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A Guide to Collecting Forest Soil Samples

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1. Introduction

This guide aims to provide general guidelines on how to collect organic forest floor (section 4) and mineral soil (section 5) samples in the field for the purpose of chemical analyses, so that the final data will be of high quality. Ensuring that samples are collected in a standardized way also allows the collected data to be incorporated into larger accessible databases that can be used by others for many different applications.

Several different approaches to soil sampling are described in this guide and your choice of method will depend on factors such as type of soil, equipment available, expertise and experience of field staff, and study purpose. If your study is interested in soil properties other than chemical analyses (e.g., environmental DNA [eDNA], enzymes, trace elements, etc.), you may require additional steps to those mentioned in this guide, such as disinfecting or cleaning sampling tools to avoid sample contamination between depths, treatments, and plots. These other types of analyses may also require alternative storage requirements (e.g., freezing).

This specific guide provides detailed instructions for the collection of samples in the field and sample storage. For a quick overview of the soil collection process, refer to the [“Collecting, Analysing, and Storing Forest Soil Data Samples in the Age of Big Data”](#) guide (NRCan-CFS, 2023).

2. Site information

Once you arrive at a site to begin soil sampling, there are several key pieces of information related to the site that should be recorded (Table 1). If you think that the site might be revisited (e.g., a permanent sampling plot), a permanent site marker or post should be inserted into the ground, usually at the centre of the plot. Because soils are naturally quite spatially heterogeneous, deciding where samples are taken is important. Sampling locations should be representative of the site. The site itself should be a relatively homogenous area in terms of canopy cover and terrain, making sure to avoid transitional areas (e.g., ecotones between different forest types or different terrain or geology).

Site map: If the site will have multiple soil sampling locations or additional measurements, create a map that shows the overall plot and subplot layout within the site, sampling locations and other measurements within each subplot (Figure 1).

Plot layout diagram: To accurately reflect the soils within the site, multiple plots should be established (section 3). Subplots are established within those plots to capture fine scale variation in soils and to collect sufficient soil volume for chemical analyses. Create a plot diagram to show how your subplots are oriented within your plots and where sampling locations are within each subplot (Figure 2).

Site identifier (ID): Give the site a name. This can either be a descriptive title of the location or project, a code, or both. Try to keep the site identifier relatively short. For example, a sampling location in the Petawawa Research Forest could have a site identifier code of PRF2024 followed by plot and subplot identifiers for each sampling location (PRF2024_plot 1_subplot120). Your soil data may be given a different code when it is submitted to a laboratory for analysis; therefore, keep a record or spreadsheet of the field sample IDs that connect to the laboratory codes.

Geolocation: The most important piece of information to collect is the geolocation of each sample collection location. Given that soils are variable, this information is important, particularly for many applications that are spatially referenced, such as digital soil mapping. Coordinates should be taken at the centre of each subplot or sampling location and should be within a 10-m accuracy. Record the coordinate system used, and any information about the Global Positioning System (GPS) used (e.g., brand and model).

Dominant vegetation: It can be useful to note the dominant canopy and understory vegetation to help create relationships between soil and vegetation. It is also useful for verifying that the vegetation on the ground matches spatial layers for vegetation that come from optical remote sensing or photo interpretation that might be used as predictors (covariates) in the digital soil mapping workflow.

Evidence of disturbance: Record important signs of disturbance. Some examples would be fire, forest harvesting, flooding, insect defoliation, or animal disturbance (bear, beaver, deer, rabbit, etc.).

Other key observations: It is important to note anything else that you think may affect or influence the soil at the site. Examples would be a steep slope, presence of earthworms, exposed bedrock, wetland areas, proximity to road, etc.

Other important information: Record the sampling date, names of field staff, and other relevant information (e.g., landmarks for locating the site).

Site or plot photos: Optional

Table 1. Examples of site information that should be recorded during soil sampling.

Plot ID (Site_plot_subplot)	Sample date (YYYY/MM/DD)	Geolocation		Coordinate system	GPS information (brand/model)	Field staff	Site description ^a
		Northing	Easting				
PRF2024_003_120	2024/07/30	5091996.164	312219.2261	NAD 1983; UTM Zone 18N	Garmin/ GPSMAP 67i	Tom W.	White pine, aspen, maple, oak
PRF2024_0457_240	2024/07/30	5094955.183	314519.6164	NAD 1983; UTM Zone 18N	Garmin/ GPSMAP 67i	Tom W.	Spruce; exposed bedrock; insect defoliation

Abbreviations: GPS, Global Positioning System; NAD1983, North American Datum 1983; UTM, Universal Transverse Mercator.

^aSite description should include dominant vegetation, evidence of disturbance and any other notable ecological or terrain observations.

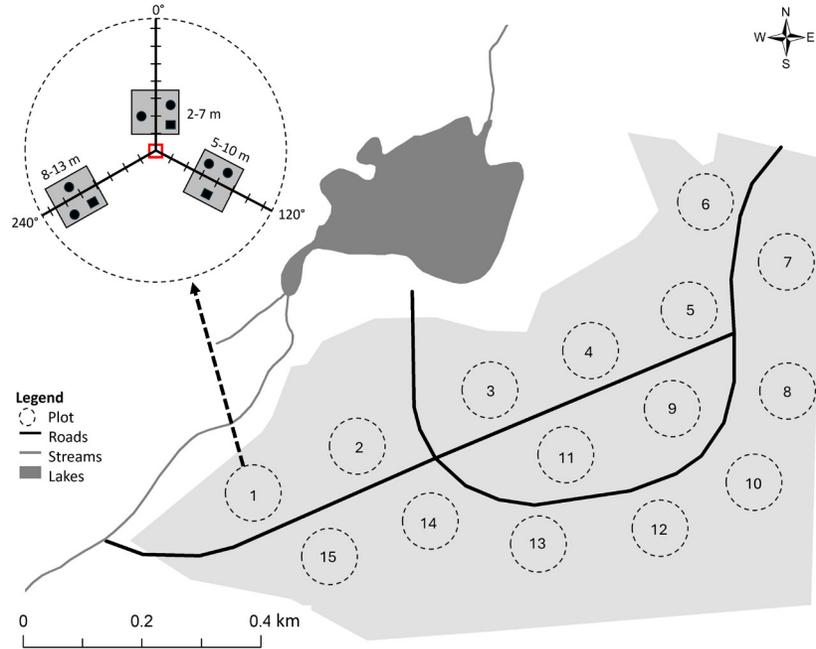


Figure 1. Site map showing the study area including plot locations, roads, streams, and lakes. The plot layout is inset and details the subplot and sampling locations within each plot.

3. Plot and subplot establishment

To accurately reflect the variation in soils within the site, multiple plots should be established. Subplots are established within those plots to capture fine scale variation in soils and to collect sufficient soil volume for chemical analyses. We recommend at least three subplots per plot. These subplots can be placed randomly or consistently (i.e., at a specific distance and azimuth from the plot centre).

Figure 2 shows two examples of plot layouts with two different subplot orientations and sampling locations within each subplot. In these examples, two mineral soil cores are collected from each subplot to capture heterogeneity in the soil and to ensure enough sample volume for analyses. An additional mineral core is taken to determine bulk density (mass per unit volume), which is required for calculating soil elemental contents or stocks (e.g., carbon and nutrients). If the purpose of the study does not require soil density, then omit the collection of this core. Three organic forest floor samples are also collected at the three sampling locations within each subplot. As an alternative to the three mineral soil cores, one mini soil pit can be excavated at each subplot location to collect samples for both chemistry and bulk density (if required).

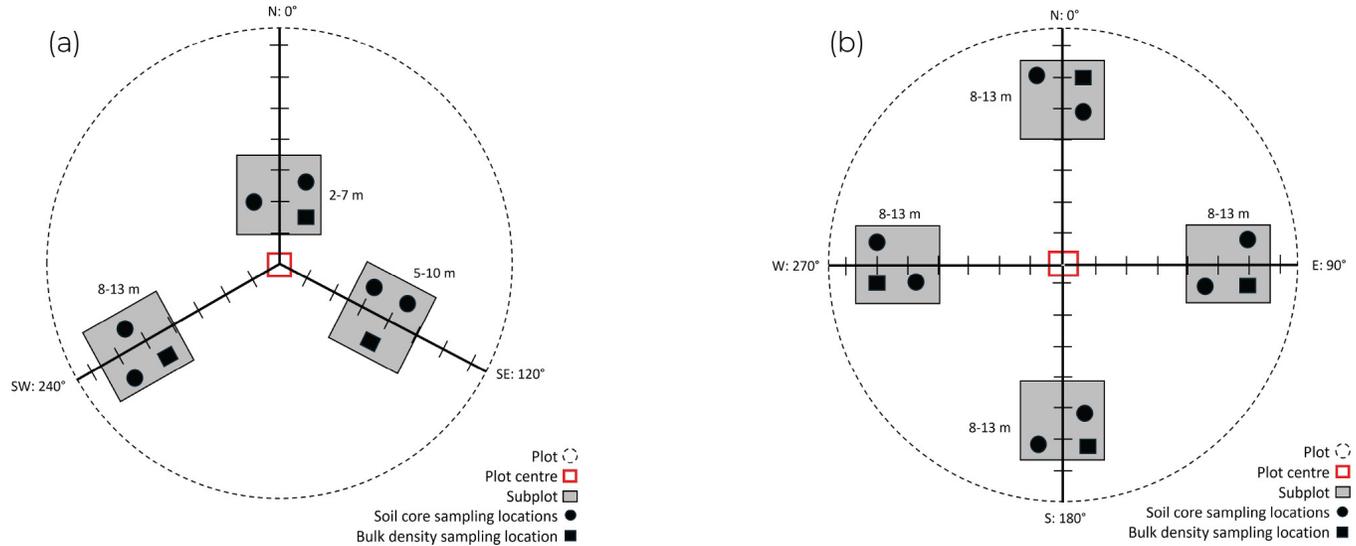


Figure 2. Examples of circular plot layouts with two different subplot orientations with three sampling locations within each subplot (1 core collected for bulk density, two cores for chemistry). Organic forest floor samples are also collected at all three locations. As an alternative to mineral soil cores, one mini pit can be excavated at each subplot location depending on the protocol used. (a) Plot (680 m²) with a radius of 14.71 m with 3 subplots (5 m × 5 m) placed at 0°, 120°, and 240° at 2–7 m, 5–10 m, and 8–13 m distances, respectively, from the plot centre. (b) Plot (680 m²) with a radius of 14.71 m with 4 subplots (5 m × 5 m) placed at 0°, 90°, 180°, and 270° at 8–13 m from the plot centre.

4. Organic forest floor sampling

Two groups of organic horizons are recognized: (1) the O horizons (organic fibric [Of], organic mesic [Om], and organic humic [Oh]) mainly developed from mosses and often present in wet forests, wetlands, or peatlands and (2) the LFH horizons (litter [L], partially decomposed litter [F], and humic [H]) developed primarily from leaves, twigs, and woody materials and present in forests. This guide describes methods for collecting LFH horizons. Methods for sampling O horizons are generally similar to that described here with the exception of very deep or waterlogged horizons that require special corers, which are not covered in this guide.

When sampling the forest floor (LFH), the material can be collected all as one combined LFH sample or by horizon, separating the L, F, and H horizons. Both types of collection use the square template method (Figure 3a-c) and require field staff to have some knowledge of the different forest floor horizons. Alternatively, the LFH layer can be sampled with the mineral soil when using the tube corer method (Figure 3d). This method may be best for those inexperienced in differentiating between organic horizons. With every LFH sampling method, it is important to record the depth of the combined LFH layer or individual horizons, as well as the size of sampling equipment (template or tube diameter). Figure 4 outlines some of the advantages and disadvantages of the different LFH sampling methods.

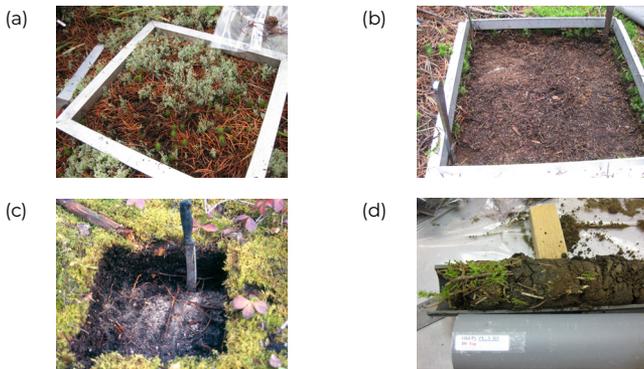


Figure 3. Organic forest floor sampling methods. (a) Template method before L horizon is removed. (b) Template method with the L horizon removed, exposing the F horizon. (c) Template method with the combined LFH layer removed. (d) Tube core method with LFH layer sampled with mineral soil.

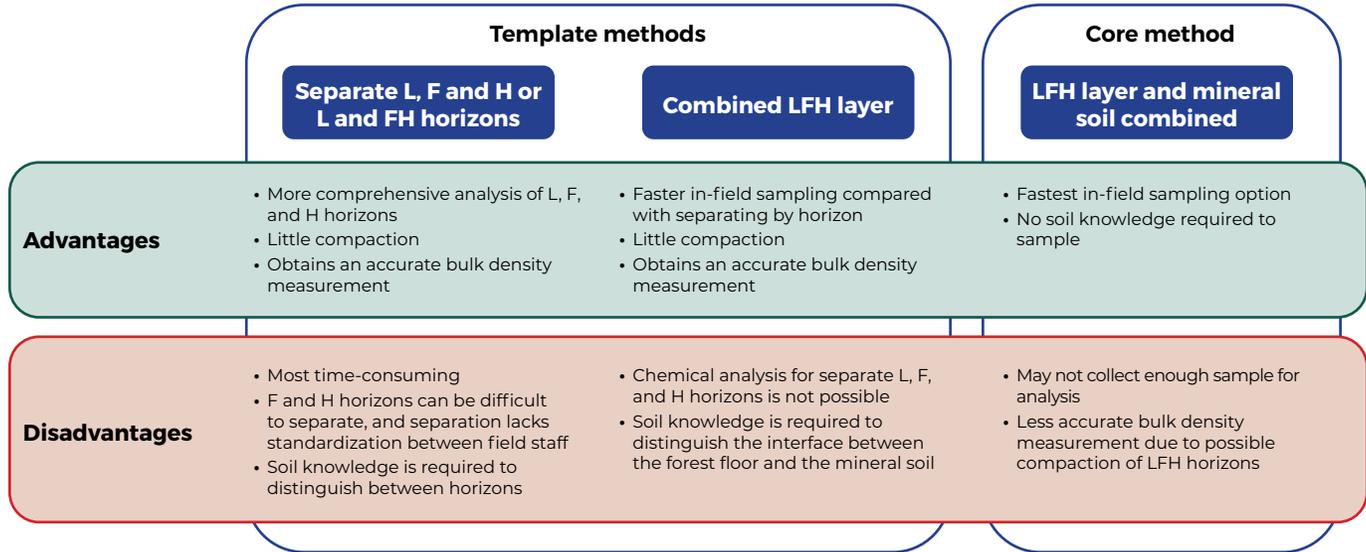


Figure 4. Advantages and disadvantages of organic forest floor sampling methods.

4.1. Square template method: Steps for sampling separate L, F, and H horizons

Choose at least three undisturbed areas within your subplot to take a sample.

1. To ensure accuracy of LFH bulk density measurements, place a template on the ground at each sampling location where you have chosen to collect your sample. The template can be a square metal frame or a homemade wooden frame (10 cm × 10 cm, 20 cm × 20 cm, or 30 cm × 30 cm). Alternatively, you can use a solid square template made of plywood (not a frame) and cut around the perimeter. Choose the size of frame based on the amount of material required and remain consistent throughout your sampling. Dimensions of the template used must be recorded for bulk density calculations.



Figure 5. LFH template sampling equipment.

2. If using a frame template, secure the template in place by inserting a butter knife or survey pin vertically into each of the inside corners to prevent it from moving while sampling.
3. Using pruners, clip away any living green plants and leaves, including live mosses from within the template area (moss may remain depending on the purpose of the study) (Figure 5). Remove any objects greater than 2 cm in diameter.
4. Using a serrated knife or saw that is ideal for cutting roots without disturbing the integrity of the sample (e.g., drywall or gyprock saw), cut the inside perimeter of the template to the depth of the LFH (if a plywood template is used, cut the outside perimeter) to ensure clean sample collection.
5. Slowly clip away and peel back the L horizon, which includes dead moss and any loose litter (less than 2 cm in diameter). Place the horizon in a bag labelled for L horizon. Include site, plot, subplot, replicate number, and date. Record the depth of the horizon.
6. Repeat step 6 for the F horizon, which includes partially decomposed litter. Place this horizon in a bag labelled for horizon F.
7. Repeat step 6 for the H horizon, which includes the black decomposed material between the F horizon and mineral soil. Place this horizon in a bag labelled for horizon H.

- a. If the H horizon is too thin or not horizontally distinct from the F horizon, the two horizons can be combined in a bag labelled for horizon FH.
8. Record the depth of the entire LFH layer by measuring the depth on each of the four sides of the excavated template area, which will be averaged later.

4.2. Square template method: Steps for sampling combined LFH layer

1. Perform steps 1 through 4 listed in section 4.1.
2. Slowly clip away and peel back the LFH layer all as one sample, cutting roots as needed.
3. Gently brush off any mineral soil on the bottom of your LFH layer.
4. Place the entire LFH sample into a bag labelled for LFH layer. Include site, plot, subplot, replicate number, date, and "LFH". You may need to separate into two bags if the LFH is thick. Label as bag "1 of 2" and "2 of 2".
5. Record the depth of the entire LFH layer by measuring the depth on each of the four sides of the excavated template area, which will be averaged later.

4.3. Tube core method: Combined LFH sampling with mineral soil sampling

Instead of taking a forest floor sample using the template method, the LFH layer can be sampled as a combined LFH and mineral sample using the tube core method (section 5.2.1). The forest floor (LFH layer) can be separated from the mineral soil in the laboratory in a post-processing stage. This method needs a larger number of replicates to yield sufficient material for chemical analyses and to provide an accurate measure of bulk density.

5. Mineral soil sampling

When sampling the mineral soil, the soil can be collected and then partitioned by depth increment (0–5, 5–15, 15–30, 30–45, 45–60, 60–100, and 100–200 cm) or by soil horizon (e.g., Ah, Ae, B, C, etc.). If collecting by soil horizon, information on the depth of each of the horizons must also be recorded. Collecting by horizon requires knowledge on how to identify horizons. Horizon identification is not always straightforward and is subjective based on the person doing the identification. Ideally, it is one consistent person identifying the horizons or if there are multiple people sampling, they should occasionally cross-calibrate their horizon determinations. For those inexperienced with soils, collecting at depth increments might be the best approach.

Alternative methods to a soil pit would be the tube core, split core sampler, open-sided sampler, and auger methods. Before starting the mineral soil sampling, make sure that the LFH sample has been collected because the forest floor can be disturbed and compacted by the mineral soil pit excavations and extractions unless using the tube core method for combined LFH and mineral soil sampling. Figure 6 outlines the advantages and disadvantages of different mineral soil sampling methods.

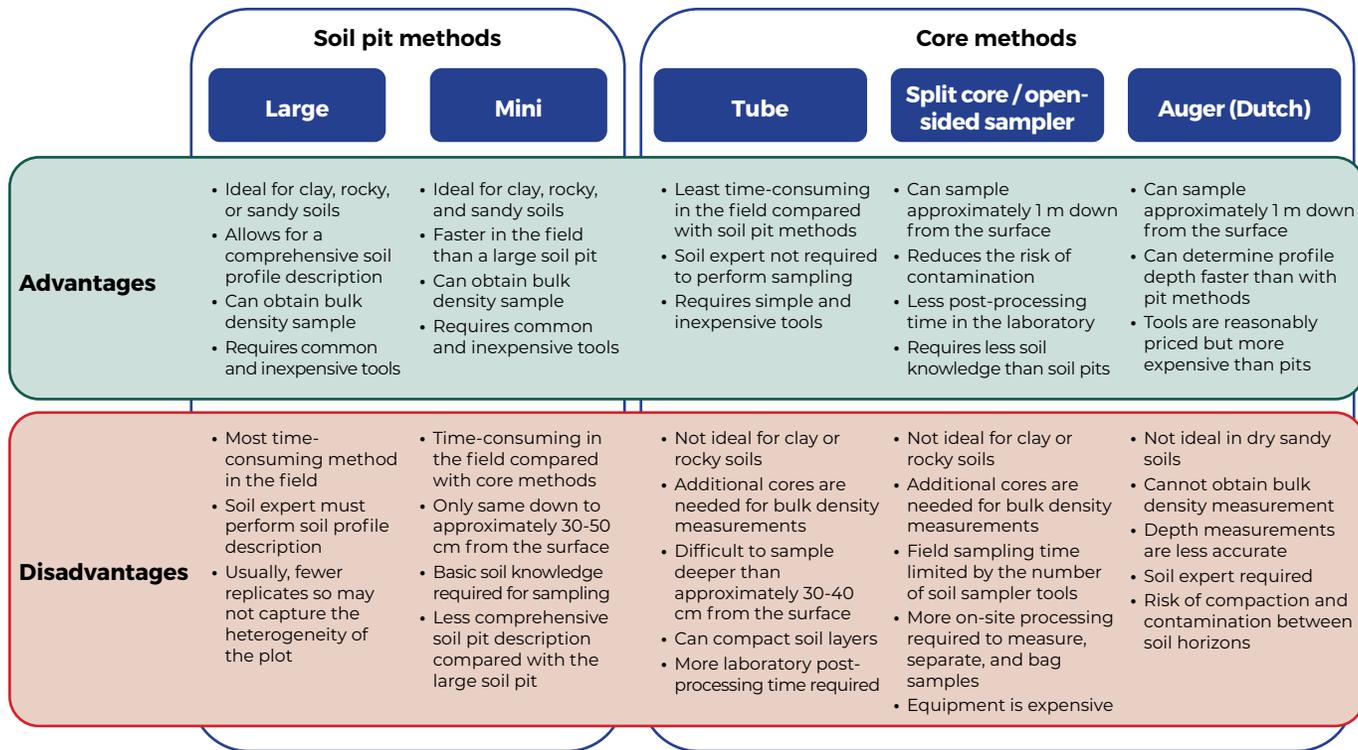


Figure 6. Advantages and disadvantages of mineral soil sampling methods

5.1. Soil pit method

The soil pit method involves digging either a large pit or a mini pit and then collecting soil samples from the pit face.

5.1.1. Large soil pit (1 m × 1 m × 1 m)

The number of pits depends on size and variability of the site location. A large pit can be a good option for a permanent sampling location. Subsequent sampling events can excavate a fresh face on the upslope side of the pit. Because these pits are destructive to the forest floor, they may need to be located outside areas where other measurements (e.g., vegetation surveys, seedling counts) are done.

1. Dig a 1 m × 1 m × 1 m (or to depth where soil is not changing or to bedrock) pit. Place excavated soil on tarps to avoid contamination of the surrounding area and so that the pit can be backfilled. Make sure you enter or exit the pit from the direction opposite to where you will collect samples to keep the pit face as pristine as possible.



Figure 7. Example of an excavated large soil pit

2. Clean the pit face with a flat shovel or hand trowel so that the soil horizons are clearly visible, as shown in Figure 7.
3. Take a picture of the pit face (optional).
4. Mark the top of each horizon on the pit face (markers could include golf tees, toothpicks, etc.). Complete a full soil profile description by horizon, recording depth and any other interesting features (e.g., charcoal layers). The 0-cm location will be at the LFH/mineral boundary. Using a meter stick or measuring tape measure up from the LFH/mineral boundary for LFH horizons and measure down for mineral soil horizons (e.g., H, 0–2 cm; F, 2–4 cm; L, 4–6 cm; A, 0–16 cm; BM1, 16–24 cm; BM2, 24–50 cm; C1, 50–71 cm; C2, 71–100 cm). At each horizon also record maximum thickness and minimum thickness across the pit face. Record the depth to bedrock or water table, if it was reached.
5. If possible, also record field texture, primary structure (kind and size [e.g., gravel]), depth to mottles, depth to gley, roots (abundance, size, orientation, distribution, minimum and maximum depth), coarse fragment size class, and volume, soil moisture regime, soil drainage class, depth to water table, soil nutrient regime, and seepage. Details

on how to collect this information can be found in many resources including “Canada’s National Forest Inventory Ground Sampling Guidelines: Specifications for Ongoing Measurement., version 5.0” (NRCan-CFS, 2008).

6. Collect samples for each horizon or depth increment. To avoid contamination, collect soil samples upward from the bottom of the pit using a hand trowel and a tin pie plate. Obtain approximately 2 cups (~500 mL) of soil from each horizon or depth increment, if possible. Take samples from 3 different horizontal locations within each sampling horizon or depth increment. If the soil has larger coarse fragments, you may need to obtain more sample volume to ensure you have enough material for analysis after the fragments have been removed in the laboratory.
7. Place samples in labelled plastic resealable freezer bags. Include site, plot, subplot (if sampling), date, and horizon or depth increment.
8. Obtain a bulk density sample at each horizon/depth increment by using a rubber mallet to insert a bulk density sampling ring into the pit face. Ensure the ring is completely full and that no material falls out for an accurate measurement. Place the sample in a plastic bag labelled for bulk density (BD). Include site, plot, date, horizon or depth increment and BD (indicating bulk density sample). Record the diameter and length of the bulk density ring used (Figure 8).
9. Backfill the pit by placing the soil back in the same horizon or depth increment order, ending with the LFH back on the top.

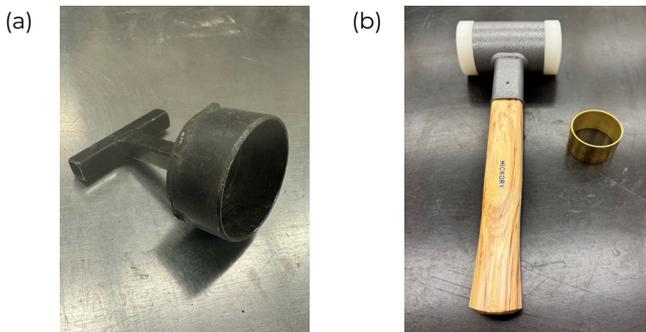


Figure 8. Bulk density sampling tools. (a) Bulk density sampler with handle. (b) Bulk density sampling ring with rubber mallet to insert into the soil face.

5.1.2. Mini soil pit (30 cm × 30 cm × 30–50 cm)

The number of pits depends on size and variability of the site location, but generally one mini pit is needed for each subplot.

1. Dig a mini soil pit approximately 30 cm × 30 cm × 30–50 cm near your LFH sampling locations (Figure 9). The depth of the mini pit will be determined by depth to bedrock or the length of your arm (because it becomes more difficult to extract material if the pit is deep). Place excavated soil on tarps to avoid contamination of the surrounding area and so the pit can be backfilled after sampling. Make sure to keep the pit face where your samples will be collected as pristine as possible.



Figure 9. Example of an excavated mini soil pit

2. Take a picture of the pit face (optional).
3. Measure the depths of the soil horizons. Measuring down from the LFH/mineral boundary.
4. Sample by horizon or depth increment. Sampling by depth increment is more typical with the mini pit (increments of 0–5, 5–15, and 15–30 cm) because it is harder to see the soil horizons.
5. To avoid contamination, collect soil samples upward from the bottom of the pit using a hand trowel and a tin pie plate. Obtain approximately 2 cups (500 mL) of soil from each horizon or depth increment, if possible.
6. Place samples in labelled plastic bags. Include site, plot, subplot, date, and horizon or depth increment.
7. Obtain a bulk density sample at each horizon or depth increment using a bulk density sampling ring (Figure 8). Place the sample in plastic bag labelled for bulk density. Include site, plot, subplot, date, horizon or depth increment and BD (indicating bulk density sample).
8. Record diameter and length of the bulk density ring used.
9. Backfill the pits by placing the soil back in the same horizon or depth increment order, ending with the LFH back on the top.

5.2. Tube core method

The tube used to extract the core can be made of polyvinyl chloride (PVC) or another suitable material (e.g., acrylonitrile-butadiene-styrene [ABS] or steel). Ideal tube diameter is approximately 5 cm, cut to a 30 cm or 40 cm length. There are other metal core samplers that use inserted liners. The tube core sampling method is often combined with the auger method to obtain samples deeper than the tube (e.g., a 30–45 cm sample and a deeper C horizon sample at a depth of ~90–100 cm). The tube cores can break if they hit larger rocks; thus, a good practice is to use a thin probing rod to test the area that you wish to insert the tube to ensure that there are no rocks that could affect tube insertion.



Figure 10. Tube core sampling (a) Tube core sampling equipment. (b) Tube inserted into divot excavation. (c) Core sampling.

5.2.1. Tube core method: Steps for sampling with LFH layer included

1. Obtain three replicate cores per subplot, directly in an unexcavated area.
2. Place the tube perpendicular to the ground. Place a hardwood block on top of the tube and pound the tube into the ground using a hammer or rubber mallet (Figure 10).
3. Use vice grips to carefully pull the tube back out. Some rocking and twisting of the tube may be necessary. If the tube cannot be extracted using the vice grips, then a shovel might be needed to extract the tube.

4. Place a plastic bag tightly on either end of the tube securing the bag with an elastic band. If using a tube core sampler with a liner, the liner may have caps to place on the ends.
5. Clean off an area on the outside of the tube after extraction and place a label on the tube (soil extraction from the tube is performed in the laboratory). Include site, plot, subplot, replicate number, and date. Place clear packing tape over the labels to ensure they do not fall off if they get wet. Permanent marker can also be used, but labels are better so that the tubes can be reused.

5.2.2. Tube core method: Steps for sampling with LFH layer excluded

1. Obtain one core per forest floor template location (3 cores per subplot), directly in the excavated LFH area.
2. Follow steps 2 through 5 in section 5.2.1.

5.3. Split core sampler or open-sided core sampler method

There are several different types of soil core samplers, all with similar construction. A split core sampler has a hinged tube that is bevelled at one end and opens after the soil is collected to allow for extraction. An open-sided core sampler has a bevelled cylindrical base but only a half cylinder barrel (Figure 11). Open-sided core samplers can also be machined from simple materials if you have that expertise within your organization or community. Similar to the tube core methods, a good practice is to use a thin probing rod to test the area that you wish to insert the tube to ensure that there are no rocks that could affect insertion.

1. Obtain three cores per subplot, directly in the excavated LFH area.
2. Place a tarp on the ground next to your sampling location.
3. Place the sampler perpendicular to the ground on the exposed soil from the LFH extracted area.
4. If using a sampler with a slide hammer, first push the core into the ground and using the slide hammer insert the sampler to the desired depth or until the top of the core is level with the ground surface. Rotate



Figure 11. A cross handled open-sided sampler with soil sample

the sampler 360° to help separate the soil at the bottom. Pull the sampler up or reverse hammer to extract the sample.

5. If using a cross handled open-sided sampler, simultaneously push and slightly twist the core end into the soil to the desired depth, until it will not insert any farther or until it is at the surface of the ground. Rotate the sampler 360° to help separate the soil at the bottom and pull up (while slightly twisting) the sampler to extract it. Getting past medium-sized roots or coarse fragments can be a challenge. You may need to probe a different location and try again.
6. Record the depth of the hole to determine if there was compression of the soil sample.
7. Place sampler horizontally on the tarp and open the core (split core sampler). Measure the length of the core. This should match the depth of the hole.
8. Record the general depth of each horizon. You can perform a soil profile analysis similar to that described in 5.1.1 (the large soil pit method), although the depth measurements are not as accurate with this method due to compaction. If you are delineating horizons, it is often useful to have a piece of white cardboard that is laminated or sealed in a plastic bag to have as a background.
9. Using a knife (a steak knife works well), divide the sample into depth increments or horizons. Place the samples in labelled plastic bags. Include site, plot, subplot, replicate number, date, and horizon or depth increment.
10. Clean the sampler between locations with a cloth (and cleaning solution depending on study) to avoid cross-contamination. This is especially important if you are not using a liner.

5.4. Auger method

This method works well for ground with frost, sites with large coarse fragments, compacted clay soils, or if there is little time to spend on the soil collection. This method can only be done for depth increments because it is difficult to identify horizons or accurately record their depth.

1. Obtain three cores per subplot, directly in the excavated LFH area. As with the other methods, it is a good practice to use a thin probing rod to test the area that you wish to insert the auger to ensure that there are no rocks that could affect the insertion of the auger.

2. Place a tarp on the ground next to your sampling location.
3. Place the auger perpendicular to the ground on the exposed mineral soil from the LFH extraction area.
4. Turn the auger 1.5 to 2 complete turns to fill the barrel of the auger.
5. Gently pull the auger up, clean the side of it with a knife to limit contamination from other horizons or depths, and place the sample at the top of the tarp. Continue to insert the auger in the same hole, placing the samples in the order of extraction to obtain a full soil profile (Figure 12).



Figure 12. Soil auger and excavated soil profile

6. To get the most accurate profile, place your thumb on the auger at the soil surface before pulling the auger out. Then when you place that sample down on your tarp, line your thumb up with the top of the sample on the ground. There may be overlap.
7. Continue the profile until the cross handle of the auger has reached the soil surface (depth of your auger) or until bedrock or the water table is reached. A useful trick is to mark the auger shaft (using permanent marker or tape) with the desired depths prior to insertion to make it easier to know when you have reached the desired depth.
8. After you have the full soil profile laid out on the tarp, record the general depth of each horizon. You can perform a soil profile analysis similar to that described in 5.1.1 (the large soil pit method), although the depth measurements are not as accurate with this method because the profile is loose soil, and the horizons are extracted separately.
9. Measure the depth of the hole. The sum of the auger profile should match the auger depth.
10. Divide the profile by depth increments, place the samples in labelled plastic bags. Include site, plot, subplot, replicate number, date, and depth increment.

6. Sample storage and chain of custody

6.1. Storing samples in the field

To prevent chemical transformation of the samples during field collection, keep samples as cool as possible until they can be brought to the laboratory for refrigeration. When possible, store samples in coolers or insulated boxes with ice packs in a shaded area.

As soon as you return from the field, store mineral and LFH samples in a 4 °C cold room or refrigerator until they can be dried and processed. Dry the samples as soon as possible.

6.2. Chain of custody

Organizations will have different chain of custody structures or workflows. In some organizations the custody of the samples changes after collection and the samples are transferred from field staff to a new group or person responsible for the drying, grinding, and sieving of the samples. In other organizations, custody remains with the field staff for these processing steps. It is important to know how your organization works so that the drying of the samples is not delayed. Drying steps are included in this guide because this step needs to happen as soon as possible after collection.

6.3. Storing LFH samples

Store LFH samples for less than two weeks in a cold room or refrigerator. They can become mouldy and start to decay if stored too long. Transfer LFH samples into paper bags or drying trays and put them in a drying oven at 50 °C to 70 °C until they stop losing moisture. To determine when the samples stop losing moisture, weigh the bags or trays periodically. If samples cannot be dried within two weeks of sampling, they should be frozen until they can be processed.

6.4. Storing mineral samples

Mineral soil samples can be stored in a cold room or refrigerator for longer than the LFH samples but should be dried as soon as possible as well. Transfer mineral samples to tin pans or pie plates or open the plastic bags and place them on a shelf at room temperature (< 30 °C). Let the samples air dry until they stop losing moisture. It is best to air dry mineral samples. If you need to oven dry them, dry in a low-heat oven (< 50 °C) to prevent chemical transformations.

7. Soil sampling checklist

◆ Collect general field sampling equipment and supplies needed for all methods

- General items:** Notebooks, pencils, soil tally sheet (blank form with list of required information to record), protocols, maps, camera, backpacks (to carry equipment and samples), GPS, compass, measuring tape, tarps, ruler, totes or coolers, ice packs, clear packing tape, permanent markers, permanent plot markers (if it is a site for repeated sampling)
- Pre-printed sample labels:** To avoid labelling errors and writability due to moisture (rain or dew), create pre-printed labels for the plastic sample bags and cores ahead of time. You can pre-label the bags ahead of time or in the field. The labels for cores should be applied after extraction. Stick the labels to the resealable freezer bag or core and cover the labels with clear packing tape to waterproof them. You can use a permanent marker directly on the bags instead of labels, but it can be hard to read, and it will not work if the bag is wet

◆ Site information

- Record:** Site ID, plot, subplot, sample collection date, geolocation (northing, easting), coordinate system, GPS information (brand/model), names of field staff, and site description (dominant vegetation, evidence of disturbance, other key observations [e.g., steep slope, exposed bedrock, wetland, etc.])
- Create:** Visual aids (Site map, plot layout diagram) and take site, plot, subplot, and pit photos

◆ Forest floor sample information

- Square Template**
 - Additional equipment and supplies:** Square template frame or plywood template, butter knives, drywall saw or serrated knife, pruners, extra large-sized resealable freezer bags
 - Record:** Size of template, depth of each LFH horizon (if sampling LFH horizons separately) and depth of the entire LFH layer

- Sample labels:** Site, plot, subplot, replicate number, date, and horizon (or combined horizons [e.g., LFH])

- Core**

- Required equipment and supplies:** PVC or metal tube cores cut to length based on study design (No. of cores = No. of subplots × 3 cores per subplot) account for breakage, thin probing rod, hardwood block, hammer or rubber mallet, vice grips, shovel, elastics, plastic bags to cover ends of PVC cores or caps (if using)
- Record:** Tube core diameter and length used
- Sample labels:** Site, plot, subplot, replicate number, and date

- ◆ **Mineral soil sample information**

- Large soil pit**

- Required equipment and supplies:** Shovel, hand trowel, pruners, golf tees or toothpicks to mark horizons/depths, tin pie plates, white cardboard in a plastic bag or laminated, medium- or large-sized resealable freezer bags for samples, bulk density sampling tools
- Record:** Depth of horizons; maximum and minimum thicknesses of each horizon across the pit face, field texture; primary structure (kind and size [e.g., gravel]); depth to mottles; depth to gley; roots (abundance, size, orientation, distribution, minimum and maximum depth); coarse fragment size class and volume; soil moisture regime; soil drainage class; depth to bedrock, depth to water table; soil nutrient regime; seepage; diameter and length of bulk density ring
- Sample labels:** Site, plot, subplot (if sampling), date, and horizon or depth increment; identify the bulk density sample from the chemistry sample

- Mini soil pit**

- Required equipment and supplies:** Shovel, hand trowel, pruners, tin pie plates, medium- or large-sized resealable freezer bags for samples, bulk density sampling tools
- Record:** Depth of horizons, diameter and length of bulk density ring

- Sample labels:** Site, plot, subplot, date, and horizon or depth increment; identify the bulk density sample from the chemistry sample
- Tube core**
 - Required equipment and supplies:** PVC or metal tubes (steel exhaust pipes) cut to length based on study design (No. of cores = No. of subplots × 3 cores per subplot) account for breakage, thin probing rod, hardwood block, hammer or rubber mallet, vice grips, shovel, elastics, plastic bags to cover end of tubes or caps (if using)
 - Record:** Diameter and length of tube cores used, any notable information (hit bedrock, etc.)
 - Sample labels:** Site, plot, subplot, replicate number, and date; label the most intact core for bulk density
- Split core and open-sided core sampler**
 - Required equipment and supplies:** Thin probing rod, sampler tool, liners (if using), knife, cloth (and cleaning solution depending on study), medium- or large-sized resealable freezer bags for samples
 - Record:** General depth of horizons, total length of core, and total depth of the hole
 - Sample labels:** Site, plot, subplot, replicate number, date, and horizon or depth increment
- Auger**
 - Required equipment and supplies:** Thin probing rod, auger, cloth (and cleaning solution depending on study), medium- or large-sized resealable freezer bags for samples
 - Record:** General depth of horizons if visible, depth of sample profile and total depth of the hole
 - Sample labels:** Site, plot, subplot, replicate number, date, and depth increment

◆ **Storage of samples**

- Store LFH and mineral soil samples in a cold room or refrigerator at 4 °C immediately after returning from field and refrigerate until drying is possible or freeze

◆ **Transfer samples to the next step in the chain of custody**

- Contact the person responsible for the next step in the workflow (i.e., drying, sieving, and grinding the samples) and transfer the samples into their custody

8. Video resources

- Valcartier DIRT (Detrital Input and Removal Treatments) device: Methodology (Demonstration of soil sampling video) <https://apps-scf-cfs.nrcan.gc.ca/visite-virtuelle/fr/methodologie>
 - Website uses a combination of French and English. All videos are in French with English subtitle option.
- Methods of Soil Resampling to Monitor Changes in the Chemical Concentrations of Forest Soils. JoVE journal. 2016 November 25. 9:16 min. <https://www.jove.com/v/54815/methods-soil-resampling-to-monitor-changes-chemical-concentrations>
 - All videos are in English.

9. References

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