



**Forest
Practices
Board**

Measuring Wood Waste in British Columbia

Complaint Investigation 080870

FPB/IRC/170

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Executive Summary

In 2009, the Canadian Centre for Policy Alternatives (the complainant) filed a complaint with the Forest Practices Board (the Board) over how wood left behind at logging operations throughout British Columbia is measured and reported.

‘Wood waste’ is any timber that meets merchantability specifications, was not removed from the cutting authority area and was not reserved from cutting. In the opinion of the complainant, wood waste that is not correctly measured and recorded may have implications on forest management (e.g., biological diversity, sustainable rate of harvest) and revenue to the Crown.

From 2004-2008 a total of 351.8 million cubic metres was harvested in BC, of which 15 million cubic metres, or 4.3 percent, was wood waste. The Coast Forest Region accounted for 60 percent of the provincial waste volume while the Northern Interior Forest Region and Southern Interior Forest Region accounted for 22 percent and 18 percent respectively.

Current and future wood waste levels are driven by government policy, and economic and ecological considerations, all of which do change and may be in conflict with each other. Current policy enables licensees to extract any logs of value to them within the cutting authority areas, subject to legislative requirements, and to leave uneconomical lower quality wood when the cost of falling, yarding, trucking and milling it exceeds the value of the end product (i.e., lumber and chips).

Economic variables are constantly changing and include matters such as demand for wood waste, available volume, proximity to the processing facility, physical properties, technological advancements and the price the consumer is willing to pay for the end product. Ecologically, wood waste left on site contributes to coarse woody debris (CWD), which plays a major role in the ecology of a healthy forest in both natural and managed stands. It sustains forest ecosystem productivity, provides habitat and food, helps maintain soil stability and stores carbon.

Once an area is harvested, a waste assessment must be completed. Waste assessments are carried out primarily to ensure the Crown receives full revenue from all harvested timber, and secondly, for cut control purposes. However, the government recently began selling some timber for a lump sum amount based on the cruised volume, rather than a price per cubic metre of scaled volume. This will eliminate the primary need for wood waste accounting.

The Board reviewed how waste surveys are conducted and whether the waste manual is being applied in a consistent manner across the province. The Board also evaluated the qualification of individuals completing the surveys. If the manual is being followed, the accuracy of the data collected and reported is largely dependent upon the qualification and experience of individuals completing the waste surveys and those conducting check surveys.

In order to get a representative provincial perspective, three coastal forest districts, three southern interior districts and one northern interior district were reviewed. Within each district, interviews were conducted with the Ministry of Forests and Range (MFR), British Columbia Timber Sales, licensees and consultants, and targeted individuals involved with operational

implementation of the waste manual. Interviews focused on qualifications of individuals, survey and check survey methodology, and reporting timelines.

The investigation found that:

- There is a wood waste accounting system in place with a primary purpose to reduce the government revenue risk (not obtaining appropriate value for wood harvested) by providing a realistic accounting of wood waste volume. The waste accounting system is designed and built with measurement and checking standards that allow some flexibility to address the diversity of economic, timber profile and operational challenges that exist in BC.
- There is not a consistent approach in how ocular estimates, accumulation surveys, risk rating and check surveys are conducted. However, each region and district had developed a structural organization and procedures tailored to their specific situation. Timelines for conducting waste surveys and check surveys, and reporting results are not always met.
- Ocular estimates appear to be reasonable due to the semi-objective measurement combined with MFR oversight through check surveys and the experience of the individuals involved with conducting and checking ocular estimates.
- MFR is not running formal analysis to correlate waste volumes with other variables since the variables change so much over time.
- Survey intensity is adjusted based on the level of waste and revenue risk; however, a risk ranking system is used to prioritize blocks for conducting check surveys on.
- Finally, as revenue risk to the Crown decreases through alternative ways of selling timber, the primary justification for the waste accounting system may no longer be valid.

Introduction

The Complaint

In 2009, the Canadian Centre for Policy Alternatives (the complainant) filed a complaint with the Forest Practices Board (the Board) over how wood left behind at logging operations throughout British Columbia is measured and reported. Using reports generated from government data, the complainant estimated that, from 2004 to 2008, more than 17.5 million cubic metres (3.9 percent of the total volume harvested) of wood was abandoned at logging sites across the province and that wood waste levels are increasing as harvest volumes are declining.

In the opinion of the complainant, wood waste is not correctly measured and recorded and this may have implications on forest management (e.g., biological diversity, sustainable rate of harvest) and revenue to the Crown.

The complainant identified five main concerns, four of which the Board investigated:

1. Waste volumes may not be accurately graded and reported.
2. Ocular estimates may not be a reliable method for assessing waste volumes.
3. Sampling 10 percent of waste surveys may not be adequate to verify waste volumes.
4. The Ministry of Forests and Range (MFR) is not checking to see if there is a correlation between waste volumes and other variables.
5. Sampling is not adjusted to reflect increases or decreases in waste volumes.

The 10 percent sampling intensity is a requirement of the *Provincial Logging Residue and Waste Measurement Procedures Manual*.¹ The investigation did not review the adequacy of the 10 percent sampling intensity since the contents of the waste manual are outside of the jurisdiction of the Board. It should be noted that a similar sampling intensity is also used for timber cruising and weigh scaling.

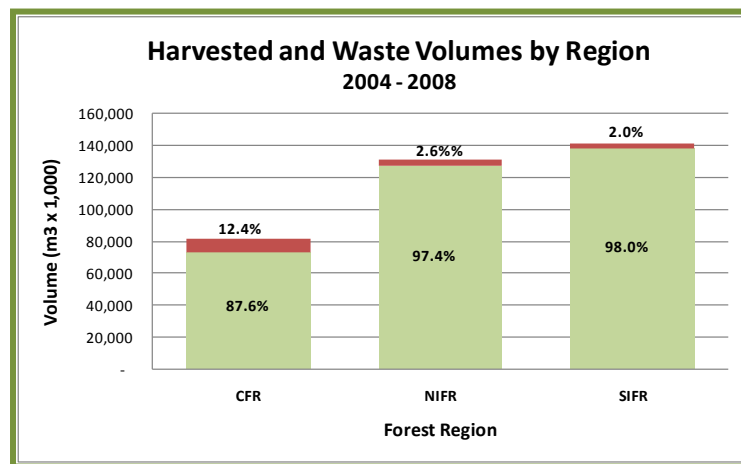
Wood waste is directly related to the amount and distribution of coarse woody debris (CWD), which influences achievement of *Forest and Range Practices Act* (FRPA) objectives such as biodiversity, soil productivity, riparian, silviculture and range. The *Wildfire Act* (WA) stipulates that a person carrying out an industrial activity or a prescribed activity on forest land must conduct fire hazard assessments and abate the fire hazard where one exists. As levels of waste, increase, the need to conduct fire hazard assessments and abatement of hazards becomes more important.

¹ <<http://www.for.gov.bc.ca/hva/manuals/rwprocedures.htm>>

The *Forest Act* (FA) addresses the allowable annual cut requirement, while FRPA requires that an economically valuable supply of commercial timber from British Columbia's forests be maintained or enhanced and also requires that the management of forest resources be done without unduly reducing the supply of timber.

Background

'Wood waste' is any timber that meets merchantability specifications,² was not removed from the cutting authority area (i.e., road right-of-way, cutblock, etc.) and was not reserved from cutting (i.e., wildlife trees/patch, seed trees, etc). Waste can be felled timber left on site or standing timber that was supposed to have been felled and removed. Some waste is physically obstructed or cannot be removed for safety reasons. This type of waste is categorized as



Graph 1. Harvest and waste volumes by Forest Region for the 2004 – 2008 period.

'unavoidable' and accounts for about eight percent of the waste volume provincially. All other waste is classed as 'avoidable' and accounts for 92 percent of the waste volume. Avoidable waste is waste that could potentially be used for lumber or chips for pulp.

The complainant used the Harvest Billing System³ (HBS) to estimate that, during the 2004 to 2008 period, 17.5 million cubic metres of wood waste was left on logging sites on Crown and private land across the province. The volume estimate was

confirmed by the Board through reports generated from HBS, however, this investigation only considered the wood waste on Crown land, which is 15 million cubic metres⁴ for this period. MFR data shows that wood waste has increased since 2003 and remained relatively steady as annual harvest levels have declined. During the 2004 to 2008 period, waste accounted for an average of 4.3 percent of the annual harvest, with a range from 3.1 percent in 2004 to 5.0 percent in 2007 and 2008. In this period, (Graph 2) wood waste accounted for 12.4 percent of the total volume harvested in the Coast Forest Region (CFR) and 2.6 and 2.0 percent in the Northern Interior Forest Region (NIFR) and Southern Interior Forest Region (SIFR) respectively. The CFR accounted for 60 percent of the provincial waste volume while the NIFR and SIFR accounted for 22 and 18 percent respectively. Between 2004 and 2008, the Crown collected 4.6 billion dollars

² Tables 1.1 and 1.2 of the *Provincial Logging Residue and Waste Measurement Procedures Manual*.

³ Harvest Billing System (HBS) is a MFR administered scale data management system that allows for the submission and resubmission of detail scale data, issuing stumpage invoices and reporting on scaling and issuing activities.

⁴ Source HBS.

from timber harvested on Crown land in BC. Of this, 31 million dollars, or 0.7 percent, was attributed to waste billing.

Once an area is harvested, a waste assessment must be completed. Waste assessments are carried out under the authority of the *Forest Act*, the waste assessment policy, the *Provincial Logging Residue and Waste Measurement Procedures Manual* (waste manual), and agreements and cutting permit documents. The waste manual details the office and field procedures to be used when planning, conducting and checking waste assessments. The manual differentiates between the Coast Forest Region and the two interior forest regions in terms of log grades and the method used for completing field assessments. The manual also provides flexibility to address the variable timber profiles and terrain conditions that exist throughout BC.

Waste surveys are specifically designed to allow for a reasonable recording and reporting of waste volumes and grades for stumpage revenue and cut control purposes. The application of survey results beyond its intended function may result in misleading conclusions. For example concluding that all avoidable waste is useable does not consider factors such as species, size, condition, volume and proximity to the processing facility, or demand for the end product. When these factors are considered, the economically useable volume will be less than the total volume measured.

To ensure fairness and equity among licensees, as well as to provide reliable data to the government, consistent application of the waste manual within the Coast and Interior Forest Regions is desirable. Overestimated waste volumes cost licensees, since they have to pay more stumpage, and underestimated waste volumes cost the Crown in terms of lost revenue. This conflict makes it in both parties' best interests to ensure that surveys are accurate, as well as to avoid the time and expenses associated with resolution of discrepancies. Therefore, if the waste manual is being applied in a consistent manner, the individual completing the surveys are qualified, and there is an appeal or checking function, then there is a high likelihood that the survey results are acceptable.

There are two primary reasons to measure wood waste. The first reason is to ensure the Crown receives full revenue from all harvested timber. When an area is logged, the licensee has to pay the Crown a fee known as 'stumpage' on all merchantable timber taken or left on site. Stumpage is based on the species and grade of the log. Waste surveys measure the merchantable volume left on site and categorize it as avoidable or unavoidable. The avoidable waste, less a benchmark⁵ volume, is billed the average stumpage rate for the grade/species for the previous 12 months.

⁵ Waste benchmarks are established acceptable levels of waste to be left on the cutblock. Only avoidable waste volumes in excess of the benchmark are subject to monetary billing. Benchmarks are established for coastal and interior operations.

The second reason to measure wood waste is for cut control. Each licensee has an annual volume of timber or allowable annual cut (AAC)⁶ that they can harvest. Each year, licensees calculate how much volume they harvested and used or left on site (wood waste) that meets merchantability specifications. The harvest volume plus the waste volume is reconciled to AAC.

Current and future wood waste levels are driven by government policy, and economic and ecological considerations (refer to Appendix 1, 2 & 3). The current policy, referred to as 'take or pay,' removes mandatory species and log grade utilization (cut and remove) requirements. This policy, which came into effect in 2003, enables licensees to extract any logs of value to them within the cutting authority areas, subject to FRPA. It also enables the licensee to leave uneconomical lower quality wood when the cost of falling, yarding, trucking and milling it exceeds the value of the end product (i.e., lumber and chips).

The government has recently begun encouraging the use of cruise-based tenures, where stumpage is paid based on the volume of timber determined by a cruise, as opposed to an actual scale. The tenure holder then has the opportunity to market the timber in the best way possible. Utilization of timber will be market driven, ranging from utilizing only the best wood to complete utilization of all wood volume. This type of sale may remove the requirement for conducting a waste survey, since the stumpage is paid for the entire stand based on the cruise. The government will have to determine whether there is any benefit in conducting post-harvest surveys since they will not be required for revenue or cut control, but may still be useful from an ecological perspective.

Cruise - The measurement and estimation of volumes of standing and down Crown timber on a given parcel of land.

Scale - The measurement and estimation of the volume of logs after the timber has been felled.

Economic variables are constantly changing and include matters such as demand for wood waste, available volume, proximity to the processing facility, physical properties, technological advancements and the price the consumer is willing to pay for the end product. Currently, the demands for wood waste are primarily for chips and sawdust for pulp and pellets, and hog fuel for power generation. It is

anticipated that demand for wood waste will continue to increase as sawmill production continues to decline (resulting in less chips and biomass available), and constraints on the land base increase (which restrict the volume available to sawmills and other processing facilities). In addition, new or increasing demands for wood waste will increase the competition for the available wood waste volume. For example, utilizing wood waste to generate electricity and heat at a commercial scale (bioenergy) is anticipated to increase and the production of liquid fuels (biofuels) is expected to emerge as a viable use for wood waste.

⁶ The rate of harvest determined by the chief forester for timber supply areas (TSAs) and tree farm licences (TFLs), and by the district manager for woodlot licences (WLs), and the rate of harvest specified in a licence or in a management and working plan.

It is also anticipated that there will be greater emphasis on coarse woody debris (CWD).⁷ CWD plays a major role in the ecology of a healthy forest in both natural and managed stands. It sustains forest ecosystem productivity, provides habitat and food, helps maintain soil stability and stores carbon. Harvesting and forest management activities modify the quantity, quality and spatial distribution of CWD and provide a periodic input of CWD at volumes significantly less than would occur naturally. Research in Europe found that decreasing the volume of deadwood to less than 30 percent of that present in natural stands is correlated with increasing numbers of deadwood-dependent species being classified as threatened and with biodiversity loss. The importance of CWD is already being recognized through new government policy. For example, the draft chief forester's directive concerning CWD will encourage operators to leave the wood waste dispersed throughout the site rather than yarding it to the roadside. This will have a positive ecological effect, but will reduce the volume of wood waste in piles readily available for utilization.

Scope and Methodology

In order to collect information for this investigation the Board considered two options:

1. audit waste surveys from across the province in the field (i.e., on the ground)
2. review adherence to the waste manual.

Option 1 was not realistic for two reasons. First, wood waste is often considered a fire hazard and may be disposed of soon after the waste survey and would not therefore be available for audit purposes. Secondly, to do an audit of waste surveys throughout the province would be cost prohibitive.

Instead, the Board reviewed how waste surveys are conducted and whether the waste manual is being applied in a consistent manner across the province. The Board also evaluated the qualification of individuals completing the surveys. If the manual is being followed, the accuracy of the data collected and reported is largely dependent upon the qualification and experience of individuals completing the waste surveys and verified by check surveyors.

In order to get a representative provincial perspective, three coastal forest districts, three southern interior districts and one northern interior district were reviewed (Table 1). Within each district, interviews were conducted with the MFR, British Columbia Timber Sales (BCTS), licensees and consultants, and targeted individuals involved with operational implementation of the waste manual. Interviews focused on qualifications of individuals, survey and check survey methodology, and reporting timelines.

⁷ CWD refers to large dead and down woody material (greater than 7.5 cm in diameter) at various stages of decomposition, located above the soil, and not self-supporting (live and dead trees as well as stumps are considered self-supporting).

Table 1. Summary of interviewees for wood waste investigation

Region	# Districts	MFR	BCTS	Major Licensees	Consultants	Other
CFR	3	3	3	6	2	2
NIFR	1	1	1	3		
SIFR	3	3	3	8	1	
Total	7	7	7	19	3	2

Two data sources were used for analysis purposes. The waste system (WS), implemented in 2005, and the HBS. The WS contains original survey and check survey information including avoidable/unavoidable, dispersed/accumulation, species and grades. Although the WS did not contain information for the full time period of the complaint, it helped establish relative percentages for avoidable/unavoidable and dispersed/accumulated volumes. Licensees or BCTS conduct the waste survey and enter the results into the waste system, where the MFR checks and approves the data. The data is then transferred to the HBS, which generates a bill for the waste volume. HBS provides revenue, species, volume and grade information for the 2004 to 2008 period.

Discussion

Are waste volumes being accurately graded and reported?

The waste manual outlines the policy and procedures for conducting and reporting waste surveys. It specifies requirements for the Coast Region and the Interior Regions for measuring accumulations and dispersed⁸ waste volumes, categorizing waste as avoidable or unavoidable, and timelines for completing and reporting the surveys. The manual provides a basis for ensuring there is consistency in the measurement and reporting of waste. At the same time, it provides flexibility on how waste is measured, since one standard approach will not work in BC due to the variability in timber types, terrain, access and block sizes.

It is the responsibility of the MFR district manager (DM) to ensure that the waste manual is administered in a fair and equitable manner. There is no consistency in the structural organization within or between forest districts. Each district had at least one or two individuals assigned to the waste program. In some districts, waste is the responsibility of pre-award staff or compliance and enforcement staff, while in other districts waste is the responsibility of post-award staff (most commonly scaling). Waste assessments are seasonal and staff often has responsibility for other activities as well. How the waste responsibilities are structured in each district is up to the DM and will reflect the uniqueness of each district.

Regional waste advisory groups have been established to ensure that the waste manual is applied in a consistent manner. They meet annually and are an important venue for disseminating policy, discussing issues, reviewing manual requirements and the waste system

⁸ Accumulations are areas where waste is concentrated (i.e. landings and along roadsides). Dispersed are areas where waste is not accumulated (i.e. in the setting or cutblock).

itself. The advisory groups also supplied feedback to MFR's revenue branch on recommendations for improving the manual, field procedures, and the waste system.

In the Board's view, consistent application of the waste manual by qualified individuals will ensure that all waste is measured and recorded in a fair and equitable manner. In order to examine this concern, the investigation evaluated planning activities, field survey procedures, promptness of conducting surveys and reporting results, check survey procedures and qualification of individuals involved with waste surveys.

Planning

The waste manual did require that an annual plan be developed by all licensees and BCTS using the waste system. The plans consisted of inputting all blocks, including road rights-of-way, to be assessed during the year and the anticipated schedule for completing the waste survey. The Board found that licensees and BCTS were meeting this requirement. However, licensees, BCTS and the MFR questioned the value of this plan. Licensees regularly update the waste system with a proposed schedule of blocks and roads to be harvested and waste surveyed, but seldom achieved full compliance with the plan due to variables beyond their control – weather, market shifts, change in harvest schedules, etc. When the plan is followed, MFR can allocate field time early on in the year. But since the plan was not always achieved, the general feeling among the MFR and licensees is that the plan provided marginal utility to the MFR in scheduling activities. As a result, the waste manual was amended in April 1, 2009, and the requirement for completing an annual plan was removed.

Finding

- Annual plans were created using the waste system; however, the utility of the annual plan was questionable and has been removed from the waste manual.

Field Procedures

The waste manual provides flexibility in how waste assessments are conducted. This flexibility is important to ensure that a reasonable level of accuracy is achieved and the costs incurred by industry and the MFR are reflective of the revenue risk to the Crown. Throughout the investigation, licensees demonstrated that the costs of conducting waste surveys often outweigh the revenue associated with the waste billing. This was particularly evident in the interior, where waste volumes are near the benchmark volumes and where stumpage is low (less than \$1.00 per cubic metre). It would be beneficial if a more cost effective way of establishing a reasonable estimate of waste was developed when revenue risk is minimal.

Dispersed Assessments

From 2005 to 2008,⁹ dispersed waste accounted for 52 percent (CFR–65 percent, NIFR–41 percent and SIFR–35 percent) of the avoidable sawlog waste volumes. There are three primary



Dispersed waste in the Kalum Forest District.

assessment options available for completing dispersed waste surveys: cutblock option or full survey intensity (FSI), aggregate option and ocular option (refer to Table 2 for a summary of the waste surveys for each region). The cutblock option requires that each cutblock be sampled in accordance with a specific number of plots to meet a sampling objective. In the aggregate option blocks are grouped according to whether they are old growth, second-growth or helicopter-logged, with the number of plots based on the total area of the blocks in the grouping. Plots for the cutblock and aggregate option are located using grid spacing with a random starting point to avoid bias. There are no standards for completing ocular estimates; however, two conditions should exist before ocular estimates are used:

1. waste volumes are below the allowable waste benchmark volumes, and
2. revenue risk is minimal.

In addition to the three assessment options, there are two alternative methods, the reduced sampling intensity (RSI) and the block exemption where parent blocks¹⁰ are used.

The RSI can be used instead of the FSI where the district manager agrees that there is a high probability that the amount of avoidable waste is below the waste benchmarks and that a reduced sampling will provide a reasonable estimate. When using the RSI option, the number of plots required is one-quarter the number required for FSI.

⁹ Report generated from waste system.

¹⁰ A previously surveyed block that is representative, in terms of the level of dispersed waste, to the block being proposed for survey exemption.

Table 2. Summary of number of blocks surveyed and check surveyed July 2007 - December 2008

Survey Option	CFR # of Blocks	CFR # & (%) of Blocks Checked	NIFR # of Blocks	NIFR # & (%) of Blocks Checked	SIFR # of Blocks	SIFR # & (%) of Blocks Checked	Total # of Blocks	Total # & (%) of Blocks Checked
Aggregate	3,133	189 (6%)	112	21 (19%)	54	0 (0%)	3,299	210 (6%)
Block	623	105 (17%)	490	18 (4%)	33	9 (27%)	1,146	132 (12%)
Ocular	244	60 (25%)	4,089	680 (17%)	10,279	1,072 (10%)	14,612	1,812 (12%)
Total	4,000	354 (9%)	4,691	719 (15%)	10,366	1,081 (10%)	19,057	2,154 (11%)

Source: Waste System

Parent blocks can be used where it is not practical to measure every block. Examples include road right-of-ways, salvage blocks and blocks less than 20 hectares which are similar to other blocks. The district manager needs to approve the application and it must be verified that the blocks included have similar levels of waste in order for parent blocks to be used. Plots are put into random blocks and the results are applied to other blocks in the aggregate.

The investigation reviewed nine licensee and BCTS operations in the CFR. Four used only the cutblock option, three used a combination of cutblock and aggregate options, and two used a combination of cutblock, aggregate and ocular options. In the past, the ocular option was rarely used in the CFR; however, use of ocular estimates is becoming more common on second-growth blocks. Generally, these have lower levels of waste since most are on gentler ground, have less decay and breakage and greater utilization.

The ocular estimates option was developed to reduce surveying costs and administrative time and still provide a reasonable estimate of waste volumes. In order for ocular estimates to be used, the estimated waste volumes are expected to be below the benchmark, be reasonably estimated and revenue risk must be minimal.

The waste system indicated 19,057 surveys were completed throughout the province in the 2005 to 2008 period, of which 14,621, or 70 percent, were ocular estimates. The interior forest regions accounted for 98 percent of the ocular estimates. Although 70 percent of all surveys completed were ocular estimates, they only accounted for 44 percent of the waste volume and 26 percent of the billed value.¹¹ The average avoidable sawlog waste volume associated with ocular estimates is 5.9 metres cubed per hectare and the total avoidable and unavoidable for all grades is 8.2 metres cubed per hectare (Table 3). In contrast, the average avoidable sawlog volume for aggregate and block survey was 62.2 metres cubed per hectare and 35.0 metres cubed per

¹¹ Report generated from the Waste System.

hectare respectively. The lower volumes associated with ocular estimates reflect that this method is used primarily in the interior regions and that waste volumes are below the waste benchmarks.

Table 3. Average waste volumes by survey type

Survey Type	Avoidable Sawlog	Avoidable Grade Y/4	Total Unavoidable All Grades	Total Avoidable and Unavoidable Waste All Grades
	(m3/ha)	(m3/ha)	(m3/ha)	(m3/ha)
Aggregate	62.2	22.7	11.8	96.7
Block	35.0	10.4	4.2	49.6
Ocular	5.9	2.0	0.3	8.2

Source: Waste System

There are no standard procedures for conducting ocular estimates. Each district or licensee had a process for completing ocular estimates but the investigation found there was little consistency on the process between districts. All 11 licensees reviewed in the interior used some level of objective survey coupled with a walkthrough and previous experience. The methodology ranged from running transects and measuring every piece on five metres each side, to walking the block and putting measure plots in representative areas. There was a good working relationship between the licensee and the MFR individuals doing the check surveys. This has allowed ocular standards to be developed within districts, which is advantageous since both MFR and licensees are completing ocular estimates and check surveys to the same standard. Regardless, it may be in the best interest of all parties for MFR to develop minimum standards, without increasing costs, for completing ocular estimates.

Accumulation Assessments

Accumulations include roadside, cable and ground skidding landing piles. Accumulations account for 48 percent of the avoidable waste volumes provincially (35 percent of the CFR, 59 percent of the NIFR and 65 percent of the SIFR waste volumes). Accumulations are much more difficult to measure accurately than dispersed waste. Dispersed waste volumes are highly visible and the surveyor can see most or all of the pieces being measured. On the other hand, the three dimensional nature of the accumulations, combined with safety issues associated with working around piles of logs, results in the majority of the volume not being visible.

As with dispersed ocular estimates, there is no standardized way of measuring accumulations and, as a result, there is no consistency between regions or districts on which method is used. The basic method for estimating waste volumes in accumulations is to measure the visible volume and apply a measure factor to the volume that cannot be seen. This factor is subjective and relies heavily on the experience of the surveyor gained through conducting waste surveys. Consequently, this is the main area of disagreement between the waste surveyor and the check surveyor. Disagreements are usually resolved by discussing issues on site. However, the Board thinks that the MFR should conduct periodic detailed measurements of waste accumulations to calibrate measure factors.



Accumulation in the Prince George Forest District.

Finding

- Dispersed and accumulation assessments are being done in accordance with the waste manual.
- Measuring dispersed waste volumes is more objective than measuring volumes in accumulations, since most of the pieces are readily visible and easily measured.
- There is no consistent method being used for ocular estimates or measuring accumulations. In order to accurately measure accumulations, the piles would have to be pulled apart and individual pieces measured. This is cost prohibitive on a broad scale, but may be a worthwhile if done periodically to allow calibration of the measure factor.
- The cost of completing waste surveys can be greater than the revenue received by the Crown.

Timelines

Waste assessment field work must be done within 60 days after primary logging has been completed on the cutblock or within 60 days of the cutting authority expiring or being terminated. If snow prohibits conducting the survey, then the survey must be completed once the cutblock is snow-free.

Forty-two percent of licensee and BCTS staff interviewed said they always meet the timeline for completion of the field work. Sixty-four percent said they met it most of the time and only four

percent said they never meet the timeline. Reasons cited for not meeting the timeline include budgetary/manpower constraints, efficiencies of resource allocation and revenue risk.

Interviewees indicated that the lack of manpower is a result of the current economic situation facing the industry. Waste surveys are a lower priority than many other operational requirements, so manpower is allocated elsewhere. In addition, waste survey field work often overlaps with the field season when other operational work has to be completed. As a result, the surveys were sometimes deferred until they could fit around other operational activities.

Licenses also cited consolidating surveys to increase efficiencies as another reason for missing the deadlines. Most licenses use consultants to complete the field surveys and a portion of the consultants' cost is associated with travel time. In order to reduce travel time, licenses tended to group blocks in the same geographic area. This happens more on the coast, where areas are accessed by boat or helicopter and access costs are much higher. Grouping blocks can result in situations where logging on some blocks may be finished before other blocks in the area are harvested, and by the time the last block is logged, the 60-day period has elapsed on some blocks.

The definition of primary logging can also impact on meeting the timelines. The manual defines primary logging as the date on which the yarding of all the timber that is cut is completed. In some situations, yarding is completed but hauling has been deferred. Since the block cannot be properly surveyed until all material has been hauled this situation can result in not meeting the 60-day timeline.

The timeline for reporting waste surveys is 30 days from completion of the survey. Licenses and BCTS said they reported within 30 days of completing the surveys 36 percent of the time, while 64 percent indicated that they reported within 30 days most of the time. The reasons for not meeting the reporting timeline are primarily associated with workloads of the individuals completing the survey. Some consultants used handheld units for recording waste survey data. When these devices are used, the data can be quickly and efficiently uploaded into the waste system. However, when handheld units were not used, inputting data was often described as cumbersome and time-consuming.

There are issues with late submissions, including degradation of the wood material and the inability to conduct check surveys (see next section for details). First, if waste and check surveys are left too long there may be more checking (cracking) of the logs. An inexperienced waste surveyor or check surveyor may not recognize that the checking of the logs came after the logs were on the ground. This may downgrade the material and reduce the waste bill and revenue to the Crown. However, most of the surveyors felt that this was something that could be overcome with experience and training.

The second issue around late submissions is related to MFR's ability to conduct check surveys. If waste surveys are pushed towards the end of field season, it may result in a disproportionate

number of waste surveys being submitted in the fall when snowfall will inhibit the ability to conduct a check survey. In these instances, it becomes difficult for MFR to do check surveys in a timely manner. As with licensees, MFR has a limited budget to contract out check surveys and must prioritize workloads. Altering their field schedule to ensure a check survey is conducted creates additional cost to MFR and may create scheduling problems elsewhere.

In some instances MFR, defers the check survey until the following year when the block becomes snow free. However, pressure is often put on MFR to approve the waste survey without conducting a check survey. Examples include blocks scheduled for hazard abatement the year of the survey or BCTS blocks where the licensee cannot obtain their security deposit until the waste survey is check surveyed and approved. If MFR forces the licensee to defer burning until the check survey is completed, it places additional risk on the licensee and MFR in terms of potential liability should a fire occur. Delaying the release of that portion of the security deposit specific to the cost of completing a survey may place financial hardship on the licensee. On the other hand, approving a waste survey without conducting a check survey increases the revenue risk to the Crown.

Findings

- Surveys were not consistently completed or reported in accordance with the timeline requirements in the waste manual.

Check Surveys

Waste surveys completed by licensees and BCTS are checked by MFR personnel. The purpose of the check survey is to verify that waste surveys are done in accordance to the waste manual and the volume estimates are reasonable. The waste manual requires a minimum of 10 percent of the areas surveyed under the cutblock option, aggregate option and ocular estimates are check surveyed. A similar sampling intensity is also used for cruising and weigh-scaling and has been deemed acceptable by MFR.

MFR check surveyors were concerned about the lack of any formal notification process when logging or waste surveys are completed. The licensee only has to notify MFR when harvesting operations have started. They do not need to notify MFR when harvesting is complete, other than on an annual basis. As a result, there is nothing to trigger when the timeline starts for conducting surveys and reporting the results. This makes it difficult for MFR to schedule their check surveys and creates inefficiencies in MFR staff's ability to carry out their responsibilities.

If the timelines are not met, the district manager has the ability to conduct the waste survey and may require the licensee to pay the costs incurred. This opportunity was seldom pursued. Generally, interviewees felt that it would be more productive if licensees and BCTS work with MFR to improve communication. It is not unreasonable to expect that a process be established whereby MFR is notified when logging has been completed. The procedure should be developed by MFR and options include informal discussions between the MFR and licensees,

notification by compliance and enforcement (C&E) staff, or linking the WS with another government tracking program (i.e., the forest tenure administration system). Notification would allow MFR to schedule their time and check surveys in a more efficient manner.

MFR uses a risk-rating system to select blocks on which to conduct check surveys. Regions had developed a risk-rating template that was forwarded to the districts, but it was inconsistently applied. Some districts used the template with or without slight modifications (formal risk rating) and other districts relied on personal experience and local knowledge instead (informal risk rating). Formal risk rating included a number of variables such as tenure type, stumpage, surveyor, species composition, logging season and average tree diameter. Even so, the results of the risk rating can be overruled. Informal risk rating is likely as effective as the formal risk rating if the check surveyor has adequate knowledge and experience. However, with informal risk rating there is little documentation to verify the selection process, which may leave MFR open to criticism. It would benefit all parties if a standard risk rating system was developed and used at the regional level.

Between July 2007 and December 2008, the WS indicates that a total of 4,000 cutblocks were surveyed in the CFR, 4,691 in the NIFR and 10,366 in the SIFR (refer to Table 2). Overall, 9 percent of the blocks in the CFR, 15 percent in the NIFR and 10 percent in the SIFR were check surveyed, with a provincial average of 11 percent. However, for individual survey types, the 10 percent target in the waste manual was not met. For example, six percent of the aggregate surveys in the CFR were check surveyed, four percent of the block option in the NIFR were check surveyed (block option in the NIFR accounted for 10 percent of the total blocks surveyed) and no aggregate options in the SIFR were check surveyed (aggregate option in the SIFR accounted for less than one percent of the blocks surveyed).

In some instances, the region provided flexibility to the districts to reduce check survey intensity. This was seen as a reasonable approach by the Board and government should consider expanding this. For example, adjusting the number of check surveys based on risk ranking may result in a higher percentage of high risk blocks and a lower percentage of low risk blocks being checked. This may allow MFR to maintain the level of accuracy required and at the same time reduce costs.

There were few instances where MFR had disagreements with the licensee. Where this did occur, the issues were discussed and dealt with in a professional manner. Most disagreements surfaced around accumulation survey results, which account for approximately 48 percent of the waste volumes.

Findings

- The percent check surveys are being met on a provincial level but not by survey type at the regional or district level.
- Achievement of the 10 percent target is dependent upon a number of factors outside the control of the individual responsible for conducting the check surveys.
- The population selection varies across districts and is based on a formal and informal risk rating systems.

Qualifications of individuals completing waste surveys and check surveys

The waste manual requires that surveys be completed by a licensed scaler, licensed waste surveyor, registered professional forester (RPF) or registered forest technician (RFT). If the surveyor is an RPF or RFT, they need to have sufficient training and be knowledgeable or experienced enough to be competent in conducting the survey and are bound by a code of ethics.¹² The investigation reviewed the qualifications of the individuals based on their education, professional designation, and field experience. Input from district staff was also considered. The investigation found that the individuals completing the surveys were qualified and had been doing waste surveys for many years. All of the waste surveyors were a licensed scaler and/or a certified waste surveyor, or an RPF or RFT.

Most licensees and BCTS hired consultants to conduct waste surveys. However, budget constraints are resulting in the need to reduce the number of consultants, including waste surveyors. One company had moved all waste surveys in-house and brought their staff up to speed by conducting a week-long training program. The investigation felt that, in this instance, a reasonable effort was made to ensure staff was competent in conducting waste surveys. BCTS used to issue a contract to a third party to complete waste surveys on all blocks logged under the program. Timber sale licence (TSL) holders opposed this arrangement, since their security deposit was held up until the waste survey was completed and waste billing was paid. As a result, in September 2008, BCTS incorporated the requirement to conduct waste surveys into the licence document and the responsibility now rests with the TSL holder.

Training is available to become a licensed scaler in the Coastal and Interior Regions. Formal training is available to become a licensed waste surveyor on the coast; however, no program is available for the interior regions. This raised some concerns about staff who are starting to conduct waste or check surveys, but may not have not had any training with an experienced mentor.

¹² ABCFP Code of Ethics sec. 3.7.

Finding

- Waste surveyors and check surveyors appeared to be qualified and experienced for the intended purpose of waste surveys.
- There is no formal waste surveyor training in the Interior.

Overall Finding

In the Board's view, there is not a consistent approach in how ocular estimates, accumulation surveys, risk rating and check surveys are conducted. However, each region and district has developed a reasonable structural organization and procedures tailored to their specific situation, and waste surveyors and check surveyors appear to have the appropriate qualifications and experience required for the intended purpose of waste surveys. This suggests waste volumes are most likely accurately graded and reported.

Do ocular estimates provide a reasonable estimate of waste volumes?

The use of ocular estimates is an accepted method and was developed to reduce surveying costs and administrative time while still providing a reasonable estimate of waste volumes. In order for ocular estimates to be used, the estimated waste volumes must be below the benchmark, be reasonably estimated and revenue risk must be minimal. There are no standard procedures for conducting ocular estimates.

Each district or licensee had a process for completing ocular estimates, although there is little consistency on the process. The methodology ranged from running transects and measuring every piece within five metres on each side, to walking the block and putting measure plots in representative areas.

Finding

- The semi-objective measurement used when conducting ocular estimates, combined with MFR oversight through check surveys, the experience of the individuals involved with conducting and checking ocular estimates and the limited application of ocular estimates is a reasonable approach and will provide a reasonable estimate of waste volumes.

Is the MFR running analysis to see if there is a correlation between waste volumes and other variables?

The complainant recognized that there did not appear to be any trend between logging rate, stumpage, area logged and waste volumes and questioned whether MFR was making any effort to determine if such a correlation exists. The MFR's revenue branch indicated that these types of analysis were not conducted since waste levels are largely a function of economics, which are constantly changing.

Finding

- The MFR is not running analysis to correlate waste volumes with other variables. Wood waste is primarily a function of economic factors which constantly change and, as a result, correlations will change over time.

Is sampling adjusted to reflect increases or decreases in waste volumes?

The complainant found that the levels of waste varied across the province and felt that sampling should reflect the discrepancies in waste volume. This discrepancy is anticipated due to the variety of timber types, harvest systems, terrain conditions and changing economic factors.

MFR uses a risk-rating system to select which blocks to conduct check surveys on. Formal risk rating included a number of variables such as licensee, stumpage, surveyor, species composition, logging season and average tree diameter, while informal risk rating was based primarily on local knowledge and experience.

The waste manual does provide an escalating sampling intensity procedure that recognizes the levels of waste and risks. When the waste level of a cutblock is below the waste benchmark, the use of ocular estimate is allowed. If the waste benchmark is exceeded, the use of an ocular estimated is only allowed by the district manger when the revenue risk to the Crown is minimal. When the waste level of a cutblock exceeds the waste benchmark, the normal manual procedure is to put in plots with sampling intensity determined based on the sampling option (aggregate or cutblock) utilized. The plots are laid out on a systematic grid and the sampling must achieve the precision targets specified as per the manual plot tables. Thus, the waste survey intensity is predicated on the level of waste and increases as waste levels increase.

Finding

- Waste survey intensity increases as waste levels increase. Check surveys are not adjusted based solely on wood waste volumes, rather MFR uses a risk rating system to prioritize blocks to conduct check surveys on.

Conclusion

Are waste volumes being accurately graded and reported?

Yes. Although there is not a consistent approach in how ocular estimates, accumulation surveys, risk rating and check surveys are conducted, the investigation found that each region and district had developed a structural organization and procedures tailored to their specific situation. Waste volumes in accumulations appeared to pose the greatest risk with accuracy of data and an effort should be made to confirm measure factors. Timelines in the waste manual for conducting surveys and check surveys, and reporting results are not always met. The timelines themselves should be reviewed and the Board feels that improved communication between the licensee and MFR may improve compliance with timeline objectives.

Do ocular estimates provide a reasonable estimate of waste volumes?

Yes. Ocular estimates appear to be reasonable due to the semi-objective measurement combined with MFR oversight through check surveys and the experience of the individuals involved with conducting and checking ocular estimates. Flexibility for conducting ocular estimates is required to deal with the variations of timber profiles, harvest and silviculture systems, and topography across the province. However, at the district level, it may be beneficial to work towards consistent minimum standard for conducting ocular estimates.

Is the MFR is running analysis to see if there is a correlation between waste volumes and other variables?

No. The MFR is not running formal analysis to correlate waste volumes with other variables. This is because the variables change so much over time.

Is sampling adjusted to reflect increases or decreases in waste volumes?

Yes. Survey intensity is adjusted based on the level of waste and revenue risk; however, a risk ranking system is used to prioritize blocks for conducting check surveys on.

Appendix 1

History of Utilization Requirements

Wood waste is any timber that meets merchantability specifications,¹³ was not removed from the cutting authority area (i.e., road right-of-way, cutblock, etc.) and was not reserved from cutting (i.e., wildlife trees/patch, seed trees, etc.). Waste can be felled timber left on site or standing timber that was supposed to have been felled and removed. Waste can occur for a number of reasons. Some waste is physically obstructed or cannot be removed for safety reasons. This type of waste is categorized as ‘unavoidable’ and accounts for about eight percent of the waste volume. All other waste is classed as ‘avoidable’ and accounts for 92 percent of the waste volume.

In the late 1960s, timber harvesting policy provided for waste measurements, but only waste considered ‘flagrant’ was billed on a monetary basis. In 1987, the provincial Ombudsman commissioned a review of waste measurement procedures and utilization practices. The review resulted in the implementation of the coast and interior utilization policies in the early 1990s, which prescribed the minimum cutting specifications, log grade utilization and cut control requirements.

The *Residue and Waste Measurement Procedures Manual* was released and approved for use in the entire province in 1991. Until the end of 1998, the province had a zero waste policy (mandatory utilization of all merchantable timber). Under this policy, all logs that were sawlog grade and physically possible to be removed were required to be utilized by the licensees. If they were not utilized and left on the cutblock, these logs were classified and billed as waste.

In 1999, waste benchmarks were established to allow a volume of waste to be left without being monetarily billed. The concept was that licensees would recover logs to their economic margins. Another purpose of the waste benchmarks was to accommodate coarse woody debris, which is important in the biological, nutrient and organic matter dynamics of forest ecosystems. The benchmarks were set as a starting point to recognize that zero waste was not a sound ecological policy and economics was not served by compelling licensees to remove every log.

In the spring of 2003, the government announced the Forestry Revitalization Plan and brought forward legislation to reform forest policy. Waste policy was changed at this time to allow market forces to drive business decisions. A significant change was the elimination of the mandatory species and log grade utilization (cut and remove) requirements. This enables licensees to extract any logs of value to them within the cutting authority areas, subject to the *Forest and Range Practices Act* (FRPA) and the required forest management standards. Licensees must pay stumpage on timber removed and scaled, and waste assessments on timber, whether standing or felled, that was not removed from the cutting authority area. This is referred to as the “take or pay” policy.

¹³ Tables 1.1 and 1.2 of the *Provincial Logging Residue and Waste Measurement Procedures Manual*.

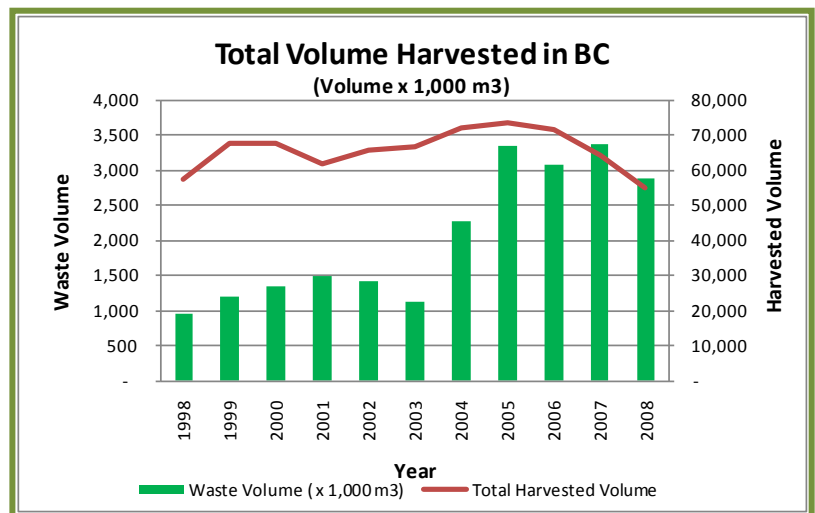
Appendix 2

Factors Affecting Volume of Wood Waste

Waste can occur for a number of reasons. Some waste is physically obstructed or cannot be removed for safety reasons. This type of waste is categorized as unavoidable and accounts for about eight percent of the waste volume. All other waste is classed as avoidable and accounts for 92 percent of the waste volume.

Economic variables are the main factors affecting the amount of avoidable wood waste. If the cost of production (stumpage, falling, yarding, transportation and milling) is less than the price being paid for the lumber and chips then a company will make a profit and the timber will be utilized. If the cost of production is greater than the price paid for the lumber and chips then it is unlikely that all the timber will be utilized. Since about 2003, several economic trends emerged which affected the forestry sector.

- In 2003, the Canadian dollar began its upward trend. This made lumber more expensive in our largest market, the USA. As a result the demand for BC lumber began to fall.
- In 2005, the housing market in USA began its downward slide, which continued into 2009. This brought about further downward pressure on the demand for lumber from BC.
- The selling price for lumber in the USA followed the housing decline and began a downward trend in 2005. This made BC lumber more expensive than lumber produced in the USA and, because of the low price, BC lumber was also subject to a duty under the softwood lumber agreement.
- Beginning in 2002, pulp prices began a steady increase, which has resulted in a sustained demand for chips.



Source: Harvest Billing System

Graph 2. Annual wood waste compared to harvest levels across BC.

The net result was a continual decline in the demand and price of lumber and the profitability of the forestry sector. As the markets and demand for forest products change the forestry sector has to adjust. During economic downturns there will be a decrease in utilization of timber as companies try to reduce costs and increase revenues. Cost reductions can be achieved in part by decreasing logging and milling costs, increasing production without increasing cost, and focusing on higher quality timber that will provide a positive return. In the 2004 to 2008 period, the economic trends resulted in a decrease in harvested volume and an increase in waste volume (Graph 2). Conversely, as markets improve, there will be an increase in timber utilization.

Most stands harvested are a mixture of species, quality and size of timber. Due to this diversity, there will be timber for which there may not be a market demand for certain species or dimensions for the lumber being produced, or the cost of production is greater than the revenue from the end product. This will affect which species or size of logs that can be economically utilized. When this occurs there are a number of options a company can pursue. One option is to shut down operations until there is a profitable market for the entire stand. A second option is for the company to manufacture the volume and build up an inventory for those products it cannot sell. However, in an economic downturn, companies have limited ability to manufacture and carry an inventory they cannot sell. Another option is to sell the logs it cannot utilize to specialty mills, pulp mills or pellet plants. This is viable if the price being paid by the mills is greater than the cost of production. A final option is to leave material, which cannot be manufactured at a profit or for which there is no market, on site. This material contributes to wood waste.

Appendix 3

Factors Affecting Utilization of Wood Waste

Utilization of wood waste requires a market driven demand with no subsidies in order to be compliant with the Softwood Lumber Agreement (SLA). If a market demand for wood waste exists, utilization is dependent upon available volume, distance to the processing plant, physical condition of the material and price.

Sufficient volumes of wood waste are required to make it viable to expend the capital necessary to obtain the material. If a geographic area has little volume of accessible wood waste it may be uneconomical to move equipment in and process the waste. As volume within a geographic area increases, the economic viability of utilizing the waste improves.

Proximity to the processing facility also affects costs. Chipping and grinding operations of wood waste accumulations in BC have indicated that they can be viable if they are within 100 kilometres or a six-hour cycle time from the processing plant. This will increase or decrease depending on variable costs (i.e., price of gasoline), fixed costs and the price the purchaser is willing to pay. The physical properties of the wood waste also need to be taken into account. For example, final moisture content of pellets is about 5 percent and hog fuel about 20 percent. If the wood waste has high moisture content, then the cost of reducing the moisture content to desired levels along with transportation and processing costs may outweigh the value of the final product. In the interior, when dealing with dead pine, the moisture content is relatively low so there is less energy required to reduce the moisture content to acceptable levels. On the coast, hemlock may typically have a moisture content of 60 percent or more so the cost of drying becomes much more expensive.

As economics change, the volume and composition of wood waste will also change. With an economic downturn in the forest sector, adjustments will be made by companies which may result in an increased level of wood waste. Similarly, as market increase and demand increases we can anticipate a decrease in wood waste.

Currently there are a number of demands for wood waste, primarily chips and hog fuel. With the downturn in the sawmill industry, the supply of chips and hog fuel from sawmills has decreased while the demand for chips increased and hog fuel has remained relatively constant. When pulp mills were first established, most chips came from whole log chippers at the pulp mill. Over time the chip supply, and eventually hog fuel, could be met more cheaply by purchasing directly from sawmills. With the reduction in sawmill production, the demand for chips and hog fuel must be supplemented from sources other than sawmills. This has led to many mills installing whole log chippers to allow the mills to purchase logs and chips or grind at the mill site. It has also resulted in an increase in utilization of wood waste.

Wood waste that is utilized is processed on site or moved to a facility where it will be processed. Both methods are used in the province although the most common is to process on site. The advantage being that the material is handled only once and only the material to be utilized is transported.



Grinding operation near Prince George.



Chipping and grinding operation at Beaver Cove near Port McNeil.

Existing and new demand for wood waste will continue to increase as sawmill production continues to decline and constraints on the land base increase. One new demand is bioenergy or utilizing wood for generating electricity. This initiative is being led by MFR in collaboration with BC Hydro. Bioenergy tenures target dead lodgepole pine stands and would be for a 20-year term, with the AAC being determined by the size of the facility being proposed. If bioenergy tenures are issued, the utilization of material on site will be greater than under a sawmill economy since the tenures are primarily concerned with biomass, not whether the timber can be utilized as sawlog or chipped for pulp.

Utilization of wood waste will also be affected by the draft chief forester's directive concerning coarse woody debris (CWD). This directive will encourage licensees and BCTS operators to leave the wood waste dispersed throughout the setting, rather than yard it to the roadside. This will have a positive ecological effect but will reduce the volume of wood waste in accumulations and readily available for third parties to access.

BCTS is also issuing innovative timber sales (ITS). These timber sales are sold based on the cruise volume only. The successful applicant will pay a lump sum stumpage for the cruised volume rather than the scaled volume. The licensee then has the opportunity to market the timber in the best way possible. The results on wood utilization will be market driven, ranging from utilizing only the best wood to complete utilization of all wood volume. This type of sale removes the revenue risk associated with wood waste, but the impact it will have on wood waste volume is unknown at this time. Although the demand for wood waste is increasing, there are administrative issues affecting the ability of third parties to access the wood waste. Tenure holders are responsible for any liability associated with the wood waste. Consequently many accumulations were burnt to reduce the fire hazard. If a third party wanted to use the wood waste, they would have to make an agreement with the tenure holder. This was an issue since the tenure holder still held the liability if anything went wrong. The government is addressing this issue and has presented Bill 31 (*Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act, 2008*)¹⁴ which will make wood waste available to third parties.

¹⁴ Bill 31 can be found at <http://www.leg.bc.ca/38th4th/1st_read/gov31-1.htm>.

Appendix 4

Wood Waste and Other Forest Values

Coarse Woody Debris

The term “wood waste” is misleading when considered in an ecological context, since most post-harvest wood volume provides valuable functions as coarse woody debris (CWD). CWD refers to large dead and down woody material (greater than 7.5 cm in diameter) at various stages of decomposition, located above the soil, and not self-supporting (live and dead trees as well as stumps are considered self-supporting).¹⁵ CWD plays a major role in the ecology of a healthy forest in natural and managed stands and yet is one of the least managed resources. It sustains forest ecosystem productivity, provides habitat and food, helps maintain soil stability and stores carbon.

CWD helps to maintain forest ecosystem productivity by providing organic matter, increasing soil moisture holding capacity, introducing nutrients and providing regeneration sites for some conifers. CWD is a long-term source of nutrients and an important source of organic matter for the soil which increases the soil’s moisture-holding capacity. In some areas, tree seedling germination is dependent on decaying wood, particularly on drier sites.

Many species of birds, mammals and reptiles use CWD for nesting, roosting, foraging and shelter. CWD provides hiding cover for predators, security cover for prey and travel ways for small mammals which are an integral part of the ecology. CWD also provides food for specialized feeders such as beetles, fungi and bacteria.

CWD stabilizes the forest by helping to preserve slope and surface stability. It helps control and disseminate water and soil movement, thereby preventing soil erosion during spring snowmelt and heavy rainfall events, particularly on steeper slopes. As a carbon store, CWD is important if it releases the carbon slower than would occur in other processes. For example, in ecosystems with natural disturbance regimes characterized by frequent catastrophic events, especially wildfire, carbon will be released more quickly than in forests with infrequent natural disturbances.

Natural levels of CWD have been determined for various biogeoclimatic zones throughout the province. Feller (2003)¹⁶ found that natural levels in old-growth forest ecosystems ranged from 31 cubic metres per hectare in the Boreal White and Black Spruce zone to 750 cubic metres per hectare in the Coastal Western Hemlock zone. Others have found from 1.37 cubic metres per hectare in the Sub Boreal Spruce zone up to 1,788 cubic metres per hectare in the Coastal Western Hemlock zone (Stevens 1997). Harvesting and forest management activities modify the

¹⁵ Standard for Terrestrial Ecosystem Mapping in British Columbia, <http://www.ilmb.gov.bc.ca/risc/pubs/teecolo/tem/tem_man.pdf>.

¹⁶ Feller, M.C., “Coarse woody debris in the old-growth forests of British Columbia,” *Environmental Review*, 2003, 11: 135-157.

quantity, quality and spatial distribution of CWD. Densmore et al. (2004)¹⁷ indicated that harvesting provides a periodic input of CWD at volumes significantly less than would occur through natural disturbances. The lower levels in managed stands are expected, since natural levels of CWD are associated with old-growth forests which have large piece size and a continual input into CWD stores. Harvesting, on the other hand, may utilize some of the existing CWD where much of the harvesting is in second-growth stands, which have less decay, a greater proportion of utilizable volume and, in many instances there is no recruitment of CWD over time.

BEC ¹ Zone	# Subzones Studied	Range of CWD (m3/ha) ¹⁸	BEC Zone	# Subzones Studied	Range of CWD (m3/ha)	BEC Zone	# Subzones Studied	Range of CWD (m3/ha)
BWBS	5	31 – 59	ICH	8	115 – 407	MS	5	102 – 351
CWH	9	119 - 750	IDF	8	51 – 332	SBPS	1	105
ESSF	7	74 – 243	MH	3	140	SBS	6	26 - 151

¹Biogeoclimatic (Source: Feller, 2003)

The volume of CWD that is required to maintain a healthy ecosystem has not been specifically identified, but is more than the legislated requirements in the *Forest Planning and Practices Regulation* (FPPR).¹⁹ Stevens (1997) suggests that natural levels are a reasonable target, however, this may not be achievable in managed stands. Densmore et al. (2004) showed that research in Europe found that decreasing the volume of deadwood to less than 30 percent of that present in natural stands is correlated with increasing numbers of deadwood-dependent species being classified as threatened. In Europe, the inappropriate management of CWD has resulted in critically low levels, threatening the survival of many forest dwelling species and biodiversity loss.

The quality of wood waste in terms of species, size and distribution also has an impact on CWD benefits. Different species and size combinations have different decay rates which help to spread the utility of CWD over a longer time. Different sizes also provide a variety of habitats and connectivity for small mammals. In a natural stands, CWD is dispersed throughout the stand whereas in managed stands a significant volume (36 percent in the 2005 to 2008 period) of CWD in the form of wood waste associated with harvesting is found in accumulations, which have less ecological value than dispersed wood waste.

¹⁷ Densmore, N., J. Parminter, and V. Stevens, "Coarse woody debris: Inventory, decay modeling, and management implications in three biogeoclimatic zones," *BC Journal of Ecosystems and Management*, 2004, 5(2):14–29, <www.forrex.org/jem/2004/vol5/no2/art3.pdf>.

¹⁸ Some CWD levels are reported as kilograms per square metre.

¹⁹ Section 68 of the FPPR specifies the minimum CWD requirements. On the Coast it is a minimum of 4 logs per hectare, each being 5 metres in length and 30 centimetres in diameter at one end (1.8 cubic metres per hectare); and in the Interior it is a minimum of 4 logs per hectare, each being a minimum of 2 metres in length and 7.5 centimetres in diameter at one end (0.02 cubic metres per hectare).

Silviculture, Fire and Range

Zielke and Bancroft (2006)²⁰ completed a study on the impacts of harvest residue on four forest districts in BC. They found that, with the exception of some coastal helicopter operations, the impacts of wood waste on silviculture and fire management were minimal. The impact on areas with high levels of wood waste was primarily related to silviculture. On these sites, the minimum inter-tree distance for regeneration was pushed, which led to clumpy distribution of regeneration. They did feel that natural regeneration would fill in over time. They also found that control over species distribution was not as great on sites with heavy slash loading. The report also found that, in general, the impact of wood waste on fire risk, range and wildlife was not significant, although there may be situations where wood waste levels do adversely affect a forest value. This was confirmed through the interviews with MFR and licensee staff.

²⁰ Symmetree Consulting Group, *Harvesting Residue and Forest Stewardship*, prepared for the Ministry of Forests and Range, 2007.