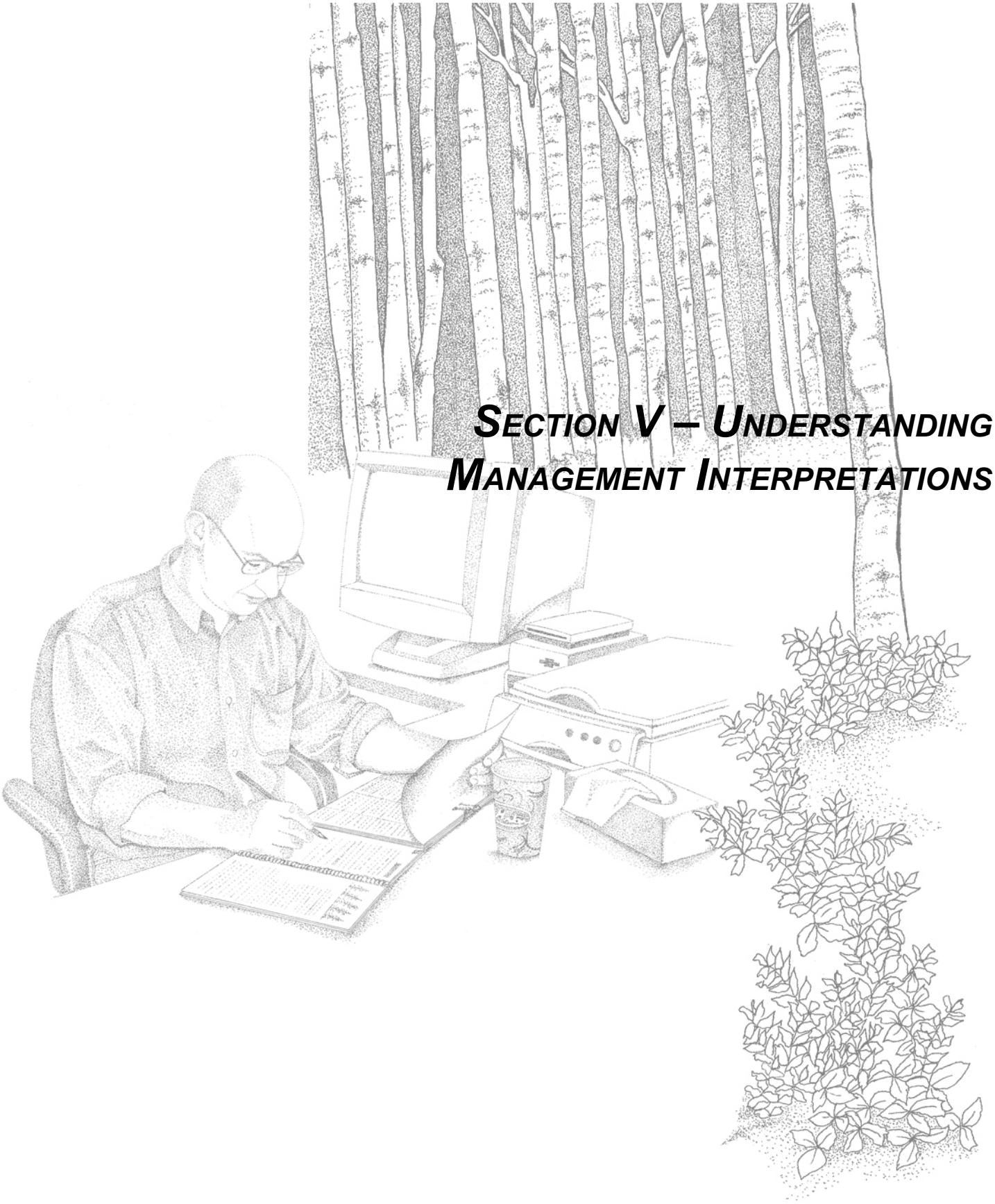


SECTION V – UNDERSTANDING MANAGEMENT INTERPRETATIONS

This section provides background information for using the management interpretation tables and fact sheets in Section VI. This section discusses:

- the use of the management interpretations (tables and fact sheets) in Section VI
- an approach for creating a string of silvicultural activities using the management interpretations
- regeneration standards for boreal mixedwood conditions
- an approach for verifying stand conditions using a pre-harvest assessment

Related to this section, Appendix 2 provides flowcharts and examples describing how the information in Section VI may be used to create boreal mixedwood forest units and prepare a silvicultural ground rule for development of a forest operations prescription.

Silvicultural methods and treatments discussed in Sections V and VI are defined and explained in Section III and the glossary. Management opportunities and challenges under boreal mixedwood conditions are also discussed in Section IV.

Context for the Management Interpretations

The management interpretations in Section VI provide information about silvicultural treatments and methods that may be used to direct a current stand condition to a desired future stand condition[1]. They were developed specifically for situations where a mixedwood stand condition has been identified through the forest management planning process as the desired future stand condition.

A number of the treatments and methods described in the management interpretations are untested operationally in boreal Ontario (Palmer 2003) and suggestions for their use come with appropriate cautions. These cautions are indicated by the use of a coding system in the tables and fact sheets in Section VI (see Coding Conventions, Section VI, page 2).

The cornerstone of mixedwood management is to develop and implement management strategies that emulate natural disturbances and processes (see Section I). The management interpretations have been developed to help recognize opportunities during the various stages of stand development when the natural advantages of the hardwood and conifer components of the stand may be encouraged to meet mixedwood stand objectives.

Working with the Management Interpretation: Tables

The management interpretations in Section VI include the following tables, colour-coded for user convenience:

- Eligible Silvicultural Systems/Harvest Methods
  - at the Stem Exclusion Stage
  - at the Canopy Transition Stage
  - at the Gap Dynamics Stage
- Eligible Logging Methods
- Eligible Regeneration Methods
- Eligible Site Preparation Methods
- Eligible Silvicultural Treatments at Stand Initiation
- Eligible Tending/Cleaning Methods
- Eligible Silvicultural Treatments at Stem Exclusion

[1] Stand condition refers to a combination of stand composition type and stage of stand development, as defined in Section II.

Eligible Silvicultural Systems/Harvest Methods

The tables for Eligible Silvicultural Systems/Harvest Methods table presents the eligible silvicultural systems and harvest methods and their suitability for securing various future stand conditions. Separate tables have been created for stands currently at the stem exclusion, canopy transition, or gap dynamics stages of stand development. To select and use the appropriate table:

- Identify the current stand composition type and the current stage of stand development.
- Select the appropriate table (Table 1, 2, or 3) for the current stage of stand development.
- Identify the (desired) future stand condition for the current stand condition. When using these tables, the desired future stand condition always refers to the stand composition type occurring at the canopy transition stage of stand development (i.e. after harvest and regeneration).

The eligibility of each of the harvest methods to achieve the desired future stand condition is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where further information about the harvest method may be obtained.

Eligible Logging Methods

The table for Eligible Logging Methods (Table 4) presents the logging methods and their eligibility for use with the various silvicultural systems/harvest methods and to achieve other objectives.

The eligibility of each of the logging methods for use with each of the silvicultural systems/harvest methods or to meet other objectives, is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where additional information about the logging method may be obtained.

Eligible Regeneration Methods

The table for Eligible Regeneration Methods (Table 5) presents the eligible regeneration methods for directing a current stand condition to various future stand conditions. To use this table:

- Identify the current stand condition.
- Specify the (desired) future stand condition (stand composition type occurring at canopy transition) (i.e. after harvest and regeneration) for each current stand condition to determine eligible regeneration methods.

The eligibility of each of the regeneration methods to achieve the desired future stand condition is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where further information about the regeneration method may be obtained.

Eligible Site Preparation Methods

The table for Eligible Site Preparation Methods (Table 6) lists the eligible site preparation methods for each of the potential regeneration methods. To use the table, a proposed regeneration method must be identified.

The compatibility of each of the site preparation methods with each of the regeneration methods is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where additional information about the site preparation method may be obtained.

Eligible Silvicultural Treatments at Stand Initiation

The table for Eligible Silvicultural Treatments at Stand Initiation (Table 7) lists eligible silvicultural treatments applicable to stands at the stand initiation stage when a (desired) future stand condition (stand composition type occurring at canopy transition) has been identified (i.e. current rotation). To use this table:

- Identify the current stand composition type at the stand initiation stage.
- Specify the desired future stand composition type at canopy transition to determine eligible silvicultural treatments.

The eligibility of each of the silvicultural treatments (cleaning, supplemental regeneration, compositional treatment, juvenile spacing, and reinitiation) is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where additional information about the silvicultural treatment is provided.

Note: not all of the eligible treatments alone will redirect the current stand condition to the future stand condition because they do not necessarily alter stand composition, e.g. juvenile spacing. However, the coding indicates whether or not the treatment is deemed compatible with the selected objective.

If tending is identified as an eligible treatment at this stage, consult the Eligible Tending/Cleaning Methods table (Table 8) (as discussed below) to select an appropriate method.

Eligible Tending/Cleaning Methods

The table for Eligible Tending/Cleaning Methods (Table 8) lists the eligible tending/cleaning methods for each of the potential regeneration methods. To use this table the regeneration method must be identified.

The compatibility of each of the tending/cleaning methods with each of the regeneration methods is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where further information about the tending/cleaning method may be obtained.

Eligible Silvicultural Treatments at Stem Exclusion

The table for Eligible Silvicultural Treatments at Stem Exclusion (Table 9) lists eligible silvicultural treatments applicable to stands at the stem exclusion stage. To use this table:

- Identify the current stand composition type at the stem exclusion stage.
- Specify the desired future stand composition type at canopy transition (*i.e. current rotation*) to determine eligible treatments.

The eligibility of each of the silvicultural treatments (compositional treatment, pre-commercial thinning, liberation treatment, commercial thinning) is indicated by a code in the appropriate column. A page number at the bottom of each column refers to the fact sheet where further information about each silvicultural treatment is provided.

Note: not all of the eligible treatments alone will redirect the stand to the future forest condition because they do not necessarily alter stand composition, e.g. pre-commercial thinning. However, the coding indicates whether or not the treatment is deemed compatible with the selected objective.

If tending is identified as an eligible treatment at this stage, consult the Eligible Tending/Cleaning Methods table (Table 8) (as discussed above) to select an appropriate method.

Developing Strings of Silvicultural Activities

Procedures for using the tables in Section VI to develop a string of silvicultural activities are presented in the following figures:

- Figure 1. Use of the management interpretation tables for stands eligible for harvest and regeneration.
- Figure 2. Use of the management interpretation tables for stands currently at the stand initiation stage.
- Figure 3. Use of the management interpretation tables for stands at the stem exclusion stage and not currently eligible for harvest.

Figure 1. Use of the management interpretation tables in Section VI for stands eligible for harvest and regeneration.

Current Stand Condition: Eligible for Harvest and Regeneration; at Stem Exclusion, Canopy Transition, or Gap Dynamics Stage

Confirm current stand composition type and stage of stand development.

Select appropriate Silvicultural Systems/Harvest Methods table (Table 1, 2, or 3) based on current stage of stand development.

↓

Determine desired future stand condition at canopy transition stage after harvest (i.e. next rotation):

- list* Eligible Silvicultural Systems/Harvest Methods (Table 1, 2, or 3)
- list Eligible Logging Methods (Table 4), compatible with listed Silvicultural Systems/Harvest Methods
- list Eligible Regeneration Methods (Table 5)

↓

Consult fact sheets as appropriate.

Select** Silvicultural System/Harvest Method – Logging Method – Regeneration Method combination.

↓

For selected Regeneration Method:

- list Eligible Site Preparation Methods (Table 6)

↓

Consult fact sheets as appropriate.

Select Site Preparation Method

↓

For the regenerated stand consider:

- Eligible Silvicultural Treatments for Stands at Stand Initiation Stage (Table 7)
- List Eligible Tending/Cleaning Methods (Table 8)

↓

Consult fact sheets as appropriate.

Select Tending/Cleaning Methods.

↓

For the regenerated stand consider:

- Eligible Silvicultural Treatments for Stands at Stem Exclusion Stage (Table 9)
- list Eligible Silvicultural Treatments

↓

Consult fact sheets as appropriate

Select treatments for stands at stem exclusion

↓

Select and record** appropriate methods and treatments to meet objectives (complete harvest-to-harvest string of silvicultural activities).

* Worksheet 1 is available in Appendix 2 to list eligible silvicultural activities.

** Worksheet 2 is available in Appendix 2 to record harvest-to-harvest silvicultural strings.

Figure 2. Use of the management interpretation tables in Section VI for stands currently at the stand initiation stage.

Current Stand Condition: At the Stand Initiation Stage as a result of harvest, regeneration treatment, or natural disturbance (e.g. fire, blowdown)

Confirm current stand composition type and stage of stand development.

↓

Determine desired future stand condition at canopy transition stage (i.e. current rotation).

↓

List* Eligible Silvicultural Treatments at Stand Initiation Stage (Table 7).

- Cleaning
- Supplemental Regeneration
- Compositional Treatment
- Juvenile Spacing
- Reinitiation

If cleaning is an eligible treatment, select Eligible Tending/Cleaning Method (Table 8) for corresponding Regeneration Method.

↓

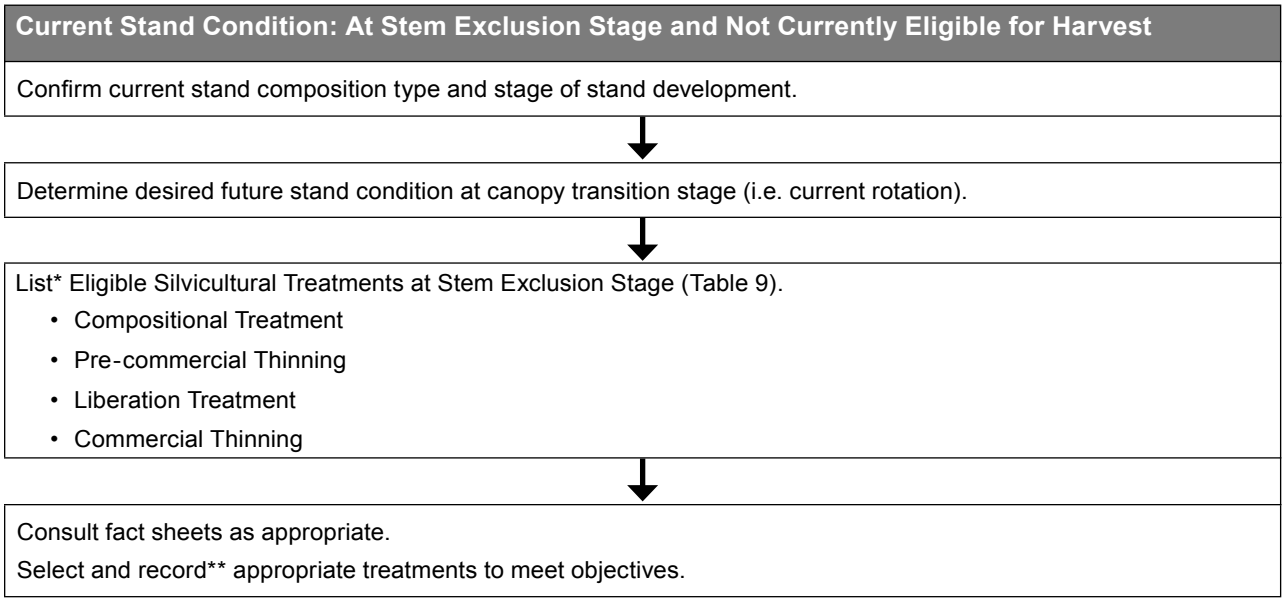
Consult fact sheets as appropriate.

Select and record** appropriate treatments to meet objectives.

* Worksheet 1 is available in Appendix 2 to list eligible silvicultural activities.

** Worksheet 2 is available in Appendix 2 to record harvest-to-harvest silvicultural strings.

Figure 3. Use of the management interpretation tables in Section VI for stands at the stem exclusion stage and not currently eligible for harvest*.



*Worksheet 1 is available in Appendix 2 to list eligible silvicultural activities.

** Worksheet 2 is available in Appendix 2 to record harvest-to-harvest silvicultural strings.

Working with the Management Interpretation: Fact Sheets

The management interpretations in Section VI include the following fact sheets, colour-coded for user convenience:

- Silvicultural Systems/Harvest Methods
- Logging Methods
- Regeneration Methods
- Site Preparation Methods
- Tending/Cleaning Methods
- Tending/Intermediate Stand Treatments

Figure 4 describes the information presented in a fact sheet and how it is used.

Regeneration Standards

Requirements and terminology for describing regeneration standards in Ontario are outlined in *Silvicultural Effectiveness Monitoring Manual for Ontario* (OMNR 2001). Additional considerations for boreal mixedwood objectives are:

- target and acceptable species must:
  - be compatible with each other
  - be compatible with the ecological conditions of the site and conditions (e.g. light regime) modified by the silvicultural system and harvest method
  - contribute to the management objectives
- minimum heights:
  - are critical attributes for the conifer component of the mixedwood stand
  - must be specified for advance growth, and additional criteria for acceptable advance growth should be specified to ensure their ability to respond to release and their suitability as future crop trees

Figure 4. Information provided in a management interpretation fact sheet.

Title: Identifies the silvicultural method or treatment.	
Overview	This section provides a brief summary of general information pertaining to a method or treatment and indicates its applicability under particular conditions. Definitions and detailed explanations of the methods and treatments are provided in Section III.
Promotion of Conifer	This section highlights procedures, observations, or other information to indicate the opportunities for using the method/treatment to promote the conifer component of a boreal mixedwood stand.
Promotion of Hardwood	This section highlights procedures, observations, or other information to indicate the opportunities for using the method/treatment to promote the hardwood component of a boreal mixedwood stand.
CR Conditionally Recommended Practices	This section describes the "conditions" that must be met to implement a method/treatment designated as "CR" (see Coding Conventions in Section VI). A "CR" may indicate a condition applicable to a specific treatment or to a general condition that applies where appropriate, across all boreal mixedwood sites. The conditions are not numbered to correspond to specific site or stand conditions. Each condition should be reviewed and evaluated to determine its applicability to the specific circumstances being considered.
D Developmental Practices	This section contains background information that may be useful in developing an approach suitable for boreal Ontario conditions. This information has been determined from literature reviews or from summaries of preliminary research results (see Coding Conventions in Section VI). The category "D" was developed for this guide because of the large number of practices that were untested operationally in mixedwood conditions in boreal Ontario but showed promise. The information in this section does not necessarily comprise a preferred option for boreal Ontario conditions. When planning a developmental practice, "conditions" listed in the "CR" section must be reviewed and applied, if applicable, to the developmental practice.
NR Not Recommended Practices	Comments in this section indicate why certain practices have been classified as "NR" (see Coding Conventions in Section VI). In some cases, "NR" may indicate that an activity is not ecologically appropriate or will not lead to the management objectives. In those instances, the reason for the NR designation may not be indicated on individual fact sheets.
Considerations for Implementation	This section presents information that is important to consider when implementing a recommended ("R") method or treatment (see Coding Conventions in Section VI). Additional information concerning the implementation of an "R" method or treatment is provided in Sections III and IV. Comments in this section should be considered for application to all categories of treatment ("R", "CR", "NR", or "D").
Opportunities	This section reports other information that may be considered in determining the appropriateness of a treatment in boreal Ontario conditions. The following information may be outlined in this section: opportunities to link to other methods/treatments, variations in the application of the method/treatment that have been attempted, opportunities for pre-harvest treatments (including site preparation, planting, and tending), potential benefits of the method/treatment, and comments indicating how the method/treatment emulates some aspect of a natural disturbance.
Go To	This section provides a link to additional tables and/or fact sheets that should be considered when evaluating silvicultural options.

- timing:
  - years to free-to-grow should be specified for clearcut and shelterwood silvicultural systems
  - years since last disturbance may be used to define assessment periods for selection silvicultural systems
- minimum and maximum density levels:
  - should be defined as they relate to the achievement of management objectives
  - will influence wood quality and the yield of specific size classes or products with variations in this attribute
- selected methodologies to assess regeneration:
  - should provide confidence limits suitable for the management decisions being made

Regeneration Standards for Developing Aspen Stands with Conifer Understories

Conifers growing in intimate mixtures with shade intolerant hardwoods (i.e. conifers in the understorey of a developing hardwood overstorey) may undergo intense competition due to differences in juvenile height growth. In these situations, it is important that the competition between species is managed so that conifer regeneration receives adequate resources, particularly light, for their survival and growth. In developing aspen stands, the lowest period of light transmission appears to occur between the ages of 15 and 25 years, and may be as low as four percent of full sunlight – far below the level of light required for spruce survival (Pinns *et al.* 2001, Lieffers *et al.* 2002, Comeau *et al.*, submitted).

Traditional methods of free-to-grow assessment, using small assessment plots and "distance to competition" rules, are not able to predict the competitive impacts of aspen for light in these situations (Lieffers *et al.* 2002). It was determined that larger assessment plots, related to the size of the aspen trees, would be required to assess light competition using a traditional "tree centre" approach. However, at the time of the "light bottleneck", it was concluded that the size of the assessment plots required would be operationally impractical (e.g. require 10 metre diameter assessment plots). Indices based on stand parameters (e.g. stand density and size, or stand basal area) for the developing aspen stand show promise as a better indication of light transmission to the understorey spruce than current free-to-grow criteria (Lieffers *et al.* 2002).

Therefore, as an alternative to traditional free to grow assessments, limits on the density of aspen (related to stand height) may be appropriate for describing criteria when spruce and aspen are growing in intimate mixtures. Aspen stands up to 30 years in age may be assessed using this stand average approach to ensure adequate light levels during the lowest period of light transmission (Lieffers *et al.* 2002, Comeau *et al.* submitted). Any standards based on this approach should be evaluated for Ontario conditions, and the density and size of aspen stands should be assessed and related to measured light transmission levels in the understorey.

Verifying Forest Operation Prescriptions for Mixedwood Management

Many of the stand and site attributes critical to the successful implementation of a boreal mixedwood silvicultural strategy (e.g. stage of stand development, broad soil group, stand composition type, understorey composition, and presence of advance growth) may not be determined from Ontario's forest resource inventory (FRI), which is currently completed in the boreal forest using leaf-on, black-and-white photography at a scale of 1:20,000. For the successful implementation of a mixedwood prescription, important ecological attributes (e.g. ecosites), as well as the traditional inventory descriptions (e.g. stocking, stand age, volumes) must be verified. This information is normally confirmed through a field based pre-harvest assessment.

The pre-harvest assessment is a field inspection designed to identify the opportunities and constraints that may influence the successful implementation of a boreal mixedwood silvicultural ground rule for a specific stand or group of stands. Some of the key factors that should be assessed include:

- broad soil group and FEC soil type

- tree species composition of the canopy, subcanopy, and understorey layers
- understorey vegetation and FEC vegetation type
- stage of stand development
- opportunities for tree regeneration, including the potential for vegetative reproduction, natural seeding, advance growth, and artificial treatments
- identification of potential damaging agents such as disease
- other site constraints or opportunities
- wildlife values

An example of a pre-harvest assessment form is provided in Appendix 5.

Important Considerations in Designing Pre-harvest Assessment Procedures

Step-by-step procedures have been described for the completion of pre-harvest assessments in the boreal forest (Towill *et al.* 1988, Bidwell *et al.* 1996). The following procedures emphasize conditions that should be assessed when completing a pre-harvest assessment for the potential application of a boreal mixedwood silvicultural prescription.

Sampling Methodology

A "free survey" (Towill *et al.* 1988) is one recommended sampling design in which the selection of sample points along transects is designed to capture "significant" variation in conditions relevant to the use of the management interpretation tables and fact sheets.

Transects should be predetermined on aerial photography to capture significant variability that may occur within the stand. Excessive variability in important site and stand attributes may require stratification of the stand and completion of separate pre-harvest assessment documentation.

Data from sample points should be supplemented with a "walk through" assessment to assess variability of conditions. The data that should be collected at each sample point are as follows (adapted from Maurer 1995).

Canopy and Sub-canopy Conditions

- at sample points, conduct prism sweep and tally by species; for three dominant canopy trees, record diameter, height, and age at dbh
- the resulting basal area sample defines species composition and stocking
- 400 square metres plot (11.28 metres radius) is used to determine density of canopy and sub-canopy species
- attributes to be recorded may include: species, height, age, stocking, density, and site class

Understorey Shrub Layer Conditions

- record coverage of shrub species by height class
- attributes to be recorded include: species, height class, and percent cover

Advance Regeneration

- at a sampling point, establish a 50 square metres plot (3.99 metres radius) and count, by species and height class, all trees considered to be advance growth
- attributes to be recorded include: stems per hectare of advance regeneration by species and height class

Soil Attributes

- at each sample plot, record soil attributes such as organic matter depth, humus form, depth to restrictive layer, moisture regime/drainage, depth to mottles/gley and soil texture class, using FEC conventions

FEC Vegetation and Soil Types and Ecosite

- determine FEC vegetation (V-type) and soil (S-type) type and ecosite (ES-type) using FEC/ELC classification procedures

Windthrow Risk

- using slenderness coefficient and other criteria, assess and record windthrow risk for canopy and sub-canopy layers by species

Strata/Stand Summary Information

Attributes to be summarized for the strata/stand are:

- canopy composition (stocking by species)
- sub-canopy composition (stocking by species)
- stage of stand development
- current stand condition
- broad soil group

Draft Pre-harvest Assessment

A pre-harvest assessment form (see example in Appendix 5) may be completed while in the field; this provides an opportunity to record the extent and magnitude of any opportunities or constraints for silvicultural activities while it is still possible to verify on-site conditions. The following information should be recorded:

Objectives

- desired stand composition and structure objectives, future stand condition and additional stand attributes that characterize the future stand objective

Harvesting Plan

- silvicultural system, preferred harvest method and compatible logging method
- proposed scheduling of partial cuts for selection and shelterwood
- seasonal restrictions
- kind and species of trees to be utilized or left and rationale
- volume/products expected
- access
- constraints and other special conditions

Renewal Plan

- preferred and alternative regeneration methods
- microsite objective and site preparation method
- regeneration method
- target densities
- tending objective and method
- constraints and rationale for all renewal treatments

Monitoring

- type of survey and schedule for monitoring the developing stand