ASSOCIATION OF BC FOREST PROFESSIONALS

2011 RPF Registration Exam
Take-Home Exam

This package contains examples of good answers for question #1 that were submitted for the take-home portion of the 2011 RPF registration exam. Although the answers were chosen as the two better answers submitted in 2011, take note of the score each answer received and be advised that answers may contain errors. There is no example provided for question # 2 as it was not answered by enough examinees. Please note that the examples do not conform to the criteria and formatting outlined in the exams procedures.

2011 RPF Registration Exam
Take-Home Exam

Table of Contents

2011 RPF Registration Exam
Take-Home Exam

Question 1

In the wake of the mountain pine beetle outbreak, the allowable annual cut (AAC) in beetle impacted timber supply areas (TSAs) are expected to decrease anywhere from 10-80% from the current levels. Section 8(8) of the Forest Act describes the things that the Chief Forester must consider in determining the AAC for a given timber supply area (TSA) or tree farm licence (TFL). Discuss these considerations as they apply to beetle affected TSAs generally (i.e., do not use a specific TSA). Consider their implications for AAC determination in beetle affected TSAs and potential strategies to improve mid-term timber supply. As an advisor to the Chief Forester, what recommendations would you make if the goal is to improve the mid-term timber supply in bark beetle affected TSAs?

Answer 1 (scored 89)

Improving Mid-Term Timber Supply in Mountain Pine Beetle Affected Timber Supply Areas

Table of Contents

Introduction

The ongoing mountain pine beetle (MPB) infestation in British Columbia has had critical impacts on forest health, harvest levels, and timber supply. By 2015, most regions of the province are expected to have lost two-thirds or more of their lodgepole pine to MPB (Schrier 2009). The salvage of beetle killed timber has required unprecedented uplifts in annual allowable cut (AAC) for nearly every beetle impacted management unit in the province, which will lead to a decline in mid-term timber supply levels before the return to stable long-term levels can be achieved (MOF 2003).

When discussing timber supply, the "mid-term" refers to the period between the end of the economic shelf life of MPB killed pine and the time when the forest has re-grown and again become merchantable (Bell 2010). The period of time in which the mid-term condition exists will vary significantly between management units, but at a provincial level, is expected to begin in approximately 10 years and last for a further 50 years (Pousette and Hawkins 2006). The extent of the decline in mid-term timber supply depends on many factors, including the extent to which harvesting follows dead and dying pine, the extent of mortality in mature and immature trees, regeneration delay in unharvested areas, and economic shelf life (Pousette and Hawkins 2006). Many analysts have shown the seriousness of the mid-term timber supply problem (Pederson 2003; Raymer and Waters 2007), and significant research funding has gone into determining ways to mitigate the decline in mid-term timber supply (MFML 2009).

This report discusses the implications of the MPB epidemic on the factors the Chief Forester must consider when making AAC determinations, summarizes potential strategies to improve mid-term timber supply in beetle affected timber supply areas, and provides recommendations for implementing these strategies.

Implications of the Mountain Pine Beetle on Annual Allowable C… Determination

The mountain pine beetle epidemic has significantly impacted many of the factors the Chief Forester must consider, as described in Section 8(8) of the *Forest Act* (1996), when determining the AAC for a timber supply area (TSA) or tree farm licence (TFL).

The rate of timber production that may be sustained on an area has been altered as a consequence of the MPB epidemic. The composition of the forest has significantly changed, as the majority of lodgepole pine has died, or is expected to die within the near future (Schrier 2009). The expected rate of growth of the forests will change in unharvested areas as the pine dies and the understory releases, and will vary based on the amount of suitable secondary structure (Raymer and Waters 2007), species and age class (Hawkins et al. 2010), and the occurrence of natural regeneration (Astrup et al. 2008). Silviculture treatments in MPB affected areas may include special treatments such as under-planting, reforestation with non-traditional species (MFML 2010), or intensive silviculture (MFR 2009). The standard of timber utilization may change as improved sawmill technology, new fiber uses, and supply-shortages dictate.

The short and long-term implications to British Columbia of alternative rates of timber harvesting have been severely impacted by the MPB epidemic. Short-term AAC uplifts have occurred in most TSAs with a significant component of lodgepole pine to address the salvage of beetle killed timber (Pederson 2003), while long-term forecasts may change due to changes in growing stock, species composition (Astrup et al. 2008), and growth and yield associated with climate change forecasts (Hawkins and Rakochy 2007). The rate of harvesting of pine versus non-pine species will have tremendous impact, as the faster the non-pine growing stock is depleted, the more adversely the mid-term levels are impacted (Snetsinger 2011a). BC will experience economic implications from increased rates of timber harvesting due to MPB salvage.

The short-term increase in AAC has led to an increase in timber harvesting and available jo coupled with a decrease in commodity prices as the supply of lumber far exceeds consumer demand (Patriquin et al. 2007). The mid-term decline in AAC is expected to cause a direct decline in economic activity within the affected regions, and commodity prices will likely increase as the lumber supply is drastically reduced (Abbott et al. 2009).

The economic and social objectives of the government stress the importance of ensuring long-term economic sustainability for communities affected by the MPB epidemic, recovering the greatest value from dead timber, and conserving long-term forest values identified in land-use plans (Bell 2010). Due to the importance of maintaining a stable timber supply for the forest industry, a primary objective in timber supply review (TSR) is to determine a harvest flow which attains a stable, long-term harvest level in which the growing stock stabilizes (Snetsinger 2011a). Balancing non-timber forests values with timber supply objectives to achieve a range of socio-economic benefits, while analyzing how changes to current management practices and administration could increase mid-term timber supply, is a key government priority (Bell 2010).

The current MPB epidemic has been the worst forest health infestation in BC's recorded history (Axelson et al. 2009; Schrier 2009). The resulting major salvage program has required unprecedented uplifts in AAC, leading to a decline in mid-term timber supply levels before stable long-term levels can be achieved (MOF 2003). The uncertainty associated with secondary stand development (Hawkins and Rakochy 2007), economic thresholds, climate change (Heineman et al. 2010) and other forest health agents (Heineman et al. 2010) makes timber supply review more challenging and complex than in the past. The Chief Forester must balance AAC uplifts to salvage dead pine with trying to reduce the decline in the mid-term timber supply, while taking into account integrated resource management objectives.

Strategies to Improve Mid-Term Timber Supply

AAC Partitions

Implementing partitions in the AAC for a TSA is one strategy that has been applied with the goal of improving mid-term timber supply. By limiting the amount of non-pine coniferous species harvested in the present, the mid-term timber supply is improved by having more non-pine species available for harvest during times when pine may not be economically viable (Snetsinger 2011a). Focusing harvest on dead pine while it is economically feasible will ensure the best utilization of that resource before it becomes unavailable, while conserving live timber types for future harvest. Provincially, prioritizing harvest of dead pine can reduce the decline in mid-term AAC up to 50% (MFR 2009). Beginning in 2008, several TSRs included a non-pine species partition, including the Morice, Kamloops, Lillooet and Merritt TSAs (Snetsinger 2008a, 2008b, 2009, 2010). These first non-pine partitions were generally proportionate to the availability of non-pine species.

In January 2011, the Chief Forester implemented partitions for non-pine coniferous species in the AAC determination for two significant TSAs: Quesnel, the TSA most heavily impacted by the MPB (Schrier 2009), and Prince George, the TSA with the largest THLB and greatest milling capacity in the province (Izzard 2011; unpublished). In the Prince George TSA, a maximum of 3.5 million m^3 of a total AAC of 12.5 million m^3 can be attributable to non-pine, non-cedar and non-deciduous leading stands, of which a maximum of 875,000 m^3 per year can come from spruce-leading stands (Snetsinger 2011a). Thus only 7% of the AAC can come from spruce-leading stands, in a TSA where 33% of the timber harvesting land base (THLB) is spruce dominated (Snetsinger 2011a). The rest of the volume in the non-pine partition is intended to be by-catch from salvage of pine-leading stands with minor components of spruce, Douglas-fir and

subalpine fir. This decision represents the most important action taken to date using partitio improve the mid-term timber supply. By severely limiting spruce harvesting in a TSA with a considerable spruce component, the majority of the spruce-leading stands will be conserved for the mid-term.

The trend towards including non-pine partitions in AAC determinations for MPB affected TSAs is becoming apparent. While the Chief Forester has indicated he believes the first partitions are being followed (Snetsinger 2011c; unpublished), the partitions remain guidance, rather than legal orders. The Minster of Forests, Mines and Lands can impose a ministerial order to make the partitions legally binding if he feels they are not being followed, but this has not been required as of yet. These non-legal partitions depend on professional reliance, and co-operation among licensees to be successfully implemented.

Protecting Secondary Stand Structure

Secondary stand structure is composed of the live overstory trees remaining following MPB attack, and advanced regeneration in the understory. Multiple studies have shown that secondary stand structure will release following MPB attack (Raymer and Waters 2007; Hawkins et al. 2010), and has the potential to significantly contribute to the mid-term timber supply (Pousette and Hawkins 2006; Hawkins and Rakochy 2007; Axelson et al. 2010). In July 2008, the *Forest Practices and Planning Regulation* (FPPR) was amended to include specific criteria for retaining secondary stand structure in MPB affected stands. Secondary stand structure can be protected both during timber harvesting, and through directed harvesting.

Some MPB attacked stands have the potential to provide timber in the short term while retaining adequate stocking to contribute to the mid-term timber supply (Stjernberg 2008). During timber harvesting, secondary stand structure can be protected by utilizing partial cutting, and through the careful selection of harvesting equipment and methodology. By minimizing the

number of trails on which machinery travels and utilizing experienced equipment operators, stand can remain fully stocked and free growing post-harvest while most of the dead pine trees are removed (Stjernberg 2008).

Timber supply analyses have shown that it will not be possible to harvest all of the lodgepole pine leading stands killed by MPB before deterioration of the dead trees makes it uneconomical (MFR 2008a). Focusing harvest in areas with little to no secondary stand structure, and leaving areas with good densities of high-quality secondary stand structure unharvested will improve the mid-term timber supply because areas with suitable secondary structure will develop into merchantable stands sooner than if they were clearcut and reforested (Raymer and Waters 2007; Hawkins et al. 2010). Unharvested MPB attacked stands with well-developed advanced regeneration can help fill the mid-term timber supply fall down by up to one million m^3 per year (Pousette 2011; unpublished). The density of advanced regeneration varies significantly by biogeoclimatic subzone (Vyse et al. 2009; Hawkins and Rakochy 2007), and may be clumpy within a stand, therefore the utility of secondary stand structure for achieving mid-term timber supply objectives is very site-specific (Griesbauer and Green 2006).

Silviculture Investments

Intensive silviculture has been shown to improve tree height and diameter growth, which in turn can help improve mid-term timber supply by shortening rotation length and increasing volume per hectare (Newsome 2007; Brockley 2008; MFR 2009). The provincial decline in AAC may be reduced up to 20% by utilizing more intensive silviculture, such as planting improved stock, fertilization and thinning (MFR 2009). The combined effects of thinning and fertilization has been shown to substantially accelerate stand development in both height repressed (Newsome 2007), and non-height repressed (Brockley 2008) lodgepole pine stands, thus helping mitigate future timber supply challenges by shortening rotation lengths up to 25%.

Silviculture investments can make forests more resilient to climate change and insect infestations, improve productivity and shorten rotation length (MFR 2009). The provincial government has recently consolidated several older forest investment programs into the Land Based Investment program, to ensure investments are focused and optimized (MFR 2010a). Offsetting the impact of the MPB on mid-term timber supply is one of the main objectives of the Land Based Investment Strategy (LBIS). Treatments to address mid-term timber supply which are supported by the LBIS include fertilization, thinning and backlog brushing in prioritized areas impacted by the MPB (MFR 2010a). Traditionally, intensive silviculture focused on sites with the highest site index to speed up return on investment. In the interior of BC, the LBIS now prioritizes areas most heavily impacted by the MPB, with the goal of mitigating the reduction in mid-term timber supply (MFR 2010a).

Other silviculture options that may help mitigate mid-term timber supply challenges include reforestation with fast growing species such as western larch in new climate change seed zones (MFML 2010a), and reducing plantation losses to forest health factors such as hard pine rusts through pruning and spacing. While investment in silviculture is generally a positive thing for timber supply, the advantages of accelerated growth and larger piece size must be weighed against the substantial cost of these treatment and the overall return on investment (Brockley 2008). In addition, consideration must be given to not exacerbating undesirable stem characteristics such as increased taper, knots, and proportion of juvenile wood (Brockley 2008).

Reciprocal Wood Flow Arrangements

Reciprocal wood flow arrangements between regions have the potential to reduce the negative economic impacts of the MPB infestation. This strategy could be used to reduce the abrupt timber supply changes in a heavily infested region through working together with an adjacent region, as described in Patriquin et al. (2008). The strategy works by the beetle-affected

region allocating their excess salvage timber (increase portion of the AAC) to an adjacent, less impacted region, which in turn reduces their AAC proportionately so that each region maintains the same regional level of timber harvest. Subsequently, at an agreed-upon time in the future, the less impacted region returns to the beetle-affected region an amount of timber equal to the earlier inflow. When modeled using the Quesnel TSA as the heavily impacted region, and the combined Williams Lake and 100 Mile House TSAs as the less impacted region, Patriquin et al. (2008) have shown the decline in mid-term AAC and the associated negative economic impacts can be reduced through the TSAs working together. Thus high-level agreements across TSAs may be more effective at mitigating provincial mid-term timber supply challenges than each TSA trying to address the problem independently.

At a smaller scale, this strategy has been shown to be effective within a large TSA. In the most recent TSR for the Prince George TSA (composed of Prince George, Vanderhoof and Fort St. James Forest Districts), it was shown that in the scenario in which harvest gradually shifts from the Prince George and Vanderhoof Districts to the Fort St. James District, the mid-term AAC was up to 29% higher than in the scenario in which harvesting capacity remains segregated by Forest District (Snetsinger 2011a). Shifting harvesting within a TSA to maximize the salvage of dead pine is more easily accomplished than across TSAs, as forest licences are not geographically restricted within a TSA. Licensee co-operation and re-defining operating areas to increase flexibility in harvesting across the TSA will be required for this strategy to succeed.

Conclusions and Recommendations

The solution to improving the mid-term timber supply in MPB affected TSAs is not a simple one. A combination of strategies, including focusing harvest on pine-leading stands for as long as possible, protecting secondary structure, utilizing intensive silviculture and forming

reciprocal wood flow arrangements will be required in order to realize maximum timber sup gains for the mid-term. While the creation of new government policies may be required in some circumstances, professional reliance and licensee co-operation will be the key to success for most of these strategies. Thus, five recommendations for the Chief Forester are described below.

1) Create a surrender policy for non-pine leading blocks

Because many recent AAC determinations have included non-pine partitions, it is important to create a mechanism by which licensees can choose to surrender cutblocks within cutting permits they currently hold for non-pine leading species, to enable them to focus on pine. The current "take-or-pay" policy, whereby waste bills are applied to all cutblocks in a cutting permit if timber harvesting has occurred on any cutblock (MFR 2008b), penalizes licensees who wish to surrender unharvested cutblocks under a permit where other cutblocks have been harvested. A suitable surrender policy for non-pine leading permits should be made available for any licensees wishing to surrender non-pine leading cutblocks without penalty.

2) Update the criteria in the FPPR to better protect secondary stand structure

Many forest professionals feel the current regulation (FPPR Part 4, Division 2, section 43.1) is not very effective because it is difficult to find stands with adequate stocking density of a sufficient size (at least 5 ha) to qualify (Snetsinger 2011c; unpublished). Because the density of advanced regeneration is often highly variable over larger areas (Griesbauer and Green 2006), the definition of "targeted pine leading stand" should be revised to reduce the minimum size from 5 ha to 1 ha. 1 ha is a common minimum size used to stratify different forest cover types in silviculture surveys (MFR 2010b), therefore it should be appropriate to use as a minimum size for identifying stands with suitable secondary structure. Once this reduction in minimum size is implemented, significantly more areas will meet the criteria, and the intent of the regulation to protect secondary stand structure will be better realized.

3) Continue stand development monitoring

Monitoring stand development in secondary stands, young MPB affected stands and subalpine fir leading stands is important to determine stand development trajectories (Snetsinger 2011a). Government staff, researchers and licensees need to continue stand development monitoring to improve our understanding of the interaction between current management and estimated losses (Snetsinger 2011b). Once a better understanding of stand development is achieved, these factors can be included to improve the accuracy of future timber supply reviews.

4) Continue focus on silviculture investments

Continuing prioritized funding for silviculture activities under the Land Based Investment program, and encouraging other silviculture investments as identified in the New Vision for Silviculture in BC (MFR 2009) can significantly help mitigate future timber supply challenges. Licensees should be encouraged to recognize and apply for funding on sites which will yield high return on investment, and to utilize new climate change seed zones (MFML 2010a).

5) Continue focus on the importance of professional reliance

The success of the strategies previously discussed to improve the mid-term timber supply depends heavily on professional reliance. As part of the ABCFP Code of Ethics, forest professionals must act in the public interest and work to improve the practices and policies affecting the stewardship of public land (ABCFP 2008). Forest professionals need to be able to recognize sites that should be managed for mid-term timber supply, either through prioritized harvest, protecting secondary stand structure or intensive silviculture. The provincial government can help support forest professionals through continuing the initiative on advancing professional reliance (MFML 2011) and encouraging co-operation among licensees. Providing workshops and guidance on strategies to improve mid-term timber supply, within the scope of current operations, will help inform forest professionals of new developments and best practices.

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Answer 1 (scored 88)

Implications of the Mountain Pine Beetle Outbreak on Allowable Annual Cut Determination and Mid-Term Timber Supply in British Columbia's Affected Management Units

TABLE OF CONTENTS

1. INTRODUCTION

British Columbia's abundant forest resource is a dynamic system subject to a plethora of variables that constantly change the status of the province's timber supply. Over the last decade, the escalation of the mountain pine beetle (MPB; *Dendroctonus ponderosae* (Hopkins)) infestation from isolated outbreak areas to a province-wide epidemic has wrought havoc on BC's ecological, industrial and economic structure. Not only has the recent epidemic affected the current mature timber supply, but it has also affected a significant portion of the forested land base considered to be the mid-term timber supply – timber available for harvest over the next 10-40 years. According to recent surveys conducted by the Ministry of Forests, Mines and Lands (MFML; 2010), the spread of the MPB infestation has slowed since its peak in 2005, however, the implications of the outbreak are far reaching and, among other things, have had a profound impact on the forest industry including the businesses, stakeholders and communities that rely on a viable timber supply.

Within BC's defined timber supply areas (TSAs) and tree farm licenses (TFLs), industrial harvesting levels are dictated by the allowable annual cut (AAC), as determined by the province's Chief Forester in accordance with Section 8 of the Forest Act (MFML 2011). This report will discuss the factors and considerations taken into account by the Chief Forester while addressing the 20 TSAs and nine TFLs (see Appendix A for a map of the affected management units in BC) currently affected by MPB, specifically those considerations outlined in Section 8(8) of the Forest Act (Ministry of Forests and Range (MOFR) 2009b, MFML 2011).

In addition to discussing the impacts of the MPB infestation on AAC determinations, this document will provide recommendations intended to improve the reduced mid-term timber supply in the affected TSAs.

2. BACKGROUND

Beginning formally in 1992, the Chief Forester's legal obligation to review timber supply and determine an appropriate AAC for BC's TSAs and TFLs has, to some degree, always dealt with the issue of MPB on the landscape (MOFR 2000). From its infancy in the mid-1990's, the current MPB infestation has consistently gained momentum, with each subsequent timber supply review (TSR) in the affected areas addressing the increasing prevalence of MPB as a major issue facing current and future timber supply. Conducting TSRs in the wake of the MPB epidemic is now a reality for the 20 TSAs and nine TFLs affected. A complete list of the affected management areas can be found in Appendix A.

According to the most recent provincial surveys, over 16 million hectares (approximately 675 million cubic meters) have been affected by MPB (MFML 2010). Consequently, recent TSRs in beetle-impacted TSAs and TFLs have been subject to significantly increased AACs – temporarily – as an attempt to prevent further spread of the beetle or to salvage infested timber while it is still merchantable. In some areas AAC uplift doubled the pre-MPB harvest levels (Pedersen 2003, MOFR 2007). As a result, future AACs are projected to decline anywhere from 10-80% of the uplifted levels once the majority of the pine-dominated timber supply has been depleted (Pousette and Hawkins 2006, MOFR 2007). This reduction in annual harvesting levels will not only have significant impacts on the forest industry in beetle impacted TSAs; it will affect the economy of the entire province.

Recently, much attention and concern has been paid to the issue of the MPB epidemic and the resultant fall-down in timber supply. As a result, research relating to the timely utilization of the of MPB-killed timber has been instrumental in providing a timeline for salvage operations and continues to give insight into what can be expected as the dead timber ages on the landscape. These studies suggest that, depending on localized climatic conditions, lodgepole

pine (*Pinus contorta* var. *latifolia*) killed by MPB has an average of 10-15 years of viability (referred to as 'shelf-life') before it begins to deteriorate (Lewis and Hartley 2006, MOFR 2007). In addition, conventional forest practices may have to be altered in the affected areas in order to preserve the vulnerable mid-term timber supply to rotation age. Studies suggest that viable mid-term timber supply does exist in places not traditionally considered (Burton 2006, Coates *et al.* 2006). In light of this information, the Chief Forester's AAC decisions have had to (and will continue to) take MPB, and its cumulative effects on the landscape, into special consideration. The increased presence of MPB in the province's timber supply has considerably complicated the issues associated with AAC determination, making additional risks to the mid-term timber supply (local climatic conditions, other pests and the increased risk of wildfire) a growing concern (MOFR 2007). With all this in mind, the Chief Forester must consider Section 8(8) and the determination of AACs carefully and with a specific focus.

3. DISCUSSION

When presented with the findings of technical reports, detailed analysis packages and public input, the Chief Forester must consider each of the factors outlined in Section 8(8) of the Forest Act when making his AAC determination for a given TSA or TFL. In the 29 management units impacted by MPB (MOFR 2009b), each of these considerations must be carefully assessed with regards to the effects of the MPB and the effects of any determination on mid-term timber supply. The following sections discuss the considerations required by the Chief Forester and how each may differ when applied to an MPB-affected area.

3.0 Sustainable Timber Production Rate (Section 8(8)(a))

The sustainable timber production rate within a given TSA can be based on a combination of inventory data and modelling software (Snetsinger 2011). However, the reality

of beetle-induced reductions in timber production has forced the Chief Forester to rely upo inventory data, modelling, research, surveys and the most recent provincial Aerial Overview Survey (AOS) results to determine how much of the timber harvesting land base (THLB) in question is affected.

As directed by the subsections of 8(8)(a), the Chief Forester further considers stand composition, growth rate, regeneration delay, applied and potential silvicultural treatments, utilization and waste, production constraints and input from specialists in order to tailor each TSR as accurately as possible (MFML 2011; Snetsinger 2011).

3.0.1 Forest Composition and Growth Expectations (Section 8(8)(a)(i))

Under this section of the review, the THLB is reviewed and changes to previously determined THLB values are noted such as new roads, trails and landings. This assessment also takes into account areas available to be harvested and makes exclusions for areas determined to be 'environmentally sensitive' (i.e.: parks, significant forest types, etc.) (Snetsinger 2011).

When assessing this aspect of Section 8 in MPB-affected units, the Chief Forester must consider the proportion of the TSA's (or TFL's) THLB that is made up of pine-leading stands – either pure or mixed with other species (see summary table in Appendix A). In addition, it is important at this point to consider available research (for example: Wright *et al.* 2000, Coates *et al.* 2006) on expected growing conditions in mixed stands after overstory death and/or removal, in order to estimate and account for short- and mid-term growth in these areas.

3.0.2 Denudation-to-Establishment Delay (Section 8(8)(a)(ii))

Though it is common to accept modelled 'base case' data under this section (Boyce 2010; Snetsinger 2011), the magnitude of the current MPB epidemic presents an unprecedented extent of area facing denudation. These newly establishing forests may react differently than previously assumed. Definition should be made, perhaps in concert with data from the Ministry

of Natural Resource Operation's (MNRO) Forests For Tomorrow (FFT) program, as to how much of the THLB will be planted following clearcutting, partial salvage operations, selective harvesting or other denudation (burning, scarification, etc.) as each of these methods will have a different effect on the regeneration and re-establishment rate (MOFR 2009a). In order to preserve mid-term timber supply, which may exist – more abundantly than previously thought – in the live understory of dead, mature pine stands, the Chief Forester should consider the results of pertinent, recent research into this exact issue (for example, Coates *et al.* 2006).

3.0.3 Silvicultural Treatments (Section 8(8)(a)(iii))

There is little evidence to suggest that silvicultural treatments – such as spacing for "beetle proofing" - have much effect on preventing the spread of MPB once the population has reached epidemic levels. However, application of silvicultural treatment may be instrumental in fostering a favourable growing environment for mid-term timber supply found in the understory and second growth within MPB-killed pine stands, so treatments should not be ruled out as ineffective (Burton 2006).

3.0.4 Timber Utilization: Decay, Waste and Breakage (Section 8(8)(a)(iv))

As stands killed by MPB age, the risk of decay, waste and breakage decreases the merchantability of the timber supply, and increases the cost of harvesting, handling and processing (Lewis and Hartley 2006). When making an AAC determination in any of the MPB-affected management units, the Chief Forester should pay special attention to the increased risk of timber value reduction as a result of factors associated with a dying, dead or decaying timber supply. Depending on the harvesting, handling and processing capabilities in any given TSA (or TFL), the ability to economically and effectively salvage MPB-killed timber is going to be a factor of increasing importance as time since death accumulates. Recent studies regarding the shelf-life of standing dead timber should be considered when addressing this aspect of the AAC

determination, particularly when a partitioned harvest for pure-pine and mixed-species area being considered.

3.0.5 Local Capacity for Timber Use (Section 8(8)(a)(v))

Finding alternative uses for MPB-killed timber is currently a hot topic in forestry and the subject of many research trials, university studies and backyard experimentation. With the growing abundance of dead timber on the landscape facing an expiration date, the race is on to develop a viable use that will prevent the majority of MPB-killed timber from going to waste. Institutions such as the University of Northern British Columbia (UNBC) are actively researching the applications of MPB-killed fibre use for products like improved bioenergy feedstock and an cement-aggregate product known as 'wood-concrete'(UNBC 2007, 2009). Considering the potential of these initiatives to provide an immediate use for a rapidly deteriorating timber supply and generation of revenue in the short- mid-term for the forest industry and its dependent communities cannot go unnoticed by the Chief Forester in his consideration of this section.

Assessing the affect this alternative capacity will have on mid-term timber supply depends on the resources available in and around the TSA in question. Innovation, funding and market viability all play a large role in determining the success of alternative timber use initiatives. Considering this option as a way to harvest MPB-killed timber sooner rather than later is completely dependent on the local situation and the constraints associated with other local resource values.

3.0.6 Other Factors Affecting Timber Production (Section 8(8)(a)(vi))

This section of consideration by the Chief Forester has the potential to be very broad, depending on the TSA or TFL being assessed. Consideration must be given to district or woodlands managers that have a local knowledge of the landbase and any significant, unique

factors that may affect the capability of the area to produce timber. In management units affected by MPB, local knowledge is invaluable in reporting any other changes in forest dynamics that may further reduce the area's capability to produce timber. For example, climate change, in concert with the MPB, is having an effect on the capability of new management areas to produce timber, both in the short- and mid-term (Carroll *et al.* 2006).

3.1 Provincial Implications of Alternative Rates of Harvest (Section 8(8)(b))

This section focuses on sustaining the mid-term timber supply through the short-term via the use of partitioned AACs that allocate specific amounts of alternative harvest from pre-determined timber types such as deciduous-leading stands and problem forest types (Snetsinger 2011). The determination of a partitioned cut allows for the allocation of certain amounts of the AAC to be comprised of both pine-leading and non-pine-leading areas of the unit (Snetsinger 2011). Depending on the species composition and ecology of the TSA or TFL being assessed, partitioning the AAC can be an effective way to shift harvesting focus away from MPB stands that may contain viable second-growth in their understory, while supporting the industry's economic condition (MOFR 2009b).

3.2 Economic and Social Objectives of the Government (Section 8(8)(d))

Though generally categorized as a 'forestry' issue, the current MPB epidemic also affects many other factors and mitigating its effect is a top priority for the Provincial Government (Government of BC 2006). Throughout his considerations, the Chief Forester is expected to make decisions that best reflect the interests of the local economy, regional and provincial governments and all First Nations involved. The Government of BC's Mountain Pine Beetle Action Plan (2006) outlines seven objectives intended to mitigate the impacts of the current MPB infestation in the province, and provides strategies to put the plan into action (see Appendix B). It is important for the Chief Forester to consider these strategies when considering

AAC levels in MBP-affected areas. Attention to key objectives such as economic stability safety are important to forest-based communities. Consideration of other forest values will aid affected communities through alternative income in the short- to mid-term through tourism and recreation.

3.3 Infestations, Devastation and Salvage (Section 8(8)(e))

In TSAs and TFLs already affected by an infestation of MPB, considerations under this heading will focus on salvage attempts as well as any other, less severe forest health factors present on the area that have the potential to further deter healthy tree growth. On top of the mature pine killed by MPB, considerations in this section will also examine factors causing mortality in young pine stands, thus affecting the mid-term timber supply. Extensive surveys have been conducted by the MOFR regarding the causes and levels of this mortality and the findings are available to the Chief Forester for his consideration (L. Maclauchlan, BC MNRO Entomologist, pers. comm., 2011). Moreover, data summarized from the provincial aerial overview surveys are also available and outline the prevalence of other pests and diseases specific in a given area (Robertson *et al.* 2009). In addition, salvage operations as a result of fire, or harvesting planned to remove the risk of fire from MPB-affected areas will also factor in to the Chief Forester's considerations.

4. RECOMMENDATIONS

In the wake of the current MPB epidemic, the goal of forest managers in affected TSAs and TFLs will be to sustain and improve the mid-term timber supply in their area. While this may seem like an insurmountable task in many areas, there are tools available to facilitate both the utilization of MPB-killed timber and to foster a sustainable timber supply for the mid-term. As an advisor to the Chief Forester, I would recommend that he bring attention to and encourage

utilization of the following initiatives in order to ensure their success and the maintenance of mid-term timber supply.

4.0 Accurate Inventory and Stand Development Monitoring

Most 'base case' numbers used in TSR modelling of managed stand productivity come from the MOFR/MFML database Reporting Silviculture Updates and Landstatus Tracking System (RESULTS). The data entered into this system originate with free-growing surveys conducted at a relatively young stand age. The numbers currently used to model future timber supplies are possibly over-estimated when projected from the young age at which free-growing data are collected (Woods and Bergerud 2008). My first recommendation to the Chief Forester in regards to mid-term timber supply would be to insist that government is held responsible for conducting more frequent, systematic inventory surveys in order to keep RESULTS current. Frequently-updated inventory information will become increasingly important as pest and disease infestations, wildfire and other factors of change - accelerated by the increasing affects of climate change – intensify on the landscape (Carroll *et al.* 2006, Woods *et al.* 2010; Sturrock *et al.* 2011). I would further advise the Chief Forester to support and utilize the Stand Development Monitoring (SDM) program under the MFML's Forest and Range Evaluation Program (FREP) that re-assesses managed stands post Free-Growing (Woods 2010). Data from the SDM program can be used to update inventories and re-calculate the projected mid- and long-term timber supplies throughout the rotation, for more accurate, specific data for input into TSRs.

4.1 Secondary Structure as Viable Mid-Term Timber Supply

Ongoing research into the condition of secondary structure, alternative species and stand restoration has the potential to identify ways to ease further reductions in the mid-term timber supply. These studies suggest that, if salvage harvesting operations are carried out in a

way that does not cause unnecessary damage to the understory, there is a considerable amo future timber supply available within those stands (Burton 2006, Coates 2006, Coates *et al.* 2006). My second recommendation to the Chief Forester is, akin to the recommendations made by Burton (2006) - to not discount MPB-killed stands as a total loss and to support development of practices that focus clearcut salvage operations on sites where little secondary structure is found.

4.2 Support for Forest Research

In the wake of government staffing cuts that have left MFML and MNRO research departments dismantled, and funding cuts in both the public and private sector that have lead to reduced support for forestry research in general, the furthering of forest technology and innovation hangs in the balance. Recent forest research has been influential in attempting to mitigate the effects of MPB and it would be naive to assume that it can continue without financial support. My final recommendation to the Chief Forester would be that he emphasizes the importance of forest research in BC and its potential impact on preserving the mid-term timber supply through the last stages of the MPB epidemic.

5. CONCLUSIONS

In conclusion, BC's Chief Forester is faced with the difficult task of considering the implications of the MPB infestation on each affected TSA's AAC; no easy task given the dynamic nature of natural systems. Hopefully, through the careful allocation of AACs in affected TSAs and TFLs, the goal of forest managers, to mitigate the effects of the MPB on the mid-term timber supply, can be effective. By building upon current knowledge and utilizing the results of innovative surveys and research, BC's forest sector has an opportunity to mitigate the most detrimental effects of the MPB epidemic on the mid-term timber supply.

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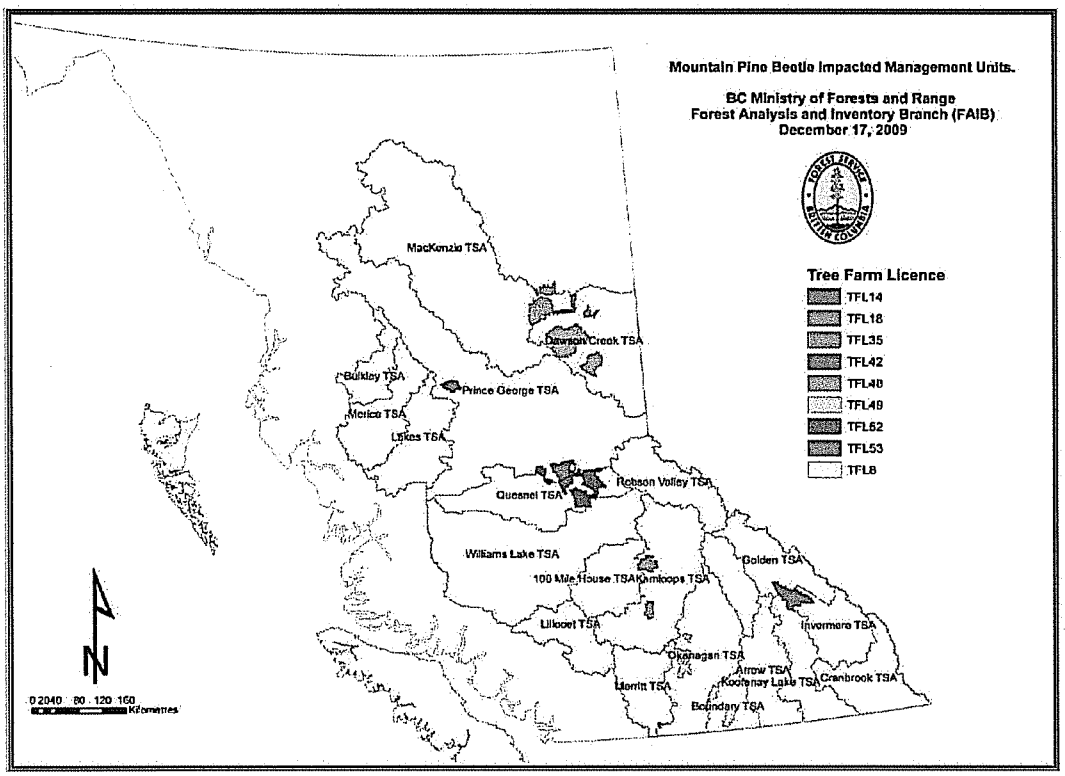
7. APPENDICES

Appendix A

MPB affected management units in BC; 20 timber supply areas and nine tree farm licenses (MOFR 2009b).



Timber Supply Areas	% Pine
Quesnel TSA	67%
Lakes TSA	64%
Williams Lake TSA	54%
100 Mile TSA	52%
Prince George TSA	51%
Merritt TSA	51%
Cranbrook TSA	47%
Morice TSA	43%
MacKenzie TSA	41%
Lillooet TSA	39%
Invermere TSA	37%
Boundary TSA	35%
Dawson Creek TSA	29%
Kamloops TSA	28%
Okanagan TSA	27%
Kootenay Lake TSA	22%
Bulkley TSA	19%
Arrow TSA	16%
Golden TSA	14%
Robson Valley TSA	13%

Tree Farm Licences	% Pine
TFL 8 (Interfor)	49%
TFL 14 (Tembec)	46%
TFL 49 (Tolko)	43%
TFL 35 (Weyerhaeuser)	39%
TFL 42 (Tanizul)	36%
TFL 18 (CANFOR)	26%
TFL 52 (West Fraser)	26%
TFL 53 (Dunkley)	24%
TFL 48 (Interfor)	23%

Appendix B

The 7 goals and objectives as listed in the Government of British Columbia's Mountain Pine Beetle Action Plan 2006-2011.

"*The Province recognizes that responding to this unprecedented situation is complex, dynamic and involves many competing interests. It will be necessary to conduct a continuing dialogue amongst stakeholders during implementation, and to update and add to these objectives and the supporting strategies when appropriate.*

Seven broad objectives have been adopted to guide the Province's activities:

1. *Encourage immediate and long-term economic sustainability for communities.*
2. *Maintain and protect worker and public health and safety.*
3. *Recover the greatest value from dead timber before it burns or decays, while respecting other forest values.*
4. *Conserve the long-term forest values identified in land use plans.*
5. *Prevent or reduce damage to forests in areas that are susceptible but not yet experiencing epidemic infestations.*
6. *Restore the forest resources in areas affected by the epidemic.*
7. *Maintain a management structure that ensures the effective and coordinated planning and implementation of mitigation measures.*"

(Government of BC 2006).