Attachments to the

Independent Evaluation of Implementation of the Forest Practices Report for Nova Scotia (2018)

by William Lahey

(November 2021)

Attachment A: Mandate

Attachment 1. Mandate

Evaluation of Forest Practices Review Implementation
Statement of Work

In 2018 William Lahey, President of University of King's College, completed an independent review of forest practices in Nova Scotia ("the Review").

The Review included a recommendation to establish an independent committee of technical experts to annually evaluate and public report on the progress in implementing the recommendations and embracing and achieving an ecological model of forestry management in Nova Scotia.
William Lahey has agreed to lead an independent committee of experts to provide the first annual evaluation of the Review's implementation, and to recommend an evaluation framework for future years.

Scope
The evaluation report will include the following components:

1) An assessment of the Province's progress on implementing the recommendations of the Review.

2) A recommended framework to guide the preparation of annual evaluations to assess progress towards achieving the ecological model of forestry management in Nova Scotia as envisioned in the Review.

Technical Experts
Under the direction of Professor Lahey, Lands and Forestry will retain experts to advise on technical aspects of the evaluation. This may include experts in evaluation, various aspects of ecological forestry and forest policy.

Stakeholder, Mi'kmaq and Public Input
In conducting the evaluation, Professor Lahey may at his discretion seek input from various stakeholders, the Mi'kmaq and the public.

Support
The review will receive secretariat support from staff within the Department of Lands and Forestry Policy Planning and Support Services Branch. This will include retaining technical experts as needed, general administrative and logistical support, and assisting and coordinating additional public, stakeholder and Mi'kmaq input that maybe required. Wherever possible, and consistent with the effective discharge of the mandate, Professor Lahey will make use of the available support resources of the Department.

Delivery of Report
Professor Lahey will deliver a final report to the Minister of Lands and Forestry. The report will be public.

Time Frame
The final report will be delivered no later than March 31, 2020.

Attachment B: Department's Progress Report and Executive Summary on Implementation of the Forest Practices Report

Executive Summary for Progress Report

Overall Intent

The overall vision to the Government of Nova Scotia's commitment to transition to the ecological forestry paradigm is to have healthy diverse multi-aged forests that support the naturally occurring biodiversity and ecosystems in our province while will still allowing its sustainable use for social, cultural and economic benefits.

The Province is committed to adopting a model that protects ecosystems and biodiversity, supports economic growth, and keeps our forests healthy and sustainable. A healthy forest is foundational to supporting sustainable use of our forests, including supporting a healthy forest sector. To achieve a healthy forest, we will ensure diversity of biology, choices and perspectives.

Biological diversity is critical. We are committed to conserve and restore ecosystem diversity, including conserving species and genetic diversity. To achieve this, we need to ensure we maintain species' habitats and the genetic variation within species in how we manage our forests.

We are committed to maintaining **diversity of choices** for human and social economic uses of our forests. This includes supporting traditional and emerging industries like sustainable forestry and biological resource businesses, but it also requires ensuring tourism and recreational use of Crown land can thrive.

To achieve these goals, we are ensuring that **diverse perspectives** are incorporated into our forest stewardship and management. We are providing opportunities for participation in the development of new and/or amended policies, practices, legislation and regulations and are building a forest management system that involves ongoing stakeholder and public participation. Effective engagement takes time, and so our consultation processes must be robust and take the time necessary to both hear from different voices, and to incorporate what we hear and learn.

Approach

In its response to Professor Lahey's Report, "*An Independent Review of Forest Practices in Nova Scotia"*, Government committed to focus on implementing recommendations related to Crown land first, particularly those under the authority of the Department of Lands and Forestry (the Department). This will allow Government to lead by example, after which, recommendations related to private land management will be considered.

Government accepted and is making changes to adopt the new paradigm of ecological forestry, including the commitment to protect and enhance ecosystems and biodiversity as the overarching policy priority. As recognized in the Lahey Report, the Department had already started to slowly move towards ecosystem-based management, however, the Lahey Report has accelerated that shift. Government decided to use its resources to move forward with implementing the Lahey Report recommendations, as

recommendation 23b laid out, rather than using those same resources to conduct further cost/benefit analyses of accepting the recommendations (#23b).

Government clearly heard from the public a strong desire to see changes on the ground, particularly a decrease in clear cutting. While one implementation option was to "start at the beginning" and look at the strategic level work first, then proceed to tactical and then operational implementation, using this option would have meant a significant amount of time would pass prior to being in a position to implement visible changes to forestry practices, including reducing clearcutting. As a result, priority was placed on implementing a number of recommendations, in parallel with strategic work, that would support relatively quick operational changes in forestry practices. The operational changes are intended to be adaptive in nature so that adjustments can be made as science develops and needs change. The prioritized work included:

(1) Revisions to the Forest Management Guide (FMG) and Pre-Treatment Assessment(PTA): The Forest Management Guide has a direct impact on the types of treatments that are used on Crown land, including clear cutting. In the interim, while the Guide was/is being revised, an interim retention guide was put in place. This interim guide, which puts a greater focus on multi-aged management practices, continues to be in place and has resulted in less clearcutting on Crown land. The new Forest Management Guide (now called the Silviculture Guide to the Ecological Matrix), once finalized, will further reduce clear cutting in the matrix. The Guide will be adaptative in nature so that as new science and experience is gained, adjustments can be made to the Guide to reflect new thinking and to help the Department achieve its outcomes related to the long term vision for Nova Scotia forests.
(2) High Production Forestry: Identification of High Production Forestry Areas has been prioritized for action in order to offset the decrease in harvesting that will take place in the matrix once the Forest Management Guide is revised.
(3) Natural Disturbance Regimes(NDR): The review of NDR was initiated as a priority action as the understanding of how natural disturbances impact forests in the province is key to various pieces of work such as the Forest Management Guide, and landscape level planning. While only one paper on mapping and methodology was originally anticipated, based on the expert advice received by the project team leading this work, it was determined that two separate papers would be required – one on natural disturbance agents and then a second paper on the application of NDR. While this new approach has extended the time period to complete the recommended work, this two-step approach will assist in confirming the accuracy of the science that is being relied on.
(4) Species at Risk: The Department has renewed its focus on wildlife and species at risk. Priority work includes establishing new policies and updating existing ones to better govern the implementation of the *Endangered Species Act*. Focus was also placed on completing outstanding recovery plans for species solely listed in Nova Scotia and increasing engagement with practitioners and others interested in assisting in protecting species at risk through Recovery Action Forums.
(5) Old Forest Policy: Work on a revised Old Forest Policy has been prioritized in order to improve the abundance and conservation of Old Forests. This work is also linked to the development of the Forest Management Guide, Pre-Treatment Assessment, and landscape level planning.
(6) Outcomes Based Forest Management: Outcomes Based Forest Management will take some time to develop, so it was determined that the development of a framework should be prioritized. The Department recognizes that Lahey recommendation 21 indicates that a number of other

conditions should be in place prior to implementing an Outcomes Based model. Work on these conditions are at different stages of development but are underway.

(7) Small Scale Wood Energy: After the Lahey Report was issued, Government quickly put together a team of representatives from within and external to provincial departments to move the wood heat initiative forward. This project was intended, as recommended, to help to create new markets for low grade wood fibre. Phase One sites are anticipated to be operational for the upcoming heating season.

(8) Environmental Assessments (EA): The legal framework for the introduction of an Environmental Assessment process for forest management planning is required prior to the negotiation of new or renegotiation of existing FULAs. Effectively this requires the completion of the legal framework (legislation/regulation) by the end of 2020, which necessitated prioritizing this recommendation. Work to this end is underway.

While the above represents the initial work underway, the Department has added other pieces of work to support the implementation of ecological forestry, including:

- The introduction of a *Biodiversity Act*
- Initial work on a review of the *Crown Lands Act*
- Work to improve transparency and accountability
- The creation of two more project teams: State of the Forest Reporting and a Silviculture Review team
- Developing a multi-year Research Strategy

Consultation processes and the approach to transparency

In the Government's response to the Lahey Report, the Department committed to improve and demonstrate a culture of openness, transparency, collaboration and accountability.

It was clear that more and earlier engagement with stakeholders and the public would be required as the Department moved ahead with transitioning to the ecological forestry paradigm. Improvements to transparency and the use of collaborative approaches has resulted in a broad range of input into decision making and appears to be well received by stakeholders. However, this approach has required more time than anticipated and has impacted planned timelines. The Department has made a number of changes in order to begin to be more transparent and accountable:

- As a first step, the Department engaged a consultant to seek advice on how it could achieve more meaningful stakeholder and public engagement. The consultant provided eight recommendations, which included the creation of a stakeholder advisory committee to provide input into the Department's work to implement Professor Lahey's recommendations, including how it engages and communicates with stakeholders to enhance transparency, consultation, and collaboration.

- Each project team is required to develop a consultation plan for their projects that should include staff, stakeholders, Mi'kmaw, and the general public. While each plan may look different due to the varying nature of each project, we are trying to engage earlier and differently than we have in the past. This includes proactively engaging stakeholders prior to the development of

a “product” where possible and designing consultation sessions that encourage face-to-face discussions with stakeholders. For example, the FMG consultation process was designed to have three stages of consultation, the first of which was to seek feedback on the policy framework for the FMG, and the second and third stages to seek feedback on draft versions of the revised Guide. The first and second stages involved a targeted group of rights holders and stakeholders that represented various positions (industry, conservation interests, Mi’kmaw, landowners, etc). The third stage is being designed to seek feedback from the general public, as well as stakeholders. Other examples of proactive engagement include an upcoming public survey on the State of the Forest Report, which is intended to solicit feedback on the current Report and seek input on the desired use and format of a new report.
The Project Teams are also seeking feedback on the consultation sessions from the participants and adapting approaches, as necessary. For example, the first stage of the FMG consultation involved bringing all of the targeted stakeholders together at the same time for discussions. This resulted in having 25 + people in one room. The feedback that we received was that this too many for true participation in discussions, and that the stakeholders wanted to be able to send additional representatives to consultation sessions. As a result, during the second stage of consultation, which included the same stakeholders as the first stage, the process was redesigned, and multiple sessions were held with 10-12 people in each. This allowed for a larger number of participants overall, while keeping the numbers in each session small enough to encourage active discussions with everyone present. Feedback on this change in design has been very positive.

Project Teams are sharing their best practices and lessons learned with each other so that future consultations will benefit.

- The Department has created a new website dedicated to providing routine and timely updates and information on implementing ecological forestry. The website includes a dedicated email address that the public can use to sent questions/comments related to ecological forestry work. In addition, Communications Nova Scotia staff work with Department staff to create videos and other products that will support information sharing and education related to implementing ecological forestry.

- In addition to the website, when significant changes occur and/or are proposed, the Deputy Minister has been sending information emails to our broad list of stakeholders.

- The Department management is working to ensure staff are engaged in and informed of progress. This includes: providing regular updates to staff on implementation progress; seeking feedback on issues/ proposed actions; and ensuring the right supports are in place for staff who engage in discussions with the public. Various communications methods are being used, including: Deputy Minister videos and webinars, newsletters, emails and a in-person meetings (between staff and Project Teams, and via a Deputy Minister office tour).

- A new position (Senior Strategist, Stakeholder Relations and Issues Management) focussed on stakeholder engagement and issues identification has been created. Specifically, this individual plays an instrumental role in shaping how the Department communicates and engages with stakeholders to ensure: alignment with and the Department’s priorities and mandate, relevant information is proactively shared, and that the Department’s strategic direction and priorities

are well-understood and incorporated into meaningful and coordinated stakeholder participation. This role has been active since January 2020.

- At Government's request, and with Professor Lahey's agreement, an evaluation of the Department's progress on implementation to-date is being conducted. Professor Lahey has also agreed to provide the Department with an evaluation framework to measure success of implementation in future.

Governance

In order to ensure accountability and a structured implementation of the Lahey Report, the Department created a governance structure specific to this work. In addition to regular briefings with the Deputy Minister and Minister, the governance structure includes a Steering Committee. which is made up of three Executive Directors and a dedicated Project Manager for implementation. The Steering Committee normally meets weekly and is responsible to: ensure alignment with Minister and government expectations, respond to issues/request for direction; consider recommendations and advances for decisions by the Department's Executive Team, Deputy Minister and Minister as appropriate; and ensure Department resources are allocated to support project implementation.

The Department is taking a project management approach to implementing the Lahey recommendations. To support this approach, a dedicated Strategic Lead was hired to support the overall coordination of the implementation work. This role includes: overall coordination of the Projects and the Project Teams; tracking and reporting to the Steering Committee and Directors team; bringing issues and recommendations to the Steering Committee; proactively identifying and addressing barriers to project progress; and, supporting change management, internal communications, and public participation processes.

As part of the project management approach, the Department has organized the work to-date into Project Teams. Each team includes representation from most of the Department's divisions (which draws on the diversity of perspectives and expertise, and increases collaboration in the Department) and each team includes at least one biologist (to ensure that the team has the expertise to give priority to biodiversity). Many of the teams also include external experts (to draw on the expertise of external academics and experienced experts) and two teams include members from other government departments (where cross-government cooperation/coordination is required and desired).

Each Project Team is required to follow project management best practices including creating a project charter, project workplan, and a communications plan (developed in cooperation with the communications staff). Team leads have also taken training in change management.

As part of the Department's commitment to increase transparency and accountability, a Minister's Advisory Committee (MAC) was created in the fall of 2019. The role of the MAC is to advise the Minister on the implementation of ecological forestry and to advise Professor Lahey on his evaluation. The MAC provides advice to the Minister on strategic decisions, policy and priorities relevant to implementing ecological forestry on Crown land as recommended in Professor Lahey's report. This includes providing advice to the Minister on: transparency and accountability; the overall framework for implementing ecological forestry; the Triad model of forestry; specific recommendations; research;

support for the sector; governance; and, other related issues. The MAC will also advise Professor Lahey on his independent evaluation of the Department's progress implementing his recommendations and on a longer-term framework to assess progress towards an ecological forestry paradigm.

Challenges

Shift in Approach

One challenge has been in adjusting mindset and culture with respect to how the Department approaches implementing ecological forestry. The Forestry Review identified the need to shift to prioritizing biodiversity – a notable difference in the way the Department has worked in the past. While the Department was in the midst of a shift to more ecosystem-based management, the Lahey Report accelerated this shift, which has also accelerated the approach required to have successful outcomes. This shift includes having a more intense focus on the work and on increased use of the expertise of the Department's biologists and ecologists.

Implementing new stakeholder engagement approaches has also created some new challenges for the Department but we are addressing them head on. As noted above, it was clear that more and earlier engagement with stakeholders and the public was and is required. Taking new approaches to stakeholder engagement required that we identify staff that had, and/or could develop, expertise in engagement. As noted, the Department also hired a new staff member whose focus is on stakeholder engagement and issues identification. One of the biggest challenges with engagement has been the increased amount of time required to effectively design and carry out these processes. This has resulted in the timelines for projects being extended beyond originally identified timelines. Based on the feedback we have received from stakeholders, our efforts in this area have been acknowledged and positive, and the input that the Department is receiving is having a direct and positive impact on the work of the project teams. However, this positive is contrasted by the perspectives of some stakeholders that we are "taking too long" to make changes.

While we are facing some challenges, we are still in the early stages of this shift. We acknowledge more work is needed and are confident that with this commitment, the Department, and the province at large, will reap the benefits of these efforts.

Northern Pulp closure

The closure of the Northern Pulp mill in January 2020 resulted in an immediate need to shift some resources and priorities in the Department. While implementation of ecological forestry continued, and the Project Teams continued to move ahead with their work plans, some Department staff were required to shift some of their work in order to respond to the closure. This shift included supporting the work of the newly created Forestry Transition Team, whose role it is to address the challenges to the industry as a result of the closure.

COVID-19

The unexpected outbreak of COVID-19 across the globe created novel challenges for everyone, including Government, and the Department. Most staff were required to work from home as of March 23, 2020. The initial weeks of working from home resulted in a slight slow down in progress as the Department shifted to a new way of working amid ever changing circumstances. For example, in-person consultations on High Production Forestry originally scheduled for April 2020 were cancelled as a result of public health directives. However, overall progress was made. The Department, and Project Teams, came up with new ways of moving their projects forward. This included rescheduling the High Production Forestry consultations, and instead holding them online using networking software. While the pandemic continues, productivity within the Department is high; work has and will continue.

General summary of accomplishments

As noted in the December 3, 2018 Government response to the Lahey Report, many of Professor Lahey's recommendations are interconnected and their implementation will be phased-in over time. It is anticipated that the actions required to fully implement ecological forestry will take years to accomplish.

The Department's implementation is moving forward and has progressed, although not as quickly as originally hoped. For example, the FMG has taken longer than expected to develop, however this is partially due to the robust consultation process that was added to the process. Stakeholders feedback has been very valuable, and the latest draft reflects the feedback received.

Delays have also been related to the Northern Pulp closure and COVID-19, discussed above.

Despite these challenges, the Department has been able to achieve a number of successes, including:

- The introduction of a governance model for the implementation of the Lahey Report to ensure accountability.
- Engagement of, and partnerships with, external experts to support and further the work of the Department in implementing ecological forestry.
- The development of seven principles to guide Department staff and the culture shift required to prioritize biodiversity and ecosystems.
- The implementation of interim retention guide to put a greater emphasis on multi-aged management practices, and which has started the shift to more ecological forestry practices on Crown land.
- The adoption of proactive, robust and adaptive consultation processes and practices, which have resulted in positive feedback from stakeholders that indicate that the Department is on the right path.
- The acceptance and implementation of the recommendations of a consultant which are enhancing the Departments' communication and engagement with staff, stakeholders and the public.
- The creation of a Minister's Advisory Committee to advise the Minister on the implementation of ecological forestry.
- A renewed focus on transforming the species at risk program, including the addition of two new biologist positions. This includes the appointment of 12 new multi-species Recovery Teams; the drafting of recovering plans for all remaining species that fall under provincial responsibility; a

new Critical Habitat Policy; and three regional Recovery Action Forums which engaged practitioners and stakeholders and offered public forums.
- The development of a new old forest/growth assessment process that is more efficient and effective in identifying old forest/growth; and the completion of the identification of 8% old forest targets under the current Old Forest Policy.
- The acceptance of a peer-reviewed NDR agents paper for publication in the journal "Environmental Reviews" in fall of 2020.
- The development of a new Nutrient Budget Model that will be used as part of the PTA process;
- Progress under the Small Wood Energy Initiative anticipating completion of its first phase with the development of 6 sites in the fall 2020/winter 2021. Work on phase 2 is already underway.
- A continued relationship between the Department and the Medway Community Forest, including through the provision of additional operating funding.
- The launch of a three-year pilot project with the Mi'kmaw (Mi'kmaw Forestry Initiative) in March 2019.

Overall, the current work underway in the Department is in the process of addressing approximately **65%** of the recommendations in the Lahey Report.

New Information/Updates since the submission of the Departmental Progress Report

- The project team working on the **Forest Management Guide** (now the Silviculture Guide to the Ecological Matrix) is close to completing the next draft version of the Guide and are currently planning the next phase of consultations.

- The **Natural Disturbance Regimes** project team has completed its research paper, *A review of natural disturbances to inform implementation of ecological forestry in Nova Scotia, Canada*, which is now available online on the Environmental Reviews Journal website. (https://www.nrcresearchpress.com/doi/10.1139/er-2020-0015#.X0fhd8vsb1V) This research provides a foundation that will inform the team's second paper on how we adapt or integrate natural disturbance regimes into Nova Scotia's existing ecosystem mapping framework, and application to ecological forestry. The team is currently working on developing this next scientific paper and is targeting submission for publication in 2021.

- The **Old Forest Policy** project team has recently completed an initial GIS layer of scored stands. The team is also about to engage in some proactive consultations with stakeholders to solicit feedback and input on what revisions should be considered for the Old Forest Policy. This input will then be used to develop a new revised Old Forest Policy which will also be subject to consultation targeted for later this year.

- The **Environmental Assessment** project team continues to work with Northwinds Consulting to develop a draft Forest Stewardship Planning (FSP) Guide, which will assist licensees in developing their 20 Year Forest Stewardship Plans which will be subject to the Environmental Assessment process. Once complete, the team will engage in stakeholder consultations to seek input on the draft Guide. The **Environmental Assessment** project team and the **Outcomes Based Forestry (OBF)** project team have recognized the valuable connection between their work. The OBF team has identified the forest management (stewardship) plan as a key

component of an OBF system and is exploring a framework using values, objectives, indicators and targets (VOITS) for designing and monitoring forest outcomes. As a result, these teams are working collaboratively, along with others (State of Forest, landscape level pilot) to ensure alignment and to avoid duplication in effort.

- **Silviculture Project Team**: A new project team has been formed to tackle the recommendations pertaining to reviewing the existing private and Crown silviculture programs. To date, this team has met five times and is currently focussed on developing a Project Charter and work plan to guide their work.

- **Research Strategy**: The Department is currently in the process of developing a multi-year Research Strategy recognising that research provides the foundation to evidence-based decisions for the stewardship of natural resources.

  The purpose of the Strategy is to:

  - provide internal guidance to improve research co-ordination, reduce knowledge gaps, and improve forest management and biodiversity stewardship in the province
  - articulate what research we are doing and how it is communicated
  - support outward communication with research partners and the public on the Department's research priorities
  - Leverage additional research collaborations

  The scope of the Strategy will include Department-wide research (biodiversity, forests, ecosystem management) and will include pure and applied research.

May 6, 2020

Department of Lands and Forestry
Progress on Implementation of Lahey Report

Submission to Evaluation Committee

Professor William Lahey's *Independent Review of Forest Practices in Nova Scotia* (the Review) provides 45 recommendations for forest management in the province. His recommendations focus on adoption of an ecological forestry paradigm using a triad model to protect and enhance ecosystems and biodiversity as the foundation for sustainable environmental, social, and economic benefits for Nova Scotians.

In December 2018, the Government of Nova Scotia committed to priority actions to achieve ecological forestry, including a commitment to first consider the protection and enhancement of biodiversity and ecosystems in decision-making. Implementation would be phased in over time, with priority placed on actions pertaining to forest management on Crown land.

At the same time, the Department of Lands and Forestry (the Department) implemented an interim retention guide to put greater focus on multi-aged forest management practices and begin the shift towards ecological forestry in Crown forests. Since the adoption of this guides, there has been a significant reduction of harvest area approved for overstory removals, as it has been replaced by variable retention. Changes in harvests resulting from the interim retention guide will assist the Department in testing ecological and economic outcomes of different levels of retention and, in turn, inform how ecological forestry is implemented going forward.

Government has also invested an additional $5.413 million over three years to support implementation of ecological forestry. The majority of these funds were allotted for silviculture funding to increase the number of partial harvests and decrease clearcutting to move towards ecological forestry. The additional investment combined with existing resources has allowed the Department to make tangible progress on this multi-year initiative.

The Department has taken a collaborative approach to implementation to ensure multiple values and perspectives are considered when designing and developing projects to implement Professor Lahey's recommendations. Project teams made up of both internal and external members representing multiple perspectives and areas of expertise were established. Stakeholder and public participation has also been incorporated into each of the projects to provide additional opportunities for input into how Crown forests are managed. This has resulted in significant changes to how the Department conducts work internally and with external partners and the public more broadly to support a culture of openness, transparency, collaboration and accountability.

As outlined on the newly created Ecological Forestry website, the Department's work initially focused on the following priority projects:

1. A Revised Forest Management Guide and Pre-Treatment Assessment Process
2. Old Forest Policy
3. Natural Disturbance Regimes
4. Outcomes-Based Forest Management
5. Reporting on the State of the Forest
6. Species at Risk Program Renewal
7. High-Production Forestry
8. Small Scale Wood Energy Initiative
9. Environmental Assessment

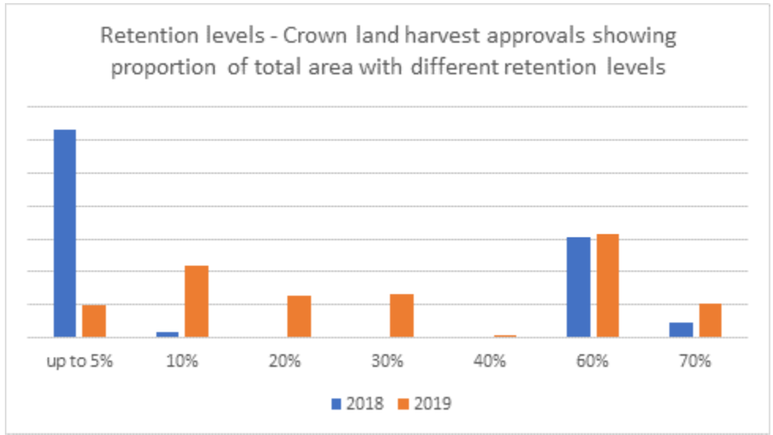
Planning for other areas of project work, such as but not limited to a silviculture review and accelerated landscape level planning, is underway.
At the Department's request, Professor Lahey agreed to lead an evaluation of the Province's implementation of his recommendations, including a one-year assessment of progress, and a longer-term framework to guide the preparation of ongoing evaluations to assess progress towards achieving the ecological model of forestry management in Nova Scotia as envisioned in the Review.
The following is a progress report to inform Professor Lahey's one-year assessment of progress. It provides detailed information on actions taken and planned in response to each of his 45 recommendations, broken down into four themes identified by Professor Lahey's evaluation team including: overarching recommendations, and recommendations pertaining to ecological values, economic values, and organizational approach.

Theme: Overarching

Sub-Themes		Recommendation	Completed Activities	Planned Activities
Priority to Ecosystems and Biodiversity	1	In respect to forestry practices and related forestry policy, economic, social, and environmental values and objectives must be balanced within a policy and operational framework that gives priority to the conservation and sustainable management of ecosystems and biodiversity.	December 2018, Government committed to protecting and enhancing ecosystems and biodiversity as the overarching policy priority. This provided an opportunity for the department to accelerate work underway to achieve this goal, while guiding new projects established in response to Professor Lahey's recommendations. ıring Spring 2019, the Department developed seven principles to guide the culture shift required to put this policy priority into practice: 1) Lands and Forestry needs to demonstrate a culture and philosophical orientation towards maintaining and restoring biodiversity and ecosystems in our policies, procedures, decision-making and operations. 2) Landscape level planning is critical and includes Crown land and incorporates conditions on private land. 3) Biodiversity and ecosystems must be maintained and restored to ensure continued system function at medium to large level and over long time periods. 4) Planning, decision-making and operations, (collectively "activities") on Crown land are guided by biodiversity and ecosystem functions at the site, system, and landscape level, including cumulative effects. 5) For activities on Crown land, Lands and Forestry must first consider ecosystems and biodiversity before identifying elements available for any use. 6) Economic and social impacts will be considered only after considerations related to biodiversity and ecosystems. Options and recommendations should be presented in this way. 7) Extraction of resources from Crown land cannot compromise continued biodiversity and ecosystem functions. ese principles provide a focal point for work underway to shift towards an ecological forestry approach in Nova Scotia. They were shared by senior leaders with staff across the department through formal/informal meetings, webinars, and emails to ensure a solid understanding of what it means to give priority to biodiversity and ecosystems and how it impacts day to day work and decision-making processes. vernment has demonstrated its commitment to these principles, including passing the Sustainable Development Goals Act which includes the "conservation and sustainable use of natural assets and support for biodiversity" as one of its focus areas. S.6 (f). e department's planning and decision-making is reflecting the guiding principles, for example the approach to implementation of the Forest Practices Review recommendations includes the formation of multi-disciplinary teams, with both internal and external experts in conservation and sustainable management of ecosystems. In addition, the department's 2020-2023 strategy map provides a strategic planning framework that integrates overarching themes from Forest Practices Review and includes the strategic objective "Give priority to ecosystems and biodiversity in the conservation and sustainable use of our natural resources." December 2018, the Department committed to implementing ecological forestry via a triad model and identified priority actions foundational to adopting ecological forestry in Nova Scotia that combines the societal mandate to protect ecosystems and biodiversity while sustaining a productive and profitable forest industry. ne projects have been established to begin the shift towards ecological forestry, including: • A Revised Forest Management Guide and Pre-Treatment Assessment Process	As stated in the Department's FY 2020 Business Plan, Government remains committed to passing a Biodiversity Act. Further, the department will continue to apply these guiding principles in its planning and decision-making.
Ecological Forestry				
Ecological Forestry-Overall Approach	2	To align forestry with the priority to be given to ecological protection and enhancement, policy and operational decision making relating to forestry practices should be guided by an overall approach to forestry called "ecological forestry," which seeks to:		

			• Old Forest Policy • Natural Disturbance Regimes • Outcomes-Based Forest Management • Reporting on the State of the Forest • Species at Risk Program Renewal • High-Production Forestry • Small Scale Wood Energy Initiative • Environmental Assessment See Appendix for project objectives.	
		a. align forestry with ecological considerations and with ecological protection and enhancement by integrating ecological knowledge, principles, and concepts, including traditional knowledge, into how forestry is conducted.	All projects are, or will be, engaging with Mi'kmaq peoples through the established process with the Office of Aboriginal Affairs. An agreement has been put in place for the Mi'kmaq Forestry Initiative; see recommendation 37 for more information. The department is also engaging with landowners with a history of traditional land management.	
		b. combine the societal mandate to both protect ecological systems and biodiversity while sustaining a productive and profitable forestry sector by aligning forestry practices with natural processes, including disturbance regimes, that ecological forestry emulates.	Work is currently underway to accelerate landscape level planning and integrate it into forest management practices, including a dedicated project team. See recommendation 13 for additional information.	In 2020, the NDR project team will be doing further work on mapping and methodology and how it informs operational application. See details in Recommendation 7.
Multi-aged, Mixed-species Forests	3	Consistent with the ecological forestry paradigm, the objective of forestry practices in Nova Scotia should be, wherever appropriate, to maintain or restore multi-aged and mixed-species forests in which late-successional species have the opportunity to grow and mature where they represent the forest's natural condition. Practices that do otherwise in those forests should be curtailed.	To support the move to ecological forestry, the department has developed an interim retention guide (https://novascotia.ca/natr/forestry/forest_review/Retention-Guide-NS-Crown-Land.pdf) that will put greater focus on multi-aged management practices. The Interim retention guide is in place to begin the shift to more ecological forestry practices on the ground, and to provide direction and clarity to licensees while the longer-term work on the Forest Management Guides is underway. This will provide an opportunity to conduct operational trials to test the ecological and economic outcomes of different levels of retention. The area of harvest by clearcutting in Nova Scotia has been steadily declining since its peak in 1997 as shown in the 2018 State of Forest Update. However, the implementation of the Interim Retention Guide in 2019 represented a significant single year change in the approval of harvesting plans on Crown land which will be reflected on the ground. The table and chart below show approved Crown lands plans and retention levels for calendar 2018 (no Interim Retention Guide) and for calendar 2019 (Interim Retention Guide required). It shows the dramatic change from 63% under 5% retention in 2018 to only 10% under 5% retention in 2019.	As stated in the FY 2020 Business Plan, the department plans to finalize and implement the *Silviculture Guide for the Ecological Matrix.* Planning for implementation will involve external expert advisors and input from stakeholders.

Retention level	2018 ha	2019 ha	2018%	2019%
up to 5%	7,204	1,029	63%	10%
10%	186	2,295	2%	22%
20%	0	1,327	0%	13%
30%	0	1,422	0%	13%
40%	0	79	0%	1%
60%	3,474	3,347	31%	32%
70%	517	1,103	5%	10%
Totals	11,380	10,602	100%	100%



The Department of Lands and Forestry has developed a revised draft of its Forest Management Guide to place more emphasis on ecological values. The Forest Management Guide dictates the types of forest practices that can be used on Crown land. As revisions are implemented, this will have the effect of further reductions in clearcutting on Crown land, particularly where multi-aged and mixed species forests in which late successional species would naturally occur.

The Department, with the help of external experts, has developed a draft Silviculture Guide for the Ecological Matrix (to replace the Forest Management Guide) that aims to facilitate the practice of ecological forestry on Crown land by promoting multi-aged, multi-species forests to maintain and enhance biodiversity and reduce clearcutting on Crown land, including the introduction of irregular shelterwood treatments. It does so through increased retention requirements on stands that would have been prescribed clearcut treatments in previous versions of the Forest Management Guide, and enhanced requirements for ecological values in Pre-Treatment Assessment data collection.

For more information see recommendations 8, 9, 10, 11 and 12.

Clearcutting Inappropriate	8	In general, those responsible for forestry practices, including the Department and	The activities completed or underway in year 1, as reported here in response to recommendation 8, are also applicable to recommendation 9, unless otherwise noted.	A draft SGEM is targeted for release for public consultation in Spring 2020. A final version of SGEM will be

		licensees on Crown land, should make decisions that favour uneven-aged management, and which recognize that clearcutting is inappropriate in the following circumstances:	The Forest Management Guide has been revised to focus on long-lived, uneven-aged management species, in support of the conservation and sustainable use of Nova Scotia's natural resources. It favors uneven-aged management and limits circumstances in which clearcutting for the Ecological Matrix would be appropriate, according to recommendations 8a - 8h. Within the matrix there are no overstory prescriptions. It has been renamed the Silviculture Guide for the Ecological Matrix (SGEM). The revision process for SGEM includes the following activities: • Consulted with stakeholders on what they would like to see in the revised Forest Management Guide (now SGEM) and how they would want to be involved in its development, Summer 2019. • Prepared a discussion paper on proposed policy direction for the revised Forest Management Guide (now SGEM) and consulted with a group of targeted technical experts and other interested stakeholders for feedback. • Consulted with the group of targeted stakeholders on the draft SGEM in March 2020. • The project team is currently reviewing all targeted stakeholder comments in preparation for a next draft.	completed and released in 2020 followed by implementation.
		a. In natural stands that are governed by gap dynamics and infrequent stand initiating regimes	• Shifted emphasis from overstory removal to irregular shelterwood resulting in significantly less clearcutting, and creation of multi-aged stands. • Multi-aged treatments including irregular shelterwood described in pages 28-36 of the guide; and prescribed in regenerate silviculture keys for various forest groups found on pages 56, 70, 80, 96, 106, 122, 138, 152 and 164. • Team is currently reviewing retention levels that may result in clear cuts in some stands governed by gap dynamics. • Given that the current condition of the forest may not align directly to late successional forest types related to an appropriate NDR for a specific site, the team is considering appropriate restoration pathways which will allow forests to succeed to NDR appropriate future forest types.	
		b. In young stands that are still exhibiting rapid growth in volume and/or value	• The current draft guide does not prescribe clearcutting immature stands. • The current draft guide has a "let it grow" and pre-commercial thinning prescriptions that addresses young and rapidly growing stands.	
		c. In forests with high recreational or social value	• Guide cannot address these values. • IRM process is designed to address these values at the harvest planning and approval stage.	
		d. Where ecological values are likely to be impaired at a landscape level	• The guide is a stand level tool that informs but cannot address landscape level concerns per se. • Landscape level planning is a separate process that is currently under development.	
		e. In areas characterized by sensitive or thin soils or on steep slopes	• The revised draft guide contains new provisions for Nutrient Budget Modeling which prescribes no harvesting or reduced harvesting in areas with thin or nutrient poor soils.	
		f. In situations that may cause deterioration of aquatic values through processes such as erosion and siltation of runoff of surface water	• Guide does not specifically address how to harvest near watercourses. • The department uses other best management practices, policy and regulations through the Wildlife Habitat and Watercourse Protection Regulations to protect water quality. • Regional IRM planning process is also used to evaluate the impact of harvest proposals on water quality.	
		g. In municipal watersheds (subject to research under way in Pockwock Watershed) or when a high	• This is outside the scope of the guide.	

		proportion of any watershed area has already been clearcut or otherwise disturbed	• These are landscape planning issues that will be addressed through other *Independent Review* projects related to landscape planning and environmental impact assessments; or are currently being addressed through local regional planning initiatives.	
		h. Adjacent to the boundaries of parks, nature reserves, wilderness areas, or other ecological reserves	• This is outside the scope of the guide • Policy is currently in place that prohibits clearcutting within 100 m of parks, wilderness areas and nature reserves • IRM planning and harvest reviews are designed to address this concern	
Clearcutting Acceptable	9	In general, subject to limitations that should be placed on the overall amount of clearcutting to protect and enhance ecosystems and biodiversity at the landscape level, those responsible for forestry practices, including the Department and licensees on Crown land, should limit clearcutting to the following situations:	The activities completed or underway in year 1, as reported here in response to recommendation 9, are also applicable to recommendation 8, unless otherwise noted. The current draft guide does not prescribe overstory removal, seed tree harvest, or regular shelterwood harvest which formerly resulted in clearcut conditions; however, the guide does prescribe a low retention irregular shelterwood option for situations such as these listed below.	
		a. In vegetation types that are naturally subject to frequent stand-replacing disturbance regimes (subject to appropriate retention)	• The guide provides a low retention irregular shelterwood option for situations such as this in silviculture retention keys for various forest groups, including Coastal (p. 56), Highland (p. 70), Intolerant Hardwood (p. 80), Mixedwood (p. 96), Old Field (p. 106), Spruce Hemlock (p. 122), Spruce Pine (p. 138), Tolerant Hardwood (p. 152), and Wet Deciduous (p. 164) • Forest groups not naturally subject to frequent stand-initiating disturbance regimes such as Mixedwood, Spruce Hemlock, and Tolerant Hardwood currently have a low retention irregular shelterwood treatment option that in some cases may result in a clearcut condition because of current on-site conditions.	
		b. In stands in which shade-intolerant, early successional species are to be perpetuated	The guide does provide a low retention irregular shelterwood option for situations such as this, e.g. Intolerant Hardwood silviculture regenerate key on page 80.	
		c. As part of well-considered restoration activities intended to address degraded conditions caused by anthropogenic influences (e.g., poor regeneration, infestation by alien species)	• The guide does provide a low retention irregular shelterwood option for situations such as this if approved by local IRM planning staff (p. 37). • The guide provides a "salvage with retention" option (currently under review) for most forest types within keys, including Coastal (p. 56), Highland (p.68, 70), Intolerant Hardwood (p. 78, 80), Mixedwood (p. 88, 94, 96), Old Field (p. 104, 106), Spruce Hemlock (p. 114, 120, 122), Spruce Pine (p. 128, 130, 132, 138), Tolerant Hardwood (p. 144, 150, 152) and Wet Coniferous (p. 158, 164).	
		d. In extraordinary circumstances, such as salvage cutting after intensive natural disturbance	• The guide does provide a low retention irregular shelterwood option for situations such as this if approved by local IRM planning staff (p. 37). • The guide provides a "salvage with retention" option (currently under review) for most forest types within keys, including Coastal (p. 56), Highland (p.68, 70), Intolerant Hardwood (p. 78, 80), Mixedwood (p. 88, 94, 96), Old Field (p. 104, 106), Spruce Hemlock (p. 114, 120, 122), Spruce Pine (p. 128, 130, 132, 138), Tolerant Hardwood (p. 144, 150, 152) and Wet Coniferous (p. 158, 164).	
		e. To create areas for plantations managed intensively to provide long-term stable sources of industrial fibre, especially within an overall triad approach to the	The Department has begun work to develop a process for identifying appropriate areas for high production forestry on Crown land. High production areas will be managed to maximize timber production but will still be subject to environmental protection for values like watercourses and species at risk. Once identified, government will allow the regulated use of herbicides in areas identified for high production forestry but will not use public funds to pay for herbicide treatments.	A final version of the definition of High Production Forestry and selection criteria will be released in Spring 2020. Selection of initial HPF sites will follow later in 2020.

		implementation of ecological forestry	A discussion paper for public consultation was released on February 20, 2020. The department is consulting on the definition of high production forestry (HPF) in the Nova Scotia context and the criteria that should be used to identify areas for HPF sites. Following public consultation, the department will consult with a group of targeted stakeholders in Spring 2020. (https://novascotia.ca/ecological-forestry/high-production-forestry/)	
Triad Model	4	Nova Scotia should explicitly and strongly embrace and robustly implement the triad model of ecological forestry and seriously develop each of its three legs: the conservation leg, the high-production leg, and the intervening landscape (or matrix) where conservation and production objectives are both applicable and combined.	Nova Scotia government is committed to implementing the triad model. As noted above in the year 1-progress update from the Department, work is underway on the matrix (draft SGEM) and high production zone of the triad. With respect to the conservation zone, in September 2019, the Government designated 17 new or expanded areas https://novascotia.ca/nse/protectedareas/map.asp. These 17 new areas bring us to about 12.6% (697,000 hectares) of Nova Scotia under legal protection. Government continues to remain committed to reaching 13% protection. Dr. Graham Forbes produced a paper on the Triad in the Nova Scotian context that has been shared on the Department's website on ecological forestry.(https://novascotia.ca/ecological-forestry/Triad-A-New-Vision-for-NS-Forests.pdf)	The government is currently consulting on 6 new proposed protected sites. Once the proposed sites are protected, NS will have 12.75% protected land. Of this, approximately 9.9% is provincial lands.
Transparency and Accountability				
Open Culture and Processes	38	The Department must deeply and pervasively embrace a culture of transparency and accountability. It must institute the information management, sharing, and distribution systems needed to put that culture into routine operational practice, including (a) adopting a practice of giving written reasons for decisions on matters of public interest wherever practicable, and (b) measures to prevent the protection of privacy provisions of the Freedom of Information and Protection of Privacy Act, as well as bureaucratic systems or resistance to disclosure, from inappropriately limiting the operation of the freedom of information provisions of the same legislation as it relates to public policy on forestry or the management of Crown lands.	In its December 2018 response, Government committed to improving and demonstrating a culture of openness, transparency and accountability. In Spring 2019, the Department engaged a consultant to develop a strategy to enhance communication and engagement with stakeholders and the public to eliminate barriers to information sharing and encourage the cultural shift within the Department required to do so. The DG Communications "Strategy for Improving Openness, Transparency, Collaboration and Accountability at the Department of Lands and Forestry" is available online at https://novascotia.ca/natr/forestry/Forest_Review/final_dg_communications_and_engagement_strategy.pdf In response to the strategy, work completed or underway by the department includes: • Created and filled a position dedicated to stakeholder relations to support the Department's communications and engagement with stakeholders and the public. • Formed the Minister's Advisory Group. This committee includes the Deputy Minister of Lands and Forestry as Chair, and 14 individuals that represent diverse perspectives and areas of expertise related to environmental, economic, and social values of our forests. The committee will advise the Minister on the policies and priorities related to implementing the model recommended in Professor Lahey's independent review of forestry practices. • Working with CNS to develop communications materials to raise awareness and understanding of ecological forestry and the triad model. This includes plain language editing of technical documents to help ease of use and understanding. Another recent example for the general public is an animated video that gives an overview of the triad model and how its three legs work together to achieve ecological forestry which was released in February 2020, https://vimeo.com/user63591273/review/392541699/45c6449925 • Developed a microsite to increase accessibility and visibility of information and progress updates associated with implementing ecological forestry. The site provides a public hub for sharing information to update the public and stakeholders regarding project progress, and engagement sessions (including what we're hearing from stakeholders). • Developing a social media strategy to be more proactive in sharing information with the public through various social media channels including Twitter.	The Department will continue its work to improve and demonstrate a culture of openness, transparency and accountability, including: • Continued support for the Ministers' Advisory Committee and public/targeted engagement, including Spring 2020 consultations related to the proposed Silviculture Guide for the Ecological Matrix, State of Forest Report, High Production Forestry, Outcomes-based Forest Management • Keeping the public and stakeholders informed about the process of implementing priority actions in the Government Response and progress towards implementing ecological forestry, including integrating Professor Lahey's anticipated evaluation framework (ongoing) • Developing and implementing an internal communications plan to ensure staff understand how decisions are made and are enabled to communicate these with stakeholders, the public, and media (Spring 2020) While planning is underway, the department has already actioned improved internal communication, for example by ensuring regular two-way communication updates on the implementation of ecological forestry via DM hosted webinars. • The new Senior Strategist, Stakeholder Relations and Issues Management will continue working to build relationships with stakeholders to better understand their priority issues and provide a

			• Since last September, around 60 staff, from a wide range of positions and locations, have received training on how to conduct media interviews. This will ensure department subject matter experts are available and prepared to respond to media requests. This work continues across the province. Building trust and changing culture takes both time and resources and will not happen overnight. However, taking actions to demonstrate the department is committed to both in the short, medium and long term is also part of the strategic approach. On June 25, 2019, the Department hosted a stakeholder engagement session to provide an opportunity for forest policy stakeholders to learn about progress on, and provide feedback related to, implementing ecological forestry in Nova Scotia. Both Minister Rankin and Deputy Minister Towers provided information and updates on the progress to date to implement ecological forestry, including an open question and answer period for participants to explore topics of interest further. This was followed by interactive sessions to seek stakeholder input on the Department's plans to implement recommendations from the Independent Review of Forest Practices. The Department produced a What We Heard report to outline the feedback and cross-cutting themes that emerged throughout these discussions, https://novascotia.ca/natr/forestry/Forest_Review/What-We-Heard-Ecological-Forestry-Forum-June-2019.pdf. The Department is demonstrating this commitment by engaging stakeholders in decision-making on each of the projects to implement the recommendations. Engagement plans are being customized and/or implemented for each of the projects, for example: • A targeted consultation session was held in August 2019 to provide information and gather input and feedback on the overall policy direction of a revised Forest Management Guide and suggested revisions proposed by the project team. Feedback from this session was incorporated into a draft guide which was shared in March 2020 for further input/feedback from the targeted stakeholders and will be followed by public consultation (Spring 2020) (see Rec 10) • Using a discussion paper and inviting written comments, there was broad public online consultation related to potential criteria for use in selecting High Production Forestry sites (Winter 2020) (see Rec 15) • The Species at Risk Program Renewal team hosted Recovery Action Forums, which will have components for both Species at Risk practitioners and the general public in late February and early March 2020 (see Rec 18) The specifics of completed and planned public/targeted engagement activities are detailed this report, see Recommendations 5, 10, 15, 17, 18, 19, 20, 21, 43	consistent and responsive channel for the public and other stakeholders to interact with the Department. • Continue to develop communications products tailored to needs of our various audiences and leverage the channels available to us (e.g. Provincial Parks, Department offices, social and traditional media) to help all Nova Scotians understand the work of the department. • Initiate the development of a long-term public and stakeholder engagement plan that ensures stakeholder and public consultation are operationalized in how the Department conducts its work.

Theme: Ecological

Sub-Theme		Recommendation	Completed Activities	Planned Activities
Legislation				
Crown Lands Act	19	The Crown Lands Act should be amended to ensure that its purpose clause encompasses and gives equal weight to the full range of the values (and uses) relevant to the management of Crown land, thereby	With Government's commitment to review the Crown Lands Act, the department commenced work in 2019 on amendments which will help lead to a more efficient and effective Act. Legislative changes for the management and administration of the province's Crown lands are to be in the best interest of the public and long-term stewardship of our natural resources. Currently, the scope of review includes the Act's purpose and known gaps department staff have previously	The department plans to hire a consultant and carry out consultation in Spring/Summer 2020.

		eliminating the statutory preference the statement of purpose currently found in the act gives to timber production objectives.	identified. A jurisdictional scan was completed in relation to these issues and it is anticipated the scan will be updated if additional issues identified in consultation are scoped into the review. Several steps in consultation planning were completed the Fall 2019/Winter 2020.	
EGSPA	45	Goals for the implementation of the triad model of ecological forestry should be added to the Environmental Goals and Sustainable Prosperity Act.	The new *Sustainable Development Goals Act* (https://nslegislature.ca/sites/default/files/legc/PDFs/annual%20statutes/2019%20Fall/c026.pdf) put in place by Nova Scotia Environment (NSE) sets ambitious new goals to fight climate change, with other goals to be set out in regulations to continue advancing Nova Scotia's economic, social, and environmental well being. The Department is represented on NSE's interdepartmental executive committee tasked with developing goals and actions for the climate change plan that is committed to in the new *Act*. While the triad is not explicitly mentioned in the new legislation, it requires that goals and initiatives must align with a number of focus areas, including "the conservation and sustainable use of natural assets and support for biodiversity (s. 6(f)).	Goals relating to implementing ecological forestry, in addition to other programs and initiatives under Lands and Forestry's mandate that support sustainable development, will be considered as a next step as NSE develops regulations under the new *Act.* Development of regulations and identification of goals will be determined as NSE works with implicated departments and leads steps to implement the new *Act* (Fall 2020).
Natural Disturbance Regime(NDR)				
Mapping and methodology of NDR	7a	The Department should transparently acknowledge and address, with peer-reviewed science, the concerns and critiques that have been raised with the Department's mapping of natural disturbance regimes in Nova Scotia and align its ecosystem-based management framework for forestry on Crown lands with its revised and peer-reviewed mapping of Nova Scotia's natural disturbance regimes	• A foundational research paper on NDR agents in NS has been developed and submitted by external experts for peer review to inform additional work that will advance the science of NDR in the province. • This foundational paper was submitted in February 2020 to a scientific journal for peer review (Ecological Review) and was approved for publication on April 28, 2020. The anticipated date of publication is in either the spring or fall 2020 editions of the journal. • To prepare this foundational paper, the Department gathered historical data, then digitized and mapped the data in order to describe and validate disturbance agents (fire, insects, wind) in Nova Scotia.	The NDR Project Team will be proceeding with advancing work on NDR, including determining additional research that may be required. This work may, but is not limited to, a research publication on methodology and mapping, and application of current NDR science for management.
	7b	The Department should align its ecosystem-based management framework for forestry on Crown lands with its revised and peer-reviewed mapping of Nova Scotia's natural disturbance regimes	To date no specific steps have been taken regarding this recommendation as further work is required on mapping and methodology.	Results of work on natural disturbance regimes will inform and guide ecosystem-based forestry management practices at strategic and tactical planning levels, including operational planning. For example, NDR can be used to • create zones for strategic forest planning that control development class targets, for example, the amount of mature forest in an ecodistrict. • During tactical planning the application of NDR to the Ecological Land Classification will inform spatial arrangements of forest ecosystems and development classes. • Incorporating NDR in strategic and tactical planning will influence targets at the operational level that are subsequently validated with the Forest Ecosystem Classification.
Forestry in Matrix				

Amend Forest Management Guide	10	The Department should continue to develop and implement its ecosystem-based forestry management framework to manage forestry on Crown land, specifically as mandated in the Forest Management Guide. For application to Crown lands that are part of the intervening matrix between protected areas and high-production areas, amendments should be made to remove features that unduly favour even-aged silviculture in natural forests and to strengthen the support the framework provides for multi-aged silviculture prescriptions. These amendments should be developed with input from an advisory group with membership from industry, technical and academic experts, representatives from forestry policy stakeholders, and foresters. This advisory group should also include representation from this Review.	The activities completed or underway in year 1 as reported here in response to recommendation 10 are also applicable to recommendations 3, 8, 8, 10, 11, 12, 22a, and 26a, unless otherwise noted.
			
			To support Government commitment to ecological forestry on Crown land, the Department has focused on the revision of the Forest Management Guide (it has been renamed the Silviculture Guide for the Ecological Matrix or SGEM) which includes the following activities:
			
			• Stakeholder engagement conducted to review and provide input into Forest Management Guide draft.
			
			• FMG Project Team consisting of departmental staff, technical expert and academics visited three field sites in Nova Scotia (Western Region – April 2019, Central Region – June and Nov 2019). Team members went to Maine in May 2019, and to Quebec in July 2019 to look at irregular shelterwood harvests and talk with local professionals.
			
			• Developed a draft revised SGEM and PTA to place a greater emphasis and consideration on biodiversity:
			  ○ Draft calls for a minimum of 20% retention for all harvests, expands biodiversity criteria within PTA, significantly reduces amount of clearcutting, and includes a new section on forest health.
			  ○ Emphasizing irregular shelterwood systems which favours multi-aged, mixed-wood species using an uneven aged management system.
			  ○ Even-aged prescriptions eliminated in most situations by removing overstory removal, variable retention, seed tree and traditional shelterwood harvest systems from the revised guide intended for use in the ecological matrix. There will still be circumstances under which a clearcut (by definition) will still occur. However, these instances will be significantly reduced. Salvage harvesting will require a minimum level of retention.
			  ○ Includes higher levels of dispersed retention to partially address 26a – some proposed retention levels meet or exceed 30% level. (Wildlife clumps cannot be eliminated without a change in regulation)
			• Conducted a literature review on the value of retention for biodiversity to provide science-based rationale to support proposed retention levels with new harvesting systems. Also examined literature on silviculture, especially irregular shelterwoods and retention silviculture.
			• Targeted stakeholder consultation sessions including members from industry, technical and academic experts, foresters and project team. This was important for gauging stakeholder reaction to the process and soliciting advice and comments on the proposed recommendations.
			• Established retention demonstration trial site at Latties Brook, Hants County to test implementation and provide discussion points for various retention levels. This helps to understand both the potential impact on biodiversity and implementation challenges.
			
			To satisfy the recommendation for an Advisory Group, the team includes two external experts, one of which was from Professor Lahey's advisory group (Drs. Graham Forbes and Robert Seymour). In addition, the team designed its stakeholder consultation process with three phases. Two of these phases were directly with a targeted stakeholder group that included industry, technical and academic experts, representatives from forestry policy stakeholders and foresters. Using the targeted stakeholder group approach also allowed for the involvement of a larger number of stakeholders than may have been feasible in an advisory group.
			
			Dr. Robert Seymour is an expert advisor to the project team and has been actively engaged in the development of the draft SGEM, including developing, reviewing and supporting the version of the draft Guide provided to a group of targeted stakeholders in February 2020. Dr. Seymour continues to play an active role and is currently working with the project team to review all of the stakeholder feedback to date and to make revisions to the next version of the draft Guide for public consultation later in 2020.
				• A draft SGEM is targeted for release for public consultation in Spring 2020. A final version of SGEM will be completed and released in 2020 followed by planning for implementation.
				
				In the context of the SGEM revision, the key planned activities for 2020-21 are as follows:
				• Team is discussing options for the distribution of retention. One option is to make wildlife clumps larger, theoretically making them more useful to biodiversity.
				• Conduct wood supply analysis for various levels of retention to understand the economic impacts of increased retention levels of wood supply.
				• Conduct biodiversity research trials to test efficacy of various retention levels which is important to understanding how biodiversity responds to different levels and patterns of retention, likely carried out over the next 10 years.
				• Conduct forest research trials which are important to understand the impacts of different levels and patterns of retention on tree regeneration, economics and implementation, likely to be carried out over the next 10 years.
				• The Department will seek advice from the newly formed Minister's Advisory Group in developing revisions for the SGEM and the PTA process.

Amend PTA Process	11	The pre-treatment assessment process under the ecosystem-based forestry management process should be expanded to encompass and address relevant wildlife issues, and the harvest planning process should more generally be designed to ensure that wildlife issues are considered earlier in harvest planning and design.	• The Project Team working on the Forest Management Guide (now SGEM) is also working concurrently on reviewing and revising- pre-treatment assessments (PTA). The team has completed a jurisdictional review and agreed that a revised PTA will include new requirement for assessment of key biodiversity and forest structural components, including super-canopy trees, legacy trees, cavity trees, snag trees, and mast trees. Once retention levels are determined, the number and distribution of these legacy structures will be coded into the new PTA program. Work is underway to complete building a geospatial web application for PTA collection and reporting by the end of March 2020.	• The PTA revision will begin in 2020, after the introduction of the revised Forest Management Guide (now SGEM). A greater emphasis will be placed on biodiversity features, specifically to recognize important wildlife features at the stand level prior to harvest planning. • Training for PTA practitioners and contractors, and update of PTA tools such as data collection, compilation, and summary tools are anticipated to begin in summer/fall 2020. Some training can only start when the PTA software is updated at the end of October 2020.
Post-harvest Retention	12	In deciding the percentage of post-harvest retention required on Crown lands under the revised ecosystem-based forestry management framework, the Department should:	The Department has conducted a literature review relating to the value of retention forestry for biodiversity. (attached)	
		a. conduct a range of wood supply scenarios to determine the impact that different ranges of retention would have on wood supply in the short, medium, and longer terms	Early work is underway to develop wood supply scenarios.	The Department is working on developing wood supply scenarios, including assumptions around triad zoning, to determine economic impact of different levels of retention. Work anticipated to be complete in Spring 2020.
		b. conduct operational trials or other applied research to test the ecological and economic outcomes of different levels of retention under various ecosystem conditions	Have established retention demonstration trial sites in each region – western, central, and eastern to test implementation and provide discussion points for various retention levels. This helps to understand both the potential impact on biodiversity and implementation challenges.	Operational trials will be ongoing.
Planning Tools				
State of the Forest Report	5	Whether the forests are in good, poor, improving, or declining condition – regionally and provincially, both from an ecological perspective and as an economic resource – should be the guiding question in discussions and decision making for forestry in Nova Scotia. To that end:	In response to the Forest Practices Review recommendations and the associated Addendum Appendix D, State of Nova Scotia Forest and Biodiversity Review (2017) produced by Mersey Tobeatic Research Institute, Government committed to improving the department's State of the Forest Report, with input from the academic community. The department conducted a gap analysis to identify information or data related to Canada's Sustainable Management Criteria (CCFM) criteria that is not available within the department and will need external sources. The department initiated consultation planning and began working with Communications Nova Scotia to start work on improving the report design, transforming what has been very technical report into a publicly accessible	• It is planned the CCFM criteria will be the basis of future state of forest reporting, although provincial-specific considerations will also be taken into account pending the outcome of consultations. The department will seek input from academics on recommended experts/sources and then engage experts /sources to

		a. The State of the Forest Report should include the kind of comprehensive information that is required to allow people to come to holistic conclusions on the state of the forests and forestry and to put their personal observations and opinions and those of others on the condition of the forests into a broad context of objective data.	and understandable source of forest information.	provide missing information or data identified in the gap analysis. - • Commencing Spring 2020, the department will seek input from the public, stakeholders and the Mi'kmaq to determine how the department can make the report and the information within it more useful and meaningful to them. Additional consultation may be planned as required. • During FY 2020, the department will consider integration of state of forest reporting with state of biodiversity reporting and continue work with CNS on the format for the next report. It is planned a new state of forest report will be published by the end of FY 2020, noting timing must take into account the need to source new information or data. The department will continue to update the current state of forest report as required until a new report is in place.
		b. Specifically, the State of the Forest Report should aim for comprehensiveness on information that is useful in understanding and explaining the ecological condition of the forests, the forests as an economic resource, and the condition, functioning, and prospects of all forest-related industries.		
		c. Tracking and reporting of the state of the forests and the forestry industry should happen at multiple scales, including provincial, regional, and landscape levels.		
		d. Nova Scotia should fully utilize Canada's Sustainable Management Criteria and Indicators (2003) and collaboratively adapt them to a Nova Scotia context.		
		e. Action must be taken to improve confidence levels in datasets about ecosystems.		
		f. The metrics tracked and reported in the State of the Forest Report should include all those recommended by the Mersey Tobeatic Research Institute's report, "State of Nova Scotia Forest and Biodiversity Review," prepared for this Review.		
		g. Measures should be taken to make information on the forests and forestry-related industries easier to access and to understand, including profiling information on the most important metrics in a smaller		

		document that focuses attention on those metrics.		
	6	The Department should work transparently and collaboratively with interested parties, including representatives from the academic community, in making improvements to reporting on forests and forestry, including in the State of the Forest Report.	Please see response above for Recommendation 5.	Please see response above for Recommendation 5.
Landscape Level Planning	13	The Department should work with interested parties, including representatives from the academic community, to assess the work that is underway for landscape-level planning, including:	Landscape level planning activities are dependent on or connected to activities on other recommendations, including those related to EA process (Rec 20), triad (Rec 4), high production forestry (Rec 15), and Forest Management Guide (Rec 10), NDR (Rec 7), Old Growth (Rec 17) all of which have been given priority in the first year of implementing Forest Practices review recommendations. The department purchased and staff were trained on the use of Patchworks, a spatial modelling software specifically to support landscape level planning. This software provides an important link between strategic and tactical (landscape) level planning.	A project team for landscape level planning is being established in early 2020 which will include representatives of the academic community. A landscape planning pilot project was undertaken with Port Hawkesbury Paper to develop and test methods. Results of this project are currently being compiled into a report, and will lead to the next phase of planning, including development of a Landscape Planning Guidebook. NDR mapping and modelling is necessary to set objectives for Strategic and Landscape level forest composition – i.e. maturity and Vegetation Community distributions. The current mapping and targets may change as a result of the NDR project. Landscape level planning is a fundamental component of EA Based planning. That project will help determine how landscape planning fits and shape the methodology in the Landscape Planning Guide.
		a. the implications of changes to forest practices as a result of this Review on the objectives and methodology for landscape-level planning		
		b. to the extent that landscape-level planning will rely on mapping of natural disturbance regimes, aligning it with its revised and peer-reviewed mapping of Nova Scotia's natural disturbance regimes		
		c. reviewing the methodology and basis for setting forest condition targets at the landscape scale (e.g., what percentage of a landscape should have old forest)		
Environmental Assessment	20	The forestry management planning process for Crown lands should be conducted under a legislated environmental assessment process, either as a Class II environmental assessment under the Environment Act or in a process that emulates the Class II process under the supervision of an independent third party (or panel) under the authority of the Minister of Natural Resources or the Ministers of	Government has committed to implementing this recommendation, and in its December 2018, response indicated: "Within the next year, establish options for an independent process for environmental reviews for proposed long term forest management licenses that includes the opportunity for public involvement". Lands and Forestry is working with Nova Scotia Environment to have a process in place in 2020. The departments are considering options for a policy/legislative/regulatory framework to implement an environmental assessment program under the *Environment Act*. The Department has retained, as of April 2020, a forest management planning expert to assist in developing the content requirements for "20-year forest stewardship plans" which is envisioned to be the submission document for the EA Process.	The departments will carry out stakeholder/public engagement and Mi'kmaq consultation, to be followed by making the required policy and regulation changes for completion in 2020.

		Natural Resources and Environment. This process should be required before the issuing or renewal of forest utilization agreements. One of the objectives of this assessment will be to ensure that forestry on Crown land will adhere to the principles of, and contribute to the objectives of, ecological forestry, as embodied in the strengthened framework for ecosystem-based forestry and the outcome based accountability to be applicable to areas of Crown land managed for high-production forestry.	Government continues to postpone entering into any long-term Forest Utilization License Agreements under the *Crown Lands Act* while the process is under development.	
Western Crown Land Use Planning	36	A land use planning process to be conducted by an independent person or panel should be established for the western Crown lands.	The department held a facilitated workshop with the Western Region Stakeholder Interaction Committee (WRSIC) on January 27, 2020. The WRSIC was established to advise the department on matters relating to the sustainable management of all Crown forest land in the Western Region. Members on the WRSIC represent a broad range of interests throughout Western Nova Scotia, including the Mi'kmaq, recreation, municipalities, research, and the forestry sector. The purpose of January's meeting was to get the committee's input on priority issues for implementing this recommendation.	The department is in the process of developing options for addressing this recommendation.
Regulation Change				
Full-tree harvesting	24	Full-tree harvesting combined with clearcutting (i.e., as a method of clearcutting) should be prohibited by regulations made under the Forests Act on Crown and private lands, with limited exceptions, if any, such as to permit use in salvage operations.	Government noted in its December 2018 response that full and whole tree harvesting combined with clearcutting are prohibited practice on Crown land and committed to formalizing this practice into policy. While this work on implementation of the forest practices review is underway, the prohibition continues to be reflected through provisions within timber licences and forest utilization license agreements with Crown licensees. The final draft of a formal policy was provided to the Ministerial Advisory Committee on 2 April 2020. Whole tree harvesting is prohibited in all situations; and full tree harvesting is prohibited in association with clearcutting. No amendments to the *Forests Act* are planned at this time as results achieved through policy. (Copy of policy available upon request)	
Riparian Zones	25	The efficacy and adequacy of a 20 metre riparian zone that is only varied on the basis of slope conditions, currently required by the Wildlife Habitat and Watercourse Protection Regulations, should be independently studied with a view to determining (a) if it should be changed and (b) how it should be changed to better address the ecological rationale for riparian buffer zones.	Initial research/jurisdictional scan completed.	Riparian Zones research to continue in 2020.

Wildlife Clumps	26a	The “wildlife clumps” currently required by the Wildlife Habitat and Watercourse Protection Regulation should be inapplicable on Crown land subject to the amended ecosystem-based forestry management framework requiring higher and more dispersed levels of retention up to 30 per cent.	We have increased retention on all harvests using the interim retention guide which supplements the wildlife clumps required by the regulation.	Research and policy work on “wildlife clumps” will begin in early 2020.
	26b	The “wildlife clumps” currently required by the Wildlife Habitat and Watercourse Protection Regulation should continue to apply to plantations and other areas of high-production forestry on Crown land and to private land, including industrial lands managed under the outcomes-based regulatory framework recommended below for private lands classified as industrial lands.	The wildlife clumps still apply to all Crown and private land in the province. As we develop high production forestry, consideration will be given to how wildlife clumps will be addressed.	
	26c	The “wildlife clumps” currently required by the Wildlife Habitat and Watercourse Protection Regulation should be independently reviewed to determine their efficacy and adequacy relative to their intended purpose and amended in accordance with the outcome of that review.	The review of wildlife clumps will begin in 2020.	
Endangered Species				
Crown Land	18	The Department must ensure, as an immediate priority, that the *Endangered Species Act* is fully implemented on Crown land, including the completion of recovery plans that identify and make provision for protection of core habitat for species at risk located on Crown lands.	The Department is establishing a foundation for full implementation by transforming its species at risk program, including refreshing its recovery teams and advancing its recovery planning activities. Improvements will support fulfillment of requirements in the Endangered Species Act, increasing efficiency and effectiveness on both Crown and Private land. This work is being supported by two new permanent Species at Risk biologists. Changes include refreshing all Recovery Teams in NS; with 100% (46) species being addressed by 12 newly appointed multi-species teams. Draft recovery plans have been completed for all remaining species that fall under the N.S. provincial government’s responsibility and are awaiting finalization and approval by Recovery Teams (Rams Head Lady Slipper, Hoary Willow and Rockrose). All others approved. NS is actively working with the federal government on reports for those species that fall under their joint responsibility. The new Critical Habitat Policy is complete. (available upon request) A guidance document “The Recovery of Species at Risk in Nova Scotia: Terms of Reference and Process under the Nova Scotia Endangered Species Act” has been completed and released to all new recovery teams as they are appointed.	The findings of the Recovery Action Forums and the review of recovery action inventories will inform implementation priorities on both Crown and private land. The department plans to have all outstanding draft recovery plans completed and all recovery plans approved in FY 2020. For all recovery plans/strategies that older than 5 years, the department plans to finalize recovery action inventories and complete recovery plan reviews. In addition, the department plans to update a number of policy/guidance documents, including the special management practices for Wood Turtles.

			In order to better implement priority recovery actions and identify implementation gaps, the department hosted three regional inaugural Recovery Action Forums to engage with conservation practitioners and stakeholders, encouraging partnerships to address recovery priorities and threats to species attended by over 200 practitioners and members of the public. Findings of the forums will be published, and the results will be used to inform implementation priorities including departmental action, government and academic research, and to enable 3rd party implementation of actions.	Planning is also underway to begin development of core habitat definitions for select species, ensuring recovery plans are finalized accordingly, and initiate associated legal process for core habitat designation. The department plans to also complete Species at Risk Assessments and initiate updating associated regulations.
Private Land	29	Working with landowners, the Department must, as an immediate priority, develop and implement a plan of action for fully and effectively implementing the Endangered Species Act on private lands.	In order to better implement priority recovery actions and identify implementation gaps, the department hosted three regional inaugural Recovery Action Forums to engage with conservation practitioners and stakeholders, encouraging partnerships to address recovery priorities and threats to species. Findings of the forums will be published, and the results will be used to inform implementation priorities including departmental action, government and academic research, and to enable 3rd party implementation of actions.	The findings of the Recovery Action Forums and the review of recovery action inventories will inform implementation priorities on both Crown and private land.
Old Forest Policy				
Old Forests	17	Steps should be taken to improve the abundance and conservation of old forests, including the following:	The Department has taken the steps described below to address recommendations 17 a-e to improve the restoration and conservation of old growth forests in NS.	The Department will continue to focus on old growth forests work, including the following planned activities for 2020-21.
Long Rotations		a. Implementation of ecological forestry, with emphasis on long-rotation stand development and multi-aged stand structures.	• The revised FMG (now SGEM) will promote the establishment of long-lived multi-aged stand development in ecological matrix. New silviculture treatments such as irregular shelterwood will lead to long(er) rotation stand development and multi-aged structure.	Planning for implementation of the new Guide (SGEM) to begin in 2020
Data Collection		b. Accelerated and improved data collection on the existence of old forests across all unprotected Crown lands. This could include improvements to the pre-treatment assessment process, targeted field assessments, and advanced applications of spatial modelling (GIS) and data capture technology such as LiDAR.	• Developed new old forest/growth assessment process for use by the Department staff and industry to provide a more efficient and effective assessment process that will help identify old forest/growth with greater confidence. ○ Eastern and Central Regions have identified more than 2000 ha of old growth over the past 18 months. • Completed 8% old forest targets by eco-district to meet the current provincial policy commitment. • Updated Old Forest Layer in the Provincial Landscape Viewer to promote transparency and public confidence in our identification process, and ability to meet targets. • Improved identification of potential old forest using GIS which is important as a first filter for selecting stands to be ground-truthed, Winter 2020.	• Refine Old Growth trigger in pre-treatment assessment to help with early detection of potential old forest/growth stands. • Improve identification using LiDAR in Spring 2022.
Targets		c. Reconsideration of the area-proportion targets in the Old Forest Policy, as well as potential inclusion of other tree species in the climax group (e.g., red oak, red maple). This will require a targeted research program that, like other Department initiatives, should become an inclusive process with participation of a suitable range of scholars and experts from various walks of life.	Reconsideration of area-proportion targets are part of the overall Old Forest Policy review and revision aspect of this larger project. Stakeholders (L and F staff, industry, academics, ENGOs) will be asked for their input into area target reviews. The Project team has completed five L and F staff sessions to date with Regional Services and Renewable Resources Branches. Targeted research on potential climax species such as red maple and black spruce is currently underway. St. Mary's University undergrad research project on red maple finished in April 2020, and University of New Brunswick graduate research on black spruce to be finished in December 2020. The Old Forest Project Team is currently in discussions with the Forest Management Guide Revision Team about old forest restoration. At this point the combined teams have not arrived at a common understanding of what is meant by restoration, the process required to achieve it, or specific targets.	Complete research to define and describe old growth conditions for vegetation communities (including non-traditional climax species) to provide better information to contribute to the recognition and delineation for conservation of old stands in forest communities that currently do not receive a lot of attention. (Undergraduate research on red maple to be finished by April 2020, and graduate work on black spruce to be finished by December 2020) • Revise Old Forest Policy, including restoration targets, old forest protection targets, and area proportion targets which are important considerations for the revised policy and will contribute to management and conservation targets, Fall 2020.

Restoration		d. Addition of old-forest restoration targets alongside the old-forest protection targets in the policy.		• Revise Old Forest Policy, including restoration targets, old forest protection targets, and area proportion targets which are important considerations for the revised policy and will contribute to management and conservation targets, Fall 2020.
Silviculture Manual		e. Development of a silvicultural manual for old-forest restoration.		• Develop an old forest restoration pathway for the Forest Management Guide (now SGEM) to promote ecological forestry, long-rotation stand developments, and multi-aged stand structure, Fall 2020
Strategies for Other Values				
Strategies for Other Values	16	The Department, with Crown licensees, must take immediate and sustained action – including by conducting or commissioning appropriate scientific research, engaging interested parties in collaborative problem-solving forums, and adopting precautionary measures – to be responsive to concerns about the potential adverse impact of forestry on Crown lands on the following interests:	The Department has begun to take actions pertaining to recommendations 16 a-e to demonstrate responsiveness to potential adverse impacts of forestry on Crown lands.	Planned activities in 2020-21 for this work are listed below.
		a. Sensitive soils, particularly on Crown lands in the western region	A Nutrient Budget Model has been developed by the Department and will be used as part of the PTA process. Specifically, the department has developed a protocol for generating Sustainable Mean Annual Increment (SusMAI) reference tables related to harvest nutrient sustainability. The generated SusMAI reference tables are for vegetation and soil type combinations found in four western region ecodistricts. Department staff gave a public presentation on “Forest Soil Chemistry in Western Nova Scotia” at MTRI sponsored event.	Finish generating SusMAI reference tables for western Nova Scotia (Summer 2020) and begin work on other ecoregions (2021). Work with staff to integrate SusMAI output with the revised SGEM to assist with decision making in ecosystem-based forestry management. Continue collecting soil and tree tissue chemistry samples and updating the Nutrient Budget Model database.
		b. Bird populations	The department is taking action on bird population values, including for the breeding season by actively avoiding/not approving harvests where Species at Risk birds are known to be present. The department is also conducting research to establish certain forest/bird habitat associations, as well as looking at how forest harvesting adjacent to protected areas affects bird abundance within the protected areas.	In FY 2020, the department plans to review the results of the of research related to bird populations to determine next steps.
		c. Tourism operations and developmental plans	To date the department has not taken any specific steps regarding this recommendation, except on Professor Lahey’s recommendation to include Mary Tulle as a member of the Minister’s Advisory Committee. Ms. Tulle brings tourism experience and expertise to the Committee.	Planning will commence in FY2020.
		d. Outdoor recreation activities, including established trails	To date no specific steps have been taken regarding this recommendation.	Planning will commence in FY2020, taking into account the four shared goals of the “Shared Strategy for Trails in NS”: strengthening alignment, leadership and collaboration, trail development; expanding supports for trail development and management; improving planning for

				trails; increasing trail use.
		e. Protected Areas	With respect to the conservation zone, in September 2019, the Province announced 17 new protected areas and the intention to designate 10 more once survey and/or consultation work is complete. https://novascotia.ca/news/release/?id=20190930007. An 11th site was added to the proposed site list in January 2020. The department directs all Crown licensees that a clearcut harvest will not be approved on Crown lands within 100m of parks, nature reserves, wilderness areas or land trust conservation easements.	The Province is currently consulting on 6 of the proposed protected area sites. https://novascotia.ca/parksandprotectedareas Once all proposed sites totalling more than 8,000 hectares are protected, Nova Scotia will have 12.75% protected land. The Province has committed to protecting 13% of Nova Scotia's landmass. The Department will continue to consult with NSE regarding forestry setback distances associated with wilderness area and nature reserves.

Theme: Economic

Sub-Theme		Recommendation	Completed Activities and Outcomes	Planned Activities and Outcomes
High Production	14	To ensure the productivity of plantations and high-production forestry where it is conducted in accordance with ecological forestry, licensees on Crown land should have access to public funding for the use of herbicides to control competing species and as a density control measure within plantations.	• High Production Forestry (HPF) project has identified the use of herbicides as a tool to successfully implement HPF. • In December 2018, Government announced that it would allow the regulated use of herbicides in areas identified for high production forestry but would not use public fund to pay for these herbicides.	See Recommendation 15 below.
Outcome Based Management			The Outcomes Management project team has: • Completed a base-line review of outcomes-based systems in other jurisdictions (Maine, NB, Ontario, Sask, BC, AB) and made site visits in NB. • Established a set of draft Principles for an outcomes based system for forest management in Nova Scotia • Drafted a list of values, objectives, indicators, and targets (VOITs) for forest management planning.	Planned next steps for the project is to move forward with consultation on the draft values, objectives, indicators, and targets (VOITs) for forest management planning.
High Production Areas	15	The Department should require areas of high-production forestry on Crown land, including plantations, to be managed to achieve outcomes such as those required under the State of Maine's Outcome-Based Forestry Policy.	• The Department has begun focusing on outcome-based forestry on Crown land, including: o Conducted field investigations/research into high production forestry (HPF) style models in several jurisdictions (NS, NB, Sweden) to ensure a solid understanding of the tools relied upon, to successfully implement HPF to inform inputs into a proposed HPF model for NS Crown lands. o Developed a definition of HPF in NS context to define the parameters of what an HPF model could look like, including key assumptions regarding tools to be used, timing and methods of silviculture interventions, and predicted timber yields. o Developed selection criteria to be used in identifying areas where HPF could be implemented. Criteria helps first identify the amount of suitable area across the province which could be considered for HPF, which can then be further refined at the landscape and operational planning scales to determine actual sites to implement HPF. ▪ Field visits to review assumptions are in progress to further refine initial estimates and better predict amount of available area to be considered for HPF on NS Crown land.	Planned activities in 2020 for this work to include: Hold in-person targeted stakeholder engagement sessions for feedback/input on the Triad model, definition and criteria for proposed HPF zones, and/or opportunities for improvement in the HPF consideration process. • Incorporate public/stakeholder feedback to further refine HPF selection process and begin identifying potential locations to implement HPF, in 2020.

			○ Discussion Paper explaining key assumptions, selection criteria, etc. developed for public/stakeholder input/feedback. It was released on February 19 for stakeholder engagement, including aboriginal consultations; written comments were due March 31. ▪ Paper includes preliminary estimates for area expected to be classified within each of the 3 zones of the Triad. ○ Developing updated growth and yield models to predict wood supply impacts to HPF. ▪ Yield curves are being updated based on findings throughout this project to predict the wood supply impacts of a high-yielding HPF zone using intensive silviculture methods and tools. ▪ Updated yield curves will also allow for inclusion of carbon yield estimates and an economic analysis including predicted silviculture costs and future revenues from the HPF zone.	
Crown Land	21	The Department should develop and implement an outcomes-based approach to management of Crown land under which operational decision making on Crown land, governed by the amended ecosystem-based management framework, will be the responsibility of licensees, subject to the following conditions-precedent being satisfied: a. The Crown Lands Act is amended as recommended. b. The legislated forestry management process, with strategic environmental assessment conducted by an independent third party, is implemented. c. Measures have been taken to ensure full and effective implementation of the Endangered Species Act. d. The Department has developed and implemented a comprehensive and rigorous monitoring, oversight, and accountability system that fully addresses the recommendations made by the Auditor General in his 2015 report on his review of the Departments activities in Forest Management and Protection.	In December 2018 Government committed to developing and implementing an outcomes-based approach to forestry management of Crown land. The department has initiated this work, completing research on use of outcomes-based systems in other jurisdictions (Maine, NB, Ontario, Sask, BC, AB) and making site visits in NB. The department also prepared draft principles for an outcomes-based system for forest management in Nova Scotia and a draft list of values for forest management planning.	In the Spring/Summer 2020 the department plans to carry out consultation on the draft principles and forest management planning values. The department will also design a framework of the Outcomes Based Forest Management System (OBFMS) (March-April 2020), which will include identifying the different parts of the system, i.e. enabling legislation/policy, forest management planning, monitoring, auditing, review, etc. Designing the overall framework will demonstrate how the OBFMS will meet the set of principles. It is planned the system framework will be the subject of consultation in Winter 2021. Further activities in 2021 will include a gap analysis to determine necessary system requirements, including the necessary tools to support implementation. The department recognizes the conditions precedent that Professor Lahey recommended be addressed before Outcomes Based Management is implemented. Work is underway on several of these conditions' precedent which are noted in column three. More details on actions and planned activities under condition a (Crown Lands Act) can be found under recommendation 19.; condition b,(Environmental Reviews) can be found under recommendation 20; and condition c (Endangered Species) can be found under recommendations 18 and 29. With respect to condition d, (fully addressing the 2015 AG recommendations), in response to the 2015 AG report, the department did a comprehensive risk assessment and put a monitoring program in place. The department will review and make any necessary changes to its monitoring program prior to implementing a new outcomes based forest management system,

		e. The Department, licensees, and their forestry professionals have demonstrated that they are committed to an approach to forestry on Crown lands consistent with modern principles of ecological forestry.		With respect to condition e, (commitment to ecological forestry), in its response in December 2018, government committed to implementing ecological forestry and prioritized actions to move forward. The department is, and will continue to, work with and involve licenses and other stakeholders in the ongoing implementation of ecological forestry.
Private Industrial Lands	28		The department has initiated work on outcomes-based forestry, with the initial focus on Crown land (Rec 21).	In the near term (FY 2020) the department's priority continues to be to proceed initially with implementation of recommendations that pertain to Crown land. While generally policy changes pertaining to private forest land will be considered when implementation of recommendations on Crown land are more advanced, it is noted that a private land silviculture review will commence in 2020 (Rec 30) The silviculture review will cover both industrial and non-industrial private.
Silviculture				
Crown Lands Silviculture Review	22	The system of silviculture on Crown lands, as part of a larger review of silvicultural programs in Nova Scotia, should be reviewed with a view to improvements that ensure its alignment with and support for the implementation of ecosystem-based forestry on Crown lands, including in the following respects:	To date no specific steps have been taken regarding this recommendation.	The Department plans to start a review of private and Crown silviculture programs in 2020, including the establishment of a project team. The Forestry Transition Team has also provided funding of $4.5 million for Crown silviculture programs in order to preserve employment in the wake of the Northern Pulp closure. (https://novascotia.ca/news/release/?id=20200204005)
		a. Ensuring it enables a broader range of silvicultural options to protect and promote uneven-aged management, including irregular shelterwood harvesting.	To date, Lands & Forestry has negotiated an agreement for private silviculture with ASF which enables a broader range of silviculture options. These options will be built into the silviculture review.	
		b. Ensuring it enables silvicultural practices that can improve the yield obtained from high-production forestry, including planting and the use of herbicides to discourage competing species.	The silviculture methods applicable to high production forestry are under consideration as part of the High Production Forestry (HPF) project.	

		c. Ensuring accountability for the effectiveness of silviculture applied to Crown lands, including the effectiveness of silviculture for high-production forestry.	The High Production Forestry team is highlighting key growth and yield expectations and outcomes for plantations in high production forestry areas.	
		d. Improving and strengthening transparency and accountability for management of silviculture-funding trust accounts.	To date no specific steps have been taken regarding this recommendation. However, the department is actioning the Auditor General's recommendations with respect to third party funding agreements.	
Private Land Silviculture Review	30	The Department, in collaboration with Registered Buyers, private landowner groups, silviculture contractors, and others, including technical experts, should initiate a review of the private land silviculture system, to be conducted in conjunction with the review of silviculture programs on Crown land. The scope of the review should address, but not be limited to, the following matters:	Department staff held a meeting with a group of private landowners/managers in January 2020 to discuss private silviculture treatments to be funded through the Transition Team funding, which included a discussion of a broader range of options including irregular shelterwood.	The Department plans to start a review of private and Crown silviculture programs in 2020, including the establishment of a review team. The Forestry Transition Team has also provided funding of $4.5 million for private woodland silviculture programs in order to preserve employment in the wake of the Northern Pulp closure. (https://novascotia.ca/news/release/?id=20200204005)
		a. The system's alignment with the effective implementation of the triad model of ecological forestry on private land, including appropriate support and incentives for intensive forestry and management of forests in accordance with the tenets of the ecosystem-based framework being implemented on Crown land.		
		b. Mechanisms for assisting landowners in making informed choices about how they want their management of their land to contribute to the triad model of ecological forestry.		
		c. Options for ensuring that at least basic reforestation activities are more consistently conducted on harvested lands, while prioritizing silviculture on a variety of optimization criteria that will contribute to long-term forest management objectives.		

		d. The appropriate mechanisms to encourage a range of partial harvesting techniques associated with developing and maintaining multi-aged forests, including irregular shelterwood systems.		
		e. Updating the credit rates for the various silviculture activities and the range of silvicultural activities for inclusion in the program.		
		f. Public reporting, auditing, and effectiveness monitoring.		
		g. The understandability of the program.		
Projects/Initiatives				
Carbon Credits	32	The Department should commission an independent study on opportunities and options for enabling owners of forested land to earn and trade in carbon credits for storing and sequestering carbon, particularly when they manage their lands in accordance with ecological forestry (or ecosystem-based forestry management).	NS Environment has hired a consulting firm to look at potential opportunities for carbon offsets in NS, including forests. The Department will work with NSE pending the outcome of this work.	The Department will be working with Nova Scotia Environment and other relevant departments to plan and implement the Nova Scotia's Cap and Trade Program according to its regulatory framework shown from the link below https://climatechange.novascotia.ca/sites/default/files/Nova-Scotia-Cap-and-Trade-Regulatory-Framework.pdf
Carbon Trading	33	Working with the Departments of Environment and Energy and other relevant departments as well as with interested stakeholders, the Department should develop, or oversee the development of, a framework for maximizing the access of Nova Scotia landowners, including woodlot owners, to carbon credit trading opportunities in and beyond Nova Scotia.	To date no specific steps have been taken regarding this recommendation.	Department Lands and Forestry will be working with Department of Environment and other relevant departments to plan and implement the Nova Scotia's Cap and Trade Program according to its regulatory framework shown from the link below https://climatechange.novascotia.ca/sites/default/files/Nova-Scotia-Cap-and-Trade-Regulatory-Framework.pdf

Small-scale Wood Energy	35	The Department and other relevant agencies of the provincial government, along with municipal governments and regional development agencies, should work together with project developers to support and enable small-scale wood-energy projects that will allow low quality wood to be used in heating hospitals, schools, government office buildings, correctional facilities, and other public buildings.	The Small Scale Wood Energy initiative is a multi-year partnership to demonstrate efficient, low carbon, renewable heating solutions for medium to large scale public buildings utilizing wood chips, and to serve as a model for private businesses. It is an economically viable wood heating model for commercial buildings in Nova Scotia. Lead by Lands and Forestry, this initiative involves liaising with multiple provincial departments, federal and municipal governments, schools, regional organizations, and industry stakeholders. This project is also part of the Government's forestry sector transition work. The design, construction and operation of new, efficient wood chip heating systems that use wood chips from private woodlots or sawmill residues will be completed for six public buildings. Suitability of the initial six potential public facilities for construction of the external structure housing the wood chip boiler systems was confirmed by performing Geotech site assessments in the Fall 2020. After a successful Request for Statements of Qualifications (RFSQ) process in the Fall 2020, the prequalified bidders were selected and contacted. A Request for Proposal (RFP) for the six initial sites was open from January 31 – March 5, 2020 and, at the request of proponents, extended to April 3.	The wood heat systems at the initial six sites are expected to be operating by the end of Fall 2020, in time for the high demand heating season; additional sites will be assessed and added in the future (planned FY 2020 through FY 2021). The department will continue to explore emerging funding, education and policy opportunities to advance the Wood Heat initiative in Nova Scotia, including larger scale clustered and district heat options with communities, municipalities, and federal assets.
Medway Community Forest and Mi'kmaq Forestry Initiative	37	The community forest should be given a licence with a term and for an area of Crown land that will provide the community forest the opportunity to be viable and self-sustaining. The Mi'kmaq Forestry Initiative should proceed as quickly as possible.	<u>Community Forest</u> As with other Crown land licensees, the community forest's existing agreement was initially extended for one year to allow time for the implementation of forest practice review recommendations germane to the negotiation of a long-term agreement (e.g. Environmental Assessment (EA) process (Rec 20) and Western Crown Land Use planning (Rec 36). A further extension of the existing agreement to March 2023 has recently been completed. Since the pilot commenced in January 2015, government has provided operational funding to the community forest of $486,800. In addition, the community forest and the department continue to meet to discuss the negotiation, the evolving policy context and what could be done to further their mutual interests, including activities undertaken in support of five jointly agreed upon provincial learning objectives: landscape planning, other forest products, species at risk, matrix forest management, and eco-tourism. <u>Mi'kmaq Forestry Initiative</u> Government and the Mi'kmaq of Nova Scotia launched the Mi'kmaq Forestry Initiative (MFI) on March 15, 2019. MFI is a three-year forestry pilot project that is intended to form the basis of a long-term agreement. The Mi'kmaq have begun management planning and intend to apply Mi'kmaq stewardship principles that will provide an example how forestry can be conducted in the ecological forestry zone (matrix) of the triad. The MFI gives the Mi'kmaq forest planning and management responsibility on two blocks of Crown totalling about 20,000 hectares. The province has committed $600,000 to the initiative over the three years. The Mi'kmaq have secured $873,600 from the Government of Canada to support forest planning for the initiative. Copies of the MFI agreement can be made available on request.	<u>Community Forest</u> The department will continue to work with the community forest to identify activities supporting the five learning objectives. The department will also seek input from the community forest regarding operational planning, harvest projections, and other relevant information to support an analysis about how additional land would impact their financial projections and activities. Current land allocation is approximately 15,000 hectares. <u>Mi'kmaq Forestry Initiative</u> The department will continue to work with the Mi'kmaq to implement the MFI, including providing support for management planning, silviculture, harvest planning, and a strategy for non-timber forest products.
Private Land				
Triad	27	The objective of provincial forestry policy in relation to private lands should be to achieve widespread participation in ecological forestry – and the associated forestry practices – by the owners of privately owned forests, recognizing that landowners can participate in	In its December 2018 response to the Lahey Report, the Department committed to working with private landowner organizations to encourage adoption of Professor Lahey's recommendations, particularly with respect to implementing ecological forestry through a triad model. However, its immediate priority is to proceed with implementation of recommendations that pertain to Crown land. Policy changes pertaining to private forest land will be considered when implementation of recommendations on Crown land are more advanced.	Promote the triad model of ecological forestry to private landowners through the continuation of the Outreach Renewal initiative, Spring/Summer 2020. Opportunities for promotion will be leveraged through the annual Woodlands Conferences (one per region) and the private land Mentorship program (six workshops, two per region: collaborators are Lands and Forestry, MTRI and FNSWO)

		any of the three branches of the triad, or in a combination of them, by:		
		a. adding some or all of their forested land to the land that is privately conserved in Nova Scotia under the Conservation Easements Act.		
		b. managing their forested land in accordance with the stewardship principles – and associated forestry practices, such as partial harvesting – that would apply to lands that are part of the ecological matrix in which a balance between conservation and harvesting objectives is expected to prevail.		
		c. managing their forested land in accordance with the forestry practices used to conduct high-production forestry, adhering to the limits and constraints on clearcutting that apply even in the high-production branch of the triad in an ecological forestry paradigm.		
Strategy for Participation in Triad	31	A comprehensive, multi-faceted and integrated strategy should be developed for encouraging and enabling private landowners, including woodlot owners, to engage in forestry management in accordance with the triad model of ecological forestry, to include	The activities completed or underway in year 1, as reported here in response to recommendation 31, are also applicable to recommendation 27.	
Demonstrate Triad on Crown Land		a. accentuated efforts by the Department to model ecological forestry practices for private landowners – and those who buy wood from them – by making its ecosystem-based management system more restrictive of clearcutting and	The Department of Lands and Forestry is committed to modelling ecological forestry practices to private landowners; particularly once the revised SGEM is issued and applied to Crown land.	The Department continues to consult with the woodlot owner membership-based organizations to develop forest management plans that incorporate sustainable forest practices. Criteria will be developed to monitor the level of implementation of these practices on private land and assess the outcomes.

		more enabling of multi-aged management, in line with the recommendations of this Review, any by more generally moving clearly to develop and effectively implement the triad model of ecological forestry on Crown land.		Reporting criteria will be developed that reflects the ecological values utilized in management plans, outcomes and practices on private land.
Woodlot Organizations		b. continued support for the efforts of woodlot owner membership-based organizations, including regionally based woodlot service organizations, to support and promote responsible forestry management among their members. The condition and accountability for this support should be demonstrated organizational commitment to a triad model of ecological forestry.	The Department completed a 5-year review of the Service Area agreements with woodlot owner membership-based organizations. The Department also consulted with these organizations on criteria to adopt that reflects the ecological and biodiversity objectives and the Triad Model approach, as outlined in the Forestry Recommendations Report.	
Management Tools for Private Woodlot Owners		c. actions to ensure private landowners have better access to the tools, information, and assistance needed to engage in effective and responsible forest management.	The Department has initiated the outreach program renewal and is working to align outreach programs with ecological forestry objectives. Current contracts with Private landowners are being reviewed and ecological and biodiversity-based measures and targets have been developed for inclusion in 2021/22 contracts. The Forest Biodiversity Stewardship Guide developed by the department is popular with woodlot owners and we continue to provide it on demand. The department has had two print runs of the Guide which has resulted in 5000 copies being printed to share with private landowners.	
Financing for New Woodlot Owners		d. consideration of the feasibility and utility of a financing program for those who want to buy woodlots to manage them in accordance with the triad model of ecological forestry.	To date no specific steps have been taken regarding this recommendation.	
Association for Sustainable Forestry		e. identification of options for making greater use and achieving higher value for private landowners from the credibility and capabilities of the Association for Sustainable Forestry.	Nova Scotia Government created a forestry transition team in January 2020 to provide supports and services for the forestry sector and workers affected by the closure of the Northern Pulp mill. https://novascotia.ca/news/release/?id=20200103002 Through the recommendations of the Forestry Transition Team, the Province has recently invested $3.5 million to the Association for Sustainable Forestry and $1 million to Forest Nova Scotia to support silviculture and roadwork on private lands. https://novascotia.ca/news/release/?id=20200204005	The Forestry Transition Team is working to identify both short and longer-term and innovative approaches for Nova Scotia forestry industry while ensuring an ecologically sustainable and globally competitive forestry sector for the province.
Diversifying Markets		f. concerted work on growing and diversifying markets for a	Nova Scotia Government created a Forestry Transition Team in January 2020 to provide supports and services for the forestry sector and workers affected by the closure of the Northern Pulp mill.	The department will continue to work with organizations such as Nova Scotia Innovation Hub, FP Innovations and

		broader range of forest products, including local markets.	The department is working with several organizations regarding innovation and research including providing financial support to the Nova Scotia Innovation Hub. Innovations being explored include potential wood (including residuals) use to replace salt in road/trail treatments, biofuels, heating greenhouses, and pellet production.	Atlantic Woodworks, on innovation and research.
Crown/Private Harvest in Western Region	34	The Department should be aware of the percentages of wood acquired in the western region from Crown and private lands to ensure that western Crown lands, including the part of them under licence to WestFor, are managed in accordance with the stated purpose of the Forests Act: to encourage the development and management of private forest lands as the primary source of timber in Nova Scotia.	The department monitors wood supply in the western region on an annual basis and meets regularly through the year with Westfor to discuss Crown land operations and the state of wood supply to shareholder mills. Department data confirms that the primary source of wood in all regions is from private land and that on average for the three years 2016 -2018 the annual percentages of wood acquired in the western region were 30% from Crown and 70% from private (including 3% of which was industrial private). General information about wood harvested is reported in the annual Registered Buyer reports published on the department's website, https://novascotia.ca/natr/forestry/registry/. In the annual reports, all of the individual data, by county, by tenure class, and by species group is presented, and selected information is presented in table and/or graph format. Some of the information is reported on a provincial basis, and not on a regional basis.	The department plans to continue to monitor wood supply in the western region.

Theme: Organizational

Sub-Theme		Recommendation	Completed Activities and Outcomes	Planned Activities and Outcomes
Science	39	The Department must dramatically increase its reliance on science and its role in conducting, enabling, and applying the scientific research that is needed to move Nova Scotia in the direction of ecological forestry with healthy forests and thriving forestry-based industries. Within reasonable limits, the instinctive approach of the department in the face of scientific uncertainty should be to enable its own excellent scientists to undertake the necessary research or to work with the broader scientific community to address or understand that uncertainty.	In its December 2018 response, government committed to increasing the use of academic partnerships, peer-review, and external scientific expertise in research and program development. This approach is reflected in the department's ongoing work and has been enhanced over the last year. For example, the inclusion of subject matter experts in the various projects initiated to implement recommendations from the Forest Practices Review. Further, the department has been actively involved leading a number of research projects on various topics including site productivity, tree improvement, old forest, ecosystems, bioenergy modelling, and resource analysis related to carbon and climate change. This work includes partnerships with universities and other organizations.	Working with recommendations from the Forest Biodiversity Science Advisory Committee and the Forest Practices Review, the department is developing a research strategy which will articulate its approach to cooperating with its partners to expand knowledge, influence and involvement and gain a greater understanding of our forest ecosystems and the impacts human intervention has on them (Spring 2020). Major areas of interest include: Ecosystems Management and Landscape Planning; Carbon Management and Climate Change Adaptation; Biodiversity, Populations and Habitats; Protecting Species at Risk; Forest Operations Management; Market and Product Development; Promoting Social Development. FY 2020 the department will initiate/ continue a number of research projects, for example: • In partnership with University of New Brunswick, Industry Partners, Canadian Wood Fiber Center, Province of New Brunswick, develop an advanced understanding of the

				effects of climate change on our Acadian Forests and understanding how our forests species may adapt. • Working with Dr. Graham Forbes, University of New Brunswick, research on the age and structural characteristics of Maritime Boreal ecotypes and edaphically limited site old growth forests in Nova Scotia • In cooperation with Dalhousie University and Nova Scotia Salmon Association, this multi-year project will research the effects of liming upland forest catchments areas as part of forest soil and stream restoration research and will involve focused soil and plant tissue chemistry responses. Plots will be set up for long-term monitoring • In the summer of 2016, the New England Governors and Eastern Canadian Premiers (NEG/ECP) signed Resolution 40-3 agreeing that ecological connectivity was an important part of climate change adaptation and convened a working group to create an implementation plan on how to advance this work. Central to the resolution is that "maintaining and restoring ecological connectivity is an important strategy for boosting the resilience of the region's native ecosystems and biodiversity, as well as its economy and human communities. Connected habitats provide the natural pathways necessary for fish, wildlife, and plants to move to meet their life needs and to find suitable habitat as climate conditions change. The Department, along with the Department of Environment, is currently working with Dr. Karen Beazley, Dalhousie University to document the state of forest and habitat connectedness using structural connectivity indicators. • Working with North Carolina State University, UNB, Province of New Brunswick, Industry partners and The Canadian Wood Fiber Center on advancing our tree improvement programs. We have been able to identify keys traits and develop tree breeding programs to produce superior seedlings for re-forestation • In cooperation with Dr. Elena Ponomarenko, University of Ottawa, determining natural disturbance history of forest stands in Nova Scotia using ecosystem archaeology • Partnering with the Clean Annapolis River Project to process, compile and present results of daily monitoring of chimney swifts at roosting sites in Bridgetown • Using results from 2017 and 2018 mainland moose survey, carry out landscape planning for mainland moose,

				examining occurrence of moose in relation to white tailed deer and land use /land cover • Initiate project to use 30+ years of woodcock survey data and Forest Resource Inventory to assess how forest and land use changes have affected probability of woodcock occurrence (Woodcock Landscape Model) • Preparation of report and paper for publication for Canada Lynx study 2013-2015 • Continue research related to Ecosystem Response to Land-Use and Climate Change • Working with Atlantic Canada Conservation Data Center, comprehensively describe and rank the conservation status of Nova Scotia forest ecosystems contributing to our understanding of provincial forest ecosystem rarity, threats, and trends (Forest Ecosystem Status Ranking) • Initiate a graduate level study for a Forested Wetland Hydrology Project to analyse hydrology data in shrub and forested wetlands collected 2014-2017 • Work with Jake Walker, Acadia University for analysis and publication preparation of data collected to assess the distribution, composition, and abundance of songbirds in forest and harvested areas within and adjacent to Wilderness Areas • Publish field studies conducted 2014-2016 and increasing sample size of 2017 study re: Using Bird Communities to Assess the Ecological Integrity of Forested Wetlands and adjacent upland sites • For American Marten, prepare report on results of camera placement Feb / March 2018 and recommendations for fall / winter 2018 / 2019 • Working with Dr. Don Stewart and Brittini Scott (MSc.), Acadia University, complete Mainland Moose genetic analysis and write-up of genetic study to estimate the effective population size, undertake a genetic structure analysis, estimate gene flow to and from different regions, and look for evidence of bottlenecking in mainland moose • Initiation into distribution of American Marten in Southwest Nova Scotia using trail cameras in winter.

Innovation and Research	40	The department should more aggressively encourage and support research and innovation by Nova Scotia's forestry sector, including partnering with the sector on its research endeavours, to improve how forestry is managed and practised in Nova Scotia within an ecological forestry paradigm. This should include true support for experimentation by the community forest and support for research on innovation opportunities for woodlot owners.	The department is working with several organizations regarding innovation and research: • advice and financial support to the Nova Scotia Innovation Hub by working on several projects. Innovations being explored include potential wood (including residuals) use to replace salt in road/trail treatments, biofuels, heating greenhouses, and pellet production • seeking opportunities to support adoption of best practices within the sector by collaborating with FP Innovations and exploring funding opportunities with Natural Resources Canada, Investments in Forest Industry Transformation (IFIT) program • Atlantic Woodworks to promote the use of wood as a climate friendly building solution in such projects as mass timber. The department is strongly supporting building with mass timber products and wood construction in buildings up to 12 stories • championing efforts to create a Province of NS "wood charter," including procurement guidelines requiring wood use and climate impact in building designs and materials • Actively networking with industry and trade groups, putting organizations like Nova Scotia Business Inc (NSBI), Verschuren Centre, Innovacorp in touch with both domestic and foreign companies looking to adopt or bring new investment and technologies to NS • increasing collaboration and outreach to other research organizations, including joining the Atlantic Forest Research Collaboration (AFRC). Housed at University of New Brunswick, the AFRC is a not-for-profit, science-based, consensus-driven organization with members from the academic, Indigenous, government, industry, small business, and conservationist communities; it helps Canadian forest managers and stewards find knowledge-based solutions to today's forest management challenges, supporting the provision of objective and scientifically-sound advice and information • Specific examples of research projects are listed above in Recommendation 39. For specific information related to the community forest, see Recommendation 37 above.	The department will continue the work listed above with the industry, trade groups and the several organizations to foster research and innovation in the forestry sector. See also Recommendation 39. For specific information related to the community forest, see Recommendation 37 above.
	41	The department should work with industry, landowners, researchers, and other stakeholders to make data and technology systems, including LiDAR, available for the purposes of research and innovation such as virtual markets, planning templates for private landowners, better management of the forest products supply chain, and improved and more cost-effective conservation measures and activities.	LiDAR has been flown across 88% of Nova Scotia. Approximately 12% of the province remains to be flown or has not met our specifications and must be re-flown. Depending on the results of the quality control review, additional area may be added. Approximately 35% of the province has been delivered to the Provincial government by the vendor for quality control review. The province has reviewed all data provided and has identified deficiencies. We are awaiting corrections. LiDAR data for around 13% of the province is currently available online through the Elevation Explorer (https://nsgi.novascotia.ca/datalocator/elevation/). Additional data will be uploaded once it passes quality control review. To date, government has invested $3.65M in LiDar.	LiDAR will be flown across the remaining portions of the province in 2020. Work with UNB researchers is continued to create Enhanced Forest Inventory (EFR) from LiDAR data. The department will continue to perform quality control reviews of the data as it comes back from the vendor and will update the online data as quality control reviews are completed.
Adaptive Management	42	The department should formally and systematically adopt an adaptive management framework for directing its own and Nova Scotia's transition to the triad model of ecological forestry.	The department is committed using adaptive management in its forest management practices.	Develop and integrate a formal adaptive management framework to support implementation of the triad model (timing TBD).
Forest Professionals	43	An overall strategy for attracting and retaining forestry professionals to Nova Scotia and for attending to their professional development – including in the mechanics, principles, and science of ecological forestry and of	The department will be addressing issues related to this recommendation, with planning underway for FY 2020 Initial steps related to forest professionals have been taken. In September 2019 the department began work to look at Professional Reliance and right-to-practice legislation as one option to support the implementation of ecological forestry within an outcomes-based forest management model. Liaising with Department of Labour and Advanced Education, a jurisdictional review, and development of an options paper have commenced.	In FY 2020, the department plans to • continue liaising with LAE, including related to labour mobility issues • complete the right to practice jurisdictional review

		the department's ecosystem-based forestry framework – should be developed and implemented. Elements to be considered should include:		• stakeholder engagement, including with professional associations • finalize options paper including analysis of public benefits and risks of self-regulation and due diligence to the corporate "Self-regulated Professions Policy (3.10 in Management Guide 100) and alternatives to right to practice
Education and Training		a. Education and training on ecosystem-based forestry and the social and communicative dimensions of forestry and its relation to society.		
Human Resources Strategy		b. a sector-wide human resources strategy for forestry professionals, with attention to the profession's generational and gender diversity.		
Right to Practice Legislation		c. right-to-practice legislation for forestry professionals on a legislative model that (i) applies to registered foresters and forestry technicians, (ii) recognizes and protects the competency of forestry technicians to play an independent role in providing professional advice on forestry matters, (iii) authorizes broad delegation of authority to well-trained paraprofessionals and non-professionals, and (iv) provides for and encourages associate membership in the professional body by those in other disciplines or professions that play an important role in forestry.		
Other	23	The department should either: A. through an open and transparent process, conduct a study of the costs to the forest industry, including the transition costs, and of the socio-economic and ecological costs and benefits of accepting and implementing the recommendations of this Review and a study of the socio-economic and ecological costs and benefits of current forest practices (i.e., the status quo), particularly on Crown land; OR, B.	With the release of its response in December 2018, Government announced its decision made to move forward with Option B and dedicate resources to review and implement the recommendations provided.	The department will continue its review and implementation activities as described in this report.

		dedicate the resources required to complete these studies to the implementation of the recommendations contained in this report, including by identifying, designing, and testing options for making the change to ecological forestry that is right for Nova Scotia.		
Transparency Accountability	44	Establish an independent committee of technical experts, including members of the Review team, to annually evaluate and publicly report on the progress of the department in implementing these recommendations and otherwise embracing and achieving an ecological model of forestry management in Nova Scotia.	At the Department's request Professor Lahey has agreed to lead an evaluation of the Province's implementation efforts and put in place a team of experts to advise him. The evaluation was to have two components: 1) A one-year assessment of the Province's progress; 2) A longer-term framework to guide the preparation of on-going evaluations to assess progress towards achieving the ecological model of forestry management in Nova Scotia as envisioned in the Review.	Both reports will be provided in 2020.

Appendix "A" - Project Objectives

- **A Revised Forest Management Guide and Pre-Treatment Assessment Process**
    1. Manage our natural resources for public benefit; and to give priority to ecosystems and biodiversity in the conservation and sustainable use of our natural resources
    2. To respond to specific recommendations in the Forest Practices Review; specifically, 3, 10, 11, 22a, 26a

- **Old Forest Policy**
    1. Accelerate old forest assessments and complete 8% targets for each ecodistrict
    2. Improving the identification of potential old forest using Geographic Information System [GIS] spatial modeling, including Light Detection and Ranging [LiDAR].
    3. Further refine the old growth trigger in Pre-Treatment Assessment [PTA].
    4. Release an updated Old Forest Layer (GIS Layer on Provincial Landscape Viewer) and status report
    5. Develop and maintain an GIS layer of forest stands that have been evaluated with the old forest scoring system that is available to the public
    6. Re-examine area-proportion targets and add restoration targets in the Old Forest Policy.
    7. Complete research to describe and define old growth conditions for vegetation communities (including role of non-traditional climax species like red maple, red oak, black spruce).
    8. Develop an old forest restoration pathway for the provincial forest management guide.
    9. Develop public communication products for the Old Forest Policy.
    10. Make recommendations on training needs and timing.
    11. Revise Old Forest Policy.

- **Natural Disturbance Regimes**
    1. Manage our natural resources for public benefit; and to give priority to ecosystems and biodiversity in the conservation and sustainable use of our natural resources
    2. To respond to specific recommendations in the Forest Practices Review; specifically review recommendation 7.

- **Outcomes-Based Forest Management**
    1. To develop a framework for Outcomes Based Forestry that is adapted specifically to Nova Scotia with a focus on managing natural resources for public benefit; and to give priority to ecosystems and biodiversity in the conservation and sustainable use of our natural resources
    2. To respond all or portions of recommendations in the Forest Practices Review; specifically, recommendations 21, 30, 31, 42 & 43.

- **Reporting on the State of the Forest**
    1. Respond to specific recommendations from Lahey Report (5 a- g, 6) - identify the gaps in the current report
    2. Improve the State of the Forest Report by making it more accessible for the general public (symbology could be used) while maintaining the integrity of the data;
    3. To be used as a guide for decisions being made on the stewardship of the forest in the future - key linkage to other projects

- **Species at Risk Program Renewal**
    1. Establish and/or update priority policy and procedures that govern the implementation of the Endangered Species Act to form a Species at Risk Policy Manual.
    2. Recovery Plans: Complete outstanding Provincial Recovery Plans for species solely listed in Nova Scotia (and are not listed under SARA). In some cases, Updated Status Reports will need to be prepared as part of this process.
    3. Recovery Action: Organize and convene the first Recovery Action Forums in 2019.

- **High-Production Forestry**
    1. To respond to all or portions of recommendations in the Forest Practices Review related to the High Production (Intensive) leg of the Triad model, specifically, recommendations #4, 9e, 14, 15, 22b, 22c & 27c
    2. Develop methods/procedures for identifying, ranking and selecting sites to be considered as candidates for High Production forest management

- **Small Scale Wood Energy Initiative**
    1. Create a new market for lower grade wood fibre from Nova Scotia with a focus on small private woodlands for heating public buildings.
    2. Substitute fuel oil imports with local renewable fuels and decrease GHG.
    3. Support sustainable forest management and strengthen the provincial wood supply chain, especially for private woodlot owners.
    4. Long-term reliable and stable heating costs for public buildings.

- **Environmental Assessments**
    1. To develop a proposed regulatory framework, for government's consideration, to review Crown land forest management plans by applicable Crown forest agreement holders (i.e. FULAs) under an Environmental Assessment (EA) Process. The regulatory framework needs to be completed in 2020 before negotiations begin for new or the extension of existing FULAs, and needs to address the following elements as recommended in the Independent Review of Forest Practices in Nova Scotia report by Bill Lahey:
        - The process must be legislated
        - It must include an independent third party or panel
        - the process must provide the public a meaningful opportunity for input

Attachment C: Laura Kenefic Review of Draft Silvicultural Guide for the Ecological Matrix (SGEM)

Review

Nova Scotia Silvicultural Guide for the Ecological Matrix

A scientific review, submitted to William Lahey for his independent evaluation of the Department of Lands and Forestry's progress in implementing the recommendations in the 2018 Independent Review of Forest Practices in Nova Scotia

March 14, 2020

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[1] See also LINE EDITS

1.0. SUMMARY

Following the Lahey report of 2018, the Department of Lands and Forestry was tasked with implementing a new approach to forest management on Provincial lands in Nova Scotia using the Triad model proposed by Seymour and Hunter (1992). The Silviculture Guide for the Ecological Matrix is part of the Department's response to this mandate. The goal of the Guide is to shift silvicultural practice in what is now called the Ecological Matrix on Provincial forestland away from a primarily commodity-production focus to ecological forestry. For the purpose of this work, the Department defined ecological forestry as "management of the forest based on maintaining or restoring the ecological functions in an ecosystem in which biodiversity is one of the most important considerations" (p. 168). Specifically, "biodiversity priorities and timber objectives are both applicable and combined" (title page).

Preparation of the Guide required description of underlying principles, conceptualization of silvicultural systems (series of treatments), and specification of individual treatments for the broad range of forest groups and site types in the Province. The document is highly complex with multiple cross references between sections. The authors are to be commended for compiling this information and for both delving into fundamentals and developing myriad prescriptions in the form of decision keys and sub-keys. Nevertheless, there are a number of inconsistencies and technical errors in the Guide that require resolution before it can be applied. These are described to the best of my ability in this review, but I suggest that someone test the decision keys for each forest group with existing stand or other inventory data to ensure they function as intended and reach logical outcomes.

Furthermore, some important concepts related to successful application of ecological forestry are not covered in the Guide, e.g., the need to distinguish between retention and reserve trees in multi-aged stands, the role of gaps for release of advance regeneration in irregular shelterwood systems, and the importance of adjusting removal percentage as needed to avoid premature liquidation of growing stock. In addition, while the decision keys are an acceptable means of prescribing one-time treatments in even-aged stands, they are a poor fit for structurally complex and spatially variable stands where an irregular shelterwood sequence was previously initiated. For this reason, it is not clear that they are useful after the first treatment of a multi-aged silvicultural system. Also, the highly prescriptive nature of the keys and similarity in treatments across different forest groups represent a lost opportunity to manage the forest in a manner that reflects the natural variability they presume to emulate. For these reasons, the keys as presented seem a poor fit for ecological forestry as envisioned in the Province.

Finally, terminology used in the Guide equates silviculture with harvesting in a manner that suggests a timber production mindset rather than a shift of focus to structure and function of residual

stands. Furthermore, while some recommended silvicultural systems seem well-suited to ecological forestry, others are similar to those deemed “traditional” and “not recommended” in the Guide. In particular, ecological justification is not well articulated for “salvage with retention” (80% removal where damage from disturbance exceeds 25%) or for some applications of “low-retention irregular shelterwood” (80% removal where stocking of long-lived intermediate-tolerant species is low). It is unclear whether applying these treatments in all instances for which they are recommended will represent a meaningful advance toward achieving an ecological forestry paradigm.

I recommend major revisions to the Guide in light of the concerns summarized here and articulated in detail on the following pages. If applied as written, it seems unlikely that outcomes will consistently align with the objective of creating a multi-aged forest in which biodiversity maintenance and timber production are well integrated and mutually achieved. I am aware that major revision is not a welcome task at this late stage, but hope the detailed comments provided in this review will facilitate that work.

2.0. APPROACH TO REVIEW

The Guide is presented in four primary sections: Background, Inventory Requirements (aka Pre-Treatment Assessment, PTA), Silviculture Prescriptions, and keys in which PTA data are input and decision pathways followed. The keys bring the user to a specific treatment (e.g. commercial thinning, selection cutting, irregular shelterwood) based on composition, stocking, tree size, windthrow hazard, presence or absence of regeneration, etc. These keys are the mechanism by which the management objectives (i.e., biodiversity and timber) are achieved. They draw upon silviculture treatment descriptions presented in the Silviculture Prescriptions section. The success of ecological forestry as a management paradigm in the ecological matrix rests fully upon the effectiveness of the keys in bringing users to suitable treatments. This success depends on 1. Whether the silvicultural prescriptions are correctly interpreted and presented in the Guide and 2. Whether the decision pathways in the keys bring the user to an appropriate treatment.

For these reasons, I approached this review in three parts. First, I reviewed the silvicultural prescriptions with regard to consistency with foundational knowledge, known definitions, and potential to achieve desired outcomes with regard to both biodiversity and timber outcomes. Second, I evaluated the decision keys for each forest type. The fact that PTA data from Nova Scotia were not used in my assessment means that my review sometimes resulted in questions for further clarification rather than a definitive conclusion about the merits of a specific key. Finally, I undertook a line-by-line review of the entire document and listed questions and concerns for consideration by the Department of Lands and Forestry in further revision. This list includes both minor corrections and substantive concerns about content.

The review is lengthy and includes comments of both an overarching nature and specific technical details. Highlights are presented in the Summary and topics of particular concern are designated in the text by asterisks (**) to help the reader identify important issues.

3.0. REVIEW: SILVICULTURAL PRESCRIPTIONS

3.1. Silviculture: Terminology

Key Points

- Some of the terminology in the Guide is used in a manner that is inconsistent with long-standing definitions. This has the potential to cause confusion.

Explanation

Proper use of silvicultural terminology is important to ensure that users understand the intent of prescriptions and technical aspects of their application. The following terms are used in the Guide in a manner that is inconsistent with either textbooks or the foundations of silvicultural practice:

All-aged stand (p. 27): defined as 4 or more cohorts in the Guide. See comments below re: multi-aged vs. all-aged. This distinction is not necessary.

Harvest, harvest system, harvesting practices:

Selection harvest system (p. 27 and elsewhere): the term harvesting (taking wood from the forest for use) should be avoided unless discussing the operational aspects of a prescription (which are outside the scope of this Guide, i.e., whole-tree or stem-only harvest, harvesting equipment etc.). Appropriate terminology is selection system. See usage by Nyland and others.

Seed tree harvest (p. 27): as above, this is a silvicultural treatment and the emphasis on harvest is misplaced. I suggest seed tree method.

Multi-aged harvesting practices (p. 28): as above, this should be multi-aged silvicultural systems. **A shift in terminology from "harvest practices" to "silvicultural systems" is not only consistent with generally recognized usage but supports the shift in management paradigm from timber production to management for multi-aged structures. Silviculture is about what one creates in the forest, not what one harvests.

Traditional shelterwood (p. 27 and elsewhere, especially p. 30): this is unclear, and is not a silvicultural term. I believe that uniform or regular shelterwood is meant here (see Raymond et al.). In addition, uniform shelterwood (specifically: what I would call overstory removal or one-cut shelterwood) with retention (a practice that the Guide states is not prescribed for the ecological matrix, p. 37) is the same as low-retention continuous cover irregular shelterwood (ISW). I am concerned that the desire to emphasize "out with the old and in with the new" has added confusion by failing to equate these practices. Furthermore, the use of this terminology implies (or explicitly states) that "traditional" silvicultural practice will not occur in the ecological matrix.

ISW is defined as distinct from "traditional shelterwood" on p. 30. In fact, if traditional means "has been around for a long time," treatments in the Guide are variants of those described in European texts since the 1800s.

Group selection as "appropriate when a stand is patchy, with trees that are not seed-bearing age, that have not reached their full economic potential in one area, while in other areas, patches of senescent or low-quality trees occur" (p. 29): this description of areas where group selection (GSC) should be applied sounds like the situation in which ISW is ideal. Clarification of the differences between these practices that does not rely on the arbitrary 3- or 4-cohort rule is needed.

Harvest (p. 28, under first photo and elsewhere): consider using the word entry instead.

Partially live snag trees (p. 28): inconsistent with common definition of a snag as a dead tree (the latter definition is used on p. 170).

Leave strips (p. 28 two lines above Figure 4 and elsewhere): by convention, a leave strip is an unharvested strip of forest retained in a stand (e.g. as in a strip clearcut or strip shelterwood). I was confused by the use of this term for selection stands (and elsewhere) until I realized that the term "leave strips" in the Guide refers to the portion of the stand not occupied by skid trails. This is potentially confusing because it suggests that these are retention strips. I suggest not calling the managed portion of a stand "leave strips." I suggest "area not occupied by machinery trails." I hope that this is the majority of the stand, and not just strips.

Growing stock of advance regeneration (p. 34, 36) is listed as an objective of retention. Growing stock refers to the trees in a stand, usually those which are of merchantable size (expressed in volume or biomass). Advance regeneration refers to regeneration (seedlings and saplings) which is present before a silvicultural treatment. Advance regeneration is not growing stock, and should not be counted as retention trees. It is unclear what is meant by this statement.

3.2. Multi-Aged Silvicultural Systems[2]

Key Points

- Some aspects of the presentation of multi-aged silviculture in the Guide are confusing and inconsistent with published literature, particularly with regard to the distinction between irregular shelterwood and selection cutting (p. 27).
- The importance of converting an even-aged stand to a multi-aged structure before applying the selection system is not addressed.
- Timelines for selection cutting removal percentages and cutting cycles (p. 28-29, Figures 4-5) suggest that treatments might not result in the numbers of cohorts desired and/or leave permanent retention. Similar issues appear in some of the ISW timelines (e.g. gap ISW p. 33, Figure 6).

Explanation

Irregular Shelterwood v. Selection Cutting

Silvicultural systems are described in the Guide as creating even- or multi-aged stands, with the latter referring to 2 or more cohorts. All-aged stands are described as a special case of multi-aged stands in which there are 4 or more cohorts. This distinction sets the stage for later differentiation between the multi-aged treatments irregular shelterwood (ISW) and selection cutting (SC), in that SC is said to lead to an all-aged structure. This focus on number of cohorts (2-3 or 4+) introduces unnecessary complication and detracts from important differences between these two treatments. The requirement that selection stands have at least 4 cohorts (p. 28, 30) is not based on definitions in silviculture textbooks. It is not apparent that a new definition is warranted for this Guide. A distinction between ISW and SC based on 3 versus 4 cohorts has little ecological meaning.

The emphasis on number of cohorts obscures more meaningful differences between ISW and SC. ISW uses even-aged silvicultural treatments (e.g., harvest of mature trees, tending, and regeneration accomplished via treatments such as overstory removal, thinning, and retention) at different places in the same stand or at different times in order to create a multi-aged stand. Such a stand does not have an equal distribution of growing space among cohorts, a fixed re-entry (cutting) cycle, or a guarantee of stand-level sustained yield consistent over time (such a guarantee is not usually

[2] See also: Technical Comments about Shelterwood Systems

required at the stand level when part of a managed forest). It can be applied in stands which are even or multi aged.

SC, on the other hand, involves harvesting mature trees, tending, and regenerating uniformly across a stand at the same time. It has the objective of creating and maintaining an even distribution of growing space among age classes using a target diameter distribution and fixed cutting cycle with the goal of consistent stand-level sustained yield. It can only be applied in stands that are multi-aged (see discussion of Conversion below) and volume removed at each entry (i.e., the allowable cut) should not exceed net growth since the previous entry.

While ISW is a flexible treatment suitable for a wide range of species, shade tolerances and site conditions, SC is a fairly inflexible treatment aimed at creating a specific allocation of tree sizes with little relevance to natural variability. While SC, particularly if a small-group variant is used, is appropriate for stands of late-successional, long-lived, and shade-tolerant to mid-tolerant species, it is less easily modified for biodiversity values. Of note, application of the single-tree variant throughout much of the Lake States of the U.S. resulted in important losses of tree species diversity (see papers by Kern, Webster, Nagel, and others); in the Northeast U.S. it has driven stands to dominance by beech unless ambitious beech control (usually by chemical means) is practiced (see Bohn, Nyland), even in small groups (see D'Amato, Rogers). Additional consideration of SC and how it can be modified for ecological forestry is warranted.

There is a place for SC and GSC in the ecological matrix if adjustments are made for permanent retention of biodiversity trees (i.e., reserve trees) and trees beyond economic maturity. However, this would be done within the context of the desire for control of diameter distribution, to ensure close intermingling of trees of various ages and sizes.

***Conversion*

Related to the differences between even- and multi-aged treatments, the Guide does not specify that SC should only be applied to stands that are already multi-aged (in fact, Figure 4 on p. 28 incorrectly shows application to mature, even-aged, mixed-species stands). The application of SC in even-aged stands will result in poor outcomes (see Bassil, Nyland). This is especially true in mixed-species, even-aged stands in which species with different growth rates and shade tolerances are arranged in layers such that the small, mid-sized, and large trees are composed of different species (i.e. stratified even-aged stands). Regardless of composition, managing even-aged stands using SC will result in poor growth because released small trees are old, not young. To avoid these concerns, I suggest

adding a section to the Guide addressing conversion from an even- to multi-aged structure, drawing upon the work of Nyland, Raymond, and/or Bedard, the latter two of whom espouse ISW or gap ISW for conversion of even-aged stands to a structure suitable for SC. The Guide currently states at the end of the paragraphs describing high-, medium, and low-retention continuous cover ISW that SC may be appropriate after multiple ages classes are present (p. 34-36), yet this is not a requirement for SC in the decision keys.

***Timelines*

The example timeline (p. 28, Figure 4) for SC shows that removing 30% of the basal area every 20 years will result in 5 cohorts. As stated above and further explained below, basal area removal should be constrained to growth since the last entry. If, for any reason, the amount previously removed has not regrown, then periodic removal on a percentage basis will deplete the residual growing stock over time. In addition, the prescription for SC does not appear to include permanent retention (reserve trees) and thus does not seem to meet either the stated treatment objective or the biodiversity objective. A similar issue arises on p. 33 (Figure 6) for high-retention gap ISW. Prescribed removal is 40% of stand area every 30 years, to create a stand with 3 cohorts; this is unclear but suggests 120% removal.

3.3. Retention

Key Points

- All trees left after any ISW treatment (i.e., the residual trees) are described in the Guide as retention. This is consistent with even-aged principles related to OSR, but is not consistent with a multi-aged approach with low removal percentages at each entry.
- Target or minimum proportions of residual trees designated for biodiversity and timber (growing stock) are not explicitly specified; this may cause confusion and lead to undesirable outcomes.
- There does not appear to be biodiversity (permanent) retention (i.e. reserve trees) in SC and final retention levels are either not specified or appear to be <20% for some multiple-entry ISW systems based on the example timelines.
- The need to continually or periodically recruit retention trees over time to replace those that die or are harvested is not addressed.

- Retention in groups within GSC, as prescribed in the Guide, should be reconsidered in light of the intent of these small openings to recruit species less tolerant of overhead shade.
- Target residual stocking (described as retention) in ISW in the Guide is proportional to amount of long-lived intermediate to tolerant (LIT) species, such that lower amounts of LIT result in lower overall stocking, creating open conditions that seem inconsistent with successful LIT regeneration and potentially liquidating immature non-LIT growing stock.

Explanation

***Retention in Multi-Aged Stands with Low Removal Percentages*

The use of the word retention in the Guide for all trees left after a harvest in ISW treatments, between openings in gap ISW (p. 31-32), and in SC stands (p. 28) in unusual within the context of multi-aged silviculture. A low basal area of residual trees left following an OSR (which I define as overstory removal with advance regeneration present and which seems to fall under the frequently prescribed "low-retention continuous cover ISW" in the keys) is reasonably deemed "retention" if retained beyond the regeneration period. However, the residual trees left after a 30% removal in SC or between the openings in gap ISW are not usually defined as "retention" (this is perhaps better termed the residual stand). Greater specificity re: intentions for these trees would improve communication and implementation of treatments. In stands where ecological forestry is applied, residual trees include those which will be retained indefinitely for biodiversity reasons (i.e., reserve trees) and those that will later be harvested.

To the authors' credit, the keys (to be discussed later) specify that retention in ISW (specified as 20 to 60% of basal area, p. 31) includes growing stock (specifically, listed in this order: uncommon species, wildlife trees and biodiversity features, growing stock, deep-rooted LIT species, shallow-rooted LIT, and deep-rooted non-LIT, e.g., p. 57 and elsewhere). However, as stated above, it is not specified how much of that is permanent (i.e., reserves) vs. growing stock. Specifying some minimum proportion or number of trees as reserves in all treatments – including SC – is necessary to ensure ecological memory and meet biodiversity objectives. On the other hand, recognizing that (depending on treatment) a small or large amount of the residual trees left after the first regeneration treatment are growing stock available for future harvest - and explicitly specifying this amount – both contributes positively to production outcomes and motivates in-field retention of AGS (see discussion of AGS retention below).

Finally, in GSC stands, retention is specified in the group openings; it is unclear whether these are reserves (permanent, biodiversity) or growing stock for future harvest. Regardless, this suggestion merits refinement due to the potential negative effect of retention on available light in these small patches, the purpose of which is to regenerate mid-tolerant species (see Webster, D'Amato and others from the Lake States, also unpublished work by Leak). Specifically, group openings with retention should be larger than those without, to ameliorate shading effects of retained overstory trees.

****Using percentages to define retention goals***

The selection and continuous-cover ISW treatments in the Guide are defined in terms of percentage of basal area removed or retained. Because pre-treatment basal area will vary across sites, retention outcomes will be highly variable and could be quite low. This is particularly a problem in the selection treatment, in which allowable cut is defined as a removal of 30% of the basal area every 20 years in perpetuity (p. 28, Figure 4). This is only sustainable if the stand returns to pre-harvest stocking before the next entry. If, instead, growth is insufficient to recover the basal area removed due to low levels of accretion, insufficient ingrowth, or unexpected mortality, continued periodic removal of 30% of basal area will cause increasingly lower residual stand basal area over time. Long-term sustainability of production would thus be endangered. Instead, I suggest that a minimum target residual basal area be established and/or allowable cut constrained to growth between entries.

*****Retention at end of rotation***

The Guide specifies "a minimum retention level of 20%" (p. 8 and 186, please note that 20% retention is not mentioned in the Silviculture Prescriptions section). Yet the treatments as prescribed (p. 30-36) do not universally result in 20% reserves at the end of the rotation. It is counter to the principles of ecological forestry to "get credit" for all residual trees after each partial harvest (termed "retention" in the Guide) if they are going to be harvested before the end of the rotation. Examples:

- p. 28: SC: no permanent retention is prescribed. A 30% removal (described as 70% retention) is conducted on a 20-year cycle (per timeline, Figure 4), with apparently no trees persisting for more than 1 rotation. This silvicultural system does not meet the requirements of ecological forestry.
- p. 29: GSC: "within these openings, dispersed retention is to be left" (amount not specified).
- p. 33: High-retention ISW (gap variant): A 40% removal is conducted on a 30-year interval with three harvests "until the initial stand is harvested except for retention." Retention amount

appears to be 10% at end of rotation (p. 186) (see discussion elsewhere about disconnect between harvest interval and harvest intensity).

- p. 34: High-retention ISW (continuous cover): No mention of retention at end of rotation in text; shown as 20% in timeline (p. 34, Figure 7, and p. 186).
- p. 34: Medium-retention ISW (gap variant): "Retain 40% of area in small patches", "10% dispersed retention will be left in the harvest patches", "A series of three harvests will be undertaken until the initial stand is harvested except for retention." This appear to leave 10% retention at the end of the rotation (as specified on p. 187), but (as discussed elsewhere in this Review), the concepts of "patches"(separate groups of standing trees left in a stand that has been cut over) and "gaps" (separate openings in the canopy, each surrounded by trees) seem to be reversed in this prescription.
- P. 35: Medium-retention ISW (continuous cover): appears to leave 20% retention
- P. 36: Low-retention ISW (continuous cover): "two cohorts are produced", "two harvests can be made." Removing 80% in the first cut (as shown on the timeline, Figure 10) does in fact leave 20%. However, the second cut prescribed and shown on the timeline at year 60 appears (based on the illustration) to remove that 20%. If correct, no permanent retention (reserves) are left.

*** General comment about harvest intensity and retention in ecological forestry*

The premise of ecological forestry is that management is based on understanding of ecological processes. As applied by Seymour and others this is achieved in two ways. The first is to base harvest frequency, intensity, and spatial pattern (disturbance) on natural disturbance dynamics. To accomplish this, observations of unmanaged stands and/or reconstruction of old-growth dynamics in a particular forest type are used to calculate an average canopy disturbance rate. Then the harvest intensity and interval are adjusted so that, though disturbances may be concentrated due to the necessity of efficient and operable harvests, the long-term average matches that of the natural dynamic. This seems not to be a consideration in this Guide, because the prescriptions for harvest intensity and interval within each ISW prescription are the same across all forest groups (thus highly unlikely to be indicative of natural disturbance). This is the part of ecological forestry that is aligned with FUNCTION. The other part of ecological forestry, retention, is aligned with STRUCTURE. This Guide more explicitly addresses that, but the prescriptions as written do not all appear to retain enough or in some cases any reserves beyond a rotation.

***Retention in stands with low LIT abundance*

Level of overstory retention in ISW in the Guide is defined by proportion of LIT species; the lower the LIT growing stock, the heavier the manager will cut (p. 31, low-retention ISW: 80% removal when LIT <30%). From a silvics perspective, this is a reasonable prescription for regenerating LIT species if stocking of established LIT regeneration is acceptable (e.g., MW-R, SH-R, and TH-R sub-keys on p. 96, 112, 152 and elsewhere: "Established and Acceptable LIT Regeneration > 30%"). Applied in this manner, this treatment is equivalent to "Overstory Removal – Stocked" as described on p. 188 if the descriptor "with Retention" is added. However, this treatment is also prescribed when LIT regeneration < 30%, and regardless of overstory LIT proportion (<30%, 30-60%, and >60%, p. 96, 122, and elsewhere) when wind hazard is high.

There are a number of potential problems with the use of low-retention ISW when LIT regeneration stocking is low if the intention of the treatment is to regenerate LIT. Retained overstory trees serve a number of purposes: continued growth of AGS for later harvest; overstory structure for biodiversity, habitat, or aesthetic purposes; seed sources for regeneration; and shade for regenerating trees. While relatively simple (two-storied) stand structures and low levels of retention may be appropriate for ecological forestry in some forest groups on some site types, such an approach (a single, heavy harvest) is generally not recommended for establishing LIT regeneration.

In fact, it is noted in the "Silviculture Prescription" section of the Guide under "Even-age Harvesting Practices" and "Traditional Uniform Shelterwood" (p. 37) that two overstory harvests 5-10 years apart with the second cut after regeneration is established (> 0.3 m tall) is appropriate for regenerating shade-tolerant species (30% removal in first cut) or intermediate species (40% removal in the first cut). The reason for the lighter first cut and the two cuts in close sequence (as opposed to the single 80% removal now recommended when LIT regeneration is low) is to establish regeneration in partial shade. In fact, the description under Uniform Shelterwood (p. 37, last two lines) states "This treatment can be used to increase the proportion of long-lived or shade-tolerant species and move the stand towards later successional vegetation types." Unfortunately, the first sentence on that page specified this treatment "will not be recommended in this Guide."

I suggest that where an increase in LIT regeneration is desired, a shelterwood sequence such as that used in a two- or three-stage uniform shelterwood (one or two thinning-like partial harvests, creating shaded understory conditions favoring regeneration of LIT species, followed by OSR + 20% retention) might be more successful. In fact, the outcome of this sequence (with retention) would be a two-aged stand of the same structure created in one entry by the low-retention ISW. Yet gradual

removal of the overstory (which does not occur in the low-retention ISW) would increase the probability of LIT species and allow further growth accumulation on non-LIT growing stock if immature. Mechanical release (PCT as a weeding or early CTR) of submerchantable LIT in the new stand might be required, but long-standing recommendations about establishing and releasing shade-tolerant regeneration in partial shade where less-tolerant species will be disadvantaged seems more likely to succeed than trying to regenerate LIT species with a single 80% canopy removal.

***Retention priorities: competing objectives*

The Guide states on p. 32: "retention priorities: a. uncommon tree species; b. wildlife trees and biodiversity features; c. growing stock and advance regeneration; d. deep-rooted overstory LIT; e. shallow-rooted overstory LIT; f. deep-rooted overstory non-LIT." Later, text says "Retain the following sorts of trees" followed by this list (e.g., p. 81 and elsewhere). I think these are presented in order of priority for retention, but am not sure. If so (please make this explicit), LIT species do not occur until half-way down the list. Yet (p. 6) "proportion of LIT species and AGS must be higher after treatment." It is unclear how to accomplish this in practice in stands of mixed LIT and non-LIT species where the LIT are primarily UGS and the non-LIT comprise most of acceptable growing stock (AGS). If the LIT are preferentially retained, UGS will increase. If AGS are preferentially retained, LIT will decrease. For example, p. 74, IH forest group: "Past Economic Maturity?" "Yes"= "Regenerate." The user is then directed to low- or medium-retention ISW. Retention guidelines require increases in LIT and AGS, with no consideration of the amount of LIT or whether they are AGS. I envision situations in the field (and in fact saw one when I visited last year) in which foresters are unable to retain LIT without retaining UGS, resulting in a degraded stand from a timber production and aesthetics standpoint. One possible solution is the revision of retention levels and/or priorities to allow greater retention of non-LIT AGS; this might prove beneficial re: achieving multiple objectives in some cases.

Retention: spatial distribution

On p. 8: "retention or wildlife trees should reflect patterns created by natural disturbance, and therefore… should exist as clumps and dispersed structures." However, p. 32 states "retention is to be distributed throughout the site" and the prescriptions for continuous cover ISW specify retention as (e.g., p. 57) "distributed throughout the site." This suggests dispersed retention. Retention of clumps in addition to dispersed trees should be explicitly permitted in all variants of ISW, particularly on sites where wind hazard is high (i.e., where low-retention continuous cover ISW [distributed retention] is

commonly prescribed in the Guide for stands in which non-LIT species predominate, particularly where proportion of LIT is low).

3.4. Even-Aged Silvicultural Systems

Key Points

- This section of the Guide contains treatments that are "not recommended" but discussed anyway; this is confusing.
- The resulting structures of the uniform shelterwood treatment ("not recommended") are effectively the same as low-retention ISW (recommended) if retention is added to the former.
- Salvage with retention is included in this section ("not recommended"), but is an outcome in the regeneration and thinning keys for almost every forest type in the Guide (i.e., it is, in fact, recommended in the Guide). This treatment does not seem appropriate for either biodiversity or timber production objectives.

Explanation

Even-aged silviculture

"Even-aged harvesting practices" are presented (p. 37-39) with the statement that they "will not be recommended in this Guide" (i.e., are not outcomes in the keys), but are included because they are applicable to private land and many mature stands are even-aged. This seems counter-intuitive given the stated desire for ecological forestry to be adopted on private lands. I recommend that treatments that are not recommended for ecological forestry be excluded from the Guide.

Uniform shelterwood with retention

As explained above, uniform (regular) shelterwood with retention (p. 37-38) and the low-retention continuous cover variant of ISW are effectively the same treatment. The latter has the disadvantage of eliminating the gradual removal of the canopy to favor establishment of LIT regeneration before final overstory removal. I fear that the attempt to embrace ISW caused useful treatments to be discarded. Please reconsider the decision not to recommend this treatment.

***Salvage with retention*

When "> 25% of the trees in a stand are damaged, dead, or dying because of natural disturbances" (p. 39), the treatment prescribed in the keys for almost every forest type is salvage with

20% retention (p. 56, 68, 70, 78, 80, and elsewhere, approval from Forest Protection required). This retention is described as based on the "live, non-damaged trees in the stand" (p. 39), which is confusing but seems to imply that retention rate will be less than 20% of all trees. Furthermore, though it is specified early in the Guide that retention must result in an increase in proportion of AGS (bullet number 6 on p. 32 of the Guide), this requirement is explicitly waived in salvage with retention (p. 185, Prescription column). It is not clear why this exception is made, and it opens the door for degrading stands during salvage operations.

Waiving the requirement for increasing AGS pre- to post-cut seems unwarranted and (given the high proportion of UGS by default due to the abundance of natural disturbance-damaged trees) unnecessary (i.e., it should not be hard to increase proportion of AGS because the UGS are the salvaged trees). There is no reason why a stand in which some proportion of trees are dead or dying could not be managed with a less intensive partial harvest. Clarification of when treatments of this type are warranted is needed, and will be aided by appropriate use of the terms "pre-salvage" (harvesting dying trees; this term does not appear in the Guide) and "salvage" (harvesting dead trees; this term is incorrectly used in the Guide to refer to harvest of all trees affected by natural disturbance).

Regardless of quality and vigor of retention, I question the appropriateness of a "salvage" of 80% of the trees in a stand when 25% or more are damaged by disturbance. At a conceptual level, the stated goal of ecological forestry as defined in the Guide is "management of the forest based on maintaining or restoring the ecological functions in an ecosystem in which biodiversity is one of the most important considerations" (p. 168). It is in complete violation of this principle to remove not only the trees damaged by natural disturbance (i.e., an ecological function) but 80% of all trees in the stand when such a disturbance has occurred. It opens the door for widespread clearcutting with reserves under the guise of capturing mortality, a problem that occurred on commercial forestland in Maine in the 1970s and 1980s outbreak and had long-lasting negative effects on species composition and forest age structure (see publications by Seymour).

This issue is further complicated by inconsistent description of the conditions that warrant this treatment: p. 39 specifies trees "damaged, dead, or dying" while p. 188 (see Clearcut, Salvage description) specifies stands where natural disturbance has caused "detrimental effects" defined only as "blowdown."

Of additional concern, blowdown is cited as a cause of mortality that would justify Salvage with Retention (p. 188 "salvage merchantable timber after a natural disturbance has caused detrimental effects (i.e., >25% blowdown)"). Yet, as mentioned for low-Retention ISW (see discussion below), leaving

only 20% retention on sites prone to blowdown seems imprudent, as scattered residual trees are highly subject to windthrow after harvest.

Finally, Salvage with Retention (80% removal of standing trees) requires special permission, with direction to contact Forest Protection. Yet low-retention ISW (80% removal of standing trees) is one of the most common outcomes in the prescription keys and does not require special permission. These two treatments result in the same residual stand condition; I suggest that justification for requiring permission for one but not the other be provided.

3.5. Additional comments about SW and ISW Systems

Key Points

- Some of the technical aspects of shelterwood systems as described in the Guide require clarification or editing for consistency.
- Considerations re: gap locations in area-based systems fail to include regeneration release, which is important for maintenance of shade-tolerance species.

Explanation

Even-aged silvicultural systems, not recommended in Guide

Uniform SW (p. 37). Past experience throughout the Acadian Forest shows that this treatment is effective for establishing and recruiting shade-tolerant species. When some portion of the overstory is retained through the rotation as stated in the text but not shown on the timeline (Figure 11), this creates the same structure as low-retention continuous cover ISW, but has the advantage of opening the canopy over 10 years instead of all at once to favor regeneration of LIT species. In fact, another name for Uniform SW with Retention is extended ISW (see Raymond et al.). I think it is a mistake to remove this as one of the prescription options in the Guide.

Patch SW (p. 38): Here and elsewhere in the Guide the text states that patch or gap openings should be used when wind hazard is high; for example, this is explicitly stated as a reason to do the gap variant of medium-retention ISW on p. 35. This is supported by work by Seymour, who saw high survival rates of retention in gaps (see Carter et al.). Yet the decision points in the keys frequently direct the user to low retention continuous cover ISW (80% removal) when wind hazard is high (e.g., see p. 70, 96, 122, 138, and elsewhere). The reason for this inconsistency is unclear to me.

The direction provided on p. 38 for patch SW (not recommended in the Guide) is more logical than a low level of dispersed retention; removing 80% of the trees in a stand via low-retention ISW and

leaving the retention dispersed will greatly increase windthrow. Furthermore, as mentioned above for Uniform SW, adding retention to Patch SW results in a 2-aged residual accurately described as an ISW treatment. It is not clear why this treatment was removed from the Guide.

***Retention targets are unclear due to inconsistency in units*

The text states that the treatments will retain "20-60% of each stand" (p. 31). It is not clear whether this is in terms of number of trees, basal area, or stand area. The criterion for the three levels of retention in ISW (p. 30) is based on "frequency of LIT species"; this is re-stated for the high-retention variant (p. 33) as "number of LIT trees." The text for the gap variant on p. 31 states that "retention will amount to 60% of the preharvest basal area." Yet the timeline for that treatment specifies "percent of area retained." Presumably, this refers to stand area. The descriptions for ISW treatments in the keys (e.g., p. 81-82) specify retention based on "basal area" for continuous cover variants and "area" for gap variants with "10% distributed retention in the gaps." This is logical; by convention, continuous cover ISW is managed based on basal area (called volume control) and gap ISW is managed based on stand area (called area control). However, inconsistencies elsewhere in the Guide as described above are confusing and warrant revision or additional explanation.

***Non-LIT retention goals are unclear*

There is lack of clarity re: non-LIT retention. On p. 31: "As well as keeping overstory LIT species or legacy and regeneration, retention should support the growing stock objective by retaining pole-sized growing stock especially of LIT…". On p. 32: "Not all retention needs consist of LIT species, as other retention objectives could be met by leaving other species (for example, trees with nests)." This reference to wildlife trees as a reason to retain non-LIT implies not retaining LIT otherwise. "In some vegetation types, no LIT species will occur. In these cases… non-LIT retention features such as growing stock… should be left" and retention priority f of a-f: "deep-rooted non-LIT overstory trees" (p. 32). The retention priorities include non-LIT overstory, but the wording re: when to leave non-LIT (when they are wildlife trees or when there are no LIT) raises the question of whether non-LIT growing stock will be routinely retained. This is important to avoid premature liquidation of immature non-LIT growing stock. Some additional clarification would be useful.

Irregular Shelterwood Prescriptions

Low-retention continuous cover ISW: Note that this treatment would more accurately be described as "Extended ISW with Reserves" (see Raymond et al.). It is prescribed in the Guide when LIT <30% based on "number of trees" (p. 36), 20% retention (80% removal). PCT is not mentioned but is shown in the timeline (Figure 10). As mentioned above, I question the appropriateness of this treatment as prescribed for regeneration of LIT species and for stands with high wind hazard. Note that when advance regeneration is present, this treatment is a "with retention" variant of what is called Clearcut in Nova Scotia (p. 188), specifically (using the terminology in the Guide) "Overstory Removal (Stocked) with Retention." The low-retention variant of ISW has little relationship to ecological processes.

Moderate-retention ISW (p. 31, called Medium-retention on p. 34): *Gap variant*: in a patchy stand or with high wind hazard, "retention should amount to 40% of the area in small patches and distributed throughout the site" (p. 35), 10% dispersed retention in gaps. I am struggling to conceptualize "40% retention in small patches": this sounds like patch retention and not gap cutting. The description of this treatment in the keys (e.g., p. 124 and elsewhere) states "leave gaps of approximately 0.1 ha" and "leave gaps of approximately 0.04 ha". This creates some confusion about whether this refers to *cutting gaps* or *leaving patches*.

In addition, if the largest prescribed gap size is 0.1 ha and the removal percentage for medium-retention gap ISW is 60%, that means that a manager must cut 6 gaps per ha, or 120 gaps in a 20-ha stand. When using the smaller gaps (prescribed for shade-tolerant species, 0.04 ha), a manager must cut 15 gaps per ha to achieve a 60% removal (40% retention), or 300 gaps in a 20-ha stand. If this interpretation is correct, then this is operationally inefficient. I suggest reviewing size of gaps or groups (as in GSC) and percentage removal targets for all treatments to ensure they are realistic.

Furthermore, the text specifies three harvests, but the timeline shows two (p. 35, Figure 8): 40% area retention than 60% area retention 50 year later. This should be resolved so that the timeline and text are in agreement. Finally, the Guide states that "Once the initial harvested areas become seed-bearing age, the stand will be considered for harvesting again." This seems to imply another regeneration harvest before the trees are economically mature, which seems undesirable. There is also no mention of PCT or CT, though we know from Seymour's work and understanding of even-aged stand (or cohort) development that this often must be conducted in gaps.

Continuous cover variant: used to create three cohorts: 40% basal area retention in cut 1 and 20% in cut 2. Text of the Guide notes that the manager may shift to high-retention continuous cover or SC once the initial cohort is seed-bearing age. This is logical, though PCT is shown on the timeline but not mentioned in the text describing this prescription (p. 35, Figure 9) and the reference to future

harvest at seed-bearing age suggests premature regeneration when an intermediate (tending, CT or CTR) treatment would be warranted.

High-retention ISW: *Gap variant*: "retention will amount to 60% of the preharvest BA" (I believe this should refer to stand area). Also, p. 33, "10% dispersed retention in harvest patches" (is this % of trees or % of BA?). Prescription calls for a series of three harvests, until initial stand is harvested except for retention (retention amount not specified here, but shown on p. 186 as 20%). Harvest again when initial areas are seed bearing age (comment: this seems too soon, and does not address needs for PCT or CT). 40% area removal every 30 years, which seems to add up to 120% removal (p. 33, Figure 6).

***Failure to locate gaps in areas of established regeneration*

With regard to gap ISW treatments: the Guide specifies not only percent removal on an area basis (40 or 60%) but the size of gaps based on one of two shade tolerance groupings (approximately 0.04 or 0.1 ha, also presented in terms of the radius of a circular opening or length of the side of a square opening, p. 58 and elsewhere). One of the most important aspects of ISW is the location of gaps and their orientation in size and shape to release already established regeneration. There is no mention of this in the Guide. Instead, all descriptions of ISW (and of GSC) specify that gaps are to be located (e.g., p. 124) in "areas within the stand suitable for harvesting or regeneration because they are predominantly mature or contain non-commercial trees." Instruction is to "Clear these areas to create conditions suitable for preferred regeneration." In addition, "10% of distributed live trees" are prescribed for retention in each gap. A more logical approach is to adjust opening size based on local conditions, and then adjust retention based on opening size, availability of seed trees, and biological legacies etc. Some adjustment to both the approach and details of the prescriptions is warranted to successfully transition to a balance between biodiversity and timber objectives.

4.0. REVIEW: DECISION KEYS

The keys step the user through multiple decision points to arrive at a specific prescription based on stand and site data. Each forest type has a main key, which tiers to sub-keys. Except where harvesting is restricted due to rarity of site condition or species (e.g. cedar) outcomes are always "Let it Grow", "Salvage with Retention" (if disturbance has damaged or killed > 25% of trees), intermediate treatment (tending, thinning), selection treatment, or "regeneration" (ISW) treatment.

**4.1. Disconnect from Silvicultural Systems

Silvicultural treatments are organized into a series of related events that form a silvicultural system. Yet the keys as presented bring the user to single treatment that does not apparently set the stage for later treatments in the same system and is not defined by earlier treatments. As such, the keys can be used for the first treatment in a multi-aged system only. There is no mechanism in the keys to specify that the stand already received one or more treatments as part of a selection or ISW prescription (as noted below, the user is asked whether the stand was treated but not how the stand was treated); the keys thus fail to direct the user to continue the silvicultural system previously initiated. Though many of the keys have a decision point in which the user is asked whether the stand is Previously Treated, the type of treatment is not specified (e.g., p. 97 and elsewhere "Previously Treated – Has the stand been precommercially thinned, planted, commercially thinned, or partially harvested?"). For intermediate treatments (thinning/tending) in stands that are immature or have relatively low stocking answering "Yes" to this treatment results in "Let it Grow" (no treatment, e.g., p. 104). Elsewhere, this appears to be a surrogate for tree form, such that previously treated mature stands on sites with windthrow hazard are allowed higher retention than those without treatment (e.g., p. 96). There is no distinction among outcomes based on what the previous treatment was: a precommercial thinning? A medium-retention continuous cover ISW? A high-retention gap ISW? Through this omission, the silvicultural system set in motion by the previous entry is not taken into consideration and it is unclear how one would ever get to the second or third treatment in an ISW sequence.

4.2. Economic Maturity

One of the important decision points early in most of the keys is whether the stand (defined as the overstory) is "past economic maturity" (p. 74, 80, 86, 100, 106 and elsewhere). Economic maturity of individual species is defined (p. 26) on the basis of tree age. This assumes tree age is an acceptable surrogate for tree size (a primary determinant of economic maturity). While this may be true in even-

aged stands with a history of thinning, this is definitely not true in multi-aged stands where there are not only different age classes but shade-tolerant trees that can be suppressed and slow growing (i.e., small) for many decades before responding to release following partial cutting. If Provincial forestlands of Nova Scotia are all in an even-aged condition, this criterion is minimally workable. Once multi-aged structures are created, this decision point in the key will no longer work.

****4.3. Using the Keys in Stands where Gaps were Created**

As mentioned earlier, the decision keys are effective for prescribing treatments in stands that are even-aged or uniformly multi-aged (e.g. in stands previously treated with SC). It is, however, unclear how a user will be directed to the second or third treatment of an ISW system after the first entry. Related to this, it is not apparent how data from stands that have already been managed for gaps will be handled, because inventory data that are not separated between the "gap" and "between-gap" forest condition will be homogenized. Averaging data in this way will result in stand tables showing average stocking conditions lower than those between the gaps but higher than those within the gaps. Additional clarification is needed in the Guide re: how the PTA assessment will be conducted in such stands, and how to use the decision keys to both determine treatment for the between-gap areas and within the regenerating gaps as needed. It is highly likely that after the first entry of a gap ISW, more than one within-stand treatment (i.e. following the model of Lussier and Meek) will be needed: tending (PCT or CT) in the developing gaps and additional overstory reduction (e.g. creation of new gaps via a percentage removal prescription). Stratified sampling will be required and keys reworked in order for the Guide to function after the first entry.

****4.4. Loss of Flexibility Inherent to ISW and Ecological Processes**

The regeneration treatments prescribed in the Guide fall into two categories: gap ISW (40% or 60% removal in gaps 0.1 or 0.04 ha) and continuous cover ISW (40%, 60%, or 80% dispersed removal); all are followed by one or more cuts that appear to leave no more than 20% basal area retention of mature trees at the end of the rotation (p. 186-187). This level of prescriptive detail and adherence to specifications is logical in timber production-oriented even-aged systems such as those common on Nova Scotia Provincial forestland in the past. It is a poor fit for both multi-aged stands of mixed species and ecological forestry. It is difficult to justify these targets, particularly the within-stand consistency in gap size, as reflecting "ecological function." I question the appropriateness of this rigid interpretation of ISW for the ecological forestry matrix of the Triad.

Related to this concern, the value of ISW over other silvicultural treatments is the inherent flexibility of the system. It is particularly well suited for managing stands with sub-stand variability in structure and composition, as noted in the Guide. A typical approach, also called a multi-treatment approach by Lussier, Meek and others, devises different sub-stand silvicultural prescriptions such that areas suitable for regeneration are regenerated and areas suitable for tending are thinned. By responding to cues in the stand, specifically the presence of UGS and senescent trees or patches of advance regeneration that would benefit from release, inherent within-stand variability is maintained. This is ostensibly the goal of the prescriptions in the Guide, but there are two difficulties. First, specifications re: gap size do not allow sufficient flexibility to encompass the wide variability of conditions found in natural stands. Second, the limited range of regeneration alternatives and consistency in removal and retention percentages suggest that treatments are not well grounded in natural disturbance dynamics, which differ markedly across forest groups based on species silvics, site, and prevailing disturbance types. For these reasons, the keys as currently presented might not fulfill the objectives of ecological forestry.

For additional comments on the Decision Keys, see Line Edits (next section)

5.0. LINE EDITS

Title page: “Silviculture Guide”; p. 5, 7 and elsewhere: “Silvicultural Guide”. Please use consistent title (the latter is preferred).

p. 5: ecological forestry treatments recommended in this Guide do not “emulate natural disturbances”. I suggest instead that they create stand structures and compositions similar to those resulting from natural disturbances.

p. 7: “retention harvests”; I suggest focus on silvicultural systems rather than harvests.

p. 8: restate as “16 potential nest trees per hectare greater than 25 cm DBH”

P. 8: consider adding text about the need to recruit snags and reserve trees over time as some of those left fall down or die.

p. 8: reference is made to leaving trees in clumps to make them less vulnerable to windthrow. This is a good idea. But it seems not to be the outcome in many keys where low-retention (dispersed) ISW is prescribed if LIT are low and wind hazard is high.

Background section, general comment: I am surprised to see no reference to climate change as worthwhile considerations in the application of ecological forestry. Those issues weren’t as high profile 30 years ago when the Triad model was conceived, but their exclusion from the Guide seems an important oversight now, especially re: adaptation, resilience, and resistance concepts (which if any are prioritized?). Also worth mentioning: effects of invasive species and the challenge of practicing ecological forestry in novel ecosystems that are changed by external stressors.

p. 10: restoration species: white ash. How is (or should) this priority be adjusted in light of emerald ash borer (EAB)?

p. 10: “prescribing retention of LIT species in all cases where they occur”; please consider role of AGS v UGS here. If all LIT are UGS, does the manager keep them? If the choice is between keeping a few UGS LIT or more retention that is UGS LIT + AGS non-LIT, which is better? Currently the key pushes the user to the few UGS LIT (low-retention). Might not higher retention with some non-LIT growing stock (and also greater shade for regeneration LIT) be desirable?

p. 10: use of the word “reforestation” where LIT density is inadequate: I believe this is correctly called fill or supplemental planting, or underplanting where some overstory trees are present. By convention, reforestation occurs where there is no forest.

p. 11: it would be helpful to the user if the abbreviations were defined. Otherwise, the user has to refer to the other publication to know what they are.

p. 12: as stated earlier in the review, I don't believe that the Guide includes harvesting practices (except in Appendix II).

p. 12: as above: "harvest planning system" suggests focus on extraction instead of a silvicultural system; see also p. 13 "harvest method"

p. 15: "snag trees: standing, dead, or dying" does not match definition in Glossary of snag tree as dead

p. 17: UGS: "leaving a high proportion of trees… prone to… decline due to… insect infestation"; in light of EAB and other pests that target certain species, does this definition of UGS mean that some species are UGS? This is unclear.

p. 17: a 15-year period is used to determine whether a tree is AGS or UGS. Cutting cycles in the prescriptions are longer than 15 years. Would it be better to specify that AGS are trees expected to maintain quality and value until the next entry?

p. 18: UGS trees are defined in the Guide as including those with an unstable height to diameter ratio; this should only apply if the plan is to release those trees. If they are to remain in clumps or densely grown until harvest, this should not be a concern.

p. 18: trees with LCR < 1/3 are UGS and "poor candidates for release"; I propose that not all trees must be candidates for release (see previous comment). Furthermore, it is not uncommon for suppressed shade-tolerant trees in multi-aged (multi-strata) stands to have low LCR ("umbrella spruce" are a classic example). These trees may respond well to release. I am concerned that classifying all trees with an unstable H:D ratio or with small crowns as UGS will result in an unnecessarily high proportion of UGS and lead to premature liquidation of trees with potential to live longer.

p. 21: windfirmness is not solely the result of root expansion as stated in the Guide (which balsam fir does better than spruce, see work by Tian and Ostrofsky), but of a shift in stemwood allocation along the bole in trees with longer (exposed) crowns, resulting in a more conical form and better H:D ratio.

p. 25: silvics: this section is insufficiently cited

p. 26: economic maturity: given the poor relationship between tree age and size in many shade-tolerant species, especially in the multi-aged stands where lower strata may be shaded (such as those to be created in this Guide), I question the usefulness of the age of economic maturity. I also disagree that 100 years is the age at which some of these species begin senescence (e.g. eastern hemlock, sugar maple). Given the shift to multi-aged and ecological forestry wherein AGS

growing stock may be retained for more than a rotation, I suggest revisiting these criteria for economic maturity.

p. 27: "silviculture prescriptions" and "silvicultural prescriptions" are used one after the other on this page

p. 27: replace "traditional shelterwood" with regular or uniform shelterwood

p. 28: replace "multi-aged harvesting practices" as discussed, here and elsewhere

p. 28-29: please clarify whether there is permanent retention (biodiversity, reserve or legacy trees) in SC and GSC; if not, these treatments do not meet the standards for ecological forestry.

p. 32: as mentioned earlier, I question why the AGS requirement is waived for low-retention ISW. Is it because of a desire to keep all LIT, regardless of quality? Given that LIT don't regenerate well in large openings, would it be good to also include some non-LIT AGS for shade, and if they aren't mature?

p. 33 and elsewhere: please prescribe conditions in which intermediate treatments (PCT, CT, etc.) would be conducted in gaps in the gap ISW variants, or in the continuous cover ISW. This is not included in these descriptions, though it does appear on two of the timelines on p. 34-35, Figures 7 and 9.

p. 35: no retention is shown in Figure 8 after final harvest in medium-retention gap ISW.

p. 36: there appears to be no permanent retention in the low-retention ISW because 2 cuts are proposed. The first removes 80% of the stand, the second 20%, totaling 100%. Or is the 20% removed a proportion of the previous 20% left, or of both the new and old cohorts? This is unclear and does not explicitly retain trees beyond one rotation.

p. 37: even-aged methods: as mentioned earlier, either crosswalk with ISW by adding "with retention" to the "traditional" treatment names, or omit.

p. 37: stand area not occupied by skid trails is not technically "strips."

p. 37-38: After uniform shelterwood, a second shelterwood is suggested if there is inadequate regeneration establishment. I don't understand how one would conduct a shelterwood a second time: overstory stocking was already reduced. Would it be reduced further? Would this result is less-shade-tolerant species?

p. 39: salvage with retention is in the "not recommended section" but it is recommended in the Guide

p. 40-43: intermediate treatments of PCT (including weeding), CT, and CTR: all thinning methods are appropriate in the gaps of ISW and/or regenerating strata. Discussion of the role of intermediate treatments within that context is warranted. Also, the keys must be adjusted so

that stands that have ISW or GS with patches in need of tending can be thinned. Currently, the keys for tending only work for even-aged stands or in the "leave areas" of GSC, they don't work for the trees that regenerate and grow in gaps in ISW stands. This is one of the reasons I think there must be a decision point early on each key: is this stand even or uneven-aged?

p. 41: CTR: I suggest adding red spruce to the list of LIT trees that merit release via CTR. I have seen good results elsewhere in early CTR of red spruce and including it on the list of trees to release contributes positively to restoration and LIT AGS objectives (see Puhlick et al.)

p. 42: PCT is prescribed in the Guide where there is a high level of AGS. AGS classification is not usually assigned to submerchantable stems. It is unclear what is meant by this.

p. 42: there is no mention of what Seymour calls "invisible species," i.e. species that should never be cut in PCT. Operators just walk by them like they aren't there. This is an important biodiversity consideration and compromise with the usual production focus on PCT/weeding. I suggest introducing this concept.

p. 43: concept of catch up: multiple times in the Guide, the user is directed not to re-enter a thinned stand until the volume has returned to that which existed prior to the thinning (called "catch up"). This is a generality that does not always apply. The underlying premise of thinning is that stand-level growth in sacrificed for the sake of improved growth of selected trees. As such, maintaining full stocking is sometimes but not always desirable. Re-entry timing is best determined by growth rates of residual trees and/or attainment of a target tree size for an intended product (e.g. sawlog, etc.)

**Related to this, it is emphasized multiple times in the Guide (e.g. p. 43 in italics, p. 142 and 147 underlined in the TH forest group keys, and elsewhere) that thinning is not to regenerate the stand. While it is true that the traditional definition of thinning states that it is not for regeneration, the truth is that it almost always does result in regeneration when managing shade-tolerant species. The prescribed removal percent (30-40%) in stands with groups and trails (both of which add side light) will certainly result in regeneration in stands of sugar maple, beech, spruce, hemlock, or fir (e.g.). I think that not explicitly stating this and incorporating it into the prescriptions as effectively the beginning of a shelterwood sequence creates a disconnect between the Guide and on-the-ground outcomes. The fact the CT can result in advance regeneration is extremely useful when later regeneration treatments are planned. This deserves some mention.

P. 40-44: the tending section as a whole is under cited with multiple factual statements (e.g., removal percent required for release of crop trees, age cutoffs for thinning) that should have a source as justification. Rules otherwise seem arbitrary.

p. 45: reforestation: "some species, such as white pine… should be planted in Nova Scotia with extreme caution. White pine is frequently infested with white pine weevil when regenerated in the open, resulting in multiple tops and crooked stems with low potential for sawlogs." I am surprised by the "extreme caution" aspect of this statement because one of the large production-oriented landowners in the Atlantic Provinces regularly plants white pine with success. They are planting white pine in mixture with spruce (mostly red or white) at high densities (reportedly up to 2200 per ha). Furthermore, past research indicates that some degree of overstory shading will reduce weevil damage to understory white pine; this suggests planting white pine for restoration could be successful in mixture with spruce or under retention in ISW and is something to consider.

p. 52: answering "No" to the question "Past Seed Bearing Age?" moves the user to the "Regenerate" (ISW) key. The answer "Yes" moves the user to the "Tend" key and ultimately "PCT." I find the question somewhat confusing, but believe it means "Are the trees in this stand old enough to have reached maximum seed production?" If this interpretation is correct, it does not make any sense to move to the "Regenerate" key after answering "No" because one cannot regenerate a stand that is not bearing seed. Similarly, PCT is an illogical treatment for trees past seed bearing age. I think this is a mistake, and the "Yes" and "No" arrows are reversed.

**Related to this, for multiple forest groups (p. 68, 74, 78, 86, 94, etc.) the user is asked early in the decision key whether the stand is "Past Seed Bearing Age." If the answer is "Yes" the user is moved to the "Regenerate" key. Yet full seed bearing age is specified on p. 26 as (for example) 45 years for red spruce, 50 years for hemlock and white pine, and 30 years for fir. This is, generally, half the age of economic maturity. I am concerned that initiating a regeneration sequence in a stand this young, particularly in multi-aged stands where trees are not always free to grow for a portion of their life and therefore smaller in size than their equivalents in even-aged stands, will result in premature liquidation of growing stock that could accrue additional volume and value. On some sites, a 45-year-old spruce stand would be appropriate for commercial thinning with subsequent initiation of an ISW sequence, not regeneration.

p. 57 and elsewhere: "regenerating commercial tree species are considered acceptable, provided… they do not have umbrella type crowns." This is contrary to long-standing observations (see papers by Westveld 1920s-1950s) and research elsewhere in the Acadian Forest generally and to

Seymour's recommendations specifically; umbrella trees of some shade-tolerant species (e.g. red spruce) are regarded as a valuable component of the lower stratum of trees in multi-aged stands and should be retained and released. They are AGS unless other problems make them UGS.

p. 57: "To be considered regeneration, trees must be taller than 30 cm and less than 9 cm DBH." This is unusual, usually all seedlings (including those < 30 cm, 1 foot) are considered regeneration, they just aren't considered "established regeneration." Is this a regulatory rather than ecological definition?

p. 58 and elsewhere: consider defining gap dimensions based on tree heights rather than a fixed size, so that gap size can vary to provide desired light levels in all stands, regardless of tree height (which depends on species, age, stage of development, and site). Also, consider increasing gap size relative to amount of retention to ensure that release of the new cohort is adequate. This is the approach Seymour suggests for ISW.

p. 80: the arrow from "Previously Treated" to "Established and Acceptable LIT" changes from "No" to "Yes" halfway along the line; I believe the "Yes" was supposed to go with the arrow from "Growing Stock > 20 m^2/ha"

p. 86 and 88: results from the Penobscot EF in Maine and from work by the QMFFP have shown poor outcomes in mixedwood stands when SC is applied. Specifically, these treatments simplify species composition and push the stand toward dominance by the most shade-tolerant species. In addition, gap size as prescribed for GSC (p. 89) appears too small to favor mixedwood composition in general, and regeneration of spruce and yellow birch specifically. See papers by Dumais, Prevost, and others.

p. 90: the prescription to "Tend the Leave Areas" in GSC in mixedwoods is an option from the p. 88 "Selection" sub-key, which was arrived at by having "Growing Stock > 25 m^2/ha and BA of more than 7 m^2/ha in trees > 25 cm dbh" (sawtimber). Yet the "Tend the Leave Areas" sub-key includes prescriptions for average tree height categories of < 6 m, 6-9 m, and > 9 m. I am perplexed how between-group areas in a mature stand selected for GSC would be occupied by submerchantable trees. This seems like a mistake to me.

p. 91, 93, 95 and elsewhere: PCT and CT are defined in the Guide as "uniform." "Spacing" of this sort (which creates stands in which trees are fairly evenly distributed) seems unnecessarily regular and homogeneous for ecological forestry treatments meant to maintain natural variability. Instead, I would suggest that approaching thinning with a crop tree mentality, in which desired

trees or species are released but areas without priority species are left unthinned, might result in greater variability of structure. This approach has the advantage of reducing thinning effort, particularly in PCT where income is not generated in the short term. In addition, I suggest listing species or criteria for identifying trees that should not be cut in PCT or CT, per the objectives of retention.

p. 112: SH forest group: stands where LIT predominate with AGS, high stocking, and at least 1/3 of BA in sawtimber are prescribed "Selection"; p. 114: low wind hazard and uniform AGS distribution results in SC. Yet long-term research at the Penobscot EF in Maine in hemlock-spruce-fir stands show that hemlock (and fir, when present) outcompete red spruce over the long term (see papers by Kenefic, Moores et al., and others). Furthermore, research from QMFFP suggests poor results from red spruce in SC stands (see papers by Raymond and others). Instead, if a mixture of spruce, hemlock and/or other species is desired, I would recommend one of the ISW variants.

**This is an example of difficulties with the keys for any entry, except the first, once an ISW sequence has been initiated. If one returns to this key (p. 112) for a stand that was treated once 20-30 years ago and the stand meets the criteria of abundant LIT, AGS, growing stock, and sawtimber, the user is moved to Selection rather than Regenerate (ISW). It is unclear how one would get to a second ISW treatment for a high-quality stand that started down the path of an ISW silvicultural system.

p. 115 and elsewhere: retention is specified in the groups of GSC. Retention (reserves, biodiversity trees) should also be specified between the groups, because a thinning treatment is prescribed there and would affect later availability of reserve trees.

p. 116: "Tending of Leave Areas in Group Selection" (note that this should be called the residual stand or between-group areas): a stand of trees of merchantable size, fully stocked, with LITS AGS comprising at least half of BA is prescribed "Commercial Thinning" is wind hazard is low and "Let it Grow" is wind hazard is high. This is perplexing to me, because the stocking will continue to accumulate, wind hazard will not decrease, and tree form will become less stable as stand density increases. What is the plan for these areas if they don't receive a light thinning? If these stands can't be thinned because the trees will fall down, won't the retention left in the groups (now and in the future) also fall down? I find this confusing.

p. 120: In spruce-hemlock stands with DBH > 12 cm, growing stock <27 m^2/ha, not previously treated, past seed bearing age (45-50 years, p. 26) the user is directed to Regenerate. All options on the Regenerate sub-key are variants of ISW. It is unclear to me why a stand that could be only

halfway to economic maturity (100 years, p. 26) would start a regeneration sequence. This sounds like it will lead to premature liquidation of immature growing stock. Am I missing something that would preclude this from happening or justify it?

p. 125: Spruce-pine silviculture decision key: “Spruce-pine stands are suited to even-aged or 2-3 age-class silviculture. These treatments can include clearcut harvesting, seed trees, traditional shelterwoods, or 2-3 age-class irregular shelterwoods.” This is confusing, because the Guide stated earlier (p. 37) that “even-aged silviculture systems will not be recommended in this guide.” The systems listed in the earlier section as not recommended include the first three in the list on p. 125.

p. 126: In spruce-pine stands (with or without larch) the user is directed to tend (thin) if the stand is less than seed bearing age (50 years, p. 26). Stand past seed bearing age but less than economically mature (approx. 100 years old, p. 26) are directed to a sub-key based on composition. In the spruce-pine-larch sub-key (p. 128) the user is directed through decision points including, toward the bottom, whether the stand is less than or greater than 50 years old. This is confusing because it seems that the only way to reach this key was to have previously answered that the stand was more than seed bearing age, which was defined as 50 years.

p. 134: The spruce-pine tend sub-key appears to have an error re: average heights. If white pine is >50% and average height is > 6 m, the user is told to Let it Grow. If average height is 2-6 m, the user is directed to another box to decide whether it is 6-9 m (impossible: we already said it was 2-6) or <6 m, in which case it is brought to Let it Grow. Was the intention for stands 2-6 m in height with more than 50% white pine to have “Let it Grow” as the only option? If so, why the extra decision points and two separate “Let it Grow” outcome boxes?

p. 138: There is a missing arrow on “No” line coming from the right side of the “Established and Acceptable Regeneration of LIT >30%” decision point.

p. 144: Users with fully stocked tolerant hardwood stands with some proportion of sawtimber trees with < 10m^2/ha of beech or <50% regeneration stocking in beech can be directed to SC (single-tree) if they want to favor sugar maple and have uniform distribution of AGS. A stand with close to 50% beech will be pushed to beech by single-tree selection cutting unless all beech are removed (which does not align with removal percentages in SC) or chemical control is conducted (herbicides). For stands with a lot less than 50 beech, this might be feasible. But someone with close to 50% could end up at the SC prescription and that is a bad idea. See the work by Bohn and Nyland for greater refinement of prescriptions based on amount of beech.

**p. 158: As mentioned elsewhere, prescription of Salvage with Retention in stands in which disturbance (e.g. blowdown) is greater than 25%, leaving 20% dispersed retention seems risky re: further blowdown. This practice, as is low retention continuous cover (20% dispersed retention) in stands with low LIT and high wind hazard (as shown in many keys), or as the first regeneration treatment in a highly stocked stand with advance regeneration in the Wet Coniferous forest group (noted as shallow rooted and prone to windthrow on p. 155), seems destined to result in a lot of blowdown and thus the perceived failure of ISW/ecological forestry.

p. 164: Wet Deciduous forest group, Regenerate sub-key: as with Wet Coniferous (previous comment), fully stocked merchantable stands with well-established advance regeneration are prescribed a Low-retention ISW (80% harvest). In addition to windthrow hazard due to shallow rooting on these wet sites, an 80% removal has the potential to result in a meaningful rise in the water table and long-lasting changes to the ecosystem. Is there past experience/citations indicating that this will not be a problem? See work by Chimner and others re: negative hydrologic effects from harvesting of lowlands.

Glossary

AGS: remove reference to "after thinning;" this definition is not specific to thinning treatments

Advance regeneration: this definition seems to be the same as that used for "regeneration" throughout (p. 57, 71, 81, elsewhere). I believe the descriptor "present before a harvest" should be added to advance regeneration. Also note that because the size classes are the same it is unclear how this differs from "established regeneration" defined elsewhere.

Basal area: specify that 1.3 m above the ground is on the uphill side of the tree (as written at the bottom on this page for DBH).

Cavity trees: "larger live or dead tree": consider defining "larger" as this is subjective and difficult to implement.

Clearcutting: this should be defined as a silviculture, not "harvesting", treatment. This may not be possible as this appears to be a regulatory definition, per the citation. Similarly, seed tree and overstory removal (referenced here) are also silviculture treatments, not "harvest treatments".

Commercial thinning (harvesting): "harvesting treatment;" incorrect terminology as noted above

Crop-tree release: it is unclear to me why this is not defined as a thinning treatment. All treatments which reduce density for the benefit of increased growth of residual immature trees are thinnings. They include precommercial and commercial thinning, the former of which includes

weeding and cleaning and the latter of which includes CTR, low thinning, crown thinning, dominant thinning, etc.

Ecological Matrix: include citation for Triad model. Re: the statement: "but allow for clearcutting where appropriate": this is confusing. Not only is clearcutting not appropriate under ecological forestry generally, it was stated earlier in the Guide (p. 37 and elsewhere) that it is not recommended.

Full-tree harvesting: I suggest also stating that this is also known as whole-tree harvesting, which is the more common terminology elsewhere.

Group selection (harvesting): a "harvesting treatment": this is incorrect. Change to a silvicultural treatment. Also groups are "cleared to create conditions for regenerating species": this is incorrect. As described in this Guide, they include dispersed retention. In addition, a common and often successful approach to GSC is to not only locate groups where mature or non-commercial trees are present (as defined here) but where advance regeneration can be released.

Single-tree selection (harvesting): a "harvesting treatment": incorrect terminology, undue emphasis on harvest (extraction). Correct terminology here and throughout to shift focus to silviculture.

**Leave-tree and Legacy tree or clump: defined for biodiversity purposes. These terms should be cross walked with retention/reserves. Also, I suggest that retention be better defined re: leave/legacy trees versus growing stock for later harvest; the proportion of each (or at a least a minimum proportion or number of reserve trees) should be specified in the ISW treatments and leave/legacy trees added to SC and GSC prescriptions.

Mature climax: I question this definition, as 80 to 125 years seems somewhat arbitrary give the varying maturities and longevities of the various species across Nova Scotia and 30% seems a very low required crown closure for a "mature" stand. I think the difficulty here is that those numbers are a minimum appropriate for some forest groups but have the possibility to cause immature stands of other forest groups (e.g. TH or SH) to be misclassified as "mature".

Old growth: the definition as presented here would overclassify numerous stands as old growth which are not, in fact, providing old-growth structure and function from an ecological perspective. This is problematic re: the Reserve areas of the Triad Model. Because that is outside the scope of this Guide, I will not go into detail about this here. But this definition will not stand up to scrutiny outside the Province. See writings by Wirth, Hunter and White, and others.

Partial harvest: "a harvest treatment leaving more than 60% of the area occupied by trees": this seems arbitrary and not consistent with common usage.

Precommercial thinning: "Harvest treatment": this definition is technically incorrect. It is a silvicultural treatment and does not remove merchantable material from the stand. It is not a harvest. Also note that weeding is a form of precommercial thinning; that is not how these terms are used in this Guide and I suggest clarification.

Regeneration (natural): omit the last two lines of this definition referring to seed tree or shelterwood. Many other silvicultural treatments (including SC, GSC, and ISW, not listed here) can be used to establish regeneration.

Rutting: also made by continuous (lag or tank) tracks of vehicles, not just tires.

**Salvage (harvesting): please reconsider the role of salvage (in which trees are already dead) and pre-salvage (not defined in this Guide, but the correct term for cutting trees that are damaged or dying before they die) in ecological forestry. I am not suggesting that these treatments are not appropriate in some situations, but the two practices need to be recognized as distinct with additional information of when they are applicable and when they aren't. I don't believe a "salvage" of 80% of a stand is always (or often) warranted when disturbance levels are far less. It is important to carefully address this to avoid repeating the abuse of "salvage," which historically occurred in Maine during budworm outbreaks when trees of many species, regardless of vulnerability or species, were liquidated unnecessarily in stands where SBW mortality occurred or was anticipated. As this seems to be primarily related to wind damage (blowdown) in this Guide, the need for "salvage", particularly of unaffected trees, is questionable. Finally, please see work by Kern and others and by Fraver re: the advantages of tip-mounds for regeneration of certain desirable species and the loss of these during salvaging.

Scarify, scarification: please distinguish between passive and active scarification. See work by the QMFFP and others. Also note that scarification is not only for site prep for planting as stated here, but to reduce established competition and mix the upper layer of soil for regeneration of birches and other similar species requiring moisture-holding substrates.

**Silviculture: the "science and art of cultivating forest crops" reflects a timber-product mindset that is neither consistent with the long-standing and foundational definition of silviculture or the use of silviculture for ecological forestry. This is unfortunate as it seems to be codified in the Forests Act. The agricultural paradigm inherent to silviculture as defined here reflects the approach previously used in Nova Scotia and would be good to revise going forward.

Skidding: this is correct, but I suggest also defining Forwarding as another means of moving trees to the landing.

Stocking: please define this term in terms of both stand stocking and regeneration stocking.

Strip cut: this term is defined using a reference to a strip shelterwood. While a strip shelterwood uses strip cuts, not all strip cuts are in shelterwoods. Strip clearcutting, for example, is a valid silvicultural term. I suggest not defining strip cut this way. I'm not sure why it is defined here, as it was stated earlier in the Guide that non-ISW variants of shelterwood are not recommended.

**Unacceptable growing stock: one of the conundrums in the Guide as written is that managers are asked to both retain LIT for seed source and increase the proportion of AGS. There will be situations, particularly where LIT and prescribed retention are low, where these two objectives cannot be simultaneously achieved. I think that the explanation of this and priorities would be much clearer and result in both better implementation and better reporting outcomes if the distinction of "seed-source UGS" which Nyland has been promoting in recent years were added. I think that this is an important breakthrough because it recognizes that the manager was being thoughtful about which UGS to keep and why. I envision that reporting proportion of residuals as only UGS or AGS would be much less desirable than reporting SUGS, UGS, and AGS. In theory, trees not needed for seed source (SUGS) should all be biodiversity trees or AGS. Related to this, some AGS should be designated as biodiversity trees in order to maintain health and vigor over the long-term (i.e., so all reserves aren't high-risk trees). I'm not sure that this is explicit in the Guide.

Unmerchantable wood: I suggest also adding a definition of unmerchantable trees and submerchantable trees.

Wildlife tree or clump: definition refers to "Legacy tree or clump." In general, legacy trees are for ecological memory and can serve many objectives other than wildlife. Please refine.

Appendix I: FAQ (p. 179-180)

Bullet 4. "Are all striped maple, mountain maple, grey birch, and pin cherry UGS?" Answer: "Yes." This is an unusual application of AGS and UGS. Usually, species are divided into non-commercial and commercial species. Commercial species are listed as AGS or UGS. Non-commercial species are not listed as AGS or UGS. Product potential is irrelevant because they are, by definition, not commercial.

Bullet 7. "Are all multiple stem trees considered UGS?" Answer: "Not necessarily. If both stems…" Please revise this answer to address situations in which there are more than two stems.

Bullet 8. Answer: "At most, tally 2 stems in a clump as AGS. If more than 2 stems in a clump meet AGS specification, count the excess stems as UGS to avoid over-estimating potential…" This misclassification of AGS stems as UGS seems like a poor workaround re: the fact that some trees (esp. red maple) sprout after harvest and can have numerous stems originating from one stump. Instead of recording some good stems (low risk, good form and quality) as UGS (high risk, poor form or quality), I suggest devising an inventory and stand prescription process that can handle designation of some proportion of stems as clumps.

Bullet 11. "Why use a 15-year project period?" Answer: "15 years is used as the typical time when the next harvest is expected in commercial thinning or selection…" This does not account for the fact that the majority of the regeneration treatments (harvests) will now be ISW with a longer-than-15-year interval between cutting, or the fact that there are no selection prescriptions with a 15-year cutting cycle in the Guide. Why not assess AGS and UGS potential based on the time until the next entry? Please consider revising the time frame for AGS assessment so that it is based on silvicultural prescription not (as currently stated on p. 180) the amount of time required for "catch up" based on land capability. The latter is an even-aged paradigm.

Bullet 15. "if a tree has a dead or missing top amounting to more than 1/4 of the crown, then it should be called an UGS." Depending on species, a broken top (regardless of proportion of live crown missing), can be an important entry port for decay and would classify a tree as an UGS. Is there a citation for the 1/4 rule? Should this vary by species? See work by Shigo, Smith, and others.

Bullet 17. I believe that this sentence should read "Some UGS are valuable for biodiversity".

***Pre-treatment Assessment*

p.183: these protocols should be revised to include stratified sampling of gaps and between-gap areas in gap ISW stands, or stand-level data will be homogenized and will not reflect the stocking between gaps (i.e. where subsequent regeneration harvests will occur) or within gaps (where PCT or CT might be needed). A similar problem will arise in GSC.

**Canopy structure (single/multiple cohorts): I agree that this is very important to determine (i.e., whether the stand is even- or multi-aged, because that will tell the manager whether conversion to a multi-aged structure is needed if SC is desired). However, canopy structure is not equivalent to age structure. Even-aged stratified stands can have different canopy layers

composed of different species, all of the same age but the different shade tolerances or growth rates. So while a multi-aged stand will have two or more strata, a stand with two or more strata is not necessarily multi-aged. The distinction should be explained somewhere; it is currently not mentioned in the Guide.

Regeneration stocking in % (Total and LIT): are noncommercial species included in this, i.e. grey birch, pin cherry, etc.? It seems like a manager would need to know if there is a lot of competition from non-commercial species, but wouldn't want to just include it in the total because those aren't representative of future AGS per the earlier definition.

Average stand height: this doesn't work in multi-aged stands, unless it means average height of the upper canopy. Even then, it won't convey heights in gaps, etc. Is this for determination of site index? Note that trees are rarely free to grow in multi-aged stands and thus the methods of Fajvan and Seymour should be used to calculate site index (not sure if that is relevant here).

Appendix III. Harvest Prescription Standards (p. 185-189)

This section seems to include a combination of both silvicultural prescriptions and instructions for operators. I suggest a revision of terminology throughout, so the word harvest is not included in the names of silvicultural systems but is used only when discussing operations. Differentiating between the two is an important shift in mindset toward ecological forestry.

p. 185: area in trails (no more than 25%) is specified for CT, SC, and uniform SW in column 4, but column 2 states that the prescription is for all but salvage with retention and low-retention ISW. Please revise for consistency. Also note that though 25% is not unreasonable for commercial harvests (in fact, many similar mechanized harvests in Maine result in >30% area in trails), this means (if trails are re-used) that 25% of the growing stock in the stand is removed from production if frequent (e.g. 20-year) re-entries are planned because regenerating trees will be repeatedly run over. If trails are relocated, it seems like all the standing trees will be removed over time in the stand, precluding stand-wide retention and distributing harvest impacts. Trails are typically reused in silvicultural systems with multiple re-entries over a rotation, unless the treatment is a strip shelterwood or similar strip clearcut.

p. 185: "maximum average width of 7 m, measured bole to bole." As an average, this standard means that there will be trails both wider and narrower than this. I am unsure of the type of harvesting equipment used in Nova Scotia, but this seems unusually and unnecessarily wide. Furthermore,

in order to keep area in trails 25% or less, between-trail distances would be 22 m, which only works with machine reach >11 m. I don't know if this is the norm; it isn't always elsewhere.

p. 185: "for group selection and patch shelterwood… trails connecting openings not to exceed 7 m in width." Patch shelterwood is not prescribed in this Guide; why is it referenced here? Also, gap ISW should be included. Though it is unclear, I am concerned that the reference to "trails connecting openings" means that trails will go through the openings. One of the keys to successful implementation of ISW is that trails do not intersect openings, but rather – to the greatest degree possible – are located adjacent to openings and the machines reach in. Otherwise, advance regeneration to be released in gaps will be damaged during operations. Though this is less of a concern where advance regeneration is not present, locating trails for re-use in gaps will hinder successful regeneration of target species in those areas, particularly in operations where slash is placed on the ground in trails for site protection. See work by Seymour, Saunders, and others.

p. 186: "increase the proportion of mast bearing trees (red oak, beech)": This seems incompatible with effective management of beech, per beech bark disease (BBD). While I agree that some beech should be left, having a universal goal of increasing the proportion of beech does not seem consistent with maintenance of a healthy forest (or a non-beech-dominated composition) in light of the effects of BBD in the aftermath forest.

p. 186: trails are excluded from the area to be managed in SC (note: incorrectly referred to as leave strips); I agree with this approach because the trails must be permanent in stands with frequent entries. Therefore, the area in trails cannot managed for a multi-aged structure (they will be cleared every 20 to 30 years).

**However, I am concerned that the standard for GSC on p. 186 specifies "remove at least 1/3 of the area in patches, including trails." In effect, this means that the regenerated areas in the stand will consist of the trails and groups; this is not a viable plan because the trails must be re-used. In addition, if a manager is planning 20% removal (as shown in the timeline on p. 29) and the area in trails (25%) is included in the area opened in groups, they have already over-regenerated the stand by 5% without cutting any actual groups. If instead, removal percent is at least 33% as specified in the Guide, then not only will the majority of "groups" still be trails, but the manager will only be able to cut 1-2 actual groups per ha and will regenerate the whole stand in less than 3 entries and have fewer younger cohorts than shown on page 29.

p. 186: I suggest not referring to areas between groups or gaps as “leave areas” and the areas between trails as “leave strips”. These are neither leave areas nor leave strips (note implied parallel to “leave trees”, i.e. reserves). Counting these areas, which are thinned based on the prescriptions and keys, as “leave areas” seems misleading as the reader will assume this means they are not harvested.

p. 186: the description of ISW (continuous cover) presented here is helpful in that it specifies that 20% (15 to 25%) must always be retained after the final harvest (this previously was not stated in either the Silviculture Prescriptions section or keys). However, I am confused that this is specified here as the “second pass”; no second harvest is possible in the low-retention (first-pass 20% retention) variant.

6.0. REFERENCES

Bassil, S.; Nyland, R.D.; Kern, C.C.; Kenefic, L.S. 2019. Dynamics of the diameter distribution after selection cutting in uneven- and even-aged northern hardwood stands: A long-term evaluation. Canadian Journal of Forest Research 49(12): 1525-1539.

Carter, D.R.; Seymour, R.S.; Fraver, S.; Weiskittel, A. 2017. Reserve tree mortality in two expanding-gap silvicultural systems 20 years after establishment in the Acadian Forest of Maine, USA. Forest Ecology and Management 389: 149-157.

Chimner, R.A.; Cooper, D.J.; Wurster, F.C.; Rochefort, L. 2017. An overview of peatland restoration in North America: Where are we after 25 years? Restoration Ecology 25(2): 283-292.

D'Amato, A.W.; Raymond, P.; Fraver, S. 2018. Old-growth disturbance dynamics and associated ecological silviculture for forests in northeastern North America. In: Barton, A.M.; Keeton, W.S. (eds). Ecology and Recovery of Eastern Old-Growth Forests. Washington DC: Island Press: 99-118.

Dumais, D.; Prévost, M. 2014. Physiology and growth of advance *Picea rubens* and *Abies balsamea* regeneration following different canopy openings. Tree Physiology 34(2): 194-204.

Fraver, S.; Dodds, K.J.; Kenefic, L.S.; Morrill, R.; Seymour, R.S.; Sypitkowski, E. 2017. Forest structure following tornado damage and salvage logging in northern Maine, USA. Canadian Journal of Forest Research 47(4): 560-564.

Graves, H.S. 1899. Practical forestry in the Adirondacks. U.S. Department of Agriculture, Division of Forestry.

Hunter, M.L. Jr.; White, A. 1997. Ecological thresholds and the definition of old-growth forests. Natural Areas Journal 17: 292-296.

Kern, C.C.; Burton, J.I.; Raymond, P.; D'Amato, A.W.; Keeton, W.S.; Royo, A.A.; Walters, M.B.; Webster, C.R.; Willis, J.L. 2017. Challenges facing gap-based silviculture and possible solutions for mesic northern forests in North America. Forestry 90: 4-17.

Kern, C.C.; Schwarzmann, J.; Kabrick, J.; Gerndt, K.; Boyden, S.; Stanovick, J.S. 2019. Mounds facilitate regeneration of light-seeded and browse-sensitive tree species after moderate-severity wind disturbance. Forest Ecology and Management 437: 139-147.

Lussier, J.M.; Meek, P. 2014. Managing heterogeneous stands using a multiple-treatment irregular shelterwood method. Journal of Forestry 112(3): 287-295.

Meek, P.; Lussier, J.M. 2008. Trials of partial cuts in heterogeneous forests using the multiple-treatment approach. Advantage 10(2): 1-16.

1155 Moores, A.R.; Seymour, R.S.; Kenefic, L.S. 2007. Height development of shade-tolerant conifer saplings
1156 in multiaged Acadian forest stands. Canadian Journal of Forest Research 37: 2715-2723.
1157 Neuendorff, J.K.; Nagel, L.M.; Webster, C.R.; Janowiak, M.K. 2007. Stand structure and composition in a
1158 northern hardwood forest after 40 years of single-tree selection. Northern Journal of Applied
1159 Forestry 24(3): 197-202.
1160 Nyland, R.D. 2003. Even- to uneven-aged: the challenges of conversion. Forest Ecology and Management
1161 172: 291-300.
1162 Nyland, R.D. with Kenefic, L.S.; Bohn, K.K.; Stout, S.L. 2016. Silviculture Concepts and Applications, Third
1163 Ed. Long Grove, IL: Waveland Press, Inc.
1164 Olson, M.; Meyer, S.; Wagner, R.; Seymour, R. 2014. Commercial thinning stimulates natural
1165 regeneration in spruce-fir stands. Canadian Journal of Forest Research 44(30: 173-181.
1166 Pinchot, G. 1898. The Adirondack Spruce. The Critic Co.
1167 Prévost, M.; Charette, L. 2015. Selection cutting in a yellow birch-conifer stand in Quebec, Canada:
1168 Comparing the single-tree and two hybrid methods using different sizes of canopy opening.
1169 Forest Ecology and Management 357: 195-205.
1170 Puhlick, J.J.; Kuehne, C.; Kenefic, L.S. 2019. Crop tree growth response and quality after silvicultural
1171 rehabilitation of cutover stands. Canadian Journal of Forest Research 49(6): 670-679.
1172 Raymond, P.; Bedard, S.; Roy, V.; Larouche, C.; Tremblay, S. 2009. The irregular shelterwood system:
1173 Review, classification, and potential application to forests affected by partial disturbances.
1174 Journal of Forestry 3(11): 35-38.
1175 Raymond, P.; Royo, A.A.; Prévost, M.; Dumais, D. 2018. Assessing the single-tree and small group
1176 selection cutting system as intermediate disturbance to promote regeneration and diversity in
1177 temperate mixedwood stands. Forest Ecology and Management 430: 21-32.
1178 Rogers, N. 2020. Long-term dynamics and silviculture of northern hardwood forests in the Northeast
1179 United States. Ph.D. Dissertation. University of Vermont.
1180 Seymour, R.S. 1992. The red spruce-balsam fir forest of Maine: Evolution of silvicultural practice in
1181 response to stand development patterns and disturbances. In Kelty, M.J.; Larson, B.C.; Oliver,
1182 C.D. (eds). The Ecology and Silviculture of Mixed-Species Forests: A Festschrift for David M.
1183 Smith. Dordrecht: Springer Netherlands.
1184 Seymour, R.S. 1995. The northeastern region. 1995. In Barrett, J. W. (ed). Regional Silviculture of the
1185 United States. New York: John Wiley and Sons, Inc.: 31-79.

1186 Seymour, R.S.; Fajvan, M.A. 2001. Influence of prior growth suppression and soil on red spruce site
1187 index. Northern Journal of Applied Forestry 18(2): 55-62.
1188 Seymour, R.S.; Hunter, M.L. Jr. 1992. New Forestry in Eastern Spruce-Fir Forests: Principles and
1189 Applications to Maine. Misc. Publ. 716. Maine Agricultural and Experiment Station, University of
1190 Maine.
1191 Shigo, A.L. 1965. Pattern of defect associated with stem stubs on northern hardwoods. Research Note
1192 NE-34. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest
1193 Experiment Station.
1194 Smith, K.T.; Shortle, W.C. 2003. Radial growth of hardwoods following the 1998 ice storm in New
1195 Hampshire and Maine. Canadian Journal of Forest Research 33: 325-329.
1196 Tian, S. 2002. Effect of precommercial thinning on root development and root and butt decay incidence
1197 of red spruce and balsam fir. Ph.D. Dissertation. University of Maine.
1198 Westveld, M. 1928. Observations on cutover pulpwood lands in the Northeast. Journal of Forestry 26(5):
1199 649-664.
1200 Wirth, C; Messier, C.; Bergeron, Y.; Frank, D.; Fankhänel, A. 2009. Old-growth forest definitions: A
1201 pragmatic view. In Wirth, C.; Gleixner, G.; Heimann, M. Old-Growth Forests: Function, Fate and
1202 Value. Berlin, DEU: Springer-Verlag: 11-33.

Attachment D:Laura Kenefic Review of Revised SGEM (April 2021 version)

April 30, 2021

Comments on the SGEM (April 2021 Revision) for the Lahey Review

Laura Kenefic, U.S. Forest Service, Northern Research Station

Summary: Aside from some language that merits minor revision to avoid the misimpression that this is an "anything but clearcutting" effort and the need/opportunity for additional information about the mechanism for learning/revision, my comments are as follows:

- the azonal versus zonal classification and associated retention targets are poorly explained and inadequately justified
- some of the restoration pathways seem more like traditional site conversion, which may be appropriate but merit clearer presentation
- salvage cutting remains problematic from an ecological standpoint as described
- the spruce-pine FG is designated as azonal but merits additional justification re: this FG-level allocation to simplified silvicultural systems with lower retention and fewer reserve trees, particularly where red spruce is present

Detailed comments: I appreciate the opportunity to review the latest version of the SGEM, focusing on content added after my first review.

The SGEM as written recognizes and accurately describes the characteristics of and inherent tradeoffs in ecological forestry. Specifically, as an approach in which both ecosystem and production objectives are combined, neither can be perfectly attained. In addition, there is no one "right" way to achieve any forestry objective (let alone competing objectives); this is why silviculture is often described as an art and a science. With that context, I find that the SGEM as a whole represents important progress toward implementation of ecological forestry on Provincial lands in Nova Scotia.

At the same time, there are some aspects of the SGEM which seem not clearly aligned with the stated objectives of this paradigm shift. These detract from the overall effectiveness of the SGEM in communicating to stakeholders and practitioners the Department's full engagement in implementation of the recommendations of the Lahey report, and could potentially lead to forestry practices that are contrary to its stated intention. Finally, there are some statements in the SGEM that give the impression that a harvest-focused (i.e., simply "not clearcutting") mentality persists. Though these are minor, they undermine the effectiveness of the effort and so I mention them here.

<u>WORDING</u>

P. 4. "The Silvicultural Guide for the Ecological Matrix *is considered adaptive in nature and will be revised as new information is gathered and analyzed*."

This is important and merits additional emphasis and explanation. This is the first, best attempt based on available literature and Nova Scotia experience. Having said that, application of ecological forestry at this scale (and in a system that was previously production-oriented with a highly simplified structure) is a new venture for the Province. I think that this fact, and that there will be lessons learned, should be more explicit.

In addition, I think it is important to clarify for stakeholders (and to ensure commitment to revision and transparency) how future revisions will be handled. Will this be ad hoc? By whom? What is the mechanism for achieving this? This isn't a new concept; "adaptive management" has been in the literature out of the Pacific Northwest for many decades. I would like to see more about what processes will be in place for updates as information comes in from the field and outcomes are evaluated. While I concede that is not needed to implement the silviculture described here, it provides transparency re: the role of this document in the larger effort. I see this as positive, as people who question whether outcomes will be successful can be reassured that there can be adjustments if things aren't going well.

P. 6. "The SGEM presents one aspect of Sustainable Forest Management and Ecological Forestry in Nova Scotia. It applies *to forest attributes retained during harvest operations* at the stand-level scale within the ecological matrix zone of the triad system (emphasis added)."

While the SGEM does address retention during harvest operations, it is much more than that. It defines silvicultural systems, or series of treatments, for achieving objectives. It also includes non-harvest treatments such as planting and precommercial thinning. This wording appears to be a holdover from earlier thinking about how to implement ecological forestry. I suggest deleting this sentence or changing it to "It applies at the stand-level scale within the ecological matrix zone of the triad system."

P. 7. "The SGEM supports biodiversity by: Not prescribing harvesting in sensitive forest groups; Moving *away from even-aged (clearcut) management* towards multiple-aged management with greater tree species diversity (emphasis added); Introducing the retention of live permanent reserve trees in all harvests; Restoring Acadian forests to late-successional conditions; Promoting a diversity of stand structures, ages and compositions."

The second item on the list is inherent in the last two. I know moving away from clearcutting is part of this process, but mentioning it here suggests a continued emphasis on this as a "not clearcutting" initiative. Though that might be an outcome of this paradigm shift, it isn't convincing as a statement of commitment to ecological forestry. I suggest simply saying "Moving towards multiple-aged management with greater tree species diversity."

P. 11. "The *emerging science* of disturbance ecology, involving reconstruction of natural disturbance regimes for forests of various kinds, provides the essential knowledge base to formulate ecologically-based silvicultural systems."

Disturbance ecology is not emerging, but a long-established field; this is stated at the bottom of the same page ("from decades of disturbance ecology research…"). Delete emerging, it creates a misimpression that the authors are not familiar with the depth of work in this field.

P. 12 "In a similar fashion, where stand-replacing disturbances predominate due to climatic, nutrient or water limiting conditions, *lighter retention* uneven-aged systems are appropriate (emphasis added)."

Lighter retention is not a commonly used phrase and seems like a way to avoid saying heavier removals. I propose a compromise as follows: "…uneven-aged systems with less retention are appropriate." "Lighter" is associated with a "lighter touch" in forestry; "lighter retention" is potentially misleading.

SILVICULTURE

P. 13 and elsewhere: (A)zonal classifications

I am very confused by this. I spent a lot of time trying to figure out what it adds to the practitioner's ability to prescribe nuanced, site-specific prescriptions as inherent to ecological forestry. As far as I can tell, previous work by Neily, Keys, and others provides an excellent and ecologically robust framework for prescribing treatments on all sites using data from the PTA. That previous work provides the basis to identify FG and VT (which themselves reflect natural disturbance and other abiotic and biotic factors), soil damage hazard, wind hazard, etc. Yet the (a)zonal classification is introduced as a means of specifying where "climate dominates successional patterns" and where "site conditions such as soil fertility dominate succession"; these are not well defined. Given that this puts individual stands (or even FGs or VTs?) onto one pathway or another, regardless of other factors such as local stand structure and nuances of composition, additional explanation is warranted. The following need to be explicit:

- What exactly does the (a)zonal distinction provide that can't be derived from the FEC and other similar resources?
- Zonal: What is meant by "climate dominates successional patterns"? Please explain.
- Azonal: What are the site conditions (such as, but apparently not only, soil fertility) that dominate succession? I am confused by the statement that soil fertility dominates succession on azonal sites, because it is later stated (P. 25) "When Azonal Acadian ecosites are encountered, where natural disturbance regimes are characterized by more severe disturbances…". Is natural disturbance or soil fertility the driver, or both?
- Why is ISW – which can be used to create two-aged stands – listed here as "feasible only on these (zonal) ecosites"? The implication here is that two-aged stands will not be created/managed on azonal sites (though it is stated that they will on P. 31). Perhaps the authors do not define the simpler two-aged versions of ISW as ISW? If so, this is an uncommon usage that contributes to confusion and the unfortunate impression that ecological forestry will not be applied appropriately on azonal sites.
- Can a table be added listing the (a)zonal classification of the FGs presented in the key? This seems important: which FGs (or subset of FGs, and if so why) are designated for only "simpler silvicultural systems" per their azonal classification? This is not clear, as some keys have retention specified for both azonal and zonal (the only one I could find that lists azonal only is spruce-pine). Is a map needed?

P. 26. Minimum level of reserve trees in zonal and azonal sites are 20 and 15 per ha, respectively. Where did these numbers come from? Why is 15 per ha acceptable on azonal sites but 20 is not?

It is difficult for me to judge the appropriateness of the silvicultural prescriptions in regard to these two types, because I don't understand them. And if I don't understand them, I suspect there are others who would be similarly confused. That in and of itself if a problem to be resolved. Current explanation is inadequate. Additional justification, explanation, and clarity are needed.

Bottom line: does this new classification system add information that can't be extracted from Neily and other work, or is it a means of simplifying classification for ease of prescription? If that latter, I suggest dropping it and being explicit about what the conditions of concern (currently defined as climate and site conditions such as soil fertility) are within each FG/VT.

P. 28. Restoration and P. 69. Restoration Planting

Restoration is introduced as a means of restoring LIT composition where few LIT trees are present; it is stated on P. 28 that this requires enrichment and fill planting as well as the need to retain LIT and sufficient non-LIT in the overstory to provide shade to favor slow-growing LIT trees over non-LIT volunteers. However, on P. 69 additional details are provided and include advice for site preparation, including reducing forest floor thickness and exposing mineral soils, with reference to soil condition "after an overstory removal." It appears based on this that restoration is conducted within the context of OSR. This is confirmed in the IH-R key on P. 95 for most cases. Of note, stands with <50% LIT regen and <75% LIT in the overstory are prescribed a 66% to 80% removal. This seems counter to providing adequate shade for non-LIT regen (especially at the 80% removal level), and is a problem I mentioned in my previous review: the less LIT present, the heavier the prescribed removal will be, even if trying to regenerate LIT. It is not apparent to me that a harvest this heavy is justified, particularly on sites where LIT overstory is on the high side of the range between 0 and <75%.

The outcome of these restoration treatments will be a very open stand (as much as 80% open). This will favor non-LIT regeneration, likely necessitating site preparation, planting of LIT, and competition control. The need for this might be minimized if more overstory is retained. I suggest that uniform shelterwood with reserves, which has a higher residual density and thus favors LIT regeneration, could be applied in more of the scenarios described here. This seems more in line with the silvics of the species you hope to regenerate and successfully recruit, even if planted.

Finally, as written, there is very little about these restoration treatments other than an emphasis on LIT regeneration that aligns with what is commonly regarded as "restoration" in ecology or forestry. Forests of large trees and high canopy cover will be converted into very open forests. I am not opposed to this approach, but fear it is misaligned with the generally accepted definition of restoration. To mitigate this, if such an approach is desired to rapidly reduce the amount of non-LIT trees and increase LIT regeneration, then call it "species restoration" or "site conversion to LIT." Otherwise, I fear this will be poorly received.

P. 59. Salvage with Retention

"Salvaging is no longer an option within the SGEM, *however it may still be necessary as a result of natural disturbance*."

I appreciate that salvaging is no longer presented as an option, but the text states it "*may still be necessary where a high proportion (> 50%) of the trees in a stand are clearly damaged, dead, or dying because of natural disturbances such as wind, insect infestation, disease, or fire, the stand may be considered for salvage."*

This is problematic as stands with low stocking may experience >50% mortality, moving them from a low retention scenario to a salvage scenario, with at times a "complete removal". Though it is stated that special permission from the NSL&F Crown land staff is needed and IPM staff must be consulted, there appears to be a great deal of latitude here. Greater clarification of the scenarios in which salvage is appropriate is needed. Salvage cutting is not inappropriate but is (with very few exceptions related to spread of insects that infest dead trees) usually done to capture commercial value. As ecological forestry balances production and ecological value, such emphases on the production side of things is reasonable

and possibly necessary to maintain economic viability of management. I suggest it would be useful to make it explicit that this is done to capture commercial value and/or be clearer about potential situations where it would be appropriate from an ecological perspective. A skeptic might think this reflects an intention to harvest all sites where half of scattered or low retention has blown down.

P. 141. Spruce – Pine Decision Key

"Spruce–pine stands *are suited to even-aged or 2 age-class silvicultural (sic). These treatments can include seed trees, regular shelterwoods, irregular shelterwoods or shelterwoods with reserves*."

I looked specifically at this key because it is for the only FG that is identified exclusively as azonal, a classification that was not used in the first version I reviewed. Very early in the SGEM, it is discussed that natural disturbances very rarely kill 100% of the trees on a site. It seems unlikely to me, in this context, that the application of traditional production-oriented silvicultural methods, particularly seed tree and regular shelterwood, would achieve a desired outcome from an ecological forestry perspective. Furthermore, the statement "Natural regeneration *should be considered the first choice for re-establishment* of an SP forest stand" is concerning because it suggests that planting is an acceptable (if not first-choice) option.

In short, the text in the key indicates that a very traditional (non-ecological) approach to silviculture will be employed. Though the keys themselves do not mention some of those treatments, uniform PCT and CT as well as variants of regular shelterwood are indicated, as well as harvests on some sites of 80%. Finally, though I can see that oak – pine composition takes the user to a different sub-key, there is discussion in the introductory section about red spruce versus black spruce with regard to hybridization. Yet the keys lead primarily to even-aged prescriptions that seem more suited to black spruce, without apparent distinction between the two species (or degree of hybridization). Red spruce is relatively more windfirm and more suited in silvical characteristics for management aimed a creating more than one or two age class(es), and certainly when in mixture with white pine. I suggest that the descriptive text at the front of the key for the FG be reviewed and revised for better consistency with prescribed treatments, and that greater clarity be offered within the keys themselves re: important distinctions between silviculture for red versus black spruce. I am not convinced, as presented, that stands with red spruce – which appear to be included here – are appropriately managed in an ecological forestry context with the more traditional even-aged (or even two-aged) applications.

In closing: I appreciate the amount of work and attention to detail, including appropriate and consistent use of terminology and careful editing, that went into the SGEM. It is clear that earlier feedback was considered and addressed. I hope my latest comments will be received in the spirit that they are provided: in service of successful implementation of ecological forestry in the Province.

Attachment E: List of Evaluation Related Activities and Material

Attachment E. Summary of Evaluation Related Activities and Material

	Implementation Material
December 1, 2018	Government Response to Review
October 2019	Implementation Report Template (Spreadsheet) provided to Department
May 7, 2020	Department's Implementation Report
September 10, 2020	Responses to Evaluation Team Questions on Implementation Report
September 10, 2020	Executive Summary to Implementation Report
	Forest Management Guide
March 14, 2020	Laura Kenefic Review of Draft Silviculture Guide for the Ecological Matrix (SGEM) (Dec 2019 version)
September 10, 2020	Confidential Draft of Revised SGEM and response to Laura's comments
April 30, 2021	Laura Kenefic Review of Revised SGEM (Apr 2021 version)
	High Production
October 29, 2020	Presentation to Al Gorely on HPF Project
November 12, 2020	Al Gorley's Report on Revised HPF Paper
	Environmental Assessment
April 26, 2021	Project Update and Draft Guide for Preparation on Forest Stewardship Plans provided to Bill Lahey
May 2, 2021	Al Gorley comments on EA material
	Species at Risk
November 12, 2020	Presentation on Species at Risk Progress
November 27, 2020	Supplemental Material on SAR Action Plans
November 26, 2020	Jane Barker – Comments on SAR Progress
December 12, 2020	Mac Hunter – Comments on SAR Progress
	Natural Disturbance Regime
December 12, 2020	Mac Hunter's Review of NDR Paper
	State of Forest Report
July 6, 2020	Presentation – Progress Update: State of Forest Report
	Minister's Advisory Committee
April 2, 2020	Minister's Advisory Committee Meeting
June 11, 2020	Minister's Advisory Committee Meeting
June 11, 2020	Evaluation Comments – Angie Gillis
June 12, 2020	Evaluation Comments – Karen Beazely
June 20, 2020	Evaluation Comments – Mary Jane Barker
July 6, 2020	Evaluation Comments – Mary Tulle
July 8, 2020	Evaluation Comments – Greg Watson

August 20, 2020	Evaluation Comments – Raymond Plourde (verbal)
August 24, 2020	Evaluation Comments – Donna Crossland
September 5, 2020	Evaluation Comments – Debbie Reeves
September 9, 2020	Evaluation Comments – Bevan Locke
April 21, 2021	Minister's Advisory Committee Meeting

Mi'kmaq

June 15, 2020	Evaluation Meeting with Mi'kmaq

Evaluation Team

Jun 27, 28, 2019	Evaluation Team Workshop
Nov 27, 28, 2019	Evaluation Team Workshop