DRAFT FOREST MANAGEMENT GUIDE FOR GREAT LAKES-ST. LAWRENCE LANDSCAPES (VERSION 2)

November 2025

Ministry of Natural Resources

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List of Standards and Guidelines

The following summary is provided for convenience only. Please refer to the main text of this document for details and explanation of the standards and guidelines.

(1) This version of the Landscape Guide will be used in its entirety in the preparation of forest management plans (FMPs) for management units in the Great Lakes-St. Lawrence Landscape Guide Regions (Figure 1) scheduled for implementation on or after April 1, 2029. (standard)

(2) Forest management plans for management units in the Great Lakes-St. Lawrence Landscape Guide Regions (Figure 1) that are being prepared for implementation before April 1, 2029, are required to use either the 2010 version or this version of the Landscape Guide and are encouraged to use this version. (guideline)

(3) Forest management plans will use the Landscape Guide indicators as the biodiversity indicators of objective achievement. The indicators required in FMPs can vary by Landscape Guide region as listed in Table 2 and Table 3 (e.g., texture of mature and old forest) and will be described in the FMP as required by the Forest Management Planning Manual. (standard)

(4) Forest management plans will include all Crown land within the management unit when measuring landscape structure and composition indicators. (standard)

(5) Forest management plans will use Landscape Guide forest units to ensure that there is compatibility with all Landscape Guide indicators (i.e., Table 2 and Table 3) and associated desirable levels. (guideline)

(6) Forest management plans will represent landscape classes in forest estate models used to develop the management direction. (standard)

(7) Forest management plans will use old growth forest indicators consistent with the Old Growth Forest Definitions for Ontario (OMNR 2003) and late development stage of Landscape Guide forest units. Old growth forest by individual Landscape Guide forest units, or appropriate groupings of Landscape Guide forest units, as determined by the forest management planning team, will be represented in forest estate models used to develop the management direction. (guideline)

(8) Forest management plans will represent the total area of red and white pine forest units (i.e., all ages combined) in forest estate models used to develop the management direction that correspond to the following Landscape Guide forest units: PWST, PWUS4, PWOR, PWUSH, PWUSC and PR. (guideline)

(9) Forest management plans will reference the 1995 amount of red and white pine forest when assessing the achievement of the red and white pine indicator. (guideline)

(10) Forest management plans will represent the amount of two types of young forest classes in forest estate models used to develop the management direction (guideline):
    i. the pre-sapling development stage of all forest units combined and
    ii. the pre-sapling, sapling and t-stage of all forest units combined.

(11) Forest management plans will represent each individual Landscape Guide forest unit in forest estate models used to develop the management direction. (guideline)

(12) Forest management plans will use Ontario's Landscape Tool (OLT) to measure the pattern indicators (i.e., texture of the mature and old forest indicator, young forest patch size indicator) or an equivalent tool that has received approval from the Ministry. (standard)

(13)Forest management planning teams may identify and delineate areas with a high degree of private land ownership fragmenting the forest in the management unit and exempt these areas from application of landscape pattern indicators. The Crown-land portion of these exempt areas will be included in the calculation for landscape structure and composition indicators. (guideline)

(14)Texture of mature and old forest will be measured at plan start (year 0), plan end (year 10), and years 20, 30, and 40 of the management direction of the forest management plan at the following scales (standard):

i. 500 ha and 5000 ha scales in the GLSL North Landscape Guide Region.
ii. 50 ha and 500 ha scales in the GLSL South Landscape Guide Region.

(15)Young forest patch size will be measured at plan start (i.e., year 0), plan end (i.e., year 10), and years 20, 30, and 40 of the management direction of the forest management plan. For the purpose of this indicator, young forest is defined as being less than 36 years of age. (standard)

(16)The desirable levels for Landscape Guide indicators will be set as, or within, the SRNV for non-spatial indicators and mean of the SRNV for pattern indicators. (guideline)

(17)Forest management plans will include targets for the Landscape Guide indicators that are consistent with milestones in the Validating and Revising Milestone Technical Note And Milestone Repository[1]. Targets will be consistent with milestones over the short (i.e., 10 years), medium (i.e., 20 years) and long terms (i.e., 100 years). (guideline)

(18)Forest management plans will document and discuss an estimate of when the desirable level will be reached for Landscape Guide indicators that have long-term targets established, including associated management challenges. (guideline)

(19)In cases where the achievement of meeting a Landscape Guide milestone conflicts with another management objective and the forest management planning team decides to favour the non-Landscape Guide objective, provide rationale in the forest management plan that describes in detail (guideline):

i. the decision and how it was determined, and
ii. the expected time to achieve all affected milestones.

(20)Forest management plans will identify large landscape patches (LLPs), using a strategic landscape map, that may be required to meet targets created for Landscape Guide pattern or habitat indicators (e.g., texture of the mature and old forest, young forest patch size), and allow for the efficient implementation of other guides (e.g., Stand and Site Guide). (guideline)

(21)The forest management planning team will practice judicious use of LLPs by considering the landscape condition at the start of the planning term, indicator projections, Indigenous knowledge and values, local and landscape context, past management, natural disturbances, and, when available and applicable, the SRNV. (guideline)

(22)Each LLP (e.g., moose emphasis area, deer emphasis area, LLP to address the texture of mature and old forest) selected by the forest management planning team as part of the management direction requires the following documentation (guideline):

a. Where: Identification of the LLP using a numbering system (e.g., Strategic Management Zone (SMZ) identifier in accordance with the Forest Information Manual and applicable technical specifications).
b. What and Why: What targets are met by the LLP (e.g., Landscape Guide indicator(s) or specific fine filter objective(s)).

[1] MNR. 2025. Forest Management Guide for Boreal Landscapes and Forest Management Guide for Great Lakes-St. Lawrence Landscapes: Milestones Repository.

c. When: When will these areas be managed, using at least 20-year periods. The strategic landscape map should identify prioritized management actions for spatially explicit indicators (e.g., pattern and habitat) over a length of time sufficient to demonstrate movement into and maintenance within desired level.
d. How: Describe what management actions will be taken in the LLP for each period, including a description of anticipated silviculture. In cases where an LLP is managed to create specific fine filter conditions, the management objectives and actions must be consistent. Describe how the LLP was taken into account in the forest estate model used to develop the management direction (e.g., available for harvest, deferred harvest, additional residual, specific silviculture).
e. Roads: Description of the expected length of time that planned or existing roads within the LLP will be required to carry out management actions. This documentation does not replace or direct road access planning; however, it can be used as input to the development of a road use management strategy.

(23) Where objectives exist for moose or deer, forest management planning teams should evaluate using models, when available, to understand how application of the coarse filter provides habitat for these species. (guideline)

(24) Within large landscape patches that emphasize moose or deer habitat following direction in the Stand and Site Guide, forest management planning teams will consider how the identification, arrangement and planning of these large landscape patches contributes to broader landscape structure, composition, and pattern objectives. (guideline)

Acknowledgements

The Ministry of Natural Resources acknowledges the long history of the lands referenced by the Landscape Guide. The forests and lands currently managed by the Ministry were cared for by Indigenous peoples long before the inception of the Ministry, Ontario, or Canada. They continue to be taken care of by Indigenous peoples today. As a Ministry, we have a responsibility for the sustainable management of the forest, and we recognize the need to work closely with First Nation and Métis communities to achieve this goal for generations to come.

The Ministry also acknowledges the many individuals who contributed to the development, review, and revision of the Landscape Guide. This includes the development team, science teams, Provincial Forest Technical Committee, First Nation peoples, Métis peoples, many practitioners, and other interested individuals that participated in the 2024 Landscape Guide review.

The Ministry recognizes that some of the geographic boundaries and areas used in this document may not resonate with all readers. The Ministry understands that the borders of Ontario and its management units may not align with some readers' conceptualizations of the landscape's boundaries. The Ministry uses this system to identify the managed forest and appreciates that it is not the only way the landscape is understood.

Summary

The Forest Management Guide for Great Lakes-St. Lawrence Landscapes (the Landscape Guide) is one of a series of forest management guides in Ontario's forest policy framework. These guides provide direction used by forest management planning teams during the development of forest management plans (FMPs). The Landscape Guide and the Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (the Stand and Site Guide) incorporate a coarse and fine filter concept into the direction for forest management. The coarse filter is based on the principle of emulating natural disturbances and is treated as a hypothesis in the context of adaptive management. The fine filter direction addresses values that are particularly sensitive to disturbances caused by management activities.

The objective of the Landscape Guide is to direct forest management activities to maintain or enhance natural landscape structure, composition and patterns that provide for the long-term health of forest ecosystems in an efficient and effective manner. Section 1 provides an overview of the guide, policy background, revisions made since the 2010 version of the Landscape Guide, and expectations for implementation. Section 2 provides background on the development of the Landscape Guide, including a description of key concepts and comparison to past management approaches. Section 3 provides direction for implementing the Landscape Guide and section 4 provides an overview of the Ministry's approach to monitoring and evaluating Landscape Guide direction in terms of its effectiveness, efficiency, and effects on other values.

The general steps for implementing the Landscape Guide, as described in section 3, are:

1. Measure the current forest condition using Landscape Guide indicators (see section 3.1).
2. Identify desirable levels using the simulated range of natural variation (SRNV) for area-based indicators and the mean SRNV for pattern indicators (see section 3.2).
3. Develop targets for the Landscape Guide indicators that are consistent with movement within or towards the SRNV for area-based indicators and movement toward the mean for pattern indicators (see section 3.3).
4. Identify large landscape patches (LLPs) when required to meet targets for landscape pattern or habitat indicators (see section 3.4).

Direction is provided as standards, guidelines, and best management practices. Standards are mandatory direction that provide precise direction. Guidelines are mandatory direction that may require professional expertise, local knowledge or Indigenous knowledge for it to be applied appropriately at the local level. Best management practices are not mandatory, however, implementation is generally considered to help achieve the overall objectives of the associated standards and guidelines.

Successful implementation of the Landscape Guide is facilitated by the knowledge and experience of forest management planning team members. Landscape Guide direction and associated implementation is supported by a series of science and information packages. This science and information is intended to be used by planning teams together with Indigenous knowledge and local knowledge in the development of sustainable forest management plans.

Résumé

Le guide de gestion forestière pour les paysages des Grands Lacs et du St-Laurent (le « guide sur les paysages ») [en anglais seulement] fait partie d'une série de guides de gestion forestière du cadre des politiques forestières de l'Ontario. Ces guides fournissent les directives utilisées par les équipes de planification de la gestion forestière lors de l'élaboration des plans de gestion forestière (PGF). Le guide sur les paysages ainsi que le guide de gestion forestière pour la conservation de la biodiversité à l'échelle du peuplement et du site (le « guide du peuplement et du site ») [en anglais seulement] intègrent un concept de filtre récapitulatif et de filtre détaillé dans les directives de gestion forestière. Le filtre récapitulatif est fondé sur le principe de l'émulation des perturbations naturelles et est traité comme une hypothèse dans le contexte de la gestion adaptative. Les directives du filtre détaillé concernent des valeurs particulièrement sensibles aux perturbations causées par les activités de gestion.

L'objectif du guide sur les paysages est d'orienter les activités de gestion forestière de façon à maintenir ou améliorer la structure, la composition et les configurations naturelles du paysage qui assurent la santé à long terme des écosystèmes forestiers de manière efficiente et efficace. La section 1 donne un aperçu du guide, du contexte des politiques, des révisions apportées depuis la version 2010 du guide sur les paysages et des attentes en matière de mise en œuvre. La section 2 présente le contexte de l'élaboration du guide sur les paysages, notamment une description des principaux concepts et une comparaison avec les approches de gestion antérieures. La section 3 fournit une orientation pour la mise en œuvre du guide sur les paysages, et la section 4 donne un aperçu de l'approche du ministère en matière de surveillance et d'évaluation de l'orientation du guide sur les paysages en termes d'efficacité, d'efficience et d'effets sur d'autres valeurs.

Les étapes générales de la mise en œuvre du guide sur les paysages, décrites à la section 3, sont les suivantes :

1. Mesurer l'état actuel des forêts à l'aide des indicateurs du guide sur les paysages (voir section 3.1).
2. Déterminer les niveaux souhaitables en utilisant la plage simulée de variation naturelle (SRNV) pour les indicateurs par région et la SRNV moyenne pour les indicateurs de configuration (voir section 3.2).
3. Définir des cibles pour les indicateurs du guide sur les paysages qui sont cohérentes avec le mouvement à l'intérieur de la SRNV ou vers la SRNV pour les indicateurs par région, ainsi que le mouvement vers la moyenne pour les indicateurs de configuration (voir la section 3.3).
4. Identifier les grandes parcelles de paysage lorsque cela est nécessaire pour atteindre les cibles relatives à la configuration du paysage ou aux indicateurs de l'habitat (voir la section 3.4).

L'orientation est fournie sous forme de normes, de lignes directrices et de pratiques de gestion exemplaires. Les normes sont des directives obligatoires qui fournissent une orientation précise. Les lignes directrices sont des directives obligatoires qui peuvent nécessiter une expertise professionnelle, des connaissances locales ou des connaissances autochtones pour qu'elles soient appliquées de façon appropriée au niveau local. Les pratiques de gestion exemplaires ne sont pas obligatoires, mais nous recommandons généralement de les mettre en œuvre pour aider à atteindre les objectifs généraux des normes et lignes directrices connexes.

La mise en œuvre réussie du guide sur les paysages est facilitée par les connaissances et l'expérience des membres de l'équipe de planification de la gestion forestière. Les directives du guide sur les paysages et leur mise en œuvre sont appuyées par une série de trousses scientifiques et d'information. Ces données scientifiques et ces informations sont destinées à être utilisées par les équipes de planification, en complément des connaissances autochtones et locales, dans le but d'élaborer des plans de gestion forestière durable.

1 Introduction

The Forest Management Guide for Great Lakes-St. Lawrence Landscapes (hereafter, Landscape Guide) is one of the forest management guides used by forest managers when planning and implementing forest management operations. To protect or enhance environmental, recreational, and cultural heritage values, the Ministry of Natural Resources (hereafter, the Ministry) maintains a series of forest management guides. These guides provide direction to assist forest managers in decision-making. For example, deciding what areas of forest to harvest (and equally important, what areas not to harvest), how large the harvest areas should be, and what harvesting and regeneration practices to use. An overview of the complete set of forest management guides and their role in the sustainable management of Ontario's forests is provided on the Ontario webpage (https://www.ontario.ca/page/forest-management-guides).

The *Crown Forest Sustainability Act*, *1994* (CFSA) provides for the sustainability (long-term health) of Crown forests that are to be managed to meet social, economic and environmental needs of present and future generations. The Landscape Guide provides direction for forest management planning that is consistent with the two CFSA principles:

1) Large, healthy, diverse and productive Crown forests and their associated ecological processes and biological diversity should be conserved.

2) The long term health and vigour of Crown forests should be provided for by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns while minimizing adverse effects on plant life, animal life, water, soil, air and social and economic values, including recreational values and heritage values.

These principles of the CFSA are foundational to the development of the Landscape Guide (see section 2) and evaluation of its effectiveness (see section 4). The Landscape Guide works together with the Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales (hereafter Stand and Site Guide) to direct planning teams to follow a coarse and fine filter management approach (see section 2.2.2). These guides help planning teams to set the management direction (i.e., strategic, tactical and operational) for a forest management plan (FMP) in the context of surrounding management units.

The most efficient way to use the Landscape Guide in forest management planning is to:

- **Read** the Landscape Guide: The main body of the guide describes how the guide was developed, forest management planning implementation steps and an approach to effectiveness monitoring of the guide direction.

- **Refer** to the Validating and Revising Milestone Technical Note And Milestone Repository regarding milestones for the applicable Landscape Guide Region. There are 6 Landscape Guide regions across Ontario. Each management unit is located in a single Landscape Guide region.

- **Use** Ontario's Landscape Tool (OLT) to measure and assess the landscape of interest. OLT is a computer-based tool that measures indicators described in the Landscape Guide and Appendices. Refer to the science and information packages, which describe the simulation models, results and supporting science used in the development of the guide.

- **Incorporate** the Landscape Guide direction into forest management planning (see section 3).

Similar to all forest management guides, the mandate of this document is limited to the managed forest within Crown lands in Ontario (specifically those forests within the Great Lake-St. Lawrence forest region). The philosophy and direction provided may also be helpful when managing other Crown forests outside of the managed forest and private forest lands.

1.1 Purpose of the Landscape Guide

The purpose of the Landscape Guide is to direct forest management activities to maintain or enhance natural landscape structure, composition and patterns that provide for the long-term health of forest ecosystems in an efficient and effective manner. For purposes of this guide, 'landscape' describes an area covering hundreds of thousands to tens of thousands of square kilometres, roughly equivalent to ecoregions (see section 1.2.1).

1.2 Content and organization

1.2.1 Landscape Guide Regions

The Landscape Guide uses a forest-centric approach to define landscapes based on natural factors that reflect structure, composition and function across space and time (Rowe and Sheard 1981, Franklin 1993). Ecoregions are ecological landscape units (ranging in resolution from hundreds of thousands to tens of thousands of square kilometres) characterized by distinct patterns of responses to climate as expressed by soils, hydrology, vegetation (species ranges and productivity), and fauna (OMNR 2000). Processes that operate at ecoregion scales include natural disturbance regimes, landscape composition and pattern, and population dynamics of some wildlife with large home ranges (e.g. wolves, moose, goshawk, great grey owl). Ecoregions were used to develop the Landscape Guide regions, which this guide considers as its landscape unit.

Landscape Guide Regions are groupings of Forest Management Units that approximate ecoregion boundaries (Figure 1). These regions have been designed with Forest Management Units nested within Landscape Guide Regions so direction for individual management units may be given efficiently within an ecoregion context (see Appendix A). Landscape Guide direction can vary among Landscape Guide Regions to reflect significant ecological differences in landscape structure, composition and/or pattern (section 3.1). Landscape Guide Regions are also used in the approach to effectiveness monitoring (section 4).

Figure 1. Landscape Guide Regions of Ontario. Landscape Guide Regions shaded in orange will use the Forest Management Guide for Great Lakes-St. Lawrence Landscapes, whereas the other Landscape Guide regions will use the Forest Management Guide for Boreal Landscapes. See

Appendix A for a list of forest management units within the Great Lakes-St. Lawrence Landscape Guide Regions.

1.2.2 Direction characterization

Direction within this document is characterized as standards, guidelines, and best management practices.

A ***standard*** is a component of a guide that provides mandatory direction. The Landscape Guide uses standards when precise direction is given, and standards must be followed as written.

A ***guideline*** is a component of a guide that provides mandatory direction that may require professional expertise, local knowledge or Indigenous knowledge for it to be applied appropriately at the local level. The Landscape Guide uses guidelines in order for planning teams to incorporate knowledge and experience of local ecological conditions to improve the application of standards and guidelines.

A best management practice is a component of a guide that suggests a practice or strategy to help implement the overall purpose of the standards and guidelines. The list of best management practices should be considered but is not intended to be exhaustive. Planning teams may think of and implement other ideas or strategies. There is no requirement to use these best management practices, and a specific best management practice may not be applicable to all local circumstances.

Standards and ***guidelines*** are formatted in ***bold italic*** in the Landscape Guide and given a number as a unique identifier. Best management practices are indicated as such, but they have normal format. A complete list of the standards and guidelines is provided on page vi.

1.3 Policy background

1.3.1 Strategic direction

The Ministry is the steward of Ontario's forests, fisheries, wildlife, mineral aggregates, and public lands and waters that make up 76 per cent of the province. This is a major responsibility which the Ministry manages through a diverse legislative mandate and an array of programs aimed at meeting the needs of a broad client base.

The Ministry envisions Ontarians benefitting from "the health and wealth of the province's natural resources today and in the future" (MNR 2025). The Ministry's mission is to sustainably manage and promote the responsible use of Ontario's natural resources. The Ministry is committed to the conservation of biodiversity and the use of natural resources in a sustainable manner.

In 2020, the Ministry revised its Statement of Environmental Values (SEV) under the Environmental Bill of Rights (EBR). The SEV is a document that describes how the purposes of the EBR are to be considered whenever decisions that might significantly affect the environment are made in the Ministry. The Ministry has considered its SEV during the development of the Landscape Guide. This document is intended to reflect the direction set out in the SEV and to further the objectives of managing Ontario's natural resources sustainably, including the consideration of the following principles:

- The ministry strives to identify and manage healthy, resilient and diverse ecosystems to provide for sustainable natural resource use.
- The ministry recognizes the finite capacity of ecosystems and takes into account environmental, social and economic values, impacts and risks.
- The ministry relies on the best available knowledge, including science, Traditional Ecological Knowledge, and other information to improve natural resource management and responsible use.
- The ministry exercises caution in the face of uncertainty and seeks to avoid, minimize or mitigate harm to the environment.

- The ministry provides for open and accessible engagement opportunities that promote awareness and understanding of natural resource management and use.
- The ministry seeks to make natural resource management and use decisions through consideration of input from the public, Indigenous peoples, stakeholders, and partners.

Ontario's comprehensive forest policy framework embodies the Ministry's strategic direction. The Policy Framework for Sustainable Forests (1994) provides high level direction for forest policy in Ontario and identifies forest sustainability as the primary objective of forest management. This framework outlines several principles for sustaining forests, using forests, and decision-making that are considered during the development, review, and revision of forest management guides. Direction in the Landscape Guide aligns with these principles and goals from more recent modernization strategies, including the framework for Taking a Broader Landscape Approach (2013) and Sustainable Growth: Ontario's Forest Sector Strategy (2020).

1.3.2 Legislative context

The key piece of legislation that governs forest management on Crown land in Ontario is the *Crown Forest Sustainability Act, 1994* (CFSA).

As noted earlier, Landscape Guide direction to emulate natural disturbances and landscape patterns are based on the principles of the CFSA. The CFSA also requires the development and distribution of four regulated manuals, two of which give legal context to the forest management guides. The Forest Management Planning Manual (FMPM) requires that forest management guides be used during the preparation of a forest management plan (FMP). Similarly, the Forest Operations and Silviculture Manual (FOSM) enables the various policies, including the forest management guides that relate to forest operations on Crown land.

The CFSA, through its regulated manuals, requires that forest management guides be used in the preparation of an FMP. The FOSM describes the requirements for maintaining forest management guides, including guiding concepts, using adaptive management to address uncertainty, and the maintenance of the Provincial Forest Technical Committee to act as a review board for proposed changes to existing guides and recommending priorities for new or existing guides. For purposes of monitoring compliance, it is important to realize that the approved FMP is the legal instrument against which forest operations are compared. What occurs on the ground is compared to what is written in the approved plan, not what is found in this guide. Therefore, it is necessary to include the direction from this guide that is relevant to locations and operations in the appropriate portion of the FMP, as required by the FMPM.

In December 2020, Ontario amended the *Crown Forest Sustainability Act, 1994* (CFSA) to provide that a person is exempt from certain prohibitions of the *Endangered Species Act, 2007* while conducting forest operations in a Crown forest, in accordance with an approved forest management plan, and on behalf of the Crown or under the authority of a forest resource licence. This change removed regulatory duplication and provided efficient approval processes for forest operations within Ontario's forest management framework. Management direction for forest-dwelling species in the Great Lakes-St. Lawrence forest that may be affected by forest operations is addressed in the Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales.

There is also other provincial and federal legislation that must be followed during forest operations. These laws formed part of the rationale behind the development of the specific direction in this guide.

1.4 Revised Landscape Guide

1.4.1 Summary of revisions to the Landscape Guide

The Landscape Guide was first reviewed in 2015 (Elkie et al 2019), at which time the Ministry decided not to revise the guide. As per the requirements of the FOSM, the Landscape Guide is required to be

reviewed at least once every ten years. As part of meeting this commitment, the Landscape Guide was reviewed again in 2024 together with the Forest Management Guide for Boreal Landscapes. The results of these reviews included a recommendation to proceed with revisions to modernize the Landscape Guides and support forest management planning in the short-term. There were also general recommendations and longer-term recommendations identified in the reviews that continue to be considered in this adaptive management process.

The changes between version one and version two of the Landscape Guides include:

- Change to Landscape Guide Region boundaries:
    - Include the Spanish Forest in the Boreal landscape Guide Region 3E and remove from Great Lakes-St. Lawrence North Landscape Guide Regions.
- Changes to align with other policies and provide clarification to planning teams:
    - Align spatial assessments with recent changes in the FMPM.
    - Clarify landscape guide application where there is disagreement between the guide and science packages.
    - Update references to policies and legislation.

Potential economic impacts were considered during the revision process, and these revisions are not expected to impact wood supply or wood costs for the forest industry.

1.4.2 Phase-in provisions for implementation

Standards and Guidelines

(1) This version of the Landscape Guide will be used in its entirety in the preparation of forest management plans (FMPs) for management units in the Great Lakes-St. Lawrence Landscape Guide Regions (Figure 1) scheduled for implementation on or after April 1, 2029. (standard)

(2) Forest management plans for management units in the Great Lakes-St. Lawrence Landscape Guide Regions (Figure 1) that are being prepared for implementation before April 1, 2029, are required to use either the 2010 version or this version of the Landscape Guide and are encouraged to use this version. (guideline)

2 Development of the Landscape Guide

At the time the Landscape Guide was developed, the Ministry's strategic plan, "Our Sustainable Future" (OMNR 2005), recognized that our understanding of the way the natural world works and how our actions affect it is often incomplete and we should exercise caution and special concern for natural values in the face of this uncertainty. The Landscape Guide deals with "caution and special concern" by applying principles of adaptive management (e.g. Holling 1978, Walters 1986, Baker 2000) and decision analysis (Howard 1966) (see Crawford *et al.* 2005 for a comparison of these concepts). The goal of adaptive management is to speed the process of learning by treating policies as hypotheses, and developing monitoring and research programs that directly test the effectiveness of the polices and guidelines. This interface between science and policy forms the foundation of forest management guide development and testing, as described in FOSM. Adaptive management links science and policy to enable the development of policy through a cycle that facilitates continuous improvement to practices (Figure 2).

Figure 2. The adaptive management cycle used in the development, implementation, monitoring and evaluation of the Landscape Guide.

Jones and Nudds (2003) outlined a Decision Analysis and Adaptive Management (DAAM) process for policy development, which was applied during the development and review of the Landscape Guide. The steps in the DAAM process are addressed in detail in Guide Effectiveness Monitoring: Strategic Direction (Rempel et al. 2011). Generally, they include an iterative process of engaging with many parties, describing management objectives and options, identifying and ranking main uncertainties, exploring and selecting management options, and monitoring and evaluating the effectiveness of policy options. Application of these steps are described in version 1 of the Landscape Guide, and they will continue to inform future reviews of the Landscape Guide (section 4).

2.1 People involved

Development and review of the Landscape Guide included participation through a variety of ad-hoc groups at provincial and local levels and several engagement sessions. This included the creation of a development team and science team when creating the guide. These groups, described below, helped to iteratively refine the problem statement and analyze the management direction that is required and appropriate to achieve the purpose of the guide (Lee 1993).

2.1.1 Development and science teams

The development team was multi-disciplinary and provided the Ministry with advice and guidance on how to develop the Landscape Guide. They ensured that the guide took a holistic approach to the management of forested landscapes, built upon past forest management experience and filled gaps in

direction. In addition to their technical and professional experience, development team members were affiliated with the Ontario Forest Industries Association, Canadian Parks and Wilderness Society - Wildlands League, and Ontario Federation of Anglers and Hunters and sought ideas from members of these organizations as the Landscape Guide was developed.

A comprehensive science team made up of natural resource science and management experts was formed to support the development team in predicting and evaluating the effectiveness and effects of possible forest management guide direction. The science team created an analytical framework that allowed the development team to take an adaptive management approach to guide development. In addition, they provided results of applicable scientific research, the results of relevant and appropriate monitoring programs, advantages and disadvantages of changes to current forest management practices, advances in analytical and operational technology, and extensive landscape-level scenario analyses. Additional discussions occurred with science advisors from Canadian Forestry Service, Canadian Wildlife Service, various universities, and natural resource agencies in other provinces.

2.1.2 Provincial Forest Technical Committee

The Provincial Forest Technical Committee (PFTC) is a group that advises the Ministry on how to ensure forest management guides are kept current with respect to scientific knowledge and management practices by acting as a review board for these guides. The PFTC received regular reports on the Landscape Guide development and review processes and were provided with opportunities to participate in various aspects of the development and review. PFTC advice on the Landscape Guide was incorporated throughout the development, review and revision of the guide.

2.1.3 Engagement

Development team members sought advice from forestry and biology practitioners' experience in forest management planning by field visits, discussing related management costs, operational realities and experience with previous management guides, and input to forest estate modelling. These discussions ensured efficiency in the development of the Landscape Guide.

Workshops were held through 2007 and 2008 in the Great Lakes-St. Lawrence Landscape Guide Regions. Foresters and biologists who had local knowledge of the landscape and experience in forest management planning provided input to landscape simulation model inputs and development of forest management simulation modelling. The public was also engaged in the development process through discussions in which ideas were exchanged to improve the content and direction of the Landscape Guide. Presentations were made to regional advisory committees, local citizens committees, local trappers councils, forest industry groups, and environmental organizations. Pilot testing of science and information products was conducted primarily by providing them to 2010 forest management planning teams for use as background information in the development of their FMPs.

The 2024 Landscape Guide review included considerations for the results of applicable scientific investigations and monitoring programs, feedback from practitioners, First Nation peoples, Métis peoples, and stakeholders, as well as advances in technology and changes to operational practices. The review workshops were held concurrently with the workshops to support of the review of the Forest Management Guide for Boreal Landscapes. The recent round of forest management planning has resulted in the landscape guides now being fully incorporated into all FMPs, and therefore receiving feedback on this implementation was emphasized in the reviews. A series of information sessions, workshops and a survey engaged approximately 200 participants in the landscape guide reviews. Feedback was received from practitioners, First Nation communities and organizations, Métis communities and organizations, stakeholders, and Ministry staff.

2.2 Key concepts

The key concepts included in the Landscape Guide are consistent with strategic direction the Ministry follows (section 1.3.1) and guidance in the FOSM. The Landscape Guide is inherently based on a landscape approach, where guidance for management actions is provided in an integrated way over large areas. This approach is intended to be an effective and efficient way of providing guidance to forest management planning teams on conserving biodiversity at the landscape scales. The direction in this guide is evidence-based, supporting science and information available in the Science and Information Packages. The adaptive management framework addresses uncertainty in this information by (1) treating policies as hypotheses and evaluating them through monitoring, and (2) using scientific investigations to explore and reduce uncertainty where management application may not be tenable (section 4).

2.2.1 Effective and efficient

The Landscape Guide was developed with consideration for the principles of effectiveness and efficiency. The principal comparison for evaluating effectiveness of the Landscape Guide direction is between forests that have developed from natural processes versus those that have arisen through application of the forest management guides. The principal measurement, as mandated by the CFSA, is the conservation of biodiversity and ecological processes. Key concepts in the CFSA principles such as conserving diverse and productive forests and their associated ecological processes and biological diversity with an explicit comparison to natural disturbances and landscape patterns are comparable to the concept of ecological integrity (Karr 1991). Integrity implies an unimpaired condition or the quality or state of being complete or undivided; it implies correspondence with some original condition (Karr 1996). A healthy ecosystem can respond to changing conditions and maintain essential ecosystem functions. Functional systems, such as a community of soil organisms, provide nutrients to future trees and habitat for amphibians and small mammals through decomposition. Nest webs, such as those that include keystone woodpeckers, help to provide nesting and feeding habitat for a variety of wildlife. Underlying habitat diversity, together with the flow of energy within integrated food webs, plays a critical role in sustaining the integrity of forest ecosystems (McCann 2007). Plant and wildlife communities are adaptive to environmental conditions, which never remain constant. Whether it is long-term cycles of solar activity, the effects of global increases in particular gases, or the adaptive cycles of exploitation, conservation, release, and reorganization (Gunderson and Holling 2002), environments will change. Genetic diversity and pathways of mobility are key elements for ensuring populations and communities can adapt to ever changing environmental conditions. As environments change through successional development stages, individual species will rise and fall in relative abundance.

The purpose of the CFSA is to ensure the long-term health of our forest ecosystems for the benefit of the local and global environments, while enabling present and future generations to meet their material and social needs. Meeting this purpose means, in part, that ecosystem patterns and processes reflect the composition, structure and function of comparable natural systems. Forest management should not negatively affect the provision of ecosystem services related to nutrient dynamics, primary and secondary production, habitat and predator-prey dynamics, hydrological cycles or pest and disease control. Forest management should not impede the ability of plant and wildlife communities to adapt to changing conditions. Genetic diversity and pathways of mobility are key elements for ensuring populations and communities can adapt to ever changing environmental conditions.

A test of the effectiveness of the Landscape Guide would be based on the prediction that forest management will result in landscapes that are similar to those created from natural disturbance in terms of diversity in forest pattern, community structure of species dependent on pattern diversity, population trends and ecological processes. Section 4 describes this review and the approach to effectiveness monitoring in more detail.

Efficiency was considered to be the ease with which people can prepare, read and implement FMPs using the Landscape Guide. Some examples of how efficiency was considered include:

- Streamlining the Landscape Guide direction to integrate with strategic forest management planning.

- Identifying parsimonious direction based on a Decision Analysis and Adaptive Management Approach.
- Discussions with practitioners and others that provided feedback on proposed direction.
- Using a coarse filter of emulating natural disturbances and landscape patterns as an efficient way to direct management.

The Ministry will continue to monitor the efficiency of the Landscape Guide through discussions and feedback from those involved in the development, implementation, and review of the Landscape Guide.

2.2.2 Coarse and fine filter management approach

To manage Ontario's forests to reflect society's ecological, social and economic expectations, Ontario relies on a nested coarse and fine filter approach to meet wildlife habitat needs and provide healthy forests. The concept of coarse and fine filters was popularized by Hunter (1990) and is illustrated in Figure 3. The coarse filter component creates a diversity of ecosystem conditions through space and time, in turn providing habitat for the majority of native species. A series of fine filters is then used, if necessary, to modify the results of applying the coarse filter. A fine filter may be required for one of two reasons: 1) the outcome of the coarse filter does not meet societal expectations, or 2) the ecological requirements of a particular species or value are not addressed or accommodated sufficiently through application of only the coarse filter, in some cases because the proposed actions cannot completely mimic natural events. The extent to which the first type of fine filter is applied will vary across the province, depending on local forest conditions and societal expectations. Both the coarse and fine filters can be applied at all scales, from the landscape to the site.

One of the principles of the CFSA provides direction on what to consider as the coarse filter as well as what fine filters to develop.

> *The long term health and vigour of Crown forests should be provided for by using forest practices that, within the limits of silvicultural requirements, emulate natural disturbances and landscape patterns* [coarse filter] *while minimizing adverse effects on plant life, animal life, water, soil, air and social and economic values, including recreational values and heritage values* [potential fine filters]. (CFSA s. 2(3)2)

Emulation of natural disturbances and landscape patterns forms the basis of the coarse filter used in Ontario's forest policy and management frameworks to conserve biodiversity and is treated as a hypothesis in the context of adaptive management. The many values that a forest provides, as identified in this principle (e.g., plant life, animal life, water, soil), that are particularly sensitive to disturbances are the topics of a series of fine filters.

Natural disturbances such as wildfire, wind, and insect outbreaks play a role in the development and shaping of the Great Lakes-St. Lawrence forest landscape. The coarse filter management approach promoted by the Landscape Guide is intended to create a natural landscape pattern and a natural landscape composition to help sustain all species, including species at risk, over the long term. In the Landscape Guide, Ontario's forest landscape is designed through application of the coarse filter by addressing three key prescriptive indicators: pattern, composition and structure. At this scale only a few fine filters are applied to provide for or evaluate the landscape scale habitat requirements for certain species (e.g., moose, deer).

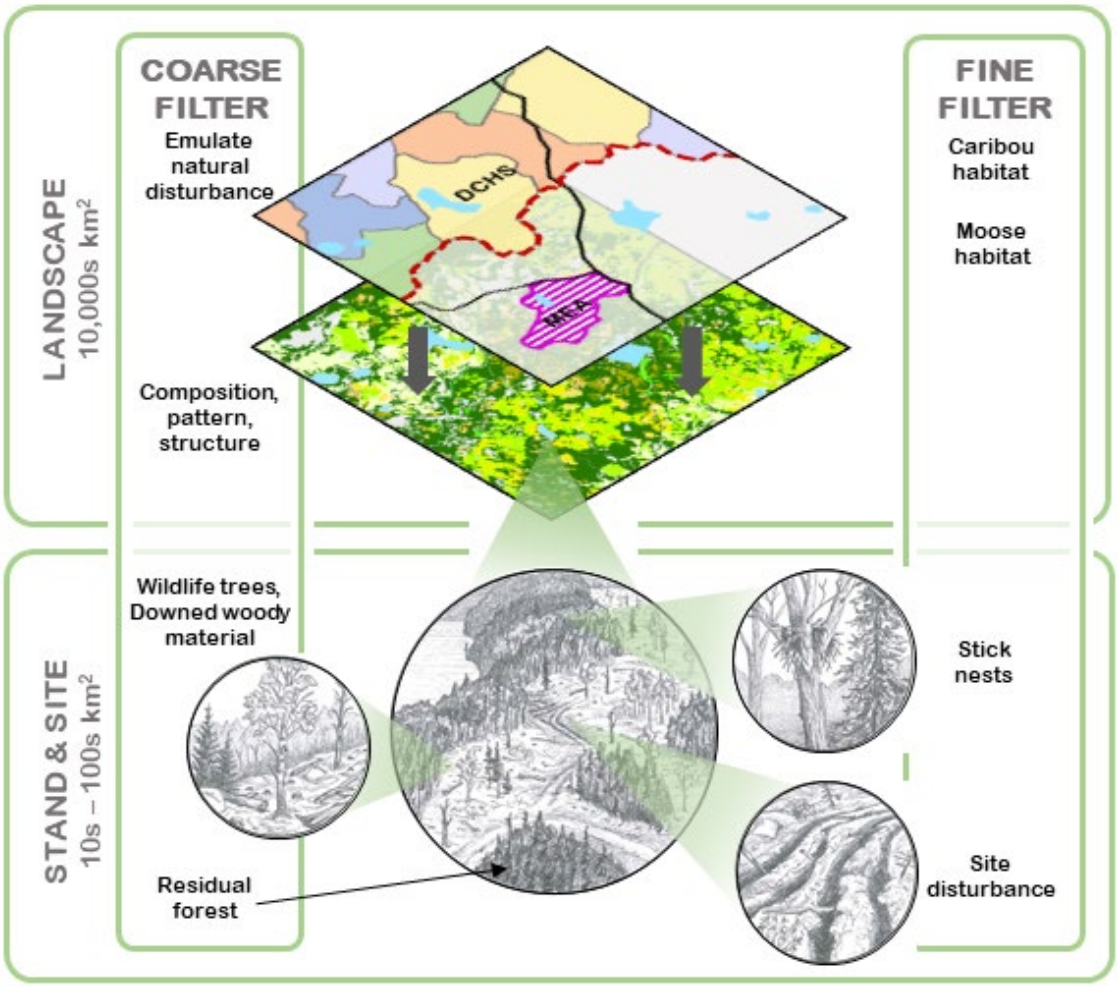


Figure 3. A conceptual model showing the relationship between coarse and fine filters in habitat management. A coarse filter operates at a variety of spatial scales to: provide habitat for a very broad range of wildlife, to support interactions among wildlife species, and to facilitate ecosystem processes. A fine filter may be required for wildlife species whose needs are not captured by the coarse filter or to mitigate adverse effects. Biodiversity is most likely to be conserved by hierarchical application of both filters on the landscape. (figure by Jodi Hall).

2.3 Comparison to past management approaches

The review and revision of previous forest management guides provided an opportunity to compare two forest management options for biodiversity conservation: the featured wildlife species approach, which was in use prior to the Landscape Guide; and the coarse and fine filter approach used in the Landscape Guide described in section 2.2.2.

The featured wildlife species approach to managing wildlife habitat is based on the assumption that managing habitat for selected species will accommodate the habitat needs of most wildlife species. This approach to wildlife habitat management was adopted by Ontario and used for a number of years (OMNR 1990). There are hundreds of species of vertebrates in the boreal and Great Lakes-St. Lawrence (GLSL) forest regions of Ontario (see D'Eon and Watt 1994, Bellhouse and Naylor 1997) and invertebrate species are likely to number in the tens of thousands. Thus, a species-by-species approach to the provision of wildlife habitat and the conservation of biodiversity is not practical. However, this might be achieved through the hierarchical application of coarse and fine filters.

The coarse and fine filter approach to wildlife habitat management has also existed for some time and was gradually introduced and implemented throughout Ontario. This approach assumes that emulating natural disturbances and landscape patterns should provide an adequate amount of habitat in general across the landscape. Landscape composition, structure and pattern direction addresses habitat for a range of wildlife, including wildlife species featured in previous habitat management guides. This includes landscape-level featured wildlife species habitat needs, such as interspersed age classes of conifer and mixed forest for moose and deer, or larger patches of mature conifer dominated or mixedwood forest for marten and pileated woodpecker. The change from a featured species approach to the coarse and fine filter has taken time for forest management planning teams and forest practitioners to become familiar with and understand.

Table 1 provides examples of landscape level direction in previous featured wildlife species guides and comparable coarse filter direction that forms the basis of the replacement Landscape Guide direction (section 3). For example, the 500-hectare scale of measure for the texture of the mature and old forest indicator used in the Landscape Guide is similar to the 500-hectare home range for marten, and thus marten habitat requirements for concentrated areas of mature and old forest at this scale is considered to be addressed by the coarse filter. The wildlife species included in Table 1 have spatial habitat models available for use in Ontario's Landscape Tool (OLT).

Table 1. Comparison of past landscape level direction for wildlife species in forest management guides to coarse filter direction in the Landscape Guide. Stand and site level direction can be found in the Stand and Site Guide.

Previous forest management guide	Landscape level direction in previous forest management guide	Comparable direction in the Landscape Guide
Timber Management Guidelines for the Provision of Moose Habitat (OMNR 1988)	• Clearcut size and arrangement • Distance to cover	• Young Forest Patch Size • Texture of the mature and old forest
Forest Management Guidelines for the Provision of White-tailed Deer Habitat (OMNR 1997)	• Forage and thermal cover that is arranged together in winter concentration areas known as deer yards	• Area of mature landscape class • Young Forest Patch Size
Forest Management Guide for the Provision of Marten Habitat (OMNR 1996a)	• Supply and arrangement of mature and older conifer-dominated forest (used and preferred habitat) across the GLSL landscape	• Texture of the mature and old forest • Area of mature conifer-dominated landscape class
Forest Management Guide for the Provision of Pileated Woodpecker Habitat (OMNR 1996b)	• Supply and arrangement of mature and older forest (used and preferred habitat) across the landscape	• Texture of the mature and old forest • Area of mature landscape classes

2.4 Understanding ranges of natural variation

The relationship between biodiversity measured at the landscape scale and ecological processes that result in natural disturbance patterns has been described as an adaptive cycle (Gunderson and Holling 2002). For example, a possible adaptive cycle for an ecological system may include stand-replacing fires as a disturbance agent (Figure 4). In this example, forested landscapes develop as a mixture of tree species which became established in a reorganization phase of the adaptive cycle after disturbance and

further develop along a trajectory during the growth, maturity and collapse phases. Perera et al. (2004) provide a thorough review of concepts and applications in emulating natural disturbance. Management strategies designed to conserve biodiversity must ensure that, at a landscape scale, future forest conditions contain all phases of the adaptive cycle in order to maintain the ecological processes that service all values. The Landscape Guide recognizes the importance of maintaining this dynamic by directing forest management to create and/or maintain the landscape structure, composition and patterns driving this adaptive cycle. Forest management seeks to emulate, not mimic, different phases of the adaptive cycle, primarily through silvicultural interventions required to create future forest conditions. Our understanding and quantification of adaptive cycles of naturally disturbed landscapes and how these landscapes provide ecological functions is one of the main uncertainties in evaluating the effectiveness of the Landscape Guide. These uncertainties are addressed in more detail in section 4.1.

Figure 4. A schematic illustration of an adaptive cycle in a forest landscape (adapted from Bunnel 2003). It shows that forest ecosystems are dynamic and can be thought of as following an adaptive cycle that has four phases: growth (r), maturity (K), collapse (Ω) and reorganization (α). Different parts of forest landscapes my undergo each phase at different spatial and temporal scales.

Quantitative estimates of the landscape structure, composition and pattern that might arise from natural disturbances and landscape patterns are required to implement Landscape Guide direction. Ontario relies on the best available science and information to provide these estimates, including simulation models, empirical data, and Indigenous, local and expert knowledge. Multiple information sources were used during the development of estimates since it is unlikely that any single source of information will provide enough insight to estimate ranges of natural variation for all indicators.

Landscape simulation models can be used to understand natural forest conditions and landscape potential. For example, a state and transition model, ST-Sim (ApexRMS 2018), was used to simulate the landscape potential in the Great Lakes-St. Lawrence Landscape Guide Regions (Elkie et al 2019). The goal of this process is to simulate variation around a natural reference condition that is similar to a pre-industrial condition (PIC). An inventory of current forest conditions is used as the starting point for the model, and the model is run for an initialization period in which natural disturbances and succession processes in the model significantly reduce the industrialized footprint. Information about a pre-industrial condition (e.g., derived Ontario land survey notes) is then used to assist in validating simulation models. However, this process acknowledges a PIC-based estimate is only for a single landscape that resulted from a specific combination of ecological, climate and disturbance events. Iterations of this process are repeated, including local knowledge and feedback from practitioners, until the PIC forest composition and amounts of disturbance are achieved by the model or could be reconciled by model limitations in representing natural processes (Figure 5). The SRNVs from this process are presented in the Science and Information Packages as a box and whisker plot for non-spatial indicators and as a frequency histogram for spatial/pattern indicators (Figure 6).

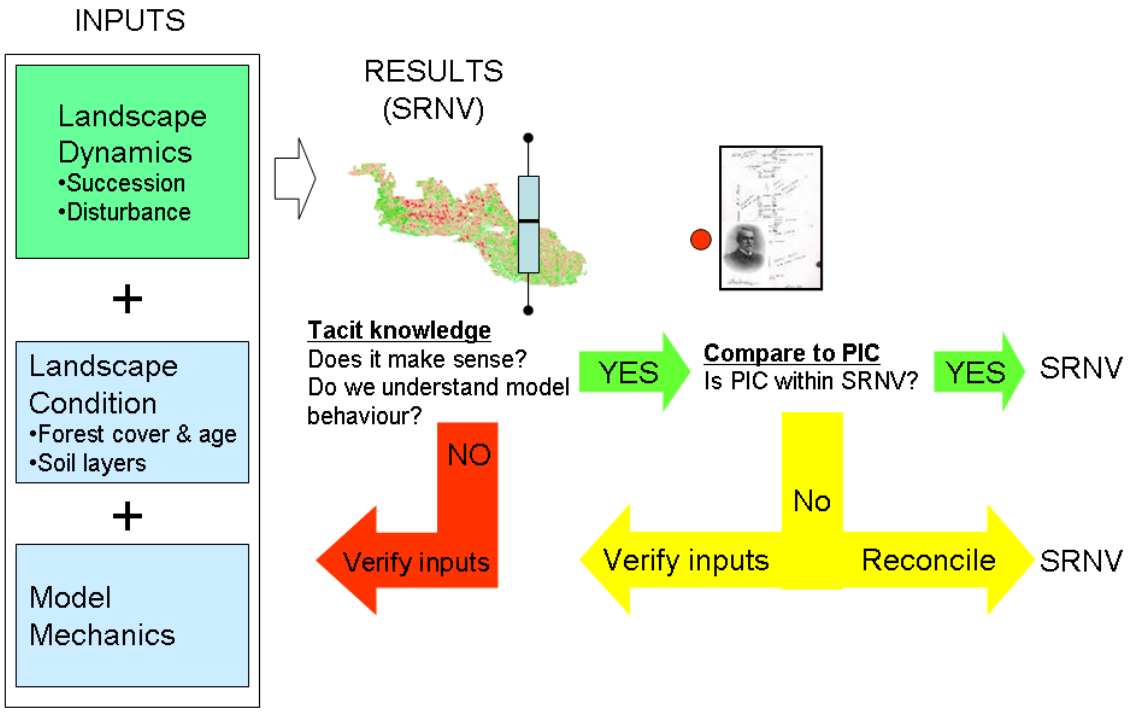


Figure 5. A decision tree showing model iterations involving modifications to model inputs based on feedback during SRNV development. These inputs included landscape dynamics, (e.g., forest succession rules) landscape condition (e.g., forest cover and age) and model mechanics (e.g., fire spread). Iterations continued until the PIC was simulated by the model.

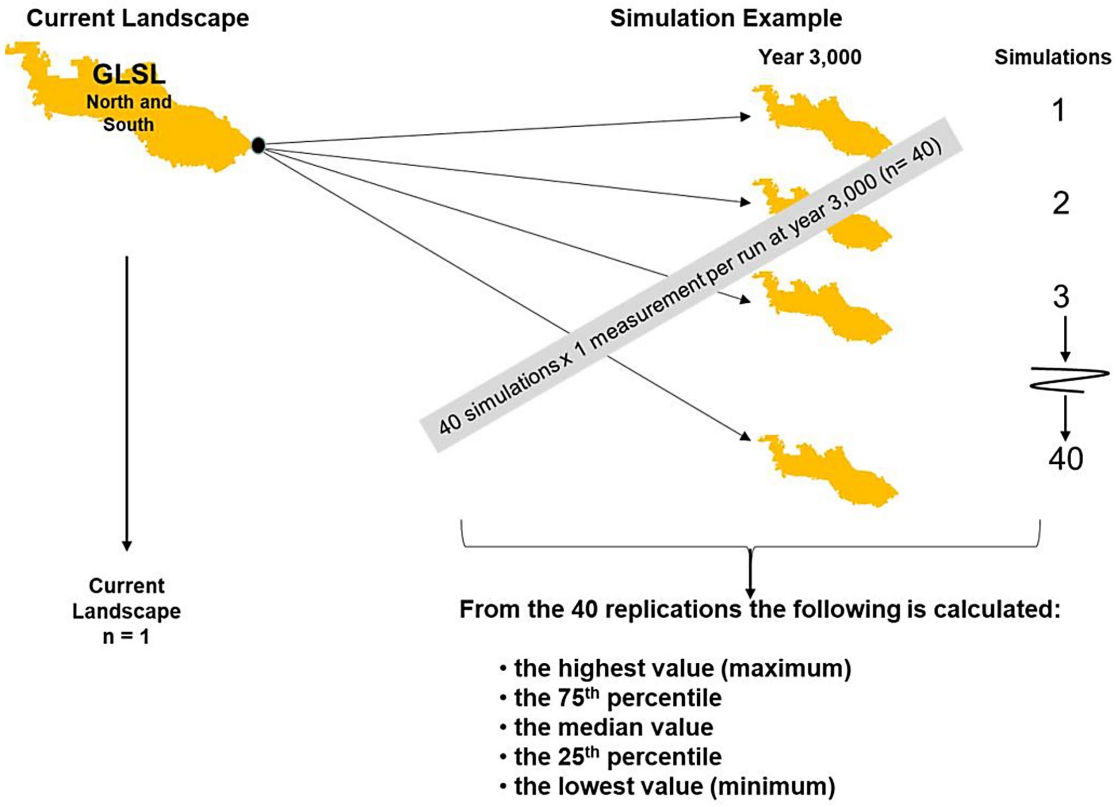


Figure 6. Example of how model results are summarized. The SRNV was calculated by taking measurements of landscape indicator values from each simulation (40 total). The resulting SRNV was expressed as a box and whisker plot for non-spatial indicators or as a histogram for spatial indicators.

The science and information packages and Ontario's Landscape Tool (OLT, Elkie et al. 2021) provide background on and support the implementation of the Landscape Guide in forest management planning (available for download at: https://www.publicdocs.mnr.gov.on.ca/cflpb/landscape-guides/supporting-documents-tools/index.html). These documents include complete descriptions of information sources including the SRNV, historical survey records (PIC), and model inputs (e.g., ecological databases). These resources are updated as new science and information becomes available.

- **Science and Information in support of the Forest Management Guides for Great Lakes-St. Lawrence Landscapes: Simulations, Rationale, Inputs and Results**: This document provides the rationale and methodology of simulation modeling that was used to simulate ranges of natural variation. It provides a detailed description of all model inputs (e.g. disturbance regimes and succession pathways) and outputs (Elkie *et al.* 2019).

Best Management Practices
Additional science and information can be used in application of the Landscape Guide with the approval of MNR forest science and regional planning specialists.

2.4.1 Climate change and the Landscape Guide

Ontario's climate has changed and is projected to continue to change at a more rapid rate during this century than has been observed in the past. Ontario's annual mean temperature has increased by 1.3°C from 1948 to 2016 and annual precipitation has increased by 9.7% between 1948 and 2012 (Bush and

Lemmen 2019). The online data portal (https://climatedata.ca/) provides future climate projections (based on shared socio-economic pathway (SSP) scenarios used in the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) and historical climate data at spatial scales appropriate for regional-level analysis across the province. Annual mean temperature and precipitation are predicted to continue to increase spanning the range of available emission scenarios from low (RCP 2.6 corresponding to SSP1-2.6) to medium (RCP4.5 corresponding to SSP2-4.5) to high (RCP 8.5 corresponding to SSP5-8.5) emission scenarios (see projections in Bush and Lemmen 2019 and McDermid et al 2015). Additionally, a warmer climate is projected to increase the frequency and intensity of some weather extremes across Ontario (Bush and Lemmen 2019, Notaro et al 2014, Burnett et al 2003). However, the magnitude and nature of potential impacts of climate change on forests is difficult to predict due to the variable responses of and complex interactions within and between organisms at multiple scales (Lawler et al 2010).

Climate change can impact biological diversity in many ways by changing patterns of insect and disease outbreaks, plant and animal distributions and natural disturbance events (Varrin et al 2007, Columbo 2008, Nituch and Bowman 2013). The ecological literature proposes policy-level strategies for climate change mitigation and adaptation (e.g. Chapin et al. 2006, Spittlehouse 2005, Safford et al, 2012, Messier et al. 2019). At a management unit level, sustainable forest management that maintains or increases forest carbon stocks and produces an annual sustained yield of timber, fibre, or energy from the forest, provides the largest sustained mitigation of climate change (Ter-Mikaelian et al. 2008, IPCC 2007), while also providing many social and environmental benefits (IPCC 2007).

Ontario's Forest Operations and Silviculture Manual (FOSM) and Forest Management Planning Manual (FMPM) describes Ontario's general approach to addressing climate change in the forest policy and management frameworks. The Landscape Guide contributes to the objective of maintaining and enhancing biodiversity, which enables forests to be resilient by maintaining diversity at multiple scales while taking into account the uncertainties associated with climate change. The Landscape Guide directs sustainable forest management to maintain a natural range of tree species mixes, ages, and patch sizes with an assumption that this variation enables forest ecosystems to be resilient (i.e., having the capacity to adapt) to changes in temperature and precipitation. Following landscape direction to manage a forest's age and tree species composition within a range of natural variation is expected to maintain the above ground forest's carbon balance within an expected range of natural variation (Colombo *et al.* 2005).

A challenge in developing guide direction that is responsive to climate change is the lack of consensus on the speed, magnitude and (for some variables) the direction of the effect climate change will have on Ontario's forests. Furthermore, as with most ecosystems, it is unlikely that this uncertainty will be resolved anytime soon (Schindler and Hilborn 2015). Accepting and incorporating this uncertainty in the guide is achieved by enabling practitioners to consider additional science and information to support implementation of the standards and guidelines.

The FOSM requires forest management guides to be reviewed at least once every ten years and revised when appropriate to reflect new knowledge and experience. Version 2 of the landscape guide was prepared to address short-term recommendations from the Landscape Guide review. Identifying options for the Landscape Guide to provide more explicit direction to planning teams regarding climate change at the landscape scale was a longer-term recommendation that the Ministry continues to work toward. The Ministry continues to improve its understanding of climate change and its potential effects on Ontario's Crown forests working with other agencies and partners on research studies and sharing information. As our understanding and predictions about climate change improve, policy options that more actively respond to climate change may be incorporated into future versions of the Landscape Guide to address its effects more directly.

3 Applying the Landscape Guide in a Forest Management Plan

Forest management plans have forest diversity and cover objectives, socio-economic objectives, silvicultural objectives, and ecological sustainability objectives (FMPM 2024). These objectives and associated desirable levels and targets are developed by the planning team with consideration of forest management guide direction and the input received from desired forest and benefits meetings with First Nation communities, Métis communities, and interested members of the public. Collectively, these objectives form the strategic management direction for the plan. Direction in this section of the Landscape Guide is intended to support the development of the management direction in a good way (Reid et al. 2024) and can be applied to support the achievement of other objectives related to the sustainable livelihoods of communities and broader conservation initiatives.

The determination of sustainability will determine whether, on balance, the ecological, socio-economic, and silvicultural objectives of the FMP are being achieved, and progress is being made towards the desired forest and benefits, consistent with the CFSA principles. The determination of sustainability, as described in the FMPM, reflects implementation of direction in this section of the Landscape Guide, and documentation requirements for biodiversity objectives are outlined in the FMPM.

The following steps summarize the application of the Landscape Guide in a forest management plan:

1. Measure the current forest condition using Landscape Guide indicators (see section 3.1).
2. Identify desirable levels using the simulated range of natural variation (SRNV) for area-based indicators and the mean SRNV for pattern indicators (see section 3.2).
3. Develop targets for the Landscape Guide indicators that are consistent with movement within or towards the SRNV for area-based indicators and movement toward the mean for pattern indicators (see section 3.3).
4. Identify large landscape patches (LLPs) when required to meet targets for landscape pattern or habitat indicators (see section 3.4).

3.1 Measure the current forest condition using Landscape Guide indicators

The Landscape Guide indicators quantify landscape structure, composition and pattern to efficiently direct forest management planning. The Landscape Guide indicators are variables that are used to describe the current landscape condition, make predictions on the future landscape conditions and assist in evaluating the effectiveness of the Landscape Guide. Previous landscape-level direction was compiled and categorized, resulting in a parsimonious set of indicators being selected to direct the landscape composition, structure and pattern.

The objective categories of the Landscape Guide indicators reflect objectives required by the CFSA and FMPM. The FMPM outlines the timing of assessment required for Landscape Guide indicators. The Landscape Guide indicators are listed in Tables 2 and 3 with a recommended order of application. The order of this hierarchy is based on experience from the development of the Landscape Guide and recognizes that pattern is dependent on composition. For example, it is difficult to arrange the texture of the mature and old forest if the amount does not exist on the landscape. Teams can follow this order through all subsequent application steps in this section.

Some indicators (e.g., texture of mature and old forest) differ between the GLSL North and GLSL South Landscape Guide Regions. These differences are primarily attributed to ecological differences across the regions. More detail on these differences is provided in the remaining subsections of section 3 and in the Science and Information Packages.

Standards and Guidelines

(3) Forest management plans will use the Landscape Guide indicators as the biodiversity indicators of objective achievement. The indicators required in FMPs can vary by Landscape

Guide region as listed in Table 2 and Table 3 (e.g., texture of mature and old forest) and will be described in the FMP as required by the Forest Management Planning Manual. (standard)

Best Management Practices

The forest management planning team can use Ontario's Landscape Tool (OLT) to calculate plan start levels for all the Landscape Guide indicators, as required by the FMPM.

Planning teams should apply Landscape Guide indicators in the order recommended in Table 2 (GLSL North Landscape Guide Region) and Table 3 (GLSL South Landscape Guide Region).

Table 2. Landscape Guide Indicators for the Great Lakes-St. Lawrence North Landscape Guide Region, arranged by objective category, indicator group, indicator name, recommended order of application and units of measurement. Refer to sections 3.1.1-3.1.2 for details about the Landscape Guide indicators.

Objective Category	Landscape Guide Indicator Group	Landscape Guide Indicator	Recommended order of application	Measurement (units)
Structure and Composition	Landscape classes (mature and older age classes)	Tolerant hardwood	1st	Area (ha)
		Intolerant hardwood		Area (ha)
		White pine mixedwood		Area (ha)
		Mixedwood		Area (ha)
		Mixed pines		Area (ha)
		Spruce-fir-cedar		Area (ha)
	Old growth forest	Old growth by Landscape Guide Forest Unit or appropriate grouping	2nd	Area (ha)
	Red and white pine forest	All ages red and white pine forest units	4th	Area (ha)
	Young forest	Pre-sapling development stage	5th	Area (ha)
		Pre-sapling + Sapling & T-stage development stages combined		Area (ha)
	Individual forest units	Individuals landscape guide forest units	6th	Area (ha)
Pattern	Texture of the mature and old forest	Texture of the mature and old forest	3rd	500 ha hexagon scale histogram
				5000 ha hexagon scale histogram
	Young forest patch size	Young forest patch size	7th	Patch size frequency histogram

Table 3. Landscape Guide Indicators for the Great Lakes-St. Lawrence South Landscape Guide Region, arranged by objective category, indicator group, indicator name, recommended order of application and units of measurement. Refer to sections 3.1.1-3.1.2 for details about the Landscape Guide indicators.

Objective Category	Landscape Guide Indicator Group	Landscape Guide Indicator	Recommended order of application	Measurement (units)
Structure and Composition	Landscape classes (mature and older age classes)	Tolerant hardwood	1st	Area (ha)
		Intolerant hardwood		Area (ha)
		White pine mixedwood		Area (ha)
		Mixedwood		Area (ha)
		Mixed pines		Area (ha)
		Spruce-fir-cedar		Area (ha)
	Old growth forest	Old growth by Landscape Guide Forest Unit or appropriate grouping	2nd	Area (ha)
	Red and white pine forest	All ages red and white pine forest units	4th	Area (ha)
	Young forest	Pre-sapling development stage	5th	Area (ha)
		Pre-sapling + Sapling & T-stage development stages combined		Area (ha)
	Individual forest units	Individuals landscape guide forest units	7th	Area (ha)
Pattern	Texture of the mature and old forest	Texture of the mature and old forest	3rd	50 ha hexagon scale histogram
				500 ha hexagon scale histogram
	Young forest patch size	Young forest patch size	6th	Patch size frequency histogram

3.1.1 Structure and Composition

The current forest age class structure and tree species composition of the landscape are two of the strongest drivers of the future forest landscape condition. The literature varies in its use of the terms “forest structure” and “composition”. For purposes of the Landscape Guide, age is currently the most consistent measure available at the landscape scale that can be used to approximate structure. Landscape Guide indicators use age to identify forest development stages (e.g. sapling, immature, mature). Composition is measured at the landscape level by classifying the species composition of forested stands into forest units. Landscape Guide structure and composition indicators are described in the sections below.

The FMPM requires the relationship between plan forest units and landscape guide forest units to be described in the FMP. Forest units are a classification system that aggregates forest stands for management purposes, combining those that normally have similar tree species composition, develop in a similar manner (both naturally and in response to silvicultural treatments), and are managed under the same silviculture system. The forest unit is the currency used for simulations in each Landscape Guide region for all SRNV results (e.g., landscape classes, evaluative indicators). The Landscape Guide forest units were derived from regional standard forest units available at the time of running simulations and are documented in the science and information packages (Elkie et al., 2019).

Standards and Guidelines

(4) Forest management plans will include all Crown land within the management unit when measuring landscape structure and composition indicators. (standard)

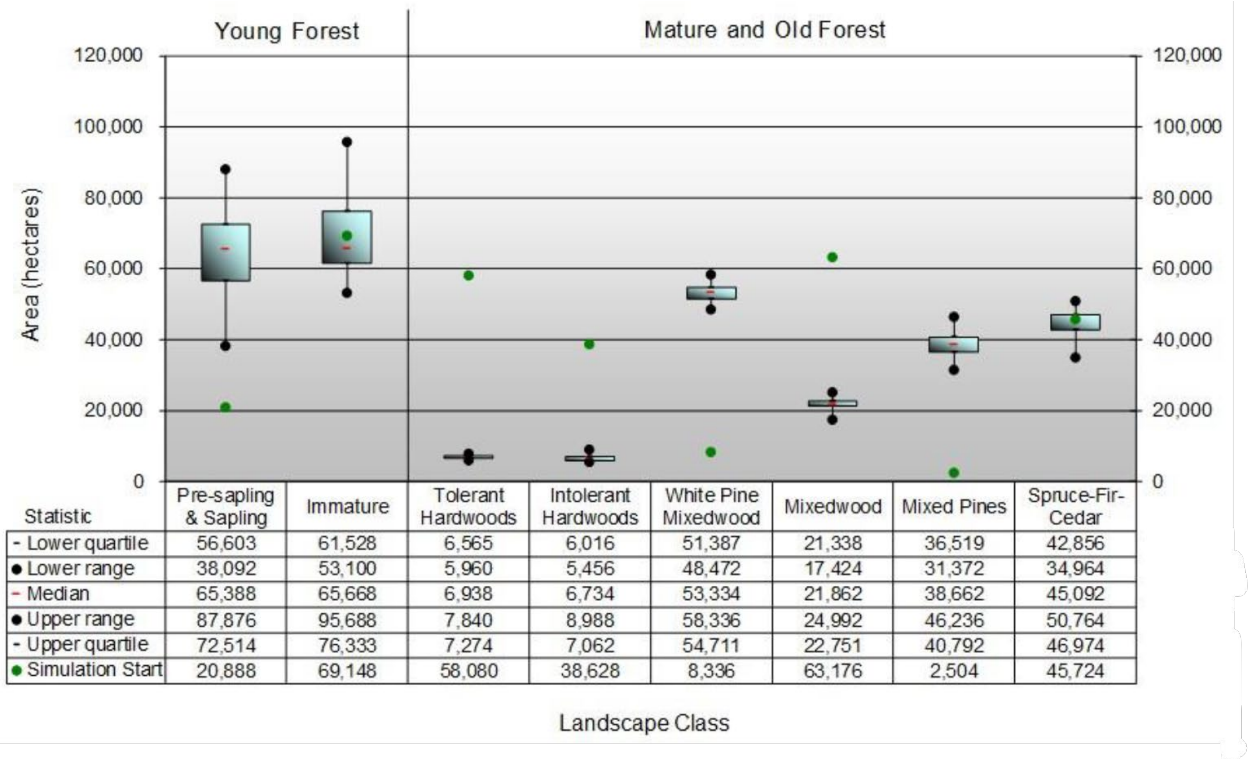
(5) Forest management plans will use Landscape Guide forest units to ensure that there is compatibility with all Landscape Guide indicators (i.e., Table 2 and Table 3) and associated desirable levels. (guideline)

3.1.1.1 Landscape classes

Landscape classes are groupings of Landscape Guide forest units by development stage and are the fundamental coarse filter assessment units. They are intended to represent how forests function as habitat and meaningful differences in wildlife use. Specifically, the landscape classes were developed based on cluster analyses of used and preferred habitat types depicted in the Ministry's habitat matrices (e.g., Holloway *et al.* 2004). Landscapes provide habitat for many wildlife species, each with its own preferences for combinations of vegetation types, development stages, patch sizes and configurations. The habitat matrices summarized these habitat affinities of selected vertebrate species based on forest type and development stage. The SRNVs for the landscape class indicators are provided for each forest management unit in the science and information packages, and an example is provided in Figure 7 (Elkie et al. 2019).

Standards and Guidelines

(6) Forest management plans will represent landscape classes in forest estate models used to develop the management direction. (standard)



Statistic	Pre-sapling & Sapling	Immature	Tolerant Hardwoods	Intolerant Hardwoods	White Pine Mixedwood	Mixedwood	Mixed Pines	Spruce-Fir-Cedar
- Lower quartile	56,603	61,528	6,565	6,016	51,387	21,338	36,519	42,856
● Lower range	38,092	53,100	5,960	5,456	48,472	17,424	31,372	34,964
- Median	65,388	65,668	6,938	6,734	53,334	21,862	38,662	45,092
● Upper range	87,876	95,688	7,840	8,988	58,336	24,992	46,236	50,764
- Upper quartile	72,514	76,333	7,274	7,062	54,711	22,751	40,792	46,974
● Simulation Start	20,888	69,148	58,080	38,628	8,336	63,176	2,504	45,724

Landscape Class

Figure 7. An example assessment of landscape classes, where the box and whisker represent the interquartile range and Simulated Range of Natural Variation (SRNV), respectively.

Table 4. Forest units, development stages and landscape classes used in the GLSL Landscape Guide. Each Landscape Guide forest unit has a name, description, ages of onset for development stages with a colour coding indicating the corresponding landscape class for each forest unit development stage. Two-stage (t-stage) refers to stands that have experienced a natural or management disturbance in which part of the overstory crown has been removed, consequently encouraging growth of an understory. Landscape classes include pre-sapling/sapling (PS), immature (I), tolerant hardwood (TOL), intolerant hardwood (INTOL), white pine mixedwood (PWMIX), mixedwood (MIXED), mixed pines (MXPRJ), and spruce-fir-cedar (SFC).

Landscape Guide Forest Unit	Development stage (age in years)					
	Pre-sapling	Sapling	Immature	Mature	Late	Two-stage
HDSL1	0 (PS)	15 (PS)	40 (I)	80 (TOL)	140 (TOL)	(TOL)
HDSL2	0 (PS)	15 (PS)	35 (I)	75 (TOL)	140 (TOL)	(TOL)
HDUS	0 (PS)	15 (PS)	35 (I)	75 (TOL)	130 (TOL)	(TOL)
BY	0 (PS)	15 (PS)	40 (I)	80 (TOL)	140 (TOL)	(TOL)
OAK	0 (PS)	15 (PS)	35 (I)	70 (TOL)	120 (TOL)	(TOL)
PoDom	0 (PS)	10 (PS)	25 (I)	65 (INTOL)	95 (INTOL)	(INTOL)
BW	0 (PS)	10 (PS)	30 (I)	65 (INTOL)	100 (INTOL)	(INTOL)
PWST	0 (PS)	15 (PS)	35 (I)	75 (PWMIX)	120 (PWMIX)	(PWMIX)
PWUS4	0 (PS)	15 (PS)	35 (I)	75 (PWMIX)	120 (PWMIX)	(PWMIX)
PWOR	0 (PS)	15 (PS)	35 (I)	80 (PWMIX)	140 (PWMIX)	(PWMIX)
PWUSH	0 (PS)	15 (PS)	35 (I)	75 (PWMIX)	120 (PWMIX)	(PWMIX)
PWUSC	0 (PS)	15 (PS)	35 (I)	75 (PWMIX)	130 (PWMIX)	(PWMIX)
HE	0 (PS)	15 (PS)	45 (I)	85 (MIXED)	155 (MIXED)	(MIXED)
LWMW	0 (PS)	15 (PS)	35 (I)	75 (MIXED)	120 (MIXED)	(MIXED)
MWD	0 (PS)	10 (PS)	30 (I)	65 (MIXED)	105 (MIXED)	(MIXED)
MWR	0 (PS)	10 (PS)	30 (I)	65 (MIXED)	105 (MIXED)	(MIXED)
MWUS	0 (PS)	15 (PS)	35 (I)	75 (MIXED)	120 (MIXED)	(MIXED)
PR	0 (PS)	15 (PS)	40 (I)	80 (MXPRJ)	140 (MXPRJ)	(MXPRJ)
PJ1	0 (PS)	10 (PS)	25 (I)	60 (MXPRJ)	100 (MXPRJ)	(MXPRJ)
PJ2	0 (PS)	10 (PS)	25 (I)	60 (MXPRJ)	100 (MXPRJ)	(MXPRJ)
SP1	0 (PS)	10 (PS)	25 (I)	65 (SFC)	110 (SFC)	(SFC)
SF	0 (PS)	15 (PS)	30 (I)	70 (SFC)	115 (SFC)	(SFC)
SB	0 (PS)	10 (PS)	25 (I)	65 (SFC)	110 (SFC)	(SFC)
LC	0 (PS)	15 (PS)	30 (I)	70 (SFC)	115 (SFC)	(SFC)
CE	0 (PS)	15 (PS)	35 (I)	75 (SFC)	125 (SFC)	(SFC)

3.1.1.2 Old growth forest

The Old Growth Policy for Ontario's Crown Forests (OMNR 2003) describes how the Ministry will ensure that old growth conditions and values are present in Ontario's Crown forests in order to conserve biological diversity at levels that maintain or restore ecological processes, while allowing for sustainable development now and in the future. This policy is compatible with the CFSA principle of emulating natural disturbance and landscape patterns. It describes a two-pronged approach for conserving old growth by providing natural heritage protection and direction for forest management planning to maintain, protect and/or restore old growth forests. Given this explicit direction, old growth is also addressed as a separate indicator group in the Landscape Guide. Planning teams are required to explain in the FMP how a supply of old growth by Landscape Guide forest unit or appropriate groupings will be maintained on the landscape and how the supply will remain within or move toward the SRNV.

Discussion on old growth can be unclear due to inconsistent use of the terms "old growth" and "mature" forest. For the purposes of this guide, a forest is in a mature stage of development when overstory trees

attain full development and sexual maturity, mortality of over-storey trees begins to create gaps and encourages understory development, and height growth slows dramatically. Old growth is a condition of dynamic forest ecosystems that tends to include complex forest stand structure, relatively large dead standing trees (snags), accumulations of downed woody material, up-turned stumps, root and soil mounds, accelerating tree mortality, and ecosystem functions that may operate at different rates or intensities compared with earlier stages of forest development. Discussion regarding the ecological and social importance of old growth forests in the scientific literature informed the development of this indicator in the Landscape Guide.

The arrangement of old growth is directed using the texture of the mature and old forest indicator, which includes old growth forest (see section 3.1.2.1). Old growth as it functions as habitat for selected wildlife species will be evaluated as part of the Ministry's approach to effectiveness monitoring of the Landscape Guide.

Standards and Guidelines

(7) Forest management plans will use old growth forest indicators consistent with the Old Growth Forest Definitions for Ontario (OMNR 2003) and late development stage of Landscape Guide forest units. Old growth forest by individual Landscape Guide forest units, or appropriate groupings of Landscape Guide forest units, as determined by the forest management planning team, will be represented in forest estate models used to develop the management direction. (guideline)

3.1.1.3 Red and white pine forest

The all ages of red and white pine forest units' indicator was selected by the science team based on differences between current landscape conditions, pre-industrial condition, and SRNV. This indicator is used to direct the total amount of area in all development stages of red and white pine forest units on the landscape. This direction is consistent with the *Old Growth Policy for Ontario's Crown Forests* (OMNR 2003), which contributes to the maintenance of all ages of red and white pine and includes old growth stands, within their natural geographic ranges by maintaining no less than the 1995 amount while permitting a sustainable harvest of red and white pine now and in the future. Forest management planning teams should use professional judgment when applying forest composition guidelines and take into account the contribution of red and white pine forest units to the mature and older upland conifer landscape class.

Standards and Guidelines

(8) Forest management plans will represent the total area of red and white pine forest units (i.e., all ages combined) in forest estate models used to develop the management direction that correspond to the following Landscape Guide forest units: PWST, PWUS4, PWOR, PWUSH, PWUSC and PR. (guideline)

(9) Forest management plans will reference the 1995 amount of red and white pine forest when assessing the achievement of the red and white pine indicator. (guideline)

3.1.1.4 Young forest

Young forest provides important ecological functions for numerous wildlife species. For example, large contiguous patches of young forest are required by Kirtland's Warbler. Young forest is the result of stand replacing disturbances (e.g., fire, harvest) and functions as habitat for a variety of wildlife (e.g. King *et al.* 2001, Costello *et al.* 2000). Other disturbance types (e.g., wind event, insect outbreak, partial harvest systems) may result in part of the overstory crown being removed. The resulting forest condition is a multi-aged stand, which is described as two-stage (t-stage) in the Landscape Guide. The young forest indicator was selected by the science team based on differences between current landscape conditions, pre-industrial condition, and simulated ranges of natural variation.

Standards and guidelines

(10)Forest management plans will represent the amount of two types of young forest classes in forest estate models used to develop the management direction (guideline):

- ***i. the pre-sapling development stage of all forest units combined and***
- ***ii. the pre-sapling, sapling and t-stage of all forest units combined.***

3.1.1.5 Individual Landscape Guide forest units

The composition indicators in the previous sections are an appropriate resolution for planning composition at the landscape scale. To complement coarse filter direction in the Stand and Site Guide, the Landscape Guide forest unit indicator is intended to address forest types that are not well represented by other Landscape Guide indicators. Desired levels for individual Landscape Guide forest units will be consistent with any grouped composition targets (e.g., upland conifer), but the milestone direction is a non-time specific "move towards or maintain within" statement.

The FMPM requires the relationship between plan forest units and landscape guide forest units to be described in the FMP. The Landscape Guide forest units were derived from regional standard forest units available at the time of running simulations. The most recent, detailed query descriptions for the Landscape Guide forest units are documented in the science and information package (Elkie et al., 2019).

Standards and Guidelines

(12)Forest management plans will represent each individual Landscape Guide forest unit in forest estate models used to develop the management direction. (guideline)

3.1.2 Pattern

Many important concepts in landscape ecology (e.g., fragmentation, edge effects, connectivity, metapopulation dynamics, reserve size) were developed where forests are not the dominant feature on the landscape (e.g., predominantly agricultural landscapes with islands of residual forest; see Lindenmayer and Franklin 2002, Perera and Baldwin 2000). However, the majority of landscapes where the Landscape Guide applies have remained continuously forested with an average rate of annual disturbance of less than one percent per year.

The texture of the mature and old forest and young forest patch size are coarse filter indicators used to characterize landscape pattern. They are related in many ways: the amount and distribution of young forest patches can affect the texture of the mature and old forest in terms of wildlife habitat (species that prefer interior forest, species that prefer edge habitat), and they are often the result of different forest management actions such as harvesting large or small contiguous areas. Private land, where forest condition information is not available and management intent is unknown, is an important consideration when assessing pattern indicators and may influence landscape connectivity. Connectivity means different things to different wildlife species and requires a species-specific assessment of movement across the landscape (e.g. Goodwin 2003). The pattern indicators indirectly measure connectivity for a range of wildlife species.

Measurement of pattern indicators is supported by Ontario's Landscape Tool (OLT), which uses a quantification technique in the Landscape Scripting Language (LSL) to build and overlay a hexagonal grid to support pattern assessments at various scales of measure. The tool assesses each hexagon and determines i) if it is forested (i.e., 50% or greater of the hexagon contains forest) and ii) the proportion of the indicator of interest within the hexagon. More details about this quantification technique is provided in the science and information packages. Projections for these indicators are a strategic assessment, as the exact size, shape, and placement of future harvest and other disturbance is unknown. The FMPM outlines the timing of assessment required for these indicators.

Standards and Guidelines

(13) Forest management plans will use Ontario's Landscape Tool (OLT) to measure the pattern indicators (i.e., texture of the mature and old forest indicator, young forest patch size indicator) or an equivalent tool that has received approval from the Ministry. (standard)

(14) Forest management planning teams may identify and delineate areas with a high degree of private land ownership fragmenting the forest in the management unit and exempt these areas from application of landscape pattern indicators The crown-land portion of these exempt areas will be included in the calculation for landscape structure and composition indicators. (guideline)

3.1.2.1 Texture of the mature and old forest

In landscape ecology terms, the dominant class, however defined, on the landscape is called the matrix. Non-matrix patches are quite easily measured and interpreted using traditional patch-measurement techniques (e.g., McGarrigal and Marks 1995). However, characterizing the pattern associated with the matrix has been identified as a challenge in landscape ecology (e.g., Fahrig 2003). The landscape matrix for most of Ontario's forests is a mature forest. Visually, one can look at a landscape map and see areas in which mature and old forest is arranged in relatively high concentrations, areas with low concentrations and areas that have a relatively medium amount. The texture of the mature and old forest indicator characterizes this matrix by representing the proportions of the landscape in different concentration classes.

The texture of the mature and old forest is measured at two scales, which varies by landscape guide region: 500 hectares and 5000 hectares for the GLSL North Landscape Guide Region, and 50 hectares and 500 hectares for the GLSL South Landscape Guide Region. The age of onset for mature and old forest is defined by forest unit (Elkie et al. 2019) and is consistent with the landscape class indicator group. A histogram is generated to represent the relative amount of mature and old forest in each hexagon at each scale (Figure 8). These scales were chosen based on sizes of observed and simulated natural disturbances to capture the character of and appropriately describe the landscape. It is possible that the texture measurement at one scale, as expressed in a proportional frequency histogram, is exactly the same between two landscapes even though the same texture measurement at a finer or coarser level is significantly different. In other words, measuring landscape texture at two levels allows better characterization of the spatial configuration of the landscape than traditional landscape ecology measurements. Both assessment scales for this indicator are required to be measured in the first 40-years of the management direction. The 40-year evaluation period is consistent with FMPM requirements to identify a spatial harvest schedule for the first four FMP periods, including discussion of ecological pressures in the selection of harvest areas for these terms and any associated management implications.

<u>Standards and Guidelines</u>

(15) Texture of mature and old forest will be measured at plan start (year 0), plan end (year 10), and years 20, 30, and 40 of the management direction of the forest management plan at the following scales (standard):

- ***i. 500 ha and 5000 ha scales in the GLSL North Landscape Guide Region.***
- ***ii. 50 ha and 500 ha scales in the GLSL South Landscape Guide Region.***

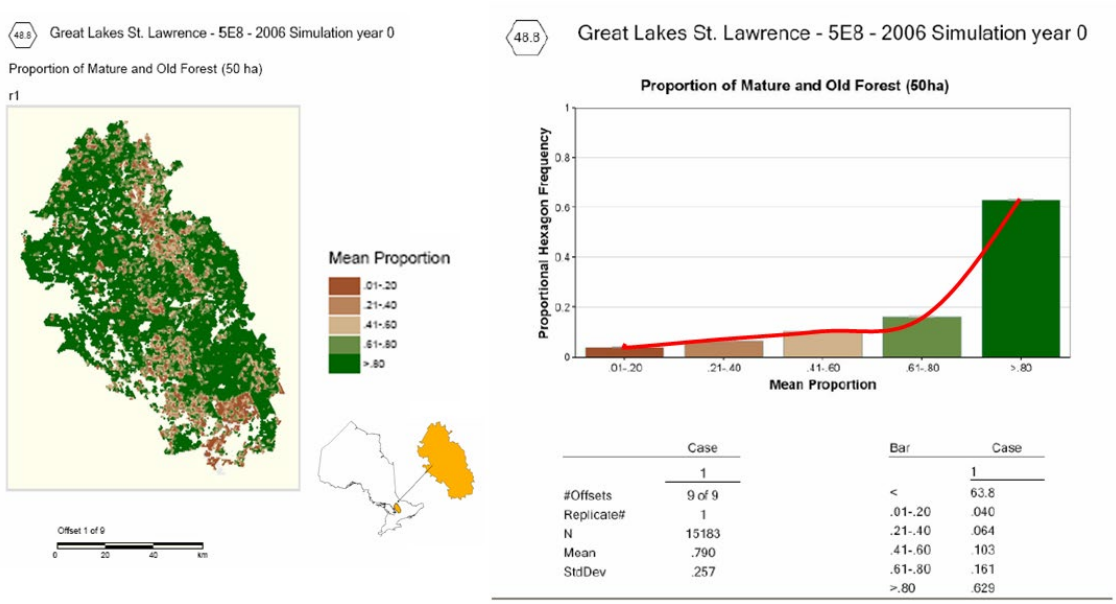


Figure 8. Texture of the mature and old forest indicator. Concentrations of mature and old forest are mapped on the left hand side of the figure and quantified in a histogram on the right. 50 ha hexagons are used in this example with green hexagons having high (> 80%) concentrations of mature and old forest and brown hexagons having a low (<20%) amount. The red line across the histogram bars depicts the landscape "signature" or the texture of the mature and old forest. In this example, the majority of the landscape has very high and high concentrations of mature and old forest (63 and 16 percent of the landscape respectively).

3.1.2.2 Young Forest Patch Size

Patches can be defined to measure the shape and size of the homogeneous forest composition and structures that make up the landscape mosaic. Patch sizes can influence the availability of specific contiguous habitat conditions, including the distribution of edge habitat (Lindenmayer *et al.* 2000). Experience with past forest management guides in Ontario demonstrated that use of specific patch sizes and shapes can have long-term consequences for forests that require focused efforts over long time periods to reverse. It is important to document the forests at these early stages of development to assist in long-term sustainable management of the entire forest.

The young forest patch size indicator uses a histogram to quantify the relative proportion of young forest patches by different patch size classes (Figure 9). Similar to the mature and old forest matrix, young forest (i.e., forest less than 36 years) is measured using a hexagonal grid. Fifteen-hectare hexagons are overlaid on the landscape of interest. Each hexagon that has at least 50% of the forested area less than 36 years is classed as young. Young hexagons that are adjacent to each other are counted as the same patch. A frequency distribution of young forest patch sizes is created in nine size classes (i.e., 1-100 ha, 101-250 ha, 251-500 ha, 501-1000 ha, 1001-2500 ha, 2501-5000 ha, 5001-10,000ha, 10,001-20,000 ha and > 20,000ha). Patches less than 15 hectares are not counted.

Standards and Guidelines

(16) Young forest patch size will be measured at plan start (i.e., year 0), plan end (i.e., year 10), and years 20, 30, and 40 of the management direction of the forest management plan. For the purpose of this indicator, young forest is defined as being less than 36 years of age. (standard)

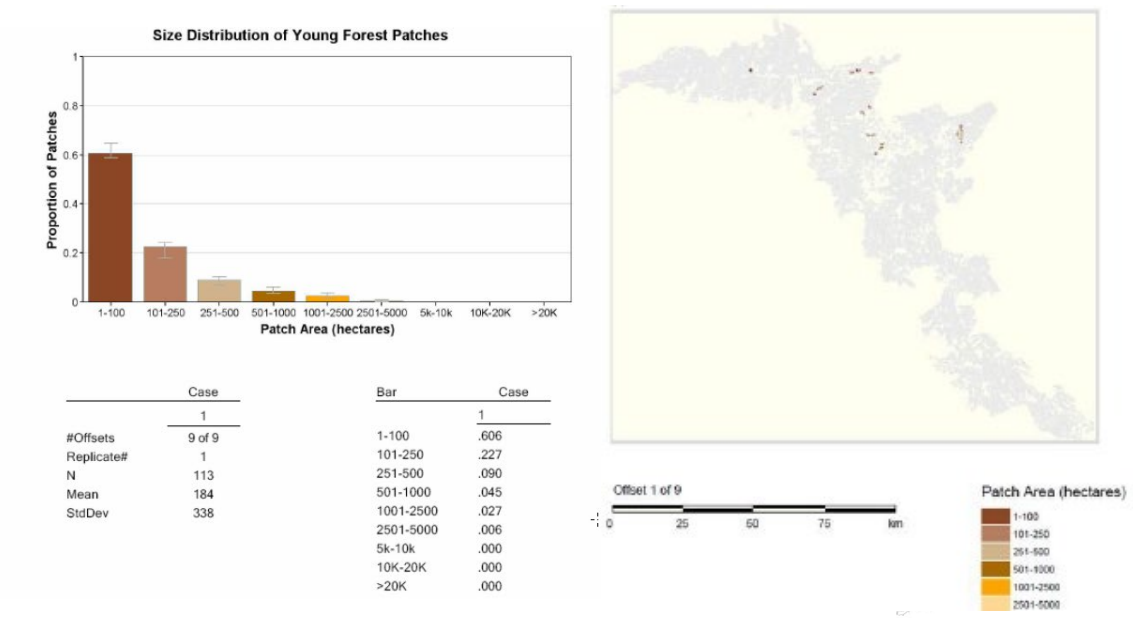


Figure 9. Young forest patch size indicator report from Ontario's Landscape Tool (OLT). The histogram describes the relative proportion of young forest patches across the landscape (Y axis) by different patch size classes (X axis).

3.2 Set desirable levels for Landscape Guide indicators

The intent of the direction in this section is to ensure that the desirable levels for biodiversity objectives in the FMP will represent a science-based estimate of landscape conditions and patterns. The simulated range of natural variation (SRNV) was modelled to reflect a range of variation representative of natural forest conditions and therefore a suitable range for management purposes.

Standards and Guidelines

(17) The desirable levels for Landscape Guide indicators will be set as, or within, the SRNV for non-spatial indicators and mean of the SRNV for pattern indicators. (guideline)

Best Management Practices

- Planning teams may compare (identify any major differences in) indicator values between the plan start level, simulation year zero and the desirable level. These values will assist planning teams in identifying reasonable rates of movement toward the desirable level. Discussion may include, but is not limited to natural disturbances, silvicultural requirements, insect and/or disease, socio-economic effects and changes in forest resources inventories.

3.3 Develop Targets for Biodiversity Objectives

Forest management planning teams are directed to use milestones to develop specific targets for and assess the achievement of Landscape Guide indicators. Milestones include directional statements (e.g. maintain, increase, or decrease) for expected movement toward desirable levels from the present condition (i.e., plan start) over the short (0-10 years), medium (0-20 years) and long term (0-100 years). As part of the initial development of the Landscape Guide Version 1, milestones were developed to describe a trajectory for each management unit and for each landscape guide indicator. Milestone development considered limited silvicultural, social and economic values that may be better understood at local levels. As forest management plans are being developed, the new, revised and updated inventories represent current forest conditions that may be different than the starting conditions used when milestones were initially developed. As a result, the milestones need to be reviewed regularly and, if

necessary, revised to ensure they are valid and achievable. Appendix B provides milestone table templates for each Landscape Guide Region, including the Landscape Guide indicators to be included in the milestone table. The process for validating and revising milestones and the current version of milestones are available in the Validating and Revising Milestone Technical Note And Milestone Repository. This technical note and repository will be revised periodically by the Ministry to ensure the milestones are valid and made available to planning teams on the Landscape Guide Supporting Documents and Tools webpage. Revisions to the technical note and repository are not intended to affect the standards and guidelines in the Landscape Guide. Any revisions that would cause a change to the standards and guidelines in the Landscape Guide are subject to the guide revision process.

The documentation requirements regarding targets for Landscape Guide indicators are outlined in the FMPM. In some cases, the planning team may conclude that, in order to balance achievement or progress for all management objectives, it will be impossible to meet some of the milestones. The rationale for these conclusions will be documented in the FMP and address the direction in this section of the Landscape Guide.

Standards and Guidelines

(18) Forest management plans will include targets for the Landscape Guide indicators that are consistent with milestones in the Validating and Revising Milestone Technical Note And Milestone Repository[1]. Targets will be consistent with milestones over the short (i.e., 10 years), medium (i.e., 20 years) and long terms (i.e., 100 years). (guideline)

(19) Forest management plans will document and discuss an estimate of when the desirable level will be reached for Landscape Guide indicators that have long-term targets established, including associated management challenges. (guideline)

(20) In cases where the achievement of meeting a Landscape Guide milestone conflicts with another management objective and the forest management planning team decides to favour the non-Landscape Guide objective, provide rationale in the forest management plan that describes in detail (guideline):

- ***i) the decision and how it was determined, and***
- ***ii) the expected time to achieve all affected milestones.***

3.4 Identify Large Landscape Patches to Meet Targets

Large landscape patches (LLPs) are areas identified to meet specific forest biodiversity objectives that may include specific management actions. A management unit map with these LLPs identified is considered to be a strategic landscape map. A strategic landscape map is a way of identifying those parts of the landscape that are being used to meet spatially explicit biodiversity objectives and are represented in a forest estate model. Application of LLPs and a strategic landscape map is the primary way Landscape Guide pattern indicators are address in the management direction of an FMP.

Examples of LLPs include areas identified to address the texture mature and old forest, and moose and deer emphasis areas (see section 3.4.1).

Standards and Guidelines

(21) Forest management plans will identify large landscape patches (LLPs), using a strategic landscape map, that may be required to meet targets created for Landscape Guide pattern or habitat indicators (e.g., texture of the mature and old forest, young forest patch size), and allow for the efficient implementation of other guides (e.g., Stand and Site Guide). (guideline)

[1] MNR. 2025. Forest Management Guide for Boreal Landscapes and Forest Management Guide for Great Lakes-St. Lawrence Landscapes: Milestones Repository.

(22) The forest management planning team will practice judicious use of LLPs by considering the landscape condition at the start of the planning term, indicator projections, Indigenous knowledge and values, local and landscape context, past management, natural disturbances, and, when available and applicable, the SRNV. (guideline)

(23) Each LLP (e.g., moose emphasis area, deer emphasis area, LLP to address the texture of mature and old forest) selected by the forest management planning team as part of the management direction requires the following documentation (guideline):

- ***a. Where: Identification of the LLP using a numbering system (e.g., Strategic Management Zone (SMZ) identifier in accordance with the Forest Information Manual and applicable technical specifications).***
- ***b. What and Why: What targets are met by the LLP (indicate Landscape Guide indicators(s) or specific fine filter objective).***
- ***c. When: When will these areas be managed, using at least 20-year periods. The strategic landscape map should identify prioritized management actions for spatially explicit indicators (e.g., pattern and habitat) over a length of time sufficient to demonstrate movement into and maintenance within desired level.***
- ***d. How: Describe what management actions will be taken in the LLP for each period, including a description of anticipated silviculture. In cases where an LLP is managed to create specific fine filter conditions, the management objectives and actions must be consistent. Describe how the LLP was taken into account in the forest estate model used to develop the management direction (e.g., available for harvest, deferred harvest, additional residual, specific silviculture).***
- ***e. Roads: Description of the expected length of time that planned or existing roads within the LLP will be required to carry out management actions. This documentation does not replace or direct road access planning; however, it can be used as input to the development of a road use management strategy.***

<u>Best Management Practices</u>

- The size of an LLP relates to the Landscape Guide indicator of interest. For example, in addressing the texture of the mature and old forest measured at 5,000 ha, an LLP should be at least 5,000 ha, but could also be much larger.
- Planning teams can design the strategic landscape map starting with the largest, most difficult patches to locate, those that will have an influence on landscape pattern for the longest period of time and/or those LLPs that require special considerations.
- LLPs should only be identified if the planning team determines that spatially explicit management direction needs to be represented in the forest estate model. For example:
    - Scoping analysis (including the application of various combinations of candidate large landscape patches) suggests the need for representation.
    - Teams can identify LLPs that have objectives for emphasizing moose or deer habitat using direction from the *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales*.
    - LLPs to address spatially explicit objectives identified in desired forest and benefits meetings (e.g., consideration of forest condition within trapline areas).
    - LLPs to address potential wildland fire risk within or near communities (e.g., planning teams may identify composition or pattern objectives for specific LLPs to reduce wildland fire risk, while also considering how these LLPs contributes to broader landscape structure, composition, and pattern objectives).
- It is assumed that the remaining areas not identified as LLPs will be comprised of harvest and retention decisions to complete the landscape mosaic. Not all areas of harvest or retention will be identified as, or incorporated into, the LLPs. These areas also contribute to meeting the overall landscape objectives for the management unit.

3.4.1 Using large landscape patches for applying fine filter direction for moose or deer habitat

Ideally, when applying the coarse filter, biodiversity at the landscape level will be maintained or enhanced. For moose and deer, browse and cover can be provided through application of the Landscape Guide direction for forest composition, structure and pattern. However, in some cases, forest management planning teams may identify large landscape patches to emphasize moose and deer habitat and allow for efficient implementation of the fine filter direction in the Stand and Site Guide. More detail on factors to consider when identifying these emphasis areas is provided in the Stand and Site Guide, including consideration of local knowledge, Ontario's Cervid Ecological Framework (OMNR 2009b) and Wildlife Management Unit (WMU) population objectives. The Stand and Site Guide also provides the stand and site level direction for forest operations and associated activities.

Standards and Guidelines

(24) Where objectives exist for moose or deer, forest management planning teams should evaluate using models, when available, to understand how application of the coarse filter provides habitat for these species. (guideline)

(25) Within large landscape patches that emphasize moose or deer habitat following direction in the Stand and Site Guide, forest management planning teams will consider how the identification, arrangement and planning of these large landscape patches contributes to broader landscape structure, composition, and pattern objectives. (guideline)

4 Monitoring and evaluating the Landscape Guide

FOSM requires the Ministry to review forest management guides regularly to determine if a revision is required. The results of past reviews should be considered, as recommendations may still be applicable in the longer-term. Monitoring, evaluating and reviewing the Landscape Guide considers evidence in the form of feedback from practitioners, First Nation peoples, Métis peoples and stakeholders; scientific investigations and monitoring programs; as well as advances in technology. Collectively, the evidence is used to assess the effectiveness, efficiency and effects of Landscape Guide direction and inform guide revisions as part of the adaptive management cycle (Figure 2).

Testing effectiveness evaluates if the Landscape Guide is contributing to biodiversity conservation as intended relative to a natural reference condition. Expected outcomes with a higher level of uncertainty become priorities for effectiveness monitoring. Testing efficiency and effects is largely based on an assessment of applying Landscape Guide direction in relation to previous comparable direction. More detailed information about effectiveness monitoring can be found in Effectiveness Monitoring of Forest Management Guides: Strategic Direction (Rempel *et al.* 2011).

4.1 Evaluating effectiveness

The CFSA implicitly states that emulation of natural disturbance and landscape patterns is an effective approach to ensuring long-term health of forest ecosystems. This approach, however, is a policy hypothesis, and the direction provided in the Landscape Guide is consistent with the intent of this policy. In essence, the hypothesis predicts that by emulating the structure, composition, and pattern of natural forest ecosystems through forest management, the natural patterns of biodiversity and ecological processes will be maintained in managed areas.

The CFSA requires the determination of sustainability with respect to the conservation of biodiversity and ecological processes. The effectiveness of Landscape Guide direction continues to be evaluated based on the prediction that forest management will result in landscapes, at similar ages, similar to those created from natural disturbance in terms of diversity in forest pattern, community structure of species dependent of pattern diversity, population sizes and ecological processes (Figure 10). These three classes are used to organize a strategy to monitor the effectiveness of landscape guide in conserving

both biodiversity and ecological processes. The response of a forest ecosystem to forest management and natural disturbance can be measured at the levels of species richness, population sizes, community organization and functional properties.

Landscape Guide indicators were developed for structure, composition, and pattern (section 3). Each element of guide direction results in expected outcomes that arise from the "emulation of natural disturbance hypothesis". Evaluating the effectiveness of the Landscape Guide is based on the prediction that forest management will result in landscapes that are similar to those created from natural disturbance in terms of their community structure, population trends and ecological processes. This prediction will be evaluated by comparing forest landscapes represented by the grey box in Figure 10 to those represented by the green box, respectively. The community structure component of the effectiveness monitoring plan requires an evaluation of vegetation and wildlife communities between the managed (grey box) and reference (green box) landscapes. This comparison is assessed by finding landscapes that are similar to both the managed (grey box) and reference (green box) landscapes and measuring Landscape Guide indicators and wildlife abundance. Rempel et al (2016) illustrates this concept using habitat niche space for a range of species that require specific forest conditions (e.g., edge habitat, conifer or deciduous dominated, young or old forest). This evaluation approach is expected to continue to inform Landscape Guide direction for structure, composition and pattern.

The Landscape Guide will continue to take years to be effectively implemented across Ontario and changes in many Landscape Guide indicators will occur over the long term. Predicted changes in wildlife abundance and population trends (based on the community structure evaluation) can be made by evaluating predicted landscape changes. For example, if we expect an increase in the amount of young jack pine in a given Landscape Guide region, then we should expect to see an increase in the abundance and distribution of species that prefer young jack pine forest as habitat, such as the spruce grouse and hermit thrush. The population trends monitored at the Landscape Guide region level can then be used to distinguish wildlife responses to factors related to Landscape Guide direction from other non-guide factors (e.g., winter habitat for migratory songbirds, insects). The Ministry, as identified in FOSM and FMPM, has a lead role in designing scientific studies to evaluate the effectiveness of forest management guides, including monitoring wildlife populations to support guide effectiveness monitoring. This component of the effectiveness monitoring plan strives to integrate and expand existing monitoring programs within the Biodiversity and Monitoring Section of the Ministry's Science and Research Branch.

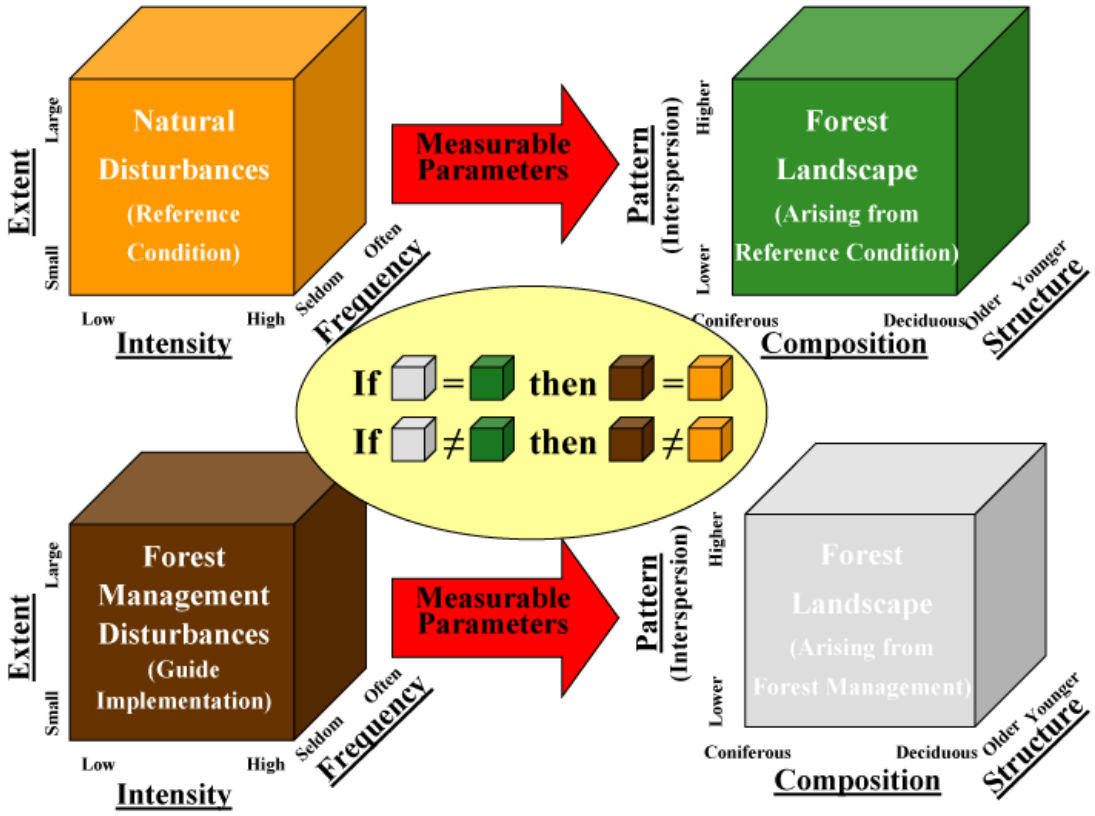


Figure 10. Predicted relationships between pattern, composition, and structure and forest management disturbances versus natural disturbances. The boxes represent characteristics of disturbances (frequency, intensity and extent) or landscapes (structure, composition and pattern). Under the hypothesis that forest management (lower left box) emulates key characteristics of natural disturbances (upper left box) the use of the Landscape Guide is predicted to result in similarities between unmanaged landscape structure composition and pattern (upper right box) and the managed areas (lower right box). Examples of applying this concept are illustrated in Figure 1 of Rempel et al. (2011) and Figure 1 of Rempel et al (2016).

The ecological processes component of the plan will require an evaluation of ecological processes between the managed (grey box) and reference (green box) landscapes. This component of the monitoring plan explicitly addresses the mandate to assess sustainability in terms of how well ecological processes are conserved and refers to a broad class of potential monitoring projects, and principally relates pattern to process through indicators. A current project focuses on the validation and evaluation of landscape classes using broad-scale wildlife monitoring results.

4.2 Identifying effects on other values

Implementation of the Landscape Guide in forest management plans may have a positive, negative or neutral effect on other values relative to previous forest management guides. Such effects are part of the main uncertainties of Landscape Guide direction and will continue to be considered by the Ministry. The following is a partial list of potential effects of Landscape Guide implementation that will be monitored as part of the guide effectiveness monitoring:

- Changes in forest access road density and/or distribution.
- Changes in available harvest area.
- Changes in habitat and population responses of wildlife species valued by First Nation communities, Métis communities, and stakeholders.

4.3 Efficiency of Landscape Guide direction

Efficiency is considered to be the ease with which people can prepare, read and implement forest management plans using the Landscape Guide. Improvements to the efficiency of landscape guide direction will consider the effectiveness and effects of implementing Landscape Guide direction. Future reviews will consider the advantages and disadvantages of the Landscape Guide direction compared with previous direction. This includes consideration of feedback from individuals with experience implementing the Landscape Guide, applicable scientific research, and advances in analytical and operational technology. Collectively, the evidence informs how Landscape Guide direction could be more parsimonious and be more efficiently applied in forest management planning.

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6 Glossary

Area of concern (AOC): A geographic area established for an identified value that may be affected by forest management activities.

Best management practice: A component of a guide that suggests a practice or strategy to help implement the overall purpose of the standards and guidelines.

Deer emphasis area (DEA): Large landscape patch with objectives to emphasize deer habitat.

Guideline: Mandatory direction that may require professional expertise, local knowledge or Indigenous knowledge for it to be applied appropriately at the local level.

Interquartile Range (IQR): between the first and third quartile (i.e., middle 50% of the sample).

Judicious: reasonable, fair and lawful, as determined by the forest management planning team, with consideration of input from all planning team members.

Landscape: For the purposes of the Landscape Guide, an area covering hundreds of thousands to tens of thousands of square kilometres, roughly equivalent to ecoregions.

Landscape Scripting Language (LSL): Program used to measure pattern (i.e., texture, patch size) indicators in Ontario's Landscape Tool.

Large landscape patches (LLP): An area identified to meet specific forest biodiversity objectives that may include specific management actions (e.g., moose emphasis areas, deer emphasis areas).

Management unit (MU): Unless otherwise specified, An area of the forest designated under section 7 of the *Crown Forest Sustainability Act*, 1994.

Milestone: Directional statements (e.g., maintain, increase, or decrease) for expected movement toward desirable levels from the present condition (i.e., plan start) over the short (0-10 years), medium (0-20 years) and long term (0-100 years).

Moose emphasis area (MEA): Large landscape patch with objectives to emphasize moose habitat.

Ontario's Landscape Tool (OLT): Computer program that supports implementation of the Landscape Guide by calculating Landscape Guide indicators.

Patch size: For the purposes of the Landscape Guide, a quantitative measure of homogenous forest composition and structure in the landscape matrix patch size classes and measured using Landscape Scripting Language quantification techniques in Ontario's Landscape Tool.

Pattern indicators: Measurements (i.e., texture, patch size) of the arrangement of forest structure and/or composition.

Simulated range of natural variation (SRNV): Quantitative estimates of the landscape structure, composition and pattern that might arise from natural disturbances and landscape patterns, derived from simulations and pre-industrial condition estimates.

Standard: Mandatory direction that provides precise direction.

Strategic landscape map (SLM): A management unit map with large landscape patches identified.

Texture: For the purposes of the Landscape Guide, a quantitative measure of the landscape matrix represented by concentration classes and measured using Landscape Scripting Language quantification techniques in Ontario's Landscape Tool.

T-Stage: Two-staged, refers to stands that have experienced a natural or management disturbance in which part of the overstory crown has been removed, consequently encouraging growth of an understory.

Appendix A: List of forest management units within the Great Lakes-St. Lawrence Landscape Guide Regions, as of April 1, 2025.

Forest Management Unit	Landscape Guide Region
Algoma Forest	GLSL North
Nipissing Forest	GLSL North
Northshore Forest	GLSL North
Sudbury Forest	GLSL North
Temagami Forest	GLSL North
Algonquin Park Forest	GLSL South
Bancroft-Minden Forest	GLSL South
French-Severn Forest	GLSL South
Mazinaw-Lanark Forest	GLSL South
Ottawa Valley Forest	GLSL South

Appendix B: Milestone table templates

Table A1: Milestone table template for the GLSL North Landscape Guide Region. Options for the blank "Directional Statement" column include: "Maintain within the IQR", "Increase and maintain within the IQR", and "Decrease and maintain within the IQR". Options for the blank "Short-term", "Medium-term" and "Long-term" columns are "Maintain", "Increase", and "Decrease". Please see the Validating and Revising Milestone Technical Note And Milestone Repository for the most current versions of milestone tables for each management unit.

Objective category	Landscape Guide Indicator Group	Landscape Guide Indicator	Units of measure	Directional Statement	Short-term (0-10 years) milestone	Medium-term (0-20 years) milestone	Long-term (0-100 years) milestone
Structure and Composition	Landscape classes	Tolerant hardwood	Area (ha)				
Structure and Composition	Landscape classes	Intolerant hardwood	Area (ha)				
Structure and Composition	Landscape classes	White pine mixedwood	Area (ha)				
Structure and Composition	Landscape classes	Mixedwood	Area (ha)				
Structure and Composition	Landscape classes	Mixed pines	Area (ha)				
Structure and Composition	Landscape classes	Spruce-fir-cedar	Area (ha)				
Structure and Composition	Old growth forest	Old growth forest by Landscape Guide forest unit or appropriate grouping	Area (ha)				
Structure and Composition	Forest Unit Groupings	All ages red and white pine forest units	Area (ha)				
Structure and Composition	Individual forest units	Individual Landscape Guide forest units	Area (ha)	Move towards and/or maintain within the SRNV	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable

Objective category	Landscape Guide Indicator Group	Landscape Guide Indicator	Units of measure	Directional Statement	Short-term (0-10 years) milestone	Medium-term (0-20 years) milestone	Long-term (0-100 years) milestone
Structure and Composition	Young forest	Pre-sapling development stage	Area (ha)	Move towards and/or maintain within SRNV	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable
Structure and Composition	Young forest	Pre-sapling, sapling and t-stage development stages combined	Area (ha)	Move towards and/or maintain within SRNV	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable
Pattern	Texture of mature and old forest	Texture of mature and old forest	500 and 5,000 ha hexagon frequency distribution	Move towards and/or maintain within the SRNV	Move towards mean	Move towards mean	N/A
Pattern	Young forest patch size	Young forest patch size	Patch size frequency distribution	Move towards and/or maintain within the SRNV	Move towards mean	Move towards mean	N/A

Table A2: Milestone table template for GLSL South Landscape Guide Region. Options for the blank "Directional Statement" column include: "Maintain within the IQR", "Increase and maintain within the IQR", and "Decrease and maintain within the IQR". Options for the blank "Short-term", "Medium-term" and "Long-term" columns are "Maintain", "Increase", and "Decrease". Please see the Validating and Revising Milestone Technical Note And Milestone Repository for the most current versions of milestone tables for each management unit.

Objective category	Landscape Guide Indicator Group	Landscape Guide Indicator	Units of measure	Directional Statement	Short-term (0-10 years) milestone	Medium-term (0-20 years) milestone	Long-term (0-100 years) milestone
Structure and Composition	Landscape classes	Tolerant hardwood	Area (ha)				
Structure and Composition	Landscape classes	Intolerant hardwood	Area (ha)				
Structure and Composition	Landscape classes	White pine mixedwood	Area (ha)				
Structure and Composition	Landscape classes	Mixedwood	Area (ha)				
Structure and Composition	Landscape classes	Mixed pines	Area (ha)				
Structure and Composition	Landscape classes	Spruce-fir-cedar	Area (ha)				
Structure and Composition	Old growth forest	Old growth forest by Landscape Guide forest unit or appropriate grouping	Area (ha)				
Structure and Composition	Forest Unit Groupings	All ages red and white pine forest units	Area (ha)				
Structure and Composition	Young forest	Pre-sapling development stage	Area (ha)	Move towards and/or maintain within SRNV	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable
Structure and Composition	Young forest	Pre-sapling, sapling and t-stage development stages combined	Area (ha)	Move towards and/or maintain within SRNV	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable

Objective category	Landscape Guide Indicator Group	Landscape Guide Indicator	Units of measure	Directional Statement	Short-term (0-10 years) milestone	Medium-term (0-20 years) milestone	Long-term (0-100 years) milestone
Structure and Composition	Individual forest units	Individual Landscape Guide forest units	Area (ha)	Move towards and/or maintain within SRNV	Move towards or maintain as applicable	Move towards or maintain as applicable	Move towards or maintain as applicable
Pattern	Texture of mature and old forest	Texture of mature and old forest	50 and 500 ha hexagon frequency distribution	Move towards and/or maintain within the SRNV	Move towards mean	Move towards mean	N/A
Pattern	Young forest patch size	Young forest patch size	Patch size frequency distribution	Move towards and/or maintain within the SRNV	Move towards mean	Move towards mean	N/A