Forest Renewal Assessment Manual

Manitoba

Developed by the Manitoba Agriculture and Resource Development
Forestry Branch

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The public is encouraged to send comments or recommendations to **forestguidelines@gov.mb.ca**

Contents

Glossary of Terms

Acceptable tree: a tree that satisfies the criteria set out in Section 3.7.

Assessment: a survey to determine how well the forest is renewing on the site. The survey is typically defined in two ways:

- **Ground assessments**: the base survey method, done with plots on the ground.
- **Alternative assessments**: uses methods such as remotely-piloted aircraft systems (RPAS), satellite interpretation, heli-ocular, etc.

Audits: a form of quality assurance; a survey completed by Manitoba government staff to determine if surveys were completed accurately.

Check survey: a form of quality assurance; a survey completed by a licensed check surveyor to determine if a ground assessment was complete and accurate.

Cover type: the composition of the stand in relation to softwood-hardwood ratio: "S" (softwood) is >76 per cent softwood; "M" (mixedwood, softwood leading) is 51 per cent to 75 per cent softwood; "N" (mixedwood, hardwood leading) is 26 per cent to 50 per cent softwood; "H" (hardwood) is <26 per cent softwood.

Density: a measure of acceptable tree population per species in a given area. Typically measured in stems per hectare (sph).

Harvest block: an area of forested land from which trees were harvested.

Management objective: a strategic plan or goal for harvest blocks. Typically the intent is to renew a harvest block back to its original stand type. However, this may vary depending on other factors such as social, environmental and wildlife values.

Non-productive plot: a plot containing zero acceptable trees and > 50 per cent of the plot is incapable of growing a merchantable tree within a reasonable length of time.

Non-stocked plot: a plot that is capable of growing trees, but contains zero acceptable trees.

Performing tree: an acceptable tree that meets the minimum height requirements set out in Section 3.7.

Renewal status: the renewal status of a harvest block may be:

- **Not sufficiently regenerated (NSR)**: has less than 80 per cent of the area (plots) stocked. This site is not regenerating and steps must be taken to assist in its renewal.
- **Sufficiently regenerated (SR)**: has greater than or equal to 80 per cent of the area stocked with acceptable trees. This site has a sufficient numbers of trees to regenerate into an established stand.
- **Sufficiently performing (SP)**: has greater than or equal to 80 per cent of the area stocked with performing trees. This established site is healthy, vigorous and could be left to produce future timber supplies without further intervention.

Stocked plot: a plot that contains one or more acceptable trees.

Stocking: expressed as a percentage; the distribution of the total trees in a harvest block, to fully utilize the growth potential of the land.

Tree family: the division of trees into classes: conifers (softwoods) and deciduous (hardwoods).

Validation survey: a form of quality assurance; a ground assessment done on a portion of alternative assessment areas. This 'validates' that performing an alternative assessment on a harvest block would give similar results as traditional ground survey.

UAV: unmanned aerial vehicle, also called a drone or remotely-piloted aircraft systems (RPAS).

Forest Renewal Assessments

1.0 Introduction

Prompt renewal of harvested forest lands is an integral component of forest management. Forest renewal assessments are essential for measuring forest renewal success and developing sound forest management strategies.

This manual is intended to provide forest surveyors in Manitoba with instructions for collecting forest renewal quantitative and qualitative data on harvest blocks.

Training and testing: All forest surveyors in Manitoba must be licensed by the Manitoba Forestry Branch. Training and testing of surveyors is completed by the agency responsible for renewal, and results are submitted to the branch. Field testing is required (written test may also be required, at the discretion of the agency responsible for renewal). Annual survey work, and passed check surveys are requirements to maintain a license without having to re-certify.

Objectives:

- To determine the extent of forest renewal in terms of stocking of acceptable and/or performing trees, and density. This will later be compiled and compared to provincial forest renewal standards to determine renewal success.
- To estimate the height of regenerating trees.
- Provide a qualitative description of the hardwood and softwood trees present.
- To determine potential site productivity and non-productive areas.
- To document observations regarding the harvest block, including forest health concerns.
- (Optional) To produce a map of the survey area that shows the physical features, location and stocking status of the plots. This includes health issues, such as dwarf mistletoe infections along edges or in residuals.

A Certificate of Sufficiently Performing will be awarded by the Manitoba Forestry Branch for harvest blocks that achieve a renewal status of: Sufficiently Performing, within the allotted time frame (see Section 2.0).

2.0 Timing of Forest Renewal Assessments

If the management objective is to renew to a **softwood** site (S or M cover types), a forest renewal assessment must be conducted between eight and 14 years after the end of the year in which harvesting was conducted.

If the management objective is to renew to a **hardwood** site (N or H cover types), the assessment must be conducted between three and seven years after the end of the year in which harvesting was conducted.

All assessments must be done at least 24 months after any stand tending treatments (e.g., herbicide) have been completed on the site, or at least 12 months after a fill plant on an NSR site.

3.0 Ground Assessment Methodology

Forest renewal assessments in Manitoba are results based, meaning that **any** methodology (at any intensity/plots) may be used. However, the benchmark standard to which all assessments are validated is the **ground assessment**.

Ground assessments use a systematic sampling method, with plots evenly distributed across the harvested area to avoid bias.

3.1 Equipment

Standard forest survey equipment is required to conduct the ground assessment accurately. The equipment should be kept in good repair and exhaustible items in good supply.

Recommended equipment includes:

GPS unit
Compass
Five-metre tape
Flagging tape
Permanent marker
Plot radius cord (marked at 1.78 m)
Plot radius stake/planting shovel
Survey manual

Communication devices:
- Radio
- inReach/SPOT

Personal protective equipment (PPE)
- Cruising vest
- Safety glasses

Tablet (iPad) or tally sheets
Maps

3.2 Survey Map

A survey map should include:

- location
- orientation
- scale
- harvest boundary and total hectares
- cover-type of the former stand
- any renewal activities which have occurred on the harvest block

Other physical features such as trails, residual stands, streams, and rock outcrops should be included on the map. Various background or base layers may be used. Aerial imagery is the most common.

Often, plot locations are pre-determined and pre-placed on the map, using a grid layout.

Plot locations must follow these rules:

- There is no minimum distance that a plot must be located from the survey boundary. However, no portion of the plot itself is allowed to fall on or outside of the survey boundary.
- Plots shall not be located in areas that have not been harvested (riparian management areas, swamps, wildlife corridors, leave-strips, etc.).
- Unique (often sequential) numbers or letters are used to identity each plot.

Prior to a field survey, during map and plot preparation, amalgamation of smaller harvest blocks can be made to reflect similar management intents of the harvest blocks. The summed area of the amalgamated harvest blocks is used to determine the sample intensity.

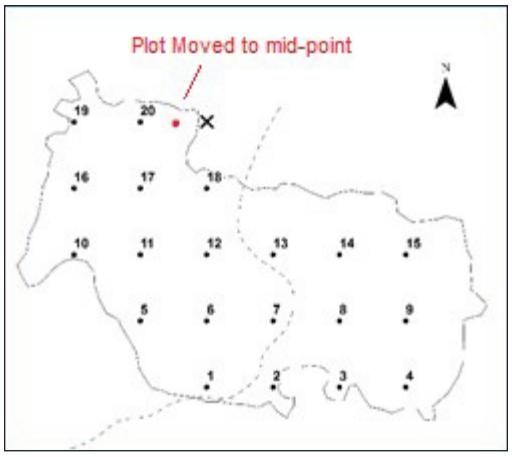


FIGURE 1: Survey Grid Layout

The Survey Grid: The design and selection of the survey grid pattern is dependent on the area of the harvest block to be surveyed (see Sample Intensity below). Manitoba recommends a square grid, using horizontal distances. The survey grid is comprised of a network of plots, evenly spaced and consistent throughout the harvest block.

Moving and Replacing Pre-determined Plots: While in the field, if a pre-determined plot lands on or outside of the survey boundary or in a non-harvested (residual) area, that plot is to be re-established to keep the proper survey sample intensity. This can be done by moving the plot exactly halfway between two existing plots. *For example, in Figure 1, the plot to the east of plot 20 would need to be moved.*

3.3 Sample Intensity

Table 1 shows the number of sample plots required, based on the harvest block size. Areas should always be rounded up to the nearest hectare for determining the number of plots.

TABLE 1: Sample Intensity

Harvest Block Size (ha)	**Number of Plots**	**Number of Plots Hardwood Sites in FML-3***
1 – 40	3 plots/ha (min 5)	2 plots/ha (min 5)
41+	2 plots/ha	1 plot/ha

* Due to the productive hardwood sites of The Mountain Forest Section (FML-3), the plots requirements are reduced where the management objective is to renew to a hardwood site (N and H).

3.4 Starting the Field Survey

When a survey crew arrives at a harvest block to be surveyed, they determine how to divide the plots among the surveyors to ensure the most efficient and effective use of field time. Once this is determined, each surveyor will begin establishing plots. As surveyors near completion of their assigned plots, they should communicate with other surveyors within the harvest block to ensure all plots are completed.

If needed, surveyors should establish tie points. Through the use of bearings and distances, tie points describe how to relocate the survey area. The tie points should be readily identifiable in the field and accurately located on a map or photo. Trail intersections, wetlands and residual stands make good tie-point references.

3.5 Plot Establishment

At each plot location a centre stake is pushed into the ground to establish plot centre, enabling the surveyor to determine the plot boundary accurately using a plot radius cord. Plots have a **radius of 1.78 metres**, which is the equivalent of 10 square metres or 1/1000 of a hectare.

PLOT RADIUS 1.78M

After establishing plot centre, the plot is thoroughly searched for the presence of acceptable and performing trees, which if present, are recorded on a Forest Renewal Assessment Plot form. Great care should be taken when a tree is near the plot boundary to determine if the tree's point of germination is within the plot. If no acceptable trees or performing trees are found in the plot, then the plot is considered empty and is checked for site productivity (Section 3.6).

Once the plot is completed, a marker is erected at the plot centre using logging debris or branches found nearby. Flagging tape, with the plot number and surveyor initials written on it, is used to create a ribbon and then tied to the marker. The ribbon should be clearly visible and the base of the plot marker firmly embedded or anchored securely. The plot centre has to be clearly marked and firmly in place so that a subsequent check surveyor can find the original survey centre.

Best Practices

To have something to attach ribbon onto, there is a tendency to move plot centre to existing vegetation. However, this can cause a bias in the survey by including stems that otherwise would have been outside the plot.

If the plot centre marker is difficult to see, tie an unmarked flag on tall foliage as close to plot centre as possible, to draw attention to plot centre marker. This additional flagging should not be marked or on a stake, ensuring it is not confused with the plot centre marker.

Poorly established plot centres or boundaries may result in a failed renewal survey, because the check surveyor may not relocate the plot centre location accurately, and subsequently observe different results.

3.6 Plot Productivity

A determination is made on the stocking status of every plot, by the presence or absence of an *acceptable tree (see Section 3.7)*:

- A **stocked plot** contains one or more *acceptable or performing trees*.
- A **performing plot** contains one or more *acceptable trees* that meet the minimum performing height.
- A **non-stocked plot** is capable of growing trees, but contains zero *acceptable trees*. These plots (often called void plots) are included in the stocking calculations (refer to Section 3.12.4).
- A **non-productive plot** contains zero *acceptable trees* and > 50 per cent of the plot is incapable of growing a merchantable tree within a reasonable length of time.

3.7 Acceptable Tree

When conducting a forest renewal assessment (all methodologies), only trees that qualify as an acceptable tree shall be included in the assessment. An acceptable tree is:

- alive
- not a residual tree (tree remaining after the last harvest); residuals should be noted in the comments (number, species and estimated height);
- a softwood tree, which has a living crown covering the top 50 per cent of the tree height
- free of lean in excess of 30 degrees from the vertical
- an acceptable tree species

TABLE 2: Acceptable Tree Species and Heights

Acceptable Species – Softwoods	Symbol	Min Acceptable Height*	Min Performing Height
White Spruce	WS	0.2m	1.0m
Black Spruce	BS	0.2m	1.0m
Jack Pine	JP	0.2m	1.5m
Red Pine	RP	0.2m	1.5m
White Pine	WP	0.2m	1.5m
Scots Pine	SP	0.2m	1.5m
Tamarack (Larch)	TL	0.2m	1.5m
Eastern White Cedar	EC	0.2m	1.5m
Balsam Fir	BF	0.2m	1.5m
Acceptable Species – Hardwoods			
Trembling Aspen	TA	1.0m	
Balsam Poplar	BA	1.0m	
Eastern Cottonwood	CO	1.0m	
White Birch	WB	1.0m	
Manitoba Maple	MM	1.0m	
Black/Green Ash	AS	1.0m	
American Elm	AE	1.0m	
Bur Oak	BO	1.0m	

* The minimum height requirements for softwoods increases to 0.3m for an Alternative Assessment.

3.8 Non-Productive Areas

Non-productive (NP) areas are incapable of growing a merchantable stand of trees within a reasonable length of time. These are untreated landings and roads, slash piles, rock, gravel pits, flooded areas, etc.

Plots are considered non-productive if they contain zero acceptable trees and > 50 per cent of the plot is incapable of growing a merchantable tree within a reasonable length of time. See Appendix I to help determine if a plot is non-productive.

Do **not** move a plot if it lands in a non-productive area. Instead, surveyors must note on the plot card why the area is non-productive (e.g., rock, flooded, roads/trails/landings, heavy slash/pile).

Plots that were determined to fall in these non-productive areas are not to be included in the stocking calculation (see Section 3.12.4).

[Until further discussion; If more than 10 per cent of the harvest block's plots fall within NP areas, a general note regarding what will be done about the excessive non-productive areas.]

Non-Productive Areas vs. Areas that were NOT Harvested

Non-Productive: These are areas within the harvest block that should be renewed, but due to adverse conditions, a merchantable tree will not grow there. For this reason, plots that fall on these areas **should NOT be moved**.

Non-Harvested: These are areas that fall outside of the survey boundary, or within the boundary that were not harvested. These include riparian management areas, wildlife retention areas, large swamps, etc. For this reason, plots that fall on these areas **should be moved and replaced** within the renewal area.

An easy way to distinguish between the two types of areas is to look for signs of harvesting (i.e., stumps) in adjacent surroundings.

3.9 Density Plots

Density plots are used to estimate the number of trees per hectare on the harvest block, in addition to determining plot productivity. Density plots occur every **fourth** plot. However, there must be a **minimum of five density plots dispersed evenly across the survey area**. Harvest blocks with small areas may have a higher frequency of density plots to achieve this minimum.

Only *acceptable trees* are to be tallied for density. A precise count of **each** species found within the plot is tallied, up to ten trees. When more than ten trees are found, their number is estimated in multiples of ten (i.e., 10, 20, 30...), rounding up. *For example, a density plot has eight Black Spruce, 15 Jack Pine and 53 Aspen. The densities would be recorded as: 8 BS (under ten), 20 JP and 50 TA (multiple of ten).*

Density plots may fall on either productive or non-productive plots.

3.9.1 Density Tree Height

Within the density plot, the tallest height for each species present is recorded. Heights are estimated to the nearest ten centimetres (10 cm) if they are less than two metres (<2m) tall, and to the nearest half metre (0.5m) if they are greater than two metres tall (>2m).

3.10 Forest Health Concerns

The collection of the forest health information in forest renewal assessments is an important step in identifying damage conditions that are affecting renewed forests in Manitoba. This information will help to identify harvest blocks with potential or existing health concerns and lead to appropriate management recommendations.

Forest health concerns are recorded for the harvest block. A map of these forest health concerns may be included. Additionally, forest health concerns may be recorded for each plot.

Table 3 lists the concerns, host species and the corresponding code used to record the information collected. For more criteria of each of these categories, see Appendix II.

TABLE 3: Forest Health Concerns

Forest Health Concern	Host Species	Code
Dead (specify how many dead trees in plot)	All	D
Galls (on, or within 10 cm of the stem)	JP, SP	G
Dwarf Mistletoe (usually in residual trees)	JP, WS, BS	DM
Insect	All	I
Disease	All	DS
Animal (usually browse)	All	BR
Poor Vigour, chlorotic, major loss of needles, etc.	All	V

Each forest health concern code, along with the tree species affected, has a corresponding severity code:

- Light "**L**": <33 per cent of the harvest block affected
- Moderate "**M**": 33 per cent to 66 per cent of the harvest block affected
- Severe "**S**": >66 per cent of the harvest block affected.

For example: gall rust on Jack Pine, observed on 40 per cent of the survey area would be recorded as: JP – G – M.

3.11 Competition

Enter the dominant shrub or brush species code from Table 4, average height (m) of the dominant species present in the harvest block, and percent cover (e.g., AL-2.0-10 per cent). This information will help to identify potential competition management recommendations.

Competition is recorded for the harvest block. Optionally, competition concerns may be recorded for each plot.

TABLE 4: Competition

Shrub Species	Code
Alder	AL
Beaked Hazel	BH
Choke Cherry	CC
Dwarf Birch	DB
Grass	GR
Pin Cherry	PC
Raspberry	RA
Red-Osier Dogwood	DW
Rose	RO
Saskatoon	SA
Willow	WI

3.12 Assessment Records

The following records shall be gathered when conducting an assessment:

3.12.1 Header Information

Gathered once for each harvest block to be assessed:

A. BLOCK # – a unique identifier that can be used to track previous and subsequent events for this harvest block. For example: NW2016-001

B. DEPLETION – type (harvest, salvage or burned) and year of activity

C. AGE – the average age of the regenerating trees

D. ORIGINAL STAND TYPE – the original/pre-harvest forest stand description

E. FMU – the forest management unit where the harvest block is located

F. AREA – the area surveyed (ha to one decimal place) and a note if it is different from the full harvest block

G. DATE – day, month and year of assessment

H. CREW – initials of crew members performing the assessment

I. TOTAL PLOTS – the total number of survey plots for the assessment

J. GENERAL FOREST HEALTH CONCERN – presence of forest health concerns. Use the codes from Table 3, along with severity code. (e.g., JP – G – M)

K. COMMENTS – general comments about the renewal of the area

L. COMPETITION – brush or shrub competition: enter competition code (See Section 3.11)

M. MANAGEMENT RECOMMENDATIONS – recommendations for future silvicultural tretments:

- **Refill**: (infill or re-plant) as the existing plantation has sparse stocking.
- **SiP**: (site prepare) and **Plant**: to help with mineral soil exposure and stocking.
- **Thin**: reduce the density of softwoods on the site to provide more growing space.
- **Release**: reduce the hardwood competition.

3.12.2 Plot Information

Gathered for each assessment plot. Every fourth (4th) plot will be a **density** plot (minimum five per survey area) with additional information gathered:

A. PLOT # – plot number

B. ACCEPABLE TREES – the presence of each 'acceptable' tree species

C. PERFORMING TREES – the presence of each 'performing' tree species

D. GENERAL COMMENTS – indicate non-productive areas, presence of advanced growth/residuals, mapping issues, etc.

E. DENSITY (*density plot only*) – count, by species, for each acceptable tree

F. HEIGHTS (*density plot only*) – the tallest height (m) of each species present

Please note: density information is gathered for inventory purposes and not used to calculate stocking.

Plot Example

Plot #1 has the presence (top row) of JP, BS, WS, and TA. There is at least one WS and TA that meets the requirements of a performing tree (bottom row).

LNE #	PLT #	SEEDLING STOCKING DATA									
		JP	RP	BS	WS	BF	TL	EC	WB	TA	BA	AS
1	1	✓		✓	✓					✓		
					✓					✓		

3.12.3 Stocking Map (post survey)

After the survey's field work has been completed, a final stocking map is created. If this map is not in spatial format (e.g., shapefile), then include Universal Transverse Mercator (UTM) coordinates for the approximate centre of the harvest block. This map will also include a survey grid and plots, symbolized with stocking status. Use the following stocking-status categories:

Stocked to Softwood and Hardwood

Stocked to Softwood

Stocked to Hardwood

Non Stocked

Non Productive

Different Map Symbology

Due to different software or practices, different companies might symbolize stocking-status differently.

The legend below shows alternate common symbolization.

- Stocked to Softwood and Hardwood
- Stocked to Softwood
- Stocked to Hardwood
- Non Stocked
- Non Productive

Category is based on stocking and tree family. When creating a map, determine the stocking-status category for each plot within a harvest block.

The final map may include areas of forest health concerns, any corrections to harvest boundaries, large non-productive areas, etc. Refer to Figure 2, for an example map.

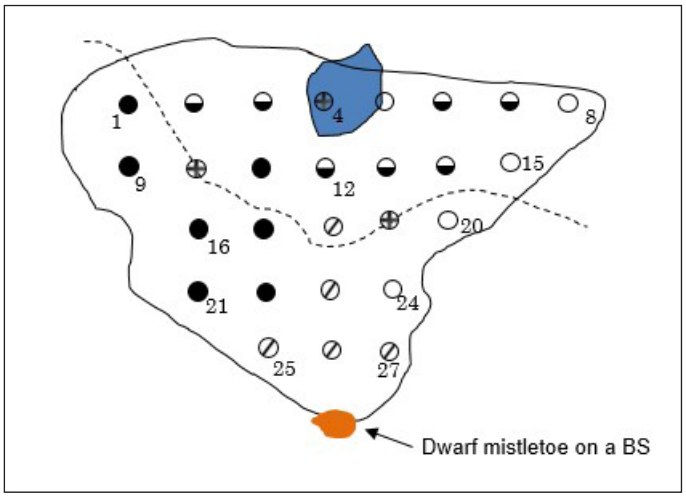


FIGURE 2: Example Stocking Map

3.12.4 Summary Stocking Calculations

Plot data is used to calculate the following stocking statistics (done once for each harvest block to be assessed):

A. TOTAL HW STOCKING – Total hardwood stocking, expressed as a per cent.

B. TOTAL SW STOCKING – Total softwood stocking, expressed as a per cent.

C. TOTAL AREA STOCKING – Total stocking, expressed as a per cent.

A stocked plot is one that has the presence of an *acceptable* HW or SW within the plot.

TOTAL HARDWOOD STOCKING is calculated as follows: $\frac{\text{\# of HW stocked plots}}{\text{\# of productive plots*}} \times 100$

TOTAL SOFTWOOD STOCKING is calculated as follows: $\frac{\text{\# of SW stocked plots}}{\text{\# of productive plots*}} \times 100$

TOTAL AREA STOCKING is calculated as follows: $\frac{\text{TOTAL \# of stocked plots}}{\text{\# of productive plots*}} \times 100$

* Non-productive plots are omitted in this calculation.

Stocking Calculation Example

There were 37 plots established in a harvest block. One of the plots was recorded as non-productive (NP). Therefore, only 36 plots are used for stocking calculations (i.e., 37-1 = 36 productive plots).

Of those 36 productive plots:

- *30 were stocked exclusively with hardwoods*
- *one was stocked exclusively with softwoods*
- *one was stocked with **both** hardwoods and softwoods present.*
- *The four remaining plots had no acceptable trees present (non-stocked).*

TOTAL HARDWOOD STOCKING: $\frac{(30 + 1) = 31 \times 100}{36}$ *= 86 per cent*

TOTAL SOFTWOOD STOCKING: $\frac{(1 + 1) = 2 \times 100}{36}$ *= six per cent*

TOTAL AREA STOCKING: $\frac{(30 + 1 + 1) = 32 \times 100}{36}$ *= 89 per cent*

Total Stocking

Is **not** calculated by adding the SW and HW stocking together.

This is because some plots may be stocked with **both** SW and HW, and adding the plots together would double count these plots.

As you can see from the example (above) that HW stocking (86 per cent) + SW stocking (six per cent) does not add up to the total stocking (89 per cent).

3.12.5 Summary Density Calculations

Density plot (every 4th plot) data is used to calculate the following statistics (done once for each harvest block to be assessed):

A. TOTAL HW DENSITY – Total hardwood density, expressed in trees/ha.

B. TOTAL SW DENSITY – Total softwood density, expressed in trees/ha.

C. TOTAL AREA DENSITY – Total density, expressed in trees/ha.

Density is calculated using the formula:

$$\text{Trees/ha (by species)} = \frac{\text{total tallied by species}}{\text{number of density plots}^{**}} \times 1{,}000$$

** Unlike stocking, both productive and non-productive plots may be density plots.

3.12.6 Species Composition

Using the density values (calculated above) for every species, state the species composition of the harvest block. This is done by expressing each recorded species as a percentage of the total density (species density/ total density x 100). Round each value to the nearest 10 per cent, ensuring all the values still add up to 100 per cent. Divide each of these values by 10 (giving a range of one to 10 for each species). Order the species from highest to lowest.

Example

A harvest block has 10,806 total trees/ha:
9556 TA/ha
140 BS/ha
1110 BA/ha

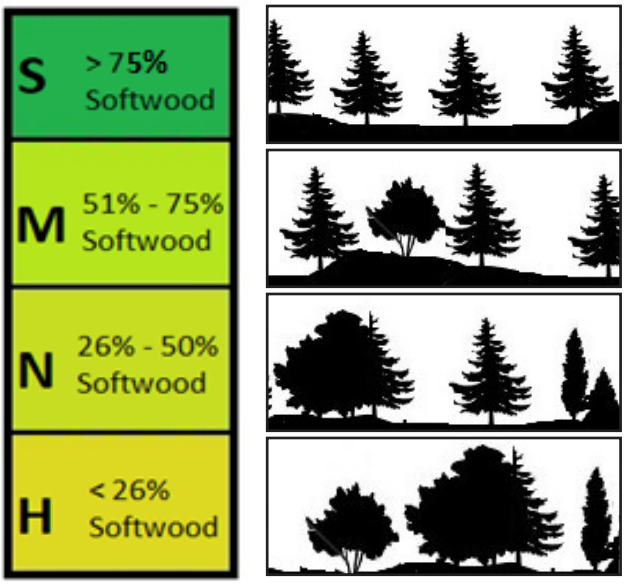
Expressed as a percentage of the total density:
TA (9556/10,806 x 100) = 88 per cent (rounded up to 89 per cent to ensure a total of 100 per cent)
BS (140/10,806 x 100) = one per cent
BA (1110/10,806 x 100) = 10 per cent

Rounding each value and dividing by 10:
TA 9
BS – (removed)
BA 1

Ordered and expressed from highest to lowest:
TA9BA1

3.12.7 Cover-Type

Using the species composition values expressed as a percentage (calculated above), determine the current cover-type:



Example

*Using the species composition from above (TA9BA1), the stand would be determined as an "**H**" (hardwood) cover type.*

4.0 Alternative Assessment Methodology

When using alternative assessment methods (UAV, satellite interpretation, etc.), gathering traditional ground plot data may be impossible. Therefore, the following alternate information will be required:

4.1 (Optional) Map Stratification of Treatment Areas

Areas within the harvest block may require different silviculture treatments. These may be areas that have different cover types (see Section 3.12.7), different ecosites, or widely different densities and stocking.

Treatment areas are typically larger than four hectares in size.

Mapping of treatment areas is **optional**.

4.2 Assessment Records

The following records shall be gathered when conducting an assessment:

4.2.1 Header Information

The same header information is required as with ground assessments (Section 3.12.1).

4.2.2 For each treatment area represented within the harvest block, the following information must be gathered:

A. SPECIES COMPOSITION – based on percent representation by crown closure *or* species summary, to the nearest 10 per cent. (See Section 3.12.6).

B. HEIGHT – the average height (in metres to one decimal place) of each species present.

C. STOCKING SUMMARY – for HW, SW and TOTAL AREA. (See Section 3.12.4).

D. DENSITY SUMMARY – per hectare for each tree species. (See Section 3.12.5).

E. COMPETITION – brush and shrub competition: enter competition code (See Section 3.11)

F. GENERAL COMMENTS – non-productive areas, presence of advanced growth or residuals, mapping issues, etc.

Calculating stocking and densities from aerial surveys is similar to using ground surveys. However, instead of using a plot sized sample, one technique is to use a grid overlay or sample.

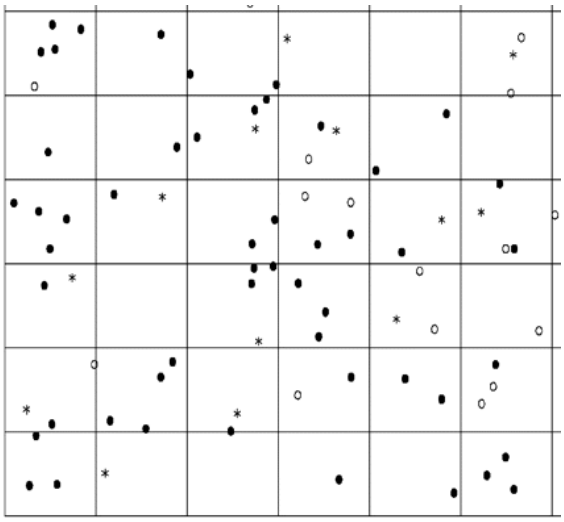


FIGURE 3: Aerial Grid Example

Example

Each square grid in Figure 3 represents 10 square metres. The black dots represent hardwoods (all aspen: TA); the hollow white circles represent Softwoods (all white spruce: WS); and the asterisks represent unacceptable trees.

In this example, we calculated percentage stocking based on the grids (36 in total).

***Total Hardwood Stocking** (black dots): 27 out of 36 squares have a HW present. That is **75 per cent**.*

***Total Softwood Stocking** (white circles): 10 out of 36 squares have a SW present. That is **28 per cent**.*

***Total Stocking**: this is calculated by determining how many grids have any acceptable trees (HW or SW) present. Exclude unacceptable trees for this calculation (two grids have only unacceptable trees present, and are discounted). Thirty out of 36 squares have either HW **and/or** SW present. That is **83 per cent**.*

[In this example, the four squares with no/zero trees present are productive voids.]

***Total Aspen Density** (black dots): 52 acceptable Aspen present, divided by the sample area (36 grids), or 1.4 trees/grid (x1000 for value in hectares) = **1,400 trees/ha**.*

***Total White Spruce Density** (white circles): 14 acceptable White Spruce present, divided by the sample area (36 grids), or 0.4 trees/grid (x1000 for value in hectares) = **400 trees/ha**.*

***Total Density** would be calculated by taking the total acceptable trees (66) and divide by the sample area (36 grids), or 1.8 trees/grid (x1000 for value in hectares) = **1,800 trees/ha**.*

5.0 Determination of Renewal Status

5.1 Harvest Block Renewal Status

The renewal status of a harvest block shall be determined using the following calculations. Plots/areas that were determined to be NP (non-productive) are **not** to be included in these calculations:

5.1.1 For Ground Assessed

Harvest blocks with greater than or equal to 80 per cent of the plots stocked (at least one acceptable tree in each plot), shall be designated **Sufficiently Regenerated** (**SR**).

If 80 per cent or greater of the plots are stocked with performing trees, the harvest block shall also be designated as **Sufficiently Performing** (**SP**).

If less than 80 per cent of the plots are stocked, the harvest block shall be designated **Not Sufficiently Regenerated** (**NSR**).

5.1.2 For Alternately Assessed

Using the Total Area Stocking (calculated in Section 3.12.4) with greater than or equal to 80 per cent of the area stocked, shall be designated **Sufficiently Regenerated** (**SR**).

If 80 per cent or greater of the area is stocked with performing trees, the harvest block shall also be designated as **Sufficiently Performing** (**SP**).

If less than 80 per cent of the area is stocked, the harvest block shall be designated **Not Sufficiently Regenerated** (**NSR**).

6.0 Forest Renewal Data Submission

In Manitoba, forest renewal assessment data is submitted **annually**, using the following guidelines:

- Data must be submitted as per the time frame identified in the licence, FML Agreement, FMP, or the annual report.
- Data must be submitted in a format compatible with MB's ledger format; i.e., MS Excel (.xls), shapefiles (.shp) or file geodatabase (.gdb).
- Data must be submitted as per all mandatory reporting requirements (see assessment records in Sections 3.12 and 4.2).
- The data submission will have each harvest block grouped by methodology (ground plots, UAVs, satellite, etc.).
- Ensure all harvest blocks have a forest renewal assessment.
  - If a harvest block (or sub-areas/treatment unit) is determined to be NSR, it must include an action plan on how the area will be renewed.
  - Until further discussion: for each harvest block that has more than 10 per cent of its area categorized as non-productive, a note should be made about the excessive non-productive areas.

Quality Assurance data is submitted with these additional guidelines:

- Manitoba may request check-survey plot cards (pdf copies) in order to conduct audits.
- Manitoba may request alternate methodology data (UAV footage, aerial photos, etc.) to conduct audits.

Manitoba will review data submissions and any discrepancies will be addressed.

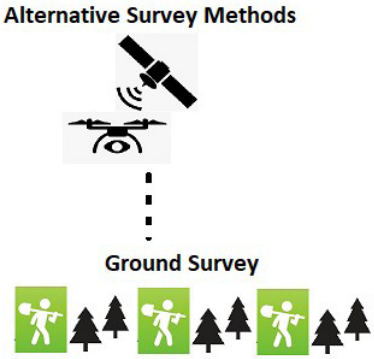
7.0 Forest Renewal Certificates

After submission, forest renewal assessment data is assessed for quality assurance. Manitoba will provide **Certificates** for the harvest blocks that are deemed sufficiently performing (SP).

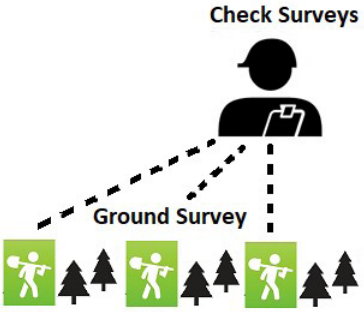
[Until further discussion: renew harvest blocks as set out in the applicable FMLA, or in the absence of that, to renew to their original cover-type, or a cover-type above or below the original cover-type.]

8.0 Three Types of Quality Assurance

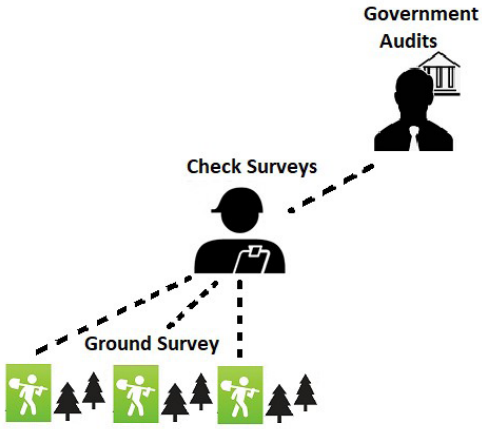
Forest renewal assessments have three types of quality assurance:



Validation. A ground survey is done on a portion of areas that were surveyed by alternative methods (drones, satellites, etc.). This validates that the alternative method would give similar results as a more intensive ground survey.



Check Surveys. These are done by a licensed check surveyor to ensure the quality of ground survey assessments.



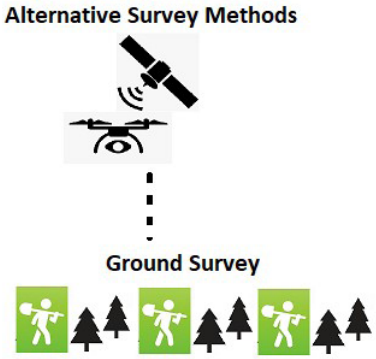
Audits. The government audits the results of surveys. This could be for ground surveys, validation surveys or alternative methods.

8.1 Purpose and Objectives of Quality Assurance

1. Quality Assurance (QA) determines the accuracy of the submitted surveys (both internally from MB, and externally from industry).
2. Determine what (if any) is the consequence of failing QA.
3. Outline the process to resolve disputes.

9.0 Quality Assurance – Validation

A ground survey must be done on a portion of areas that were surveyed by alternative methods (drones, satellites, etc.). This 'validates' (or "ground truth") that the alternative method would give similar results as a more intensive ground survey.



9.1 Amount of Area to Validate

How much alternative method submission will need to be validated?

For each different alternative survey methodology, this starts at **20 per cent** of the submitted area.

The success or failure (see Sections 9.4 – 9.5 for a definition) of the submission will raise or lower this requirement by **five per cent** for the following year's submission, for a maximum of 20 per cent and a minimum of five per cent of the submitted area.

Exception: Radical changes in service providers, contractors, and staff may warrant an increase to the validation area percentage.

Percentage Area to Validate	
20	Maximum (untested)
15	
10	
5	Minimum (confident)

Validation is conducted on harvest blocks in their entirety (not partial areas/harvest blocks). Therefore, the validation area (in hectares) is always rounded to accommodate this.

Example of Calculating Validation Area

A company makes a submission of their forest renewal assessment surveys, using two different alternative methodologies:

- *1,000 ha were done using heli-ocular surveys*
- *1,500 ha were done using a UAV*

This company had two years of successful heli-ocular surveys in the past. therefore the requirement is reduced by 10 per cent (five per cent x two years). Therefore, they will require 10 per cent (20 per cent start – 10 per cent success) of the submitted area to be validated = ***100 ha****. (1,000 ha x 10 per cent).*

This is the first year that the company has used UAVs, so the starting (maximum) 20 per cent of that submission must be validated = ***300 ha****. (1,500 ha x 20 per cent).*

9.2 Which Harvest Blocks to Validate

After determining the amount of area to validate, a list of harvest blocks that makes up that area must be made.

High Risk Areas: Harvest blocks with a high risk of regeneration failure will be prioritized for validation (this will provide greater assurance that higher risk sites are being properly assessed and thus renewed).

Potential **high** regeneration risk areas are:

- areas identified as previously NSR
- original softwood S cover types that have been naturally regenerated or seeded, and have not been treated with herbicides
- original mixedwood cover types ('M" and N'")
- areas that were previously identified as at risk for renewal (from PHSPs, planting reports, summer logging, moisture issues, site specific knowledge, etc.)

At least half (50 per cent) of the area to be validated should be first chosen from high risk areas, if possible. The remaining half (50 per cent) may be chosen randomly, taking into account access constraints or other logistical factors.

Example Continued (from above)

*Previously, we had determined that the company's UAV-inspected areas would require **300 ha** of validation. Each of the UAV areas are 100 ha, so three randomly chosen areas would need to be validated. At least two of those areas (50 per cent, rounded up) should come from high risk areas, if possible.*

9.3 How to Validate

No matter what alternative assessment method was used, validation will be completed by using the traditional ground plot methodology outlined in Section 3.

Example

A submitted UAV assessment will be validated using ground plots.

9.4 Passing or Failing Validation

The alternate method assessment survey results will be compared to the validation survey ground results. To **pass**, both results must have the same **Renewal Status** (NSR, SR, or SP). If they have a different **Renewal Status**, the harvest block has **failed** the validation.

Example – Renewal Status

The UAV survey results found a stocking of 70 per cent of the area, resulting in a renewal status of NSR.

The ground validation showed 80 per cent of the plots were stocked, resulting in SR. This is a difference in renewal status, so this harvest block fails its validation.

9.5 Validation Consequences

If **<20 per cent** of the validated area (rounded up, by harvest block) **fails** for a specific methodology, this will decrease the validation area by five per cent for the following year, as outlined in Section 9.1.

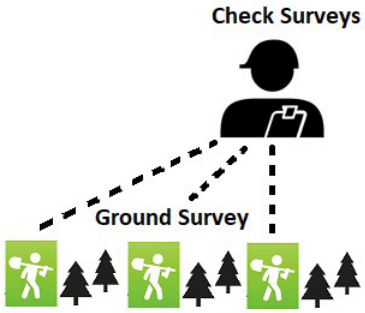
If **20 per cent to 49 per cent** of the validated area (rounded up, by harvest block) **fails** for a specific methodology, this will increase the validation area by five per cent for the following year, as outlined in Section 9.1. (This only applies once per methodology, per yearly submission, not five per cent for each failed area).

In this case, the validation (ground) survey may be substituted for the alternative method survey, for the harvest block's submission for certification (see Section 7.0).

If **50 per cent+** of the validated area (rounded up, by harvest block) **fails** for a specific **alternative** methodology (UAV, satellite, etc.), then **all** of the harvest blocks submitted for that methodology will be considered failures. Until the submitting company has shown that they have improved upon the process of that methodology (to avoid future failures), it will remain unacceptable as a methodology option for that company.

10.0 Quality Assurance – Check Survey

A check survey is done by a licensed check surveyor to ensure the quality c ground survey assessments. It is conducted to determine that submitted ground surveys have accurate, correct and consistent results, and help identify surveyors who are having difficulties.



10.1 Who can Conduct a Check Survey?

Check surveys require a licensed check surveyor.

- Both MB and industry are responsible for the training and licensing of their own check surveyors.
- Licensing involves both a written exam and field exam.

10.2 Amount of Area to Check Survey

Total check survey area must add up to a **minimum** of **10 per cent** of the **total area** that has been ground surveyed during the year. Check surveys are conducted on harvest blocks in their entirety (no partial areas or harvest blocks).

Example

A company conducts 1,000 ha of ground surveys during the year. They must choose to check survey areas that add up to minium of 100 ha, which is 10 per cent of this total area.

Several harvest blocks may need to be chosen as rarely will harvest block sizes add up exactly to the required area amount. Typically, more area is checked to meet the minimum, as partial areas **cannot** be chosen.

Continuing from the Previous Example

A single large harvest block of 140 ha might be chosen to check, or two smaller harvest blocks of 25 ha + 90 ha might need to be selected, in order to fulfill the minimum harvest block size required.

Catch Mistakes Early

Most check surveys should be scheduled early in the season to identify and correct issues quickly.

Don't Delay Check Surveys

Check surveys should be completed as soon as possible after the initial survey to avoid height discrepancies (trees grow) and wildlife damaging flagging tape.

10.3 How many plots should be checked in a chosen harvest block?

On chosen harvest blocks, the check surveyor designates **25 per cent of the total plots** from the original survey to check.

Example

A harvest block with 100 ground survey plots, would need 25 of those plots checked (100 plots x 0.25).

10.4 Which plots should I choose?

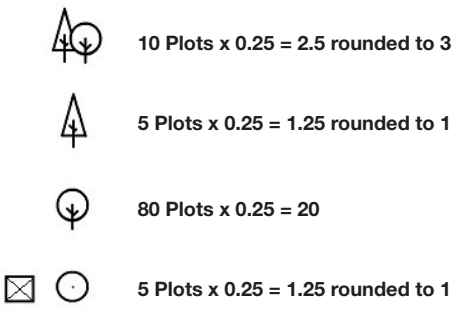
Plot selection is based on two categories: stocking status, and surveyor.

10.4.1 Stocking-Status Category

Check plots are to be proportionally distributed, based on plot's stocking-status category:

Category is based on stocking and tree family. Determine which stocking-status category to which each plot belongs. Do this for all of the plots in the harvest block. Then multiply the amount of plots in each category by 25 per cent (x 0.25) to get the proportional amount of plots to be checked. Round decimals to the nearest whole number.

Empty Plots: both not-stocked and non-productive plots are considered empty, and therefore, always grouped together for categorizing and calculations.



Continuing With the Previous Example

Out of the original 100 plots, 10 plots are stocked to softwood and hardwood, five plots are stocked to softwood only, 80 plots are stocked to hardwood only and five plots are not stocked. Multiply each of these values by 0.25 to calculate the number of plots in each stocking category to be checked.

Why Do We Proportion Our Checks Into Different Stocking Categories?

We do this because different stocking categories have higher frequencies of errors than others. More missed trees are found in non-stocked plots, for example.

However, focusing on these error-prone areas would greatly skew the check results, which is why an even distribution is important.

10.4.2 Surveyor

If more than one surveyor has surveyed the harvest block, check plots are to be distributed proportional to the number of plots done by **each surveyor**.

Identify Surveyors Who are Having Problems

Some surveyors may require less checking than others if they are experienced and they have few, if any, problems. Other surveyors may be inexperienced and warrant a greater amount of their work be checked.

All Surveyors Need to be Checked

Regardless of how much experience or how error-free a surveyor is, they must have a portion of their work checked.

Determine what percentage of the plots each surveyor did within the harvest block. This is done by dividing the number of plots each surveyor did, by the total number of plots in the harvest block.

Then, multiply the amount of plots in each stocking category (determined in the previous step) by the percentage of plots each surveyor did. Round decimals to the nearest whole number (ensuring you still meet the minimum of 25 per cent). Sometimes a single surveyor accounts for all the plots in a stocking category. In that case, they cannot be proportioned, but should still be checked.

Example Continued (from above)

If two surveyors performed this survey, and 55 of the plots were done by surveyor A, while surveyor B did 45, surveyor A has done 55 per cent of the plots (55 divided by 100) and Surveyor B has done 45 per cent of the plots (45 divided by 100).

Using the number of plots in each stocking category (calculated previously), the check plots can be proportioned for each surveyor.

Stocking Category	# of Plots to Check	Surveyor "A" (55%)	Surveyor "B" (45%)
	3	3 x 0.55 = 1.65 rounded to 2	3 x 0.45 = 1.3 rounded to 1
	1	1 x 0.55 = 0.55 rounded to 1	1 x 0.45 = 0.45 or 0
	20	20 x 0.55 = 11	20 x 0.45 = 9
	1	1 x 0.55 = 0.55 rounded to 1	1 x 0.45 = 0.45 rounded to 0

10.5 Select Your Plots

The check surveyor selects the specific plots based on the distribution (established in the above steps). An effort should be made to ensure these check plots are distributed throughout the harvest block.

Unable to Relocate a Plot to Check?

Occasionally it is impossible to find a plot which had been pre-selected for checking. If this occurs, the check surveyor should substitute a nearby plot, preferably with the same stocking.

A note should always be made when a plot could not be found.

Density Plots: Density plots are also checked at the same ratio as the original surveys (one of every four plots, or 25 per cent). Ensure that the correct amount of density plots are selected. These density plots should be chosen with proportional representation from various stocking categories, as well as surveyors.

Full Example

A 9.0 ha harvest block had 27 plots established in the original survey. Figure 4 shows the completed survey map, along with the total amount of plots in each stocking category.

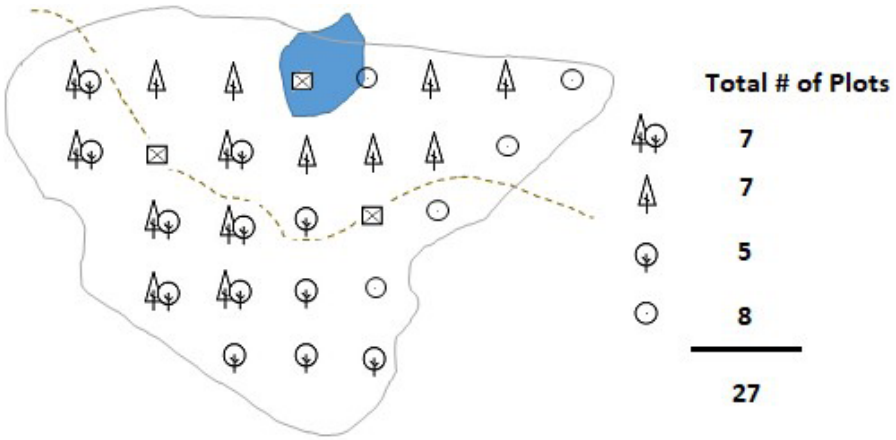


FIGURE 4: Completed Survey Map

The first step is to determine the number of plots that need to be checked: there are 27 plots in the original survey and 25 per cent must be checked, equalling 7 check plots (27 x 0.25 = 6.75 rounded to 7).

Next, determine the total number of plots that fall into each of the four stocking categories. Then calculate the proportion (25 per cent) of each stocking category to be allocated with a Check plot.

Surveyor Jane established 15 plots or 56 per cent of the survey (15 divided by 27). The other surveyor, John, established 12 plots or 44 per cent of the survey (12 divided by 27). The next step is to calculate the number of each type of plot to be checked for each surveyor.

	Total # of Plots	# of Plots to be Checked
	7	x 0.25 = 1.75 rounded to 2
	7	x 0.25 = 1.75 rounded to 2
	5	x 0.25 = 1.25 rounded to 1
⊠ ○	8	x 0.25 = 2
	27	= 7 Check Plots

	# of Plots to be Checked	Jane (56%)	John (44%)
	2	2 x 0.56 = 1.12 rounded to 1	2 x 0.44 = 0.88 rounded to 1
	2	2 x 0.56 = 1.12 rounded to 1	2 x 0.44 = 0.88 rounded to 1
	1	Because only 1 needs to be checked, it could come from either surveyor	
⊠ ○	2	2 x 0.56 = 1.12 rounded to 1	2 x 0.44 = 0.88 rounded to 1
	7 Check Plots	4 checked	3 checked

Density plots are also checked at the same ratio as the original surveys, which is one-of-every-four plots. In this example, among the total of seven plots to be checked, ensure that two of those are density plots (seven x 0.25 rounded to the nearest whole number); preferably one from each surveyor.

Refer to figure 5: The plots outlined with a red box are the seven chosen to be evaluated during the check survey.

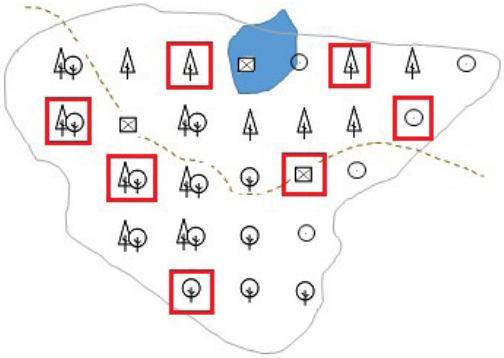


FIGURE 5: Chosen Check Plots

10.6 Check Survey Procedures

The original plot data is **compared** to the check survey plot data and demerit points are assigned according to the severity of any infractions found.

10.6.1 The Demerit System

During a check survey, **only the highest infraction receives demerits** for each plot. For this reason, the infractions are assessed in order (steps) from highest penalty (demerits) to smaller penalties.

Training

During training and field tests, **all infractions** may be noted (not just the highest penalty). This is to catch any mistakes early in a surveyor's training, and to enforce accurate survey habits.

Go through the following check-steps (in order). See more details (below).

Step #1) Was the plot's **Stocking Status** correct?

Step #2) Was the plot's **Family Category** correct?

Step #3) Was the plot's **Species Identified** correctly?

Step #4) [Density Plots Only] Was the **Species Count** correct?

Note: Most infractions are caused by:

- a missed tree within the plot
- a tree recorded but fell outside the plot
- a tree's species was incorrectly identified
- an acceptable tree was unacceptable, OR vice versa

Step #1) Check Stocking Status

DEMERITS 10

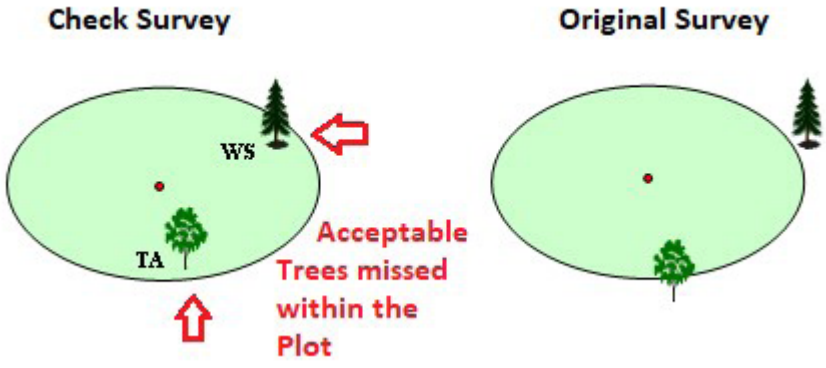
Was the plot's stocking status correct (SP, SR, NSR)? No = 10 demerits.

Stop here if this infraction exists, otherwise go to the next step.

Sufficiently Performing (SP) | **Sufficiently Regenerated (SR)** | **Not Sufficiently Regenerated (NSR)**

Example Stocking Status Infracti

In this example, the check surveyor found that both an acceptable TA an a WS were missed (they fell within the plot). This infraction changes the plot from NSR (non-stocked) to SR (stocked with softwood and hardwood). This is a 10 demerit infraction. Because this is the highest infraction, the check surveyor stops looking for any further infractions.



Note: had either the TA or WS been tall enough to qualify for SP, the demerits (10) would remain the same – as any change in stocking status (e.g., from NSR to SP) qualifies for this infraction.

A Missed or Added Tree Causes a Change in Plot Stocking Status

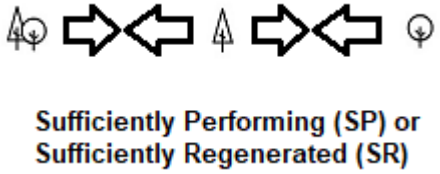
This usually happens if there were **no other** softwood or hardwood trees in the plot.

Step #2) Check Tree Family

Was the plot's tree family correct (e.g., mixedwood, softwood or hardwood)? No = five demerits.

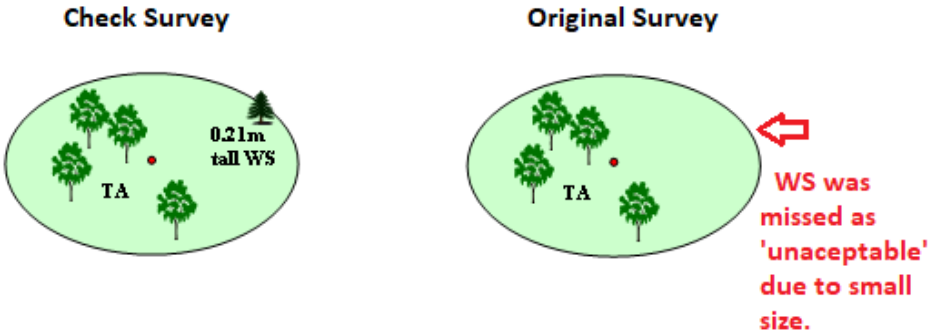
DEMERITS 5

Stop here if this infraction exists, otherwise go to the next step.



Example of Family Category Infraction

In this example, the check surveyor found that a WS w acceptable, but in the origir survey, it was mistakenly marked as unacceptable, due to its small size. This infraction changes the plot from stocked with hardwoo to stocked with softwood an hardwood. This is a five-demerit infraction. The che surveyor stops looking for any further infractions.



Step #3) Check Species Identification

DEMERITS 3

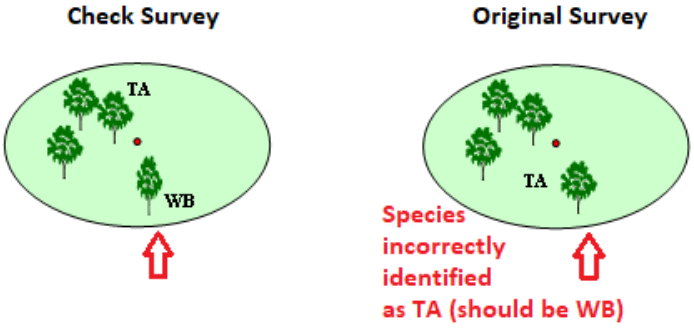
Was the plot's species identified correctly and no species were missed? No = three demerits.

Stop here if this infraction exists, otherwise go to the next step.

Sufficiently Performing (SP) or Sufficiently Regenerated (SR)

Example of Species Identification Infraction

In this example, the check surveyor found that an acceptable WB was incorrectly identified as TA in the original survey. This infraction does not change the family category of stocked with hardwood. This is a three-demerit infraction. The check surveyor stops looking for any further infractions.



Multiple Species Missed or Misidentified?

Regardless of how many species were missed or misidentified, a single infraction of three demerits is tallied.

In the above example, if a balsam poplar (BA) was also missed, the infraction total for this plot would still be three demerits.

Step #4) Species Count [density plots only]

DEMERITS 1 - 4

Within a density plot, was the species count correct? No = one demerit.

Density counts are evaluated spearately for each species. For **each** species count that is incorrect (or missed entirely), one demerit is applied, up to a **maximum** of four demerits (for four incorrect species counts). A single demerit is given for an incorrect species count – regardless of the number of trees of that species that were missed.

This infraction **does not** apply to any species where the check survey and the original survey count was five or more for that species.

Examples

A surveyor counted six TA, but the check survey counted only four TA. Since the checker's count was under five for that species, this penalty will apply. This is an infraction of one demerit.

A surveyor counted only two TA, 1 JP, and two BS, while the check survey counted three TA, three JP, and one BS. Both the checker and the surveyor's species counts were under five, so penalties will apply for each of these species. This plot is penalized three times because the counts for three different species were incorrect. Three incorrect species counts = three demerits.

Had this checker found even more missed species, only a maximum of four demerits could be applied.

10.7 Check Survey Results

10.7.1 Demerit Limit for each Surveyor

The maximum amount of demerits a surveyor can have for a harvest block is **40 per cent** of the total plots that surveyor completed. A surveyor fails if they accrue more demerits than this limit.

Example

A harvest block has 100 plots. Of those, Jane completed 70 and John completed 30. Jane would be allowed 28 demerits (70 plots x 0.40) and John would be allowed 12 demerits (30 plots x 0.40).

Surveyor Failure: Any surveyor that fails a check survey has to re-do **all of their plots** within that harvest block (not just the ones where demerits were found). Those plots must then be **re-checked**.

Continuing the Example Above

John completed 30 plots on the harvest block, and has a maximum of 12 demerits before he fails. If John had 13+ demerits, he would have to redo all 30 of his plots (not just the ones where demerits were found).

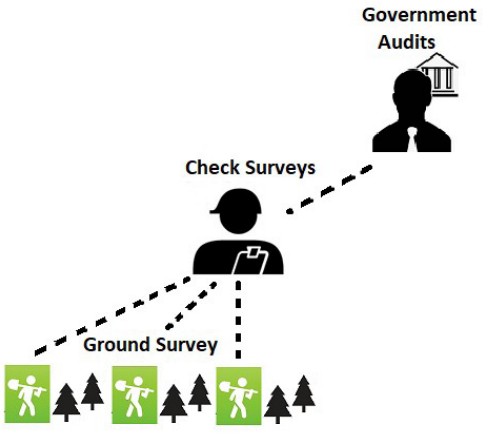
Jane passed her check survey with less than her maximum demerits of 28. None of her 70 plots will need to be redone.

What if the Original Surveyor is Not Available to Redo Their Plots?

While it is ideal that the surveyor who failed their plots would be the person who has to redo their plots (this way they can learn from their mistakes), it is not always practical. Often surveyors are on other projects or have left for the season.

In this case, any surveyor can redo the failed person's plots.

11.0 Government Audits



While industry will be conducting quality assurance on their own forest renewal assessment submissions, the government may, at their discretion, audit any portion of industry's submission. Audits are made so government can ensure the accuracy of industry submissions.

Audits may be conducted on any portion of a company's forest renewal assessment surveys (both ground plots and alternative methodologies).

Typically, audits follow the same procedures and pass/fail criteria as check plots (Sections 10.6 and 10.7). A surveyor who fails an audit would need to redo all of their plots in a harvest block, and have them rechecked.

12.0 Dispute Resolution

For each of the audited areas that fail, the submitter has the following options:

- accept Manitoba's results, with no further action required
- voluntarily resurvey the area
- dispute Manitoba's results

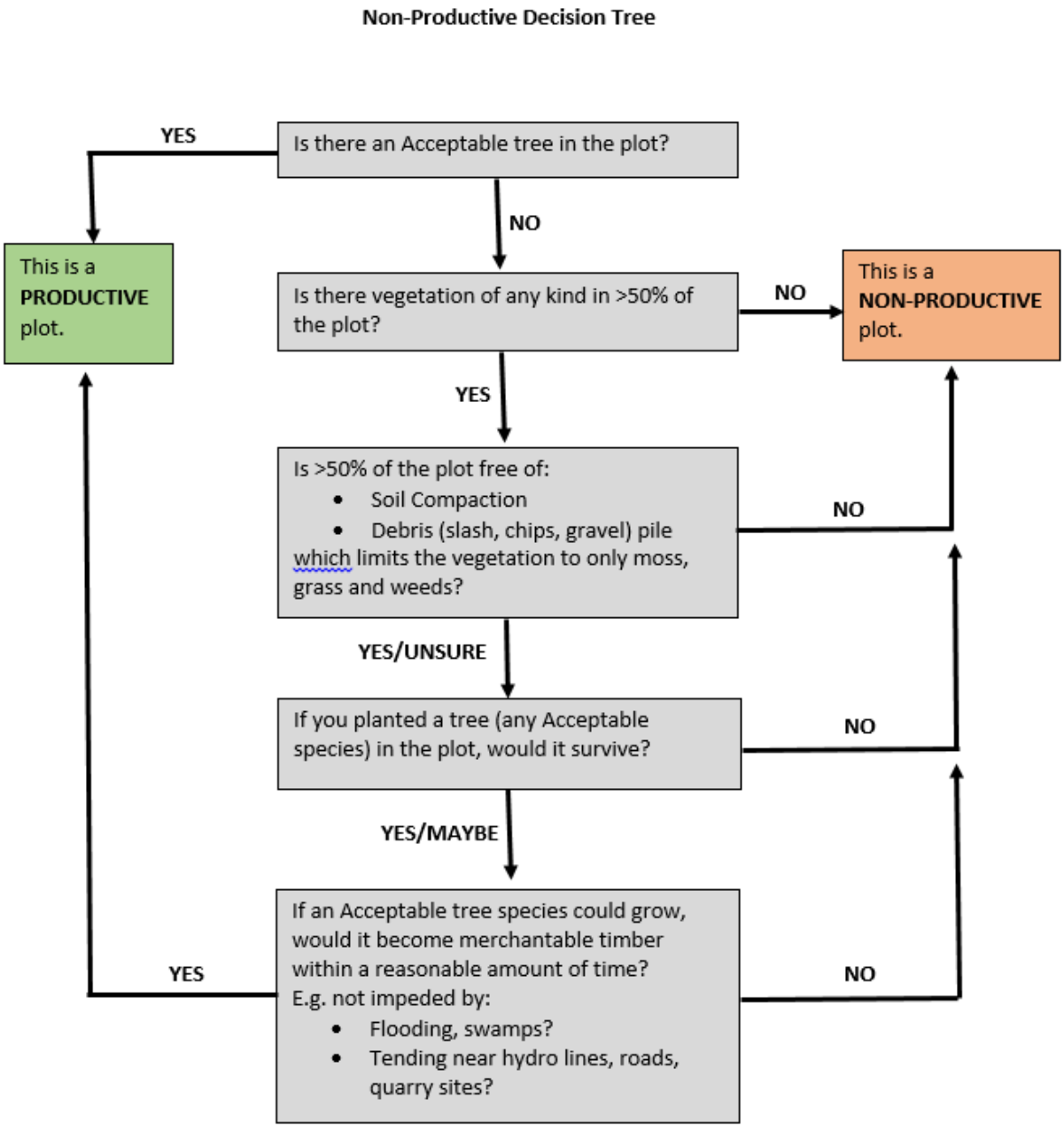
In the event an audit assessment results in a failure, the submitter may dispute the audit results.

During this resolution, Manitoba will consult with the submitter and consider whether the failure was due to oversights, data interpretation errors, or other errors that may have caused failure.

If a resolution cannot be solved in the above manner, Manitoba and the submitter may meet (commonly at the harvest block in question) at a mutually agreeable time to consider and examine any errors.

If a mutual site visit still does not resolve the situation, Manitoba will be responsible to determine if the survey results are acceptable or not.

APPENDIX I: Non-Productive Plot Determination



APPENDIX II: Forest Health Determination

Forest Health Concern and Host	Tree Unacceptable If:	Signs and Symptoms
Dead – D All Species	Unknown cause of death.	Foliage on entire crown dead or missing. Stem broken at base.
Galls – G Jack Pine Scots Pine **NOT TA**	N/A as not visible in alternative methods, but presence should be noted.	Perennial globose galls on stem or branch. Orange yellow spores on surface of galls in May to June.
Dwarf Mistletoe – DM Jack Pine, Spruce, Tamarack	Any visible infection. ***Map & comment on data sheets if DM is on residual or bordering trees.**	Witches broom. Branches or stem swelling. Aerial shoots-greenish yellow, up to 10 cm in length on jack pine and green to brown up to three cm on spruce. Basal cups remaining from dead aerial shoots.
Insect – I All species	Catch-all category (make notes if specific insect can be identified). If more than 50 per cent of the crown/foliage has been killed due to insects.	Defoliation, bore holes, stem girdling, etc.
Disease – DS All softwoods	Catch-all category (make notes if specific disease can be identified). If more than 50 per cent of the crown/foliage has been killed due to disease.	Defoliation, cankers/fungus, deformed, etc.
Animal/Browse – BR All species	Feeding/clipping damage to 50 per cent+ of crown.	Buds and shoots clipped off. Adventitious budding. Loss of main stem dominance. Rabbits, mice, voles, deer, moose etc.
Poor Vigour – V All species	Tree has extreme foliage loss, very suppressed or stunted. **Poor vigour only chosen if tree doesn't fit into any other category or has multiple damages.**	Thin crown, stunted shoot growth, dead shoots, low height. Causes include extreme competition (grass, shrubs), flooding, repeated frost damage.