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Re: Draft Nova Scotia Silvicultural Guide for the Ecological Matrix

Key conclusions

The draft Nova Scotia Silvicultural Guide for the Ecological Matrix (SGEM) represents an improvement over previous published Forest Management Guides (McGrath, 2018), yet it is deficient in significant ways and requires further refinement.

Given the highly technical nature of the SGEM and the extensive revisions since review of the earlier draft, another peer-review by Dr. Laura Kenefic or other arms-length expert is warranted for the current version.

As the SGEM is an improvement over previous guides, it should be implemented as soon as possible as an 'interim' guide, with the caveate that further refinements will be required pending peer review, incorporating suggestions that arise from this public consultation, and as other parts of the Lahey recommendation implementation process advance and understanding improves.

In the meantime and throughout the 'interim' period there should be an immediate moratorium on variable retention 10-30%, uniform shelterwood, overstory removal, salvage cuts and other clearcut and near-clearcut harvest approvals.

Critical aspects to be better understood, developed, implemented and accounted for within the SGEM prior to considering it 'final' rather than 'interim' include:

- A province-wide, spatially-explicit, systematically-designed, biodiversity-ecological network plan to serve as the underlying blueprint for ecological and biodiversity considerations for implementing the triad and spatial application of the SGEM, consisting of: core areas of protection; other key areas where biodiversity conservation objectives are prioritized; ecological corridors connecting them; and, buffer areas surrounding them;
- Complete implementation of the current NS Parks and Protected Areas plan and expansion to protect additional areas to capture representative examples of all eco-districts and ecosites on Crown lands, including those that currently are not adequately represented;
- Formal acceptance of species-at-risk recovery plans, including designated spatially-delineated core and other key habitat areas required for population and habitat connectivity;
- Dramatically enhanced special management practices to better reflect the demographic, behavioural and habitat requirements of vulnerable species;
- Ecologically-relevant guidelines for riparian and other buffer widths that are based on active river area (hydrological and topographical parameters) and wildlife species needs

rather than minimal fixed-width buffers based solely on runoff (erosion, pollution, sedimentation) considerations;
- Embedded guidelines for planning, constructing, managing and decommissioning forest roads to minimize road density and direct and impacts of roads on wildlife and other ecological function, structures and processes in both terrestrial and aquatic systems;
- Inclusion of tree removals for forest roads, skid tracks and trails, and other access and operational purposes in calculations of areas and biomass of harvest removals and retentions;
- Specification of ecosystem and biodiversity outcomes (not just 'forestry'-related outcomes such as volumes and retentions) anticipated from the application of SGEMs for specific geographical areas/locations on Crown land;
- Incorporation of required pre-post inventories, monitoring and reporting by independent, arms-length biodiversity or wildlife experts rather than solely by foresters or their consultants;
- Procedures and criteria for inventories, monitoring, auditing, reporting and enforcing accurate application of the SGEMs in planning and on the ground; these should include provisions for ensuring surveys for biodiversity and ecosystem values occur in ways that take into account seasonal and other factors related to timing of presence, such as migrations, breeding, denning and other life-history requisites; and,
- Explicit review schedule, process and criteria for assessing efficacy of the SGEMs towards ecosystem and biodiversity outcomes.

Crucially required, asap, is the province-wide spatial delineation of the three legs of the triad in a way that demonstrates that it will serve to "*protect and enhance ecosystems and biodiversity as the overarching policy priority,"* as recommended in the Lahey Report and committed by the Government of Nova Scotia.

Until the spatial distributions and relative proportions of the three legs of the triad are understood, the efficacy of the SGEMs for retaining and restoring ecosystem and biodiversity objectives on Crown Land within the ecological-matrix leg cannot be assessed. Further, appropriate locations for applying the various pre-treatment assessments and harvesting systems cannot be determined without understanding broader ecological and biodiversity objectives and considerations beyond site-specific natural disturbance patterns, vegetation and soil types, nutrient levels and designated core habitat for species at risk. By my understanding on close reading of the harvesting systems, application of the mix of systems across all Crown lands in the ecological matrix leg, unless very carefully orchestrated in terms of initiation of sequencing, could result in a forest that, while uneven in age, would at times consist primarily of relatively young cohorts and little retention of mature-old forests.

Key concerns

There is a notable absence of consideration and integration of the SGEM within a context of a broader systematically designed, biodiversity conservation plan across the province (public and private lands) that spatially delineates the distribution and extent of land needed to: 1) maintain representative samples of all ecosite types (coarse filter); 2) support viable populations of focal species (those most sensitive to human activities and habitat loss and fragmentation such as wide-ranging and large-area requiring species); and, 3) protect species at risk and other 'fine filter' elements such as hotspots of diversity and rarity. The spatial plan should delineate an ecological network comprised of core areas of formally designated and strictly protected areas (PAs), supplemental habitat and buffers that may be managed for multiple activities that do not

compromise biodiversity values (IPCAs, OECMs), ecological and riparian corridors and stepping stones, integrated into sustainably managed landscapes.

Until such a comprehensive plan is developed, decisions on where to apply the three legs of the triad are being made without adequate attention to the biodiversity objectives featured in Lahey's recommendations. Specific to the SGEM, such biodiversity considerations should influence where the ecological matrix leg of the triad and its various treatments and systems are applied, from a broad-scaled regional landscape perspective that incorporates the spatial patterns of habitat needed to support these diverse biodiversity values.

Some key biodiversity considerations at the stand level are referenced in the SGEM, including biodiversity reserve trees and special habitats as described in the A Field Guide to Forest Biodiversity Stewardship, and Special Management Practices for some Species at Risk. However, these represent only the third component of systematic biodiversity conservation planning refenced above (i.e. fine filter elements). The key gap in the SGEM is consideration of broad spatial patterns that support viable populations of species that are not currently listed as 'at risk' yet are sensitive and vulnerable to forestry practices and other land use and land cover changes that convert, degrade and fragment their habitats and populations into smaller and more isolated patches. A recent forest connectivity study (Cunningham et al. 2020) funded and supervised by L&F has found that, when calculated across the entire province, median patch size for mature forest (height over 12 m) was found to be 3.2 ha (p. 6) (Fig. 1). By ecodistrict, median patch sizes range from 1.08 to 3.8 ha in Northern Plateau and Cape Breton Coastal, respectively) (pp. 43-45). Compared to the historical baseline of 2937.8 ha, today's median patch size for natural ecosystems (1.6 ha) represents a 99.9% reduction (p. 6).

The SGEM relies on natural disturbance regimes as a foundation for ecological forestry. However, natural disturbance is only one of many foundational ecological processes relevant to ecosystem and biodiversity objectives. Other critical processes that warrant attention include, for example, active river area, species distribution, population demographics and viability, minimum critical habitat area, minimum dynamic area, genetic connectivity and metapopulation dynamics, edge effects, etc. Accordingly, a sole focus on natural disturbance ecology ignores many other foundational principles and emerging sciences that should be brought to bear. While a focus on disturbance ecology may suffice at the operational scale, assuming it represents a small portion of the overall forest, applying the concept to landscape and provincial scales is inappropriate. Application of the SGEM on Crown land across larger ecological matrix landscape at a provincial scale entails a broader suite of considerations and careful assessment of where and when SGEM should be applied across space and time. Provisions for carefully orchestrated coordination are not sufficiently considered, accounted for or elaborated in the SGEM. It continues to rely on the cumulative effect of operational decisions, an approach criticized as inadequate by Lahey (2018).

There seems to be no acknowledgement within the SGEM that natural disturbances will continue along with the additional mimicking of these disturbances in forest harvesting processes, thereby resulting in excessively high levels of cumulative disturbance. The total frequency and distribution of natural and anthropogenic disturbances across larger landscapes (e.g., ecoregions, ecodistricts, and/or large watersheds/basins) need to be assessed to ensure they do not exceed levels required to also sustain key ecosystem and biodiversity structures, functions and processes, including wildlife population viability and minimum critical area of suitable habitat, such as through calculations of minimum dynamic area. The cumulative effect of numerous stand-level prescriptions across large landscapes need to be fully considered in a way that ensures ecosystem and biodiversity values are retained, maintained and restored.

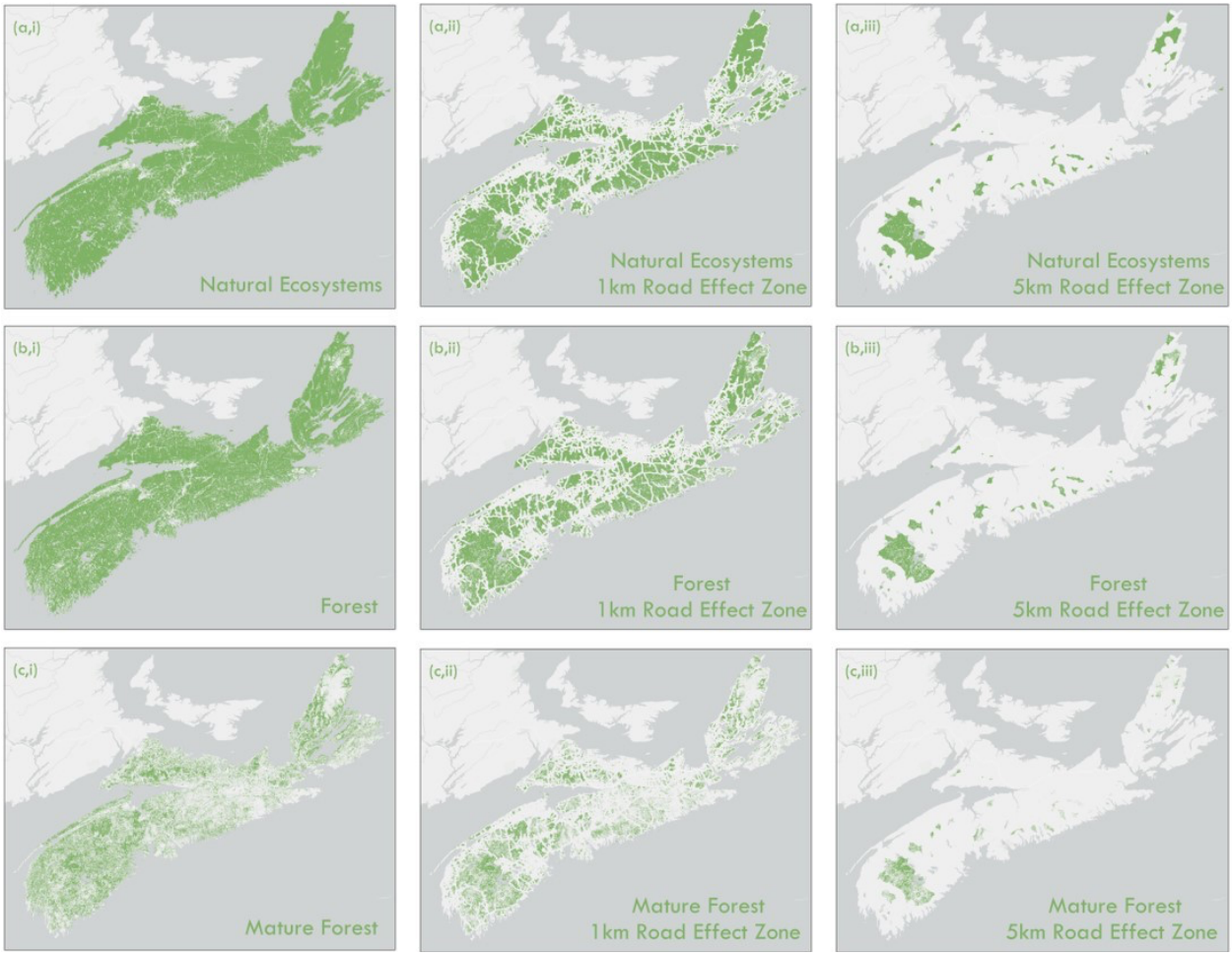

Figure 1. Different classifications of forest on which the analysis was conducted in the study region. Natural ecosystems are defined as all forested, wetland and barren classifications in the Nova Scotia forest inventory (a), forest consists of all treed classifications in the Nova Scotia forest inventory (b) and mature forest are those forested stands with a minimum age of 40 years (proxied as a minimum stand height of 12m) (c). Analyses were conducted on each forest classification without taking into account the road effect zone (i), using a 1km road effect zone (ii) and using a 5km road effect zone (iii). Nova Scotia forest inventory data is from the Nova Scotia Department of Lands and Forestry; Nova Scotia Roads database is from GeoNova; basemap is from ESRI. (Figure and caption copied from Cunningham et al. 2020, p. 6).

If, as referenced in the SGEM, silvicultural systems should be designed such that "emphasis is placed on natural patterns and processes, understanding them, working in harmony with them, and maintaining their integrity" (Seymour and Hunter 1999), then significantly more patterns and processes than those encompassed in disturbance ecology are crucial. A general appeal to coarse-filter theory is insufficient to compensate for this deficiency or to substitute for these ecological considerations. As noted in the SGEM, "the coarse-filter theory of conservation biology states that *if management provides the full range (suite) of structures and compositions that existed in unmanaged forests*, then we can expect such forests to provide habitat for most species, thereby maintaining biodiversity on the managed landscape (Hunter and Schmiegelow 2011)" (emphasis added). However, in its present form it is highly unlikely that the SGEM will "*provide the full range (suite) of*

structures and compositions that existed in unmanaged forests." Accordingly, additional provisions are required to ensure key ecosystem and biodiversity values are maintained and restored.

In general, the sources referenced in support of the overall approach are primarily limited to those with a narrow focus on silviculture, a few focused on ecological forestry, and none focused on ecosystem and biodiversity foundations and emerging sciences or broader biodiversity landscape/conservation planning. As such, the SGEM remains grounded in 'forestry' and is insufficiently representative of the scientific and professional cultural and normative changes necessary to the fundamental transition to a form of ecological forestry that combines "ecological and production objectives, contributing both to ecological conservation and to commercial forestry" (Lahey 2018, p. v).

Unfortunately, I am not convinced that the SGEM adequately overcomes the problem identified by Lahey in his primary conclusions:

> The pre-treatment assessment process that largely determines the prescriptions applied within the current system of ecosystem-based management does not sufficiently take wildlife issues into account. The lack of attention to wildlife in the pre-treatment assessment process is not counterbalanced by reassurance that wildlife receives adequate attention in the Integrated Resource Management Process (2018, p. vi).

The SGEM process still does not sufficiently take wildlife issues into account.

Retention levels and age structure

The SGEM states that, "Implementing the SGEM requires techniques that will create structures that would occur as a result of natural disturbances (Neily et al., 2013). It is intended to help create an older and more diverse forest that reflects the Maritime Boreal and Acadian Ecosites of Nova Scotia" (p. 11). Beyond the inherent logistical flaw related to the cumulative effects of both natural disturbances and the additional mimicking of them through harvesting practices, as previously described, the claim that the SGEMs will 'create and older forest' seems unfounded given the harvesting systems described. While the SGEM may result in an older and more diverse forest than would result from continued application of the current guides, it will not create a forest that reflects age and diversity structures and distributions of the Acadian forest.

Recurring claims that "the goal is to retain 1/5-2/3 of each stand" are misleading. These ranges accrue to each harvest period, accumulate over subsequent harvests, and result in stands that are predominantly younger stands for significant and recurring periods of time. The 1/5-2/3 retention range is only present at one point in time: the first harvest. After subsequent harvests 'retention' of the original forest is essentially zero, other than the few permanent retention trees (which may or may not have survived). For example, the Public consultation web page features the High-retention gap irregular shelterwood system (Figure 6) as a 'typical' example of how forests will grow and be harvested under the new draft guide on Crown land in the ecological matrix zone. In this highlighted 'high retention' example, the entire area would have been harvested by the 40-year mark and thus none of the original forest retained: at that point, the forest is comprised totally of regenerated forest, 1/3 of which is 0-years old, 1/3 is 20 years old, and 1/3 is 40 years old. After the next three cuts, at the 130-year mark, we are again left with 1/3 at 0 years old, 1/3 at 20 years old, and 1/3 at 40 years old. Admittedly, these are the youngest phases of this cycling, but as the highest retention system in the mix, it is far from satisfactory. In the case of a Medium-retention gap irregular shelterwood system (Fig 8), 0% of the forest is retained at the 30-year mark after two harvests of 1/2 of the area. In this example, at the 30-year mark this stand would be comprised of ½ at 0 years old and ½ at 30 years old. The other systems result in even smaller areas of retention

and thus larger areas of younger forests. Adding to removals prescribed through these harvest systems are allowances for pre-commercial thinning and skid/machinery tracts and roads, further reducing the area of forest. In both of these high- and medium-retention examples, arguably none of the original forest cover is retained, the cumulative effects exceed natural disturbance patterns in terms of spatial extent and rate of return interval, and the forest is not "older" than would be typical in a natural Acadian forest system.

A mix of stands across the landscape that are predominantly younger for significant and recurring periods of time are unlikely to support key ecosystems and biodiversity values. And, the fact remains that 'natural' disturbances will also continue to take place, contributing to additional areas of younger forests, beyond those harvested. Though I appreciate the retention of permanent reserve trees, these are at risk of mortality due to blow down or other threat factors related to their sudden isolation from their supporting surrounding trees/forest, and their isolation makes them less or unsuitable in terms of habitat provision. On balance, I am far from convinced that the mix of SGEM systems will be applied across broad areas in ways that retain sufficient mature and old forests across the Crown-land landscape to support components of biodiversity that are sensitive to human activities and dependent on interior and mature-old forests, and that provide "the full range (suite) of structures and compositions that existed in unmanaged forests" stated in the SGEM as key to the coarse filter approach to ecological forestry.

For such claims of helping to 'create an older and more diverse forest' to ring true, the SGEM would have to be applied only to unnaturally-low-diversity, even-aged forests that require restoration to increase age and diversity. Arguably, uneven-aged stands should include a large percentage of old trees, as would have been the predominant Acadian forest cover prior to clearing and harvesting, including with natural disturbances taken into account.

Further, the Restoration prescription includes provisions for high levels of forest removal followed by tree planting. An alternative prescription should be devised that retains ecosystem and biodiversity values during the restoration phase, such as by maintaining areas of forest cover while supporting regeneration of more-diverse native tree and understory species.

On balance, across prescriptions, the regeneration rate is 2.5 to 3.3 times higher than it should be. High retention irregular shelterwood would see 1/3 of the area regenerated in years 0, 20 & 40 (2.5%/year harvest intensity). Medium retention irregular shelterwood would be 1/2 in year 0 and 1/2 in year 30 (3%/year harvest intensity). Instead, maximum removal should be 30% by basal area in a single harvest with the frequency of harvest tied to the rate of regeneration (~1%/year). As such, on average, 30 years should pass before another 30% harvest is permitted. Gap-based systems should be used, consistently favoring LIT species for retention and permanent leave trees, with harvests not exceeding 1 % over a time frame of 100 years or more, to support biodiversity values, wildlife needs, and broader landscape requirements at the same time as production values.

Maritime Boreal forest

The comment about 'temporarily separating out the Maritime Boreal forest' (13% of the province's forested Crown Land) is potentially concerning. Further detail is needed as to what this is and why it is separated out. Previous forest classifications have identified only small portions of NS as 'boreal', largely restricted to Cape Breton highlands. On the other hand, there are criticisms of poor forestry practices that have resulted in the 'borealization' of the Acadian forest. As such, borealization is not something that should be protected or retained. I hope that the separate attention to the Maritime Boreal forest is limited to the naturally occurring Boreal forests, and that

it recognizes that such forests are likely to be transitioning to more mixed and temperate forests due to climate change.

Azonal sites, soil damage and nutrient levels

The generic definition of azonal sites without indication of the distribution and proportion of forest considered to be situated within azonal sites is problematic. In NS, climate is less likely to result in variations in dominant succession across the province due to the coastal moderation of climate. Arguably, non-climatic site conditions predominate in influencing successional variability across the province. Large areas of the province may be considered low in soil fertility, as consequence of both soil and bedrock geology and poor forestry practices. If so, the SGEM prescriptions for azonal ecosites could be applied widely, with significant negative implications for ecosystems and biodiversity, as well as the sustainability of forestry production values.

Among the so-called azonal ecosites, the SGEM states that those with "more severe site limitations support more frequently disturbed and shorter-lived climax forests that are more appropriately managed with simpler silvicultural systems with lower retention levels" (p. 8). While it may be true that such sites may experience more frequent disturbance and support shorter-lived forests, it is counter intuitive to then conclude that these sites should be further disturbed through silviculture that prescribes 'lower retention levels'. Instead, sites with severe limitations and frequently natural disturbances should be subjected to no or low-frequency, high-retention harvests in order to minimize cumulative disturbances and further deterioration of already severe non-climate-related site conditions such as low soil fertility. Such areas do not support frequent cutting and regeneration and yet they do support ecosystem and biodiversity values and should be retained as such, allowing for maintenance and recovery of soil conditions.

It is further unclear as to how differentiated applications of the SGEM to zonal and azonal ecosites will integrate measures to identify and minimize soil damage hazards and to sustain or enhance nutrient sustainability. Nutrient Budget Model guidance should be applied in order to improve soil fertility and nutrient quality and limit impacts of forest harvesting on deficient sites.

Riparian buffers

A fixed riparian buffer width of 30 m along shorelines of lakes, rivers and streams is not wide enough to support many species wildlife. Buffers in the 20-30m range are defined primarily to reduce erosional effects such as sedimentation. To accommodate species that are most sensitive to forest fragmentation and edge effects, riparian buffers should be at least 100 m and idealy ~200 m from the high-water mark. The USDA Natural Resources Conservation Service Conservation Standard for riparian buffers recommends a 600 foot (183 m) riparian forest buffer width as the minimum for accommodating sensitive species (USDA-NRCS-MICH, 391-M, 231-10/10).

Forest access roads and skid trails

There is absolutely no mention of roads in the SGEM. A search of the document revealed no use of the word 'road' or 'roads' anywhere in the document, and only two brief references to 'access' (e.g., Gap Shelterwood with Reserves, p. 44; Strip Shelterwood with Reserves, p. 46). Forest roads degrade and fragment habitat and open up forests in ways that result in numerous direct and indirect negative impacts to ecosystems and biodiversity. Primary among these are providing access to previously intact remnant patches of forest, resulting in incursions of competitors, predators, diseases and pests. These include humans and their associated activities and developments such as off-highway vehicle use; legal and illegal fishing, hunting and trapping; fires, spread of invasive and domestic species; seasonal and permanent structures; spur roads; etc.

Prescriptions are needed to minimize new road construction; properly construct roads and maintain existing roads; apply, monitor and enforce restrictions on road access; and decommission roads.

Trees removals for roads and extraction/skid trails and other harvest operations need to be take into account as harvest-related removals and accounted for in calculations of areas of retentions and removals and of harvest volumes. The portion of the stand to be occupied by roads and other extraction trails should be minimized, and those areas should be included in calculations of the portion of the stand that is considered managed (e.g., as part of the area of harvest removals).

The negative impacts of roads and extraction trails on ecosystems and biodiversity provides one clear example of why Lahey cautioned against taking it as a given that protecting biodiversity through ecological forestry could be achieved without an overall reduction in harvest volume. Achieving the same or higher harvest volumes without intensive (clearcut) harvests would entail more extensive harvests, which would require an expanded network of harvest roads and trails. Consequently, in addition to careful planning and management to limit the road network and its impacts, reductions in wood volume are needed, further emphasizing the need to transition to a high-value forest product economy.

SGEM in the broader management context

Moving forward with an improved SGEM is important but its efficacy in terms of supporting ecosystem and biodiversity values is impossible to gauge in the absence of other complementary initiatives required to implement the Lahey recommendations. Its efficacy for meeting ecosystem and biodiversity objectives cannot be assessed without understanding the intended outcomes of the SGEM. Neither can it be assessed without knowing where the SGEM is to be applied (i.e. the distribution and extent of the ecological matrix portion of the triad), and without knowing the distribution and extent of 'protection/conservation' leg. If the protection/conservation' leg is intended as the primary leg for maintaining and recovering ecosystem and biodiversity values that are sensitive to human activities in sufficient quality and quantity to remain viable over time, then the conservation leg will need to be much larger than existing protected and conserved areas. In such a context, the SGEM may suffice on the ecological matrix lands. However, if the 'protection/conservation' leg is smaller or not carefully sited, the SGEM and ecological matrix lands will need to provide much stronger prescriptions for biodiversity objectives.

Many associated initiatives need to be completed, such as: amendments to the Crown Lands Act and Forestry Act; requirements for Environmental Assessment; designation of Species at Risk recovery and action plans, including core habitat and connectivity areas; spatial delineation of the three legs of the triad; development of outcomes-based-forestry criteria; riparian buffer assessment; revisions to special management practices; completion of landscape level planning for biodiversity; etc.

The SGEM is intended to be applied at the stand level, however, the spatial distribution of the stands to which they are to be applied has as yet to be determined, as this hinges on broader decisions. Biodiversity and ecosystem objectives will not be achieved by decision driven at the stand level. Means of grounding stand-level decisions within a broader regional-landscape-province-wide plan are missing, as is any acknowledgement that this is necessary to achieving the stated objectives. Spatial delineations of restrictions to harvesting in order to support biodiversity outcomes should be identified in a biodiversity conservation/landscape plan prior to application of SGEMs or any harvesting approvals.

As concluded by Lahey (2018, p. 55, recommendation 143),

> … forestry on Crown lands should be governed by a forest management planning process under which "FULA holders" will be required to develop a forest management plan for the lands they are to manage through a Class II environmental assessment…The requirement for such plans developed through a public process is a level of forest management on Crown lands – required in other jurisdictions – that is missing in Nova Scotia. It is a level that should be instituted however forestry is to be conducted on public lands, but it is especially important if Nova Scotia is serious about conducting ecosystem-based forestry on a landscape basis. …Doing so in Nova Scotia under the authority of the Minister of Environment creates an opportunity to bring transparency and accountability to the process and to mitigate the concerns about how DNR internally manages its competing responsibilities.

There is no apparent role of NS Department of Environment in the development, implementation or monitoring of SGEMs. Without these broader requirements and external oversight, it is unlikely that the SGEMs will support ecosystem-based forestry on a landscape basis.

On balance, despite improvements, the SGEM retains a focus on forestry outcomes for timber, pulp or biomass volume. Further emphasis is needed on enhancing forest values and reducing the volume of wood harvested. Sustainable forest economies will depend on healthier forests which offer higher value/lower volume timber and retain and enhance ecosystem and biodiversity values.

In closing, I acknowledge that these forests are located in *Mi'kma'ki,* the ancestral and unceded territory of the Mi'kmaq. As citizens and gvoernments in Canda, we are all Treaty people with responsibilites to the Peace and Friendship Treaties. The land belongs to everyone and our highest responsibilitiy is to the land and all our relations, in respect and reciprocity. As a peace and freindship ally, I fully support the expressed views of the Mi'kmaw people in their submissions to this and other processes of consultation, such as in the letter to the Minister of Lands and Forestry from the Assembly of Nova Scotia Mi'kmaw Chiefs, dated October 29th. In this letter, they urge implementation of high-retention eco-forestry without further delay, in line with Lahey recommendations and the standards of Netukulimk. I concur. I urge continued meaningful engagement with Mi'kmaw governing bodies in ways that reflect ethical space and a nation-to-nation relationship.

References

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