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GUIDELINES

Establishing Permanent Plots for Monitoring the Environmental Effects of Forest Biomass Harvesting

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Abstract

The effects of the removal of forest biomass on soils and soil productivity are still not well understood, particularly over the medium and long term. Since there is a growing interest in biomass harvesting, establishing permanent plots to monitor the environmental effects of biomass removal seems a suitable way to generate knowledge to ensure the sustainability of these operations. The objective of this Canadian Forest Service of Natural Resources Canada initiative is to encourage the establishment of permanent plots that will favour the development of indicators that aim to ensure the sustainable harvest of forest biomass. The present guidelines describe how to establish permanent plots to monitor the environmental effects of forest biomass removal in accordance with statistical analysis criteria. It also explains the methodology used for gathering data on soils, vegetation and woody debris and the manner in which to send data on the plots for archiving, to make it possible to resample the plots and conduct a follow-up on the long-term effects. The analysis of data from a large number of plots, representing a wide range of soil and climatic conditions and stand types, will provide deeper knowledge of the impacts of biomass removal and a better understanding of the environmental issues involved.

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Introduction

The use of logging residues (tree branches and crowns) as a sustainable source of energy appears to be a promising strategy for reducing the use of non-renewable energy sources such as fossil fuels. These residues fulfill a number of key ecological functions in forest ecosystems. However, to ensure that forest biomass is used sustainably in bioenergy production, the ecological consequences of removing residues from the forest must be considered.

Long-term field studies and environmental monitoring are probably the best tools for evaluating the effects of forest biomass removal, since they also contribute to our knowledge of ecological processes. For this reason, the Canadian Forest Service is piloting a project whose main objective is to encourage the establishment of permanent plots that will favour the development and use of more precise standards and indicators that aim to ensure the sustainable harvest of forest biomass. To achieve this, the Canadian Forest Service is seeking partners willing to participate in the implementation of a Canada-wide, long-term monitoring study encompassing a wide range of ecozones, stands and site conditions. This guide describes a step-by-step process for establishing permanent plots to monitor the effects of the removal of logging residues on site productivity. Establishment of permanent plots will allow resampling at various intervals after harvesting. Consequently, it is essential to document as accurately as possible the location and ecological characteristics of the sites and plots. This guide is largely based on the methods developed for the National Forest Inventory, as described in "Canada's National Forest Inventory ground sampling guidelines: specifications for ongoing measurements, Version 5.0".

In this project, partners are initially asked to perform harvesting treatments, establish the plots and carry out the inventories according to the guidelines in this guide, and to ensure the continuous maintenance of the plots in the field. The Canadian Forest Service will be responsible for the centralization, storage and analyses of data, and will provide guidance and help for carrying out any of the steps in this guide. Further remeasurements of the plots are currently planned as follows: 3, 5, 10 and 20 years after harvest, but this schedule can be modified according to requirements or resource constraints. Resources for remeasurements will be negotiated with the partners when the time comes. All results, analyses and conclusions drawn from this monitoring program will be shared with the partners.

Plots will be used to monitor the effects of forest biomass harvesting based on the following ecological parameters:

- Soil acid/base status (soil pH, soil base saturation)
- Soil nutrient reserves
- Soil carbon stocks
- Growth and foliar nutrition of post-harvest stands

The same plots could also be used to monitor other parameters, particularly various components of biodiversity, if new survey and sampling methods are developed for this purpose.

The project compares the effects of two treatments, which correspond to two levels of harvesting intensity:

1) stem-only harvesting, which involves removing to the roadside only the boles of merchantable trees, with the logging residues (tops of trees and branches) left on-site;
2) whole-tree harvesting, in which almost all above-stump biomass of the tree is removed from the site (boles, tops and branches).

The nature of these two treatments may differ from region to region and from operator to operator. A number of different harvesting and recovery operations, or a combination of operations, can be carried out on a site and can allow the same comparison between a cutting area where the logging residues are left on-site and a cutting area where they are removed from the site.

It is therefore crucial to describe the operations and machinery used in as much detail as possible. It is important to underline that the aim of the project is not to monitor the effects of specific harvesting methods; it is rather to evaluate the effects of harvesting intensity, by comparing treatments leaving more or less organic material (slash) on the ground.

The study focuses primarily on sites with clearcutting or cutting with protection of regeneration and soils, but plots can also be established at sites where partial cutting is done. Sites with precommercial and commercial thinnings may also be considered.

The guide explains the procedure for locating and describing plots as well as the sampling method to be used for woody debris, vegetation and soils. A list of suggested material for carrying out the inventory is provided in Appendix 1.

For the purposes of this guide, **a site** corresponds to a cutting area, or a portion of a cutting area, with homogenous soil and vegetation conditions; for example, it may consist of an area with balsam fir / white birch stands on well-drained till. A **plot** is an experimental unit of approximately 1250 m^2 which receives one harvesting treatment, either stem-only harvesting or whole-tree harvesting (one treatment per plot). On a given site, plots must be established in pairs, with a pair consisting of one plot of stem-only harvesting and one plot of whole-tree harvesting. A pair of plots will hereafter be referred to as a **block**; for statistical analyses, a block corresponds to one replicate.

To fulfill statistical needs and ensure that a rigorous comparison of harvesting treatments can be carried out, at least three blocks per site should be established (3 blocks = 3 pairs of plots = 6 plots / site); this would need a site with an area of approximately 1.5 hectares (1 block per 0.5 hectare). If the availability of space and operational resources allow it, more than three blocks can be established on a given site. On the other hand, if available resources are not sufficient for the establishment of three blocks, a site with only one or two blocks can still be considered useful for monitoring purposes.

It is the possible to test supplementary treatments, in addition to stem-only harvesting and whole-tree harvesting (for example: whole-tree + stump harvesting, whole-tree harvesting + scarification, stem + coarse branches harvesting). For this, additional plots can be added to a block beside the initial pair of plots, and harvesting done according to the desired treatment.

Any questions about the planning of plots and experimental design can be directed to the Canadian Forest Service (see list of contacts on page 2).

All the steps described in this guide should be carried out when the plots are established or soon afterward. Although it may represent a substantial amount of time and work, the importance of having good and complete initial information on the plots is invaluable for a good monitoring program, and will ensure that data collected later can be interpreted correctly. Guidance and help for carrying out the different steps will be provided by the Canadian Forest Service upon request.

This guide may also be used as a source of inspiration by organizations wishing to develop their own monitoring system.

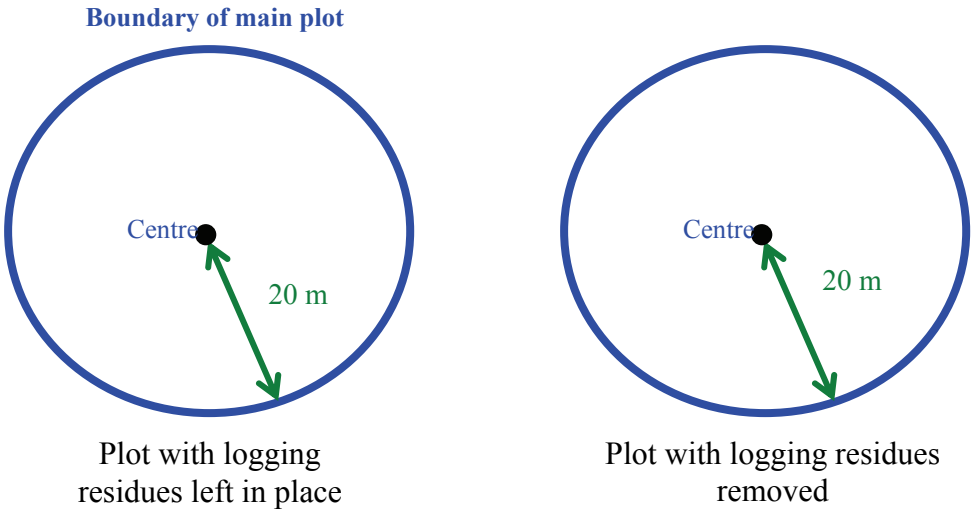
Step 1. Planning the experimental design of monitoring plots

This step has to be conducted prior to sending inventory teams into the field. A site has to be identified. A site may correspond to a cutting area, or portion of a cutting area, if it contains several cutblocks with homogenous operations, and if it has homogenous soil and vegetation conditions (for example, balsam fir / white birch stands on well-drained till).

In all cases, GPS coordinates have to be recorded in a Latitude/Longitude format and in decimal degrees (DDD.ddddd). All azimuths have to be taken using the true North, and not the Magnetic North.

Two main plots (circles with a radius of 20 m) are to be located. One plot will be logged with residues left on the ground and the other logged with the residues removed (Figure 1).

Figure 1
Main plots and logging treatments



Plot with logging residues left in place

Plot with logging residues removed

This pair of main plots constitutes a block (i.e. one replicate). Within a pair, the plots must have similar ecological characteristics for valid comparisons between treatments. To fulfill research requirements, treatments must be assigned at random to the two plots at each site (see box).

Random selection is the basis of research

Random selection is used to ensure that the initial conditions of a study do not favour one result over another. For example, at a given site, if the plot with the treatment "with residues" is located in a wetter area where logging residues have been deliberately concentrated to improve the soil's bearing capacity, this would definitely compromise random selection. This could bias the comparison between the two treatments, with one treatment favoured over another, and therefore make any conclusions drawn difficult if not impossible to defend scientifically.

The random selection of plots can be done by dividing the site, or a portion thereof, with homogenous ecological conditions into a grid. Two squares of the grid are then selected at random, after excluding any squares (e.g., alder swamps, streams, bedrock) that are not representative of the overall site. Each of the two squares will house a main plot; the treatment (logging with or without residues) must also be assigned randomly to a square (Figure 2). Side-by-side plots in a same block are allowed, as are treatments covering an area larger than the plot itself (Figure 3).

Given the operational constraints and additional requirements for planning and supervision that may arise due to random selection, a second method can be used to assign treatments. The site is divided into strips, each containing three or more skidding trails. Treatments are assigned randomly to each strip. Plots are then located randomly within the strips.

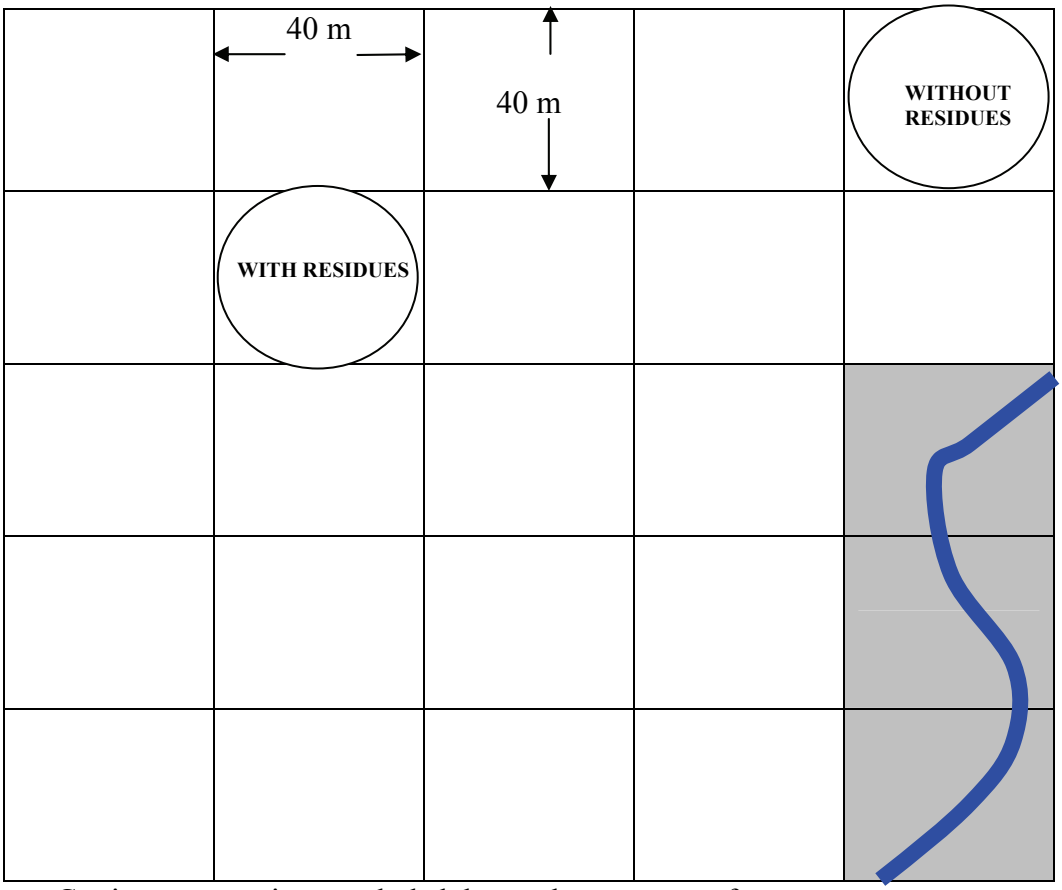
Wherever possible, a block (one pair of plots) should be established for each 0.5 ha of the site, and three blocks should be established on each site. In the case where more than one block is established on a given site, care must be taken to ensure interspersion of harvesting treatments, that is, cut patches receiving harvesting treatments should be randomly assigned and interspersed in space. For example, plots from different blocks receiving the same harvesting treatment should not simply be placed at intervals in the same continuous cut patch (see Figures 4, 5 and 6). Two plots receiving the same treatment can be contiguous if assigned this way by randomization.

IMPORTANT

When subsequent treatments are planned that involve moving woody debris (e.g., windrowing) in the cutting areas where the plots are located, such treatments should not be carried out in the actual plots. If other silvicultural treatments such as precommercial thinning are planned, ensure that they are carried out uniformly in both plots of a block and for all blocks of a site, and that description of the treatments is archived.

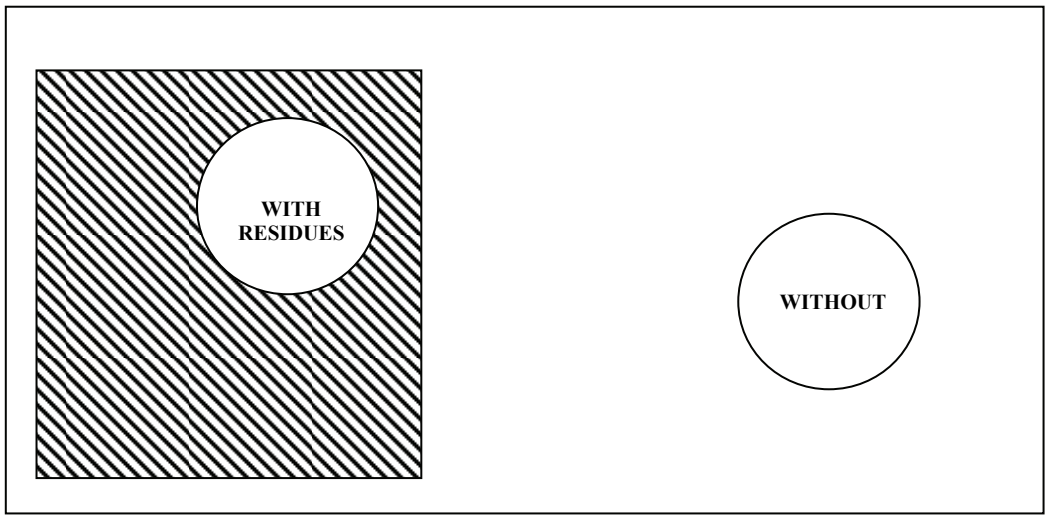
Pre-harvest stand data (tree species composition and proportion, stems per hectare, stand basal area, mean height, volume per hectare, and any other mensurational data that are available), as well as the volume of merchantable timber harvested and logging residues recovered, should be compiled if possible for the main plots themselves and, if not, for the cutting area where the plots are located.

Figure 2
Random selection of the pair of plots on a site



In grey: Cutting area sections excluded due to the presence of a stream.

Figure 3
Treatments can be carried out on areas larger than the plots themselves



Crosshatched area represents the treatment with residues.

Figure 4
One block on the site without replication

WRONG

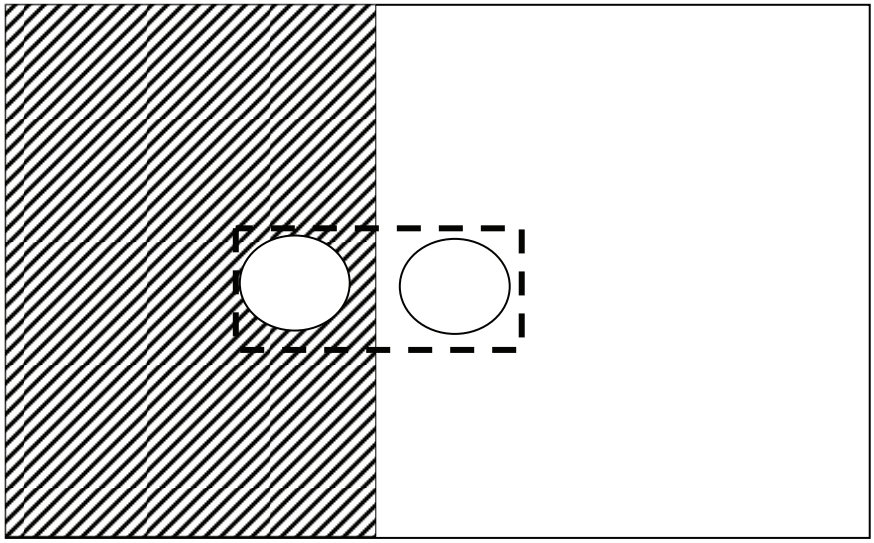


Figure 5
Example of location of blocks without interspersion of treatments

WRONG

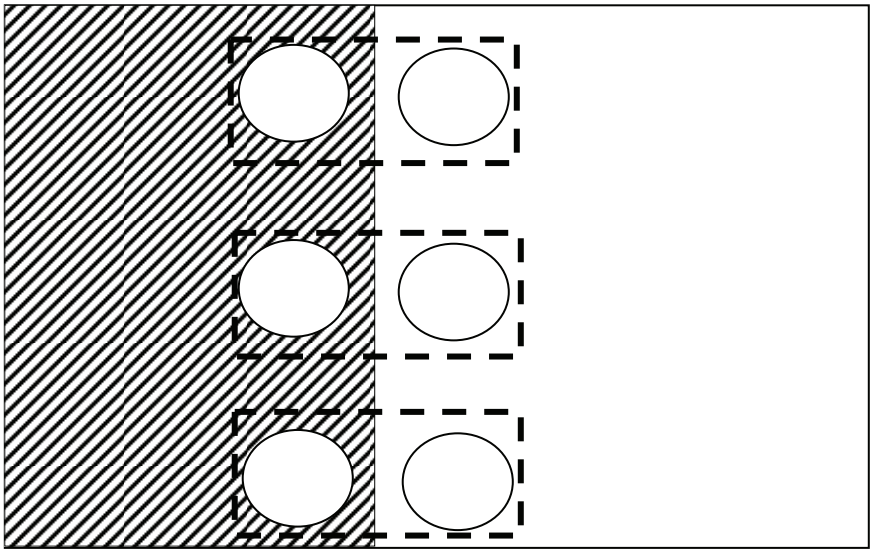
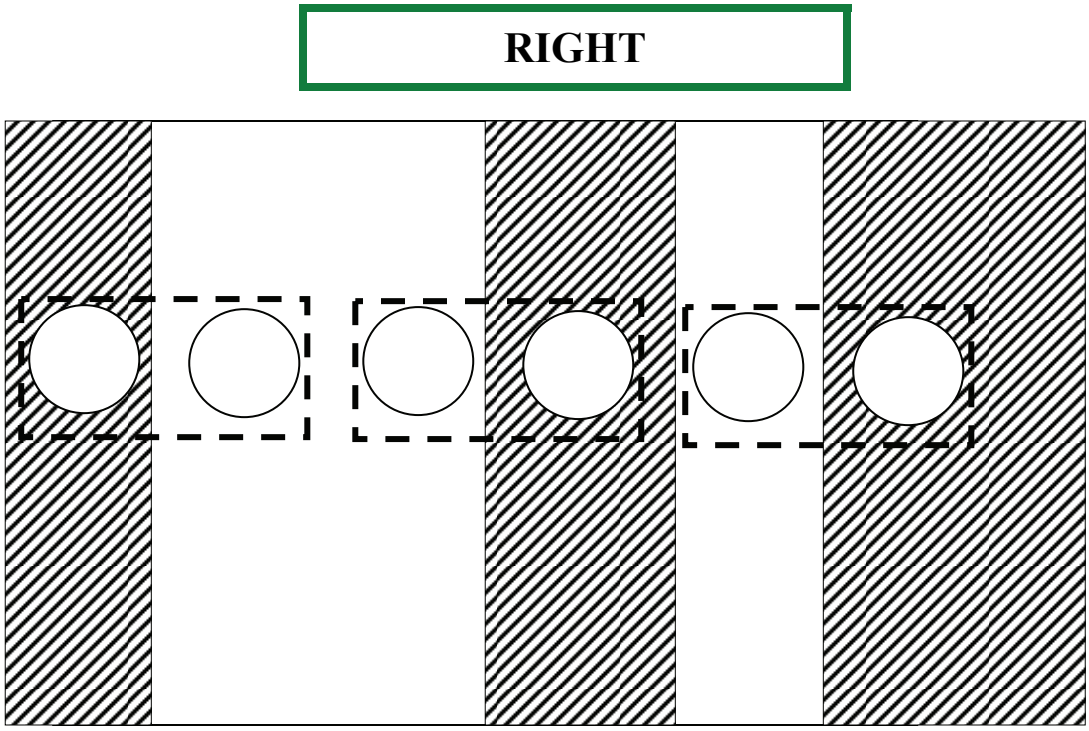


Figure 6
Example of location of blocks with interspersion of treatments



Step 2. Assessment of site

- **Form 1 – Monitoring site summary**

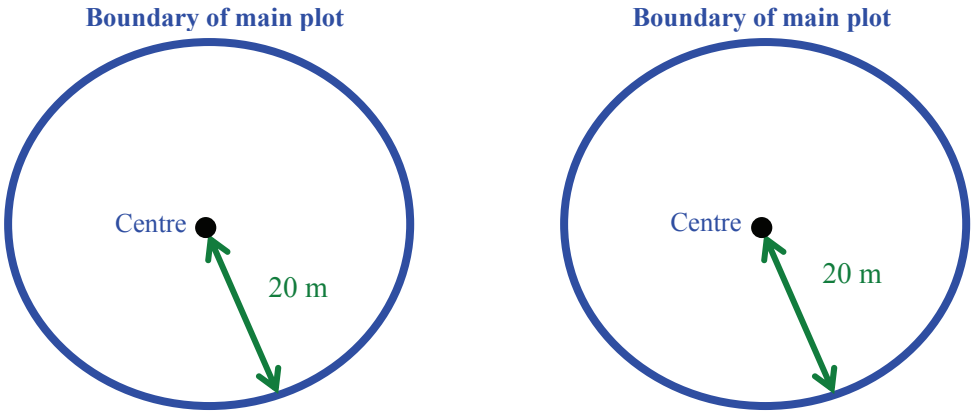
During the site visit, use *Form 1 — Monitoring site summary* to locate and identify the site and collect specific information to characterize it. The site boundaries should be determined by GPS, as should those of the different logging treatments used within each site.

Step 3. Establishment of main plots

- **Form 2 – Location of main plot**
- **Form 3 – Description of main plot**

As stated earlier, monitoring plots are to be established in pairs. Two main plots (circles with a radius of 20 m) are to be mapped and their centre marked out by GPS. One plot will be logged with residues left on the ground and the other logged with the residues removed (Figure 7).

Figure 7
Main plots and logging treatments



Plot with logging residues left in place

Plot with logging residues removed

An aluminum stake with an identification tag is used to mark the centre of each plot. The Canadian Forest Service will provide the aluminum stakes and the tags upon request. The following information should appear on the tag:

[3-letter code for the site name] – [Plot number] – [Treatment]

The treatment should be identified as follows:

- **Residues left in cutting area: A**
- **Residues removed: B**

For example, the third pair of plots on the "Casey site" would be identified as follows:

- **Plot with residues: CAS-3-A**
- **Plot without residues: CAS-3-B**

For each plot, the GPS-derived coordinates of the plot centre should be recorded on *Form 2 — Location of main plot* (one form per plot). A witness post should be put at the roadside and its GPS position recorded, and the bearing and distance to the plot should be noted on *Form 2*. Just outside of each plot, a tie point (for example, a big rock) should be identified, its GPS position recorded and its bearing and distance to the centre of the plot should be noted on *Form 2*. An identification tag should be used to mark the tie point. The same information found on the tag for the centre of the plot should appear on the tag for the tie point, preceded by the letters TIE:

TIE - [3-letter code for the site name] – [Plot number] – [Treatment]

Figure 8 shows one main plot and all the inventory plots and transects that should be put in place.

- Main plot: 20 m in radius.
- Transects for debris, soil disturbance and substrates: two 20-m-long perpendicular transects that intersect the centre of the main plot (with 10 m on either side of the centre). The bearing of the first transect is determined using a table of random numbers (Table 1), and the second transect is placed at a +90° angle to the first.
- Large trees and snags plot: 11.28 m in radius, located in the centre of the main plot.
- Small trees and stumps plot: 3.99 m in radius, located in the centre of the main plot.
- Regeneration microplots: 4 square microplots of 1 m x 1 m, located at a distance of 15 m from the centre of the main plot, their diagonal aligned with the transects.
- Soil sampling stations: 6 stations, four of them located in the regeneration microplots at a distance of 15 m from the centre of the main plot and aligned with the transects, and the two remaining ones located at a distance of 11 m from the centre of the main plot, also aligned with the transects.

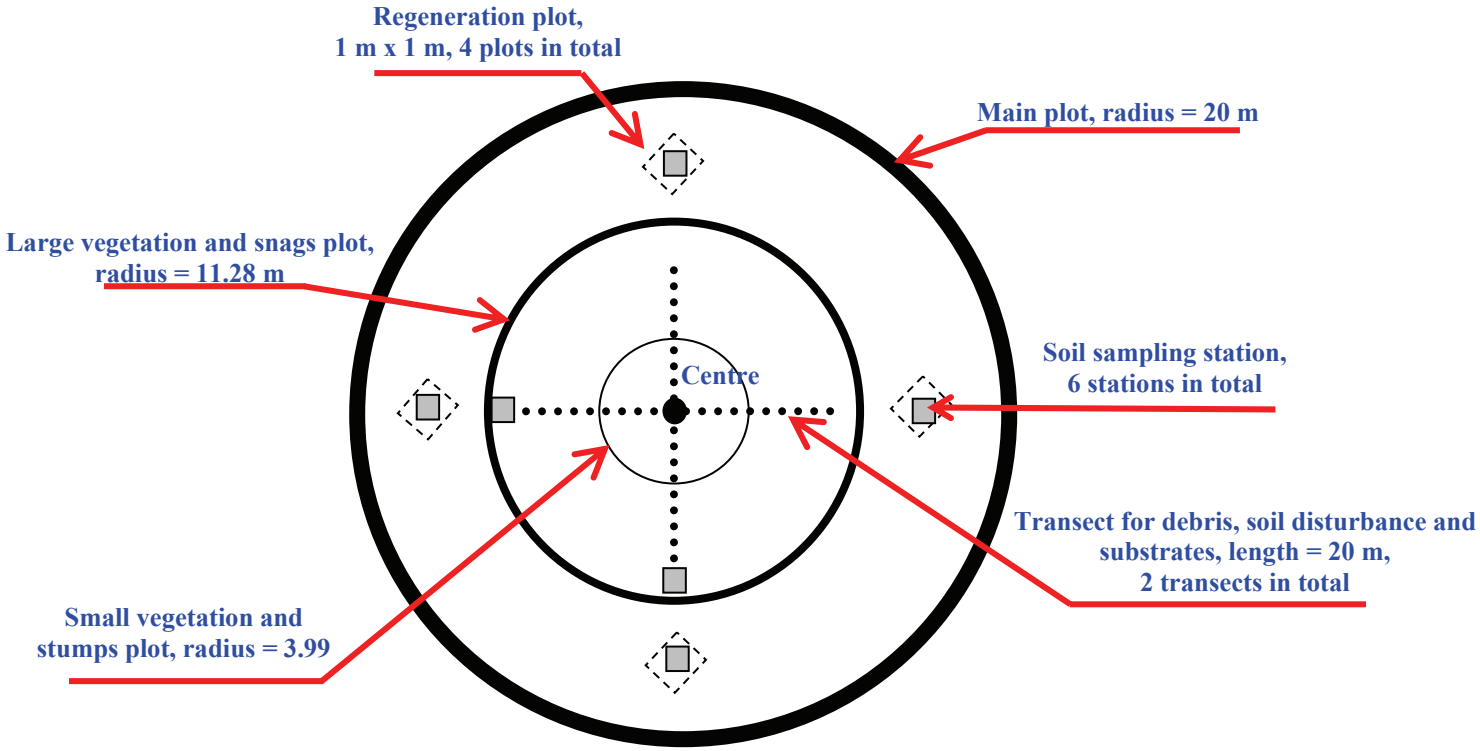
Note that although the main plot has a radius of 20 m, no inventory will occur beyond the distance of 15 m from the centre of the plot; the remaining 5 m to the edge of the main plot thus serves as a buffer.

IMPORTANT

Four photographs of each plot, one taken from each end of the transect facing toward the centre of the plot, should be annexed to *Form 3.*

Ecological characteristics of the plot should be assessed and recorded on *Form 3 – Description of main plot*. A map of local features in and around the plot should be done summarily by using *Form 3*, which should include features such as streams, rock outcrops, forest roads or skid trails, etc. If the field team has the requisite knowledge, it can provide a description of the soil based on a soil pit using *Form 11*. If not, a Canadian Forest Service team will perform this task.

Figure 8
Main plots, inventory plots and transects



Step 4. Inventory of woody debris

- **Form 4 – Woody debris**

Woody debris is defined as all pieces of deadwood lying on or suspended above the ground at various stages of decomposition—as opposed to, for example, stumps, snags, and standing dead stems that are still self-supporting. The following procedure to assess debris must be carried out in each plot with the help of *Form 4 – Woody debris*.

IMPORTANT

All woody debris on the ground that has been **severed from its original source of growth** is included (branches, crowns, downed logs, dry roundwood, etc.) **Only non-self-supporting woody material that is lying on the ground or located above the soil surface and the humus layer is counted.** Self-supporting pieces of wood that are still rooted are considered stumps, if less than 1.3 m tall, or snags, if 1.3 m tall or taller).

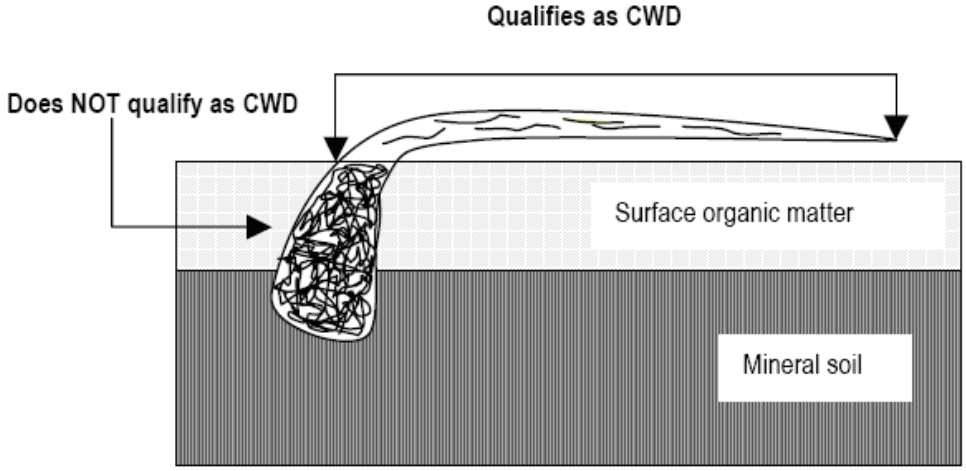
Debris may include:

- Portions of dead trees that have fallen on the ground or are leaning on other trees (i.e., that do not stand on their own);
- Portions of fallen trees, with or without green foliage, that are not self-supporting;
- Fallen trees that have broken into pieces of wood or bark on the surface of the soil;
- Fallen branches and crowns;
- Recently cut logs;
- Uprooted stumps and their exposed roots.

The following **are not considered debris** and should not be counted:

- Dead or live standing trees that are self-supporting (i.e., are still rooted);
- The exposed roots of standing live or dead trees or stumps that are standing on their own;
- Dead branches still attached to standing trees;
- Stumps that are still rooted and their exposed roots;
- Wood decomposed to the extent that it can be described as humus or duff, or having less than 50% exposed above organic horizons;
- Decomposing wood covered by a layer of soil, organic matter or moss over 1-cm thick (Figure 9).
- Wood buried in the soil.

Figure 9
Buried and unburied wood

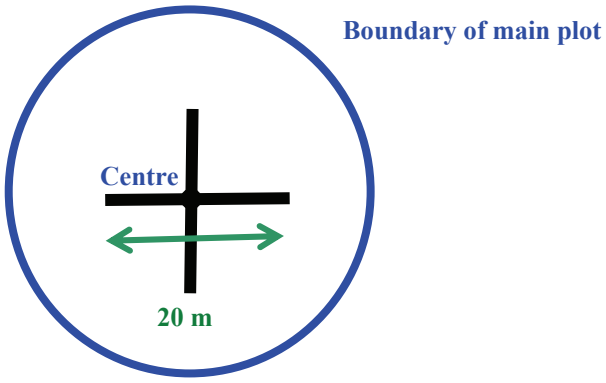


For this inventory, the sample plots consist of two 20-m-long perpendicular transects that intersect the centre of the main plot (Figure 10).

IMPORTANT

The bearing of the first transect is determined using the following method: in Table 1, select the line corresponding to the date of the day during which the establishment of the plot is being executed (numbers from 1 to 31), and take the first number in this line as the bearing of the first transect of the first plot; for the second plot established during the same day, take the second number of the line, etc. **Note the bearing on *Form 4***. From the centre of the plot, use the azimuth selected and measure 10 m in that direction. **The second transect** is placed at a +90° angle to the first.

Figure 10
Transects for inventory of woody debris



The inventory begins at the starting point of the first transect, progresses to the centre and then to the end point. Do the same thing for the second transect.

Table 1
Numbers for the selection of bearing for the first transect

Date										
1	6	42	65	75	65	71	4	57	55	16
2	89	63	3	55	64	69	40	10	6	0
3	23	69	38	49	49	13	39	36	18	33
4	71	31	18	73	6	80	13	79	40	29
5	47	70	73	82	1	53	10	51	8	56
6	80	68	69	61	53	48	36	68	61	6
7	69	29	28	41	72	46	35	29	61	77
8	30	62	10	85	71	49	18	2	48	70
9	85	25	7	67	50	47	69	48	49	27
10	21	70	85	82	50	61	26	64	36	22
11	50	87	42	52	83	67	41	64	46	20
12	58	81	14	20	26	16	86	54	49	88
13	13	12	0	66	45	69	81	10	29	83
14	44	43	8	64	3	62	61	13	73	62
15	13	23	50	6	2	16	42	75	51	38
16	84	58	55	8	15	49	75	42	62	50
17	23	13	51	55	59	45	56	81	52	79
18	5	40	31	31	62	2	71	52	43	3
19	31	67	20	18	63	48	5	30	14	1
20	44	38	1	71	23	26	32	12	16	43
21	62	16	32	48	44	28	83	61	56	37
22	39	74	44	58	6	11	9	22	83	26
23	27	62	2	54	54	42	21	56	2	42
24	5	17	78	86	1	9	85	19	65	55
25	41	42	89	69	40	90	50	7	44	26
26	36	72	42	22	34	17	22	1	50	77
27	13	15	5	1	31	80	7	3	7	4
28	66	84	31	85	71	62	4	88	27	79
29	13	58	3	8	56	79	63	35	52	37
30	27	53	72	79	0	74	38	23	18	77
31	4	51	44	69	63	44	35	14	15	20

Two categories of debris are counted when they intersect the transect:

1) Debris 1.1 – 3 cm in diameter

For the first and the last 5-m section of each transect (from 0 to 5 m, and from 15 to 20 m, 4 sections in total; Figure 11), the debris is counted regardless of the species. The total number of pieces in each 5 m section is tallied, and an average decay class (see Table 2) is assigned to all debris for each section.

2) Debris > 3.1 cm in diameter

The diameter (in centimetres, with a precision of 0.1 cm), genus and species, and decomposition class (see Table 2) for each intersection are recorded along all transects, for example, "PINU BAN 6 cm Class 2". See Appendix 2 for a list of tree species. If the species cannot be determined, "softwood" or "hardwood" is indicated, and if this cannot be ascertained, "unknown" is used. The diameter of each piece of residue is measured using a calliper perpendicular to the piece at the point where it intersects the transect.

Figure 11
Transect layout and inventory along transect

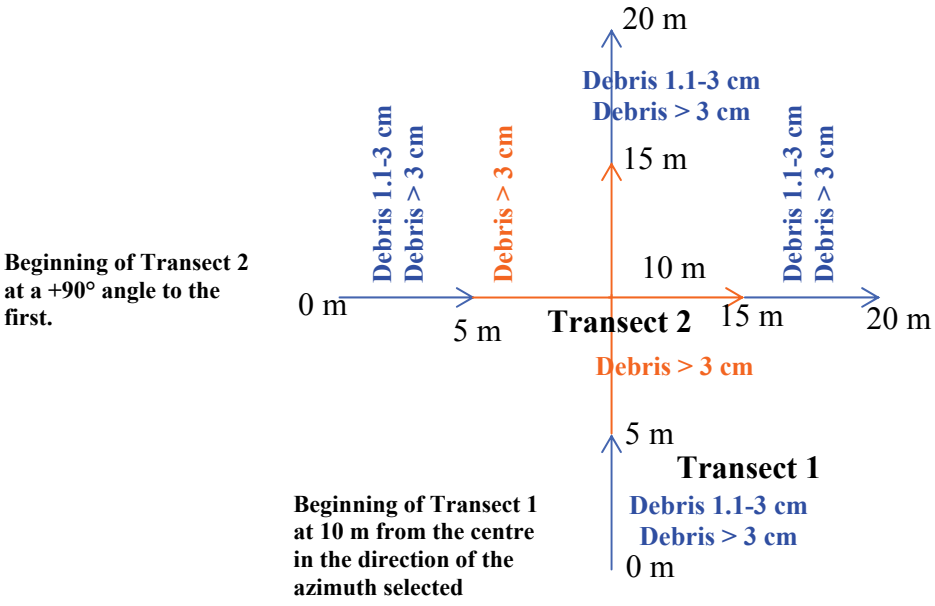


Table 2
Characteristics of woody debris according to decomposition class

	Decomposition Class				
Characteristics	**Class 1**	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Wood texture	Intact and hard	Intact, hard to partially decomposed	Still hard, large portions decomposed	Decomposed but still hard in the centre	Totally decomposed and soft
Branches	Present	Sometimes present	Absent	Absent	Absent
Bark	Intact	Completely or partially intact	Trace	Absent	Absent
Shape	Round	Round	Round	Ovoid	Oval

If a log intersects the transect, it is counted only if its central axis (Figure 12) intersects the transect. If its central axis coincides exactly with the transect, a very rare situation, it is not counted. If it intersects the transect several times, it is counted every time it intersects (Figure 13). All splints and pieces of logs found on the ground are tallied individually. Rooted stumps are not counted. Uprooted stumps are counted the same way as logs are.

Figure 12
Central axes of a section of debris

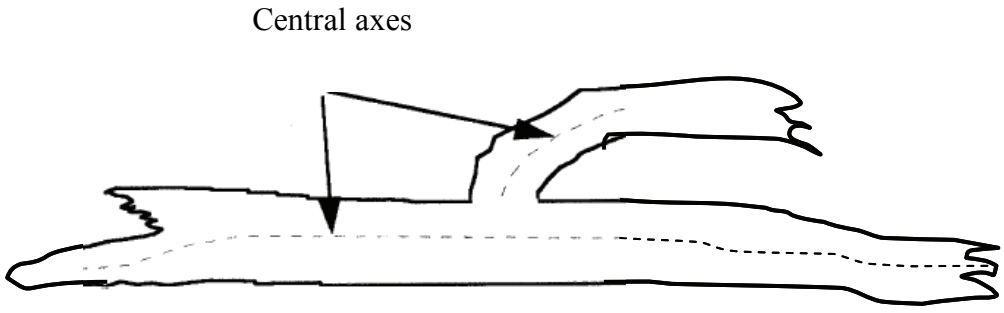
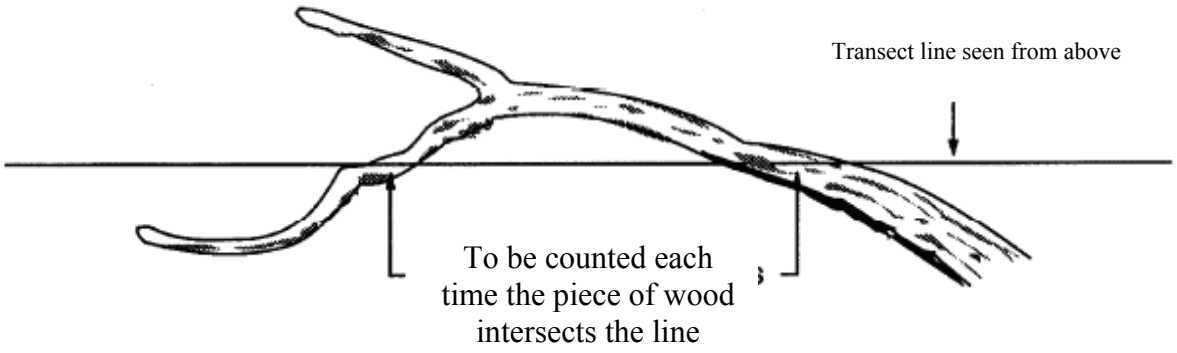


Figure 13
Measuring woody debris when it intersects the transect



Step 5. Inventory of soil disturbance and surface substrates

➢ Form 5 – Soil disturbance and surface substrates

The purpose of this step is to evaluate soil disturbance, as well as estimate the variability in the thickness and cover of the surface organic layer, which is important for calculating carbon stocks. It is carried out using the same transects used for woody debris, with the help of *Form 5 — Soil disturbance and surface substrates*. Soil disturbance is evaluated and the substrate is sampled every 2 m along each 20-m transect at 10 sampling points per transect (Figure 14): at distance 0, 2, 4, 6, 8, 12, 14, 16, 18, 20 m (no sampling at the centre of the main plot).

Soil disturbance is evaluated in a 15 cm × 15 cm area for each sampling point based on the flow chart presented in Figure 15. At each sampling point, the type of surface substrate is identified (see Table 3). If the substrate is identified as **Type 1 or 2**, that is, either organic matter or buried wood, the depth of this substrate is measured to the mineral or other horizon (bedrock, frozen layer, etc.), or to a depth equal to the length of the soil core sampler. The result is recorded on the form.

Figure 14
Soil disturbance and substrate sampling points along a transect

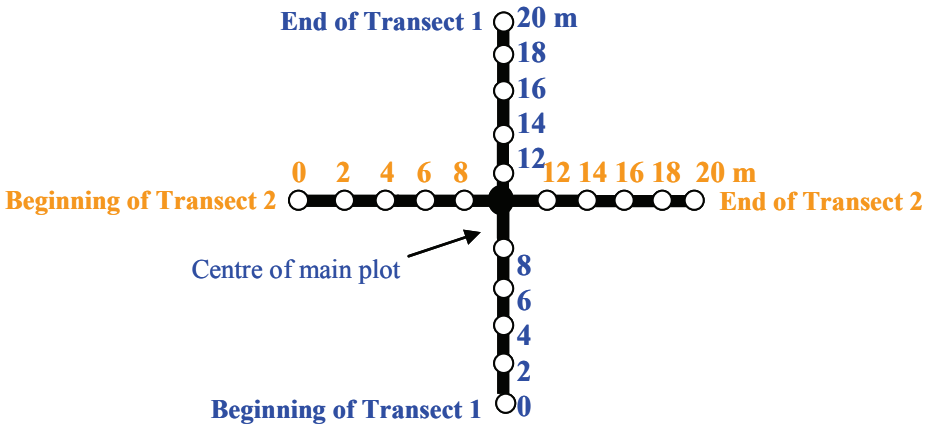
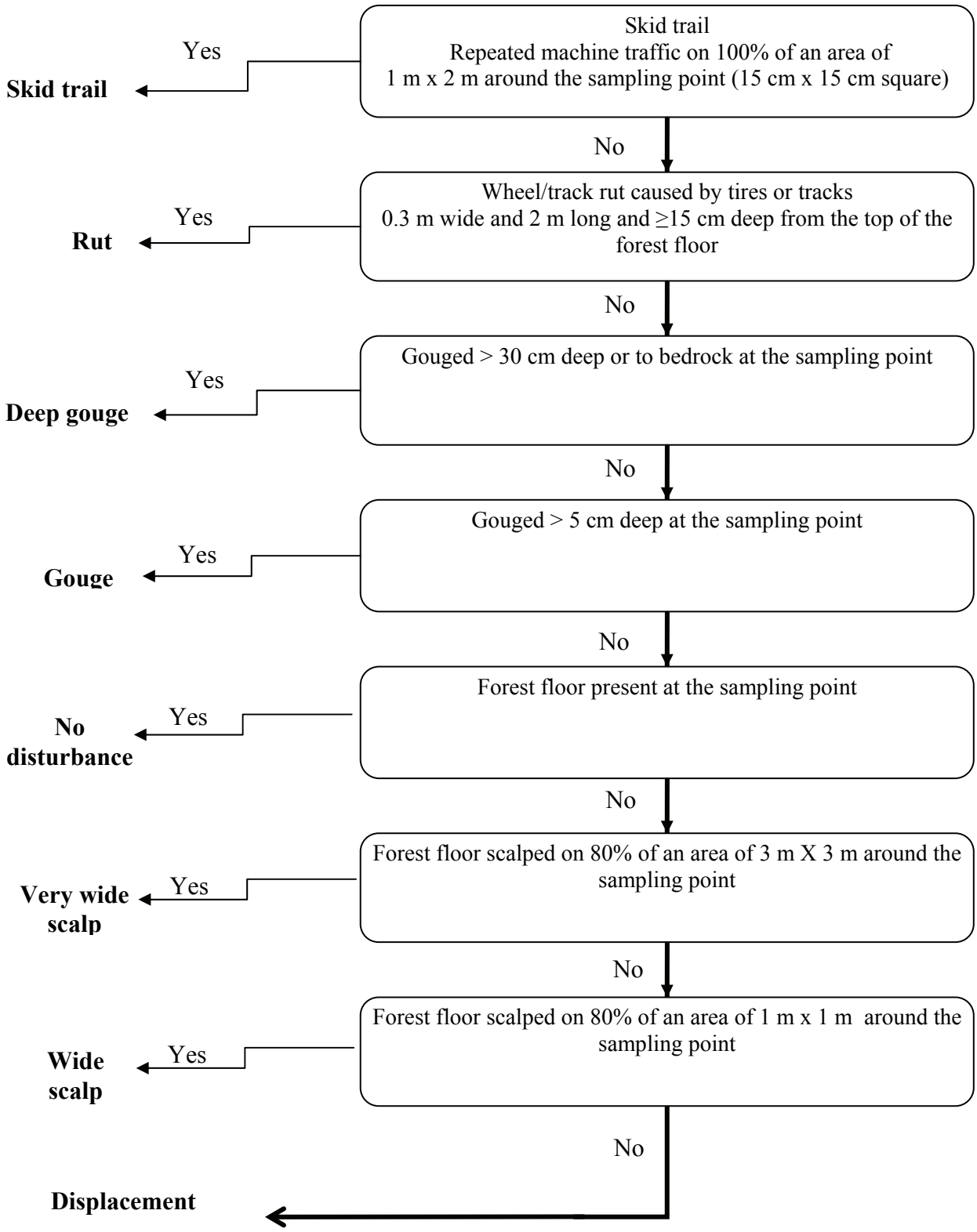


Table 3
Types of substrates

Substrate type	Definition
1. Organic matter (forest humus)	• Organic horizon (humus) at least 1 cm deep, including mosses, lichens and other plants. • Layer of decomposing wood 10 cm deep or less. • Can be a combination of organic matter and buried wood dominated by the former.
2. Buried wood	• Woody debris over 10 cm deep in decomposition classes 3, 4 or 5, with over 50% (by depth) located below the soil surface. If the decomposition class is 1 or 2, identify the substrate immediately adjoining the woody debris. • Can be covered with mosses, lichens or other plants. • Can be a combination of organic matter and buried wood dominated by the latter.
3. Decomposing wood	• Woody debris more than 10 cm deep in decomposition classes 3, 4 or 5, with over 50% (by depth) located above the soil surface. If the decomposition class is 1 or 2, identify the substrate immediately adjoining the woody debris. • Can be covered with mosses, lichens or other plants.
4. Bedrock	• Consolidated mineral matter (bedrock). • Can be covered with mosses, lichens, other plants or organic matter less than 1 cm thick.
5. Rocks or stones and pebbles	• Fragments of unconsolidated mineral matter over 7.5 cm in diameter. • Can be covered with mosses, lichens, other plants or organic matter less than 1 cm thick.
6. Mineral soil	• Fragments of unconsolidated mineral matter 7.5 cm or less in diameter. • Can be partially covered with mosses, lichens, other plants or organic matter less than 1 cm thick.

Figure 15
Flow chart for soil disturbance



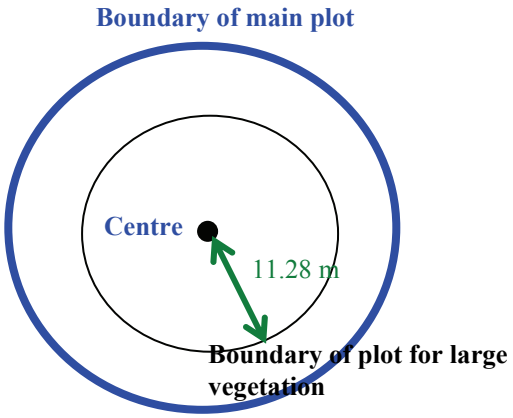
Step 6. Inventory of large trees and snags

➢ Form 6 – Large trees and snags

The purpose of this survey is to estimate the biomass of trees 1.3 m and taller with a DBH of 9 cm and up, using *Form 6 – Large trees and snags*. A circular plot with a radius of 11.28 m and an area of 400 m^2, located in the centre of each main plot, is used (Figure 16). The genus/species and dbh of every tree is recorded. In addition, three trees representative of the remaining trees in the plot should be selected and their heights measured. See Appendix 2 for the list of tree species. If trees with broken tops are present, their height should be measured (with a precision to the nearest 0.5 m).

Snags (dead trees standing on their own) with a height of 1.3 m and taller and a DBH ≥ 9 cm are also included in this category, while snags < 1.3 m tall are considered stumps and are counted in Step 8. Downed dead trees (not able to stand on their own) are considered woody debris and are counted in Step 4.

Figure 16
Survey plot for large trees and snags



Step 7. Inventory of small trees and shrubs

➢ Form 7 – Small trees and shrubs

This sampling is done to estimate the biomass of small trees (live or dead) with a height ≥ 1.3 m and a diameter at breast height (DBH) less than 9 cm. The biomass of all shrubs ≥ 1.3 m in height is also measured. This information is recorded on Form 7 – *Small Trees and shrubs*. A circular plot with a radius of 3.99 m and an area of 50 m^2, established at the centre of each main plot (Figure 17), is used for this purpose. The genus, species and dbh are recorded for all trees. Stump sprouts are also counted during this inventory if they are 1.3 m or taller (Figure 18). Species and basal diameter (diameter measured at ground level or just above the root collar) are recorded for shrubs. In the case of shrubs growing in clumps (willows and alders), each stem emerging from the ground is measured separately. However, for a shrub with a large stem that splits into smaller stems a few centimetres above the ground, only the large stem is measured (Figure 19). A list of tree species is provided in Appendix 2. Shrub identification should be based on the list published by the province concerned.

Figure 17
Plot for surveying small trees and shrubs

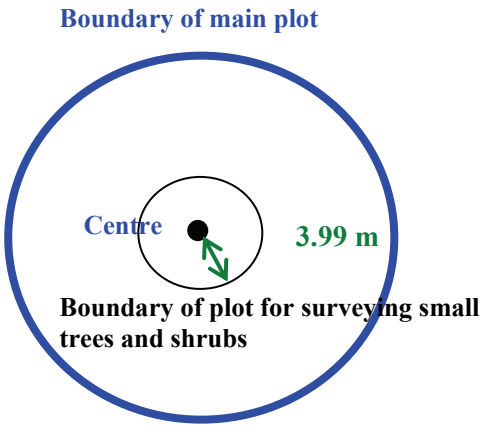


Figure 18
Measuring stump sprouts

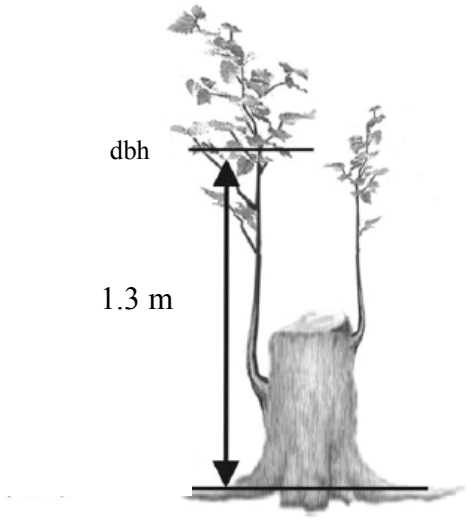
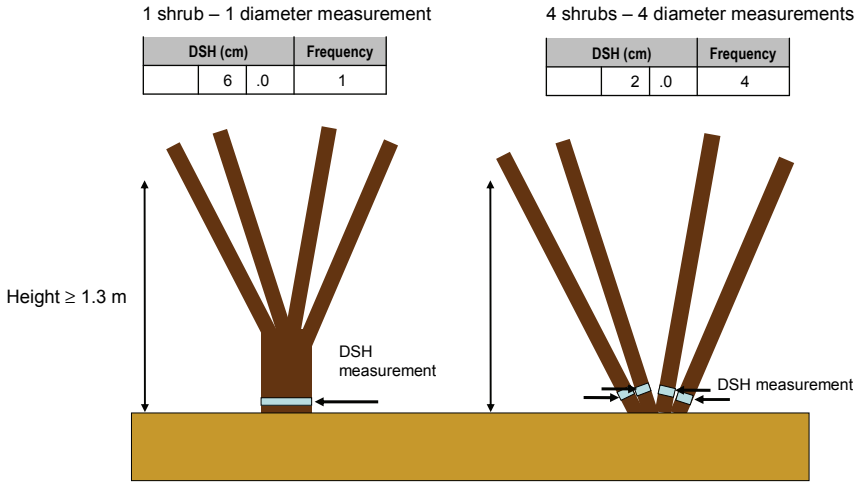


Figure 19
Measuring the basal diameter of shrubs growing in clumps



Step 8. Inventory of stumps

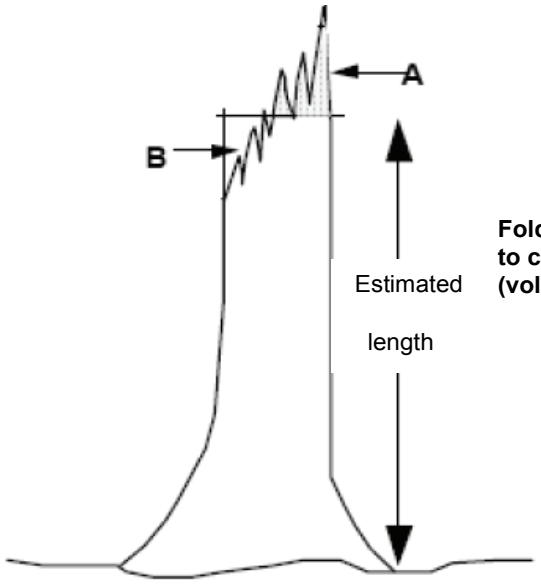
- **Form 8 – Stumps**

The purpose of this inventory is to estimate the biomass of stumps. A stump is defined as:

- the base of a tree (cut or broken) **AND**
- it stands upright on its own (rooted) (if not, it is considered to be woody debris and surveyed in Step 4) **AND**
- less than 1.3 m tall (if taller, it is considered to be a snag and surveyed in Step 6) **AND**
- with a top diameter ≥ 4 cm inside bark.

If a stump has live sprouts, sprouts are considered to be small vegetation and counted at Step 7 (see Figure 18). Stumps are surveyed using the same plot of 3.99 m radius used for small vegetation (Figure 17). The stump genus/species, length, top diameter inside the bark (measured with the tree caliper facing toward the centre of the plot) and decay class (Table 2) should be recorded on *Form 8 - Stumps*. Length of stumps must be measured from the highest level of the ground. To measure the length of broken stumps, visually fold down the broken sections to compensate for the missing parts (Figure 20).

Figure 20
Length measurement of a broken stump



Fold down broken sections (volume A) to compensate for the missing sections (volume B)

Step 9. Inventory of tree regeneration and understory vegetation

➢ Form 9 – Tree regeneration

This sampling involves estimating the abundance of regenerating trees ≥ 15 cm in height and < 1.3 m in height. All understory vegetation < 1.3 m in height is also measured. It is strongly recommended that a 1 m × 1 m quadrat with gradation marks be used (see Appendix 1).

Regenerating trees are tallied based on two height classes:

- Height from 15 cm to 60 cm;
- Height greater than 60 cm and less than 1.3 m.

Four square 1 m × 1 m microplots are used to carry out this sampling. The diagonals of each plot are aligned with the transects, and the farthest corner is located 15 m from the centre of the main plot (Figure 21). The microplots are numbered as follows: microplot 1 is placed on the same axis as transect 1, 5 m from its starting point; microplot 2 is situated at right angles (90°) to the first microplot; and so on (Figure 21). In each microplot, seedlings are tallied by species and by height class. A list of tree species is provided in Appendix 2. The seedlings must have their germination point within the microplot in order to be tallied.

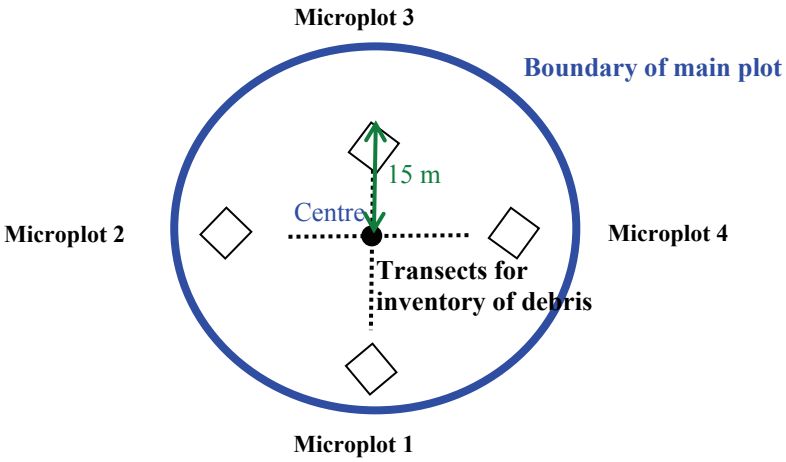
The presence of other plant categories, such as shrubs < 1.3 m in height, plants and bryophytes, is assessed in each microplot based on the percent cover of each species.

IMPORTANT

The coverage of each species may be expressed as a fraction of a percentage. For example, if a species has less than 1% coverage, a value of 0.5% may be assigned.

In the case of an unknown species, the plant may be identified by indicating its genus or some other classification level for known species (e.g., lichens). Plant identification should be based on the list published by the province concerned. *Form 9 – Tree regeneration* is used to record the information.

Figure 21
Microplots for sampling tree regeneration and understory vegetation



Step 10. Soil sampling

- **Form 10 – Soil**

Six soil sampling stations are located in line with the transects (Figure 22). They are located as follows (see Figure 23):

- four of them are located at the same place as the regeneration microplots, at a distance of 15 m from the centre of the main plot, i.e., 5 m from the beginning and end of each transect,
- the two remaining ones are located at a distance of 11 m from the centre of the main plot, i.e., 1 m from the beginning of each transect.

Figure 23 shows the way to number sampling stations.

Form 10 — Soil is used to record the information obtained. The position of each soil sampling station in relation to skidding trail is recorded (on or off the trails).

Soil sampling is adapted to the type of soil encountered:

- mineral soil: the depth of the organic layer is ≤ 40 cm;
- organic soil: the depth of the organic layer is > 40 cm (rare situation).

The choice of a sampling method is determined by the results of the surface substrate inventory (Step 5). If more than 50% of the substrate inventory points indicate that the organic material is ≤ 40 cm in depth, the main plot is classified as mineral soil and all the stations are sampled by using the method for mineral soils. If more than 50% of the substrate inventory points indicate that the depth of the organic material is more than 40 cm, the main plot is classified as organic soil and all stations are sampled by using the method for organic soils. For a plot classified as mineral soil, if one of the soil stations is in a zone where the organic layer is more than 40 cm thick, the station is nonetheless sampled as a mineral soil. The first 40 cm of the organic horizon is collected; the rest of the organic layer down to the mineral horizon is removed and set aside, and the mineral horizon is sampled using the method for mineral soils, if possible (if no mineral horizon is present—for example, if the organic layer overlies rock—record only the samples from the organic layer and move on to the next station).

- **For mineral soils, i.e., with an organic layer ≤ 40 cm:**

A 20 cm x 20 cm square template is used to sample each station. The template is put in the most suitable place to collect soil. First, the organic horizons surrounding the template are cut off around the edges of the template using a straight or wallboard saw. Then, inside the resulting quadrat, the fine woody debris (all woody material <1 cm in diameter) is collected and placed in a bag on which the main plot number and the soil station number (1 to 6), followed by the letters FWD, are recorded. Then, the upper portion of the organic horizons, which is called the L horizon and consists of leaf litter and live plants, is removed and placed in a bag on which the depth (cm), the main plot number and the soil station number (1 to 6), followed by the letter L, are recorded. The underlying FH horizon (Figure 24) is collected down to the boundary of the

first mineral horizon and its depth is noted (cm). The FH horizon is then placed in a bag on which the main plot number and the soil station number (1 to 6), followed by the letters FH, are recorded.

Figure 22
Soil sampling stations

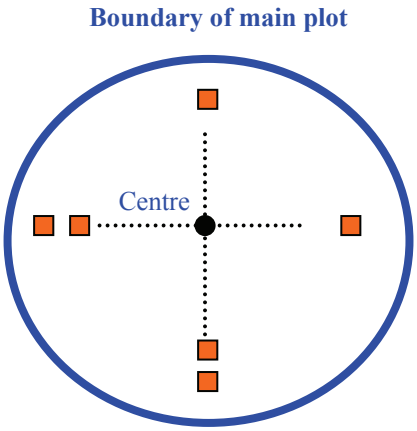


Figure 23
Layout of soil sampling stations

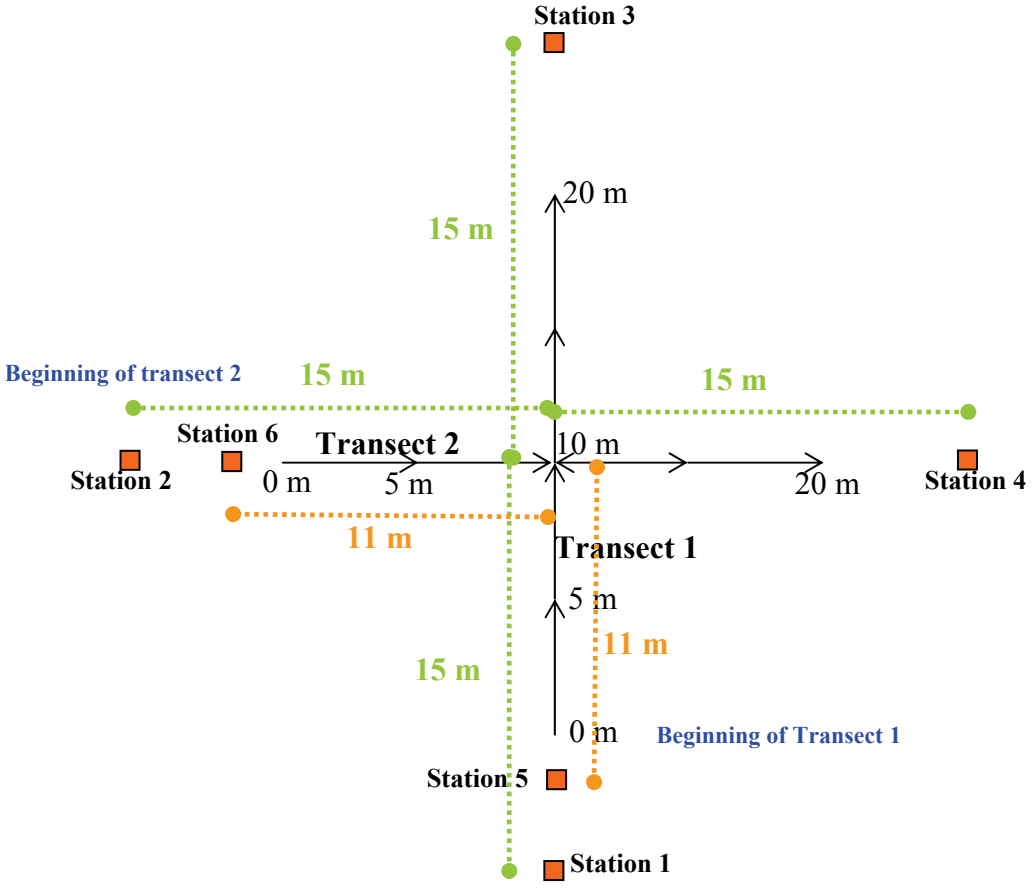
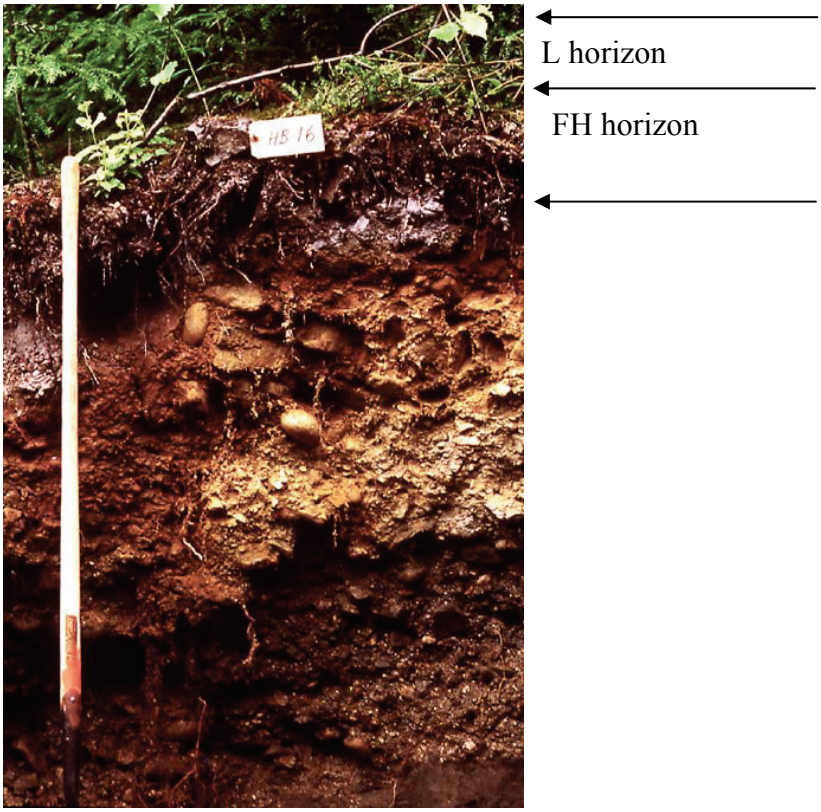


Figure 24
L and FH horizons



The mineral soil is sampled in each sampling station in the middle of the 20 cm x 20 cm quadrat. Three depths – 0-15 cm, 15-35 and 35-55 cm layers - are sampled using a 25-cm-long, 5-cm-**internal diameter** tube or pipe. **Any other size of tube is acceptable as long as it is over 20 cm long and the internal diameter is measured and recorded**. The use of a tube with a known volume makes it possible to carry out bulk density sampling and calculate the soil bulk density.

In total, there are 10 samples to be collected:

- six samples from depths of 0-15 cm,
- three samples from depths of 15-35 cm, and
- one sample from depths of 35-55 cm.

They will be collected as follows:

- At the station that best represents the site:
  - One mineral soil sample from 0-15 cm
  - One mineral soil sample from 15-35 cm
  - One mineral soil sample from 35-55 cm

- At two other stations:
  - One mineral soil sample from 0-15 cm
  - One mineral soil sample from 15-35 cm

- At the three remaining stations:
  - One mineral soil sample from 0-15 cm.

The tube is sunk vertically to a 15-cm depth. The first 15-cm core is obtained by using a small sledgehammer to drive the tube into the soil as far as the 15-cm mark. The tube and its contents are then extracted from the ground ("Vise-Grip" pliers can be used to facilitate the operation) and the contents are emptied into a bag by gently hitting the side of the tube with the sledgehammer. Make sure to carefully remove any soil clinging to the sides of the tube. Label the bag with the main plot number, the soil sampling station number and the notation "Min. 0-15."

The next step is to dig around the first sampling hole down to a depth of 15 cm in a roughly 25 cm x 25 cm area, so that the 15-35 cm core can be obtained (Figure 25). Place the core in the bag and label the bag with the main plot number, the soil sampling station number and the notation "Min. 15-35."

Then the last step is to dig around the sampling hole down to a depth of 35 cm, so that the 35-55 cm core can be obtained. Place the core in the bag and label the bag with the main plot number, the soil sampling station number and the notation "Min. 35-55".

IMPORTANT

The bags must be properly labelled with the plot identifier, the soil plot number and the sampling depth. In addition, it is important to excavate the samples at depths that are continuous with one another.

Figure 25
Sampling the mineral soil

Generally, in soils with a high clay and loam content, no soil will be lost from the base of the tube during extraction. However, if a gap in the core is found, the average thickness of the gap should be evaluated and noted. For example, if 1.5 cm of soil is observed to be missing from the base of the tube, the value of 13.5 cm should be recorded in the "Comments" column on *Form 10*.

In soils containing a high percentage of rocks, several attempts may be required to obtain samples down to 55 cm. If the tube cannot be driven all the way into the soil because it hits a rock, remove the tube, empty it, and begin again right next to the previous attempt (record this on *Form 10* in the "Comments" column). If you are still unsuccessful after two or three tries, note the actual depth sampled and empty the soil into a bag labelled accordingly. Then take a sample from the other depths using a shovel or auger (non-density sampling) and record it on the form.

If no mineral soil can be obtained from a soil sampling station due to a large rock, move the sampling station 1 m to the left or to the right of its original position. Once again**,** it is important to collect samples at depths that are continuous with the previous excavation.

- **For organic soils, i.e., with an organic layer > 40 cm:**

A 20 cm x 20 cm square template is used to sample each station. First, the organic horizons surrounding the template are cut off around the edges of the template using a straight or wallboard saw. Then, inside the resulting quadrat, the fine woody debris (all woody material ≤ 1 cm in diameter) is collected and placed in a bag on which the main plot number and the soil station number (1 to 6), followed by the letters FWD, are recorded.

Four depths will be sampled: 0-15 cm, 15-35 cm, 35-55 cm and 55-75 cm.
In total, there are 10 samples to be collected:

- six samples from depths of 0-15 cm,
- two samples from depths of 15-35 cm,
- one sample from depths of 35-55 cm, and
- one sample from depths of 55-75 cm.

They will be collected as follows:

- At one station:
  - One sample from 0-15 cm
  - One sample from 15-35 cm
  - One sample from 35-55 cm
  - One sample from 55-75 cm.

Collect samples from the successive depths to the mineral soil, bedrock, or 75 cm, whichever is encountered first. If there are mineral soils below the organic soils, collect a single, non-density sample of the mineral soil with an auger, and record the depth of the mineral soil collection.

- At another station:
  - One sample from 0-15 cm
  - One sample from 15-35 cm.

- At the four remaining stations:
  - One sample from 0-15 cm.

Excavate the area adjacent to one side of the template until the required depth is reached. Cut along the bottom of the organic layer at the required depth and remove the sample. Using organic material from the surrounding area, identify and record the degree of decomposition of the collected sample using the Von Post scale (Appendix 3). Place the sample in a bag, and label the bag with the main plot number, the soil sampling station number and the notation “Org 0-15.” Collect the other samples at the successive depths in the same manner, and label the bags according to the depth.

IMPORTANT

The bags must be properly labelled with the plot identifier, the soil plot number and the sampling depth.

When you return from the field, the soil samples should be kept in a cool place (at roughly 5ºC) for further analyses.

Acknowledgements

The following people provided valuable comments that helped make this guide possible:

- Michèle Bernier-Cardou, statistician, Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre
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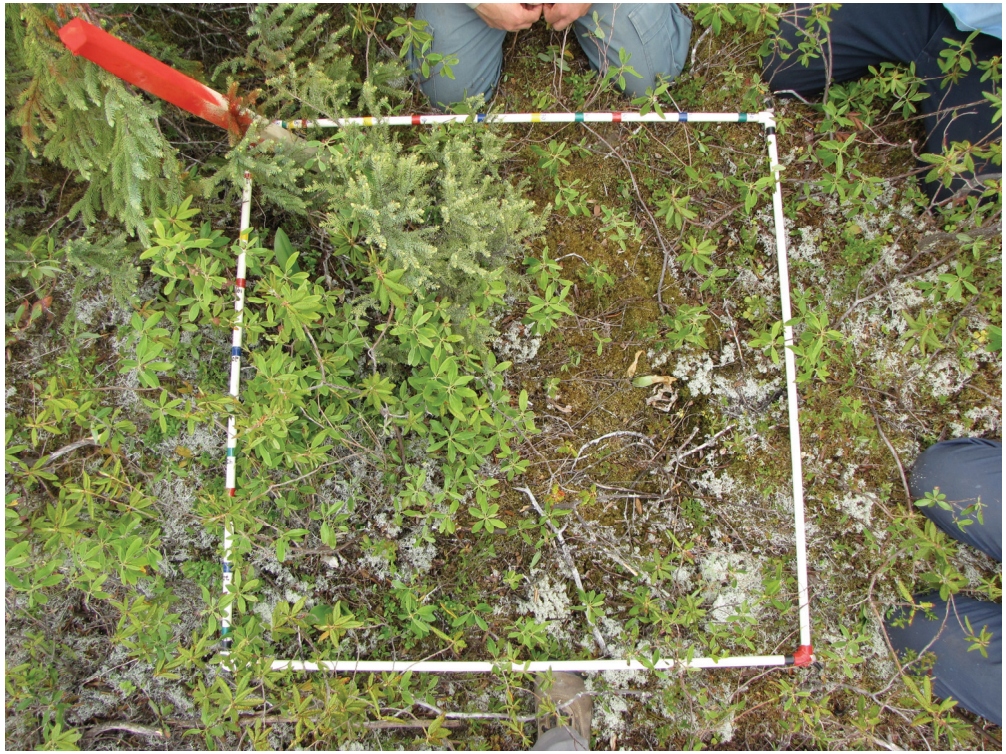
- Barbara Kishchuk, Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre
- Robert Myre, forest engineer, forestry commissioner, Centre local de développement du Haut-Saint-François
- Patrick Paiement, forest engineer, Gestion Cyclofor Inc.
- Robert St-Amour, forest engineer, Groupe Kékéko
- Brian Titus, Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre

Appendix 1
List of material for the inventory

Name	Quantity	Remark
Digital camera	1	
Compass	2	
Square frame soil sampling (20 × 20 cm)	3	
Sheet form holder (aluminum)	2	
Clinometer	1	
Gypsum knife	2	
GPS	1	
Sledgehammer (2 or 2½ lb)	1	
"Nelson" Long lasting paint	4	2 colours
Square shovel	2	
Round shovel	2	
Guide for species identification	1	
Caliper (0,1 cm)	2	
Vise-Grip pliers (medium size)	2	
Aluminium stakes	1	For plot centre
Wooden posts	4	To mark distance of 15 m from centre
Marker and tie-point posts	2	For roadside marker and tie-point
Posts to attach measuring tapes	2	To be placed 10 m from centre for transects
PVC quadrat (1×1 m)	1	For inventory of understory species: see Figure 26, and refer to Web site for details
Measuring tape (carpenter)	1	
Measuring tape (30 m)	2	
Flagging tape	10	2 to 3 colours
12 lb plastic bags	30	
20 lb plastic bags	20	
Arborist saw	1	
Hand shears	3	
"Edelman" auger	1	
Trowel	1	
Soil sampler tube	2	

Figure A1
Graduated PVC quadrat for understory vegetation inventory



If you want to obtain instructions for building a frame, consult the following Web site:

http://www.nrel.colostate.edu/projects/fhm/equipment/SamplingFrame/VegSamplingFrameInstructions.htm

Appendix 2
List of tree species

(From *Canada's National Forest inventory ground sampling guidelines*)

The following is a list of tree species as recognized for the National Forest Inventory. The species on this list meet the definition for a "tree" in this inventory: a woody plant, usually with a single stem and definite crown that can reach a mature height of 5.0 m somewhere within its natural range.

1. Native conifers

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
amabilis fir	Sapin gracieux	Abies amabilis	ABIE	AMA		
balsam fir	Sapin baumier	Abies balsamea	ABIE	BAL		
Rocky Mountain alpine fir	Sapin bifolié	Abies bifolia	ABIE	BIF		
grand fir	sapin grandissime	Abies grandis	ABIE	GRA		
subalpine fir	sapin subalpin	Abies lasiocarpa	ABIE	LAS		
unidentified fir	Sapin sp.	Abies spp.	ABIE	SPP		
yellow-cedar	chamaecyparis jaune	Chamaecyparis nootkatensis	CHAM	NOO		
unidentified cypress	Cyprès sp.	Chamaecyparis spp.	CHAM	SPP		
unidentified softwood	Résineux non-identifié		**GENC**	**SPP**		
Rocky Mountain juniper	genévrier des Rocheuses	Juniperus scopulorum	JUNI	SCO		T/S
unidentified juniper	Genévrier sp.	Juniperus spp.	JUNI	SPP		
Eastern redcedar	genévrier de Virginie	Juniperus virginiana	JUNI	VIR		T/S
tamarack	mélèze laricin	Larix laricina	LARI	LAR		
subalpine larch	mélèze subalpin	Larix lyallii	LARI	LYA		
Western larch	mélèze de l'Ouest	Larix occidentalis	LARI	OCC		
unidentified larch	Mélèze sp.	Larix spp.	LARI	SPP		
Engelmann spruce	épinette d'Engelmann	Picea engelmannii	PICE	ENG		
Engelmann x white	épinette d'Engelmann blanche	Picea engelmannii x glauca	PICE	ENG	GLA	
white spruce	épinette blanche	Picea glauca	PICE	GLA		
Sitka x white	Épinette de sitka x lutzii	Picea x lutzii	PICE	LUT	X	
black spruce	épinette noire	Picea mariana	PICE	MAR		
red spruce	épinette rouge	Picea rubens	PICE	RUB		
Sitka spruce	épinette de Sitka	Picea sitchensis	PICE	SIT		
Sitka x unidentified	épinette de Sitka x inconnue	Picea sitchensis x unknown	PICE	SIT	X	
unidentified spruce	Épinette sp.	Picea spp.	PICE	SPP		
whitebark pine	pin à blanche écorce	Pinus albicaulis	PINU	ALB		
jack pine	pin gris	Pinus banksiana	PINU	BAN		
lodgepole pine	Pin lodgepole	Pinus contorta	PINU	CON		
shore pine	pin tordu	Pinus contorta var. contorta	PINU	CON	CON	

***** ***Notes*: "x"** denotes hybridization.

T/S **Tree/Shrub:** Some woody species can have a form resembling a tree on some sites, while on other sites it more closely resembles a shrub. For the above species, coded "T/S", the sampling crew should refer to the local jurisdiction plant list to determine whether the species should be measured as a tree or a shrub.

Native conifers (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
lodgepole pine	pin tordu latifolié	Pinus contorta var. latifolia	PINU	CON	LAT	
limber pine	pin flexible	Pinus flexilis	PINU	FLE		
Western white pine	pin argenté	Pinus monticola	PINU	MON		
lodgepole x jack pine	pin tordu x gris	Pinus x murraybanksiana	PINU	MUR		
Ponderosa pine	pin ponderosa	Pinus ponderosa	PINU	PON		
red pine	pin rouge	Pinus resinosa	PINU	RES		
pitch pine	pin rigide	Pinus rigida	PINU	RIG		
unidentified pine	Pin sp.	Pinus spp.	PINU	SPP		
eastern white pine	pin blanc	Pinus strobus	PINU	STR		
Douglas-fir	Douglas vert	Pseudotsuga menziesii	PSEU	MEN		
Interior Douglas-fir	Douglas bleu	Pseudotsuga menziesii var. glauca	PSEU	MEN	GLA	
Coastal Douglas-fir	Douglas vert	Pseudotsuga menziesii var. menziesii	PSEU	MEN	MEN	
western yew	if de l'Ouest	Taxus brevifolia	TAXU	BRE		
unidentified yew	If sp.	Taxus spp.	TAXU	SPP		
eastern white-cedar	thuya occidental	Thuja occidentalis	THUJ	OCC		
western redcedar	thuya geant	Thuja plicata	THUJ	PLI		
unidentified thuja	Cèdre sp.	Thuja spp.	THUJ	SPP		
eastern hemlock	pruche du Canada	Tsuga canadensis	TSUG	CAN		
western hemlock	pruche de l'Ouest	Tsuga heterophylla	TSUG	HET		
mountain hemlock	pruche subalpine	Tsuga mertensiana	TSUG	MER		
mountain x western hemlock hybrid	Pruche subalpine x de l'ouest	Tsuga mertensiana x heterophylla	TSUG	MER	HET	
unidentified hemlock	Pruche sp.	Tsuga spp.	TSUG	SPP		

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2. Native hardwoods

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
vine maple	érable circiné	Acer circinatum	ACER	CIR		T/S
Douglas maple	érable nain	Acer glabrum var. douglasii	ACER	GLA	DOU	T/S
bigleaf maple	érable à grandes feuilles	Acer macrophyllum	ACER	MAC		
Manitoba maple (box-elder)	érable négondo (à Giguère)	Acer negundo	ACER	NEG		
black maple	érable noir	Acer nigrum	ACER	NIG		
striped maple	érable de Pennsylvanie	Acer pennsylvanicum	ACER	PEN		
red maple	érable rouge	Acer rubrum	ACER	RUB		
silver maple	érable argenté	Acer saccharinum	ACER	SAC		

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Native hardwoods (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
sugar maple	érable à sucre	Acer saccharum	ACER	SAH		
mountain maple	érable à épis	Acer spicatum	ACER	SPI		T/S
mountain alder	aulne à feuilles minces	Alnus incana ssp. tenuifolia	ALNU	INC	TEN	
red alder	aulne rouge	Alnus rubra	ALNU	RUB		
speckled alder	aulne rugueux	Alnus rugosa	ALNU	RUG		T/S
hazel alder	aulne blanc	Alnus serrulata	ALNU	SER		T/S
Sitka alder	aulne de Sitka	Alnus sinuata	ALNU	SIN		T/S
unidentified alder	Aulne sp.	Alnus spp.	ALNU	SPP		
Siberian alder	aulne de Sibérie	Alnus viridis ssp. fruticosa	ALNU	VIR	FRU	T/S
Sitka alder	aulne de Sitka	Alnus viridis ssp. sinuata	ALNU	VIR	SIN	T/S
Saskatoon-berry	amélanchier à feuilles d'aulne	Amelanchier alnifolia	AMEL	ALN		T/S
downy serviceberry	Amélanchier aborescent	Amelanchier arborea	AMEL	ARB		T/S
mountain serviceberry	Amélanchier de Bartram	Amelanchier bartramiana	AMEL	BAR		T/S
Pacific serviceberry	Amélanchier de l'Ouest	Amelanchier florida	AMEL	FLO		T/S
smooth juneberry	Amélanchier glabre	Amelanchier laevis	AMEL	LAE		T/S
roundleaf juneberry	Amélanchier sanguin	Amelanchier sanguinea	AMEL	SAN		T/S
unidentified serviceberry	Amélanchier	Amelanchier spp.	AMEL	SPP		
arbutus	arbousier d'Amérique	Arbutus menziesii	ARBU	MEN		
unidentified asimina	Asiminier sp.	Asimina	ASIM	SPP		
pawpaw	asiminier trilobé	Asimina triloba	ASIM	TRI		
Alaska paper birch	bouleau d'Alaska	Betula alaskana	BETU	ALA		
yellow birch	bouleau jaune	Betula alleghaniensis	BETU	ALL		
blueleaf birch	bouleau bleu	Betula x caerulea	BETU	CAE		
mountain paper birch	bouleau à feuilles cordées	Betula cordifolia	BETU	COR		
Kenai birch	bouleau Kenai	Betula kenaica	BETU	KEN		
cherry birch	bouleau flexible	Betula lenta	BETU	LEN		
Alaska paper birch	bouleau d'Alaska	Betula neoalaskana	BETU	NEO		
water birch	bouleau fontinal	Betula occidentalis	BETU	OCC		
white birch	bouleau à papier (blanc)	Betula papyrifera	BETU	PAP		
Alaska paper birch	Bouleau à papier d'Alaska	Betula papyrifera var. neoalaskana	BETU	PAP	NEO	
white birch	bouleau à papier (blanc)	Betula papyrifera var. papyrifera	BETU	PAP	PAP	
gray birch	bouleau gris	Betula populifolia	BETU	POP		
unidentified birch	Bouleau sp.	Betula spp.	BETU	SPP		
Alaska x paper birch hybrid	Bouleau à papier x d'Alaska	Betula x winteri	BETU	WIN		
blue-beech	charme de Caroline	Carpinus caroliniana	CARP	CAR		
unidentified hornbeam	Charme sp.	Carpinus spp.	CARP	SPP		
bitternut hickory	caryer cordiforme	Carya cordiformis	CARY	COR		

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Native hardwoods (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
red hickory	caryer glabre	Carya glabra var. odorata	CARY	GLA	ODO	
shellbark hickory	caryer lacinié	Carya liciniosa	CARY	LAC		
shagbark hickory	caryer ovale	Carya ovata	CARY	OVA		
unidentified hickory	Caryer sp.	Carya spp.	CARY	SPP		
mockernut	Caryer tomenteux	Carya tomentosa	CARY	TOM		
unidentified maple	Érable sp.	Acer spp.	ACER	SPP		
Ohio buckeye	marronnier glabre	Aesculus glabra	AESC	GLA		
gray alder	Aulne blanc	Alnus incana	ALNU	INC		T/S
speckled alder	aulne rugueux	Alnus incana ssp. rugosa	ALNU	INC	RUG	T/S
American chestnut	châtaignier d'Amérique	Castanea dentata	CAST	DEN		
unidentified chestnut	Châtaigner sp.	Castanea spp.	CAST	SPP		
hackberry	micocoulier occidental	Celtis occidentalis	CELT	OCC		
unidentified hackberry	Micocoulier sp.	Celtis spp.	CELT	SPP		
dwarf hackberry	micocoulier rabougri	Celtis tenuifolia	CELT	TEN		T/S
button-bush	céphalante occidental	Cephalanthus occidentalis	CEPH	OCC		T/S
redbud	gainier rouge	Cercis canadensis	CERC	CAN		
alternate-leaf dogwood	cornouiller à feuilles alternes	Cornus alternifolia	CORN	ALT		T/S
eastern flowering dogwood	cornouiller fleuri	Cornus florida	CORN	FLO		T/S
Pacific dogwood	cornouiller de nuttall	Cornus nuttallii	CORN	NUT		
round leaf dogwood	Cornouiller rugueux	Cornus rugosa	CORN	RUG		T/S
unidentified dogwood	Cornouiller sp.	Cornus spp.	CORN	SPP		
redosier dogwood	cornouiller stolonifère	Cornus stolonifera	CORN	STO		T/S
hawthorn	Aubépine	Crataegus spp.	CRAT	SPP		T/S
silverberry	chalef argenté	Elaeagnus commutata	ELAE	COM		T/S
burning-bush euonymus	fusain pourpre	Euonymus atropurpureus	EUON	ATR		T/S
American beech	hêtre à grandes feuilles	Fagus grandifolia	FAGU	GRA		
unidentified beech	Hêtre sp.	Fagus spp.	FAGU	SPP		
white ash	frêne d'Amérique (blanc)	Fraxinus americana	FRAX	AME		
black ash	frêne noir	Fraxinus nigra	FRAX	NIG		
red ash	frêne de Pennsylvanie (rouge)	Fraxinus pennsylvanica	FRAX	PEN		
northern red ash	frêne d'Austin	Fraxinus pennsylvanica var. austini	FRAX	PEN	AUS	
green ash	frêne vert	Fraxinus pennsylvanica var. subintegerrima	FRAX	PEN	SUB	
blue ash	frêne anguleux	Fraxinus quadrangulata	FRAX	QUA		
unidentified ash	Frêne sp.	Fraxinus spp.	FRAX	SPP		
unidentified hardwood	**Feuillu non-identifié**		**GENH**	**SPP**		
honey-locust	févier épineux	Gleditsia triacanthos	GLED	TRI		
Kentucky coffetree	chicot févier	Gymnocladus dioicus	GYMN	DIO		
witch-hazel	hamamélis de Virginie	Hamamelis virginiana	HAMA	VIR		T/S
unidentified holly	Ilex sp.	Ilex spp.	ILEX	SPP		T/S

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Native hardwoods (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
common winterberry	houx verticillé	Ilex verticillata	ILEX	VER		T/S
butternut	noyer cendé	Juglans cinerea	JUGL	CIN		
black walnut	noyer noir	Juglans nigra	JUGL	NIG		
unidentified walnut	Noyer sp.	Juglans spp.	JUGL	SPP		
northern spicebush	Laurier benzoin	Lindera benzoin	LIND	BEN		
unidentified liriodendron	Liriodendron spp.	Liriodendron spp.	LIRI	SPP		
tulip-tree	tulipier de Virginie	Liriodendron tulipifera	LIRI	TUL		
cucumber-tree	magnolia amuminé	Magnolia acuminata	MAGN	ACU		
wild crab apple	pommier odorant	Malus coronaria	MALU	COR		
Pacific crab apple	pommier du Pacifique	Malus fusca	MALU	FUS		
unidentified apple	Pommier	Malus spp.	MALU	SPP		
red mulberry	mûrier rouge	Morus rubra	MORU	RUB		
Pacific bayberry	myrique du Pacifique	Myrica californica	MYRI	CAL		T/S
mountain-holly	Némopanthe mucroné	Nemopanthus mucronatus	NEMO	MUC		T/S
unidentified nemopanthus	Némopanthe sp.	Nemopanthus spp.	NEMO	SPP		T/S
tupelo	Nyssa sp.	Nyssa spp.	NYSS	SPP		
black-gum	nyssa sylvestre	Nyssa sylvatica	NYSS	SYL		
unidentified hop-hornbeam	Ostryer sp.	Ostrya spp.	OSTR	SPP		
ironwood (hop-hornbeam)	ostryer de Virginie	Ostrya virginiana	OSTR	VIR		
sycamore	platane occidental	Platanus occidentalis	PLAT	OCC		
unidentified sycamore	Platane sp.	Platanus spp.	PLAT	SPP		
narrowleaf cottonwood	peuplier à feuilles étroites	Populus angustifolia	POPU	AGU		
balsam poplar	peuplier baumier	Populus balsamifera	POPU	BAL		
balsam poplar	peuplier baumier	Populus balsamifera ssp balsamifera	POPU	BAL	BAL	
eastern cottonwood	peuplier deltoïde	Populus deltoides	POPU	DEL		
eastern cottonwood	peuplier deltoïde	Populus deltoides ssp. deltoides	POPU	DEL	DEL	
southern (or plains) cottonwood	peuplier deltoïde de l'Ouest	Populus deltoides ssp. monilifera	POPU	DEL	MON	
largetooth aspen	peuplier à grandes dents	Populus grandidentata	POPU	GRA		
Jack's hybrid poplar	peuplier hybride de Jack	Populus x jackii	POPU	JAC		
hybrid poplars	peuplier hybride	Populus spp.	POPU	SPP		
unidentified poplar	Peuplier sp.	Populus spp.	POPU	SPP		
trembling aspen	peuplier faux-tremble	Populus tremuloides	POPU	TRE		
black cottonwood	peuplier de l'Ouest	Populus trichocarpa	POPU	TRI		
bitter cherry	cerisier amer	Prunus emarginata	PRUN	EMA		
Canada plum	prunier noir	Prunus nigra	PRUN	NIG		
pin cherry	cerisier de Pennsylvanie	Prunus pennsylvanica	PRUN	PEN		
black cherry	cerisier tardif	Prunus serotina	PRUN	SER		
unidentified cherry	Cerisier sp.	Prunus spp.	PRUN	SPP		
choke cherry	cerisier de Virginie	Prunus virginiana	PRUN	VIR		T/S

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Native hardwoods (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
choke cherry	cerisier de Virginie	Prunus virginiana var. virginiana	PRUN	VIR	VIR	T/S
common hoptree	ptéléa trifolié	Ptelea trifoliata	PTEL	TRI		
white oak	chêne blanc	Quercus alba	QUER	ALB		
swamp white oak	chêne bicolore	Quercus bicolor	QUER	BIC		
northern pin oak	chêne ellipsoïdal	Quercus ellipsoidalis	QUER	ELL		
Garry oak	chêne de Garry	Quercus garryana	QUER	GAR		
bur oak	chêne à gros fruits	Quercus macrocarpa	QUER	MAC		
Chinquapin oak	chêne jaune	Quercus muehlenbergii	QUER	MUE		
pin oak	chêne de marais	Quercus palustris	QUER	PAL		
dwarf Chinquapin oak	chêne nain	Quercus prinoides	QUER	PRI		T/S
red oak	chêne rouge	Quercus rubra	QUER	RUB		
Shumard oak	chêne de Shumard	Quercus shumardii	QUER	SHU		
unidentified oak	Chêne sp.	Quercus spp.	QUER	SPP		
black oak	chêne noir	Quercus velutina	QUER	VEL		
common buckthorn	Nerprun carthatique	Rhamnus cathartica	RHAM	CAT		T/S
cascara buckthorn	nerprun cascara	Rhamnus purshiana	RHAM	PUR		
unidentified buckthorn	Nerprun sp.	Rhamnus spp.	RHAM	SPP		
unidentified sumac	Rhus sp.	Rhus spp.	RHUS	SPP		T/S
staghorn sumac	sumac vinaigrier	Rhus typhina	RHUS	TYP		T/S
black locust	robinier faux-acacia	Robinia pseudoacacia	ROBI	PSE		
unidentified robinia	Robinier sp.	Robinia spp.	ROBI	SPP		
peachleaf willow	saule à feuilles de pêcher	Salix amygdaloides	SALI	AMY		
Bebb willow	saule de Bebb	Salix bebbiana	SALI	BEB		T/S
pussy willow	saule discolore	Salix discolor	SALI	DIS		T/S
shining willow	saule brillant	Salix lucida	SALI	LUC		T/S
Pacific willow	saule du Pacifique	Salix lucida ssp. lasiandra	SALI	LUC	LAS	T/S
shining willow	saule brillant	Salix lucida ssp. lucida	SALI	LUC	LUC	T/S
McCalla's willow	Saule de McCalla	Salix maccalliana	SALI	MAC		
black willow	saule noir	Salix nigra	SALI	NIG		
meadow willow	Saule petiole	Salix petiolaris	SALI	PET		T/S
diamond leaf willow	Saule à feuilles planes	Salix planifolia	SALI	PLA		T/S
Balsam willow	saule baumier	Salix pyrifolia	SALI	PYR		T/S
Scouler willow	saule de Scouler	Salix scouleriana	SALI	SCO		T/S
Sitka willow	saule de Sitka	Salix sitchensis	SALI	SIT		T/S
unidentified willow	Saule sp.	Salix spp.	SALI	SPP		T/S
red-berry elder	sureau rouge du Pacifique	Sambucus callicarpa	SAMB	CAL		T/S
American elder	sureau blanc	Sambucus canadensis	SAMB	CAN		T/S
blue-berry elder	sureau bleu	Sambucus cerulea	SAMB	CER		T/S
sassafras	Sassafras officinal	Sassafras albidum	SASS	ALB		
unidentified sassafras	Sassafras	Sassafras	SASS	SPP		

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Native hardwoods (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
silver buffalo-berry	shépherdie argentée	Shepherdia argentea	SHEP	ARG		T/S
American mountain-ash	sorbier d'Amérique	Sorbus americana	SORB	AME		T/S
showy mountain-ash	sorbier des montagnes	Sorbus decora	SORB	DEC		
mountain-ash	Sorbier	Sorbus spp.	SORB	SPP		
basswood	tilleul d'Amérique	Tilia americana	TILI	AME		
unidentified linden	Tilleul sp.	Tilia spp.	TILI	SPP		
poison-sumac	sumac à veris	Toxicodendron vernix	TOXI	VER		T/S
white elm	orme d'Amérique	Ulmus americana	ULMU	AME		
red elm	orme rouge	Ulmus rubra	ULMU	RUB		
unidentified elm	Orme sp.	Ulmus spp.	ULMU	SPP		
rock elm	orme liège	Ulmus thomasii	ULMU	THO		
northern wild-raisin (withe-rod)	Viorne cassinoïde	Viburnum cassinoides	VIBU	CAS		T/S
nannyberry	viorne flexible	Viburnum lentago	VIBU	LEN		T/S
viburnum	Viorne sp.	Viburnum spp.	VIBU	SPP		T/S
common prickly-ash	clavalier d'Amérique	Zanthoxylum americanum	ZANT	AME		T/S

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3. Exotics

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
white fir	Sapin argenté	Abies concolor	ABIE	CON		
red fir	sapin rouge	Abies magnifica	ABIE	MAG		
Shasta red fir	Sapin rouge	Abies magnifica var. shastensis	ABIE	MAG	SHA	
Nordmann fir	sapin de Nordmann	Abies nordmanniana	ABIE	NOR		
Spanish fir	sapin d'Espagne	Abies pinsapo	ABIE	PIN		
noble fir	sapin noble	Abies procera	ABIE	PRO		
Amur maple	érable ginnala	Acer ginnala	ACER	GIN		T/S
Japanese maple	érable palmé	Acer palmatum	ACER	PAL		T/S
Norway maple	érable de Norvège	Acer platanoides	ACER	PLA		
sycamore maple	érable sycomore	Acer pseudoplatanus	ACER	PSE		
red horsechestnut	Marronier rouge	Aesculus x carnea	AESC	CAR		
horsechestnut	Marronier d'Inde	Aesculus hippocastanum	AESC	HIP		
ailanthus	ailante glanduleux	Ailanthus altissima	AILA	ALT		
European black alder	aulne glutineux	Alnus glutinosa	ALNU	GLU		
Japanese angelica-tree	Angélique du Japon	Aralia elata	ARAL	ELA		

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Exotics (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
monkey puzzle	araucaria du Chili	Araucaria araucana	ARAU	ARA		
European white birch	bouleau verruqueux	Betula pendula	BETU	PEN		
silver (downy) birch	Bouleau pubescent	Betula pubescens	BETU	PUB		
incense cedar	Cèdre à encens	Calocedrus decurrens	CALO	DEC		
Siberian pea-tree	caragana arborescent	Caragana arborescens	CARA	ARB		T/S
Chinese chestnut	châtaignier de Chine	Castanea mollissima	CAST	MOL		
southern catalpa	catalpa commun	Catalpa bignonioides	CATA	BIG		
northern catalpa	catalpa à feuilles cordées	Catalpa speciosa	CATA	SPE		
Atlas cedar	cèdre de l'Atlas	Cedrus atlantica	CEDR	ATL		
Deodar cedar	cèdre de l'Himalaya	Cedrus deodara	CEDR	DEO		
Cedar-of-Lebanon	cèdre de Liban	Cedrus libani	CEDR	LIB		
Katsura-tree	cercidiphyllum du Japon	Cercidiphyllum japonicum	CERC	JAP		
Port-Orford-cedar	chamaecyparis de Lawson	Chamaecyparis lawsoniana	CHAM	LAW		
Hinoki-cypress	chamaecyparis du Japon	Chamaecyparis obtusa	CHAM	OBT		
Sawara-cypress	chamaecyparis de Sawara	Chamaecyparis pisifera	CHAM	PIS		
Yellow-wood	virgilier à bois jaune	Cladrastis lutea	CLAD	LUT		
Kousa dogwood	cornouiller de Kousa	Cornus kousa	CORN	KOU		
Cornelian cherry	cornouiller mâle	Cornus mas	CORN	MAS		
European beech	hêtre commun	Fagus sylvatica	FAGU	SYL		
Oregon ash	frêne de l'Orégon	Fraxinus latifolia	FRAX	LAT		
unidentified exotic	Exotique non-identifié		GENX	SPP		
Ginkgo	ginkgo bilobé	Ginkgo biloba	GINK	BIL		
European larch	mélèze d'Europe	Larix decidua	LARI	DEC		
Japanese larch	mélèze du Japon	Larix kaempferi	LARI	KAE		
Siberian larch	mélèze de Sibérie	Larix sibirica	LARI	SIB		
Norway spruce	épinette de Norvège	Picea abies	PICE	ABI		
Colorado spruce	épinette du Colorado	Picea pungens	PICE	PUN		
sugar pine	Pin lambertiana	Pinus lambertiana	PINU	LAM		
Austrian pine	pin noir d'Autriche	Pinus nigra	PINU	NIG		
Monterey pine	pin de Monterey	Pinus radiata	PINU	RAD		
Scots pine	pin sylvestre	Pinus sylvestris	PINU	SYL		
European white poplar	peuplier blanc	Populus alba	POPU	ALB		
Lombardy poplar	peuplier noir d'Italie	Populus nigra	POPU	NIG		
sweet cherry	cerisier sauvage	Prunus avium	PRUN	AVI		
common pear	Poirier commun	Pyrus communis	PYRU	COM		
English oak	chêne pédonculé	Quercus robur	QUER	ROB		
Weeping willow	saule pleureur doré	Salix alba var. vitellina	SALI	ALB	VIT	
giant sequoia	séquoia géant	Sequoiadendron giganteum	SEQU	GIG		
coast redwood	séquoia toujours vert	Sequoia sempervirens	SEQU	SEM		

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Exotics (continued)

Common Name		Scientific Name	Code			
English	French		Genus	Species	Var	Form
European mountain-ash	sorbier des oiseleurs	Sorbus aucuparia	SORB	AUC		
Common lilac	lilas commun	Syringa vulgaris	SYRI	VUL		T/S
English yew	if commun	Taxus baccata	TAXU	BAC		
Siberian elm	orme de Sibérie	Ulmus pumila	ULMU	PUM		
European cranberry viburnum	viorne obier	Viburnum opulus	VIBU	OPU		T/S

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Appendix 3
Von Post scale of humification

Class	Description
Fibric	
1	Completely undecomposed peat which, when squeezed, releases almost clear water. No amorphous material present.
2	Almost entirely undecomposed peat which, when squeezed, releases clear or yellowish water. No amorphous material present.
3	Very slightly decomposed peat which, when squeezed, releases muddy brown water, but from which no peat passes between the fingers. No amorphous material present.
4	Slightly decomposed peat which, when squeezed, releases very muddy dark water. No peat is passed between the fingers but the plant remains are slightly pasty.
Mesic	
5	Moderately decomposed peat which, when squeezed, releases very “muddy” water with a very small amount of amorphous granular peat escaping between the fingers. The structure of the plant remains is quite indistinct. The residue is very pasty.
6	Moderately highly decomposed peat with a very indistict plant structure. When squeezed, about one-third of the peat escapes between the fingers. The residue is very pasty but shows the plant structure more distinctly than before squeezing.
Humic	
7	Highly decomposed peat. Contains a lot of amorphous material with very faintly recognizable plant structure. When squeezed, about one-half of the peat escapes between the fingers. The water, if any is released, is very dark and almost pasty.
8	Very highly decomposed peat with a large quantity of amorphous material and very indistinct plant structure. When squeezed, about two-thirds of the peat escapes between the fingers. A small quantity of pasty water may be released. The plant material remaining in the hand consists of residues such as roots and fibres that resist decomposition.
9	Practically fully decomposed peat in which there is hardly any recognizable plant structure. When squeezed, almost all the peat escapes between the fingers.
10	Completely decomposed peat with no discernible plant structure. When squeezed, all the peat escapes between the fingers.

Form 1

Monitoring Site Summary

Site name:

3-letter code for site name:

Town **Region** **Province** **Ecoregion and subregion** **Established by:**

Date of establishment of main plots:

Number of pairs of main plots established at this site:

Identification of pairs of main plots (plot identifiers):

Information on company responsible for harvesting operations

Company
Address
Town
Postal Code
Telephone No.

Contact
Name
Address
Town
Postal Code
Telephone No.

Information on site

UTM Zone **y-axis** **x-axis** **Elevation** **Area (ha)**

Date of harvesting **Date of residue recovery**

Type of harvesting done (cutting with protection of regeneration and soil, commercial thinning, etc.)

Harvesting methods used; residue recovery methods

Site history

USE A GPS TO IDENTIFY THE CONTOURS OF THE SITE AND THE HARVESTING TREATMENTS WITHIN THE SITE
COMPILE PRE-HARVEST INVENTORY DATA; DATA ON MERCHANTABLE VOLUME HARVESTED AND RESIDUES RECOVERED

Form 2

Location of Main Plot

Page of

2a

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M M		D D		Name 1	Name 2	Name 3

GPS roadside marker									
Geographic co-ordinates (DDD.ddddd) NAD83									
	D	D	D	.	d	d	d	d	d
Longitude				.					
Latitude				.					
Elevation (m)									

VERY IMPORTANT SECTION (we need the information AND the GPS points)

Roadside marker to plot centre												
Mag. azimuth. (0 to 359 deg.)					Distance (m)					Declination (deg.)			

GPS plot centre									
Geographic co-ordinates (DDD.ddddd) NAD83									
	D	D	D	.	d	d	d	d	d
Longitude				.					
Latitude				.					
Elevation (m)									

Tie-point for plot centre												
Mag. azimuth. (0 to 359 deg.)					Distance (m)					Declination (deg.)			

GPS tie-point									
Geographic co-ordinates (DDD.ddddd) NAD83									
	D	D	D	.	d	d	d	d	d
Longitude				.					
Latitude				.					
Elevation (m)									

Navigation Notes

Comments

Form 2

Drawing of Site

Page of

2b

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M M		D D		Name 1	Name 2	Name 3

Optional section for mapping route and/or recording details related to route, etc.

N

Scale = 1:

Form 3

Description of Main Plot

Page of

3a

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y	Y	Y	Y	M	M	M	D	D	Name 1	Name 2	Name 3

Position on slope	Slope (%)	Backslope length (m)	Aspect (degrees)	Surface deposit	Type of soil	Drainage class	% stones

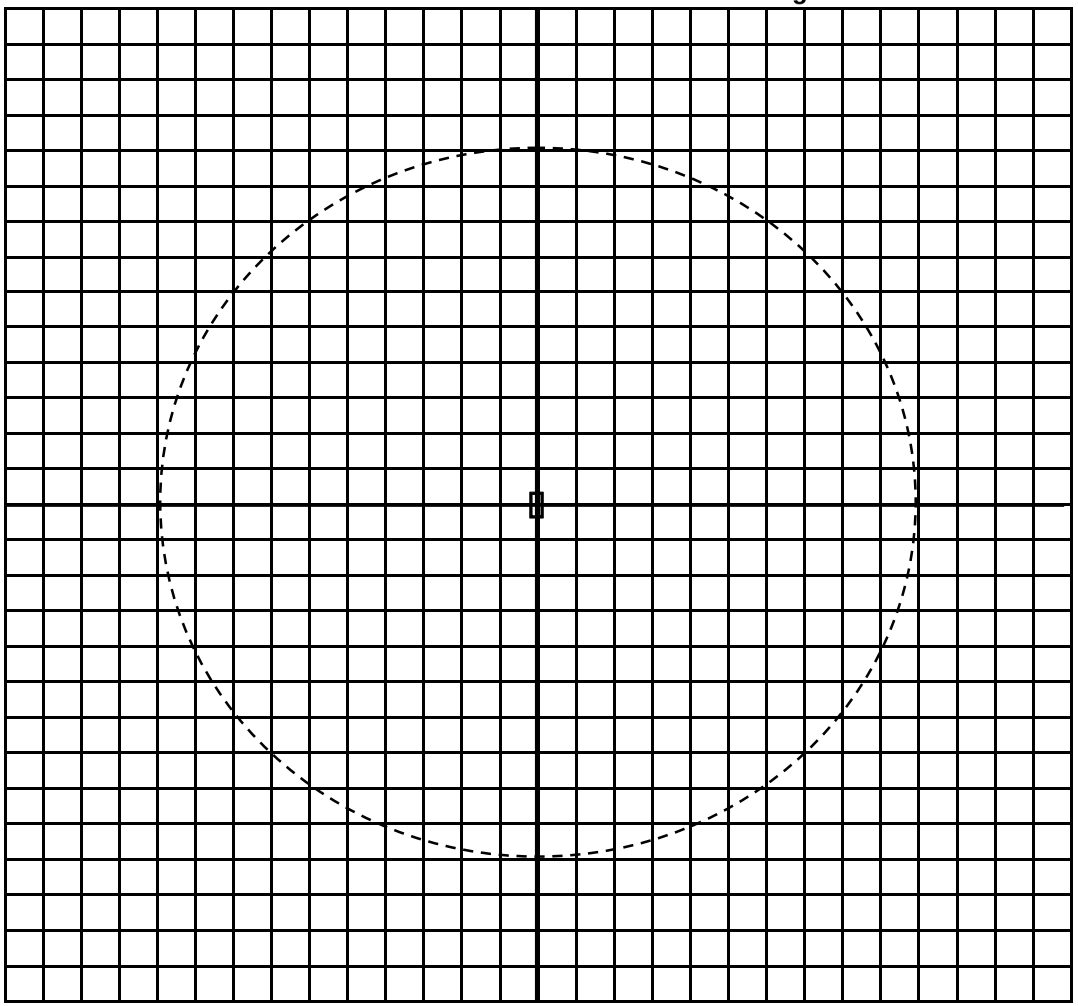
TAKE 4 PHOTOS OF THE PLOT, FROM THE END OF EACH TRANSECT LINE TOWARD THE PLOT CENTRE

Map of plot details

Include the transect lines, the pedon, the boundaries of the non-forested area, location of trees studied outside the plot, etc.

Map details such as streams, rock outcrops, forest roads, skid trails, forest type changes and ecological boundaries, etc. that could affect plot attributes.

Indicate direction of magnetic north



Comments

1 box = 4 m^2

The outside circle represents the main plot (r = 20 m)

3c

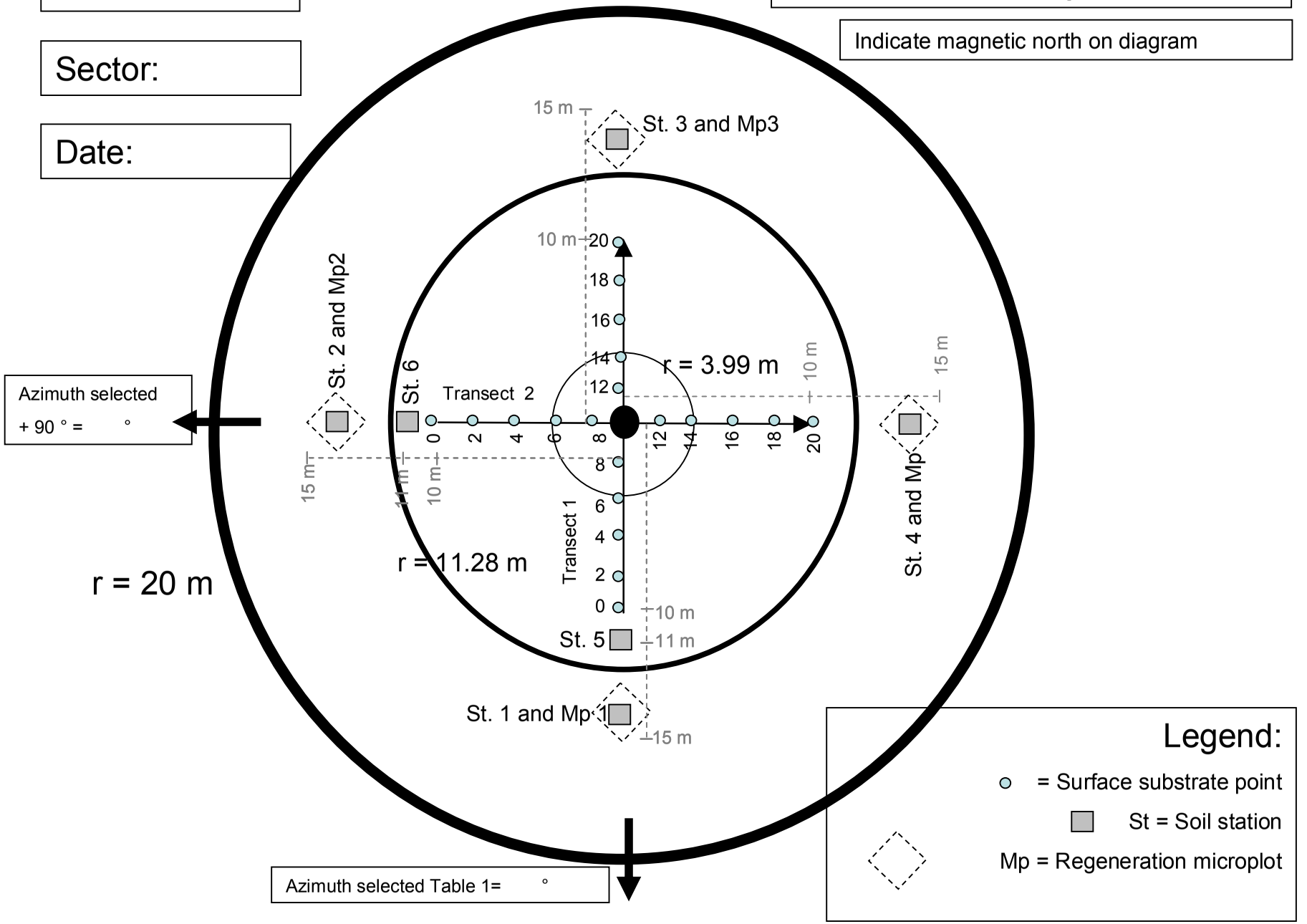
Plot No.:

Sector:

Date:

Set declination on compass to 0°

Indicate magnetic north on diagram



Form 4

Transect 1 - Coarse Woody Debris (> 3 cm)

Page of

4a

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y	Y	Y	Y	M	M	M	D D	Name 1	Name 2	Name 3

Azimuth starting point of first transect (degrees)

Transect 1 - Coarse woody debris > 3 cm				
Piece Number	Genus	Species	Decay Class	Diameter (cm)

Measure debris at:	
0 - 5 m	> 3 cm
5 - 15 m	> 3 cm
15 - 20 m	> 3 cm

Decay Classes

Characteristics	Class 1	Class 2	Class 3	Class 4	Class 5
Wood texture	Intact and hard	Intact, hard to partially decomposed	Still hard, large portions decomposed	Decomposed but still hard in centre	Totally decomposed and soft
Branches	Present	Sometimes present	Absent	Absent	Absent
Bark	Intact	Intact or partially present	Trace	Absent	Absent
Shape	Round	Round	Round	Ovoid	Oval

Comments: Refer to piece numbers	

Form 4

4b

Transect 1 - Small Woody Debris (1.1 - 3 cm)

Plot Label			Measurement Date									Team (Initials)		
Site	Number	Treatment	Y	Y	Y	Y	M	M	M	D	D	Name 1	Name 2	Name 3

Tally pieces from 1.1 - 3 cm	
Transect 1: 0 - 5 m	
Total	Ave. Decay Class

Tally pieces from 1.1 - 3 cm	
Transect 1: 15 - 20 m	
Total	Ave. Decay Class

Measure debris at:	
0 - 5 m	1.1 - 3 cm
15 - 20 m	1.1 - 3 cm

	Decay Classes				
Characteristics	Class 1	Class 2	Class 3	Class 4	Class 5
Wood texture	Intact and hard	Intact, hard to partially decomposed	Still hard, large portions decomposed	Decomposed but still hard in centre	Totally decomposed and soft
Branches	Present	Sometimes present	Absent	Absent	Absent
Bark	Intact	Intact or partially present	Trace	Absent	Absent
Shape	Round	Round	Round	Ovoid	Oval

Comments

Form 4

Transect 2 - Coarse Woody Debris (> 3 cm)

Page of

4c

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y	Y	Y	Y	M	M	M	D D	Name 1	Name 2	Name 3

Azimuth starting point of second transect (degrees)

Transect 1 - Coarse woody debris > 3 cm				
Piece Number	Genus	Species	Decay Class	Diameter (cm)

Measure debris at:	
0 - 5 m	> 3 cm
5 - 15 m	> 3 cm
15 - 20 m	> 3 cm

Decay Classes

Characteristics	Class 1	Class 2	Class 3	Class 4	Class 5
Wood texture	Intact and hard	Intact, hard to partially decomposed	Still hard, large portions decomposed	Decomposed but still hard in centre	Totally decomposed and soft
Branches	Present	Sometimes present	Absent	Absent	Absent
Bark	Intact	Intact or partially present	Trace	Absent	Absent
Shape	Round	Round	Round	Ovoid	Oval

Comments: Refer to piece numbers	

Form 4

Page of

4d

Transect 2 - Small Woody Debris (1.1 - 3 cm)

Plot Label			Measurement Date									Team (Initials)		
Site	Number	Treatment	Y	Y	Y	Y	M	M	M	D	D	Name 1	Name 2	Name 3

Tally pieces from 1.1 - 3 cm	
Transect 2: 0 - 5 m	
Total	Average Decay Class

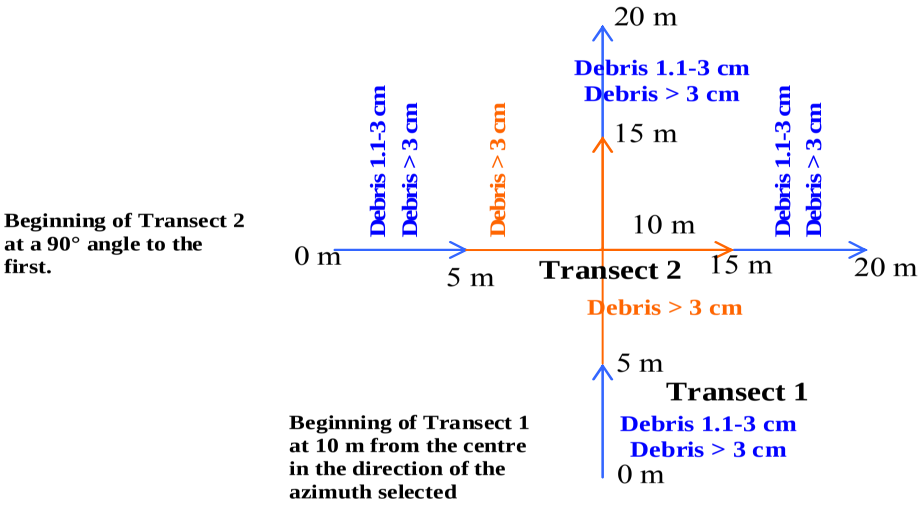
Tally pieces from 1.1 - 3 cm	
Transect 2: 15 - 20 m	
Total	Average Decay Class

Measure debris at:	
0 - 5 m	1.1 - 3 cm
15 - 20 m	1.1 - 3 cm

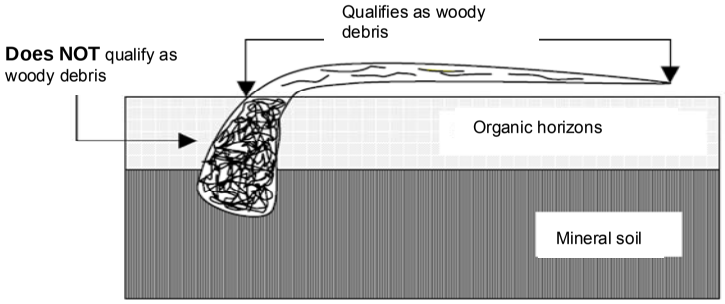
	Decay Classes				
Characteristics	Class 1	Class 2	Class 3	Class 4	Class 5
Wood texture	Intact and hard	Intact, hard to partially decomposed	Still hard, large portions decomposed	Decomposed but still hard in centre	Totally decomposed and soft
Branches	Present	Sometimes present	Absent	Absent	Absent
Bark	Intact	Intact or partially present	Trace	Absent	Absent
Shape	Round	Round	Round	Ovoid	Oval

Comments

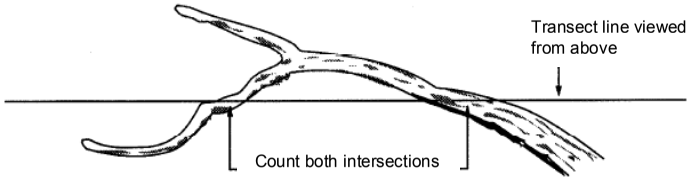
Woody Debris - Diagram and Figures



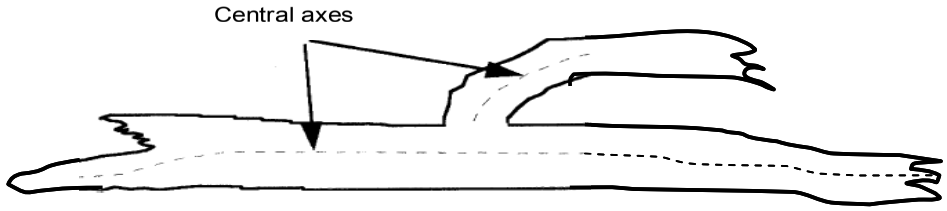
Transect layout and inventory along transect



Buried wood and woody debris



Measure woody debris where its centreline intersects the transect



Central axes of debris

Form 5

Transect 1 - Soil Disturbance and Surface Substrates

Page of

5a

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y	M M M	D D						Name 1	Name 2	Name 3

Azimuth starting point of first transect (degrees)

Distance in metres	Soil Disturbance (check one box per line)								Substrate Type (check one box per line)						Depth (cm)	Depth measured to … (check one box per line)							Comments: Refer to station numbers
	Skid trail	Rut	Deep gouge	Gouge	No disturbance	Very wide scalp	Wide scalp	Displacement	1. Organic matter (forest humus)	2. Buried wood	3. Decaying wood	4. Bedrock	5. Rock or pebbles and stones	6. Mineral soil	* Measure only if "organic matter" (forest humus) or "buried wood"	Mineral soil	Bedrock	Frozen layer	Sound wood	Rock	Other impenetrable object	Max. depth	
0																							
2																							
4																							
6																							
8																							
12																							
14																							
16																							
18																							
20																							

* If the substrate is identified as type 1 or 2 [i.e., organic matter or buried wood (see definitions)], measure substrate depth to the mineral or other horizon (e.g., bedrock or frozen layer), OR to a depth equivalent to length of soil core sampler, and record on form.

Form 5

Transect 2 - Soil Disturbance and Surface Substrates

Page of

5b

Plot Label						Measurement Date									Team (Initials)					
Site		Number			Treatment	Y	Y	Y	Y	M	M	M	D	D	Name 1		Name 2		Name 3	

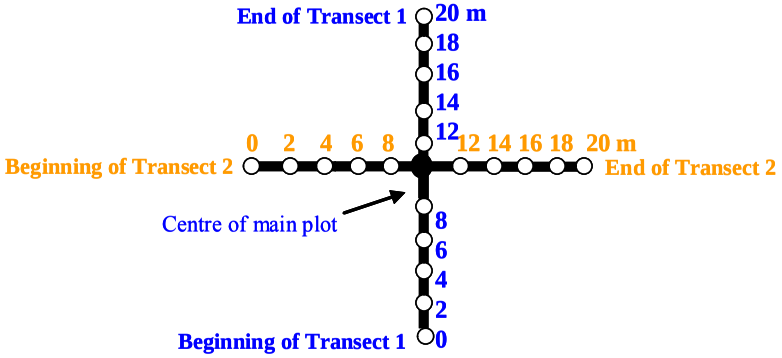
Azimuth starting point of second transect (degrees)

Distance in metres	Soil Disturbance (check one box per line)								Substrate Type (check one box per line)						Depth (cm)	Depth measured to … (check one box per line)							Comments: Refer to station numbers
	Skid trail	Rut	Deep gouge	Gouge	No disturbance	Very wide scalp	Wide scalp	Displacement	1. Organic matter (forest humus)	2. Buried wood	3. Decaying wood	4. Bedrock	5. Rocks or pebbles and stones	6. Mineral soil	* Measure only if "organic matter"(forest humus) or "buried wood"	Mineral soil	Bedrock	Frozen layer	Sound wood	Rock	Other impenetrable object	Max. depth	
0																							
2																							
4																							
6																							
8																							
12																							
14																							
16																							
18																							
20																							

* If the substrate is identified as being type 1 or 2 [i.e., organic matter or buried wood (see definitions)], measure substrate depth to the mineral or other horizon (e.g., bedrock or frozen layer), OR to a depth equivalent to length of soil core sampler, and record on form.

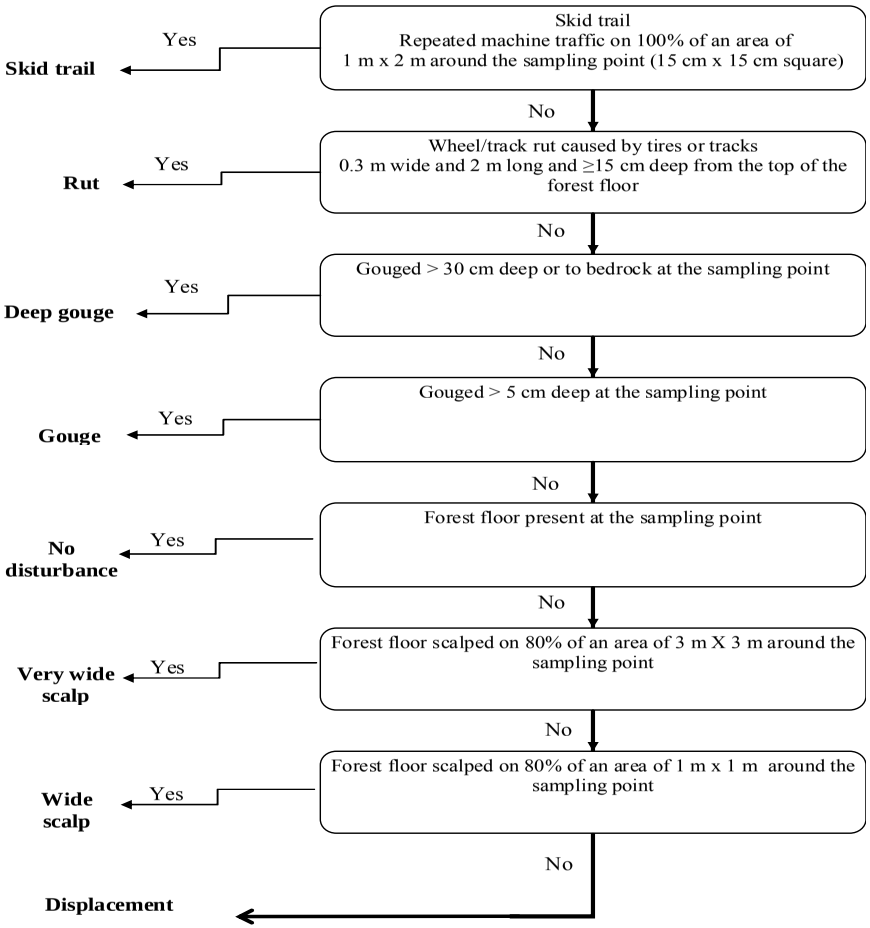
Form 5

Transects 1 and 2 - General Diagram - Table: Substrate Type



Substrate Type	Definitions
1. Organic matter (forest humus)	· Organic horizon (humus) or organic deposit at least 1 cm thick, including mosses, lichens and other plants. · Layers of decaying wood 10 cm deep or less. · May be a combination of organic matter and buried wood dominated by the former.
2. Buried wood	· Woody debris over 10 cm thick in decay classes 3, 4 or 5, with 50% of its thickness located below the soil surface. If the decay class is 1 or 2, identify the substrate right beside the woody debris. · May be covered by mosses, lichens or other plants. · May be a combination of organic matter and buried wood dominated by the latter.
3. Decaying wood	· Woody debris more than 10 cm thick in decay classes 3, 4 or 5, with over 50% located above the soil surface. If the decay class is 1 or 2, identify the substrate right beside the woody debris. · May be covered by mosses, lichens or other plants.
4. Bedrock	· Consolidated mineral material (bedrock). · May be covered by mosses, lichens, other plants or an organic layer less than 1 cm thick.
5. Rock or pebbles/stones	· Fragments of unconsolidated mineral material over 7.5 cm in diameter. · May be covered by mosses, lichens, other plants or an organic layer less than 1 cm thick.
6. Mineral soil	· Fragments of unconsolidated mineral material up to 7.5 cm in diameter. · May be partially covered by mosses, lichens, other plants or organic matter less than 1 cm thick.

Transects 1 and 2 - Figure - Soil Disturbance



Flow chart for soil disturbance

Form 6

Large Trees and Snags (circular plot r = 11.28 m)

Page of

6

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M M			D D	Name 1	Name 2	Name 3

Measure height of 3 representative trees
For tree with broken top, measure height

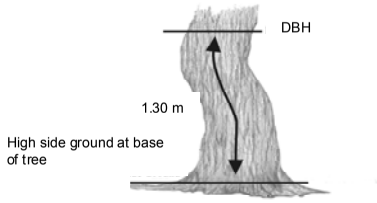
Commercial and non-commercial species
Living or dead
Height ≥ 1.3 m
DBH ≥ 9 cm

Tree Details							
Tree Number	Genus	Species	Variety	State (dead or live)	DBH (cm)	Height (m) of 3 representative trees	Height (m) if crown broken

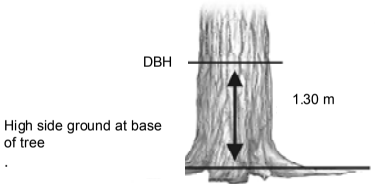
CONT: Tree Details							
Tree Number	Genus	Species	Variety	State (dead or live)	DBH (cm)	Height (m) of 3 representative trees	Height (m) if top broken

Comments: Refer to tree numbers	

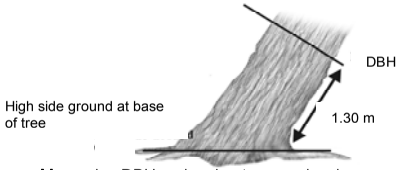
Large Trees and Snags - Figures



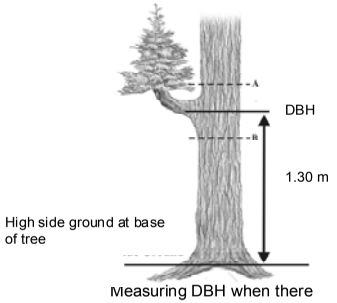
Measuring DBH on a curved stem.



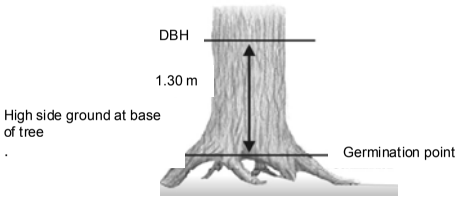
Measuring DBH from high side ground at base of tree.



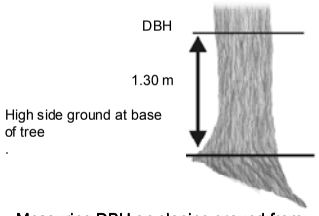
Measuring DBH on leaning trees on level ground.



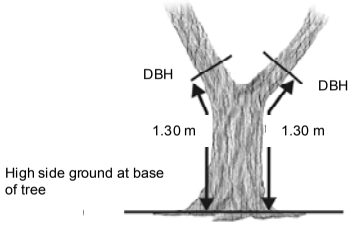
Measuring DBH when there is a branch at 1.3 m. Measure diameter at "A" above 1.3 m and at "B" below 1.3 m, and calculate the DBH value for 1.3 m.



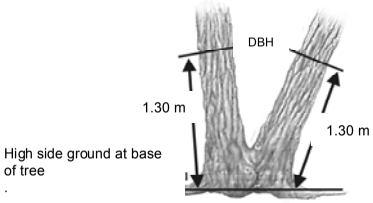
Measuring DBH on a tree with an elevated root system.



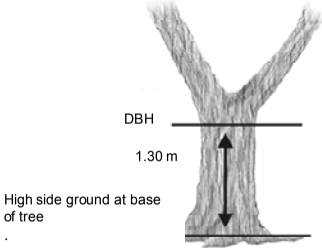
Measuring DBH on sloping ground from high side at base of tree.



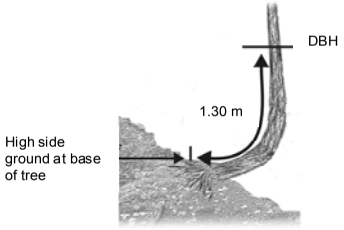
Measuring trees forked above DBH.



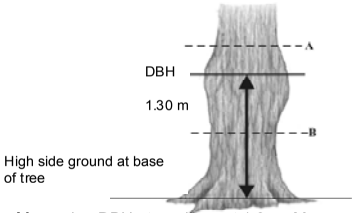
Measuring tree forked at the base.



Measuring tree forked above DBH.



Measuring DBH on curved stem on a slope.



Measuring DBH at swelling at 1.3 m. Measure diameter at "A" above 1.3 m and at "B" below 1.3 m, and calculate the DBH value for 1.3 m.

Form 7

Small Trees and Shrubs (circular plot r = 3.99 m)

Page of 7

Plot Label			Measurement Date		Team (Initials)		
Site	Number	Treatment	Y Y Y Y M M M D D		Person 1	Person 2	Person 3

Small Tree Details

Sapling Number	Genus	Species	Variety	Status (dead or live)	DBH (cm)
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,
					,

Shrub Details

Sapling Number	Genus	Species	Variety	Status (dead or live)	Basal diameter (cm)	Frequency
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	
					,	

Small trees

Commercial and non-commercial species
Live or dead
Height ≥ 1.3 m
DBH < 9 cm

Shrubs

Shrub species
Live or dead
Height ≥ 1.3 m
Basal diameter (diameter measured at ground level or at root collar, whichever is higher)
Frequency: tally of stems of the same species, same status (live or dead) and same diameter.

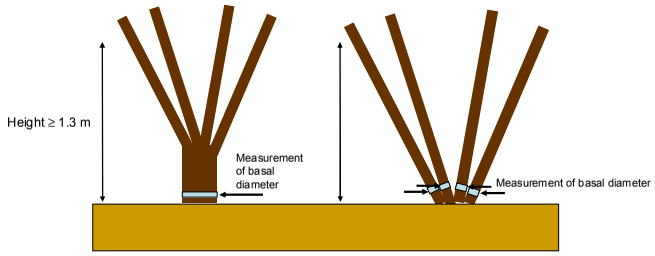
Comments: Refer to tree numbers	

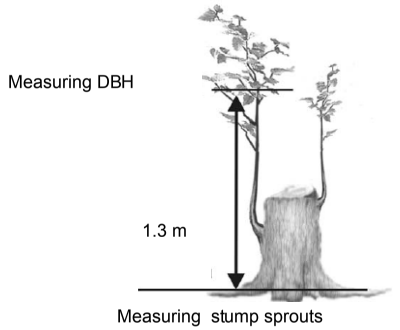
1 shrub – 1 diameter measurement

Basal Diameter (cm)			Frequency
	6	.0	1

4 shrubs – 4 diameter measurements

Basal Diameter (cm)			Frequency
	2	.0	4





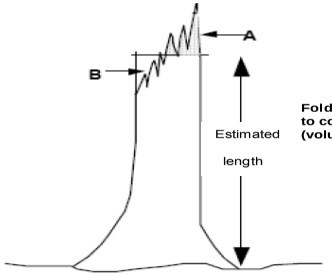
Form 8

Stumps (circular plot r = 3.99 m)

Page of 8

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M		D D		Name 1	Name 2	Name 3

Height < 1.3 m
Top diameter inside bark ≥ 4 cm



Measuring the length of a broken stump

Fold down broken sections (volume A) to compensate for the missing sections (volume B)

Stumps < 1.3 m (height) and top diameter (inside bark) ≥ 4.0 cm						
Stump No.	Genus	Species	Variety	Top Diameter Inside Bark (cm)	Decay Class	Stump Length (m)

Decay Class

Characteristics	Class 1	Class 2	Class 3	Class 4	Class 5
Wood texture	Intact and hard	Intact, hard to partially decomposed	Still hard, large portions decomposed	Decomposed but still hard in centre	Totally decomposed and soft
Branches	Present	Sometimes present	Absent	Absent	Absent
Bark	Intact	Intact or partially present	Trace	Absent	Absent
Shape	Round	Round	Round	Ovoid	Oval

Comments: Refer to stump numbers	

Form 9

Tree Regeneration (microplots)

Page of

9a

Plot Label			Measurement Date							Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M M		D D	Name 1	Name 2	Name 3

No.	Genus	Species	Variety	Count seedlings 15 cm to 60 cm	Count seedlings > 60 cm to < 1.3 m	Enter total count 15 cm to 60 cm	Enter total count > 60 cm to < 1.3 m
Microplot 1						Microplot 1	
1							
2							
3							
4							
5							
6							
7							
Microplot 2						Microplot 2	
1							
2							
3							
4							
5							
6							
7							

Form 9

Tree Regeneration (microplots)

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9b

Plot Label			Measurement Date							Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M M		D D	Name 1	Name 2	Name 3

No.	Genus	Species	Variety	Count seedlings 15 cm to 60 cm	Count seedlings > 60 cm to < 1.3 m	Enter total count 15 cm to 60 cm	Enter total count > 60 cm to < 1.3 m
Microplot 3						Microplot 3	
1							
2							
3							
4							
5							
6							
7							
Microplot 4						Microplot 4	
1							
2							
3							
4							
5							
6							
7							

Form 9

Understory Vegetation (microplots)

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9c

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y	Y	Y	Y	M	M	M	D	D	Name 1	Name 2	Name 3

If necessary, describe coverage (%) as a fraction of a percentage (e.g., 0.1%, 0.5%).
For an unknown species, record all information useful for identifying it in future in the comments section and enter the code UNKN (unknown) in the genus column.

MICROPLOT 1

No.	Genus	Species	Coverage (%)	Comments
1			.	
2			.	
3			.	
4			.	
5			.	
6			.	
7			.	
8			.	
9			.	
10			.	
11			.	
12			.	
13			.	
14			.	

MICROPLOT 2

No.	Genus	Species	Coverage (%)	Comments
1			.	
2			.	
3			.	
4			.	
5			.	
6			.	
7			.	
8			.	
9			.	
10			.	
11			.	
12			.	
13			.	
14			.	

MICROPLOT 3

No.	Genus	Species	Coverage (%)	Comments
1			.	
2			.	
3			.	
4			.	
5			.	
6			.	
7			.	
8			.	
9			.	
10			.	
11			.	
12			.	
13			.	
14			.	

MICROPLOT 4

No.	Genus	Species	Coverage (%)	Comments
1			.	
2			.	
3			.	
4			.	
5			.	
6			.	
7			.	
8			.	
9			.	
10			.	
11			.	
12			.	
13			.	
14			.	

Form 10

Soil

Mineral soil - Organic horizons

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10a

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M		D D		Name 1	Name 2	Name 3

FOR THE 6 STATIONS:

COLLECT FINE WOODY DEBRIS (1 CM OR LESS IN DIAMETER) WITHIN THE SAMPLING FRAME AND BAG BEFORE SAMPLING SOIL

Sampling of Organic Horizons (LV and FH)						
Soil Station No.	Horizon	Skid trail? Yes or no	Upper Depth (cm)	Lower Depth (cm)	Width (cm)	Length (cm)

Comments: Indicate if impossible to take bulk density sample. Refer to soil station No.	

Soil Station No.	Tot. thickness organic layer: LV + FH (cm)
1	
2	
3	
4	
5	
6	

6 stations:
FWD, LV horizon and FH horizon

12 to 18
samples in all

	Check if sample collected						
	1	2	3	4	5	6	Quantity to collect
FWD							6
LV							6
FH 0 - 15 cm							6
FH 15 - 40 cm MAX							from 0 to 6

Memory Jogger

FWD: woody material ≤1 cm in diameter (no depth).

FH: underlies LV, collected in two parts: the first part is 0-15 cm thick and the second, 15 cm to a maximum of 40 cm (both layers are recorded). If thickness of the FH horizon exceeds 40 cm, the remaining portion is removed (but not collected) down to the first mineral horizon, so that the latter can be sampled.

Form 10

Soil

Mineral soil - Mineral horizons

Page of

10b

Plot Label			Measurement Date							Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M		D D	Name 1	Name 2	Name 3

Sampling of Mineral Horizons			
Soil Station No.	Upper Depth (cm)	Lower Depth (cm)	Tube Diameter (cm)

Comments: Horizon from which sample is taken. Refer to soil station numbers.	

	Check if sample collected						
	1	2	3	4	5	6	Quantity to collect
0 - 15 cm							6
15 - 35 cm							3
35 - 55 cm							1

6 stations:	layer 0 - 15 cm
3 stations:	layer 15 - 35 cm
1 station:	layer 35 - 55 cm
10 samples in all	

Soil sampling is adapted to the type of soil involved (mineral soil: organic layer is 40 cm thick or less; or organic soil: organic layer is thicker than 40 cm). The choice of a sampling method is determined by the results of the surface substrate inventory (Step 5):

– If more than 50% of the substrate inventory points indicate the presence of an organic layer 40 cm thick or less, the main plot is classified as mineral soil and all the soil stations are sampled by using the method for mineral soils.

– If more than 50% of the substrate inventory points indicate the presence of an organic layer thicker than 40 cm, the main plot is classified as organic soil and all the soil stations are sampled by using the method for organic soils (rare).

Form 10

Soil

Organic soil (> 40 cm) - uncommon

Plot Label			Measurement Date								Team (Initials)		
Site	Number	Treatment	Y Y Y Y				M M		M	D D	Name 1	Name 2	Name 3

FOR THE 6 STATIONS:

COLLECT THE FINE WOODY DEBRIS (1 CM AND LESS IN DIAMETER) WITHIN THE SAMPLING FRAME AND BAG BEFORE SAMPLING SOIL

Sampling of Organic Horizons					
Soil Station No.	Von Post scale of decomposition	Upper Depth (cm)	Lower Depth (cm)	Width (cm)	Length (cm)

Comments: Indicate if impossible to take bulk density sample.

	Check if sample collected						
	1	2	3	4	5	6	Quantity to collect
FWD							6
0 - 15 cm							6
15 - 35 cm							2
35 - 55 cm							1
55 - 75 cm							1
Mineral soil							from 0 to 6

Sampling of Mineral Horizons *		
No. Soil Station	Upper Depth (cm)	Lower Depth (cm)

Comments

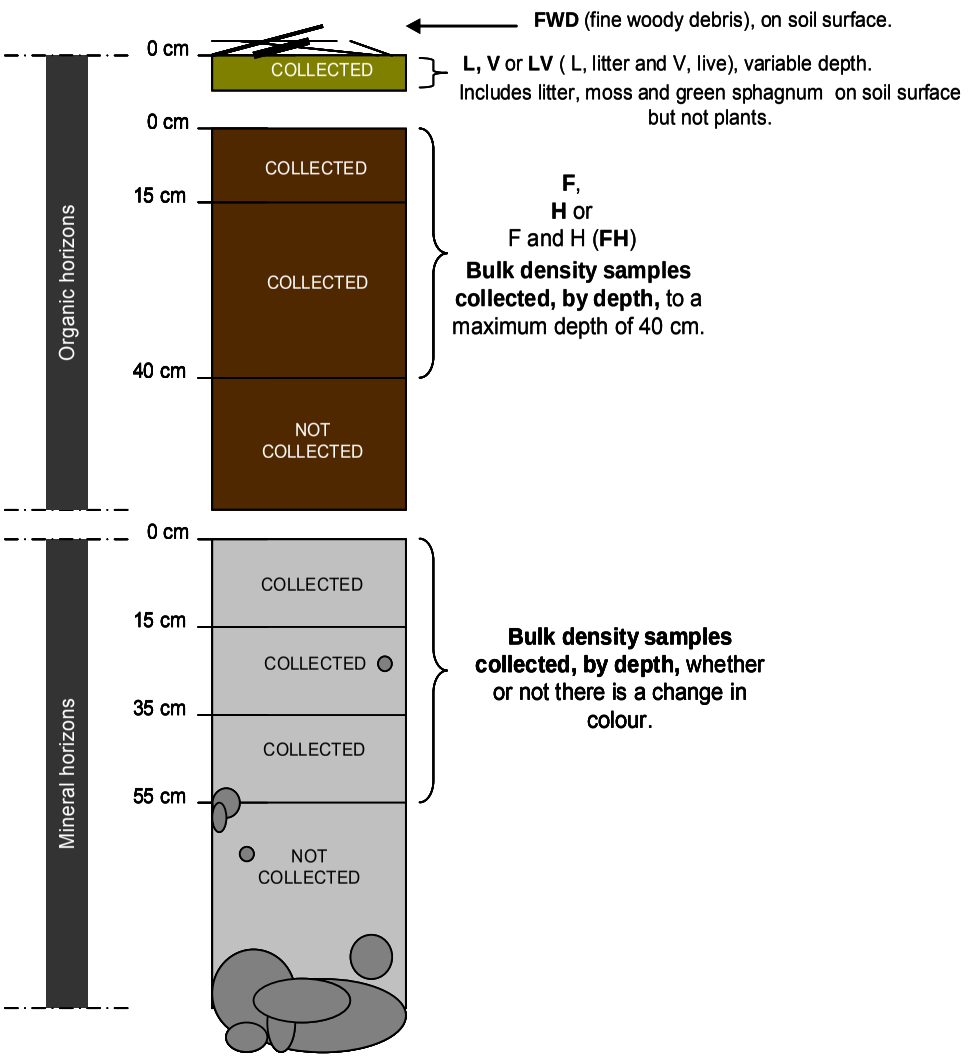
6 stations:	FWD
6 stations:	layer 0 - 15 cm
2 stations:	layer 15 - 35 cm
1 station:	layer 35 - 55 cm
1 station:	layer 55 - 75 cm
6 stations:	Mineral soil
10 to 16 samples in all	

Memory Jogger
FWD: woody material ≤ 1 cm in diameter (no depth).
Samples must be collected from successive depths until the mineral soil, the bedrock or a depth of 75 cm is reached, whichever comes first.
* When the mineral soil is accessible, a bulk density sample is collected using a soil core sampler. The depth of this sample is recorded.

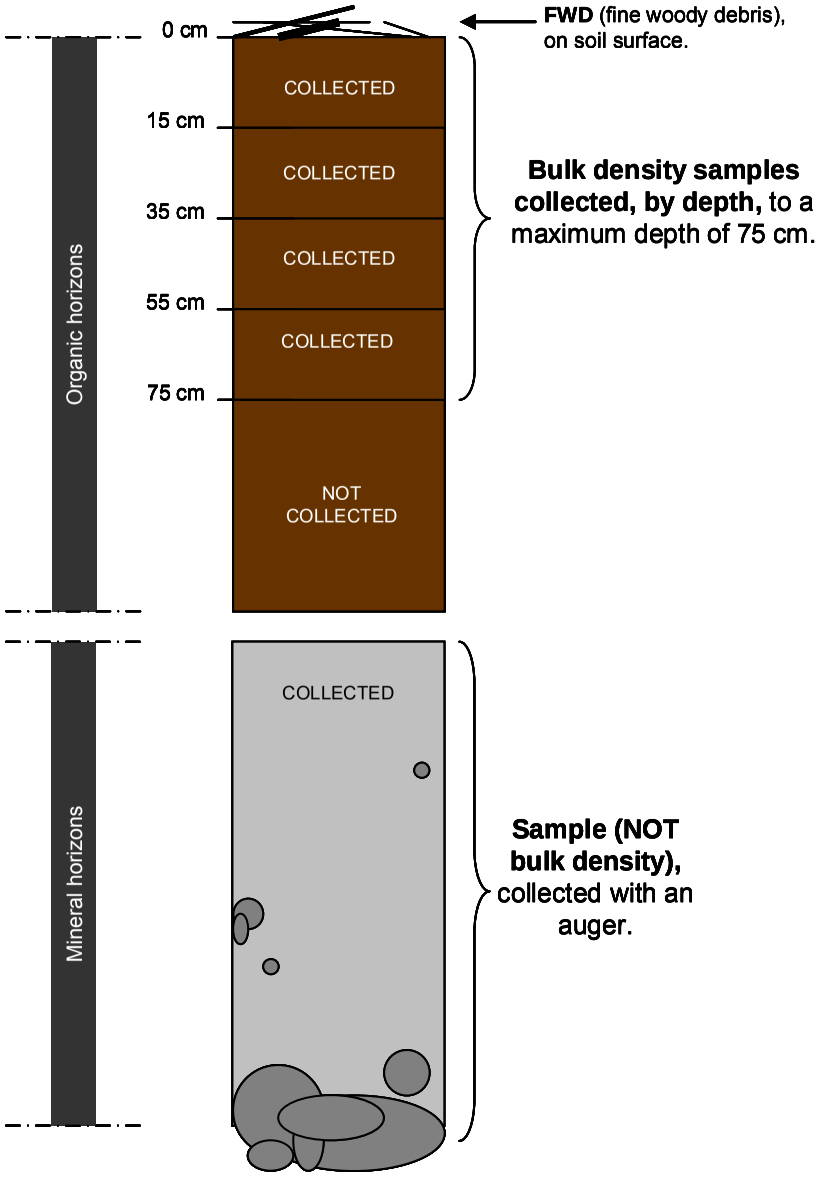
Form 10

Soil Sampling - Figures

Simplified diagram of mineral soil



Simplified diagram of organic soil (uncommon)



Form 11

Soil pit description

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11

Plot Label			Measurement Date							Team (Initials)		
Site	Number	Treatment	Y Y Y Y	M M M			D D			Name 1	Name 2	Name 3

CSSC Soil Classification (of soil pit)	Profile Depth (cm)	Drainage	Mottles	Parent Material	Humus Form

Soil pit Characteristics									Soil Characteristics	
	Note for mineral and organic soils			Note for mineral soil only						
Horizon No.	Horizon Designation	Horizon Upper Depth (cm)	Horizon Thickness (cm)	Colour	Texture	Percent Gravels	Percent Cobbles	Percent Stones	Charact. Code	Depth of Charact. (cm)
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							
		-	-							

Comments: