

# **3 Quality Assurance**

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### 3.1 Introduction

MFLNRO audits timber cruises to ensure all appropriate standards are followed, support revenue objectives, ensure the equitable distribution of stumpage among licensees and to ensure the consistent application of cruise data in the price modelling process.

As such, MFLNRO is responsible for setting the standards for timber cruising, while licensees are responsible, under contract, to meet these minimum standards. Information from the cruise that meets these standards may be used for appraisal.

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

#### Objectives

The objectives of the quality assurance review are to ensure:

1. The integrity of the sample design. This is achieved by assessing the cruise plan as specified in section 3.2.
2. The measurements of the tree or site attributes meet the minimum standards. This is achieved by comparing a sample of cruiser's measurements against the check cruiser's measurements as specified in sections [3.3](#), [3.4](#), [3.5](#), and [3.6](#).
3. The reports generated from the approved cruise compilation program and final cruise submission are consistent with the cruise plan and reflect the data collected in the field. This is achieved by assessing the cruise compilation and final cruise submission as specified in section [3.8](#).

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

**In addition, if the cruise is not consistent with the procedures included in this manual the MFLNRO may require that corrective action be undertaken before the cruise data is used for appraisal purposes.**

## 3.2 Cruise Plan Standards

The cruise plan is a key document that supports the integrity of the sample design.

A cruise plan must include the requirements identified in sections [2.2](#) and [3.2.1](#), as well as the cruise plan form ([FS 693](#)). If all the required information is included on the cruise plan map, a cruise plan form (FS693) is not required.

The cruise fieldwork and compilation may not be accepted for use in the appraisal if the above conditions are not met.

### 3.2.1 Cruise Plan Map Standards

1. The cruise plan map will be legible and of good quality 1:5 000 or 1:10 000 scale.
2. The cruise plan map will provide neat and clear lines, lettering and numbers.
3. The cruise plan and/or cruise plan map shall include the items indicated in Table [3-1](#).

A sample cruise plan map can be seen at the following link:

[Sample Cruise Plan Map.pdf](#)

**Table 3-1 Requirements for Cruise Plan and Final Cruise Submissions**

	<b>Requirements</b>	<b>Cruise Plan Submission</b>	<b>Final Cruise Submission</b>
a	Tenure and Cutting authority	Yes (if known)	Yes
b	Forest Region and District	Yes	Yes
c	Scale	Yes	Yes
d	Timber Supply Area	Not required	Yes
e	North Arrow, Declination, Map base	Yes	Yes
f	<b>Cruise or Scale Base Indicator</b>	<b>Yes (Coast only)</b>	<b>Yes (Interior and Coast)</b>
g	Maturity of forest inventory polygons/blocks identified	Yes	Yes
h	Timber type lines and identifier (including a forest cover map of the cruise and adjacent areas for cruises containing Lodgepole Pine)	Yes (Forest Cover map not required for Coast)	Yes
i	Plots identified as measure or count plots and numbered	Yes	Yes
j	Block numbers (including any old numbers if changed)	Yes	Yes
k	Block and type net areas	Yes	Yes
l	Harvest methods and areas	Only required for heli logging areas	Yes
m	Existing and proposed roads	Yes	Yes
n	Forest Inventory Zone	Not Required	Yes
o	PSYU	Not Required	Yes
p	Biogeoclimatic zone(s) and sub zone(s)	Not Required	Interior only
q	Portions of each cut block boundary where boundary trees will be stubbed	Yes – Interior only (if known)	Yes – Interior only
r	Plots used in the compilation are clearly indicated	Not required	Yes
s	Locations of baselines (when used), boundary tie lines, points of commencement and actual strip line location with direction of travel ( <b>direction of travel and strip line location not required for GPS located plots</b> )	Not Required	Yes
t	<b>Actual location of plots in field (after fieldwork is completed)</b>	Not <b>Applicable</b>	Yes

	<b>Requirements</b>	<b>Cruise Plan Submission</b>	<b>Final Cruise Submission</b>
<b>u</b>	Physiographic features	Only if they affect sampling	Only if they affect sampling
<b>v</b>	Legal survey features	Only if they affect sampling	Yes
<b>w</b>	Forest and non-forest type boundaries	Yes	Yes
<b>x</b>	Cutting boundaries	Yes	Yes
<b>y</b>	Name of person or company who produced map and date map was produced	Yes	Yes
<b>z</b>	Name of person(s) who complete the cruise field work	Yes - proposed	Yes

### 3.3 Principles

The following summary outlines the general principles that guide the check cruising process:

The check cruiser has the necessary experience and knowledge to perform the audit.

The check cruiser will strive to select plots to audit using a random process or by a process agreed to by the cruiser and the check cruiser.

**In order to reject a cruise on the basis of tree data attributes or plot slopes, the check cruisers will audit at least 10.0% of the plots or 5 plots within the sample population (ex. cruiser, block, cutting authority), whichever is greater. If a cruise is being rejected for measure plot data, the minimum number of plots must be based on measure plots. Otherwise, the minimum number of check plots can include both count and measure plots. If fewer plots have been audited and there is mutual agreement between the cruiser or licensee representative and the check cruiser, the cruise may be rejected or accepted.**

The check cruiser should provide an opportunity for the cruiser or company representative to attend the audit by providing advance notice.

The cruiser must take responsibility for the cruise data in accordance with Section [3.8\(5\)](#) of this manual.

A copy of the check cruise report will be provided to the cruiser in a format that is acceptable to the Regional Executive Director.

Benefit of the doubt will be extended to the cruiser. If the call is considered borderline or difficult to discern, a brief rationale should be noted on the cruise card and where appropriate, in the field. The cruiser's decision will be accepted where the decision is reasonable in the particular circumstances.

Plot centres, plot centre reference trees, sample trees and strip lines (where used) must be marked in the field and in a fashion so as to provide a reasonable level of identification to support the audit function.

For quality assurance purposes, **cruising field work** will be assessed according to the Cruising Manual in effect at the time the **field work was completed**.

### 3.4 Tree Data

If the standards in this section are not met, the tree data cannot be used for appraisal.

The following standards define the maximum variations allowed between the cruiser’s and check cruiser’s measurements.

Western yew is excluded from the tree standards.

#### 1 – Tree Count (Section [4.3.1.15](#))

The maximum number of tree count errors allowed for all merchantable live and dead potential and useless trees are shown in Table 3-2:

**Table 3-2 Allowable Tree Count Errors**

<b>Number of Merchantable Trees Checked</b>	<b>Allowable Error</b>
1 to 50	plus or minus 1 tree
51 to 100	plus or minus 2 trees
101 to 150	plus or minus 3 trees
<b>Number of Useless Trees Checked – Interior Only</b>	<b>Allowable Error</b>
1 to 50	plus or minus 1 tree
51 to 100	plus or minus 2 trees
101 to 150	plus or minus 3 trees

- a. This standard applies to measure and count plots.
- b. Trees incorrectly identified as dead potential versus dead useless or live useless versus live potential are considered an incorrect tree count.
- c. Tree count errors are absolute, missed trees do not compensate for trees that should not have been tallied.
- d. If the borderline ‘in’ or ‘out’ tree has been measured it will be accepted, provided that the original plot radius calculated for the tree does not exceed one (1.0) percent variation from the check plot radius and the original horizontal distance determined for the tree does not exceed one (1.0) percent variation from the check horizontal distance.

- e. A timber cruise may be rejected if more than two BAFs are used in a timber type polygon.
- f. An error on walkthrough trees that are tallied twice counts as 2 trees (not one).

## 2 – Species Identification (Section [4.3.2.4](#))

The maximum number of tree species errors allowed for all merchantable live and dead potential trees are shown in Table 3-3:

**Table 3-3 Allowable Species Errors**

Number of Merchantable Trees Checked	Allowable Error
1 to 50	plus or minus 1 tree
51 to 100	plus or minus 2 trees
101 to 150	plus or minus 3 trees

This standard applies to both full measure and count plots

## 3 – Tree Heights (Section [4.3.2.3](#))

The absolute variation of all tree heights must not exceed 5.0 %. An example of how to calculate this variation is shown in Table 3-4:

**Table 3-4 Example Tree Height Variation Calculation**

Original – Height (m)	Check – Height (m)	Difference – (m)
40.0	42.0	-2.0
42.0	41.0	1.0
43.0	44.0	-1.0
46.0	44.0	2.0
Sum	171.0	6.0

Absolute Variation =  $6.0/171.0 * 100 = 3.51$  percent

The check cruiser will attempt to audit a minimum of 20 merchantable tree heights. All tree heights in the check plots will be audited.



The height in metres must be recorded in the plot record (Card Type 9) in the Bowron, Longworth, Monkman, Purden and Robson PSYUs and TFL 30. Tree heights are used to determine mature red cedar loss factors in these PSYUs and TFL (Loss Factor Table 0296). The height in metres in Card Type 9 is not a check cruise item in any other PSYU or TFL. (See [4.3.1.9](#))

#### **4 – Pathological Indicators** (Section [4.3.2.7](#))

No more than 10.0 % of all trees checked can have a risk group change resulting from incorrect pathological indicator records.

#### **5 – Damage Codes** (Section [4.3.2.18](#))

The following standards apply to the measurement of damage codes:

- a. No more than 5.0 percent of all trees checked can have an incorrect code.
- b. Incorrect codes that result in a risk group change will contribute to the number of pathological indicators and risk group changes (not applicable to CGNF cruises).
- c. In the case of a reappraisal due to damage as specified in the [Interior Appraisal Manual](#), the following standards will apply:
  - i. All reclassification of insect damage and down tree codes must be based on field data collection.
  - ii. In order to provide the MFLNRO with adequate time to perform check cruises, re-sweep data must be provided to the MFLNRO at least 10 working days prior to the commencement of any harvest activity, or some other mutually agreed upon time frame. In turn, the MFLNRO must respond to the licensee within that time frame if there are any concerns with the cruise, otherwise the cruise will be considered acceptable.
  - iii. In order to check and verify the re-sweep insect and down tree code data and confirm who performed the cruise, the following information must be made available to the MFLNRO:

The date(s) the re-sweep was completed.

The cruiser must take responsibility for the cruise data in accordance with Section [3.8\(5\)](#) of this manual.

The original and the updated damage code for each re-classified tree.

- iv. Due to the rapid nature of change associated with the needle colour attribute versus other timber attributes, insect code classification will only be counted as an incorrect damage code if the cruiser's code is greater than the code determined by the MFLNRO (e.g., the cruiser called a red

attack (code 2) and the check cruise assessed the tree as green attack (code 1).

- v. The intent of allowing licensees to re-sweep for insect and down tree codes is to provide the most recent description of the damage. As such, the MFLNRO check cruise efforts will focus primarily on the correct determination of the insect and down tree code attribute; however if in the general practice of completing the insect and down tree code assessment, the MFLNRO becomes aware of other significant inconsistencies with respect to the cruise standards, these issues will be addressed on a case by case basis.

## 6 – Tree Ages (Section [4.3.2.6](#))

The standards applied to the measurement of tree ages are:

1. Tree ages determined by increment boring:
  - a. The age in 10's and tree classes must **be consistent** with the Tree Class Modification of Loss Factor Tables (Table 17 – see Appendices), where applicable. **The age in 10's is recorded as the dominant age class by volume (except when age class 13 and 14 trees are present in a plot). See Section [4.3.1.8](#).**
  - b. At least ninety-five (95.0) percent of all trees must be placed in the correct age in 10's and tree class, where applicable.
  - c. Coast - age in 10's of 13 and 14 - all of the tree classes must be verified since tree classes 1, 2, 3, 8 and 9 contribute to the percent second growth reporting.
2. Tree ages determined by forest cover age classes:
  1. All interior PI trees must have the correct age class as determined from the most current forest inventory types.

## 7 – Diameter at Breast Height (Section [4.3.2.5](#))

The height of the diameter line marked at breast height must not exceed plus or minus 5 percent (plus or minus 6.5 cm) from the true breast-height of 1.3 m above high side. When this limit is exceeded, the true position is used for a. and b. below.

The DBH measurement standards are shown in Table [3-5](#). **Both a. and b.** must be exceeded before the standard is determined to be incorrect.

**Table 3-5 DBH Measurement Standards**

Diameter at Breast Height (DBH)		
Live and dead potential trees.	a.	At least 90.0 percent of individual stems checked must be within 2.0 percent of true DBH.
	b.	Average absolute variation of all DBHs checked must be within 2.0 percent of the original DBHs.

Dead useless trees should be estimated to the nearest 5cm DBH class.

**8 – Quality Remarks** (Sections [4.3.2.8](#))

The following standards apply to the assessment of tree quality remarks used in coast appraisals only:

- 1. Pathological indicators:** At least 90.0 percent of the individual indicators that occur in the middle or lower third must be coded in the correct third of the tree.
- 2. Quality indicators:**

For All Check Plots – At least 90.0 percent of all quality indicators checked must be within plus or minus one code change. The exceptions are:

- Knot codes 5 and 6 are not allowed any variation.
- Spiral Grain – if the check code is greater than 4 and the original is less than 5, or vice verse, it is an error.

### 3.5 Survey and Area Measurement Standards

This section outlines the distance and area measurement standards used to locate plots and or harvest boundaries. Cruisers or check cruisers may use any appropriate method to measure and or initially verify a distance or area. For audit purposes, the true distance and or area measure may be derived from conventional measurement systems such as a survey chain and compass except when GPS is used to establish cruise plot locations. In these situations, plot location must be audited using a GPS unit that meets the standards specified in this section.

#### 1 – Strip or Tie Lines (Conventional Methods Only - Sections [4.3.1.4](#) and [4.3.1.5](#))

Strip lines are only used with conventional measurement systems (i.e. without GPS technology).

The following standards apply to the strip or tie line measurements used to locate the plot centre. These standards apply from plot to plot or for any combined strip interval distance. The check cruiser will follow the same route (i.e. direction of travel) that the original cruiser traversed. The plot will be re-cruised if the plot location is not within the following standards:

Horizontal distance: plus or minus 2.0 percent (2.0 m per 100m).

Bearing: plus or minus 2.0 degrees (+/- 3.5 m per 100m).

Plus or minus  $2^{\circ}$  - this translates to 3.5 m in 100 m using the formula:  
( $100 * (\tan 2 \text{ degrees})$ ) = 3.49 percent, therefore: 3.49 percent \* 100m = 3.49m (rounds to 3.5).

Moving plot centres from the measured/ traversed location presents significant bias and is not permitted in any case.

#### 2 – Plot Measurements (Section [4.3.1.5](#))

##### Establishing Cruise Plots Using Conventional Methods

The standards applied to the distance measurement used to locate the plot reference tree and the plot are shown in Table [3-6](#):

**Table 3-6 Plot Distance Standards**

Attribute	Maximum Variation
Plot centre reference tree to plot centre	Plus or minus 1.0 percent of horizontal distance
Radius - fixed and variable radius plots	Plus or minus 1.0 percent of horizontal distance
Length and width: fixed rectangular plots	Plus or minus 1.0 percent of horizontal distance

### Establishing Cruise Plots Using GPS Technology

As of November 1, 2014, cruises may be rejected for not meeting the **standards in this section** when GPS is used to establish cruise plots.

In order to use GPS technology to establish cruise plots, the GPS receiver must meet the following standards:

- Able to achieve submetre accuracy under ideal conditions (i.e. open area, no interference, good satellite coverage)
- Real time correction system with external antenna
- Minimum satellite elevation angle/mask is 15 degrees above the horizon
- RMS (Root Mean Square) minimum rating of 100 cm

If GPS is used to establish cruise plots, the following data must be submitted to the Ministry in a **Plot Reference Point (PRP)** table (if requested as per Section 3.8):

- Cutblock
- Timber type
- Cruise plot number
- Horizontal Distance (m) from PRP to Cruise plot - *must be a minimum of 5.0 m horizontal distance*
- Calculated bearing (degrees) from PRP to Cruise plot
- Average PDOP – *maximum of 6.0*
- Average HDOP – *maximum of 4.0*
- Number of satellites when establishing PRP – *minimum of 4*
- Number of hits received when establishing PRP – *minimum of 50 hits*
- Mean difference of hits in metres (MDH) – *maximum of 1.0*
- Time of PRP establishment – specify UTC or GMT
- PRP coordinates – specify UTM or BC Albers\*
- Cruise plot coordinates - specify UTM or BC Albers\*

The required format of the PRP table is shown in Table 3-7.

\*The map projection system used (i.e. BC Albers, UTM, etc) must be consistent with the cruise plan.

**Table 3-7 Sample of Required Format for PRP Table**

C B	T Y P E	P L O T	H D (m)	B R G (°)	P D O P	H D O P	# S A T	# H I T	MDH (m)	Time (UTC)	PRP Easting	PRP Northing	PT Easting	PT Northing
											UTM	UTM	UTM	UTM
7	2	1	16.6	110	3.4	1.9	6	50	0.3	144144.00	683417.473	5657508.768	683433.292	5657503.723
7	2	2	9.7	329	3.9	2.3	8	50	0.1	163211.00	682934.854	5657577.685	682929.529	5657585.834
7	2	3	8.9	157	2.3	2.9	8	50	0.5	181932.00	683125.834	5657600.981	683129.624	5657592.922
7	2	4	11.6	063	2.0	1.7	9	50	0.4	214811.00	683219.529	5657590.781	683229.672	5657596.466
7	2	5	11.7	349	2.0	2.2	9	50	0.2	220113.00	683332.437	5657588.624	683329.720	5657600.010

Cruise plots that are located with GPS must meet the following standards. In order for a cruise to be rejected for cruise plot location data, either both of the first 2 standards (1 and 2) must be exceeded or the last standard (3) must be exceeded:

1. The average absolute variation of all cruise plot locations checked must be within 3.0 m of the check cruise plot locations.
2. The Circular Error Probability standards:
  - a) 50.0% of all cruise plots checked must be within 2.5 m of their respective check cruise plot locations, and
  - b) 90.0% of all cruise plots checked must be within 5.0 m of their respective check cruise plot locations.
3. The distance and bearing between the cruiser's PRP and cruise plot must meet the same standards as those for conventional methods:
  - a) Horizontal distance: plus or minus 2.0 percent
  - b) Bearing: plus or minus 2.0 degrees

In order to require a re-cruise based on these standards, a minimum of 5 cruise plot locations or 10% of the cruise plot locations, whichever is greater, must be checked with a GPS unit that meets the aforementioned standards.

For additional information on precision standards for GPS plot locations, please see [Circular Error Probability Method](#) in the appendices.

At each cruise plot that is checked for plot location (GPS or conventional), a count plot will be completed at the check cruise plot location using the same BAF as the original cruise plot. The count plot data will be tracked to enable the Ministry to compare trends and variations between original and check cruise data over time.

### 3 – Harvest Boundary Traverse

The standards used for the measurements to establish the harvest boundaries are in Table [3-8](#):

**Table 3-8 Harvest Boundary Standards**

Boundary Traverse	Cruise-Based	MPB Cruise-Based & Scale-Based
Closure Error	+ or – 0.7%	+ or – 1.0%
Area Error	+ or – 1.0%	+ or – 1.5%
Inter-station Distance	+ or – 1.0%	+ or – 2.0%

For conventional traverses, both closure error and area error must be exceeded before the traverse is deemed to be incorrect. The closure error standards do not apply to GPS traverses. To calculate closure error for traverses that are a combination of GPS and conventional traverses, refer to the [Combined GPS and Conventional Traverse Procedure](#) found in the appendices.

### 3.6 Plot Slopes (Section [4.3.1.23](#))

The following standards apply to the measurement of plot slope. To support the audit process, the cruiser may establish flagging tape at the location used to determine the maximum slope at 15m slope distance from plot centre.

**Either** (a) **or** (b) must be exceeded before the standard is determined to be incorrect.

- a. Plot slopes:**  $\geq 90.0$  percent of the plots must be within plus or minus 5.0 slope percentage points of the actual slope reading.
- b. Block or Cutting Permit:** the average variation of all slopes checked must be within plus or minus 5.0 slope percent.



### 3.7 Check Cruise Dispute Mechanism

If the licensee wishes to dispute the result of a check cruise the following process will be provided:

Step	Action
1	The licensee and/or their agent responds to the rejected check cruise results.
2	The MFLNRO check cruiser and licensee and/or their agent attend the site and attempt to resolve the concerns.
3	If the concerns from step 2 are not resolved , the licensee may submit a written complaint to the District Manager <b>within 30 days of the site visit in step 2</b> requesting further review.
4	The District Manager will review the concerns and respond to the licensee and/or their agent within 30 days of receipt of the written complaint.
5	The licensee may appeal the District Manager's decision to the Regional Executive Director within 30 days of the District Manager's decision.

### 3.8 Cruise Data Submission Standards

The following conditions must be met. If they are not met, the cruise data may not be used for an appraisal:

1. The field data must be consistent with the data used in the appraisal compilation.
2. The field data must be compiled in a manner that is consistent with the cruise plan or final cruise map and changes to the cruise plan in accordance with Section [2.2](#).
3. When requested by the MFLNRO, the licensee must submit the original tally sheets, traverse notes (if traversed with chain and compass), and raw and corrected GPS files (if traversed with GPS).
4. If GPS is used to establish cruise plots, the following items must be submitted upon request to the Ministry:
  1. PRP Table in pdf format **as** specified in Section [3.5](#).
  2. Digital shape file depicting the established GPS cruise plot locations and plot numbers.
5. The cruiser must take responsibility for the cruise data by either:
  1. signing, printing their full name and dating (day, month and year) the original cruise card and any subsequent changes they made to that data, or
  2. submitting a cover letter (including name, date and signature) with the cruise data indicating which plots they cruised or made subsequent changes to.

If the cruiser is a registered or associate member of the Association of BC Forest Professionals (ABCFP), they must provide their professional designation.

If the cruiser is not a registered or associate member of the ABCFP, an additional cover letter must be submitted with the cruise data signed by a registered member or associate member indicating they are accepting responsibility for the information collected by the cruiser on that cutting authority. This cover letter is in addition to any letter submitted by a cruiser who is not a registered or associate member of the ABCFP.

6. The cruise data must be compiled on an approved version of the compilation software. (See Section [5.10.2](#))
7. Final cruise maps must accompany the compilation report and the final submission must include the requirements identified in Table [3-1](#).