
Change Monitoring Inventory

Ground Sampling Quality Assurance Standards

Prepared by
Ministry of Sustainable Resource Management
Terrestrial Information Branch
for the Terrestrial Ecosystem Task Force
Resources Inventory Committee

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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report "The Future of our Forests".

For further information about the Resources Inventory Committee and its various Task Forces, please access the Resources Inventory Committee Website at:
<http://www.for.gov.bc.ca/ric>.

Terrestrial Ecosystems Task Force

The Vegetation Inventory Working Group was formed in 1993 and issued their final report in March 1995 on a "Proposed New Inventory" for British Columbia. The Ministry of Forests, Resources Inventory Branch, in cooperation with the Ministry of Environment and other Ministry of Forests branches and consultants, developed the suite of Vegetation Resources Inventory Procedures based on the recommendations in that report. Many individuals were involved in writing the original version of the various Vegetation Resources Inventory Procedures documents.

For questions concerning the content of this publication please contact the:

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Ground Sampling Standards

Introduction

This document contains the standards for the Ground Sampling phase of the Ministry of Forests, Change Monitoring Inventory (CMI), that are to be used in the 2001 field season. The standards were established in consultation with quality assurance auditors, and after a partial review of 2000 audit field data, and are considered achievable by sampling crews.

The standards are based on the assumption that **all batches will be complete when submitted**. This means that all field cards must be completely filled out, photos and maps must meet the requirements as set out in the prework conference, and any other required information must be present as well. If the submitted batches are not complete they will not be accepted and will be returned to the field crew for completion.

There are two sets of standards specified in this document: pass/fail standards set for the entire sample and individual standards set for specific attributes and/or details. Most individual attributes are not considered pass/fail criteria, however the established standards are expected to be met.

It is expected that the standards will change over time. Feedback about these standards is appreciated and should be directed to:

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<http://www.for.gov.bc.ca/resinv/Veginv/ChangeMgmt00/change.htm>

Pass / Fail Criteria

Within the CMI Ground Sampling there are important attributes for which pass/fail standards have been established. Not meeting these standards for a cluster will result in the failure of the sample batch from which the sample was selected. The batch as a whole will then need to be revisited to correct the attributes in question and will be subject to additional audit.

Change Monitoring Inventory

The following are the current pass / fail attributes:

- **Plot Location**
 - plot cluster within standards as determined on the ground
 - auditor must be able to relocate plot following access and navigation notes

- **Tree Attributes**
 - gross volume per hectare
 - net volume per hectare
 - net value per hectare
 - tree count per cluster
 - tree genus
 - tree species
 - live/dead classification
 - diameter at breast height
 - tree length
 - selection of age/height trees

- **Ecological Attributes**
 - range transect total shrub coverage
 - coarse woody debris gross volume per hectare
 - tree - shrub species identification
 - herb - bryoid species identification

The pass/fail criteria listed above apply to all projects conducted using CMI procedures. Note that specific projects may have additional requirements specified in the contract documents. For instance, “non-fail” attributes that are repeatedly measured or conducted below standard may require a revisit to the batch to ensure project standards are attained.

Pass/Fail Standards

Plot Cluster Location

Attribute	Crew standard
Relative sample location	± 30 metres when appropriate field ties available

Tree Attributes

The audit procedures involve checking one (or more) quadrants for tree measurements therefore the following standards refer to errors per quadrant. Site tree data is checked for the entire sample.

Attribute	Crew Standard
Gross volume (m ³ /ha) (4.0cm ⁺ live and dead)	± 10 m ³ for volumes ≤ 100 m ³ /ha ± 10% for volumes > 100 m ³ /ha
Net volume (m ³ /ha) (live trees 4.0cm ⁺)	± 10 m ³ for volumes ≤ 100 m ³ /ha ± 10% for volumes > 100 m ³ /ha
Net value (\$/m ³) (live trees 4.0cm ⁺)	± 15%
Tree count	no error on quadrants with ≤ 25 trees 1 error maximum for quadrants with > 25 trees (missed and added trees do not cancel each other)
Tree genus	1 error maximum per quadrant
Tree species	1 error maximum per quadrant
Live/dead	1 error maximum per quadrant
DBH	Average absolute variation ≤ 2%
Tree length	Average absolute variation ≤ 3%; none over 5%
Age/height tree selection	No error allowed in determining the leading species and second species 1 error allowed in the selection of leading species trees

Ecological Attributes

Attribute	Crew Standard
Range transect total shrub coverage (m)	± 15%
CWD – Gross volume (m ³ /hectare)	± 15%
Tree/shrub species identification ¹	> 90% of occurrences correctly identified
Herb/bryoid species identification ¹	> 80% of occurrences correctly identified

¹Species identification: the species is correctly listed as “counted” and “species correctly recorded” (either as a “known” or else collected and called an “unknown”) by the crew.

Plot Cluster Location Standards

Attribute	Crew Standard
Azimuth – tie point tree to tie point	±2°
Azimuth – reference tree to reference pin	± 2°
Azimuth – tie point to Reference Pin	± 4°
Distance from tie point to tie point tree	± 4% of distance
Distance from reference tree to reference pin	± 4% of distance
Distance from tie point to Reference Pin	± 5% of distance
Distance from reference pin to IPC (15.0 m)	± 0.2m
Offset GPS bearing to point	± 2°
Offset GPS distance to point	± 4% of distance
Random and second transect azimuth	± 4°
Transect length	± 0.5 m
Location of forage plots	± 0.2 m
Herb and bryoid plot (5.64 m)	± 0.2 m
Tree and shrub plot (10.0 m)	± 0.4 m
Azimuth for stem mapping	± 2°
Distance for stem mapping	± 2% of distance

Tree Attribute Standards

Tree Details Attributes

Attribute	Crew Standard
Tree count	No Error when tree count less than or equal to 25 trees in quadrant Maximum 1 added or missed tree when tree count in quadrant > 25
Genus	1 error maximum per quadrant
Species	1 error maximum per quadrant
Live/dead	1 error maximum per quadrant
Stand/fall	1 error maximum per quadrant
Diameter breast height	Average absolute variation $\leq 2\%$
Bark remaining %	$\pm 10\%$
Tree length	Average absolute variation $\leq 3\%$; none over 5%
Crown class	90/100 in correct class
Height to live crown	± 2 m on crowns < 10 m $\pm 20\%$ on crowns > 10 m
First log grade	90/100 within correct category
First log length	$\pm 30\%$ of length
First log net factor	$\pm 5\%$ when net factor > 80% $\pm 20\%$ when net factor < 80%
Second log grade	90/100 within correct category
Second log length	$\pm 30\%$ of length
Second log net factor	$\pm 5\%$ when net factor > 80% $\pm 20\%$ when net factor < 80%
Third + log grade	* 90/100 in correct "category"
Third log length	$\pm 30\%$ of length
Third log net factor	$\pm 5\%$ when net factor > 80% $\pm 20\%$ when net factor < 80%
Visual appearance	90/100 in correct or adjacent class
Crown condition	90/100 in correct or adjacent class
Bark retention	90/100 in correct or adjacent class
Wood condition	90/100 in correct or adjacent class
Lichen loading	90/100 in correct or adjacent class
Wildlife use	90/100 in correct class
Broken top diameter	$\pm 20\%$ of diameter
Projected height	$\pm 10\%$ of length

Tree Loss Indicators Attributes

Attribute	Crew Standard
Damage agents	90/100 correctly identified
Loss indicators	90/100 correctly identified
Position of loss indicator or upper and lower extent of loss indicator(s)	± 1.0 m for indicator in lower 10 m ± 2.0 m for indicator in upper stem
Frequency	90/100 correctly identified

Age/Height Tree Attributes

Attribute	Crew Standard
Top height tree	no error allowed in selection
Leading species tree(s)	no error allowed in determining leading species 1 error/sample allowed in the selection of leading species trees
Second species tree	no error allowed in selection of species, 1 error allowed in the selection of second leading species trees
Bark thickness	± 2 mm when bark < 10 mm ± 20% bark > 10 mm
Field Bored age	± 2 rings if < 20 years ± 5% if ≥ 20 years and < 100 years ± 10% if ≥ 100 and years and < 200 years ± 20% if > 200 years
5 year growth	± 2 mm
10 year growth	± 4 mm
20 year growth	± 6 mm
Pro-rate Core length	± 1.0 cm

Small Tree Attributes

Attribute	Crew Standard
Small tree species	90/100 correctly identified
Trees 10 to 30 cm in height	± 20% of tree count
Trees 31 to 130 cm in height	± 10% of tree count
Trees 130 cm in height to 3.9 cm in diameter at breast height	± 10% of tree count

Stump Attributes

Attribute	Crew Standard
Stump species	90/100 correctly identified
Diameter inside bark	± 2 cm for stems < 25 cm ± 5 cm for stems > 25 cm
Length	± 0.2 m
Percentage sound wood	± 5% when sound portion > 80% ± 20% when sound portion < 80%
Bark retention code	90/100 in correct or adjacent class
Wood condition code	90/100 in correct or adjacent class

Ecological Attribute Standards**Range Attributes**

Attribute	Crew Standard
Shrub species	85/100 [Maximum ± 2 added or missed]
Layer designation B1 vs. B2	95/100 within correct layer
Shrub genus	90/100 within correct genus [Maximum 1 missed or added]
Phenology	95/100 within correct class
Transect – percent shrub coverage per species	± 10% of actual when coverage is < 10.0 m. ± 15% of actual when coverage is ≥ 10.0 m.
Graminoid and forb separation	90/100 of weight within correct designation
Forage utilization	95% in correct or adjacent class
Forage (dry wt.) abundance	± 2 grams if 0–50g ± 4% if ≥ 50g

Coarse Woody Debris Attributes

Attribute	Crew Standard
CWD pieces	± 2 pieces per transect
Species	90/100 correct species identified for decay class 1, 2 or 3 pieces 75/100 correct species identified for decay class 4 or 5 pieces
Diameter	± 4 cm for stems < 40 cm ± 10% for stems ≥ 40 cm
Length (optional in VRI)	± 0.4 m for pieces < 10 m

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Attribute	Crew Standard
	± 5% for pieces > 10 m
Percent decay class 1	± 10% when sound portion > 80% ± 20% when sound portion < 80%
Other decay class	90/100 in correct class
Tilt angle	± 5°
Merchantability	80/100 correctly identified as “X” grade or better [Maximum 1 error]
Product to remove	98/100 in correct class [Maximum 1 error]
Decay class for the piece	90/100 in correct or adjacent class

Ecological Site Description

Attribute	Crew Standard
Uniformity code	± 1 class
Zone	No error unless on a transition boundary
Subzone	No error unless on a transition boundary
Variant	No error unless on a transition boundary
Slope	± 5%
Aspect	± 20°
Elevation	± 50 metres
Surface shape	100% within correct or adjacent class
Meso-slope position	100% within correct or adjacent class
Microtopography	100% within correct or adjacent class
% coverage of cobbles and stones	± 5% if < 20% coverage ± 10% if ≥ 20% coverage
% coverage of bedrock	± 5% if < 20% coverage ± 10% if ≥ 20% coverage
Flood hazard	100% in correct or adjacent category
% coverage of flowing water	± 5% if < 20% coverage ± 10% if ≥ 20% coverage ± 4%
% coverage of standing water	± 5% if < 20% coverage ± 10% if ≥ 20% coverage ± 4%
Slope failure in plot	No error
Slope failure within 25 metre plot	No error
Gullies within plot	No error
Gullies within 25 metre plot	No error
Soil moisture regime	± one category
Soil nutrient regime	± one category
Site series number	no error unless on boundary transition (use SMR/SNR)
Land cover - level 1 (vegetated versus non vegetated)	no error unless on boundary of class

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Attribute	Crew Standard
Land cover - level 2 (treed versus non-treed)	no error unless on boundary of class
Land cover - level 3 (wetland / upland / alpine)	no error unless on boundary of class
Land cover - level 4 (cover type)	± one category
Land cover - level 5 (density description)	± one category

Soil Description

Attribute	Crew Standard
Soil horizons	main rhizosphere identified correctly, for other layers ± one layer
Distance from zero for each layer	± 10 cm
Texture for each identified layer	100 % in correct or adjacent class
Total % coarse fragments	± 10% for fragments < 35 % ± 20 %for fragments ≥ 35 %
% gravel	± 10% for fragments < 35 % ± 20 %for fragments ≥ 35 %
% cobbles and stones	± 10% for fragments < 35 % ± 20 % for fragments ≥ 35 %
Depth to water table	± 10 cm
Depth to gleying	± 5 cm
Depth to root restricting pan	± 5 cm
Depth to bedrock	± 10 cm
Depth to frozen layers	± 10 cm
Depth to carbonates	± 10 cm
Humus form	no error within main category (mull, moder, mor)
Surficial material (primary layer)	no error
Soil colour	± one category
L/F/H description and depth	layers correctly identified and within 2 cm. Cumulative depth

Vegetation Layers

Attribute	Crew Standard
Tree Species identified	90/100 correctly identified
Overall cover estimate "A" layer	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 %
Overall cover estimate "B1" layer	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 %
Shrub species identified	90/100 correctly identified
Overall cover estimate "B2" layer	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 %
Species coverage Layer "A"	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 %
Species coverage – layer "B1"	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 % ± 10% if "A" layer > 10% ± 5%
Species coverage – layer "B2"	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 %
Average height of B 1 layer	± 1 metre
Average height of B 2 layer	± 0.4 metres
Percent coverage by species of seedlings (Dh, Dw, and Dr)	± 10 % for cover > 25 % ± 5 % for cover 11 to 25 % ± 3 % for cover 6 to 10 % ± 0.5 % for cover 0.5 % to 5 %
Herb species identified	90/100 correctly identified
Bryoid species identified	80/100 correctly identified

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Attribute	Crew Standard
Overall coverage of layer C	$\pm 10\%$ for coverage $> 30\%$ $\pm 5\%$ for coverage 16 to 30% $\pm 2\%$ for coverage 6 to 15% $\pm 1\%$ for coverage 1 to 5%
Overall coverage of layer D	$\pm 10\%$ for coverage $> 30\%$ $\pm 5\%$ for coverage 16 to 30% $\pm 2\%$ for coverage 6 to 15% $\pm 1\%$ for coverage 1 to 5%
Species ID ¹ – layer “C, Dh, Dw, Dr”	80/100 correct species
Species coverage – layer “C”	$\pm 10\%$ for coverage $> 30\%$ $\pm 5\%$ for coverage 16 to 30% $\pm 2\%$ for coverage 6 to 15% $\pm 1\%$ for coverage 1 to 5%
Species coverage – layer “Dh”	$\pm 10\%$ for coverage $> 30\%$ $\pm 5\%$ for coverage 16 to 30% $\pm 2\%$ for coverage 6 to 15% $\pm 1\%$ for coverage 1 to 5%
Species coverage – layer “Dw”	$\pm 10\%$ for coverage $> 30\%$ $\pm 5\%$ for coverage 16 to 30% $\pm 2\%$ for coverage 6 to 15% $\pm 1\%$ for coverage 1 to 5%
Species coverage – layer “Dr”	$\pm 10\%$ for coverage $> 30\%$ $\pm 5\%$ for coverage 16 to 30% $\pm 2\%$ for coverage 6 to 15% $\pm 1\%$ for coverage 1 to 5%

Species identification is for species listed as “known” by crew.

Succession Interpretation

Attribute	Crew Standard
Factors influencing vegetation establishment	± one factor missed or added
Previous species	must have at least one species of two correctly identified
Current species	must have at least one species of two correctly identified
Tree harvesting	In correct or adjacent category
Presence of snags	In correct or adjacent category
Snags and CWD presence	In correct or adjacent category
Canopy gaps	In correct or adjacent category
Vertical structure	In correct or adjacent category
Successional stability	In correct or adjacent category
Tree size	In correct or adjacent category
Tree age	In correct or adjacent category
Structural stages	In correct or adjacent category
% old trees alive	± 10%
Old growth	“No” correctly identified “No (some) or Yes in correct or adjacent class