



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F407

Soil Profile Description

Standard Operating Procedure

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1. Purpose

This SOP describes the systematic description of soil profiles exposed in hand-dug pits or road cuts. A soil profile description documents the vertical sequence of horizons, their physical and morphological properties, and the relationships among them. Profile descriptions are fundamental to soil classification, land use assessment, understanding pedogenic processes, and interpreting laboratory analytical data in a landscape context (Schoeneberger et al., 2012; Soil Survey Staff, 2022). The systematic description of soil horizons is the foundation of pedology and provides the morphological evidence from which pedogenic processes (e.g., eluviation, illuviation, gleization) are inferred (Buol et al., 2011; Schaetzl & Anderson, 2015).

2. Scope

- **Applies to:** Field description of soil profiles at all EA Program sites, including research plots, restoration sites, and instructional field exercises
- **Does not apply to:** Auger-based sampling where no profile face is exposed (see [SOP-F400](#)); engineering soil classifications (Unified Soil Classification System); geotechnical borehole logging
- **Location:** All EA Program field sites where soil pits can be safely excavated

3. Responsibilities

Role	Responsibility
PI / Field Lead	Select pit locations; approve excavation; ensure safety
Trained Personnel	Excavate pits and describe profiles per this SOP
New Students	Complete training before independent profile description

4. Definitions

- **Consistence:** The resistance of soil to deformation or rupture; described at field moisture conditions (loose, very friable, friable, firm, very firm, extremely firm for moist soil) and separately for dry and wet conditions (sticky, plastic ratings).
- **Horizon:** A layer of soil approximately parallel to the land surface with distinct physical, chemical, or biological properties that differ from adjacent layers; the fundamental unit of soil profile description; designated by master symbols (O, A, E, B, C, R) and subordinate suffixes (e.g., Bt, Bh).
- **Horizon boundary:** The contact between two soil horizons; described by distinctness (very abrupt, abrupt, clear, gradual, diffuse based on transition thickness) and topography (smooth, wavy, irregular, broken).
- **Master horizon:** A primary genetic horizon designation: O (organic surface), A (mineral surface with organic matter accumulation), E (eluviated), B (subsoil with illuvial accumulation or alteration), C (parent material), R (bedrock).
- **Ped:** A natural soil aggregate formed by soil-forming processes; described by type (granular, blocky, subangular blocky, prismatic, columnar, platy) and size class (very fine, fine, medium, coarse, very coarse).
- **Pedon:** The smallest three-dimensional body of soil that fully represents the range of properties of a given soil; typically 1–10 m² in surface area and extending to the C horizon or bedrock.
- **Soil profile:** A vertical cross-section of soil from the surface to the parent material or bedrock, exposing the sequence of genetic horizons; described in a pit or by augering.
- **Soil structure:** The arrangement and organization of soil particles into aggregates (peds); described by type (shape), class (size), and grade (distinctness of development: structureless, weak, moderate, strong).

- **Texture (field):** The relative proportions of sand, silt, and clay in the fine earth fraction (less than 2 mm); estimated in the field by the feel method (see [SOP-F401](#)) and confirmed by hydrometer analysis (see [SOP-L401](#)).

5. Safety and Hazards

Hazards

- **Physical:** Soil pits deeper than 50 cm can collapse, especially in sandy or dry soils. Pits deeper than 1.2 m (4 ft) require shoring or sloping per OSHA regulations (29 CFR 1926, Subpart P). Never enter an unshored pit deeper than 1.2 m.
- **Biological:** Soil-borne pathogens; ticks, snakes, and burrowing insects in riparian or wildland settings.
- **Environmental:** Heat exposure; dehydration during summer fieldwork.

5.1. Required PPE

- ☐ Closed-toed shoes or field boots
- ☐ Nitrile gloves
- ☐ Sun protection (hat, sunscreen)
- ☐ Safety glasses (when chopping through indurated horizons)
- ☐ Hard hat (if working in deep pits or near road cuts)

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#). If a pit wall collapses while someone is inside, call 911 immediately. Do not attempt excavation without proper rescue training and equipment.

6. Equipment and Materials

Item	Notes
Sharpshooter shovel	For excavating the pit
Flat-edged spade or soil knife	For cleaning the profile face
Hand pick or mattock	For indurated or cemented horizons
Munsell Soil Color Charts	See SOP-F405
Squeeze bottle with DI water	For moistening soil for color and texture
Metric tape measure (2 m)	For measuring horizon depths
Clinometer or hand level	For measuring slope at the pit site
Compass	For recording aspect
10% HCl solution in dropper bottle	For testing for carbonates (effervescence)
Field notebook or profile description form	NRCS-style form preferred
Camera	For photographing the profile face

Item	Notes
Ruler or scale bar	Placed against the profile for photo scale
GPS unit	For recording pit coordinates per SOP-F006
Flagging tape	For marking horizon boundaries
Sample bags (labeled)	If collecting horizon samples for lab analysis

7. Procedure

7.1. Pit Excavation

1. Select the pit location based on the project objectives and landscape position. Avoid disturbed areas, utility lines, and locations near structures.
2. Excavate a pit approximately 50 cm wide and 80–120 cm deep (or to the parent material or restrictive layer, whichever is shallower). One vertical face should be oriented to receive even light (face the sun or open shade).
3. Pile excavated soil upslope and on a tarp to facilitate backfilling.
4. Clean the profile face with the flat-edged spade or soil knife to expose a fresh, undisturbed surface. Avoid smearing.

7.2. Identifying Horizon Boundaries

1. Examine the profile face for changes in color, texture, structure, roots, pores, and cementation. Each distinct zone is a horizon.
2. Mark horizon boundaries with flagging tape pins or nails.
3. Measure the depth of each boundary from the soil surface using the metric tape. Record the upper and lower boundary depth for each horizon (e.g., A: 0–18 cm; Bt: 18–45 cm).
4. Describe the boundary distinctness and topography:

Distinctness	Width of Transition
Abrupt	< 2 cm
Clear	2–5 cm
Gradual	5–15 cm
Diffuse	> 15 cm

Topography	Description
Smooth	Nearly a plane
Wavy	Pockets wider than deep
Irregular	Pockets deeper than wide
Broken	Discontinuous

Boundary distinctness reflects the rate and nature of pedogenic change between horizons; abrupt boundaries often indicate a lithologic discontinuity or a strong process boundary (e.g., plowing), while diffuse boundaries suggest gradual, ongoing translocation (Schaetzl & Anderson, 2015).

7.3. Describing Each Horizon

For each horizon, record the following properties:

Horizon designation: Use standard USDA master horizon symbols (O, A, E, B, C, R) with appropriate suffixes (t, k, w, g, etc.) (Soil Survey Division Staff, 2017). When assigning subordinate suffixes (e.g., **t** for clay accumulation, **k** for carbonate, **g** for gleying), verify the morphological evidence for each suffix against the criteria in Keys to Soil Taxonomy (Soil Survey Staff, 2022) to ensure that the designation supports formal classification.

Color: Determine moist and dry color using Munsell charts per [SOP-F405](#). Record matrix color and any mottles.

Texture: Determine texture by feel per [SOP-F401](#). Record the USDA textural class (e.g., sandy loam, clay loam).

Structure: Describe the type, size, and grade:

Type	Shape Description
Granular	Roughly spherical, porous
Blocky (angular)	Sharp-edged blocks
Blocky (subangular)	Rounded-edge blocks
Platy	Flat, plate-like
Prismatic	Vertical columns, flat tops
Columnar	Vertical columns, rounded tops
Massive	No visible structure (coherent mass)
Single grain	No structure (loose, individual particles)

Size: very fine, fine, medium, coarse, very coarse (ranges depend on structure type; consult the *Field Book for Describing and Sampling Soils*).

Grade: weak, moderate, strong.

Soil structure type and grade influence water movement, root penetration, and aeration. Strongly developed angular blocky structure in B horizons often correlates with high clay content and shrink-swell behavior, while granular structure in A horizons is associated with biological activity and high organic matter (Schaetzl & Anderson, 2015; Soil Survey Division Staff, 2017).

Consistence: Describe the resistance to rupture at the appropriate moisture state:

- Dry: loose, soft, slightly hard, hard, very hard, extremely hard
- Moist: loose, very friable, friable, firm, very firm, extremely firm
- Wet: nonsticky/nonplastic to very sticky/very plastic

Roots: Record abundance (few, common, many) and size (very fine, fine, medium, coarse).

Pores: Record abundance and size.

Effervescence: Apply 1–2 drops of 10% HCl to the horizon face and record the reaction:

Effervescence	Description
None	No visible bubbles
Slight	Few bubbles, barely audible
Strong	Obvious bubbles, clearly audible
Violent	Vigorous bubbling, foam

Other features: Record any clay films, coatings, concretions, cementation, or biological features (krotovinas, worm casts).

7.4. Site Description

Record the following site-level information:

- GPS coordinates per [SOP-F006](#)
- Slope (percent) and aspect (degrees)
- Landscape position (summit, shoulder, backslope, footslope, toeslope)
- Parent material (if identifiable: alluvium, colluvium, residuum, loess, etc.). At EA Program sites in the Pomona/Claremont area, parent materials are commonly alluvium derived from the San Gabriel Mountains or residuum from granitic bedrock, and argillic horizons (Bt) are frequently developed in older geomorphic surfaces (Buol et al., 2011).
- Vegetation and land use
- Drainage class (excessively drained to very poorly drained)
- Depth to water table or bedrock (if encountered)
- Evidence of erosion or deposition

7.5. Photography

1. Place a ruler or scale bar vertically against the profile face.
2. Photograph the entire profile with horizon labels visible.
3. Take close-up photos of features of interest (mottles, clay films, cementation, root channels).
4. Record photo numbers in the field notebook.

7.6. Backfilling

Backfill the pit promptly after description and sampling. Replace soil in reverse order (subsoil first, topsoil last). Compact gently to prevent subsidence. Restore surface litter.

8. Quality Control

- Use the NRCS *Field Book for Describing and Sampling Soils* as the authoritative reference for all terminology and classification.
- Have a second observer verify at least the horizon designations and colors for profiles used in research publications.

- Photograph every profile with a scale bar as a permanent record.
- Cross-check field texture estimates with laboratory hydrometer results ([SOP-L401](#)) for at least one horizon per profile.

9. References

- Buol, S. W., Southard, R. J., Graham, R. C., & McDaniel, P. A. (2011). *Soil genesis and classification* (6th ed.). Wiley-Blackwell.
- Schaetzl, R. J., & Anderson, S. (2015). *Soils: Genesis and geomorphology* (2nd ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9780511815560>
- Schoeneberger, P. J., Wysocki, D. A., Benham, E. C., & Soil Survey Staff. (2012). *Field book for describing and sampling soils* (3.0). USDA NRCS, National Soil Survey Center. <https://www.nrcs.usda.gov/resources/guides-and-instructions/field-book-for-describing-and-sampling-soils>
- Soil Survey Division Staff. (2017). *Soil survey manual*. Government Printing Office. <https://www.nrcs.usda.gov/resources/guides-and-instructions/soil-survey-manual>
- Soil Survey Staff. (2022). *Keys to soil taxonomy* (13th ed.). USDA Natural Resources Conservation Service. <https://www.nrcs.usda.gov/resources/guides-and-instructions/keys-to-soil-taxonomy>

10. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F400	Soil Sampling	Horizon samples for lab analysis
F401	Texture by Feel	Field texture for each horizon
F402	Soil Bulk Density	Core samples from horizons
F405	Soil Color (Munsell)	Color determination per horizon
L401	Texture (Hydrometer)	Lab confirmation of field texture

11. Training Record

Before describing soil profiles independently, personnel must:

1. Read this SOP, [SOP-F405](#), and [SOP-F401](#) in full
2. Describe at least two supervised soil profiles with results reviewed by the PI or a trained pedologist
3. Demonstrate correct use of the Munsell charts, texture by feel, HCl effervescence test, and structure terminology
4. Be signed off by the PI or field lead