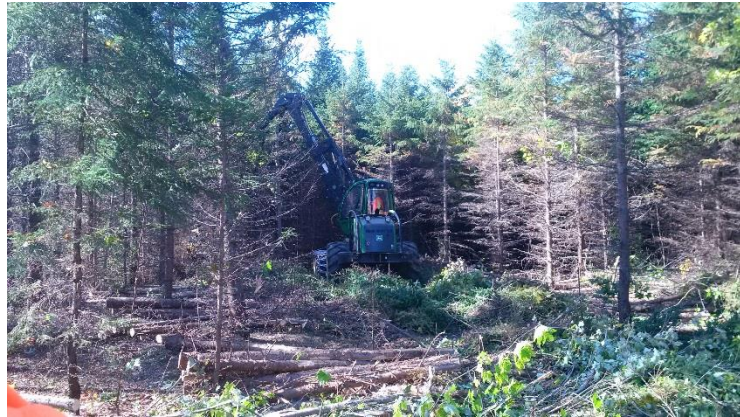
sprouts. In this case, the thinning may be more effective when carried out later (6 m) as the red maple clumps will re-sprout and overtake crop trees unless controlled. It is also prudent to leave a couple of weak stems in the clumps to reduce re-sprouting. The crop trees left should be high-quality trees of preferred species. Care should be taken to maintain tree species diversity when carrying out this treatment. See the FEC (Neily *et al.* 2013) for guidance on natural species diversity.

For hardwoods, spacing should be 2.4 metres, as released trees require a growing space of 2.4 metres to reach an average diameter (at breast height) of 15 cm before self-thinning occurs. It is especially important to limit PCT spacing to 2.4 metres in hardwoods when the goal is to produce sawlogs as a future product. Wider spacings produce increased branching and more defects. Pre-commercial thinning hardwoods should occur later than for softwoods, as branching has a larger potential impact on future value, due to the stimulation of branching. Hardwoods should be thinned when between 6 and 9 metres tall.



**Commercial Thinning (CT)** – This goal of this treatment is to harvest commercial trees, while improving the growth, quality and species content of the leave trees for harvesting at a future date.

It is recommended where high levels of uniformly distributed AGS and adequate merchantable basal area exist. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long-lived species to accelerate their growth. The objective of this treatment is not to regenerate the stand but to improve the growth and species mix of leave trees. It can result in higher yields of quality products, with an increased piece size and harvesting efficiency. It also can be used as a tool to influence stand succession to favour high-quality later successional species and later successional vegetation types.



The leave trees should be left until the stand grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips on average sites. Care should be taken to release trees throughout the stand. Limited



release is achieved from the extraction trails, therefore trees left in the leave strips should be thinned to maximize the benefit of the treatment. Care must be taken to limit stem, root and crown damage when harvesting and extracting trees. It is also important to minimize trail width and maximize leave-strip width within the limits of the harvesting and extraction equipment used. Root and soil damage can be minimized by using brush mats on extraction trails. At least 30% of the basal area must be taken from the leave strips to achieve sufficient release of future crop trees.

The best opportunities for Commercial Thinning occur on more productive ecosites with average to high Land Capabilities (LC 4+ softwoods LC 2+ hardwoods; NSDNR, 1993). Response times will be quicker and the time for the volume removed to be replaced through growth to be reduced. Stand age also affects commercial thinning response, especially in shorter-lived species. For example, it is not recommended to commercially thin black spruce when it is over 50 years old.



When performing Commercial Thinning in stands that were previously Pre-Commercially Thinned or Planted, special care is required in timing Commercial Thinning treatments. Commercial Thinning too early will result in increased costs, amounts of low-quality products and lower volumes. A late Commercial Thinning will result in dense, slow growth and low live crown ratios that will negatively impact the response of a stand. To obtain estimates of optimum timing of commercial thinnings and predicted response times and growth results refer to the Forestry Field Handbook (NSDNR, 1993)

- **Pruning** - Pruning is best applied to those species that have a high economic return through the production of knot free lumber and veneer. The pruning of sugar maple, yellow birch, red oak and white pine is a viable management option where high-value tolerant hardwood or white pine can be grown. Only healthy trees with high-value potential should be pruned. The number of trees released should be limited to only trees with the highest potential for high-value products exceeding 15 cm in Dbh. No more than one tree should be pruned every 10 metres. Release of these trees should also be considered to accelerate their growth to reach merchantable sizes. Trees should not be pruned and released in the same year.



## Natural Regeneration

Natural regeneration is an ecologically acceptable and economically viable way to reforest harvested stands. If there is not enough advanced natural regeneration established at the time of harvest, seed trees can be left or a shelterwood can be prescribed.

- **Overstory Removal (stocked)** – This is a regeneration treatment that removes the mature overstory to release existing regeneration where sufficient established acceptable regeneration exists. Harvesting activities must protect the preferred advanced regeneration. Where sufficient stocking of trees exists throughout the stand of trees exceeding breast-height this is considered a **Final Felling**.

- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. See the “Artificial Regeneration” section for plantation recommendations.



- **Overstory Removal & Weed** – This is a regeneration treatment, prescribed where sufficient regeneration of acceptable and established regeneration is present and high levels of red maple sprout and/or aspen suckering competition is anticipated. Harvesting activities must protect the preferred advanced regeneration. The overstory is removed and the site weeded to remove competing species to insure successful establishment of preferred regeneration.
- **Shelterwood Harvest** – This system can be used to thin a stand to produce light conditions suited for regenerating desired species, when existing adequate stocking of established and acceptable regeneration does not exist. Shelterwood harvesting systems may be applied in a uniform manner over the stand or arranged in strips or patches. Where high windthrow hazards occur Shelterwoods generally are not recommended. This is an even-aged regeneration technique. At minimum, it includes at least one partial removal of the overstory to create conditions for regeneration and then a final overstory removal when sufficient established regeneration exists. More than one partial harvest may be required to create conditions suited for establishing sufficient stocking or to protect the quality of regeneration. For example, where regeneration of high-quality white pine is desired where white pine weevil infestations are common, shade may have to be left until regeneration reaches over 10 metres tall. Scarification may aid in the regeneration of species such as yellow birch and pine.

- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for regeneration of desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from the leave strips when regenerating shade tolerant species (sugar maple, red spruce or eastern hemlock). If regenerating intermediate shade tolerant species such as yellow birch, white ash, red oak or white pine, 40% of the basal area should be removed from the leave strips. This treatment can be used to increase the proportion of long-lived or shade tolerant species and move the stand towards later successional vegetation types. The stand should be assessed 5 years after the shelterwood. If sufficient established regeneration exists, an overstory removal is recommended. If adequate regeneration has not been realized after 10 years, another shelterwood treatment should be considered.



- **Patch Shelterwood** – In some cases Uniform Shelterwoods are not possible because of the shallow rooting nature of the species (e.g. black spruce) to be regenerated or because of rugged ground conditions or windthrow risk. In these cases, it may be more suited to regenerate stands using small patches to increase wind firmness or allow access. For species, such as black spruce, small openings from 0.04-0.1 hectares are required. Where intermediate shade tolerant and deep rooted species such as white pine are regenerated, larger openings should be used (0.1-.15 hectares). This system should not be used with heavy seed species such as red oak. This Patch Shelterwood system is distinguished from a group selection in that the patches are uniformly distributed throughout the site and the overstory is removed over a relatively shorter period. Typically, 5 years (or when the previous patches are regenerated) separates the series of patch harvest, with the entire overstory removed in less than 20% of the rotation age, forming an even-aged stand.



- **Strip Shelterwood** - In some cases Uniform Shelterwoods are not possible because of the shallow rooting nature of the species (black spruce) to be regenerated or because of rugged ground conditions or windthrow hazard. In these cases, it may be more suited to regenerate stands using narrow strips to increase wind firmness or allow access. For species, such as black spruce, strips equal to one tree height in width is recommended. Where intermediate shade tolerant and deep rooted species such as white pine are regenerated, strips 2 tree heights in width is recommended. This system should not be used with heavy seed species such as red oak. This system results in an even-aged stand as the stand is harvested in a series of strips separated by a relatively short period of time; typically, every 5 years or when the previous harvested strip is regenerated. Two to three passes are usually used in this system to harvest the mature forest. This system can be used in conjunction

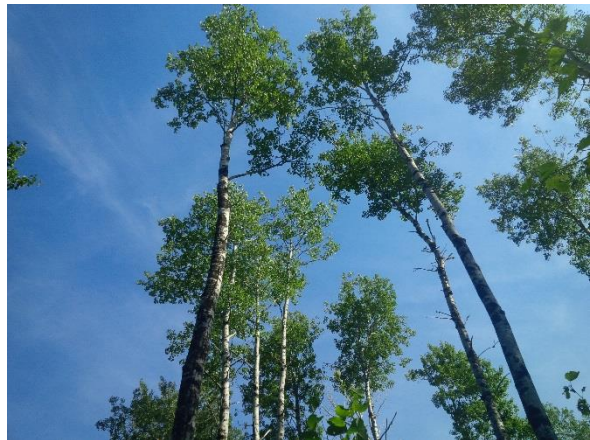


with a thinning on the side of the strips to insure regeneration of the entire area and minimizing damage to regeneration produced previously.

- **Restoration Shelterwood** - A uniform shelterwood treatment whose purpose is to move a stand dominated by intolerant or short-lived species to a later-successional stage dominated by more shade tolerant later successional species.

This treatment is suited to stands with sufficient seed source or advanced regeneration of long-lived intermediate to tolerant species (LIT, Table 3). The choice of whether to use the restoration shelterwood option when conditions justify it, depends on an evaluation of the landscape within which the stand is located, its condition and management objectives. For, example an area (Eco-District) may be deficient in late successional vegetation types. The Ecological Land Classification (ELC; NSDNR, 2006) forms the basis for classifying the landscapes in Nova Scotia. Removal levels are to be limited to 30% of the basal area of leave strips (excluding trails) to create shade conditions suited to more shade tolerant species.

Some Vegetation Types (Neily *et al.*, 2013), dominated by intolerant or shorter lived species<sup>A</sup>, are early successional types with the potential to move towards their naturally occurring later successional version dominated by Long-lived Intermediate to Tolerant Species (LIT, Table 3). This process can be accelerated using a uniform restoration shelterwood. Table 4 (extracted from Neily *et al.* 2013) shows the possible successional links for vegetation types dominated by shorter-lived or intolerant-medium tolerant species. For example, a stand classified as IH3 (Intolerant Hardwood - Large-tooth aspen/Christmas fern-New York fern) has the potential to move towards TH3 (Tolerant Hardwood - Sugar maple-White ash/Christmas fern). The ability to move from IH3 to TH3 through partial harvesting, depends on several stand characteristics, such as, the presence of seed source trees or advanced regeneration of later successional species (e.g. sugar maple).



The IH and Old Field (OF) forest management guides define stand conditions that indicate whether a forest manager could be successful in restoring these later successional species using restoration shelterwoods.

The Ecological Land Classification (ELC; NSDNR, 2006) forms the basis for classifying the landscapes in Nova Scotia. In some cases, it may be more appropriate to maintain an Intolerant Hardwood stand's early successional stage even when restoration is possible. The choice of whether to restore, will impact the harvesting methods chosen. In our IH3 example, early successional Large-tooth aspen trees

would likely occupy the site after clearcutting due to the species' ability to regenerate by suckering in open conditions. If restoration was preferred and adequate amounts of later-successional seed-source trees or regeneration exist, a restoration shelterwood treatment may be effective in moving the stand towards its later successional stage. It should be noted that other methods could be used to restore later successional species. For example, an IH3 stand could be restored to a mid-successional SH-5 Red spruce-Balsam fir /Schreber's moss by clearcutting, planting red spruce and weeding the suckering Large-tooth aspen where herbicides are available for use.

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<sup>A</sup> rM (non-TH stands), bF, tA, ItA, eL, jP, bS, bP, rP, wS (Old Field and Coastal Forest Groups), wB



The Intolerant Hardwood (IH) and Old-Field (OF) management keys explicitly ask whether restoration of Long-Lived Intermediate to Tolerant (LIT, Table 3) species is the management objective. The Tolerant Hardwood (TH), Spruce Hemlock (SH) and Mixedwood (MW) stands are also considered for Restoration Shelterwoods in situations where Long-lived Intermediate to Tolerant species (LIT, Table 3) are deficient. This is implemented in the FMG by reference to the OF or IH keys from the TH, SH and MW keys. Depending on the user's response to this question, a restoration shelterwood may be recommended (Key R). In situations where the overstory is already dominated by Long-Lived Intermediate to Tolerant species, traditional shelterwood treatments are recommended to maintain later successional vegetation types in situations where advanced regeneration is not already present.

**Table 4. Successional Links for the Vegetation Types Dominated by Short Lived or Intolerant to Medium Shade Tolerance Species (Neily et al., 2013).**

Vegetation Type	Dominant Species	Successional Stage		
		Early	Mid	Late
<b>IH1</b>	Large-tooth aspen	<b>IH1,IH2</b>	SP6	SH4,SP9
<b>IH2</b>	Red oak	<b>IH1,IH2</b>	SP4	SH4,SP9
<b>IH3</b>	Large-tooth aspen	<b>IH3,IH4,IH5,IH6</b>	IH7,MW2,MW4,SH5,SH6,SH7,SH8	MW1,MW3,SH1,SH2,SH3,TH1,TH2,TH3,TH4,TH6,TH8
<b>IH4</b>	Trembling aspen	<b>IH4</b>	IH7,MW2,MW4,SH5,SH6,SH7,SH8,SH9,SH10	MW1,MW3,SH1,SH2,SH3,SH4,TH6,TH8
<b>IH5</b>	Trembling aspen	<b>IH5,MW5</b>	IH7,MW4,SH5,SH6,SH7,SH8	MW1,MW3,SH3,SH4,TH1,TH2,TH3,TH4,TH8
<b>IH6</b>	White Birch	<b>IH6</b>	IH7,MW2,SH5,SH6,SH7,SH8,SH9,SH10	MW1,MW3,SH1,SH2,SH3,SH4,TH1,TH2,TH3,TH6,TH8
<b>IH7</b>	Red Maple	IH3,IH4,IH5,IH6	<b>IH7,TH7</b>	MW1,TH1,TH2,TH3,TH6,TH8
<b>MW4</b>	Red Maple	IH4,IH5	MW2,MW4,SH5,SH6,SH7,SH10,TH7	MW1,MW3,SH1,SH2,SH3,SH4
<b>MW5</b>	White Birch	IH5,MW5	MW2,SH5,SH6,SH8,SH10,TH7	MW1,MW3,SH1,SH2,SH3,SH4
<b>OF1</b>	White spruce	<b>OF1</b>	OF4, IH1-7	TH1,TH2
<b>OF2</b>	Tamarack	<b>OF2</b>	OF4,OF5,IH1-7, MW4	MW1
<b>OF3</b>	White Pine	<b>OF3</b>	<b>OF3,OF4,SH1-7</b>	MW3
<b>OF4</b>	Balsam fir	OF1,OF2,OF3, <b>OF4</b>	<b>OF4</b>	TH1,TH2,MW1,MW3
<b>OF5</b>	Trembling aspen	<b>OF5</b>	<b>OF4</b>	TH1,TH2,MW1,MW3
<b>SH8</b>	Balsam fir	IH3,IH4,IH5,IH6,MW5	SH5,SH6,SH7, <b>SH8</b> ,SH10	MW1,MW3,SH1,SH2,SH3,SH4
<b>SH9</b>	Balsam fir	IH4,IH6	<b>SH9</b> ,SP4	SH4,SP5
<b>SH10</b>	White spruce	IH4,IH6,MW4, MW5	SH8, <b>SH10</b> ,TH7	MW1,MW3,TH8

- **Seed tree harvest** – Regenerate a stand to intolerant or intermediate shade tolerant species by leaving wind-firm, well-formed, mature seed trees



uniformly distributed through a stand. These trees are left to provide a seed source for regenerating desired tree species. Limited shade is provided by this treatment and therefore is used to regenerate species that are adapted to growing in non-shaded conditions

For regenerating white or red pine, leave 15-35 trees/ha. Leave 8-15 trees/ha for regenerating yellow birch. Regenerating species such as spruce, hemlock, fir and jack pine are not recommended using the seed tree method due to their shallow rooting and windthrow risk. Species such as red oak have heavy seed not disseminated by wind. Use of a Seed Tree system to regenerate oak is not recommended. Pine species and yellow birch regenerate

best on exposed mineral soil. The creation of mineral soil seedbeds can be achieved with scarification during or after harvesting to create conditions suited to these species.

## Artificial Regeneration (Reforestation)

Reforestation is the planting of tree seedlings for areas without adequate stocking after harvesting.

Planting is recommended if after two growing seasons, adequate regeneration has not established after an overstory removal. This two-year delay period provides two possible benefits (i) The wait could result in adequate regeneration becoming established and (ii) Debarking weevil hazard is reduced.

Where severe competition is anticipated, in areas where damage to debarking weevil is expected to be low and competition control with herbicides is not an option, hot planting may be the best choice to ensure successful regeneration.



Some sites have thick forest floors which dry out after an overstory removal causing seedling mortality if the roots of the seedlings are not rooted in mineral soil. The use of site preparation equipment can be used to reduce the thickness of the forest floor creating plantable microsites.

It is imperative to maintain plantations, once established, to insure adequate survival and growth. On some sites weeding is required to prevent competition such as raspberry or coppice growth from overtopping planted seedlings. A spacing may also be required when ingrowth of non-crop species such as balsam fir crowd planted-seedlings, limiting growth of plantations.

To match naturally occurring species with a given Ecosite refer to Table 5 “Species Planting Recommendations by Ecosite”. In some cases, reforestation by planting is not recommended due to poor site conditions, resulting in slow growth rates and limited return for the cost of plantation establishment. Some species should be planted in Nova Scotia with extreme caution, such as white pine and red pine. White pine frequently is infested with white pine weevil when regenerated in the open, resulting in multiple tops and crooked stems with low potential for sawlogs. Sirococcus shoot blight is common in Nova Scotia and frequently kills red pine plantations.

For a plantation to be successful adequate stocking must be maintained and the seedlings must be free from competition.

Planting in mineral soil micro-sites can reduce debarking weevil damage. Site preparation to produce these micro-sites may be necessary in situations where debarking weevil damage is expected.

Competition from non-crop species is often a concern with this method. For example, some sites have moderate to high levels of competition due to herbs (e.g. bracken fern) and ericaceous species which can impede regeneration. Site preparation can be used to increase planting opportunity and success.



**Table 5. Species Planting Recommendations by Ecosite (Neily et. al. 2013). Refer to Forestry Field Handbook (NSDNR, 1993) for hazard identifications and recommendations.**

Ecosite	Moisture	Nutrient Regime	Climax Species	Rec. Species***	Rec. Timber Mgmt*
AC1	Dry	Very Poor	jP, bS, wP	bS, jP, wP	No
AC2	Fresh	Very Poor	bS, wP	bS, wP, jP, rP**	No
AC3	Moist	Very Poor	bS, wP	bS, wP, jP, rP**	No
AC4	Wet	Very Poor	bS, eL	bS, eL	No
AC5	Dry	Poor	wP, rO	wP	No
AC6	Fresh	Poor	bS, wP	bS, wP, jP, rP**	Yes
AC7	Moist	Poor	bS, wP	bS, wP, rP**	Yes
AC8	Wet	Poor	rS, bF, rM	bS	No
AC9	Dry	Medium	rM, rS	rS	Yes
AC10	Fresh	Medium	rS, eH	rS, wS	Yes
AC11	Moist	Medium	rS, Yb	rS, wS	Yes
AC12	Wet	Medium	rM, wA, bF	bS, eL	No
AC13	Fresh	Rich	sM, aB, wS	wS, rS	Yes
AC14	Moist	Rich	sM, yB, wS	wS, rS	Yes
AC15	Wet	Rich	wA, rM, wS	bS, eL	No
AC16	Fresh	Very Rich	sM, wA, wS, rS	wS, rS	No
AC17	Moist	Very Rich	sM, wA, wS, rS	wS, rS	No
MB1	Dry	Poor	bS, wS, bF, jP	bS, wS	No
MB2	Fresh	Poor	bS	bS	Yes
MB3	Moist	Poor	bS	bS	Yes
MB4	Wet	Poor	bS	bS	No
MB5	Fresh	Medium	bF, wS	wS	Yes
MB6	Moist	Medium	bF, wS	wS	Yes
MB7	Wet	Medium	rM	bS	No
MB8	Fresh	Rich	rM, wB (coastal) yB, bF (highlands)	wS	Yes
MB9	Moist	Rich	rM, wB (coastal) yB, bF (highlands)	wS	Yes
MB10	Wet	Rich	rM	bS	No
MB11	Fresh-Moist	Very Rich	rM, wB (coastal) yB, bF (highlands)	wS	Yes

\* Recommended for planting when timber management is the main objective and where conditions warrant.

\*\* Red Pine should be planted with caution. Where Sirococcus is known to occur, do not plant red pine. Only plant stock from local seed sources.

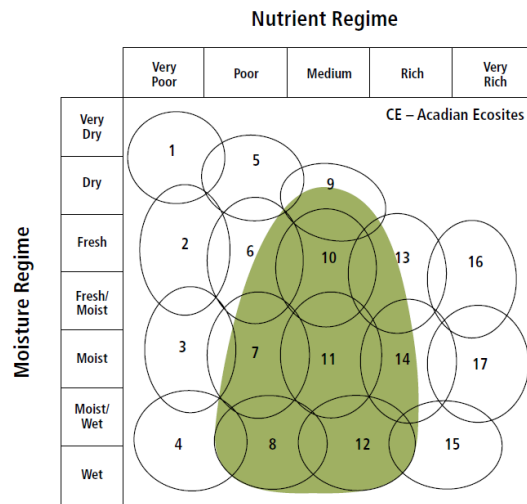
\*\*\*aB = American Beech, bF = Balsam Fir, bS = Black Spruce, eL = Eastern Larch, jP = Jack Pine, rM = red Maple, rO = Red Oak, rP = Red Pine, rS = Red Spruce, sM = Sugar Maple, wA = White Ash, wB = White Birch, wP = White Pine, wS = White Spruce, yB = Yellow Birch

# Cedar (CE) Management Guide

## Forest Group Characteristics

The Cedar Forest Group (CE) includes any stand where cedar occurs (excluding ornamental escapees). This Forest Group is rare and cedar are legally protected. Cedar is listed as a vulnerable species under the Nova Scotia Endangered Species Act (NS statutes 2010). Cedar stands are usually small patches and rarely exceed 1 hectare in size (Neily et al., 2013).

These vegetation types cover a wide range of moisture regimes from dry to wet and mainly are medium in fertility. Wet Cedar types are more common than those growing in drier conditions.



## Management Considerations

Harvesting of Cedar in Nova Scotia is not recommended due to its “vulnerable” status.

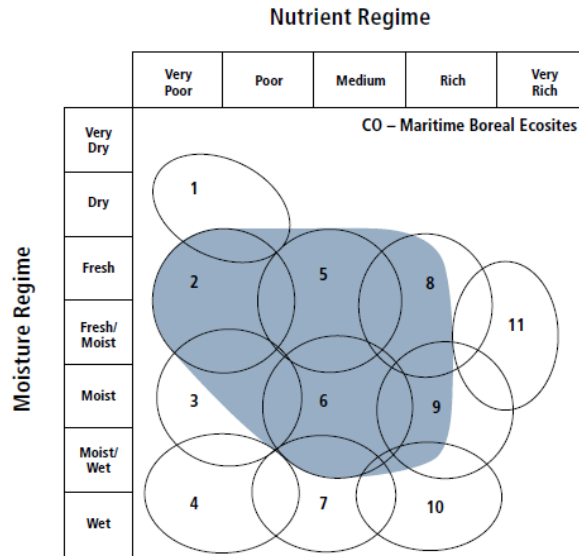


# Coastal (CO) Management Guide

## Forest Group Characteristics

Coastal (CO) vegetation types occur on a range of sites (very poor to rich) and moisture regimes (fresh-moist), but all are characterized by exposure to winds from either the Atlantic or Bay of Fundy coasts (Neily et al., 2013). This Forest group occurs in the Maritime Boreal ecosite group with significant coastal influences, such as high winds, salt spray and elevated humidity and fog.

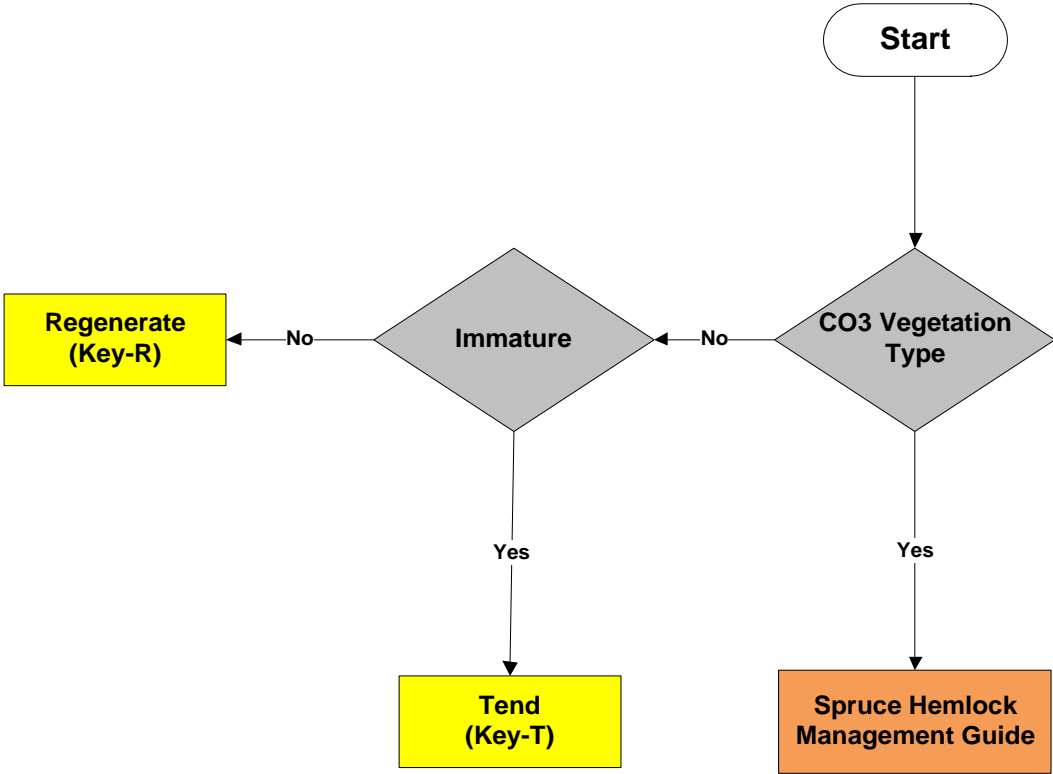
Coastal vegetation types are usually dominated by softwoods, most frequently white spruce, balsam fir or black spruce. On the more sheltered sites farther inland, red spruce, white birch or red maple may occur. Coastal vegetation types are usually even-aged and frequent windthrow or insect infestations occur. Long-lived, Intermediate-Tolerant species do not frequently occur in these vegetation types.



## Management Considerations

Most Coastal vegetation types are limited in height growth due to high winds. The coastal conditions also tend to produce even-aged stands due to the high incidence of winds and frequent storms. Hardwoods and long-lived shade tolerant species such as hemlock and sugar maple rarely occur with the exception of the Red spruce / Mountain-ash / Foxberry vegetation type (CO-3) occurring on the Bay of Fundy Coast. Frequently, dense tree-regeneration of softwoods exists in mature stands. This regeneration is usually dominated by balsam fir. In the most exposed types within this group, cover is sparse or tree height severely stunted making them inoperable for harvesting.

# Coastal Management Guide Key M - Main





## **KEY CO-M – Main**

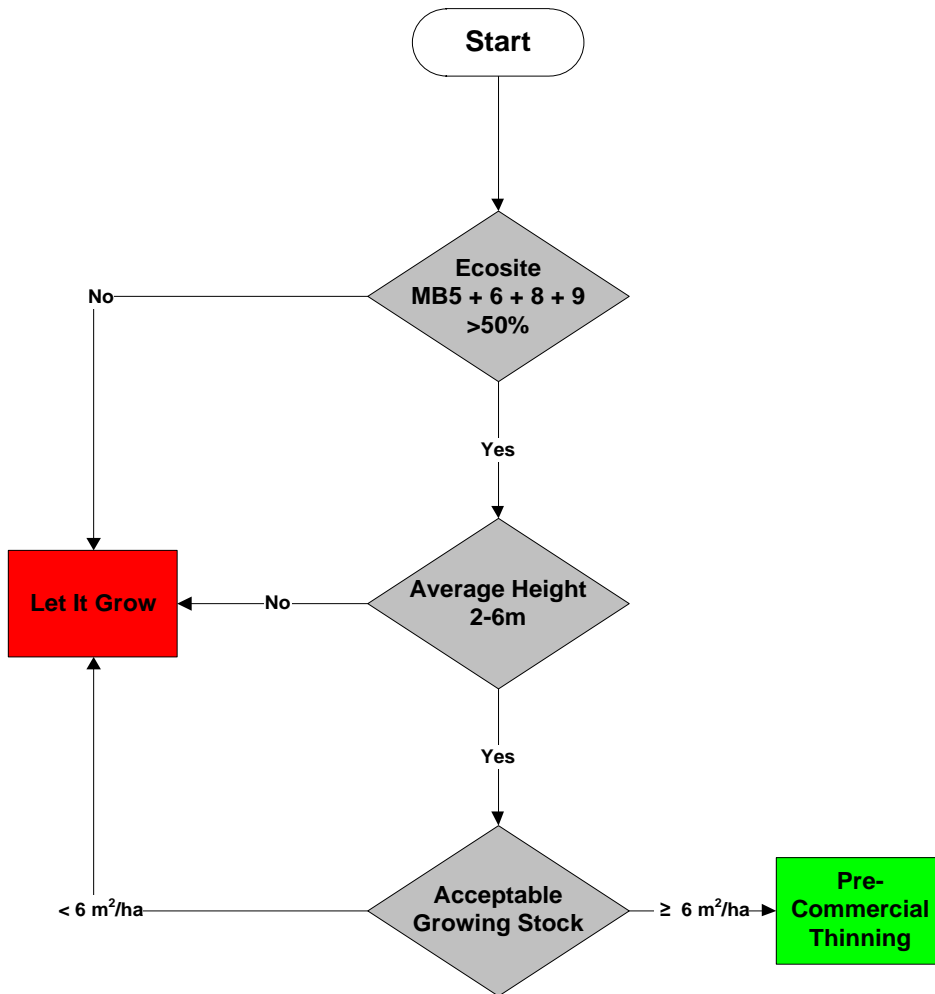
### **Instructions and Definitions for:**

#### **Decision Diamonds**

- **CO3 Vegetation Type** – Is the vegetation type Coastal 3 – Red spruce/Mountain ash/Foxberry (Neily et al., 2013)?
- **Immature** – Is the overstory predominantly immature (Table 3)?

# Coastal Management Guide

## Sub-Key T - Tend



## SUB-KEY CO-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Ecosite MB5 + 6 + 8 + 9 > 50%** –Does the stand area consist of more than 50% Maritime Boreal Ecosites 5, 6, 8, and 9 combined (Neily et al., 2013)?
- **Average Height 2-6m** – Is the average height of the stand between 2 and 6 m?
- **Acceptable Growing Stock** – What is the basal area in m<sup>2</sup>/ha of **Acceptable Growing Stock (AGS<sup>B</sup>)**? Is it less than 6 m<sup>2</sup>/ha, or greater than or equal to 6 m<sup>2</sup>/ha?

#### Management Prescriptions

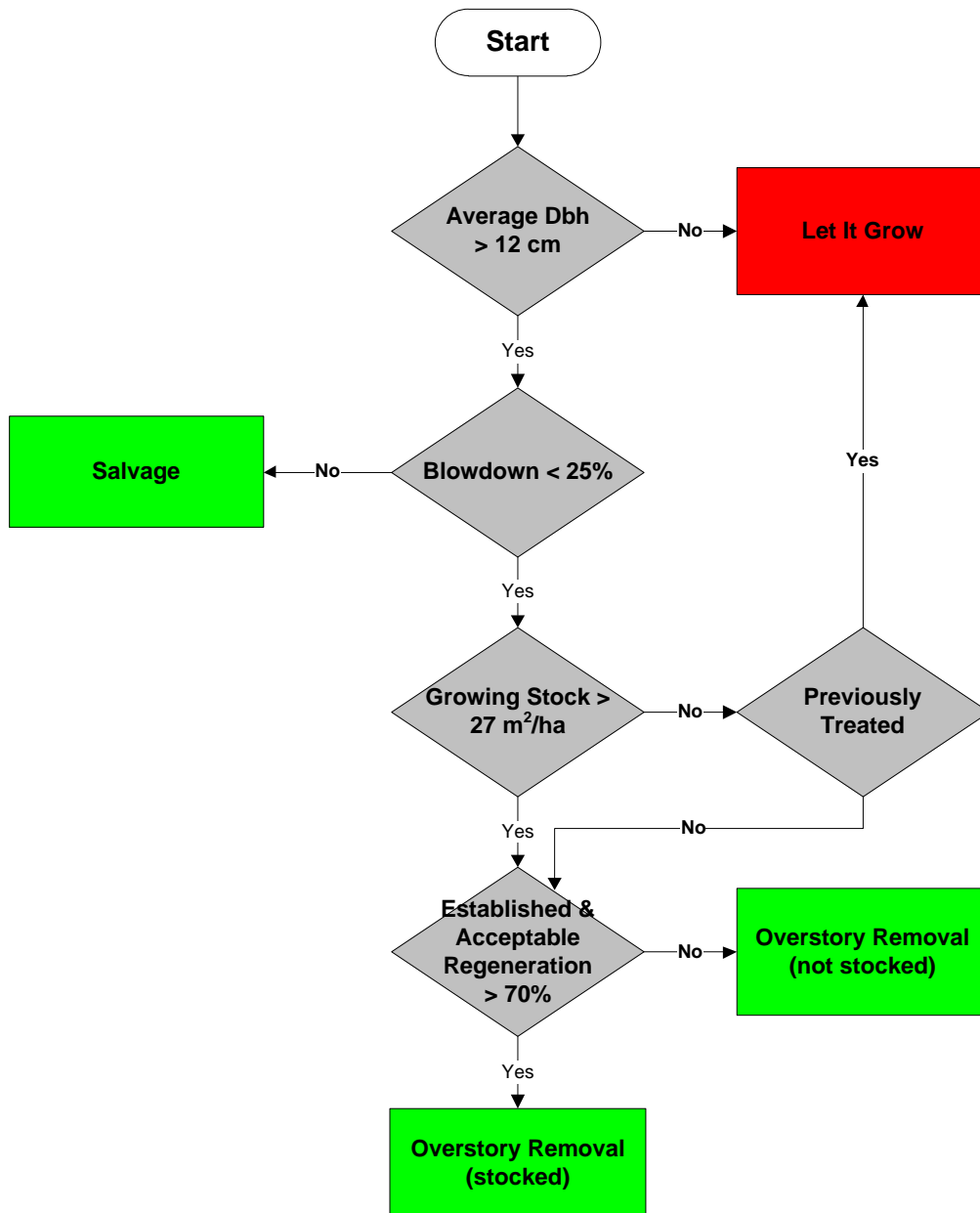
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at least every 3 m), a uniform pre-commercial thinning is appropriate.
- **Let it grow** – Let the stand grow and re-evaluate later.

---

<sup>B</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Coastal Management Guide

## Sub Key R - Regenerate



## SUB-KEY C-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the total basal area (of trees in Dbh class  $\geq 10$ cm) greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>C</sup> regeneration greater than 70% (at 2.4 m spacing)?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. See Table 5 for plantation recommendations.

---

<sup>C</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.



# Flood Plain (FP) Management Guide

## Forest Group Characteristics

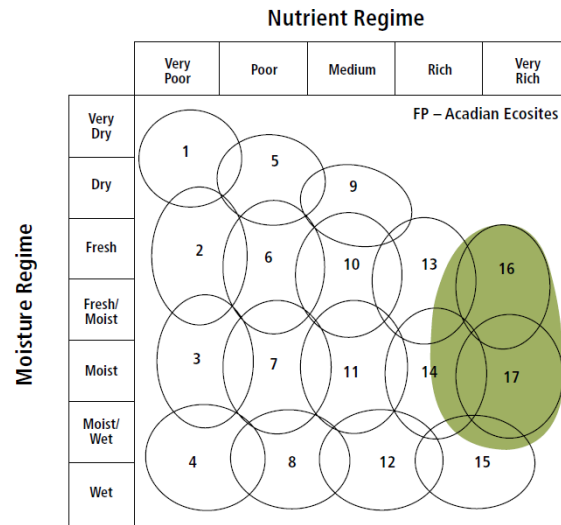
Flood Plain vegetation types (FP) occur on very rich sites with fresh to moist moisture regimes. They occur along active floodplains that receive an annual or periodic enrichment from sediment. They form linear, narrow stands along rivers or streams and provide filtering benefits for these waterways. Rare plants can occur in these types and a wide variety of plants and wildlife occur within them (Neily et al., 2013).

These riparian vegetation types have been frequently disturbed by human activities including farming, cottages and historically from spring-time log drives and streamside businesses using hydro power.

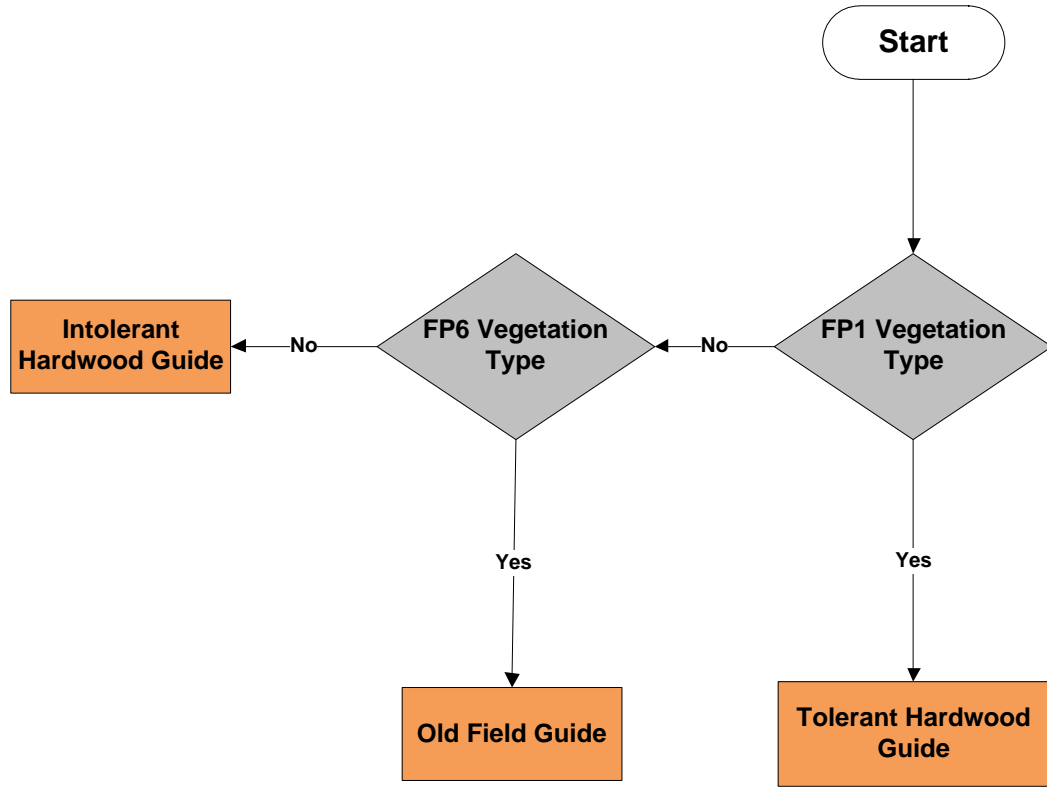
These types are usually dominated by hardwoods, although one white spruce dominated type is included in this group. Most of the sites can form uneven-aged structures due to their ability to support long lived and intermediate to shade tolerant species such as sugar maple. Flooding, channelization and ice scouring are common in this Forest Group.

## Management Considerations

Harvesting in Flood Plain stands will likely be limited due to the following; (i) their value in providing water filtering, buffering and connectivity (ii) occurrence of rare plants (iii) their rarity due to human development and (iv) their limited width adjacent to rivers or streams where a minimum 20m Special Management Zone (SMZ) is required by law (NS Statutes, 2002). When harvested, care should be taken to avoid rutting and siltation to adjacent streams and rivers.



# Flood Plain Management Guide Key M - Main





## **KEY FP-M - Main**

### **Instructions and Definitions for:**

#### **Decision Diamonds**

- **FP1 Vegetation Type** - Is the dominant vegetation type Flood Plain 1 – Sugar maple – White ash/Ostrich fern – Wood goldenrod (Neily et al., 2013)?
- **FP6 Vegetation Type** - Is the vegetation type Flood Plain 6 – White Spruce/ Wood goldenrod/Shaggy moss (Neily et al., 2013)?

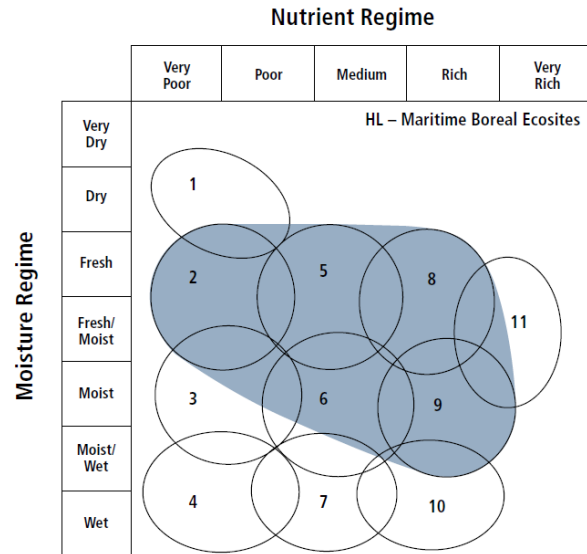


# Highland (HL) Management Guide

## Forest Group Characteristics

Highland (HL) vegetation types occur on a range of sites; very poor to rich and fresh to moist. All Highland types are dominated by exposure to winds common on the Cape Breton Highlands and Cape Breton Taiga (Neily et al., 2013). This group occurs in the Maritime Boreal ecosite due to these highland influences, such as moist, cold temperatures and exposure to winds and freeze/thaw cycles.

Highland vegetation types are usually dominated by balsam fir but in some of the richer sites, hardwoods can co-dominate or dominate. These mixedwood or hardwood dominated vegetation types are usually found on the shoulder upper slope transition zones between the Acadian hardwood dominated slopes and the Maritime Boreal balsam fir dominated Cape Breton plateau.



## Management Considerations

Height growth is limited for these vegetation types with heights not usually exceeding 15m. The balsam fir and white spruce growing on the highlands is adapted to the harsh climate resulting in trees with more taper (higher Dbh for a given height). This also results in the trees being more resistant to blowdown.

Highland forest types are usually even-aged due to infestations of spruce budworm, windthrow or senescence as balsam fir is relatively short lived. In less common situations, longer-lived yellow birch forms an older age-class with younger balsam fir forming another age-class. The Birch component of Highland vegetation types is often damaged due to ice and wind storms.

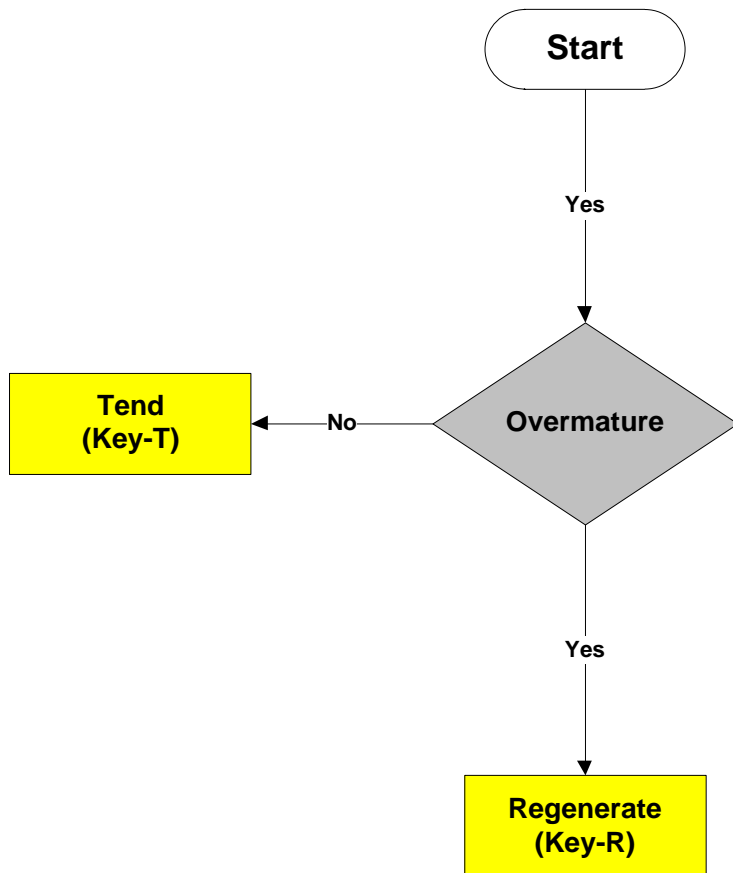
The cold winter temperatures give some protection to the balsam fir from the Balsam Woolly Adelgid as it is set-back at temperatures below -20 degrees Celsius ([Balsam woolly adelgid](#))

The balsam fir dominated plateaus of Cape Breton highlands are strongly influenced by the spruce budworm cycle which occurs every 30-40 years in eastern Canada (NSDNR 2005).

Thick balsam fir regeneration is common in Highland types. On the most exposed sites, tree cover is sparse or tree height severely stunted making them inoperable for harvesting.

Highland types are often dominated by pin cherry and raspberry competition making regenerating in open conditions difficult early after harvesting. Moose browsing can impede balsam fir and hardwood regeneration.

# Highland Management Guide Key M - Main



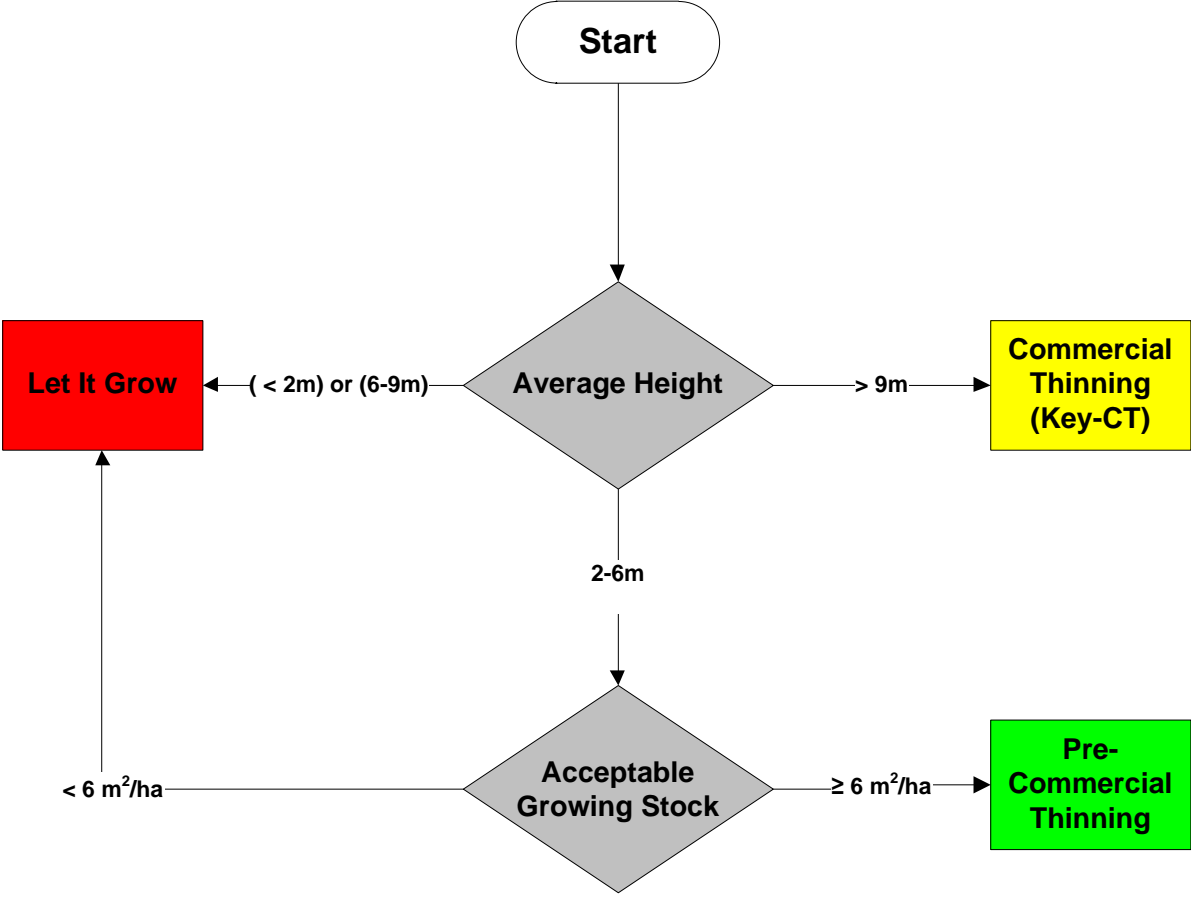
## **KEY HL-M – Main**

### **Instructions and Definitions for:**

#### **Decision Diamonds**

- **Overmature** – Is the overstory predominantly overmature (Table 3)?

# Highland Management Guide Sub-Key T - Tend



## **SUB-KEY HL-T – Tend**

### **Instructions and Definitions for:**

#### **Decision Diamonds**

- **Average Height** – What is the average height of the stand in metres? Is it less than 2 m or between 6m to 9 m, between 2 and 6 m or greater than 9 m?
- **Acceptable Growing Stock** – What is the basal area in m<sup>2</sup>/ha of **Acceptable Growing Stock (AGS<sup>D</sup>)**?

#### **Management Prescriptions**

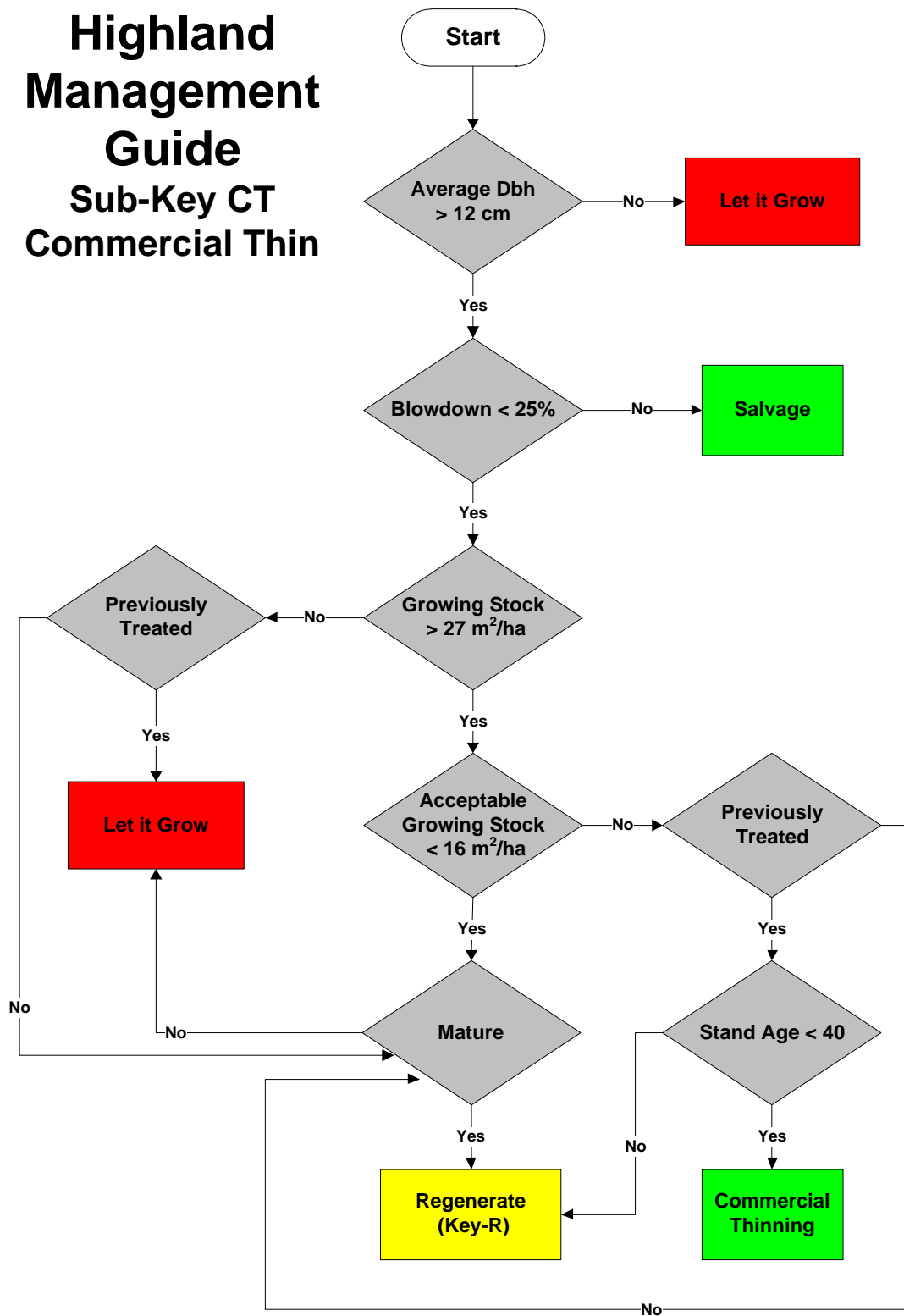
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at least every 3 m), a uniform pre-commercial thinning is appropriate.
- **Let it grow** – Let the stand grow and re-evaluate later.

---

<sup>D</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Highland Management Guide

## Sub-Key CT Commercial Thin





## SUB-KEY HL-CT – Commercial Thinning

### Instructions and Definitions for: Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class  $\geq 10$  cm) greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Acceptable Growing Stock < 16 m<sup>2</sup>/ha** – Is the basal area of **Acceptable Growing Stock (AGS<sup>E</sup>)** less than 16 m<sup>2</sup>/ha?
- **Mature** – Is the overstory predominantly mature in terms of producing good seed crops, necessary for natural regeneration (Table 3)?
- **Stand Age < 40** – Is the stand age less than 40 years?

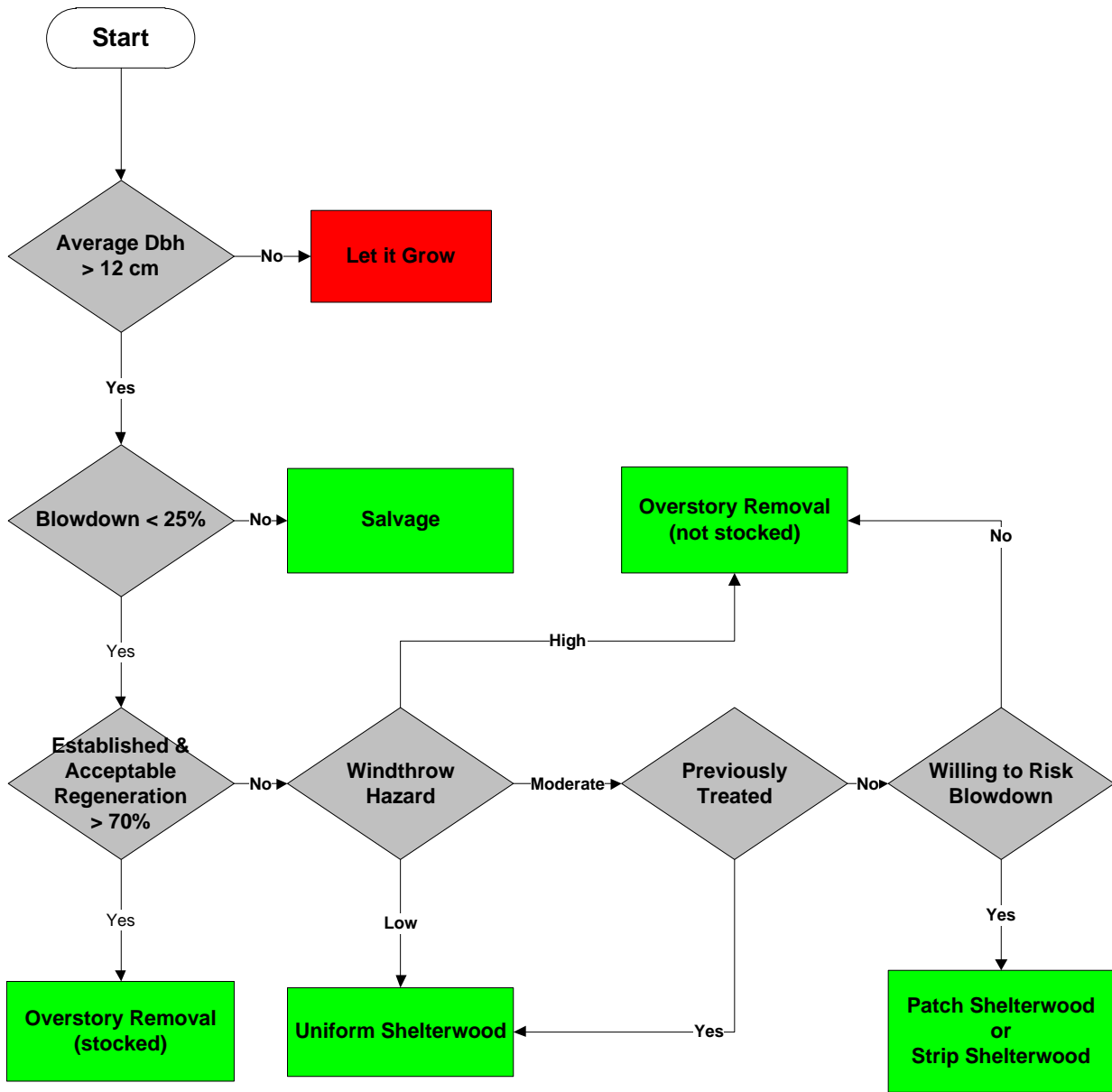
### Management Prescriptions

- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exists uniformly thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.
- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.

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<sup>E</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwood) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Highland Management Guide Sub Key R - Regenerate



## SUB-KEY HL-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12 cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>F</sup> regeneration greater than 70% (at 2.4 m spacing)?
- **Windthrow Hazard?** – Is the windthrow hazard low, moderate, or high? (refer to Table 2).
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Willing to Risk Blowdown** – Is the landowner willing to accept risk of losing leave trees to windthrow before regeneration established?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. See Table 5 for plantation recommendations.
- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from leave strips.
- **Patch Shelterwood** – Small groups of trees are cut uniformly throughout the stand without tending the unharvested areas, as there is not sufficient immature Acceptable Growing Stock. The main objective is to create the conditions to regenerate the desired species and to harvest the Sawlog Stock before it becomes overmature. Openings are to be 0.04-0.1ha and up to 35% of the area is to be harvested in patches. In some cases, where low-quality hardwoods are in the overstory, they may be left for sheltering effects.
- **Strip Shelterwood** – Harvest strips to produce shade requirements necessary to regenerate desired species. Leave at least 2 strips unharvested between harvested strips. Strips are to be 1 tree height in width.

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<sup>F</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.

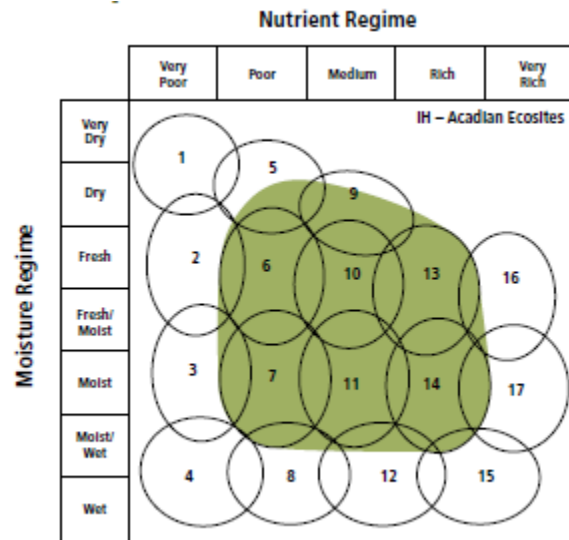


# Intolerant Hardwood (IH) Management Guide

## Forest Group Characteristics

Intolerant Hardwood (IH) vegetation types are one of the most diverse in Nova Scotia due to their occurrence on a wide variety of sites, from dry to moist and poor to rich (Neily et al., 2013).

IH vegetation types are mainly dominated by shade intolerant and shorter lived species such as red maple, white birch, grey birch and/or aspen. They naturally occur on sites that have had a stand-level disturbance and are mostly even-aged. The species that dominate these vegetation types effectively colonize open sites through prolific and frequent seeding and vegetative propagation such as suckering and sprouting. Because of this, they are mainly early successional stands that in some cases would naturally progress towards later successional vegetation types that contain more shade tolerant species. For example, where tolerant hardwood seed source occurs, a rich IH5 – Large-tooth Aspen-White Ash/Beaked Hazelnut/Christmas fern vegetation type could naturally succeed to high-value tolerant hardwood stands such as a TH3 – Sugar maple-white ash/Christmas fern (Table 4).

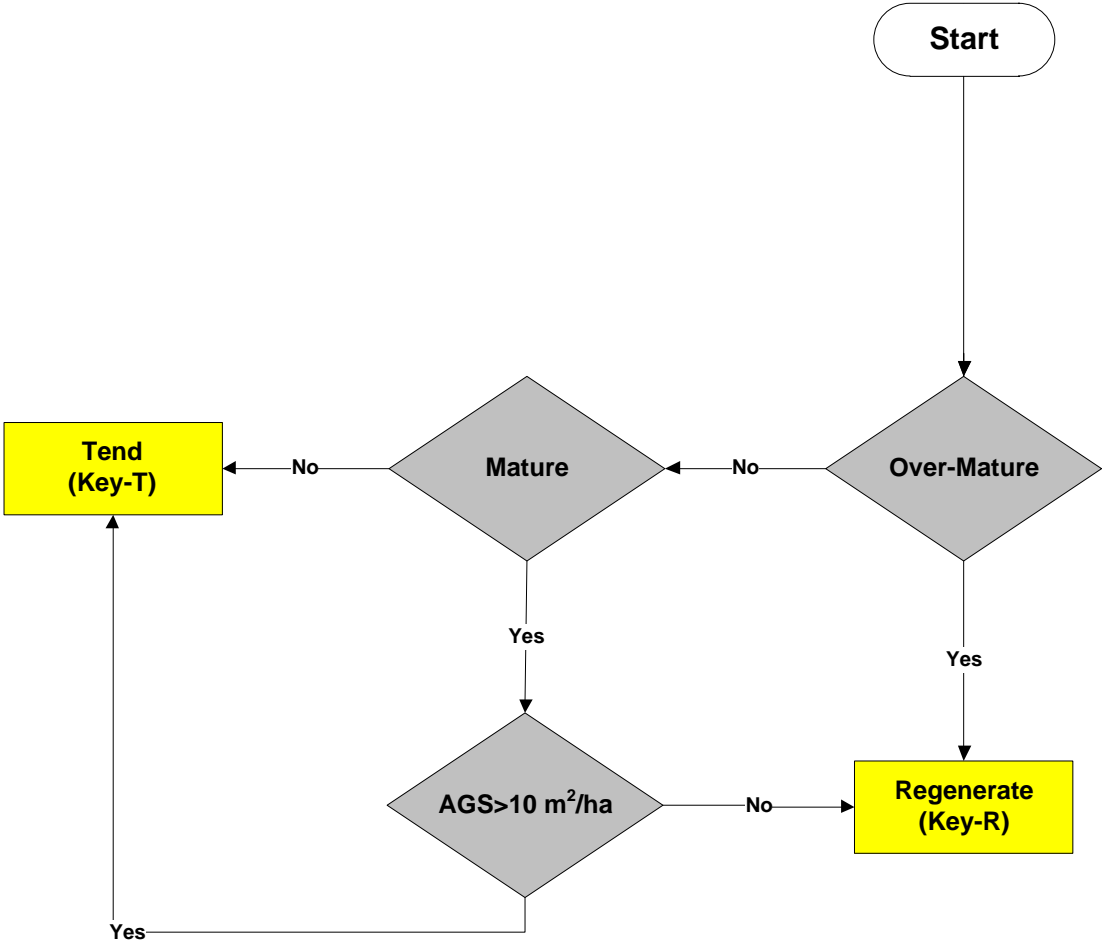


## Management Considerations

Regenerating red maple or aspen dominated IH stands in open conditions will result in the stand being dominated by these species. Red maple stumps typically produce numerous sprouts, while aspen produce root suckers forming dense thickets. The red maple sprouts often contain rot and are of low-quality potential for production of sawlogs. Red maple sprouts and aspen suckers are troublesome in open conditions when trying to regenerate IH stands to softwood species where they naturally occur. They grow quickly from their existing root system, overtopping softwood regeneration. Where herbicides are not used, these sprouts and aspen suckers are difficult to control. Manual weeding is usually not effective in controlling suckers and sprouts. In the case of red maple sprouts, if manual methods of control are utilized it is more effective to keep one or two stems to reduce the amount of re-sprouting.

Restoration Shelterwood harvesting can help accelerate the natural process of moving a stand from an IH type to a latter successional type such as TH where the conditions are favourable. Where existing seed source mature trees or advanced regeneration of shade tolerant species occur a partial harvest can be prescribed to provide shade to favour shade tolerant species. Regenerating these stands with clear-cuts will favour the existing shade intolerant species.

# Intolerant Hardwood Management Guide Key M - Main



## KEY IH-M – Main

### Instructions and Definitions for:

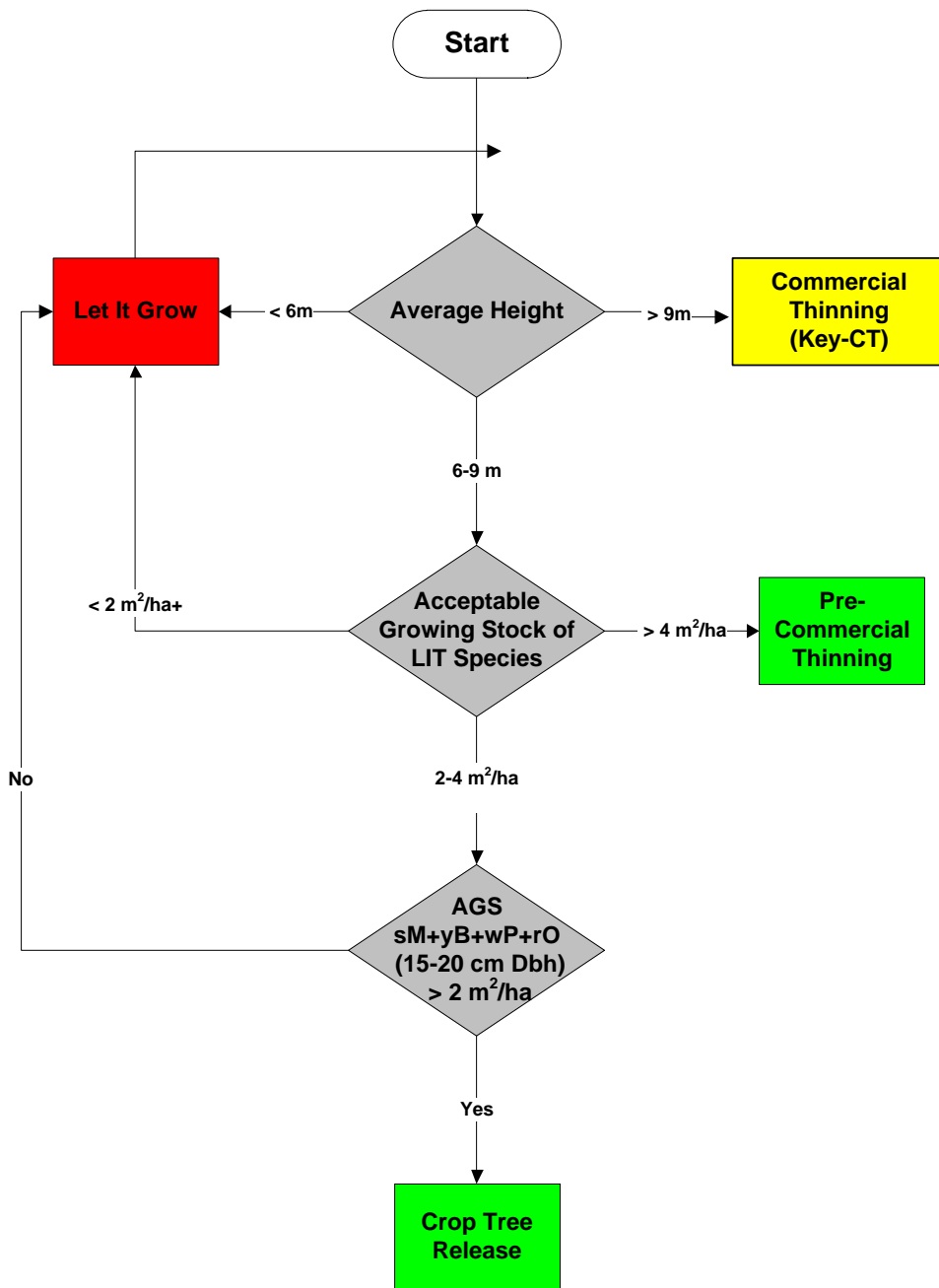
#### Decision Diamonds

- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Mature** – Is the overstory predominantly mature in terms of producing adequate seed for regeneration (Table 3)?
- **AGS > 10 m<sup>2</sup>/ha** – Is the basal area of **Acceptable Growing Stock (AGS<sup>G</sup>)** greater than 10 m<sup>2</sup>/ha?

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<sup>G</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Intolerant Hardwood Management Key Sub-Key T - Tend





## SUB-KEY IH-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres? Is it less than 6 m, between 6 and 9 m, or greater than 9 m?
- **Acceptable Growing Stock of LIT Species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>H</sup>) of Long-live Intermediate to Tolerant (LIT<sup>I</sup>) species? Is it less than 2 m<sup>2</sup>/ha, between 2 and 4 m<sup>2</sup>/ha, or greater than 4 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 2 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 2 m<sup>2</sup>/ha?

#### Management Prescriptions

- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m apart. Only trees touching the crowns of crop trees are to be cut; remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at least every 3 m), a uniform pre-commercial thinning is appropriate.
- **Let it grow** – Let the stand grow and re-evaluate later.

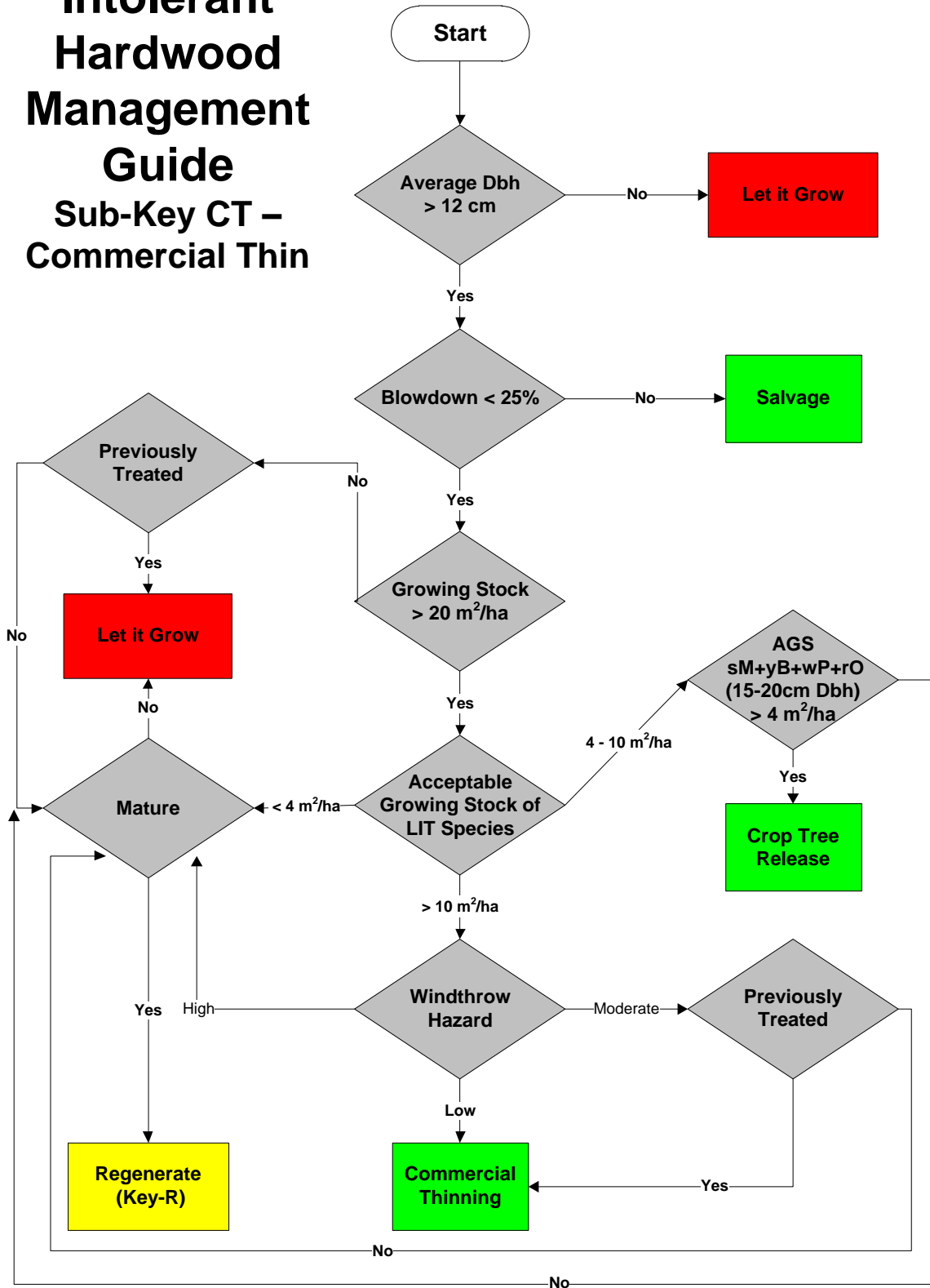
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<sup>H</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>I</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Intolerant Hardwood Management Guide

## Sub-Key CT – Commercial Thin



## SUB-KEY IH-CT – Commercial Thinning

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 20 m<sup>2</sup>/ha** – Is the basal area (of trees Dbh class  $\geq 10$  cm) greater than 20 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Acceptable Growing Stock of LIT species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>J</sup>) of Long-lived Intermediate to Tolerant (LIT<sup>K</sup>) species? Is it less than 4 m<sup>2</sup>/ha, between 4 and 10 m<sup>2</sup>/ha or greater than 10 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 4 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 4 m<sup>2</sup>/ha?
- **Windthrow Hazard** – Is the windthrow hazard Low, Moderate or High (refer to Table 2)?
- **Mature** – Is the overstory predominantly mature in terms of producing good seed crops, necessary for natural regeneration (Table 3)?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m apart. Only trees touching the crowns of crop trees are to be cut; remaining trees to be left standing.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exists, uniformly thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.

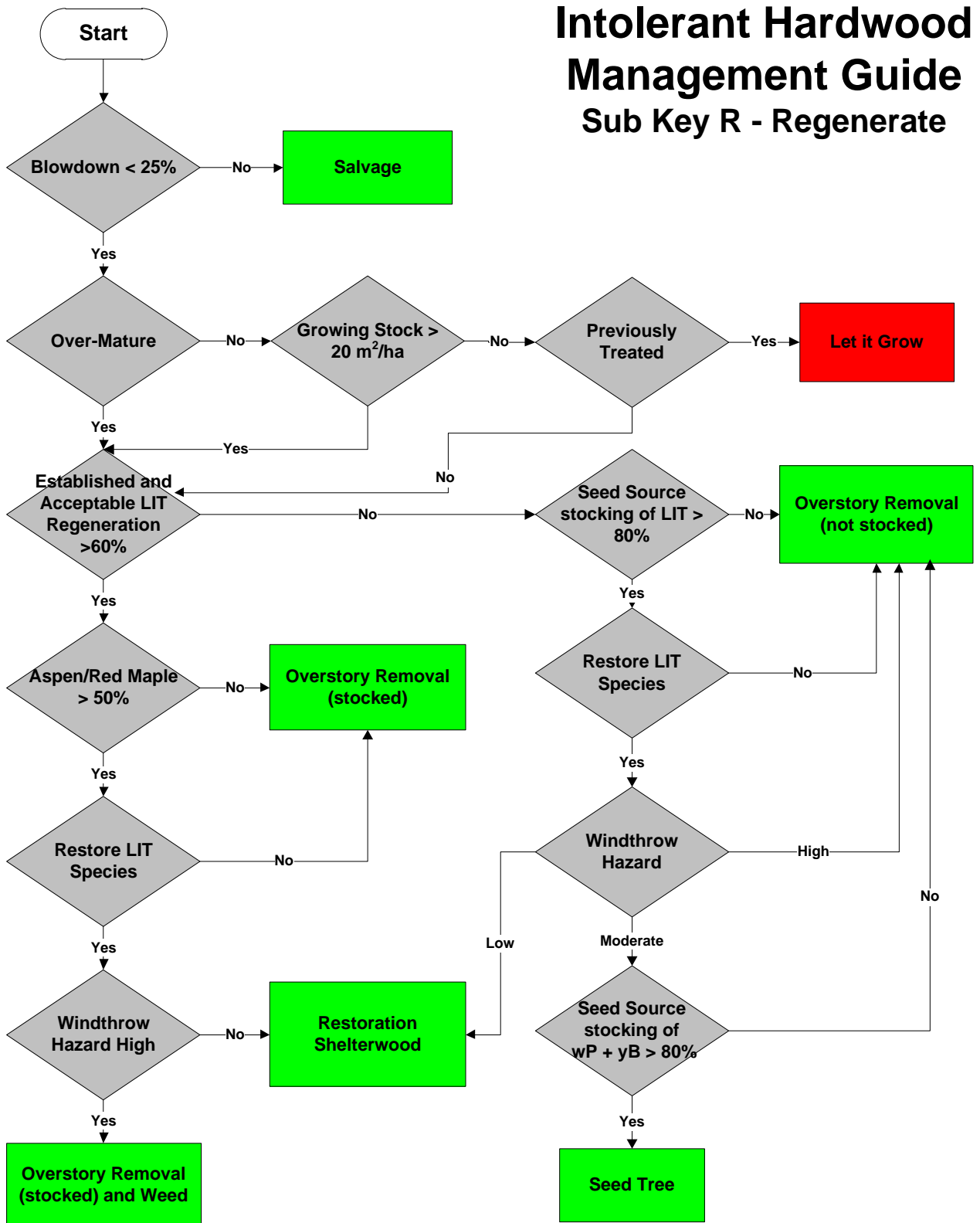
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<sup>J</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>K</sup> **LIT species** - Long lived species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Intolerant Hardwood Management Guide

## Sub Key R - Regenerate



## SUB-KEY IH-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)
- **Growing Stock > 20 m<sup>2</sup>/ha** – Is the basal area (of trees Dbh class  $\geq$  10 cm) greater than 20 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Established and Acceptable LIT Regeneration > 60%** – Is the stocking to acceptable established<sup>12</sup> of Long-lived Intermediate to Tolerant species (**LIT**<sup>13</sup>) regeneration greater than 60% (at 2.4 m spacing)?
- **Seed source stocking of LIT species > 80%** – Is the stocking (to 20 m spacing) of seed source trees of Long-lived Intermediate to Tolerant species (**LIT**<sup>H</sup>) species greater than 80%?
- **Aspen/Red Maple > 50%** – Is the % of Aspen<sup>14</sup> and Red Maple basal area combined more than 50% of the total basal area of the stand?
- **Restore LIT Species** – Is one of the objectives of this harvest to restore Long-lived Intermediate to Tolerant species (**LIT**<sup>H</sup>)?
- **Windthrow Hazard?** – Is the windthrow hazard low, moderate, or high? (refer to Table 2).
- **Seed source stocking of wP + yB > 80%** – Is the stocking (to 20 m spacing) of seed source trees of white pine and yellow birch combined greater than 80%?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Let it grow** – Let the stand grow and re-evaluate later.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. See Table 5 for plantation recommendations.
- **Overstory Removal (stocked) & Weed** – Remove overstory and weed competing species to insure establishment of LL regeneration. Protect advanced regeneration during harvest operation.
- **Restoration Shelterwood** – Uniformly thin overstory to produce light conditions suited for intermediate to tolerant shade-tolerant late-succession species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from leave strips, when regenerating shade tolerant species (sugar maple, red spruce or eastern hemlock). If intermediate shade tolerant species such as yellow birch, white ash, red oak or white pine is predominant, remove 40% basal area from the leave strips (Table 3). Care must be taken to leave wind firm trees of seed bearing age of intermediate to tolerant shade-tolerant, late-succession species as a seed source for natural regeneration.
- **Seed Tree** - Leave well-distributed, wind-firm seed trees throughout the stand. Where white pine regeneration is desired, leave 15-35 trees/ha. For yellow birch regeneration, leave 8-15 trees/ha. White Pine and Yellow Birch regenerate best on exposed mineral soil. Scarification to produce mineral soil micro-sites will enhance regeneration of these species.

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<sup>12</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.

<sup>13</sup> **LIT** species - Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

<sup>14</sup> Aspen – Includes Trembling Aspen, Large tooth Aspen and Balsam Poplar.



# Karst (KA) Management Guide

## Forest Group Characteristics

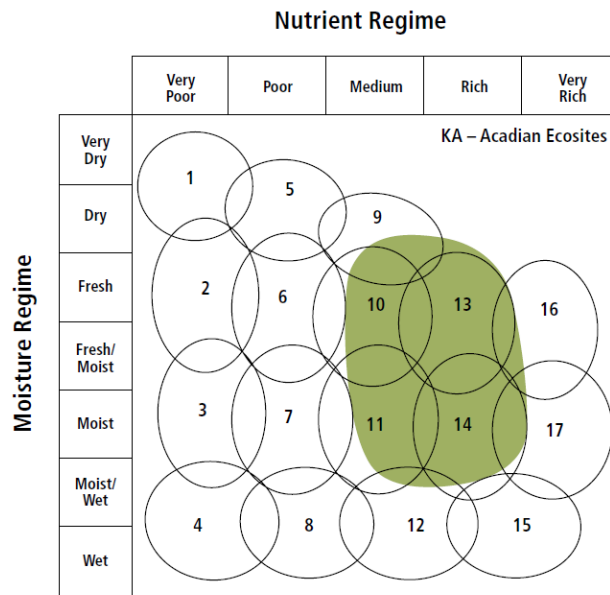
The Karst Forest Group (KA) is identified by its occurrence on karst topography. A stand is categorized as Karst if it occurs on areas with exposed bedrock of gypsum, limestone or dolomite. The topography is rugged, and often includes caves, sinkholes and other formations resulting from easily dissolved calcareous bedrock. Karst types mainly occur on rich sites with a fresh to moist moisture regime (Neily et al., 2013).

Karst is rare for temperate Canada and often contains rare plants and habitat for bat colonies.

Late successional tree species occurring in these types are hemlock and sugar maple.

## Management Considerations

Harvesting in Karst vegetation types is not recommended for several reasons, including (i) the danger to humans and machinery during harvesting due to rugged terrain, (ii) the rarity of these vegetation types in Canada, (iii) the occurrence of rare plants in them, (iv) their potential for bat habitat and (v) the sensitivity to damage by machinery during harvest operations.



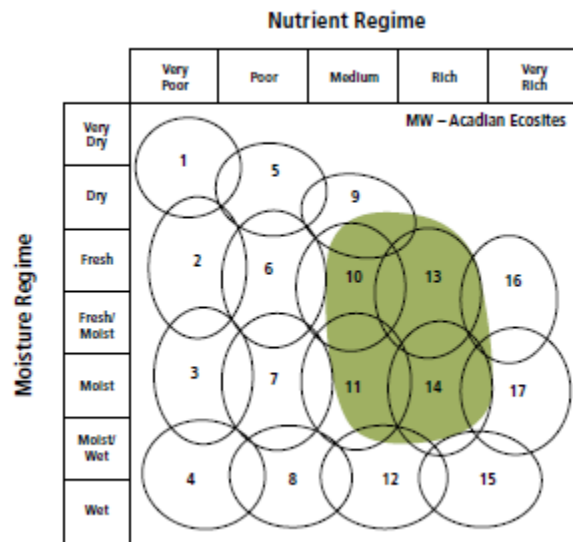




# Mixedwood (MW) Management Guide

## Forest Group Characteristics

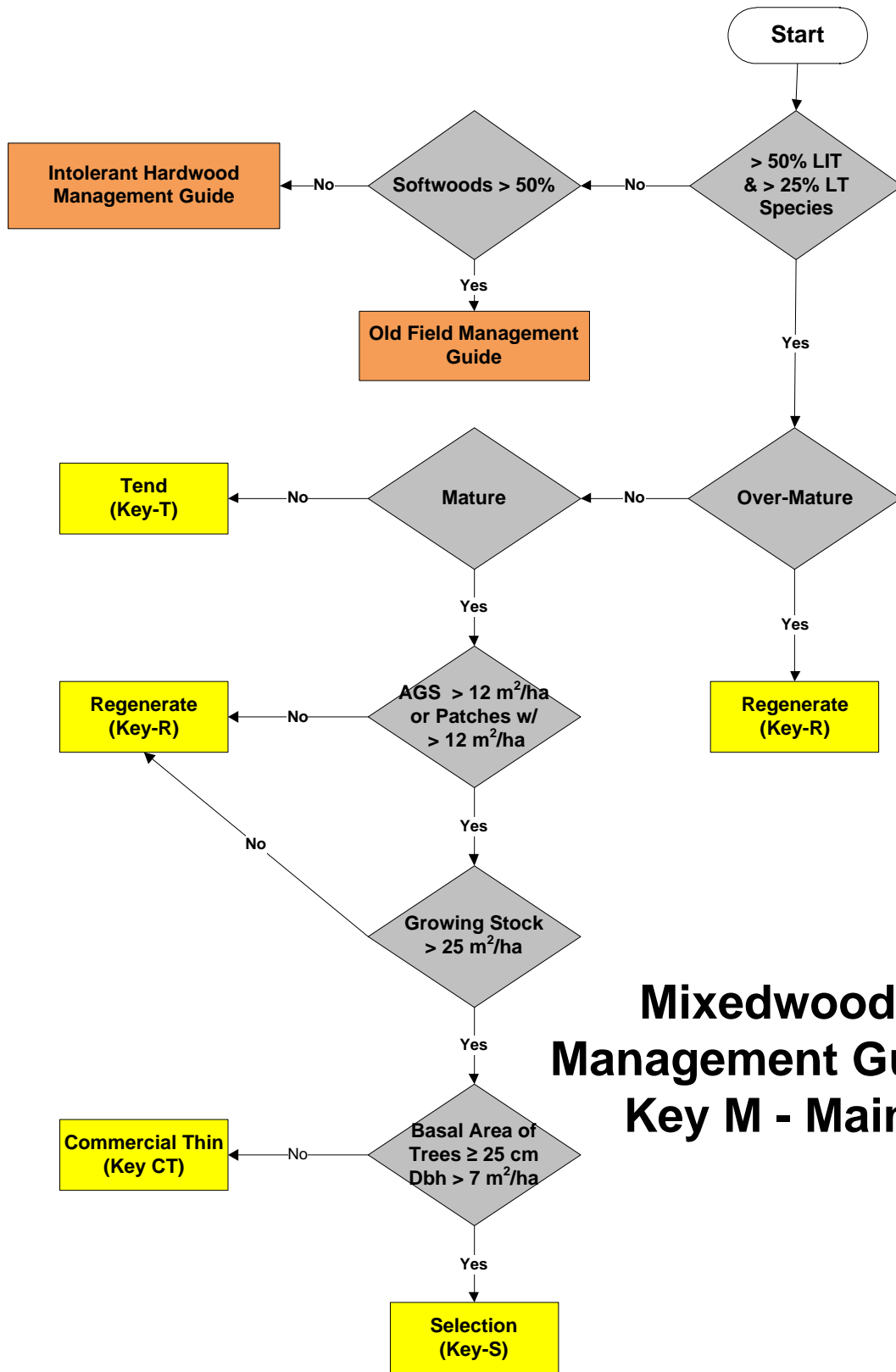
The Mixedwood Forest Group (MW) contains some of the most diverse stands in terms of tree species. They also include a wide range of successional stages, from early to late. Short lived and/or shade intolerant species such as red maple, balsam fir, white birch and aspen occur in the early successional versions of mixedwood vegetation types (for example MW5 -White Birch-Balsam Fir). Red spruce, eastern hemlock, yellow birch and sugar maple dominate the later successional mixedwood types (for example MW1 Red Spruce/Yellow Birch). Another feature of Mixedwood types is that the early successional version is mainly even-aged, while the later successional mixedwood types can develop an uneven-aged structure. The Mixedwood group occurs on productive sites ranging from medium to rich in fertility and fresh to moist sites.



## Management Considerations

Since Mixedwood vegetation types include early to late successional stands with shade intolerant to tolerant species, a wide variety of treatments are recommended for these types. Early successional Mixedwoods that are dominated by red maple, white birch and balsam fir can be transitioned towards later successional mixedwood versions through Restoration Shelterwood harvests if sufficient seed source of late successional shade tolerant species like red spruce, and sugar maple are present and windthrow hazard is low. Alternatively, early successional species can be maintained by removing most of the overstory, although low-quality red maple sprouts could dominate the site reducing the growth and survival of softwoods and later successional species. Softwood plantations of late-successional red spruce could be established by controlling these sprouts. In some cases where a later successional mixedwood is already present and dominated by shade tolerant and long lived species, uneven-aged management methods can be utilized.

Care must be taken when pre-commercial thinning (PCT) Mixedwood stands with both hardwoods and softwoods of potential high log value such as yellow birch and red spruce. If PCTing at an early stage, typical for softwoods (2m tall), heavy branching will be produced in hardwoods degrading its potential for lumber. In this situation, the hardwoods should not be thinned until at least it is 6 m tall and spaced to 2.4 m.



## Mixedwood Management Guide Key M - Main

## KEY MW-M – Main

### Instructions and Definitions for:

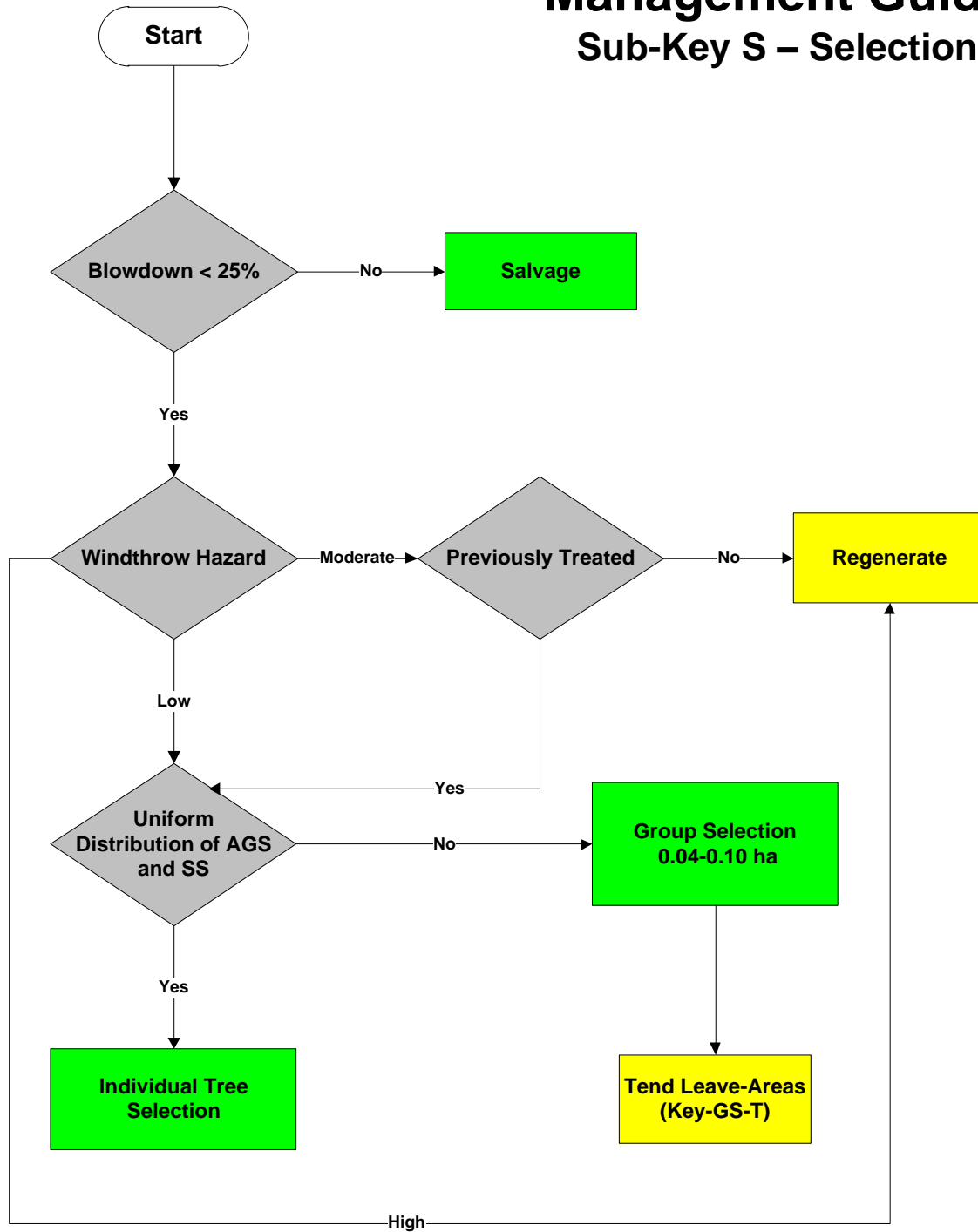
#### Decision Diamonds

- **> 50% LIT & > 25% LT Species** – Is the stand made up of more than 50% Long-lived Intermediate to Tolerant (**LIT**) species including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash, and does stand consist of more than 25% Long-lived Tolerant (**LT**, Table 3)) species, including red spruce, eastern hemlock and sugar maple (as a % of stand basal area)?
- **Softwoods > 50%** – Is the % of softwoods greater than 50% by basal area?
- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Mature** – Is the overstory predominantly mature in terms of being able to produce adequate seed for regeneration (Table 3)?
- **AGS > 12 m<sup>2</sup>/ha or Patches w/ AGS > 12 m<sup>2</sup>/ha** – Is the basal area of Acceptable Growing Stock (**AGS**<sup>15</sup>) greater than 12 m<sup>2</sup>/ha, or does the stand have patches of mature trees to be harvested intermixed with patches in different areas of smaller AGS worthy of tending? The amount of AGS in the patches must be greater than 12 m<sup>2</sup>/ha.
- **Growing Stock > 25 m<sup>2</sup>/ha** – Is the basal area (of trees Dbh class ≥ 10 cm) greater than 25 m<sup>2</sup>/ha?
- **Basal Area of Trees ≥ 25 cm Dbh > 7 m<sup>2</sup>/ha** – Is there more than 7 m<sup>2</sup>/ha of trees with Diameter at Breast Height (Dbh) class ≥ 25 cm?

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<sup>15</sup> **AGS**- Acceptable Growing Stock trees are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Mixedwood Management Guide Sub-Key S – Selection



## SUB-KEY MW-S – Selection

### Instructions and Definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Windthrow Hazard** – Is the windthrow hazard Low, Medium or High (refer to Table 2)?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Uniform distribution of AGS and SS** – Is the **Acceptable Growing Stock (AGS<sup>16</sup>)** and **Sawlog /Seed Stock** (trees with Dbh class  $\geq 25$  cm, **SS**) intermixed uniformly throughout the stand?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Individual Tree Selection** – Individual Tree Selection involves a thinning across all size classes throughout the stand. This is done to create a diameter class distribution suitable for sustaining a periodic harvest of suitable trees over relatively short harvesting cycles (10-20 years). The objective is to create conditions suitable for regeneration of preferred species at each entry while also improving the growing stock by releasing the highest quality immature trees. Basal area removals of 30% from leave strips are recommended, especially where regenerating shade tolerant species is desired. Trail widths should be left to a minimum and distance between trails maximized to avoid windthrow. Shade tolerant regeneration, such as red spruce, eastern hemlock and sugar maple are favoured.
- **Group Selection** – Group Selection involves identifying areas within the stand that are suitable for harvesting or regeneration because they are predominantly mature or contain non-commercial trees. These areas are to be cleared to create conditions suitable for preferred regeneration. Areas predominantly AGS are to be left. They can be tended using pre-commercial thinning, commercial thinning or crop tree release methods. Intermediate shade tolerance regeneration of white pine, yellow birch and red oak are favoured.

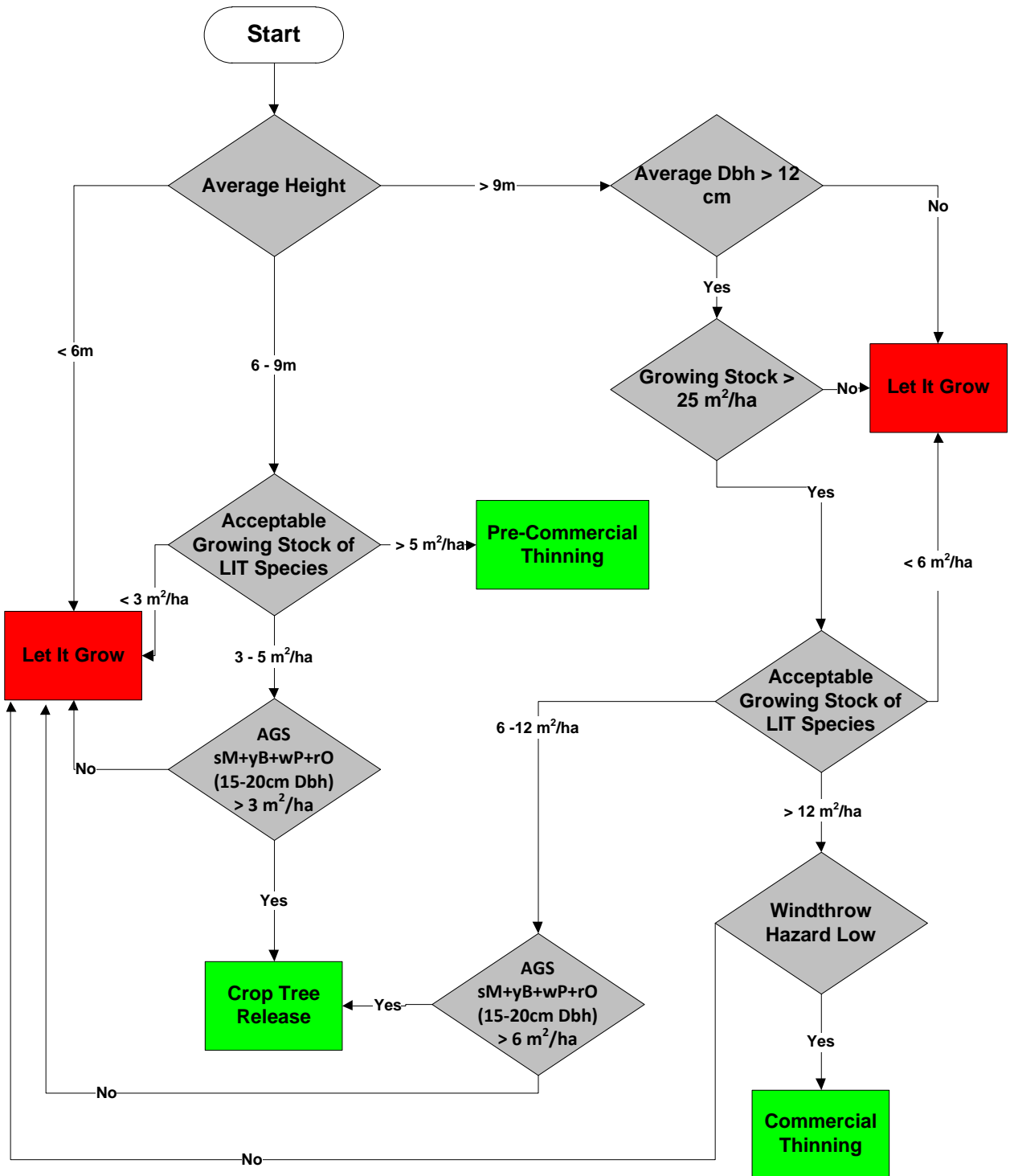
Harvest Patch Dimensions.					
Area		Circular Radius		Square Side Length	
(ha)	(acre)	(m)	(ft)	(m)	(ft)
0.04	1/10	11	37	20	66
0.10	¼	18	59	32	104

<sup>16</sup> Trees are **Acceptable Growing Stock (AGS)** when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Mixedwood Management Guide

## Sub-Key GS-T

### Tending of Leave Areas in Group Selection



## SUB-KEY MW- GS-T – Tending of leave areas in Group Selections

*These questions refer to only the leave areas of the stand.*

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres in the leave areas? Is it less than 6 m, between 6 and 9 m or greater than 9 m?
- **Acceptable Growing Stock of LIT Species** – when height between 6 and 9 metres - What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>17</sup>) of Long-live Intermediate to Tolerant (LIT<sup>18</sup>) species in the leave-area? Is it less than 3 m<sup>2</sup>/ha, between 3 and 5 m<sup>2</sup>/ha, or greater than 5 m<sup>2</sup>/ha? - when height is greater than 9 metres - Is it less than 6 m<sup>2</sup>/ha, between 6 and 12 m<sup>2</sup>/ha, or greater than 12 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 3 m<sup>2</sup>/ha** - when height between 6 and 9 metres Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 3 m<sup>2</sup>/ha in the leave-area?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 6 m<sup>2</sup>/ha** - when height is greater than 9 metres Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 6 m<sup>2</sup>/ha in the leave-area?
- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees ≥10 cm Dbh class) in the leave-area?
- **Growing Stock > 25 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class ≥ 10 cm) greater than 25 m<sup>2</sup>/ha in the leave-area?

#### Management Prescriptions

- **Let it grow** – Let the leave-areas grow and re-evaluate later.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist in the leave-areas, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30 ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist in the leave-areas, uniformly distributed throughout the stand (on average at most every 3 m (10 ft)), a uniform pre-commercial thinning is appropriate.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly in the leave-areas thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.

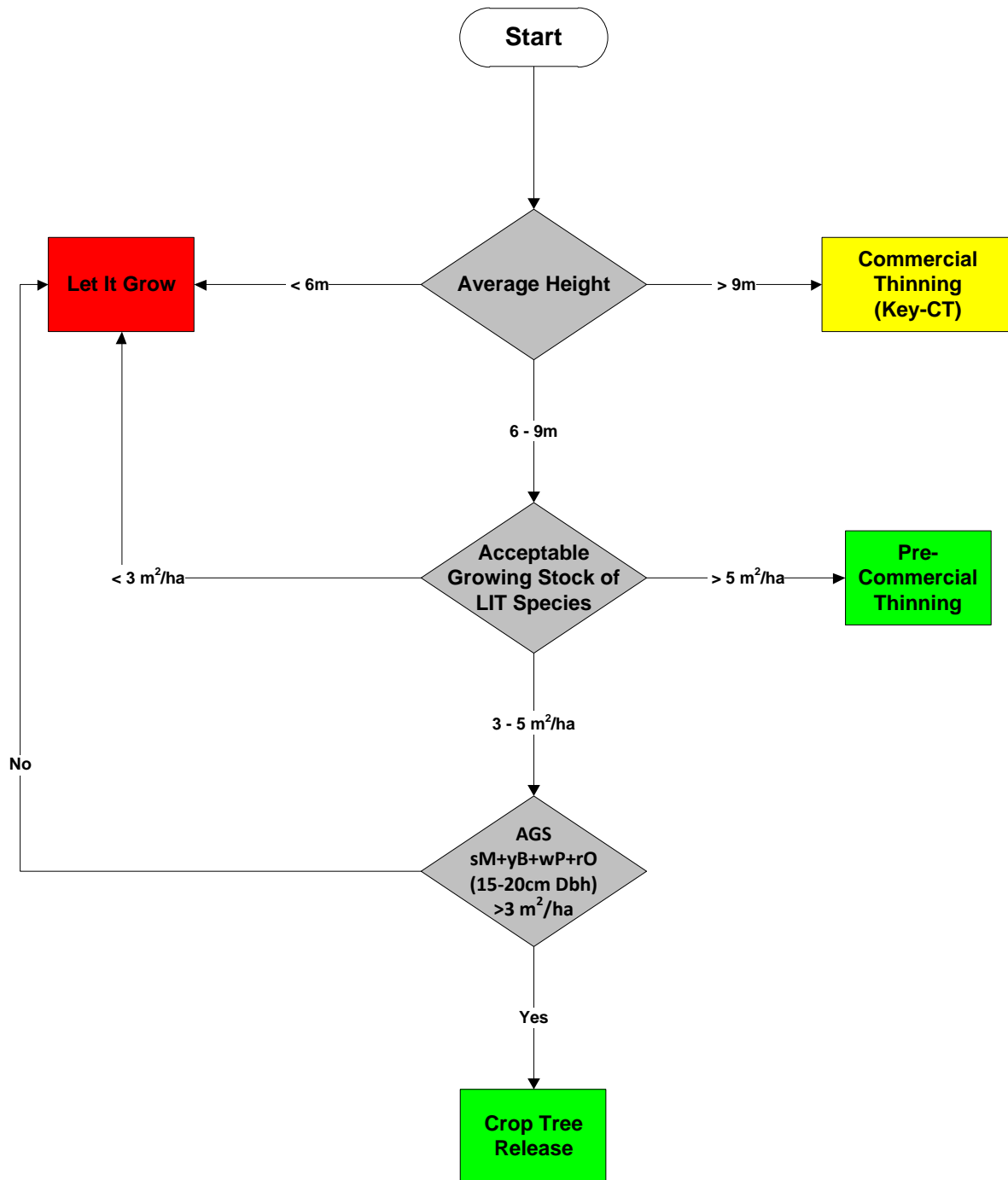
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<sup>17</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>18</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Mixedwood Management Guide

## Sub-Key T - Tend





## SUB-KEY MW-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres? Is it less than 6 m, between 6 and 9 m or greater than 9 m?
- **Acceptable Growing Stock of LIT Species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>19</sup>) of Long-live Intermediate to Tolerant (LIT<sup>20</sup>) species? Is it less than 3 m<sup>2</sup>/ha, between 3 and 5 m<sup>2</sup>/ha, or greater than 5 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 3 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 3 m<sup>2</sup>/ha?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30 ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at most every 3 m (10 ft)), a uniform pre-commercial thinning is appropriate.

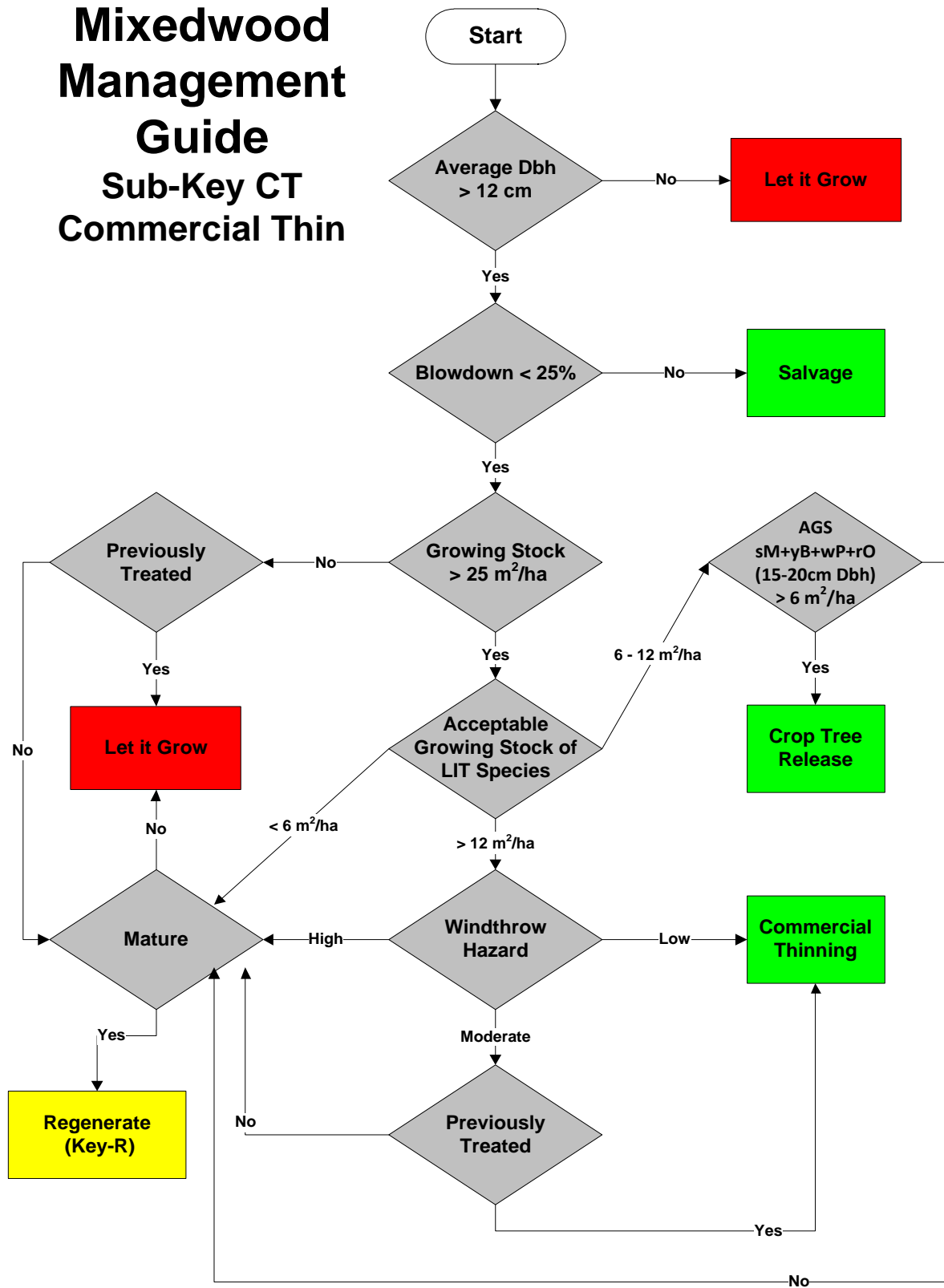
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<sup>19</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>20</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Mixedwood Management Guide

## Sub-Key CT Commercial Thin



## SUB-KEY MW-CT – Commercial Thin

### Instructions and Definitions for: Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 25 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class  $\geq 10$  cm) greater than 25 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Acceptable Growing Stock of LIT species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>21</sup>) of Long-lived Intermediate to Tolerant species (LIT<sup>22</sup>)? Is it less than 6 m<sup>2</sup>/ha, between 6 and 12 m<sup>2</sup>/ha, or greater than 12 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 6 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 6 m<sup>2</sup>/ha?
- **Windthrow Hazard** – Is the windthrow hazard Low Moderate or High (refer to Table 2)?
- **Mature** – Is the overstory predominantly mature in terms of producing good seed crops, necessary for natural regeneration (Table 3)?

### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30 ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.

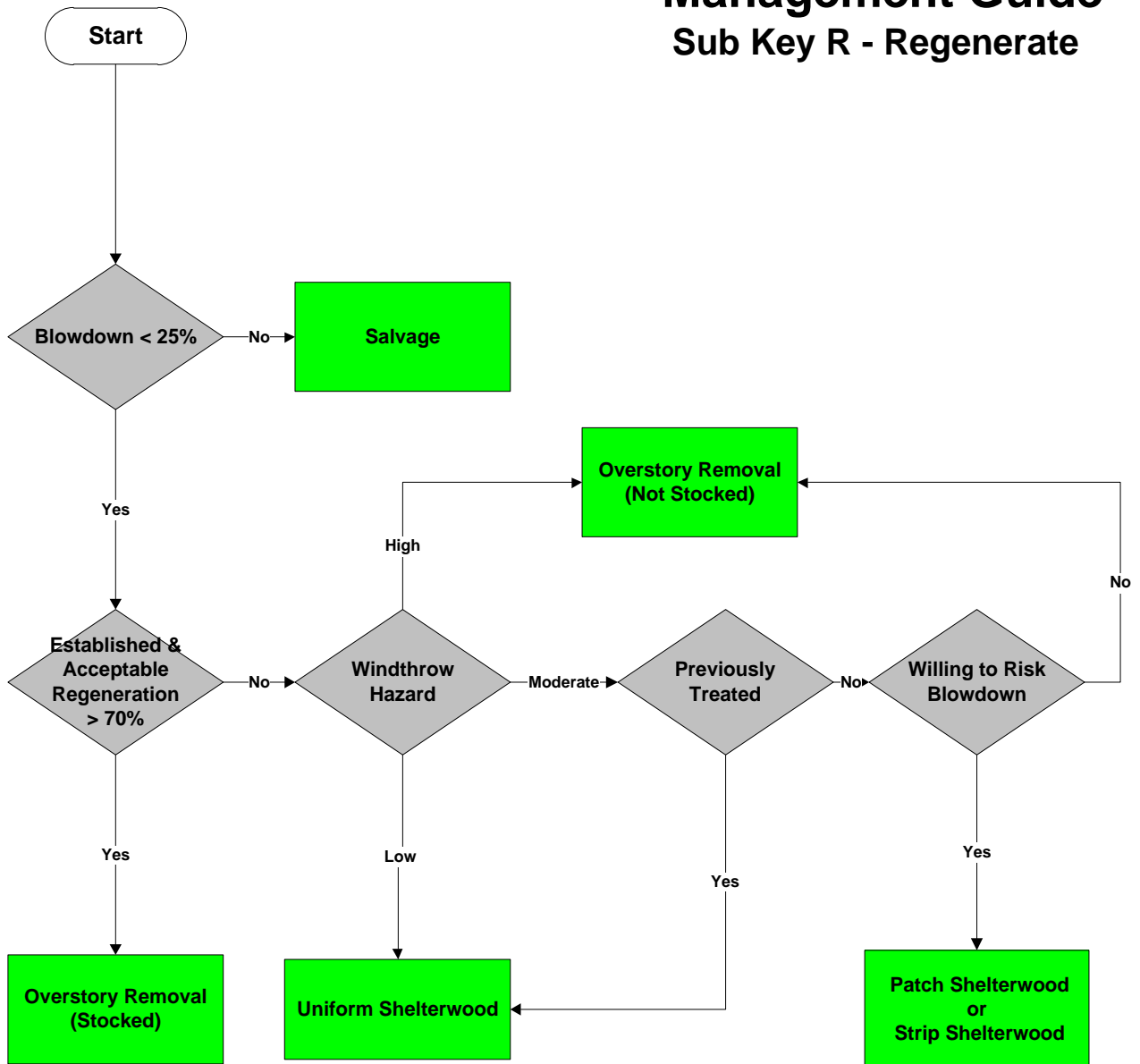
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<sup>21</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>22</sup> **LIT species** – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash.

# Mixedwood Management Guide

## Sub Key R - Regenerate



## SUB-KEY MW-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>23</sup> regeneration greater than 70% (at 2.4 m spacing)?
- **Windthrow Hazard** – Is the windthrow hazard Low, Moderate or High (Table 2)?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Willing to Risk Blowdown** – Is the landowner willing to accept risk of losing leave trees to windthrow before regeneration is established?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to ensure successful plantation establishment. Table 5 shows plantation recommendations.
- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from leave strips, when regenerating shade tolerant species (sugar maple, red spruce or eastern hemlock). If intermediate shade tolerant species such as yellow birch, white ash, red oak or white pine is predominant, remove 40% basal area from the leave strips (Table 3).
- **Patch Shelterwood** – Small groups of trees are cut uniformly throughout the stand without tending the unharvested areas, as there is not sufficient immature Acceptable Growing Stock. The main objective is to create the conditions to regenerate the desired species and to harvest the Sawlog Stock before it becomes overmature. Openings are to be 0.04-0.1ha (1/10 – 1/4 acre) and up to 35% of the area is to be harvested in patches.
- **Strip Shelterwood** – Harvest strips to produce shade requirements necessary to regenerate desired species. Leave at least 2 strips unharvested between harvested strips. Strips are to be 1 tree height in width.

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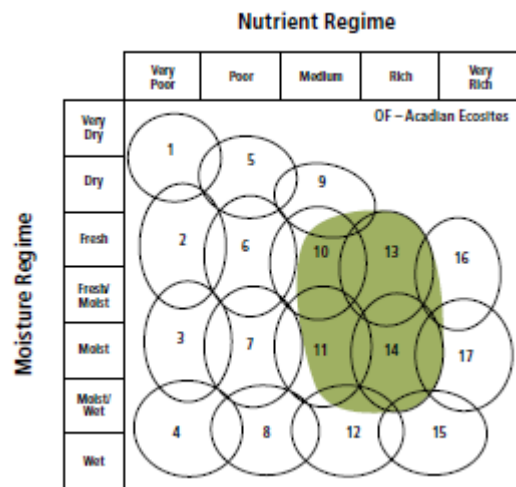
<sup>23</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.



# Old Field (OF) Management Guide

## Forest Group Characteristics

The old field Forest Group are forested sites that have established on abandoned agriculture or grazing land. They often have organic enriched soils, are smooth (due to tilling) and have rocks cleared. Grazed old-field land is not always smooth or cleared of rocks. Old Field vegetation types are usually dominated by softwoods but were often fertile hardwood sites originally occupied by shade tolerant hardwoods. Hints of the Old Field stand origins can be found by the occurrence of the occasional tolerant hardwood mixed in with the primary early colonizers such as white spruce. These sites are medium to rich in fertility with a Fresh to Moist Moisture regime. They typically are less complex ecosystems of one tree species, most frequently white spruce, but also can contain Tamarack on the moister sites, white pine (most frequently in western Nova Scotia), balsam fir (most frequently in the Nova Scotia uplands) and trembling aspen (most frequently in lowland ecoregions).



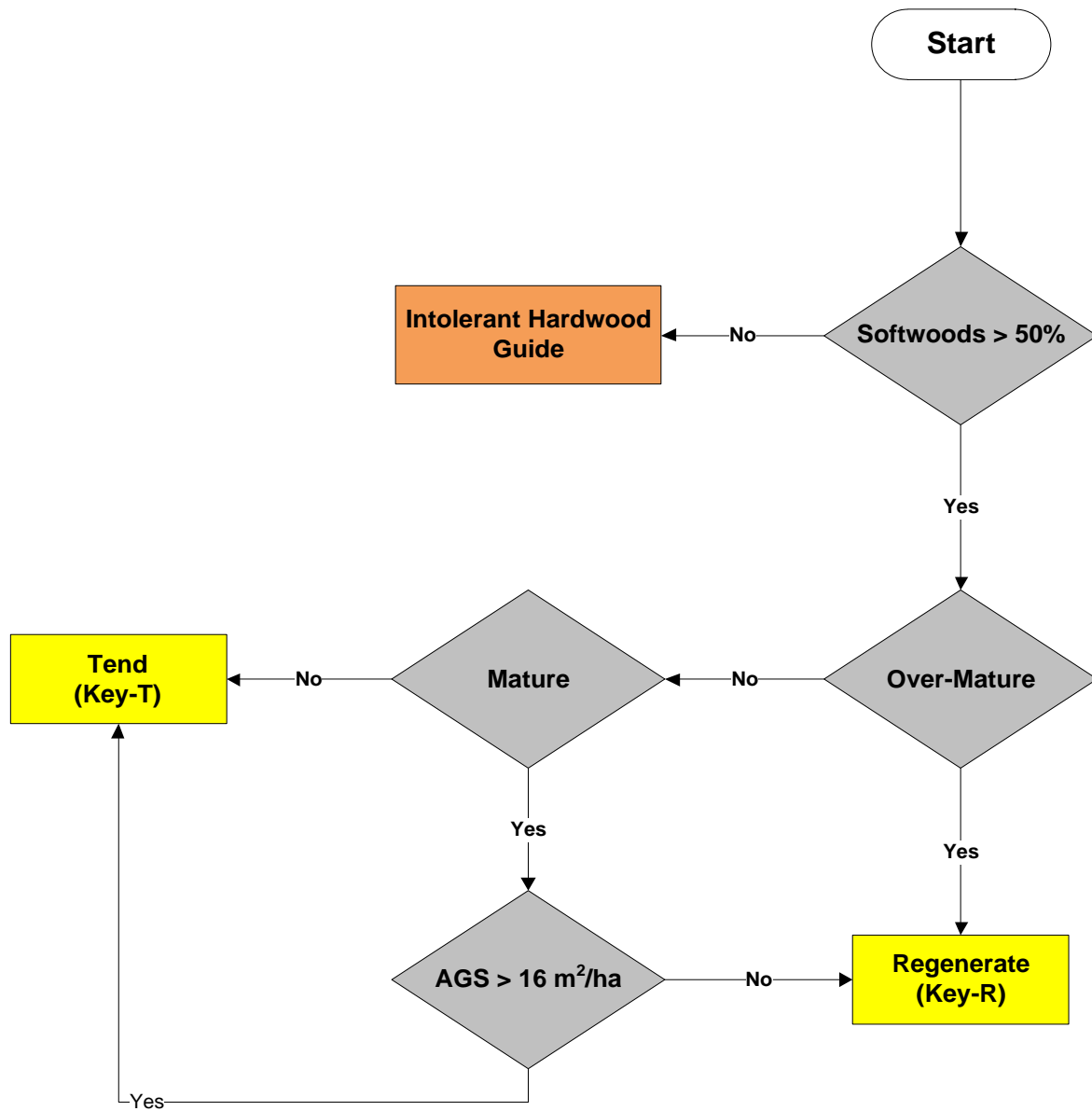
## Management Considerations

Old Fields are even-aged early successional stands, but often contain remnants of their original stand type especially where seed source trees are nearby. Old Fields that contain adequate remnant seed source or regenerating shade tolerant and long lived species such as sugar maple could benefit from a Restoration Shelterwood to accelerate the succession towards their original condition. Shelterwood treatments have not been successful in regenerating white spruce when it appears in pure stands on old fields.

White spruce growing on these old-field sites is typically shorter lived than white spruce found growing in Acadian forested sites. White spruce does not typically form pure stands in other forest groups except for the Coastal CO7 White spruce/ Bayberry vegetation type. Old Field white spruce on old fields is especially susceptible to bark beetle at a relatively young age and can quickly succumb to severe infestations.

These sites may be a natural choice for intensive (timber-based) forest management as the natural site composition and processes have already been altered by farming. Site preparation, planting and weed control could be used where insufficient long-lived tolerant seed source or advanced regeneration occurs.

# Old Field Management Guide Key M - Main





## KEY OF-M – Main

### Instructions and Definitions for:

#### Decision Diamonds

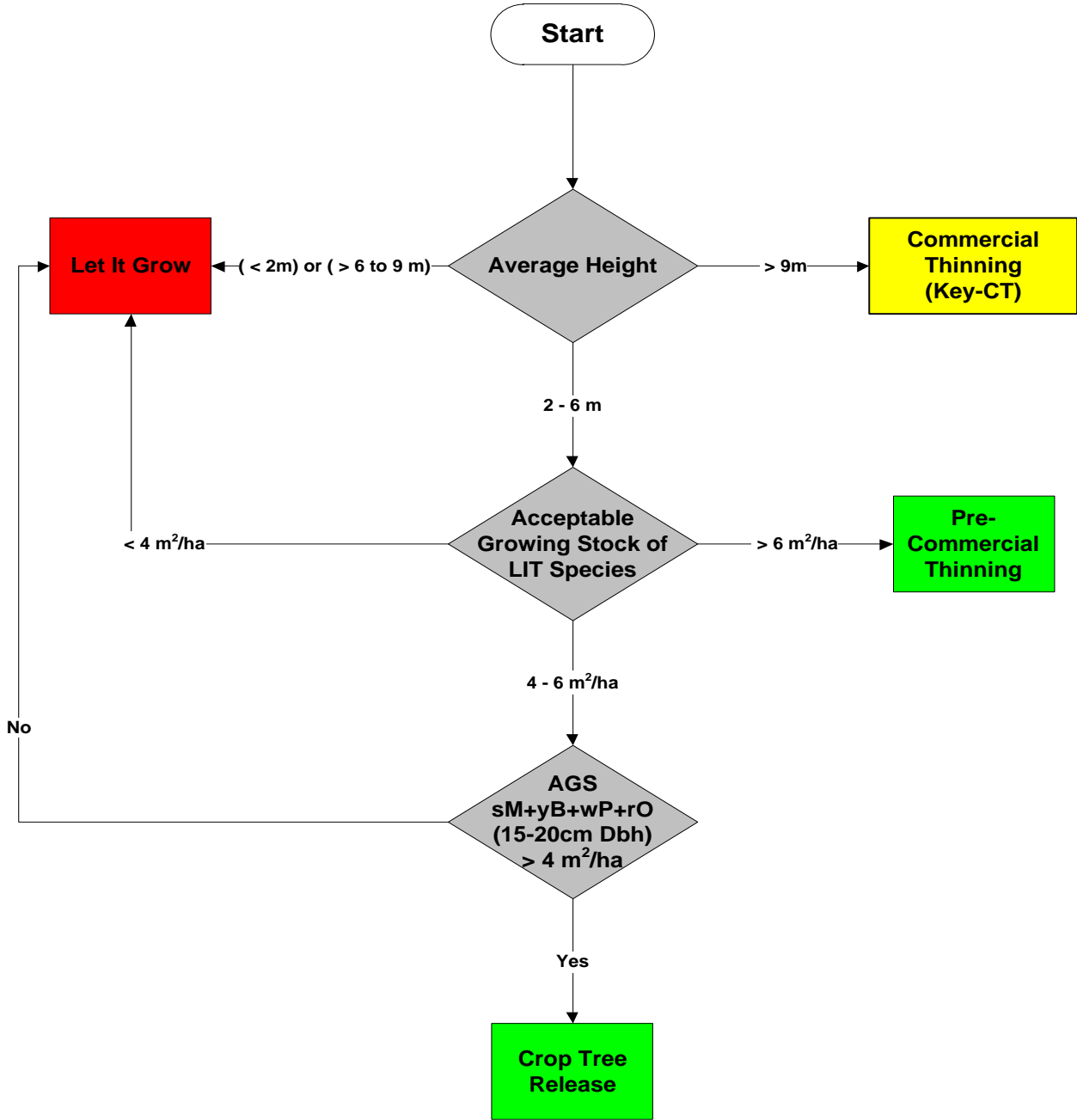
- **Softwoods > 50%** – Is the stand made of more than 50% softwood (by basal area)?
- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Mature** – Is the overstory predominantly mature in terms of producing adequate seed for regeneration (Table 3)?
- **AGS > 16 m<sup>2</sup>/ha** – Is the basal area of **Acceptable Growing Stock (AGS<sup>x</sup>)** greater than 16 m<sup>2</sup>/ha?

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<sup>x</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest..

# Old Field Management Guide

## Sub-Key T - Tend



## SUB-KEY OF-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres? Is it less than 2 m, greater than 6 m to 9 m, between 2 and 6 m or greater than 9 m?
- **Acceptable Growing Stock of LIT Species** – What is the basal area in m<sup>2</sup>/ha of **Acceptable Growing Stock (AGS<sup>Y</sup>)** of **Long-lived Intermediate to Tolerant (LIT<sup>Z</sup>)** species? Is it less than 4 m<sup>2</sup>/ha, between 4 and 6 m<sup>2</sup>/ha, or greater than 6 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 4 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 4 m<sup>2</sup>/ha?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m apart. Only trees touching the crowns of crop trees are to be cut; remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at least every 3 m), a uniform pre-commercial thinning is appropriate.

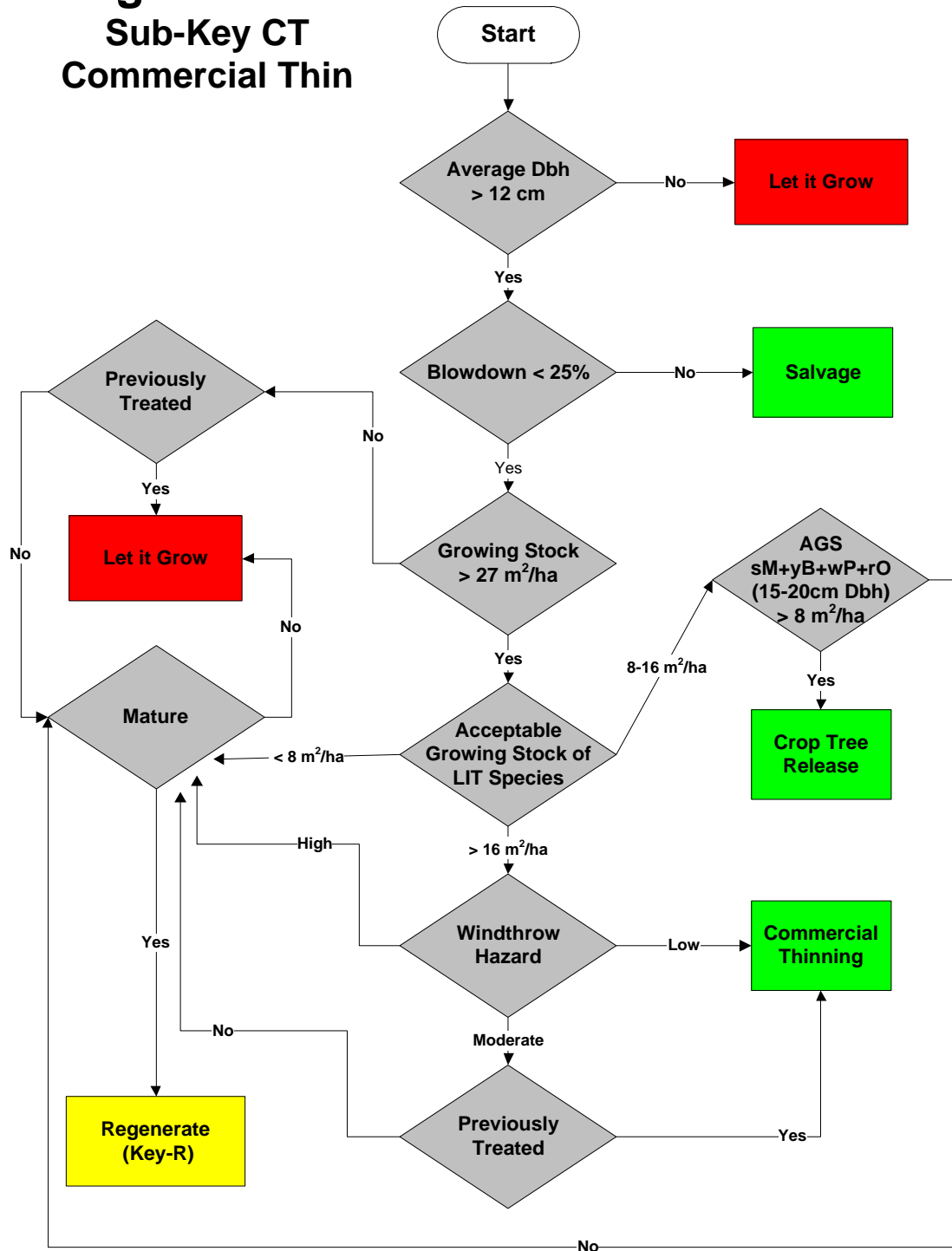
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<sup>Y</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>Z</sup> **LIT species** – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Old Field Management Guide

## Sub-Key CT Commercial Thin



# SUB-KEY OF-CT – Commercial Thinning

## Instructions and Definitions for:

### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class  $\geq 10$  cm) greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Acceptable Growing Stock of LIT species** – What is the basal area in m<sup>2</sup>/ha of **Acceptable Growing Stock (AGS<sup>AA</sup>)** of **Long-lived Intermediate to Tolerant species (LIT<sup>BB</sup>)**? Is it less than 8 m<sup>2</sup>/ha, between 8 and 16 m<sup>2</sup>/ha, or greater than 16 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 8 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 8 m<sup>2</sup>/ha?
- **Windthrow Hazard** – Is the windthrow hazard Low, Moderate or High (refer to Table 2)?
- **Mature** – Is the overstory predominantly mature in terms of producing good seed crops, necessary for natural regeneration (Table 3)?

### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m apart. Only trees touching the crowns of crop trees are to be cut; remaining trees to be left standing
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.

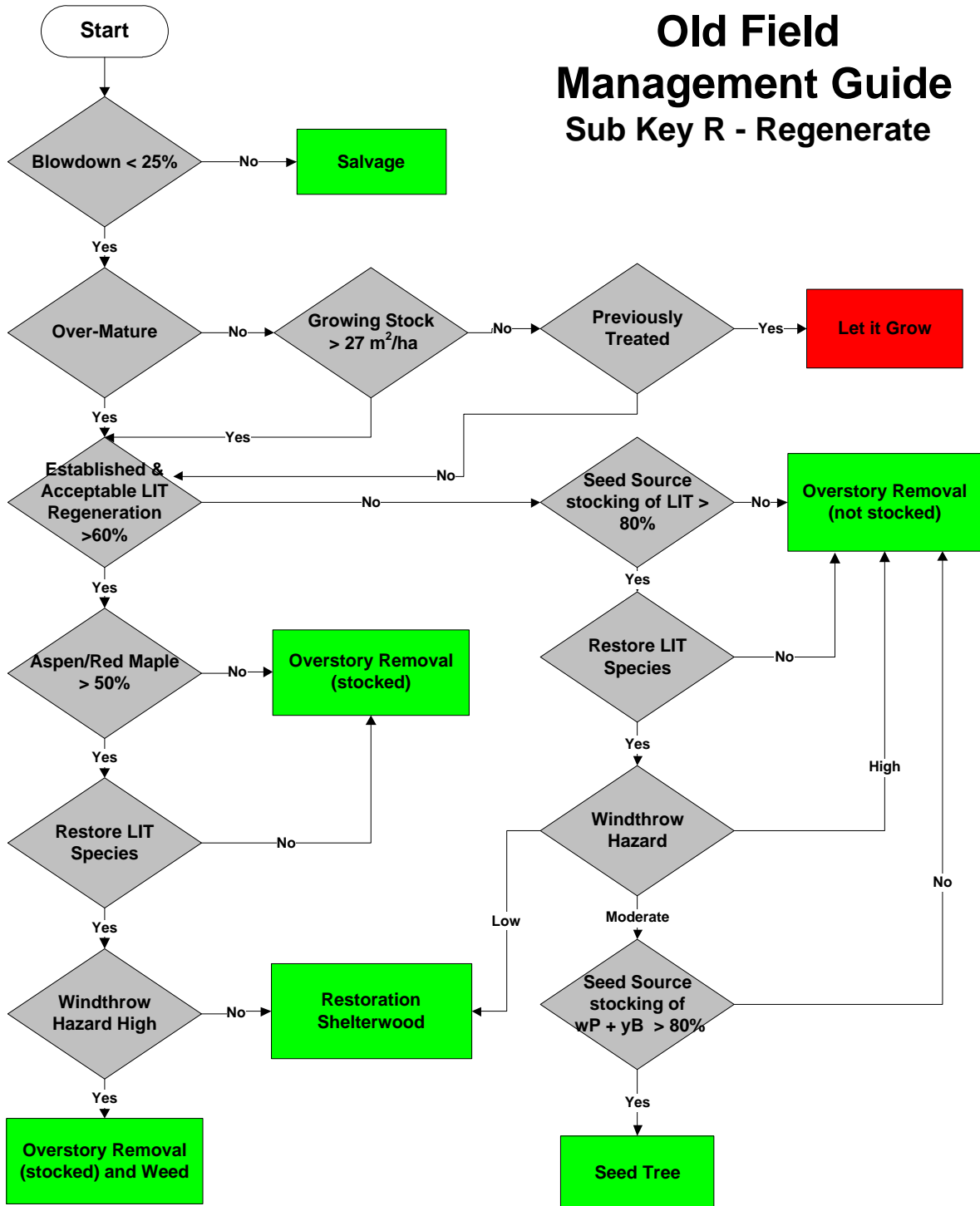
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<sup>AA</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>BB</sup> **LIT species** – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Old Field Management Guide

## Sub Key R - Regenerate



## SUB-KEY OF-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the total basal area (of trees with Dbh class  $\geq$  10 cm) greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Established and Acceptable LIT Regeneration > 60%** – Is the stocking to acceptable established<sup>CC</sup> of Long-lived Intermediate to Tolerant species (LIT<sup>DD</sup>) regeneration greater than 60% (at 2.4 m spacing)?
- **Windthrow Hazard** – Is the windthrow hazard low, moderate, or high (refer to Table 2)?
- **Seed Source Stocking of LIT > 80%** – Is the stocking (to 20 m spacing) of seed source trees of Long-lived Intermediate to Tolerant (LIT<sup>BB</sup>) species greater than 80%?
- **Aspen/Red Maple > 50%** – Is the % of Aspen<sup>EE</sup> and Red Maple basal area combined more than 50% of the total basal area of the stand?
- **Restore LIT Species** – Is one of the objectives of this harvest to restore Long-lived Intermediate to Tolerant (LIT<sup>BB</sup>) species?
- **Seed Source Stocking of wP + yB > 80%** – Is the stocking (to 20 m spacing) of seed source trees of white pine and yellow birch combined greater than 80%?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Let it grow** – Let the stand grow and re-evaluate later.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. See Table 5 for plantation recommendations.
- **Overstory Removal (stocked) & Weed** – Remove overstory and weed competing species to insure establishment of LIT regeneration. Protect advanced regeneration during harvesting operation.
- **Restoration Shelterwood** – Uniformly thin overstory to produce light conditions suited for intermediate to tolerant shade-tolerant late-succession species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from leave strips, when regenerating shade tolerant species (sugar maple, red spruce or eastern hemlock). If intermediate shade tolerant species such as yellow birch, white ash, red oak or white pine is predominant, remove 40% basal area from the leave strips (Table 3). Care must be taken to leave wind firm trees of seed bearing age of intermediate to tolerant shade-tolerant, late-succession species as a seed source for natural regeneration.
- **Seed Tree** – Leave well-distributed, wind-firm seed trees throughout the stand. Where white pine regeneration is desired, leave 15-35 trees/ha. For yellow birch regeneration, leave 8-15 trees/ha. White Pine and Yellow Birch regenerate best on exposed mineral soil. Scarification to produce mineral soil micro-sites will enhance regeneration of these species.

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<sup>CC</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.

<sup>DD</sup> LIT species - Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak, and white ash (Table 3).

<sup>EE</sup> Aspen – Includes Trembling Aspen, Large tooth Aspen and Balsam Poplar.





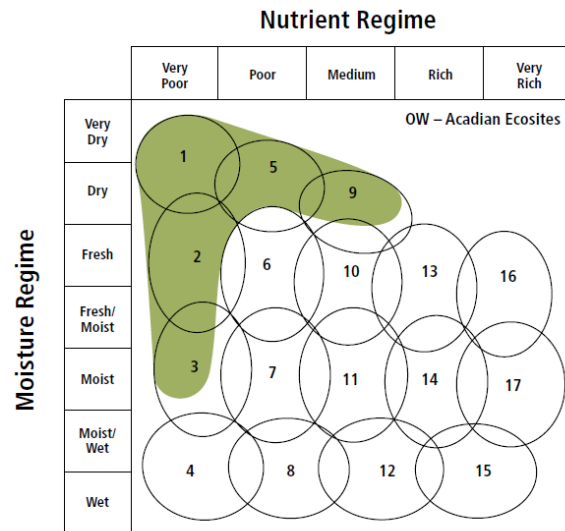
# Open Woodland (OW) Management Guide

## Forest Group Characteristics

The Open Woodland Forest Group is characterized by sites that naturally limit growth and tree density. Tree cover is usually less than 30%. These types have low productivity; often with stunted growth and occur on very poor and/or very dry sites. Fertility is limited due to conditions such as shallow soils and talus slopes (Neily et al., 2013).

The Open woodland vegetation types are either uncommon to Nova Scotia or unique to Nova Scotia or the Maritimes.

A variety of tree species grow in these types including most frequently, pines, black spruce and red oak.



## Management Considerations

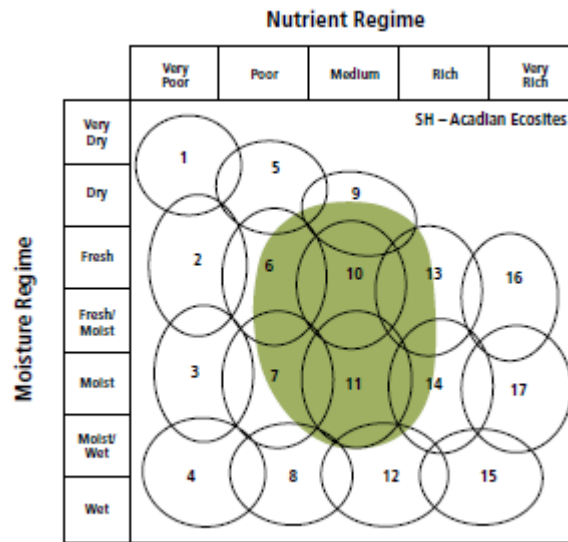
Harvesting in Open Woodlands is not common due to the low productivity and standing volumes. It is not recommended to harvest these types due to their unique habitat features and inoperability due to low timber volumes.



# Spruce Hemlock (SH) Management Guide

## Forest Group Characteristics

Spruce Hemlock vegetation types contain mid to late successional stands. The late successional types are dominated by long lived, shade tolerant red spruce and/or eastern hemlock. These stands can form un-even-aged characteristics between stand replacement disturbances. The mid-successional SH types are dominated by shorter lived species such as balsam fir and white spruce and are usually even-aged stands. The SH Forest Group occurs on medium fertility fresh to moist sites.



## Management Considerations

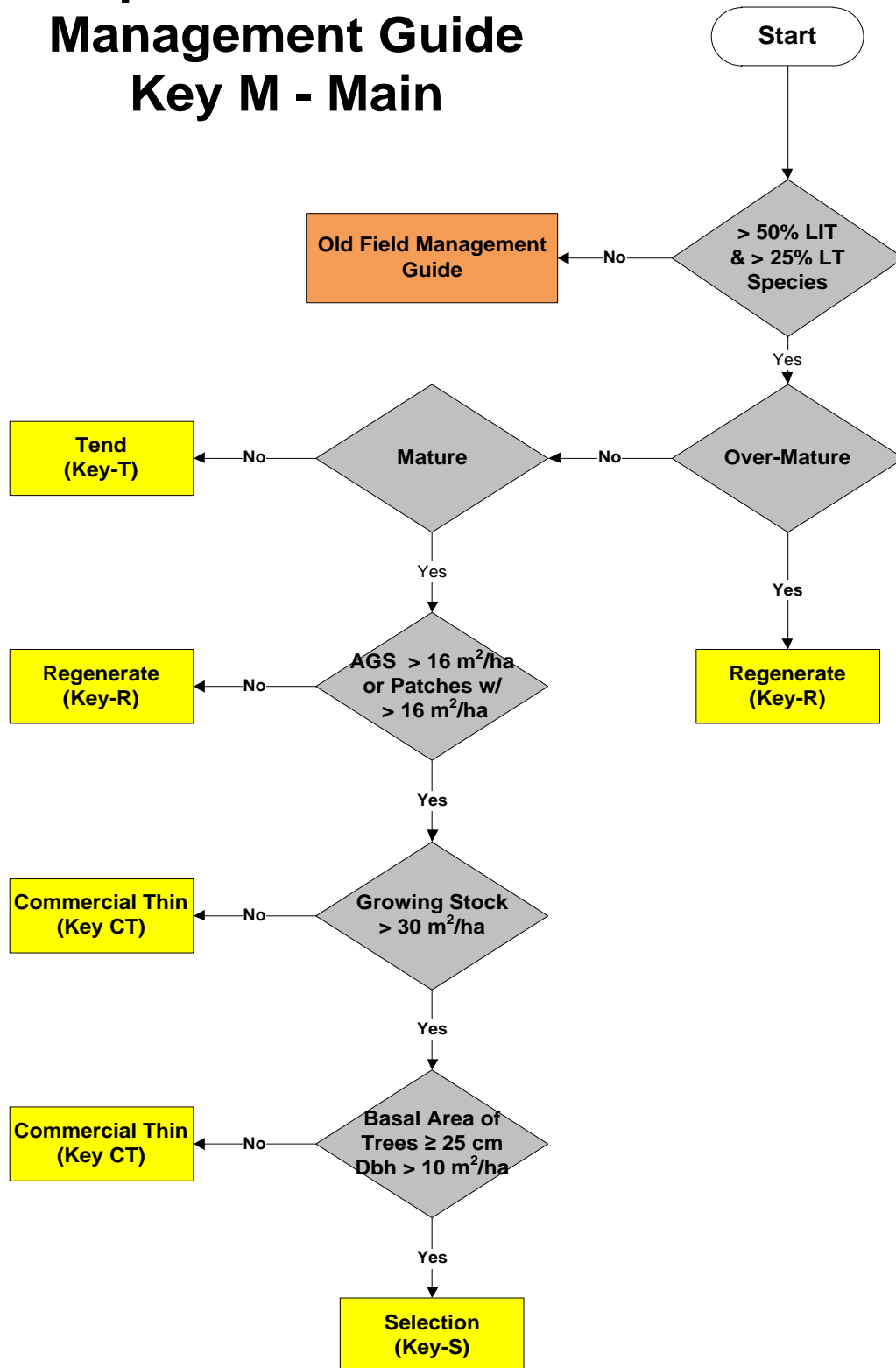
The Spruce Hemlock (SH) vegetation types generally occur on medium fertility sites and are mainly dominated by red spruce. Spruce Pine (SP) vegetation types, on the other hand, are associated with black spruce on poor sites. Since red spruce are long-lived and more tolerant of shade than black spruce, they are more suited to uneven-aged management. Red spruce hybridizes with black spruce, complicating the selection of the appropriate keys. This will have implications on the selection of the appropriate prescription. If hybrid spruces are found on medium fertility sites, they are to be treated like red spruce and the SH guide applies. When hybrids are found on poor sites (e.g. high cover of ericaceous<sup>32</sup> vegetation and bracken fern), they are to be treated as black spruce where the SP guide applies. For information on identifying black spruce, red spruce and hybridization between them refer to Manley (1971).

Caution is required in carrying out partial harvesting methods, such as commercial thinning and selection harvesting in SH stands due to their susceptibility to windthrow. Red spruce and to a lesser extent hemlock, balsam fir and white spruce are shallow rooting species. Shallow soils, stony phase soils, wet soils or exposed sites are especially susceptible to blowdown. In all cases, where partial harvesting is carried out in this vegetation type, removal levels should be limited and un-thinned buffers should be considered along stand boundaries.

In almost all SH stands, balsam fir and or red maple are a component. When regenerating SH stands by removing overstories, early successional species such as balsam fir and red maple sprouts are favoured due to their prolific seeding and in the case of red maple, vigorous sprouting. Competition control is necessary to regenerate late succession species such as red spruce and eastern hemlock when regenerating with overstory removals. This can be accomplished with weeding and/or cleaning stands.

<sup>32</sup> **Ericaceous species** – plants in or related to the heath family (*Ericaceae*) usually found on acidic (nutrient poor) soils including lambkill (*Kalmia angustifolium*), *Vaccinium* spp., e.g. blueberry, rhodora (*Rhododendron canadense*), and huckleberry (*Gaylussacia baccata*).

# Spruce Hemlock Management Guide Key M - Main



## KEY SH-M – Main

### Instructions and Definitions for:

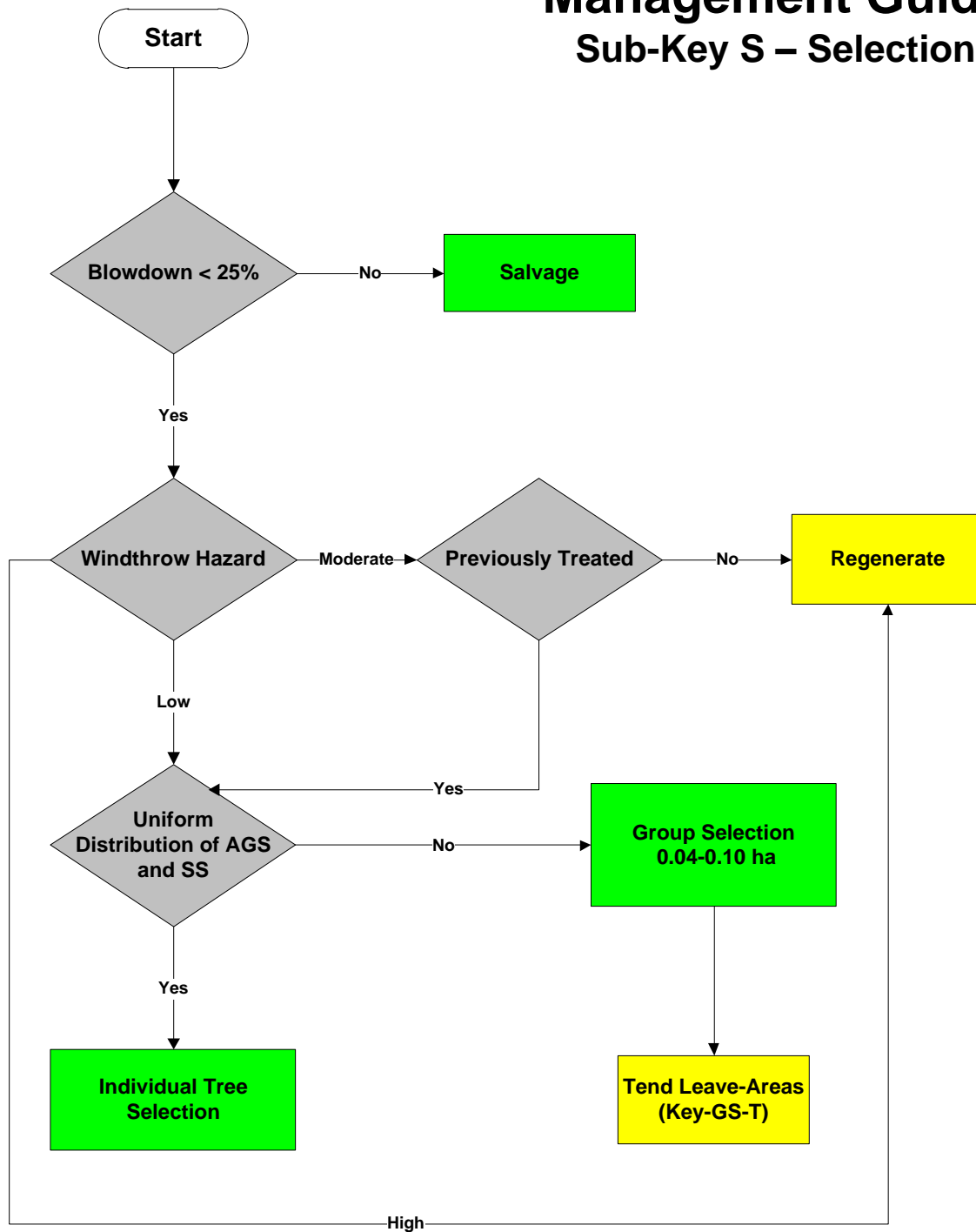
#### Decision Diamonds

- **> 50% LIT & > 25% LT Species** – Is the stand made up of more than 50% Long-lived Intermediate to Tolerant (**LIT**) species including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash and more than 25% Long-lived Tolerant (**LT**) species, including red spruce, eastern hemlock and sugar maple (as a % of stand basal area)?
- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Mature** – Is the overstory predominantly mature in terms of being able to produce adequate seed for regeneration (Table 3)?
- **AGS > 16 m<sup>2</sup>/ha or Patches w/ AGS > 16 m<sup>2</sup>/ha** – Is the basal area of Acceptable Growing Stock (**AGS<sup>GG</sup>**) greater than 16 m<sup>2</sup>/ha? or does the stand have patches of mature trees to be harvested intermixed with patches in different areas of smaller AGS worthy of tending? The amount of AGS in the unharvested patches must be greater than 16 m<sup>2</sup>/ha.
- **Growing Stock > 30 m<sup>2</sup>/ha** – Is the total basal area (of trees in Dbh class ≥ 10cm) greater than 30 m<sup>2</sup>/ha?
- **Basal Area of Trees ≥ 25 cm Dbh > 10 m<sup>2</sup>/ha** – Is there more than 10 m<sup>2</sup>/ha of trees with Diameter at Breast Height (Dbh) class ≥ 25 cm?

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<sup>GG</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwood) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Spruce Hemlock Management Guide Sub-Key S – Selection



## SUB-KEY SH-S – Selection

### Instructions and Definitions for: Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Windthrow Hazard** – Is the windthrow hazard Low, Moderate or High (refer to Table 2)?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Uniform distribution of AGS and SS** – Is the **Acceptable Growing Stock (AGS<sup>HH</sup>)** and the **Sawlog /Seed Stock** (trees with Dbh class  $\geq 25\text{cm}$ , **SS**) uniformly distributed throughout the stand?

### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Individual Tree Selection** – Individual Tree Selection involves a thinning across all size classes throughout the stand. This is done to create a diameter class distribution suitable for sustaining a periodic harvest of suitable trees over relatively short harvesting cycles (10-20 years). The objective is to create conditions suitable for regeneration of preferred species at each entry while also improving the growing stock by releasing the highest quality immature trees. Basal area removals of 30% from leave strips are recommended, especially where regenerating shade tolerant species is desired. Trail widths should be left to a minimum and distance between trails maximized to avoid windthrow. Shade tolerant regeneration, such as red spruce, eastern hemlock and sugar maple are favoured.
- **Group Selection** – Group Selection involves identifying areas within the stand that are suitable for harvesting or regeneration because they are predominantly mature or contain non-commercial trees. These areas are to be cleared to create conditions suitable for preferred regeneration. Areas predominantly AGS are to be left. They can be tended using pre-commercial thinning, commercial thinning or crop tree release methods. Intermediate shade tolerance regeneration of white pine, white spruce (forest), yellow birch and red oak are favoured.

Harvest Patch Dimensions.					
Area		Circular Radius		Square Side Length	
(ha)	(acre)	(m)	(ft)	(m)	(ft)
<b>0.04</b>	<b>0.10</b>	<b>11</b>	<b>37</b>	<b>20</b>	<b>66</b>
<b>0.10</b>	<b>0.25</b>	<b>18</b>	<b>59</b>	<b>32</b>	<b>104</b>

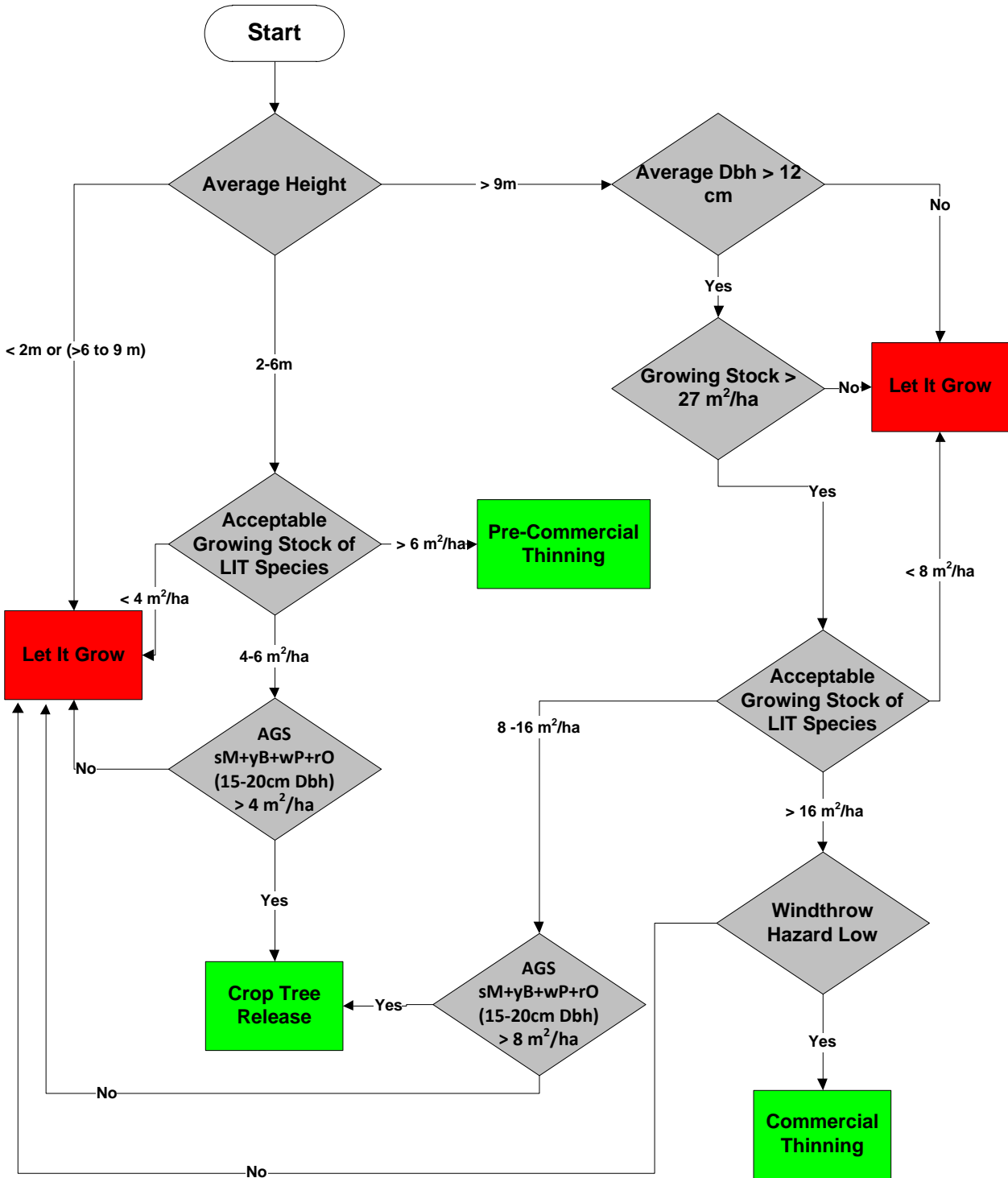
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<sup>HH</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwood) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Spruce Hemlock Management Guide

## Sub-Key GS-T

### Tending of Leave Areas in Group Selection





## SUB-KEY SH- GS-T – Tending of leave areas in Group Selections

*These questions refer to the only leave areas of the stand.*

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres in the leave areas? Is it less than 2 m or greater than 6 and less than 9 m, between 2 and 6 m or greater than 9 m?
- **Acceptable Growing Stock of LIT Species** – *when height between 2 and 6 metres* - What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>II</sup>) of Long-lived Intermediate to Tolerant (LIT<sup>JJ</sup>) species in the leave-area? Is it less than 4 m<sup>2</sup>/ha, between 4 and 6 m<sup>2</sup>/ha, or greater than 6 m<sup>2</sup>/ha? - *when height is greater than 9 metres* - Is it less than 8 m<sup>2</sup>/ha, between 8 and 16 m<sup>2</sup>/ha, or greater than 16 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 4 m<sup>2</sup>/ha** - *when height between 2 and 6 metres* Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 4 m<sup>2</sup>/ha in the leave-area?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 8 m<sup>2</sup>/ha** - *when height is greater than 9 metres* Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 8 m<sup>2</sup>/ha in the leave-area?
- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees ≥10 cm Dbh class) in the leave-area?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class ≥ 10 cm) greater than 27 m<sup>2</sup>/ha in the leave-area?

#### Management Prescriptions

- **Let it grow** – Let the leave-areas grow and re-evaluate later.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist in the leave-areas, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30 ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist in the leave-areas, uniformly distributed throughout the stand (on average at most every 3 m (10 ft)), a uniform pre-commercial thinning is appropriate.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly in the leave-areas thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.

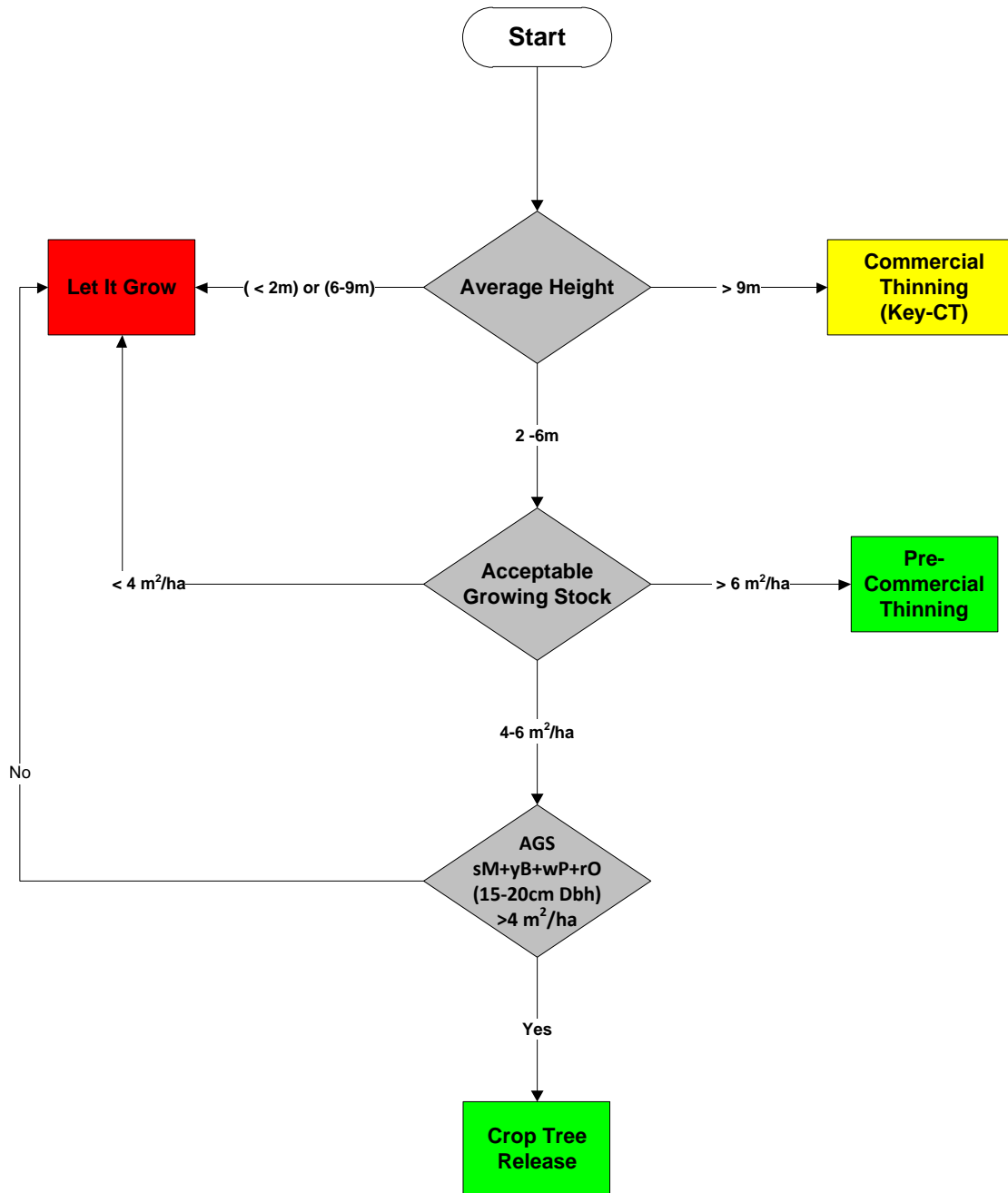
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<sup>II</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>JJ</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Spruce Hemlock Management Guide

## Sub-Key T - Tend



## SUB-KEY SH-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres? Is it less than 2 m or between 6m to 9 m, between 2 and 6 m or greater than 9 m?
- **Acceptable Growing Stock** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>KK</sup>)?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 4 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 4 m<sup>2</sup>/ha?

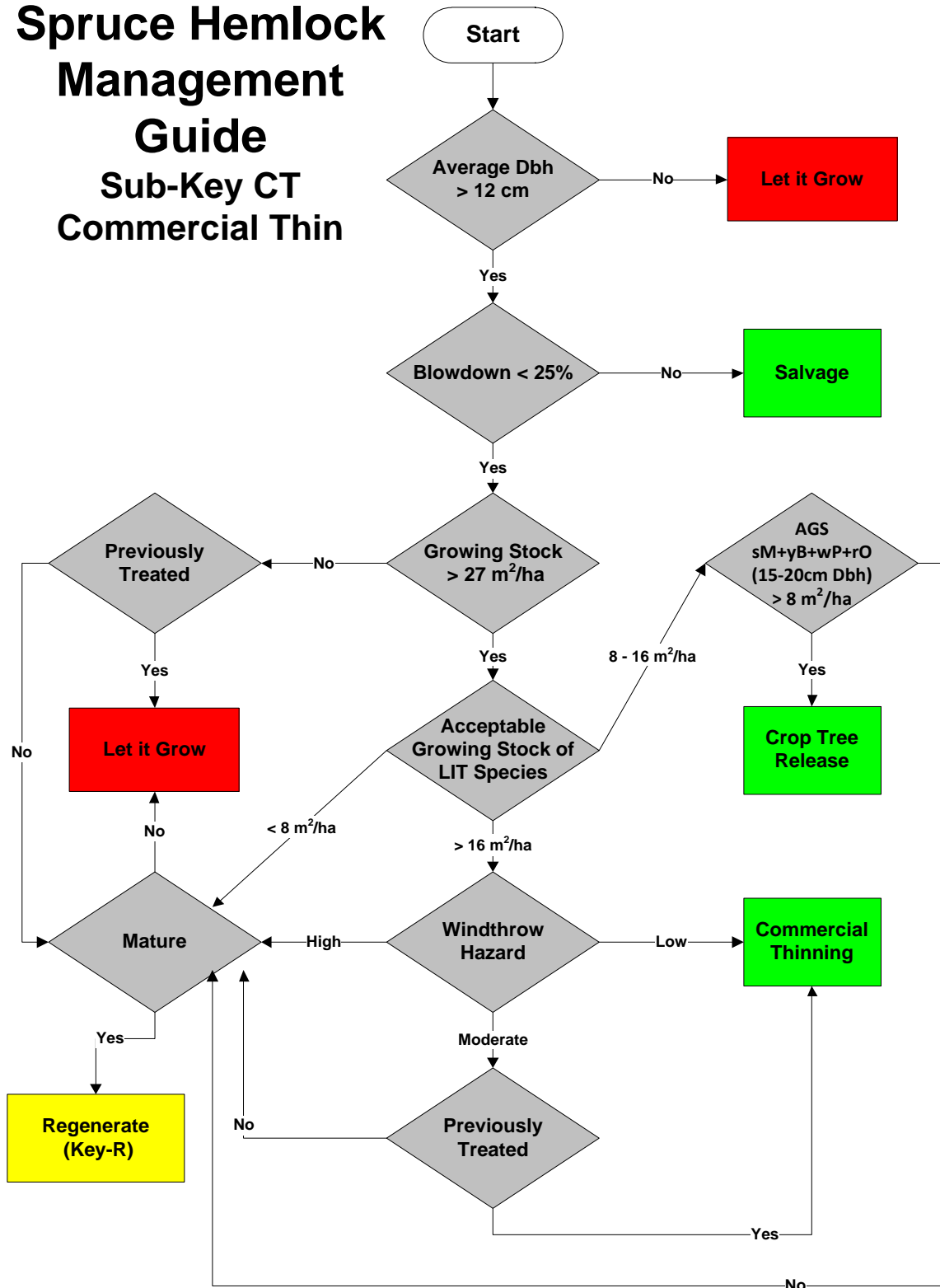
#### Management Prescriptions

- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30 ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of **AGS** exist uniformly distributed throughout the stand (on average at most every 3 m), a uniform pre-commercial thinning is appropriate.
- **Let it grow** – Let the stand grow and re-evaluate later.

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<sup>KK</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwood) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Spruce Hemlock Management Guide Sub-Key CT Commercial Thin



## SUB-KEY SH-CT – Commercial Thinning

### Instructions and Definitions for: Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class  $\geq 10$  cm) greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Acceptable Growing Stock of LIT species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>LL</sup>) of Long-lived Intermediate to Tolerant species (LIT<sup>MM</sup>). Is it less than 8 m<sup>2</sup>/ha, between 8 and 16 m<sup>2</sup>/ha or greater than 16 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 8 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 8 m<sup>2</sup>/ha?
- **Windthrow Hazard** – Is the windthrow hazard Low, Moderate or High (Table 2)?
- **Mature** – Is the overstory predominantly mature in terms of producing good seed crops, necessary for natural regeneration (Table 3)?

### Management Prescriptions

- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.
- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.

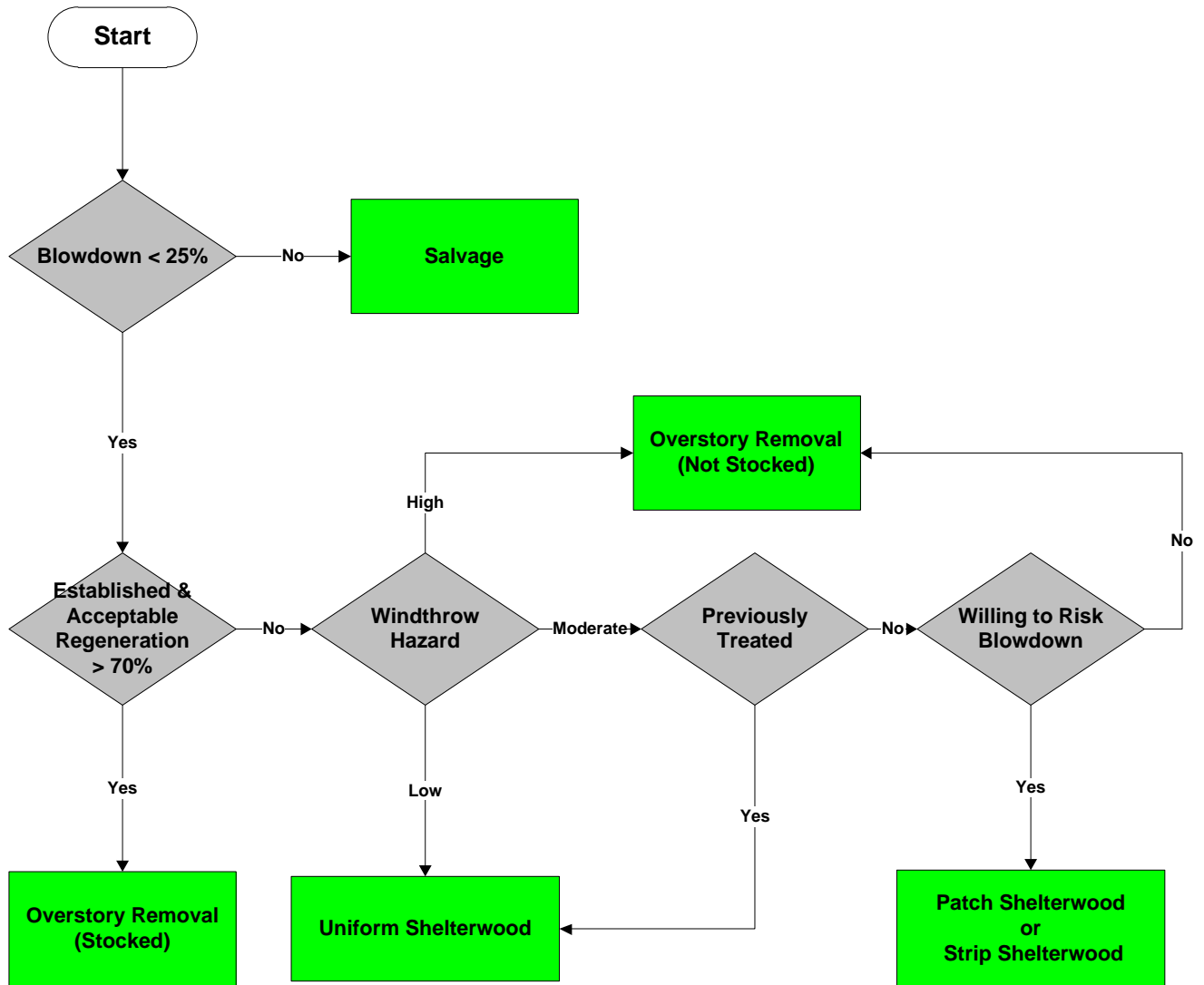
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<sup>LL</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwood) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>MM</sup> **LIT species** – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash.

# Spruce Hemlock Management Guide

## Sub Key R - Regenerate



## SUB-KEY SH-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>NN</sup> regeneration greater than 70% (at 2.4 m spacing)?
- **Windthrow Hazard** – Is the windthrow hazard low, moderate or high (Table 2)?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Willing to Risk Blowdown** – Is the landowner willing to accept risk of losing leave trees to windthrow before regeneration established?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to ensure successful plantation establishment. See Table 5 for plantation recommendations.
- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from leave strips, when regenerating shade tolerant species (sugar maple, red spruce or eastern hemlock). If intermediate shade tolerant species such as yellow birch, white ash, red oak or white pine is predominant, remove 40% basal from the leave strips.
- **Patch Shelterwood** – Small groups of trees are cut uniformly throughout the stand without tending the unharvested areas, as there is not sufficient immature Acceptable Growing Stock. The main objective is to create the conditions to regenerate the desired species and to harvest the Sawlog Stock before it becomes overmature. Openings are to be 0.04-0.1ha and up to 35% of the area is to be harvested in patches.
- **Strip Shelterwood** – Harvest strips to produce shade requirements necessary to regenerate desired species. Leave at least 2 strips unharvested between harvested strips. Strips are to be 1 tree height in width.

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<sup>NN</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.





# Spruce – Pine (SP) Management Guide

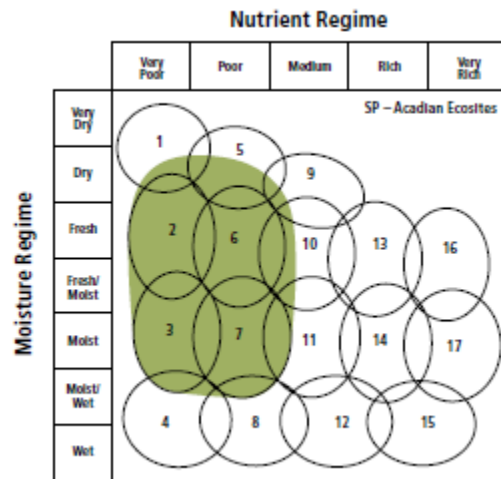
## Forest Group Characteristics

The frequent occurrence of stand-level natural disturbances will maintain a cycle of even-aged forests in Spruce Pine (SP) stands. Thus, evidence of gap dynamics and understory recruitment is usually not common (Neily et al., 2013).

Vegetation types in the Spruce-Pine forest group are often associated with sandy soils, shallow soils over bedrock and outcrops and stony sites. A wide range of soil moisture levels can be found and fertility is generally poor throughout. Spruce-pine vegetation types cover a range of successional stages, but typically lead to an edaphic<sup>OO</sup> climax dominated by black spruce, white pine or red oak.

## Management Considerations

Spruce Pine stands are suited to even-aged forest management. These treatments can include clearcut harvesting, seed trees, or shelterwoods. Stand tending and commercial thinning can also be prescribed to improve stand quality on the better Ecosites.



Since SP types occur primarily on very poor to poor ecosites, economic returns from intensive forest management such as plantation establishment are limited. Stands that are planted can increase production compared to untreated stands but gains are limited due to the lengthy response to such treatments. The establishment of plantations on any site is expensive and is usually reserved for the most productive sites. Natural regeneration should be considered the first choice for re-establishment of a SP forest stand. Those SP types dominated by black spruce are especially susceptible to windthrow because of their shallow rooting. Caution is warranted if conducting Commercial Thinning or shelterwoods in this Forest Group. If stands are productive enough to support red spruce-hemlock, the Spruce Hemlock (SH) forest management guide should be used.

In the SP group, fire and windthrow can occur frequently as stand-level natural disturbances resulting in the establishment of a new stand. Succession on these low fertility ecosites is less complex with stand-level disturbances creating even-aged forests of similar species. The removal of fire in the ecosystem due to fire suppression will require forest managers to consider duff thickness management and ericaceous vegetation control in their management prescriptions.

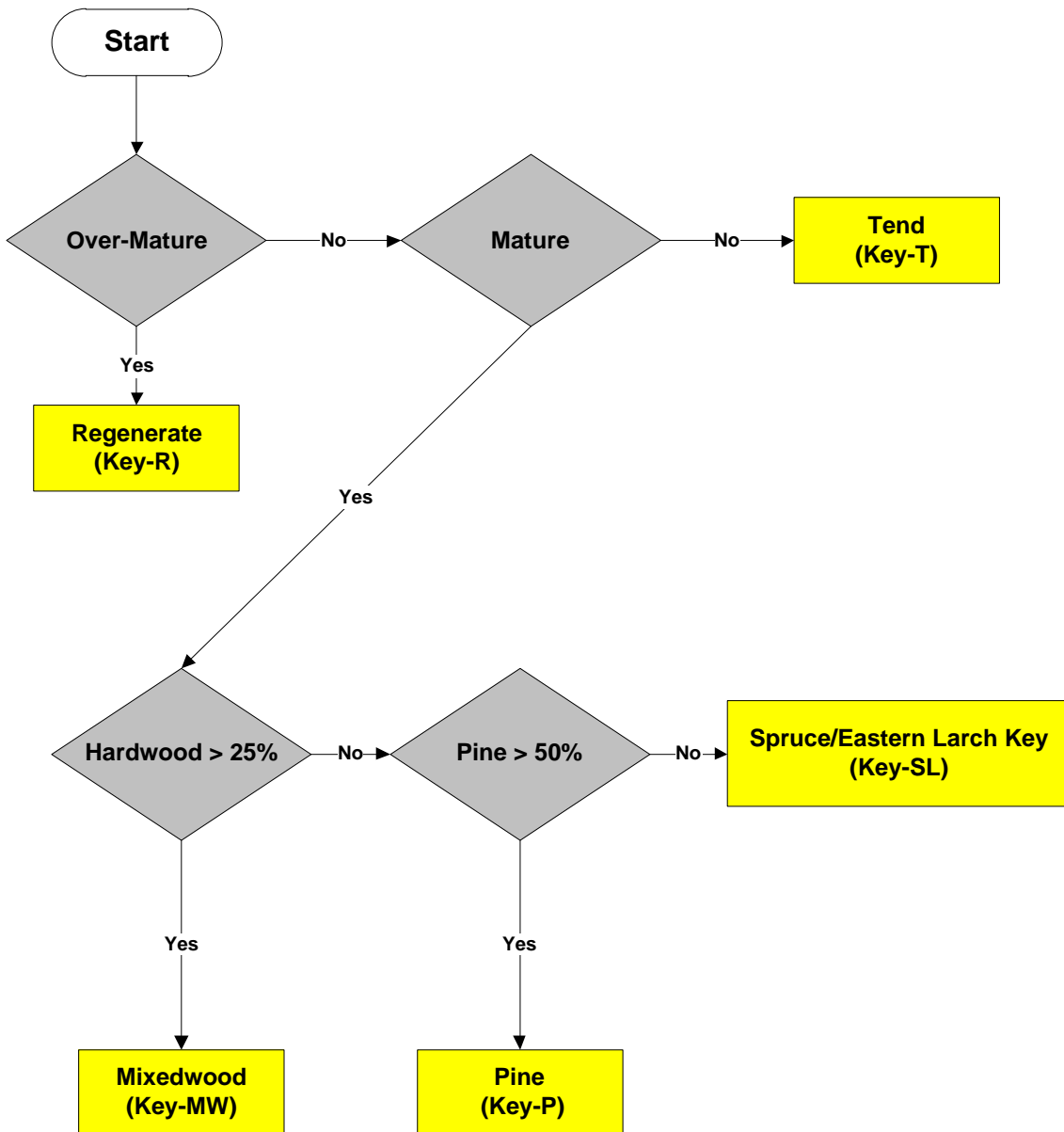
## Hybridized Spruce

Red spruce and black spruce will produce hybrid off-spring that have traits of both species. The potential for hybridization occurs where ecosites AC6 and AC7 overlap with ecosites AC10 and AC11. Hybridized spruce is less nutrient demanding than red spruce. It is important to recognize hybrid spruce since the SP management interpretations use even-aged systems and not the uneven-aged systems more appropriate for the Spruce – Hemlock Group. Site features are often helpful in recognizing hybrid spruce. Sites of lower fertility are often associated with soils derived from coarse sandstones and granites, occur on soils shallow to bedrock, and have soils that are either rapidly and/or imperfectly drained. A significant coverage to ericaceous species<sup>PP</sup> and bracken fern can also be used to indicate less fertile sites. An abundance of pine may also indicate lower fertility. To use these Forest Management Guides, hybrid spruce must be called either black spruce or red spruce, depending on site-characteristics.

<sup>OO</sup> **Edaphic** – refers to the influence of soil and site conditions on plant growth. It is used to express the dominance of site over climate in vegetation development. An edaphic climax forest community cannot progress to the zonal (normal) climatic climax due to local limitations in site condition.

<sup>PP</sup> **Ericaceous species** – plants in or related to the heath family (*Ericaceae*) usually found on acidic (nutrient poor) soils including lambkill (*Kalmia angustifolium*), *Vaccinium* spp., e.g. blueberry, rhodora (*Rhododendron canadense*), and huckleberry (*Gaylussacia baccata*).

# Spruce Pine Management Guide Key M - Main



## KEY SP-M – Main

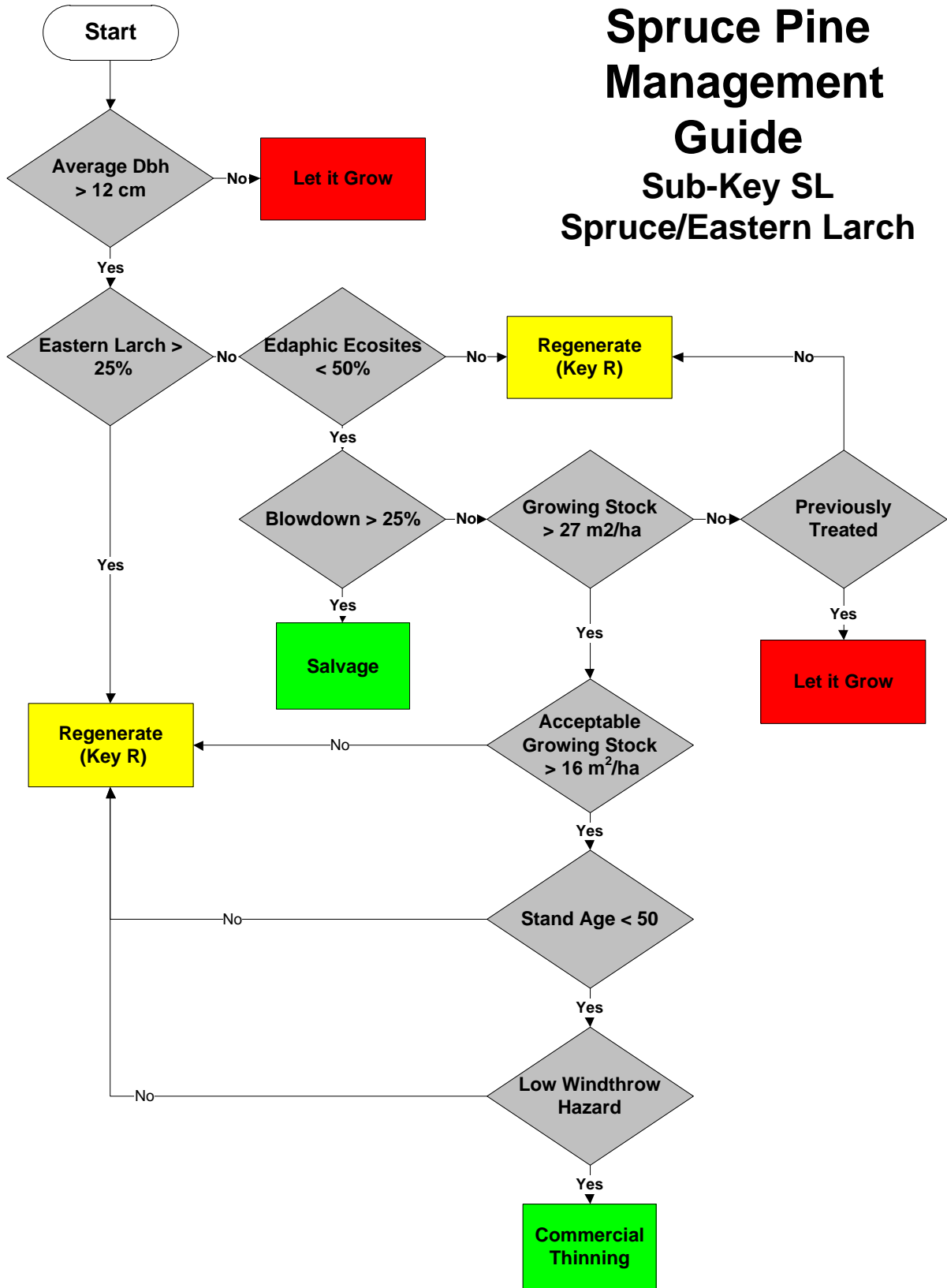
### Instructions and Definitions for:

#### Decision Diamonds

- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Mature** – Is the overstory predominantly mature in terms of producing adequate seed for regeneration (Table 3)?
- **Hardwood > 25%** – Is the stand made up of more than 25% hardwood species (as a % of stand basal area)?
- **Pine > 50%** – Is the stand made up of more than 50% pine (as a % of stand basal area)?

# Spruce Pine Management Guide

## Sub-Key SL Spruce/Eastern Larch



## SUB KEY SP-SL – Spruce/Eastern Larch

### Instructions and Definitions for:

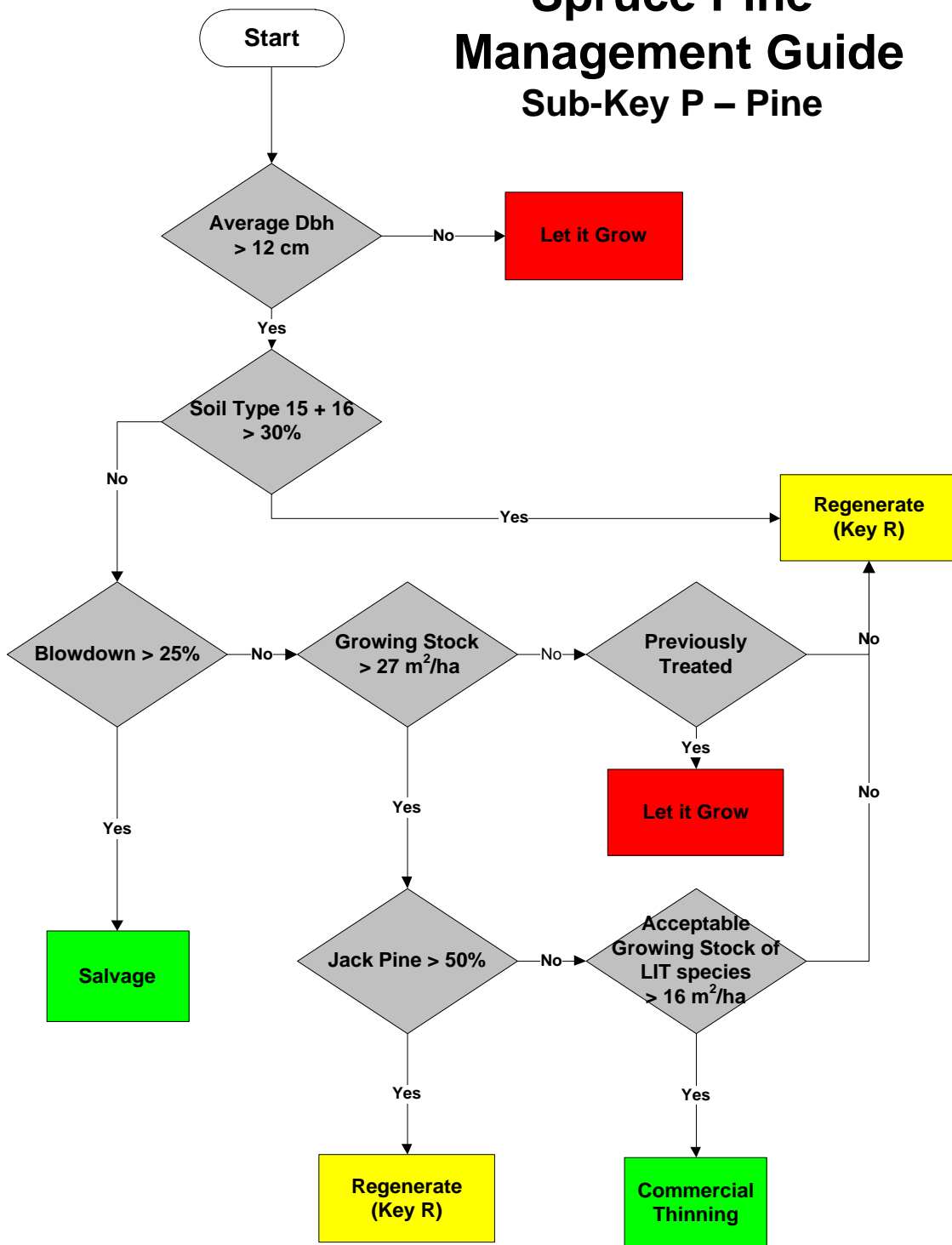
#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Eastern Larch > 25%** – Is the stand made up of more than 25% eastern larch (as a % of stand basal area)?
- **Edaphic Ecosites < 50%** – Is less than 50% of the area in edaphic ecosites (AC1-5, 8, 12, 15, Neily et al., 2013, pg. 365)?
- **Blowdown > 25%** – Are more than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area of trees greater than or equal to the 10 cm Dbh class greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Acceptable Growing Stock > 16 m<sup>2</sup>/ha** – Is the basal area of Acceptable Growing Stock (AGS) greater than 16 m<sup>2</sup>/ha?
- **Stand Age < 50** – Is the stand age less than 50 years?
- **Low Windthrow Hazard** – Is the windthrow hazard low (Table 2)?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist, uniformly thin the stand insuring the leave trees are released. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30% of the basal area from the leave strips on average sites. Catch-up will be slower on poorer sites or if more basal area is removed. The best opportunities for an economically viable commercial thinning occur on the more productive ecosites (AC6 or AC7) capable of recapturing harvested volume from the thinning in a reasonable amount of time. Age is also a factor that impacts the economic viability of commercial thinning, as over-mature stands may not recover the harvested volume. Windthrow is a concern in all partially harvested stands especially where soils are imperfectly to poorly drained or shallow to bedrock. Pine (except jack pine) and oak are deeper rooted than black spruce and less susceptible to windthrow. Commercial thinning is not recommended in eastern larch due to the natural lower stocking levels and self-thinning characteristics of this species. The objective of this treatment is not to regenerate the stand.
- **Salvage** – Remove overstory and salvage merchantable blowdown.

# Spruce Pine Management Guide Sub-Key P – Pine



## SUB KEY SP-P – Pine

### Instructions and Definitions for:

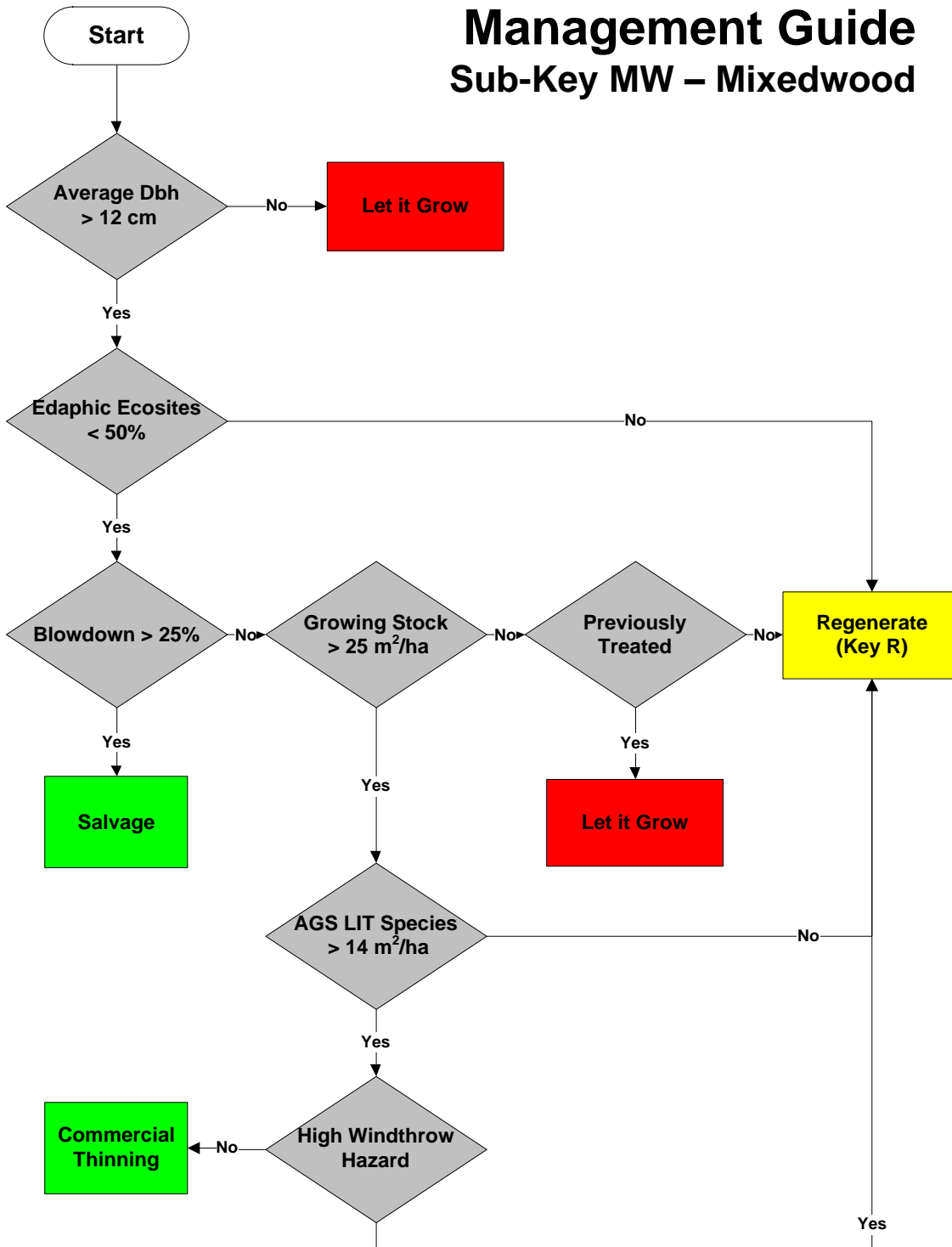
#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12 cm (trees  $\geq 10$  cm Dbh class)?
- **Soil Type 15 + 16 > 30%** – Does more than 30% of the area have shallow soil (Soil Type 15 and 16 combined, including all phases; G, S or L)?
- **Blowdown > 25%** – Are more than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area of trees greater than or equal to the 10 cm Dbh class greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Jack Pine > 50%** – Is the stand made up of more than 50% jack pine (as a % of stand basal area)?
- **Acceptable Growing Stock of LIT species > 16m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) of Long-Lived, Intermediate to Tolerant species (LIT, Table 3) greater than 16 m<sup>2</sup>/ha?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist, uniformly thin the stand insuring the leave trees are released. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30% of the basal area from the leave strips on average sites. Catch-up will be slower on poorer sites or if more basal area is removed. The best opportunities for an economically viable commercial thinning occur on the more productive ecosites (AC6 or AC7) capable of recapturing harvested volume from the thinning in a reasonable amount of time. Windthrow is a concern in all partially harvested stands especially where soils are imperfectly to poorly drained or shallow to bedrock. Pine (except jack pine) and oak are deeper rooted than black spruce and less susceptible to windthrow. The objective of this treatment is not to regenerate the stand.
- **Salvage** – Remove overstory and salvage merchantable blowdown.

# Spruce Pine Management Guide Sub-Key MW – Mixedwood





# SUB KEY SP-MW – Mixedwood

## Instructions and Definitions for:

### Decision Diamonds

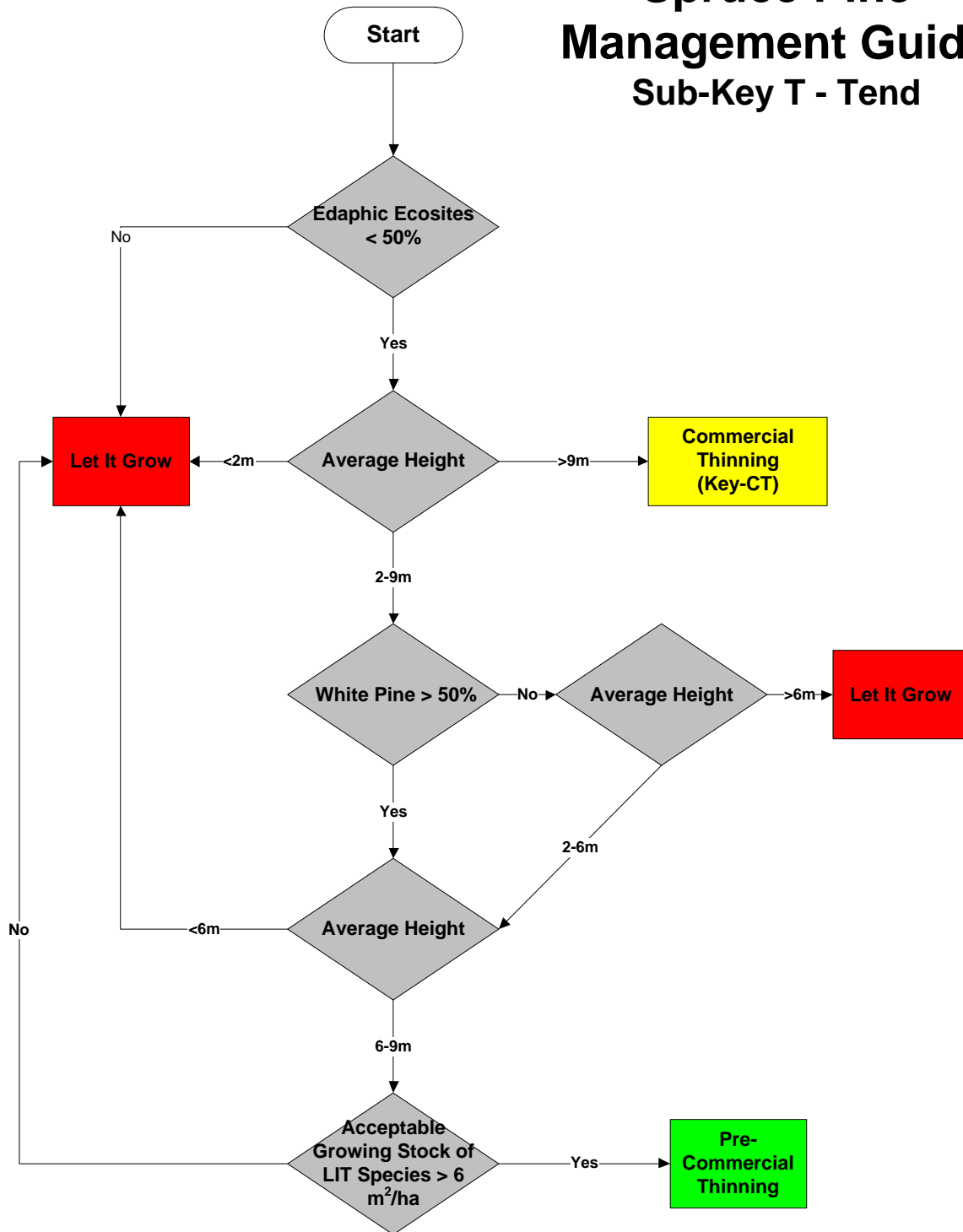
- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Edaphic Ecosites < 50%** – Is less than 50% of the area in edaphic ecosites (AC1-5, 8, 12, 15, Neily et al., 2013, pg. 365)?
- **Blowdown > 25%** – Are more than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 25 m<sup>2</sup>/ha** – Is the basal area of trees greater than or equal to the 10 cm Dbh class greater than 25 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **AGS of LIT Species > 14 m<sup>2</sup>/ha** – Is the basal area of Acceptable Growing Stock (AGS) of Long-Lived, Intermediate to Tolerant species (LIT, Table 3) greater than 14 m<sup>2</sup>/ha?
- **High Windthrow Hazard** – Is the windthrow hazard high (Table 2)?

### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist, uniformly thin the stand insuring the leave trees are released. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30% of the basal area from the leave strips on average sites. Catch-up will be slower on poorer sites or if more basal area is removed. The best opportunities for an economically viable commercial thinning occur on the more productive ecosites (AC6 and AC7) capable of recapturing harvested volume from the thinning in a reasonable amount of time. Windthrow is a concern in all partially harvested stands especially where soils are imperfectly to poorly drained or shallow to bedrock. Pine (except jack pine) and oak are deeper rooted than black spruce and less susceptible to windthrow. Commercial thinning is not recommended in eastern larch due to the natural lower stocking levels and self-thinning characteristics of this species. The objective of this treatment is not to regenerate the stand.
- **Salvage** – Remove overstory and salvage merchantable blowdown.

# Spruce Pine Management Guide

## Sub-Key T - Tend



## SUB KEY SP-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Edaphic Ecosites < 50%** – Is less than 50% of the area in edaphic ecosites (AC1-5, 8, 12, 15, Neily et al., 2013)?
- **Average Height** – What is the average height of the stand in metres?
- **White Pine > 50%** – Is the stand made up of more than 50% white pine (as a % of stand basal area)?
- **Acceptable Growing Stock of LIT Species > 6 m<sup>2</sup>/ha**– Is the basal area of Acceptable Growing Stock (**AGS<sup>QQ</sup>**) of Long-Lived Intermediate to Tolerant (**LIT<sup>RR</sup>**) species greater than 6 m<sup>2</sup>/ha?

#### Management Prescriptions

- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at least every 3 m), a uniform pre-commercial thinning is appropriate.
- **Let it grow** – Let the stand grow and re-evaluate later.

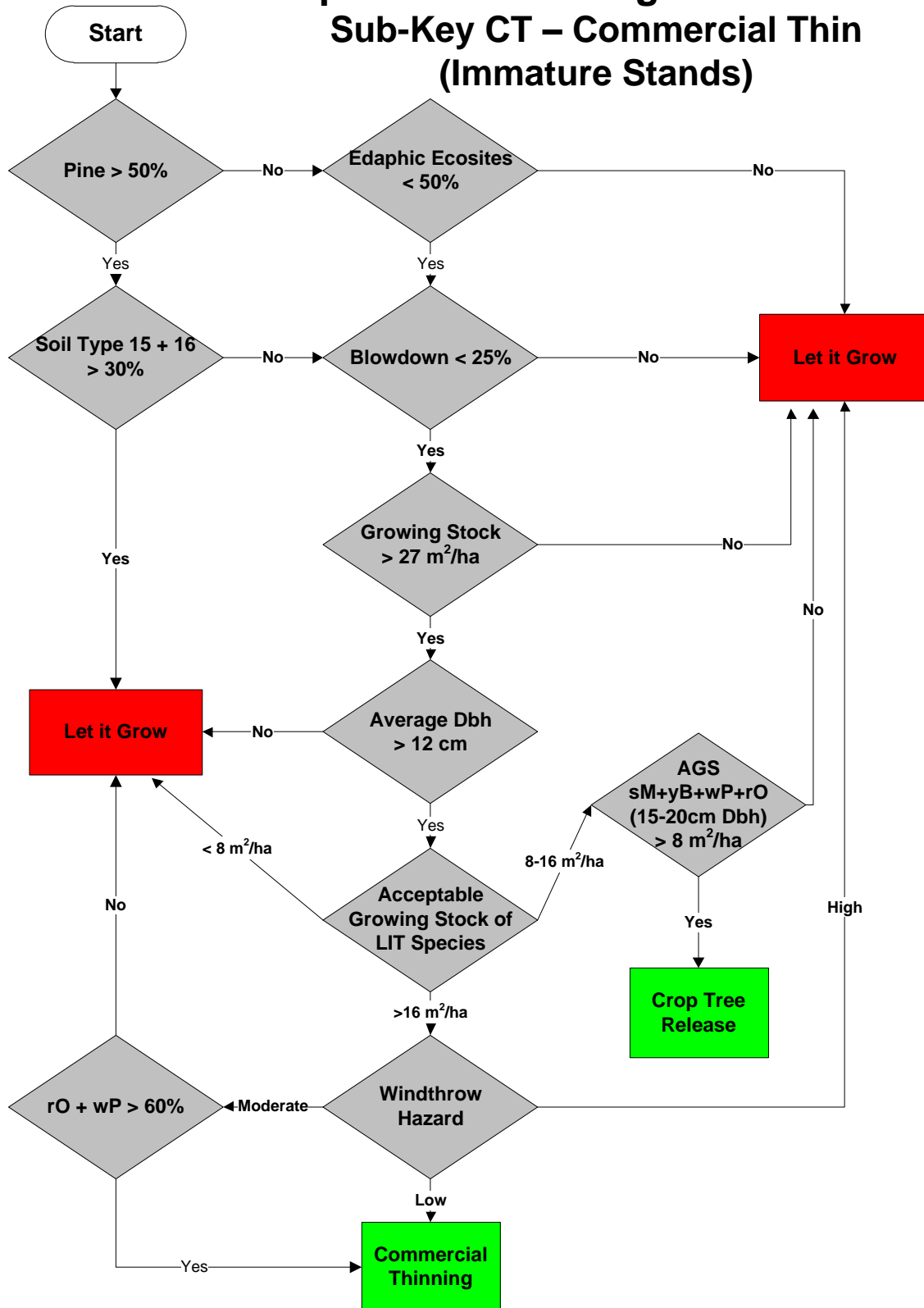
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<sup>QQ</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>RR</sup> **LIT** species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Spruce Pine Management Guide

## Sub-Key CT – Commercial Thin (Immature Stands)



## SUB KEY SP-CT – Commercial Thinning (Immature Stands)

### Instructions and Definitions for:

#### Decision Diamonds

- **Pine > 50%** – Is the stand made up of more than 50% pine (as a % of stand basal area)?
- **Soil Type 15 +16 > 30%** – Is more than 30% of the area Soil Type 15 and 16 combined (shallow), including all phases (G, S or L)?
- **Edaphic Ecosites < 50%** – Is less than 50% of the area in edaphic ecosites (AC1-5, 8, 12, 15, Neily et al., 2013)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the basal area of trees greater than or equal to the 10 cm Dbh class greater than 27 m<sup>2</sup>/ha?
- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12 cm (trees ≥10 cm Dbh class)?
- **Acceptable Growing Stock of LIT Species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>SS</sup>) of Long-live Intermediate to Tolerant (LIT<sup>TT</sup>) species? Is it less than 8 m<sup>2</sup>/ha, between 8 and 16 m<sup>2</sup>/ha, or greater than 16 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 8 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 8 m<sup>2</sup>/ha?
- **Windthrow Hazard** – Is the windthrow hazard Low, Moderate or High (Table 2)?
- **wP + rO > 60%** – Is the stand made up of more than 60% red oak and white pine combined by basal area?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Crop Tree Release** – Where intermediate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m apart. Only trees touching the crowns of crop trees are to be cut; remaining trees to be left standing.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist, uniformly thin the stand insuring the leave trees are released. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30% of the basal area from the leave strips on average sites. Catch-up will be slower on poorer sites or if more basal area is removed. The best opportunities for an economically viable commercial thinning occur on more productive ecosites capable of recapturing harvested volume from the thinning in a reasonable amount of time. Windthrow is a concern in all partially harvested stands especially where soils are imperfectly to poorly drained or shallow to bedrock. Pine (except jack pine) and oak are deeper rooted than black spruce and less susceptible to windthrow. Commercial thinning is not recommended in eastern larch due to the natural lower stocking levels and self-thinning characteristics of this species. The objective of this treatment is not to regenerate the stand.

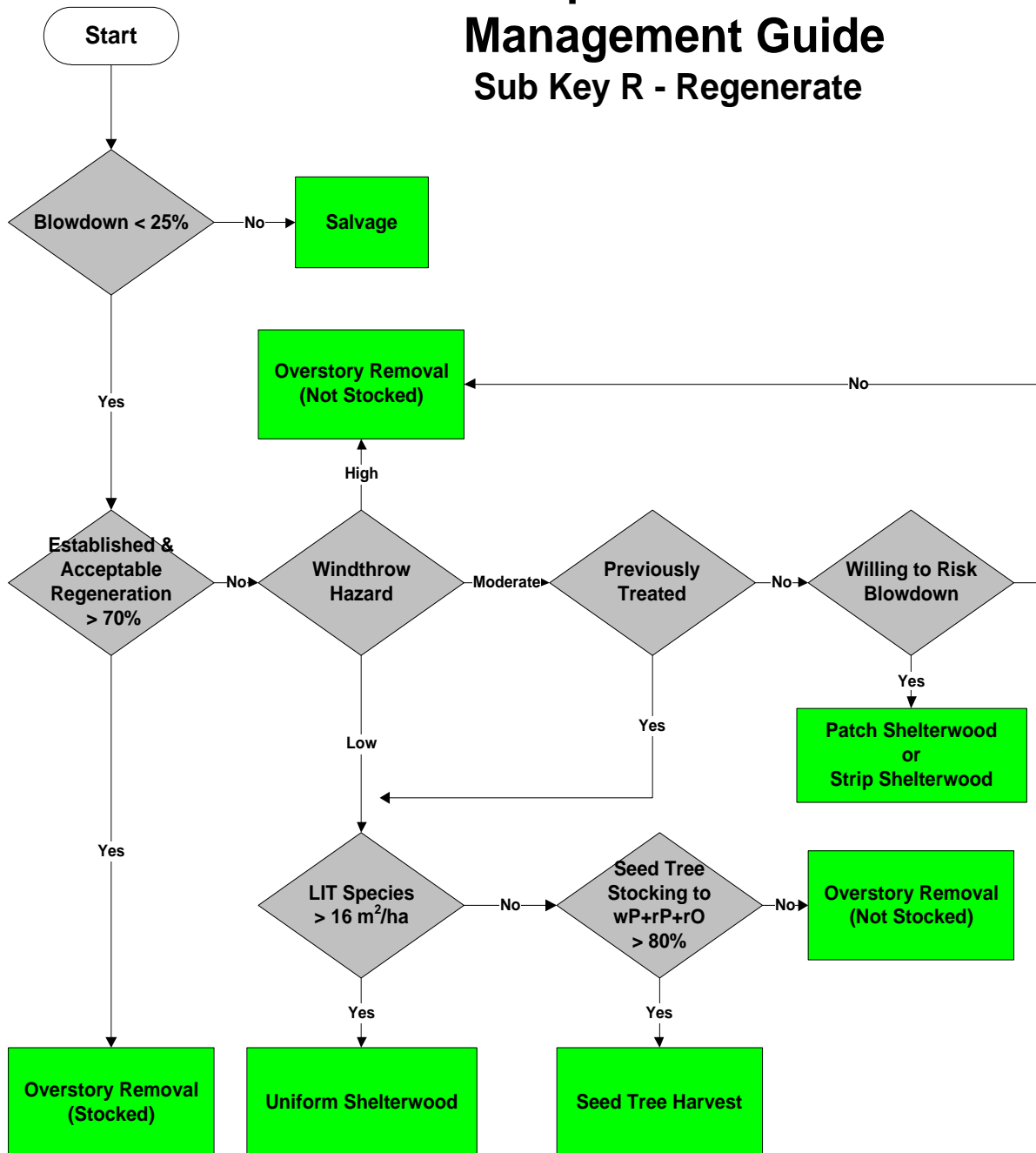
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<sup>SS</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>TT</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Spruce Pine Management Guide

## Sub Key R - Regenerate



## SUB-KEY SP-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>UU</sup> regeneration greater than 70% (at 2.4 m spacing)? Black spruce regeneration from layering could be acceptable.
- **Windthrow Hazard?** – Is the Windthrow Hazard (Table 2) Low, Moderate or High?
- **LIT<sup>VV</sup> Species > 16 m<sup>2</sup>/ha.** – Does the stand have more than 16 m<sup>2</sup>/ha of Long-Lived, Intermediate to Tolerant species (LIT, Table 3)?
- **Seed Tree stocking to wP+rP+rO > 80%** – Is the stocking (to 20 m spacing, 15-35 trees per hectare) of wP, rP and rO combined greater than 80%? Red pine, white pine and red oak trees must be mature and have at least one third live crown ratio (capable of producing large viable seed crops). Trees should be wind firm.
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation. Where high stocking to dense white pine regeneration occurs, an additional shelterwood may be required to prevent white pine weevil from damaging the log potential of the stand.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. See Table 5 for species planting recommendations by Ecosite.
- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking. Thirty percent of the basal area is to be removed from leave strips, when regenerating shade tolerant species (black spruce). If intermediate shade tolerant species such as red oak or white pine is predominant, remove 40% basal from the leave strips (Table 3).
- **Patch Shelterwood** – Small groups of trees are cut uniformly throughout the stand without tending the unharvested areas, as there is not sufficient immature Acceptable Growing Stock. The main objective is to create the conditions to regenerate the desired species and to harvest the Sawlog Stock before it becomes overmature. Openings are to be 0.04-0.1ha for black spruce and from 0.10 to 0.15 for white pine and red oak. Up to 35% of the area is to be harvested in patches.
- **Strip Shelterwood** – Harvest strips to produce shade requirements necessary to regenerate desired species. Leave at least 2 strips unharvested between harvested strips. Strips are to be 1 tree height in width when regenerating black spruce and 2 tree heights in width for regenerating red oak and white pine.
- **Seed Tree Harvest** – During a harvest operation 15-35 seed trees per hectare (NSDNR, 1993) of uniformly-distributed wind-firm white pine, red pine or red oak trees of seed-bearing age are required to be left on-site. Black spruce and jack pine are not recommended due to their shallow rooting and windthrow risk, but cone-bearing slash of these species should be considered in the overall regeneration potential for the site. All pine species regenerate best on exposed mineral soil. The creation of mineral soil seedbeds can be achieved with scarification during or after harvesting.

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<sup>UU</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.

<sup>VV</sup> **LIT** species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table3).

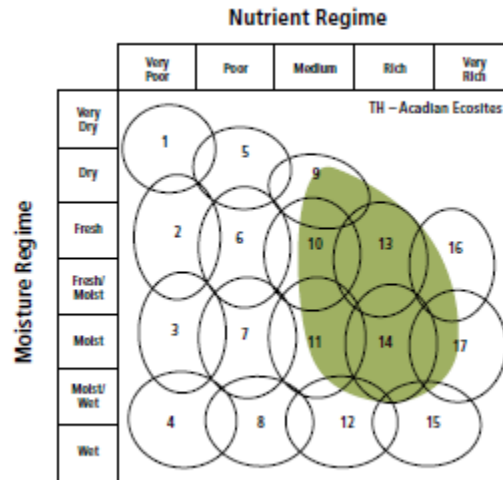




# Tolerant Hardwood (TH) Management Guide

## Forest Group Characteristics

Tolerant Hardwood (TH) vegetation types include mostly late successional stands. Most TH types are dominated by moderate to shade tolerant long lived deep rooted species such as sugar maple, yellow birch, and white ash. Tolerant hardwoods usually grow in rich, well-drained, deep soils with drainage ranging from fresh to moist. Late successional uneven-aged stands are often found due to the relatively low frequency of stand replacing events and the predominance of gap replacement disturbances. In mid successional TH stands the shorter lived and/or moderate shade tolerant species such as red maple, red oak and yellow birch are dominant. The species content of TH stands is often influenced by slope position. Drier crest and upper slope are more frequently occupied by beech. Sugar maple tends to thrive in mid-slope positions, while low slopes tend to be occupied by red maple and softwoods. In riparian areas sugar maple frequently occurs along with white ash.

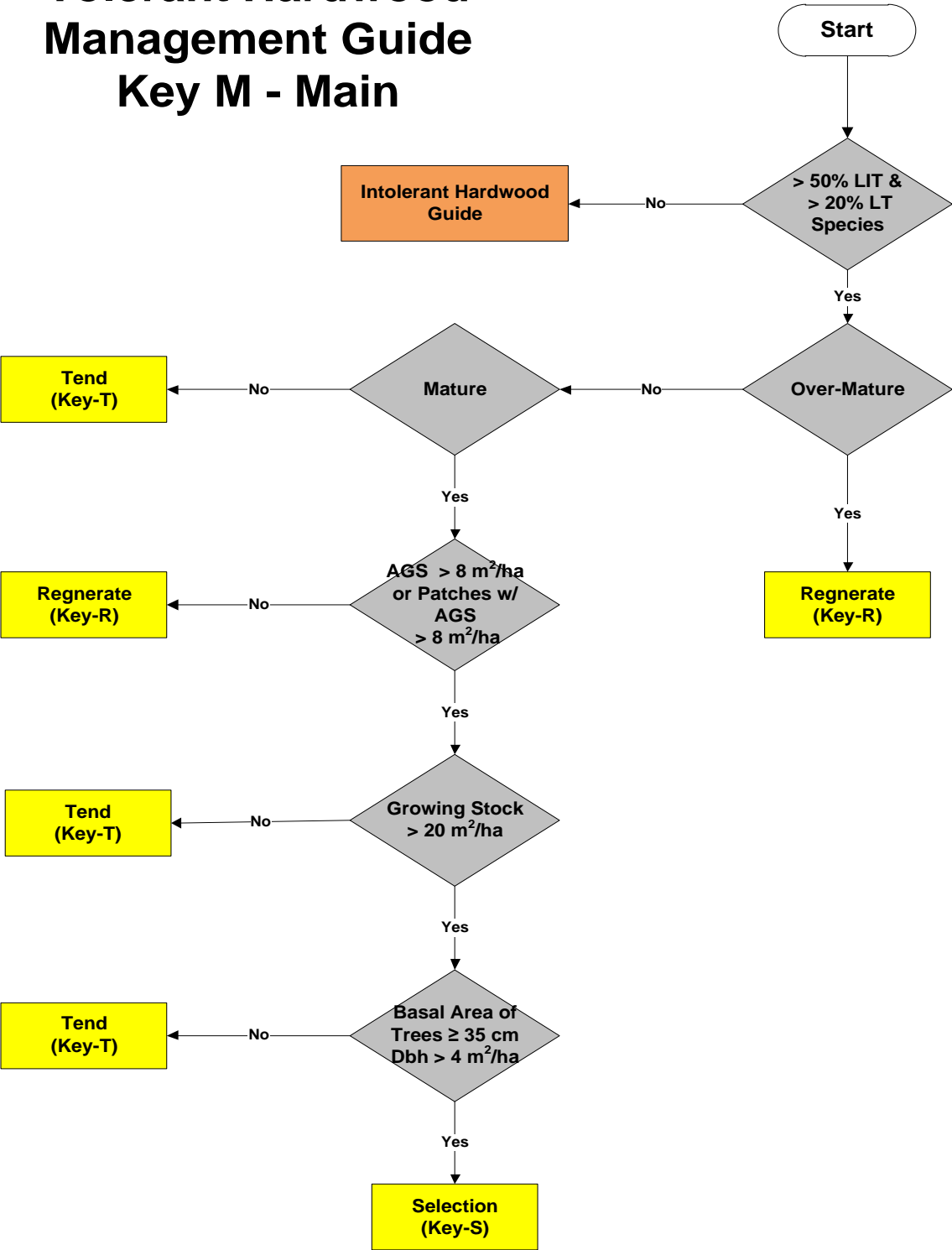


## Management Considerations

Tolerant hardwoods (yellow birch, sugar maple and white ash) account for 28% of the hardwood volume (39 million m<sup>3</sup>) growing in Nova Scotia per Townsend (2004). Part of this tolerant hardwood volume (4 %) has high-value for sawlogs and veneer (Keys et al., 2007). Although the portion of hardwoods suitable for high-value products is low at present, with proper management it can be increased. To accomplish this, silviculture practices must be compatible with production of quality sawlogs on appropriate sites. Clear cutting high-quality young growing stock and high-grading the best logs, leaving poor quality stems, reduces the future potential for growing quality timber.

High beech content can impede the recruitment of sugar maple regeneration. Beech suckers proliferate after harvest and are very shade tolerant, giving it a competitive advantage over slower growing sugar maple. Beech has been relegated to a low-quality, short lived species because of the high incidence of Beech bark disease (see AGS/UGS section). In situations where Beech is prevalent, consideration should be given to harvesting the overstory in small patches and site prepare to create mineral soils microsites favourable to faster growing and less shade tolerant yellow birch.

# Tolerant Hardwood Management Guide Key M - Main



## KEY TH-M – Main

### Instructions and Definitions for:

#### Decision Diamonds

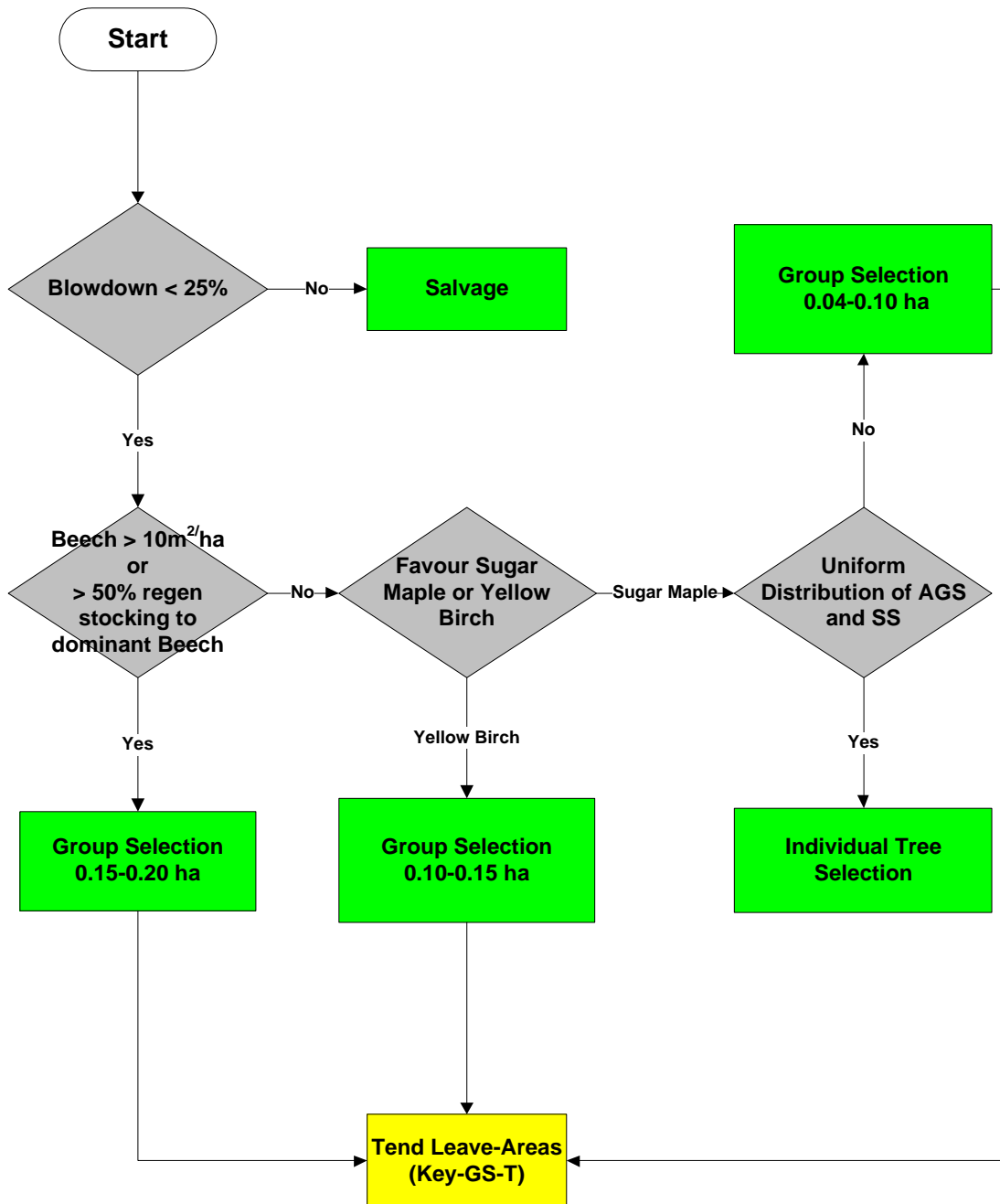
- **> 50% LIT & > 20% LT Species** – Is the stand made up of more than 50% Long-lived Intermediate to Tolerant (**LIT**) species including red spruce, eastern hemlock, white pine, white spruce, sugar maple, yellow birch, red oak, and white ash and more than 20% Long-lived Tolerant (**LT**) species, including red spruce, eastern hemlock and sugar maple (as a % of stand basal area)?
- **Over-Mature** – Is the overstory predominantly over-mature, meaning in a declining state, evidenced by very slow growth and mortality of larger trees (Table 3)?
- **Mature** – Is the overstory predominantly mature in terms of being able to produce adequate seed for regeneration (Table 3)?
- **AGS > 8 m<sup>2</sup>/ha or Patches w/ AGS > 8 m<sup>2</sup>/ha** – Is there 8 m<sup>2</sup>/ha of Acceptable Growing Stock (**AGS<sup>WW</sup>**) or does the stand have patches of mature trees to be harvested intermixed with patches in different areas of smaller Acceptable Growing Stock worthy of tending? The amount of **AGS** must be greater than 8 m<sup>2</sup>/ha.
- **Growing Stock > 20 m<sup>2</sup>/ha** – Is the total basal area (of trees in Dbh class  $\geq 10$ cm) greater than 20 m<sup>2</sup>/ha?
- **Basal Area of Trees  $\geq 35$  cm Dbh > 4 m<sup>2</sup>/ha** – Is there more than 4 m<sup>2</sup>/ha of trees with Diameter at Breast Height (Dbh) class  $\geq 35$  cm?

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<sup>WW</sup> Trees are Acceptable Growing Stock (**AGS**) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Tolerant Hardwood Management Guide

## Sub-Key S – Selection



## SUB-KEY TH-S – Selection

### Instructions and Definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Beech > 10m<sup>2</sup>/ha or regen > 50% stocked to dom. Beech** – Is beech growing stock greater than 10 m<sup>2</sup>/ha or dominant regeneration stocking to Beech greater than 50%?
- **Favour Sugar Maple or Yellow Birch** – Do you wish to favour sugar maple or yellow birch regeneration if beech does not exceed > 10m<sup>2</sup>/ha or exceed a stocking to dominant regeneration of 50%?
- **Uniform distribution of AGS and SS** – Is the **Acceptable Growing Stock (AGS<sup>xx</sup>)** and the **Sawlog /Seed Stock** (trees with sawlog quality and Dbh class ≥35 cm, **SS**) intermixed uniformly throughout the stand?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Individual Tree Selection** – Individual Tree Selection involves a thinning across all size classes throughout the stand to create a diameter class distribution suitable for sustaining a periodic harvest of suitable trees over relatively short harvesting cycles (10-20 years). The objective is to create conditions suitable for regeneration of preferred species at each entry while also improving the growing stock by releasing the highest quality immature trees. Basal area removals of 30% from leave strips are recommended. Shade Tolerant species regeneration such as beech and sugar maple are favoured. Where the proportion of beech is high it will dominate sugar maple under high shade conditions.
- **Group Selection** – Group Selection involves identifying areas within the stand that are suitable for harvesting or regeneration because they are predominantly mature or contain non-commercial trees. These areas are to be cleared to create conditions suitable for preferred regeneration. Areas predominantly AGS are to be left. They can be tended using either pre-commercial thinning, commercial thinning or crop tree release methods (Lamson and Leak, 2000).
- Where **Beech** is dominant, larger openings are prescribed (0.15 to 0.2 ha) . Yellow Birch, Sugar Maple and Beech will be favoured in that order.
- Where favouring **Yellow Birch**, regeneration is desired and Beech is not dominant, 0.1 to 0.15 ha openings are prescribed. Mineral soil mixing with the forest floor is also desired. Yellow Birch and Sugar Maple will be favoured in that order.
- Where Beech is not dominant and **Sugar Maple** is desired a smaller opening size is prescribed (0.04-0.1 ha). Sugar Maple and Yellow Birch will be favoured in that order.

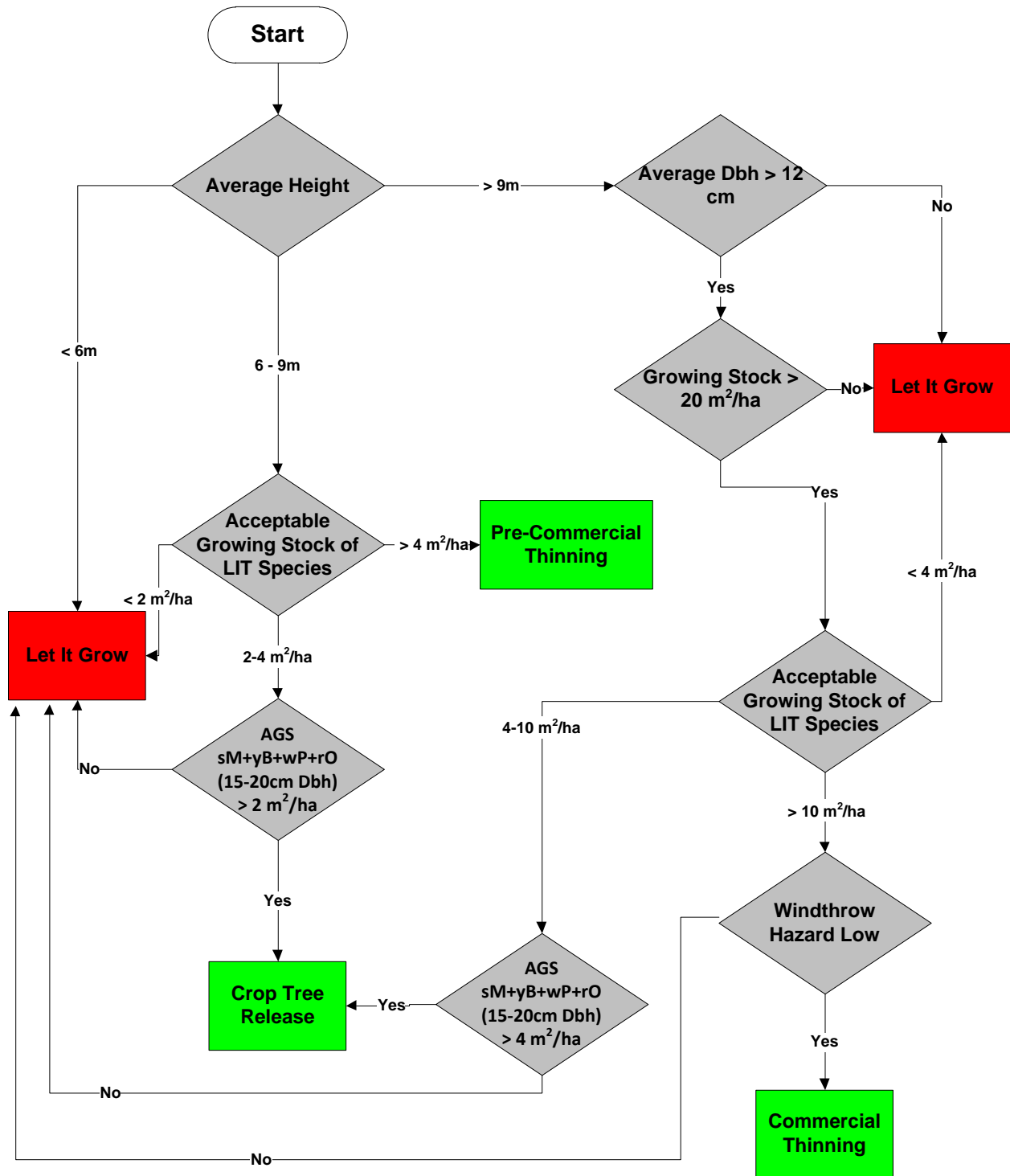
Harvest Patch Dimensions.					
Area		Circular Radius		Square Length	
(ha)	(acre)	(m)	(ft)	(m)	(ft)
<b>0.04</b>	<b>1/10</b>	<b>11</b>	<b>37</b>	<b>20</b>	<b>66</b>
<b>0.10</b>	<b>1/4</b>	<b>18</b>	<b>59</b>	<b>32</b>	<b>104</b>
<b>0.15</b>	<b>1/3</b>	<b>22</b>	<b>72</b>	<b>39</b>	<b>127</b>
<b>0.20</b>	<b>1/2</b>	<b>25</b>	<b>83</b>	<b>45</b>	<b>147</b>

<sup>xx</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

# Tolerant Hardwood Management Guide

## Sub-Key GS-T

### Tending of Leave Areas in Group Selection



## **SUB-KEY TH- GS-T – Tending of leave areas in Group Selections**

**These questions refer to only the leave areas of the stand.**

### **Instructions and Definitions for:**

#### **Decision Diamonds**

- **Average Height** – What is the average height of the stand in metres in the leave areas? Is it less than 6 m, between 6 and 9 m or greater than 9 m?
- **Acceptable Growing Stock of LIT Species** – *when height between 6 and 9 metres* - What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>YY</sup>) of Long-live Intermediate to Tolerant (LIT<sup>ZZ</sup>) species in the leave-area? Is it less than 2 m<sup>2</sup>/ha, between 2 and 4 m<sup>2</sup>/ha, or greater than 4 m<sup>2</sup>/ha? - *when height is greater than 9 metres* - Is it less than 4 m<sup>2</sup>/ha, between 4 and 10 m<sup>2</sup>/ha, or greater than 10 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 2 m<sup>2</sup>/ha** - *when height between 6 and 9 metres* Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 2 m<sup>2</sup>/ha in the leave-area?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 4 m<sup>2</sup>/ha** - *when height is greater than 9 metres* Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 4 m<sup>2</sup>/ha in the leave-area?
- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees ≥10 cm Dbh class) in the leave-area?
- **Growing Stock > 20 m<sup>2</sup>/ha** – Is the basal area (of trees with Dbh Class ≥ 10 cm) greater than 20 m<sup>2</sup>/ha in the leave-area?

#### **Management Prescriptions**

- **Let it grow** – Let the leave-areas grow and re-evaluate later.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist in the leave-areas, release only the best quality trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous, of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30 ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist in the leave-areas, uniformly distributed throughout the stand (on average at most every 3 m (10 ft)), a uniform pre-commercial thinning is appropriate.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly in the leave-areas thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.

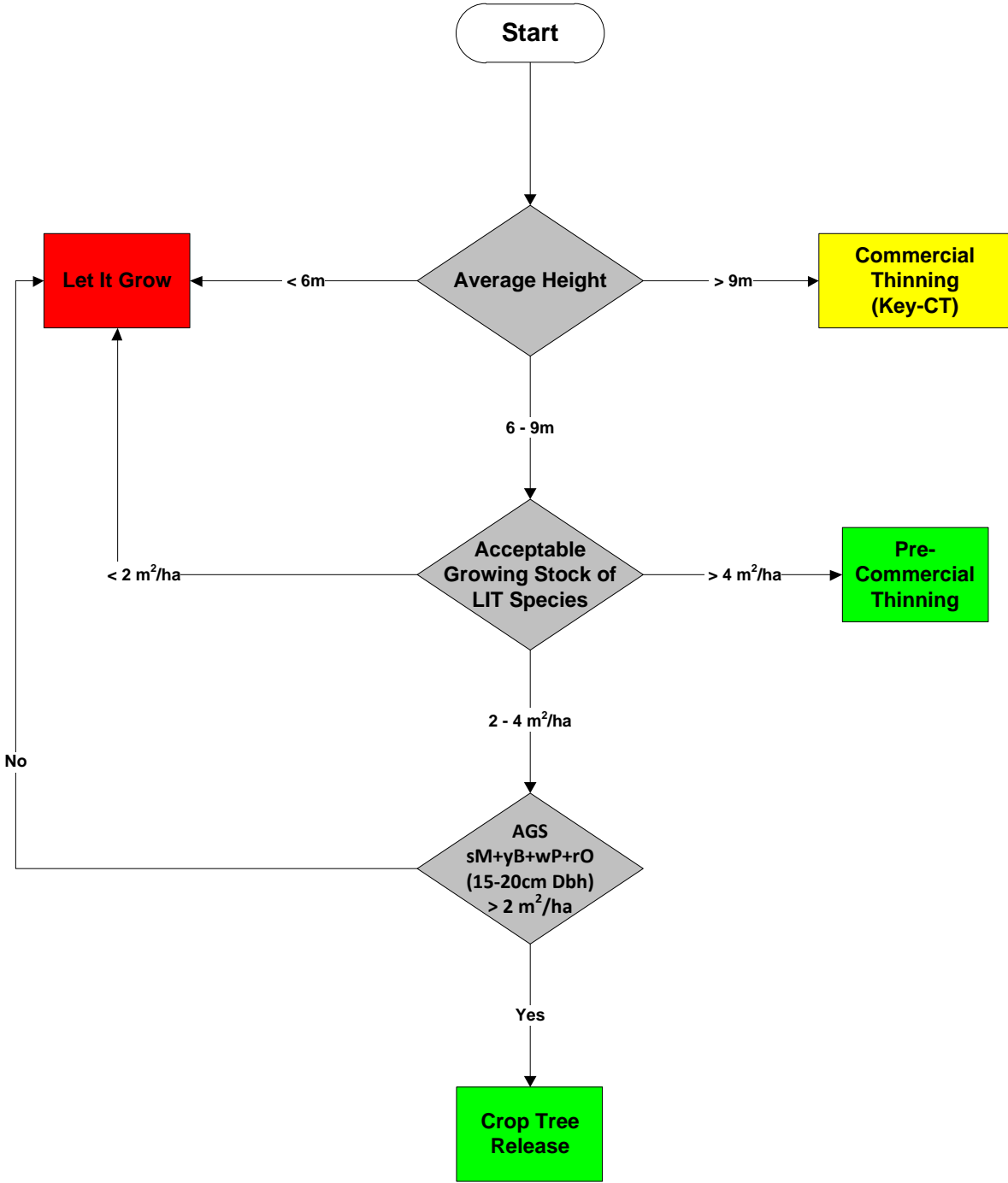
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<sup>YY</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>ZZ</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak and white ash (Table 3).

# Tolerant Hardwood Management Guide

## Sub-Key T - Tend





## SUB-KEY TH-T – Tend

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Height** – What is the average height of the stand in metres?
- **Acceptable Growing Stock of LIT Species** – What is the basal area in m<sup>2</sup>/ha of **Acceptable Growing Stock (AGS<sup>AAA</sup>)** of **Long-lived Intermediate to Tolerant species (LIT<sup>BBB</sup>)**? Is it less than 2 m<sup>2</sup>/ha, between 2 and 4 m<sup>2</sup>/ha, or greater than 4 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) > 2 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 2 m<sup>2</sup>/ha?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous trees of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Pre-commercial Thinning (PCT)** – Where high levels of AGS exist uniformly distributed throughout the stand (on average at most every 3m), a uniform pre-commercial thinning is appropriate.

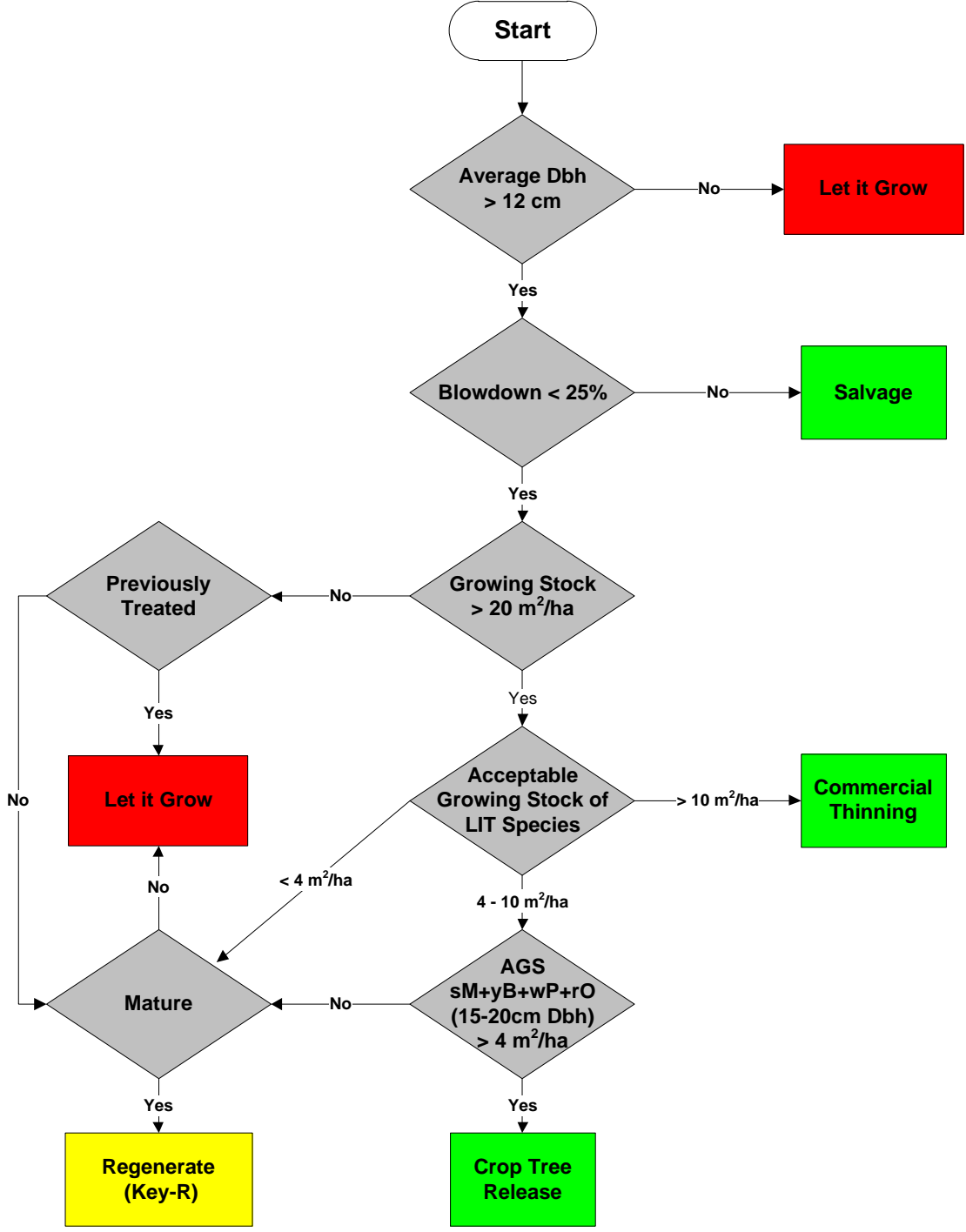
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<sup>AAA</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwoods) or studwood (softwoods) specifications in the future and the ability to thrive after thinning until the time of the next harvest .

<sup>BBB</sup> **LIT species** – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak, red maple and white ash (Table 3).

# Tolerant Hardwood Management Guide

## Sub-Key CT – Commercial Thin



## SUB-KEY TH-CT – Commercial Thinning

### Instructions and Definitions for:

#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12 cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 20 m<sup>2</sup>/ha** – Is the basal area (of trees Dbh class  $\geq 10$  cm) greater than 20 m<sup>2</sup>/ha?
- **Acceptable Growing Stock of LIT Species** – What is the basal area in m<sup>2</sup>/ha of Acceptable Growing Stock (AGS<sup>CCC</sup>) of Long-lived Intermediate to Tolerant (LIT<sup>DDD</sup>) species? Is it less than 4 m<sup>2</sup>/ha, between 4 and 10 m<sup>2</sup>/ha, or greater than 10 m<sup>2</sup>/ha?
- **AGS<sup>F</sup> sM + yB + wP + rO (15-20cm Dbh) >4 m<sup>2</sup>/ha** – Is the Acceptable Growing Stock (AGS) basal area of sugar maple, yellow birch, white pine and red oak trees in the 15 or 20 cm Dbh class greater than 4 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Mature** – Is the overstory predominantly mature in terms of producing good seed crops, necessary for natural regeneration (Table 3)?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Crop Tree Release** – Where moderate levels of sugar maple, yellow birch, white pine and red oak AGS exist, release trees on at least three sides so that no trees are touching or overtopping the crowns of the released trees. The released trees must be vigorous trees of good form and have high-value potential. Trees must be self-pruned for at least the length of one sawlog or be manually pruned. Released trees must be at least 10 m (30ft) apart. Only trees touching the crowns of crop trees are to be cut, remaining trees to be left standing.
- **Commercial Thinning (CT)** – Where high levels of AGS and adequate merchantable basal area exist uniformly thin the stand. The objective of this treatment is to harvest lower quality merchantable trees and leave well-formed, healthy trees of preferred long lived species to accelerate their growth. The stand should be left until it grows back the volume removed and becomes fully stocked (“catch-up”). This will take on average 15-20 years when removing 30-40% of the basal area from the leave strips. The objective of this treatment is not to regenerate the stand.
- **Let it grow** – Let the stand grow and re-evaluate later.

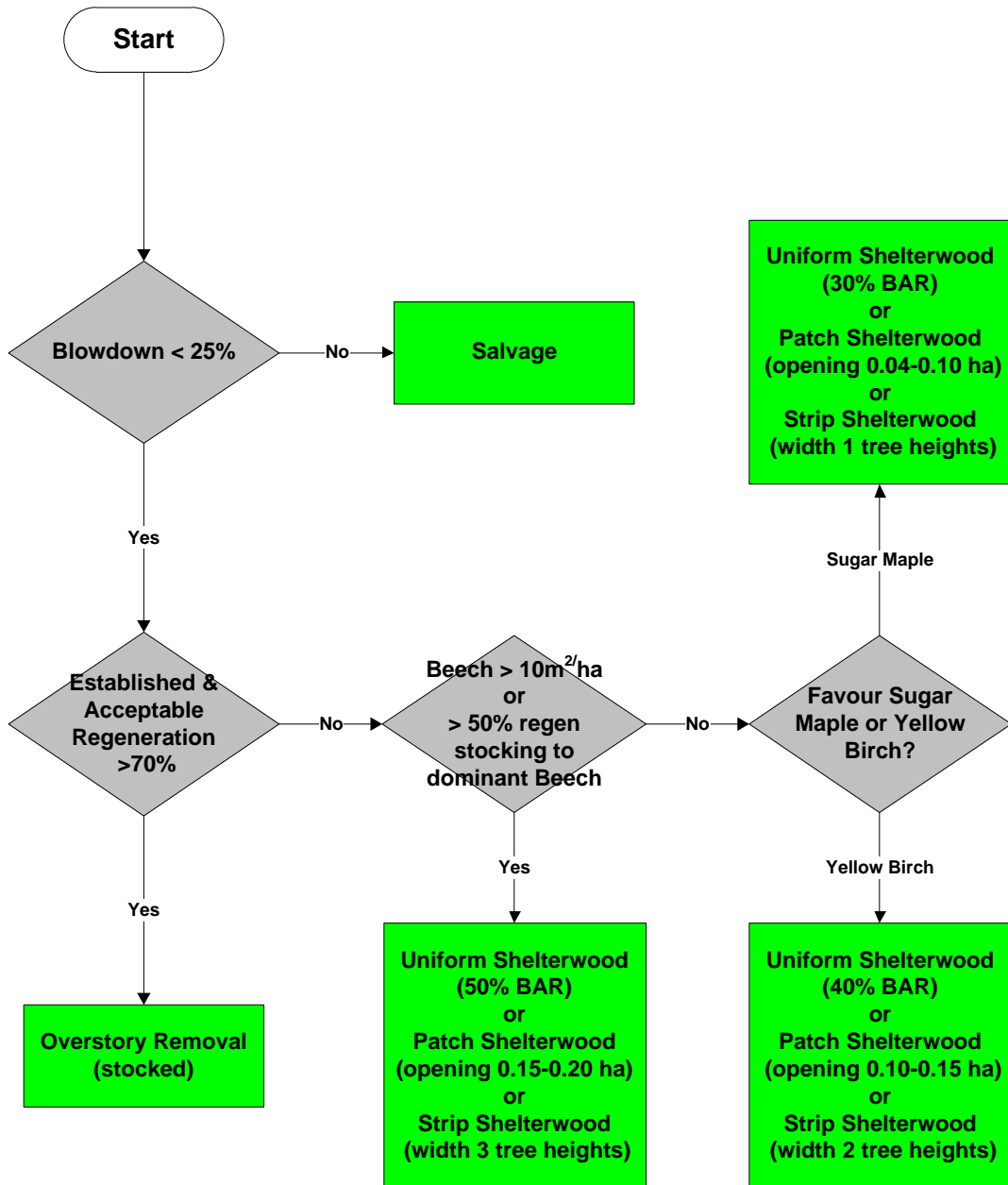
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<sup>CCC</sup> Trees are Acceptable Growing Stock (AGS) when they are healthy with potential to produce high-value stems suitable to meet sawlog (hardwood) or studwood (softwood) specifications in the future and the ability to thrive after thinning until the time of the next harvest.

<sup>DDD</sup> LIT species – Long-lived Intermediate to Tolerant species, including red spruce, eastern hemlock, white pine, white spruce (forest), sugar maple, yellow birch, red oak, red maple and white ash.

# Tolerant Hardwood Management Guide

## Sub-Key R – Regeneration



## SUB-KEY TH-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>EEE</sup> regeneration greater than 70% (at 2.4 m spacing)?
- **Beech > 10m<sup>2</sup>/ha or regen > 50% stocked to dom. Beech** – Is beech growing stock greater than 10 m<sup>2</sup>/ha or dominant regeneration stocking to Beech greater than 50%?
- **Favour Sugar Maple or Yellow Birch?** – Do you wish to favour sugar maple or yellow birch regeneration if beech does not exceed > 10m<sup>2</sup>/ha or exceed a stocking to dominant regeneration of 50%?

#### Management Prescriptions

- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal** – Release regeneration by removing overstory. Protect advanced regeneration during forest operations.
- **Uniform Shelterwood** – Uniformly thin overstory to produce light conditions suited for desired species. The remaining overstory must be harvested when suitable regeneration is established to sufficient stocking.
  - Where **Beech** is dominant remove 50% of the basal area from leave strips (BAR).
  - Where favouring **Yellow Birch** regeneration is desired (mineral soil mixing with the forest floor is also desired) and Beech is not dominant remove 40% of the basal area from leave strips.
  - Where Beech is not dominant and **Sugar Maple** is desired remove 30% of the basal area from leave strips.
- **Patch Shelterwood** – Small groups of trees are cut systematically throughout the stand without tending the unharvested areas, as there is not sufficient immature Acceptable Growing Stock. The main objective is to create the conditions to regenerate the desired species and to harvest the Sawlog Stock before it becomes overmature.
  - Where **Beech** is dominant the larger openings are prescribed (0.15 to 0.2 ha (1/3 – 1/2 acre). Yellow Birch, Sugar Maple and Beech will be favoured in that order.
  - Where favouring **Yellow Birch** regeneration is desired and Beech is not dominant, 0.1 to 0.15 ha (1/4-1/3 acre) harvest groups are prescribed. Mineral soil mixing with the forest floor is also desired. Yellow Birch and Sugar Maple will be favoured in that order.
  - Where Beech is not dominant and **Sugar Maple** is desired the smaller opening size is prescribed (0.04-0.1ha (1/10 - 1/4 acre)). Sugar Maple and Yellow Birch will be favoured in that order.
- **Strip Shelterwood** – Harvest strips to produce shade requirements necessary to regenerate desired species. Leave at least 2 strips unharvested between harvested strips.
  - Where **Beech** is dominant remove strips of 3 tree heights in width.
  - Where favouring **Yellow Birch** regeneration is desired (mineral soil mixing with the forest floor is also desired) and Beech is not dominant remove strips 2 tree heights in width.
  - Where Beech is not or will not be dominant and **Sugar Maple** is desired remove strips of 1 tree height in width.

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<sup>EEE</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.



# Wet Coniferous (WC) Management Guide

## Forest Group Characteristics

The Wet Coniferous (WC) Forest Group is characterized by sites with water near or at surface level most of the year. Moisture regime is typically wet resulting in poorly to very poorly drained soils. Fertility is also a challenge on most of these sites (very poor to medium fertility, Neily et al., 2013).

Black spruce is the dominant species in most cases, but on some of the nutrient poor to medium sites red spruce, balsam fir and eastern hemlock occur. On the poorer and wetter sites tamarack may dominate.

In all cases, trees have limited rooting space due to moisture conditions.

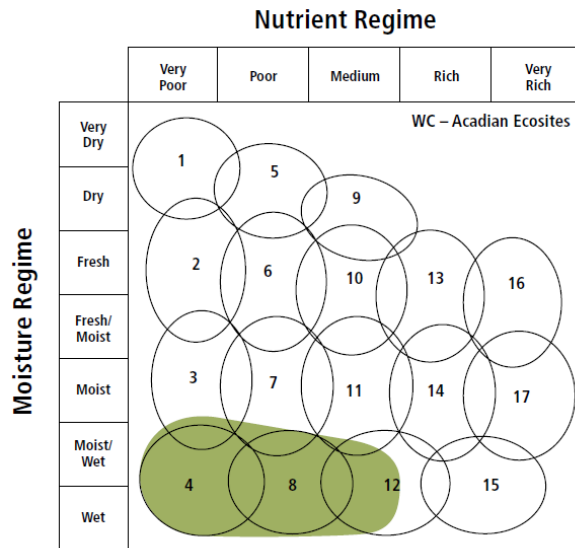
Some of the black spruce sites have limited cover due to site conditions. Cover increases in the relatively richer red spruce, balsam fir and hemlock dominated wet coniferous stands.

## Management Considerations

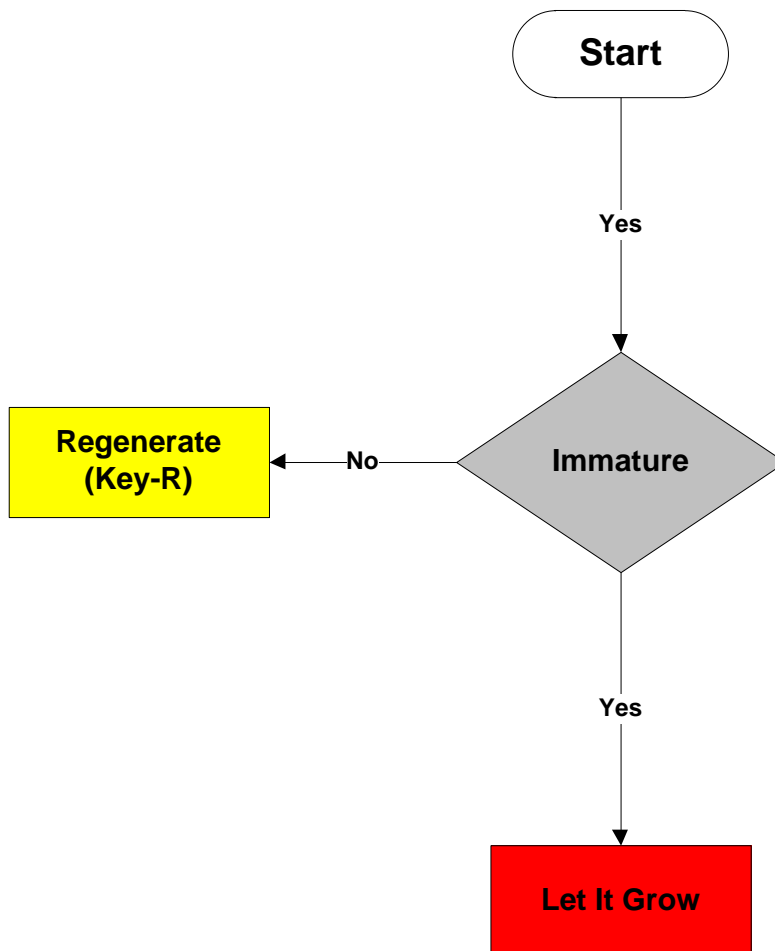
In all cases, windthrow is a major concern due to limited rooting depth resulting from poor drainage. This eliminates the use of partial harvesting due to the high incidence of windthrow.

Low stocking also impacts the timber harvesting operability on many of the black spruce dominated vegetation sites.

Where good stocking occurs, most likely in red spruce, balsam fir and hemlock dominated WC sites, extreme care is recommended when harvesting to ensure that soils are not damaged. It is recommended that these sites only be harvested when soils are frozen.



# Wet Coniferous Management Guide Key M - Main





## **KEY WC-M – Main**

### **Instructions and Definitions for:**

#### **Decision Diamonds**

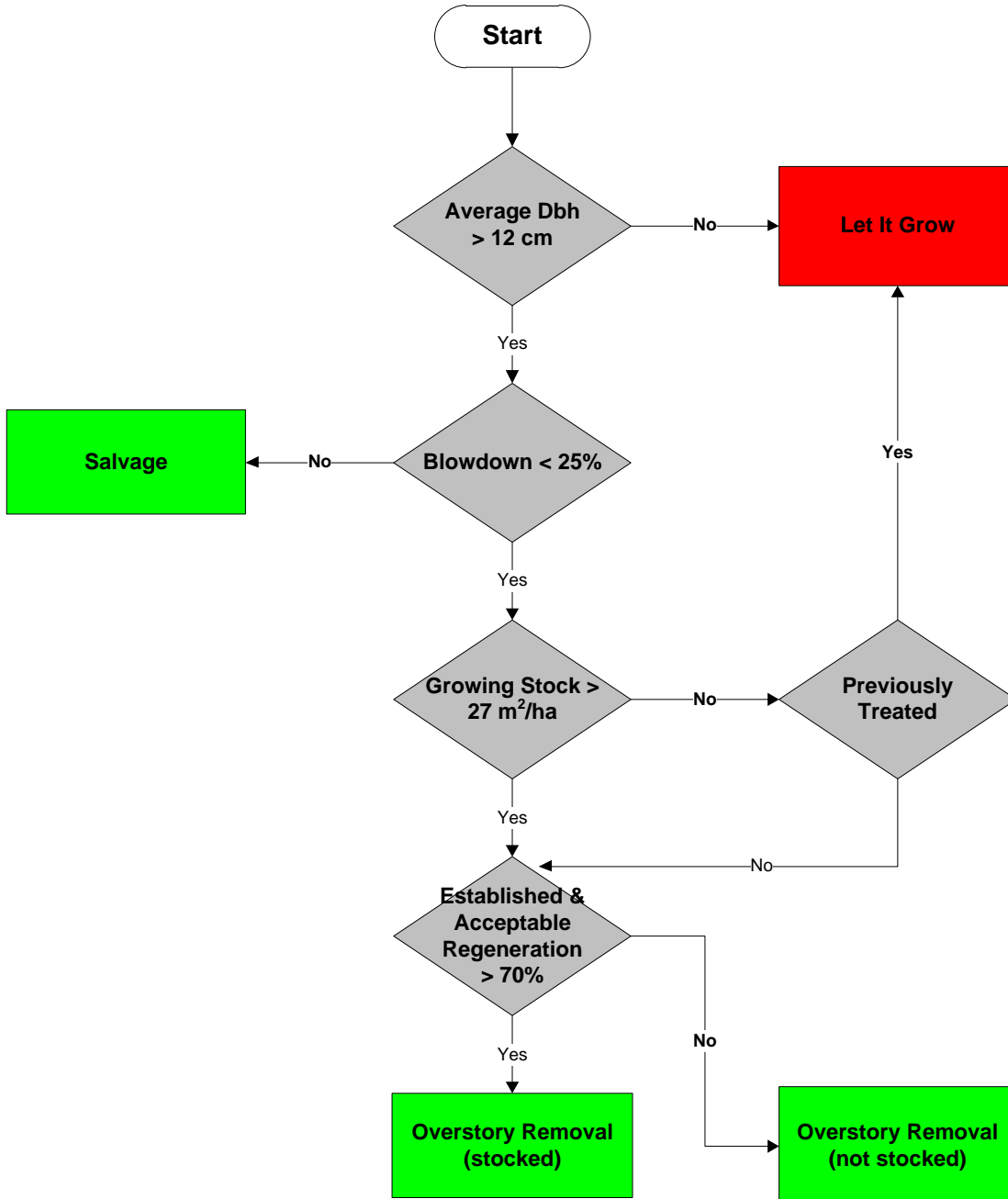
- **Immature** – Is the overstory predominantly immature (Table 3)?

#### **Management Prescription**

- **Let it grow** – Let the stand grow and re-evaluate later.

# Wet Coniferous Management Guide

## Sub Key R - Regenerate



## SUB-KEY WC-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 27 m<sup>2</sup>/ha** – Is the total basal area (of trees in Dbh class  $\geq 10$ cm) greater than 27 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>FFF</sup> regeneration greater than 70% (at 2.4 m spacing)?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. Table 5 shows plantation recommendations.

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<sup>FFF</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.



# Wet Deciduous (WD) Management Guide

## Forest Group Characteristics

This Wet Deciduous Forest Group (WD) is characterized by sites with water near or at surface level most of the year. Thus, moisture regime is typically wet resulting in poorly to very poorly drained soils. Wet Deciduous types grow in medium to very rich sites although sometimes nutrient availability is limited due to standing water saturated soils. On other Wet Deciduous sites, seepage water increases fertility resulting in moderate to high nutrient availability (Neily et al., 2013).

Red Maple is the dominant species in most cases, sometimes in a mixedwood situation. White ash and Trembling Aspen dominate as well on some types.

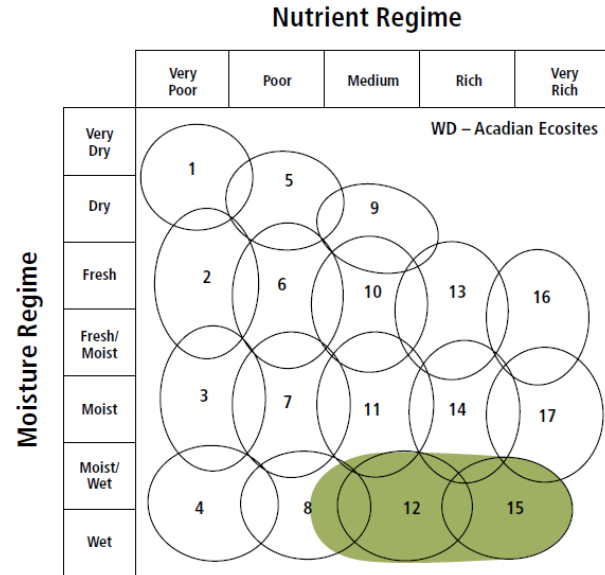
In all cases, trees have limited rooting space due to moisture conditions.

In most cases, WD vegetation types have moderate to high crown closure.

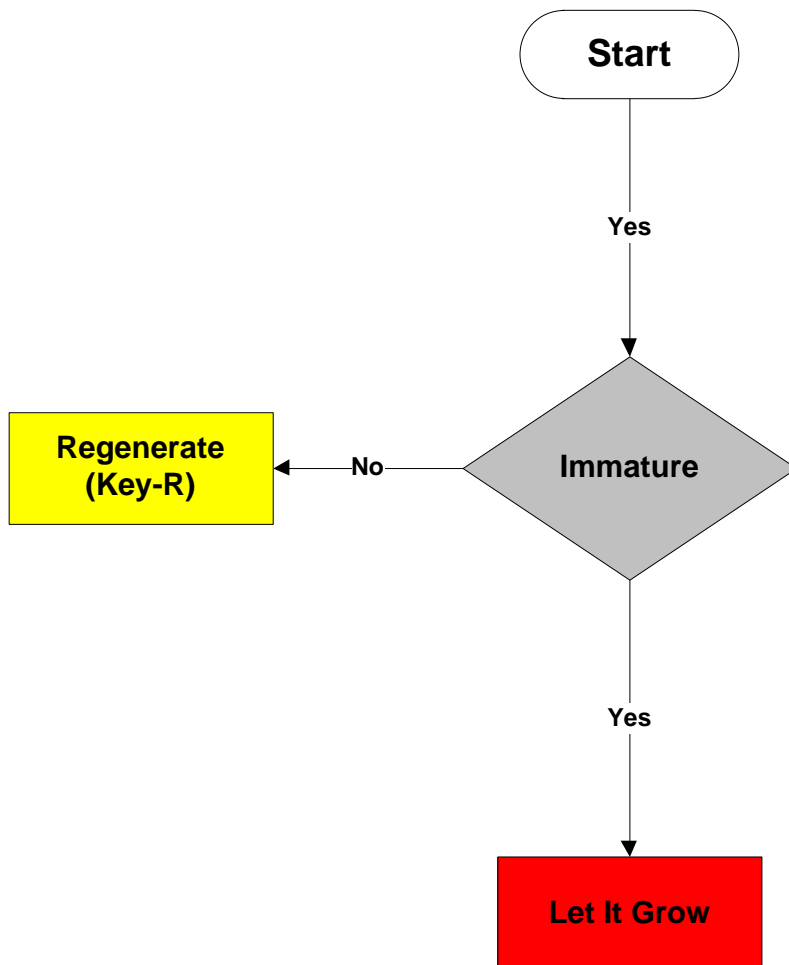
## Management Considerations

In all cases, windthrow is a major concern due to limited rooting depths that occurs on these sites resulting from poor drainage. This eliminates the practicality of partial harvesting due to the high incidence of windthrow.

Where good stocking occurs, extreme care is indicated when harvesting to ensure that soils are not damaged. It is recommended that these sites only be harvested when soils are frozen.



# Wet Deciduous Management Guide Key M - Main



## **KEY WD-M – Main**

### **Instructions and Definitions for:**

#### **Decision Diamonds**

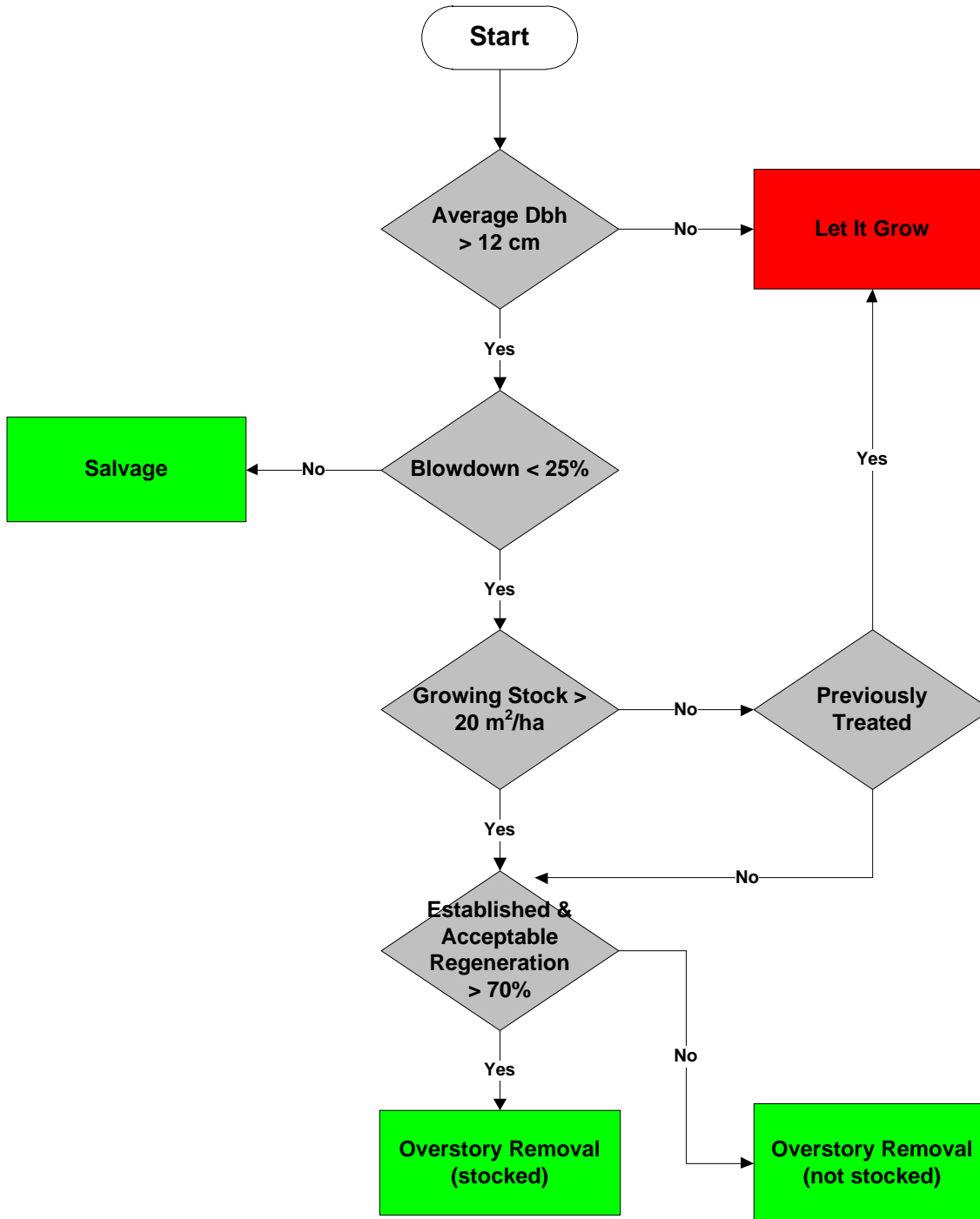
- **Immature** – Is the overstory predominantly immature (Table 3)?

#### **Management Prescription**

- **Let it grow** – Let the stand grow and re-evaluate later.

# Wet Deciduous Management Guide

## Sub Key R - Regenerate





## SUB-KEY WD-R – Regenerate

### Instructions and definitions for:

#### Decision Diamonds

- **Average Dbh > 12 cm** – Is the quadratic mean diameter at breast height greater than 12cm (trees  $\geq 10$  cm Dbh class)?
- **Blowdown < 25%** – Are less than 25% of the trees (measured in basal area) uprooted (blowdown still merchantable)?
- **Growing Stock > 20 m<sup>2</sup>/ha** – Is the total basal area (of trees in Dbh class  $\geq 10$ cm) greater than 20 m<sup>2</sup>/ha?
- **Previously Treated** – Has the stand been pre-commercially thinned, planted, commercially thinned or partially harvested?
- **Established & Acceptable Regeneration > 70%** – Is the stocking to acceptable established<sup>59</sup> regeneration greater than 70% (at 2.4 m spacing)?

#### Management Prescriptions

- **Let it grow** – Let the stand grow and re-evaluate later.
- **Salvage** – Remove overstory and salvage merchantable blowdown.
- **Overstory Removal (stocked)** – Release regeneration by removing overstory. Protect advanced regeneration during harvest operation.
- **Overstory Removal (not stocked)** – Remove overstory and plant or fill plant if adequate regeneration not present after two growing seasons. Weeding of competition must be completed where necessary to insure successful plantation establishment. Table 5 shows plantation recommendations.

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<sup>59</sup> Regeneration is considered **established** when taller than 30 cm, rooted in mineral soil and capable of withstanding increased light and heat due to complete overstory removal. All trees greater than 30 cm tall and less than 9cm in Dbh are considered regeneration. All regenerating commercial tree species (Table 3) are considered **acceptable** provided they are not poorly formed, have umbrella type crowns or have live crown ratios less than 1/3.

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[http://www.na.fs.fed.us/spfo/pubs/silvics\\_manual/table\\_of\\_contents.htm](http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm)
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# Appendix I - Pre-Treatment Assessment (PTA) procedures and tally sheets

To be able to use the Forest Management Guides information must be collected on the stands of interest. The required stand information includes:

- Species
- Size class
- Stem quality
- Patchiness of the stand (uniformity)
- Existing regeneration
- Exposure
- FEC Vegetation Type(s)
- FEC Soil Type(s)
- FEC Ecosite(s)
- Height
- Health issues
- Maturity
- Previous Treatments
- Existing Blowdown

## Cruising Instructions

Take a minimum of 1 prism point every 2 hectares with a minimum of 3 prism points and a maximum of 50. Enough data must be collected to enable prescribing a unique prescription on 2 hectare portion of a block.

- Use a BAF 2 prism.
- Evenly distribute these points throughout the stand.
- Tally trees into at least three Dbh classes ( $< 10$  cm,  $\geq 10$  cm and  $< 25$  cm,  $\geq 25$  cm for all Vegetation types except  $\geq 35$  cm for tolerant hardwoods). Where more refined estimates of volume and prescriptions are desired tallying in 2 or 5 cm DBH classes would be preferred.
- If volume estimates are required, take at least one height, from the tree of average basal area (average co-dominant tree), for each product class at each point (e.g. pulpwood, studwood, sawlog).
- The following information will be calculated from the pre-treatment assessment to use with management keys to determine a recommended prescription:
  - Growing Stock (Total Basal Area of trees  $\geq 10$  cm Dbh class)
  - Basal Area of **A**cceptable **G**rowing **S**tock (all trees)
  - Basal Area of trees  $\geq 25$  cm Dbh class (except  $\geq 35$  cm Dbh class – TH stands)
  - Regeneration stocking in %
  - Windthrow Hazard (L, M or H)
  - Average height of stand (m)
  - Species composition (% by basal area)
  - FEC ecosite(s) (Neily et al., 2013)



Pre Treatment Tree Assessment Tally Sheet    Date: <i>June 25, 2008</i> __ Prism Factor: <i>2</i> __ <b>*****SAMPLE*****</b>																											
Loc: <i>Milton</i> __ Co: <i>Queens</i> __ BL: <i>1</i> __ ST: <i>1</i> __ # Plots: <i>6</i> __ Cruiser: <i>TM</i> __ Page: <i>1</i> __ of <i>1</i> __																											
Sp	<i>RS</i>						<i>EH</i>						<i>WP</i>						<i>RM</i>								
TC	<i>UU</i>	<i>AU</i>	<i>UP</i>	<i>AP</i>	<i>US1</i>	<i>AS1</i>	<i>UU</i>	<i>AU</i>	<i>UP</i>	<i>AP</i>	<i>US1</i>	<i>AS1</i>	<i>UU</i>	<i>AU</i>	<i>UP</i>	<i>AP</i>	<i>US1</i>	<i>AS1</i>	<i>UU</i>	<i>AU</i>	<i>UP</i>	<i>AP</i>	<i>US2</i>	<i>AS2</i>	<i>US3</i>	<i>AS3</i>	
Dbh																											
5																											
10			1						3			1															
15					3				2				2		1								1			1	
20					3	4					1							1								1	
25						6					1	8						2					1				
30						2					2	11													9		
35					1	1					2	6													10		
40											1	10													12		
45											3	3						1							6		
50											2	5													6		
55																									1		
70											2																
90												1															

Pre-Treatment Site Assessment Tally Sheet. Loc: <u>Milton</u> Co: <u>Queens</u> Block: <u>QU123456</u> Section: <u>A</u>													
Plot	ST	VT	EX	BD	MAT	PT	WET	TF	WT	WF	Patch	Regeneration	Heights/age/notes
<i>1</i>	<i>2</i>	<i>SH3</i>	<i>M</i>	<i>2</i>	<i>M</i>	<i>N</i>	-	-	-	-	<i>U</i>	<i>50% (all) 5% (LL)</i>	
<i>2</i>	<i>2</i>	<i>SH3</i>	<i>M</i>	<i>0</i>	<i>M</i>	<i>N</i>	-	-	-	-	<i>M</i>	<i>50% (all) 50% (LL)</i>	<i>1</i>
<i>3</i>	<i>3</i>	<i>SH1</i>	<i>M</i>	<i>0</i>	<i>M</i>	<i>N</i>	-	-	-	-	<i>U</i>	<i>0 %</i>	<i>2</i>
<i>4</i>	<i>2</i>	<i>SH3</i>	<i>M</i>	<i>1</i>	<i>M</i>	<i>N</i>	-	-	-	-	<i>U</i>	<i>80% (all) 80% (LL)</i>	
<i>5</i>	<i>2</i>	<i>SH3</i>	<i>M</i>	<i>0</i>	<i>M</i>	<i>N</i>	-	-	-	-	<i>U</i>	<i>10% (all) 10% (LL)</i>	
<i>6</i>	<i>2</i>	<i>SH3</i>	<i>M</i>	<i>0</i>	<i>M</i>	<i>N</i>	-	-	-	-	<i>U</i>	<i>0%</i>	
Comments: <i>1: on Knoll 2: In Depression</i>													

## Sample Cruise Summary & Prescription

Based on the sample cruise, the stand characteristics are as follows:

Vegetation Type.....	<u>SH3</u> – Red spruce-Hemlock/Wild lily-of the-valley (85%)
Long Lived Species.....	<u>96 %</u> (Eastern Hemlock=45%, White Pine = 36%, Red Spruce = 15%)
Tolerant Species.....	<u>60%</u> (Eastern Hemlock=45%, Red Spruce = 15%)
Total Growing Stock (≥ 10cm Dbh).....	<u>47 m<sup>2</sup>/ha</u>
Sawlog Stock (≥ 25 cm Dbh).....	<u>38 m<sup>2</sup>/ha</u>
Acceptable Growing Stock (≥ 10cm Dbh)....	<u>35 m<sup>2</sup>/ha</u>
Windthrow Hazard.....	<u>Low</u> (Moderate Exposure, Soil Type = ST2, Fresh, Medium to Coarse-Textured)
Uniform Distribution.....	<u>83%</u>

**Recommended Stand Prescription according to Spruce Hemlock Guide based on cruise summary above:**

### Individual Tree Selection





## Pre-Treatment Tree Assessment Tally Sheet

**Sp**= Species, **Dbh**=Diameter (at breast height) classes; **TC**=Tree Codes: Depending on the information required from the PTA, a one letter Tree Code may be sufficient (U=UGS or A=AGS). When product information is desired, the second letter code can be used to calculate volume by product.

### Softwoods:

#### **1st letter U or A:**

**U** - Unacceptable Growing Stock (UGS) - will not make a sawlog or studwood quality stem in the future, or has stud or sawlog quality stem now, but tree will degrade in quality within 15 years. If tree vigor is low due to reasons such as broken/dead top, insect/disease damage, small crown etc., (which make it a poor candidate to leave growing as a future crop tree) it should be called UGS.

**A** - Acceptable Growing Stock (AGS) - will make a studwood or sawlog quality stem in the future or is one now and will still have studwood or sawlog quality 15 years in the future.

#### **2nd letter U, P or S1:**

**U** – Unmerchantable - Does not have any merchantable products in the stem at present, **P** - Pulp – Existing pulp log, **S1** – Softwood Sawlog – Existing Studwood or better

### Hardwoods:

#### **1st letter (U or A):**

**U** - Unacceptable growing Stock (UGS) - will not make a sawlog quality stem in the future, or has sawlog quality stem now, but will degrade in quality within 15 years. If tree vigor is low due to reasons such as broken/dead top, insect/disease damage, small crown etc., (which make it a poor candidate to leave growing as a future crop tree) it should be called UGS.

**A** - Acceptable Growing Stock (AGS) - will make a sawlog quality stem in the future or is one now and will maintain or improve in quality by the next harvest.

#### **2nd letter (U, P, S1 or S2):**

**U** – Unmerchantable - Does not have potential for any merchantable products, **P** - Pulp - Potential for Pulp log at best,

**S2** - Low Grade Sawlog – Existing low grade sawlog (must have better than pallet log potential) – G 3

**S3** - High Grade Sawlog – Existing high grade sawlog (high end sawlog or veneer log) – G2 or better

### Examples

**UU** - Unacceptable growing stock without current merchantable products

**AU** – Acceptable growing stock without current merchantable products

**UP** - Unacceptable growing stock with current pulp product

**AP** – Acceptable growing stock with current pulp product

**US2** - Unacceptable growing stock with current low grade hardwood sawlog quality stem now but will degrade by the next harvest.

**US3** - Unacceptable growing stock with high grade hardwood sawlog quality stem now, but will degrade by the next harvest.

**AS2** - Acceptable growing stock with existing low grade hardwood sawlog quality stem - will not degrade by the next harvest.

**AS3** - Acceptable growing stock with existing high grade hardwood sawlog quality stem - will not degrade by the next harvest.

**US1** - Unacceptable growing stock with studwood or sawlog quality softwood stem, but will degrade by the next harvest.

**AS1** - Acceptable growing stock with studwood or sawlog quality softwood stem - will not degrade by the next harvest.



## Pre-Treatment Site Assessment Tally Sheet:

### Codes

**ST**- FEC soil type (Neily et al., 2013)

**VT**- FEC vegetation type (Neily et al., 2013)

**EX** – Exposure: **E** = Exposed; **ME** = Moderately Exposed; **M** = Moderate; **MS** = Moderately Sheltered; **S** = Sheltered

**BD** - % of Basal Area Blowdown

**MAT** – Maturity: **I** = Immature, **M** = Mature, **O** = Overmature

**PT** – Previously treated? PCT or Plantation or Commercial Thinning or Previous Partial Harvest: **Y** = Yes, **N** = No

**WET** – Non mapped wetlands: **V** = Vernal Pools, **S**= Springs, **ST** = Streams

**T.F.** – Topographic Features: **K**=Karst, **R** = Ravine, **O** = Rock Outcrop/Boulder fields, **C**= Caves

**W.T.** – Wildlife Trees: **CT**=Cavity Trees (trees greater than 20 cm dbh with existing cavity of size suitable for nesting), **N**=Nests (raptors, heron colonies), **M**= Mast (oak, beech or witch hazel with mast)

**W.F.** – Wildlife Features: **D**=Deer Wintering Areas, **W**=Wildlife Concentrations, **SR**=Species at Risk/concern (<http://novascotia.ca/natr/wildlife/biodiversity/species-recovery.asp>),

**U**=Unique features (specify in comments).

**Patch:** - is the area around the sample plot dominated by **M** - mature to over mature trees, **I** - Immature AGS , **R**- Advanced regeneration of preferred species , or **U**- Uniform mix of all age classes

**Regeneration:** Species, Cover (%), Average Height (m) e.g.: rS/30/0.3 - red spruce, 30% cover, 30cm tall

**Heights/ages:** Heights for volume calculations (Tree of average basal area) and/or Land Capability determination (breast height age and height of Dominant free growing trees)

## Post-Treatment Information Requirements – Selection

In order to meet quality specifications for Selection Harvest the following information must be collected:

- Basal area remaining after harvest
- Basal area of trees damaged during harvest activities with exposed cambium exceeding 100 cm<sup>2</sup> (4”x4”) in area, or with damage to more than 1/3 of the crown
- Basal area of Acceptable Growing Stock (AGS) after harvest.

### Instructions

- Take 1 prism point per hectare with a minimum of 5 prism points and a maximum of 50.
- Use a BAF 2 prism.
- Evenly distribute these points throughout the stand.
- When tallying basal area, do so by AGS, UGS and damaged trees (HD). If species specific information is necessary, also tally by species
- AGS - Acceptable Growing Stock
  - **Softwoods:** Trees that will make a studwood or sawlog quality stem in the future or has one now and will still have studwood or sawlog quality within 15 years. These trees must not have been scarred by harvesting activities with scars of exposed wood exceeding 100 cm<sup>2</sup> in area, or have greater than 1/3 of their live crowns damaged by harvesting activities.
  - **Hardwoods:** Trees that have the potential for producing sawlog quality logs of better than pallet quality and will not degrade within 15 years. These trees must not have been scarred by harvesting activities with scars of exposed wood exceeding 100 cm<sup>2</sup> in area or have greater than 1/3 of their crowns damaged by harvesting activities.
- UGS – Unacceptable Growing Stock
  - **Softwoods:** Trees that will not make studwood or sawlog quality stem in the future, or has stud or sawlog quality stem now but tree will degrade in quality within 15 years. If tree vigor is low due to reasons such as broken/dead tops, insect/disease damage, small crowns (< 1/3 live crown ratio) etc. which make it a poor candidate to leave growing as a future crop tree it should be called UGS.
  - **Hardwoods:** Trees that do not have the potential to produce a better than pallet quality sawlog or one with a sawlog now but that will degrade within 15 years. If tree vigor is low due to reasons such as broken/dead tops, insect/disease damage, small crowns (< 1/3 live crown ratio) etc. which make it a poor candidate to leave growing as a future crop tree it should be called UGS.
- HT = Average height in metres of the species tallied, only if required.
- HD = Trees with harvesting damage of exposed wood exceeding 100 cm<sup>2</sup> in area or crown damage exceeding 1/3 of the live crown
- Calculate the following: % and basal area of acceptable growing stock in m<sup>2</sup>/ha, % and basal area that is damaged in m<sup>2</sup>/ha

