Non-Confidential

IN THE LONDON COURT OF INTERNATIONAL ARBITRATION

In the Matter of Arbitration between:	)	
THE UNITED STATES OF AMERICA,	)	**No. 111790**
Claimant,	)	
vs.	)	
CANADA,	)	
Respondent.	)	

EXPERT WITNESS REPORT

OF

JONATHAN A. NEUBERGER, PH.D.

August 9, 2011

TABLE OF CONTENTS

EXHIBITS

I. INTRODUCTION AND ASSIGNMENT

1. My name is Jonathan A. Neuberger. I am a Principal in the San Francisco office of the consulting firm Economists Incorporated. My qualifications and experience are described in Section II below, and set forth in more detail in my c*urriculum vitae*, attached as **Exhibit 1** to this report.

2. This case involves an alleged breach of the Softwood Lumber Agreement ("SLA") signed by the United States of America ("US") and Canada in September 2006. More specifically, the US alleges that British Columbia ("BC") has breached the SLA through changes made since July 1, 2006 to the system by which logs are assigned different "grades."[1] These changes in the grading system used in the "Interior BC" region have resulted in significant increases in the quantity of logs assigned to "Grade 4." Since logs in this category receive the lowest permissible stumpage price, the US alleges that the grading changes have reduced costs to Interior BC lumber producers and provided them with a benefit that violates the terms of the SLA. Canada asserts that the rise in Grade 4 timber is the result of the mountain pine beetle ("MPB") infestation.

3. I have been asked by counsel for the United States Department of Justice ("USDOJ") to address the following:

    a. Examine the relevant forest industry data in the BC Interior and, using economic principles, examine the trend in Grade 4 volumes from 2006 to the present;

    b. Based on my economic analysis of the data, provide an opinion on whether the increase in Grade 4 from 2007 to the present in the BC Interior is attributable to the MPB infestation, as Canada states, or some other cause;

    c. If data and other evidence suggest that logs have been misgraded, estimate the benefit of that misgrading to Interior BC lumber producers; and

[1] It is my understanding that the parties to the SLA agreed that, as a general matter, programs or systems that existed as of July 1, 2006 are allowed to continue, but post-July 1, 2006 changes to programs, or new programs, can be considered circumvention of the agreement under certain circumstances. See discussion below in Section VII.

d. If there is a benefit to Interior BC lumber producers, propose remedies in the form of adjustments to the Export Measures as defined in the SLA.

4. I have been instructed to act as an expert economic witness and not as a witness of fact. I understand that my duties as an expert witness are to the Tribunal. As I explain above, this report has been prepared on the basis of my instructions and the evidence available to me. Therefore, if the scope of my instructions changes or if further relevant information comes to my attention after the date of this report, including matters raised by other factual or expert evidence to be adduced, I may reconsider my opinions. If this occurs, I shall inform the Tribunal accordingly.

5. I have been assisted in this case by members of my firm's staff whose work I have supervised personally. The opinions expressed in this report are my own.[2]

6. In preparing this report I have examined and relied upon the statements of case in so far as they relate to the matters that I have been asked to consider. I attach at **Exhibit 2** a list of the documents that I have examined in forming my opinions.

7. This report has been prepared solely for the purposes of the current arbitration, *United States of America v. Canada* (LCIA Arbitration No. 111790). This report must not be used for any other purpose and no reliance may be placed on this report by any other party without the express written permission of Economists Incorporated.

II. QUALIFICATIONS

8. I am a Principal in the economic consulting firm Economists Incorporated ("EI"). My *curriculum vitae*, which contains a list of my publications, professional experience, and prior testimony, is attached as **Exhibit 1** to this report.

[2] My firm was previously retained by the Coalition for Fair Lumber Imports in conjunction with the longstanding trade case against Canada. That matter ended in 2006. I personally was not involved in that proceeding.

9. In May 1978 I received an undergraduate degree in international relations from Georgetown University. I received my master's degree in economics from Johns Hopkins University in May 1985, and my Ph.D. in economics from Johns Hopkins University in July 1988.

10. From 1988 to 1994, I was an Economist in the Research Department of the Federal Reserve Bank of San Francisco. In that capacity, I conducted research and policy analyses of banking and financial markets. In particular, I studied aspects of bank and thrift lending decisions, portfolio management, risk, and the behavior of bank holding company stocks. I also performed competitive analyses related to regulatory applications for bank mergers and acquisitions. During most of this period, I also served as Visiting Assistant Professor of Economics at Mills College, Oakland, California, teaching courses in economics and finance.

11. Subsequent to leaving the Federal Reserve Bank of San Francisco, I served as: an Economist and Manager at the accounting firm Deloitte & Touche, LLP; a Senior Economist at Benderly Economic Associates; a Senior Managing Economist at LECG, Inc.; and a Partner at the consulting firm Bates & White, LLC. In each of these positions, I used the analytical tools of economics, statistics and finance to address issues of financial performance, business conduct, risk management, and economic policy. In addition, much of my professional experience has focused on estimating and assessing measures of economic harm in commercial litigation involving companies in a broad range of industries.

12. I have extensive experience serving as an expert witness. Previously, I was the expert witness on remedy for the United States in LCIA No. 7941 in 2008 and LCIA No. 91312 in 2009. I have provided expert trial testimony on 18 previous occasions. I have been qualified in court as an expert in economics, economic damages, econometrics, economic modeling, the economics of uncertainty, risk management, and corporate finance. In addition to my trial testimony, I have written expert reports and provided deposition testimony involving a variety of economic issues on numerous occasions. A list of my prior testimony is contained in my *curriculum vitae*, attached as Exhibit 1 to this report.

III. SUMMARY OF OPINIONS

13. In April 2006, British Columbia introduced new grading rules for logs harvested in its Interior BC region. The rules were changed in part due to the severity of the MPB outbreak. In particular, under the old grading rules large quantities of logs from beetle-killed trees were automatically given the C$0.25 minimum stumpage rate regardless of their ability to produce merchantable lumber. On the eve of the grading change in March 2006, with the MPB outbreak at or near its peak, almost 65 percent of Interior BC lodgepole pine was being graded such that it received the C$0.25 rate.

14. The new rules, which were grandfathered into the SLA, produced a significantly lower quantity of minimum rate (Grade 4) logs during the first year of implementation, as was the intended consequence of the altered rules. In the spring of 2007, however, there was an abrupt change in that pattern, as the proportion of Grade 4 lodgepole pine began to rise rapidly. Over the next three years, the Grade 4 percentage eligible for the C$0.25 stumpage rate under the new grading system rose to virtually the same level as had been eligible for that rate under the old grading system.

15. I considered the possibility that the increase in Grade 4 was largely due to the MPB epidemic. I found evidence of significant misgrading even after considering the effect of the MPB epidemic. There are several bases for this conclusion. First, there is no close relationship between the geographic spread of the MPB epidemic in Interior BC and the observed increases in Grade 4. Second, there is no evidence of a change in harvesting practices that would have increased the quantity of Grade 4. Third, any loss in the quantity and value of lumber caused by the MPB is not large enough to explain the significant increases in the amount of logs assigned to Grade 4. In fact, losses in lumber volume and value due to the MPB were already taken into account by changes made in BC's Market Pricing System ("MPS"), the system that determines stumpage rates for government-owned timber. These

changes in the MPS were made at the same time as the new grading rules were adopted.

16. I have developed estimates of the extent of log misgrading in Interior BC starting in early 2007. These estimates quantify the amount of misgrading by taking the difference between the actual observed amount of Grade 4 logs and the amount of logs that would have been Grade 4 "but for" the misgrading. A potentially reasonable benchmark for the "but for" share of Grade 4 is 17.8 percent – the actual average share of logs assigned to Grade 4 during the first year of the new system. Using the Grade 4 share from the first year of the new grading system as a benchmark for the "but for" world does not ignore the effects of MPB attack on the value of timber, but instead incorporates these effects – as does the MPS itself – through avenues other than the share of logs assigned to Grade 4 and given the minimum stumpage rate.

17. Changes in the grading system that led to an increase in Grade 4 do not appear to have improved the extent to which stumpage prices reflect market conditions. The increase in the amount of Grade 4 logs might have reflected market conditions had there been a large decline in the market value of timber in the BC Interior attributable to a decline in its quality, but that has not been the case. Data from several sources indicate that there has been no decline in the quality of BC timber that reduced its market value.

18. Moreover, while the stumpage rates applied to Grades 1 and 2 logs under the MPS use auction data as one factor in setting prices, the stumpage rate applied to Grade 4 logs is a fixed administered price (C$0.25) that is unrelated to market conditions. Thus, grading changes that increase the share of Grade 4 in the harvest do not increase the extent to which stumpage prices reflect market conditions because Grade 4 prices are not influenced by those conditions.

19. Misgrading benefits Interior BC lumber producers by reducing the stumpage prices they pay for sawlogs. As a result, a major input in the production of lumber is available to producers for a significantly lower price. I estimate the benefit to Interior BC lumber producers inherent in the misgrading. To present the Tribunal

with several options, I use three distinct calculation methodologies. Each of the methodologies shares a similar overall approach to estimating the benefit arising from misgrading, with a but-for misgrading percentage estimated using a base period or other baseline. The first method uses a base period of the first year of the new grading system; the second relies on a base period of the last year of the old grading system; while the third method incorporates an adjustment for the extent of grey-attack MPB. The estimated benefit to Interior BC sawmills from the three methods are C$499.2 million, C$1,054.9 million, and C$337.9 million, respectively. The first estimate, C$499.2 million, is the preferred estimate.

20. The most logical approach to remedy under the SLA is an additional export charge designed to collect an amount equal to the estimated benefit. That collection should be completed either before the SLA expires in October 2013 or, if the parties agree under Article XX to extend the SLA for two years, before October 2015. Therefore, I present estimates based on two alternative remedy periods: the 19-month period from April 2012 to October 2013; and the 43-month period from April 2012 to October 2015. The level of the additional export charge needed to recover the amount of the estimated benefit, calculated using my preferred method, is 30.6 percent for the 19-month period, or 13.5 percent for the 43-month period.

IV. BACKGROUND

21. The dispute in this proceeding involves the grading and scaling of logs in the Interior BC region. Under the timber pricing system that BC had in place for the Interior region as of July 1, 2006, timber harvesters are required to have logs graded and scaled after harvest.[3] This process is carried out at or near a sawmill by "scalers" who are lumber company employees licensed by the province.[4] These

[3] Grading involves determining the quality of the log in terms of the lumber it is likely to produce; scaling entails measuring the volume of the log.

[4] The BC log scaling system requires that all loads of logs be weighed, with randomly sampled loads of logs measured for volume (log scaling) and graded. These sampling results, which usually are based on a very small portion of the log loads (usually no more than three percent), are then applied to the remainder of the loads at that scaling site.

scalers, in turn, are periodically audited by "check scalers," BC provincial employees who randomly check and potentially correct scalers' grading.

22. The SLA was signed by representatives of the US and Canada on September 12, 2006. Under the terms of this agreement, Canada agreed to apply "Export Measures" to shipments of softwood lumber products to the US in return for which the US agreed to cease collection of antidumping and countervailing duties and to refund deposits previously collected on Canadian imports. Canada further agreed not to offset or circumvent the Export Measures. According to the SLA, systems in place as of July 1, 2006 were, as a general matter, allowed to continue, while new programs were generally considered circumvention if they provided benefits to lumber producers beyond those available as of July 1, 2006.

23. It is my understanding that some post-July 2006 modifications to the provincial timber pricing or forest management systems may not be circumvention under certain specified conditions – namely, if the change maintains or improves the extent to which stumpage prices reflect market conditions.[5] Accordingly, I analyze below as part of my assessment the extent to which BC's alleged underpricing of timber due to post-SLA changes in grading reflects market conditions more accurately.

24. In April 2006, prior to the signing of the SLA, BC implemented a new grading system for the Interior region. The goal of this change, as announced by the Ministry of Forest and Range, was "to better reflect the quality of timber affected by the mountain pine beetle."[6] The old grading system had six grades – three sawlog grades ("blank," 3, and 6), two "lumber reject" pulp log grades (4 and 5), and one "reject" grade (Z). However, Grade 3 within sawlog (like Grade 5 within pulp log) was a "dead and dry" grade[7] that automatically sold at the minimum stumpage price

[5] SLA, art. XVII.2(a).

[6] "New Interior Log Grades to be Introduced," Press Release by Ministry of Forests and Range, March 21, 2006.

[7] "Dead and dry" refers to logs that came from a tree that was believed to have died prior to harvest. Death could occur for any number of reasons, e.g., lightning, beaver attack, or beetle infestation. However, as the MPB attack worsened, the "dead and dry" designation increasingly related to logs from trees killed by the beetle.

even if the sawlog was useful for making lumber. The problem with this system was that graders had to make a subjective determination as to whether a log came from a dead tree, and if they believed it did, the log was given Grade 3 and sold for the minimum price.[8] As the MPB infestation worsened, more and more timber under the old grading system had been categorized as "dead and dry" and was automatically (i.e., without evaluation as to the quantity or quality of lumber that could be produced from the log) assigned the minimum stumpage price of C$0.25 per cubic meter.[9] Under the April 2006 grading rules, two categories of logs previously categorized as "dead and dry" (Grades 3 and 5) were eliminated, with so-called "reject" grades being consolidated into a new Grade 4.[10] In addition, the prior sawlog ("blank") grade was expanded to two grades (Grades 1 and 2). The intent of the grading rule change was stated in the press release: "As a result of the mountain pine beetle infestation, about 25 percent of the Interior harvest is currently being assessed as dead and dry. Under the new grades, the majority of this timber will be assessed as saw logs, recognizing their potential to produce good quality lumber. Saw log stumpage will apply."[11]

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[8] See "Grade 3 Discussion Paper," Ministry of Forests – Revenue Branch, June 4, 2004 at 2-3 (CAN-000017-18)

[9] According to the press release that announced the new grading system, "[u]nder the current grades, or categories, a log is assessed according to whether the tree it came from was alive or dead at the time of the harvest. In contrast, the new grades will be based on the log's size and quality at the time it is scaled, or assessed. In addition to fairly reflecting the quality of beetle-killed timber, the new grades will create simpler and more consistent assessment of timber harvested." ("New Interior Log Grades to be Introduced," Press Release by Ministry of Forests and Range, March 21, 2006.)

[10] Previous Grades 3 ("dead and dry" sawlog), 4 ("green" pulp log), and 5 ("dead and dry" pulp log) were eliminated. The new system had two lumber reject grades, Grade 4 and Grade 6. The latter, a reject grade for "undersized" logs, had existed under the old system. While Grade 6 also contained "reject" logs, it represented a very small portion of reject logs.

[11] "New Interior Log Grades to be Introduced," Press Release by Ministry of Forests and Range, March 21, 2006. This result is consistent with tests that were conducted on the draft version of the new grading rules reported in July 2005. BC's Interior Scaling Advisory Committee (ISAC) conducted a test that found that almost all of the Grade 3 sawlog volume under the old grading system went into Grades 1 and 2 under the (proposed) new grading system. (BC Interior Scaling Advisory Committee, "Interior Log Grades: A Report from the Interior Scaling Technical Advisory Subcommittee," July 12, 2005 at 10.) It is also consistent with the statement of the BC Ministry of Forests and Range in its annual report for the fiscal year ending in March 2006 when it listed among its accomplishments for the year that it "[c]hanged Interior log grades to more accurately reflect the value of beetle-damaged wood and ensure the Province receives fair stumpage revenue." (BC Ministry of Forests & Range & Minister Responsible for Housing, 2005/06 Annual Service Plan Report at 8.)

25. This statement from the BC ministry reflects an expectation that most of the logs assigned to Grade 3 under the old grading system would end up in sawlog grades (Grades 1 and 2) under the new grading system. For example, in a memorandum written in March 2006 just before the grading change was instituted, BC officials stated that, "[g]iven the current harvest profile…approximately 5-10% of existing grade 3 will shift to new grade 4."[12] This expectation is made clear in the methodology outlined in a BC document entitled "Interior Market Pricing System: Tenure Obligation Adjustments." In the Low Grade Percent Adjustments ("LG"), there is a calculation of the sawlog (vs. low grade) percentage, attempting to equate the prior log grades with the new log grades. In that calculation, 95 percent of the prior Grade 3 (dead and dry sawlog) is added to the prior sawlog ("blank") grade to achieve equivalency under the "new" sawlog Grades 1 and 2. In other words, this document appears to assume that 95 percent of the volume that had previously been included in Grade 3 would now move into the Grades 1 or 2 categories. By contrast, only 5 percent of the former Grade 3 was expected to go into the new Grade 4[13] (along with all of the former Grades 4 and 5).[14] This is consistent with the goals of BC's 2005 "Mountain Pine Beetle Action Plan," namely "[

]"[15]

26. The new grading rules put the grading standard for sawlogs in line with the longstanding BC grading standard for distinguishing a "sawlog" from a "lumber reject" log. By that standard, it was expected that logs would be classified as (Grade 2) sawlogs under the new grading rules if 50 percent or more of the gross scale (i.e., volume) could be manufactured into lumber, and 50 percent or more of the lumber

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[12] "Interior Log Grades – Issues and Decisions," Revenue Branch, Ministry of Forests and Range (March 3, 2006) at CAN-029625. The January 2006 minutes of the Interior Scaling Advisory Sub-Committee stated that "[b]etween five percent and ten percent of Grade 3 go to Grade 4, based on testing." (CAN-007123)

[13] As stated above, there were two reject grades, Grade 4 and Grade 6, under the new grading system. Since Grade 6 is so small, I include it as part of Grade 4 for purposes of this report.

[14] "Interior Market Pricing System, Tenure Obligation Adjustments," Revenue Branch, British Columbia Ministry of Forests and Range, June 5, 2006 at 5. See also "Interior Market Pricing System, Average Market Price," Revenue Branch, British Columbia Ministry of Forests and Range, June 5, 2006 at 2.

[15] CAN-000971.

produced would be "merchantable."[16] I refer to this expectation for convenience as the "50/50" rule. In addition, a new "premium" Grade 1 sawlog was established for which 75 percent or more of the gross scale could be manufactured into lumber and 75 percent of the lumber produced would be "merchantable." Only logs that could not meet the minimum 50/50 Grade 2 sawlog standard (and were not otherwise "undersize" or "rotted"[17]) would be classified as "lumber reject" and assigned to Grade 4 under the new grading rules.

27. At the same time the new grades were implemented in April 2006, BC also adjusted the MPS[18] so that the (stumpage) price of Grade 1 and Grade 2 timber in a stand could be reduced based on the degree of MPB attack in that stand. This adjustment was implemented through two amendments to the BC *Cruise Compilation Manual* on that date. One significant change relates to the calculation of the "lumber recovery factor" ("LRF") in a given stand. The LRF measures the volume of the lumber likely to be produced from a stand of timber, based on the attributes of the logs in

[16] CAN-000031-32. In the BC Scaling Manual § 6.6.3 (as amended Nov. 1, 1996), "merchantable lumber" is defined as "good, strong, general purpose lumber graded as better than utility or number 3." (BC Scaling Manual §6.6.5 (as amended Nov. 1, 1996).

[17] Logs with rot under the new grading rules, as under the old, were designated as Grade Z (Firmwood Reject).

[18] The MPS as it existed on July 1, 2006 determines stumpage rates for timber harvested under long-term tenures in Interior BC. The central concept underlying the MPS is that auctions of standing timber (accounting for approximately 20 percent of Interior BC standing timber) would be used to determine the stumpage price for the 80 percent of timber harvested under long-term tenures. The Interior MPS determines stumpage rates in two steps. First, the average market price ("AMP") for the timber under long-term tenures is calculated from a regression model based on past auction data, where the regression equation is applied to the characteristics and market conditions that exist in the tenure sector. Certain adjustments are then made to this computed price, particularly adjustments for the additional obligations of tenure holders ("tenure obligation adjustment" or "TOA"). The percentage of Grade 4 logs enters into the AMP calculation both through the TOA and through the share of Grade 4 in each cutting authority, as discussed below. Second, a stumpage rate is determined for each cutting authority (designated as a "mark") under the tenure system. The stumpage rate for a specific cutting authority is higher or lower than the AMP to the extent that the cutting authority is more or less valuable than the average stand. This calculation, in turn, is based on the lumber recovery factor ("LRF") and other characteristics of logs in that cutting authority, which are inputs into the calculation of the Stand Value Index ("SVI"), which is then compared to the value index of an "average" stand. The various steps involved in the calculation of the AMP and of the stumpage rate for specific marks, and how the percentage of Grade 4 and the LRF enter into those calculations, are described in more detail in **Appendix A.**

A change in the MPS was made on July 1, 2010. For stands where 35 percent or more of MPB-damaged timber is so-called "red" and "grey" attacked lodgepole pine, a single stumpage rate is determined for all the merchantable timber on the cutting authority area and billed to the harvester based on a cruise of the timber. Logs are no longer graded after the fact. For other stands (i.e., those with less than 35 percent of MPB-attacked lodgepole pine), the MPS adopted on July 1, 2006 (referred to as "MPS B") continues in effect in a slightly altered form, called "MPS A," with a two-year transition mandated before MPS A is fully implemented. ("Specifications: The Interior Market Pricing System," November 1, 2010, Timber Pricing Branch, Ministry of Forests and Range, p. 12.)

that stand. The change in the calculation of the LRF was designed to take into account the degree of MPB attack ("green," "red," or "grey") in the stand as a variable that would influence the estimated stumpage price.[19] Beginning April 2006, the LRF was reduced by three board-feet ("BF") per cubic meter for "green-attack" lodgepole pine, by 33 BF per cubic meter for "red-attack," and by 83 BF per cubic meter for "grey-attack." In light of the fact that the maximum unadjusted LRF for lodgepole pine is 267 BF/cubic meter, these proposed LRF changes were substantial.[20] Thus, the LRF was reduced by at least 1 percent for green-attack, 12 percent for red-attack, and 31 percent for grey-attack.

28. The weighted average LRF for each species on a stand is a direct input to the "stand value index" calculated for the stand, such that a decrease in the stand's weighted average LRF leads directly to a lower indicated stumpage price for all sawlogs in that stand.[21] Thus, the more MPB-attacked lodgepole pine in a stand, and the more severe the level of attack, the lower the Grade 1 and Grade 2 stumpage prices for that stand.[22] As such, while the changes in the grades and grading rules were expected to reduce the quantity of Interior BC logs given the C$0.25 minimum rate, changes to the MPS system adopted at the same time were expected to decrease the stumpage rate for stands with a high incidence of MPB-attacked timber. In this way, changes in the MPS system were explicitly designed to account for the progression of the MPB infestation.

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[19] Green-attack refers to a tree in the initial stages of MPB infestation. Adult beetles have tunneled under the tree's bark to lay their eggs. The tree may have died, but its needles are still green. The needles stay green for several months after the tree's death and then turn red, which is referred to as red-attack. Grey-attack refers to the later stage when the needles have fallen off the tree and only the bare branches remain.

[20] *Cruise Compilation Manual*, June 1, 2005, Appendix 7. The LRF depends on the volume of the tree. Lumber recovery factors as low as 91 BF/cubic meter are possible, but I am informed that it is unlikely a sawmill would experience a LRF that low. For lodgepole pine in the AMP data, the arithmetic average LRF in the first quarter of 2007, adjusted for zone and for attack, was 240 BF/cubic meter.

[21] *Cruise Compilation Manual*, Section 11.5.1 and 11.5.2 – as amended April 2006; see also BC Ministry of Forests & Range, "Specifications: Calculation of Interior Stumpage Rates," July 1, 2006, at steps 2.3, 2.16, 2.17, 2.22, 2.34, 5.1, and 5.2.

[22] At the same time, breakage factors for red and grey-attack trees were increased, which lowered the calculated net merchantable volume of those trees. That change would not necessarily reduce the stumpage rate, but it would reduce the total payment for a stand. Ministry of Forests and Range, Amendment No. 3 to the *Cruise Compilation Manual*, March 3, 2006 (effective date April 2006).

29. The new grading rules adopted in April 2006 appear to have initially had the intended effect of reducing the amount of lodgepole pine that was graded and priced at the "reject" C$0.25 per cubic meter level. In the six months before the adoption of the new grading rules, for example, the percentage of lodgepole pine in Interior BC that was assigned Grade 3 (dead/dry) and priced at C$0.25 per cubic meter varied between 43.1 percent and 52.3 percent. When logs from two other reject categories (Grade 4 "Reject" and Grade 5 "Reject Dead/Dry") are added to these Grade 3 figures, the percentage of lodgepole pine in Interior BC that was given the "reject" price of C$0.25 per cubic meter in the six months prior to the April 2006 grading change varied between 50.9 percent and 63.6 percent. By contrast, in the six months immediately after the April 2006 grading change, the percentage of lodgepole pine in Interior BC that was assigned the new Grade 4 "lumber reject" grade and given a price of C$0.25 per cubic meter varied between 5.7 percent and 19.2 percent (and stayed at a level between 16.0 percent and 18.4 percent over the subsequent six months, a period ending March 2007). These figures are displayed in **Exhibit 3**.

30. To investigate the behavior of the share of Grade 4 since the change in grading standards, I conducted a regression analysis looking for evidence of a time trend in the share of Grade 4. The regression uses as the dependent variable the share of Grade 4 as shown in Exhibit 3, expressed as a natural logarithm. The results are consistent with the absence of any trend in the share from April 2006 until April 2007. After April 2007, however, there was a significant increase in the Grade 4 share.[23]

31. I also looked at BC's *forecast* of the reject grade percentage under the old grading system and compared that to the *actual* reject grade percentage under the new grading system. The goal of this comparison was to see whether actual performance under the new system differed significantly from projections under the

[23] The independent variables are a time trend that was allowed to change after April 2007 and monthly dummy variables. The time trend is statistically significant at the 1 percent level. These results are explained in more detail in **Appendix B**. The estimated coefficients on the monthly dummy variables suggest a seasonal pattern in the Grade 4 share. This share is relatively low in April and May, and also (but to a lesser extent) in November and December. It is relatively high in July, August, and (to a lesser extent) September.

old system, which was the stated intent of the adoption of the new grading rules. I show the results of this analysis in **Exhibit 4**. The blue line represents BC's forecast of the lodgepole pine Grade 3 percentage going forward as the MPB infestation progressed under the old grading system. The red line represents actual lodgepole pine Grade 3 percentage under the latter period of the old grading system and then Grade 4 percentage under the new grading system. At first, the actual Grade 3 percentage increases faster than the forecast, as the time of the grading change in April 2006 approaches. Significantly, when the new grading system was adopted in April 2006, there is a substantial decline of reject grade relative to the forecast under the old system, as was the stated intention under the new system. Starting in mid-2007 and continuing in 2008 and 2009 and to a lesser extent 2010, however, there was a rapid increase in the Grade 4 percentage to the point where it approaches and then exceeds the blue line representing the forecast (of Grade 3) under the old system.

V. EVIDENCE OF MISGRADING

32. While the new grading rules produced a significantly lower quantity of "lumber reject" Grade 4 during the first year of implementation, there is an abrupt change in this pattern starting approximately in the spring of 2007. At that time, the proportion of Grade 4 lodgepole pine began to rise rapidly, with further growth in the proportion of Grade 4 during the remainder of 2007, 2008, and 2009. As can be seen in Exhibit 3 (contrasting the solid red line at the beginning of the grading-change period with the dotted red line afterwards), the proportion of Grade 4, which had been in the vicinity of 15 to 20 percent for much of the initial period after the grading change, rose first into the 20-35 percent range for the remainder of 2007, then into the 35-60 percent range for 2008, peaking at almost 66 percent in 2009, before falling slightly in 2010.

33. It is important to reiterate that the changes in the grading rules in April 2006 were made in large part due to the severity of the MPB outbreak – i.e., they were made because large amounts of beetle-killed logs under the old grading rules were

automatically given the C$0.25 minimum stumpage rate regardless of their ability to produce merchantable lumber. On the eve of the grading change in March 2006, with the MPB outbreak at or near its peak,[24] Exhibit 3 shows that almost 65 percent of Interior BC lodgepole pine (Grades 3, 4, and 5 combined) was being graded such that it received the C$0.25 rate. When the new grading system was introduced, the Grade 4 percentage stabilized in the 15-20 percent range over much of the next year (after two initial transition months where the lodgepole pine Grade 4 percentage was less than 10 percent). As such, an equilibrium appears to have been reached under the new grading system despite the advanced state of the MPB attack in Interior BC.[25]

34. This apparent equilibrium condition was not sustained. The relevant question is what caused the Grade 4 percentage eligible for the C$0.25 rate under the new grading system to rise over the next three years to virtually the same level as the combined Grades 3/4/5 percentage (that also received the C$0.25 rate) under the old grading system – the very system that was discarded before the SLA was adopted because it produced too much lumber reject-grade timber.

35. One explanation I have explored is Canada's position in this arbitration that the increase in Grade 4 was largely due to the MPB epidemic. I considered the

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[24] According to BC's own analysis, the observed annual kill (red-attack) in British Columbia from the MPB epidemic peaked in 2005, and the infestation slowed considerably after then. ("Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the 2009 Provincial Aerial Overview of Forest Health and the BCMPB model – year 7," Adrian Walton, Research Branch, BC Forest Service, May 11, 2010, p. 5) Nevertheless, this same source (at p. 7) indicates that the peak of the outbreak varies considerably from region to region in BC – some areas (generally those with the largest volumes of timber) appear to have peaked as early as 2003-2004, while other areas peaked later or are yet to peak. In addition, to the extent that MPB-infested timber in some previous outbreak areas was not immediately harvested, some areas began to experience increased timber quantities that had a longer time since death, e.g., grey-stage timber that has been dead 5+ years. Below, I analyze whether this latter factor is responsible for the increased incidence of Grade 4 despite the slowing of the MPB infestation.

[25] The beginning of the MPB infestation in Interior BC is usually considered to be 1998-1999, and, as discussed above, the peak annual kill of pine volume in this outbreak occurred in 2005. There are 22 "pine units" in Interior BC, defined as those Timber Supply Areas where more than 10 percent of the merchantable volume is pine. These pine units account for most of the pine harvested in Interior BC. By 2006, the MPB infestation had peaked in 9 of these pine units (Vanderhoof, Quesnel, Lakes, Prince George District, Williams Lake, 100 Mile House, Kamloops, Ft. St. James District, and Morice), and is slated to peak between 2009 and 2012 (with considerably lower volume loss) in the remaining pine units at the periphery of the initial attack. The total cumulative (green) attacked pine volume from 2004-2006 (i.e., at the time of the grade change) in the 22 pine units was 333.4 million cubic meters, compared to a projected 2004-2012 cumulative (green) attacked volume in the 22 pine units of 588.4 million cubic meters. (CAN001060-66)

possibility that the increase in Grade 4 logs came from large-volume timber areas within Interior BC where the MPB attack had peaked early and had left significant tracts of dead timber. I considered whether an increase in the harvest of that timber in the 2007-2010 timeframe, when it had been dead for some time, was the reason why the Grade 4 percentage rose so quickly. My analysis, described in more detail below, concludes that there was significant misgrading even holding equal the effect of the MPB epidemic. There are several bases for this conclusion. First, there is no close relationship between the geographic spread of the MPB epidemic and the increase in the share of Grade 4. Second, there is no evidence of a change in harvesting practices that would have increased the quantity of Grade 4. Third, the loss in the quantity and value of lumber that would have been caused by the MPB is not large enough to explain the significant increases in the amount of timber assigned to Grade 4. In fact, as previously described, losses due to the MPB were already taken into account under the new system by changes in the calculation of the lumber recovery factor.

A. The MPB does not explain the observed increase in Grade 4

36. I examined data on the MPB's spread to determine its possible relationship to the increase in Grade 4. In **Exhibit 5**, I display a comparison of the progression of the MPB outbreak (actual and/or projected) for the various "pine units" in BC with the reported percentage of Grade 4 lodgepole pine in the forest district within which the pine units are located. While some of the highest percentages of Grade 4 reported in 2007, 2008, 2009 and 2010 are in those pine units and forest districts affected most by the MPB (and peaking earliest), there are also numerous examples of extremely high Grade 4 percentages for pine units where the MPB attack was considerably later and did not peak at the early stages. For example, the Lillooet, Robson Valley, Bulkley, and Okanagan pine units were not projected to have their peak MPB volumes until 2009 or later, and yet the percentage of Grade 4 in the associated forest district in 2008 and 2009 was in the 35 to 65 percent range. Even for the pine units such as Williams Lake, 100 Mile House, Kamloops, Ft. St. James District, and Morice where the MPB peak occurred somewhat earlier (i.e., in 2005 and 2006), the percentage of Grade 4 had already increased into the 35-47 percent

range within two years of peak attack, and into the 36-67 percent range within three years of peak attack. This result is at odds with BC's own assessment of the intended impact of the April 2006 grading change, which was to price timber "based on the market value for the particular stand and species harvested…," recognizing that "beetle-killed timber that is harvested within one or two years of attack retains much of its original value and is priced accordingly…."[26]

37. Additional data also indicate that MPB attack does not explain the increase in Grade 4. Data provided by the Canadian government to the United States Trade Representative ("USTR") to show the calculation of the "average market price" ("AMP") includes information on the amount of green, red, grey and other attack by timber tract ("mark") starting in the third quarter of 2008 and in subsequent quarters. These data allow a determination of the amount of timber assigned to Grade 4[27] for marks with no insect attack in those quarters.[28] In the third quarter of 2008, for example, the Grade 4 share was 25 percent in marks with no insect attack, which is substantially above the levels described above in Exhibit 3 in the entire Interior BC region in 2006 and early 2007.[29] (See Table I.)

Table I: Grade 4 Share of Marks With Varying Levels of Insect Attack: Q3 2008 to Q2 2010

	2008		2009				2010	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
No Attack	25%	25%	25%	24%	25%	25%	26%	29%
Red + Grey below 25%	21%	20%	21%	21%	21%	21%	19%	20%
Grey over 50%	43%	45%	54%	59%	62%	63%	65%	65%

[26] "Mountain Pine Beetle Action Plan, Annual Progress Report 2006/2007," Ministry of Forests and Range, Mountain Pine Beetle Emergency Response Division, August 2007 at 23.

[27] Again, the Grade 4 share in this analysis includes a very small amount of Grade 6.

[28] These marks have zero reported green, red, grey, and other (non-MPB) attack. Such marks accounted for 12 percent of AMP volume in the third quarter of 2008. That share fell steadily after that quarter and was three percent in both the first and second quarters of 2010.

[29] While the high percentage of Grade 4 in "no attack" marks could to some extent be caused by a lag between the date of attack determination and the date of harvest, this explanation is unlikely to undo the result. The US has asked Canada to supply information regarding the dates when the attack determination was made in the AMP data, but Canada has not yet supplied this information.

38. The share of Grade 4 at other levels of attack also is shown in Table I. Grade 4 share is shown at both a severe level of attack (grey-attack over 50 percent of volume) and a relatively limited level of attack (red and grey-attack combined below 25 percent of volume). The Grade 4 share is highest in the marks with the severe levels of attack, as expected. The Grade 4 share, however, is lower in the marks with an intermediate level of attack than in the marks with no attack. This finding provides additional evidence to support the conclusion that MPB attack does not provide a sufficient explanation for the observed increases in the levels of Grades 4.

B. Changes in harvesting practices do not explain increase in Grade 4

39. As described above, the MPB attack does not adequately explain the observed increases in the share of logs assigned to Grade 4. I also considered whether changes in harvesting practices due to the progression of the MPB disease could contribute to such an explanation. In my view, they do not. Harvesting practices even prior to 2006 had targeted MPB-infested stands, and there was no significant change in these practices after 2006. For example, an assessment of harvesting practices in 16 BC Interior Timber Supply Areas ("TSAs") during the 2004-2006 period concluded that "licensees were targeting heavily pine-dominated stands prior to the summer of 2006…."[30] A follow-up to this study in 2009 found that "[o]n the whole licensees are continuing to do a good job targeting pine for salvage [through 2008/2009]…. The emphasis on pine harvested essentially remained unchanged for the other 17 TSAs and five TFLs ['tree farm licenses']."[31] Based on these studies, it appears that harvesting practices did not change substantially as the Grade 4 share increased.

C. Results of mill studies are inconsistent with Grade 4 increase

40. Several studies of BC sawmills' use of logs at an advanced stage of MPB attack (grey-stage) provide additional evidence that the overall increase in Grade 4 was not

[30] "Monitoring Harvest Activity Across 16 Mountain Pine Beetle Impacted Timber Supply Areas," B.C. Ministry of Forests and Range, June 2007 at 2; 5.

[31] "Monitoring Harvest Activity Across 29 Mountain Pine Beetle Impacted Management Units," B.C. Ministry of Forests and Range, December 17, 2009 at 35.

due to the increase in beetle-attacked timber. Recent log testing has been conducted in Interior BC as a result of the MPB outbreak.[32] These tests, conducted at several BC Interior mills, compared lumber volume and value recovered from grey-stage MPB-killed trees (predominantly dead 5-7 years) with comparable green live trees.[33] These tests were conducted "to determine the difference in lumber recovery and value for a BC Interior sawmill processing grey-stage (5+ years) MPB-attacked lodgepole pine when compared to processing green timber."[34]

41. I summarize the results of these sawmill tests in **Exhibit 6**. For the four tests, the volume losses between green timber and grey-stage MPB timber were between 1.5 percent and 12.5 percent, averaging 7.3 percent across the four tests. The corresponding value losses were between 5.7 percent and 23.5 percent, averaging 13.5 percent across the four tests. Thus, even in the most extreme case of 100 percent grey-stage MPB attack (which would occur when all trees have been dead approximately five or more years), the combined losses of volume and value across the four test regions average a little more than 20 percent.[35] Assuming that the 50/50 rule is operative, this result is well below the level that would cause even a 100 percent grey-stage MPB attack incidence to bring about the observed wholesale changes in the percentage of lodgepole pine categorized as Grade 4.

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[32] The log testing has been conducted by Forestry Innovations Investments, Inc. as part of the "Mountain Pine Beetle Action Plan" announced in April 2005.

[33] The first test was conducted at a stud mill in Vanderhoof, BC (Northern Interior Region) in March 2006. (J. David Barrett and Frank Lam, "Stud Mill Lumber Grade and Value Yields From Green Spruce-Pine-Fir and Grey-Stage Dry Mountain Pine Beetle Attacked Logs," Forestry Innovation Investment, Ltd., March 26, 2007.) The second test was conducted at a sawmill in Quesnel (Southern Interior Region) in September 2007. (FPInnovations, "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 1. Quesnel Sawmill," Forestry Innovation Investment, Ltd., September 2007.) The third test was conducted at the Prince George (Northern Interior Region) sawmill in November-December 2007. (FPInnovations, "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 2. Prince George Sawmill," Forestry Innovation Investment, Ltd., November/December 2007.) And the fourth test took place in Princeton (Southern Interior Region) in December 2008. (FPInnovations, "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 3. Princeton Sawmill," Forestry Innovation Investment, Ltd., December 2008.)

[34] "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 3. Princeton Sawmill," p. i.

[35] "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 3. Princeton Sawmill," p. 20.

42. Other information from these mill tests suggests that there is little relationship between the grades assigned to logs and the quality and quantity of the lumber recovered from them.[36] The tests measure the performance (in terms of lumber production) of grey-stage logs relative to those of green logs. For example, comparing the logs used in the Prince George test to those used in the Quesnel test, in Prince George the Grade 4 share of grey-stage logs is much higher (47 percent vs. 36 percent for Quesnel), and the Grade 4 share of green logs is much lower (5 percent vs. 17 percent for Quesnel). Therefore, if lumber recovery and value were significantly lower in Grade 4 logs (which would be expected if grading were accurate), the Prince George test should indicate a much higher grey-stage loss than the Quesnel test. Despite this expectation, Prince George had a lower combined loss of lumber recovery and lumber value than Quesnel (19.0 percent vs. 29.0 percent for Quesnel). Again, there appears to be little relationship between the share of logs assigned to Grade 4 and the quantity and quality of lumber recovered from those logs. The only reasonable conclusion is that the logs in the mill studies cannot have been graded consistently with the underlying rationale of the new grading rules, i.e., that there has been significant misgrading of logs under the new system.

43. Moreover, a comparison of log grades for the above mill tests provides data on the Grade 4 shares of each of four batches of grey-stage logs from trees that were dead for at least five years. These batches, which were processed between November 2006 and November 2008, had an average Grade 4 share of 38 percent.[37] If MPB attack caused the growth of Grade 4, it seems reasonable to expect that the Grade 4 share in the harvest would not go above that level, because the logs in those samples consisted solely of grey-stage logs dead for over five years, practically a worst-case scenario in terms of MPB attack. Nevertheless, the share of Grade 4 in the harvest as a whole significantly exceeded that level in late 2008, 2009, and 2010, providing further evidence of misgrading.

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[36] "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 3. Princeton Sawmill," pp. 20-21.

[37] "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 3. Princeton Sawmill,". p. 21.

44. I have also reviewed a March 2010 Study by Wood Products entitled "BC Interior – Mountain Pine Beetle Attack" that has additional sawmill data. This study looked at lumber recovery factors and lumber grade recovery for sawlogs at different levels of MPB attack for "average" BC Interior sawmills. With respect to LRF, the study found, based on a 2008/2009 analysis conducted at a number of BC interior sawmills, that LRF was virtually the same (between 63 and 65 percent) for green sawlogs, one-year green-attacked sawlogs, two- to three-year red-attacked sawlogs, and four- to five-year grey-attacked sawlogs. The LRF dipped slightly for eight-year grey-attacked sawlogs (59 percent) and 12-year grey-attacked sawlogs (56 percent).[38] In terms of lumber grade, the Wood Products study updated the above-reported 2007-2008 Forintek mill studies and found the percentage of lumber produced from sawlogs at different levels of MPB attack that was merchantable. The merchantable shares of the lumber produced at different attack levels were: "green no attack" 87 percent; "one-year green-attack" 87 percent; "two- to three-year red-attack" 83 percent; "four-year grey-attack" 80 percent; "eight-year grey-attack" 73 percent, and "12-year grey-attack" 67 percent.[39] These relatively small decreases in lumber recovery and lumber grade recovery factors, reflecting significant shelf-life of MPB logs,[40] are inconsistent with a multi-fold increase in Grade 4 starting in early 2007.

45. Furthermore, as described above, LRFs were already lowered (in grandfathered adjustments to the MPS system) for green, red, and grey-attack pine to take account of the effects of MPB activity. Thus, if there were a decline in lumber recovery due to MPB activity, that decline was already accounted for by the change in the LRF calculation and should not be associated with increases in the share of logs assigned to Grade 4.

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[38] "BC Interior Mountain Pine Beetle Attack – Impact and Outlook on BC Timber-Availability and Wood Products Production," Wood Products, March 2010 at 32.

[39] "BC Interior Mountain Pine Beetle Attack – Impact and Outlook on BC Timber-Availability and Wood Products Production," Wood Products, March 2010 at 34. Note that these grade recoveries are based solely on MPB-killed sawlogs that enter the sawmill, i.e., not on pulp logs left in the bush or logs harvested for other uses.

[40] BC Forests and Range Minister Pat Bell has stated publicly that he believes that the shelf-life of dead MPB pine is even longer than is assumed in the Wood Products report. (CAN-000445)

D. Additional evidence from lumber markets

46. Another potential explanation for the large increase in the percentage of Grade 4 lodgepole pine after 2007 is that the increase can be attributed to a corresponding decrease in the quantity or value of lumber being produced from BC Interior timber. I reviewed several sources of relevant information and found that data on lumber and log production and lumber prices in the BC Interior during this period are not consistent with this explanation.

47. First, the Government of Canada, under the SLA, provides monthly data on the volume and export tax (assessed at 15 percent of exported lumber value) of BC Interior lumber exported to the United States. I compared the average unit value of BC Interior lumber exports with a widely used measure of the overall lumber market, the Random Lengths market price for Western Spruce-Pine-Fir ("SPF"). I depict this comparison in **Exhibit 7**, which does not reveal any significant decrease in the unit value of BC Interior lumber exports relative to the overall market.[41]

48. Second, the BC Interior is the single largest lumber-producing state or province in North America. As such, if the BC Interior began to produce significantly greater quantities of low-quality lumber, I would expect that to be reflected, all else equal, in an increased supply of low-grade lumber in North America. This increased supply, in turn, should result in a higher spread between the market price of standard "merchantable" lumber and low-grade "non-merchantable" lumber. In **Exhibit 8**, I present the degree of discount in the Random Lengths price for Western SPF 2 x 4 "Utility" lumber (which is non-merchantable under the BC grading regulations) relative to the Random Lengths price for Western SPF 2 x 4 "Number 2 and Better" lumber (defined as "merchantable" by BC regulations) from April 2006 to April 2011. The data in Exhibit 8 and the companion **Exhibit 8a** show that the spread between these prices has, in fact, been declining. In the first 12 months of the period, the spread averaged 43 percent of the price of the non-merchantable

[41] Although lumber exported to the United States does not necessarily have the same grade mix as the overall market, it would be expected that if there were a large increase in the production of low-grade lumber due to the MPB attack in Interior BC, there would be a noticeable decline in BC Interior lumber unit values relative to the market.

lumber. In the last 12 months, the spread averaged only 12 percent. The decline in this spread is consistent with no significant increase in the export of low-grade lumber from Interior BC as a result of the MPB outbreak (or for any other reason).

49. A statistical analysis confirms that the spread between the prices of merchantable and non-merchantable lumber has been declining. This analysis also enables one to determine if the increase in demand for Canadian lumber from China, an area where the relative demand for non-merchantable lumber is sometimes said to be higher than in the United States or Canada, is causing this price spread to shrink in a way that obscures the effects of a hypothetical decline in the value of lumber from BC. I estimated a regression with the natural logarithm of the percent price spread as the dependent variable and with the logarithm of the share of Canadian lumber exports going to China and a time trend starting in April 2007 as independent variables.[42] The coefficient for the share of exports that went to China was statistically insignificant, and the coefficient on the time trend variable was statistically significant and negative, which indicates that even after holding constant the effect of increased demand from China, this price spread was declining. Thus, the behavior of the price spread between merchantable and non-merchantable lumber is exactly the opposite of what one would expect were the quality of lumber from the BC Interior declining.

50. Third, if there were a significant decrease in the quality of logs harvested in the BC Interior, I would expect that the quantity of lumber produced from those logs would decline. In fact, that is not the case. In **Exhibit 9**, I show the ratio of lumber production to harvest for the BC Interior from January 2006 to December 2010. Due to changes in inventories, these ratios can vary widely from month to month,[43] but they do not have any significant tendency to decline over time. Statistical analysis confirms that the ratio of production to harvest in the BC Interior did not decline significantly during the period when the Grade 4 share was

[42] The results of this regression are presented in more detail in **Appendix C**.

[43] Harvesting activity in Interior BC halts for several weeks every year in the spring due to melting/wet conditions. Roads are soft, muddy, and easily damaged so harvesting must stop. Therefore, inventories are built up in anticipation of this non-harvesting period, to be depleted until harvesting can begin again. This inventory behavior explains the seasonal pattern observed in the data in Exhibit 9.

increasing. I estimated a regression with the natural logarithm of that ratio as the dependent variable and a time trend as an independent variable. Since the ratio is also affected by inventory behavior, and inventories tend to vary due to seasonal factors, I also included monthly dummy variables in the regression. The results indicated that there was no tendency for the quantity of lumber produced from a given volume of logs to decline. (Technical details concerning the regression are in **Appendix D.**)

51. Fourth, additional evidence that the quality of BC logs has not declined at the same time as the increase in Grade 4 can be found by comparing the average unit value of exports of lumber to the United States from BC to the average unit value of exports of lumber to the US from Alberta. I selected Alberta as the basis for comparison because it neighbors BC, has a similar distribution of lumber species, and has seen little MPB salvage harvesting.[44] In **Exhibit 10**, I compare the unit values of exports from the two provinces. As can be seen, the value of lumber from BC did not decline relative to the value of lumber from Alberta, consistent with the view that the quality of lumber in BC did not fall as the Grade 4 share rose.

52. Fifth, if the quality of logs harvested in the BC Interior did decline, that drop would cause the share of those logs going to sawmills also to decline as lower quality logs were sent to other uses, such as pulp mills. In fact, data from BC Interior Log Market Reports indicate that the share of traded SPF logs that went to sawmills actually *rose* from 89 percent in 2007 to 91 percent in 2010.[45] If the share of logs unusable for lumber were truly increasing due to the MPB outbreak (or some other cause), one would expect that log sales from sawmills to pulp mills would account for an increasing share of traded SPF logs in the BC Interior. The data show exactly the opposite is occurring.

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[44] There is evidence, for example, that the MPB arrived somewhat later in Alberta. See http://www.mpb.alberta.ca/BeetleFacts/historyinfestations.aspx

[45] In 2008, the share fell to 83 percent and then rose to 85 percent in 2009. These reports are from the Revenue Branch of the Ministry of Forests and Range. Note that these reports only include logs that were sold to mills in arms-length transactions and thus exclude most logs harvested in the BC Interior. For that reason, I have not used these data in my analysis.

53. Finally, the aforementioned sawmill tests also indicate that there was not a significant decline in the quantity of "merchantable" lumber recovered from MPB-affected logs. Highlighting the Princeton mill test, for example, the percentage of merchantable lumber ("Lumber Grade 2 and better") was 95.6 percent from the "green" logs and 84.0 percent from the longer-dead "grey" logs. Both figures are far above the "50 percent merchantable" cut-off under the 50/50 rule, the standard below which it is appropriate to designate a log Grade 4.

54. Based on my analyses above of attack data, harvest practices, mill studies and lumber market data, I conclude that there is significant evidence of misgrading in Interior BC post-April 2007. I find that the percentage of Grade 4 increased consistently over time even when the level of MPB attack is held constant. The mill studies, in particular, indicate that the percentage of logs assigned to Grade 4 as a result of the MPB infestation should not have increased dramatically, since these studies do not find a significant loss of log volume that can produce merchantable lumber – the criterion in the grandfathered grading regulations for classifying a log as Grade 4 (under the 50/50 rule). This is consistent, as well, with my analysis of lumber markets, which found little or no evidence of declines in merchantable lumber quantity produced from MPB logs. According to these data, the effect of the MPB attack is not large enough to result in a significant increase in the share of logs assigned to Grade 4 under the grandfathered grading regulations. Rather, at most, the beetle infestation should result in "market-based" adjustments in the Grade 1 and Grade 2 log stumpage prices for MPB-affected timber. As discussed earlier, BC in fact established in its grandfathered April 2006 reforms a mechanism, through changes in the calculation of the LRF, to lower the stumpage rate on Grade 1 and 2 logs based on the degree of MPB attack.

VI. QUANTIFICATION OF MISGRADING

55. The evidence summarized in previous sections of this report indicates a significant amount of misgrading of logs in BC starting in about 2007. I have attempted to quantify the amount of logs that was incorrectly placed in Grade 4 and should have

been given a higher grade. The quantity of misgraded logs can be found by taking the difference between the actual observed amount of Grade 4 logs and the amount of logs that would have been assigned to Grade 4 "but for" the misgrading.

56. The first step in the analysis is to estimate the quantity of logs that would have been classified as Grade 4 "but for" the misgrading. One plausible estimate of the "but for" amount of Grade 4 is to evaluate the level of Grade 4 that was projected to occur when the new grading system was introduced. As described above, the intent behind the new grading system implemented in April 2006 (and grandfathered into the SLA) was to grade more accurately the timber that resulted from the acute MPB infestation which had already peaked in many BC Interior districts. In particular, as discussed above, the documents that accompany the implementation of the new grading system indicate an expectation that approximately 5-10 percent of the lodgepole pine logs previously designated Grade 3 under the old system would be given Grade 4 under the new system. That is, there was an expectation that the amount of "reject" grade would decrease from nearly 60 percent of lodgepole pine logs in the final months under the old grading system (where "reject" grades included Grades 3, 4, and 5), to approximately 7.5-10.0 percent of lodgepole pine logs under the new system (where the old Grades 3, 4, and 5 were consolidated into the new Grade 4).[46] I use this range as one possible benchmark for the amount of Grade 4 that would have occurred "but for" misgrading.

57. In fact, during the first year of the new grading system, the percentage of Grade 4 lodgepole pine was under 10 percent for the first two months, and then varied between 13.9 percent and 19.2 percent during the remainder of the year. Over the course of the first year, the percentage of Grade 4 averaged 17.8 percent, somewhat above the 7.5-10.0 percent range that was anticipated prior to the introduction of

[46] The 7.5-10.0 percent figure is calculated as follows. Grades 4 and 5 under the old system (both reject grades involving either green logs or obvious pulp logs) constituted approximately 5 percent of all lodgepole pine logs. These logs were all expected to be classified as reject (Grade 4) under the new grading rules. As discussed above, Grade 3 logs under the old system ("dead and dry" sawlogs), which made up about 50 percent of all lodgepole pine logs, were expected to go 90-95 percent into Grade 1 and Grade 2 sawlogs under the new system, with 5-10 percent of these logs going into the new Grade 4. (These Grade 3 logs that would go into Grade 4 represent, in turn, 2.5- 5.0 percent of all lodgepole pine logs.) Thus the total expected Grade 4 percentage of all lodgepole pine logs under the new grading system is 7.5-10.0 percent (= 5 percent of all lodgepole logs from the old Grades 4 and 5 + 2.5-5.0 percent of all lodgepole pine logs from the old Grade 3).

the new grading system, but still well below the levels that occurred after the Grade 4 percentage rose rapidly starting in mid-2007. As such, another potentially reasonable benchmark for the "but for" level of Grade 4 is 17.8 percent – the actual average level during the first year of the new system.

58. One possible objection to this benchmark is that the beetle infestation continued to spread over the 2007-2011 period such that an increase in the amount of Grade 4 was to be expected even in a system without any misgrading. While this objection might initially appear reasonable, since some of the beetle-killed timber that was not immediately harvested might be expected to deteriorate the longer it was dead, evidence in the record indicates this effect should be small. First, as discussed above, the MPB attack had peaked in a significant portion of the BC Interior prior to the adoption of the new grading system, so to the extent that the beetle continued to spread to other areas, it would be expected that the MPB-attacked timber harvested from those areas would be relatively newly killed. As such, the harvested timber would retain much of its lumber-producing value for several years to come. Moreover, BC's harvesting/salvage policy continued to encourage the harvesting of newly killed timber. Second, with respect to the areas where the beetle attack had peaked a number of years earlier and where harvests had not kept up with the attack, many of those trees were increasingly entering their red and grey-attack stages. At the same time, however, the mill studies discussed earlier demonstrate that much of even the grey-stage timber is still usable for merchantable lumber, easily passing the 50/50 test that is supposed to demarcate Grades 1 and 2 from Grade 4 logs under the new grading system. As a result, there is no necessary reason to expect a significant increase in the Grade 4 percentage over and above the 2006 to early-2007 level even with an increase in grey-stage MPB timber from mid-2007 to the present.

59. I have estimated the implications of the findings of the mill studies and determined that they generally support the use of the percentage of Grade 4 close to the level during the earlier (2006-2007) period as a reasonable estimate of the "but for" level of Grade 4. While the Grade 4 share might be expected to increase somewhat with increased grey-attack share, the results of the mill studies indicate that in late 2007

and late 2008, the amount of Grade 4 in grey-stage timber was significantly overstated.

60. The mill studies provide data on the average volume and value of lumber recovered from green vs. grey-attack logs. The mill studies also provide data on the amount of Grade 4 in green vs. grey-attack logs. Given these data and assuming that the Grade 4 share of the green logs represents correct grading (an assumption that may understate the extent of misgrading), it is possible to use the lumber volume/value loss results for grey-attack logs to estimate an appropriate (or "true") Grade 4 share of the grey-attack logs in the Prince George test, which involves logs processed in November 2007, and in the Princeton test, which involves logs processed in November 2008.[47] In the Prince George test, while the actual observed Grade 4 share was 47 percent, the estimated true share based on reported lumber volume/value loss is 27 percent, or 58 percent of the actual observed Grade 4 share. In the Princeton test, while the actual observed Grade 4 share was 33 percent, the estimated true share, again based on the reported lumber volume/value loss, was 6.4 percent, or 20 percent of the observed Grade 4 share. Thus, the results of these tests indicate that the Grade 4 share in grey-attack timber is substantially overstated by late 2007, and the overstatement (albeit for a different mill) worsens in 2008.

61. In addition, it should be noted that any reduction in lumber value due to MPB damage is already taken into account in a number of ways in the MPS other than through the Grade 4 share. First, as discussed above, the assumed lumber recovery factor (used in connection with the computation of stumpage prices on tenure tracts) is reduced by the incidence of attack. Second, MPB damage lowers the stumpage rates for timber under the MPS, as MPB damage suppresses the prices paid for auctioned timber, prices that influence the stumpage rate calculated for

[47] The estimate of "true" Grade 4 share is made as follows. The mill studies report the average volume/value loss for grey-attack logs, but there is no information about the distribution of logs around that average. I assume a distribution of recoverable logs in the mill tests (called a beta distribution) and I estimate the parameters of that distribution using the Grade 4 data from the green-stage logs. Those parameters are then used to estimate the proper Grade 4 percentage of the grey-attack logs. I present this methodology in detail in **Appendix E**.

tenure marks.[48] Third, to the extent that any logs were so badly damaged that they were not suitable for use in a sawmill (and instead usable only at pulp mills), this reduces the share of timber that went to sawmills and thus reduces the share of the estimated benefit from misgrading that is considered a benefit to lumber producers, as will be discussed below. For all of these reasons, using the Grade 4 share from the first year of the new grading system as a benchmark for the "but for" world (as I do in my first estimate of misgrading, presented in Section VIII.A. below) does not ignore the effects of MPB attack on the value of timber but instead incorporates these effects through avenues other than the share of logs assigned to Grade 4.

VII. BC POLICY CHANGES DID NOT IMPROVE THE EXTENT TO WHICH STUMPAGE RATES REFLECT MARKET CONDITIONS

62. I understand that under the terms of the SLA, BC may make changes to its policies if such changes maintain or improve the extent to which stumpage prices reflect market conditions. I have considered whether the changes in policies that led to the increase in Grade 4 were of that nature. The increase in the amount of Grade 4 logs might have reflected market conditions had there been a large decline in the market value of timber in the BC Interior attributable to a decline in its quality. While I understand that stumpage prices have declined due to a decline in demand stemming from the 2007-08 recession, that decline in demand affects all grades of softwood lumber, and is not related to a change in the share of logs assigned to Grade 4.

63. The available data show that the apparent misgrading does not maintain or improve the extent to which stumpage prices reflect market conditions. Data that I presented in an earlier section of this report indicate that there has been no decline in the quality of BC timber that reduced its market value. The data also show that

[48] [ ] (CAN-053884) In the first years of the market pricing system, the BC government did not include any consideration of the level of MPB attack in the MPS equation. Starting in July 2008, the equation for determining the estimated winning bids as part of the BC market pricing system explicitly included a variable for red and grey-attack.

there has been no decline in the relative value of lumber from the BC Interior and no apparent increase in the relative amount of low-quality lumber from BC Interior sawmills. Moreover, studies of the use of logs by BC sawmills at various stages of MPB attack contradict the view that the changes in grading simply reflect a change in quality due to MPB attack.

64. Moreover, while the stumpage rates for Grades 1 and 2 are based on a system that uses auction prices as one factor in setting rates, the stumpage rate for Grade 4 is an administered price that is set at a fixed level regardless of market conditions. Thus, grading changes that increase the share of Grade 4 in the harvest do not increase the extent to which stumpage prices reflect market conditions because Grade 4 prices are not influenced by those conditions.

65. By contrast, I observed above that the market pricing system does attempt to take into account, through market-related adjustments that affect the Grade 1/Grade 2 stumpage prices, any changes in the volume and value of lumber output relative to log inputs.

66. In sum, to the extent that rising Grade 4 percentages are due to misgrading and are unrelated to any decrease in lumber volume, the increase in the quantity of logs priced administratively at C$0.25 cannot cause the stumpage system to better reflect market conditions. For these reasons, the grading changes that led to an increase in Grade 4 do not appear to have improved the extent to which stumpage prices reflect market conditions.

VIII. ESTIMATE OF BENEFIT TO INTERIOR BC LUMBER PRODUCERS

67. Misgrading benefits BC lumber producers by reducing the stumpage prices paid for sawlogs. As a result, a major input in the production of lumber is available for a much lower price. Below I estimate the benefit to lumber producers inherent in the misgrading. In order to present the Tribunal with several options, I estimate this benefit using the three distinct benchmarks described above in Section VI. Each of

these calculations shares a similar overall approach to estimating the benefit arising from misgrading.

68. The total benefit to lumber producers from misgrading (scaling logs as Grade 4[49] that are properly scaled as Grades 1 or 2) comprises two elements. First, there is the volume/share of logs misgraded times the difference between the amount charged for such logs (C$0.25 per cubic meter) and the amount charged for logs properly graded as Grade 1 or Grade 2. I call this the "share effect" of misgrading. Second, there is an improper decrease in the AMP due to misgrading that forms the basis of the Crown stumpage rate for Grade 1 and Grade 2 under the MPS. An important input into the AMP calculation is the relative volumes of Grades 1 and 2 versus Grade 4 during the quarter in which the AMP is calculated. The higher the reported share of Grade 4, the lower the AMP, and the lower the stumpage collected on all Grades 1 and 2 logs.[50] I call this the "AMP effect" of misgrading.

69. With respect to the first effect (share effect), it is worth noting that a large and growing share of tenure-tract timber in fact is sold at the minimum price of C$0.25/$m^3$. In **Exhibit 11**, I show the share of tenure tract timber sold at the minimum price in each quarter from the beginning of 2007 until the third quarter of 2010, the last quarter for which I have data. As can be seen, at the beginning of 2007, only five percent of this timber was sold for the minimum price. By the middle of 2009, however, well over half of that timber was sold at the minimum price. As such, the "share effect" is likely to be significant.

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[49] As above, the Grade 4 measure contains a very small amount of Grade 6.

[50] This "AMP effect" arises for at least two reasons. First, the greater the share of Grade 4 relative to Grades 1/2 in each mark, the lower the contribution of that mark to the overall AMP, since the contribution of each mark to the overall AMP is the weighted average of its share of Grade 4, valued at C$ 0.25, plus its share of Grades 1/2, valued at the MPS-derived rate. The more Grade 4 in each mark, the lower this weighted average value, and the lower the overall AMP. Second, as discussed above, the AMP is adjusted downward, relative to the outcome of BCTS auctions, to take account of the obligations of tenure holders for silviculture, road building, and other costs. These are lump-sum costs. A "tenure obligation adjustment," or "TOA," is applied by dividing these lump-sum costs by the quantity of Grades 1/2 in the harvest, and subtracting that quantity from the estimated winning bid ("EWB") in calculating the AMP. The more Grade 4 in the harvest, therefore, and the less the quantity of Grades 1/2, the higher the (negative) TOA that is made to the EWB and the AMP. Each of these effects is taken into account in my assessment of the benefits due to misgrading.

A. Benefit calculation using base period April 2006-March 2007

70. The first methodology I use to quantify the benefit of misgrading to BC Interior lumber producers is based on a "but for" level of Grade 4 timber equal to the average share of Grade 4 during the first year after the new grading rules were adopted in April 2006. The share of grade 4 in this period is assumed to be proper under the grandfathered grading rules. I call this period the "base period." (These calculations depend on invoice data rather than scaling data, and because invoicing typically occurs roughly a month after scaling, the base period uses data from May 2006 through April 2007.) The period of misgrading includes all invoiced months from May 2007 forward. I refer to this as the "violation period."

71. I have calculated the benefit to Interior BC lumber producers up to March 2012, the month immediately after the hearing scheduled in this matter. Much of my calculation incorporates the spreadsheets that the BC government uses to calculate the "average market price," the so-called AMP data. The AMP data, however, are only available to the end of the third quarter of 2010. Thus, I have made certain assumptions to extend my estimates beyond that period. I intend to supplement these estimates with actual data when they become available.

72. The basic methodology I employ is to measure the difference between any given mark's share of Grade 4[51] in each month of the violation period against that mark's average Grade 4 share in the base period. I treat the latter as the Grade 4 share but for the misgrading. The difference is a measure of the extent of misgrading. If data on the Grade 4 share for a specific mark in the base period are available, I use those data to measure the share of Grade 4 in that mark in the absence of misgrading, i.e., the but-for Grade 4 share. If those data are not available for a specific mark, I estimate the but-for share by the base-period share of Grade 4 in the forest district containing that mark.

73. To determine the "share effect" misgrading benefit for any quarter, the misgraded volume in each mark is multiplied by the quarter's AMP rate for that mark net of

[51] Grades 4 and 6 both have stumpage rates of C$0.25 and their respective volumes are grouped together in the AMP data. Because Grade 6 is very small, for calculation purposes, I refer to these two grades as "Grade 4."

the C$0.25 minimum rate (i.e., the difference in revenue for that mark on the misgraded timber). I use the specific AMP rate for that mark, rather than the average price over all marks, which is the AMP itself.[52]

74. To determine the "AMP effect" misgrading benefit, I input the corrected volume of Grades 1 and 2 ("Grade 1&2") and of Grade 4 into the actual BC spreadsheets that calculate the AMP for each quarter. The result is a recalculated rate for each mark. The difference between the original rate and the higher rate after the grade shares have been corrected is then multiplied by the total Grade 1&2 volume for each mark (including the improper Grade 4 volume reassigned in these calculations as Grade 1&2 volume) and then summed over all marks to obtain the AMP-effect benefit.

75. As previously noted, the spreadsheets for calculating the AMP are not available after the third quarter of 2010. I therefore estimate the size of the benefit to BC producers for subsequent quarters by assuming that the difference between the reported AMP and the AMP that would apply given the Grade 4 share in that quarter applies to subsequent quarters. I have data for the shares of the harvest that were Grade 4 up to the end of 2010. For the subsequent periods, I assume the amount of misgrading was the same as the amount of misgrading in the corresponding month of 2010.[53]

76. Lumber producers will not realize all the benefits of the misgrading because not all timber harvested at reduced stumpage rates goes to sawmills. Thus, the total benefit from misgrading is multiplied by the share of logs that goes to sawmills. Data on this share are available only for 2007 and 2008, so I assume that the share decreases between all subsequent years by the same amount that it falls between

[52] As noted, for many marks, that rate will be the minimum rate.

[53] In July 2010, the B.C. government introduced grades 7 and 8, which are used when billing is based on a cruise rather than scaling of individual logs. As of the third quarter of 2010, none of the marks were subject to cruise-based billing. For that reason, at this time I have not estimated any benefits due to misgrading that involves these grades. I note, however, that these grades may well be involved in misgrading, and I may supplement my estimates with benefit calculations involving these grades in later work.

those two years.[54] This assumption may significantly underestimate the share of the benefit that goes to sawmills, as data from the BC Interior Log Market Reports indicate that the share of logs that went to sawmills actually rose from 2008 to 2010.[55]

77. I present in Table II the estimated share effect, AMP effect, and the total estimated benefit using my first benefit methodology for the periods from Q2 2007 to Q3 2010 and from Q2 2007 to Q1 2012. I also present in this table the share of those benefits that goes to lumber producers. The total benefit projected to March 2012 is C$620.1 million, of which C$499.2 million goes to sawmills.

Table II: Estimated Benefit Due to Misgrading for the Period Beginning April 2007 (million Canadian $)		
	Period Ending:	
	September 2010	**March 2012**
Total Benefit:		
Share Effect	254.9	332.5
AMP Effect	203.6	287.6
Total Effect	458.5	620.1
Sawmill Share:		
Share Effect	208.1	268.1
AMP Effect	164.6	231.2
Total Effect	372.7	499.2

78. The estimated benefit to BC lumber producers calculated in Table II is large. I have looked for corroborating evidence in the record that the benefit is on this order of magnitude. BC itself has provided such an analysis. In 2003 under the old grading system but in light of the increased incidence of the MPB attack, BC forecast the

[54] This share is 84.0 percent in 2007 and 82.4 percent in 2008, a decline of 1.6 percentage points. Applying this decrease to subsequent years, I estimate the percentage of logs going to sawmills as 80.8 percent in 2009, 79.2 percent in 2010, 77.6 percent in 2011, and 76.0 percent in 2012. Data are from "Major Primary Timber Processing Facilities in British Columbia 2008," Ministry of Forests and Range, June 2010; p.6; and "Major Primary Timber Processing Facilities In British Columbia 2007," Ministry of Forests and Range, p.6.

[55] These reports, which are from the Revenue Branch of the Ministry of Forests and Range, indicate that the share of all harvested logs that went to sawmills was 86 percent in 2007, 79 percent in 2008, 81 percent in 2009, and 87 percent in 2010. These reports only include logs that were sold to mills in arms-length transactions and thus exclude most logs harvested in the BC Interior. For that reason, I have not used these data in my analysis.

loss of stumpage revenues that was expected to occur over the period 2003-2014 if BC maintained a grading system that gave the C$0.25 reject rate to all "dead and dry" logs regardless of their value in producing lumber.[56] (This is the grading system that in early 2006, just before the introduction of the new system, put over 60 percent of lodgepole pine logs in the reject category as "dead and dry.") BC clearly understood that this system would produce a huge loss in stumpage revenues relative to one in which logs were graded commensurate with the volume and value of lumber that could be extracted from those logs, regardless of whether they were MPB-killed logs or not. BC calculated the difference between a grading system that gives a "reject" grade yielding C$0.25 for all "dead and dry" logs and one that grades these logs as sawlogs, yielding the prevailing sawlog stumpage. (This is equivalent to a calculation only of the "share effect" above.) This calculation, presented in **Exhibit 12**, was limited to four forest districts.[57] The difference between these grading regimes is C$567.2 million over the period 2002/2003 to 2012/2013. This means that if BC had continued with the old grading system, it estimated that, based only on the "share effect," stumpage revenues in the four forest districts would have been C$567.2 million less over the period analyzed than if it moved to a grading system that allowed it to charge full value for MPB-attacked logs. Canada also calculated a second figure, shown in **Exhibit 13**, which attempted to make some accommodation for possible loss of value of MPB logs. This is the difference between a grading system that charges C$0.25 for all "dead and dry" logs and one that gives these logs approximately one-half of the prevailing stumpage rate for sawlogs (presumably an attempt to downgrade these logs somewhat for anticipated loss of value). The difference between these grading regimes over the 10-year period is C$319.9 million. This latter calculation is arguably BC's attempt to estimate a "but for" world of correct grading, and to contrast it to a world where "dead and dry" timber is graded reject and sold for C$0.25.

79. As another example of the significant benefit available from misgrading, the evidence is indisputable that log kiln warming increased the incidence of Grade 4

[56] CAN-015833.XLS.

[57] These are Quesnel, Lakes, Vanderhoof, and Williams Lake. (See CAN-015833.XLS)

over and above the level that was established in the first full year of the new grading system. A BC analysis of the effects of the initial kiln warming experiences of several mills involved in the initial tests in the fall/winter of 2007 confirms this. At the beginning of November 2007, [

]:[59] One company, [

[

]:[60]

The BC Ministry subsequently [

]" (CAN-028707) Furthermore, "[

]" (CAN-028707) Finally, the analysis concluded that, "[

]" (CAN-028707).

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[58] [ ] (CAN-028706)

[59] [ ] (CAN-019670; CAN-028447; CAN028441; CAN-012236; CAN-028450). [ ] (CAN-019666)

[60] (CAN-028706).

80. The Ministry [

]"

81. This is indisputable evidence that log kiln warming, which was not adopted until almost 13 months after the SLA went into effect, [

]. Over an entire year,[61] stumpage decreases attributable to log kiln warming are likely to be many times this amount, and over many years, tens of millions of dollars.

B. Benefit calculation using benchmark estimated by BC just prior to the adoption of the new grading rules

82. An alternative method of estimating the benefit to BC lumber producers is to base the but-for estimates of the Grade 4 share on analyses conducted by Canadian government officials when they were considering introducing the new grading system.

83. At that time, as described above, it was expected that the new Grade 4 would comprise timber in the old Grade 4 and Grade 5 as well as from 5 to 10 percent of the timber in the old Grade 3.[62] I thus calculated the Grade 4 percentage for each quarter of the fiscal year from April 2005 to March 2006 based on the assumption

[61] FPInnovations (Forintek) prepared a March 2008 study for the BC Ministry as to precisely how log kiln warming would be implemented. The practice of log kiln warming as recommended by Forintek would "**be continued, without any interruption, throughout the year**. Under those circumstances, mills would have the option of using the kilns whenever it is believed that the practice could yield improved accuracy when assessing log quality (for example for periods of prolonged and continuous rainfall independent of the time of the year.)" (CAN-002824; emphasis in original)

[62] *Interior Market Pricing System, Tenure Obligation Adjustments*, Revenue Branch, British Columbia Ministry of Forests and Range Columbia, June 5, 2006 at 5. See also *Interior Market Pricing System, Average Market Price*, Revenue Branch, British Columbia Ministry of Forests and Range, June 5, 2006 at 2.

that Grade 4 would include all timber in old Grade 4 and Grade 5 and 7.5 percent of timber in old Grade 3.[63] I then used those estimated Grade 4 shares to estimate the extent of misgrading. I present these estimates in Table III.

Table III: Actual and But For Grade 4 Shares, and Percentage Misgrading by Quarter,Q1 2007 to Q1 2012

Quarter	Actual Grade 4 Share[64]	"But for" Grade 4 Share	Percentage Misgrading
Q1 2007	12%	13%	0%[65]
Q2 2007	14%	11%	18%
Q3 2007	15%	13%	17%
Q4 2007	17%	12%	30%
Q1 2008	21%	13%	35%
Q2 2008	24%	11%	54%
Q3 2008	30%	13%	57%
Q4 2008	31%	12%	62%
Q1 2009	37%	13%	64%
Q2 2009	41%	11%	72%
Q3 2009	44%	13%	71%
Q4 2009	45%	12%	74%
Q1 2010	45%	13%	70%
Q2 2010	46%	11%	75%
Q3 2010	46%	13%	72%
Q4 2010	47%	12%	75%
Q1 2011	45%	13%	70%
Q2 2011	46%	11%	75%
Q3 2011	46%	13%	72%
Q4 2011	47%	12%	75%
Q1 2012	45%	13%	70%

84. For each quarter from Q2 2007 to Q3 2010, I then estimate the benefit due to misgrading by reducing the share of Grade 4 in each mark in the AMP data by the

[63] Data for this analysis, which also were used for Exhibit 3, were retrieved on January 11, 2011 from <https://www15.for.gov.bc.ca/hbs/. The data for April 2005 appeared flawed. The old Grade 4 timber was negative and there was more Grade 3 timber than total timber. Therefore, I did not use the data from that month, and estimated the Grade 4 share in the second quarter of the calendar year using only data from May and June. Data include only lodgepole pine.

[64] Actual shares are calculated from AMP data up to Q3 2010. The share for Q4 2010 is from the Harvest Billing System. For every quarter in 2011 and 2012, the Grade 4 percentage is the same as the share in the corresponding quarter of 2010.

[65] The misgrading percentage is set to zero as the but-for Grade 4 share is above actual. Significant misgrading is not believed to have begun until after this quarter. The fact that the but-for Grade 4 share is above actual suggests those but-for shares may be overestimated, thus underestimating the percentage misgrading and the associated benefit.

misgrading percentage for that quarter as shown in Table III. For quarters from Q4 2010 to Q1 2012, I use the misgrading percentage for that quarter, but I use data from the corresponding quarter of the period Q4 2009 to Q3 2010 as a proxy for the other data for that quarter. I present the resulting benefit estimate, under my second benefit methodology, in Table IV. The total benefit, projected to March 2012 is C$1,313.0 million, of which C$1,054.9 million goes to sawmills.

Table IV: Estimated Benefit Due to Misgrading for the Period Beginning April 2007 (million Canadian $)		
	Period Ending:	
	September 2010	**March 2012**
Total Benefit:		
Share Effect	$169.3	$203.5
AMP Effect	$781.5	$1,109.6
Total Effect	$950.8	$1,313.0
Sawmill Share:		
Share Effect	$138.6	$165.1
AMP Effect	$634.9	$889.7
Total Effect	$773.4	$1,054.9

C. Benefit calculation adjusting for progression of MPB attack

85. It may be argued that part of the increase in Grade 4 is the result of an increased share of grey-attack logs in the harvest, and that the two calculations shown above overstate the benefit because they ignore this effect. As I have noted above, grey-attack has been accounted for in the formulation of stumpage rates in several ways. Moreover, the mill studies described above indicate that the effects of grey-attack on lumber recovery are limited. Thus, it is unclear that there is any justification for adjusting the but-for Grade 4 share due to the increase of grey-attack. Nonetheless, to be conservative, and to give the Tribunal an additional option, I have prepared an alternative estimate of the benefit based on various adjustments for the increasing share of grey-attack in the harvest.

86. The first step in estimating a benefit that makes an additional adjustment for the increasing share of grey-attack is to estimate the share of grey-attack for each

quarter. For the quarters from Q3 2008 to Q3 2010 (the only quarters for which attack data are available), I use the actual share of grey-attack in the AMP data. I then performed a regression analysis to fit a time trend to these data. The results of that regression indicate that the share of grey-attack grew at a decreasing rate over time.[66] I use the results of that regression to predict ("backcast") the share of grey-attack in the quarters from Q1 2007 to Q2 2010 and to forecast those shares in the quarters from Q3 2010 to Q1 2012. The estimated shares of grey-attack, which increase steadily until mid-2011 and then decline somewhat, are presented in Table V.

87. The next step is to determine how those grey-attack values should influence Grade 4. Determining that relationship requires estimating two parameters. The first parameter is the relationship between grey-attack and Grade 4 when timber is properly graded. That relationship is represented by the ratio of Grade 4 in grey-attack timber to Grade 4 in other timber. I call this parameter "r"; it represents how many times more likely grey-attack timber is than other timber to be properly classified Grade 4. This parameter can be derived from the mill studies' estimate of the percentage of grey-stage logs that were grade 4, but those estimates have to be corrected since the logs that were part of the mill study would have been affected by misgrading.

88. I apply my correction as follows. As discussed above, the mill studies report the average volume/value loss for grey-attack logs, but they give no information about the underlying distribution of those logs around the average. I assume a distribution of recoverable logs in the mill tests (called a beta distribution) and the parameters of that distribution are estimated using the Grade 4 data from green logs. Those parameters are then used to estimate the proper Grade 4 percentage of the grey-attack logs, which allows me to derive a corrected r value.

[66] The regression uses the natural logarithm of the grey-attack share as the dependent variable and a time trend and time trend squared as the independent variables. The time trend squared is included to allow the rate of change in the share of grey-attack to change over time. The time trend has a positive coefficient (0.38) and the time trend squared has a negative coefficient (-0.01), indicating that the rate of increase in grey-attack decreased over time. Both coefficients are significant at the 1 percent level. The R-squared for the regression is 0.98. See **Appendix F**.

89. I calculated corrected Grade 4 shares in the grey-attack timber in two of the mill tests.[67] I then applied those results to the uncorrected r ratios for three of the mill areas, in order to incorporate some experience from each.[68] The resulting corrected r ratio was 4.85. This ratio means that grey-attack timber is 4.85 times more likely to merit Grade 4 status than other timber.

90. Using the corrected r ratio, I then calculate my second parameter, the share of Grade 4 in non-grey-attack timber. That share can be determined mathematically using data on the share of Grade 4 in all timber, the grey-attack share, and the corrected r = 4.85 ratio described in the paragraph above. The share of Grade 4 in non-grey-attack timber is estimated using data from the base period and is found to be 10.7 percent.[69] I hold constant this share of Grade 4 in grey-attack timber throughout subsequent time periods, as it was derived during the base period of correct grading.

91. I use these parameters to estimate the but-for share of Grade 4 in each quarter through Q1 2012.[70] Those but-for Grade 4 shares can then be used to determine the percentage of misgrading. I present these results in Table V.

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[67] I was able to perform a beta correction on the Grade 4 shares of grey-attack for Princeton and Prince George, but not for Vanderhoof and Quesnel. I did not conduct such a correction for Vanderhoof because it was a stud mill and thus had a different product mix than the other mills and because some of the necessary data were unavailable. I did not perform the beta correction for Quesnel because the data for that mill were outliers that could not be fit to the beta distribution and because the large share of Grade 4 in its non-grey-attack timber indicated that timber was likely subject to serious misgrading. For Princeton and Prince George, the uncorrected value of r was 13.33 and the corrected value was 6.13. The use of the beta distribution is discussed in detail in Appendix E above.

[68] I took the ratio of the corrected ratio to the uncorrected ratio for Princeton and Prince George, 0.41 (= 6.13/13.33). I multiplied that by 10.54, the uncorrected ratio for three of the four areas tested: Princeton, Prince George, and Vanderhoof. (This yielded the corrected r = 4.85.) Data from Quesnel were not used because the large share of Grade 4 in its non-grey-attack timber indicated that timber was likely subject to serious misgrading. Also while Quesnel has the highest loss of value and volume in its grey-attack timber, the ratio of the Grade 4 share of grey-attack to green timber for that test is by far the lowest of the four, which is additional reason to suspect substantial misgrading of its green timber. As it has the highest ratio of Grade 4 in green relative to grey-attack timber, the Quesnel data suggest the smallest grey-attack adjustment, and its inclusion would increase the calculated subsidy.

[69] The share of Grade 4 in the base quarter is 12.31 percent, and this is equal algebraically to the grey-attack share in that quarter (3.83 percent) x the ratio r (4.85) + 1-share of grey-attack in that quarter (96.17 percent) x the unknown value of the share of grade 4 in other timber in that quarter. I then solve for the unknown.

[70] Let the ratio of the Grade 4 share in grey-attack timber to the Grade 4 share in other (non-grey-attack) timber be r, so grey-attack has r times as high a Grade 4 share as non-grey-attack timber. The Grade 4 share in any quarter = (grey-attack share*r + the non-grey-attack share)*the share of grade 4 in other timber. The non-

Table V: Grey-Attack Shares, Actual and But For Grade 4 Shares, and Percentage Misgrading by Quarter, Grey-Attack Adjustment With r = 4.85, Q1 2007 to Q1 2012				
Quarter	Grey-Attack Share	Actual Grade 4 Share[71]	"But for" Grade 4 Share	Percentage Misgrading
Q1 2007	4%	12%	12%	0%
Q2 2007	5%	14%	13%	5%
Q3 2007	7%	15%	14%	11%
Q4 2007	10%	17%	15%	10%
Q1 2008	13%	21%	16%	22%
Q2 2008	17%	24%	18%	27%
Q3 2008	23%	30%	20%	33%
Q4 2008	25%	31%	21%	33%
Q1 2009	33%	37%	24%	34%
Q2 2009	40%	41%	27%	33%
Q3 2009	45%	44%	29%	34%
Q4 2009	49%	45%	31%	32%
Q1 2010	54%	45%	33%	26%
Q2 2010	61%	46%	36%	22%
Q3 2010	62%	46%	36%	21%
Q4 2010	65%	47%	38%	21%
Q1 2011	65%	45%	38%	16%
Q2 2011	65%	46%	37%	19%
Q3 2011	62%	46%	36%	21%
Q4 2011	59%	47%	35%	26%
Q1 2012	54%	45%	33%	27%

92. For each quarter from Q2 2007 to Q3 2010, I then estimate the benefit due to misgrading by reducing the share of Grade 4 in each mark in the AMP data by the misgrading percentage for that quarter as shown in Table V. For quarters from Q4 2010 to Q1 2012, I use the misgrading percentage for that quarter, but I use data from the corresponding quarter of the period Q4 2009 to Q3 2010 as a proxy for

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grey-attack share =1-grey-attack share. Thus, Grade 4 share in any quarter = (grey-attack share*r + (1-grey-attack share))*the share of grade 4 in other timber. In the base period, the Grade 4 share is 12.31 percent; the grey-attack share is 3.83 percent. This implies that the share of Grade 4 in other timber is 10.7 percent. In the next quarter, the grey-attack share is 5.41 percent. The Grade 4 share = (5.41 percent*4.85 + (1-5.41 percent))*10.7 percent = 13.0 percent.

[71] Actual shares are calculated from AMP data up to Q3 2010. The share for Q4 2010 is from the Harvest Billing System. For every quarter in 2011 and 2012, the Grade 4 percentage is the same as the share in the corresponding quarter of 2010.

the other data for that quarter. The resulting estimated subsidies are in Table VI. The total benefit, projected to March 2012 is C$416.8 million, of which C$337.9 million goes to sawmills.

Table VI: Estimated Benefit Due to Misgrading for the Period Beginning April 2007 (million Canadian $), Including Grey-Attack Adjustment		
	Period Ending:	
	September 2010	**March 2012**
Total Benefit:		
Share Effect	82.0	92.1
AMP Effect	274.5	324.7
Total Effect	356.5	416.8
Sawmill Share:		
Share Effect	67.1	75.0
AMP Effect	224.0	263.0
Total Effect	291.2	337.9

D. Preferred methodology

93. This section has described three different methods of estimating the benefit inherent in misgrading. The first method uses a base period of the first year of the new grading system, the second relies on a base period of the last year of the old grading system, and the third method incorporates a grey-attack adjustment. The estimated benefits to sawmills from the three methods were C$499.2 million, C$1,054.9 million, and C$337.9 million, respectively.

94. The third method makes an adjustment for MPB activity, but the methodology used is very sensitive to the estimate of the r ratio. Moreover, MPB attack has been taken into account in several other ways in the determination of stumpage rates. The second estimate is based on expectations of how the new grading system was supposed to work, which arguably was subject to "learning" once the new system was actually implemented. The Tribunal may prefer the first estimate, which is based on actual experience (during the first 12 months) with the new grading system. If any misgrading took place in the first 12 months of that new system, this would cause the first method to underestimate subsidies, but based on the record

substantial misgrading does not appear to have occurred until after that period, around April 2007. In light of these considerations, the first estimate, C$499.2 million, is the preferred estimate.

IX. REMEDY

95. According to the language of the SLA, the purpose of proposed remedies or compensatory adjustments is to "cure the breach."[72] As an economist, I interpret this language to mean that remedies should counteract or offset any SLA violations. Based on this interpretation, effective remedies should encourage meaningful restrictions in export volumes, either directly through volume restraints, or, if this is unlikely to be effective, by changing the incentives faced by Canadian producers to export softwood lumber into the US, for example by assessing an additional charge on exports.

96. It is my understanding that remedies allowed under the SLA are limited to trade-related remedies, such as quantitative export restraints or export charges. I have been instructed to limit my consideration of possible remedies to export charges. Since the SLA will expire in the near future, a natural concern is that it may not be possible for an export charge to collect sufficient revenue to offset the calculated benefit before the expiration of the SLA. Below I propose different export charge regimes that address this concern.

97. The most logical approach is to design the export charge to collect an amount equal to the estimated benefit and to do so before the SLA expires in October 2013. I assume that the charge will be collected over the 19-month period from April 2012 to October 2013, which I refer to as the "remedy period." An alternative approach is to assume that the export charge is in effect for a 43-month period from April 2012 to October 2015, as the SLA has an option to renew for two years. To

[72] For example, Article XIV, paragraph 24 states: "Such adjustments may be applied from the end of the reasonable period of time until the Party Complained Against cures the breach."

provide the Tribunal with options, I present estimates based on both remedy periods.

98. I understand that the export charge may be limited to exports from the area that benefited from the misgrading, that is, the BC Interior. I assume the average monthly volume of softwood lumber exports from that region to the US during the remedy period without the (additional) export charge is the same as the average monthly exports for the two most recent years for which I have data, May 2009 to April 2011. Given that the demand for lumber has been depressed by the decline in economic activity and the accompanying fall in housing starts, that assumption is likely conservative in terms of ensuring that the appropriate amount can be collected in the remedy period. During that period, BC Interior exports of softwood lumber to the US averaged US$88.3 million or C$85.8 per month.[73]

99. For an estimate of the benefit to be recovered, I use C$499.2 million. That is the sawmill share of the benefit from April 2007 to March 2012 calculated by the first method described above, which is my preferred methodology. Table VII shows the level of the additional export charge needed to recover this amount, 30.6 percent for the 19-month period, or 13.5 percent for the 43-month period.[74]

Table VII: Level of Additional Export Charge on B.C. Interior Exports Assuming Different Recovery Periods		
Recovery period (months)	19	43
Benefit (million C$)	499.2	499.2
Estimated exports (million C$)	$1,629.91	$3,688.75
Level of Additional Charge	30.6%	13.5%

[73] The exchange rate C$1.029=US$1.00 is from x-rates.com and was the exchange rate in effect on August 4, 2011.

[74] I considered the possibility that the imposition of export charges at these levels would not be sufficient, because the charge would cause the volume of lumber exports to fall, thereby reducing the volume on which the charge would be collected. I found, however, that such effects can be safely ignored. That decline in volume would cause US lumber prices to rise, which in turn would encourage lumber exports and offset part of the effect of the export charge on volume. At the same time, the increase in the value of exports also would increase collections, as the charge is assessed on an *ad valorem* basis. If the charge falls somewhat short of the desired level of collections at the end of the remedy period, it is possible to extend it for a few months, until that level is reached, if the SLA is renewed. Similarly, if the export charge reaches the desired level of collections before the end of the remedy period, collections can be stopped.

EXPERT'S DECLARATION

i. I understand that my duty in providing written reports and giving evidence is to help the Tribunal, and that this duty overrides any obligation to the party who has engaged me. I have complied with my duty.

ii. I believe that the facts I have stated in this report are true and that the opinions I have expressed are correct.

iii. I have endeavored to include in my report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion.

iv. I have indicated the sources of all information I have used.

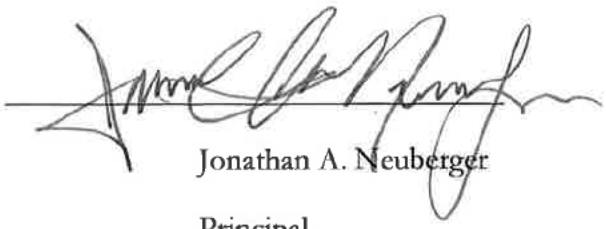
v. I have not without forming an independent view included or excluded anything which has been suggested to me by others (in particular my instructing lawyers).

vi. I will notify those instructing me immediately and confirm in writing if for any reason my existing report requires correction or qualification.

vii. I understand that:

   a. my report, subject to any corrections before swearing as to its correctness, will form the evidence to be given under oath or affirmation;
   b. I may be cross-examined on my report by a lawyer assisted by an expert; and
   c. I am likely to be the subject of public adverse criticism if the Tribunal concludes that I have not taken reasonable care in trying to meet the standards set out above.

viii. I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of the case.



Jonathan A. Neuberger

Principal

APPENDIX A: DESCRIPTION OF THE MPS

1. The Market Pricing System ("MPS") was adopted on July 1, 2006 to determine stumpage rates for timber harvested under long-term tenures in Interior BC. The central concept underlying the MPS is that winning bids from auctions of standing timber, which account for approximately 20 percent of BC harvested timber, are used to determine stumpage prices for the 80 percent of timber harvested under long-term tenures.

2. The MPS develops stumpage rates in a multi-step process. Broadly, there are two steps in the process, which will be discussed in more detail below. First, the average market price ("AMP") is calculated for the timber under long-term tenures. The calculation uses auction data to determine the market value of the timber, adjusting for long-term tenure obligations. Second, a stumpage rate is determined for each cutting authority or mark, which is higher or lower than the AMP depending on whether the cutting authority is more or less valuable than the average.

Determination of the AMP

3. The first step in estimation of the AMP is the determination of the estimated winning bid (EWB). The EWB is an estimate of the stumpage price that would have been paid for the cutting authority on the tenured mark[75] had it been sold at auction. The EWB is derived from a regression on five years of BC Timber Sales ("BCTS") auctions in which winning bids from the auctions are the dependent variable and various characteristics of the tracts being auctioned are independent variables.

4. This regression is run annually, with data from five years of previous auctions. The results of each regression are first used to calculate the EWB (and resulting AMP) in the third quarter of the calendar year and then those same results are applied to the next three quarters. For example, EWBs (and AMPs) for the BC Interior for the

[75] Technically, the price is being determined not for the tenure tract itself, but for what is called the "cutting authority" on the tenure tract. This "cutting authority" is often referred to as a "mark."

first two calendar quarters of 2010 are based on a regression run six to nine months previous in July 2009, which, in turn, utilizes a dataset of 1145 BCTS timber auctions from January 1, 2004 to December 31, 2008.[76] Of those 1145 observations, 250 (22 percent) are from auctions in 2005. Those auctions actually occurred before the introduction of the new grading system in April 2006, as apparently did some of the 223 (19 percent) auctions that took place in 2006. An additional 188 auctions (16 percent) are from 2007 while 263 (23 percent) were in 2008.[77] Similarly, the regression run in July 2010 (for the four calendar quarters starting mid-year 2010) utilizes a dataset of 1148 BCTS timber auctions from January 1, 2005 to December 31, 2009.[78]

5. One variable in the EWB regression is the natural logarithm of the number of bidders. A second regression is estimated with that variable as the dependent variable. The results of that second regression are substituted into the estimated winning bid equation, and the coefficients of the resulting equation are used to calculate the AMP.[79] The estimated coefficients from the 2010 EWB equation are shown in Table A-1. As can be seen in that table, the number of bidders in the AMP calculation is the average number of bidders for the district where the mark is located.

6. Another important variable used in the calculation of the EWB, as seen in Table A-1, is the "stand price index." The stand price index (in C$/$m^3$) is determined for each species using (a) lumber recovery factors ("LRFs") that are estimated based on species, zone, and degree of MPB attack, and (b) lumber average market values ("AMVs") that take into account lumber prices by species.[80] The weighted average LRF is adjusted for the degree of MPB attack, among other factors. Beginning April 2006, the LRF was reduced by three board-feet ("BF") per cubic meter for

[76] *Interior Market Pricing System Update—2009,* Revenue Branch, British Columbia, Ministry of Forests and Range, p. 1.

[77] Information on how many auctions were in each year is from the AMP data.

[78] *Interior Market Pricing System Update—2010,* Revenue Branch, British Columbia, Ministry of Forests and Range, p. 1.

[79] *Interior Market Pricing System Update—2009,* p.3.

[80] The July 2010 *Interior Appraisal Manual* effectively eliminates the change in the LRF due to MPB attack.

green-attack lodgepole pine, by 33 BF per cubic meter for red-attack, and by 83 BF per cubic meter for grey-attack. Given that the maximum LRF for lodgepole pine is 267 BF/cubic meter, the LRF would be reduced by at least 1 percent for green-attack, 12 percent for red-attack, and 31 percent for grey-attack. The stand price index essentially represents the value of recoverable lumber in the mark or cutting authority, and is calculated as follows. First the stand value is determined for each species by multiplying the AMV of that species by the estimated LRF. The weighted average of those values is then found by using the relative shares of each species in the mark as the weights. (There is also an adjustment for the proportion of stud logs.) Before the variable is used in the regression, it is converted to constant dollars using the consumer price index.

7. Beginning with the regression run in Q3 2008, variables were included in the regression to measure the extent of insect attack (in addition to the attack adjustment used in the LRF). Two such variables were included in the regression: "green & other attack" and "red & grey-attack."

8. The results from the auction regression are then used to determine the EWB for each tenure mark, with measures of the characteristics of the tenure mark corresponding to the characteristics in the regression. Those characteristics are multiplied by the corresponding coefficients from the pricing regression to determine the extent to which each variable contributes to the auction price of the tenure mark, as if an auction had been held. Those results are then summed to determine a constant dollar version of the EWB, which is called the REWB. The REWB is then adjusted to reflect current prices, which results in the EWB.[81] An example of the calculation of the EWB for a mark from the first quarter of 2010 is shown in Table A-I.

[81]In the third quarter of 2006, the EWB was adjusted for the fraction of the sawlog harvest that was Grade 3. That adjustment was also made for subsequent quarters, but was based on the share of Grade 3 in the auction sales. Even though there was no Grade 3 since the introduction of the new grading system in April 2006, the auction dataset contained some Grade 3 timber as late as the running of the regression that will be used to calculate the AMP for the second quarter of 2011. *Interior Market Pricing System Average Market Price,* Revenue Branch, British Columbia, Ministry of Forests and Range, June 5, 2006, p. 2.

Table A-I: Calculation of the Estimated Winning Bid for Mark 1/0AV in the First Quarter of 2010			
Variable	Coefficient	Variable	Variable times Coefficient
Constant	41.74	1.00	C$41.74
Stand price index	0.162	29.26	C$4.74
Exchange rate	(15.93)	0.93	C$(14.82)
Fir fraction[82]	2.52	0	C$0
HemBal fraction	(19.10)	0.84	C$(16.06)
Cedar fraction	41.76	0.15	C$6.07
Net coniferous volume[83]	2.06	3.46	C$7.13
Average volume per tree adjusted for HemBal[84]	(0.53)	0.11	C$(0.06)
Volume per tree[85]	8.22	0.35	C$2.90
Deciduous fraction	(8.44)	0	C$0
Decay share	(21.91)	0.12	C$(2.58)
Slope	(.02)	56.19	C$(1.27)
Partial Cut	(2.20)	0	C$0
Cable Yarding[86]	(11.42)	0.89	C$(10.22)
Heli[87]	(70.00)	0	C$0
Horse[88]	(7.78)	0	C$0
Burn share	(11.57)	0	C$0
Cycle Time	(1.37)	3.30	C$(4.52)
Fort Nelson - Peace[89]	(4.98)	0	C$0
Latest year	(6.07)	1.00	C$(6.07)
Highway transportation[90]	0.547	1.00	C$0.55
Green and other attack	(6.40)	0	C$0
Red and grey-attack	(6.05)	0	C$0
District avg. number of bidders	0.92	2.30	C$2.12
REWB			C$9.65
Consumer price index			1.21
EWB			C$11.66

[82] These fractions refer to the fraction of the net coniferous volume that is of a specific type of tree.

[83] Net coniferous volume and volume per tree are entered as logarithms.

[84] This variable is 1/(vpt-hembal fraction), where vpt is the cutting permit average volume per tree.

[85] This average is measured for the cutting permit.

[86] Fraction of total harvest method volume that is appraised as overhead cable yarding.

[87] Fraction of total harvest method volume that is appraised as helicopter yarding.

[88] Fraction of total harvest method volume that is appraised as horse yarding.

[89] This variable is 1 if the mark is located in that area, 0 otherwise.

[90] This variable is 1 if the primary means of hauling is highway transportation, 0 otherwise.

9. Once the EWB is found, the next step is the determination of the final estimated winning bid (FEWB). The FEWB is found by subtracting the inflation-adjusted cost of various specified operations from the EWB. These operations include water and other special forms of transportation between the cutting authority and the appraisal point, camps, skyline yarding, and horse logging. The cost of specified operations also may include an allowance for areas with particularly high development costs. No specified operations adjustments were made for the mark shown in Table A-I.[91]

10. The next step is to determine the Tenure Obligation Adjustment ("TOA"). The TOA accounts for certain costs that tenure holders incur but bidders in BCTS auctions do not. These are administration costs, development costs, road management costs, and silviculture costs. They also include a return to forest management. After these costs are estimated and adjusted for inflation, they are divided by 1 minus the Grade 4&6 share to determine the TOA, as shown in Table A-II.[92] This means that, effectively, the larger the percentage of Grade 4&6 logs in the cutting authority, the larger the TOA adjustment because the fixed TOA expenses are spread over fewer Grade 1&2 logs.

Table A-II: Calculation of the TOA, the Indicated Rate, and the Minimum Rate for Mark 1/0AV in the First Quarter of 2010	
Sum of costs	C$20.51
Grade 4&6 share	40.22%
TOA	C$34.31
EWB	C$11.66
Indicated Rate	C$(22.65)
Minimum Rate	C$0.25

[91] In the first quarter of 2010, only 112 of the 985 marks had special operations adjustments.

[92] Starting in July of 2010, this adjustment for the Grade 4&6 share will not be made when billing is based on a cruise rather than on scaling.

from that mark is the Indicated Rate, unless that rate is below the minimum rate of C$0.25, in which case it is set at the minimum rate.

12. In the example, the TOA exceeds the EWB, so the Indicated Rate is negative and the stumpage contribution for the mark is the minimum of C$0.25. (See Table A-II.) This result was common for marks in the first quarter of 2010. In that quarter, the weighted average EWB for all marks was C$19.54; the weighted average TOA was C$94.61. Of the 985 marks in the AMP data for that quarter, 588 had negative Indicated Rates.

13. The Indicated Rate (or the Minimum Rate for the mark if the TOA is greater than the Indicated Rate) is assigned to all Grade 1 and Grade 2 timber from that mark. Grade 4&6 timber is priced at the statutory minimum rate. The total rate contribution for the mark is the weighted average of volume valued at the Indicated Rate and the volume valued at the minimum rate. For example, for mark 14/191, the Indicated Rate is C$8.27, the Grade 1&2 share is 89 percent, and the Grade 4&6 share is 11 percent. The total rate contribution for this mark is thus C$8.27*0.89+C$0.25*0.11=C$7.37.

14. The AMP is calculated through a weighting process of all the individual mark contributions. All of the volume of timber in marks for which the TOA exceeds the EWB (i.e., marks with a negative Indicated Rate) is valued at C$0.25/cubic meter. The volume of timber in marks with a positive Indicated Rate is valued at the Indicated Rate for Grades 1&2 volume, and at C$0.25/cubic meter for Grade 4&6 volume. The resulting values are summed over all the marks, and divided by the total volume for all the marks. The result is the AMP, or average market price. Note that the Grade 4&6 volume enters this final AMP calculation in two ways. First, the larger the Grade 4&6 volume (and the smaller the Grade 1&2 volume), the larger the TOA adjustment and the smaller the Indicated Rate. Second, the larger the Grade 4&6 volume, the more of each mark's volume is averaged into the AMP at C$0.25, rather than at the Indicated Rate.

Calculation of the Stumpage Rate for Each Mark

15. Once the AMP has been established, a stumpage rate is calculated for each cutting authority or mark. The stumpage rate calculated for the mark will be higher or lower than the average if the timber in the cutting authority is more or less valuable than the average.

16. The relative value of the timber in each mark depends on the difference between the total selling price of products that can be generated from the timber and the cost of producing them. This is called the cutting authority "value index" ("VI"). The cutting authority value index is then compared to a similarly calculated "mean value index" ("MVI") for the BC Interior as a whole. The difference between the cutting authority "value index" and the "mean value index" (which can be positive or negative) is then added to the base AMP calculated above to determine the stumpage rate for the mark:

[Stumpage Rate for Each Mark = Base AMP[93] + (VI – MVI)]

This step raises the stumpage rate for marks with high value indices and lowers it for lower value indices. It does not alter the overall average stumpage rate.

June 2010 Changes in the MPS

17. Effective June 1, 2010, BC began to implement certain changes in the MPS. These changes will have the effect of eliminating the VI adjustment (i.e., the second step in the stumpage calculation above). The stumpage rate calculated above using the VI adjustment can be referred to as the "MPS-B." Beginning with the third quarter of

[93] The Base AMP used in this equation is adjusted to offset the fact, described above, that some marks are charged the prescribed minimum rate rather than a lower-than-C$0.25 indicated rate and also to offset the low quality logs priced at C$0.25 per cubic meter. *Interior Market Pricing System,* Revenue Branch, British Columbia, Ministry of Forests and Range, June 1, 2006, p. 5.

2010, BC will begin to use the "MPS-A," which is essentially the MPS-B before the VI adjustment.[94]

18. The MPS-A will be phased in over a two-year period in the following manner. In the first quarter, the stumpage rate will be one-eighth times the MPS-A plus seven-eighths times the MPS-B. In the second quarter, the stumpage rate will be two-eighth times the MPS-A plus six-eighths times the MPS-B. In the third quarter, the relative weights will be three eighths and five-eighths, and so on. Finally in the eighth quarter, the stumpage rate will be the MPS-A.

19. Other changes will affect marks where 35 percent or more of the lodgepole pine is grey or red-attack. Billing for such marks will be based on a cruise of the stand, rather than on scaling. Moreover, they will be subject to "stand–as-a-whole" pricing. A single stumpage rate will be assessed for all the merchantable timber in the cutting authority area.[95]

[94] The MPS-A is found by netting the TOA and specified operations adjustments from the estimated winning bid. Hugh A. Gordon and Steve J. Potter, "Impact of 2010 Interior Pricing Policy Changes on Selling Price Zone 25 Licenses," September 14, 2010, p.3.

[95] Announcement of the Ministry of Forests and Range, File 280-30, Ref: 123866, April 1, 2010.

APPENDIX B: REGRESSION ANALYSIS OF THE TIME TREND IN THE GRADE 4 SHARE

1. To investigate the behavior of the share of Grade 4 since the change in grading standards, I conducted a regression analysis looking for evidence of a time trend in the share of Grade 4. The regression used as the dependent variable the share of Grade 4 as shown in Exhibit 3, expressed as a natural logarithm. The independent variables were dummy variables for each month, and two time-trend variables, one for the period from April 2006 until April 2007 ("Starting Trend") and the other for the period after April 2007 ("Later Trend"). The regression was run using monthly data from April 2006 to December 2010. The results are in Table B-I.

2. As shown in Table B-I, the time trend before April 2007 is not statistically significant. This result supports the hypothesis that there was no trend in the Grade 4 share before that month. The coefficient on the later trend, however, is statistically significant and indicates that after April 2007, the Grade 4 share increased at an average rate of about two percent per month.

Table B-I: Results of the Regression on the Time Trend in the Grade 4 Share

Regression Statistics			
R^2			0.79
Adjusted R^2			0.73
F-Statistic			12.1*
Variable	**Coefficient**	**Standard Error**	**t-Stat**
Constant*	(1.56)	0.18	(8.64)
February	0.04	0.20	0.22
March	0.07	0.20	0.35
April	(0.40)	0.22	(1.82)
May	(0.28)	0.20	(1.42)
June	(0.08)	0.20	(0.42)
July	0.13	0.20	0.67
August	0.11	0.19	0.54
September	0.05	0.19	0.27
October	(0.06)	0.19	(0.29)
November	(0.15)	0.19	(0.78)
December	(0.13)	0.19	(0.66)
Starting Trend	(0.01)	0.02	(0.72)
Later Trend*	0.02	0.00	7.71
* Significant at the 1% level.			

APPENDIX C: REGRESSION ANALYSIS OF THE PRICE SPREAD BETWEEN MERCHANTABLE AND NON-MERCHANTABLE LUMBER

1. As described in the text, I used a regression analysis to investigate the behavior of the spread between the prices of merchantable and non-merchantable lumber. The dependent variable in this regression was the natural logarithm of the difference between the price of Western 2x4 #2&Btr SPF and the price of Western 2x4 Utility expressed as a percentage of the latter price. Price data, which are also used in **Exhibit 8**, are from *Random Lengths*. The independent variables were the natural logarithm of the share of Canadian exports to China, based on Canadian government export statistics, and a time trend starting in April 2007. The regression was estimated using monthly data from April 2006 to April 2011. The results are presented in Table C-I.

Table C-I: Results of the Regression on the Merchantable Lumber Price Spread

Regression Statistics			
R^2			0.56
Adjusted R^2			0.55
F-Statistic			37.04*
Variable	**Coefficient**	**Standard Error**	**t-Stat**
Constant	(0.42)	0.66	(0.64)
Exports to China	0.10	0.16	0.60
Time Trend	(0.03)*	0.01	(3.08)
* Significant at the 1% level.			

2. As can be seen in Table C-I, the coefficient on the share of exports going to China is statistically insignificant at the five percent level. At the same time, the time trend is statistically significant and indicates that the spread between the two prices decreased by approximately three percent per month after April 2007.

APPENDIX D: REGRESSION ANALYSIS EXAMINING TRENDS IN THE RATIO OF PRODUCTION TO HARVEST

1. To determine whether the ratio of production to harvest in the BC Interior declined significantly during the period when the Grade 4 share was increasing, I estimated a regression with the natural logarithm of that ratio as the dependent variable and a time trend as an independent variable. Since the ratio is affected by inventory behavior, and inventories tend to vary due to seasonal factors, I also included monthly dummy variables in the regression. The regression was run using monthly data from January 2006 to December 2010. The results are in Table D-I.

Table D-I: Results of the Regression Looking for Evidence of a Time Trend in the Ratio of Production to Harvest

Regression Statistics			
R^2			0.95
Adjusted R^2			0.93
F-Statistic			69.0*
Variable	**Coefficient**	**Standard Error**	**t-Stat**
Time Trend	(0.00)	0.00	(1.59)
February	(0.46)*	0.14	(3.20)
March	(0.42)*	0.14	(2.94)
April	0.10	0.14	0.72
May	2.14*	0.14	14.93
June	2.02*	0.14	14.06
July	1.06	0.14	7.39
August	0.22	0.14	1.53
September	0.07	0.14	0.47
October	0.10	0.14	0.71
November	0.03	0.14	0.22
December	(0.19)	0.14	(1.34)
Constant	(7.52)*	0.11	(68.24)
* Significant at the 1% level.			

2. The coefficient on the time trend is extremely small, less than 0.005 in absolute value, and is not significant at the 10 percent level. These results are consistent with the view that the lumber recovery factor, as measured by the ratio of production to harvest, had no tendency to decline during the period when the measured Grade 4 share was increasing.

APPENDIX E: THE USE OF THE BETA DISTRIBUTION TO ESTIMATE BUT-FOR GRADE 4 SHARES

1. As discussed in the text, I used a beta distribution to correct the Grade 4 shares in grey-attack timber in the Princeton and Prince George mill studies. Those studies provide the average recoverability share for samples of green (unattacked) and grey-attack timber, but they give no information about the underlying distribution of the logs' recoverability shares around that average.[96] They also provide the shares of those logs with recoverability (merchantability) below 50 percent, the Grade 4 share. For grey-attack timber, however, that share is likely affected by misgrading.[97] I use the information concerning the Grade 4 share in the green timber to derive the parameters of the distribution of the recoverability shares in each study. I then determine the Grade 4 share that is consistent with those parameters and the average recoverability share in the grey-stage timber.

2. Since recoverability percentages are between 0 and 1, their distribution can be modeled using the beta distribution, a continuous probability distribution that is determined by two parameters, alpha and beta.[98] Given an average value of the recoverability share, one can assume various values for alpha. Each combination of the average recoverability and an assumed value of alpha will be consistent with a specific value of beta.[99] I determined the unique combination of alpha and beta that is consistent with both the average recovery share and the Grade 4 share of the green sample in each of the two mill tests. The alpha parameters derived for each test are shown in Table E-I.

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[96] I define the average recoverability share as the share of recovered lumber that is in the merchantable grades (Grade 2 or better) times the ratio of the lumber recovery factor for the timber to the lumber recovery factor for green timber.

[97] For purposes of this analysis, I assume that the green timber is correctly graded. As misgrading apparently affects green timber to some extent, that assumption may overstate the correct share of Grade 4 in grey-stage timber, thus understating the extent of misgrading.

[98] "Distributions are often chosen on the basis of the range within which the random variable is constrained to vary. … For a variable constrained between 0 and c>0, the beta distribution has proved useful. … This functional form is extremely flexible in the shapes it will accommodate." William Greene, *Econometric Analysis*, 2nd edition, Prentice Hall, p. 61.

[99] Beta=alpha*(1/average-1).

3. Once I derive the parameters of the beta distribution, I find the share of a distribution that has recoverability below 50 percent (i.e., Grade 4) assuming the distribution has those parameters and also has the average recoverability percentage found in the grey-attack timber. The result is the corrected Grade 4 share of the grey-attack timber, which is shown in Table E-I.

Table E-I: Estimated Parameters of the Beta Distribution for Two Mill Studies

	Princeton	Prince George
Green average recoverability	95.6%	91.7%
Green Grade 4 share	1%	5%
Alpha	3.1	1.6
Grey-attack average recoverability	82.7%	64.9%
Grey-attack corrected Grade 4 share	6.4%	27.2%

APPENDIX F: REGRESSION ANALYSIS FOR FORECASTING AND "BACKCASTING" GREY-ATTACK SHARES

1. To determine how the grey-attack share has changed over time, and to allow it to be backcast and forecast for quarters where its value is unknown, I estimate a regression model. The regression uses as the dependent variable the share of grey-attack in each quarter's harvest from tenure tracts, expressed as a natural logarithm. This variable was taken from the AMP data. The independent variables are a time trend and that time trend squared. The inclusion of the latter regressor allows the growth rate in grey-attack shares to change over time. The regression was run using quarterly data from Q3 2008 to Q3 2010, the only quarters for which AMP data on grey-attack are available. The results are in Table F-I.

2. The time trend has a positive coefficient, 0.38, and the time trend squared has a negative coefficient, -0.01. Thus,

   Ln(grey-attack share) = Constant + 0.38*time trend - 0.01*time trend*time trend

   Ln(grey-attack share) = Constant + (0.38 - 0.01*time trend)*time trend

3. The rate of growth in the grey-attack share depends on the term in parentheses in the above equation.[100] Note that as the time trend grows larger, that term decreases and eventually becomes negative. The results of the regression thus indicate that the share of grey-attack will grow at the start of the time period expressed in the data, but the growth rate will slow over time and eventually the share will begin to decrease. Such a result is expected, as a constant or increasing rate of growth over time would lead to a grey-attack share that iss greater than one, which is impossible.

[100] Specifically, it is the antilog of that term minus 1. For example, in the first period time trend=1,the term in parentheses is 0.37, and the growth rate is 44 percent. In the tenth period, time trend=10, the term in parentheses is 0.27, and the growth rate is 31 percent.

Table F-I: Results of the Time Trend Regression On Grey-Attack Shares			
Regression Statistics			
R^2			0.99
Adjusted R^2			0.98
F-Statistic			229.22
Variable	**Coefficient**	**Standard Error**	**t-Stat**
Constant	(3.63)*	0.33	(11.14)
Time Trend	0.38*	0.06	6.17
Time Trend Squared	(0.01)*	0.00	(4.03)
* Significant at the 1% level.			

Exhibit 1

Curriculum Vitae of Jonathan A. Neuberger

JONATHAN A. NEUBERGER

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Education

Ph.D. Economics, Johns Hopkins University, 1988

M.A. Economics, Johns Hopkins University, 1985

B.S. International Relations, Georgetown University, 1978
(Magna Cum Laude, Phi Beta Kappa)

Areas of Expertise

Economic Damages; Commercial and Financial Litigation Analysis; Intellectual Property Valuation and Litigation Analysis; Microeconomic and Financial Analysis; Tax and Transfer Pricing Analysis; Risk Management; Statistics and Econometrics

Professional Experience

Principal, Economists Incorporated (2006 – present)

Senior Vice-President, Economists Incorporated (2002 – 2006)

Partner, Bates & White, LLC (2000 – 2002)

Senior Managing Economist, LECG, Inc. (1998 – 2000)

Senior Economist, Benderly Economic Associates (1996 – 1998)

Economist and Manager, Deloitte & Touche, LLP (1994 – 1996)

Economist, Federal Reserve Bank of San Francisco (1988 – 1994)

Qualifications

Analysis of Economic Damages

- Served as testifying expert for the U.S. government in multiple breach of contract cases involving private companies and federal government agencies
- Analyzed companies operating in a broad range of industries, including aerospace and defense, electric power generation, telecommunications, timber, and financial services
- Calculated economic damages under alternate theories, including expectations, lost profits, restitution, reliance and replacement cost of capital
- Testified on behalf of non-government clients involved in commercial and other private litigation
- Designed, developed, and implemented opinion survey regarding loss of asset values on behalf of private client in the civil aviation industry; interpreted and testified on survey results
- Served as consulting expert in dozens of commercial litigation matters involving economic damages; developed analyses, prepared written reports, and briefed testifiers

Financial Analysis for Litigation

- Testified on behalf of the federal government in the largest government contracting dispute in history; analyzed corporate financial condition, financing requirements and available sources and costs of external finance; performed *pro forma* financial projections; estimated bankruptcy risk
- Served as testifying expert in *Winstar* litigation involving failed savings and loan associations; analyzed thrift operations, lending decisions, board of directors' oversight and corporate governance; estimated the value of goodwill and the costs of raising external capital to replace goodwill

Qualifications (continued)

Financial Analysis for Litigation

- Conducted financial analyses in a number of securities litigation matters, involving such instruments as common and preferred stock, corporate bonds, derivative securities, futures, swaps and options
- Evaluated the appropriateness of investment recommendations by financial advisors
- Performed event studies and other stock price analyses to estimate damages
- Analyzed damages claims involving prejudgment interest

Analysis for Intellectual Property Litigation

- Performed economic analyses of damages and other issues in patent and copyright disputes
- Computed damages using different methodologies, including lost profits, unjust enrichment and reasonable royalties
- Quantified the value of complementary assets in the income generated by use of patented technology
- Estimated costs to "invent around" patented technology

Antitrust Analysis

- Performed economic analysis of competitive impacts arising from bank mergers and acquisitions
- Defined relevant geographic markets, analyzed mix of available banking services, and investigated actual and potential competition from bank and non-bank financial institutions
- Designed, developed and implemented surveys of consumer and business banking customers

Qualifications (continued)

Antitrust Analysis

- Analyzed economic consequences of non-competitive behavior in consumer goods markets, including price fixing, illegal cartels, and other restraints of trade
- Assessed the impact of alleged anticompetitive behavior by motor sports sanctioning bodies

Valuation and Other Non-Litigation Analyses

- Performed valuation analyses of companies, divisions, tangible property and intangible assets in a broad range of manufacturing and service industries
- Utilized alternative valuation methodologies, including discounted cash-flow, market, and cost-based approaches
- Conducted valuation analyses of intellectual property
- Helped companies to develop strategies to maximize the value of intellectual property portfolios
- Authored research in applied microeconomic issues in banking and financial markets

Transfer Pricing

- Performed transfer-pricing analyses for a broad range of multinational companies operating in industries such as computer peripheral equipment, semi-conductors, semiconductor manufacturing equipment, aerospace, engineering services, and employment services
- Analyzed intercompany transfers of goods, services, and intellectual property
- Prepared transfer-pricing analyses for multiple purposes, including tax planning and strategy, audit defense work, and Tax Court litigation
- Worked for a variety of clients, including U.S. companies, foreign companies, and the Internal Revenue Service

Qualifications (continued)

Risk Management

- Co-founded EI's Risk Management Practice
- Designed, developed and implemented models of risk measurement to assist banks and other financial institutions to manage multiple types of business risk, including market, interest rate, and operational risks
- Co-authored chapter in risk-management handbook prepared by Casualty Actuarial Society

Testimony

Sacramento Municipal Utility District v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, July 2011.

Portland General Electric Company, The City of Eugene, Oregon, Eugene Water and Electric Board, and Pacificorp v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, June 2011.

Detroit Edison Company v. United States, U.S. Court of Federal Claims; filed expert report; testified at deposition and trial, December 2009, December 2010.

PPL Susquehanna LLC v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, October 2010.

Northern States Power Company (2) v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, August 2010.

Alabama Power Company, Georgia Power Company, and Southern Nuclear Operating Company, Inc. v. United States, U.S. Court of Federal Claims; filed expert report, February 2010.

Kansas Gas & Electric Company, et. al. v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, February 2010.

Consumers Energy Company v. United States, U.S. Court of Federal Claims; filed expert reports; testified at deposition, March 2009, January 2010.

Pacific Gas & Electric Co. v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, March 2006; filed expert report in remanded case, testified at deposition and trial, October 2009.

Testimony (continued)

Yankee Atomic Electric Company, Connecticut Yankee Atomic Power Company, Maine Yankee Atomic Power Company v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, August 2009.

Consolidated Edison Company of New York, Inc. v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, June 2009.

In the Matter of Arbitration Between The United States of America and Canada, London Court of International Arbitration; filed expert reports, testified at arbitration hearings, September 2008, June 2009.

Southern California Edison Co. v. United States, U.S. Court of Federal Claims; filed expert reports, testified at depositions and trial, April 2009.

Westlake Services, Inc. v. Cenveo, Inc., Superior Court of the State of California, County of Los Angeles – Central District; filed expert reports, January 2009, February 2009.

Arizona Public Services Company v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, February 2009.

Dairyland Power Cooperative v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, July 2008.

Dominion Resources, Inc., Dominion Nuclear Connecticut, Inc. and Virginia Electric and Power Company v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, May 2008.

Boston Edison Company and Entergy Nuclear Generation Company v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, June 2007.

Northern States Power Company v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, November 2006.

Ralph Franklin & Son Logging v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, August 2006.

Janeanne Doar, et al. v. Chiao Smith & Associates, et al., Superior Court of California, County of Marin; testified at deposition, December 2005, May 2006.

Timothy Gens v. Gary Ferrell et al., Superior Court of California, County of San Mateo; testified at deposition, March 2006.

Testimony (continued)

Southern Nuclear Operating Co., Alabama Power Co., Georgia Power Co. v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, October 2005.

In Re J.T. Thorpe Inc., J.T. Thorpe, Thorpe Holding Co., Thorpe Technologies, Inc., U.S. Bankruptcy Court, Central District of California; filed expert report and declaration, testified at deposition, June 2005.

Metabyte, Inc., and Vivek Mehta v. Canal+ Technologies, S.A., U.S. District Court for the Northern District of California; filed expert report, testified at trial, June 2005.

Precision Pine & Timber Co. v. United States, U.S. Court of Federal Claims; filed expert reports, testified at deposition and trial, June 2005.

Barron Aircraft, LLC v. Dassault Falcon Jet Corp.; Superior Court of the State of Delaware, New Castle County; filed expert report, September 2004.

Gwen Sykes v. Douglas Sykes, Superior Court of the State of California, County of Alameda; filed expert report, September 2004.

Indiana Michigan Power Co. v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition and trial, March 2004.

Local America Bank of Tulsa, FSB, et al. v. United States, U.S. Court of Federal Claims; filed expert report, testified at deposition, April 2003, August 2003.

Dan Hixson v. El Monte Motors, State of California Arbitration filed expert report; testified at deposition, May 2003.

Pinpoint Consumer Targeting Services, LLC v. United States, U.S. Court of Federal Claims; filed expert report, March 2003.

A.G. Route Seven Partnership, et al. and Federal Deposit Insurance Corporation v. United States, U.S. Court of Federal Claims; filed expert report; testified at deposition, January 2002.

McDonnell Douglas Corporation and General Dynamics Corporation v. United States, U.S. Court of Federal Claims; filed expert report; testified at deposition and trial, May 2001.

Publications and Working Papers

"Tax Reform and Bank Behavior," *FRBSF Weekly Letter*, December 16, 1988.

"Capital Market Imperfections and the q-Theory of Investment: Theory and Evidence," *Federal Reserve Bank of San Francisco Working Papers in Applied Economics, #89-03,* 1989.

"The Thrift Insurance Crisis," with Michael C. Keeley, *FRBSF Weekly Letter*, March 31, 1989.

"Corporate Investment," *FRBSF Weekly Letter*, June 30, 1989.

"FIRREA and Deposit Insurance Reform," *FRBSF Weekly Letter*, December 1, 1989.

"Bank Pricing of Retail Deposit Accounts and 'The California Rate Mystery,"' with Gary C. Zimmerman, *Federal Reserve Bank of San Francisco Economic Review*, No. 2, 1990.

"Imperfect Information and the Community Reinvestment Act," with William C. Gruben and Ronald H. Schmidt, *Federal Reserve Bank of San Francisco Economic Review*, No. 3, 1990.

"Interest Rate Competition," with Gary C. Zimmerman, *FRBSF Weekly Letter*, July 27, 1990.

"Costly Information and the CRA," with Ronald H. Schmidt, *FRBSF Weekly Letter*, September 21, 1990.

"How to Close Troubled Banks," *FRBSF Weekly Letter*, December 7, 1990.

"Risk and Return in Banking: Evidence from Bank Stock Returns," *Federal Reserve Bank of San Francisco Economic Review*, No. 4, 1991.

"Depositor Discipline and Bank Runs," *FRBSF Weekly Letter*, April 12, 1991.

"Bank Stock Risk and Return," *FRBSF Weekly Letter*, November 1, 1991.

"Bank Holding Company Stock Risk and the Composition of Bank Asset Portfolios," *Federal Reserve Bank of San Francisco Economic Review*, No. 3, 1992.

Publications and Working Papers (continued)

"Risk-Based Capital Standards and Bank Portfolios," *FRBSF Weekly Letter*, January 10, 1992.

"Is A Bad Bank Always Bad?" *FRBSF Weekly Letter*, May 1, 1992.

"First Quarter Bank Results: Good News, Bad News," with Karen J. Trenholme, *FRBSF Weekly Letter*, July 24, 1992.

"Interest Rate Risk and Bank Capital Standards," *FRBSF Weekly Letter*, November 6, 1992.

"On the Changing Composition of Bank Portfolios," *FRBSF Weekly Letter*, March 19, 1993.

"Interest Rate Risk at U.S. Commercial Banks," *FRBSF Weekly Letter*, July 23, 1993.

"Conditional Risk and Return in Bank Holding Company Stocks: A Factor-GARCH Approach," in *Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, 1994.

"Industry Effects in the Stock Returns of Banks and Nonfinancial Firms," *FRBSF Weekly Letter*, March 24, 1994.

"A Market-Based Approach to CRA," with Ronald H. Schmidt, *FRBSF Weekly Letter*, May 27, 1994.

"Transfer Pricing and Foreign Exchange Risk," (with Mukesh Bajaj and Brian Becker), *Transfer Pricing*, Tax Management, Inc., Vol. 8, No. 6, July 14, 1999.

"Financial Analyses and Termination of the A-12 Aircraft Contract," *Economists Ink*, Winter 2002.

"Patent Damages: Lost Profits or Reasonable Royalties," (with Robert B. Petersen), *Economists Ink*, Spring/Summer 2002.

"Portfolio Risk in Financial Suitability Lawsuits," (with Schyler M. Thiessen), *Economists Ink*, Winter 2005.

"Financial Crisis: What Went Wrong?," *Economists Ink*, November 2008 Special Issue.

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"Sensitivity Analysis in Economic Modeling," (with Stuart D. Gurrea), *Economists Ink,* Winter 2010.

"The Two Faces of Credit Default Swaps: Risk Management versus Speculation," (with Stuart D. Gurrea), *Economists Ink,* Summer 2010.

Exhibit 2

Documents Reviewed and Considered

1. 2006 Softwood Lumber Agreement between the Government of Canada and the Government of the United States of America.

2. Canada's document productions in response to the United States' Requests for Disclosure.

3. United States' Request for Arbitration, dated January 18, 2011.

4. Canada's Response to Request for Arbitration, dated February 17, 2011.

5. "New Interior Log Grades to be Introduced," Press Release by Ministry of Forests and Range, March 21, 2006.

6. "Grade 3 Discussion Paper," Ministry of Forests – Revenue Branch, June 4, 2004 at 2-3 (CAN-000017-18).

7. "2005/06 Annual Service Plan Report," BC Ministry of Forests & Range & Minister Responsible for Housing.

8. "Interior Log Grades – Issues and Decisions," Revenue Branch, Ministry of Forests and Range (March 3, 2006).

9. Minutes of the Interior Scaling Advisory Committee, various dates.

10. "Interior Market Pricing System, Tenure Obligation Adjustments," Revenue Branch, British Columbia Ministry of Forests and Range, June 5, 2006.

11. "Interior Market Pricing System, Average Market Price," Revenue Branch, British Columbia Ministry of Forests and Range, June 5, 2006.

12. "Interior Market Pricing System – Update," Revenue Branch, British Columbia Ministry of Forests and Range, various dates.

13. *BC Scaling Manual*, various dates.

14. *Interior Appraisal Manual*, various dates.

15. "Specifications: The Interior Market Pricing System," Timber Pricing Branch, Ministry of Forests and Range, various dates.

16. *Cruise Compilation Manual*, including appendices, various dates.

17. "Specifications: Calculation of Interior Stumpage Rates," BC Ministry of Forests & Range, various dates.

18. "Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the 2009 Provincial Aerial Overview of Forest Health and the BCMPB model – year 7," Adrian Walton, Research Branch, BC Forest Service, May 11, 2010.

19. "Mountain Pine Beetle Action Plan," Ministry of Forests and Range, 2006-2011.

20. "Mountain Pine Beetle Action Plan, Annual Progress Report 2006/2007," Ministry of Forests and Range, Mountain Pine Beetle Emergency Response Division, August 2007.

21. "Monitoring Harvest Activity Across 16 Mountain Pine Beetle Impacted Timber Supply Areas," B.C. Ministry of Forests and Range, June 2007.

22. "Monitoring Harvest Activity Across 29 Mountain Pine Beetle Impacted Management Units," B.C. Ministry of Forests and Range, December 17, 2009.

23. "Stud Mill Lumber Grade and Value Yields From Green Spruce-Pine-Fir and Grey-Stage Dry Mountain Pine Beetle Attacked Logs," J. David Barrett and Frank Lam, Forestry Innovation Investment, Ltd., March 26, 2007.

24. "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 1. Quesnel Sawmill," FPInnovations, Forestry Innovation Investment, Ltd., September 2007.

25. "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 2. Prince George Sawmill," FPInnovations, Forestry Innovation Investment, Ltd., November/December 2007.

26. "Comparison of Lumber Recovery and Value Yields when Processing Green S-P-F Logs and Grey-Stage (5+ Years) Mountain Pine Beetle Attacked Logs, Part 3. Princeton Sawmill," FPInnovations, Forestry Innovation Investment, Ltd., December 2008.

27. "BC Interior Mountain Pine Beetle Attack—Impact and Outlook on BC Timber-Availability and Wood Products Production," Wood Products, March 2010.

28. "Major Primary Timber Processing Facilities in British Columbia 2008," Ministry of Forests and Range, June 2010.

29. "Impact of 2010 Interior Pricing Policy Changes on Selling Price Zone 25 Licenses," Hugh A. Gordon and Steve J. Potter, September 14, 2010.

30. Announcement of the Ministry of Forests and Range, File 280-30, Ref: 123866, April 1, 2010.

31. *Econometric Analysis*, William Greene, 2nd edition, Prentice Hall.

32. Ministry of Forests, *Harvest Billing System*, Mark Monthly Scaling History Reports from 2005-2010, accessed June 13, 2011.

33. Interior Auction Data.xls, quarterly, July 1, 2006 to July 1, 2010.

34. Interior MPS AMP final detailed calculations.xls, quarterly, Jan 2007-July 2010.

35. Volume & Value Billed—British Columbia.xls, quarterly, Jan 2007-July 2010.

36. Mountain Pine Beetle in Alberta—History of Infestations, at http://www.mpb.alberta.ca/BeetleFacts/historyinfestations.aspx

37. Adrian Walton, "Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the Infestation Projection Based on the 2008 Provincial Aerial Overview of Forest Health and Revisions to the 'Model'" (BCMPB.v6), Research Branch, BC Forest Service, May 26, 2009.

38. [ ].

39. www.bankofcanada.ca/rates/exchange/monthly-average-lookup/.

40. Weekly Random Lengths Composite.xls.

41. Copy of RL Composite Analysis.xlsx.

42. Random Lengths 2009 Yearbook and Yardstick Publications.

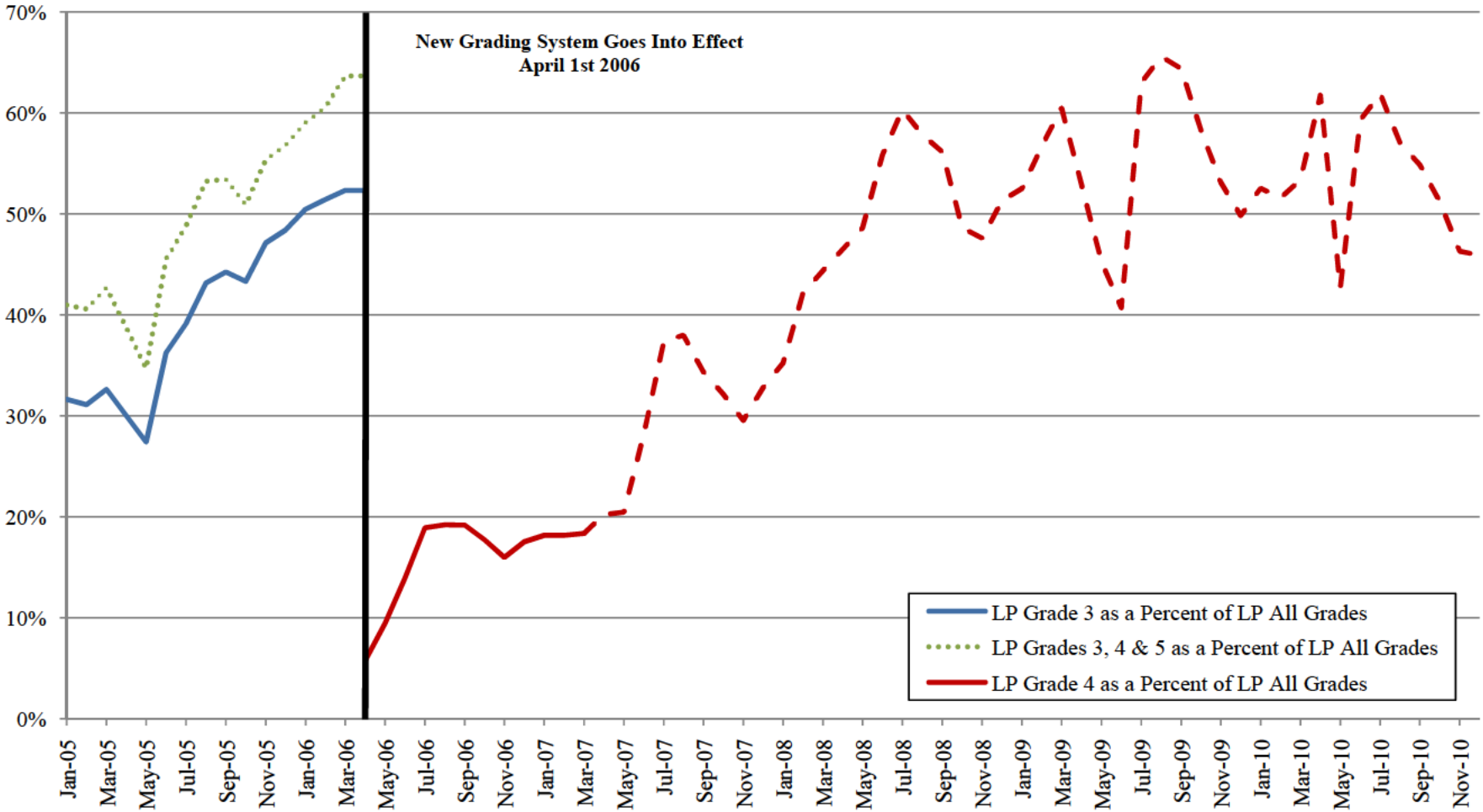
43. A3 LRF Proxy 2011 05 31.xls.

44. Statistics Canada, HS 44071031.

45. FPInnovations Forintek, "Follow-up on the Implementation of the 'Guidelines for Heating up MPB Logs in Conventional Lumber Dry Kilns,'" March 2008.

46. "Interior Log Grades: A Report from the Interior Scaling Technical Advisory Subcommittee," BC Interior Scaling Advisory Committee, July 12, 2005.

Exhibit 3
Percentage of Lodgepole Pine Assigned to "Reject" Grades
Old vs. New BC Interior Grading System

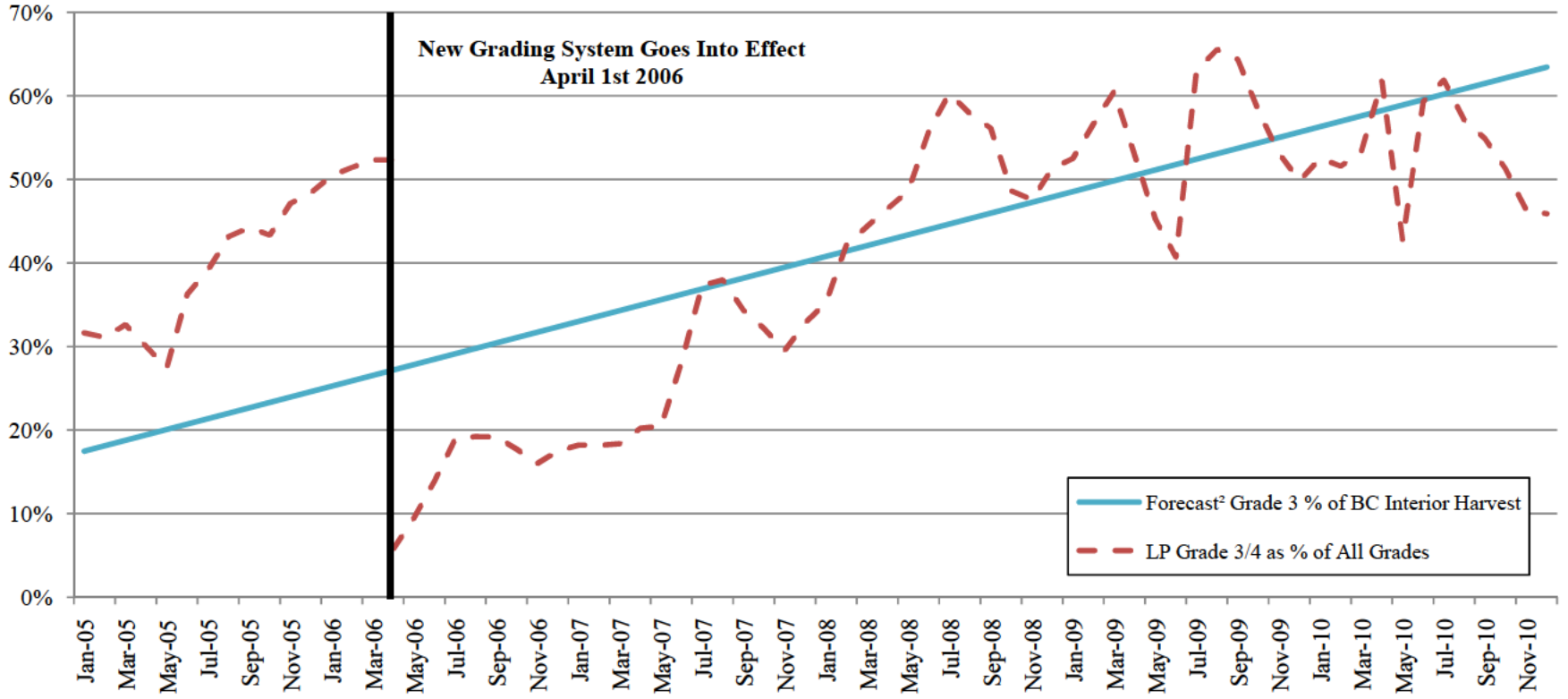


Notes:

1. The following months have incomplete data in the Harvest Billing System and are not depicted on the chart: April 2005, April 2008, and April 2009.
2. Chart depicts "reject" grades for lodgepole pine ("LP"), by scale date, for BC Interior.
3. The solid portion of the red line represents the first year under the new grading system.

Source: Ministry of Forests Harvest Billing System, Mark Monthly Scaling History Reports from 2005 - 2010. Accessed June 13, 2011.

Exhibit 4
Grade 3/Grade 4[1] Percentage of Lodgepole Pine BC Interior Harvest Forecast[2] vs. Actual



Notes:

1. Actual Grade 3 percentages are shown before the April 2006 grading change. Actual Grade 4 percentages are shown after the April 2006 grading change.
2. Forecast Grade 3 percentage is based on the annual forecast of Interior Grade 3 from "Bark Beetle Infested PI" as a percentage of Interior "Lodgepole Pine" from CAN-015833. The annual forecast percentage for each year, since it is based on an April –March fiscal year, is attributed to the mid-point (October) of that fiscal year, and then is grown in each succeeding month of the fiscal year by 1/12 of the difference between the fiscal year forecast and the next fiscal year's forecast.
3. The following months have incomplete data in the Harvest Billing System and are not depicted on the chart: April 2005, April 2008, and April 2009.
4. The dotted red line depicts "reject" Grade 3/Grade 4 for lodgepole pine, by scale date, for BC Interior.

Sources:

1. Ministry of Forests Harvest Billing System, Mark Monthly Scaling History Reports from 2005 - 2010. Accessed June 13, 2011.
2. CAN-015833 (Forecast date approximately May 2003).

Exhibit 5

Observed and Projected Annual MPB Green-Attack Volume (Million Cubic Meters) by Pine Unit and Percentage of Lodgepole Pine Assigned to Grade 4 by Forest District

Pine Unit	2004	2005	2006	2007	2008	2009	2010	2011	2012	2006 (Apr - Dec)	2007	2008	2009	2010
	Observed				Projected					Percentage of Lodgepole Pine Grade 4[1] (By Associated Forest District)				
Vanderhoof	24.5	7.1	3.9	0.1	0.1	0.0	0.1	0.1	0.1	15%	19%	64%	80%	73%
Quesnel	23.7	11.8	5.1	0.9	3.0	2.4	2.0	1.5	1.1	15%	36%	57%	66%	61%
Lakes	15.0	9.8	6.4	1.3	0.5	0.3	0.2	0.2	0.1	16%	21%	47%	65%	69%
Prince George District	12.7	8.2	8.0	0.3	0.2	0.3	0.3	0.4	0.4	31%	40%	67%	77%	78%
Williams Lake	19.3	20.5	17.7	4.5	3.0	2.4	2.0	1.5	1.1	24%	40%	56%	56%	57%
100 Mile House	8.7	17.8	7.5	1.9	0.8	0.4	0.3	0.2	0.2	24%	46%	65%	67%	75%
Kamloops	6.1	9.1	7.1	2.0	2.0	1.9	1.8	1.5	1.2	17%	37%	67%	49%	46%
Ft St James District	10.7	8.9	15.0	3.9	4.5	5.1	5.2	4.9	4.3	20%	20%	35%	36%	55%
Morice	3.7	6.3	7.1	6.2	4.8	3.4	2.2	1.3	0.8	16%	21%	47%	65%	69%
Merritt	1.3	2.5	4.1	3.5	4.8	5.4	5.4	4.6	3.4	10%	13%	18%	27%	29%
Lillooet	0.4	0.9	1.3	1.0	1.6	2.0	1.9	1.5	1.1	39%	42%	58%	N/A[2]	N/A[2]
Robson Valley	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.4	0.3	13%	28%	40%	44%	20%
Dawson Creek	0.0	0.1	2.7	1.0	1.9	3.2	4.0	3.4	2.5	9%	12%	15%	15%	28%
Bulkley	0.1	0.1	0.2	0.4	0.8	1.4	1.9	1.8	1.3	16%	21%	47%	65%	69%
Arrow	0.5	0.5	0.2	0.2	0.4	0.6	0.7	0.6	0.5	6%	9%	17%	33%	45%
Mackenzie	0.7	2.2	5.1	2.2	4.8	8.7	11.8	13.1	10.7	11%	10%	24%	83%	87%
Okanagan	1.0	1.3	1.7	1.6	2.4	3.9	4.8	4.9	4.2	12%	17%	39%	35%	33%
Boundary	0.1	0.2	0.1	0.1	0.3	0.7	1.4	1.8	1.7	6%	9%	17%	33%	45%
Invermere	0.2	0.3	0.2	0.3	0.3	0.7	0.9	1.0	0.9	4%	6%	8%	9%	6%
Golden	0.2	0.3	0.1	0.1	0.1	0.2	0.3	0.4	0.4	1%	22%	24%	71%	55%
Cranbrook	0.6	0.5	0.3	0.6	0.7	1.3	1.9	2.4	2.5	4%	6%	8%	9%	6%
Kootenay Lake	0.3	0.4	0.3	0.5	0.5	0.7	0.9	1.1	1.1	5%	5%	3%	3%	3%
Grand Total	130.0	109.0	94.4	32.8	37.9	45.6	50.6	48.4	39.7	17%	28%	49%	55%	53%

Notes:
1. Grade 4 percentages are for BC Interior by scale date.
2. 2009 and 2010 Lillooet figures are negative/non-existant in the HBS file.

Sources:
1. Adrian Walton, *Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak Update of the Infestation Projection Based on the 2008 Provincial Aerial Overview of Forest Health and Revisions to the "Model" (BCMPB.v6)*, Research Branch, BC Forest Service, May 26, 2009, page 7.
2. Ministry of Forests Harvest Billing System, Mark Monthly Scaling History Reports from 2006 - 2010. Accessed June 13, 2011.

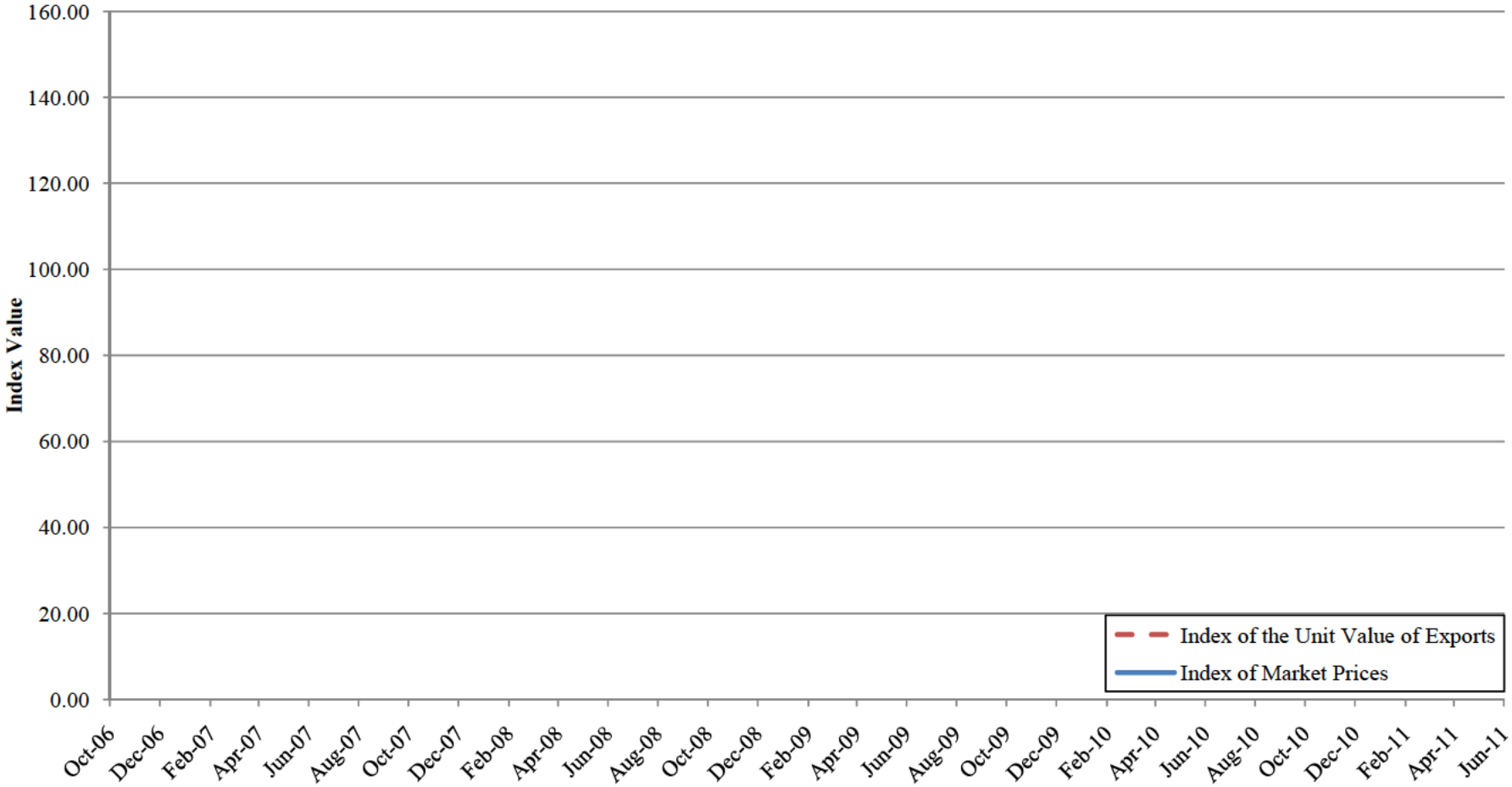
Exhibit 6

Comparison of Lumber Recovery and Value Losses for Four Sawmill Tests Green vs. Grey-Stage MPB Timber

Mill Location	Product	Recovery Loss	Value Loss	Combined Loss
Princeton	Narrow Dimension (6-20 ft)	1.5 %	14.1 %	15.6 %
Quesnel	Dimension (6-20 ft)	7.1 %	23.5 %	29.0 %
Prince George	Dimension (6-20 ft)	8.2 %	11.9 %	19.0 %
Vanderhoof	Studs (5-8 ft)	12.5 %	5.7 %	17.5 %

Source: *Comparison of Lumber Recovery and Value Yields from Green Lodgepole Pine Logs and Grey-Stage (5+ years) Mountain Pine Beetle Attacked Logs*, Part 3. Princeton Sawmill - December 2008, page 20.

Exhibit 7
BC Interior Market Price and Export Value Indices For Lumber
October 2006 - June 2011

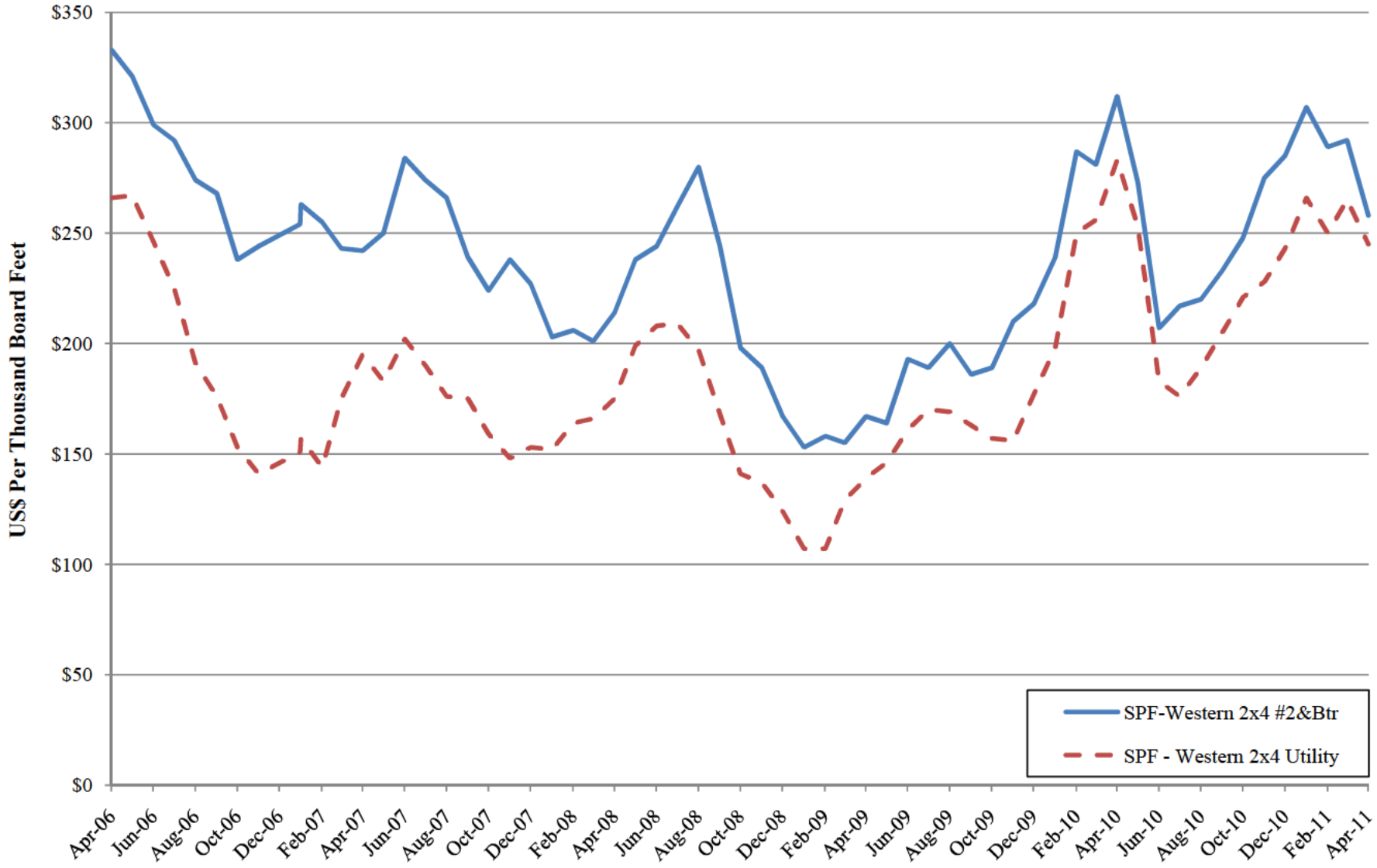


Note: Data prior to September 25, 2009 are taken from Weekly Random Lengths Composite.xls; Data from September 25, 2009 - June 17, 2011 are from Copy of RL Composite Analysis.xlsx.

Sources:

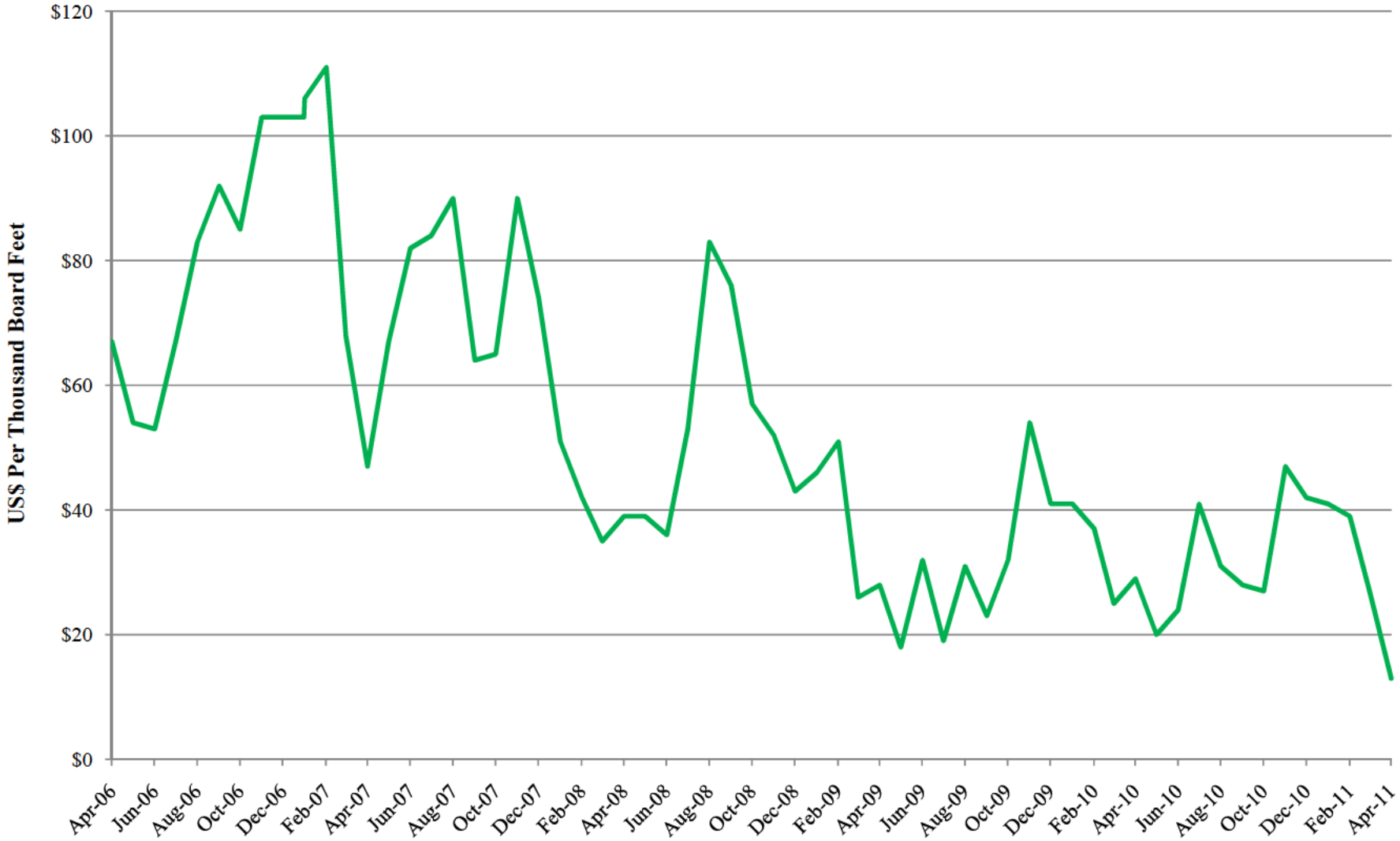
1. Export Value Index: [ ]; www.bankofcanada.ca/rates/exchange/monthly-average-lookup/.
2. Market Price Index: Weekly Random Lengths Composite.xls & Copy of RL Composite Analysis.xlsx.

Exhibit 8
"Merchantable" & "Non-Merchantable" Lumber Prices



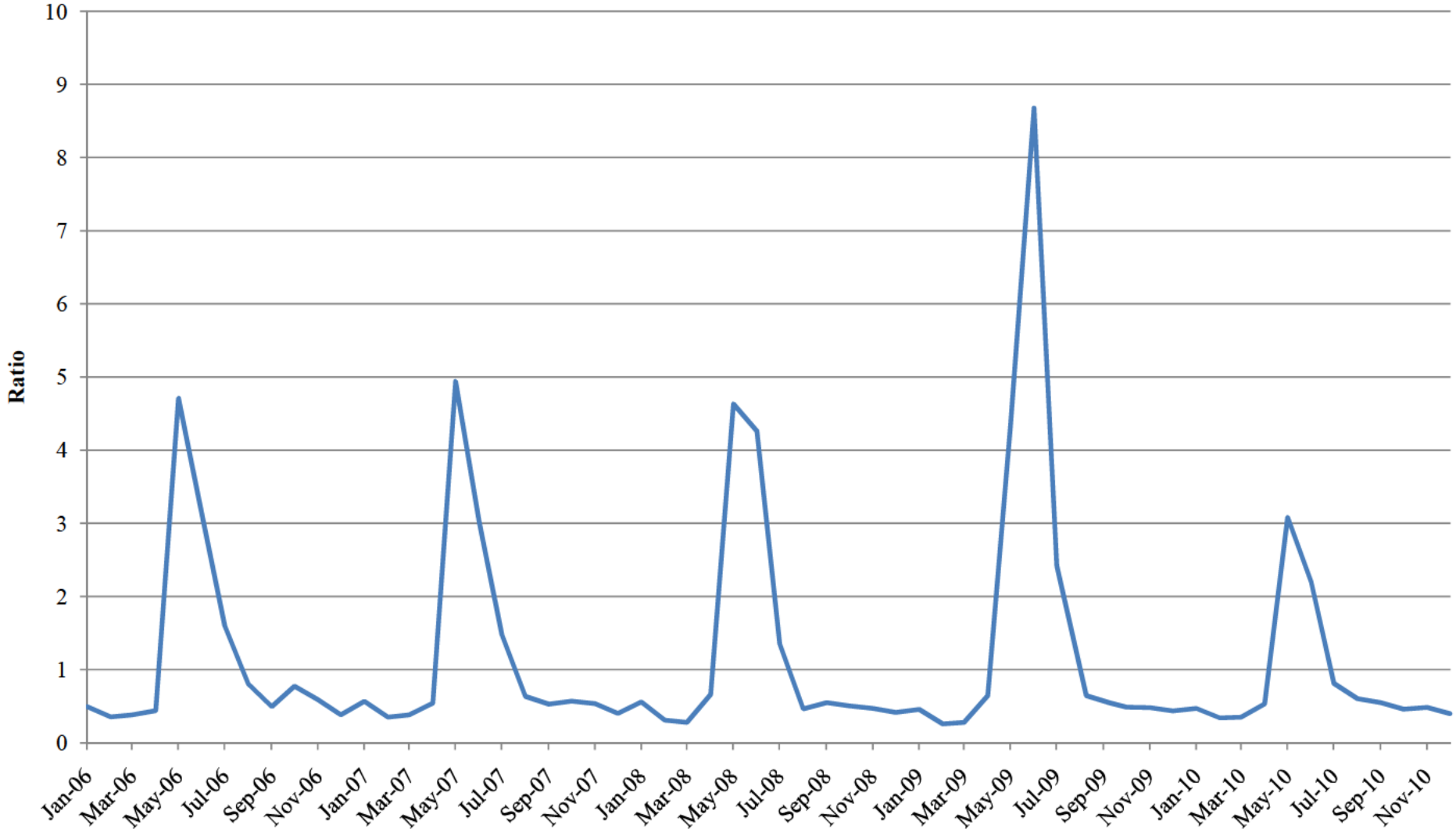
Sources: Random Lengths 2009 Yearbook and Random Lengths Yardstick Publications.

Exhibit 8a
Difference between "Merchantable" & "Non-Merchantable" Lumber Prices



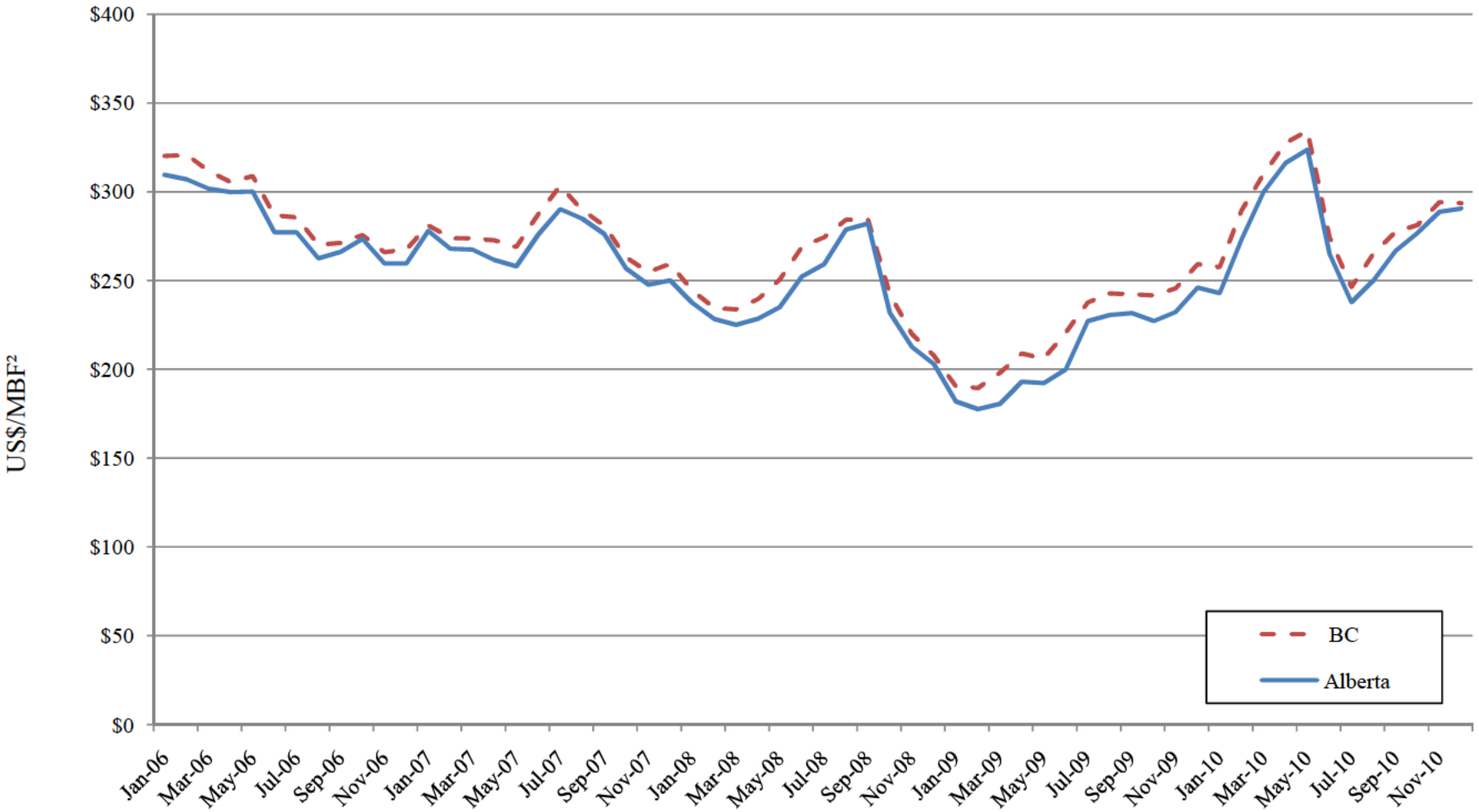
Note: Series is defined as difference between SPF-Western 2x4 #2&Btr and SPF-Western 2x4 Utility in Exhibit 8.
Sources: Random Lengths 2009 Yearbook and Random Lengths Yardstick Publications.

Exhibit 9
Ratio of Production to Harvest
January 2006 - December 2010



Source: A3 LRF Proxy 2011 05 31.xls.

Exhibit 10
Average Unit Value of SPF Exports to the United States During SLA For BC[1] and Alberta

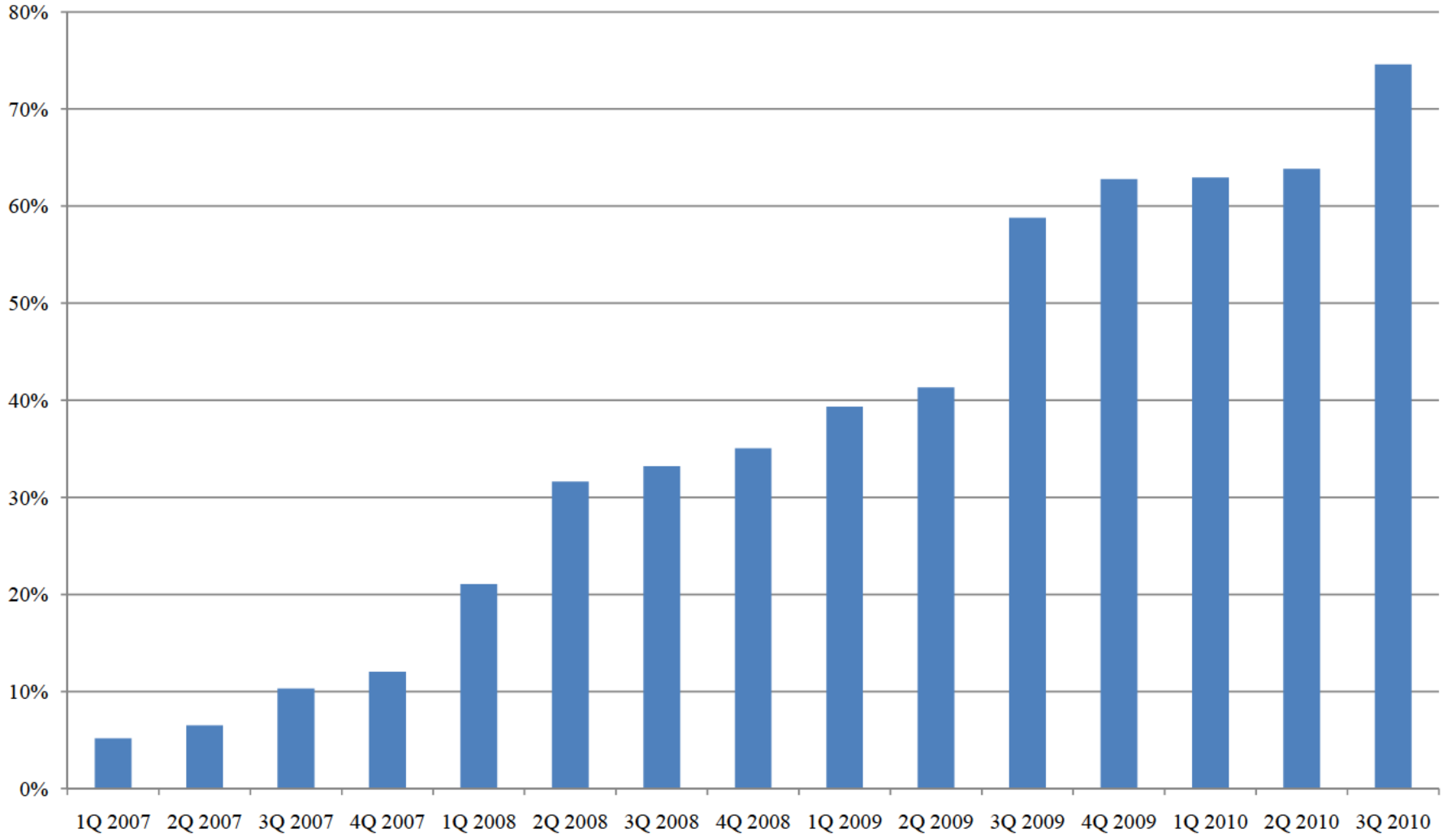


Notes:
1. BC figures are for entire province, but SPF is almost entirely scaled in the BC Interior.
2. Converted from cubic meters (m^3) to thousand board feet ("MBF") at 0.42378.
3. Lodgepole Pine is reported almost entirely in harmonized system ("HS") category 44071031 and not in 44071054, "other-pine-lodgepole."

Source: Statistics Canada, HS 44071031.

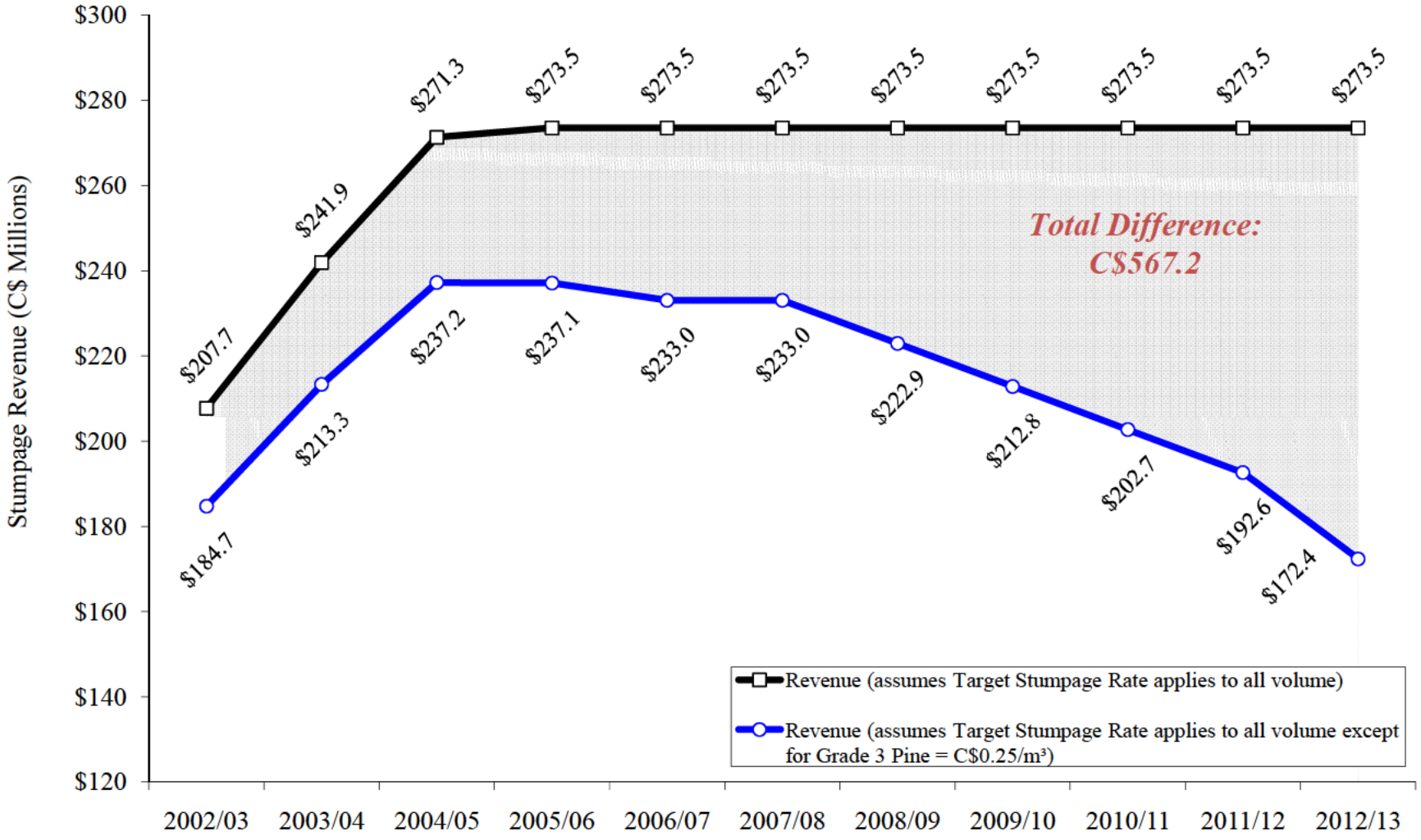
Non-Confidential

Exhibit 11
Share of Tenure Tract Timber Sold in BC Interior at the Minimum Price
Q1 2007 - Q3 2010



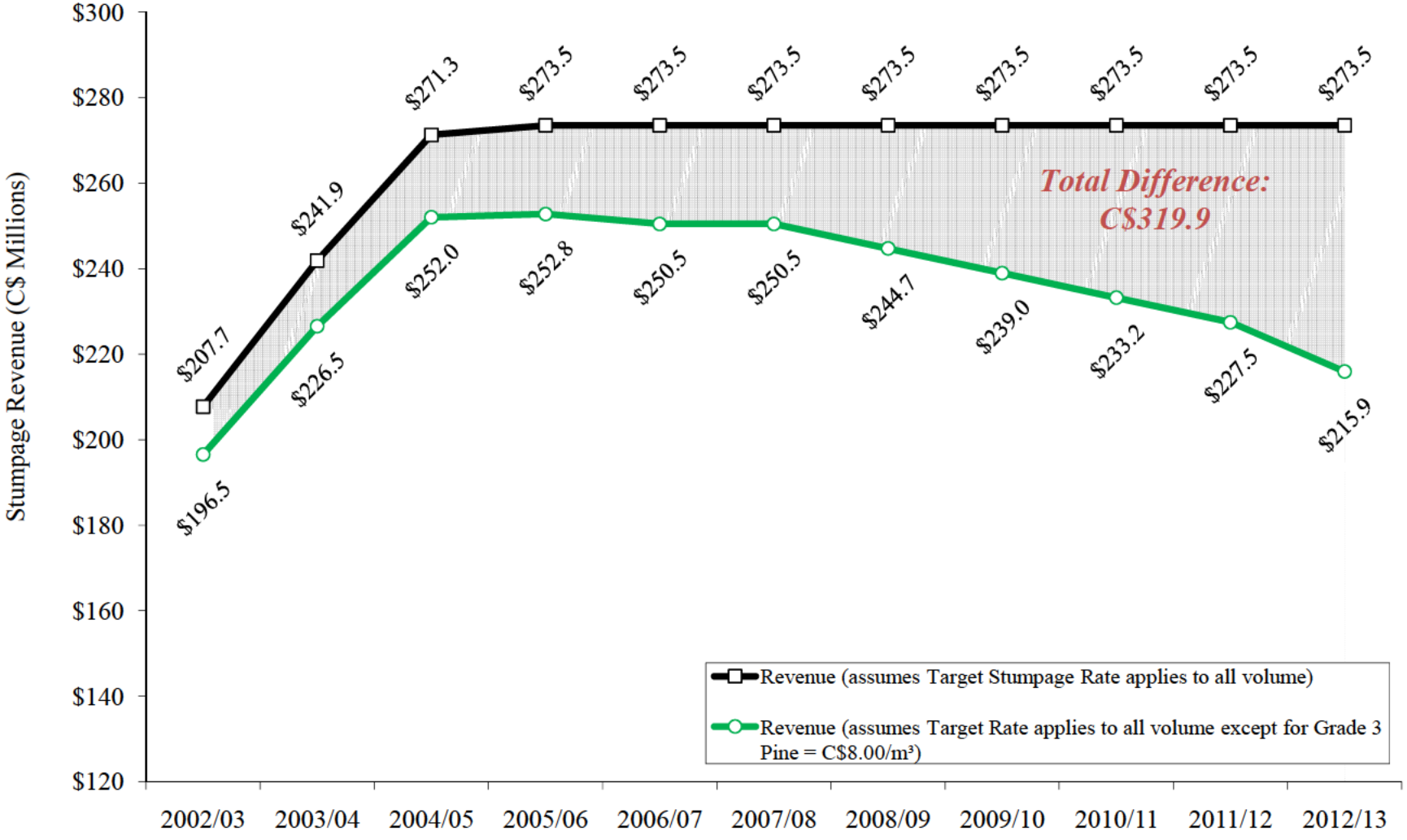
Note: This exhibit is based on data in Excel workbooks provided to USTR by BC, such as "4. Int MPS AMP Jan 2010 final detailed calculations.xlsx".
Source: USTR Data.

Exhibit 12
Revenue Projections of Beetle Harvest Effect for Forest Districts: Quesnel, Lakes, Vanderhoof and Williams Lake (All Species - C$ Millions) 2002/03 to 2012/13



Source: CAN-015833.xls (Forecast date approximately May 2003).

Exhibit 13
Revenue Projections of Beetle Harvest Effect for Forest Districts: Quesnel, Lakes, Vanderhoof and Williams Lake (All Species - C$ Millions) 2002/03 to 2012/13



Source: CAN-015833.xls (Forecast date approximately May 2003).