T I M B E R P R I C I N G B R A N C H

Provincial Logging Residue and Waste Measurement Procedures Manual
Interior Procedures

Effective: April 1, 2019

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1. Introduction

In British Columbia, the right to harvest Crown timber is conferred through the form of Agreements under the *Forest Act*. The *Forest Act* and subsequent Agreements require licensees to carry out waste and residue assessments.

Waste assessments are carried out to quantify the volumes of waste and residue remaining on harvested areas following the completion of harvesting operations. The waste volume data compiled from the assessments are used to invoice licensees for monetary and cut control charges.

This manual outlines the administration and field measurement procedures to be used in the assessments and is intended to serve as the reference for industry and government staff who conduct or check waste assessments in British Columbia.

1.1 Application

The manual is applicable to waste assessments located in the North Area, South Area, and Manning Park other than those:

i. required under a Community Forest Agreement,

ii. required under a Woodlot Licence, or

iii. that will be submitted using the Pre Harvest Waste Assessment method prior to June 30, 2019.

1.2 Scale Based

Where the amount of stumpage payable on the timber harvested from a cutting authority is calculated using the information reported in a scale of the timber, the holder of the agreement must conduct a waste assessment on that cutting authority.

1.3 Cruise Based

Where the amount of stumpage payable on the timber harvested from a cutting authority is calculated using the information reported in a cruise of the timber, the holder of the agreement is not required to conduct a waste assessment on that cutting authority.

1.4 Responsibility

The responsibilities are as follows:

1.4.1 Timber Pricing Branch

1.4.1.1 Director, Timber Pricing Branch

The Director, Timber Pricing Branch is responsible for:

1. Approving *Provincial Logging Residue and Waste Measurement Procedures Manual* and amendments.
2. Processing and maintaining waste data.
3. Billing licensees by issuing waste invoices.

1.4.1.2 Residue and Log Salvage Policy Forester, Timber Pricing Branch

The Residue and Log Salvage Policy Forester is responsible for:

1. Developing and maintaining standards and procedures for determining and reporting waste.
2. Providing training and technical support.
3. Providing policy interpretation to industry and ministry staff.
4. Maintaining software compilation programs and standards.
5. Conducting technical reviews of Forest Regions and Forest Districts for policy and procedure compliance.

1.4.2 Regional Manager

The Regional Manager is responsible for:

1. Ensuring that district staff adhere to policy and procedures, and where necessary, provide training to district staff.
2. Recommending survey procedure changes where necessary, to the Director, Timber Pricing Branch.
3. Advising industry and forest district staff on matters relating to waste assessments.
4. Processing waste reports and FS 702 for waste monetary billing and cut control where required.
5. Providing Waste System guidance and training to district staff and industry users.

1.4.3 District Manager

The District Manager is responsible for:

1. Conducting check surveys in accordance with manual standards.
2. Implementing and administering the policy and procedures, and recommending survey procedure changes where necessary to the Regional Manager.
3. Approving waste assessment plans and issuing reporting unit numbers.
4. Checking for completeness of licensees' submitted reports.
5. Processing waste reports and FS 702 for waste monetary billing and cut control where required.

1.4.4 Timber Sales Manager

Unless otherwise specified in the agreement, the Timber Sales Manager is responsible for:

1. Ensuring BCTS Licensees submit waste assessments in accordance with licence
2. agreements, Waste Policy and the *Provincial Logging Waste Measurement Procedures Manual*.
3. Where a BCTS licensee does not submit a waste assessment as required under 1.5.4(1) the timber sales manager may carry out the assessment, and in a notice given to the holder, may require the holder to pay the costs incurred by the timber sales manager in carrying out the assessment.

1.4.5 Licensees

Holders of a Major Licence, and Road Permits are responsible for conducting waste assessments on their scale based cutting authorities.

The licensees are responsible for:

1. Submitting annual waste assessment plans.
2. Conducting waste assessments in accordance with this manual.
3. Submitting waste field data into the online Waste System.

Where the above-mentioned work is performed by a contractor or a sub-contractor, it is the licensee's responsibility for ensuring that the work is carried out in compliance with Ministry standards and requirements.

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2. Administration

2.1 Waste Assessment Objective

Waste assessments are conducted to obtain an unbiased estimate of the volume and quality of timber on a cutblock whether standing or felled, that meets or exceeds the timber merchantability specifications described in Table 2-2 which was not removed from the cutting authority area and was not reserved from cutting.

2.2 Authority

The right to harvest Crown timber is granted in the form of Agreements under the *Forest Act*.

Waste assessments are carried out under the authority of:

1. The *Forest Act* section 103.1,
2. Agreements and cutting authority documents, and
3. The *Provincial Logging Residue and Waste Measurement Procedures Manual*.

The licensee has the discretion of whether or not to harvest the timber from the agreement area subject to the forest management standards required.

Under the *Forest Act* and the Agreements, the licensee must pay a waste assessment for timber not harvested.

2.3 Complete and Accurate Information

In accordance with section 105.1 (3) of the *Forest Act*, the licensee must ensure that any information that is submitted to the government for the purposes of a waste assessment or check survey is complete and accurate at the time the information is submitted.

2.4 Measurement and Billing Overview

Waste volumes are measured and billed monetarily in accordance with the following table.

Table 2-1 The Disposition of Residue and Waste Volumes in Monetary Billing

Table Effective April 1, 2019 (Valid for all Species)							
		Avoidable			Unavoidable		
Waste Type	GRADE	Measure / Record	Rate	AAC	Measure / Record	Rate	AAC
Sawlog	1 and 2	Yes	Full $*	Yes	Yes	$0.00	Yes
Lumber Reject	4	Yes	$0.25	Yes	Yes	$0.00	Yes
Dead Dry Lumber Reject	Dry 4	Yes	$0.25	Yes	Yes	$0.00	Yes
Undersize	6	Optional	$0.00	No	Optional	$0.00	No
Firmwood Reject	Z	Optional	$0.00	No	Optional	$0.00	No

*Full $ Waste Rate ($/m^3) from section 2.6.2
AAC Volume contribute to Cut Control

2.5 Timber Merchantability Specifications

Timber merchantability specifications are based on the determination of maturity in a timber cruise of the cutblock and are further refined by species.

All species except Lodgepole pine are assessed if the stump diameter exceeds 20cm (outside bark) at 30cm stump height, Lodgepole pine is assessed if the stump diameter exceeds 15cm (outside bark) at 30cm stump height. All species except Red Cedar are assessed if the top diameter exceeds 10cm (inside bark).

Table 2-2 Timber Merchantability Specifications

Description		**All Stands**
Stumps**		
●	no higher than	30 cm
Diameter (outside bark) at stump height		
●	Lodgepole pine: all timber that meets or exceeds	15 cm
●	All other species: all timber that meets or exceeds	20 cm
Top diameter (inside bark or slab thickness)		
●	For all species and ages, except Cedar older than 141 years, all timber that meets or exceeds	10 cm
●	For Cedar older than 141 years	15 cm
Minimum length		
●	log or slab	3 m
**	Measured on the side of the stump adjacent to the highest ground.	

2.6 Waste Monetary Billing

2.6.1 Waste Amount Payable

For merchantable Crown timber that is not cut and removed, the amount payable is calculated by multiplying the volumes of avoidable waste reported in a waste assessment after deducting the waste benchmark volume allowed under 2.7.5, by the applicable waste rates specified in 2.6.2

Unavoidable waste volumes will not result in amounts payable but will be included in the harvested volume for cut control purposes when applicable in accordance with the *Forest Act*.

2.6.2 Waste Rate

The applicable waste rate will be determined as follows:

1) Coniferous species graded:
    1) Grade 1 and 2 – The total billed sawlog stumpage rate for one year multiplied by the WMRF, and
    2) Grade 4 – the rates established in the *Interior Appraisal Manual*.
2) Deciduous species graded:
    1) sawlog - the fixed rate for the species as specified in the *Interior Appraisal Manual*, plus any bonus and levies where applicable, and
    2) other than sawlog: the fixed rate in the *Interior Appraisal Manual*.

The applicable rates charged will include any bonus bids and levies as applicable.

2.6.3 Total Billed Sawlog Stumpage Rate for One Year

The calculation of the total billed sawlog stumpage rate for one year to be used in the calculation of the waste rate is dependent on whether there has been timber harvesting on a cutting authority. If timber has been harvested on a cutting authority, then the stumpage rate is determined and applied on a cutblock basis.

2.7 Cutblocks With Harvesting

For cutblocks with harvesting, the conifer stumpage rate is calculated for the cutblock using the weighted average stumpage rate charged for the sawlogs (grade code 1 and 2) in invoices issued during the 12-month period ending one month after the ready for survey date on the cutblock area was completed. The formula to be used is:

$$\mathbf{WR=TS/TV}$$

Where:

WR=	Waste Rate for the cutting authority.
TS*=	Total billed sawlog stumpage (sum of Upset Stumpage*, and Bonus Bid) for the twelve-months prior to one month after the month the cutblock was ready for survey.
TV*=	Total billed volume (accumulated volume in cubic metres that derived the total billed stumpage for the sawlogs) for the twelve-months prior to one month after the month the cutblock was ready for survey.
*Include silviculture and development levies	

2.7.1 Cutblocks with No Harvesting but Harvesting has Occurred on the Cutting Authority

If there has been no harvesting on the cutblock but there has been harvesting for the cutting authority, then the conifer stumpage rate for the cutblock is derived using the average of the cutting authority's four quarterly timber appraisal stumpage rate (plus any bonus and levies where applicable) in effect during the twelve-months preceding the date of cutting authority's expiry, surrender, termination or cancellation, as the case may be. The formula to be used is:

$$\mathbf{WR = ACASR}$$

Where:

WR=	Waste Rate for the cutblock
ACASR=	Average Cutting Authority Stumpage Rate over the four quarters preceding the expiry, surrender, termination or cancellation date.

Example 1
If Cutting Authority A (CP A) became effective on September 5, 2017, and expires on September 4, 2018, then the ACASR is the simple average of the four quarterly stumpage rates for CP A from October 1, 2017, January 1, 2018, April 1, 2018 to July 1, 2018.

Example 2
If Cutting Authority B (CP B) became effective on April 20, 2016, and is surrendered on September 5, 2016, then the ACASR is the simple average of the April 20, 2016 and July 1, 2016 stumpage rates for CP B.

2.7.2 Cutblocks with No Harvesting and No Harvesting has Occurred on the Cutting Authority

If there has been no harvesting on the cutblock and there has been no harvesting on the cutting authority, then waste billings do not apply to cutblocks upon expiry, surrender, termination or cancellation of the cutting authority.

2.7.3 Occupant Licence to Cut

For occupant licences to cut that require the licensee to deck but not remove the timber, the conifer stumpage rate is based on the Average Sawlog Stumpage Rates by District and Species as per in the *Interior Appraisal Manual*.

2.7.4 Waste Benchmarks

2.7.4.1 Benchmark Levels

The following waste benchmarks will be used for monetary billing of avoidable waste and applied on an individual cutblock basis:

Table 2-3 Benchmark Levels

Benchmark Zone	Dry Belt	Transition	Wet Belt
Benchmark Level	4 m3/ha	10m3/ha	20m3/ha

The Waste Benchmark zones are identified using the document '***Interior Forest Residue and Waste Benchmark and BEC 2018***' available at the following website and Appendix 3:

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/timber-pricing/residue-and-waste/bec_zones_linkage_to_interior_waste_benchmarks.pdf

The waste benchmark volume of a cutblock is derived by multiplying the value of the benchmark with the total of the dispersed, accumulation and standing trees sub population areas reported in a waste assessment of the cutblock.

2.7.4.2 Benchmark Eligibility

The benchmarks are administered on an individual cut block basis. Therefore, each cut block must be individually assessed to determine whether the avoidable waste within the cutblock is above or below the benchmark.

No waste benchmarks will be applied to log decks that in the determination of a forest officer are subject to scaling at a scale site or being field scaled. Such log decks must be clearly marked by the licensee and not to be included in the waste assessment.

Waste benchmarks do not apply to the unharvested cutblocks.

Merchantable volume that may be required to meet coarse woody debris requirements is not exempt from billing and will be included in the waste benchmarks. No special provisions are made for coarse woody debris in waste assessments.

2.7.5 Benchmark Calculations and Billings

Avoidable waste volumes in conifer sawlog grades 1 and 2 (Interior) from the dispersed, accumulated and the standing tree subpopulations of the cutblock will be applied to the benchmarks.

Where the avoidable waste volumes in sawlog grades are below the established benchmark for the cutblock, no monetary billing of avoidable waste in sawlog grades will be made.

Where the avoidable waste volumes in sawlog grades are above the established benchmark for the cutblock, monetary billings will be made on the sawlog grade volumes exceeding the

benchmark. Avoidable waste volumes in grade 4 will not be applied to the benchmark but will be billed monetarily in all cases.

2.7.5.1 WMRF and Billing

A Waste Monetary Reduction Factor (WMRF) is calculated for billing purposes. The WMRF reduces the waste rate to reflect benchmark values for avoidable coniferous waste volumes.

The formula for calculating the WMRF is: **CAV-BM/CAV=WMRF**
Where:

CAV=	Conifer Avoidable Waste (Gr 1 & 2)
BM =	Benchmark Value
WMRF=	Waste Monetary Reduction Factor

The WMRF is applied to the waste rate as determined in section 2.6.2 to calculate the conifer grade 1 and 2 waste amount payable.

a. The WMRF is calculated to 4 decimal points.
b. The minimum WMRF is 0.0000

See Appendix 2 for example calculations.

2.8 Waste Assessor Qualifications

The minimum requirements for completion and submission of waste surveys are as follows:

2.8.1 Waste Sample Planning

Preparation of survey plans including development of sample populations, sampling designs and cutblock survey plans must be completed or endorsed by a Registered Forest Professional (RPF or RFT).

2.8.2 Field Survey

Field survey work, including the establishment of survey plot samples, estimation of plot volumes, measurement of plot pieces, collection of waste data and upload of waste data into the Harvest Residue Compiler (HRC) software must be completed by a person that is competent in field measurements, plot survey techniques, cruising and/or scaling.

2.8.3 Survey Compilation and Reporting

Compilation and reporting of waste assessment information must be completed or endorsed by a Registered Forest Professional (RPF or RFT).

2.9 Waste Relief

A licensee may submit a request for waste relief to the district manager or a timber sale manager.

The Executive Director responsible for waste assessments may direct that no waste assessment will be issued to a licensee where:

(A) (1)

a) No Waste Assessment has not been issued to the licensee for the timber on the cutting authority area and,

b) In the opinion of the Executive Director the licensee left the timber on the cutting authority area because of circumstances that were:

i. Beyond the control of the licensee, and

ii. Unrelated to the licensee's:

a) Financial situation, and

b) Economic circumstances.

(2) Some examples of circumstances in (1)(b)(i) where it would be reasonable for the Executive Director to exercise his or her discretion in favor of the licensee are as follows:

a) Where the licensee is prevented from removing the timber from the cutting authority area by an act of God.

b) Where the licensee is prevented from removing the timber from the cutting authority area by a physical barrier or a manmade blockade over which the licensee has no control.

c) Where the licensee is prevented from concluding harvesting operations prior to expiration of the cutting authority because of misfortune that an employee of the government has provided to the licensee with respect to the cutting authority provisions or the harvesting operations.

d) Where the licensee is prevented from concluding harvesting operations prior to expiration of the cutting authority because land from the cutting authority has been set aside by agreement between the licensee and the government.

(B) The licensee held a cutting authority that was issued prior to June 1, 2004 and where,

a) Merchantable crown timber that was authorized for harvest under the cutting authority, at the agreement holder's discretion was not cut and removed,

b) The timber is standing,

c) In the opinion of the Executive Director the timber is of sufficient quantity, quality and concentrations that can be marketed at a reasonable price, and

d) In the opinion of the Executive Director the licensee has exhausted all the licensee's rights under the *Forest Act* to extend the term of the licence, and

e) The Ministry has not issued a waste assessment for the timber to the licensee.

2.10 Waste Relief Procedures

A licensee may apply, in writing, for waste relief with respect to the timber left on a cutting authority provided the government has not issued a waste assessment (invoice) for the timber to the licensee.

2.10.1 Initiating Applications

1. The application for waste relief must include the reasons for seeking relief and data on the timber volume and grades for which relief is being sought (the supporting data).
2. An application must be submitted by:
    a. BCTS licensees to the Timber Sales Manager with a copy to the District Manager, and,
    b. All other licensees to the District Manager.
3. The application must be submitted prior to issuance of the waste assessment (invoice).

2.10.2 Content and Processing of Applications

1. The licensee shall submit the supporting data to the Timber Sales Manager or District Manager, as the case may be.
2. The supporting data must provide an accurate estimate of timber volume remaining on each of the cut block(s) in the cutting authority. That timber volume estimate may be determined by, but not necessarily limited to, the following methods:
    a. A cut/cruise comparison analysis with a map showing the location of the timber included in the waste relief application, and/or,
    b. A full waste survey conducted in accordance with this manual, and/or,
    c. A timber cruise with a map showing the locations of the timber included in the waste relief application.

> **Note:** The supporting data for the timber for which waste relief is requested must be submitted by the licensee into the Waste System as a separate waste survey, prior to the waste relief application being processed. This waste survey will be kept in the Waste System in 'Submitted' status and must not be processed by District staff until after a determination has been rendered on the application for waste relief.

3. The supporting data will be submitted by the licensee into the Waste System and identified by way of a notation or comment in the waste system that the information pertains to an application for waste relief.

4. Timber Sales Manager or District Manager, as applicable, upon receipt of the data submitted, will prepare an information package that should include:
   a. Relevant information on the cutting authority,
   a. An estimated waste monetary assessment based on the timber grade profile, on a block by block basis, and the applicable waste rates.
   b. An assessment of the opportunity for resale of the timber included in the waste relief application, including the current market value, and,
   c. A Briefing Note to the Executive Director, responsible for waste assessments confirming receipt of the waste relief application.
5. The information package will be forwarded in electronic form to the Director, Timber Pricing Branch, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, with a copy to the Regional Executive Director and the Regional Revenue Manager.

2.10.3 Waste Relief Determination

The Executive Director, upon reviewing the information provided, and considering the pertinent documentation, will make a determination and notify the licensee, with a copy to the District Manager, the Timber Sales Manager (in the case of BCTS Agreements) and the appropriate Regional Executive Director and the Regional Revenue Manager.

If the waste relief application is not approved, the District Manager will process the waste survey and issue an invoice for that timber included in the waste relief application.

If the waste relief application is approved, the District Manager will deactivate the waste survey submitted to the Waste System for that timber included in the waste relief application.

2.11 Continuing Liability

In accordance with section 79 of the *Forest Act***,** and notwithstanding the time frames specified in section 3.2 for conducting and submitting a waste assessment, and despite the expiry, surrender, suspension or cancellation of a holder's agreement, the holder of an agreement is required to conduct a waste assessment, and pay the fees, costs and invoice billings owing to the government in respect of the waste assessment.

2.12 Overdue Waste Assessments and Reports

Where the holder of an agreement, other than an agreement entered into with the timber sales manager, does not complete the waste assessment and submit it to the district manager as required under section 3.2, the district manager may in a notice given to the licensees, take actions to ensure assessment of waste for a block or blocks.

Where the holder of an agreement entered into with the timber sales manager that is required by that agreement to conduct a waste assessment, fails to conduct that waste assessment, the timber sales manager may carry out the assessment, and in a notice given to the holder, may require the holder to pay the costs incurred by the timber sales manager in carrying out the assessment.

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3. Reporting Structure and Timeframes

3.1 Reporting Structure

Waste assessments are reported through the Waste System. In the Waste System cutblocks or partial cutblock waste assessments are reported and organized using a reporting unit unique to the client number associated with a licence.

1. Reporting units can be created for single or multiple cutblocks held by a licensee.
2. Reporting units can contain:
   a. One or more single cutblock sample designs for one or more survey years,
   b. All cutblocks within an aggregate sample plan, or
   c. All cutblocks for the client within a large multiple cutblock sample plan.

3.2 Timeframes

The completion and submission of waste surveys are linked to the completion of harvesting activities and the seasonal ability to complete field measurements. Waste surveys cannot be completed when snow is present in sufficient quantities to prevent the accurate measurement and grading of waste pieces.

3.2.1 Waste Survey Plan

A waste survey plan involves the creation of a population sampling plan and the development of cutblock survey plans for waste assessment.

It is *mandatory* for licensees to prepare and submit waste population sampling plans and cutblock waste survey plans to the District Manager in accordance with the timelines outlined below.

Waste survey plans must be submitted prior to commencement of a waste survey.

3.2.2 Cutblock Waste Survey Plan Maps

Cutblock waste survey plans must include a map that accurately reflects the post-harvest location and shape of areas of reserved timber, whether grouped or dispersed.

The cutblock waste survey plan map must be submitted to the District Manager a minimum of 1 day prior to the survey.

3.2.3 Waste Populations with Less Than 20 Blocks

Single cutblock waste populations require the submission of a waste survey plan to the ministry where the Ready for Survey date is:

1. Between September 1st and December 31st, no later than June 30th of the following year,
2. Between January 1st and May 31st, no later than June 30th of the same year, or
3. Between June 1st and August 31st, no later than thirty (30) days after the Ready for Survey date.

For aggregate cutblock populations, a population sampling plan must be submitted no later than seven (7) days before field survey. The plan must only include cutblocks, that are ready to survey.

3.2.4 Survey Populations With Greater Than 20 Blocks

For multiple cutblock populations, a population sampling plan must be submitted no later than June 1. The plan must include completed, active, and proposed cutblocks as outlined below:

1. Cutblocks not surveyed where the Ready for Survey date is or will be after September 1st of the preceding year, and
2. Cutblocks where the Ready for Survey date is planned to be prior to August 30th of the submission year.

3.2.5 Completion Timelines

Government's expectation is that waste surveys will be completed promptly after harvesting has been completed and prior to site treatments and hazard abatement requirements. Where cutblocks are completed in the fall and surveys are prevented due to snowfall, it is expected the survey will be completed as soon as possible in the following field season.

In all cases waste assessments must be surveyed:

1. Thirty (30) days prior to completion of any postharvest site treatments that will alter the waste volumes or grades (i.e. stumping, burning, mounding), and
2. Thirty (30) days prior to the reduction of the fuel hazard as required by the Wildfire Regulation section 12.1.

In all cases waste assessments must be surveyed and submitted by where a cutblock has a Ready for Survey date between:

1. January 1st and August 31st, the waste assessment must be completed no later than September 30st of the same year, or
2. September 1st and December 31st, the waste assessment must be submitted no later than September 30st of the year following the Ready for Survey date.

3.2.6 Submission of Waste Assessments Not Requiring a Field Survey

Cutblocks that will have the waste assessment volumes determined through alternate methods (i.e. cutblocks <=2.0ha,) must be submitted no later than thirty (30) days after:

1. The data required for completion and compilation of the sample population to be used to generate the required information is available, and/or
2. The Ready for Survey date.

4. Sampling Designs

The objective of the sampling process is to develop a statistically-based estimate of the quantity and quality (volume and grade) of residue and waste material remaining in given areas after primary harvesting of those areas is complete. The sampling process is based on statistical principles of unbiased selection of a sample and appropriate data compilation and analysis methods. The result of the process is an estimate of how much material remains after harvest (volume), where it is (cutblock specific), and its type and classification (grade, species, category of material, etc.).

4.1 Overview

The main steps in the waste sampling process are:

1. Define the population of interest. This is the area where estimates of the amount of waste and residue material is needed.
2. Select the method of sampling. The residue and waste sampling process includes options to increase the efficiency of sampling (i.e. lower costs) and improve estimates.
3. Develop the sample plan. The method of sampling chosen will determine how blocks are selected for sampling, how data is collected within the blocks, how the data is analyzed, and how the results from the sample are applied back to the population.
4. Collect data from the sample. This requires a field sampling from the different strata in the areas/blocks selected in the sample.
5. Compile the data. The data is entered into EforwasteBC or field cards and compiled using standard volume equations and processes.
6. Analyze the data. The result is an estimate of the total amount of residue and waste material in the population (volume by species, grade, etc.) which is apportioned over the population (one or more cutblocks, etc.).

4.2 Population Format

The sample population is the area where estimates of residue and waste material is needed.

Sample populations can be comprised of a single cutblock or a group of cutblocks using the following criteria:

1. A single or partial cutblock within any licence,
2. One or more cutblock(s), or partial cutblock(s) within an area-based tenure (TFL, FNWL, etc.),
3. One or more cutblock(s), or partial cutblock(s) within a Timber Sale Licence, or
4. One or more cutblock(s), or partial cutblock(s) held by one or more licensees that are all within the same Timber Supply Area where:
    i. The population does not contain any cutblocks from a Timber Sale Licence, and
        1. All licences within the population are held by the same company (client code), or

2. A population is comprised of two or more licensees (client codes) with and an agreement made between the licensees accepting the waste sampling results within the population for each licence. This agreement must be included as an attachment in each waste submission entry in the Waste System. Each licensee will need a separate RU for reporting purposes in the waste system.

Example waste populations:

1. A Tree Farm Licence containing one or more cutblocks.
2. One or more Forest Licence's held by the same licensee containing more than one cutblock in the same TSA.
3. One or more Forest Licence's held by multiple licensee's containing more than one cutblock in the same TSA (agreement required).
4. A Timber Sale Licence.
5. A First Nation Woodland Licence containing one or more cutblocks.

4.3 Full or Partial Cutblocks

Either complete cutblocks or completed portions of a cutblock may be included in a sample population. The decision to include a partial cutblock within a population should be based on factors such as post-harvest treatments (hazard abatement) and reforestation requirements, location, and cutblock size. No limits exist on the size of a partial cutblock; however, partial cutblock submissions less than 2.0 hectares will require a rationale.

Partial cutblock submissions may be submitted in order to complete waste assessment prior to hazard abatement.

4.4 Cutblocks Less Than 2.0 Hectares

Cutblocks less than 2.0 ha do not need to be sampled as alternate population averages are used to estimate waste volumes for these areas.

Portions of cutblocks less than 2.0 ha must have a clear forest stewardship rationale for the survey portion size.

4.5 Cutblock Sampling Design

4.5.1 Sub Populations

The population usually consists of three subpopulations: accumulated, dispersed, and standing trees. Each sub-population may be subdivided into one or more strata.

4.5.1.1 Dispersed

Dispersed waste occurs on the areas from which trees or logs have been cut or removed and where sample plots can be safely established. Dispersed subpopulations are sampled independently of accumulation areas through the establishment of sample plots. The area of road rights-of-way leading into the cutblock must be included in the net area of the cutblock unless the waste volume has been included in a previous waste survey or as provided under section 6.3.5.

4.5.1.2 Accumulations

Accumulated waste occurs at landings, along roadsides, and at other areas in a cutblock where waste material has been piled (accumulated) by a machine. Accumulated strata can include spot accumulations, roadside accumulations from yarding, windrows, and cold decks. The key identifying feature of accumulated strata is the waste material is gathered onto a small area creating a very condensed pile of waste material. Accumulation strata must not be confused with areas of high waste volume in the dispersed stratum.

4.5.1.3 Standing Trees

Standing trees are trees authorized for harvest under the cutting authority (excepting reserved trees) but at the discretion of the licence holder, are not cut and removed.

Individual standing trees that are found at different locations of the cutblock can be measured and scaled individually and be treated as part of the dispersed sub-population. Standing tree patches will be delineated separately from the dispersed to form their own sub-population and the volumes determined with methods outlined under section 7-49.

4.5.2 Stratification

Stratification can increase the precision of population volume estimates and reduce the amount of sampling required to achieve a desired level of precision. Therefore, it is useful to stratify subpopulations where possible and practical.

In waste assessments, stratification should be limited to significant differences in the relative quantity of waste. Unique strata must be easily and consistently identifiable and must be estimated in the same manner throughout the population. All stratification must occur prior to field sampling.

Each strata must be assigned one of the three subpopulation types listed in section **Error! Reference source not found.** and requires the minimum number of samples required for that strata type. Each subpopulation must be sampled independently of other subpopulation areas.

4.5.3 Waste Stratum

At least one unique stratum must be identified within a cutblock. The correct and consistent coding of these strata is a key driver in the compilation of the survey information. Identification of strata within a cutblock must be completed using the codes in tables below. Each stratum name is comprised of four characters: waste type, harvest method, plot size, and sub stratification variable.

Example: Stratum code SB2X

S= Open slash/clearcut dispersed waste type
B= Hoe chucking or machine yarding
2= 200m2 plot
X= Not stratified waste level

The FIRST character, (alpha) starting from the left identifies the waste type and defines a new stratum type. The recognized waste types and their codes are as follows:

Table 4-1 Waste Type Code

	Waste Types	**Code**
1.	**Dispersed Types**	
	Dispersed Retention	D
	Felled and bucked	F
	Group Retention	G
	Historic Waste	H
	Open Slash/Clearcut	S
	Standing Stem	T
2.	**Accumulated Types**	
	Landings	L
	Roadside	R
	Windrow, Debuilt road	W
	Cold decked	C
	Spot accumulation	P
	Off-site landing (i.e. not in the block)	O

The SECOND character (alpha) identifies the method used to harvest the waste type being sampled. This is a descriptive label only and will not cause a separate stratum to be created. Harvesting method codes are shown as follows:

Table 4-2 Waste Stratum Harvest Method Codes

Harvesting Method	Code
Spar (high lead)	S
Grapple yarder	G
Rubber-tired skidder	R
Tractor (cat)	T
Horse	P
Hand logging	M
Hoe chucking	B
Helicopter	H
Any combination	C
Wyssen	W
Other	O

The THIRD character identifies the assessment method used. There are three assessment methods:

Table 4-3 Waste Stratum Assessment Method Codes

Code Position	Assessment Method	Code
3rd	• Estimate Percent	E
	• 100% Measure	S
	• Plot	*

*When plot method is used select code that corresponds with the plot in table below:

Table 4-4 Plot Size Codes

0 - 50 m^2	5 - 500 m^2
1 -100 m^2	6 - 600 m^2
2- 200 m^2	7 - 1 000 m^2
3 - 300 m^2	8 - 5 000 m^2
4 - 400 m^2	9 - 10 000 m^2

The FOURTH character (alphanumeric) identifies any *sub stratification* of waste types within a predefined stratum within the cutblock.

When significantly different levels of waste occur within a waste type and they can be easily identified and mapped, the waste surveyor may sub stratify them into unique waste levels.

Table 4-5 Waste Stratum Sub Stratification Codes

Code Position	Sub Stratification	Code
3rd	Not stratified	X
	Light	L
	Medium	M
	Heavy	H

1) If no sub stratification is done, or for 100 percent piece scales, record X under waste level.
2) Where sub strata are defined, each sub strata will require the minimum number of plots for that strata type as defined in Table 4-6.
3) Any stratification of waste types must be supported with field notes and a map and must be consistently applied within each cutblock of the population.
4) An accurate area calculation is required for each stratum and all of the plots attributed to a stratum must fall within its boundaries (i.e., stratification cannot be done on a plot by plot basis).

4.5.4 Standing Trees

Depending on the assessment method used, the stratum codes are:

STRS	Where stranding trees are measured individually using the one hundred percent measure method.
STRE	Where standing tree volumes in a patch are estimated using the estimate percent method.

4.6 Sampling Options

The standards provide for the establishment of field samples or estimation of waste volumes based on field sampling for all cutblocks greater than 2.0 ha

There are a number of Sampling options for licensees to use that are specific to the size of the population (number of cutblocks) and the level of accuracy and precision (risk) desired.

The sampling options use two sampling principles to collect and compile waste information: Simple Random Sampling (SRS) and Ratio Adjustment Sampling.

4.7 Sample System Naming Conventions

The sampling and analysis approach name contains of one or two concepts (Simple Random Sample or Ratio). Where a single phrase is used for the name the sampling design employs a single sampling technique to develop the result. These designs are typically used on single blocks or small populations of less than 20 blocks. Where two phrases have been used the sampling design employs two sampling techniques to develop the result. The first term defines how the volume is estimated within sampled blocks and the second term defines how the volume is estimated among the blocks in the population (blocks sampled and blocks not sampled).

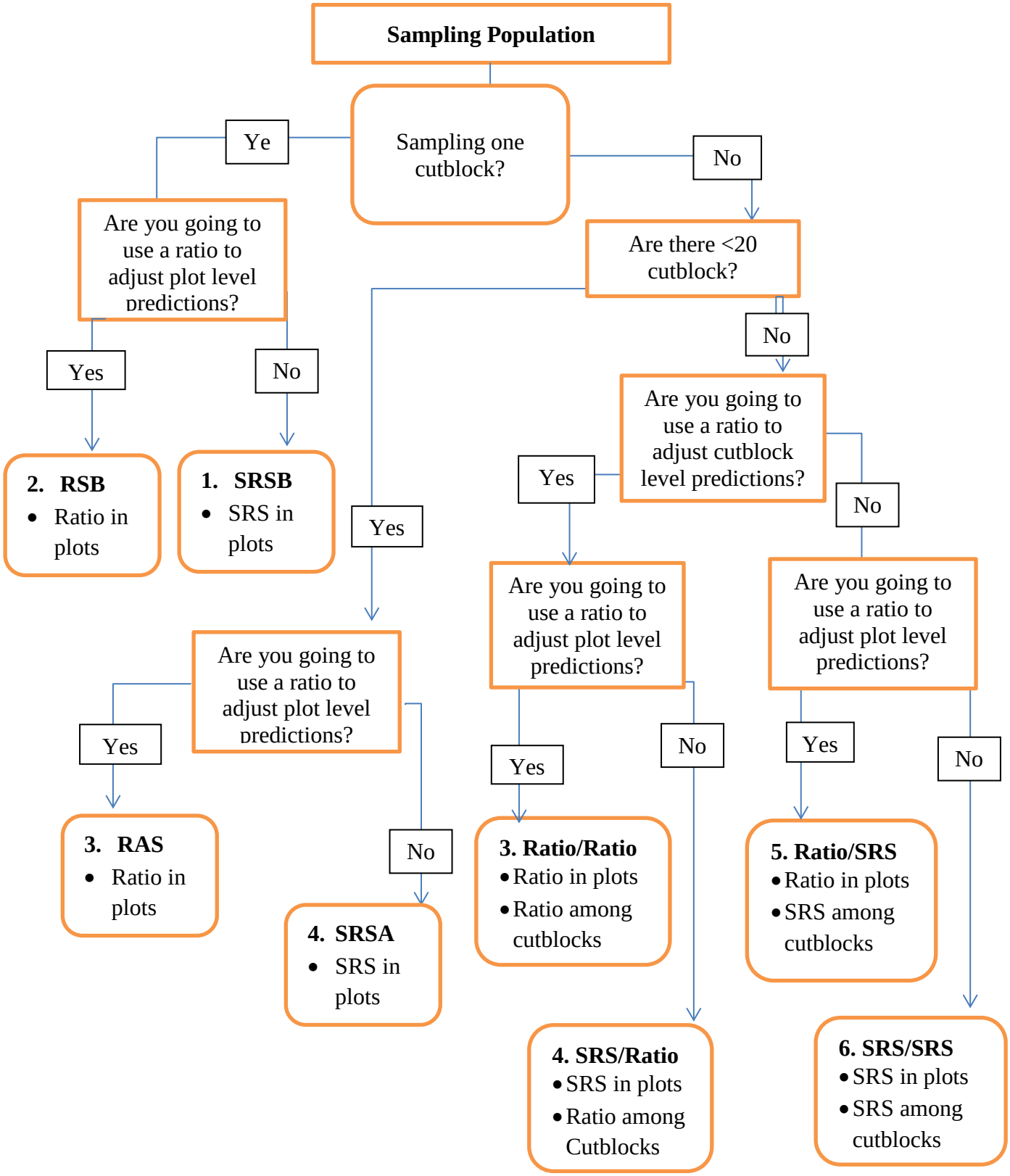
4.7.1 Small Population Sampling Designs

- SRSB – Simple Random Sampling – single cutblock
- SRSA – Simple Random Sampling – aggregate (multiple cutblocks)
- RSB – Ratio Sampling – single cutblock
- RAS – Ratio Sampling – aggregate sampling (multiple cutblocks)

4.7.2 Large Population Sampling Designs

- Ratio/Ratio– Ratio Sampling (Cutblock)/ Ratio Sampling (Population)
- SRS/Ratio – Simple Random Sampling (Cutblock)/Ratio Sampling (Population)
- Ratio/SRS – Ratio Sampling (Cutblock)/Simple Random Sampling (Population)
- SRS/SRS – Simple Random Sampling (Cutblock) / Simple Random Sampling (Population)

Figure 1 Sampling Population Flowchart



4.7.3 Sample Size and Number of Plots

The sample size (number of sample cutblocks or sample plots within a cutblock) is based on the sampling system to be used for the population or size of the sample cutblock. The number of sample plots required within each cutblock is dependent on the sampling design (single cutblock, aggregate or large multi cutblock). The required number of sample cutblocks and plots are identified in Table 4-6 Minimum Sampling Requirements by Sampling System. The HRC system will calculate the required number of dispersed plots outlined in the table below when creating a sample plan.

Table 4-6 Minimum Sampling Requirements by Sampling System

Minimum Sampling Requirements					
Small Populations					
Sampling System (Cutblock/ Plots)	**Cutblocks Sampled (Minimum)**	**Number of Plots per Population (Minimum)**			
		Dispersed Stratum		**Spot Accumulation Stratum**	
		Estimate	**Measure**	**Estimate**	**Measure**
1. Simple Random Sampling (SRSB, SRSA)	All	0	Min 10 plots, <=30ha: 1 plot/ha, >30ha: 1plot/ha up to 30ha+1 plot/7ha, Maximum 50 plots	0	<=10: 10, >10 piles: 10 +(1 per 5 in excess of 10 piles), Maximum 30
2. Ratio Sampling Cutblock (RBS) Aggregate (RAS)	All	Minimum 18 Plots, >=20 ha: SRS measure plots X 1.2, Maximum 60 plots	1 out of 3	<12: 12, >12 piles: 12 +(1 out of 5 piles in excess of 12 piles) Maximum 30 piles	1 out of 3
Large Populations					
Sampling System (Cutblock/Plots)	**Cutblocks Sampled (Minimum)**	**Number of Plots per Cutblock (Minimum)**			
		Dispersed		**Accumulation**	
		Estimate	**Measure**	**Estimate**	**Measure**
3. Ratio/Ratio	**20, 25, 30***	18	6	12	4
4. Ratio/SRS	**20, 25, 30***				
5. SRS/Ratio	**20, 25, 30***	0	12	0	12
6. SRS/SRS	**20, 25, 30***				

* as per table below

Table 4-7 Minimum Sample Cutblock Requirements for Population Ratio Sampling

Population size	**Minimum # of Sample Cutblocks**
20-100 cutblocks	20 Samples
100-150 cutblocks	25 Samples
150+ cutblocks	30 Samples

4.8 Small Population Sampling Designs (Less than 20 Cutblocks)

Small population sample designs can only be used on populations sizes less than 20 cutblocks.

4.8.1 Simple Random Sampling

For all methods using SRS sampling, the sampling error and confidence interval are calculated from the measured samples.

4.8.1.1 Simple Random Sampling – Single Cutblock (SRSB)

In this sampling method, the sample population is a single cutblock. Within the cutblock, a predetermined number of samples are measured and averaged to determine an estimate of volume for the population.

4.8.1.2 Simple Random Sampling – Aggregate (SRSA)

The SRSA sampling method requires the measurement of a predetermined number of samples within an aggregated sample population (group of cutblocks). SRSA sampling is applied to a group of cutblocks. In this method:

- All cutblocks must have primary harvest complete on the waste assessment area included in the sampling plan
- Cutblocks are sampled proportional to their size within the population,
- All sample plots are measured and averaged to determine an estimate for the population,
- The results for the population are then applied to each cutblock within the population, with each cutblock receiving the same estimate of volume per hectare.

4.8.1.3 The Minimum Sampling Requirements for SRSB and SRSA

The minimum sampling requirements are:

1. Within the dispersed strata:
   i) A minimum of 10 plots, or
   ii) For cutblocks less than 30 ha, establish 1 plot per hectare, or
   iii) For cutblocks greater than 30 ha, establish 1 plot per hectare up to 30 ha, plus an additional 1 plot per 7 ha, or
   iv) A maximum of 50 plots.
2. Within the spot accumulation strata:
   i) If there are less than 10 piles, establish 10 plots on existing piles, or
   ii) If there are greater than 10 piles, measure 10 plus one (1) pile out of every five (5) piles in excess of 10, or
   iii) Measure a maximum of 30 piles.

4.8.2 Ratio Sampling

4.8.2.1 Ratio Sampling – Single Cutblock (RSB)

The RSB method combines the efficiencies of ratio sampling with the increased sampling intensity of an SRSB survey. The RSB method requires the establishment of full measure and volume prediction plots for a predetermined number of samples within a cutblock. In this method:

1. A ratio between the measured plot volumes and predicted plot volumes is developed. This ratio adjustment is applied to all prediction plots, and
2. The resulting volumes are averaged to determine an estimated volume for the cutblock.

4.8.2.2 The Ratio Sampling – Aggregate Sampling (RAS)

Like the SRSA method, the RAS method applies the principles of SRS sampling across a population of 2 to 19 cutblocks. The RAS method requires the establishment of a predetermined number of samples across the full population. In this method:

- All cutblocks must have primary harvest complete on the waste assessment area included in the sampling plan.
- The plots are located within each cutblock in the population proportional to its weighted size within the population,
- A ratio between the measured plot volumes and predicted plot volumes is developed,
- The ratio adjustment is applied to all prediction plots,
- The resulting volumes are averaged to determine an estimate for the population, and
- The results for the population are applied to each cutblock within the population (each cutblock receiving the same estimate of volume and grade per hectare).

4.8.2.3 Minimum Sampling Requirements for RSB and RAS Methods

1. Dispersed strata
    i. Minimum 18 prediction,
    ii. Measure 1/3 of the prediction plots.
    iii. Greater than 20ha =SRS plus 1 plot/1.2 ha,
    iv. Maximum 60 plots
2. Spot accumulation strata
    i. Less than 12 piles evenly distribute 12 plots on existing piles. Predict all plots and measure 1/3 of plots,
    ii. If there are greater than 12 piles, predict one (1) pile out of every five (5) piles in excess of 12, and measure 1/3,
    iii. Maximum 30 samples.

4.9 Large Population Sampling Design (20 or More Cutblocks)

Large population sample designs can only be used on population sizes with 20 or more cutblocks.

4.9.1 Large Population Cutblock Sample Size

Large populations require the identification of the reporting population and the selection of sample cutblocks from that population. The minimum sample cutblock requirements are outlined in Table 4-6 Minimum Sampling Requirements by Sampling System.

4.9.2 Populations With Greater Than 20 Cutblocks RR & RS

4.9.3 Ratio/Ratio (RR)

Ratio/Ratio sampling is typically the most efficient and accurate sample method. The method uses a prediction of cutblock volumes for the population and a prediction of plot volumes to develop two ratio adjustments. The two types of ratios are:

- Ratio within cutblocks
    - Sample plots are established within the selected sample cutblocks and a prediction of the plot volumes recorded,
    - Randomly selected plots are fully measured,
    - A ratio is developed between the predicted plot volumes and the measured plot volumes,
    - The volume within each sampled cutblock is estimated by applying the sampled ratio to all predicted plots, and
    - Other strata volumes are added to derive the total cutblock volume.
- Ratio among cutblocks
    - Cutblock volumes are predicted for each cutblock before sampling, and
    - Randomly selected cutblocks are chosen from the population for sampling.

4.9.4 Ratio Sampling/Simple Random Sampling (RS)

The RS method uses a prediction of cutblock volumes for the population and a measurement of plot volumes to develop the ratio adjustments. In this method:

- Ratio sampling within cutblocks
    - Sample plots are established within the selected sample cutblocks,
    - The volume within each sampled cutblock is estimated by combining the sampled average of all predicted plots with other strata volumes to develop the measured cutblock volume,
    - A ratio is developed between the predicted volumes and the measured volumes for each sampled cutblock,
- SRS Among cutblocks
    - Sample cutblocks are randomly selected for measurement,
    - The sample cutblock volumes are then proportionally weighted by area and the resulting volume per hectare applied to all cutblocks in the population,

4.9.5 Minimum Sampling Ratio/Ratio and Ratio/SRS

The minimum sampling requirements are:

a. In the dispersed strata, 18 prediction plots and 6 measure plots per cutblock are to be completed
b. In the spot accumulation stratum, all piles are to be identified and counted.
    i. If there are less than 12 piles, evenly distribute 12 plots on existing piles. Predict all plots and measure 4 plots,
    ii. If there are greater than 12 piles, predict 12, and measure 4 piles.

4.10 Populations with Greater Than 20 Cutblocks SR & SS

4.10.1 Simple Random Sampling / Ratio (SR)

The SR method uses a prediction of cutblock volumes for the population combined with measurements within selected cutblocks to develop a ratio. The ratio is then used to adjust all cutblock predictions within the population. In this method:

- SRS Within Cutblocks
    - All plots established in selected cut blocks are measure plots,
    - Individual cutblock volumes are determined by averaging the sample plots within each cutblock,
    - All cutblocks in the population receive the same waste and residue values.
- Ratio Among Cutblocks
    - Individual cutblock volumes are predicted for each cutblock before sampling,
    - Randomly selected cutblocks are chosen from the population for sampling and are measured.

4.10.2 Simple Random Sampling / Simple Random Sampling (SS)

The SS method requires the measurement of selected cutblocks within a population and measurement of all sample plots established within the selected cutblocks. SRS/SRS sampling does not employ the concepts of ratio adjustment sampling. The results of SRS/SRS sampling can be less accurate and more costly than Ratio/Ratio or SRS/Ratio sampling.

In this method:

- SRS within cutblocks:
    - All plots established in selected cut blocks are measure plots,
    - Individual cutblock volumes are determined by averaging the sample plots within each cutblock,
    - All cutblocks in the population receive the same waste and residue values.
- SRS among cutblocks:
    - sample cutblocks are randomly selected for measurement,
    - The sample cutblock volumes are then proportionally weighted by area and the resulting volume per hectare applied to all cutblocks in the population.

4.10.3 Minimum Sampling SRS/Ratio and SRS/SRS

The minimum sampling requirements per cutblock are:

a) In the dispersed strata, a minimum 12 measure plots per cutblock, and
b) In the spot accumulation strata, all accumulations are identified and counted:
   (i) If less than 12 piles, evenly disburse the 12 measure plots on existing piles,
   (ii) If greater than 12 piles measure a total of 12 piles.

4.11 Sample Plan Development and Implementation

The development of sampling plans is defined by the sampling design and size of the population. Three scenarios can occur in the development and implementation of the sample plan: single cutblock plans, small multi cutblock plans and large multi cutblock plans.

Sample plans are to be developed using the HRC system.

4.11.1 Single Cutblock Plans

1. Identify the sample population
2. Select a sampling and analysis approach (SRSB, RBS)
3. Determine the sample size, including:
   a. The number of plots in dispersed stratums
   b. The number of accumulation samples
4. Prepare the sample plan map
5. The sample plan is signed by a Forest Professional
6. No significant changes to the sample plan are permitted once sampling has commenced.

4.11.2 Small Multi Cutblock Plans

1. Identify the sample population
2. Select a sampling and analysis approach (SRSA, RAS)
3. Determine the sample size:
   a. Number of plots in dispersed stratums (aggregate)
   b. Number of other samples as required,
4. The sample plan is signed by a Forest Professional
5. Prepare cutblock sample plans.

4.11.2.1 Sample Plan Amendments

The objective of a small multi cutblock sample design is to identify a population of cutblocks that will be sampled as a single unit. Changes to a plan can significantly impact the sample size and the number of plots required. Changes to a plan should be minimized and only undertaken to affect unforeseen operational issues.

The submitting forest professional recognizes that changes to a plan, such as the addition or removal of a cutblock or a significant change in area will significantly alter the sample plan requirements. The forest professional will assess the impact of the changes against the principles of sampling identified in these standards.

Upon request the submitting forest professional will submit a rationale for any changes to a sample plan. This model is consistent with the direction of professional reliance.

For guidance on how to prepare a professional rationale, please refer to the document "Guidance for Professional Quality Rationales and Commitments" published by the ABCFP and available at:
www.abcfp.ca/regulating_the_profession/documents/Pro_Quality_Rationales.pdf

The District Manager will review each change on a case by case basis and determine if the change meets the intent of the sampling principles within this manual.

4.11.3 Large Multi Cutblock Plan Development

The following describes the process for preparing, compiling, and amending large multiblock plans.

1. Identify the sample population
   Prior to the field sampling season, the sample planner lists all cutblocks that will likely require waste assessments for the current sampling year. This population of cutblocks forms the basis to develop the sampling plan. The population includes cutblocks where harvesting is:
   Complete: Primary Harvesting operations are completed and '*Ready for Survey*' status has been achieved. The cutblock has not been surveyed since the end of the last sampling year.

   Active: Harvesting operations have commenced and the cutblock has not achieved '*Ready for Survey*' status. The cutblock is expected to be completed before the end of the sampling season. These cutblocks are in progress at the time the plan is developed and are expected to be completed in time for inclusion into the population and subsequent sampling. If operational requirements prevent the completion of harvesting of the block, sample it as soon as possible.

   Not Started: Cutblocks that are planned for harvest completion within the sampling year; however, harvesting operations have not yet commenced.

   The sample population data needs to be entered into the HRC System.
2. Select a sampling and analysis approach (Ratio/Ratio, SRS/Ratio, Ratio/SRS, SRS-SRS)
3. Determine the sample size
   i. The sample size for the population is based on the desired sampling frequency, assuming that all cutblocks in the population will be completed.
   ii. A minimum sample size is determined in the HRC application. Licensees can choose to increase the sample size if desired.
   iii. Determine the number of plots per cutblock in dispersed stratums
   iv. Determine the number of accumulation samples per cutblock
4. If a ratio is used to estimate volume among cutblocks (Ratio/Ratio, RSRS/Ratio):
   a. Predict the volume on all cutblocks in the population, including:
      i. The estimated total green waste volume (Green Grades 1, 2, 4)
      ii. The estimated total of dry waste volume (Dead Grade 4).

5. Determine the sample cutblocks from the population
   The HRC system completes the sample selection and identifies the block population for sampling.
   i. Batch 1 is all cutblocks where harvest is Complete.
   ii. The remaining (active or not complete) cutblocks are retained in the system for subsequent batches.

6. The size of batch 1 is checked against the minimum requirements for sampling within HRC:
   a. The minimum population size must result in a sample size of five cutblocks using the sampling frequency developed for the full population.
   b. If the minimum size is not achieved, the licensee must wait until there are enough completed cutblocks to achieve the minimum sample of five.
7. The HRC system selects the batch 1 sample cutblocks from the population. This is done systematically from a sorted list with a random start.
8. The sample plan is signed by a Forest Professional in HRC.
9. Implement the field measurement program on sample batch 1.
10. Prepare sample plan maps.
11. Update the sample plan as needed (plan logging status, adding or deleting cutblocks)

4.11.3.1 Sample Plan Amendments

As harvesting operations continue through the year, cutblock scheduling and harvest completion will change. The *Plan Logging Status* will also change through the season thereby making cutblocks available for survey. These changes will initiate changes to the sampling plan and sample cutblock selection. To accommodate these changes, cutblocks can be added to or deleted from a sample plan in the HRC throughout the sampling season and additional sample cutblock batches will be selected. This is done by creating new population batches and selecting samples from those batches using the same method as batch 1. The minimum new population batch size must result in a sample size of five cutblocks using the sampling probability developed for the full population.

Deleting of cutblocks selected for sampling may only be done in unusual circumstances. Approval by the District Manager is required prior to removal of a sample cutblock.

4.11.3.2 Amendment Procedure

Cutblocks that will not be harvested or do not achieve Ready for Survey status during the current sampling year can be deleted from the sample population at any time. New cutblocks can be added to the sample population by adding them to the sample plan file as they become available.

A new sample batch can be created when there are sufficient existing and new blocks in Ready for Survey status since the creation of batch 1 to result in a sample size of at least five (5) blocks. The sample size for batch 2 and subsequent batches is based on the sampling frequency of batch 1 and the number of newly completed and added cutblocks. A third batch can be created using the same process if needed.

At the end of the field season, if the number of new completed cutblocks to be added to the sample plan does not meet the sample batch threshold noted above, HRC will randomly select cutblocks using the same sampling probability as the preceding batches.

The amendment procedure may generate more or less sample cutblocks than was required in the original sample plan and is a result of the need for compromise between operational flexibility and sample design requirements.

4.12 Sample Cutblock Selection Principles

A sample of cutblocks is selected from the population for measurement. The cutblocks are selected with equal probability, systematically from a sorted list with a random start. Sorting the cutblocks in the population by common criteria prior to selecting samples helps to ensure that the sample represents the population.

In the HRC, the number of sorts within a given population is limited to three. Two of sort criteria are predefined in HRC: Waste Benchmark Zone and Stand Type. The third sort criterion can be defined by the waste survey planner (i.e. logging contractor, harvest season, location, etc).

Stand Type is defined by the cutblock cruise species information submitted into HRC as part of the sample planning process. The cruise information is grouped by HRC into species groups in the table below:

Table 4-8 Stand Type Composition

Stand Type Composition	
Leading Species	81-100%
Leading Species Mix	51-80%
Leading species	<=50%

4.12.1 Apportionment of Population Total

The estimated population total is apportioned among all cutblocks in the population by using the sample ratio to adjust the predicted total of each cutblock. Cutblock totals need to be apportioned by species and grade.

When the sample plan is prepared, each cutblock is assigned to a stand type within the population. The volume by species and grade within each stand type is calculated by using the sampled cutblocks within that stand type. Sampled cutblocks are assigned the species and grade proportions from the sampling completed within that cutblock. Unsampled cutblocks are assigned the species and grade proportions from their assigned stand type proportional to the estimated total volume in all cutblocks in that stand type.

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5. Cutblock Waste Area Determination

The determination of the cutblock area to be surveyed is an important component in obtaining the correct waste volume per hectare, cutblock volume and waste billing. The waste survey planner must develop waste survey plans and conduct area calculations to determine accurate areas for waste reporting.

A cutblock can contain areas of reserved timber, non- productive areas (roads), merchantable timber areas (standing timber), and areas outside of the appraised cutblock boundaries (i.e. external landings) that contain waste from the cutblock to be sampled.

5.1 Principles

1. The area used to calculate waste volumes is the total area of a cutblock that was authorized to remove timber and/or will contain waste material from the cutblock.
    a. The cutblock net waste area is calculated as follows:
        i. Identify the harvested area
        ii. Subtract any mapped retention from the block's gross area
        iii. Add the sum of the area associated with external roads and/or any external landings to the figure determined in step 1
        iv. Subtract the area of all non-productive areas (i.e. built road surface) from the figure determined in step 2.
2. The net waste area reported into the Waste System does not need to and usually will not reconcile with the cutblock net area in other reporting systems i.e. RESULTS, FTA etc.
3. Cutblock net areas may be increased by adding external areas containing waste volumes attributable to the cutblock (i.e. external landings or road permit areas outside of the cutblock).
4. Road permit areas outside of the cutblock are only added into the net waste area if they contained merchantable timber. Road sections that did not contain merchantable timber should not be added to the net waste area.
5. The net waste area of a cutblock will form the area that the surveyed average waste volume per hectare is applied to.
6. Non-timbered and reserve areas attributed to the cutblock where timber is not cut or removed are excluded from the net waste area (i.e. WTRA).
7. Partial cut, machine free, riparian management zones etc. within the external boundaries of the cutblock are assessed for waste material.
8. The combined sum of all sub-strata areas within a block must equal the net waste area.

5.2 Net Waste Assessment Area Calculation Method

Refer to Appendix 6 for an example of a waste area calculation.

5.2.1 Cutblock With or Without External Areas

1. From a suitable map, identify the net harvestable area including any areas deducted from the block's area for road permitted road construction. This is often calculated from the block's gross area, less any mapped reserves or retention and should reconcile to the ECAS submission and the cruise compilation report.
2. Add in external areas to the area determined in step 1 above, including:
    i. Off-site Landings
    ii. External road right of way (section 6.3.5)

3. Determine the area of non-productive (NP) areas (i.e. roads, landings, or other features). NP areas that do not contain any waste material, are removed from the block area, and are not sampled.

   To calculate the NP area of roads for waste area calculations, the road surface area is the same as the road running surface area (see Figure below); it does not include ditches and fill slopes. To determine the road NP area:

   i. Measure the average road width (running track of the road)
   ii. Determine the length in meters of the constructed roads
   iii. Multiply the road length by the width to determine the net road surface area.
   iv. Enter the NP area into the Waste System on the Waste102 page under 'Roads (NP/NF).'

4. Calculating the Area of Other Features:
   i. Identify other areas within the gross area that do not contain any waste material (i.e. WTRA, Large Landings etc.).
   ii. Determine the external dimensions of the NP area in a manner similar to roads and calculate the area in hectares.
   iii. All areas of a similar type must be identified within a cutblock.
   iv. Areas must be greater than 0.01ha to be recordable
5. Subtract non-productive (NP) waste areas from the area determined in step 2

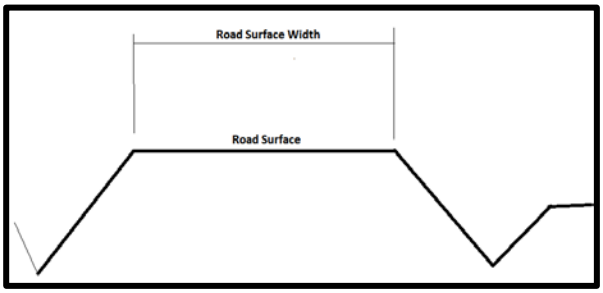

Figure 2 Road Prism Diagram

5.3 Stratum Areas

Stratum areas are defined as unique areas within the net waste assessment area that contain similar waste characteristics (volume per hectare, species, grade, etc.) The cutblock net waste area is segregated into unique stratum areas and the total of the stratum areas must equal the net waste cutblock area.

Minimum plot requirements must be met within each unique stratum.

5.4 Multiple Timber Mark Cutblocks

Most areas assessed for waste contain at least two cutting permit and road permit marks. Where this situation occurs, each timber mark within the areas assessed for waste must be reported into the Waste System.

The correct area of each applicable timber mark must be calculated. The waste volume for each timber mark is calculated by applying the block average waste volume (m3/ha) and grade breakdown to each mark.

Note: the total of the timber mark areas must equal the cutblock net waste area.

5.4.1 Submitting A Block Containing Road Permit Area

In the Waste System, the block and road permit timber marks are submitted within the cutblock submission using the Waste 104 – Multiple Timber Marks screen.

The net waste area of a road permit is the right of way width minus the road surface (NP) area. Where the road has been de-built and waste material is located on the road surface area, the road surface is not removed from the area calculation.

5.4.2 Cutblock Authorized Under Two or More Tenures

Where a cutblock is authorized under two or more tenures (i.e. Timber Licence, Tree Farm Licence), the cutblock is surveyed and reported in one waste submission.

In the Waste 104 – Multiple Timber Marks screen, enter the timber mark that corresponds with each tenure, along with each individual mark area. The sum of all the mark areas must equal the net area of the waste assessment area entered on the Waste 102 (Block Details) screen.

The waste volume for each timber mark is calculated by applying the block average waste volume (m3/ha) and grade breakdown to each mark.

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6. Cutblock Planning and Plot Layout

6.1 The Plot Sampling Process

The planning and implementation of plot sampling surveys involves either a single cutblock, a group of cutblocks within an aggregate, or a group of sample cutblocks within a large ratio adjustment sample plan. The following steps are required to complete a waste assessment.

Determine the number of plots required for each cutblock within the population

Obtain the appropriate SPIF for each cutblock

Determine the plot grid spacing within the cutblocks

Prepare the cutblock sample plan

Complete the field survey

Submit the data into the Waste System for compilation and reporting

6.2 Waste Survey Plan

The waste survey plan is a professional document that forms the basis for the statistical sample. It identifies the cutblock population to be sampled and the design that will be used to meet the minimum sampling standards. The waste survey plan is the key document that provides the information needed by the waste surveyor to complete a waste survey and provides assurances to the Ministry that the waste assessment data was collected in an unbiased manner.

Waste survey plans are professional documents and must be:

1) Prepared by a qualified registered member (RPF, RFT) of the Association of BC Forest Professionals, or
2) Supervised by a registered member (RPF, RFT) of the Association of BC Forest Professionals.

A licensee or party responsible for survey must submit a waste plan and waste cutblock plan map in accordance with the timing outlined in Chapter 3 of this manual.

The waste survey plan is not required to be approved by the District Manager.

The waste survey plan is submitted to the Ministry staff to allow for the development of field quality assurance schedules and to provide a basis for comparison against the final waste submission.

Cutblock Waste Plan Maps

Only one survey plan or notification may be submitted for each waste assessment area, and waste report submissions must comply with the submitted plan or notification. No alterations will be allowed to be made to the waste billing volumes.

After the field survey is completed for the block, the final Block Survey Plan map must be submitted with the waste survey reports.

6.2.1 Partial Cutblock Submissions

Where a partial cutblock will be submitted in a waste assessment, the surveyed portion must be clearly identifiable in the field and on the waste survey plan map. This may require field marking prior to survey. All requirements for the determination of the waste net area must be completed on the portion to be reported.

6.2.2 Waste Survey Plan Map Requirements

The maps used in a waste survey must accurately reflect the post-harvest condition of a cutblock including the location and shape of areas of unharvested standing timber, and reserved timber, whether grouped or dispersed.

A waste survey plan map must show the cutblock boundaries, roads, the point of commencement, strip and plot locations, stratum types and locations, and any other areas that are excluded from waste estimations. Accumulations and standing trees not harvested should be clearly indicated on the maps.

The waste survey plan map is required as part of a complete waste submission. The cartographic standards used by the Ministry of Forests, Lands and Natural Resource Operations are mandatory.

The waste plan map must:

a. Be legible and of good quality 1:5,000 scale,
b. Provide neat and clean lines, lettering and numbers,
c. Reflect the post-harvest conditions of the cutblock, and
d. Include the items indicated in Table 6-1.

Table 6-1 Waste Survey Plan Map Requirements

	Requirements	**Survey Plan**	**Final Waste Submission**
a	Tenure, CP, timber mark areas	Yes	Yes
b	Forest Region and District	Yes	Yes
c	Cutblock identifier	Yes	Yes
d	Map scale	Yes	Yes
e	Harvest boundary (with verifiable reference points such as falling corners)	Yes	Yes
f	Non-harvest areas (non-productive etc.)	Yes	Yes
g	Biogeoclimatic zone(s)	Yes	Yes
h	North arrow, declination, map base	Yes	Yes
i	Cutblock maturity (where applicable)	Yes	Yes
j	Roads and other NP areas	Yes	Yes
k	Areas of reserved timber and zones of partial cutting (with appropriate prescription and/or CP Schedule B)	Yes	Yes
l	Areas of high stump exemptions	Yes	Yes
m	Strata type lines and identifier	If known	Yes
n	Cutblock and strata net areas	If known	Yes
o	POC, baseline, and plot locations	Yes	Yes
p	Strip line direction of travel	No	Yes
q	Contour lines - clearly legible	Yes	Yes
r	Physiographic features	Only if they affect sampling	Only if they affect sampling

6.3 Sampling Procedures

Sample size (number of sample blocks or sample plots) and selection will follow the procedures outlined in Chapter 4 of this manual.

6.3.1 Dispersed Stratum Plot Location (SB2X)

Plots for dispersed types are to be located on a systematic, staggered grid. The steps required are as follows:

1) Compute the grid spacing distance (GSD) using the grid spacing worksheet or the procedure described in section 6.3.2.
2) Locate the POC where the main road enters the cutblock.
   a. Where a road forms the cutblock boundary, it cannot be used to locate the POC until yarding associated with the road is complete.
   b. the POC for helicopter blocks is the most south-westerly point on the block.
3) Establish a baseline in the cardinal direction which most closely parallels the majority of contours within the cutblock. Where this cannot be easily determined, establish the baseline in a North/South orientation and note this on the waste survey plan map.
4) Obtain the Starting Point Interval Factor (SPIF) from the Ministry staff for the Ready for Survey month. The SPIF multiplied by the GSD will determine the horizontal distance from the POC to the location of the initial strip (IS).
5) Locate the initial strip (IS) at the SPIF distance along and at right angles to the baseline from the POC. On North/South baselines locate the IS north of the POC, on East/West baselines locate the IS East of the POC.
6) Locate all remaining strips at the full GSD along the baseline in both directions from the IS. All strips are located perpendicular to the baseline.
7) Numbering the strips:
   a. All strips that fall within the harvested area must be numbered
   b. On cutblocks with North/South baselines number the strips sequentially from South to North, and
   c. On cutblocks with East/West baselines number the strips sequentially from West to East.
8) Locating the plots:
   a. All plot locations that fall within the harvested area are to be mapped.
   b. On odd numbered strips, locate the first two plots at one half the GSD along the strip in both directions from the baseline. Locate the remaining plots at full GSD along the strip.
   c. On even numbered strips, locate one plot at the intersection of the strip and the baseline, and all remaining plots at full GSD along the strip.

   Occasionally the number of located plots will not match the intended number of plots. This can be caused by two situations:
      i. The sample grid was not completed correctly (incorrect GSD, missed plot location, etc.), or
      ii. The configuration of the cutblock results in a reduced or increased number of sample points.

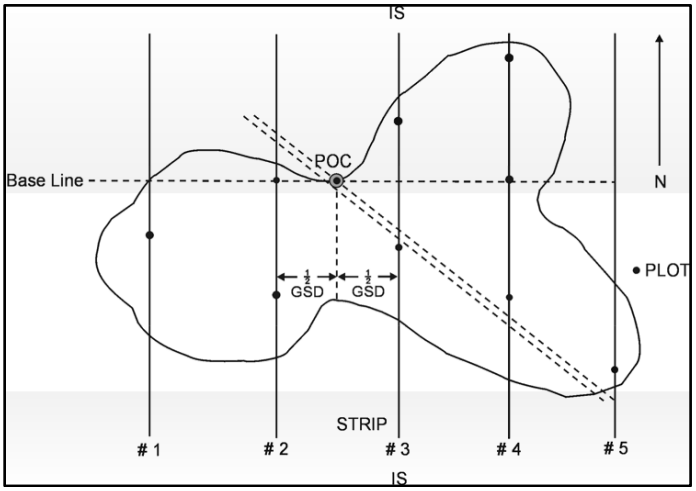
   Where the located number of plots is within plus or minus one plot of the intended number the plan, it is deemed to be acceptable.

Where the number of plots is greater than plus or minus 1 plot from the intended number, the GSD must be adjusted. To adjust the GSD, adjust the interval in ten (10) meter increments until the desired number of plots is achieved.

9) Number the plots. Each plot in a given cutblock must have a unique number identified on the survey plan map.

Figure below provides an example of the dispersed plot design.

Figure 3 Example Strip and Plot Placement Using a 50% SPIF



6.3.2 Dispersed Plot Spacing (Grid Size)

Once the number of plots within each cutblock or population (aggregate populations) has been determined, the inter-plot spacing (grid spacing) must be determined. The grid spacing is calculated from the formula of SQR (10 000 X ha/plots) where SQR means "take the square root of." Refer to the Grid Spacing Worksheet (Appendix 4) for assistance.

For the single cutblock and large multi cutblock population sampling designs, the number of plots required for each cutblock is taken in accordance with Chapter 4 of the manual.

For Aggregate sampling, the number of plots required for the population is determined from Table 4-6 Minimum Sampling Requirements by Sampling System The number of plots required within each cutblock is then distributed across the cutblocks weighted by each cutblock size within the population. The number of plots per cutblock is calculated in the following manner within the HRC Compiler:

1) Identify the net waste area of each cutblock,
2) Sum the net waste area of all cutblocks in the population,
3) Divide the net waste area of each cutblock by the population net waste area to calculate the hectare to plot ratio (HPR),
4) Multiply the HPR by the population number of plots to generate the required number of plots for each cutblock, and
5) Round up to nearest whole number.

The grid spacing calculation will generate a result to within one meter or less. This value should be used if the survey plan is generated within a GIS mapping system. If the survey plan will be produced by hand, the calculated grid spacing value must be rounded down to the nearest 5 metre value (the smallest measurable measurement at 1: 5,000 scale).

If necessary when drawing the waste survey plan, after the grid spacing value is calculated, the grid spacing can be reduced or increased, in 10 m increments, to generate the required number of plots within the cutblock.

Example: 30 plots required in a 122.0 ha cutblock will generate a GSD of 201.7m (202m)

- For survey plans drawn using GIS, use a 202m GSD
- For survey plans drawn by hand, use a 200m GSD
- If the 200m GSD generates less than 29 plots, reduce the GSD to 190m
- If the 200m GSD generates more than 31 plots, increase the GSD to 210m

6.3.3 The Right Hand Rule (RHR)

To assist the surveyor and to provide a consistent and unbiased approach, the right hand rule has been developed. The rule directs the surveyor to move or select an action by selecting the first option available from the right-hand side or direction. A sequence of actions can then follow however; the initiation of the action has been started through an unbiased selection.

6.3.4 Spot Accumulations

Spot accumulations may exist in the roadside stratum area or the dispersed stratum area. Both types of accumulations are identified as unique accumulation stratums and must be sampled accordingly when stratified.

6.3.4.1 Identification and Measurement of Spot Accumulation Stratums

Spot accumulation identification requires the surveyor to visually identify each pile and estimate or measure the pile dimensions.

6.3.4.2 Roadside Spot Accumulation Accumulations (PB_ _)

Roadside spot accumulations must be identified as a unique stratum and measured independently from the dispersed stratum. Roadside piles must be defined using the following criteria:

1) The piles are located in the roadside area of the cutblock (less than 20 meters from the road edge).
2) All piles within the stratum are counted sequentially from the POC of the cutblock using the right hand rule.
3) The roadside piles are sampled separately from the dispersed stratum. This requires assessing the area of the piles.
4) If a roadside stratum is established, roadside pile accumulations must be excluded from all roadside plots.

6.3.4.3 Dispersed Spot Accumulations (PB_ _)

Dispersed spot accumulations may be identified as a unique stratum and measured independently of the dispersed stratum accumulations provided the following conditions exist:

1) The piles are located in the dispersed area of the cutblock (greater than 20 meters from the road edge).
2) All piles within the dispersed portion of the cutblock or aggregate sample plan are counted.
3) All piles within the stratum are counted sequentially from the POC of the cutblock using the right hand rule.
4) The piles are sampled separately from the dispersed stratum. This requires assessing the number of piles and sizes.

6.3.4.4 Spot Accumulation Numbering

The selection of sample piles must be completed in a systematic and random manner. The numbering and selection of sample piles utilizes the right hand rule and can be completed using one of the two following procedures. The method selected and used by the surveyor must be consistently applied on all cutblocks within the population.

Pile numbers must be either marked on a minimum of 1 out of every 10 piles or in a method that provides for replication of sampling procedures for auditing purposes.

The options available for sampling piles are:

The One-Sided Method

1. Starting at the POC of the cutblock, number piles sequentially on the right hand side of all roads.
2. Always stay to the right hand side of the road in the direction of travel when numbering the piles. When coming to a branch or spur, go up the spur on the right hand side. At the end of the spur, turn around and come down on the right hand side.

The Two-Sided Method

1. Starting at the POC for the block, number piles sequentially as they are encountered along either side of the road. Start the numbering on the right hand side of the road.
2. When a spur road is encountered, always proceed up the spur on the right hand side.

Plot number in aggregate populations will require all piles to be numbered sequentially through all cutblocks. This should be completed by ordering the cutblocks alphabetically and then numerically where required.

6.3.4.5 Measurement and Sampling Method

The measurement, sampling methods, and requirements for piles vary depending on the sample design to be used.

The process for selecting sample and measure pile plots is outlined below:

Small Populations

For simple random sampling (SRSB or SRSA):

i. Count all piles and label them using the procedure outlined in section 6.3.4.4,
ii. Determine the number of samples required as per Table 4-6,
iii. Identify the sample piles to be measured as described in section 6.3.4.5,
iv. Measure the required pile attributes for the selected piles, and
v. Record the data.

For ratio sampling (RBS or RAS):

i. Count all piles and label them using the procedure outlined in section 6.3.4.4
ii. Determine the number of samples required as per Table 4-6,
iii. Identify the sample piles to be predicted,
iv. Complete predictions on the identified sample piles,
v. Using EForwasteBC, generate the measure samples,
vi. Measure the required pile attributes for the randomly selected piles, and
vii. Enter the data into EForwasteBC application.

Large Populations
These procedures only apply to the sample cutblocks within the population.

For SRS/Ratio or SRS/SRS sampling:

i. Count the number of piles within the sample cutblock and label them using the procedure outlined in section 6.3.4.4,
ii. Determine the number of samples required as per Table 4-6,
iii. Identify the samples required as per Table 4-6,
iv. Measure the required pile attributes for the randomly selected piles, and
v. Enter the data into EForwasteBC application.

For Ratio/Ratio or Ratio/SRS sampling:

i. Count the number of piles within sample the cutblock,
ii. Determine the number of samples required as per Table 4-6,
iii. Identify the sample piles to be predicted,
iv. Complete predictions on the identified sample piles,
v. Using EForwasteBC, generate the measure samples,
vi. Measure the required pile attributes for the randomly selected piles, and
vii. Enter the data into EForwasteBC application.

6.3.4.6 Selecting Spot Accumulations for Measurement

All spot accumulation stratums will require the identification and counting of the piles. The requirement to estimate and measure randomly selected samples depends on the sampling system chosen. In order to achieve this requirement, the surveyor must use the following procedure:

1) Identify and number all piles using the procedure outlined in section 6.3.4.4.
2) Calculate the sample pile interval. To do this:
   a. Divide the number of piles by the planned number of samples.
   b. Round the result down to the nearest whole number.
      Note: This will occasionally result in more samples than intended.
      In an aggregate, the number of sample piles will be identified after all piles in all blocks are counted.
3) The method for selecting the first pile to be sampled is to use the date of the month when the surveyor first arrives on site to do the survey. Where the date is greater than the number of piles use the last digit of the date. In an aggregate, the date will be based on the first block surveyed, and sample piles will be identified throughout the population based on this date.

Example 1:

- 36 piles requiring 12 samples, surveyed on the 23rd of the month,
- 36/12 = 3.00; Survey every 3th pile
- Select the following piles: 23,26,29,32,35,2,5,8,11,14,17,20

Example 2:

- 25 piles requiring 12 samples, surveyed on the 30th
- 25/12= 2.08; Survey every 2nd pile
- Select the following piles: 5,7,9,11,13,15,17,19,21,23,25,2,4.

Note: This process is programmed into the EForwasteBC data collection application. Once the required number of piles has been selected for prediction estimates, the application will randomly select one or more samples out of three prediction samples for measurement. For aggregates the calculated measure and prediction plots need to be entered for each cutblock.

6.3.4.7 Spot Accumulation Plot Location Procedure

In spot accumulation strata, the plot is placed on the front for even numbered piles, and on the back for odd. If it is not safe to work around the correct plot location, establish the plot on the side of the pile closest to the POC for odd numbered plots and farthest away from the POC for even numbered plots.

The plot size and shape to be used for pile plots is 50 m2. When a rectangular (or other shape as necessitated by the shape of the pile) is used, the plot edges must be clearly marked in the field.

6.3.4.8 Dispersed Spot Accumulations (PB_ _)

Piles found within the dispersed subpopulation area may be surveyed in one of two different ways.

1) Surveyed as part of the dispersed subpopulation. Under this method:
   a. Dispersed plots established in the field will include all dispersed piles or portions thereof within the plot. Where piles are included within a plot, a measure factor may be applied.
   b. All pieces that fall within a dispersed plot will be measured and recorded.
   c. Plots cannot be moved or altered to exclude piles or portion of piles contained within the plot boundary.
2) Surveyed as a unique stratum. Under this method:
   a. All piles within the dispersed stratum must be stratified separately from the dispersed stratum,
   b. All piles must be identified and numbered sequentially throughout the cutblock,
   c. Piles are selected for sampling by applying the Roadside Pile sampling selection procedures (section 6.3.4.2),
   d. Dispersed sample plots must be offset away from all pile accumulations, and
   e. Irregular shaped dispersed plots may be used if required; however, must retain a $200m^2$ size.

6.3.5 Road Rights-of-Way External to a Cutblock

6.3.5.1 Reporting

Waste assessments are required on road rights-of-way.

Where a cutting authority uses scale based stumpage billing, waste information for the road permit areas within and leading up to a cutblock must be included in a waste assessment if it contained merchantable timber. Waste volumes for the road permit area are generated using the block average waste volume in cubic metres per hectare and grade breakdown from the tributary cutblock they are associated with or through the establishment of plots as described in section 6.3.5.2.

Where cruise based cutting authorities are accessed by a scale based road permit, the cutblocks are not subject to a waste assessment; however, all internal and external road permit areas require a waste assessment. When this occurs, no waste information is available from the cutblock; therefore, alternate sources of waste information are required.

To obtain the waste information for the road permit area, the options are:

1. Complete a full waste survey of the road permit area, see section 6.3.5.2,
2. Use the right of way survey information from another surveyed road permit area containing similar species composition and waste levels, or
3. Procedures in section 9.3 for determining waste in cutblocks < 2.0ha.

Once the source of waste information is determined, the road permit waste submission information is submitted into the Waste System.

6.3.5.2 Procedures

The road right-of-way to be assessed includes all access roads leading into the cutblock from the closest previously logged cutblock or the preceding road junction. To be included in a waste assessment, the road permit area must have been built through areas containing merchantable timber.

The area of the right of way is calculated by multiplying the road length by the clearing width. The clearing width is measured from the edge of the built road to the clearing edge containing standing timber.

The reporting options vary depending of the size of the sample population and sampling design.

1) In a single block population, or sample block in a population greater than 20 cutblocks where:
   a. The net right of way area is less than 2.0 ha in size or is less than 50% of the cutblock area:
      i. No plot sampling is required,
      ii. Include the road right of way area with the dispersed subpopulation area of the cutblock on the Waste 102 screen, and
      iii. Report the road permit timber mark and area on the Waste 104 screen.
   b. The net right of way area is greater than 2.0 ha in size or is more than 50% of the cutblock net waste area:

i. Sample the right of way area with plots as part of the dispersed strata and use the stratum code OT2X,
ii. Include the road right of way area with the dispersed subpopulation area of the cutblock on the Waste 102 screen, and
iii. Report the road permit timber mark and area on the Waste 104 screen.

2) In an aggregate population where:
    1) The net right of way area is less than 2.0 ha in size and is less than 10% of the block area:
        i. No plot sampling is required,
        ii. Include the road right of way area with the dispersed subpopulation area of the cutblock on the Waste 102 screen, and
        iii. Report the road permit timber mark and area on the Waste 104 screen.
    2) The net right of way area is greater than 2.0ha in size and is greater than 10% of the block area:
        i. Sample with plots as part of the dispersed strata and use the stratum code OT2X. Include the road right of way area with the dispersed subpopulation area of the cutblock that it relates to on the Waste 102 screen, and
        ii. Report the road permit timber mark and area on the Waste 104 screen.

    3) In a large multi cutblock population
        a. Non-sample cutblock
            i. Sampling is not required.
            ii. Calculate the net waste area as required in this manual.

6.3.5.3 Plot Location Procedure

Right of way sampling as part of a dispersed stratum is completed using rectangular 200m2 plots. Locate plots in the right of way portion starting from the POC for the cutblock. Locate the plots covering the width of the area between the edge of the road and the edge of the timber using the right hand rule.

1) Determine the GSD between the plots. This is calculated by dividing the right of way length by the number of plots that are required.
2) Apply the SPIF to the GSD for the first plot.

To establish plots, follow the procedures in Chapter 7 for roadside plot establishment.

6.3.6 Roadside Stratum Within a Cutblock (RB0_)

The roadside stratum is the area adjacent to a road and typically contains roadside piles and cold decks. If decision is made to stratify roadside then, the roadside strata must be isolated from other strata found within it by removing the area of piles and cold decks. Roadside strata can contain heavier or lighter waste volume than the dispersed area.

A roadside stratum should only be identified where there is clear evidence of a difference in volume per hectare and the strata edges can be consistently identified across the population. If this cannot be determined, then the area should remain within the dispersed stratum.

This area is calculated by measuring the length, along the road of one-sided strata (occurs when a roadside stratum only exists on one side of the road) and/or two-sided strata (occurs when a roadside stratum that exists on both sides of the road). The length is multiplied by an average width for the strata (usually, but not restricted to, 15 m). The number of plots required is based on the sample design and dispersed strata requirements in Table 4-6 Minimum Sampling Requirements by Sampling System.

The plot location procedure is identified in the table below.

Table 6-2 Roadside Stratum Plot Location Procedure

<table>
<tr><th>One-sided or a mixture of one and two-sided strata</th><th>Two-sided strata</th></tr>
<tr><td>1. Start from the POC.
2. Measure the length of the one-sided strata and the length of the two-sided strata
3. Multiply the two-sided strata length by two.
4. Add the one-sided and two-sided strata together.</td><td>1. Start from the POC.
2. Measure the length of the strata and multiply it by two.
3. Determine width of roadside stratum.
4. Go to step 5</td></tr>
<tr><td colspan="2">5. Calculate the area of the stratum as follows:
Area (ha) = (length x width) / 10,000.
6. Look up the number of plots required from Table 4-6 (Dispersed).
7. Calculate the grid spacing distance (GSD) as follows:
Grid Spacing = length / number of plots required.</td></tr>
<tr><td>Example:
• Total length of one-sided strata= 1500m
• Total length of two-sided strata= 750m x 2 = 1500m
• 1500m + 1500m = 3000m
• Area= 3000m x 15m= 4.5ha (10 plots in SRSB sample population)
• Grid Spacing Distance= 3000/10=300 m</td><td>Example:
• Total length of roadside strata= 3000 m x 2 = 6000
• Width of roadside accumulation= 30m (average 15m on each side of the road)
• Area = 6000m x 15m=9 ha (10 plots in SRSB sample population)
• Grid Spacing Distance= 6000/10=600m</td></tr>
</table>

6.3.6.1 Plot Layout

1) Start from the POC and follow the right hand rule.
2) Using the SPIF, establish the first plot at the GSD times the SPIF.
3) For one-sided or a mixture of one and two-sided strata, locate a 50m2 plot on the right side of the road. For two-sided strata, locate a 50m2 plot on each side of the road.
4) If the stratum is sectioned along the road, stop measuring distance at the end of each strata section and resume measuring at the beginning of the next strata section until each GSD is located.

5) Always stay to the right hand side of the road in the direction of travel when laying out the plots. When coming to a spur, go up the spur on the right hand side. At the end of the spur, turn around and come down on the right hand side.
6) For two sided strata when an odd number of plots are required, establish the last plot on one side of the road. If the last digit of the cutting permit is odd, establish it on the right hand side. If the last digit of the cutting permit is even, establish it on the left hand side.
7) Roadside strata must be marked on the waste survey map so the layout can be audited.

6.3.7 Linear Tenure Unrelated to Forest Harvesting

Linear tenures may be authorized for non-forestry projects such as mining access roads or powerlines.

The requirement to complete a waste assessment for these tenures is determined based on the tenure document. Linear tenures with a net waste area of greater than 2.0 ha will require a full survey using one of the survey designs identified under Chapter 4. The determination of net waste assessment area follows the same principles identified in this Chapter 5.

6.3.8 Debuilt Road

If a road has been debuilt, logs and stumps have been pulled back from the side-slopes and scattered over the top of the deactivated road. A debuilt road may be surveyed in one of two different ways:

1. Include with the Dispersed Stratum

A debuilt road can be surveyed as part of the dispersed sub-population; Any plots located on the debuilt portion are sampled where they are located using a circular plot. All pieces that fall within the plot will be measured and recorded.

Note: The road surface area for debuilt roads is added back into the net waste area of the cutblock.

2. Sample as a Unique Stratum

A debuilt road can be stratified from the dispersed sub-population and surveyed as a unique stratum.

a. The minimum number of plots for a dispersed stratum type must be established
b. The stratum area is determined by the road surface width and length (as used in Appendix 8), i.e. 400m length multiplied by a 5m width equals 2000m^2 (0.20ha)
c. Locate 200m^2 rectangular plots on the debuilt portion. Plot dimensions will be 200m^2 divided by the road width (5m) (i.e. 200m^2/5m = 40m)
    i. Determine the GSD between the plots (stratum length/number of plots).
    ii. Apply the SPIF to the GSD for the first plot.
    iii. Starting at the POC, proceed down the road the calculated distance to the first plot. This point (C1) establishes the center point of the first plot.
    iv. From C1 locate a plot 5m X 40m on the debuilt road area.
    v. Establish the next plot by measuring the full GSD from C1 down the debuilt road to C1 of the next plot.

7. Field Procedures

This chapter assumes the waste surveyor is knowledgeable in the principles of sampling, forest surveying techniques, is competent with conventional field traverse procedures and equipment and is familiar with log scaling and grading procedures.

If there are uncertainties over any aspect of the field procedures, waste surveyors are encouraged to direct questions to the forest professional responsible for submitting the work. If the forest professional is uncertain, they can direct questions to the district staff.

7.1 General Requirements

7.1.1 Material to be Measured

All waste volumes within the sample cutblock boundaries, external areas attributed to a cutblock and/or plots must be included in a waste assessment according to the timber merchantability specifications specified in this manual.

All coniferous and deciduous timber, except reserved timber which is within the specifications of timber merchantability described in this manual, must be included in a waste assessment.

7.1.1.1 Plot Surveys

For pieces that lie across plot boundaries, record the in-plot portion only and classify the piece (kind, waste class, grade) based on the entire piece as if it were completely within the plot.

7.1.2 Plot Sizes

Plots in dispersed must be 200m^2

Plots in accumulations and roadside strata may be rectangular or circular, or other shapes as required and must be 50 m^2.

The formula for calculating the horizontal plot radius is: SQR (plot size in m^2 / PI), where SQR means "the square root of", and PI means 3.1415927.

7.1.3 Road Deactivation Material

Road deactivation material is timber previously used in the construction of a culvert, bridge, other required structure, or a right-of-way which has since been deactivated.

At the time of a waste assessment, all road deactivation material that has not been previously scaled must be included in the waste assessment. All road material must be measured within a unique stratum using the one hundred percent or percent estimate measurement methods, unless it is unsafe, then the volume may be estimated using an accepted method.

7.1.4 Cold Decks

Cold decks that are to be included in a waste assessment must be measured using a one hundred percent or percent estimate method. Another acceptable estimation method is a top scale which is the determination of the average piece size multiplied by the number of pieces.

7.1.5 Measurement and Recording Standards

Waste material, logs, and trees are measured for volume and graded using the principles and procedures identified in the Ministry of Forests, Lands, Natural Resource Operations and Rural Development *Scaling Manual* except where otherwise described in this manual. Waste stumps and bucking waste are graded using the principles and procedures identified in this manual.

Record gross length measurements to the nearest one-tenth (0.1) of a metre and gross diameter measurements in radius class units (rads, 1 rad = 2 cm). Record deductions in length to the nearest one-tenth (0.1) of a metre and deductions in radius to the nearest rad.

Record the gross dimensions of each piece including rot or other defects. In addition, the waste surveyor calculates the volume deductions for any defects or missing wood and records the deduction equivalent under "Deduction for Rot/Holes" in rads and/or in metres as a length deduction, along with the most appropriate "decay type."

When netting down the dimensions of a log because of defect or missing wood, the gross length will be used to determine if the piece meets the 3.0 m minimum log length. Therefore, the net length of a log used for volume calculations can be less than 3 m. Both the gross length and deductions are always recorded.

Top measurements on logs which have very little taper must be made carefully due to the length of merchantable wood involved between radius classes.

a. For oversized tops, the top measurement is made at the last occurrence (i.e. at the uppermost point on the tree) of the applicable timber merchantability top dimension specification.
b. When using a scale stick, for a 10 cm top, it will be the mid-point of the 5 radius class. For a 15 cm top, it will be the line separating the 7 and the 8 radius class.

Recording the measurements of the portion of borderline pieces that are outside the plot is optional. The minimum requirement will be the measurements of the portions of the pieces within the plot, together with a code (when needed) that will override computer checks on minimum log length.

Measurement of Grade 6 or Grade code Z logs is optional.

7.1.6 Minimum Measurement Requirements

The minimum length requirement for measurement is 0.1 of a meter (10cm). Pieces less than 0.10 of a meter (10cm) at the midpoint of the diameter are not recorded.

All dead pieces greater than fifty percent (50%) sound that meet or exceed the TMS must be measured.

The minimum specifications are:

i. For logs, all pieces with a gross length of 3.0 meters or greater as measured between the utilization top and butt diameter,
ii. For bucking waste, pieces must be 50% or more of the original log diameter and meet the TMS, and

iii. For a tree, it must contain a log meeting the minimum timber merchantability length (3.0m) from high side of the stump to the utilization top diameter.

7.1.7 Waste Class

Waste classification must not be biased for any reason such as accommodating inadequate planning and supervision, poor harvesting methods, inadequate/careless logging practices, or a licensee's own manufacturing or market specifications.

All waste pieces must be classified as either avoidable or unavoidable.

> ***Unavoidable*** volumes are those which cannot be removed because of physical impediments, safety considerations, or environmental constraints. By definition, all other volumes are ***avoidable***.

7.1.7.1 Examples of Unavoidable Waste

1. Due to physical impediments:
   a. Logs wedged between boulders, or
   b. A log stranded on an inaccessible ledge.
2. Due to safety:
   a. The portion of a high stump (with a rock against it) between the maximum allowable stump height and the height where the stump could have been safely cut (Figure below),
   b. Logs with shards of embedded rock, usually resulting from blasting. If the pieces are trimmed within 20 cm of the rock, such pieces may be classified as unavoidable. If the pieces have been trimmed longer, the segment beyond the rock should be classified as avoidable, without making any trim allowance,
   c. Log pieces in hand falling cutblocks that were cut to create escape paths for the fallers. The pieces must be less than 35cm in diameter and angle cut,
   d. Bucking waste with severe deformities as outlined in bucking waste section, or
   e. Logs that are unsafe to remove due to site specific circumstances.
3. Due to environmental or stewardship requirements:
   a. A log if removed will cause excessive site disturbance or soil degradations,
   b. A log left bridging a class 4 stream,
   c. Stub trees or high stumps left to protect reserve trees within a WTRP (where required under a operational plan, or identified in schedule B), or
   d. Approved high stumps due to snowpack 7.3.5.2.

Figure 4 Example of Unavoidable Waste

7.1.8 Examples of Avoidable Waste

1. Stub trees that have not been identified in a operational plan and/or the retained volume was not accounted for in the appraisal of the cutting authority.
2. Chunks on a skidding trail used to support the machinery that resulted in the breakage of pieces greater than the minimum log length. Such pieces are classified as avoidable, and are graded according to the characteristics of the whole original piece.
3. Helicopter bucking waste. Incorrect estimation of log weights may result in having to buck the logs shorter after attempting to lift them. Such waste is always regarded as avoidable.
4. Pieces bucked from a log to 'zero' the processor.
5. Bucking waste cut from a log to remove a defect that extends beyond the effect of the defect.

7.1.9 Piece Numbers

Waste pieces are to be clearly marked in such a manner as to allow identification of the piece for audit purposes. Mark all pieces measured in the plot clearly with the piece number, using tree marking paint.

Piece marking must be completed in a manner that retains the marking for a up to six (6) months.

Waste pieces are usually assigned one piece number. However, some pieces contain both avoidable and unavoidable segments. In these situations, the segments are marked and recorded separately, each with its own piece number.

7.1.10 Grading Pieces

Logs and trees must be graded according to the rules in *the Scaling Manual except* where the waste rules are different and then waste rules are used. For example:

a. The minimum log length for waste is 3.0 m (instead of 2.5 m in the *Scaling Manual*)
b. Dead Grade 4 logs are identified as grade code '5'

> Note: Grade code 5 is used as an identifier for the reporting and tracking of dry grade 4 timber. Grade code 5 is not a standard scale grade code and is grade 5 as defined by this manual.

To be classified as dry, a piece ***must*** have one or more of the following characteristics (indicators):

a. Deteriorated cambium,
b. Loose or shedding bark,
c. Sap rot,
d. Wood borers,
e. Deep checks (not weather checks).

Pieces ***cannot*** be classified as dry if they display any of the following characteristics (contraindicators):

a. Curling bark (green bark that is curling or cupping due to the drying process),
b. Green needles,
c. Fresh cambium (sticky),
d. Mildew or mold on wood surface (except on windthrow),
e. Charred wood (recent fire kill),
f. Dark weathered ends (indicative of decked timber), or
g. Pitching log ends.

Logs which display at least one indicator plus one or more contraindicators are deemed to have come from a live, green tree.

Where the logs display characteristics (i.e. sun checks) which were caused by delays between timber felling and survey, they do not qualify as dry 4.

Bucking waste and stumps must be graded according to the rules in this manual.

All waste pieces must be measured and graded according to their condition (i.e. grade and decay) at the time the timber was felled. The effect of time and weather since the date the timber was felled is not taken into account when measuring waste pieces.

7.1.11 Piece Estimates

Waste pieces are often partially obstructed by branches, soil and other loose debris. The correct measurement of waste pieces is dependent on the ability of the surveyor to view a piece and confidently measure dimensions and observe defects affecting volume and grade. Surveyors are expected to attempt to clear loose debris to facilitate measurement and classification of pieces. To meet this objective a "15 second rule" should be applied.

The 15 Second Rule – If loose debris cannot be removed from a piece in 15 seconds or less the piece should not be measured.

In order to correctly establish the grade of a log, at least one end must be visible or the piece should not be recorded.

7.1.12 Measure Factor

In some situations, it may not be possible to measure or visually estimate each piece within a plot. In these cases, a measure factor can be applied to the plot. The measure factor adjusts the plot volume upward to account for pieces within the plot boundary that have not been measured.

In these cases:

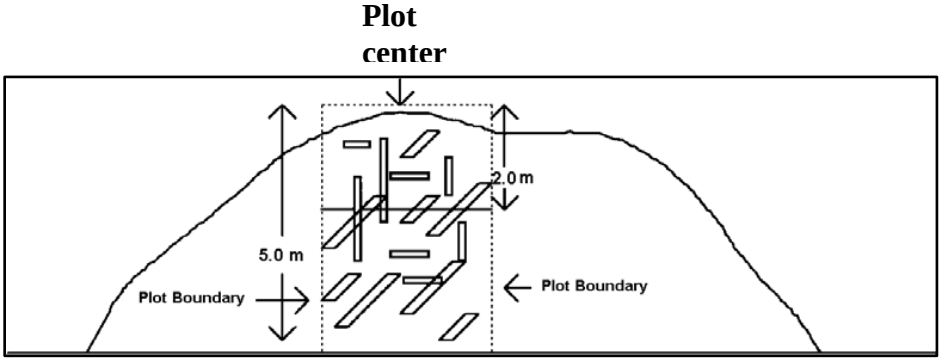
1) Measure and/or visually estimate the waste material that is accessible. Measure as many pieces as possible, even when some dimensions of an individual piece must be estimated.
2) Project the plot boundaries down to the ground and visually estimate what portions of the volumes within the plot boundaries were measured. Record this portion on the plot tally card under "measure %."

This percent is known as the "Measure Factor" and is only applied to the plot method.

Example

In the example below: If you were able to measure down approximately 2 m, you would record a measure factor of 40 percent providing that the volumes of waste were spread evenly through the cylinder within the plot boundaries. The measure factor is derived from 2m/5m x 100% = 40%.

Figure 5 Measure Factor



7.1.13 Waste Survey Safety Procedures

In accordance with WorksafeBC section 3.12(1) of the Occupational Health and Safety Regulation - "*A person **must not** carry out or cause to be carried out any work process or operate or cause to be operated any tool, appliance or equipment if that person has reasonable cause to believe that to do so would create an undue hazard to the health and safety of any person.*"

The objective of this section is to provide an alternative method of determining waste volumes where a portion or the entire plot or cutblock cannot be measured safely.

The procedures are intended to provide the surveyor with a set of procedures to follow that will provide the best available information and support the key principles of sampling while maintaining worker safety.

1. Where a piece or portion of a plot or an entire plot cannot be measured safely, attempt to complete the piece or plot through estimation from a nearby location.
2. Where the plot cannot be measured or estimated safely, move the plot to a safe location as specified in section 7.2.4 up to a maximum of 32 meters. If there is no safe location within 32m, drop the plot.
3. When a plot must be dropped for safety, use replacement data of an existing plot from the same cutblock or licence that has similar waste levels, species, grade profile, age and method of harvesting. The surveyor may have to use a measure factor to adjust the volume to make it representative of the actual waste levels.

   > If replacement data from another plot is used, ensure the volume is the same or less of the dropped plot. If the volume is less, then apply the measure factor to increase the waste volume to the appropriate level. The waste system cannot reduce a plot volume; therefore, assigning a measure factor greater than 100% will not work.

4. Where more than half of the plots cannot be established safely, the waste volumes on the cutblock can be determined using the following alternate methods:
   a) Within a single and aggregate cutblock sample plan, the following replacement data may be used:
      i. The closest cutblock owned by the licensee with the same benchmark, harvest system, and stand type,
      ii. The closest population average,
      iii. The district average volume/ha from the waste system and species and grade from HBS, or the
   b) Within large multiple cutblock sample plans, delete the cutblock from the sample cutblock population and select a replacement cutblock of similar sort criteria.

7.2 Plot Establishment

Sample plots must be established at the location identified on the waste survey plan. Moving plot centres from the measured or traversed location presents significant bias and is only permitted in accordance with section 7.2.4 of this manual. If the plot cannot be completed safely, the procedures outlined in section 7.1.13 of the manual are to be used.

7.2.1 Locating Waste Plots Using Conventional Methods

To locate waste plots using conventional (hand survey) methods, determine the distance and bearing from a tie point on the survey plan map to a sample point. Using field traverse procedures, travel the required distance and bearing from the tie point to the plot location as indicated on the waste plan. When the required distance has been measured, a stake, pin or equally effective center point marker must be established at the plot centre.

Tie points must be linked to the survey grid with a hand traverse that meets the standards in Chapter 8. All distances are to be corrected for slope and must be measured to the standards listed in this manual.

7.2.2 Establishing Waste Plots Using GPS Technology

Waste plots may be located with the use of GPS technology provided the following procedures are followed:

1. The survey plan map has been created using GIS software,
2. The plot location coordinates are generated through GIS software,
3. The plot locations are identified from 'system derived' X, Y coordinates with the coordinate in an attribute table,
4. **Coordinates must be labeled to the plot number**,
5. Plot coordinates must be transferred to the GPS unit via digital file, and
6. Plot coordinate files must be provided to the Ministry upon request.

7.2.3 Plot Establishment

All POCs and tie points should be marked with aluminum tags or flagging ribbon and high-visibility paint and be easily observed from access roads.

Plot centres are to be established with a sturdy stake driven well into the ground and made clearly visible with paint or surveyors flagging ribbon and labeled using a waterproof felt pen or other method (i.e. aluminum tags) that clearly identifies the plot number.

The plot centre is the point at which the center stake enters the ground, not the top of the stake. If the plot center location is within a stump or other impenetrable object, mark the plot centre with an "X" at the point on the object with paint and locate a plot center stake close to the indicated center point. Record the distance and bearing from the plot stake to the actual plot center on the field tally card.

Plot boundaries are to be clearly marked on all borderline pieces with paint. Marking the entire plot radius is not required.

Recorded pieces are to be clearly numbered with tree marking paint.

The formula for calculating the horizontal radius of a circular plot is:

$$\sqrt{[\text{plot size in } m^2 \ / \ \pi]}$$

Any odd shaped accumulations may be sampled with a long rectangular plot or strip so long as the plot size is consistent within the stratum.

All distances between plots and plot radii are to be corrected for slope and must be measured to the standards listed in Chapter 8. The formula used to correct for slope is:

$$\text{COS [Tan}^{-1}\text{ (slope \%/100)]}$$

The inverse (1/*x*) of this number is multiplied by the plot radius to obtain the corrected slope distance.

Example: Slope of 74% and plot radius of 7.98m

COS [Tan $^{-1}$ (74/100)] = 0.8038

0.8038 $^{-1}$ = 1.2441

1.2441 x 7.98m = 9.93m Slope distance

Appendix 5 contains the corrected slope distances for a 7.98m (200 m^2 plot) plot radius.

7.2.3.1 Roadside Stratum Plot Location

Plots located within a roadside stratum must be located in an unbiased and random manner. Plots must be located in such a way that all areas of the stratum are available for and have an equal probability of sampling.

In the field, plot centres are located alternately at 4 m for even numbered plots and 11m for odd numbered plots from the road surface edge when a 15 metre wide roadside stratum is used. If a different stratum width is used, the surveyor must ensure the plots cover the entire stratum width and may use a rectangular 50 m2 plot where needed.

7.2.4 Requirements for Plots Falling Near the Cutblock Edge or Outside of the Sample Area

The completion of all the sample points identified on the survey plan and the location of the sample point at, or very near its intended location, is a key principle of sampling. Sample points will occasionally fall outside or too close to the edge of the dispersed stratum due to map inaccuracies, acceptable location errors, obstructions (i.e. pile) or safety reasons (i.e. a wasp nest). When this occurs, two options are available - the completion of a border plot or moving the plot.

Prior to applying one of the two options the surveyor must:

1. Confirm the plot location procedures and sample plan map are correct.
2. Never move a plot center that falls completely within the stratum it was intended to sample.
3. Follow the procedures in the order they are presented:
    a) Locate a border plot, or, if that is not successful,
    b) Move the plot location using the method described in the manual.

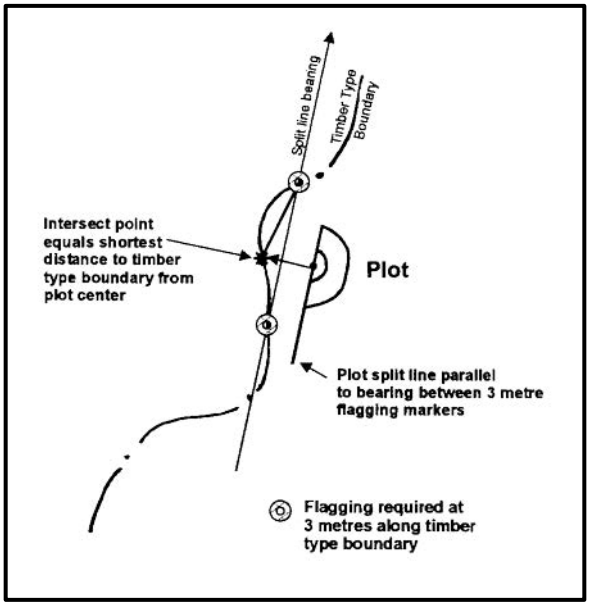
Plots Falling Too Close to a Stratum Boundary (Using Border Plots)

If the dispersed plot centre falls within the stratum to be sampled but a 200 m^2 circular plot cannot be established because a portion of the plot falls outside the stratum, establish a 200 m^2 half circular plot (11.28 m radius).

To establish a plot, proceed the shortest possible distance to the edge of the stratum from the plot center point, measure 3.0m in each direction along the edge of the stratum and take a compass bearing between the two points. This compass bearing will be used, to determine the edge (straight line boundary) of the half-circle plot.

From plot center, travel the determined bearing 11.28m and establish a 'corner' of the border plot. Establish the second corner of the border plot using opposite bearing of first plot. Proceed within the stratum locating the plot boundary using the 11.28m radius. Plot corners must be clearly marked in the field.

Figure 6 Border Plot



If a 200 m2 half-circle plot (11.28 m radius) cannot be established without sampling outside of the stratum, move the plot using the procedure described below.

Plots Falling Outside of the Dispersed Stratum (Moving Plots)
Dispersed plots that fall outside the type stratum they were intended to sample are to be moved in a consistent and therefore auditable manner. The procedures for moving plots are as follows:

a. From the traversed plot location, move the plot center North one plot radius (8.0 m) to establish either a full circle plot or a half circle (border) plot. If this point does not result in a plot that remains entirely within the stratum it is meant to sample, attempt the same process East with the same distance and procedure, then South, then West.
b. If the above fails, repeat the same procedure but increase the distance by 8 m increments.

A full or half circle plot must be established at the first possible location. The plot may be dropped if it cannot be located within ½ of the intended GSD.

Note: this is the only situation where a plot will be excluded from sampling.

7.3 Kind of Material

7.3.1 Logs

A log is defined as any near-round piece with more than half of its original circumference remaining and with an average diameter equal to or larger than the timber merchantability specification diameter for at least 3 m of length.

In a waste survey, the term "logs" encompasses all pieces that are broken or cut at each end, are a minimum of 3.0m in length with a top diameter of 10 cm or 15 cm. Record as "L" under "Kind of Material" on the plot survey card (FS 161).

"Log length" is the length that a scaler records to accurately determine the gross volume of the piece; i.e., without making any deductions for rot.

A broken top piece is measured from the top contractual diameter, and then a length deduction (from the diameter to the XY line) is applied to account for the missing wood, as illustrated in Figure below.

Logs are measured and recorded as a single piece, they are never ‘pencil bucked’ into multiple pieces to separate defects or waste class.

Figure 7 Example of a Log Measured as a Single Piece

7.3.2 Trees

"Tree length" is determined using a tape/chain and a clinometer or an electronic measuring device such as a laser instrument. The waste surveyor visually estimates the location of the top diameter and then measures the length from this point down to the timber merchantability stump height (must make a 3 m log that meets the timber merchantability specifications).

Record the timber merchantability specification top diameter in rads as the top diameter. If the top is broken, visually estimate the diameter at the break.
The butt diameter is the tree diameter at the timber merchantability specification stump height, accounting for flare (See Scaling Manual section 6.2.2).

Record as "T" under "Kind of Material" on the plot survey card (FS 161). The classification of a tree versus log is not significant unless the determination impacts measurement of reserve trees.

Trees are measured and recorded as a single piece, they are never ‘pencil bucked’ into multiple pieces.

7.3.3 Standing Trees

Trees left standing after timber harvesting that are not reserved for silviculture, biodiversity or a forest management reason are measured in a waste assessment and classified as avoidable or unavoidable waste.

Appropriate documents such as tenure licence documents, timber appraisal applications and maps need to be referenced to determine the conifer and/or deciduous leave trees identified by species to be retained as reserved timber for the area being waste assessed. These specifications apply to trees outside of the mapped wildlife tree patches.

7.3.3.1 Clearcut

Individual standing tree volumes that are measured must be kept separate from the plot waste volumes. Standing tree dimensions are recorded using FS 161, Waste Survey Plot Tally. Trees that were left scattered sparingly throughout the cutblock are measured individually and each tree is numbered and marked with paint. Record the timber merchantability specification top diameter in rads as the top diameter. The length is determined using a tape/chain and a clinometer or an electronic measuring device such as a laser instrument. The waste surveyor visually estimates the location of the top diameter and then measures the length from this point down to the timber merchantability stump height (must make a 3 m log that meets the timber merchantability specifications). If the top is broken, the waste surveyor visually estimates the diameter at the break and measures the length from the break mid-point to the stump height. The butt diameter is obtained by measuring the tree diameter at the timber merchantability specification stump height, accounting for flare.

On the FS 161, under Kind, record T for standing trees or D for downed trees, classify the trees as avoidable or unavoidable. Enter the dimensions for length, top and butt diameters, end codes, and assign a log grade.

One possible method for determining the volume of standing trees is to record the species and diameter of each tree and use the Extended Type Stand and Stock Table from the timber cruise compilation.

For trees that were left in a large patch where individual tree measurement is impractical, the waste surveyor will perform a closed traverse measuring the precise area represented by the tree patch. The cruise net volume per hectare (for that timber type(s)) will be used to determine the volume of timber in the tree patch that was not harvested. A patch is defined to be a grouping of trees occupying an area of more than one hectare. For a patch that is less than one hectare, a surveyor may apply the cruise net average or opt for individual tree measurement.

For scattered standing trees, the standing tree areas must be properly stratified. Plots will be allowed but the block must be surveyed using the Cutblock option.

Except for individual standing or downed trees where each tree is individually graded, the grade allocations for large tree patches left in clearcuts, are based on the historic billing grade profile of the timber mark for the cutting authority. Only in the absence of the billing history records or if an RPF or RFT considers the historical records are unrepresentative of the grade profile on site, grades may be derived by an RPF or RFT based on examinations of the actual grade compositions of the stand left on site.

7.3.3.2 Partial Cut

Surveyors should reference appropriate documents that provide the volume percent reduction by either one or more of species, timber type, risk group/tree class or treatment unit for each individual cutblock within the cutting permit or agreement.

Timber volume that is left in excess of the leave volume will be billed as waste subject to the application of the waste benchmarks.

There are at least two methods – re-cruise or fixed area waste plots, for determining the unharvested standing tree volume in a partial cut. Choose a method that is appropriate for the cutblock.

For a re-cruise, a licensee must strive to put in a sufficient number of cruise plots that will either meet or exceed the sampling error achieved in the original cruise.

If waste plots are used, the plot size should be 200 m^2. A licensee must strive to put in a sufficient number of waste plots that will meet or exceed the sampling error objective approved for the reporting unit. The minimum sampling intensity required is at least two plots per stratum or if the cutblock is not stratified, two plots per cutblock.

Once the unharvested standing tree volume has been derived, the timber scale grades will be assigned using the historic billing grade profile of the timber mark for the cutting authority. Only in the absence of the billing history records or if an RPF or RFT considers the records are unrepresentative, grades may be derived by an RPF or RFT on the basis of actual grade compositions of the stand left on site.

The survey results for cutblocks that have been harvested using partial cut systems must be sponsored by an RPF or RFT. This is to confirm that the partial cut timber harvesting requirements that were previously stated in Schedule B, or the Percent Reduction Report in the Appraisal Cruise Compilation Submission have been met and there are no waste

billing concerns on the remaining standing tree volumes. If a field or office review by ministry staff identifies an apparent discrepancy with the species or volume harvested, the licensee or the TSM may be directed by the District Manager to re-cruise or resurvey the residual standing trees.

7.3.3.3 Unharvested Cutblocks

The District Manager may bill an unharvested cutblock in an expired, surrendered or cancelled cutting permit or authority. The billings will be made on the basis of the net cruise volume attributed to the unharvested cutblock.

Once the net cruise volume is determined, the grade allocations will be based on the historic billing grade profile of the timber mark for the cutting authority. Only in the absence of the billing history records or if an RPF or RFT considers the records are unrepresentative, grades may be derived by an RPF or RFT based on examinations of the actual grade compositions of the stand left on site.

7.3.4 Slabs

A slab is defined as any non-round piece with less than half (1/2) of its original circumference remaining, a minimum thickness of 10 cm and an average diameter equal to or larger than the timber merchantability specification diameter.

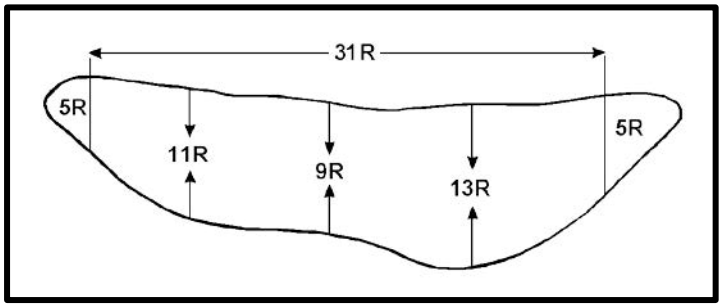
Slabs are measured, graded and recorded as a "Log" (L) if greater than 3.0m in length and have a minimum thickness of a least 10 cm for at least 3.0m.

Refer to Chapter 5 of the *Scaling Manual* for measurement procedures for slab ends in various shapes (i.e., semi-circle, quadrant, sector, segment, etc). Alternatively, the following method is accepted for computing slab diameters, for waste purposes.

Using Figure 7-5, slab diameters are computed using the following steps:

i. Measure and average 3 thicknesses. i.e., 11 + 9 + 13 = 33/3 = 11 rads
ii. Measure 1 width between 5 rad edges. i.e., Width = 31 rads
iii. Average the thickness and the width. i.e., 11 + 31 = 42/2 = 21 rads

Figure 7-5 Measuring Slabs



7.3.5 Stumps

A stump is defined as any piece with more than half (1/2) of its original circumference remaining, less than 3.3 m in length and still attached to the roots. The length is to be measured from the high side of the stump. A stump that is at least 3 m in length after the maximum allowable stump height (usually 30 cm) has been deducted is classified as a log because of its length.

Stump heights are always measured from the high side.

Stump height *is not* measured from the top of any root flare or any obstacles such as accumulated bark, moss, or other loose duff and vegetation that could be avoided during the falling process. No consideration should be given to brush and undergrowth that should cut away before falling.

Measure from where the ground high side meets the base of the stem to the top of the felling cut (as shown in Figure below) to the nearest tenth (0.1) of a metre. The volume of an undercut is included in the measured stump volume. Deduct the stump height of 0.3 m and record the result under length on the FS 161.

- If the total stump height is less than or equal to the stump height of 0.3 m measured from the high side, then the stump *does not have to be recorded.*

For raised stumps (nurse stumps) where the tree has grown out of a rotten log, the stump height should be measured from the point of germination, or the high side, whichever is higher.

Stumps will not normally be graded and will default to sawlog grade. However, if the log from the stump is present the stump should be graded the same as the log.

If the stump has less than 50 percent firmwood volume due to decay, the stump is not recorded. If the stump has greater than 50% firmwood and less than 75% firmwood volume due to decay it is graded as Grade 4.

In the Interior, dead stumps will only be measured and recorded where the timber stand is designated to be catastrophic.
Use the following guidelines to differentiate between dead/live stumps:

Dead	considerable crumbling sap rot and/or loose or missing bark.
Live	little or no crumbling sap rot and bark not loose.

Sometimes stumps can be broken up in logging. Any stump fragments are ignored. Conversely, any stumps with missing fragments are measured as if the fragment was still in place.

7.3.5.1 Measuring Stumps

Careful measurement of stumps is critical because they contain high volume per unit of length.

Measure the top diameter (inside bark) of the stump (unless the total height of the stump exceeds 1.3 m) and record it in the "top" column.

Butt dimensions are not required for stumps.

For a stump whose total height exceeds 1.3 m, record the diameter (inside bark) at 1.3 m above the ground on the high side of the stump. The taper of the stump should be finished at approximately that point and recording the top diameter above 1.3 m would end up under estimating the volume of the stump.

No entry is required in either the top or butt end code fields on the FS 161.

For stumps damaged during logging.

i. Where less than 50% of the original stump diameter remains do not tally the piece.
ii. Where greater than 50% of the original stump diameter remains measure as the full original diameter.

7.3.5.2 Waste in Stumps

The surveyor should always view high stumps with consideration to safety. Physical obstructions are often moved away from stumps during harvesting operations. Look for unusual bark patterns that indicate the presence of a log or rock before falling.

Unless there are physical obstructions or safety precautions because of decayed wood, waste in stumps is classified as avoidable waste.

Unavoidable waste occurs where an obstruction prevents cutting the tree to the timber merchantability specifications. Where there are physical obstructions, the lowest height that the tree could have been cut must be established.

Frequently, trees and snags with butt rot are felled above the TMS stump height for safety reasons. Under these circumstances, a stump may have both avoidable and unavoidable components. This situation is illustrated in Figure below.

The District Manager may approve a higher allowed stump height on all or a portion of a cutblock where:

i. Higher stumps are required for safety reasons,
ii. Higher stumps are required for identified stewardship or other environmental reasons or,
iii. Snow depth prevents access to the cutting authority TMS stump height or,
iv. Higher stumps are required for retaining logs within the cutblock on very steep slopes.

Where an exemption for a portion of a cutblock is submitted the application must include a map and/or written description indicating the requested portions of the cutblock.

i. The exemption will specify a new maximum stump height.
ii. Measurement of approved high stumps
    a. High stumps are always measured and recorded as waste.
    b. The portions of the stump between the TMS stump height and the approved exemption stump height is considered unavoidable waste and is recorded appropriately.
    c. The portion of the stump above the approved exemption stump height is considered avoidable waste and recorded appropriately.

Record multiple piece stumps as individual pieces with appropriate dimensions and comments as per the diagram below.

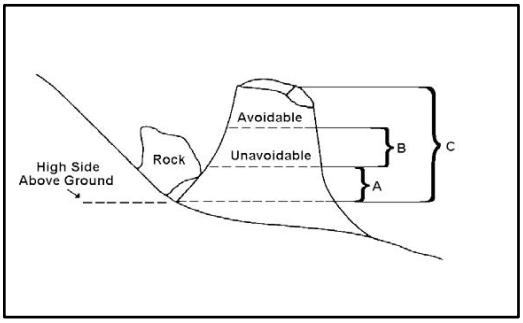


Figure 8 Avoidable and Unavoidable Waste

Descriptions:

A. *Timber merchantability specifications (TMS) stump height* of 30 cm is measured from the ground on the *high side*. This part is not recorded. If the stump is higher, length measurements start from the 30 cm mark.

B. *Unavoidable stump height* is the height specified is the minimum distance from the ground on the *high side* of a stump up to a point above a physical obstruction which allows for safe falling. B minus A = unavoidable piece.

C. *Total stump height* is the distance from the ground on the *high side* to the top of the felling cut. C minus B = avoidable piece.

7.3.5.3 Windfall Stumps

High stumps often occur in areas damaged by wind or as single trees within a stand. Safety for the person cutting the log off a tree that has been blown over is the primary consideration when classifying these pieces.

Windfall stumps can typically be identified by the presence of the roots where the soil has fallen away. The stump and roots will appear weathered and or contain other plants growing perpendicular to the tree stem.

1) It is very difficult to determine if a stump is avoidable or unavoidable after the logging has been completed since the cause for the high stump will likely be moved.
2) In some blowdown situations, there may be wind sheared trees resulting in high stumps that could not yield a minimum-length (3.0m) log. These stumps are considered breakage and are not measured.
3) In hand falling areas, for borderline calls, if there is any question as to whether the stump should be called avoidable or unavoidable the waste surveyor should give the licensee the benefit of the doubt and call the stump unavoidable.
4) In machine falling areas, the safety considerations are reduced therefore, stumps should not contain significant waste volumes.
5) In machine falling areas where there is evidence a machine was used to push over the tree or has damaged or broken the stem of the tree, the stumps will be measured from the TMS stump height.
6) Examples of unavoidable stumps:
   a. Other windfall trees obstruct the trunks of standing trees preventing lower cuts.
   b. Blowdown stumps which stand back up when the logs are bucked off.
   c. Guy line stumps if there is no unnecessary waste of wood. Any portion that is excessive waste must be classified as avoidable.
   d. Blowdown stumps on a roadside or landing should be classified as unavoidable.
7) If a minimum length log (3.0m) is left attached to a windfall stumps, the volume above the TMS stump height is recorded.

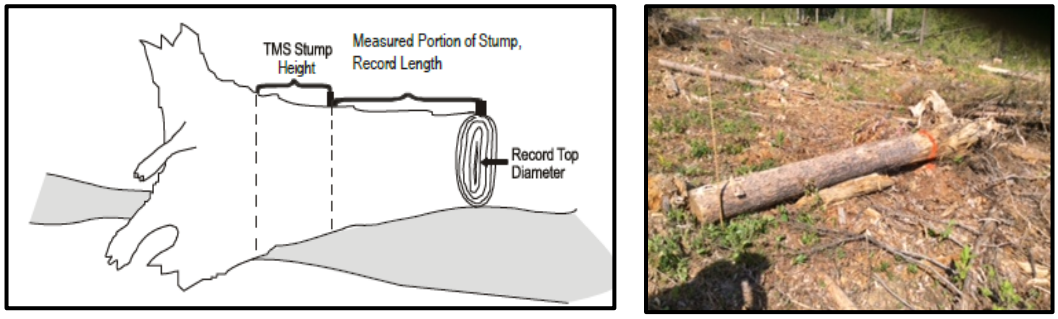


Figure 9 Examples of Windfall Stumps

7.3.5.4 Borderline Stumps

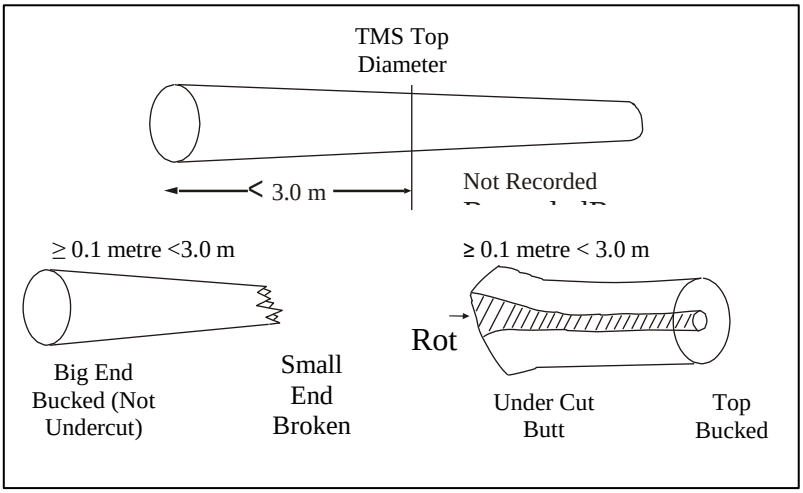
For borderline stumps, measure the horizontal distance from the plot centre to the geometric centre of the stump at a point 30 cm above the high side. If this point is located inside the plot, the entire stump is recorded. If it is not, the entire stump is not recorded.

For knocked-over and uprooted stumps, measure the horizontal distance from the plot centre to a point 30 cm above the high side or the point of germination (POG), whichever is higher. If this point is located inside the plot, measure the entire stump.

7.3.6 Bucking Waste

Bucking waste is recorded as "W" under "Kind of Material" on the FS 161 (Plot Survey Card).
Figure below shows a number of bucking waste pieces.

Figure 10 Examples of Bucking Waste



7.3.6.1 Sequential Pieces of Bucking Waste

Pieces that physically meet the minimum requirements, however, contain severe shatter that extends through the entire piece and/or the piece would easily break apart into pieces less than the TMS are not measured.

Where more than one piece of bucking waste is present within a plot and there is clear evidence all pieces are cut sequentially from the same log, the pieces must be tallied and graded as a single piece provided the following conditions are met:

1. Clear evidence is defined as consistent taper, matching cuts and matching features (shape, rot, and knot pattern) amongst the pieces,
2. The piece can only be graded based on characteristics of the smallest top and largest butt segments,
3. Sequential pieces must be the same waste class, species and grade, and
4. Pieces can be combined to create a log for data entry reasons; however, the piece will be graded as bucking waste.

7.3.6.2 Waste Class

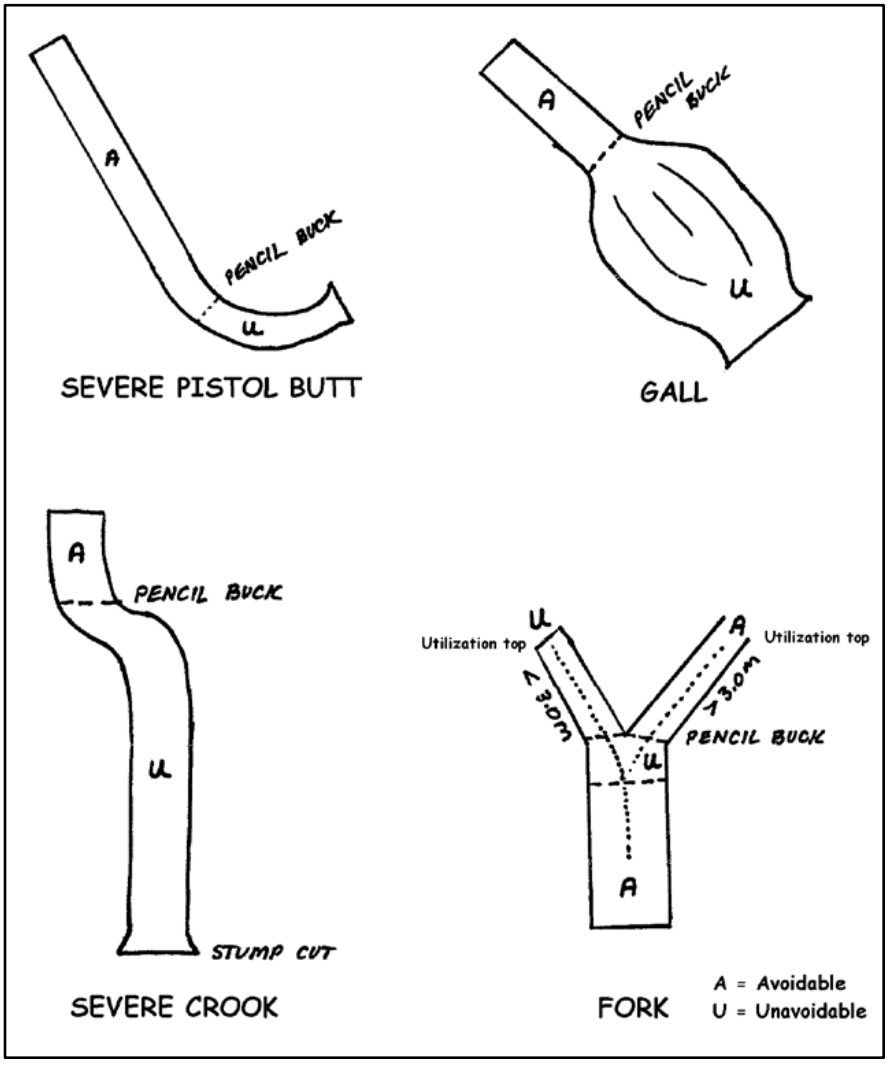
All bucking waste pieces are classified as avoidable or unavoidable waste class.

Bucking waste is usually considered avoidable unless there is clear evidence that pieces were cut out for physical, environmental, or safety reasons during falling and bucking. Unavoidable bucking waste can usually be identified through on-site evidence and/or oblique cut angles required during hand bucking.

Some pieces may contain sections of avoidable and unavoidable waste which must be tallied separately. Pieces may be pencil bucked and recorded as unique pieces to separate avoidable and unavoidable portions as shown in Figure below. Segregations must be identified and tallied separately for any section greater than 0.10m in length.

Severely deformed sections of logs must be removed because they cause difficulty (and in some instances a safety hazard) when the logs are processed, loaded and transported. Pieces with severe physical deformities such as forks, crooks, pistol butt, extreme sweep, galls or goitres can be pencil bucked and classified appropriately.

Figure 11 Examples of Severely Deformed Bucking Waste



7.3.6.3 Bucking Waste Grading

All bucking waste pieces must be assigned a grade code. Grading assigns the waste billing

rate and the cut control attribution category for the piece. The grades assigned to bucking waste pieces will be grades 1, 2, 4 and 5.

The short lengths as well as field conditions that affect the measurement and classification of the pieces limit the amount of information available to correctly assign a grade code. Harvest methods, utilization standards, log quality, decay and many other factors influence how and why pieces of bucking waste are cut from logs.

The application of the scaling grade rules for logs are not always possible or practical for bucking waste pieces. To provide a reasonable, repeatable, and accurate method of identifying bucking waste grades, a grade code matrix has been developed with an objective to assign a grade that most likely would be correct for the piece given its current dimensions and condition. The grading matrix has been designed so it will not always generate the correct grade on all pieces; however, it should generate the most likely grade on most pieces.

> **Note:** In all cases where the parent log is present the bucking waste was cut from, the bucking waste will be graded including the characteristics of the parent log.

Bucking Waste Grading Matrix

Pieces Less than 50% Sound

- **Measurement is optional,** record as ‘Z’ grade if measured
- Must show rot at both ends of piece and be less than 50% sound.
- Must meet ‘Z’ Grade criteria as per the *Scaling Manual* section 9.5
- Equivalent to inventory W2 volumes
- Not billed as waste

Pieces Greater than 50% Sound

i. Grade 6

- **Measurement is optional**
- Must meet Grade 6 requirements of the *Scaling Manual* section 9.1.3
- Must contain evidence of felling cut

ii. Unavoidable

- Identification of correct waste class is key principle
- No monetary waste billing applied
- Identify correct grade where possible:
  - Identify Grade 4 and 5 pieces
  - Identification of Grade between grade 1 and 2 is not auditable

Avoidable Pieces

Avoidable pieces greater than 50% sound are further classified by the location in the tree they were cut from - the top, the middle, or butt. The three classifications are designed to be a surrogate for the diameter requirements within the *Scaling Manual* checking criteria.

- **Top** – Pieces cut from the top of the tree with a cut butt greater than 5 rads (10cm) and extend to the maximum utilization point 5 rads (10cm).
  - The intent is to include the pieces cut from the top of the tree
- **Middle** – Pieces cut from the middle portions of the tree. No evidence of the felling cut or utilization top exist. The top must be greater than 6R (12cm).
  - The intent is to include mid-range diameter pieces cut from the middle sections of the tree and contain a top diameter greater than 6 rads (12cm)
- **Butt** – Pieces cut from the base of the tree which must include evidence of the felling cut.
  - The intent is to include large diameter pieces cut from the base of the tree

All pieces that are better than the top, middle, butt requirements are assigned Grade 1 or 2 and contain:

  - Sound and round or slab,
  - No severe defect or deformity,
  - Less than 3 - 4 cm checks,
  - Any butt rot must be conical in shape,
  - ¾ and $^{4}/_{4}$ diameter rot will normally appear as through rot and be graded 'Z,'
  - Slabs greater than 7.5R (15cm)

- **Top pieces**
  - **Grade 4:** Live/green pieces with 1 or more checks to the heart, or 1 or more oversize knots, or greater than 4cm Spiral Grain
  - **Grade 5:** Dead pieces with 1 or more checks, or 1 or more oversize knots, or greater than 4cm Spiral Grain
- **Middle pieces**
  - **Grade 4:** Live/green pieces with 2 or more 4 cm deep checks, or 3 or more oversize knots, or severe shatter, or greater than 15% Spiral Grain
  - **Grade 5:** pieces with 2 or more 4cm deep checks, or 3 or more oversize knots, or severe shatter, or greater than 15% Spiral Grain
- **Butt pieces**
  - **Grade 4:** Live/green pieces with 3 or more 4 cm checks, or severe shatter, or greater than 15% spiral grain, severe scar/defect from surface to heart greater than 25% of diameter, or 25-50% heart rot
  - **Grade 5:** Dead pieces with 3 or more 4 cm checks, 3 or severe shatter or greater than 15% spiral grain, severe scar/defect from surface to heart greater than 25% of diameter, or 25-50% heart rot

Bucking Waste Grading Matrix Field Card

The bucking waste grading matrix has been summarized into a field card format as provided in Appendix 6. The field card is designed to provide a condensed summary of the grading rules to be applied to bucking waste.

7.4 Measurement Protocol and Standards

7.4.1 Lengths

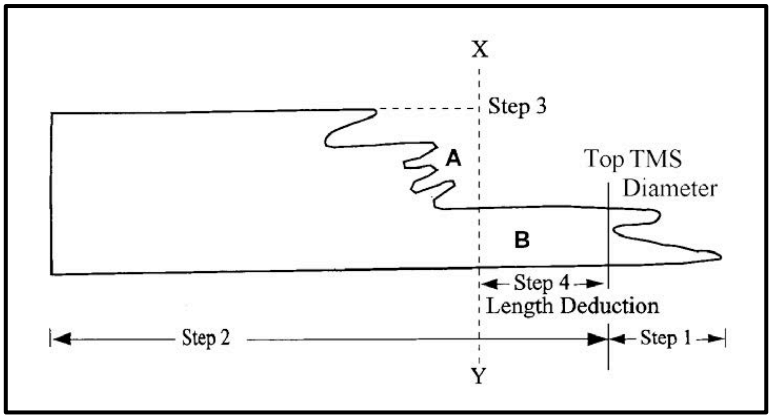
1) Lengths will be recorded to the nearest tenth (0.1) of a metre:
   a. For exact 0.05 m lengths round to the lower tenth (0.1) of a metre.
   b. Example:
      i. A log 4.25 m in length - record as 4.2 m
      ii. A log 4.26 m in length - record as 4.3 m
2) Logs broken at both ends are tallied only if they meet or exceed 3.0 m, TMS point to TMS point. Logs less than 3.0 m are breakage and are not tallied.
   Example A:
   a. A log 2.99 m in length - is breakage - do not tally
   b. A log 3.0 m in length - is a log - tally as 3.0 m
   c. A log 3.06 m in length - tally as 3.1 m
   Example B
   a. A log 3.2 m from TMS to TMS with a 0.2m length deduction at the top and a 0.1 length deduction at the butt is a log,
   b. Tally as 3.2 m with 0.3m length deduction
   c. Do not tally as a log 2.90m in length
   d. Pieces less than 0.05m in length (cookies) are not measured
   e. Pieces 0.06m and greater are measured. Pieces 0.06m to 0.1 m are recorded as 0.1m

7.4.2 Broken Ends

The length measurement procedure for broken ends is (refer to Figures below):

1) Locate the TMS diameter (must have minimum slab thickness of 5 rads) measured from the small end.
2) Measure the gross length, which commences from the TMS diameter.
3) Locate the X Y line upon which the volume above the TMS diameter to the X Y line (Section B) equals to the void of the missing wood (Section A).
4) Record a length deduction which is measured from the TMS diameter to the X Y line.

Figure 12 Measuring Broken Tops



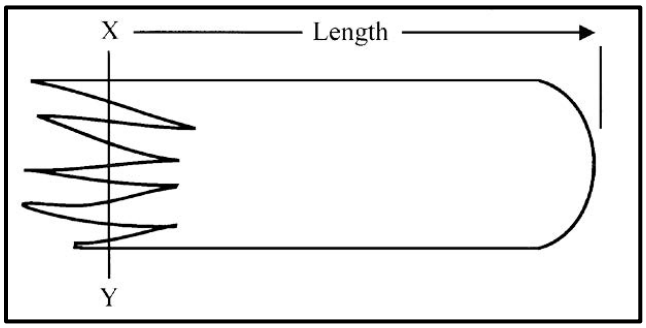
7.4.3 Shattered Ends

Length is measured to the XY line where the protrusions are folded in to compensate the missing wood in the voids.

Pencil buck each finger to the TMS before folding as shown for broken tops

Do not measure fractured pieces where little effort would be required to break the piece into numerous pieces all below the TMS.

Figure 13 Measuring Shattered Ends



7.4.4 Forks

A fork is defined as a division of a log into two or more stems.

The point at which the pith separates is the starting point of a fork.

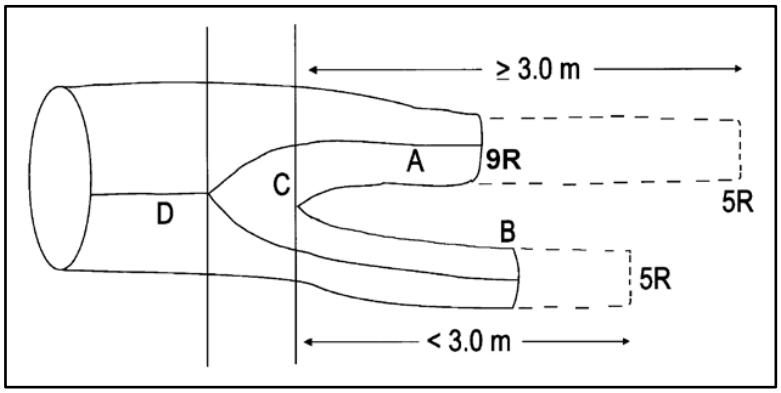
If the diameter of a fork is greater than or equal to the minimum diameter of the timber merchantability specifications, the portion(s) of the tree above the fork or crook must meet the criteria for minimum log length to be considered avoidable.

If the portion(s) of the tree, above the fork or crook, doesn't meet the minimum log length criteria (3.0 m) to the TMS top diameter, it is not measured.

As demonstrated in Figure 7-12:

i. Segment A, if visually extended to the minimum top diameter (5R), would meet the minimum log length (3.0 m); therefore, is classified as avoidable waste.
ii. Segment B, if visually extended to the minimum top diameter (5R), would not meet the minimum log length (3.0 m) and therefore is not measured.
iii. Segment C is recorded as unavoidable waste for safety reasons. The length of segment C is determined by the separation point of the pith between segment C and D.
iv. Segment D (with one pith showing) is recorded as avoidable waste.
v. Segments A, B, C and D are recorded as separate pieces on the FS 161, each with its own piece number.
vi. Use ‘FK’ as comment code to indicate the pieces belong to a fork and the reason for classification of piece C as unavoidable.

Figure 14 Example of Forked Bucking Waste



7.4.5 Piece Diameters

Diameters will be recorded to the nearest radius class unit (rad), inside bark.

If the end is out of round, the average of measurements taken across two or more representative diameters shall be recorded as the end measurement.

All half measurements shall be taken to the nearest even number. Thus 24.5 will be recorded as 24 while 25.5 will be recorded as 26.

Top log diameter standards reflect log diameters in centimeters, which must be converted to radius class units for field measurement.

7.4.6 Stump Diameters

A minimum diameter at stump height (outside bark) is specified in the timber merchantability specification measured at a point 0.3 m above the high side of the stump. The minimum stump diameter must be obtained (without rounding up) or the stump is not tallied.

All tallied stumps are measured and recorded using inside bark, therefore, it is possible to have a stump diameter which is less than the minimum stump cutting specification.

If the stump total height, including the TMS of 30 cm, is 1.3 m or less, measure the top diameter on the top of the stump. If the stump total height exceeds 1.3 m, measure the top diameter at 1.3 m above the ground on the high side.

Stumps are not tallied if there is clear evidence a log equal to or exceeding the Timber Merchantability specifications did not exist.

7.4.7 Bucking Waste

When cut at both ends - tally to the nearest tenth (0.1) of a metre regardless of length.

When cut at large end - tally as waste if length meets or exceeds a tenth (0.1) of a metre.
Example:
0.09 m in length - do not tally,
0.10 m in length - tally as 0.10m.
0.15m in length – tally as 0.20m.

7.4.8 Deductions

It is a standard convention in the *Scaling Manual* to account for the volume of decay by reducing the gross dimensions of a piece by a length and/or diameter (rad) deduction (computed using the volume data on the scale stick). This gives net dimensions that will produce a volume equal to the net volume of the piece.

Deductions for defect must be calculated in the field using the British Columbia metric scale stick.

For waste assessments, the length and/or diameter (rad) deductions must be recorded along with the gross dimensions of the piece. The compilation program will subtract the deduction values (if any) in the deduction columns for length, top and/or butt dimensions respectively. The resulting dimensions will then be used to calculate volume.

The values recorded in the deduction columns are not the actual dimensions of the decay or missing wood. The decay values represent the length or radius deductions to be applied to the gross piece dimensions as a result of the decay or missing wood.

Example: a log with gross dimensions of 4.2 m and 18 rad top / 20 rad butt with 0.6 m length and a 2 rad top would be calculated as a 3.6 m, 16 rad top / 20 rad butt.

7.5 Data Entry Requirements

The Waste System, EForwasteBC, and paper field tally cards can be used to collect survey information. The EForwasteBC application must be used for ratio sampling projects.

The following requirements outline the data recording format and requirements for the collection of this information. Failure to apply these requirements may result in data collection and compilation warnings or errors. The EForwasteBC user manual also provides a brief description of the data entry requirements.

7.5.1 Cutblock Header Information

The cutblock information data fields contain the general identification information for the cutblock.

Table 7-13 Cutblock Header Data Format

Field	Data requirement		Data Format	Comments
	Field	Compilation		
Licence	Optional	Required	Alpha Numeric	The Licence number under which harvesting of the cutblock was authorized
Cutting Permit	Optional	Required	Alpha Numeric	The cutting permit number under which harvesting of the cutblock was authorized
Timber Mark	Optional	Required	Alpha Numeric	The timber mark used for the cutblock
Cutblock Name	Required	Required	Alpha Numeric	The cutblock being sampled
Location	Optional	Optional	Alpha	
Logged From	Optional	Required	Numeric	The year primary logging started
Logged To	Optional	Required	Numeric	The year primary logging was completed
Logging Completion Date	Optional	Required	Date	"Ready for Survey" Date
Survey Date	Required	Required	Date	The date the survey was started on the cutblock
Net Area (ha)	Required	Required	Alpha, 2 decimals	Area, in hectares, The total area of all stratum areas available for sampling and/or estimating.
NP/NF area	Optional	Optional	Alpha, 2 decimals	Area, in hectares, The total area of road surface or non-productive area.
Waste Benchmark Zone (Site Code)	Required	Required	Numeric	Dry Belt 4 m3/ha, Transition 10m3/ha, Wet Belt 20m3/ha
Cruise Volume	Not required	Optional	Numeric	
Reason for Survey	Not required	Required	Alpha	

Return Number	Required	Required	Numeric	Identifies the annual survey number of the waste surveyor responsible for the establishment of the plot. Return numbers will increment by one for each new cutblock sampled by the surveyor in a given year. It is the responsibility of each waste surveyor to keep track of their own return number.
Surveyor Licence	Required	Required	Alpha numeric	Identifies the certificate number of the waste surveyor responsible for the establishment of the plot. Those without a certificate number may use the following: Southern Forest Region =WASI Northern Forest Region =WANI
Waste Surveyor Name	Required	Required	Alpha	The name of the waste surveyor responsible for the establishment of the plot.
Professional Designation	Required If registered	Required If registered	Alpha	
Registration Number	Required If registered	Required If registered	Alpha	
Position	Optional	Optional	Alpha	
Notes	Optional	Optional	Alpha	General notes regarding the cutblock waste survey

7.5.2 Completion of the FS 161 (Plot Tally Card)

Refer to Appendix 5 for example tally card.

A Plot Tally card (FS 161) must be completed for each plot established.

i. If a plot has no pieces, record "Nil Plot" in the notes section.
ii. If using paper tally cards and more than one page is required
    a. Record the page number on all pages, and
    b. Fill out the header line on all individual plot cards so they can be identified and reunited should they become separated.

7.5.2.1 Plot Tally Card Header

Table 7-2 Plot Tally Card Header Description

Field	Requirement	Format	Description
DATE	Required	Alpha Numeric	Identifies the year, month and day when the plot was established.
CERTIFICATE NUMBER	Required	Alpha Numeric	Identifies the certificate number of the waste surveyor responsible for the establishment of the plot.
RETURN NUMBER	Required	Numeric	Identifies the return number of the waste surveyor responsible for the establishment of the plot.
BASELINE	Optional	Alpha	Identifies the baseline the plot is tied to. Use codes such as "A" "B" "C" etc.
STRIP	Optional	Alpha Numeric	Identifies the strip number that plots are located on.
PLOT NO.	Required	Numeric	Identifies the plot number as identified on the waste survey plan.
PLOT SHAPE	Required	Alpha	Identifies the plot shape. Use codes “C”=Circular, “R”=Rectangular, “S”= Square. Must be blank for estimated plots and 100 percent measure plots.
MEASURE %	Required (default 100)	Numeric	Quantifies the percentage of the volume within the plot boundaries that has been measured and recorded.
TYPE STRATUM	Required	Alpha Numeric	Identifies the stratum the plot is located within.

7.5.2.2 Plot Tally Card Piece Descriptions

The piece dimensions recorded in this section are inclusive of decay (i.e. they are not reduced to account for the volume of decay) and only include the portion of the piece within the plot boundaries. The length is measured to the plot boundary and the diameter of that end is taken at that point.

Table 7-3 Plot Tally Card Piece Description

Tally Card Heading	Description
PIECE NO.	The unique numeric identifier for each tally piece. Increment by one for each new piece. For pieces that are segmented for classification purposes (i.e. a stump with one avoidable segment and one unavoidable segment), use a different piece number for each segment
BORDERLINE	Identifies pieces that lay across the plot boundary.

Tally Card Heading	Description				
	I	Piece completely inside plot.			
	B	Borderline piece (measure inside portion only).			
	X	Pieces that exceed the plot diameter.			
SPECIES	Identifies the species of the piece. Acceptable codes are as follows:				
	DOUGLAS FIR		FI	WHITEBARK PINE	WB
	RED CEDAR		CE	CYPRESS	CY
	WHITE PINE		WH	BIRCH	BI
	YELLOW PINE		YE	LARCH	LA
	ASPEN		AS	BALSAM	BA
	COTTONWOOD		CO	SPRUCE	SP
	LODGEPOLE PINE		LO	ALDER	AL
	HEMLOCK		HE	MAPLE	MA
KIND	Identifies the nature or shape of the piece.				
	Logs (L)	Includes all logs and slabs at least 3.0 m in length.			
	Down Trees (D)	Includes all down trees exceeding the timber merchantability specification.			
	Standing Trees (T)	Includes all standing trees exceeding the timber merchantability specifications.			
	Stumps (S)	Includes all stumps greater than 0.3m above high side			
	Bucking Waste (W)	Includes all portions of logs and slabs and less than 3 m in length and cut on at least one end in accumulations and cut at the larger or both ends in dispersed waste types.			
	Special Products (X)	Includes already manufactured products less than 3 m in length such as shake bolts or fence posts that have been left on the cutblock.			
WASTE CLASS	Identifies the waste class (avoidable/unavoidable) class of the piece. Acceptable codes: *A, U*				
Length (dm)	Quantifies in decimeters the "in plot" length of the piece.				
Top (R)	Quantifies in rads the gross diameter, inside bark, of the top (small) end.				
Top End	Describes the top end. Acceptable codes: natural (N), cut (C), broken (B) or buried (X).				
Butt (R)	Quantifies in rads the gross diameter, inside bark, of the butt (large) end.				
Butt End	Describes the butt end. Acceptable codes: undercut (U), cut (C), natural (N), broken (B) or buried (X).				
Grade	Identifies the grade of the piece regardless of the kind of wood or waste class. Acceptable codes: 1,2,4,5,6,Z				
COMMENT CODE	Additional descriptive information that may be useful. Acceptable codes, see Table 7-18				

<table>
<tr><th>Tally Card Heading</th><th>Description</th></tr>
<tr><td>PIECE VOLUME</td><td>This column displays the net piece volume.
<table>
<tr><td colspan="3">A simple formula for computing volume with a pocket calculator is:</td></tr>
<tr><td colspan="3">VOLUME = [(t * t) + (b * b)] * L * K</td></tr>
<tr><td>Where</td><td>V =</td><td>volume in cubic meters</td></tr>
<tr><td></td><td>t =</td><td>top diameter in rads</td></tr>
<tr><td></td><td>B =</td><td>butt diameter in rads</td></tr>
<tr><td></td><td>L =</td><td>Length in meters</td></tr>
<tr><td></td><td>K =</td><td>0.0001571</td></tr>
</table>
</td></tr>
</table>

7.5.2.3 Deductions for Rot or Missing Wood

Waste surveyors must be able to calculate these deductions accurately and record them on the Plot Tally card (FS 161).

Table 7-4 Deduction Descriptions

LENGTH	Quantifies the length deduction in tenths of meters.
TOP	Quantifies in rads the diameter deduction for the top end.
BUTT	Quantifies in rads the diameter deduction for the butt end.
D-DEFECT TYPE	Identifies the type of decay in the piece. Must be recorded whenever a deduction has been recorded.

7.5.2.4 Outside Plot Measurements

Outside plot measurements are optional to collect.

Table 7-5 Optional Outside Plot Measurement Descriptions

FAR END	Quantifies the diameter in rads of the actual end of the piece when it is outside the plot boundary.
ADD LENGTH - ADDITIONAL LENGTH	Quantifies in meters the additional length of the piece that is outside the plot boundary.

7.5.2.5 Comment Codes

The comment codes are used to help explain a waste piece. A code is required for all unavoidable waste pieces. The acceptable codes are:

Table 7-6 Comment Codes

Code	Description	Code	Description
BK	Breakage	LB	Long butt
BN	Bunch knots	LN	Large knots
BR	Buried	MB	Machine breakage
CA	Candelabra	MP	Multiple part piece
CC	Creek cleaning	NP	Nil plot
CF	Cat face	OB	Obstructed
CK	Crook	ON	Oversize knots
CL	Culvert log	PR	Pocket rot
CP	Company piece	RE	Reconstructed
CR	Severe Crook	S1	Segment 1
DP	Dead potential	S2	Segment 2
DU	Dead useless	S3	Segment 3
FC	Frost crack	SA	Sapling
FK	Fork	SB	Shake block
FL	Fluted Butt	SH	Shatter
FP	Fence post	SL	Slab
FW	Firewood	ST	Standing tree
GL	Guy line stump	SW	Sweep
HK	Hooked	TR	Whole tree
HN	Heavy knots	US	Unsafe
HP	Helipad	WD	Coarse woody debris
HS	Holding stump	WF	Windfall
IN	Inaccessible	WS	Wind shear
KN	Knots		

7.6 Field Standards

Those responsible for waste assessments must ensure that proper field procedures are followed including the use of industry standard equipment, materials, and conventions. Assessments which do not meet the standards in Chapter 8 may not be accepted by the District Manager.

7.6.1 Field Equipment and Supplies

The waste survey crew should use equipment that can perform the work within the allowable error limits. The recommended equipment is:

- Hand compass
- Clinometer
- Sub-meter real time GPS (described below)
- Hip chain or 50m chain
- Logger's tape
- BC metric scale stick
    - Axe
    - Tree marking paint
    - Flagging ribbon and felt markers.

7.6.2 Field Survey standards

When a field assessment requires traversing areas, standard field survey methods must be used including proper notes to support the area compilations.

Identification of cutblock substrata must be done prior to commencement of plot sampling. Any strata identification within subpopulations must be supported by field notes and must not be done on a plot-by-plot basis.

8. Quality Assurance

8.1 Introduction

Information from the waste survey that meets the standards under this Manual will be used for billing and Cut Control reconciliation where applicable.

The Ministry is responsible for setting the standards for waste surveys, while licensees are responsible, under contract, to meet these minimum standards.

The Ministry audits waste survey information to ensure the standards within this Manual are followed, support the principles of the Take or Pay Policy, revenue, cut control objectives, and to ensure the consistent application of waste information in the billing process.

The Ministry may consider exceptions to these standards in extenuating circumstances on a case by case basis.

8.2 Objectives

The objectives of the quality assurance review are to ensure:

1. The integrity of the sample design by assessing the accuracy and completeness of:
    a. The waste survey sampling plan and,
    b. The waste survey plan.
2. The survey has been completed within the maximum volume and value allowances identified in this section.
3. The measurements and classification of the waste piece attributes meet the minimum standards when comparing a sample of the waste surveyor's measurements against checked measurements.
4. The reports generated from the HRC Waste compilation software are consistent with the survey plan and reflect the data collected in the field.

If any of the preceding components of the survey are not acceptable, the licensee must undertake corrective actions to ensure the survey meets the minimum Ministry standards.

8.3 Check Survey Timing

Completion of timely checking during the sampling process is critical to the successful completion of a sampling plan. Aggregate and large sample plans can take up to six months to complete, represent numerous survey cutblocks contain over a hundred cutblocks within a plan and thousands of hectares of waste survey submissions. Prompt check surveys through the survey season are required to ensure a smooth completion and submission of the survey project. Both Government and Industry carry an obligation to complete the survey work and required checking throughout the survey season.

Check surveys should be completed as soon as possible after completion of the survey for a number of reasons:

1. To view the waste pieces in the same condition as encountered during the original survey,
2. To view the waste pieces with the required marking visible,
3. To complete the waste billing process in a timely manner, and
4. To allow for post-harvest treatments after completion of the waste survey.

It is the Ministry prerogative to conduct a check survey at any time; however, whenever possible the check survey should be completed promptly after the survey.

Completed field surveys must be submitted as required in Chapter 3. Submission of the survey data is required to allow time for the district staff to schedule an audit, notify the licensee and complete the audit. In the case of aggregate or large sampling projects, a consistent submission and audit workflow will aid in completion of the survey plan and compilation of the results. Post-harvest treatments cannot be commenced until the waste survey audits have been completed.

On multi cutblock sample plans, post-harvest treatments can be completed on cutblocks once the waste survey has been completed and audited. Post-harvest treatments may commence at any time on cutblocks that do not require a field survey (non-survey cutblocks).

8.4 Check Survey Standards and Procedures

Check surveys verify that the sampling plan was developed according to the standards and that the field measurements were collected and recorded correctly. Check surveys may be comprised of office checks of the survey planning process or checking of the field survey work, and data submitted to waste system. Field checking may constitute audits of plot location attributes, cutblock strata delineation, piece data audits or a combination of all.

The check survey will remeasure the attributes that were measured in the original survey. The full survey or parts of a survey of a cutblock can be accepted or rejected based on the results of the check survey.

When requested by the Ministry, the licensee must submit the original waste survey data in the format it was collected (either digital format or paper tally cards), a copy of the final survey plan map, and any notes related to the survey. Digital plot data must be submitted in a format compatible with Ministry data recorders.

8.4.1 Sample Plan Standards

Table 8-1 Sample Plan Standards

Attribute	Standard
Net waste area	Plus or minus 2.0 % of check area
Multiple mark identification	No variation allowed
Multiple mark area	Plus or minus 2.0 % of check area
Number of plots	Plus or minus one (1) from check number
Grid spacing distance	Plus or minus 2.0 % from check value

8.4.2 Field Checking Standards

8.4.2.1 Maximum Allowable Errors

Measurement of a random selection of samples within a cutblock is used to assess the acceptability of the survey results. The items to be checked and their acceptable limits of errors are specified below.

Net Volume and Value

Exceeding the parameter for either the net volume or net value of waste (avoidable and unavoidable) is grounds for rejection of the survey.

Net Volume	The net volume of waste within a cutblock must not vary by 10.0 percent from the net volume of waste determined by the check surveyor.
Net Value	The net value of waste within a cutblock must not vary by 10.0 percent from the net value of the waste determined by the check surveyor. The net value is derived by multiplying the volume of each species/grade combination by the applicable waste rate

Individual Parameters

Although the net volume and net value are the main determining factors for accepting or rejecting a survey, a survey may be rejected if any of the individual parameters identified below have been exceeded. Additionally, even when the volume and value standards have been achieved within a cutblock, if a pattern of continuous and/or repeated errors is identified, the District Manager may order a resurvey as required.

Table 8-2 Individual Parameters

Attribute	Standard
Conifer/Deciduous identification	Plus or Minus two (2.0) percent of all pieces
Species Identification	Plus or minus five (5.0) percent of all pieces
Live/Dead identification (Gr 4 to Gr 5)	Plus or minus ten (10.0) percent of all pieces
Area of standing tree patches	Plus or minus two (2.0) percent.
Piece length measurement	a. Pieces greater than 3.0m - plus or minus 0.10 m (10cm) b. Pieces less than 3.0m – plus or minus 0.05m (5cm)
Measure Percent	Plus or minus 10 percent.
Measured Plot radius	Plus or minus 0.10m (10cm) when measured on borderline pieces.
Count of Waste Piles	Less than ten (10) check piles – no variation allowed. Greater than ten (10) piles - the count must be within 5% of the checked number.
Waste Pile Gross Volume	+- 10% of total pile gross volume

8.4.2.2 Plot Location Standards

Plot establishment audits will be conducted using the same form of survey equipment used to establish the plots. Where hand traverse methods are used field audits will be completed with hand traverse equipment of equal or higher quality. Where GPS plot location methods are used sub meter real time GPS data collectors will be used to audit the work.

8.4.2.3 Hand Traverse Plot Location

Hand traverse plot locations will be audited using hand compass, tight chain and Suunto. Traverse auditing will follow the same direction of travel as the original survey. Audit standards will be calculated by totaling the cumulative survey distance divided by the cumulative audit distance.

Table 8-3 Hand Traverse Plot Location Standards

Attribute	Standard
Horizontal Distance	Plus or minus 2.0 percent (2.0 m per 100m).
Bearings	Plus or minus 2.0 degrees (+/- 3.5 m per 100m).
GPS Plot Location	Plus or minus 3.0m

Note: Plus or minus 2^0 translates to 3.5 m in 100 m using the formula:

(100 (tan 2 degrees)) = 3.49 percent, therefore: 3.49 percent * 100m = 3.49m (rounds to 3.5).

8.4.2.4 GPS Plot Location

1. Sub meter real time GPS data collectors must be used to audit the work.
2. The auditor will travel to the surveyed plot location and collect a GPS data point, a minimum of 50 GPS data points will be required to collect a point.
3. If the real time averaged GPS plot location is within 3.0 meters of the intended plot location the plot location will be accepted.
4. If the collected GPS data point is more than 3.0 meters from the intended plot location the plot location will be considered unacceptable.
5. Where 3 or more of 5 plots are found to be unacceptable during field checking the GPS data points will be post processed to determine the true GPS location.
6. If the post processed plot locations are found to be 3.0 or more meters from the intended location the plot location will not meet the location standard.
7. For a waste survey to be rejected for plot locations, a minimum of 5 plots must be checked and 3 or more plot locations must not meet the plot location standard.

8.4.3 Non-Compliance with Check Survey Standards

If the survey work is rejected after a check survey, the District Manager may order the licensee to resurvey the entire cutblock or those portions of the original survey that do not meet the standards. The resurvey must be completed prior to any post harvest treatment occurring and/or prior to completion of all survey cutblocks within the sample plan.

The licensee will be responsible for any costs they incur in the re-survey.

A full or partial resurvey may be subject to a second check survey carried out at the District Manager's discretion.

8.4.4 Dispute Resolution

A licensee who has been ordered to perform a resurvey may request a second check survey in writing to the District Manager. The District Manager may have a second check survey performed using ministry personnel that were not involved in the first check survey. The second check survey must be completed within 30 days of the original survey rejection, no later than September 15th of the check survey year or as agreed by the District Manager and licensee.

If the second check survey:

a. Finds the original survey in non-compliance with check survey standards,
   i. The licensee will perform a resurvey to replace the original survey at their expense, and
   ii. The licensee who requested the second check survey must pay to the government the charges, costs and expenses incurred by the government in respect of conducting the second check survey.

b. Finds the original survey in compliance with check survey standards:
   i. The original survey will be accepted as submitted, and
   ii. No charges, costs, and expenses in respect of the 2nd check survey will be charged.

8.4.5 Material Disposed of Prior to Waste Assessments

If waste materials on a cutblock or road right of way are disposed of prior to the completion of a waste assessment, the District Manager may bill the licensee and determine volume for cut control purposes by using the higher of:

i. the district or the licensee waste volume average experienced for the stratum type in the past year, or
ii. the best information available to complete the assessment.

The District Manager may bill the licensee for the administration and field costs incurred in preparing the estimates.

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9. Reporting

9.1 Software Support

To support the collection and compilation of waste data, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development maintains three software programs - The online Waste System (Waste System), the Harvest Residue Compiler (HRC), and EForwasteBC.

The **Waste System** is used to submit waste information, generate reports and upload data into the Harvest Billing System for billing. Access is provided through the Waste System application located on the Timber Pricing Branch website at: https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/forest-residue-waste.

The ***Harvest Residue Compiler*** (HRC) is used by waste planners to create waste sampling plans, collect and compile cutblock and population information and export data to the *Waste System*.

EForwasteBC is an iPad based software application used by waste surveyors to collect cutblock level waste information. EForwasteBC is available from the Apple App store. A user manual is available on the Timber Pricing Branch website at: https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/forest-residue-waste/eforwastebc.

9.2 Reporting Requirements

1. Licensees must enter and submit the data into the Waste System for a cutblock as required in section 3.2.
2. A final survey map for each cutblock as required in Table 6-1 must be included in the submission.

9.3 Cutblocks Less than 2.0 ha

Cutblocks or partial cutblocks less than 2.0 ha are too small to sample through plot measurement systems. The waste volumes for these cutblocks may be estimated using the volume and grade profile from an alternate data source. This information will be automatically calculated within the HRC application or the data can be manually entered. Alternate waste data sources to use for these small cutblocks may be selected in the following order:

1. Data submitted for the same cutblock as part of a previous partial cutblock submission.
2. Closest cutblock owned by the licensee of the same benchmark, harvest system and stand type.
3. Closest population average.
4. District Average.

9.4 Review of Reports

The Ministry staff will review all data submitted and either approve or reject the waste assessment(s).

9.4.1 Processing Waste Volume Estimates

Once checking is completed as per section 8.4, the Ministry will:

1. Process the submission and forward to HBS for billing or,
2. Advise the licensee if the submission has been rejected.

10. Appendices

Appendix 1 Glossary

Words and expressions used but not defined in this Manual, unless the context otherwise requires, have the same meaning as in the Forest Act.

"**AAC**" means Allowable Annual Cut as defined in the *Forest Act*;

"**Act**" means *Forest Act*;

"Aggregate Waste Submission" means a waste submission relating to two (2) or more cutblocks but not exceeding 20 cutblocks;

"**Agreement**" means a form of agreement granting rights to harvest Crown timber referred to in section 12 of the *Act*, or a pulpwood agreement;

"Avoidable Waste" means wood material that meets or exceeds the Timber Merchantability Specifications that does not fall within the definition of unavoidable waste;

"**Batch**" means a grouping of one or more cutblocks selected from a population that have been selected to be surveyed;

"**BCTS**" means BCTS as defined in the *Forest Act*;

"**Bernoulli Selection process**" means to sample cutblocks for waste assessment in accordance with the requirements for a Bernoulli or binomial trial whereby each cutblock is selected individually for inclusion into the sample, using the same selection probability as in previous batches;

"**Bernoulli trial**" or "**binomial trial**" means a random experiment with exactly two possible outcomes: "success" or "failure", in which the probability of success is the same every time the experiment is conducted;

"**Breakage**" means any piece of a tree, meeting the minimum diameter set by the TMS, which has a gross length shorter than 3.0 m in length and is broken at the large end or broken at both ends;

"**Bucking Waste**" means a portion of a tree or log greater than the top diameter set by the TMS that is less than 3.0 m in length and which has been cut at the large or both ends. To be measured as bucking waste the piece must have originated from a tree or log at least 3.0 m in length;

"**Cardinal directions**" means North, South, East and West. All references to azimuths or bearings mean the "true" value;

"**Coefficient of Variation"** means the Standard Deviation as a percent of the average;

"**Cold Deck**" means, for the purposes of this Manual, decked timber and is defined as;

1. Ten or more grade 1, 2, 4 or 5 logs that are mechanically placed together in a single pile, accumulation or group, or
2. A group of less than 10 grade 1, 2, 4 or 5 logs that in the opinion of the Forest Professional or waste surveyor should not be measured or sampled within a plot measurement system.

"**Cruise Based**" means a cutting authority where under section 106 of the *Act* the stumpage payable is calculated using information provided by a cruise of the timber conducted before the timber is cut;

"**Cutblock**" means an area that meets the cutblock requirements as specified in the Interior Appraisal Manual;

"**Cutting Authority**" means:

A cutting permit issued under a:

1. Forest Licence;
2. Timber Sale Licence that provides for cutting permits;
3. Tree Farm Licence;
4. Timber licence;
5. Community Salvage Licence;
6. Master Licence to Cut;
7. Forestry Licence to Cut; or
8. First Nation Woodland Licence.
9. All other Licences to Cut;
10. A Timber Sale Licence entered into under section 20 of the Act; or
11. A Road Permit.

"**Cutting Authority Area**" means the area where timber may be harvested under the cutting authority being appraised, and which has a unique timber mark;

"**Deciduous Timber**" means timber that is not of a coniferous species;

"**Decked Timber**" has the same meaning as "Cold Deck";

"**Director**" means the Director of Timber Pricing Branch of the Ministry of Forests, Lands and Natural Resource Operations and Rural Development;

"**District Manager**" means:

1. Except as provided in paragraph (2) of this definition, the District Manager;
2. Where the cutting authority area being appraised or reappraised is located in a controlled recreation area designated under the *Resort Timber Administration Act*, an employee of the government, to whom the Minister has delegated the Minister's powers and duties under section 2 of the *Resort Timber Administration Act*;

"**Firmwood**" means the amount of solid wood within a log or waste piece after accounting for rot, hole, char and missing wood.

"**Forest Professional**" means a Registered Professional Forester (RPF), a Registered Forest Technologist (RFT) or a special permit holder acting within the scope of their permit, registered and in good standing with the Association of British Columbia Forest Professionals;

"**GIS Software**" means a Geographic Information System designed to capture, store, manipulate, analyze, manage, and present geographical data;

"Harvest" means to cut, cut and remove or remove timber from a cutting authority;

"Harvest Residue Compiler" means a data compilation software application used to create sample populations and to calculate waste data for input into the Waste system;

"HBS" means the Harvest Billing System administered by the Ministry;

"**Higher Level Plan**" means, for the purpose of this manual, an Operating Plan and or a Site Plan;

"**Licensee**" means the holder of a cutting authority;

"**Log**" means any near-round piece with more than half of its *original circumference* remaining and with an average diameter equal to or larger than the timber merchantability specification diameter for at least 3.0m of length;

"**Major Harvesting Licence**" means a major licence as defined in the *Forest Act;*

"**Manual**" means the *Provincial Logging Waste and Measurement Procedures Manual-Interior Version;*

"**Merchantable Timber**" means timber that meets or exceeds the timber merchantability specifications that are described in Table 2-2 of this Manual. Timber that is graded 6 or Z is not merchantable;

"**Minister**" means the Minister of Forests, Lands, Natural Resource Operations and Rural Development;

"**Ministry**" means the Ministry of Forests, Lands, Natural Resource Operations and Rural Development;

"Multiple Ratio Sample Plan Submission" means a waste submission containing more than 20 cutblocks sampled as part of a ratio adjustment sample design;

"Net Waste Area" means the area of a cutblock in hectares reported in a waste submission as the area in which merchantable timber that was authorized to be cut was harvested less any non-productive area created during harvest operations (i.e. roads);

"**North Area**" means Northeast, Omineca, and Skeena Regions excluding that portion that lies geographically within the North Coast Timber Supply Area;

"Number of Samples" means the number of samples of either cutblocks or plots in a waste survey. The number is dependent on the variation from plot to plot or cutblock to cutblock (this is measured by the standard deviation of the volume per hectare) and the desired accuracy (sampling error percentage) of the sample plan;

"Pencil Buck" means the act of recording one piece of waste material as two or more pieces of waste material, as in the case of a piece of bucking waste with a fork as two or more pieces. Surveyors will

divide (pencil buck) the piece of waste at the point where the waste class changes from avoidable to unavoidable waste as a result of a defect in the piece;

"Pile" means an accumulation of woody material created by a machine that contains one or more pieces of waste;

1. Roadside Pile means a pile in which the majority of the pile area (footprint) is located adjacent to and within 20 meters of a road edge.
2. Dispersed Pile means a pile in which the majority of the pile area (footprint) is located greater than 20 meters from the road edge.

"POC" means 'Point of Commencement' – a point in or near a cutblock used to locate sample plots or to start a sampling procedure;

"Population" means a single item or group of items for which an estimate through the sampling process is made including but not limited to an estimate for a group of cutblocks, sample cutblocks, plots or waste pieces.

"**Primary Logging**" The cutting of timber and the yarding of that timber to a central landing, road side, or drop area in a logging operation.

"Primary Logging Completion Date" The earlier of the date on which:

- the yarding of all the timber that is cut in a cutblock to a central landing, roadside, or drop area in a logging operation is completed

"**Reporting Unit**" means a tracking mechanism to store, track and report waste information;

"**Regulations**" means regulations unde**r** the *Act*;

"Ready for Survey (RFS)" means the earlier of :

1. The Primary Logging Complete Date, or
2. The date that the cutting authority authorizing harvest expires, is suspended or otherwise terminated

"Reserved Timber" means standing timber left after completion of primary logging within the cutting authority area that is intentionally retained for silviculture, riparian management, biodiversity or forest management reasons. It must be identified as;

1. Areas reserved from harvest on a map submitted by the licensee for waste assessment purposes, and/or
2. Standing timber retained in accordance with a partial cutting regime, or otherwise reserved from cutting, as described in the Schedule B of the Cutting Permit (CP).

"Residue" means timber, whether standing or felled, except timber reserved from harvest, which does not meet or exceed the timber merchantability specifications described in this Manual that was not removed from the cutting authority area;

"**Road Permit**" means road permit as defined in the *Forest Act*;

"Sampling Error Objective" means an expression of the accuracy of the sampling of the Waste Survey, calculated as a percent of an estimated mean to desired probability;

"Sample Frequency" means the interval or rate at which a sample is selected from a population;

"Sampling Plan" means;

1. The strategy or design used to sample one or more cutblocks to a desired sampling objective. The sampling plan outlines the cutblocks to be reported and other criteria that will be used to define the sample size and sampling methodology.
2. The strategy or design used to randomly locate samples within a cutblock.

"Sample size" means the number of samples included in a waste survey to meet the objectives of the Sample Plan;

"**Scale Based**" in relation to a cutting authority means where the stumpage payable is calculated using a scale of the timber;

"Single Cutblock Submission" means a waste submission consisting of only one cutblock;

"**SPIF**" (**S**tarting **P**oint **I**nterval **F**actor) means a value determined on a monthly basis by the Ministry to be used by Agreement holders to generate a random starting point for sampling grids. The SPIF will be randomly determined at 10% intervals ranging from 10 to 90%;

"Slab" means any non-round piece of timber that has fractured along a plane roughly parallel to the longitudinal axis of the original log that has a minimum thickness of 10 cm for at least 3.0m of its length and an average diameter equal to or larger than the TMS diameter;

"**South Area**" means Cariboo, Kootenay-Boundary and Thompson-Okanagan Regions;

"Standard Deviation" is a characteristic of the population that reflects the variation between cutblocks;

"Standing trees" means trees authorized for harvest under the cutting authority (excepting reserved trees) but at the discretion of the licence holder are not cut and removed.

"**Stub (Stubbed) trees**" means the practice of harvesting or removing a portion of the tree so that part of the bole (stem) above stump height remains;

"**Stump"** means any piece of timber in which more than one half (1/2) of its original circumference is remaining, is less than 3.30 m in length and which has a cut top and is still attached to the roots;

"Timber Merchantability Specifications or TMS" means the stump height and diameter, log top diameter, slab thickness and log length specified in this Manual;

"**Timber Pricing Branch or TPB**" means the Timber Pricing Branch of the Ministry;

"**Timber Sales Manager or TSM**" means the Timber Sales Manager or the Timber Sales Manager's designate;

"Tree" means any live or dead piece of a tree still attached to its roots having an average diameter equal to or larger than the TMS diameter for at least 3.0m of its length;

"Unavoidable Waste" means wood material that meets or exceeds the Timber Merchantability Specifications that:

1. Is inaccessible or physically obstructed;
2. Could not be felled, bucked or removed due to safety reasons;
3. Could not be felled, bucked or removed due to physical, environmental or stewardship reasons;

"Volume Estimate" means the determination of a volume of material using sampling principles and measurements in accordance with this Manual;

"Volume Prediction" means a forecast of waste volume at the cutblock or plot level;

"Waste" means timber, whether standing or felled, except timber reserved from cutting, which meets or exceeds the Timber Merchantability Specifications described in this Manual that was not removed from the cutting authority area by the Agreement holder;

"Waste Assessment" means an assessment conducted in accordance with the procedures set out in the Manual for determining the volumes of Waste and Residue left on a harvested area following completion of harvesting operations;

"Waste Benchmark" means the volume of avoidable waste, expressed in cubic meters per hectare that can be left on a harvested area without being subject to a monetary waste assessment;

"**Waste System**" means the online Waste System;

"**WMRF**" **(W**aste **M**onetary **R**eduction **F**actor) means a factor applied to the waste rate to generate a waste billing rate.

Appendix 2 WMRF and Billing Calculations

BRITISH COLUMBIA

INTERIOR

Worksheet for Waste Billing Against Benchmarks

Ministry of Forests

To be Completed by by Licensees

Licence No.		CP No.	Cut Block
Timber Mark		Reporting Unit No.	
Primary Logging Completion Date		Cut Block Net Area	ha
Location		Stand/Site Type	

Calculations

Avoidable waste conifer sawlog (grades 1 and 2) = _____ M^3/ha..... (A)

Established benchmark = _____ M^3/ha..... (B)

(A) - (B) = _____ M^3/ha..... (C)

If (C) < or = 0.0000, stop

If (C) > 0.0000, proceed as follows:

Waste Monetary Reduction Factor (WMRF) = (C)/(A) = _____ (to four decimals) .....(D)

To be Completed by Forest Service

Processing

If (C) is < or = 0.0000, on FS 702, code:

Avoidable all species sawlogs (grades 1 and 2):	$0.00/$m^3$
Avoidable all species grade 4:	$0.25/$m^3$
Unavoidable all species all grades:	$0.00/$m^3$

If (C) is > 0.0000, request average sawlog rate from HBS

Average coniferous sawlog rate (HBS) =	$ _____ /m^3	.....(E)
Deciduous sawlog rate =	$ _____ /m^3	.....(F)

On FS 702, code

Avoidable coniferous species sawlogs (D x E) =	$ _____ /m^3
Avoidable deciduous species sawlogs: (F) =	$ _____ /m^3
Avoidable all species grade 4: $0.25/$m^3$	
Unavoidable all species all grades: $0.00/$m^3$	

Approved by Forest Officer (signature)	Date

Appendix 3 Interior Forest Residue and Waste Benchmarks and BEC 2018

AVOIDABLE WASTE BENCHMARK	BIOGEOCLIMATIC ZONE	BIOGEOCLIMATIC SUBZONE/VARIANT
DRY BELT BENCHMARK 4 m3 / hectare NDT4	IDF (Interior Douglas-fir)	un, dc, dk, dm, mw, ww, xc, xh, xk, xm, xw, xx
	PP (Ponderosa Pine)	dh, xh
	BG (Bunchgrass)	xh, xw
TRANSITION BENCHMARK 10 m3 / hectare NDT3	ESSF (Engelmann Spruce - Subalpine Fir)	un, dc2, dc3, dcw, dk, dkw, dv, dvw, xc, xcw
	ICH (Interior Cedar - Hemlock)	dk, dm, dw, mk1, mk2, mk4, mk5
	MS (Montane Spruce)	un, dc, dk, dm, dv, dw, mw, xk, xv
	BWBS (Boreal White and Black Spruce)	dk, mk, mw, vk, wk
	SBS (Sub-Boreal Spruce)	un, dh, dk, dw, mc, mh, mk, mm, mw, wk3
	SBPS (Sub-Boreal Pine - Spruce)	dc, mc, mk, xc
WET BELT BENCHMARK 20 m3 / ha NDT1 and NDT2	ICH (Interior Cedar - Hemlock)	mc, mk3, mm, mw, vc, vk, wc, wk
	MH (Mountain Hemlock)	un, mm, wh
	CWH (Coastal Western Hemlock)	un, ds, mm, ms, vh, vm, wm, ws, xm
	CDF (Coastal Douglas-fir)	mm
	SWB (Spruce Willow Birch)	un, mk, vk
	SBS (Sub-Boreal Spruce)	vk, wk1, wk2
	ESSF (Englemann Spruce - Subalpine Fir)	un, dc1, dcw, mc, mh, mk, mm, mmw, mv, mw, mww, vc, vcw, wc, wcw, wh, wk, wkw, wm, wmw, wv, xv, xvw

Table updated September 1, 2018. Update assistance provided by the Regional Ecologists.

Forest Residue & Waste Website:
https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/forest-residue-waste

Provincial Logging Residue and Waste Measurement Procedures Manual and Amendments:
https://www2.gov.bc.ca/gov/content/industry/forestry/competitive-forest-industry/timber-pricing/forest-residue-waste/provincial-logging-residue-and-waste-measurements-procedure-manual

Benchmark Eligibility

1) The benchmarks are applied on an individual cutblock basis.
2) Where a cutblock contains one or more Biogeoclimatic zones the benchmark applying to that cutblock will be determined by the zone covering the largest proportion of the cutblock area.
3) Waste benchmarks do not apply to unharvested cutblocks.

Appendix 4 Grid Spacing Worksheet

Waste Grid Spacing Worksheet

Sample Plan:		Example			
Required Plots:		45			
Plot Grid formula:		SQRT(10,000 * Area/ # plots)			
Column Number	(1)	(2)	(3)	(4)	(5)
Block	**Block Area (ha)**	**Ha/plot Ratio** (Col 1 / Total)	**Plots per Block** (Col 2 /total Plots) (Rounded)	**Calculated Grid Spacing (m)** (Col 1/Col 3)	**Adjusted Grid Spacing (m)**
1	10	0.13	6	129	125
2	5	0.06	3	129	125
3	15	0.19	8	137	135
4	20	0.25	11	135	135
5	30	0.38	17	133	130
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
		0.00	0	0	
Total	80		45		

Appendix 5 Slope Distances for 7.98m plot radius

Slope distances for 7.98m Plot Radius					
Slope %	**Plot Radius**	**Slope %**	**Plot Radius**	**Slope %**	**Plot Radius**
5	7.99	39	8.57	73	9.88
6	7.99	40	8.59	74	9.93
7	8.00	41	8.62	75	9.98
8	8.01	42	8.66	76	10.02
9	8.01	43	8.69	77	10.07
10	8.02	44	8.72	78	10.12
11	8.03	45	8.75	79	10.17
12	8.04	46	8.78	80	10.22
13	8.05	47	8.82	81	10.27
14	8.06	48	8.85	82	10.32
15	8.07	49	8.89	83	10.37
16	8.08	50	8.92	84	10.42
17	8.09	51	8.96	85	10.47
18	8.11	52	8.99	86	10.53
19	8.12	53	9.03	87	10.58
20	8.14	54	9.07	88	10.63
21	8.15	55	9.11	89	10.68
22	8.17	56	9.15	90	10.74
23	8.19	57	9.19	91	10.79
24	8.21	58	9.23	92	10.84
25	8.23	59	9.27	93	10.90
26	8.25	60	9.31	94	10.95
27	8.27	61	9.35	95	11.01
28	8.29	62	9.39	96	11.06
29	8.31	63	9.43	97	11.12
30	8.33	64	9.47	98	11.17
31	8.35	65	9.52	99	11.23
32	8.38	66	9.56	100	11.29
33	8.40	67	9.61	110	11.86
34	8.43	68	9.65	120	12.47
35	8.45	69	9.70	130	13.09
36	8.48	70	9.74	140	13.73
37	8.51	71	9.79	150	14.39
38	8.54	72	9.83	160	15.06

Appendix 6 Bucking Waste Field Card

Bucking Waste Grading Conventions

Waste Grading rules for Bucking Waste

Only applies to pieces with a gross length less than 3.0m with cut at butt or both ends

Waste grades determined by the Balance of probability the grade would have been. Not all results will generate the correct grade on all pieces.

Pieces < 50% of it's original log diameter (at the butt)with a broken end and gross length of less than 0.4 metres, not measured

All Bucking Waste that is 50% or more of the original log diameter and meets the TMS must be measured and graded

Grade 5 = descriptor of Dead Grade 4

All pieces must be pencil bucked to identify correct waste class

Where more than 1 piece of bucking waste is present within a plot and there is clear evidence all pieces are cut sequentially from the same log, the pieces must be tallied and graded as a single piece provided the following conditions are met:

1) Clear evidence is defined as consistent taper, matching cuts and matching features (shape, rot, knot pattern).

2) Pieces can be combined to create a log to minimize key punching requirements, Redorded Grade must be the Grade of the bucking Waste

3) The piece can only be graded based on characteristics of the smallest top and largest butt segments.)

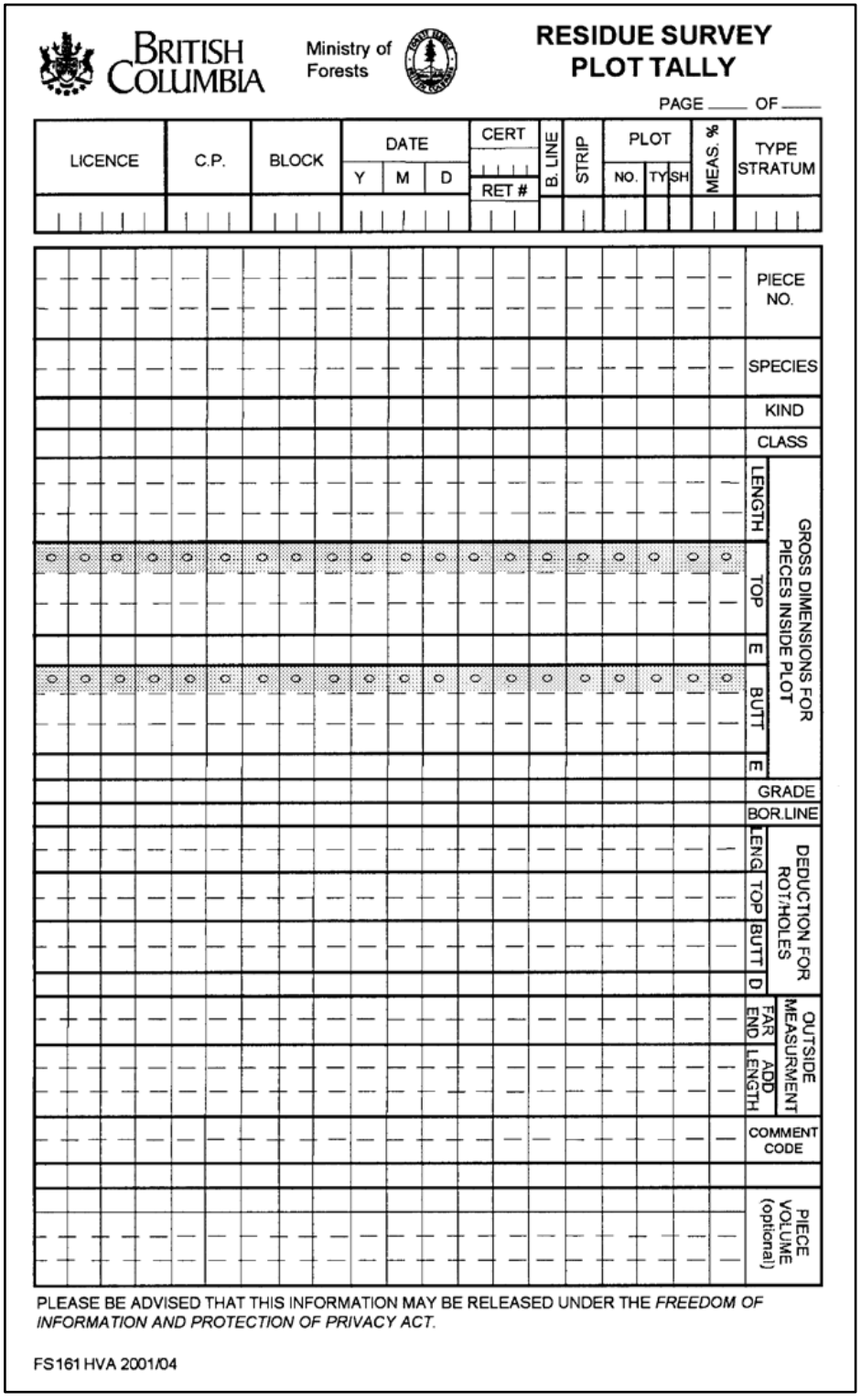
4) Sequential pieces must be the same waste class, species and grade

Bucking Waste Grading Field Card

% Sound	Waste Class	Piece Grade			Description
<50%	A / U	Grade 'Z'			Optional, Scaling Manual Sec 9.5, W2 volume, Non AAC, Non Billable, must show rot at both ends
>50%	A/U	Grade '6'			15cm, Other Species <20cm at 15cm, Must contain evidence of felling cut.
	U	Grade 1,2			Grade not auditable, Non Billable
		Grade 4,5			Grade defined as below, Non Billable
	A	SL (1,2)			Sound/Round, No severe defect or deformity, <3 checks, Butt Rot must be conical shape, 3/4 and 4/4 dia. rot will normally appear as through rot and be graded Z, Slabs >7.5R
		Top	Mid	Butt	
		4(5)			1 or more checks to heart, >1 OS knots, >4cm SG
			4(5)		2 or more checks >4cm, >3 OS knots, severe shatter, >15% SG
				4(5)	, Shatter, > 3-4cm checks, >15% SG, Severe scar/defect from surface to heart > 25% of Dia, 25-50% Heart Rot

Piece Type — Top = Cut butt extending to utilization or broken top (<5R)
Middle = cut or broken with no evidence of utilization top or felling cut
Butt= piece includes evidence of felling cut

Appendix 7 Waste Survey Plot Tally Card



BRITISH COLUMBIA
Ministry of Forests

RESIDUE SURVEY PLOT TALLY

PAGE ____ OF ____

LICENCE	C.P.	BLOCK	DATE Y	DATE M	DATE D	CERT / RET #	B. LINE	STRIP	PLOT NO.	PLOT TY	PLOT SH	MEAS. %	TYPE STRATUM

PIECE NO.	SPECIES	KIND	CLASS	GROSS DIMENSIONS FOR PIECES INSIDE PLOT: LENGTH	TOP	E	BUTT	E	GRADE	BOR.LINE	DEDUCTION FOR ROT/HOLES: LENG	TOP	BUTT	D	OUTSIDE MEASURMENT: FAR END	ADD LENGTH	COMMENT CODE	PIECE VOLUME (optional)

PLEASE BE ADVISED THAT THIS INFORMATION MAY BE RELEASED UNDER THE *FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT.*

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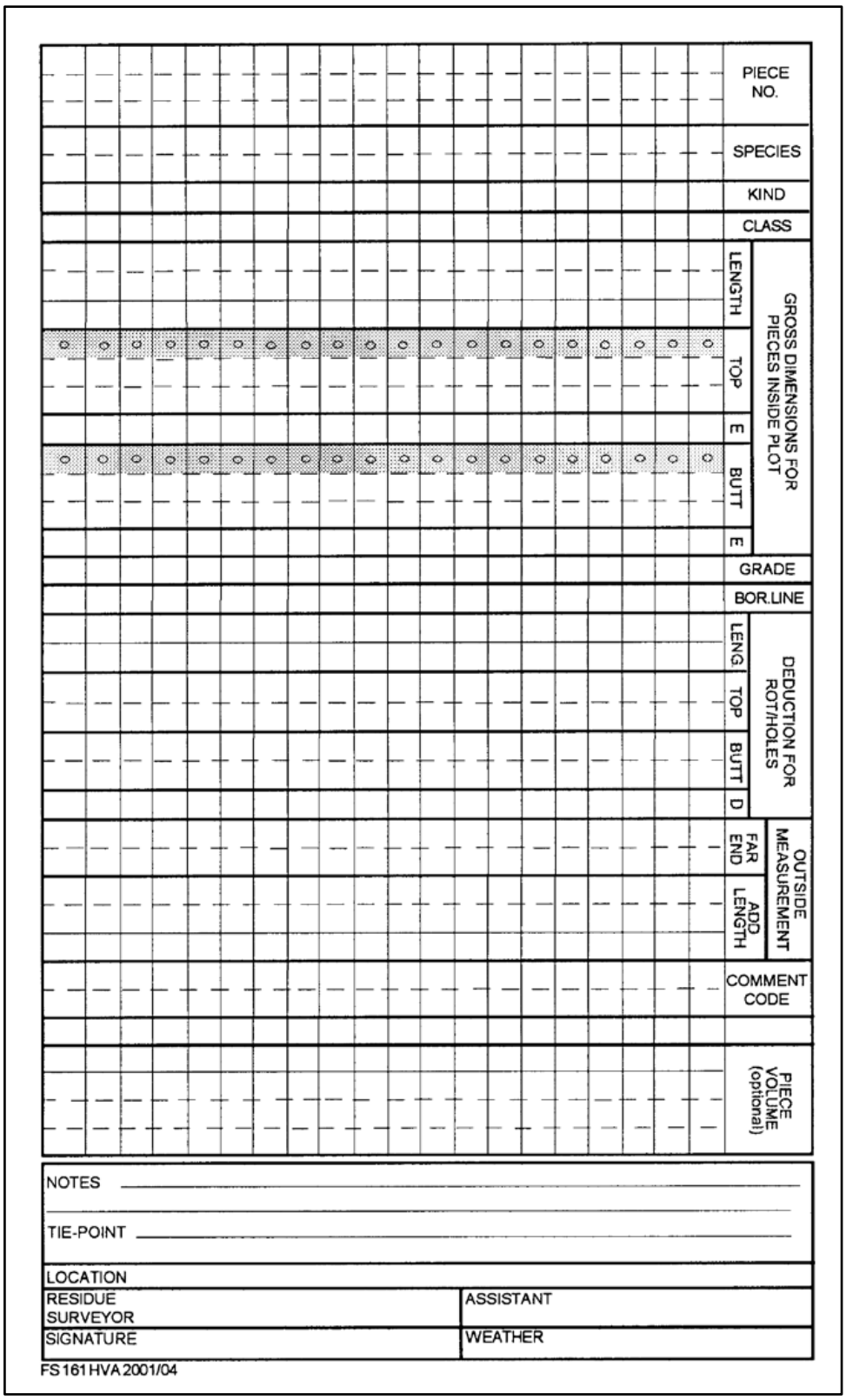

PIECE NO.
SPECIES
KIND
CLASS
GROSS DIMENSIONS FOR PIECES INSIDE PLOT
LENGTH
TOP
E
BUTT
E
GRADE
BOR.LINE
DEDUCTION FOR ROT/HOLES
LENG.
TOP
BUTT
D
OUTSIDE MEASUREMENT
FAR END
ADD LENGTH
COMMENT CODE
PIECE VOLUME (optional)
NOTES
TIE-POINT
LOCATION
RESIDUE SURVEYOR
ASSISTANT
SIGNATURE
WEATHER
FS 161 HVA 2001/04

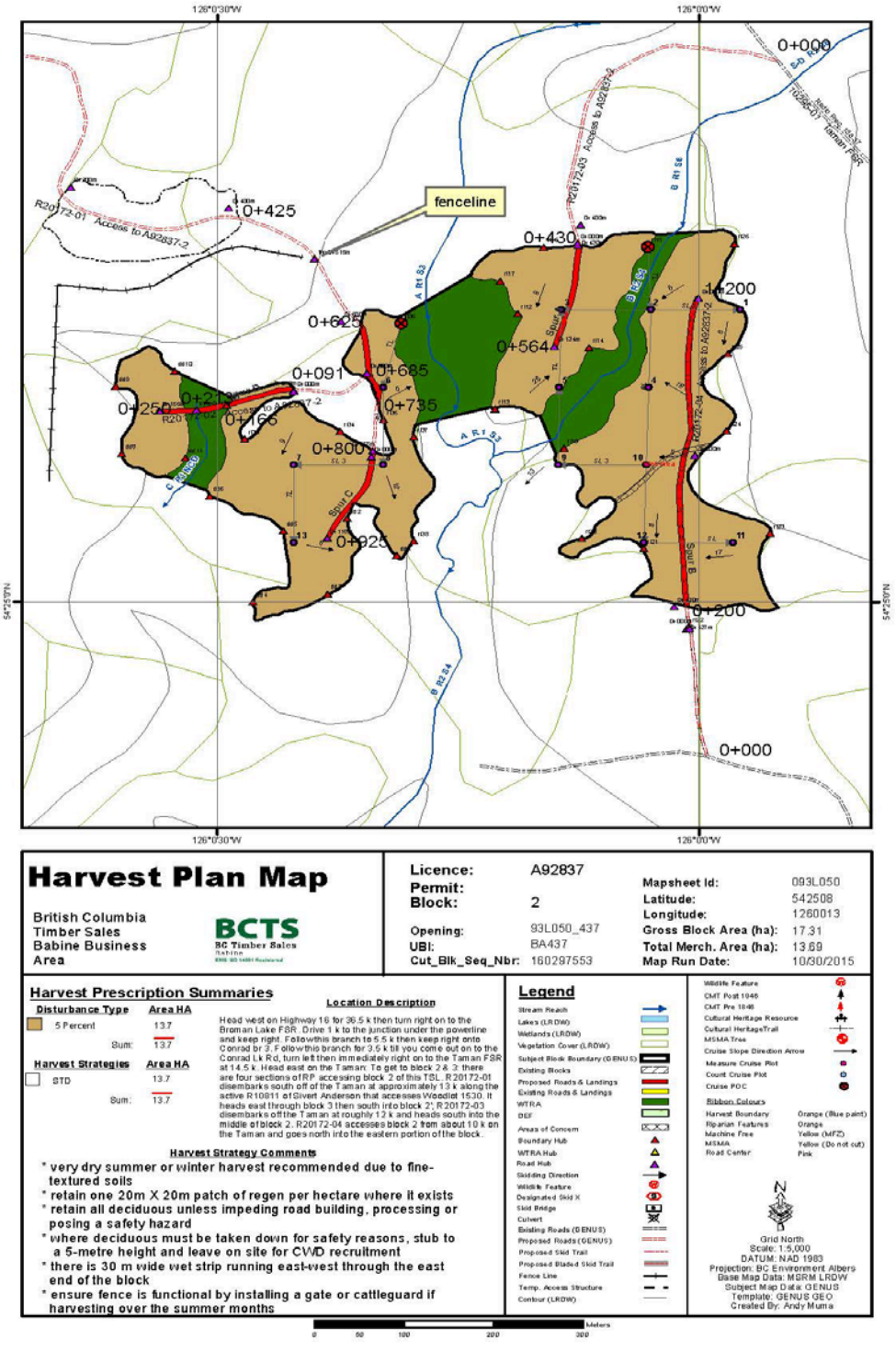
Appendix 8 Net Waste Area Example Calculation

This example of waste area calculations is based on the following map of TS A92837 Cutblock 2.

1) Assumptions
    a. Right of way width 20m
    b. Road surface width 5m
    c. Roads marked to RP20172
2) Cutblock harvested area calculation
    d. Cutblock Area (from ECAS/Cruise)= 17.31ha
    e. WTRA (from map)= 3.62.0 ha
    f. Net harvested = 13.69ha
3) Add external roads (20m Right of way)
    g. Spur A 0m-430m = 430m X 20m = 8600m2 (0.86ha)
    h. Spur B 0m-200m = 200m X 20m = 4000m2 (0.40ha)
    i. Spur C 425m-625m = 200m X 20m = 4000m2 (0.40ha)
        i. 735m-800m = 65m X 20m = 1300m2 (0.13ha)
    j. Spur D 10m-091m = 81m X 20m = 1620m2 (0.16ha)
        i. 166m-213m= 47m X 20m = 940m2 (0.09ha)
    k. Total Roads =20460m2 (2.05ha)
4) Subtract nonproductive (road surface) areas (Road surface 5m width):
    a. Spur A 0m-564m = 564m X 5M = 2820m2 (0.28ha)
    b. Spur B 0m-1200m = 1200 X 5m = 6000m2 (0.60ha)
    c. Spur C 425m-925m = 500m X 5m = 2500m2 (0.25ha)
    d. Spur D 0m-250m = 250m X 5M = 1250m2 (0.13ha)
    e. Total Roads = 2514m =12570m2 (1.26ha)
5) Cutblock Net Waste Area
    a. Cutblock Net Harvested area 13.69ha
        i. + External Roads 2.05ha
        ii. - Non Productive 1.26ha
    b. Cutblock Net Waste Area 14.48ha
6) Timber Mark Area (Multi Mark Submission)
    a. Road Permit Mark: - Total Road Length of 2514m X 15m* = 3.77ha
    b. Primary CP Mark: 14.48ha -3.77 = 10.71ha

Total = 14.48ha

*Road permit width is 20m R/W – 5m road surface = 15m.


126°03'0"W
126°00'0"W
54°25'0"N
fenceline
0+425
0+430
0+000
0+200
0+564
0+625
0+091
0+685
0+735
0+800
0+925
0+166
0+215
0+250
R20172-01 Access to A92837-2
R20172-03 Access to A92837-2
R20172-04 Access to A92837-2
Harvest Plan Map
British Columbia
Timber Sales
Babine Business
Area
BCTS
BC Timber Sales
Licence: A92837
Permit:
Block: 2
Opening: 93L050_437
UBI: BA437
Cut_Blk_Seq_Nbr: 160297553
Mapsheet Id: 093L050
Latitude: 542508
Longitude: 1260013
Gross Block Area (ha): 17.31
Total Merch. Area (ha): 13.69
Map Run Date: 10/30/2015
Harvest Prescription Summaries
Disturbance Type Area HA
5 Percent 13.7
Sum: 13.7
Harvest Strategies Area HA
STD 13.7
Sum: 13.7
Location Description
Head west on Highway 16 for 36.5 k then turn right on to the Broman Lake FSR. Drive 1 k to the junction under the powerline and keep right. Follow this branch to 5.5 k then keep right onto Conrad Lk Rd, turn left then immediately right on to the Taman FSR at 14.5 k. Head east on the Taman. To get to block 2 & 3 there are four sections of RP accessing block 2 of this TSL. R20172-01 disembarks south off of the Taman at approximately 13 k along the active R10811 of Sivert Anderson that accesses Woodlot 1530. It heads east through block 3 then south into block 2; R20172-03 disembarks off the Taman at roughly 12 k and heads south into the middle of block 2. R20172-04 accesses block 2 from about 10 k on the Taman and goes north into the eastern portion of the block.
Harvest Strategy Comments
* very dry summer or winter harvest recommended due to fine-textured soils
* retain one 20m X 20m patch of regen per hectare where it exists
* retain all deciduous unless impeding road building, processing or posing a safety hazard
* where deciduous must be taken down for safety reasons, stub to a 5-metre height and leave on site for CWD recruitment
* there is 30 m wide wet strip running east-west through the east end of the block
* ensure fence is functional by installing a gate or cattleguard if harvesting over the summer months
Legend
Stream Reach
Lakes (LRDW)
Wetlands (LRDW)
Vegetation Cover (LRDW)
Subject Block Boundary (GENUS)
Existing Blocks
Proposed Roads & Landings
Existing Roads & Landings
WTRA
DEF
Areas of Concern
Boundary Hub
WTRA Hub
Road Hub
Skidding Direction
Wildlife Feature
Designated Skid X
Skid Bridge
Culvert
Existing Roads (GENUS)
Proposed Roads (GENUS)
Proposed Skid Trail
Proposed Bladed Skid Trail
Fence Line
Temp. Access Structure
Contour (LRDW)
Wildlife Feature
CMT Post 1946
CMT Pre 1946
Cultural Heritage Resource
Cultural HeritageTrail
MSMA Tree
Cruise Slope Direction Arrow
Measure Cruise Plot
Count Cruise Plot
Cruise POC
Ribbon Colours
Harvest Boundary Orange (Blue paint)
Riparian Features Orange
Machine Free Yellow (MFZ)
MSMA Yellow (Do not cut)
Road Center Pink
Grid North
Scale: 1:5,000
DATUM: NAD 1983
Projection: BC Environment Albers
Base Map Data: MGRM LRDW
Subject Map Data: GENUS
Template: GENUS GEO
Created By: Andy Muma
Meters
0 50 100 200 300