FOREST PRACTICES CODE

of

BRITISH COLUMBIA

Soil Conservation Surveys Guidebook

2nd Edition
May 2001

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Preface

This guidebook has been prepared to help forest resource managers plan, prescribe, and implement sound forest practices that comply with the Forest Practices Code.

Guidebooks are one of the four components of the Forest Practices Code. The others are the ***Forest Practices Code of British Columbia Act***, the **regulations**, and the **standards**. The *Forest Practices Code of British Columbia Act* is the legislative umbrella authorizing the Code's other components. It enables the Code, establishes mandatory requirements for planning and forest practices, sets enforcement and penalty provisions, and specifies administrative arrangements. The regulations lay out the forest practices that apply province-wide. Standards may be established by the chief forester, where required, to expand on a regulation. Both regulations and standards, where required and established under the Code, must be followed.

Forest Practices Code guidebooks have been developed to support the regulations, but are not part of the legislation. The recommendations in the guidebooks are not mandatory requirements, but once a recommended practice is included in a plan, prescription, or contract, it becomes legally enforceable. Guidebooks are not intended to provide a legal interpretation of the *Act* or regulations. In general, they describe procedures, practices, and results that are consistent with the legislated requirements of the Code.

The information provided in each guidebook is to help users exercise their professional judgement in developing site-specific management strategies and prescriptions to accommodate resource management objectives. Some guidebook recommendations provide a range of options or outcomes considered acceptable under varying circumstances.

Where ranges are not specified, flexibility in the application of guidebook recommendations may be required to adequately achieve land use and resource management objectives specified in higher-level plans. A recommended practice may also be modified when an alternative could provide better results for forest resource stewardship. The examples provided in many guidebooks are not intended to be definitive and should not be interpreted as the only acceptable options.

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1 Introduction

Soil conservation is a key component in the *Forest Practices Code of British Columbia Act.* This guidebook describes procedures for measuring disturbance to soil caused by forest practices.

The first part of this guidebook provides an overview of post-harvest and post-treatment inspection procedures. The section discusses how soil conservation requirements have changed, and describes generally how disturbance on access structures and in the net area to be reforested (NAR) should be measured.

The second part of the guidebook provides the current requirements and definitions that apply to soil conservation surveys.

The third part of the guidebook describes how soil conservation surveys should be carried out. It details the requirements for visual inspections, road traverse surveys, landing surveys, and transect surveys for small and large areas. Also described are how survey points established during transect surveys are classified.

Appendix 1 provides the requirements and definitions that apply to prescriptions that were approved under the Forest Practices Code (Code) before June 15, 1998. Appendix 2 outlines the sequence used for classifying survey points, Appendix 3 presents a random number table, Appendix 4 shows a table of grid spacings for the transect survey method for large areas, Appendix 5 describes field marking conventions, Appendix 6 contains the forms to be used in conducting soil conservation surveys, and Appendix 7 presents the recommended limits of soil disturbance for coastal and interior sites.

2 Overview of post-harvest and post-treatment soil inspection procedures

Important aspects of soil conservation are the inspections carried out to check that detrimental impacts to forest soils are being minimized. This section of the guidebook outlines survey procedures appropriate for given situations.

Soil conservation surveys examine:

- the proportion of the prescription area occupied by access structures,
- the amount of soil disturbance within the net area to be reforested (NAR), and
- the amount of forest floor displacement within the NAR.[1]

Pre-harvest silviculture prescriptions, silviculture prescriptions and stand management prescriptions set maximum limits for some or all, three of these factors. The limits depend on the standards in effect when the particular prescription was approved. Compliance surveys can be conducted for each factor.

2.1 Different soil conservation requirements over time

A number of significant changes to soil conservation requirements have been introduced over the years. Before any soil conservation survey is undertaken, the first step is to determine what soil conservation requirements were specified and what definitions apply. **Each soil conservation survey must be based on the standards specified in the prescription and must use the definitions in place when the prescription was approved.**

In the time prior to full Forest Practices Code compliance, there are three periods during which different soil conservation requirements and different definitions applied to prescriptions. (Requirements and definitions for these periods can be found in the first edition of the *Soil Conservation Surveys Guidebook* [1997]).

Since the Code was introduced, there have continued to be some changes, including the elimination of requirements to specify limits for forest floor displacement and forest floor reduction, and modification of how limits for temporary access structures are specified. A further description of these changes is provided in Appendix 1.

[1] Although specifying limits for forest floor displacement is no longer required for silviculture prescriptions approved under current legislation. It is a requirement on Code prescriptions approved before June 15, 1998.

In addition, soil conservation requirements for areas under woodlot licences have also undergone some changes and can be different from those of other tenures. These are discussed in a later section in this guidebook entitled "Woodlot licence area requirements."

Unless otherwise specified, the following sections of this guidebook provide the soil conservation requirements and definitions of the regulations and *Act* in effect at the time of this guidebook's publication.

Under the current requirements, silviculture prescriptions must specify:

- the maximum percentage of the total area under the prescription that may be occupied by permanent access structures;
- the maximum percentage of the NAR that may be occupied by soil disturbance; and
- the extent to which the maximum percentage of soil disturbance in the NAR can be temporarily exceeded to construct temporary access structures.

2.2 Requirement for soil conservation surveys

Soil conservation compliance reports are required in all areas where the government must establish a free-growing stand (in keeping with the Silviculture Practices Regulation). The district manager must complete a report that states the extent to which an area under a silviculture prescription is in compliance with the allowable limits prescribed for the area that may be occupied by permanent access structures and the amount of soil disturbance.

An assessment should be in the form of a visual inspection to confirm that the maximum limits in the prescription have not been exceeded. **No formal survey measurements need to be done, unless it is apparent that the limits may have been exceeded.**

For major licensees, soil conservation surveys are not mandatory. However, if visual inspections indicate that their operations may be in non-compliance, the district manager, in accordance with the Silviculture Practices Regulation, can direct the licensees to conduct surveys. The purpose of these surveys is to inspect a) the nature and extent of the total area under the silviculture prescription occupied by permanent access structures, and b) soil disturbance in the NAR, including temporary access structures.

2.3 Measuring the area occupied by permanent access structures

Silviculture prescriptions must specify the maximum percentage of the total area under the plan that can be occupied by permanent access structures (e.g. permanent haul roads, landings, gravel pits, borrow pits, and permanent logging trails). The types and definitions of access structures that count towards the maximum percentage in the prescription have changed over time, but the field measurement procedures are very similar.

Assessment of access structures begins with visual inspection. Where problems appear, a more detailed road and landing survey procedure is used to determine the percentage of the area occupied by permanent access structures.

2.4 Measuring soil disturbance

Maximum soil disturbance limits are specified in a prescription by standards unit. For each standards unit, the prescription should state the assessed hazards for soil compaction, soil displacement, and soil erosion, and indicate the likelihood of landslides (if detailed terrain stability mapping has been done). The assessed hazards should be used to determine:

- the maximum amount of soil disturbance allowed within a standards unit; and
- which types of soil disturbance to count in each standards unit (see the summary table in Appendix 7).

When a person is checking for compliance, it is important to know both of these factors. Separate strata must be used when surveying standards units that have different maximum limits or different categories of soil disturbance that count.

Where the method of timber harvesting is cable or aerial, it is not necessary to specify the soil hazards, only the likelihood of landslides (if warranted). **Where soil hazards have not been assessed, compacted areas and all categories of dispersed disturbance must be counted as soil disturbance** (i.e., those categories normally counted only on more sensitive sites).

Measuring soil disturbance begins with a visual inspection. Where disturbance appears to exceed the limits set out in the silviculture prescription, a transect survey may be required to determine the percentage of the area occupied by soil disturbance.

Transect surveys classify survey points along transect lines. Survey points are classified based on the soil conditions observed at and around each point.

In some cases, surveys may be conducted on strata that are smaller than the standards unit. The procedures and criteria for site stratification are discussed in the section “Survey methods for soil disturbance – Site stratification.”

3 Definitions and requirements

3.1 Access structures

Access structures located within a cutblock are identified as either permanent or temporary in a silviculture prescription.

Permanent access structures include main haul roads, spur roads, landings, gravel pits, borrow pits, quarries, and permanent logging trails that are built within the total area under the prescription. To be classified as permanent in a prescription, they must satisfy one of the following conditions: a) they must be in use for a long enough period such that, even if they were to be rehabilitated, a commercial crop of trees could not be established on the area occupied by these structures by the time a commercial crop is established on an adjacent area of the cutblock; or b) they must be constructed through soil or rock or ballasted with material that would make them unsuitable for rehabilitation. Such structures are not part of the net area to be reforested (NAR) and do not count towards soil disturbance.

Temporary access structures include roads, landings, pits or quarries, excavated or bladed trails, main skid trails, backspar trails, corduroyed trails, and similar structures within the NAR that are identified as being temporary in a silviculture prescription. Such structures count towards soil disturbance unless they have been rehabilitated. (See "Soil disturbance requiring rehabilitation," below.)

3.2 Soil disturbance

Soil disturbance is a general term referring to the following types of disturbance that occur on the NAR:

- unrehabilitated temporary access structures, including excavated or bladed trails of a temporary nature,
- corduroyed trails,
- compacted areas, and
- dispersed disturbance.

Dispersed disturbance is itself a general term referring to dispersed trails, gouges, and scalps. *Dispersed trails* include wheel and track ruts (normally created during the operation of ground-based equipment on wet soils of limited load-bearing strength) and compaction from repeated machine traffic. *Gouges* are subdivided into deep gouges, wide gouges, and long gouges. *Scalps* are divided into wide scalps and very wide scalps.

Some types of disturbance, such as wide scalps and repeated machine traffic, count as soil disturbance only on more sensitive sites.

When soil disturbance is being assessed, it is necessary first to determine which types of soil disturbance will count on the standards unit and which measurement criteria will be appropriate for each disturbance type.

3.3 Soil disturbance requiring rehabilitation

Temporary access structures (including excavated or bladed trails of a temporary nature), compacted areas, and corduroyed trails require rehabilitation, unless exempted by the district manager. If they are not rehabilitated in accordance with the requirements of the regulations, they count as soil disturbance. (Once satisfactorily rehabilitated, they no longer count as soil disturbance.) Survey symbols for bladed trails and similar structures are shown in Table 1.

Soil conservation surveys can be done before these structures are rehabilitated, with the objective of determining the percentage of the NAR occupied by temporary access. Normally, however, soil conservation surveys are conducted after rehabilitation is complete.

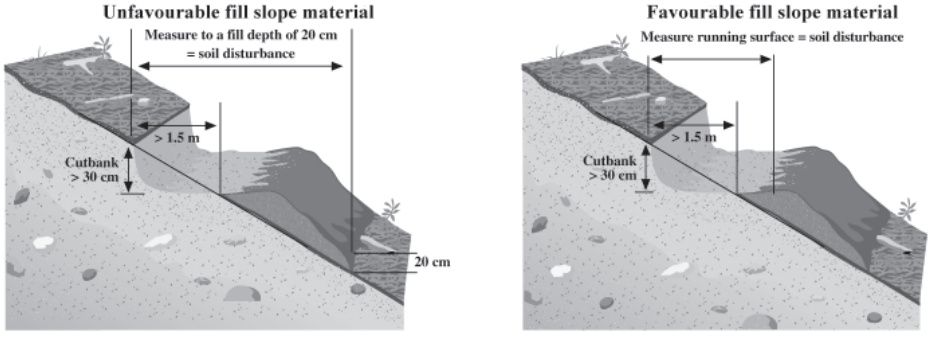
Table 1. Soil disturbance categories requiring rehabilitation[a]

Symbol[b]	Category	Example
R	Excavated/bladed trails	Contour-built skid roads that have not been rehabilitated
Y	Corduroyed trails	Skid trails or backspar trails that have been ballasted with logs
A	Compacted areas	Junctions of skid trails and excessively compacted roadside work areas

[a] These categories require rehabilitation unless exempted by the district manager.

[b] These one-letter symbols are used to record a category of disturbance when conducting a survey.

3.3.1 Excavated or bladed trails (R)



Excavated or bladed trails are constructed trails that have:

- a mineral soil cutbank height greater than 30 cm, and
- an excavated width greater than 1.5 m.

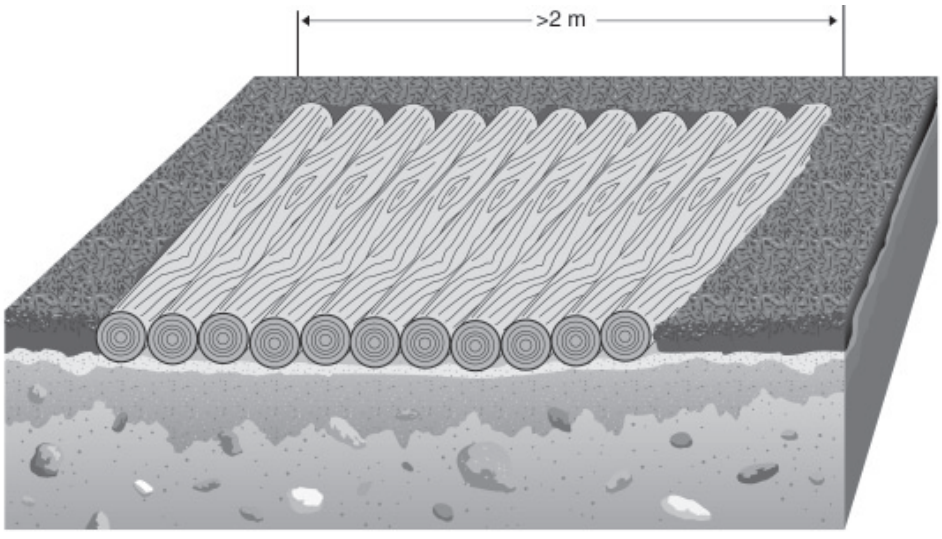
The classification of soil disturbance on excavated and bladed trails depends on whether fill slopes are considered a favourable or unfavourable medium for growing trees. (If this is not stated in the silviculture prescription, the section on fill slope soil material in the *Soil Conservation Guidebook* should be consulted.)

- If fill slopes are unfavourable: Classify survey points as soil disturbance (R) if they fall on the trail between the place where the sidecast is consistently greater than 20 cm deep and the top of the cut. Do not count as part of the sidecast any accumulations of slash that are clean woody debris (i.e., those that contain less than 30% mineral soil).
- If fill slopes are favourable: Classify survey points as soil disturbance (R) if they fall on the trail between the top of the cut to the outside edge of the compacted running surface. If the running surface is not compacted (e.g., on a winter trail), then include only survey points that fall within the excavated width.

If excavated or bladed trails have been satisfactorily rehabilitated, the exposed mineral soil surface associated with the trail does not count as soil disturbance. The exception is if the trail is under a woodlot site plan (as discussed in the section "Woodlot licence area requirements.")

Unrehabilitated excavated or bladed trails that are not identified as permanent logging trails in a silviculture prescription must be counted as soil disturbance on all sites.

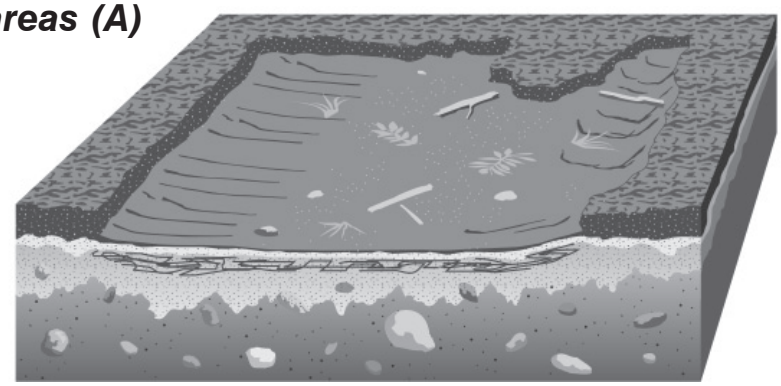
3.3.2 Corduroyed trails (Y)



Corduroyed trails are constructed using logs and woody debris placed side by side to form a surface greater than 2 m in length and capable of supporting equipment traffic. Tree tops and limbs placed in front of harvesting equipment to distribute machine load and reduce soil compaction should not be considered as corduroyed trails, unless the debris prevents the establishment of regeneration at close to the approved target stocking standards. If satisfactorily rehabilitated, a corduroyed trail does not count as soil disturbance.

Unrehabilitated corduroyed trails must be counted as soil disturbance on all sites.

3.3.3 Compacted areas (A)



Compacted areas are areas on which there is evidence of compaction at the survey point and on 100% of a portion that is both greater than 100 m^2 in area and greater than 5 m wide.

Assessing compaction

Any of these conditions is considered to be compacted soil: compacted mineral soil, puddled mineral soil, and compacted deposits of slash and organic debris.

Mineral soil compaction is assessed relative to the conditions of adjacent undisturbed soil. Any one of the following defines a compacted condition:

- Coarse platy structure.

  The soil breaks apart in consolidated plates that are typically 1 cm or greater in thickness. This structure is not evident in the adjacent undisturbed soil.

- Loss of the normal structure evident in the undisturbed soil.
- A noticeable change in density. If the disturbed and undisturbed soils have the same moisture content, their difference in density may be recognized by:
  - a difference in resistance when a shovel is used to penetrate the soils, or
  - a difference in resistance when blocks of soil 2.5 cm thick are crushed between the thumb and index finger.

- Compacted deposits of forest floor, fine slash, and woody debris, overlaying and partially imbedded in, or crushed into, the mineral soil that cannot be readily excavated with a shovel (e.g., deposits of compacted and cribbed-in slash on winter skid trails that are deeper than 20 cm). Compaction of mineral soil occurs when accumulations of slash and woody debris are compacted and pressed into the mineral soil by repeated heavy machine traffic. Often the overlying accumulations are difficult to dig through or separate with a shovel; however, it may be necessary to sample the underlying mineral soil for evidence of compaction (in accordance with the three previous points), if there is any doubt about impacts to the soil.

Unrehabilitated compacted areas are counted as soil disturbance on all sites except those with low compaction hazard. Where the compaction hazard has not been assessed, compacted areas are always counted as soil disturbance.

3.4 Dispersed disturbance

The dispersed disturbance categories and symbols are shown in Table 2.

Note that while all the descriptions provided in this section are contained in the Operational Planning Regulation, the regulation does not identify the specific categories by the reference names used here (e.g., the term "repeated machine traffic" is not specified in the regulation, but the description of this category does fall under the definition of a dispersed trail).

Table 2. Dispersed disturbance categories

Symbol[a]	Category	Example
T	Wheel or track ruts	Machine traffic on wet soils
E	Repeated machine traffic	Skid trails
G	Deep gouges	Mound excavations
L	Long gouges	Excessive ripper-plow trenches, poor mounding
W	Wide gouges	Poor screefing, mounding, or stumping; intermittent trail blading
V	Very wide scalps	Scalping during piling, scalping on skid trails, areas where the forest floor has been completely burned off
S	Wide scalps	Aggressive patch scarification scalping during piling, or on skid trails
–	Not counted (undisturbed, etc.)	Survey points not meeting the criteria of categories above, or that fall on large logs, boulders, or slash piles where the ground surface cannot be seen and reliable assessment cannot be made
X	Not surveyed	Points that fall outside the NAR (e.g., on a permanent landing)

[a] These one-letter symbols should be used in field surveys to record soil disturbance.

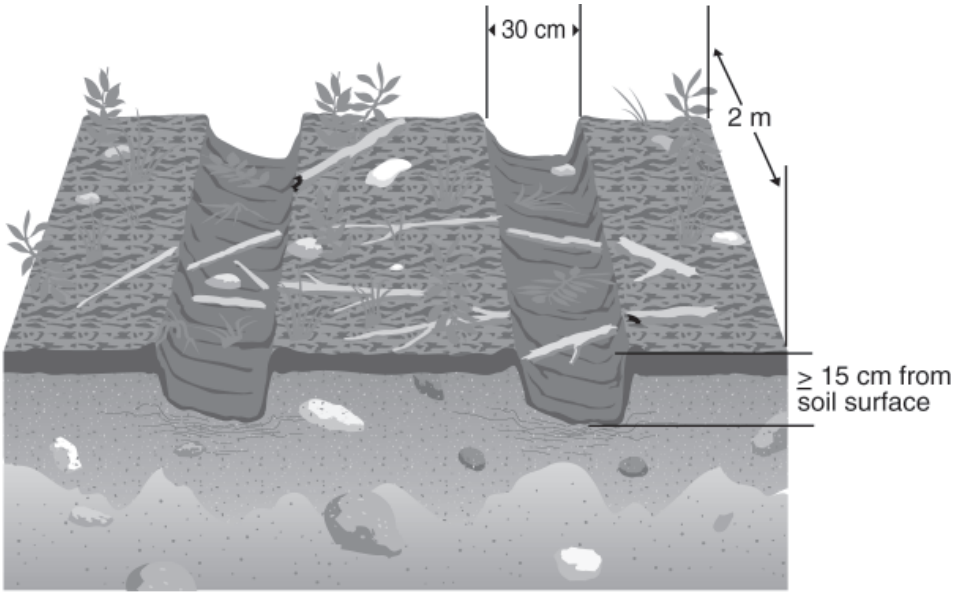
3.4.1 Dispersed trail: wheel or track ruts (T)

Wheel or track ruts are impressions or ruts in the soil caused by heavy equipment traffic. They are at least 30 cm wide and 2 m long. Two different depth criteria (5 cm and 15 cm) apply, depending on the compaction hazard of the standards unit being assessed. On sites with a high or very high compaction hazard, or where the compaction hazard has not been assessed, both depth criteria apply. On sites with a moderate or low compaction hazard, only the 15 cm depth criterion applies. This category does not require the survey point to be assessed for evidence of compaction.

Ruts 15 cm deep

Ruts must have a minimum depth of 15 cm at the deepest point in the perpendicular cross-section, over the entire length of 2 m. Depth is measured from the surface of the undisturbed forest floor to either the forest floor surface in the bottom of the rut or the mineral soil surface in the bottom of the rut if a forest floor is not present.

- For areas of organic soil within cutblocks, measure 15 cm from the undisturbed organic soil surface to the surface in the bottom of the rut (Figure 1).

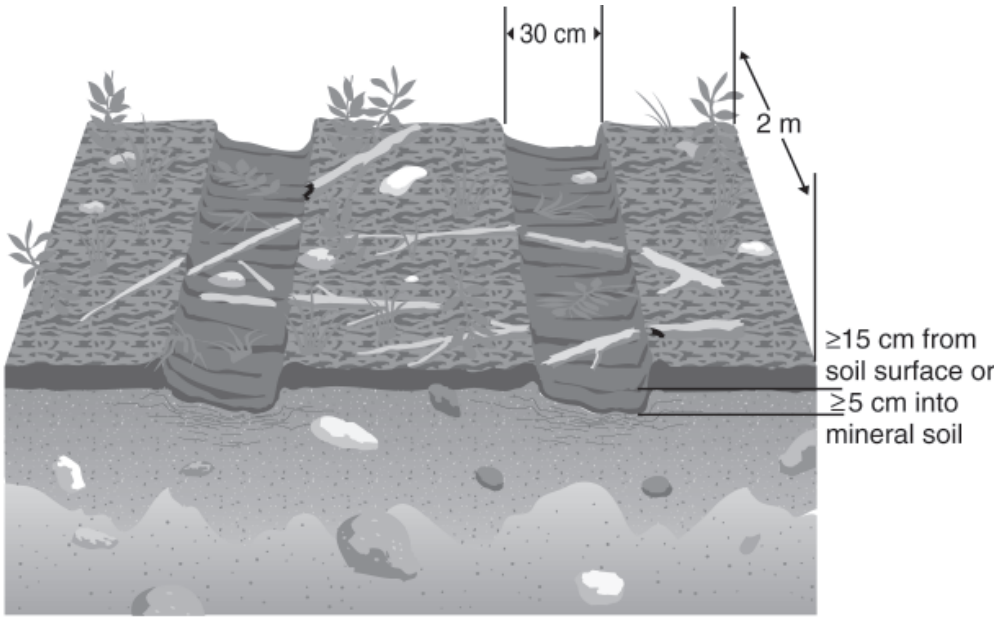


Wheel or track ruts 15 cm deep are counted as soil disturbance on all sites.

Ruts 5 cm deep

On sites with high or very high compaction hazard, both 15-cm-deep ruts and ruts at least 5 cm deep into mineral soil should be counted. Depth is measured from the surface of the undisturbed mineral soil to the mineral soil surface in the bottom of the rut, ignoring any forest floor that may be in the rut.

⇒ Measure at the deepest point in the perpendicular cross-section over the entire length of 2 m (Figure 1).



Wheel or track ruts 5 cm deep are counted as soil disturbance on sites with high or very high soil compaction hazard or where compaction hazard has not been assessed.

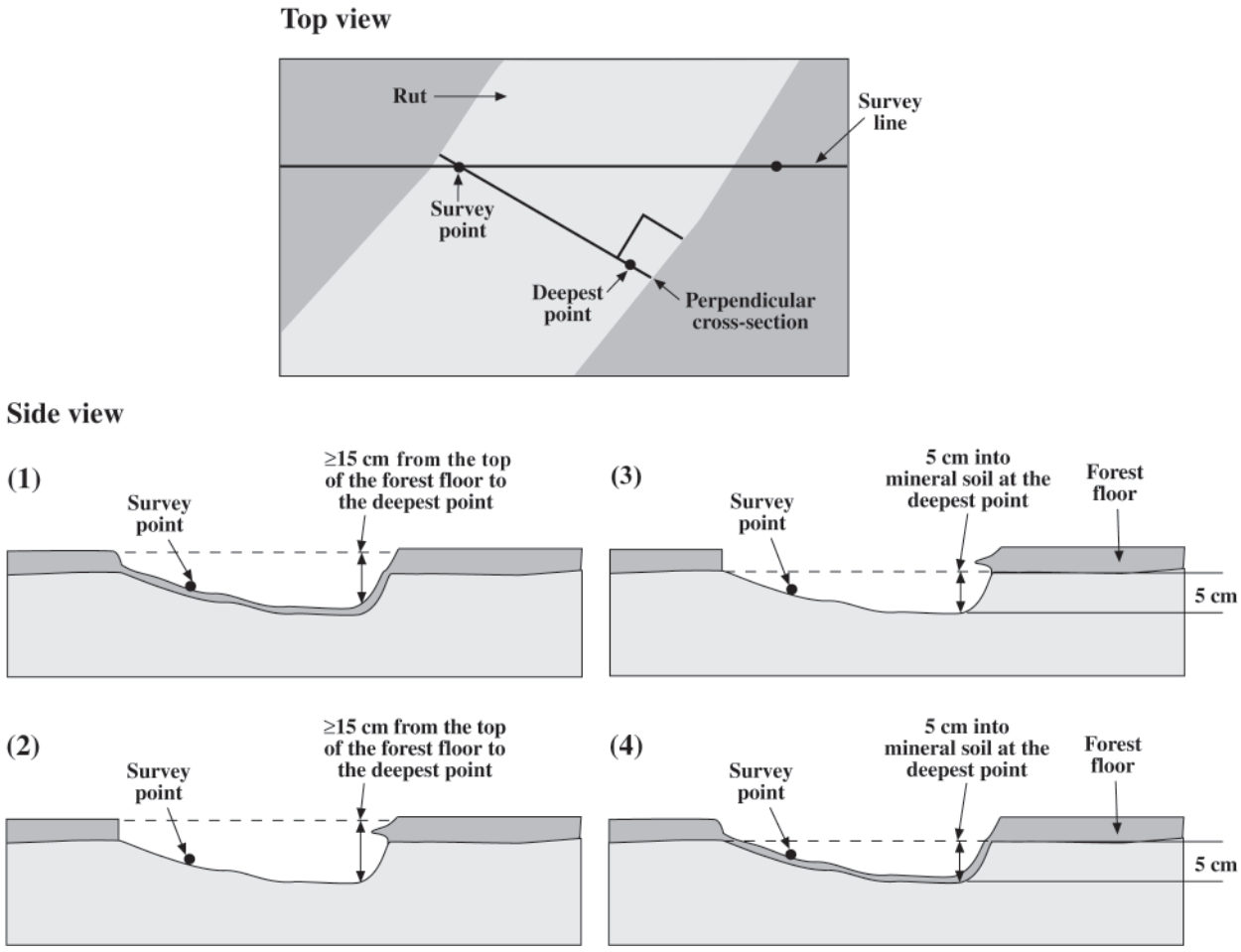


Figure 1. Depth assessment of wheel or track ruts.

Top view: The depth assessment for wheel or track ruts uses the deepest point in the perpendicular cross-section of the rut, not the depth exactly at the survey point, as is the case for most other disturbances.

Side view:

(1) On all sites, ruts can be assessed using the depth of 15 cm from the surface of the undisturbed forest floor to the top of the forest floor in the rut.

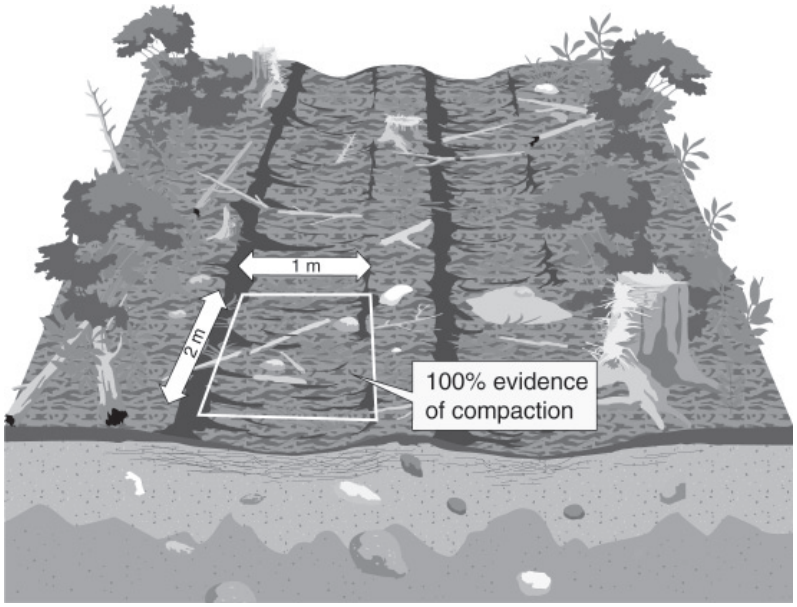
(2) Where forest floor is not present in the rut, measure at least 15 cm from the top of the undisturbed forest floor to the mineral soil surface in the rut.

(3) For sites with very high or high soil compaction hazard or where the compaction hazard has not been assessed, measure at least 5 cm from the surface of the undisturbed mineral soil to the mineral soil surface in the bottom of the rut. The mineral soil itself must be depressed 5 cm.

(4) When assessing 5-cm-deep ruts into mineral soil, gently brush aside any forest floor if it is present in the bottom of the rut, and measure to the mineral soil surface in the bottom of the rut.

3.4.2 Dispersed trail: repeated machine traffic (E)

The category *repeated machine traffic* describes disturbance resulting from repeated heavy machine traffic. Such disturbance is typically found on repeatedly used skid trails, which are obvious linear features. It may also occur on heavy traffic areas associated with roadside work areas and around piles constructed by windrowing or piling slash. This disturbance rarely occurs on moderate compaction hazard soils logged under dry conditions, where random skidding operations have limited the use of trails to one or two passes.



The following criteria define repeated machine traffic:

- The survey point shows evidence of compaction (see "Assessing compaction," above), indicated by:
  - altered soil structure or increased density relative to the surrounding soil,
  - puddling, and
  - compacted deposits of forest floor, fine slash, and woody debris overlaying and partially imbedded in, or crushed into, the mineral soil (compacted such that they cannot be readily excavated with a shovel).
- There is evidence of compaction across 100% of a 1 x 2 m rectangle. (If digging in the 1 x 2 m rectangle shows less than 100% compaction, the disturbance should not be called repeated machine traffic.)

Repeated machine traffic must be counted as soil disturbance on all sites except those with low compaction hazard. Where the compaction hazard has not been assessed, repeated machine traffic must be counted as soil disturbance.