# 2 SOIL DESCRIPTION

## Contents

**Figures**

4

# SOIL DESCRIPTION

| GEOLOGY | BEDROCK (3) | C. F. LITH. (4) | SURVEYOR(S) (1) | PLOT NO. (2) |
|---|---|---|---|---|

| TERRAIN (5) | TEXTURE 1 / 2 | SURFICIAL MATERIAL 1 / 2 | SURFACE EXPR. 1 / 2 | GEOMORPH. PROCESS 1 / 2 |
|---|---|---|---|---|

| SOIL CLASS. (6) | HUMUS FORM (7) | HYDROGEO. (8) |
|---|---|---|

3

| ROOTING DEPTH (9) cm | ROOT RESTRICT. LAYER TYPE (11) | WATER SOURCE (12) | DRAINAGE (14) |
|---|---|---|---|
| R. Z. PART. SIZE (10) | DEPTH cm | SEEPAGE (13) cm | FLOOD RG. (15) |

1

## ORGANIC HORIZONS/LAYERS

| HOR/ LAYER | DEPTH | FABRIC | | MYCEL. AB. | FECAL AB. | ROOTS | | pH | COMMENTS (consistency, character, fauna, etc): |
|---|---|---|---|---|---|---|---|---|---|
| | | STRUCTURE | vPOST | | | AB. | SIZE | | |
| (16) | (17) | (18) | | (19) | (20) | (21) | | (22) | (23) |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

1

## MINERAL HORIZONS/LAYERS

| HOR/ LAYER | DEPTH | COLOUR | ASP. | TEXT. | % COARSE FRAGMENTS | | | | | ROOTS | | STRUCTURE | | pH | COMMENTS (mottles, clay films, effervesc., etc): |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | G | C | S | TOTAL | SHAPE | AB. | SIZE | CLASS | KIND | | |
| (24) | (25) | (26) | | (27) | | | (28) | | | (29) | | (30) | | (31) | (32) |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

2

PROFILE DIAGRAM (33)

5

NOTES: (34)

FS882 (2) HRE 98/5

# Field Procedure

## Getting Started

1. Locate plot boundaries, **assess variability**, select pit location(s).
2. Excavate pit (generally 50–75 cm in depth) leaving the face and sides undisturbed around the ground surface.
3. While excavating, **observe**:
   - organic horizon depths and fabric;
   - mineral horizon depths, colours, structure, and textural changes;
   - percentage and shape of coarse fragments;
   - rooting abundance, depth, and restrictions; and
   - mottling, water seepage, or water table.
4. Lay out notes, forms, and soil description tools.
5. Clean off face from top to bottom (and photograph if required).
   - Note horizon changes and mark with knife indentations or golf tees.
   - Collect soil texture samples from bottom to top and put aside.

## Record and Classify (see tab numbers on sample form, facing page)

**1** Designate horizons on form (organic and mineral horizons / layers).
For each horizon (depending on survey objectives / requirements):
- Record average starting and ending depths.
- For organic horizon, record fabric, mycelia and fecal abundance, rooting, and pH.
- For mineral horizons, hand-texture soil samples and determine colours. Record percent and shape of coarse fragments, rooting, structure, and pH.
- Note important observations in comments (e.g. soil fauna, mottles, clay films, etc.).
- confirm original horizon designations

**2** Sketch a profile diagram to approximate scale.

**3** Record:
- rooting depth, particle size, and restricting layer
- water source, seepage depth, drainage class, and flooding regime

**4** Classify:
- bedrock geology and coarse fragment lithology type(s)
- terrain unit(s), soil pedon, humus form, and hydrogeomorphic unit

**5** Use the "Notes" section to summarize or describe important soil features not otherwise collected on the form, or are significant to the study, classifications, or management interpretations.

## Check and Integrate

Check the form to ensure there are no missing data, and then (under most circumstances) fill in the pit. Strike through any fields that were not assessed. Integrate the soil data with other site factors to determine and record the soil moisture and soil nutrient regimes on the site description form.

# Completing the Form

Numbered items below refer to circled numbers on the Soil Description Form shown at the beginning of this section. See "Field Procedure" for a recommended sequence for completing the form.

## 1. Surveyor

Indicate the first initial and last name of the person(s) who described and classified the soil profile.

## 2. Plot Number

Record the plot number from the top of the Site Description Form.

## 3. Bedrock Type

Record general or specific codes (see Tables 2.1, 2.2, 2.3) for up to three rock types in the underlying bedrock, in order of dominance if possible. This is particularly important on sites with shallow soils or bedrock exposure.

**TABLE 2.1. Sedimentary rock codes**

| | General | Code | Specific | Code |
|---|---|---|---|---|
| **Clastic, calcareous** | Fine grained | **kf** | Calcareous Siltstone | **kz** |
| | | | Calcareous Mudstone | **kd** |
| | | | Calcareous Shale | **kh** |
| | Medium grained | **km** | Calcareous Greywacke | **kg** |
| | | | Calcareous Arkose | **ka** |
| | | | Calcareous Sandstone | **ks** |
| | Coarse grained | **kc** | Calcareous Conglomerate | **kn** |
| | | | Calcareous Breccia | **kb** |
| **Clastic, non-calcareous** | Fine grained | **uf** | Siltstone | **zl** |
| | | | Mudstone | **md** |
| | | | Shale | **sh** |
| | Medium grained | **um** | Sandstone | **ss** |
| | | | Greywacke | **gk** |
| | | | Arkose | **ak** |
| | Coarse grained | **uc** | Conglomerate | **cg** |
| | | | Breccia | **bx** |

| | General | Code | Specific | Code |
|---|---|---|---|---|
| **Precipitates, crystalline** | Calcareous | **pk** | Travertine | **tv** |
| | | | Limestone | **ls** |
| | | | Dolomite | **do** |
| | Non-calcareous | **pu** | Gypsum | **gy** |
| | | | Limonite | **li** |
| | | | Barite | **ba** |
| **Organic** | Calcareous | **ok** | Mar | **ma** |
| | Carbonaceous | **oc** | Lignite | **lg** |
| | | | Coal | **co** |

**TABLE 2.2. Igneous rock codes**

| | General | Code | Specific | Code |
|---|---|---|---|---|
| **Intrusive** | Acid (felsic) | **ia** | Syenite | **sy** |
| | | | Granite | **gr** |
| | | | Quartz Monzonite | **qm** |
| | | | Granodiorite | **gd** |
| | Intermediate | **ii** | Quartz Diorite | **qd** |
| | | | Diorite | **di** |
| | Basic (mafic) | **ib** | Quartz | **qg** |
| | | | Gabbro | **gb** |
| | | | Pyroxenite | **py** |
| | | | Dunite | **du** |
| **Extrusive** | Acid (felsic) | **ea** | Trachyte | **tr** |
| | | | Rhyolite | **rh** |
| | | | Dacite | **da** |
| | Intermediate | **ei** | Andesite | **an** |
| | Basic (mafic) | **eb** | Quartz Basalt | **qb** |
| | | | Basalt | **bs** |
| | Recent lava flow | **la** | | |
| | Pyroclastic | **ep** | Tuff | **tu** |
| | | | Volcanic Breccia | **vb** |
| | | | Agglomerate | **ag** |

**TABLE 2.3. Metamorphic rock codes**

| | General | Code | Specific | Code |
|---|---|---|---|---|
| **Foliated** | Fine grained | **ff** | Slate<br>Phylite | **sl**<br>**ph** |
| | Medium to coarse grained | **fm** | Schist<br>Gneiss<br>Granite Gneiss<br>Diorite Gneiss | **sc**<br>**gn**<br>**gg**<br>**dg** |
| | Coarse grained | **fc** | Migmatite | **mi** |
| **Non-foliated** | Fine grained | **nf** | Argillite<br>Serpentinite | **ar**<br>**sp** |
| | Medium to coarse grained | **nm** | Quartzite<br>Hornfels<br>Granulite | **qt**<br>**hf**<br>**gl** |
| | Coarse grained | **nc** | Amphibolite<br>Hornblendite | **am**<br>**hb** |
| | Calcareous | **nk** | Marble<br>Dolomite Marble<br>Serpentine Marble | **mb**<br>**dm**<br>**sm** |

## 4. Coarse Fragment Lithology

Record up to three rock types in order of dominance from left to right on the form that make up the coarse fraction (i.e., gravels, cobbles, and stones) of the soil material. Characters are recorded using the same codes as outlined for bedrock type. If the lithologies are so mixed that dominance can not be determined, record by entering the code **“mx**.”

## 5. Terrain Classification

Four information fields are provided for recording terrain texture, surficial material, surface expression and geomorphological process, respectively (Howes and Kenk 1997) (see Tables 2.4, 2.5, 2.6, and 2.7 and Figure 2.1). Up to three codes can be entered in each of these fields. Place qualifying descriptor codes (Table 2.8) in the appropriate field to the right of any other codes used in that field (superscript codes are no longer used). Code line 1 for the uppermost stratigraphic layer, and code line 2 for an underlying layer. For those wishing to use terrain subclasses and subtypes, refer to Howes and Kenk (1997).

**TABLE 2.4. Terrain texture codes**

| Code | Name | Size (mm) | Other Characteristics |
|---|---|---|---|
| **a** | Blocks | > 256 | Angular particles |
| **b** | Boulders | > 256 | Rounded and subrounded particles |
| **k** | Cobble | 64–256 | Rounded and subrounded particles |
| **p** | Pebbles | 2–64 | Rounded and subrounded particles |
| **s** | Sand | 0.062–2.000 | |
| **z** | Silt | 0.002–0.062 | |
| **c** | Clay | < 0.002 | |
| **d** | Mixed fragments | > 2 | Mix of rounded and angular particles |
| **g** | Gravel | > 2 | Mix of boulders, cobbles, and pebbles |
| **x** | Angular | > 2 | Mix of blocks and rubble |
| **r** | Rubble | 2–256 | Angular particles |
| **m** | Mud | < 0.062 | Mix of clay and silt |
| **y** | Shells | — | Shells or shell fragments |
| **e** | Fibric | — | Well-preserved fibre; (40%) identified after rubbing |
| **u** | Mesic | — | Intermediate composition between fibric and humic |
| **h** | Humic | — | Decomposed organic material; (10%) identified after rubbing |

| | Roundness \ Size (mm) | | 256 | 64 | 2 | .062 | .002 |
|---|---|---|---|---|---|---|---|
| Specific | Rounded | boulder **b** | cobble **k** | pebble **p** | | | |
| Specific | Rounded/ Angular | | | | sand **s** | silt **z** | clay **c** |
| Specific | Angular | blocks **a** | | | | | |
| Common | Rounded | gravel **g** | | | | | |
| Common | Rounded/ Angular | mxed fragments **d** | | | | mud **m** | |
| Common | Angular | | rubble **r** | | | | |
| Common | Angular | angular fragments **x** | | | | | |

**FIGURE 2.1. Relationship of size and roundness of the clastic textural terms.**

**TABLE 2.5. Surficial (genetic) material codes**

| Code | Name | (Assumed status) | Description |
|---|---|---|---|
| **A** | Anthropogenic | (A) | Artificial or human-modified material |
| **C** | Colluvium | (A) | Products of mass wastage |
| **D** | Weathered bedrock | (A) | *In situ*, decomposed bedrock |
| **E** | Eolian | (I) | Materials deposited by wind action |
| **F** | Fluvial | (I) | River deposits |
| **FG** | Glaciofluvial | (I) | Ice contact fluvial material |
| **I** | Ice | (A) | Permanent snow, glaciers, and icefields |
| **L** | Lacustrine | (I) | Lake sediments; includes wave deposits |
| **LG** | Glaciolacustrine | (I) | Ice contact lacustrine material |
| **M** | Morainal | (I) | Material deposited directly by glaciers |
| **O** | Organic | (A) | Accumulation / decay of vegetative matter |
| **R** | Bedrock | (–) | Outcrops / rocks covered by less than 10 cm of soil |
| **U** | Undifferentiated | (–) | Layered sequence; three materials or more |
| **V** | Volcanic | (I) | Unconsolidated pyroclastic sediments |
| **W** | Marine | (I) | Marine sediments; includes wave deposits |
| **WG** | Glaciomarine | (I) | Ice contact marine sediments |

**TABLE 2.6. Surface expression codes**

| Code | Name | Description |
|---|---|---|
| **a** | Moderate slope | Unidirectional surface; > 15° to < 26° |
| **b** | Blanket | A mantle of unconsolidated materials; > 1 m thick |
| **c** | Cone(s) | A cone or segment of a cone; > 15° |
| **d** | Depression(s) | A lower area surrounded by a higher terrain |
| **f** | Fan(s) | A segment of a cone; up to 15° |
| **h** | Hummock(s) | Hillocks and hollows, irregular in plan; 15–35° |
| **j** | Gentle slope | Unidirectional surface; > 3° and ≤ 15° |
| **k** | Moderately steep slope | Unidirectional surface; > 26° and < 35 |
| **m** | Rolling | Elongate hillocks; 3–15°; parallel forms in plan view |
| **p** | Plain | Unidirectional surface; up to 3° |
| **r** | Ridge(s) | Elongate hillocks; 15–35°; parallel forms in plan view |
| **s** | Steep slope | Steep slopes; > 35° |
| **t** | Terrace(s) | Step-like topography |
| **u** | Undulating | Hillocks and hollows; up to < 15°; irregular in plan view |
| **v** | Veneer | Mantle of unconsolidated material; 0.1 to 1.0 m thick |
| **w** | Mantle of variable thickness | A layer or discontinuous layer of surficial materials of variable thickness that fills or partially fills depressions in an irregular substrate. The thickness ranges from 0 to 3 m. |
| **x** | Thin veneer | A dominance of very thin surficial materials about 2–20 cm thick |

**TABLE 2.7. Geomorphological process codes**

| Code | Name | (Assumed status) | Description |
|---|---|---|---|
| **A** | Avalanches | (A) | Terrain modified by snow avalanches |
| **B** | Braiding | (A) | Diverging/converging channels; unvegetated bars |
| **C** | Cryoturbation | (A) | Materials modified by frost heaving and churning |
| **D** | Deflation | (A) | Removal of sand and silt by wind action |
| **E** | Channeled | (I) | Channel formation by meltwater |
| **F** | Slow mass | (A) | Slow downslope movement of masses of cohesive or non-cohesive material |
| **H** | Kettle | (I) | Depressions in surficial material resulting from the melting of buried or partially buried glacier ice |
| **I** | Irregular channel | (A) | A single, clearly defined main channel displaying irregular turns and bends |
| **J** | Anastomosing channel | (A) | A channel zone where channels diverge and converge around many vegetated islands |
| **K** | Karst | (A) | Processes associated with the solution of carbonates |
| **L** | Surface seepage | (A) | Zones of active seepage often found along the base of slope positions |
| **M** | Meandering channels | (A) | Channels characterized by a regular pattern of bends with uniformed amplitude and wave length |
| **N** | Nivation | (A) | Erosion beneath and along the margin of snow patches |

| Code | Name | (Assumed status) | Description |
|---|---|---|---|
| **P** | Piping | (A) | Subterranean erosion by flowing water |
| **R** | Rapid mass movement | (A) | Rapid downslope movement of dry, moist, or saturated debris |
| **S** | Solifluction | (A) | Slow downslope movement of saturated overburden across a frozen or otherwise impermeable substrate |
| **U** | Inundation | (A) | Seasonally under water because of high water table |
| **V** | Gully erosion | (A) | Parallel/subparallel ravines caused by running water |
| **W** | Washing | (A) | Modification by wave action |
| **X** | Permafrost | (A) | Processes controlled by the presence of permafrost |
| **Z** | Periglacial processes | (A) | Solifluction, cryoturbation, and nivation processes occurring within a single unit |

**TABLE 2.8. Qualifier codes**

| Code | Name | Description |
|---|---|---|
| **A** | Active | *Used to qualify surficial material and geomorphological* |
| **I** | Inactive | *processes with regard to their current state of activity.* |

## 6. Soil Classification

The Canadian System of Soil Classification (Soil Classification Working Group, 1998) is tabulated alphabetically by soil order. Codes for great groups and subgroups are given in Appendix 2.1. Appendix 2.2 includes a key to soil orders. For those wishing to use family and phase criteria, refer to Soil Classification Working Group (1998) and include in “Notes.”

## 7. Humus Form

Humus forms are classified to order and group according to *Towards a Taxonomic Classification of Humus Forms* (Green et al. 1993) Use Table 2.9 to enter codes. Appendix 2.3 contains a key to humus forms. For those wishing to use phases, refer to Green et.al. (1993), and include in "Notes."

**TABLE 2.9. Codes for humus orders and groups**

| Order | Group | Code |
|---|---|---|
| MOR (R) | Hemimor | **HR** |
| | Humimor | **UR** |
| | Resimor | **RR** |
| | Lignomor | **LR** |
| | Hydromor | **YR** |
| | Fibrimor | **FR** |
| | Mesimor | **MR** |
| MODER (D) | Mormoder | **RD** |
| | Leptomoder | **TD** |
| | Mullmoder | **MD** |
| | Lignomoder | **LD** |
| | Hydromoder | **YD** |
| | Saprimoder | **SD** |
| MULL (L) | Vermimull | **VL** |
| | Rhizomull | **ZL** |
| | Hydromull | **YL** |

## 8. Hydrogeomorphic Units

The *system* defines broad hydrological processes which characterize landscape units and ecosystems by water sources and hydrodynamics. *Element groups* divide a system by patterns of waterflow which indicate generically hydrodynamics, water source, and connectivity in the landscape. Record the system code first and the element group code (where applicable) second (e.g., Fra= alluvial river). Subsystem codes are only presented for lacustrine, palustrine, and fluvial sites; those for other systems are under development. Use the codes in Tables 2.10 and 2.11.

**TABLE 2.10. Codes for hydrogeomorphic systems**

| Code | System | **Description** |
|---|---|---|
| **L** | Lacustrine | Occurs adjacent to lakes and ponds and is directly affected by lacustrine processes (e.g., wave action, sedimentation, and relatively high nutrient content of flood waters). |
| **P** | Palustrine | Occurs in basins and depressions with poor drainage that collect water flows from runoff, groundwater, and precipitation. Often peatlands, ponds, and marshes. |
| **F** | Fluvial[a] | Occurs along flowing water courses, the water course itself, and the surrounding (riparian) terrain and vegetation. Subject to flooding and sedimentation processes. |
| **U** | Upland | Occurs in sloping, level, and depressional sites not described by other hydrogeomorphic systems. |
| **E** | Estuarine | Consists of intertidal habitats where ocean water is at least occasionally diluted by freshwater runoff from the land. Occurs at the confluence of rivers and ocean and has characteristics that reflect the flooding and salinity gradients found there. |
| **M** | Marine | Exposed to waves and currents of the open ocean. Water regimes are determined primarily by the ebb and flow of oceanic tides. |

[a] Modifiers: **r** = river (20 m+ wide); **s** = stream (5–20 m); **c** = creek (1.5–5 m); **v** = rivulet (< 1.5 m).

**TABLE 2.11. Codes for hydrogeomorphic subsystems**

| **System** | **Element Group** | **Code** | **Description** |
|---|---|---|---|
| Lacustrine or palustrine; confined basins | Closed basin | **cb** | Basin receives water from surrounding upland only, no inlet or outlet channel. |
| | Overflow basin | **ob** | Basin receives water from upland only; excess water flows through an outlet channel. |

| System | Element Group | Code | Description |
|---|---|---|---|
| | Linked basin | **lb** | Basin receives water from upland and an inflow stream; excess water flows though an outflow. Includes basins with slow streams where there is little sedimentation or erosion. |
| | Terminal basin | **tb** | Basin receives water from upland and an inflow stream; no outlet channel. |
| Palustrine; unconfined slopes and hollows | Overflow hollow | **oh** | Hollow receives ground water from upslope; drains through outlet channel or watertrack. |
| | Linked hollow | **lh** | Hollow receives water from upland and an inflow stream; excess water flows out through an outflow stream or watertrack. Includes gullies with slow streams where there is little sedimentation or erosion. |
| | Blanket slope | **bs** | Occurs in subdued topography where basin types are not defineable. |
| | Toe slope | **ts** | Occurs on toe slope positions not confined by basin or hollow; water received from upslope, sheet or channelled flow |
| | Lobe slope | **ls** | Peatlands on slopes with a downslope edge elevated above the upland in the form of a lobe; water received from upslope, sheet or channelled flow. |
| Fluvial | Alluvial | **a** | Associated with low gradient streams where floodplain building processes predominate; flooding and subsequent deposition of alluvium leads to extensive floodplains of sandy or silty soils. |

| System | Element Group | Code | Description |
|---|---|---|---|
| | Transport | **t** | Associated with moderate gradient streams where neither erosion or deposition forces predominate; floodplain development limited, in-stream bars and gravelly soil common. |
| | Headwater | **h** | Associated with high gradient streams where erosive processes predominate; flood plain and bar development limited; cobble, stone or bedrock substrates common |

## 9. Rooting Depth

Rooting depth refers to the depth (cm) from the *ground surface,* which is the top of the uppermost soil horizon including organic horizons (e.g., Fm1), down to the bottom of the rooting zone (i.e., the level at which the majority of roots stop; for example, the end of "plentiful" and beginning of "few" rooting abundance).

## 10. Rooting Zone Particle Size

The particle size distribution within the mineral portion of the rooting zone is used to make broad interpretations. After determining rooting depth, estimate the rooting zone particle-size class as a weighted average of the mineral horizons within the rooting zone (Figure 2.2, Table 2.12). Where rooting is restricted to the organic horizons, use the organic material codes in Table 2.12. For the most part, class names and definitions have been modified from the Canadian System of Soil Classification family particle size criteria. Rooting zone classes are greatly simplified and use only percent coarse fragments
(≥ 2 mm) by volume, and texture class sizes by percent weight for sand (.05 to < 2 mm), silt (< .05 to .002 mm), and clay (< .002). Two different classes can be entered on the data form if strongly contrasting size classes occur (e.g. CLS/FC= coarse-loamy over fine-clayey), however ranges of rooting zone particle-size classes can not be shown.

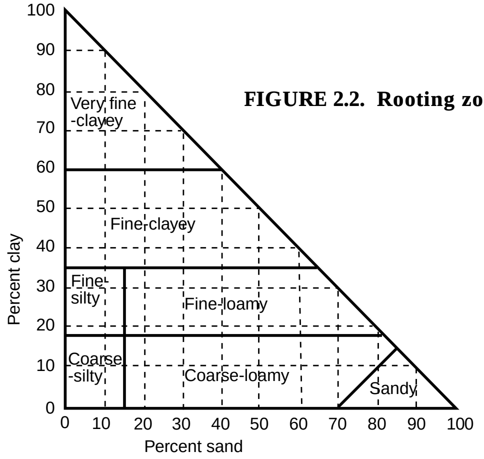



**FIGURE 2.2. Rooting zone particle size classes.**

**TABLE 2.12. Rooting zone particle size classes**

| Code | Class[a] | Definitions |
|---|---|---|
| **Coarse fragments ≥ 70%:** | | |
| **F** | Fragmental | Particles < 2 mm of various textures |
| **Coarse fragments ≥ 35 and less than 70%:** | | |
| **SS** | Sandy-skeletal | Particles < 2 mm sandy |
| **CLS** | Coarse-loamy-skeletal | Particles < 2 mm coarse-loamy |
| **FLS** | Fine-loamy-skeletal | Particles < 2 mm fine-loamy |
| **SIS** | Silty-skeletal | Particles < 2 mm fine-silty or coarse-silty |
| **CS** | Clayey-skeletal | Particles < 2 mm clayey |
| **Coarse fragments < 35 %** | | |
| **S** | Sandy | Organic Material Codes: |
| **CL** | Coarse-loamy | **F** Fibric |
| **FL** | Fine-loamy | **M** Mesic |
| **CSI** | Coarse-silty | **H** Humic |
| **FSI** | Fine-silty | **W** Woody |
| **FC** | Fine-clayey | |
| **VFC** | Very-fine-clayey | |

[a] Refer to triangle in Figure 2.2 for proportion of sand and clay in the fine particle sizes (< 2 mm) of these classes.

## 11. Root Restricting Layer

If present, enter a code for the type of root restricting layer (Table 2.13), and the depth (cm) from the *ground surface* down to the top of the layer.

**TABLE 2.13. Codes for root restricting layers**

| Code | Description |
|---|---|
| **C** | Strongly cemented horizon |
| **P** | Clay pan or restriction due to fines |
| **K** | Compacted morainal material |
| **L** | Lithic contact |
| **W** | Excessive moisture; this refers to the depth where the roots are being restricted by excessive moisture, but does not require the presence of free water at the time of sampling |
| **X** | Excessive accumulations of chemicals within the profile which inhibit root growth (i.e., $CaCO_3$) |
| **Z** | Permafrost; characterized by temperatures never exceeding 0°C, ice cementation, ice lenses, or massive ice. |
| N | No root restriction evident. |

## 12. Water Source

The most influential source of water on a site (determined by a qualitative assessment) is recorded using the codes in Table 2.14.

**TABLE 2.14. Water source codes**

| Code | Water Source |
|---|---|
| **P** | Precipitation |
| **G** | Groundwater |
| **S** | Snowmelt (prolonged through the growing season) |
| **F** | Stream sub-irrigation and flooding |
| **M** | Mineral spring |
| **T** | Tidal, freshwater |
| **E** | Tidal, saltwater |
| **Z** | Permafrost |

## 13. Seepage Water Depth

If seepage is present at the time of sampling, record the depth (cm) from the *ground surface* to the level of temporary or permanent subsurface water flow. Enter "**NP**" if not present.

## 14. Drainage Class and Soil Moisture Subclass

Drainage class describes the speed and extent to which water is removed from a mineral soil in relation to additions (Table 2.15.) s

**TABLE 2.15. Drainage classes and codes**

| Code | Class | Description |
|---|---|---|
| **x** | Very rapidly drained | Water is removed from the soil very rapidly in relation to supply. Water source is precipitation and available water storage capacity following precipitation is essentially nil. Soils are typically fragmental or skeletal, shallow, or both. |
| **r** | Rapidly drained | Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Water source is precipitation. Soils are generally coarse textured. |
| **w** | Well drained | Water is removed from the soil readily, but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Water source is precipitation. On slopes, subsurface flow may occur for short durations, but additions are equalled by losses. Soils are generally intermediate in texture and lack restricting layers. |
| **m** | Moderately well drained | Water is removed from the soil somewhat slowly in relation to supply because of imperviousness or lack of gradient. Precipitation is the dominant water source in medium- to fine-textured soils; precipitation and significant additions by subsurface flow are necessary in coarse-textured soils. |

| Code | Class | Description |
|---|---|---|
| **i** | Imperfectly drained | Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is the major source. If subsurface water or groundwater (or both) is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by subsurface or groundwater flow (or both) increases as available water storage capacity decreases. Soils generally have a wide range of texture, and some mottling is common. |
| **p** | Poorly drained | Water is removed so slowly in relation to supply that the soil remains wet for much of the time that it is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface or groundwater flow (or both), in addition to precipitation, are the main water sources. A perched water table may be present. Soils are generally mottled and/or gleyed. |
| **v** | Very poorly drained | Water is removed from the soil so slowly that the water table remains at or near the surface for most of the time the soil is not frozen. Groundwater flow and subsurface flow are the major water sources. Precipitation is less important, except where there is a perched water table with precipitation exceeding evapotranspiration. Typically associated with wetlands. For organic wetlands, also evaluate the soil moisture subclass, and when entering on the form, separate from drainage by a slash. For example, v/ac. |

Soil moisture subclasses (applied to organic soil order only) indicate the length of time the soil is saturated (Table 2.16). Record the subclass code in the “drainage” information field.

**TABLE 2.16. Soil moisture subclasses and codes**

| Code | Moisture subclass | Description | Saturation period (mo.) | Moist period (mo.) |
|---|---|---|---|---|
| **aq** | Aqueous | Free surface water | 11.5–12 | < 0.5 |
| **pa** | Peraquic | Soil saturated for very long periods | > 10 | < 2 |
| **ac** | Aquic | Soil saturated for moderately long periods | 4–10 | 2–8 |
| **sa** | Subaquic | Soil saturated for short periods | < 4 | 8–11.5 |
| **ph** | Perhumid | No significant water deficits in growing season | < 2 | 8–11.5 |
| **hu** | Humid | Very slight deficits in growing season | < 0.5 | > 11.5 |

## 15. Flooding Regime

Flooding is defined as immersion of substrate by water (i.e., saturated peats not covered by surface water are *not* considered flooded). Flooding regimes may be indicated by one- or two-letter codes as appropriate for yearly frequency and seasonal duration (Table 2.17 and 2.18). A range of flooding regimes may also be entered (e.g., OB = occasional brief flooding and FT–AM = frequent temporary flooding to annual moderate flooding).

**TABLE 2.17. Codes for frequency of flooding**

| Code | Description |
|---|---|
| **A** | Annual flood (at least once per year) |
| **F** | Frequent flooding (every 2–5 years) |
| **O** | Occasional flooding (> 5-year interval between flooding) |
| **R** | Rare flood (only during extreme events) |
| **X** | Never flooded |

**TABLE 2.18. Codes for duration and timing of flooding**

| Code | Description |
|---|---|
| **W** | Winter flooding |
| **P** | Permanent flooding during growing season |
| **E** | Extended flooding (exposed < 1 month during last part of growing season) |
| **M** | Moderate flooding (flooded for 1–3 months; exposed substrate for prolonged periods of the growing season) |
| **T** | Temporary flooding (7–30 days during the growing season) |
| **B** | Brief flooding (< 7 days during the growing season) |
| **D** | Diurnal flooding |

# Organic Horizons and Layers

The soil horizon and layer definitions and methods for field description that follow are taken or modified from Soil Classification Working Group (1998), Green et al. (1993), and Luttmerding et al. (1990).

## 16. Horizon/Layer

Record the organic horizon or layer designation. Two groups of master organic horizons are recognized: L, F, H ("upland") horizons, and O ("wetland") horizons. All contain > 17% organic C by mass. These two groups are differentiated primarily by the features outlined in Table 2.19.

**TABLE 2.19. Guidelines for differentiating between upland and wetland organic horizons**

| Property | L, F, and H horizons | O horizons |
|---|---|---|
| Physiography | Sloping to level | Depression to gently sloping |
| Soil drainage | Very rapid to imperfect | Poor to very poor |

| Property | L, F, and H horizons | O horizons |
|---|---|---|
| Water table | Absent in organic horizons (may fluctuate in response to water input) | At or near ground surface for significant duration during the frost-free period |
| Origin of materials | Organic residues from plant communities typically associated with soil moisture regimes 0–6 | Organic residues from plant communities typically associated with soil moisture regimes 7–8 |

**Codes for master organic horizons:**

**L** An upland horizon consisting of relatively fresh organic residues that are readily identifiable as to origin.

**F** An upland horizon comprised of partly decomposed plant residues in which fragmented plant structures are generally recognizable as to origin.

**H** An upland horizon comprised of well-decomposed plant residues in which plant structures are generally not recognizable.

**O** A wetland organic horizon comprised of materials in varying degrees of decomposition.

**Codes for subordinate organic horizons:**

**Ln** An L horizon composed of newly accreted and essentially unfragmented plant residues.

**Lv** An L horizon exhibiting initial decay and strong discoloration.

**Fm** An F horizon in which plant residues are aggregated in a matted structure, with a tenacious consistence. Fungal mycelia are clearly a predominant biotic component; some faunal droppings may be present.

**Fz** An F horizon in which plant residues are weakly aggregated with a loose or friable consistence. Faunal droppings are typically numerous and easily observed under magnification with a hand lens or binocular microscope; fungal mycelia may be present.

**Fa** An F horizon in which plant residues are aggregated into a weak to moderate, non-compact matted structure. This is an intergrade between the Fm and Fz horizons, and as such, reflects properties of both, but neither fungal mycelia or faunal droppings predominates.

**Hh** An H horizon dominated by fine substances with very few, if any, recognizable plant residues.

**Hz** An H horizon dominated by fine substances with very few, if any, recognizable plant residues; faunal droppings constitute most of the fabric.

**Hr** An H horizon dominated by fine substances, but that also contains recognizable plant residues, usually from fine roots, wood, or bark; typically dark reddish-brown hues, around 2.5YR.

**Of** An O horizon comprised largely of poorly decomposed plant residues that are readily identifiable as to origin. It has 40% or more rubbed fibre (i.e., fibre that remains after rubbing a sample about 10 times between thumb and forefinger). These materials are classified in the von Post scale of decomposition (defined below, in Item 18, “Fabric”) as class 1 to class 4.

**Om** An O horizon comprised of partly decomposed plant residues which are at a stage of decomposition intermediate between Of and Oh horizons. Rubbed fibre usually ranges between 10 and 40% by volume. These materials are classified in the von Post scale of decomposition as class 5 or 6.

**Oh** An O horizon of well-decomposed plant residues that for the most part have been transformed into humic materials. The rubbed fibre content is less than 10% by volume. These materials are usually classified in the von Post scale of decomposition as class 7 or higher, and very rarely as class 6.

**Oco** Coprogenous earth, deposited or modified by aquatic organisms.

**Lowercase modifiers:**
The following lowercase modifiers may be applied to any organic horizon without restriction.

**i** An organic horizon that contains intermixed mineral particles finer than 2 mm, with 17–35% organic C by mass. This intermixing of mineral particles with organic materials may result from several different processes (e.g., colluvial, eolian, alluvial, cryoturbation, silvoturbation, and zooturbation).

**p**, **u**, **y** May also be used with organic horizons, and are defined under "Mineral lowercase modifiers" in Item 24.

**w** An organic horizon that contains significant amounts (> 35% of the volume of solids) of coarse woody debris in various stages of decomposition.

**Codes for organic layers:**

**S** A distinct ground surface layer of living materials such as bryophytes or "soil crusts."

**Limno** A layer or layers 5 cm or more thick of sedimentary peat, diatomaceous earth, or marl.

**Cumulo** A 5–30 cm thick layer or layers of mineral material in Organic soils.

**Terric** An unconsolidated mineral substratum not underlain by organic matter, or one continuous unconsolidated mineral layer more than 30 cm thick in the middle or bottom tiers underlain by organic matter within a depth of 160 cm.

**Lithic** Bedrock occurring within 10–160 cm in Organic soils

**Hydric** A layer of water that extends from a depth of not less than 40 cm from the organic surface to a depth of more than 160 cm.

**Tiers:**

Tiers are arbitrary depth intervals used in *classifying* wetland Organic soils, and consist of the surface (0–40 cm), middle (40–120 cm) and bottom tiers (120–160 cm). They are not recorded.

## 17. Depth

Record the average depths (in centimetres) of the upper and lower boundaries of the horizon being described. The depth of organic horizons in mineral soils are measured upward from zero depth (e.g., L 12–9, Fm 9–2, and Ah 2–0), and in organic soils they are measured downward from the ground surface, or uppermost soil horizon (e.g., S 4–0, Of 0–35, and Om 35–110).

## 18. Fabric

Describe the structure and consistence of the upland organic horizons and record the von Post classes for wetland horizons. Structure is important in distinguishing between Fm, Fz, and Fa horizons, and the von Post scale of decomposition helps to distinguish the Of, Om, and Oh horizons.

**Structure:**

Describe structure according to the *degree* and *kind* of the macromorphological aggregation of the material within a horizon. Record the structure “degree” code (Table 2.20) in the first column and the “kind” code (Table 2.21) in the second column.

**TABLE 2.20. Degree of aggregation codes**

| Code | Class | Description |
|---|---|---|
| **W** | Weak | Disaggregated materials are dominant; < 20% distinctly aggregated |
| **M** | Moderate | Some disaggregated materials are found; 20–60% distinctly aggregated |
| **S** | Strong | Aggregated materials are dominant; most material conforms to the same arrangement; > 60% distinctly aggregated |

**TABLE 2.21. Kind of aggregation codes**

| Code | Class | Description |
|---|---|---|
| **SP** | Single particle | An incoherent mass of individual particles with no aggregation |
| **BK** | Blocky | Faces rectangular and flattened; vertices angular |
| **GR** | Granular | Spheroidal and characterized by rounded or subrounded vertices |
| **NM** | Non-compact matted | Materials arranged along horizontal planes with no compaction |
| **CM** | Compact matted | Materials arranged along horizontal planes with evident compaction |
| **ER** | Erect | Materials arranged vertically |
| **RC** | Recumbent | Materials arranged in recumbent (reclining) position |
| **MA** | Massive | A coherent mass showing no evidence of aggregation |

**von Post scale of decomposition**:
Squeeze a sample of the O horizon and observe the colour of the solution that is squeezed out between the fingers, the nature of the fibre, and the proportion of the original sample that remains in the hand. Record the class (Table 2.22).

**TABLE 2.22. von Post scale of decomposition classes**

| Code/Class | Description |
|---|---|
| **1** | Undecomposed; plant structure unaltered; yields only clear water coloured light yellow brown. |
| **2** | Almost undecomposed; plant structure distinct; yields only clear water coloured light yellow brown. |
| **3** | Very weakly decomposed; plant structure distinct; yields distinctly turbid brown water, no peat substance passes between the fingers, residue not mushy. |
| **4** | Weakly decomposed; plant structure distinct; yields strongly turbid water, no peat substance escapes between the fingers, residue rather mushy. |
| **5** | Moderately decomposed; plant structure evident, but becoming indistinct; yields much turbid brown water, some peat escapes between the fingers, residue very mushy. |
| **6** | Strongly decomposed; plant structure somewhat indistinct, but more evident in the squeezed residue than in the undisturbed peat; about one-third of the peat escapes between the fingers, residue strongly mushy. |
| **7** | Strongly decomposed; plant structure indistinct, but recognizable; about one-half of the peat escapes between the fingers. |
| **8** | Very strongly decomposed; plant structure very indistinct; about two-thirds of the peat escapes between the fingers, residue almost entirely resistant remnants such as root fibres and wood. |
| **9** | Almost completely decomposed; plant structure almost unrecognizable; nearly all the peat escapes between the fingers. |
| **10** | Completely decomposed; plant structure unrecognizable; all the peat escapes between the fingers. |

## 19. Mycelial Abundance

In most cases, fungal presence is indicated by masses of hyphae called mycelia. While individual hyphae are generally too small to be seen, the mycelial mass is usually visible. Determining mycelial abundance helps to distinguish the Fm, Fz, and Fa horizons, and therefore the humus form classification. Describe fungal mycelia by noting their abundance class as indicated in Table 2.23.

**TABLE 2.23. Mycelial abundance classes and codes**

| Code | Class | Description |
|---|---|---|
| **X** | None | Fungal mycelia are not visible |
| **F** | Few | Fungal mycelia are occasionally present, but are scattered and not easily observed |
| **C** | Common | Fungal mycelia are commonly observed |
| **A** | Abundant | Fungal mycelia are observed continuously throughout the horizon, often "matting" materials together and creating a "felty" tactility |

## 20. Fecal Abundance

The presence of soil fauna may be observed directly, or indirectly by the presence of fecal droppings or casts. Determining fecal abundance helps to distinguish the Fm, Fz, and Fa horizons, and therefore the humus form classification. Describe the presence of soil fauna by noting their abundance class as indicated in Table 2.24.

**TABLE 2.24. Fecal abundance classes and codes**

| Code | Class | Description |
|---|---|---|
| **X** | None | No feces or fauna observed |
| **F** | Few | Fecal droppings or fauna occasionally observed, but scattered |
| **C** | Common | Droppings or fauna commonly observed |
| **A** | Abundant | Droppings or fauna frequently observed (droppings in relatively large numbers throughout the horizon) |

## 21. Roots

Since root distribution in organic horizons differs substantially from that in mineral soils, the abundance and size classes and the reference unit areas are somewhat different from those used for mineral horizons (Table 2.25). Record the most abundant size first; secondary roots can be recorded by using a slash (/) in the columns as shown below:

Example: Abundant fine and plentiful medium roots.

| ROOTS | |
|---|---|
| AB. | SIZE |
| A / P | F / M |

**TABLE 2.25. Root abundance and size classes and codes**

| Size class | v. fine | fine | medium | coarse | very coarse |
|---|---|---|---|---|---|
| Code | **V** | **F** | **M** | **C** | **K** |
| Size (mm) | < 1 | 1–2 | 3–5 | 6–15 | > 15 |
| **Abundance code and class** | **Reference area** | | | | |
| | **25 $cm^2$** | | **100 $cm^2$** | | |
| **X** None | 0 | 0 | 0 | 0 | 0 |
| **F** Few | < 10[a] | < 10 | 1 | 1 | 1 |
| **P** Plentiful | 10–50 | 10–50 | 2–10 | 2–5 | 2–5 |
| **A** Abundant | > 50 | > 50 | > 10 | > 5 | > 5 |

[a] Values observed in reference area represent number of roots of size class

## 22. pH

Record pH, noting the method of measurement in the column header (e.g., pH/3 for Hellige-Truog) (Table 2.26), and the determined values for each horizon to one decimal place.

**TABLE 2.26. Codes for methods of pH measurement**

| Code | Method | Code | Method |
|---|---|---|---|
| **1** | Bromothymol blue | **6** | pH meter (0.1 M $CaCl_2$) |
| **2** | Cresol red | **7** | Phenol red |
| **3** | Hellige-Truog | **8** | Soiltex |
| **4** | Lamotte-Morgan | **9** | Thymol blue |
| **5** | pH meter ($H_2O$) | **10** | pHydrion |
| **5a** | pH meter for ground water sample | **11** | Litmus paper |

## 23. Comments Section

Record any observations or measurements that are unique, unconforming, or could be of particular significance to the study, classification, or management interpretations. Examples include: consistence, character, faunal species, colour of mycelium, percentage of decaying wood, presence of charcoal, and disturbance history. When coding a property, be sure to note the property being described.

**Consistence:**

This describes the nature and strength of forces holding materials together. It is determined by the kind of deformation or rupture that occurs when pressure is applied and then released. Use the codes in Table 2.27 to describe consistency.

**TABLE 2.27. Consistency classes and codes**

| Code | Class | Description |
|---|---|---|
| **LO** | Loose | Material has no consistence |
| **FR** | Friable | Material crumbles easily under gentle pressure |
| **FM** | Firm | Material can be crushed under moderate pressure; resistance is noticeable |
| **PL** | Pliable | Material is soft and plastic |
| **RE** | Resilient | Material is springy or elastic; assumes its original shape after pressure is released |
| **TE** | Tenacious | Material is cohesive and not easily pulled apart |

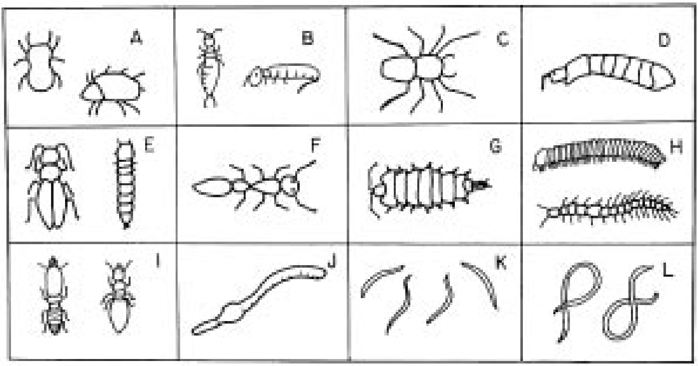
**Character:**

This describes tactile qualities, particulate shapes, and other noteworthy qualities of materials in organic horizons. Determining the character requires a qualitative examination of the fabric. Use the codes in Table 2.28 to describe character.

**TABLE 2.28. Character classes and codes**

| Code | Class | Description |
|---|---|---|
| **MS** | Mushy | Soft and spongy tactility; materials wet or saturated |
| **MK** | Mucky | Smooth and sticky tactility; materials usually wet; silt- and clay-sized mineral particles usually present |
| **GR** | Greasy | Smooth and greasy tactility; materials easily workable when moist; fine mineral particles are usually absent |
| **GT** | Gritty | Rough tactility produced by mineral granules or coarse fragments |
| **LF** | Leafy | Tactility of materials produced by deciduous foliage showing a shingle-like layering (banded structure) |
| **GA** | Grassy | Tactility of materials produced by graminoid remains |
| **MO** | Mossy | Tactility produced by bryophytes with more or less preserved vegetative structures |
| **AC** | Acerose | Tactility produced by particles having a tip, such as the needles of conifers |
| **FE** | Felty | Tactility produced by abundant fungal mycelia |
| **FI** | Fibrous | Tactility produced by an abundance of fibrous plant residues which do not break down when rubbed between fingers (i.e., fine roots) |
| **LG** | Ligneous | Tactility produced by coniferous or deciduous wood fibres |
| **CR** | Crusty | Hard and brittle tactility of dry or desiccated materials |

**Fauna:**
When describing soil fauna, use the name (Figure 2.3), e.g., few earthworms, several nematodes.




| Label | Fauna | Label | Fauna |
|---|---|---|---|
| **A** | Mites (Acarina) | **G** | Woodlice (Isopoda) |
| **B** | Springtails (Collembola) | **H** | Centipedes and millipedes (Myriapoda) |
| **C** | Spiders (Araneida) | **I** | Termites (Isoptera) |
| **D** | Fly larvae (Diptera) | **J** | Earthworms (Lumbricida) |
| **E** | Beetles and larvae (Coleoptera) | **K** | Potworms (Enchytraeida) |
| **F** | Ants (Hymenoptera) | **L** | Nematodes (Nematoda) |

**FIGURE 2.3. Major kinds of soil fauna.**

# Mineral Horizons/Layers

The soil horizon and layer definitions and methods for field description that follow are taken or modified from Agriculture Canada Expert Committee on Soil Survey (1997), Green et al. (1993), and Luttmerding et al. (1990).

## 24. Horizon/Layer

Record the mineral horizon or layer designation followed by lowercase modifiers, e.g., Btg.

**Codes for major horizons:**

**A** Mineral horizon, containing < 17% organic C by mass, that has formed at or near the soil surface in the zone of leaching or eluviation of organic materials in solution or suspension, or of maximum *in situ* accumulation of organic matter, or both.

**B** Mineral horizon characterized by enrichment in organic matter, sequioxides, or clay; or by the development of soil structure; or by a change of colour denoting hydrolysis, reduction, or oxidation.

**C** Mineral horizon comparatively unaffected by the pedogenic processes operative in the A and B horizons, except the process of gleying (Cg), and the accumulation of calcium and magnesium carbonates (Cca) and more soluble salts (Cs, Csa).

**Codes for layers:**

**R** Consolidated bedrock layer which is too hard to break with the hands.

**W** Layer of water in Gleysolic, Organic, or Cryosolic soils.

**Lowercase modifiers:**

**b** Buried soil horizon.

**c** Irreversibly cemented horizon (ortstein, placic, duric, and $CaCO_3$ cemented layers are examples).

**ca** Horizon > 10 cm thick of secondary carbonate enrichment in which the concentration of lime exceeds that in the unenriched parent material.

**cc** Irreversibly cemented concretions.

**e** Horizon characterized by the eluviation of clay, Fe, Al, or organic matter alone or in combination.

**f** Horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It must have a hue of 7.5YR or redder, or its hue must be 10YR near the upper boundary and becomes yellower with depth. When moist the chroma is higher than three or the value is three or less. It is used primarily with the Bf, Bhf, Bfg, and Bgf codes. The following f horizons are differentiated on the basis of the organic C content:

Bf 0.5–5% organic C
Bhf > 5% organic C

**g** Horizon characterized by gray colours, or prominent mottling, or both, which indicates of permanent or periodic intense reduction. Chromas of the matrix are generally one or less. It is used with the Aeg, Bg, Bfg, Bgf, Bhfg, Btg, Cg, Ckg codes, and others. When used with the Ae, Bf, Bhf, and Bt codes, the limits set for the other modifiers must be met. The Bgf horizons are usually prominently mottled; more than half of the soil material occurs as mottles of high chroma. The Bgf horizons occur in Fera Gleysols and Fera Humic Gleysols and possibly below the Bfg of gleyed Podzols.

**h** Horizon enriched with organic matter. It is used with the Ah, Ahe, Bh, and Bhf codes.

**Ah** - An A horizon enriched with humified organic matter; at least one colour value unit lower that the underlying horizon, or 0.5% more organic C than the C horizon or both.

**Ahe** - An Ah horizon that has undergone eluviation as evidenced by streaks and splotches of different shades of gray, and often by plated structure.

**Bh** - Contains > 1% organic C with less than 0.3% pyrophosphate-extractable Fe [Fe(p)] and a ratio of C : Fe(p) of 20 or more (*very* rare in British Columbia).

**Bhf** - Defined under f above.

**j** Used with e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the letter code it modifies. It is placed to the right of the letter it modifies.

**k** Denotes the presence of carbonate as indicated by visible effervescence when a dilute HCl solution is added.

**m** Horizon slightly altered by hydrolysis, oxidation, or solution, or all three to give a change in colour or structure, or both. It is used with the Bm, Bmgj, Bmk, and Bms codes.

It has:

1. Evidence of one of or more of the following:
   - higher chromas and redder hues than the underlying horizons;
   - enrichment or complete removal of carbonates either as Bmk or Bm; and/or
   - change in structure from that of the original material.
2. Illuviation too slight to meet requirements of a Bt or podzolic B.
3. No cementation or induration and lacks a brittle consistence when moist.

**n** Horizon with distinctive prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry; the exchangeable Ca to exchangeable Na is 10 or less. It is used with Bn or Bnt codes.

**p** Horizon disturbed by human activities, such as cultivation, logging, and habitation.

**s** Horizon with salts, including gypsum, which may be detected as crystal or veins, or as surface crusts of salt crystals. It is used with any combination of horizon codes.

**sa** Horizon > 10 cm thick with secondary enrichment of salts more soluble than Ca and Mg carbonates; the concentration of salts exceeds that in the unenriched parent material.

**t** An illuvial horizon enriched with silicate clay. It is used with the Bt, Btg, and Bnt codes and may be modified by j.
To use Bt:

- The horizon must be at least 5 cm thick.
- If any part of an the eluvial horizon has < 15% total clay in the fine fraction (< 2 mm), the Bt horizon must contain at least 3% more clay and if > 40% total clay, then it must contain at least 8% more clay. If the eluvial horizon has > 15% and < 40% clay in the fine fraction, then the ratio of the clay in the Bt to that of the eluvial horizon must be 1.2 or more (e.g., Ae 25 % clay; Bt at least 30% clay).
- In massive soils, there should be oriented clay in pores and as bridges between sand grains.
- If peds are present, clay films (skins) should be visible on ped surfaces and in pores.

**u** Horizon that is markedly disrupted by physical (e.g., blowdown of trees, mass movement, etc.) or faunal processes (e.g., burrowing animals), but not from cryoturbation.

**x** Horizon of fragipan character; loamy subsurface horizon of high bulk density and very low organic matter. When dry, it is hard and seems to be cemented; when moist is has moderate to weak brittleness. Air-dried clods slake (crumble) in water.

**y** Horizon affected by cryoturbation. It is used with any combination of horizon codes.

**z** A frozen layer, it may be used with any horizon or layer code.

**Mineral diagnostic horizons**:
**Chernozemic A**

- At least 10 cm thick;
- Colour value darker than 5.5 dry and 3.5 moist, chroma is lower than 3.5 moist;
- Organic C content 1–17% and C:N ratio < 17;
- Structure, when dry, is neither massive and hard, nor single grained; and
- Mean annual soil temperature of $0^{o}$ C or higher and a soil moisture regime subclass drier than humid.

**Duric horizon**
A strongly cemented horizon that does not satisfy the criteria of a podzolic B horizon. Usually has an abrupt upper boundary and a diffuse lower boundary. Air-dried clods do not hydrate in water, and moist clods at least 3 cm thick usually can not be broken in the hands.

**Fragipan horizon**
See definition of “x” above.

**Ortstein horizon**
A strongly cemented Bh, Bhf, of Bf horizon at least 3 cm thick which occurs in more than one-third of the exposed pedon. Generally reddish brown to very dark reddish brown.

**Placic horizon**
A thin layer (commonly 5 mm or less thick) or a series of thin layers that are irregular or involuted, hard, impervious, often vitreous, and dark reddish brown to black.

**Podzolic B horizon (field criteria only)**

- At least 10 cm thick;
- Moist crushed color: hue is 7.5YR or redder or 10YR near the upper boundary and becomes yellower with depth. The chroma is higher than 3 or the value is 3 or less;
- Accumulation of amorphous material is indicated by brown to black coatings on some mineral grains or brown to black microaggregates. Silty feel when the material is rubbed wet, unless cemented; and
- Texture coarser than clay.

**Solonetzic B horizon**

The term includes both Bn and Bnt horizons.

**Lithic layer**

Bedrock (R) below a depth of 10 cm. The upper surface of a lithic layer is a lithic contact.

## 25. Depth

Record the average depths (in centimetres) of the upper and lower boundaries of the soil horizon being described, e.g., Ah 0–5, Bm 5–20. The top of the uppermost mineral horizon is considered as zero depth.

## 26. Colour

Soil colour is determined by comparison with Munsell Colour Charts . The notation for a specific colour should be in the order of hue, value / chroma. Intermediate hues, values, and chromas may be expressed with the use of decimals.

**ASP - Colour Aspect**

The colour of a soil varies with its moisture content and physical state. Record the aspect of the Munsell colour notation using the codes in Table 2.29.

**TABLE 2.29. Colour aspects and codes for mineral soils**

| Code | Aspect | Description |
|---|---|---|
| **1**<br>**2** | Matrix moist<br>Matrix dry | Matrix is the main soil constituent or material that encloses other soil features, for example, peds. This colour aspect is reserved for structureless soils or weakly structured soils whose peds crumble upon handling. |
| **3**<br>**4** | Exped moist<br>Exped dry | Colour of ped surfaces in soils with moderately durable peds which may be broken open and examined. |
| **5**<br>**6** | Inped moist<br>Inped dry | Dominant colour of ped interiors in soils with moderately durable peds that may be broken open and examined. |
| **7**<br>**8** | Crushed moist<br>Crush dry | Soil material is crushed and mixed. Surface of the sample is smoothed to reduce irregularities that affect colour. |

## 27. Texture

Soil texture is defined by the size distribution of primary mineral particles (2 mm diameter or less). The textural classes and codes are determined from the soil texture triangle by estimating the percentage of clay (less than 0.002 mm diameter) and sand (0.05 to < 2.0 mm diameter)(Figure 2.4). See Appendix 2.4 for a key to soil texture (and letter-code descriptions).

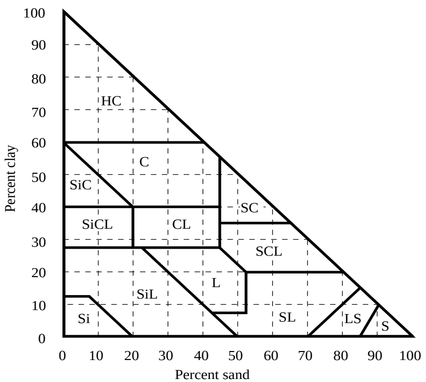



**FIGURE 2.4. Soil texture triangle.**

## 28. Percent Coarse Fragments

Estimate the percent coarse fragment (> 2 mm diameter) volume in each size class and record the total percent. Describe the coarse fragment shape using the type codes in Table 2.30.

**TABLE 2.30. Size classes and type codes for coarse fragments**

| | **Shape type: R, S, A**[a] | **Shape type: T** |
|---|---|---|
| **Size Classes** | **Diameter (cm)** | **Length (cm)** |
| G - Gravel | < 7.5 | < 15 |
| C - Cobbles | 7.5–25 | 15–38 |
| S - Stones and boulders | >25 | > 38 |

[a] type codes: **R** = rounded; **S** = subrounded and subangular; **A** = angular; **T** = thin, flat.

## 29. Roots

Describe roots by noting their abundance and size (Table 2.31). Record the most abundant size first; secondary roots can be recorded by using a slash (/) in the columns (see example in Item 21).

**TABLE 2.31. Root abundance and size classes and codes**

| **Size class** | Very fine | Fine | Medium | Coarse |
|---|---|---|---|---|
| Code | **V** | **F** | **M** | **C** |
| Size (mm) | < 1 | 1 to 2 | 3 to 5 | > 5 |
| **Abundance code and class** | | | | |
| **X** None | 0 | 0 | 0 | 0 |
| **F** Few | < 10[a] | < 10 | 1 | 1 |
| **P** Plentiful | 10–100 | 10–100 | 2–10 | 2–5 |
| **A** Abundant | > 100 | > 100 | > 10 | > 5 |

[a] Values represent number of roots of size class observed in reference area of 100 $cm^2$.

## 30. Structure

Record the kind and class of structure (see Table 2.32 below and Figure 2.5). When more than one kind of primary structure is present, record the dominant under structure, and the subordinate in comments.

**TABLE 2.32. Codes for kind and class of soil particle structure**

| Kind | Class | | Size (mm)[a] |
|---|---|---|---|
| **ABK**: Angular blocky; peds bounded by flattened, rectangular faces intersecting at relatively sharp angles | **VF** | very fine angular blocky | < 5 |
| | **F** | fine angular blocky | 5–10 |
| | **M** | medium angular blocky | 10–20 |
| | **C** | coarse angular blocky | 20–50 |
| | **VC** | very coarse angular blocky | > 50 |
| **SBK**: Subangular blocky; peds bounded by slightly rounded, subrectangular faces with vertices[b] of their intersections mostly subrounded | **VF** | very fine subangular blocky | < 5 |
| | **F** | fine subangular blocky | 5–10 |
| | **M** | medium subangular blocky | 10–20 |
| | **C** | coarse subangular blocky | 20–50 |
| | **VC** | very coarse subangular blocky | > 50 |
| **GR**: Granular; spheroidal peds bounded by curved or very irregular faces that do not adjoin those of adjacent peds | **VF** | very fine granular | < 1 |
| | **F** | fine granular | 1–2 |
| | **M** | medium granular | 2–5 |
| | **C** | coarse granular | 5–10 |
| | **VC** | very coarse granular | > 10 |
| **PL**: Platy; peds flat or platelike; horizontal planes more or less well developed | **VF** | very fine platy | < 1 |
| | **F** | fine platy | 1–2 |
| | **M** | medium platy | 2–5 |
| | **C** | coarse platy | 5–10 |
| | **VC** | very coarse platy | > 10 |

| Kind | Class | | Size (mm)[a] |
|---|---|---|---|
| **PR**: Prismatic; vertical faces of peds well defined and vertices[b] angular (edges sharp); prism tops essentially flat | **VF** | very fine prismatic | < 10 |
| | **F** | fine prismatic | 10–20 |
| | **M** | medium prismatic | 20–50 |
| | **C** | coarse prismatic | 50–100 |
| | **VC** | very coarse prismatic | > 100 |
| **COL**: Columnar; vertical edges near top of columns not sharp (vertices[b] subrounded); column tops flat, rounded, or irregular | **VF** | very fine columnar | < 10 |
| | **F** | fine columnar | 10–20 |
| | **M** | medium columnar | 20–50 |
| | **C** | coarse columnar | 50–100 |
| | **VC** | very coarse columnar | > 100 |
| **SGR**: single grained | Loose, incoherent mass of individual primary particles, as in sands | | |
| **MA**: Massive | Amorphous; a coherent mass showing no evidence of any distinct arrangement of soil particles; separates into clusters of particles, not peds | | |
| **CDY**: | Cloddy; not a structure, used to indicate the condition of some ploughed surfaces. | | |

[a] The size limits refer to measurements in the smallest dimension of platy, prismatic, and columnar peds, and to the largest of the nearly equal dimensions of blocky and granular peds.

[b] Definition of vertex (plural, vertices): the intersection of two planes of a geometrical figure.

**Grade** The degree of distinctness of aggregation of soil particles. If grade of structure is described, record with class code separated by a slash (e.g., S/VC = strong/very coarse).

**W** = Weak
**WM** = Weak to moderate
**M** = Moderate
**MS** = Moderate to strong
**S** = Strong

## 31. pH

Record pH by noting the method of measurement (see Table 2.26 under Item 22) and the determined values to one decimal place.

## 32. Comments

Record any observations or measurements that are unique, unconforming, or could be of particular significance to the study, classification, or management interpretations. Examples include: colour and description of mottles (see colour section), description of clay films, and porosity.

**Mottling:**
Described by recording *abundance*, *size*, and *contrast* and *colour* (see Tables 2.33 and 2.34). Use Munsell Colour Charts, defaulting to aspect 7, crushed moist, unless otherwise noted. For example, *FMD 7.5YR mottles* = few, medium, distinct, strong brown (crushed moist) mottles.

**TABLE 2.33. Abundance and size codes for mottles**

| Abundance | | | Size | | |
|---|---|---|---|---|---|
| **Code** | **Class** | **% of exposed surface** | **Code** | **Class** | **Diameter (mm)** |
| **F** | Few | < 2 | **F** | Fine | < 5 |
| **C** | Common | 2–20 | **M** | Medium | 5–15 |
| **M** | Many | > 20 | **C** | Coarse | > 15 |

**TABLE 2.34. Contrast codes for mottles**

| Code | Description |
|---|---|
| **F** | **Faint:** Evident only on close examination. Faint mottles commonly have the same hue as the colour to which they are compared and differ by no more than 1 unit of chroma or 2 units of value. Some faint mottles of similar but low chroma and value can differ by 2.5 units of hue. |

| Code | Description |
|---|---|
| **D** | **Distinct:** Readily seen, but contrast only moderately with the colour to which they are compared. Distinct mottles commonly have the same hue as the colour to which they are compared, but differ by 2–4 units of chroma or 3–4 units of value; or differ from the colour to which they are compared by 2.5 units of hue, but by no more than 1 unit of chroma or 2 units of value. |
| **P** | **Prominent:** Contrast strongly with the colour to which they are compared. Prominent mottles are commonly the most obvious colour feature in a soil. Prominent mottles that have medium chroma and value commonly differ from the colour to which they are compared by at least 5 units of hue, if chroma and value are the same; by at least 4 units of value or chroma, if the hue is the same; or by at least 1 unit of chroma or 2 units of value, if hue differs by 2.5 units. |

**Clay films (skins):**
Accumulations of oriented clay translocated from another part of the soil. Clay films are described by recording the *frequency* of occurrence, and estimated *thickness* (see Tables 2.35 and 2.36). Most Bt horizons will exhibit clay films and should be noted. For example, *FMTK clay films* = Few, moderately thick clay films.

**TABLE 2.35. Clay film frequency classes**

| Code | Class | Description |
|---|---|---|
| **X** | None | No clay films present. |
| **F** | Few | Clay films cover less than 2% of the total area of the specified surface(s). Patches of film are identifiable, but their frequency is so low that the significance of their presence may be nil or doubtful. |
| **C** | Common | Clay films cover 2–20% of the total area of the specified surface(s). |
| **M** | Many | Clay films cover 20–80% of the total area of the specified surface(s). They may occur as discrete patches or as a continuous network. |
| **CS** | Continuous | Clay films cover more than 80% of the total area of the specified surface(s). Patches of these surfaces may be free of clay films, but the films are essentially continuous. |

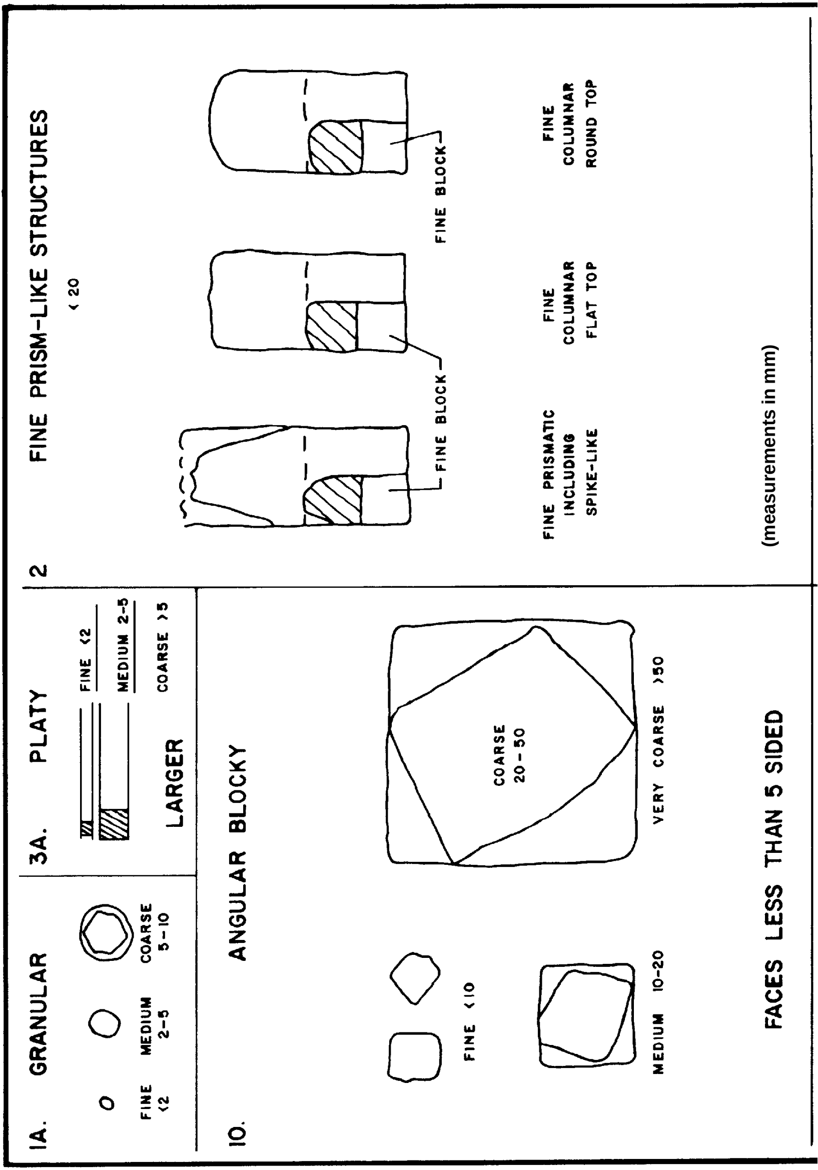



**FIGURE 2.5. Diagrammatic representation of soil structure.**

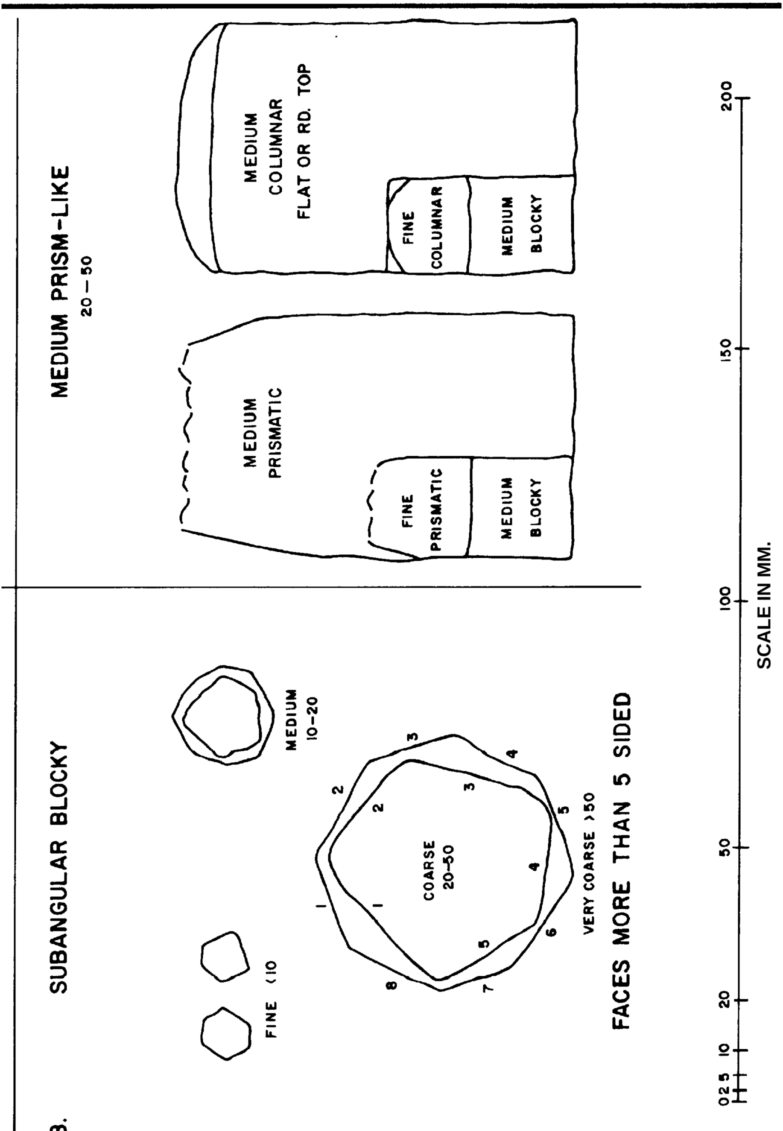



**FIGURE 2.5. (continued).**

**TABLE 2.36. Clay film thickness classes**

| Code | Class | mm | Description |
|---|---|---|---|
| **TN** | Thin | < 0.05 | Hand lens is needed for identification; visible in cross-section with 10X lens, but not to the unaided eye. If present, fine sand grains protrude through the film or are only thinly coated and are readily apparent. |
| **MTK** | Moderately thick | 0.05–0.5 | Clay films are visible in cross-section to the unaided eye. Fine sand grains are enveloped by the film or their outlines are indistinct. Film surfaces are relatively smooth. |
| **TK** | Thick | 0.5–1.0 | Clay films and their broken edges are readily visible without magnification. Film surfaces are smooth. |
| **VTK** | Very thick | > 1.0 | Clay films are a striking feature of the morphology |

**Effervescence:**
The bubbling, hissing, or foaming that occurs when a 10% HCl solution is added to a sample of soil. Enter the appropriate code from Table 2.37.

**TABLE 2.37. Codes to describe degree of effervescence**

| Code | Class | Degree of effervescence |
|---|---|---|
| **X** | None | No evidence of effervescence |
| **VW** | Very Weak | Few bubbles. (Note: ensure that the crackling sound is from reaction rather than absorption of liquid; compare with water). |
| **W** | Weak | Bubbles readily observed |
| **M** | Moderate | Bubbles form low foam |
| **S** | Strong | Bubbles form thick foam |

**Horizon porosity:**
An estimate of total pore volume that reflects the combined effects of soil structure and density. Record porosity classes for mineral horizons as described in Table 2.38.

**TABLE 2.38. Mineral horizon porosity classes**

| Code | Porosity class | Description |
|---|---|---|
| **S** | Slightly porous | Closely packed structureless soil material; highly compacted material. |
| **M** | Moderately porous | Horizons with weak to moderate structure and moderately close packing; closely packed soils with large, well-developed peds. |
| **H** | Highly porous | Horizons that are loosely packed, and/or very well structured with small peds. |

## 33. Profile diagram

Sketch a cross-sectional profile diagram of the horizon boundaries, and add other significant features (relative coarse fragment distribution and size, piping, turbation, seepage, water table, lithic contact, etc.) (see example, Figure 2.6.

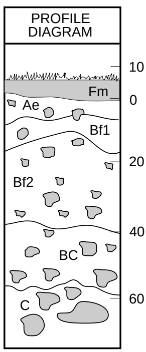



**FIGURE 2.6. Example of profile diagram.**

## 34. Notes

Use this section to summarize or describe soil features not otherwise recorded on the form or that are significant to the study, classifications, or management interpretations.

# Appendix 2.1 Codes for Soil Orders, Great Groups and Subgroups

## Brunisolic Order

**Melanic Brunisol MB**
Orthic **O.MB**
Eluviated **E.MB**
Gleyed **GL.MB**
Gleyed Eluviated **GLE.MB**

**Eutric Brunisol EB**
Orthic **O.EB**
Eluviated **E.EB**
Gleyed **GL.EB**
Gleyed Eluviated **GLE.EB**

**Sombric Brunisol SB**
Orthic **O.SB**
Eluviated **E.SB**
Duric **DU.SB**
Gleyed **GL.SB**
Gleyed Eluviated **GLE.SB**

**Dystric Brunisol DYB**
Orthic **O.DYB**
Eluviated **E.DYB**
Duric **DU.DYB**
Gleyed **GL.DYB**
Gleyed Eluviated **GLE.DYB**

## Chernozemic Order

**Brown Chernozem BC**
Orthic **O.BC**
Rego **R.BC**
Calcareous **CA.BC**
Eluviated **E.BC**
Solonetzic **SZ.BC**
Vertic **V.BC**
Gleyed **GL.BC**
Gleyed Rego **GLR.BC**
Gleyed Calcareous **GLA.BC**
Gleyed Eluviated **GLE.BC**
Gleyed Solonetzic **GLSZ.BC**
Gleyed Vertic **GLV.BC**

**Dark Brown Chernozem DBC**
Orthic **O.DBC**
Rego **R.DBC**
Calcareous **CA.DBC**
Eluviated **E.DBC**
Solonetzic **SZ.DBC**
Gleyed **GL.DBC**
Gleyed Rego **GLR.DBC**
Gleyed Calcareous **GLCA.DBC**
Gleyed Eluviated **GLE.DBC**
Gleyed Solonetzic **GLSZ.DBC**

**Black Chernozem BLC**
Orthic **O.BLC**
Rego **R.BLC**
Calcareous **CA.BLC**
Eluviated **E.BLC**
Solonetzic **SZ.BLC**
Vertic **V.BLC**
Gleyed **GL.BLC**
Gleyed Rego **GLR.BLC**
Gleyed Calcareous **GLCA.BLC**
Gleyed Eluviated **GLE.BLC**
Gleyed Solonetzic **GLSZ.BLC**
Gleyed Vertic **GLV.BLC**

**Dark Gray Chernozem DGC**
Orthic **O.DGC**
Rego **R.DGC**
Calcareous **CA.DGC**
Solonetzic **SZ.DGC**
Vertic **V.DGC**
Gleyed **GL.DGC**
Gleyed Rego **GLR.DGC**
Gleyed Calcareous **GLCA.DGC**
Gleyed Solonetzic **GLSZ.DGC**
Gleyed Vertic **GLV.DGC**

## Cryosolic Order

**Turbic Cryosol TC**
Orthic Eutric **OE.TC**
Orthic Dystric **OD.TC**
Brunisolic Eutric **BRE.TC**
Brunisolic Dystric **BRD.TC**
Histic Eutric **HE.TC**
Histic Dystric **HD.TC**
Luvisolic **L.TC**
Regosolic **R.TC**
Gleysolic **GL.TC**

**Static Cryosol SC**
Orthic Eutric **OE.SC**
Orthic Dystric **OD.SC**
Brunisolic Eutric **BRE.SC**
Brunisolic Dystric **BRD.SC**
Histic Eutric **HE.SC**
Histic Dystric **HD.SC**
Luvisolic **L.SC**
Gleysolic Static Cryosol **GL.SC**
Regosolic Static Cryosol **R.SC**

**Organic Cryosol OC**
Fibric **FI.OC**
Mesic **ME.OC**
Humic **HU.OC**
Terric Fibric **TFI.OC**
Terric Mesic **TME.OC**
Terric Humic **THU.OC**
Glacic **GC.OC**

## Gleysolic Order

**Luvic Gleysol LG**
Solonetzic **SZ.LG**
Fragic **FR.LG**
Humic **HU.LG**
Fera **FE.LG**
Orthic **O.LG**
Vertic **V.LG**

**Humic Gleysol HG**
Solonetzic **SZ.HG**
Fera **FE.HG**
Orthic **O.HG**
Rego **R.HG**
Vertic **V.HG**

**Gleysol G**
Solonetzic **SZ.G**
Fera **FE.G**
Orthic **O.G**
Rego **R.G**
Vertic **V.G**

## Luvisolic Order

**Gray Brown Luvisol GBL**
Orthic **O.GBL**
Brunisolic **BR.GBL**
Podzolic **PZ.GBL**
Vertic **V.GBL**
Gleyed **GL.GBL**
Gleyed Brunisolic **GLBR.GBL**
Gleyed Podzolic **GLPZ.GBL**
Gleyed Vertic **GLV.GBL**

**Gray Luvisol GL**
Orthic **O.GL**
Dark **D.GL**
Brunisolic **BR.GL**
Podzolic **PZ.GL**
Solonetzic **SZ.GL**
Fragic **FR.GL**
Vertic **V.GL**
Gleyed **GL.GL**
Gleyed Dark **GLD.GL**
Gleyed Brunisolic **GLBR.GL**
Gleyed Podzolic **GLPZ.GL**
Gleyed Solonetzic **GLSZ.GL**
Gleyed Fragic **GLFR.GL**
Gleyed Vertic **GLV.GL**

## Organic Order

**Fibrisol F**
Typic **TY.F**
Mesic **ME.F**
Humic **HU.F**
Limnic **LM.F**
Cumulic **CU.F**
Terric **T.F**

Terric Mesic **TME.F**
Terric Humic **THU.F**
Hydric **HY.F**

**Mesisol M**
Typic **TY.M**
Fibric **FI.M**
Humic **HU.M**
Limnic **LM.M**
Cumulic **CU.M**
Terric **T.M.**
Terric Fibric **TFI.M**
Terric Humic **THU.M**
Hydric **HY.M**

**Humisol H**
Typic **TY.H**
Fibric **FI.H**
Mesic **ME.H**
Limnic **LM.H**
Cumulic **CU.H**
Terric **T.H**
Terric Fibric **TFI.H**
Terric Mesic **TME.H**
Hydric **HY.H**

**Folisol FO**
Hemic **HE.FO**
Humic **HU.FO**
Lignic **LI.FO**
Histic **HI.FO**

## Podzolic Order

**Humic Podzol HP**
Orthic **O.HP**
Ortstein **OT.HP**
Placic **P.HP**
Duric **DU.HP**
Fragic **FR.HP**

**Ferro-Humic Podzol FHP**
Orthic **O.FHP**
Ortstein **OT.FHP**
Placic **P.FHP**
Duric **DU.FHP**
Fragic **FR.FHP**
Luvisolic **LU.FHP**
Sombric **SM.FHP**
Gleyed **GL.FHP**
Gleyed Ortstein **GLOT.FHP**
Gleyed Sombric **GLSM.FHP**

**Humo-Ferric Podzol HFP**
Orthic **O.HFP**
Ortstein **OT.HFP**
Placic **P.HFP**
Duric **DU.HFP**
Fragic **FR.HFP**
Luvisolic **LU.HFP**
Sombric **SM.HFP**
Gleyed **GL.HFP**
GleyedOrtstein **GLOT.HFP**
Gleyed Sombric **GLSM.HFP**

## Regosolic Order

**Regosol R**
Orthic **O.R**
Cumulic **CU.R**
Gleyed **GL.R**
Gleyed Cumulic **GLCU.R**

**Humic Regosol HR**
Orthic **O.HR**
Cumulic **CU.HR**
Gleyed **GL.HR**
Gleyed Cumulic **GLCU.HR**

## Solonetzic Order

**Solonetz SZ**
Brown **B.SZ**
Dark Brown **DB.SZ**
Black **BL.SZ**
Alkaline **A.SZ**
Gleyed Brown **GLB.SZ**
Gleyed Dark Brown **GLDB.SZ**
Gleyed Black **GLBL.SZ**

**Solodized Solonetz SS**
Brown **B.SS**
Dark Brown **DB.SS**

Black **BL.SS**
Dark Gray **DG.SS**
Gray **G.SS**
Gleyed Brown **GLB.SS**
Gleyed Dark Brown **GLDB.SS**
Gleyed Black **GLBL.SS**
Gleyed Dark Gray **GLDG.SS**
Gleyed Gray **GLG.SS**

**Solod SO**
Brown **B.SO**
Dark Brown **DB.SO**
Black **BL.SO**
Dark Gray **DG.SO**
Gray **G.SO**
Gleyed Brown **GLB.SO**
Gleyed Dark Brown **GLDB.SO**
Gleyed Black **GLBL.SO**
Gleyed Dark Gray **GLDG.SO**
Gleyed Gray **GLG.SO**

## Vertisolic

**Vertisol V**
Orthic **O.V**
Gleyed **GL.V**
Gleysolic **GLC.V**

**Humic Vertisol HV**
Orthic **O.HV**
Gleyed **GL.HV**
Gleysolic **GLC.HV**

# Appendix 2.2 Key to Soil Orders

**Key to Soil Orders (Soil Classification Working Group 1998)**

A. Soils that have permafrost within 100 cm of the surface, or 200 cm if strongly cryoturbated. ..................................................... **Cryosolic Order**

B. Other soils with:
   1. Organic horizons (more than 17% organic C by mass) that extend from the surface to one of the following:
      a. A depth of 60 cm or more if the surface layer is fibric material (Of) having a bulk density of $< 0.075$ g/cm$^3$.
      b. A depth of 40 cm or more if the surface layer consists of mesic or humic material (Om or Oh) having a bulk density $\geq 0.075$ g/cm$^3$.
      c. A depth of more than 40 cm if composed of folic materials (L, F, and H), or at least 10 cm if a lithic contact or fragmental materials are present. Folic materials must be more than twice the thickness of a mineral soil layer if the mineral layer is less than 20 cm thick.

   OR

   2. One or more mineral horizons or layers within 40 cm of the surface in addition to the organic horizons (O) as follows:
      a. If a mineral horizon or layer thinner than 40 cm occurs at the surface, the underlying organic horizon or horizons must have a total thickness of at least 40 cm.
      b. If one or more mineral horizons or layers occur within 40 cm of the surface, the organic material must occupy more than 40 cm of the upper 80 cm of the control section.
      ........................................................................... **Organic Order**

C. Other soils that have both a vertic horizon and a slickenside horizon, the top of which occurs within 1 m of the surface. ... **Vertisolic Order**

D. Other soils that have a podzolic B horizon and do not have a Bt horizon within 50 cm of the mineral surface. ............................. **Podzolic Order**

E. Other soils that are saturated with water and under reducing conditions either continuously or during some period of the year as indicated either by direct measurements of the water table and the oxidation-reduction status, or by any of the following morphological features within 50 cm of the mineral surface:

1. For all but red soil materials (hue 5YR or redder and colour fades slowly on dithionite treatment).

   a. Chromas of 1 or less, without mottles, on ped surfaces or in the matrix if peds are lacking in materials that develop higher chromas under oxidizing conditions.
   b. Chromas of 2 or less, in hues of 10YR and 7.5YR, on ped surfaces or in the matrix if peds are lacking, accompanied by prominent mottles.
   c. Chromas of 3 or less, in hues yellower than 10YR, on ped surfaces or in the matrix if peds are lacking, accompanied by prominent mottles.
   d. Hues bluer than 10Y, with or without mottles, on ped surfaces or in the matrix if peds are lacking. ................ **Gleysolic Order**

2. Other soils that have a solonetzic B horizon. ..... **Solonetzic Order**

G. Other soils that have a chernozemic A horizon and any one of the following:
1. No Ae horizon.
2. A weakly expressed Ae horizon (Aej) with a dry colour value lower than 5.
3. An Ae horizon thinner than an overlying Ah or Ap horizon that does not appear to be eluviated.
4. An Ae horizon not more than 5 cm thick if the chernozemic A is eluviated (Ahe), as indicated by grey streaks and splotches when the soil is dry. .................................................. **Chernozemic Order**

H. Other soils that have a Bt horizon. ............................. **Luvisolic Order**

I. Other soils that have either Bm, Btj, or Bfj horizons at least 5 cm thick, or a Bf horizon less than 10 cm in thickness. .......... **Brunisolic Order**

J. Other soils. ........................................................................ **Regosolic Order**

# Appendix 2.3  Key to Humus Forms

**Key to Humus Forms**

1a. Well to imperfectly drained sites; humus form not saturated for prolonged periods

- 2a. Combined thickness of F and H horizons > 2 cm if Ah < 2 cm
    - 3a. > 50% thickness of F horizon(s) is Fm .......... **MORS (R)**
        - 4a. Decaying wood > 35% of organic matter volume in humus form profile ........................ **Lignomor (LR)**
        - 4b. Decaying wood ≤ 35% of organic matter volume in humus form profile
            - 5a. F horizon > 50% of thickness of F and H horizon .................................... **Hemimor (HR)**
            - 5b. Hh horizon > 50% of thickness of F and H horizons ................................. **Humimor (UR)**
            - 5c. Hr horizon > 50% of thickness of F and H horizons .................................... **Resimor (RR)**
    - 3b. F horizon(s) includes Fz and / or Fa ......... **MODERS (D)**
        - 6a. Decaying wood > 35% of organic matter volume in humus form profile .................... **Lignomoder (LD)**
        - 6b. Decaying wood ≤ 35% of organic matter volume in humus form profile
            - 7a. Fa horizon > 50% of thickness of F horizons; or Fm horizon present .............. **Mormoder (RD)**
            - 7b. Fz horizon > 50% of thickness of F horizons
                - 8a. F and H horizons greater than or equal to thickness of Ah horizon ................................... **Leptomoder (TD)**
                - 8b. F and H horizons less than thickness of Ah horizon ....................... **Mullmoder (MD)**

2b. Combined thickness of F and H horizons $\leq$ 2 cm and Ah horizon $\geq$ 2cm .................................................... **MULLS (L)**

9a. Rhizogenous Ah horizon formed from decomposition of dense fine roots ............................... **Rhizomull (ZL)**

9b. Zoogenous Ah horizon formed through actions of abundant earthworms ....................... **Vermimull (VL)**

1b. Poor to very poorly drained sites; humus form saturated for prolonged periods

10a. Combined thickness of F, H, and O horizons $\leq$ 2 cm and Ah horizon > 2 cm .......................................... **Hydromull (YL)**

10b. Combined thickness of F, H, and O horizons > 2 cm if Ah < 2 cm

11a. Thickness of F and H horizons $\geq$ O horizons

12a. F horizon(s) is Fm ...................... **Hydromor (YR)**

12b. F horizon(s) includes Fz and / or Fa ................................................ **Hydromoder (YD)**

11b. Combined thickness of O horizons greater than F and H horizons

13a. Of horizon > 50% of thickness of O horizons ........................................................ **Fibrimor (FR)**

13b. Om horizon $\geq$ 50% of thickness of O horizons ...................................................... **Mesimor (MR)**

13c. Oh horizon > 50% of thickness of O horizons ................................................... **Saprimoder (SD)**

# Appendix 2.4 Key to Soil Texture

## Soil texture field tests

**Graininess Test** Rub the soil between your fingers. If sand is present, it will feel “grainy.” Determining whether sand constitutes more or less than 50% of the sample is the first decision in the key.

**Moist Cast Test** Compress some moist soil by clenching it in your hand. If the soil holds together (i.e., forms a “cast”), then test the durability of the cast by tossing it from hand to hand. The more durable it is, the more clay is present.

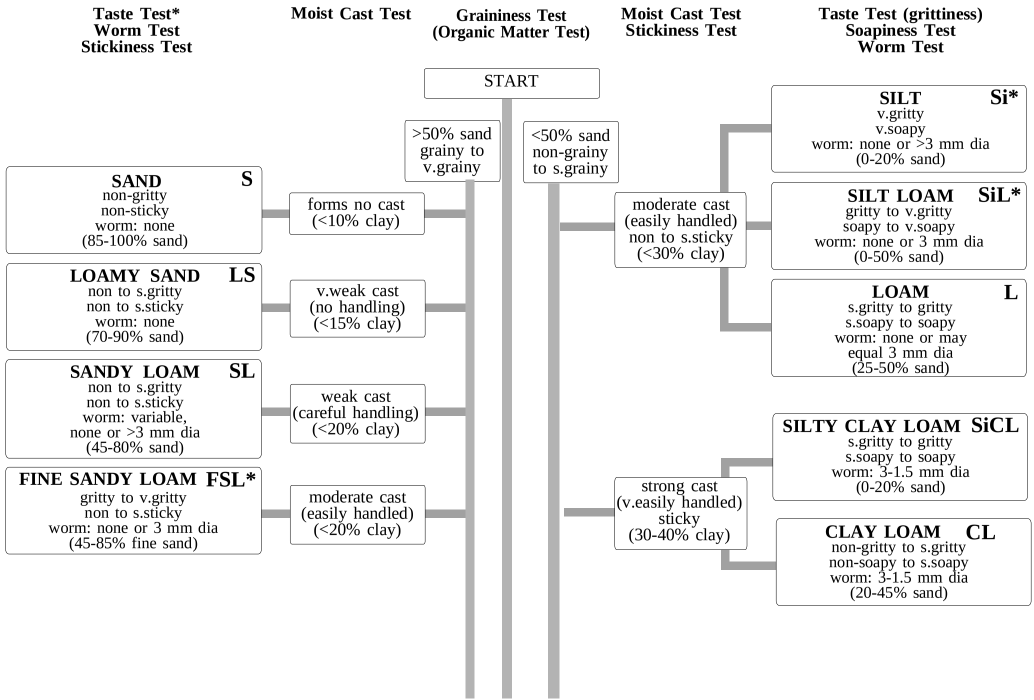
**Stickiness Test** Moisten the soil thoroughly and compress it between thumb and forefinger. Determine degree of stickiness by noting how strongly the soil adheres to the thumb and forefinger when pressure is released, and how much it stretches. Stickiness increases with clay content.

**Worm Test** Roll some moist soil between the palms of your hands to form the longest, thinnest worm possible. The more clay present, the longer, thinner and more durable the worm will be.

**Taste Test (Not recommended due to health concerns)** Work a small amount of moist soil between your front teeth. Silt particles are distinguished as fine “grittiness,” unlike sand which is distinguished as individual grains (i.e., graininess). Clay has no grittiness.

Well-decomposed organic matter imparts silt-like properties to the soil. However, when subjected to the taste test, it feels non-gritty. It is generally very dark in colour when moist or wet, and stains the hands brown or black. This organic matter is not used as a determinant of soil texture; an estimate of the silt content of humus-enriched mineral soils should be reduced accordingly.

**Soapiness Test** Work a small amount of wet soil between your thumb and fingers. Silt feels slick and not too sticky (i.e., clay) or grainy (i.e., sand); the greater the dominance of a slick feel, the greater the silt content.


Taste Test*
Worm Test
Stickiness Test
Moist Cast Test
Graininess Test
(Organic Matter Test)
Moist Cast Test
Stickiness Test
Taste Test (grittiness)
Soapiness Test
Worm Test
START
>50% sand
grainy to
v.grainy
<50% sand
non-grainy
to s.grainy
SAND S
non-gritty
non-sticky
worm: none
(85-100% sand)
forms no cast
(<10% clay)
LOAMY SAND LS
non to s.gritty
non to s.sticky
worm: none
(70-90% sand)
v.weak cast
(no handling)
(<15% clay)
SANDY LOAM SL
non to s.gritty
non to s.sticky
worm: variable,
none or >3 mm dia
(45-80% sand)
weak cast
(careful handling)
(<20% clay)
FINE SANDY LOAM FSL*
gritty to v.gritty
non to s.sticky
worm: none or 3 mm dia
(45-85% fine sand)
moderate cast
(easily handled)
(<20% clay)
moderate cast
(easily handled)
non to s.sticky
(<30% clay)
SILT Si*
v.gritty
v.soapy
worm: none or >3 mm dia
(0-20% sand)
SILT LOAM SiL*
gritty to v.gritty
soapy to v.soapy
worm: none or 3 mm dia
(0-50% sand)
LOAM L
s.gritty to gritty
s.soapy to soapy
worm: none or may
equal 3 mm dia
(25-50% sand)
strong cast
(v.easily handled)
sticky
(30-40% clay)
SILTY CLAY LOAM SiCL
s.gritty to gritty
s.soapy to soapy
worm: 3-1.5 mm dia
(0-20% sand)
CLAY LOAM CL
non-gritty to s.gritty
non-soapy to s.soapy
worm: 3-1.5 mm dia
(20-45% sand)

**SANDY CLAY LOAM SCL**
non to s.gritty
s.sticky to sticky
worm: 3 mm dia
(45-80% sand)

**SANDY CLAY SC**
non-gritty
sticky to v.sticky
worm: 3-1.5 mm dia
(45-65% sand)

strong cast
(v.easily handled)
(20-55% clay)

very strong cast
(v.easily handled)
v.sticky
(>40% clay)

**SILTY CLAY SiC**
s.gritty to gritty
s.soapy to soapy
worm: strong; 1.5 mm dia
(0-20% sand)

**CLAY or HEAVY CLAY C or HC**
non-gritty to s.gritty
non-soapy to s.soapy
worm: strong; 1.5 mm dia
(0-45% sand)

>30% organic matter

**ORGANIC O**
(no texture)

* Silt feels slippery or soapy when wet; fine sand feels stiffer, like grinding compound or fine sandpaper.

**Key to Abbreviations**
s = slightly
v = very
dia = diameter

**Measurement Conversions**
3.0 mm = 1/8"
1.5 mm = 1/16"

| **Fine Fraction** | **(particle diameter)** |
|---|---|
| SAND ------------- (S) | 2 - .05 mm |
| SILT --------------- (Si) | .05 - .002 mm |
| CLAY ------------- (C) | <.002 mm |